SC-CAMLR-XXX

SCIENTIFIC COMMITTEE FOR THE CONSERVATION
OF ANTARCTIC MARINE LIVING RESOURCES

REPORT OF THE THIRTIETH MEETING OF THE SCIENTIFIC COMMITTEE

HOBART, AUSTRALIA
24–28 OCTOBER 2011

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Chair of the Scientific Committee
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Abstract

This document presents the adopted report of the Thirtieth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, from 24 to 28 October 2011. Reports of meetings and intersessional activities of subsidiary bodies of the Scientific Committee, including the Working Groups on Ecosystem Monitoring and Management, Fish Stock Assessment, Incidental Mortality Associated with Fishing, Statistics, Assessments and Modelling, and a Workshop on Marine Protected Areas, are appended.

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REPORT OF THE THIRTIETH MEETING OF THE SCIENTIFIC COMMITTEE

(Hobart, Australia, 24 to 28 October 2011)

OPENING OF MEETING

1.1 The Scientific Committee for the Conservation of Antarctic Marine Living Resources met from 24 to 28 October 2011 at the CCAMLR Headquarters in Hobart, Tasmania, Australia. The meeting was chaired by Dr D. Agnew (UK).

1.2 The Chair welcomed to the meeting representatives from Argentina, Australia, Belgium, Brazil, Chile, People's Republic of China (hereafter referred to as China), European Union, France, Germany, 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 the Netherlands (Acceding State), along with observers from ACAP, ASOC, CCSBT, CEP, COLTO, IUCN, IWC, SCAR and SEAFO, and encouraged them to participate in the meeting to the extent possible. SCAR also represented SCOR in relation to their joint activity relevant to CCAMLR's work (Southern Ocean Observing System (SOOS)).

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), E. Barrera-Oro (Argentina), M. Belchier (UK), A. Constable (Australia), S. Hanchet (New Zealand), S. Kawaguchi (Australia), R. Leslie (South Africa), Ms I. Lutchman (UK), Dr G. Parkes (UK), Mr T. Peatman (UK), Drs D. Ramm (Data Manager), K. Reid (Science Officer), R. Sarralde (Spain), B. Sharp (New Zealand), V. Siegel (EU), H. Steen (Norway), P. Trathan (UK), J. van Franeker (EU), D. Welsford (Australia) and X. Zhao (China).

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 Provisional Agenda had been circulated prior to the meeting (SC-CAMLR-XXX/1) and was adopted without change (Annex 3).

Chair's report

1.8 The following meetings took place in 2011:

(i) WG-EMM met in Busan, Republic of Korea, from 11 to 22 July 2011 and was convened by Dr G. Watters (USA) (Annex 4)

(ii) WG-SAM was also held in Busan from 11 to 15 July 2011, concurrently with the meeting of WG-EMM, and was co-convened by Drs Constable and C. Jones (USA) (Annex 5)

(iii) WS-MPA was held at the Institut Paul Emile Victor (IPEV), Brest, France, 29 August to 2 September 2011, was co-convened by Dr P. Penhale (USA) and Prof. P. Koubbi (France), and hosted by IPEV and the Agence des Aires Marines Protégées (AAMP) (Annex 6)

(iv) WG-FSA was held from 10 to 22 October 2011 in Hobart. It was convened by Dr Jones (Annex 7)

(v) WG-IMAF was held from 10 to 12 October 2011 in Hobart. It was convened by Mr J. Moir Clark (UK) (Annex 8).

1.9 Dr Agnew, on behalf of the Scientific Committee, thanked all chairs, conveners and coordinators of intersessional meetings, and France and the Republic of Korea for hosting the meetings of WG-SAM, WG-EMM and WS-MPA in 2011.

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

Statistics, assessments and modelling

2.1 The Scientific Committee reviewed advice from WG-SAM. It recalled that this year's meeting of WG-SAM included a focus topic on data-poor exploratory fisheries (the terms of reference of which were set out in SC-CAMLR-XXIX, paragraph 3.133). The Working Group was co-convened by Drs Constable and Jones.

2.2 The Scientific Committee noted that most of the advice of WG-SAM (Annex 5) directly informed the work of WG-FSA and is considered under the relevant agenda items. The Scientific Committee noted, in particular, advice pertaining to the following items in Annex 5:

(i) evaluation of research hauls in exploratory fisheries (paragraph 2.9)
(ii) CPUE in longline fisheries (paragraphs 2.15 and 2.33)
(iii) preliminary assessment in Divisions 58.4.4a and 58.4.4b (paragraph 2.17)
(iv) research fishing (paragraphs 2.19, 2.25, 2.26 and 5.3 to 5.6)
(v) performance metrics for surveys and tag-based research (paragraphs 2.38, 2.46 and 2.48)
(vi) research design for data-poor fisheries (paragraphs 2.40, 2.44 and 2.47 to 2.49)
(vii) tag-loss rates used in CASAL (paragraph 3.6)

(viii) pre-recruit survey in Subareas 88.1 and 88.2 (paragraph 3.14)
(ix) research fishing in areas which cannot support a viable fishery (paragraph 5.7)
(x) review of the Secretariat's Strategic Plan (paragraph 6.5)
(xi) Convener of WG-SAM (paragraph 8.3).

2.3 The Scientific Committee noted that the advice arising from the focus topic discussion on research plans for data-poor exploratory fisheries and the opportunity for Members to incorporate this advice into revised proposals in advance of WG-FSA, had contributed to substantially improved proposals for CCAMLR-sponsored research in data-poor toothfish fisheries being proposed and agreed this year.

2.4 The Scientific Committee agreed that the primary purpose of research in data-poor fisheries should be to collect data that will lead to a robust estimate of stock status and enable the estimation of precautionary catch limits consistent with CCAMLR decision rules (Annex 5, paragraphs 2.25 and 2.26 and Table 6).

2.5 The Scientific Committee noted that this year's focus topic on data-poor fisheries was outside the traditional quantitative remit of WG-SAM, and agreed that the terms of reference for WG-SAM could productively be expanded to allow consideration of a wider range of focus topics on an as-needed basis to inform the work of CCAMLR. The Scientific Committee agreed that the designation of different focus topics in particular years was a useful model to allow Members to prepare papers on a coherent topic and to send different experts to the meetings as appropriate for particular topics. The Scientific Committee identified the following focus topics as potentially valuable for discussion by WG-SAM in the short to medium term:

(i) applying international best practice from tagging programs and tag-based research

(ii) developing and evaluating methods to estimate IUU removals and trends in levels of IUU effort (SC-CAMLR-XXIX, paragraph 6.5; Annex 7, paragraph 3.24)

(iii) evaluating preliminary research plans

(iv) developing spatially explicit operating models to evaluate toothfish management procedures

(v) developing methods for assessing the impact of larval fish by-catch from the krill fishery (Annex 7, paragraph 3.23)

(vi) developing risk assessment methods for skate and macrourid by-catch in toothfish fisheries.

2.6 The Scientific Committee noted that the review and evaluation of research plans would likely need to be a standing topic for discussion every year and may constitute a considerable workload in its own right, but that if Members follow the clear guidance arising from this years' focus topic discussion and from WG-FSA, then the standard of the research proposals can be expected to improve and it should be possible to complete this work within a standing subgroup of WG-SAM and WG-FSA.

2.7 Some Members noted that the scheduling of WG-SAM with the mid-year meeting of WG-EMM was useful in order to draw on a range of expertise, but that these meetings should be held consecutively rather than in parallel, to allow effective participation by Members with small delegations.

2.8 The Scientific Committee thanked Dr Constable for his leadership of WG-SAM, noting that this was his final meeting as Convener.

Acoustic survey and analysis methods

2.9 SG-ASAM did not meet intersessionally between SC-CAMLR-XXIX and SC-CAMLR-XXX. However, the Scientific Committee noted the recommendation of WG-EMM for a meeting of SG-ASAM to be held during the forthcoming intersessional period along with a proposed list of issues that this meeting should address (Annex 4, paragraphs 2.225 and 2.226). The Scientific Committee noted that fishing-vessel-based acoustic data could provide qualitative and some quantifiable data on the distribution and relative abundance of other pelagic species such as myctophiids and salps, as well as krill.

2.10 Consequently, the Scientific Committee requested that SG-ASAM meet in 2012 and provide advice on:

(i) Survey design –

(a) the implications of directed and undirected survey design for collection of acoustic data by fishing vessels, including the location and timing of transects, and the desirability of using existing acoustic transects in Subareas 48.1, 48.2 and 48.3 (including those used in the CCAMLR-2000 Survey)

(b) the potential for collection of acoustic data between and at trawl stations during fishing operations

(c) the collection of biological data, CPUE and information on spatial patterns of fished krill aggregations required to interpret acoustic data and assist in target identification and aggregation characteristics.

(ii) Acoustic data collection –

(a) define the minimum requirements for acoustic data collection that could provide quantifiable estimates of krill biomass/distribution from fishing vessels, recognising that the vessels may not be configured to collect acoustic data at 38, 120 and 200 kHz as per the CCAMLR protocol (assuming appropriate survey design). This should include details of calibration, vessel noise characteristics and acoustic frequencies available on the vessel and whether the data are to be collected in a supervised (e.g. by scientists or suitably qualified observers on the vessel) or unsupervised (by vessel crew) manner. Where data are to be collected in an unsupervised manner, SG-ASAM should be requested to provide a detailed set of instructions to ensure that acoustic data are properly collected and stored

(b) define requirements for acoustic data collection and analysis methods that provide information on abundance and distribution of pelagic species other than krill.

(iii) Acoustic data processing –

(a) provide advice on the most appropriate way to process acoustic data arising from fishing vessels, including target identification, biomass estimation and associated uncertainty. This should include advice on the most appropriate data formats and data management implications of collection of acoustic data.

HARVESTED SPECIES

Krill resources

2009/10 fishery

3.1 The krill fishery in Subarea 48.1 was closed when the catch reached 99.8% of the trigger level for the subarea (155 000 tonnes). This was the first time that the krill fishery has been closed because it has reached one of the trigger levels (Subarea 48.1), noting that these were introduced for the first time in 2009. The final verified catch for Subarea 48.1 was 153 262 tonnes based on STATLANT data (Table 1; Annex 4, paragraph 2.3). The catch in Subarea 48.1 in 2009/10 remains the highest ever recorded in this subarea.

2010/11 fishery

3.2 Six Members with a total of 13 vessels fished for krill in 2010/11 with about two-thirds of the catch taken from Subarea 48.2 (Table 2). The reported catch to 24 September 2011 was 179 131 tonnes (SC-CAMLR-XXX/BG/1). The three major fishing nations were Norway (102 815 tonnes), Republic of Korea (29 052 tonnes) and Japan (26 390 tonnes). There was also a small amount of krill taken as by-catch (<1 tonne) during a UK trawl survey in Subarea 48.3.

3.3 Following modification of CM 23-06 in 2010, in-season data are now reported at five-day intervals when catches in any one season exceed 50% of the subarea-specific limit (Annex 4, paragraph 2.14). In addition, all vessels are required to submit haul-by-haul catch and effort (C1) data in accordance with CM 23-06 (Annex 4, paragraph 2.15).

3.4 The Scientific Committee noted that at the time of the meeting, all vessels fishing for krill in 2011 had exited the fishery, and it was not known if any vessels would return to the fishery prior to the end of 2010/11.

Fishing patterns

3.5 The fishery had concentrated in the Bransfield Strait area in 2009/10 due to low sea-ice cover allowing extended access to the region. In 2010/11, Subarea 48.1 was mostly covered by sea-ice and fishing operations moved to Subareas 48.2 and 48.3 (Annex 4, paragraph 2.7).

3.6 Dr M. Kiyota (Japan) noted the importance of facilitating spatial flexibility in fishery operation if the fishery was to be commercially sustainable. This was because there were large fluctuations in the spatial distribution of krill, as well as in the year-to-year variability in access to the fishing grounds.

Krill fishery notifications for 2011/12

3.7 At the time of WG-EMM-11, six Members had submitted notifications for a total of 15 vessels intending to participate in krill fishing operations during 2011/12 (Table 3). The notifications were for trawl fisheries for krill in Subareas 48.1, 48.2, 48.3 and 48.4. No notifications were submitted for exploratory krill fisheries in Subarea 48.6 or elsewhere. The three largest expected catches notified were from Norway (175 000 tonnes), China (70 000 tonnes) and the Republic of Korea (67 000 tonnes). The total notified catch was 391 000 tonnes (Annex 4, paragraph 2.9).

3.8 The notification for one of the two Chilean krill fishing vessels was withdrawn prior to the Scientific Committee meeting, leaving just one notified Chilean-flagged vessel (*Betanzos*).

3.9 The EU reported that the *Dalmor II*, notified by Poland, may not operate in the fishery in 2011/12 and may be replaced by another Polish-flagged krill fishing vessel. The expected level of catch by the replacement vessel will remain at the same level as previously notified.

3.10 Ukraine submitted a late notification for one vessel and an expected catch of 30 000 tonnes from Subareas 48.1 to 48.4 (SC-CAMLR-XXX/BG/13). The Scientific Committee noted that it was a matter for the Commission to decide whether the late notification should be accepted.

3.11 The Scientific Committee advised the Commission that the withdrawal of a Chilean-flagged vessel and the addition of the Ukrainian-flagged vessel would result in the total notified catch for 2011/12 being 401 000 tonnes, a similar level notified for 2009/10 and 2010/11, and not substantially different from the 391 000 tonnes considered by WG-EMM.

Escape mortality and green weight

3.12 Two pilot studies to estimate escape mortality were conducted in 2010/11, one by Ukraine using fine-mesh ‘chafers’ and another by Japan using video cameras. Both studies demonstrated that it will be challenging to estimate escape mortality. The Scientific Committee encouraged further work noting that it would be valuable to combine results from the two methods and standardise approaches (Annex 4, paragraphs 2.54 and 2.55).

3.13 Norway noted it could not pursue the planned observation of krill escapement using the trial camera system (SC-CAMLR-XXIX, paragraph 3.13) due to financial problems experienced by the vessel operator.

3.14 The Scientific Committee noted that all methods for estimating green weight of krill have associated uncertainty, and that the absolute uncertainty in catch estimates increases in proportion to the catch. This uncertainty is not accounted for in the current management process which uses a point estimate of total catch, without any uncertainty estimate, to monitor progress in catches taken during the season (Annex 4, paragraphs 2.56 to 2.58).

3.15 The Scientific Committee noted the importance of understanding the source of variation, overall level of variation, and potential bias in the estimates of green weight, in order to be able to reflect these uncertainties in management advice. The Scientific Committee requested that WG-EMM characterise such variability and uncertainty to investigate their impacts on krill management advice.

Trigger level

3.16 The Scientific Committee noted that CM 51-07 will expire this year and that it should be reviewed and revised in order to meet the requirements of Article II of the Convention, taking into account the resource requirements of krill-dependent predators (Annex 4, paragraph 2.66).

3.17 The Scientific Committee considered two main questions that would be pertinent to this review, and noted the advice of WG-EMM which had investigated these questions in relation to Subarea 48.1 where the interim catch limit of 155 000 tonnes was reached in 2009/10 (Annex 4, paragraph 2.73):

(i) Was the current subdivision effective in limiting the impact on predators in Subarea 48.1 in 2009/10?

(ii) Is the cap in Subarea 48.1 at an appropriate level if the fishery is going to be concentrated in Subarea 48.1, perhaps regularly, in the future?

3.18 Twenty-three CEMP parameters covering three CEMP sites and three CEMP species that forage in the Bransfield Strait were examined. These monitoring parameters did not substantially overlap in time with the fishery. The Scientific Committee concluded that the CEMP data were unlikely to reflect the immediate impact the fishery might have had. The Scientific Committee was unable to determine whether the aggregated fishing in Bransfield Strait during 2009/10 had impacted the predators in that area or not. The Scientific Committee also noted that no data were available to evaluate the likely impact of other catch levels for the Subarea 48.1 allocation of the trigger level (Annex 4, paragraphs 2.80 and 2.82).

3.19 Given the experience in 2009/10, the Scientific Committee noted that unless the timings of the fishery catches and CEMP observations are aligned in particular years, it will be difficult to answer these two questions under existing CEMP monitoring arrangements.

3.20 The Scientific Committee agreed that it would need to address the following points to investigate whether the spatial subdivision of the trigger level is effective for protecting predators (Annex 4, paragraph 2.87):

(i) advance notice of the areas in which the fishery will/could be concentrated so that monitoring can occur relative to those areas

(ii) an assessment of abundance of krill in the area before fishing begins and the flux of krill through the area

(iii) an assessment of the requirements of predators in the area to be fished

(iv) an assessment of whether the requirements of predators were affected by fishing.

3.21 The Scientific Committee noted that to investigate whether predators were effectively protected would require a large injection of resources, and that Members currently undertook such investigations to the best extent possible within their resources, providing the best science possible. The Scientific Committee was therefore unable to determine from available data, whether the subdivision between subareas according to CM 51-07 was precautionary enough or over-precautionary.

3.22 The Scientific Committee reiterated that in the absence of additional information, the advice remains that to be consistent with the precautionary approach and to avoid concentration of the catch as the trigger level is approached, a spatial allocation of the trigger level (620 000 tonnes) by subarea (CM 51-07) is required (Annex 4, paragraph 2.95).

3.23 The Scientific Committee advised the Commission that the precautionary subarea allocation scheme for the trigger level described in CM 51-07 should be retained until sufficient information is acquired for its revision (Annex 4, paragraph 2.97).

3.24 The Scientific Committee noted that in 2009/10 the krill fishery had operated in Admiralty Bay, which is ASMA No. 1. After reviewing the management plan for that ASMA, the Scientific Committee was unsure whether such fishing activity was compatible with the Code of Conduct for that ASMA, as described in point 8.2 of its management plan. Accordingly, the Scientific Committee advised the Commission of the overlap of commercial fishing operations within the ASMA. Such information may also need to be communicated to the ATCM as it may impact on the values within ASMA No. 1 (Annex 4, paragraph 2.84).

3.25 Dr Barrera-Oro expressed his concern on the lack of clarity in the management plan in relation to fisheries' access into the area where many seabird and fur seal breeding colonies exist, and that if, in the future, the ice conditions similar to 2009/10 occur again, it may impact on the performance of these land-based predators.

3.26 The Scientific Committee noted that at the time when this management plan was established, the effects of fishing in the region were not considered. Due to the recent development of the fishery, the Scientific Committee noted that it may be appropriate to revise the management plan to include fishing operations.

3.27 Dr Penhale referred to the management plan of ASMA No. 7, Southwest Anvers Island and Palmer Basin. The management plan notes that harvesting of marine living resources should be conducted in accordance with the provisions of the management plan and with due recognition of the important scientific and environmental values of the area. Any such activities should be conducted in coordination with research and other activities taking place, and could include development of a plan and guidelines that would help to ensure that harvesting activities did not pose a significant risk to the other important values of the area.

Krill recruitment variation, B_0 and precautionary yield

3.28 The Scientific Committee noted WG-EMM's discussions on estimates of recruitment variation, B_0, and precautionary yield for krill (Annex 4, paragraphs 2.59 to 2.65). It noted that the degree of recruitment variability currently used in the GYM might be an underestimate and that, for stocks with high interannual variability in abundance arising from recruitment, the probability of biomass falling below 20% of the initial biomass might be greater than 0.1 even in the absence of fishing (Annex 4, paragraph 2.64). The Scientific Committee further noted that in these circumstances it would be impossible to satisfy that part of the GYM decision rule designed to limit the probability of biomass falling below the 20% reference point to a maximum of 0.1.

3.29 The Scientific Committee noted WG-EMM's concern that current estimates of recruitment variability derive from samples taken in the early 1990s, and may not reflect krill recruitment variability. It was noted that recruitment variability may also alter with climate change.

3.30 The Scientific Committee agreed that investigation of recruitment variability, including estimating recruitment strengths in years since the early 1990s, is needed and may require reassessment of the catch limit. It also agreed that alternative application of the decision rules that would be appropriate in these circumstances (such as the decision rules used to establish annual catch limits for icefish) may need to be investigated if recruitment variability is too high or there are long-term trends in recruitment. These should be afforded a high priority.

Other issues related to management of the krill fishery

3.31 The Scientific Committee also noted WG-EMM's discussions concerning ecosystems other than the krill-centric ecosystem, and discussions on the status and trends of krill predators, species composition of fish by-catch in the krill fishery, the biology and ecology of krill, issues related to climate change effects on krill and krill predators, as well as the results from both acoustics and net surveys of krill; the Scientific Committee also noted the conclusions from a workshop entitled 'Antarctic krill in a changing ocean' which was co-sponsored by the EU and the Netherlands (Annex 4, paragraphs 2.138 to 2.141). The Scientific Committee noted that SC-CAMLR-XXX/BG/3 provided a number of recommendations for future work that broadly overlap with the priorities of the Scientific Committee (see also section 8).

3.32 The Scientific Committee specifically noted advice that juvenile krill of age-class 1+ are predominately concentrated in near-shore areas along the entire Antarctic Peninsula from Marguerite Bay in the south, to Bransfield Strait in the north. Fishing in nursery areas will have a different impact on the stock than fishing on adults, and management of the krill fishery will need to account for this (Annex 4, paragraph 2.137).

Symposium on Feedback Management of Krill

3.33 The Scientific Committee endorsed the six components proposed by WG-EMM that will form the basis of its future work to develop a feedback management procedure for krill (Annex 4, paragraph 2.155). The six components are:

1. development of a list of candidate feedback management approaches, including consideration of any operational implications for the fishery and for monitoring

2. identification of an agreed suite of indicators appropriate to candidate feedback management approaches

3. review of spatial and temporal structure in the ecosystem in which the current Area 48 fishery operates and consideration of the implications for monitoring and management

4. development of agreed decision-making mechanisms for the candidate feedback management approaches, including decision rules which identify how fishing strategies and/or monitoring are to be adjusted on the basis of the indicators

5. provision of advice on operationalising the objectives of Article II in the context of a changing ecosystem

6. evaluation of candidate feedback management approaches.

3.34 The Scientific Committee specifically recommended that the Commission note advice from WG-EMM on each of these six components (Annex 4, paragraphs 2.156, 2.160, 2.163, 2.167, 2.172 to 2.174, 2.179, 2.182, 2.186, 2.188 and 2.191).

3.35 The Scientific Committee endorsed the proposed work schedule outlined by WG-EMM (Annex 4, paragraph 2.157). It acknowledged that such a work schedule would be facilitated by the development of computer simulation models and that such models could expedite the delivery of the feedback management approach. It agreed that WG-EMM would undertake elements 1 to 2 of feedback management development in 2012, 3 to 4 in 2013 and 5 to 6 in 2014.

CEMP and STAPP

3.36 The Scientific Committee noted progress made by WG-EMM and WG-EMM-STAPP (Annex 4, paragraphs 2.193 to 2.214).

3.37 The Scientific Committee particularly noted the status of work to estimate abundance and consumption of krill by pack-ice seals, fur seals, penguins and flying seabirds in Area 48, and to partition the overall foraging effort by these predator groups into SSMUs (Annex 4, paragraph 2.199 and Table 5). It noted that work has been completed for pack-ice seals, and work on estimating overall abundance and krill consumption for fur seals and penguins is expected to be completed within the next few years. The remaining components of the work plan, which involve estimating overall abundance and consumption for flying seabirds, and partitioning the foraging effort by fur seals, penguins and flying seabirds across SSMUs, is expected to take at least another five years.

3.38 The Scientific Committee recognised that there is a significant knowledge gap for flying seabird status and trend information for birds in the CAMLR Convention Area, and considered that CCAMLR needs to find a means of engaging with the broader community of scientists working on flying seabirds (Annex 4, paragraph 2.203).

3.39 The Scientific Committee noted that the value of time-series data collected under prescribed CEMP methodologies increase as the time series grow in length and that reducing or stopping existing CEMP programs would severely compromise the ability to monitor change in the ecosystem (Annex 4, paragraph 2.212). However, it recognised that rising costs and funding restrictions are making it increasingly difficult for Members to continue long-term work as individual national programs. The Scientific Committee therefore encouraged the development of multinational CEMP programs wherever possible.

3.40 The Scientific Committee agreed that CEMP needs to focus on information required by the Commission to make management decisions (Annex 4, paragraph 2.213). The development of a feedback monitoring and management system may require CEMP to change or evolve from its present form to include greater spatial coverage, to monitor at different spatial and temporal scales, and to include more or different parameters and revised methods for existing parameters.

3.41 The Scientific Committee noted that products and outcomes of WG-EMM-STAPP in regard to estimates of penguin population size and trends will be very useful to CCAMLR in providing a larger-scale context for the detailed measurements made locally at CEMP sites.

3.42 The Scientific Committee welcomed plans by Ukraine to increase data available to CEMP by collecting information on seabirds and seals around the Argentine Islands.

Fish resources

Fisheries information

Catch, effort, length and age data reported to CCAMLR

3.43 Members' fishing vessels operated in the fisheries targeting icefish (*Champsocephalus gunnari*), toothfish (*Dissostichus eleginoides* and/or *D. mawsoni*) and krill (*Euphausia superba*), and catches reported to 24 September 2011 are summarised in Table 1; no directed fishing occurred on crabs (*Paralomis* spp.) during the season (see also SC-CAMLR-XXX/BG/1).

3.44 Three other fisheries were conducted in the Convention Area in 2010/11:

- fishery for *D. eleginoides* in the French EEZ in Division 58.5.1
- fishery for *D. eleginoides* in the French EEZ in Subarea 58.6
- fishery for *D. eleginoides* in the South African EEZ in Subareas 58.6 and 58.7, which also includes associated fishing in Area 51 outside the Convention Area.

3.45 The preliminary total catch of target species by country and region reported from fisheries conducted in the CAMLR Convention Area in 2010/11 are summarised in Table 2.

3.46 The Scientific Committee noted the catches of toothfish from waters outside the Convention Area reported in the CDS (Annex 7, Table 2).

3.47 Dr Barrera-Oro advised that the catch limit in the Argentine EEZ in Area 41 in 2010/11 was 3 250 tonnes. The fishery is carried out by longline and trawl but is restricted to depths greater than 800 m to protect juveniles. Since 2007, vessels are required to tag *D. eleginoides* at a rate of two fish per tonne of green weight caught, and to date 3 500 individuals have been tagged and released. Recapture rates have been low in the current season and there is little evidence of large-scale fish movement.

3.48 Prof. O. Pin (Uruguay) advised that 567 tonnes of *D. eleginoides* had been caught in the Uruguayan EEZ in Area 41 in 2010/11. The catch had been taken by longline or trotline (approximately 95% of the catch) and pots (5%).

3.49 The Scientific Committee welcomed this information and urged Members managing fisheries for *D. eleginoides* outside the Convention Area to provide information to WG-FSA on these fisheries, including details of the assessments and management measures in place. The Scientific Committee also urged Members with such fisheries to attend the meetings of WG-FSA to the extent possible.

3.50 The Scientific Committee noted the development of procedures, databases and data forms developed by the Secretariat during the intersessional period (Annex 7, paragraph 3.1). This included updating the fishery and scientific observer data forms, developing the tag overlap statistic calculator, processing data, allocating research hauls in the exploratory fisheries in Subareas 48.6 and 58.4, and updating the Fishery Reports and Bottom Fishing and VME report.

3.51 The Scientific Committee discussed whether maps depicting the fine-scale characterisation of *Dissostichus* fisheries in the Convention Area should be made available in publicly accessible documents such as the *Statistical Bulletin*. It was agreed that the maps are highly informative, but it was noted that there could be commercial sensitivity around the publication of such fine-scale data.

3.52 The Scientific Committee agreed that further work should be carried out in advance of next year's meeting to ensure that only high-quality validated data are included in any maps being produced. It was also recommended that the Secretariat write to Members in order to determine factors that might restrict the type and spatial resolution of data that could be included in maps for public access.

3.53 The COLTO Observer (Mr M. Exel) informed the Scientific Committee that the publication of detailed maps showing the location of catches could be used by IUU operators.

3.54 The Scientific Committee noted that it could only advise on the scientific rationale for wider publication of maps; issues of data access and confidentiality were areas to be dealt with by the Commission.

Input for stock assessment

3.55 The Scientific Committee noted that WG-FSA had reviewed all available research data which were subsequently used in updating stock assessments of fish in the Convention Area. This included catch-at-length/age data from fisheries, research surveys, catch and effort analyses, tagging studies, biological parameters, stock structure and management areas, unaccounted mortality from lost fishing gear, and depredation.

Research surveys

3.56 The Scientific Committee noted that two Members reported on research surveys undertaken in 2010/11 (Annex 7, paragraphs 4.6, 4.7 and 4.10 to 4.13):

(i) A bottom trawl survey in Subarea 48.3 was carried out by the UK. The results from the survey were used to update the assessments of icefish and toothfish in this subarea.

(ii) Three bottom trawl surveys in Division 58.5.2 were carried out by Australia in September 2010, March 2011 and May 2011. The results of the May 2011 survey were used to update assessments of toothfish and icefish in this division.

Assessments and management advice

Champsocephalus gunnari South Georgia (Subarea 48.3)

3.57 The Fishery Report for *C. gunnari* at South Georgia (Subarea 48.3) is contained in Annex 7, Appendix E, and discussion by WG-FSA is in Annex 7, paragraphs 6.1 to 6.6.

3.58 In 2010/11 the catch limit set for *C. gunnari* in Subarea 48.3 was 2 305 tonnes. Limited commercial fishing was conducted by one vessel in February and one in September/October 2011 but with zero catches. A total of 10 tonnes was reported from the research survey.

3.59 The Scientific Committee noted that there had now been two years of negligible commercial catches despite catch limits of over 2 000 tonnes. The very low availability of krill observed in 2009 (SC-CAMLR-XXIX, Annex 8, paragraph 3.18) is thought to have had an impact on the vertical distribution of icefish and may have made them less available to the pelagic trawl fishery. The Scientific Committee recommended that the issue of negligible commercial catches should be addressed at next year's WG-FSA meeting if they remain low in 2011/12.

3.60 Dr S. Kasatkina (Russia) noted that Russia has prepared a manual on icefish age determination which will be submitted for discussion at the next meeting of WG-FSA.

3.61 The Scientific Committee endorsed the short-term assessment method of the Working Group, implemented using the length-based method described in WG-FSA-11/30 to calculate future catch limits in accordance with the CCAMLR decision rules for icefish.

Management advice

3.62 The Scientific Committee recommended that the catch limit for *C. gunnari* should be set at 3 072 tonnes in 2011/12 and 2 933 tonnes in 2012/13 based on the outcome of the short-term assessment.

Champsocephalus gunnari Heard Island (Division 58.5.2)

3.63 The Fishery Report for *C. gunnari* in Division 58.5.2 is contained in Annex 7, Appendix F, and discussion by WG-FSA is in Annex 7, paragraphs 6.7 to 6.13.

3.64 The catch limit of *C. gunnari* in Division 58.5.2 for 2010/11 was 78 tonnes and the catch reported for this division as of 9 October was 1 tonne.

3.65 The Scientific Committee noted that WG-FSA had considered a proposal to introduce a limit reference point for the *C. gunnari* fishery in Division 58.5.2, whereby where the stock assessment of *C. gunnari* in Division 58.5.2 indicated a stock biomass (represented by the lower one-sided 95% confidence limit of the survey biomass estimate) of less than 1 000 tonnes, or the decision rules indicated a catch limit of less than 100 tonnes, a commercial catch limit would not be set. Instead, a 30-tonne combined research and by-catch limit would apply, which would allow the annual trawl survey to continue to monitor the stock, and accommodate by-catch of icefish that may occur in the *D. eleginoides* trawl fishery in this division.

3.66 The Scientific Committee noted that the rationale for the proposed limit reference point was not based on detailed analyses and would be strengthened by further evaluation taking into account stock-specific biology and ecosystem roles. The Scientific Committee also agreed that limit reference points be explored for other *C. gunnari* fisheries in the Convention Area.

3.67 The Scientific Committee noted that a short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass of 983 tonnes from the 2011 survey and using the revised growth parameters described in WG-FSA-10/12; other fixed parameters remained unchanged from previous assessments.

3.68 The projection of fish of 1+ to 3+ age classes from 2010/11 gave a projected yield of 101 tonnes in 2011/12 and 82 tonnes in 2012/13.

3.69 The Scientific Committee noted that the assessment for catch in 2011/12 indicated a lower one-sided 95% confidence level of biomass less than 1 000 tonnes and therefore recommended that the new limit reference point be applied pending the results of a planned survey in 2012.

Management advice

3.70 The Scientific Committee recommended that the conservation measures applying to the fisheries in Division 58.5.2 be modified to take account of the interim limit reference point.

3.71 Scientific Committee recommended a catch limit for *C. gunnari* in 2011/12 of 0 tonnes, with a 30-tonne research and by-catch limit.

Dissostichus eleginoides South Georgia (Subarea 48.3)

3.72 The Fishery Report for *D. eleginoides* in Subarea 48.3 is contained in Annex 7, Appendix G, and the discussion by WG-FSA is in Annex 7, paragraphs 6.14 to 6.25.

3.73 The catch limit for *D. eleginoides* in 2010/11 was 3 000 tonnes, and the recorded catch was 1 788 tonnes.

3.74 The Scientific Committee noted that while the groundfish survey and commercial catch-at-age both suggest the 2001 cohort was relatively strong (Annex 7, paragraph 6.20), there is still uncertainty in the strength of this cohort. The Scientific Committee also noted the importance of the assumptions regarding fleet structure and associated selectivity on estimates of year-class strength, and the effects of this on estimation of long-term yield.

3.75 The Scientific Committee noted that two CASAL assessment models were considered by WG-FSA: a two-fleet model, with an initial fleet 1985–1997 and a new fleet 1998–2011; and a three-fleet model, with an initial fleet 1985–1997, an intermediate fleet 1998–2003 and a new fleet 2004–2011.

3.76 The Scientific Committee endorsed the assessment undertaken by WG-FSA using the two-fleet model presented in Annex 7, paragraphs 6.21 to 6.23 and Appendix G.

Management advice

3.77 The Scientific Committee noted the advice of WG-IMAF that the 2011/12 season for longline fishing operations may be extended in two periods: (i) to start on 16 April; and (ii) to end on 14 September for any vessel which has demonstrated full compliance with CM 25-02 in the previous season (paragraphs 4.9 and 4.10; Annex 8, paragraph 8.11).

3.78 The Scientific Committee recommended a catch limit of 2 600 tonnes for 2011/12 and 2012/13.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

3.79 The Fishery Report for *D. eleginoides* in Subarea 48.4 is contained in Annex 7, Appendix H, and the discussion by WG-FSA is in Annex 7, paragraphs 6.26 to 6.33.

3.80 A tagging experiment has been conducted in Subarea 48.4 North over the last six years. This experiment was extended to Subarea 48.4 South in 2008/09.

3.81 The catch limits for *D. eleginoides* and *D. mawsoni* in Subarea 48.4 North in 2010/11 were 40 and 0 tonnes (except for scientific purposes) respectively, with recorded catches of 36 and 1 tonne respectively. The catch limit for *Dissostichus* spp. in Subarea 48.4 South in the 2010/11 season was 30 tonnes, with a recorded catch of 17 tonnes.

D. eleginoides in the northern area

3.82 The Scientific Committee noted that the use of an integrated assessment model incorporating both catch-at-age and catch-at-length data was recommended by WG-FSA (Annex 7, paragraph 6.29).

3.83 The yield satisfying the CCAMLR decision rule using projections with randomised lognormal year-class strength with a mean of the long-term average of the stock and a CV of 1, was 48 tonnes.

Dissostichus spp. in the southern area

3.84 The Scientific Committee noted that a three-year tagging experiment in Subarea 48.4 South was completed in 2010/11.

3.85 Due to reduced catches and low tag returns realised in the last year of the experiment, it was proposed to extend the tagging experiment for a fourth year in Subarea 48.4 South in 2011/12, carrying forward the original proposal objectives from 2009 as detailed in WG-FSA-09/18.

3.86 The Scientific Committee noted that Petersen estimates from tag recaptures to date suggest a vulnerable population of approximately 600 tonnes for *D. mawsoni* and 150–350 tonnes for *D. eleginoides*. This is consistent with estimates made in 2010 (SC-CAMLR-XXIX). Application of γ from the most recent Subarea 48.3 assessment (0.038) to estimates of vulnerable biomass resulted in a yield estimate of 33 tonnes.

Management advice

3.87 The Scientific Committee recommended the following limits for toothfish and by-catch in Subarea 48.4:

Subarea 48.4 North –

(i) a catch limit of 48 tonnes for *D. eleginoides*

(ii) the continued prohibition of the targeting of *D. mawsoni* other than for scientific research purposes

(iii) maintenance of catch limits for by-catch species, with a limit for macrourids of 7.5 tonnes (16% of the catch limit for *D. eleginoides*) and a limit for rajids of 2.5 tonnes (5% of the catch limit for *D. eleginoides*).

Subarea 48.4 South –

(i) a catch limit of 33 tonnes for *Dissostichus* spp. (*D. eleginoides* and *D. mawsoni* combined)

(ii) maintenance of a move-on rule for by-catch species, with a macrourid trigger of 150 kg and 16% of the catch of *Dissostichus* spp., and a trigger for rajids set at 5% of the catch of *Dissostichus* spp.

(iii) the tagging experiment be extended for a fourth year carrying forward the original proposal objectives.

Dissostichus eleginoides Heard Island (Division 58.5.2)

3.88 The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Annex 7, Appendix I, and the discussion by WG-FSA is in Annex 7, paragraphs 6.34 to 6.42.

3.89 The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E for 2010/11 was 2 550 tonnes (CM 41-08). The catch of *D. eleginoides* reported for 2010/11 up to 10 October was 1 676 tonnes. Of this, 1 122 tonnes was taken by longline, 521 tonnes by trawl and 33 tonnes by pot.

3.90 The Scientific Committee endorsed the work of WG-FSA and agreed that the estimated current stock status at 2011 was 63% of B_0 and the long-term annual yield that meets the CCAMLR decision rules was calculated to be 2 730 tonnes.

3.91 The Scientific Committee noted the program of future work outlined in Annex 7, paragraph 6.41.

Management advice

3.92 The Scientific Committee recommended that the catch limit for *D. eleginoides* in Division 58.5.2 west of 79°20'E should be 2 730 tonnes for 2011/12 and 2012/13.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

3.93 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Annex 6, Appendix J, and the discussion by WG-FSA is in Annex 7, paragraphs 6.43 to 6.47.

3.94 The catch of *D. eleginoides* reported for this division to August 2011 was 2 906 tonnes.

3.95 The Scientific Committee noted that WG-FSA reviewed a preliminary assessment of *D. eleginoides* in Division 58.5.1. The CASAL integrated assessment model uses catch, CPUE and length-frequency data from the commercial fishery (1979–2011), IUU estimates, abundance estimates from scientific surveys and tagging data to derive estimates of yield. The Scientific Committee noted that the model as it is currently configured could not be used for management advice.

3.96 The Scientific Committee commended the considerable progress made in the development of the assessment model and recognised the cooperative work between France and Australia during the intersessional period. It encouraged further development of this assessment along with continued collection and analysis of data on catch and effort and tagging and other data that could be used to progress understanding of fish stocks and fishery dynamics on the Kerguelen Plateau.

Management advice

3.97 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 32-13, remains in force.

Dissostichus eleginoides Crozet Islands (Subarea 58.6)

3.98 The Fishery Report for *D. eleginoides* in Subarea 58.6 (French EEZ) is contained in Annex 7, Appendix K, and the discussion by WG-FSA is in Annex 7, paragraphs 6.48 to 6.53.

3.99 The catch of *D. eleginoides* reported for this subarea to August 2011 was 551 tonnes. Only longlining is currently permitted in the fishery. The IUU catch for 2010/11 had not been estimated.

3.100 The standardised CPUE series for this fishery was not updated by WG-FSA.

Management advice

3.101 The Scientific Committee encouraged the estimation of biological parameters for *D. eleginoides* in the French EEZ of Subarea 58.6, and the development of a stock assessment for this area. The Scientific Committee encouraged France to continue its tagging program in Subarea 58.6.

3.102 The Scientific Committee recommended that avoidance of zones of high by-catch abundance should also be considered.

3.103 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 32-11, remain in force.

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

3.104 The Fishery Report for *D. eleginoides* in Subareas 58.6 and 58.7 inside the South African EEZ is contained in Annex 7, Appendix L, and the discussion by WG-FSA is in Annex 7, paragraphs 6.54 to 6.60.

3.105 The catch limit of *D. eleginoides* in the South African EEZ for 2010/11 was 440 tonnes for the period 1 December 2010 to 30 November 2011. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2011 was 176 tonnes and 129 tonnes in Area 51, all of which was taken by trotlines.

3.106 The Scientific Committee noted that the catch limit of *D. eleginoides* in the South African EEZ for 2011/12 is likely to be 320 tonnes, and that a revised operational management procedure to form the basis for management advice is under development by national scientists.

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

3.107 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

3.108 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 CMs 32-10, 32-11 and 32-12, remains in force.

Other fisheries

Antarctic Peninsula and South Shetland Islands (Subarea 48.1) and South Orkney Islands (Subarea 48.2)

3.109 The Scientific Committee recommended that the existing CMs 32-02 and 32-04 on the prohibition of finishing in Subareas 48.1 and 48.2 respectively, remain in force.

Crabs (*Paralomis* spp. Subarea 48.3)

3.110 Crabs were not harvested during 2010/11 and no notifications of intention to fish for crabs in 2011/12 have been received by CCAMLR.

3.111 The Scientific Committee noted that WG-FSA had considered a review of information on biology and ecology of Lithodidae crabs around South Georgia which also provided an overview of the development of a management regime (WG-FSA-11/26).

3.112 The Scientific Committee noted that the current precautionary catch limit might not be sustainable in the long term if it were reached consistently. There is a high level of discarding and uncertainty surrounding discard mortality.

Management advice

3.113 The Scientific Committee recommended that the crab fishery in Subarea 48.3 be closed.

Fish and invertebrate by-catch

3.114 The Scientific Committee deliberations on this item are reported in section 7. This agenda item will be considered in detail by WG-FSA in 2012.

New and exploratory fisheries

3.115 Seven exploratory longline fisheries for *Dissostichus* spp. were agreed for 2010/11 (CMs 41-04 to 41-07 and 41-09 to 41-11). Activities in these fisheries are summarised in Annex 7, Table 1.

3.116 Nine Members notified for exploratory longline fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b for 2011/12 (Annex 7, Table 6). Another Member (Ukraine) withdrew its notification for Subareas 88.1 and 88.2 before the meeting.

3.117 The Scientific Committee noted the exceptionally high CPUEs recorded in SSRU 5841E in the last two seasons and in SSRU 5842E in 2010/11, which were at least five times higher than those recorded in previous seasons for the same SSRUs. The Scientific Committee agreed that they were anomalously high and requested further investigation by the Secretariat, WG-FSA and Members, to understand the reason for this.

3.118 Consideration of the cumulative tag releases prepared by the Secretariat showed that in exploratory fisheries most vessels released tags continuously, at or above the required rates, throughout their fishing trips. The Scientific Committee recommended that a performance metric to reflect the deviations away from the required tag-to-tonne ratio line be developed during the intersessional period.

3.119 Length-frequency overlap statistics showed that in all subareas/divisions all vessels had achieved the required overlap statistic of at least 50% between tag-release length frequency and catch-weighted length frequency under CM 41-01 during 2010/11 (Annex 7, Tables 8 and 9). The Scientific Committee was encouraged to see that almost all vessels had improved their performance over the last three years, some significantly, and this confirms that vessels can achieve the required overlap statistic of 60% in 2011/12.

3.120 In November 2010, prior to the start of the 2010/11 fishing season, the Korean government invited the Secretariat's Science Officer and the Scientific Observer Data Analyst to visit Korea in order to provide a briefing to Korean stakeholders involved in CCAMLR fisheries (CCAMLR-XXIX, paragraph 11.24). The aim of the visit was to clarify the requirements for, and methods of, data collection on board fishing vessels, including tagging of toothfish. Dr K. Seok (Republic of Korea) thanked the Secretariat for undertaking this outreach task and noted that the success of this work was reflected in the much improved performance in the tagging program in 2010/11.

3.121 In 2010/11, 6 279 *Dissostichus* spp. were tagged and released in the exploratory longline fisheries and 285 tags were recovered (Annex 7, Tables 10 and 11). As in previous years, most tags have been recaptured in Subareas 88.1 and 88.2. Of almost 14 000 tags released in Subareas 48.6 and 58.4, there have been only 69 (0.5%) recaptures. Only seven tags were recaptured from these subareas in 2010/11: two from Subarea 48.6 and five from Division 58.4.1. This is the lowest number of tags recaptured in these subareas since the start of the tagging program even though catches in 2010/11 in these subareas were higher than in the previous two years.

Progress on assessments in data-poor exploratory fisheries (Subareas 48.6 and 58.4)

3.122 The Scientific Committee recalled its discussion on 'data-poor fisheries' at its 2010 meeting (SC-CAMLR-XXIX, paragraphs 3.125 to 3.133), which had led to the focus topic at WG-SAM in 2011. The term 'data-poor exploratory fisheries' was adopted for this purpose to refer to fisheries for which a robust stock assessment that provides advice on catch limits according to CCAMLR decision rules has not been developed due to lack of information. The term was used to refer to the exploratory fishery in Subarea 48.6 as well as to exploratory and closed fisheries in Subarea 58.4. The following section refers to those exploratory fisheries with non-zero catch limits (i.e. Subarea 48.6, Divisions 58.4.1, 58.4.2 and 58.4.3a).

3.123 The Scientific Committee noted that the failure to acquire the data necessary to develop assessments in data-poor exploratory fisheries (Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a) may be a consequence of research implementation rather than research design, and that the success of tagging programs may be undermined in a number of different ways, including a low tag overlap statistic, lack of spatial overlap between fishing effort and previous release of tags, depredation of tagged fish by killer whales, release of fish in poor condition (e.g. high mortality of tagged fish associated with trotlines) and capture of tagged fish by IUU vessels (Annex 7, paragraph 6.73).

3.124 Drs L. Pshenichnov (Ukraine) and V. Bizikov (Russia) considered that one of the main reasons for the lack of tag recaptures in Divisions 58.4.1 and 58.4.2 were the closed SSRUs in those divisions. They also noted that capture of fish by IUU vessels was also likely to be a problem.

3.125 Dr Pshenichnov noted that the most recent scientific and fishing data show that unstandardised CPUEs in Divisions 58.4.1 and 58.4.2 are at a similar or higher level to those in Subareas 88.1 and 88.2. Following this logic, he noted that the divisions in Subarea 58.4 had a similar or higher population of *D. eleginoides* to that in Subareas 88.1 and 88.2. He considered that, to be able to assess the population of the stock in these divisions, all the SSRUs should be open to fishing. He further proposed that the catch limits for these divisions should revert to the same levels that they were in 2008: 780 tonnes in Division 58.4.2, 600 tonnes in Division 58.4.1, with not more than 160 tonnes from each SSRU.

3.126 Dr Constable noted that the Scientific Committee had already questioned the anomalously high CPUEs reported in the last two years for certain SSRUs in these divisions, and that there was a need for further investigation to understand the reason for this (paragraph 3.117). He further noted the problems identified in standardising CPUEs between different gear types and these will need to be resolved before the Scientific Committee draws conclusions from the CPUE data. Dr Watters considered that the success in other tagging programs in Subareas 48.4, 88.1 and 88.2 had come from concentrating tagging effort and that fishing in the closed SSRUs was unlikely to increase the recapture rates.

3.127 The Scientific Committee recalled its advice from last year that the assessment of *Dissostichus* spp. in data-poor exploratory fisheries was of a very high priority, and noted that no progress had been made in the assessment of these fisheries over the past few years. It also agreed that the research being conducted under the existing research plan in CM 41-01, Annex B, is unlikely to lead to assessments in these fisheries in the next 3–5 years.

3.128 The Scientific Committee therefore recommended that the number of research hauls be increased, and that the tagging rates should be increased to five tagged fish per tonne caught in Subareas 48.6 and 58.4 (CMs 41-04, 41-05, 41-06 and 41-11), to increase the amount of data and the number of tags available for recapture. Increasing the number of research hauls in aggregations of fine-scale rectangles in which tags have been released in the past few years will increase the likelihood of tagged fish being recaptured.

3.129 The Scientific Committee agreed that the aim of research hauls was to concentrate effort in locations where tagged fish had been released. It reviewed catch and effort data from the SSRUs and number of fine-scale rectangles fished in Subareas 48.6 and 58.4 over the past three seasons (Table 4). The Scientific Committee recommended that research hauls should be restricted to those fine-scale rectangles and a buffer zone of the width of one fine-scale rectangle around them. This buffer zone would allow for recapture of tagged fish that had moved since being released, and would improve fishing access even when some of the fine-scale rectangles were inaccessible due to sea-ice cover. The Scientific Committee recommended that after the first 10 research hauls were completed, fishing should continue with research hauls and commercial hauls at or above a ratio of 1:3.

3.130 To concentrate effort in locations where tagged fish had been released, the Scientific Committee further recommended that the minimum distance between research hauls be reduced from 5 n miles to 3 n miles.

3.131 The Scientific Committee therefore recommended replacing paragraph 3 of CM 41-01, Annex B, as follows:

> 'Except when fishing in Statistical Subareas 88.1 and 88.2 (see paragraph 5), any vessel undertaking prospecting or commercial fishing in any SSRU must undertake the following research activities:
>
> (i) On first entry into an SSRU, the first 10 hauls, whether by trawl or longline, shall be designated 'research hauls' and must satisfy the criteria set out in paragraph 4. All research hauls shall be carried out within the fine-scale rectangles defined by the CCAMLR Secretariat[1].
>
> (ii) On completion of the first 10 research hauls the vessel may continue fishing in the SSRU, but is required to complete at least one research haul for every three commercial hauls thereafter in the SSRU, such that the ratio of research hauls to commercial hauls after the completion of the first 10 research hauls does not fall below a ratio of 1:3.
>
> [1] The Secretariat will generate a list of fine-scale rectangles for each SSRU in exploratory fisheries. These lists will be provided to notifying Members prior to the start of the fishing season. If fine-scale rectangles designated for research sets are blocked by sea-ice the vessel should move to the nearest available rectangle(s) with fishing depth between 550 and 2 200 m, and conduct the research sets in this (those) rectangle(s).'

3.132 The Scientific Committee recommended making the following modification to CM 41-01, Annex B, paragraph 4(i):

> '(i) ~~each research haul must be separated by not less than 5 n miles from any other research haul~~ each research haul must be separated by not less than 3 n miles from any other research haul;'

3.133 The Scientific Committee recommended making the following modifications to CM 41-01, Annex C, paragraph 2(ii):

> '(ii) The program shall target toothfish of all sizes in order to meet the tagging requirement, ~~only toothfish that are in good condition shall be tagged and the availability~~ only single-hooked fish in good condition shall be tagged and released (noting that fish hooked only in the mouth are counted as single-hooked). The availability of these fish shall be reported by the observer. The length frequency of tagged toothfish shall reflect the length frequency of the

catch of each species of *Dissostichus*[2]. Each vessel catching more than 10 tonnes of *Dissostichus* spp. in a fishery shall achieve a minimum tag overlap statistic of 60% from 2011/12 onward[3]. All released toothfish must be double-tagged and releases should cover as broad a geographical area as possible. In regions where both species occur, the tagging rate shall be in proportion to the species and lengths of each *Dissostichus* spp. present in the catches.'

3.134 Pending the submission of research proposals in 2012 (as recommended in paragraphs 3.137 and 3.138), those changes identified in paragraphs 3.131 and 3.132 will expire at the end of 2011/12.

3.135 The Scientific Committee noted that the focus topic on implementing research proposals in data-poor exploratory fisheries held by WG-SAM (Annex 5, paragraph 2.21) had identified a number of key elements which had led to assessments of toothfish in SSRU 882E and Subarea 48.4 North. These included a robust experimental design with a well-coordinated multi-year tagging program focused on repeatedly visiting a relatively small area and a commitment by vessels to achieving high tagging performance. It further noted that research incorporating these elements could potentially be applied in data-poor exploratory fisheries to provide the data necessary to assess the stocks.

3.136 The Scientific Committee noted the principles elaborated by WG-SAM for research in data-poor exploratory fisheries and the requirement for research proposals to provide details on how these principles will be addressed (Annex 5, paragraphs 2.25 and 2.26). The Scientific Committee discussed the detailed format presented in Table 6 of Annex 5 that would enable the Scientific Committee to evaluate, inter alia, the likelihood that the proposal will satisfy the requirements for CCAMLR-sponsored research. During the meeting, the Scientific Committee revised this table to incorporate elements in format 2 of CM 24-01 (Table 2).

3.137 The Scientific Committee noted the general applicability of the format in Table 5 and recommended that this table should replace the current format 2 in CM 24-01. The Scientific Committee recommended that CM 21-02 be revised to refer to the format in Table 5 for the submission of research proposals associated with notifications for participation in data-poor exploratory fisheries within Subareas 48.6 and 58.4.

3.138 To give effect to the process of review of research proposals by the Scientific Committee and its working groups, the Scientific Committee recommended a change to the deadline by which notifications for participation in data-poor exploratory fisheries and the associated research proposals are to be submitted to the Secretariat. This could be achieved by aligning this with the existing deadline of 1 June for submission of notifications for participation in exploratory fisheries for krill (CM 21-02, paragraph 5i). This will enable research proposals to be reviewed iteratively at the intersessional working group meetings during July and again by WG-FSA in October in advance of the 2012 meeting of the Scientific Committee.

Other research

3.139 The Scientific Committee noted that several Members were ageing *D. mawsoni* otoliths (Annex 7, paragraphs 6.81 and 6.82) and requested WG-FSA to initiate a coordinated plan to age *D. mawsoni* otoliths from all the data-poor exploratory fisheries in Subareas 48.6 and 58.4 at its 2012 meeting.

3.140 The Scientific Committee recommended that on all research hauls (paragraph 3.131) observers be required to collect data characterising the suitability of captured fish for tagging, including the number of hooking injuries (Annex 7, paragraph 5.41).

3.141 The Scientific Committee recognised that the 2-tonne trigger level currently set to activate Annex 41-01/C was too low and could result in an unintentional failure to implement the conservation measure and recommended that Annex 41-01/C, paragraph 2(ii), be modified as follows: 'Each vessel catching more than 10 tonnes of *Dissostichus* spp. in a fishery shall achieve a minimum tag overlap statistic of 60% from 2011/12 onward'.

3.142 The Scientific Committee recommended that the CCAMLR tagging protocols be reviewed, updated and translated into other languages intersessionally.

Development of advice on catch limits for *Dissostichus* spp.

Dissostichus spp. in Subarea 48.6

3.143 Three Members (Japan, Republic of Korea and South Africa) and four vessels fished in Subarea 48.6 SSRUs A, B, C and G in 2010/11. The precautionary catch limit for *Dissostichus* spp. was 200 tonnes north of 60°S (SSRUs A and G) and 200 tonnes south of 60°S (SSRUs B–F). A total catch of 393 tonnes was taken. Information on this fishery is summarised in Annex 7, Appendix M.

3.144 The number of tag recaptures was very low in Subarea 48.6 in 2010/11. The Scientific Committee noted that in total there have been very few tag recaptures from this subarea, and that no progress could be made on assessments of *D. eleginoides* in Subarea 48.6. The Scientific Committee noted all vessels fishing in Subarea 48.6 in 2010/11 achieved a tag overlap statistic greater than 50% (range 53–95%).

3.145 Five Members (Japan, Republic of Korea, Norway, Russia and South Africa) and a total of seven vessels notified their intention to fish for toothfish in Subarea 48.6 in 2011/12.

3.146 The Scientific Committee agreed that it could provide no new advice on catch limits for this subarea for 2011/12. It recommended increasing the research requirements in this fishery for 2011/12 (paragraphs 3.128 to 3.134) and for the 2012/13 fishing season (paragraphs 3.137 and 3.138).

3.147 The Scientific Committee requested the Secretariat examine the possibility of obtaining a Petersen estimate of *Dissostichus* spp. biomass from tag recaptures in Subarea 48.6 in the intersessional period.

Dissostichus spp. Division 58.4.1

3.148 Three vessels from two Members (Republic of Korea and Spain) fished in the exploratory fishery in Division 58.4.1 in 2010/11. The precautionary catch limit for toothfish was 210 tonnes in three SSRUs (C: 100 tonnes, E: 50 tonnes and G: 60 tonnes), and 216 tonnes were taken between 1 December 2010 and 12 March 2011. Information on this fishery is summarised in Annex 7, Appendix N.

3.149 High levels of IUU fishing have been reported in 2005/06 and 2006/07 and an estimated IUU catch of 910 tonnes was taken in 2009/10. The IUU catch of *Dissostichus* spp. in 2010/11 was not estimated.

3.150 A total of 5 759 *D. mawsoni* and 314 *D. eleginoides* have been tagged and released in Division 58.4.1, and 26 *D. mawsoni* and one *D. eleginoides* have been recaptured in that division. The Scientific Committee noted that all vessels fishing in Division 58.4.1 in 2010/11 achieved a tag overlap statistic greater than 50% (range 52–74%).

3.151 Six Members (Japan, Republic of Korea, New Zealand, Russia, South Africa and Spain) and a total of 11 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2011/12.

3.152 The Scientific Committee agreed that it could provide no new advice on catch limits for this division for 2011/12. It recommended increasing the research requirements in this fishery for 2011/12 (paragraphs 3.128 to 3.133) and for 2012/13 (paragraphs 3.137 and 3.138).

Dissostichus spp. Division 58.4.2

3.153 In 2010/11, one Member (Republic of Korea) fished in Division 58.4.2 and reported a catch of 136 tonnes. SSRU E was closed on 24 February 2011 (SSRU E catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 136 tonnes), and consequently the fishery was closed on 25 February 2011 (SSRU A catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 0 tonnes). Information on this fishery is summarised in Annex 7, Appendix O.

3.154 The IUU catch of *Dissostichus* spp. in 2010/11 was not estimated.

3.155 The vessel fishing in Division 58.4.2 achieved the target tagging rate of three tags per tonne of green weight and achieved a tag overlap statistic greater than 60%. A total of 408 toothfish were tagged and released in 2010/11 and no tagged toothfish were recaptured.

3.156 Five Members (Japan, Republic of Korea, New Zealand, South Africa and Spain) and a total of five vessels notified their intention to fish for toothfish in Division 58.4.2 in 2011/12.

3.157 The Scientific Committee noted the large catch overrun in SSRU E (catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 136 tonnes) and expressed concern that this may compromise the long-term research in this division and the ability to develop adaptive management strategies and stock assessments.

3.158 Dr Constable noted that the consequence of the overrun in SSRU 5842E needs to be considered in light of the distribution of the overall population and the risks to the stock. With respect to risks, the level of IUU fishing and the historical time series of catches need to be considered.

3.159 The Scientific Committee recommended the development of simulation studies which could provide a suitable method for exploring how these fisheries could be managed, including overruns in any one area.

3.160 Some Members requested that the Commission consider reducing the recommended catch limit in SSRU E for a period of time to reflect the overrun of catches, but noted that if the limit is reduced to zero there would be no possibility of recaptures of tagged fish.

3.161 The Scientific Committee agreed that it could provide no new advice on catch limits for this division for 2011/12. It recommended increasing the research requirements in this fishery for 2011/12 (paragraphs 3.128 to 3.133) and for 2012/13 (paragraphs 3.137 and 3.138).

Dissostichus spp. Division 58.4.3a

3.162 In 2010/11, the exploratory fishery for *Dissostichus* spp. in Division 58.4.3a was limited to one Japanese vessel using longlines only. The precautionary catch limit for toothfish was 86 tonnes. The vessel fished and reported a total catch of 4 tonnes of *D. eleginoides*. Information on this fishery is summarised in Annex 7, Appendix P. There was no estimate of IUU fishing in 2010/11.

3.163 Fourteen toothfish were tagged and released in 2010/11 and no tagged toothfish were recaptured during that season.

3.164 Three Members (France, Japan and South Africa) notified their intention to fish for toothfish in Division 58.4.3a in 2011/12.

3.165 The Scientific Committee agreed that it could provide no new advice on catch limits for this division for 2011/12. It recommended increasing the research requirements in this fishery for 2011/12 (paragraphs 3.128 to 3.133) and for 2012/13 (paragraphs 3.137 and 3.138).

Dissostichus spp. Subareas 88.1 and 88.2

3.166 In 2010/11, five Members and 16 vessels fished in the exploratory fishery in Subarea 88.1 between December 2010 and January 2011. The fishery was closed on 14 January 2011 and the total reported catch of *Dissostichus* spp. was 2 882 tonnes (101% of the limit). The following SSRUs were closed during the course of fishing:

- SSRUs B, C and G closed on 10 December 2010, triggered by the catch of *Dissostichus* spp. (total catch 349 tonnes; 94% of the catch limit)

- SSRUs J and L closed on 9 January 2011, triggered by the catch of *Dissostichus* spp. (total catch 428 tonnes; 114% of the catch limit)

- SSRUs H, I and K closed on 14 January 2011, triggered by the catch of *Dissostichus* spp. (total catch 2 105 tonnes; 100% of the catch limit).

3.167 Five Members and 12 vessels fished in the exploratory fishery in Subarea 88.2 between December 2010 and February 2011. The fishery closed on 8 February 2011 and the total reported catch of *Dissostichus* spp. was 576 tonnes, including 10 tonnes taken during research fishing in SSRU A (100% of the limit) (CCAMLR-XXX/BG/8, Table 2). The following SSRUs were closed during the course of fishing:

- SSRUs C, D, F and G closed on 8 February 2011, triggered by the catch of *Dissostichus* spp. (total catch 216 tonnes; 101% of the catch limit)

- SSRU E closed on 8 February 2011, triggered by the catch of *Dissostichus* spp. (total catch 350 tonnes; 97% of the catch limit).

3.168 Details of notifications of intentions to fish in 2011/12 are summarised in CCAMLR-XXX/11. For Subarea 88.1, notifications were submitted by seven Members with a total of 20 vessels. For Subarea 88.2, notifications were submitted by six Members with a total of 19 vessels. The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is in Annex 7, Appendix R.

3.169 The Scientific Committee agreed that estimation of fishing mortality due to lost gear was a useful development and should be estimated for other fishery regions and considered for use in other assessment models (Annex 7, paragraphs 4.35 and 4.36). The Scientific Committee reminded Members of the requirement to complete C2 fields, by reporting zeros if no hooks attached to sections of the main line were lost.

3.170 Within Subarea 88.2, SSRUs 882C–G were assessed as a single stock for the first time, and two fisheries were identified: north of 70°50'S and south of 70°50'S.

3.171 The CASAL model, using catch-at-age and tag-recapture data and *D. mawsoni* biological parameters, was used to estimate the current and initial population size, and to calculate the long-term annual yield for Subareas 88.1 and 88.2 (SSRUs C–G) that would satisfy the CCAMLR decision rules as detailed in Annex 7, paragraphs 6.121 to 6.123.

3.172 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 3 282 tonnes. A total catch limit of 3 282 tonnes was therefore recommended.

3.173 The Scientific Committee recommended that the allocation method used to set the 2009/10 catch limits for SSRUs in Subarea 88.1 be continued for 2011/12. This resulted in 428 tonnes in the north (SSRUs 881B, C, G), 2 423 tonnes on the slope (SSRUs 881H, I, K) and 431 tonnes on the shelf (SSRUs 881J, L).

3.174 The Scientific Committee further noted that allowance would need to be made for the estimated catch associated with the 65 prescribed sets in the proposed pre-recruit survey (detailed in paragraphs 9.40 to 9.42). The Scientific Committee noted that the anticipated catch from the survey was 40 tonnes, but that the actual catch could be in the range of 22 to 71 tonnes. The Scientific Committee noted that the survey should be effort-limited, rather than catch-limited, and therefore recommended that a research catch of 80 tonnes, which would nominally cover the first two surveys, be set aside from the catch limit on the shelf in 2011/12 to allow the pre-recruit survey to be conducted immediately following the closure of the fishery in Subarea 88.1. The research catch limit will be reviewed at the 2012 CCAMLR meeting.

3.175 The Scientific Committee agreed that gear standardisation, both within and between years, was a critical factor in the implementation of this survey and noted that this would be easiest to achieve by using the same vessel between years.

3.176 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 SSRUs 882C–G was 530 tonnes. A total catch limit of 530 tonnes for these SSRUs combined is therefore recommended.

3.177 The Scientific Committee noted that the Subarea 88.2 fishery had been modelled as two fisheries with a split at 70°50'S, and considered that this was also an appropriate way to allocate catch limits. Over the last three seasons 76.7% of the catch was taken from the north of 70°50'S and 23.3% of the catch was taken from the south. The Scientific Committee therefore recommended that 406 tonnes be assigned to the region between 65°S and 70°50'S and the remaining 124 tonnes be assigned to the region south of 70°50'S. It further recommended that the SSRUs in Subarea 88.2 be renumbered in accordance with that outlined in Annex 7, Figure 7, noting that a catch limit of 406 tonnes should be applied to the new SSRU 882H and the catch limit of 124 tonnes be amalgamated across the new SSRUs 882C–G. It further recommended that the proportional allocation and SSRUs should be reviewed in two years' time when this subarea is next assessed.

3.178 The Scientific Committee agreed that other measures in the research and data collection plans, including the tagging requirement of one fish per tonne, be retained for the exploratory fisheries in Subareas 88.1 and 88.2.

3.179 The Scientific Committee considered a proposal for the conditional transition of the fishery for *Dissostichus* spp. in the Ross Sea from exploratory to established (WG-FSA-11/32). The Scientific Committee noted the view of WG-FSA (Annex 7, paragraphs 10.5 and 10.6) that sufficient information had become available to warrant removal of its exploratory status as it meets the criteria set out for exploratory fisheries in paragraph 1 of CM 21-02. The Scientific Committee agreed that there were many elements of the existing conservation measures which had been essential for reaching this status and whose retention would be essential in the future.

3.180 However, before the Scientific Committee can recommend to the Commission that this fishery can fully satisfy the requirements in paragraph 1 of CM 21-02, it requested advice from WG-FSA on the key elements of the data collection plan, research plan and assessment procedures in the existing conservation measures that would be necessary for the requirements in CM 21-02 to be met in the future and to ensure the continued assessment and management of the fishery.

INCIDENTAL MORTALITY ARISING FROM FISHING OPERATIONS

4.1 WG-IMAF met this year in parallel with WG-FSA, but with a reduced agenda which is presented in Annex 8, Appendix A.

Marine debris

4.2 WG-IMAF reported that surveys to monitor marine debris at study sites in Subareas 48.1, 48.2, 48.3 and 58.7 showed that the types of debris found are generally non-fishing items.

4.3 Dr Trathan drew the attention of the Scientific Committee to Figure 5 of SC-CAMLR-XXX/BG/5, which showed that marine debris associated with albatrosses at South Georgia has increased. Most of the items of debris cannot be directly attributed to fishing activities. The UK will continue to monitor trends in the occurrence of marine debris and encouraged other Members to establish similar monitoring programs so as to expand the area surveyed.

4.4 Prof. G. Duhamel (France) indicated that France will present further monitoring on marine debris from the Crozet and Kerguelen Islands next year.

4.5 The Scientific Committee endorsed the decision by WG-IMAF that observers should be trained to identify animals with hydrocarbon soiling and report them to CCAMLR (Annex 8, paragraph 7.7).

Incidental mortality of seabirds and marine mammals associated with fisheries

4.6 Incidental mortality of seabirds and marine mammals in fisheries was discussed by WG-IMAF. WG-IMAF-11/5 Rev. 2 contained a review of the information by the Secretariat.

4.7 The Scientific Committee noted that the total extrapolated mortalities within Subarea 58.6 and Division 58.5.1 was estimated to be 220 seabirds, which was down from 2009/10, and noted the progress made by France in recent years to reduce the incidental mortalities within their EEZs; incidental mortalities elsewhere in the Convention Area were similar to the near-zero levels of recent years.

4.8 The Scientific Committee considered three proposals to vary mitigation measures within a fishery: WG-IMAF-11/8 and 11/9 for Subarea 48.3 and WG-IMAF-11/7 for Division 58.5.2. The Scientific Committee endorsed the advice of WG-IMAF in respect of these proposals.

4.9 To give effect to the proposal for an additional season extension in Subarea 48.3, the Scientific Committee advised the Commission that paragraphs 5, 6 and 7 of CM 41-02 be modified as follows (new text in bold):

> 5. For the purpose of the longline fishery for *Dissostichus eleginoides* in Statistical Subarea 48.3, the **2011/12 and 2012/13** season**s are** defined as the period from 1 May to 31 August in each season, or until the catch limit is reached, whichever

is sooner. For the purpose of the pot fishery for *Dissostichus eleginoides* in Statistical Subarea 48.3, the **2011/12** and **2012/13** seasons are defined as the period from 1 December to 30 November, or until the catch limit is reached, whichever is sooner. The **2011/12** season for longline fishing operations may be extended in two periods: (i) to start on **16 April** and (ii) to end on 14 September for any vessel which has demonstrated full compliance with Conservation Measure 25-02 in the previous season.

6. The following decision rule shall apply to the extension of the **2012/13** season:

(i) if, on average, less than one bird per vessel is caught during the two extension periods in the **2011/12** season, the **2012/13** season **extension** shall start on **11 April 2013**;

(ii) if, on average, between one and three birds per vessel, or more than 10 and fewer than 16 birds in total, are caught during the extension periods in the **2011/12** season, the **2012/13** season **extension** shall start on **16 April 2013**; or

(iii) if, on average, more than three birds per vessel, or more than 15 birds in total, are caught during the extension periods in the **2011/12** season, the **2012/13** season shall start on **21 April 2013**.

7. The extensions to the seasons in **2011/12** and **2012/13** shall be subject to a combined catch limit of three (3) seabirds per vessel per season. If a total of three seabirds is caught **by one vessel** during the two extension periods in any one season, fishing shall cease immediately for that vessel **in the extension periods**. In the case of the extension at the start of the season, fishing shall not resume until 1 May of the corresponding season and the extension at the end of that season shall not apply.

4.10 The Scientific Committee also advised the Commission that paragraphs 5 and 6 of CM 41-08 be modified for 2011/12 and 2012/13 as follows (new text in bold):

5. The operation of the trawl fishery shall be carried out in accordance with Conservation Measure 25-03 so as to minimise the incidental mortality of seabirds and mammals through the course of fishing. The operation of the longline fishery shall be carried out in accordance with Conservation Measure 25-02, except paragraph 5 (night setting) shall not apply for vessels using integrated weight lines (IWLs) during the period **15 April**~~1 May~~ to 31 October in **the 2011/12 and 2012/13**~~each season~~ **seasons**. Such vessels may deploy IWL gear during daylight hours if, prior to entry into force of the licence, each vessel shall demonstrate its capacity to comply with experimental line-weighting trials as approved by the Scientific Committee and described in Conservation Measure 24-02.

During the period 15 April to 30 April in ~~each season~~**the 2011/12 and 2012/13 seasons**, vessels shall use IWL gear in conjunction with ~~night setting and~~ paired streamer lines.

6. Each vessel participating in this fishery shall have at least one scientific observer, and may include one appointed in accordance with the CCAMLR Scheme of

International Scientific Observation, on board throughout all fishing activities within the fishing period, with the exception of the period 15 April to 30 April in ~~each season~~**the 2011/12 and 2012/13 seasons** when two scientific observers shall be carried.

4.11 The Scientific Committee noted that the proposal contained in WG-IMAF-11/8 was not supported by WG-IMAF as it may cause an added risk to wandering albatross populations. Noting operational safety benefits in daylight setting, the UK indicated an intention to resubmit the proposal taking into consideration additional information on mitigating the risk to seabirds, including results from the trial period for daylight setting in Division 58.5.2.

4.12 The Scientific Committee endorsed the decision by WG-IMAF that the requirement to record the aerial extent of streamer lines should be discontinued in areas where only night setting is allowed (Annex 8, paragraph 3.39) and recommended that appropriate changes be made to the observer logbooks.

4.13 Recognising that there will always be a risk of incidental mortality of seabirds associated with fishing, the Scientific Committee noted that there is a need to understand the potential impact of different levels of incidental mortality on seabird populations and to estimate the risks to different species of flying seabirds of mortality both within and outside the CCAMLR area. The Scientific Committee requested models to be developed to examine this question and the results brought to the attention of the Scientific Committee.

Future consideration of incidental mortality of seabirds and marine mammals associated with fisheries

4.14 The Scientific Committee considered the discussion by WG-IMAF on the future requirements for the consideration of incidental mortality (Annex 8, paragraphs 10.1 to 10.8) and agreed that, while the number of seabirds being killed had reduced, the risk to those seabirds had not reduced. Therefore, there remains a need for the Scientific Committee to retain the issue of incidental mortality on its agenda.

4.15 The Scientific Committee agreed that the routine review of incidental mortality and of the implementation of conservation measures associated with mitigation measures, could be undertaken by the Secretariat and reported to the Scientific Committee. The Scientific Committee encouraged further coordination between the Secretariats of ACAP and CCAMLR in order to ensure that requests for information to ACAP on by-catch mitigation and data with which to review seabird risk assessments are provided on a schedule that allows consideration by the appropriate expert group of ACAP.

4.16 The Scientific Committee recalled the history of WG-IMAF noting that the success of WG-IMAF could be partly attributed to the fact that it stimulated cooperation between various stakeholders in the Southern Ocean in the Scheme of International Scientific Observation.

Advice to the Commission

4.17 Noting that 'stickwater' is an unavoidable by-product of at-sea processing of krill, and that stick water is not a strong attractant to seabirds and therefore does not pose a significant threat to seabirds (Annex 8 paragraph 3.43), the Scientific Committee recommended the following change to CM 25-03:

> [footnote 3] 'Stickwater' is a liquid discharge produced as a by-product of krill processing. As stickwater does not contain a source of food for birds it is not considered as offal in respect of CM 25-03, footnote 2.

SPATIAL MANAGEMENT OF IMPACTS ON THE ANTARCTIC ECOSYSTEM

Bottom fishing and VMEs

5.1 The Scientific Committee considered the deliberations of WG-FSA and WG-EMM with respect to bottom fishing and VMEs. As endorsed by the Scientific Committee in 2010 (SC-CAMLR-XXIX, paragraph 15.4) these discussions were restricted to three main topics: (i) reviewing notifications of new VMEs under CM 22-06; (ii) reviewing Members' preliminary assessments of bottom fishing impacts; and (iii) updating the assessment of bottom fishing impacts in the VME report. Other matters pertaining to VMEs will be considered in 2012.

5.2 The Scientific Committee considered two new notifications of encounters with potential VMEs notified under CM 22-06 (WG-EMM-11/10) and endorsed advice from WG-EMM that these two areas be added to the VME registry (Annex 4, paragraph 3.4). The Scientific Committee noted that these areas are the first VMEs notified in an area currently open to fisheries for *Dissostichus* spp. (SSRU 881G) and that no mechanism currently exists to ensure protection of these areas. The Scientific Committee agreed that the appropriate mechanism for protection in such instances is a matter for the Commission, but that protection measures could be applied as appropriate on a case-by-case basis.

5.3 The Scientific Committee recommended prohibiting bottom fishing within the areas of two circles, centred at 66°56.04'S 170°51.66'E and 67°10.14'S 171°10.26'E, with radii of 1.25 n miles (2.32 km) (Annex 7, paragraph 7.4) to provide protection of these VMEs from direct effects of interactions with fishing gear.

5.4 The Scientific Committee recalled its advice (SC-CAMLR-XXIX, paragraph 5.8) that combined cumulative impact assessments for all bottom fishing methods be updated annually by the Secretariat. The Scientific Committee recommended that the PlotImpact software be used by the Secretariat to update the combined bottom fishing impact assessment (Annex 7, paragraph 7.6).

5.5 The Scientific Committee recommended that all Members with vessels using bottom fishing gear types for which vessel-specific gear descriptions are not yet available in the CCAMLR gear library be required to provide detailed descriptions of their vessel-specific fishing gear, including gear configuration, setting and hauling procedures, likely bottom fishing footprint (per unit effort) and estimated impacts on VME taxa within the footprint (Annex 7, paragraph 7.8).

5.6 The Scientific Committee noted that these gear descriptions are important not only for estimating bottom fishing impacts, but also for understanding other aspects of the interaction of different fishing gears with target and by-catch species, e.g. gear selectivity and rates of multiple-hooking injuries affecting the suitability of captured fish for tagging programs (Annex 7, paragraph 5.39).

5.7 The Scientific Committee endorsed the recommendations in Annex 7, paragraph 7.9, that the Spanish gear description in WG-FSA-11/53 and trotline configuration shown in Annex 7, Figure 5, should be added to the CCAMLR gear library for reference and use by other Members. It also recommended that previous papers describing fishing gear configurations (WG-FSA-05/26, 06/5 and 06/15) should be added to the gear library with author permission.

5.8 The preparation and evaluation of Members' preliminary bottom fishing impact assessments in new and exploratory fishery notifications is very time-consuming, both for Members and for WG-FSA, and is largely unnecessary for those gear types for which gear descriptions and gear-specific impact assessments are already available in the CCAMLR gear library.

5.9 The Scientific Committee recommended that the preliminary impact assessment pro forma be simplified to require that, for Members intending to use vessel-specific gear configurations already described in the CCAMLR gear library, they provide only their expected level of effort deployment in the coming season and a cross-reference to an existing gear description/impact assessment in the CCAMLR gear library (paragraph 5.5).

Marine Protected Areas

Report of the 2011 Workshop on Marine Protected Areas

5.10 Dr Penhale and Prof. Koubbi presented the report of the Workshop on Marine Protected Areas held in Brest, France, from 29 August to 2 September 2011 (Annex 6).

5.11 The Scientific Committee noted that a number of methods could be used for designing a representative system of MPAs, including bioregionalisation and/or systematic conservation planning (SCP).

5.12 The Scientific Committee noted that insights from the invited experts may assist in the development of SCP processes in the Southern Ocean (Annex 6, Appendix D).

5.13 The Scientific Committee endorsed further development of a GIS database proposed by the UK (Annex 6, paragraph 2.5) as this would aid the management of spatial data, including in the development of proposals for MPAs. It encouraged the CCAMLR Secretariat to liaise with the UK to further develop the GIS database so that it may be made available for the use of all Members.

5.14 The Scientific Committee recalled the kinds of objectives for which MPAs may be designated to achieve the aims of Article II (SC-CAMLR-XXIV, paragraphs 3.53 and 3.54). It also noted that MPA proposals should clearly state the specific objectives for which they are designated in different areas.

5.15 Some Members recommended that the areas selected for protection, as well as the levels of protection sought for each area, should be made explicit for all MPA proposals, consistent with the discussion in Annex 6, paragraph 3.41. Proposals should clearly define conservation values, monitoring plan, implementation and research plans (hereunder time horizons) for MPAs.

5.16 The Scientific Committee recommended that proposals include a clear description of the balance between protection of ecological function and allowance for, and impact on, harvesting.

5.17 The Scientific Committee noted the importance of (i) defining clear objectives for MPAs, (ii) having clear approaches and methods to determine how the objectives will be achieved by designating MPAs, (iii) providing explicit consideration of rational use, and (iv) devising a method for showing the trade-offs, if any, between possible MPAs and harvesting (Annex 6, paragraph 5.4).

5.18 The Scientific Committee noted paragraph 5.6 of Annex 6, which noted that in order to achieve a representative system of MPAs:

(i) the interests of rational use need to be accounted for in the process of establishing a network of MPAs

(ii) the objectives of each MPA need to be stated explicitly and that the system of MPAs needs to take account of achieving the objectives over the region, noting that individual MPAs may have differing specific objectives to other MPAs, such as protection of vulnerable communities from fishing, reference areas for managing fisheries or for understanding impacts of climate change, or for providing protection to predators from direct competition with fishing

(iii) when an MPA is designed to include protection of spawning areas as part of stock management, then it would be beneficial for the Scientific Committee and, as appropriate, the working groups, to review the implications for the stocks

(iv) individual MPAs may have zones within them to regulate different activities in different locations

(v) MPAs can be established using the precautionary approach and that the performance of any of the MPAs with respect to their values needs to be reviewed, based on monitoring or other data, to determine if the values of the MPAs are likely to have remained in the MPAs, particularly in light of the effects of climate change, and whether the MPA is still required and/or whether its boundaries should be revised or moved

(vi) in presenting a proposal for an MPA, an analysis, which may include an optimisation analysis, needs to be presented on the degree to which the objectives for an MPA have been met along with the degree to which rational use may be affected

(vii) stakeholder consultation is expected through the processes of the Scientific Committee and Commission.

5.19 The Scientific Committee discussed progress made to develop MPAs in the 11 priority areas identified in 2008. It was noted that the utility of the priority area was limited, because the entire CCAMLR area was not included. Research on bioregionalisation for MPA development, such as for East Antarctica, the Ross Sea and Crozet–Kerguelen, identified larger regions of importance.

5.20 The Scientific Committee endorsed the development of planning domains for representative systems of MPAs (Annex 6, Figure 3). It noted the substantial work done on the Ross Sea and Eastern Antarctica and agreed that the next phase of development of MPAs could include the Western Antarctic Peninsula–South Scotia Arc domain (domain 1), the del Cano–Crozet domain (domain 5) and the circumpolar SCP effort (SCP) (Annex 6, paragraph 6.22). The Scientific Committee endorsed proposals by Members to hold technical workshops for each of these areas in 2012, and encouraged them to present their results to WG-EMM for consideration by all Members.

5.21 Dr Pshenichnov informed the Scientific Committee that Ukraine will begin research in the coming season on the determination, and establishment, of an MPA in the area of the Argentine Islands Archipelago (SC-CAMLR-XXX/BG/11). The research plan will include geophysical, hydrological and biological research, and a survey of coastal areas adjacent to an MPA and accessible benthic habitat. After completion of the research, final MPA boundaries will be determined and the management and ecological monitoring plans for the MPA will be developed and submitted according to the procedure described in Annex V to the Protocol on Environmental Protection to the Antarctic Treaty.

5.22 Some Members noted that it was important that management plans and research and/or scientific monitoring plans be associated with every MPA proposal, together with a clear timeframe within which MPAs will be reviewed on the basis of the information collected under these plans. Scientific review needs to consider the timescales of the relevant ecological processes, and may vary from a few years to several decades.

5.23 Some Members considered that monitoring and research plans should be developed prior to the designation of an MPA. Other Members considered that it was possible to first designate MPAs and later to consider such plans.

5.24 Some Members considered that the process for designating the South Orkneys MPA should not be considered a precedent for the establishment of MPAs because it did not include a management plan or scientific monitoring plan.

5.25 Dr Trathan reminded the Scientific Committee that at the time of adoption of CM 91-03, the conservation measure was viewed as the management plan (CM 91-03, paragraph 1). He informed the Scientific Committee that the UK continued to undertake research on the ecosystem covered by the South Orkneys MPA.

5.26 Taking account of the views of Members expressed in paragraphs 5.22 to 5.25, the Scientific Committee requested the Commission to consider how monitoring and implementation plans for MPAs might be developed and provide guidance to the Scientific Committee, on what the Commission expected of it in this regard.

5.27 The Scientific Committee agreed that monitoring could take several forms and there is a need to be clear, when using the term, which type of monitoring was being referred. For example, monitoring could be:

(i) directed at establishing whether the MPA objectives are being delivered, and particularly whether the threats to the values are being successfully mitigated by the MPA

(ii) monitoring to establish whether the values on which the MPA was designated are changing, for instance in response to climate change

(iii) monitoring in comparison to other areas, where MPAs have been designated as reference areas under wider ecosystem monitoring schemes.

Proposals

5.28 The Scientific Committee received two submissions describing MPA scenarios for the Ross Sea region (New Zealand and the USA), one proposal for a representative system of MPAs covering East Antarctica (Australia and France) and one proposal concerning areas now covered by ice shelves that in the future are expected to collapse or disappear due to climate change (UK).

5.29 At the introduction of the debate on specific proposals, the Scientific Committee Chair clarified that the objective of the work of the Scientific Committee would be to comment on the science underlying the MPA proposals, and in particular whether this was the best available scientific advice to support the proposed MPA boundaries consistent with the objectives of the proposal.

Ross Sea planning domain

5.30 Dr Watters introduced the US scenario for an MPA in the Ross Sea region (SC-CAMLR-XXX/9). It was emphasised that this was not a proposal to be forwarded to the Commission this year, but that a proposal was intended to be forwarded next year. The scientific basis of the suggested proposal had been evaluated and endorsed at the MPA Workshop in Brest.

5.31 Several delegates questioned the basis for the boundaries and size of the proposed area, and also the difference in area boundaries between the US and New Zealand proposals. Dr Watters emphasised that the areas were selected taking into account several ecological aspects as outlined in the proposal, and that the aims and methods differed between the US and New Zealand proposals, but that the scientific approaches were sound. The exact boundaries need to be re-thought for the final version.

5.32 Dr Arata expressed concern that a reallocation of the fishery out of the proposed MPA would potentially affect fish populations outside the MPA through concentration of effort. The areas closed to fishery may also result in an overcrowding of the fishing vessels in the open areas outside the proposed MPAs. Dr Arata also expressed that in regard of the area being proposed for protecting the spawning ground for *D. eleginoides*, he considered that there are other measures that are more appropriate such as seasonal closures, so before proceeding, the expected outcome of creating such an MPA should be better discussed within the appropriate CCAMLR working group. Dr Watters acknowledged that these issues would have to be considered in the final proposal with a monitoring plan.

5.33 Dr Kiyota stated that since one objective of the US scenario for an MPA in the Ross Sea region was a reference area, it should have a mechanism to ensure the exclusion of human activities that would negatively impact the objectives established for the MPA. Dr Watters emphasised that rational use in the definition was not simply related to fishing.

5.34 Several delegates expressed concern about the feasibility of implementing a monitoring plan for such a large area to ensure its value as a reference area. Dr Watters agreed that there would be large, but not insurmountable, challenges connected to the monitoring and research that would have to be considered when developing a monitoring plan.

5.35 Dr Sharp introduced the MPA scenario by New Zealand for the Ross Sea region (SC-CAMLR-XXX/10). It was emphasised that this was not a finished proposal to be forwarded to the Commission this year, but that New Zealand sought feedback from the Scientific Committee and Commission on boundaries and the MPA planning method that New Zealand used. The scientific basis had been evaluated and endorsed at the MPA Workshop in Brest.

5.36 Dr Bizikov supported the planning approach used in the New Zealand proposal and especially the rigorous and transparent approach and the consultation process with the stakeholders during the preparation. He questioned the size of the suggested MPA. Dr Sharp pointed out that the size and the borders result from the input parameters (protection targets) as shown in Table 1 of SC-CAMLR-XXX/10. They can be changed with accompanying changes in outcomes.

5.37 Dr Kiyota emphasised the need for an SCP process when planning MPAs since many of the stakeholders' interests could be considered in the light of clear objectives and conservation target. He welcomed the use of SCP in the New Zealand proposal, and the fact that it had explicitly considered the effect of fisheries on the value of each target area, which was requested by Japan during the discussion at the MPA Workshop (Annex 6, paragraph 5.10). Dr Kiyota noted that such analysis of the effect of the fishery on the value of target areas should be included in every MPA scenario.

5.38 Mr L. Yang (China) commented that the suggested area was quite large and that there was not enough data presented for the eastern part of the proposed MPA.

5.39 Dr Sharp responded that the northeast area protects spawning *D. mawsoni* providing recruits to the Ross Sea stock (target area 22), and that the southeast area protects moulting habitats for emperor penguins and crabeater seals (target area 5). The eastern area at moderate latitudes is protected only to achieve representativeness targets with respect to bioregions, and is of lesser importance.

5.40 Dr Sharp emphasised that the similarities between the US and New Zealand scenarios reflect protection objectives that were broadly similar and MPA planning methods that were different but compatible. The differences between the New Zealand and US scenarios reflect different policy aims regarding choosing an appropriate balance between protection and rational use. Specifically, the New Zealand scenario includes a higher level of accommodation for fishery outcomes than does the US scenario. The appropriate balance between protection and rational use is a decision for which advice from the Commission would be useful.

5.41 Some Members questioned whether protection of benthic features in the absence of a clearly identified threat provided sufficient justification for declaring MPAs over large areas.

5.42 Dr Sharp clarified that the New Zealand MPA scenario was only weakly driven by benthic protection objectives, because even though benthic habitat areas were assigned high protection targets in Table 1 of SC-CAMLR-XXX/10, these areas are very small (WS-MPA-11/25, Figure 2). He emphasised that the boundaries of the New Zealand MPA scenario are strongly driven by the choice of high-protection targets for target areas 10 (*Pleuragramma antarcticum*), 13 and 14 (top predators on toothfish), 18 and 19 (habitats for sub-adult *D. mawsoni*), and lower protection targets for target areas 21 and 22 (presumed *D. mawsoni* spawning locations), and that the rationale for these protection targets was endorsed by the MPA Workshop (Annex 6, paragraph 3.40). Dr Sharp emphasised that under the systematic conservation planning framework described in SC-CAMLR-XXX/10, assigning similar protection targets for these areas will result in MPA boundaries similar to those in the New Zealand scenario.

5.43 Dr Sharp offered to share the MPA planning software used in New Zealand's planning process with interested Members, to aid transparent MPA development and evaluation. The software will generate the information in Table 1 of SC-CAMLR-XXX/10 for any user-defined MPA boundary.

5.44 The ASOC Observer (Dr R. Werner) pointed out that the Ross Sea's unique values make it extremely valuable to science and that 520 scientists world-wide had signed a statement calling for protection of the entire shelf and slope to prevent degradation of those values by human activities. Furthermore, the ASOC Observer also noted that in 2010 the Commission had concluded that the development of a designation process and a monitoring plan may proceed in a step-wise fashion or both processes may occur simultaneously (SC-CAMLR-XXIX, paragraphs 5.36 and 5.37; CCAMLR-XXIX, paragraph 7.8).

Recommendations to the Commission

5.45 The Scientific Committee endorsed the scientific basis of the Ross Sea region scenarios put forward by New Zealand and the USA. It agreed that the scenarios contained the best scientific advice for the area, and supported the rationale for the identification of conservation objectives presented in the scenarios.

5.46 The Scientific Committee agreed that the differences between the scenarios reflected different objectives and choices for implementation, in particular, the relative weight given to the displacement of fishing effort, but that these were matters for the Commission.

5.47 The Scientific Committee agreed that these scenarios needed no further scientific analysis and debate within the Scientific Committee.

East Antarctica planning domain

5.48 Dr Constable presented the proposal by Australia and France for a representative system of MPAs (RSMPA) in the East Antarctica planning domain (SC-CAMLR-XXX/11). This paper proposed that the East Antarctic RSMPA be endorsed by the Scientific Committee and that it be recommended to the Commission as part of the commitment to delivering MPAs by 2012:

(i) The primary data, analyses and interpretation leading to the bioregionalisation and identification of values and the placement of the proposed MPAs were provided to WG-EMM and the Scientific Committee (SC-CAMLR-XXIX/11) for consideration in 2010, with further analyses and revision provided to the MPA Workshop and in this proposal in 2011. These assessments were based on known biology, ecology and biogeography of the region combined with the application of general ecological theory.

(ii) The structure of the paper was due to the limited translation available for the proposal resulting in the translated section only containing the proposal with the justification placed in the second section. The third section contained the review of data and analyses available for this task, constituting the best scientific evidence available. The sections that were new to the Scientific Committee were the recent analyses concerning krill and toothfish fisheries and an assessment of the trade-offs between ecological and biodiversity values, reference areas and fisheries. This new work resulted in revision of the Prydz Bay MPA and the D'Urville Sea–Mertz MPA to better provide for, respectively, fisheries for toothfish and location of the conservation and reference area values. This layout of the paper did not mean that the areas were determined prior to justification.

(iii) The conservation values are summarised in SC-CAMLR-XXX/11, Tables 2.1 to 2.3, noting that the scale of the areas derived from the size of summer foraging areas for Adélie penguins was the primary determinant of size of the proposed areas.

(iv) The detailed assessments of rational use for krill and toothfish show that access to the target populations will not be impacted by the proposal while ensuring suitable reference areas are available for monitoring trends and change in the ecosystem unaffected by fishing activities and allowing for monitoring for the effects of fishing.

5.49 Drs Bizikov and Pshenichnov pointed out that the proposal was not adequately translated into Russian. This was due to time constraints and length of the proposal due to it representing seven suggested MPAs. The Scientific Committee agreed to allow Dr Constable to present the proposal to enable discussion of its scientific background.

5.50 Dr Bizikov and Mr Yang noted that the proposal for a representative system of MPAs by Australia and France lacks sufficient scientific logic and data in identifying the threat or risk from which the values of the proposed MPAs should be protected, and to which extent and through what mechanism. Thus, the conservation values in this proposal are not properly identified. They noted that the proposed sizes of the MPAs are unnecessarily large, and their boundaries are not well justified. As most proposed MPAs cover existing and former fishing grounds of toothfish and krill, and there is no quantitative analysis of historical fishing distributions, it is not clear how the proposed system of MPAs is balanced with 'rational use'.

5.51 Dr Constable noted that data on historical fisheries activities in the region were analysed and included in the paper on rational use submitted to the Scientific Committee last year (SC-CAMLR-XXIX/BG/9). He had been advised that such data would not be useful in this work and, as a result, they have not been included in the paper this year. The analyses can be consulted if needed, but confirm the additional analyses undertaken this year.

5.52 Dr Bizikov and Mr Yang acknowledged the efforts of Australia and France in conducting research on bioregionalisation of East Antarctica and made a general request for further data to prove the necessity to protect particular areas, the objectives and aims of protection, research and monitoring programs for each protected area and the proposed periodicity of revision of the research programs and MPA status by the Scientific Committee.

5.53 Dr Bizikov questioned the actual boundaries and the size of the suggested MPAs and thought that, since they followed the meridians and not any other feature, the MPAs became unnecessarily large. This claim was supported by Dr Pshenichnov. It was also questioned why the suggested MPAs seem to follow those already established SSRUs that are currently closed for the toothfish fishery.

5.54 In response, Dr Constable noted the following partial longitudinal overlap between the proposed MPAs and current access to SSRUs in exploratory fisheries for *Dissostichus* spp.:

(i) Gunnarus MPA – Division 58.4.2 SSRU A (open)
(ii) Enderby MPA – Division 58.4.2 SSRUs B (closed) and C (closed)
(iii) MacRobertson MPA – Division 58.4.2 SSRU D (closed)
(iv) Prydz MPA – Division 58.4.2 SSRU E (open) and Division 58.4.1 SSRU B (closed)
(v) Drygalski MPA – Division 58.4.2 SSRUs B (closed) and C (open)
(vi) Wilkes MPA – Division 58.4.2 SSRUs E (open) and F (closed)
(vii) D'Urville Sea–Mertz MPA – Division 58.4.2 SSRUs G (open) and H (closed).

5.55 Some Members of the Scientific Committee felt that the constraints to fisheries were not adequately covered in the proposal.

5.56 Mr Yang and Drs Bizikov and Pshenichnov also pointed out insufficient background data supporting any of the claims that would warrant an MPA. They questioned the conservation targets and argued that there was no identified risk to any of the ecosystem components.

5.57 Dr Constable noted that conservation targets were likely to be satisfied because the scale of population and ecosystem processes have determined the size of the MPAs, particularly the reference areas.

5.58 This view was supported by Prof. Koubbi and Drs Watters and Trathan.

5.59 In summarising the discussion, many Members noted that:

(i) catch limits on toothfish and krill will not be impacted

(ii) research within MPAs to help assess catch limits and fishing options will still be possible

(iii) the methods to distribute fisheries activities (SSRUs) would need to be revised given the proposed MPAs

(iv) how fisheries and research will be progressed after the establishment of MPAs is an implementation issue that will need to be addressed by the Commission

(v) there is agreement that –

(a) the conservation values and values of reference areas have been identified
(b) the locations where those values are most important have been identified
(c) all of the available data and scientific evidence have been examined and utilised in this process, meaning that the best scientific evidence available has been used

(vi) the boundaries have been determined based on the best scientific evidence available and are the minimum area to be highly likely to encompass the conservation and reference values, noting that –

(a) they have been adjusted since the original proposal to take better account of fisheries requirements and that fisheries will now not be affected

(b) they can be reviewed and revised as more data become available

(vii) the main question concerns how to manage current and future threats and risks and whether MPAs are required to protect the values before there is demonstrable evidence that the values have been impacted.

5.60 Prof. Koubbi emphasised that the results and justification of the East Antarctica RSMPA were presented last year and, with improvements, this year to the appropriate forums of the Scientific Committee. There is a strong scientific basis for this proposal following the use of approved concepts of bioregionalisation and the approach for establishing a comprehensive, adequate and representative (CAR) system. Additional ecoregionalisation of the D'Urville Sea–Mertz area since last year enabled revision of the location of the D'Urville Sea–Mertz MPA. Further, a long-term monitoring program is being established for this region.

5.61 Dr Trathan noted that the work undertaken by Australia and France in East Antarctica provided the best available scientific evidence for providing spatial marine protection for the ecological values present in that region. He noted that Australia and France had jointly collated all available evidence and that it was difficult to conceive what other evidence could be provided. Dr Trathan noted that it would be helpful if those Members that felt the evidence was insufficient could provide detailed and specific comments so that Australia and France could address any outstanding objections. Dr Trathan noted that the work of the Scientific Committee could only move forward if scientific proposals were evaluated and subjected to detailed scientific criticism, rather that receiving less-well-defined broad generic concerns.

5.62 Dr Watters concurred with this view and stated that if specific comments and criticism could not be provided, the Scientific Committee must infer that the evidence presented is indeed the best available. He also noted that some of the MPAs are unique at a circumpolar scale, including the D'Urville Sea–Mertz and Gunnarus MPAs.

Recommendations to the Commission

5.63 The Scientific Committee agreed that the East Antarctica proposal (SC-CAMLR-XXX/11) contains the best scientific evidence available.

5.64 Some Members argued that there is insufficient scientific background to say that there is great risk to specific conservation values, and requested more and better scientific background for the proposal.

5.65 Other Members argued that the MPAs were an appropriate size to achieve the specific objectives for the MPAs, including conservation and reference areas, while allowing for rational use. They also noted that there was sufficient information for the Commission to establish the East Antarctica RSMPA.

5.66 The Scientific Committee had no further scientific guidance on how the proposal might be improved and whether there is sufficient information for the Commission to decide on these matters. It requested the Commission to consider the proposal to decide if it is sufficiently detailed, and if not, provide guidance on how this proposal can be progressed.

Ice shelves

5.67 Dr Trathan presented an MPA proposal for protection of marine habitats exposed after the collapse of an ice shelf (SC-CAMLR-XXX/13). He recalled that regional climate change is now known to be well established in the Antarctic, particularly in Area 48 and especially in the Antarctic Peninsula region. One of the most evident signs of climate change has been ice-shelf collapse and glacial retreat; overall, 87% of the Peninsula's glaciers have retreated in recent decades.

5.68 The Scientific Committee recognised that ice-shelf collapse will lead to the exposure, and generation, of new marine habitats and to subsequent biological colonisation. It noted that colonisation of these habitats may simply include species from areas that are immediately adjacent to the collapsed ice shelf; however, other complex processes may also take place as warmer waters may also create opportunities for species to return that were last present during the last interglacial, a warmer period than at present. In addition, altered ecosystem dynamics may also allow new alien species to invade as ocean warming potentially removes physiological barriers that have previously led to the isolation of the Antarctic benthos.

5.69 The intent of the UK MPA proposal was to provide strong protection which does not preclude scientific research in the future. The Scientific Committee thought that the newly exposed marine environments after a shelf collapses offer a unique chance to study colonisation and other important processes. The Scientific Committee noted that scientific research on ecological processes underneath, and adjacent to, ice shelves was already being carried out and that any spatial protection must not restrict the ability of scientists to undertake scientific research.

5.70 Drs Zhao and Bizikov stated that they thought the proposal lacked any clear conservation target and furthermore contained no scientific analysis.

5.71 The Scientific Committee noted that providing spatial protection to the areas occupied by ice shelves would not have any impact on any existing fisheries or logistic operations because the areas covered by ice shelves are not currently accessible or utilised by shipping. However, it recognised that regional climate change will make these areas more accessible in the future and greater access would increase the risk of human perturbation.

5.72 The Scientific Committee emphasised that any proposals to designate areas under ice shelves as ASMAs/ASPAs would require coordination of the CEP and ATCM with CCAMLR since areas under ice shelves were marine areas and any agreed spatial protection would require CCAMLR's prior approval.

5.73 Dr Trathan recalled the Scientific Committee's previous discussions concerning the ATME on Climate Change (SC-CAMLR-XXIX, paragraphs 8.3 to 8.7). ATME Recommendation 26 highlighted the need to provide automatic interim protection to newly exposed areas such as marine areas exposed through ice-shelf collapse.

5.74 The IUCN Observer (Ms D. Herr) welcomed the precautionary approach put forward by the UK in its proposal on providing precautionary protection for locations under retreating ice shelves, and underscored the need to develop enhanced spatial management responses based on the use of best scientific evidence available.

5.75 The ASOC Observer thanked the UK for this paper and its proposal to protect areas of the Southern Ocean that are exposed by the retreat or collapse of ice shelves. Protecting these areas provides a unique opportunity to understand how ecosystems respond to environmental change, including climate change. Implementing such protection is consistent with CCAMLR's precautionary approach to management. Plans for research would be useful and the ASOC Observer pointed out that research is currently proposed by Australia to investigate changes in the oceanic environment where the Mertz Glacier tongue has recently calved away and it is these types of studies that the UK proposal would facilitate.

Recommendations to the Commission

5.76 The Scientific Committee recognised that the UK proposal necessarily lacked detailed scientific data. Nevertheless, it acknowledged the scientific and conservation value of habitats exposed after an ice-shelf collapse, and their value to scientific research.

5.77 The Scientific Committee noted that spatial protection could be implemented as a precautionary measure, so that protection was automatically afforded to those areas when ice shelves collapsed. Alternatively, it recognised that protection could be implemented in a reactive manner once ice-shelf collapse had occurred. The Scientific Committee therefore requested that the Commission provide advice about the manner (precautionary or reactive) in which spatial protection should be afforded to ice shelves, ice tongues and glaciers.

General comments

5.78 Drs Parkes and Leslie noted that the Scientific Committee had received a number of well-developed papers concerning the establishment of MPAs in the Antarctic this year and that earlier versions of some of these papers had already been reviewed by WG-EMM-11 and the MPA Workshop. The establishment of MPAs is itself a reflection of the choice between a precautionary and a reactive management approach. CCAMLR has a long history of taking a precautionary approach and establishment of MPAs on the basis of the best scientific evidence available is entirely consistent with that. Dr Parkes expressed concern that, during discussion of these papers, some Members had articulated views that appeared to contradict the precautionary approach and reverse the burden of proof by judging the sufficiency of data and scientific advice rather than whether it is the best available. Dr Parkes considered that such views were extremely disturbing as they had the potential to seriously undermine the work of the Scientific Committee.

5.79 Drs Zhao and Bizikov expressed the view that it is the lack of a suitable working mechanism that is creating all these difficulties. At present, the working process towards the establishment of an MPA is primarily a one-way bottom-up process in that not enough guidance has been given to the Scientific Committee from the Commission, especially on issues with a policy nature but that have important scientific implications; and not enough effort has been invested in seeking a common ground amongst Members on important issues that govern the outcomes of the working process, and different proponents may aim at different objectives and with different protection targets. They urged the Scientific Committee to seek advice from the Commission on this matter.

5.80 The IUCN Observer recalled the Commission's endorsement of the use of MPAs as one means to furthering the objective of CCAMLR and of the work plan towards the achievement of a representative system of MPAs within the Convention Area by 2012. She highlighted that the critical aspect of representativeness is dependent on the inherent characteristics of ecosystems. It is not dependent on the potential impacts of human uses or activities.

5.81 The IUCN Observer reiterated that MPAs function as a long-term insurance policy for the conservation of nature and associated ecosystem services. They range from strictly protected no-take areas to multiple-use zones, with different objectives and characteristics as laid out by the IUCN Protected Areas categories. Protected areas should prevent any exploitation or management practices that will be harmful to the objectives of designation. However, activities consistent with these objectives are permissible.

IUU FISHING IN THE CONVENTION AREA

6.1 The Scientific Committee noted the report of WG-FSA on the level of IUU fishing in the Convention Area (Annex 7, paragraphs 3.24 to 3.28). The Scientific Committee noted that last year it asked the Secretariat to monitor trends in IUU effort rather than estimate IUU catch, but that estimates of total removals are needed for stock assessments (SC-CAMLR-XXIX, paragraph 6.5). It also noted that WG-FSA this year recommended that the Scientific Committee task appropriate experts to develop methodologies to generate these estimates for IUU removals (Annex 7, paragraph 3.24). It agreed with the recommendation of WG-FSA that there were sufficient data available to begin a statistical analysis of the trends in IUU fishing (see WG-FSA-11/10, Table 4). The Scientific Committee endorsed the recommendation of WG-FSA that WG-SAM advise on how this work can be further developed in order to provide information on trends in IUU fishing and estimates of IUU catches.

6.2 The Scientific Committee noted that the estimation of IUU catches may not be urgent given that IUU fishing is mostly occurring currently in areas where exploratory fisheries do not have assessments. However, it did note that such estimates will help the Scientific Committee understand the potential impacts of IUU fishing in those areas. The Scientific Committee requested the Commission assemble experts with knowledge of IUU catches and the market data that could be used for investigating total IUU removals to help with this task. This may involve assembling experts from SCIC and WG-SAM in the same way that the Joint Assessment Group was established in the past.

6.3 Given the trends in the observations of IUU fishing indicated by WG-FSA (WG-FSA-11/10, Table 4), the Scientific Committee drew to the attention of the Commission that IUU fishing is unlikely to be declining in Subarea 58.4, with IUU catches predominantly being *D. mawsoni*.

CCAMLR SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

7.1 Information collected by scientific observers for finfish on board longline, trawl and pot vessels and krill trawl cruises was summarised by the Secretariat in SC-CAMLR-XXX/BG/4. In accordance with the text of the CCAMLR Scheme of International Scientific Observation, paragraph A(f), the Secretariat provided copies of all scientific observer reports to the Receiving Members.

7.2 The Scientific Committee endorsed the recommendation of WG-EMM (Annex 4, paragraph 2.42) to revise the logbook forms used by observers on krill fishing vessels according to Table 1 in Annex 4. It further endorsed the recommendation by WG-FSA that the K12 form be modified to enable length measurements of fish and fish larval by-catch to be recorded (Annex 7, paragraph 8.6i).

7.3 The Scientific Committee endorsed the recommendation by WG-EMM that sample collection for measurement of krill length frequency and fish by-catch must be taken before any other sorting of the catch has taken place (i.e. before any large fish are removed).

7.4 The Scientific Committee noted the review by WG-EMM of the *Scientific Observers Manual* (2011) (Annex 4, paragraph 2.43). The Scientific Committee agreed that the paragraphs listing priorities for krill observers in Section 2 should be revised as follows, with the understanding that items (i) and (ii) should take priority over item (iii) over the two-year period of the observer trial.

(i) Krill length measurement using 'Krill biological data form' to:

- collect length-frequency data from all regions for the understanding of stock structure
- facilitate the understanding of the differences in gear selectivity between different fishing techniques and gear configurations.

(ii) Fish by-catch data collection using 'fish sampling protocol' to:

- determine the level of by-catch of fish, including fish larvae.

(iii) Incidental mortality data collection using 'Incidental mortality and warp strike forms' to:

- determine the level of warp strikes and incidental mortality of seabirds and seals.

7.5 The Scientific Committee noted the clarification made by WG-EMM on the definition of 'haul' used in the observer logbook (Annex 4, paragraph 2.35). The Scientific Committee endorsed the clarification that the 'observed haul' be linked with krill length measurements.

7.6 The Scientific Committee noted that vessels use different meshes and net configurations across the krill fleet, and requested vessels and observers record which net and configuration is being used on each haul, to enable the selectivity of the different net mesh and configurations to be analysed.

7.7 The Scientific Committee requested that the Secretariat communicate the agreed changes to observer priorities and logbooks to technical coordinators pending the next revision of the *Scientific Observers Manual*.

7.8 The Scientific Committee agreed that observer data and reports from all observers referred to in CM 51-06 need to be available for review and analysis by the Scientific Committee and its working groups. The Scientific Committee agreed that the second sentence of footnote 1 in CM 51-06 should be modified as follows: 'Data and observer reports shall be submitted to CCAMLR **according to the requirements of the CCAMLR Scheme of International Scientific Observation** for inclusion in the CCAMLR database and analysis by the Scientific Committee and its working groups'.

7.9 The Scientific Committee noted that the difference between the continuous and conventional mode of krill trawling led to some ambiguity regarding the application of paragraph 3(ii). The Scientific Committee recommended that paragraph 3(ii) be modified as follows: 'a target coverage rate of more than 20% of hauls or haul units shall be sampled during the period that an observer is on board the vessel per fishing season'. The Scientific Committee also recommended the addition of a footnote to this paragraph, defining a haul unit as a two-hour contiguous period of fishing using the continuous trawling method.

7.10 The Scientific Committee noted the discussions on the potential conflict between the sampling flexibility allowed in the instructions in the *Scientific Observers Manual* and the precise requirements of CM 51-06. The Scientific Committee requested that WG-EMM consider this matter at its 2012 meeting, recognising that CM 51-06 is due to be reviewed in 2012.

7.11 With regard to the observer coverage of the krill fishery, the ASOC Observer made the following statement:

> 'ASOC would like to call your attention to our paper, CCAMLR-XXX/BG/19 – "30 years of krill fisheries management – challenges remain". Particularly with regard to the scheme of scientific observation in the krill fishery, although the two-year experimental design of scientific observation produced positive results, it seems that sufficient observer data will not be obtained to allow the CCAMLR Scientific Committee to provide advice to the Commission. Therefore, we sustain that CCAMLR should extend CM 51-06 for another fishing season (2012/13) and at the same time persist in its efforts to work toward 100% observer coverage across all vessels in the krill fishery as the best way to achieve systematic observer coverage.'

7.12 Dr Pshenichnov presented SC-CAMLR-XXX/BG/6, submitted by Ukraine, noting that the majority of krill vessels intending to fish in 2011/12 are likely to carry observers and that the implementation of 100% observer coverage should be seriously considered by WG-EMM in reviewing CM 51-06 in 2012.

7.13 The Scientific Committee endorsed the recommendation by WG-FSA (Annex 7, paragraph 8.3) to modify the position reporting format for vessels and observers.

7.14 The Scientific Committee noted paragraph 8.6 in Annex 7, describing the results of observations of fish by-catch and cetaceans from on board krill vessels in 2010/11. It endorsed the recommendation that observers be requested to continue to photograph and retain samples of larval fish to validate identification of some fish species.

7.15 The Scientific Committee noted the recommendation of WG-FSA (Annex 7, paragraph 8.7) to constitute a task group with representation from all interested parties (including WG-FSA, WG-EMM, WG-IMAF and SCIC) to review observer sampling requirements across all fishing sectors and conservation measures. The Scientific Committee recommended that the Secretariat develop a scoping paper on this matter in the intersessional period.

7.16 The Scientific Committee noted the recommendation by WG-FSA that CM 41-01, Annex B, be revised to clarify the rate of *Dissostichus* spp. sampling required in Subareas 88.1 and 88.2 (Annex 7, paragraph 8.7i). It noted that it was a vessel's responsibility to ensure sufficient samples were available to observers to complete their duties as outlined in the CCAMLR Scheme of International Scientific Observation and the CCAMLR *Scientific Observers Manual*. It therefore recommended the following changes to CM 41-01:

(i) Annex B, paragraph 5, be altered to read '…the vessel shall ensure that the observer has access to sufficient samples to enable all fish of each *Dissostichus* species in a haul (at a rate of 7 fish per 1 000 hooks up to a maximum of 35 fish for each species) are measured…'

(ii) Annex A, paragraph 2, be altered to read 'The vessel shall ensure that sufficient samples are available to ensure all data required by the CCAMLR *Scientific Observers Manual* for finfish fisheries can be collected by the on-board observers', and the following subparagraphs (i) to (viii) be removed.

7.17 The Scientific Committee also requested that the technical coordinators ask observers to include details in their cruise reports as to the circumstances if insufficient samples are collected as required by the CCAMLR *Scientific Observers Manual*.

7.18 The Scientific Committee noted that WG-FSA had considered the way in which hook types were recorded by observers in logbooks; currently these data are not recorded in a standardised way and are difficult to interpret. WG-FSA has requested that the Secretariat change the observer logbooks to include optional fields for the following:

- hook dimensions
- instructions to take a scaled photograph of the hook.

The Scientific Committee endorsed this recommendation, and also recommended that standardisation of corresponding fields in the C2 forms be explored intersessionally.

7.19 The Scientific Committee Chair introduced SC-CAMLR-XXX/8, which presented a proposal for the implementation of the CCAMLR Observer Training Program Accreditation Scheme (COTPAS). The Scientific Committee noted that COTPAS represented significant progress in ensuring uniform high-quality data is maintained across CCAMLR observer programs. The Scientific Committee Chair thanked the co-authors of the paper for their work in significantly advancing this issue.

7.20 The Scientific Committee endorsed the proposal described in SC-CAMLR-XXX/8 but noted that some of the details required further scrutiny. The Scientific Committee requested that Members provide commentary on the details of the proposed procedure described in SC-CAMLR-XXX/8 early in the intersessional period to assist the Scientific Committee to progress this issue. It also encouraged Members to consider participating in a trial of the initial review and technical peer review (parts a–c of the proposed procedure), to enable the Scientific Committee Chair to provide a final proposal for the implementation of COTPAS at SC-CAMLR-XXXI.

CLIMATE CHANGE

8.1 Dr van Franeker presented the report of a workshop entitled 'Antarctic Krill and Climate Change' (SC-CAMLR-XXX/BG/3). The one-week workshop was co-sponsored by the EU and the Netherlands on Texel Island (Netherlands) in April 2011. The intention was to bring krill specialists together from inside and outside CCAMLR to discuss krill biology under the scenario of climate change and the implications for management of krill stocks. Past and future trends in agents of climate change, such as ocean warming, sea-ice decline, and ocean acidification, and their impact on Antarctic krill and ecosystems, were reviewed.

8.2 The following conclusions were drawn by the workshop (SC-CAMLR-XXX/BG/3):

- Ocean warming: As a stenotherm, krill are unlikely to tolerate large oscillations in temperature outside –0.5° and 1°C over longer periods of time. Signs of stress will become most evident at the northern limit, such as South Georgia.

- Changing sea-ice: Changes in the structural composition and extent of sea-ice will disproportionally impact larvae and juveniles as they most strongly depend on sea-ice algae, so recruitment and immature survival are seriously compromised by climate change.

- Acidification: Embryonic development may be affected by acidification and in larvae and post-larvae somatic growth, reproduction, fitness and behaviour may be compromised.

- Circulation patterns: Expected changes in ocean circulation on the one hand, may trigger better nutrient advection and increase connectivity of krill populations and transport of larvae. On the other hand, changes in stratification may change phytoplankton composition and productivity, reducing food availability for krill, and exporting larvae out of suitable conditions. Which of these effects prevails is likely to vary considerably among regions, depending on local hydrography and bathymetry.

- Elevated UV radiation: The direct impact of UV-B on the krill population can occur through genetic damage, physiological effects or behavioural reactions. Indirect effects can arise through declines in primary productivity caused by increased UV radiation, and changes in the structure of food webs.

8.3 The workshop noted that most of the issues noted in paragraph 8.2 highlight the potential negative effects of climate change on krill.

8.4 The Scientific Committee noted the recommendation of the workshop of the need for precaution in the light of climate change and growing fisheries interest, and in particular that a group of experts from outside CCAMLR also recommended that the subdivided trigger levels for Area 48 in CM 51-07 should be maintained until better scientific information is available.

8.5 The workshop also recommended that a substantial increase in research, including CEMP, effort is needed to provide improved estimates of krill biomass and production, variability in recruitment and mortality in relation to climate change.

8.6 The Scientific Committee discussed the possibility of extending the work carried out by Atkinson et al. (2004) to determine whether the declines in krill stocks reported in that paper are continuing, given the eight years of additional survey data that have been added to the KRILLBASE database. The Scientific Committee asked the incoming Scientific

Committee Chair to contact the relevant data holders and originators and request that the database be submitted to CCAMLR and made available for work by the CCAMLR Scientific Committee under the Rules for Access and Use of CCAMLR Data.

8.7 Dr G. Milinevsky (Ukraine) expressed his gratitude to the KRILLBASE data originators for recent access to the database for his study and indicated that KRILLBASE should also be made available to oceanographers who study impacts of various parameters on krill distribution and abundance.

8.8 SC-CAMLR-XXX/BG/9 proposed that analyses of the CCAMLR fishery database be combined with available data on acoustic surveys, in order to study the distribution of fishable biomass of krill. The paper also proposed a program for providing an international survey to obtain information on the trends in distribution of krill in the Scotia Sea.

8.9 The Scientific Committee encouraged Members to develop papers on the subject of large-scale surveys to address this issue, for submission to WG-EMM.

8.10 Dr S. Iversen (Norway) informed the Scientific Committee that Norway, subject to availability of funds, is planning another krill project, including a survey with the research vessel *G.O. Sars* in 2013/14. If more vessels are made available it may be an opportunity to undertake another synoptic survey.

8.11 Dr Constable provided an update to the Scientific Committee on work being undertaken in the IMBER program on ICED. A second workshop is to be held in Hobart, Australia, from 7 to 11 May 2012, to further discuss a collective approach to the Southern Ocean Sentinel, including optimal locations for routine monitoring and places where integrated studies might be useful for this task. The expectation is that these discussions will further add to the development of the biological monitoring envisaged for SOOS (paragraphs 10.4 and 10.5) and provide the opportunity to benchmark the status of Southern Ocean ecosystems and to understand trends in status that could be used to provide the overall context for ecosystem-based fisheries management in CCAMLR.

SCIENTIFIC RESEARCH EXEMPTION

9.1 The Scientific Committee considered information regarding research undertaken and notifications received in accordance with CM 24-01. Research fishing undertaken as part of exploratory fisheries with overall catch limits greater than zero, conducted in accordance with CM 41-01, is considered under Item 3(v).

9.2 The Scientific Committee noted that WG-FSA addressed research plans to inform current or future assessments and fishing using commercial vessels and considered the advice of WG-FSA regarding research undertaken during 2010/11 and research notified for 2011/12 set out in Annex 7, paragraphs 5.1 to 5.45 and paragraphs 9.4 to 9.7.

Proposals for research fishing under CM 24-01 in closed fisheries or fisheries with zero catch limits

9.3 There were three proposals for research fishing under CM 24-01 in closed fisheries or fisheries with zero catch limits:

- in the closed *Dissostichus* spp. fisheries in Subarea 88.3 submitted by Russia (WG-FSA-11/37)
- in the closed *D. eleginoides* fishery in Divisions 58.4.4a and 58.4.4b submitted by Japan (Ob and Lena Banks) (WG-FSA-11/15 Rev. 1)
- in the closed *Dissostichus* spp. fishery in Division 58.4.3b (BANZARE Bank) submitted by Japan (WG-FSA-11/13 Rev. 1).

9.4 There was also a notification for a 10-tonne research catch in the *Dissostichus* spp. fishery in SSRU 882A (for which the catch limit is currently zero) submitted by Russia.

9.5 The Scientific Committee noted that WG-FSA had considered these proposals with reference to the principles to be followed when developing CCAMLR-sponsored research (SC-CAMLR-XXVII, paragraphs 8.9 to 8.11), and further noted that the focus topic at WG-SAM-11 had provided specific advice based on the principles to be used in evaluating plans for research in data-poor exploratory fisheries (Annex 7, paragraph 5.2).

9.6 The evaluation of the extent to which each proposal addressed the general principles for CCAMLR-sponsored research and the advice and specific recommendations provided by WG-SAM is set out in Annex 7, Table 3. Several changes were made to the research design arising from discussions in WG-FSA and the evaluation in Annex 7, Table 3, refers to the research proposal, including these changes.

Subarea 88.3 *Dissostichus* spp.

9.7 The Scientific Committee noted that the research proposed by Russia is the second year of a three-year program that was first proposed at last year's meeting.

9.8 The Scientific Committee noted the conclusion of WG-FSA that the research described in WG-FSA-11/37 was unlikely to lead to a robust estimate of stock status (Annex 7, paragraph 5.6), and provided recommendations to modify the research proposal. The Scientific Committee agreed that the research should be spatially concentrated within the area in which toothfish are most abundant and tag recaptures are most likely (i.e. SSRUs 883B–C), and that the research proposal should utilise the process outlined by Annex 5, paragraph 2.40, to estimate appropriate research catch levels. In addition, the Scientific Committee noted that the catch limit of 65 tonnes included in the proposal was inconsistent with catch rates reported in WG-FSA-11/36 and was unlikely to be caught on the 50 trotline sets proposed in the research design.

9.9 The Scientific Committee endorsed the specific advice of Annex 5, paragraph 5.6, regarding the assessment of stock biomass, the provision of additional data on the spatial distribution of tag releases in 2010/11, consideration of the likely condition of tagged fish on release and an increase in the tagging rate to 10 fish per tonne.

9.10 With respect to the proposed catch limit of 65 tonnes, Dr Bizikov noted that this was an upper limit calculated on the basis of a figure of 1 300 kg per haul, which is close to the highest catch from an individual line recorded in 2010/11, multiplied by 50 sets. Hence, it is unlikely to be realised and should be regarded not as an objective, but as an allocation sufficient to ensure that the research could be completed.

9.11 The Scientific Committee considered a revised version of the research proposal in SC-CAMLR-XXX/BG/17. The revised proposal undertook to take into account all the recommendations of WG-FSA (Annex 7, paragraph 5.6) and WG-SAM (Annex 5, paragraph 5.6), including an increase in the tagging rate to 10 fish per tonne. The Scientific Committee agreed that the research should proceed in 2011/12 on this basis.

9.12 In presenting the revised proposal, Dr Bizikov extended an invitation for scientists from other delegations to collaborate in the modelling of stock status based on the results of the research. Dr Welsford welcomed this invitation and looked forward to working on this with Russian colleagues.

9.13 In recommending that this research proceed, the Scientific Committee recalled that there is now very clear guidance from WG-SAM and WG-FSA both on the level of information expected to be submitted with proposals for CCAMLR-sponsored research, and also the procedure by which those proposals should be submitted for review by the Scientific Committee and its working groups. In particular, the Scientific Committee noted the great benefit that had been derived this year from research proposals being reviewed first by WG-SAM and subsequently being revised and resubmitted to WG-FSA. The Scientific Committee noted its recommendation for a revised format for research proposals in CM 24-01 and a revised deadline for notifications and research proposals in data-poor exploratory fisheries in CM 21-02 (paragraphs 3.137 and 3.138).

Subarea 88.2 SSRU 882A *Dissostichus* spp.

9.14 The Scientific Committee noted the review by WG-FSA of a notification from Russia for scientific research under CM 24-01 with a catch limit of up to 10 tonnes of toothfish in SSRU 882A (for which the catch limit is currently zero). No associated research proposal was submitted. The research notification states that the purpose of the research is to collect biological and spatial distribution information, but does not include an indication of how data collected during the research would be analysed and used to inform the management of the Ross Sea fishery. The Scientific Committee also noted that the results of the previous years' research fishing in the same SSRU had not been submitted for review by the Scientific Committee.

9.15 Dr Bizikov advised the Scientific Committee that the research was part of a two-year program that was presented to the Scientific Committee last year (SC-CAMLR-XXIX, paragraphs 9.13 to 9.22) and the results would be submitted to the next meeting of WG-FSA.

9.16 The Scientific Committee recalled that the process of annual review and recommendation for improvement to research proposals by WG-SAM and WG-FSA had been an important part of developing successful research and urged all Members engaged in research to participate fully in this process.

Division 58.4.4 (Ob and Lena Banks), *Dissostichus* spp.

9.17 The Scientific Committee noted the consideration by WG-FSA of the research conducted in 2010/11 in Divisions 58.4.4a and 58.4.4b (Ob and Lena Banks) and a proposal to continue the survey in 2011/12. The Scientific Committee agreed that the purpose and design of the proposed research were consistent with the advice of WG-SAM for data-poor fisheries and that the research was likely to achieve its aims, subject to the adoption of changes recommended by the Working Group (Annex 7, paragraphs 5.10 and 5.11).

9.18 The Scientific Commission endorsed the conclusions of WG-FSA with respect to the suitability of fish to be tagged, depredation, preliminary estimation of plausible biomass, target CVs for tag-based estimates and a precautionary research catch limit (Annex 7, paragraphs 5.12 to 5.22). The Scientific Committee welcomed the level of detail presented in Annex 7 regarding how this research should be conducted and how it is intended to support the development of a stock assessment for the subarea.

9.19 The Scientific Committee noted the use in CCAMLR documents of various terms to refer to factors that affect the suitability of a fish to be tagged, including 'condition', 'injury' and 'trauma' and the associated potential for confusion. 'Condition' may be confused with the relationship between fish length and weight. The aim of tagging fish in 'good condition' as required under CM 41-01, paragraph 2(ii), is to release tagged fish that have a high probability of survival and are therefore suitable for tagging. The Scientific Committee recommended that the terminology in CM 41-01, paragraph 2(ii), be modified this year to refer to tagging fish with a high probability of survival.

9.20 The Scientific Committee expressed concern over the multiple-hooking injuries and the general poor condition of toothfish caught on trotlines (Annex 7, Figure 4) and noted that it may be difficult for vessels using trotlines to achieve the required tagging rate and high tag overlap statistic while only tagging fish with a high probability of survival.

9.21 The Scientific Committee recommended that if, for particular gear types, the number of fish suitable for tagging across all size classes is insufficient to achieve a high tag overlap statistic, a greater proportion of research fishing should be conducted using alternative gear types for which multiple-hooking injury rates are lower (e.g. autoline or Spanish line).

9.22 The Scientific Committee noted that the paired deployment of mixed Spanish line and trotline sets used by the *Shinsei Maru No. 3* in 2010/11 provided valuable information to evaluate the suitability for tagging of fish caught using different gear types, and recommended that this research should be continued in 2011/12.

9.23 The Scientific Committee requested WG-FSA to consider the implications of potentially high post-capture tagging mortality of tagged fish associated with trotlines on the time series of data on tag releases and the suitability of historical tagging data for use in assessments. The Scientific Committee recommended that the best practices for evaluating the suitability of a fish for tagging be developed intersessionally.

9.24 Information describing the 'fate' of tagged fish (e.g. swam away alive, attacked by predators) have been routinely recorded by CCAMLR international scientific observers since 2009. No data exists on injury status and condition relating to the likelihood of survival. The Scientific Committee noted that the analysis in Division 58.4.4 relied on detailed supplemental information on the suitability of fish for tagging recorded during the research carried out by Japan in 2011. The Scientific Committee agreed that information of this kind should continue to be collected by vessels engaged in research fishing.

9.25 The Scientific Committee agreed that there was value in maintaining a consistent survey design over time and recommended that the survey be effort-limited in 2012, deploying a total of 71 sets in an allocated spatial grid including SSRUs B–C. The Scientific Committee endorsed the proposal to deploy at least 14 mixed Spanish line/trotline sets to provide an increased number of single-hooked fish in good condition suitable for tagging. This would also provide additional data for examining the effects of different gear types on fish condition and gear selectivity.

9.26 With respect to a precautionary catch limit, the Scientific Committee noted the advice of WG-FSA that research catches up to 115 tonnes could be appropriate for this stock (Annex 7, paragraph 5.22). In 2011, using an identical survey design to that proposed for 2012, the total catch was 35.4 tonnes. The Scientific Committee recommended that the research proceed subject to the advice of WG-FSA (Annex 7, paragraphs 5.10 to 5.18) with a catch limit of 70 tonnes, noting that the actual catch is expected to be lower than this.

Division 58.4.3b (BANZARE Bank), *Dissostichus* spp.

9.27 The Scientific Committee noted the consideration by WG-FSA of the research conducted in 2010/11 in Division 58.4.3b and a proposal to continue the survey in 2011/12 (Annex 7, paragraphs 5.24 to 5.43). The Scientific Committee endorsed WG-FSA's evaluation of performance metrics for the research undertaken in 2010/11 and the spatial design of the research to be carried out in 2011/12, as set out in Annex 7, Figure 3.

9.28 The Scientific Committee noted the discussion on the suitability of fish to be tagged (Annex 7, paragraphs 5.27 to 5.29), the issues being similar to those raised with respect to the research fishing in Division 58.4.4 (Ob and Lena Banks). Only 2.9% of the trotline-caught *D. mawsoni* on BANZARE Bank were single-hooked and in good condition and hence would be suitable for tagging under the revised tagging recommendations. Only 31% of *Dissostichus* spp. actually tagged in 2010/11 were single-hooked and in good condition. The Scientific Committee recommended that any analysis of future recaptures of tagged fish should consider their 'trauma status' at the time of release (Annex 7, paragraph 5.27).

9.29 The Scientific Committee recommended that Members undertaking tag-based research in data-poor exploratory fisheries under CM 24-01 be required to evaluate and report the effects of their fishing gear on fish condition and injury status and modify their research design and/or choice of fishing gear configuration accordingly to ensure that the requirements of an effective tagging program are met. Where particular gear types are incapable of capturing sufficient fish suitable for tagging, alternate sampling tools should be used.

9.30 The Scientific Committee endorsed the advice of WG-FSA regarding the gear configuration to be used in the survey in order to achieve higher numbers of single-hooked fish suitable for tagging (Annex 7, paragraphs 5.30 to 5.32) and to test the effects of different gear configurations on the suitability of fish for tagging.

9.31 The Scientific Committee endorsed the recommendation of WG-FSA that a detailed analysis of the distribution of tags, the effect of different gear types on trauma and condition and tagging rates across the survey area be provided by Japan at next year's meeting.

9.32 The Scientific Committee noted the Working Group's conclusions with respect to a preliminary estimation of plausible biomass and a precautionary research catch limit for the research on BANZARE Bank (Annex 7, paragraphs 5.33 to 5.36).

9.33 The Scientific Committee recalled its previous discussions on the stock in Division 58.4.3b, including agreeing that:

(i) areas of the division have been depleted by unsustainable levels of IUU fishing (SC-CAMLR-XXVI, paragraphs 4.144 and 4.145; SC-CAMLR-XXVII, paragraphs 4.145 to 4.147; SC-CAMLR-XXVIII, paragraphs 4.198 and 4.199)

(ii) the population of fish on BANZARE Bank was primarily large spawning *D. mawsoni* (SC-CAMLR-XXVII, paragraph 4.146) and these fish were likely to originate in East Antarctica (Divisions 58.4.1 and 58.4.2) (SC-CAMLR-XXVIII, paragraphs 4.196 and 4.197).

9.34 The Scientific Committee agreed that it was difficult to provide advice on the status and trends of the stock, and the potential for a future fishery in the area until such time as available data on the current status of the stock on BANZARE Bank, historical fishing data, the results of past surveys and current research, and estimates of past and ongoing IUU removals, have been fully analysed and reviewed. It agreed that such analyses should be focused on providing estimates of the current status of the stock, and identifying the additional data needed to provide a robust stock assessment. It agreed that it would not be able to revise its future management advice until such time as these analyses have been reviewed.

9.35 The Scientific Committee recommended that, in the interim, the proposed research using the *Shinsei Maru No. 3* on BANZARE Bank proceed in 2011/12 subject to the advice of WG-FSA (Annex 7, paragraphs 5.27 to 5.32 and 5.36), limited to 48 sets as shown in Annex 7, Figure 3, with a catch limit of 40 tonnes.

9.36 Plans for research in the subsequent year should be determined following the analyses and review noted above. The Scientific Committee noted that analyses of the impacts of delaying a subsequent year of research on the recovery of tags and development of stock assessments, including the effects of expected levels of movement and mortality, would assist with planning future tag-based research in data-poor exploratory fisheries such as in Division 58.4.3b.

General advice on tag-based research in other areas

9.37 The Scientific Committee endorsed the advice of WG-FSA with respect to tag-based research (Annex 7, paragraphs 5.37 to 5.43), noting in particular:

- the general applicability of the advice provided in respect of research in Divisions 58.4.3b and 58.4.4 concerning the tagging of fish with a high probability of survival

- the differences between trotline gear configurations utilised by different vessels, and that some of these differences, e.g. numbers of hooks per bundle, bundle spacing or snood length, are likely to substantially influence the rate of multiple-hooking injury and the corresponding suitability of fish for tag and release (Annex 7, paragraph 5.39)

- the request that all vessels participating in data-poor exploratory fisheries provide detailed information from all research hauls to assess the suitability for tagging of fish caught using different gear types (Annex 7, paragraph 5.41)

- the recommendation that depredation avoidance and mitigation practices be developed as much as possible into clearly defined protocols, and that the use of a holding tank to retain tagged fish until predators are absent be considered on board vessels undertaking tag-based research in areas where depredation is known to occur (Annex 7, paragraph 5.42).

9.38 The Scientific Committee noted that several vessels have notified for participation in exploratory fisheries for *Dissostichus* spp. using trotline gear only. Using only trotlines may pose a significant challenge to these vessels meeting the requirements of tagging for the purposes of stock assessment.

9.39 The Scientific Committee recommended that the tagging requirements in CM 41-01, Annex C, be updated to require that only *single-hooked fish with a high probability of survival* be tagged and released. It also recommended operational guidance for tagging programs be developed to achieve CCAMLR's objectives in the intersessional period (Annex 7, paragraph 5.38).

Proposals for research fishing in fisheries with assessments

9.40 The Scientific Committee considered a proposal for a CCAMLR-sponsored research survey to monitor the abundance of pre-recruit *D. mawsoni* in the southern Ross Sea presented in SC-CAMLR-XXX/7, and endorsed the advice of WG-FSA regarding this proposal (Annex 7, paragraphs 5.44 and 5.45).

9.41 The Scientific Committee noted that this proposed survey design was consistent with the advice in SC-CAMLR-XXIX, paragraph 3.185, and agreed with the conclusions of WG-SAM and WG-FSA that it is likely to achieve its objectives and represented a good example of how research proposals should be reviewed by the Scientific Committee and its working groups.

9.42 The Scientific Committee endorsed the research design proposed in SC-CAMLR-XXX/7 (see also paragraphs 3.173 to 3.174) and recommended annual reporting and review of interim research results by WG-FSA.

9.43 The Scientific Committee also noted the following other notifications of scientific research activities in 2011/12 received by the Secretariat in accordance with CM 24-01, paragraph 2:

(i) Germany: Subarea 48.1 (March–April 2012), fish research
(ii) Chile: Subarea 48.3 (August 2012), toothfish
(iii) UK: research survey in Subarea 48.3
(iv) Australia: research survey in Division 58.5.2
(v) USA: research survey for pelagic fish in Subarea 48.1.

COOPERATION WITH OTHER ORGANISATIONS

10.1 The CEP Observer to SC-CAMLR (Dr Penhale) introduced SC-CAMLR-XXX/BG/12 and noted that prior to the last CEP meeting in Argentina in June–July 2011, Uruguay hosted a two-day workshop on marine and terrestrial specially managed areas. During CEP IV and the preceding workshop, cooperation with SC-CAMLR in relation to spatial protection was highlighted as being of particular importance.

Cooperation with SCAR

10.2 The SCAR Observer to SC-CAMLR (Dr Trathan) presented three papers: CCAMLR-XXX/BG/11, BG/14 and BG/15. In relation to CCAMLR-XXX/BG/11, it was noted that the 'Biogeographic Atlas of the Southern Ocean' and the work of CAML had generated much scientific information. It was suggested that Russia's work on crustaceans in the Atlantic sector could be included (paragraph 15.10). The importance of the data from CAML and the modelling of spatial distribution was an important input into the development of a representative system of MPAs.

10.3 Mr D. Delbare (Belgium) noted the utility of the SCAR-MarBIN database, but also noted that due to financial constraints, Belgium could not ensure the future financial security of the project, and urged Members to consider how this will be addressed.

10.4 The Observer from SCAR and SCOR (Dr L. Newman) presented a report on SOOS (CCAMLR-XXX/BG/13) which was launched in August 2011. The report provided an update on IPY efforts, the establishment of a multidisciplinary observation system, climate change and sea level rise. SOOS noted that an initial science plan and implementation strategy was soon to be released, and this would provide clear steps to achieve the key objectives of SOOS. Areas of overlap in relation to CEMP, as well as the Southern Ocean Sentinel project, were noted. The Scientific Committee nominated the Science Officer to be its representative on the SOOS Steering Committee.

10.5 The Scientific Committee congratulated SCAR and SCOR in relation to the establishment of SOOS noting that it provides a good source of future data and encouraged the maintenance of strong linkages between the Scientific Committee with SOOS, including enhanced cooperation on feedback management of krill through engagement in the relevant working groups.

10.6 The SCAR Observer to SC-CAMLR introduced CCAMLR-XXX/BG/15, providing SCAR highlights and noting the fruitful interactions between CCAMLR and SCAR. Recent SCAR highlights of relevance to SC-CAMLR include: the publishing of a new strategic plan for 2011 to 2016; three new potential scientific research programs of relevance to CCAMLR; the conclusion of CAML; and a horizon scanning workshop on Antarctic conservation for the 21st century which was attended by the CCAMLR Science Officer.

10.7 The Scientific Committee noted the work of SCAR in understanding the impact of climate change state and on the status of marine ecosystems, highlighting that it is an important topic in relation to the CCAMLR performance review. It also recommended that the second SCAR ACCE update (CCAMLR-XXX/BG/13) be forwarded to WG-EMM for detailed consideration.

Report from observers from other organisations

10.8 The IWC Observer presented SC-CAMLR-XXX/BG/2 on the outcomes of the 63rd Meeting of SC-IWC. The Scientific Committee noted that:

- the current abundance estimates of Antarctic minke whales from the circum-Antarctic survey II (CP2) and circum-Antarctic survey III (CP3) were 612 000 (CP2) and 421 000 whales (CP3) respectively
- minke whales are present in the pack-ice in some numbers year-round and abundance estimates are currently being calculated, however, whether the number of minke whales present in the pack-ice is sufficient to explain the difference in minke whale abundance, remains questionable.

10.9 ASOC submitted four papers relevant to the Scientific Committee, CCAMLR-XXX/BG/19, BG/20, BG/21 and BG/23. In respect of these papers, ASOC highlighted the need for CCAMLR to:

- retain CM 51-07 to avoid the spatial concentration of krill catches
- continue to work towards 100% observer coverage of all vessels in the krill fishery as the best way to achieve systematic observer coverage
- support an expanded and developed CEMP program, including by supporting new sources of funding
- support the designation of an initial representative system of MPAs by 2012 and to support the outcomes of the MPA Workshop
- the importance of providing comprehensive protection to the Ross Sea.

10.10 The Scientific Committee thanked ASOC for its continued positive engagement in the work of CCAMLR.

Future cooperation with other international organisations

10.11 The Scientific Committee reviewed the calendar of meetings of interest to the Scientific Committee (SC-CAMLR-XXX/BG/14) and invited Members to provide reports of those meetings to its meeting next year, noting that the Secretariat's Data Manager is the current Chair of the CWP and will report from that meeting (as well as the concurrent meeting of FIRMS).

10.12 Australia informed the Scientific Committee of its intention to hold a krill workshop in 2012 (CCAMLR-XXX/BG/15).

10.13 The Chair noted the request of the Association of Responsible Krill Harvesting Companies (ARK) to attend SC-CAMLR meetings and the Scientific Committee agreed that ARK should be afforded status as an Observer in 2012.

PERFORMANCE REVIEW

CEMP Fund

11.1 Norway and the EU introduced a proposal for creating a new Special Fund for supporting CEMP sites to increase the monitoring of the Antarctic ecosystem (CCAMLR-XXX/40). The proposal is supported by a contribution from Norway of A$100 000; the EU will also announce a contribution to this proposed fund. Norway and the EU invited other Members, particularly those participating in the krill fishery, to contribute to this fund. The Scientific Committee welcomed the proposal and its likely ability to contribute to krill management, and the contributions to the fund from Norway and, in the future, the EU.

11.2 The Scientific Committee agreed to the creation of an ad hoc CEMP Fund correspondence group and the development of terms of reference for the use of the funds. The Scientific Committee Chair, the WG-EMM Convener and the contributors to this fund will coordinate intersessionally to develop the terms of reference for this group and its composition.

11.3 It was noted that there was some overlap between the Science Capacity Fund and the proposed CEMP Fund, which could be managed more efficiently if harmonisation between the two funds and their objectives was achieved, and that this should be considered also by the correspondence group. The Secretariat noted that any amalgamation of the special funds would have to be considered by SCAF.

Scholarship Scheme

11.4 SC-CAMLR-XXIX established the CCAMLR Scientific Scholarship Scheme (SC-CAMLR-XXIX, paragraphs 15.10 to 15.13). The aim of the scheme is to contribute to capacity building within the CCAMLR scientific community and to contribute to consistent and high attendance and participation by scientists from all Members, and consistent and high-quality scientific advice being provided by the Scientific Committee.

11.5 The call for applications for the Scholarship Scheme was distributed as COMM CIRC 11/62–SC CIRC 11/29 and was also disseminated through other appropriate organisations such as SCAR and the Association of Polar Early Career Scientists (APECS).

11.6 Eight applications were received from five Members.

11.7 The Scholarship Review Panel was chaired by the senior Vice-Chair (Dr Jones) and included the other Vice-Chair of the Scientific Committee (Prof. Koubbi), the remaining conveners of the Scientific Committee's working groups (Drs Constable and Watters), two other senior members of the CCAMLR scientific community (Dr Barrera-Oro and Prof. M. Vacchi (Italy)) and the CCAMLR Science Officer (Dr Reid).

11.8 The Review Panel reviewed all applications and came to a unanimous decision that the first award of the CCAMLR Scientific Scholarship, of up to A$30 000 over two years, should be made to Dr R. Wiff from Chile. Dr Wiff received a PhD from the University of St Andrews in 2010 and is currently working on determining the stock status of data-poor exploratory fisheries in Chile, including those for *D. eleginoides*. The panel particularly commended Dr Wiff for clearly aligning his proposal with a specific priority area of work of the Scientific Committee and with a mentor (Dr R. Mitchell, UK) who is currently actively engaged in the working group to which that work would be delivered.

11.9 The Review Panel also agreed to write to unsuccessful applicants to provide advice on the level of detail and information required and to encourage them to apply in future where appropriate.

11.10 Dr Bizikov noted that the Scientific Scholarship Scheme, from the outset, was conceived to support young scientists from Member States in the working groups of CCAMLR. Awarding one young expert during the year does not correspond with the original objectives of this scheme.

11.11 Dr Arata thanked the Review Panel and looked forward to Dr Wiff's fruitful and positive participation in the working groups and the Scientific Committee.

11.12 The Scientific Committee noted that this year the Review Panel had agreed to fund a single applicant, but that in future it may be possible to fund more than one scholarship in a given year depending on the number of suitable applicants.

11.13 In reviewing the proposals, the Review Panel agreed that the assessment of the applicants suitability had been difficult because of a lack of detail, including how the proposed research would contribute to the work of the working group. In an effort to improve this, the Panel suggested that the application form be modified to include a greater degree of detail on the proposed science project and expected deliverables. The Panel also agreed that for the purposes of this scheme 'early-career scientists' would be within one year prior of the expected completion of a PhD or within five years after obtaining a PhD.

Invitation of Observers to CCAMLR working groups

11.14 At SC-CAMLR-XXIX, the WG-EMM Convener agreed to lead an intersessional discussion on the potential mechanism to facilitate Observer involvement in the working groups (SC-CAMLR-XXIX, paragraph 15.19). Dr Watters presented the suggestion that he had made at WG-EMM and the ensuing discussion at that meeting (Annex 4, paragraphs 6.4 to 6.7). WG-FSA also discussed the proposal and arrived at some suggestions for increasing transparency and communication with observer groups (Annex 7, paragraph 10.12).

11.15 Dr Watters reported that whilst there was discussion on various aspects at these two meetings, there was neither disagreement nor agreement on the proposal.

11.16 The Scientific Committee agreed to ask these two working groups to again consider the proposals, and the solutions to issues raised at the meetings and at the Scientific Committee (SC-CAMLR-XXIX, paragraph 15.19), at their meetings in 2012.

11.17 These discussions should, inter alia, include consideration of:

(i) the relevant qualifications of individuals who might participate in working group meetings on behalf of Observers, noting that fishing industry representatives have provided important insight on the operation of fisheries and that relevant expertise does not necessarily correspond with an individual's academic qualifications

(ii) minimum standards for allowing their participation in the meetings, such as authoring of a paper submitted for the discussion by one of the working groups, and its presentation during a meeting of the group, as proof of their interest and expertise on the matters being discussed

(iii) mechanisms to ensure confidentiality, including mechanisms to ensure that Members can have private discussions as needed.

11.18 The Scientific Committee also noted that WG-EMM (Annex 4, paragraph 6.7) and WG-FSA (Annex 7, paragraph 10.12) gave further consideration to alternative ways of enhancing transparency and communication with observer groups and audiences outside the CCAMLR community more broadly (e.g. the public and the media). While the Secretariat may be able to play an increased role in such communication (e.g. as per suggestions in CCAMLR-XXX/8), the Scientific Committee agreed that this should be carefully considered in the light of the other priorities set for the Secretariat. It was recognised that, if Members' participants from the working groups engage in outreach and communications, it would be useful for the Secretariat to provide standard material for these activities.

BUDGET FOR 2012 AND FORECAST BUDGET FOR 2013

12.1 The Scientific Committee noted 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 (e.g. attendance of staff at meetings, production and translation of reports), and the Executive Secretary manages the allocation of resources in this fund to ensure the provision of adequate support for intersessional activities. The Scientific Committee also noted that the implementation of the accounting changes initiated by the Secretariat in 2010 has resulted in a change in the way that the cost of staff support to meetings in Hobart is allocated in the accounts.

12.2 The Scientific Committee agreed to focus its budget discussion on consideration of Special Funds of relevance to the work of the Scientific Committee, as well as identifying projects requiring additional funds from the Commission.

12.3 The Scientific Committee agreed to the following expenditures:

- a two-year scientific scholarship funded from the General Science Capacity Special Fund (up to A$30 000 over two years, starting in 2012)

- participation costs for invited experts and Secretariat staff at the technical workshops on MPAs, funded from the MPA Special Fund and following consultation with the MPA Special Fund correspondence group (Circumpolar SCP Workshop in Brussels, Belgium, in April–May 2012 – approximately A$25 000; del Cano–Crozet Workshop in 2012 – approximately A$20 000; Western Antarctic Peninsula–South Scotia Arc Workshop in early 2012 – approximately A$14 000).

12.4 The Scientific Committee endorsed the following expenditures under the General Fund:

- translation of the tagging protocol into the languages commonly spoken on board fishing vessels in exploratory fisheries (approximately seven languages – A$2 000)

- translation into English, where required, of research plans in exploratory fishery notifications in order for the working groups to fully consider the information provided

- participation costs for external experts on the review panel of COTPAS (up to A$10 000).

ADVICE TO SCIC AND SCAF

13.1 The Chair transmitted the Scientific Committee's advice to SCIC and SCAF during the meeting. The advice to SCAF is summarised in section 12. The advice to SCIC was derived from the Scientific Committee's consideration of information provided by WG-EMM, WG-FSA and WG-IMAF.

SECRETARIAT SUPPORTED ACTIVITIES

Review of the Secretariat's Strategic Plan and data management systems

14.1 The Scientific Committee noted the review of the Secretariat's Strategic Plan (CCAMLR-XXX/8), and the advice from WG-EMM (Annex 4, paragraph 6.3), WG-FSA (Annex 7, paragraph 10.4) and WG-SAM (Annex 5, paragraph 6.5). The Scientific Committee agreed that it would not comment on the revised plan given that this matter was being reviewed concurrently by SCAF.

14.2 The Scientific Committee also noted the outcomes of the independent review of the Secretariat's data management systems (CCAMLR-XXX/5) and associated work in 2011 on the redevelopment of the Secretariat's document archive, development of an Enterprise Data Model and redevelopment of the CCAMLR website. The Scientific Committee also noted the Secretariat's plan for further work in 2012 and 2013.

Data Centre

14.3 The Scientific Committee noted the Data Centre's activities in 2010/11 and measures taken to maintain the integrity of CCAMLR data (SC-CAMLR-XXX/BG/8). It also noted the growing need for developing the Secretariat's capacity for storing, displaying and analysing spatial data, including digital maps of VMEs (CM 22-06) and the requirements identified by WG-EMM (Annex 4, paragraph 2.101) and WS-MPA (Annex 6, paragraph 2.5).

14.4 The Secretariat is currently working with the British Antarctic Survey (BAS) to identify CCAMLR's mapping requirements and their potential delivery, including consideration of a GIS tool for use by Members and a standard protocol for the submission of GIS data. The Scientific Committee thanked BAS for this collaboration.

14.5 The Scientific Committee endorsed the development of the Secretariat's capacity for handling and analysing spatial data, and encouraged Members participating in spatial analysis to contribute data to the Secretariat's GIS database once established. The Scientific Committee agreed that the availability of the data underlying spatial analysis reported at meetings would further assist in the development of advice on MPAs and the impacts of bottom fishing.

14.6 The Scientific Committee noted that during a recent scientific collaboration between two Members, each collaborating Member submitted a data request in order to gain access to a common set of CCAMLR data. In order to facilitate such collaboration in the future, the Scientific Committee agreed that data released to one Member under the Rules for Access and Use of CCAMLR Data may be forwarded by that Member to other nominated Members collaborating on the project team.

Publications

14.7 The following documents were published in 2011 in support of the Scientific Committee's work:

(i) *Report of the Twenty-ninth Meeting of the Scientific Committee*
(ii) *CCAMLR Science*, Volume 18
(iii) *Statistical Bulletin*, Volume 23.

14.8 In 2011, papers published in Volume 18 of the journal were publicly available on the CCAMLR website immediately following approval of the proof by the primary author. All subscribers were notified of the availability of the 2011 volume once the final paper was posted. The hard copy of Volume 18 will be distributed in November 2011.

14.9 In 2011, *CCAMLR Science* had a five-year impact factor of 1.196 and an Article Influence of 0.529 and these scores were ranked 29th and 18th respectively out of the 46 journals in the Fisheries subject category in Thomson Reuters *Journal Citation Reports*, Science Edition.

14.10 The Scientific Committee thanked the authors and reviewers for their outstanding contributions to the journal, and the Secretariat's editorial team for maintaining the high publication standards.

14.11 The Scientific Committee also thanked the Secretariat for developing a new searchable document archive which was trialled during the meeting, and for the use of USB memory sticks which provided access to documents and related updates during the meeting. These developments had further reduced the amount of paper used at the meeting.

14.12 The Scientific Committee endorsed the proposal to simplify the permission system used for the CCAMLR website (CCAMLR-XXX/41). The new system would provide a single sign-on method, and would be role-based with roles able to be set to expire annually, or at a pre-set time.

SCIENTIFIC COMMITTEE ACTIVITIES

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

15.1 The Scientific Committee noted that WG-SAM was originally intended to provide a forum for quantitative experts to discuss technical quantitative matters and provide advice to other CCAMLR working groups (primarily WG-FSA, but also WG-EMM and SG-ASAM) or to the Scientific Committee regarding new statistical methods or stock assessment modelling frameworks. With the development in recent years of established and agreed stock assessment model frameworks for use in many CCAMLR fisheries, the work of WG-SAM to undertake statistical review of new modelling methods may no longer be required on an annual basis.

15.2 The Scientific Committee considered the following four options for scheduling the work of WG-SAM: (i) that the work of WG-SAM be absorbed into WG-FSA; (ii) that the status quo of annual mid-year meetings be retained; (iii) that the periodicity of the WG-SAM meetings be adjusted to reflect a reduced workload, e.g. meeting every second year; (iv) that WG-SAM be organised on a more ad hoc basis as needed, similar to the current arrangement for SG-ASAM. The Scientific Committee agreed that the first option was not desirable because it was often necessary that WG-SAM provide its advice well in advance of WG-FSA. The Scientific Committee agreed that with regard to the frequency of the meetings, options (iii) or (iv) were preferred, but that if the terms of reference for WG-SAM were expanded to include consideration of more diverse focus topics, then in practice WG-SAM would likely occur on an annual or near-annual basis, given the number of suitable topics already identified and likely to arise in future.

15.3 The Scientific Committee agreed that the terms of reference for WG-SAM should be modified to allow consideration of a wider range of focus topics identified as required on an annual basis to inform the work of CCAMLR, that the evaluation of research plans should be a standing item on the agenda every year, and that WG-SAM should also continue to provide advice as required on quantitative and statistical matters consistent with its original terms of reference.

15.4 If the requirement to submit research proposals in notifications for exploratory fisheries is adopted, then the Scientific Committee noted that there was likely to be a number of research proposals to be reviewed during its intersessional meetings in July and again in October. The Scientific Committee also noted the increasing reliance of the assessments of *Dissostichus* spp. on tagging programs throughout the Convention Area. Given this increased emphasis on tagging, it agreed that it was timely to have a focus topic on tagging, which could include implementation of the tagging program, alternative tagging technologies, experiments to examine tag mortality and tag detectability, tag-based stock assessment issues, review of tagging protocols, and development and provision of a training module for vessel operators. The Scientific Committee recommended this be a focus topic during its intersessional meetings in July 2012.

15.5 In considering the priorities for the work of the working groups (Table 6) the Scientific Committee agreed that the priority items were feedback management of krill, research proposals for data-poor exploratory fisheries and MPAs. It also noted:

(i) the utility of analyses of krill CPUE and acoustic data series in Area 48

(ii) the evaluation of potential factors affecting the recovery of depleted stocks and whether any current management activities could impede the recovery of such stocks

(iii) the removal of climate change from Table 6 reflects the need to consider this issue as a component of a range of issues, rather than simply as a stand-alone item.

Intersessional activities during 2010/11

15.6 The Scientific Committee considered the requirements for conveners of working groups, noting advice from WG-EMM (Annex 4, paragraph 6.11), WG-SAM (Annex 5, paragraph 8.3) and WG-FSA (Annex 7, paragraph 13.2).

15.7 The Scientific Committee welcomed Dr Belchier as the new Convener of WG-FSA, and Dr Hanchet as the new Convener of WG-SAM, and Dr Kawaguchi as the new Co-convener of WG-EMM in 2012.

15.8 The Scientific Committee noted the request from the MPA Workshop for three workshops in 2012 (paragraph 5.20) and welcomed the offers to host technical workshops from:

- Chile and Argentina in respect of the Western Antarctic Peninsula–South Scotia Arc domain (domain 1)

- France in respect of the del Cano–Crozet domain (domain 5)

- Belgium in respect of the circumpolar SCP.

15.9 The Scientific Committee agreed that the MPA Special Fund correspondence group should review the terms of reference and organisation of these technical workshops and that outputs of these technical workshops be presented to WG-EMM in order to facilitate broader engagement in the provision of advice to the Scientific Committee.

15.10 Dr Bizikov informed the Scientific Committee of the preparation by Russian scientists of a field identification guide to Decapod crustaceans in the Atlantic Sector of Antarctica. The Scientific Committee encouraged Russia to submit a translated final version to the technical workshop on MPA planning in domain 1 (West Antarctic Peninsula and the South Scotia Arc) to be held in 2012.

15.11 The Scientific Committee agreed to the following meetings in the 2011/12 intersessional period:

- SG-ASAM (Bergen, Norway, April/May 2012) (Co-conveners: Drs R. Korneliussen (Norway) and J. Watkins (UK))
- WG-SAM (Tenerife, Spain, July) (Convener: Dr Hanchet)
- WG-EMM (Tenerife, Spain, July) (Co-conveners: Drs Watters and Kawaguchi)
- WG-FSA (CCAMLR Headquarters, Hobart, Australia, from 8 to 19 October 2012) (Convener: Dr Belchier).

15.12 The Scientific Committee recalled the discussion in SC-CAMLR-XXIV, paragraphs 13.1 to 13.11, on reorganising the working groups of the Scientific Committee and suggested that there may be benefit in considering this issue in the light of the current workload experienced by the Committee and its working groups. The Scientific Committee recognised that there were a number of issues to consider in changing the current structure and timing of its intersessional meeting and agreed to put this item on the agenda of WG-EMM, WG-FSA and the Scientific Committee next year.

15.13 Dr Constable undertook to consult with Members intersessionally and to prepare a paper on potential alternative arrangements for intersessional meetings that would facilitate greater engagement and would also allow better consideration of issues related to ecology, biology and conservation.

15.14 Dr Barrera-Oro emphasised that in identifying priority items for future work, it was essential that important issues related to the functioning of the Antarctic marine ecosystem were not neglected. In particular, he noted the importance of fish-centric ecosystem interactions, noting that these had not been considered in the working groups for the past three years.

15.15 The Scientific Committee agreed that the reports of its meeting and of its working groups need to accurately reflect the range of important and complex issues under consideration and that it was timely to review the instructions and processes required to ensure that all rapporteurs are able to use a consistent style. The incoming Scientific

Committee Chair agreed to prepare a paper in the intersessional period, in consultation with Scientific Committee representatives, in order to develop a set of style guidelines and protocols, including, for example, instruction on the use of personal rather than Member attribution of statements.

Invitation of Observers to the next meeting

15.16 The Scientific Committee agreed that all Observers invited to the 2011 meeting would be invited to participate in SC-CAMLR-XXXI.

Invitation of experts to the meetings of working groups

15.17 The Scientific Committee agreed that, where appropriate experts were identified, that these could be invited to participate in working groups and subgroups through consultation with the conveners of those meetings and the Secretariat in respect of budgetary matters.

ELECTION OF CHAIR AND VICE-CHAIR

16.1 Dr Agnew's term as Chair ended with SC-CAMLR-XXX and the Scientific Committee sought nominations for a new Chair. Dr E. Marschoff (Argentina) nominated Dr Jones and this nomination was seconded by Dr Constable. Dr Jones was unanimously elected to the position for a term of two regular meetings and the Scientific Committee extended a very warm welcome to the incoming Chair.

16.2 Dr Jones' term as Vice-Chair also ended with this meeting and the Scientific Committee sought nominations for a new Vice-Chair. Dr Koubbi nominated Dr Zhao and this nomination was seconded by Mr L. López Abellán (Spain). Dr Zhao was unanimously elected to the position for a term of two regular meetings (2012 and 2013). A very warm welcome was extended to the incoming Vice-Chair.

OTHER BUSINESS

17.1 Prof. Duhamel informed the Scientific Committee that a publication arising from a Symposium on the Ecosystem and Fisheries of the Kerguelen Plateau, held from 14 to 16 April 2010 in Concarneau, France (SC-CAMLR-XXVIII, paragraph 9.42), has now been published and copies are available on request from Dr Welsford.

17.2 Dr Barrera-Oro informed the Scientific Committee that Argentina will conduct a second consecutive research cruise on krill larvae on board the oceanographic vessel *Puerto Deseado* to the South Orkney Islands and Weddell–Scotia region from 20 January to 8 March 2012 (SC-CAMLR-XXX/BG/16).

ADOPTION OF THE REPORT

18.1 The report of the Thirtieth meeting of the Scientific Committee was adopted.

CLOSE OF THE MEETING

19.1 The close of the meeting completed Dr Agnew's term as Chair of the Scientific Committee.

19.2 In closing the meeting, Dr Agnew thanked the conveners of the working groups and all meeting participants for their expert contributions to the work of the Scientific Committee. He recalled the concerns expressed in 2008 by the Scientific Committee and the Performance Review Panel at the declining levels of participation in the Scientific Committee and its working groups (SC-CAMLR-XXVII, paragraphs 16.5 to 16.8). Since that time the Scientific Committee has successfully introduced a range of measures to address this situation, including practices to facilitate capacity such as mentoring of new working group attendees, widening the responsibility for rapporteuring and engagement of participants not having English as a first language, joint research activities, and the development of the CCAMLR Scholarship Scheme, made possible by the establishment of the General Science Capacity Fund. Dr Agnew was pleased to report that although more effort will continue to be needed, there is evidence that these measures are working to increase participation by individual scientists and by Members in the work of the Scientific Committee. For example, in 2007, 27 scientists from 10 Members attended WG-EMM, and a total of 133 papers were produced for the combined subsidiary groups of the Committee; in 2011 these numbers were 44, 14 and 196 respectively.

19.3 Dr Agnew thanked the Secretariat, interpreters and meeting services for supporting the meeting of the Scientific Committee. These collective efforts had contributed to another successful meeting. Dr Agnew also thanked Drs Constable (outgoing Convener of WG-SAM) and Jones (outgoing Convener of WG-FSA) for their scientific leadership.

19.4 Dr Constable and Mr A. Wright (Executive Secretary), on behalf of the Scientific Committee, thanked Dr Agnew for his expertise in chairing the Committee's deliberations, and for guiding a busy and productive meeting. The Scientific Committee recognised Dr Agnew's long-standing involvement in CCAMLR, from his work as the Secretariat's Data Manager (1989–1996) to his role as Chair of the Scientific Committee. Dr Agnew has been instrumental in developing and guiding the work of the Scientific Committee and the Commission, as well as the Antarctic Treaty System.

19.5 Mr Wright presented Dr Agnew with a gavel in commemoration of his time in the Chair.

REFERENCES

Atkinson, A., V. Siegel, E. Pakhomov and P. Rothery. 2004. Long-term decline in krill stock and increase in salps within the Southern Ocean. *Nature*, 432: 100–103.

Table 1: Catches (tonnes) of target species reported in 2009/10 (December 2009 to November 2010) (source: STATLANT data). All catches shown for Divisions 58.4.3b and 58.4.4 resulted from research fishing.

Species	Country	Subarea or division																	Total
		48.1	48.2	48.3	48.4	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	
Icefish	Australia													352					352
Champsocephalus gunnari	Chile			1															1
	UK			11															11
Total (icefish)		0	0	12	0	0	0	0	0	0	0	0	0	352	0	0	0	0	364
Toothfish	Australia													2 459					2 459
Dissostichus eleginoides	Chile			351															351
	EU – Spain			648															648
	France												4 912		663				5 575
	Japan					10	2			2	9	50							73
	Korea					39													39
	New Zealand			336	27												<1		363
	South Africa			175											77	72			325
	UK			864	31														894
	Uruguay			145															145
Dissostichus mawsoni	Argentina																30	8	38
	China	<1*																	<1*
	EU – Spain																309	42	352
	Japan					184	86			12									282
	Korea					159	108	93									789		1 148
	New Zealand				31												1 310		1 341
	Russia		<1*																<1*
	UK				26												200	259	484
Total (toothfish)		<1*	<1*	2 519	114	392	196	93	0	14	9	50	4 912	2 459	741	72	2 639	309	14 518

(continued)

Table 1 (continued)

Species	Country	Subarea or division																	Total
		48.1	48.2	48.3	48.4	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	
Krill	China	67	1 879																1 946
Euphausia superba	EU – Poland	6 605	390																6 995
	Japan	28 924	995																29 919
	Korea	41 863	3 784																45 648
	Norway	75 803	34 886	8 712															119 401
	Russia		8 065																8 065
Total (krill)		153 262	49 999	8 712	0	0	0	0	0	0	0	0	0	0	0	0	0	0	211 974
Crab	Australia													0					<1*
Paralomis spp.	EU – Spain			<1*														<1*	<1*
	Japan					<1*					<1*	<1*							<1*
	Korea					<1*													<1*
	New Zealand			<1*	<1*												<1*		<1*
	Russia			62															62
	South Africa														<1*				<1*
	UK			<1*															<1*
	Uruguay			<1*															<1*
Total (crab)		0	0	62	<1*	<1*	0	0	0	0	<1*	<1*	0	0	<1*	0	<1*	<1*	62

* Taken as by-catch

Table 2: Preliminary total catch (tonnes) of target species reported in 2010/11 (source: catch and effort reports unless indicated otherwise). Note: The season started on 1 December 2010 and closes on 30 November 2011, and catches are those reported to the Secretariat to 24 September 2011, unless indicated otherwise. All catches shown in Divisions 58.4.3b and 58.4.4 and Subareas 88.2 (SSRU A) and 88.3 resulted from research fishing.

Species	Country	Subarea or division																		Total
		48.1	48.2	48.3	48.4	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	
Icefish	Australia													1						1
Champsocephalus gunnari	China		<1*																	<1*
	Korea	<1*	<1*																	<1*
	Norway		<1*																	<1*
	UK			10																10
Total (icefish)		<1*	<1*	10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	11
Toothfish	Australia													1 614						1 614
Dissostichus eleginoides	Chile			272																272
	EU – Spain						0										0			0
	France**												2 906		551					3 457
	Japan					0			4	2		35								41
	Korea					11											1			12
	New Zealand			383	19												0			402
	Russia																1			1
	South Africa					22									34	51				107
	UK			1 119	20															1 139
	Uruguay			14																14
Dissostichus mawsoni	China		<1*																	<1*
	EU – Spain						75										427			502
	Japan					197				8										205
	Korea					156	141	136									721	76		1 230
	New Zealand			0	5												889	244		1 137
	Russia																318	122	5	445
	South Africa					6														6
	UK				10												525	120		655
	Uruguay																	13		13
Total (toothfish)		0	0	1 788	54	393	216	136	4	11	0	35	2 906	1 614	585	51	2 882	576	5	11 254

(continued)

Table 2 (continued)

Species	Country	Subarea or division																		Total
		48.1	48.2	48.3	48.4	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	
Krill	Chile		13	1 799																1 811
Euphausia superba	China	2 088	13 932																	16 020
	EU – Poland	489	2 555																	3 044
	Japan	222	19 467	6 701																26 390
	Korea	4 999	17 615	6 439																29 052
	Norway	1 360	62 971	38 483																10 2815
	UK			<1*																<1*
Total (krill)		9 158	116 552	53 421	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17 9131
Crab	Australia													<1*						<1*
Paralomis spp.	Chile			<1*																<1*
	Japan											<1*								<1*
	New Zealand			<1*													<1*	<1*		<1*
	Russia																	<1*	<1*	<1*
	UK			<1*	<1*													<1*		<1*
	Uruguay			<1*																<1*
Total (crab)		0	0	<1*	<1*	0	0	0	0	0	0	<1*	0	<1*	0	0	<1*	<1*	<1*	<1*

* Taken as by-catch

** Catch reported in fine-scale data to 12 August 2011

Table 3: Information provided in the notifications for krill fisheries in 2011/12.

Member	Vessel	Expected level of krill catch (tonnes)	Months during which fishing has been notified												Subareas and/or divisions where fishing has been notified					
			2011	2012											Subarea				Division	
			Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	48.1	48.2	48.3	48.4	58.4.1	58.4.2
Chile[a]	*Betanzos*	20 000	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
China	*An Xing Hai*	15 000	x	x	x	x	x	x	x	x	x				x	x	x			
	Kai Li	11 000	x	x	x	x	x	x	x	x	x				x	x	x			
	Kai Xin	18 000	x	x	x	x	x	x	x	x	x				x	x	x			
	Kai Yu	11 000	x	x	x	x	x	x	x	x	x				x	x	x			
	Lian Xing Hai	15 000	x	x	x	x	x	x	x	x	x				x	x	x			
Japan	*Fukuei Maru*	30 000		x	x	x	x	x	x	x	x				x	x	x			
Korea	*Dongsan Ho*	37 000			x	x	x	x	x	x	x	x	x	x	x	x	x			
	Insung Ho	12 000			x	x	x	x	x	x	x				x	x	x			
	Kwang Ja Ho	18 000			x	x	x	x	x	x	x				x	x	x			
Norway	*Juvel*	50 000	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			
	Saga Sea	65 000	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x		
	Thorshøvdi	60 000	x	x	x	x	x	x	x	x	x	x			x	x	x			
Poland[b]	*Dalmor II*	9 000			x	x	x	x	x	x	x				x	x	x			
Ukraine[c]	*Maksim Starostin*	30 000	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Total	15 vessels	401 000	10	11	15	15	15	15	15	15	15	6	5	4	15	15	15	3	0	0

[a] Chile withdrew its notification for the vessel 'to be announced'.
[b] Poland has indicated that the *Dalmor II* may be replaced by another vessel.
[c] Ukraine submitted a late notification (SC-CAMLR-XXX/BG/13).

Table 4: Number of sets, *Dissostichus* catch and mean CPUE in fishable depths (600–1 800 m) over the previous three seasons (2008/09 to 2010/11) inside and outside proposed research areas. FSR – fine-scale rectangle.

		Inside research area						Outside research area		
Subarea/ division	SSRU	Number FSRs	Total number sets	Number research sets	% Research sets	Catch (tonnes)	CPUE (tonnes/set)	Total number sets	Catch (tonnes)	CPUE (tonnes/set)
48.6	486A	11	94	18	19	42	0.4	12	4	0.4
	486B	4	27	8	30	95	3.5	5	9	1.8
	486C	5	49	7	14	92	1.9	0	0	-
	486D	3	38	8	21	96	2.5	1	0	0.4
	486E	3	42	17	40	249	5.9	5	29	5.9
	486G	21	350	55	16	419	1.2	12	2	0.2
58.4.1	5841C	11	219	42	19	302	1.4	5	2	0.4
	5841E	5	44	11	25	135	3.1	6	18	2.9
	5841G	12	267	24	9	159	0.6	4	6	1.4
58.4.2	5842A	1	3	3	100	22	7.5	7	36	5.1
	5842E	8	99	34	34	236	2.4	2	1	0.3
58.4.3a	5843aA	7	64	16	25	34	0.5	4	1	0.2

Table 5: Proposed format for research proposals submitted in accordance with CM 24-01, paragraph 3.

Category	Information
1. Main objective	(a) Objectives for the research and why it is a priority for CCAMLR. (b) Detailed description of how the proposed research will meet the objectives, including annual research goals (where applicable). (c) Rationale for research, including relevant existing information on the target species from this region, and information from other fisheries in the region or similar fisheries elsewhere.
2. Fishery operations	(a) Fishing Member (b) Vessel to be used: • Vessel name • Vessel owner • Vessel type (research or commercial vessel) • Port of registration and registration number • Radio call sign • Overall length and tonnage • Equipment used for determining position • Fishing capacity • Fishing processing and storage capacity (c) Target species (d) Fishing or acoustic gear to be used: • Trawl type; mesh shape and size • Longline type • Other sampling gear • Type of acoustic gear and frequency (e) Fishing regions (divisions, subareas and SSRUs) and geographical boundaries (f) Estimated dates of entering and leaving CAMLR Convention Area.
3. Survey design, data collection and data analysis	(a) Research survey/fishing design (description and rationale): • Spatial arrangements of stations/hauls (random or semi-random) • Stratification according to e.g. depth or fish density • Calibration/standardisation of sampling gear • Proposed number and duration of stations/hauls • Other requirements (e.g. tagging rates) • How will performance metrics be achieved? (e.g. tag overlap statistics for tagging program) (b) Data collection: types and sample size or quantities of catch, effort and related biological, ecological and environmental data (e.g. sample size by location/haul) (c) Methods for data analysis (description of methods by data types detailed in (b)). (d) How and when will the data meet the objectives of the research (e.g. lead to a robust estimate of stock status and precautionary catch limits). Include evidence that the proposed methods are highly likely to be successful.
4. Proposed catch limits	(a) Proposed catch limits and justification. (Note that the catch limits should be at a level not substantially above that necessary to obtain the information specified in the research plans and required to meet the objectives of the proposed research.) (b) Evaluation of the impact of the proposed catch on stock status: • Rationale that proposed catch limits are consistent with Article II of the Convention • Evaluation of time scales involved in determining the responses of harvested, dependent and related populations to fishing activities. • Information on estimated removals, including IUU activities. (c) Details of dependent and related species and the likelihood of their being affected by the proposed fishery

(continued)

Table 5 (continued)

Category	Information
5. Research capability	(a) Name(s) and address of the chief scientist(s) responsible for planning and coordinating the research (b) Number of scientists and crew to be on board the vessel (c) Is there opportunity for inviting scientists from other Members? If so, indicate a number of such scientists. (d) Evidence that the proposed fishing vessels and nominated research providers have the resources and capability to fulfil all obligations of the proposed research plan.
6. Reporting for evaluation and review	(a) List of dates by which specific actions will be completed and reported to CCAMLR. If the research is a stand-alone survey, Members shall commit to providing a progress report to WG-FSA and/or WG-EMM for review and comment and a final report within 12 months of completion of the research to the Scientific Committee. (b) If research is multi-annual, Members shall commit to providing annual research reviews to be submitted to WG-FSA and/or WG-EMM, including review of progress towards meeting research objectives and associated proposed time lines in initial proposal, and proposals for adjustments to the research proposal if required.

Table 6: Indicative program of work for the Scientific Committee for the next three years. Where items of work will contribute towards completion of the Performance Review recommendations, this is indicated. The year in which issues will be addressed is indicated by an 'x' and the group which will be responsible for undertaking the work is indicated in the final column.

		PRP report	2012	2013	2014	Work by
Krill						
	Analysis of fisheries data		x	x	x	EMM
	Feedback management	3.1.2.2, 3.1, 3.2.6	1–2	3–4	5–6	EMM (SAM 2014)
	Recruitment variation, B_0		x	x		EMM
	Fishing vessel survey		x		x	EMM/ASAM
	Catch monitoring, escape mortality, green weight	3.3.4.2, 3.3.4.3		x		EMM
	CEMP review and STAPP	3.1.2.2, 3.1.2.3, 3.1.3.2.6, 3.1.3.2.7, 3.2.1.4	x	x	x	EMM
	Krill observer scheme		x	x		EMM
Fish						
	Biennial assessments			x		FSA/SAM
	Other assessments 48.4, 58.5.1		x	x	x	FSA
	By-catch	3.1.3.2.1, 3.1.3.2.2	x		x	FSA
	Data-poor fisheries	3.1.1.2, 3.1.1.3	x	x	x	FSA/SAM*
	Depleted/recovering stocks	3.1.1.1	x		x	FSA
	Biology and ecology and fish-based ecosystem interactions		x	x	x	FSA/EMM
	Tagging program		x		x	FSA/SAM*
MPA		2.4.3.1, 2.4.3.2				
	MPA issues		x		x	EMM†
Observers						
	Accreditation	3.3.4.1	x	x	x	COTPAS
	Observer scheme review	3.3.4.2		x		
VME						
	Outstanding future work (SC-CAMLR-XXIX, Annex 8, paragraph 9.37)		x			FSA
	Modelling			x		SAM
	CM 22-06		x	x	x	EMM
	Review and update of impact assessments		x	x	x	FSA
	Method assessment for all bottom methods			x		FSA

* Potential focus topic for SAM in 2012 noting the potentially revised role of SAM (paragraph 2.5). The numbers in 'Feedback management' refer to the milestones in paragraph 3.33.

† Technical workshops during 2012

2012	SG-ASAM	1 week in April/May
	SAM or *	1 week prior to, or following, EMM
	EMM	2 weeks (early July)
	FSA	2 weeks

ANNEX 1

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ANNEX 2

LIST OF DOCUMENTS

LIST OF DOCUMENTS

SC-CAMLR-XXX/1	Provisional Agenda for the Thirtieth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
SC-CAMLR-XXX/2	Provisional Annotated Agenda for the Thirtieth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
SC-CAMLR-XXX/3	Report of the Working Group on Ecosystem Monitoring and Management (Busan, Republic of Korea, 11 to 22 July 2011)
SC-CAMLR-XXX/4	Report of the Working Group on Fish Stock Assessment (Hobart, Australia, 10 to 21 October 2011)
SC-CAMLR-XXX/5	Report of the Working Group on Statistics, Assessments and Modelling (Busan, Republic of Korea, 11 to 15 July 2011)
SC-CAMLR-XXX/6	Report of the Workshop on Marine Protected Areas (Brest, France, 29 August to 2 September 2011)
SC-CAMLR-XXX/7	Proposal for a CCAMLR-sponsored research survey to monitor abundance of pre-recruit Antarctic toothfish in the southern Ross Sea Delegation of New Zealand
SC-CAMLR-XXX/8	Implementation considerations for the CCAMLR Observer Training Program Accreditation Scheme (COTPAS) Chair of the Scientific Committee, Chair of SCIC and former Co-conveners of ad hoc TASO
SC-CAMLR-XXX/9	An MPA scenario for the Ross Sea region Delegation of the USA
SC-CAMLR-XXX/10	A Marine Protected Area scenario by New Zealand for the Ross Sea region Delegation of New Zealand
SC-CAMLR-XXX/11	Proposal for a Representative System of Marine Protected Areas (RSMPA) in the East Antarctica planning domain Delegations of Australia and France

SC-CAMLR-XXX/12	Report of the Working Group on Incidental Mortality Associated with Fishing (Hobart, Australia, 10 to 12 October 2011)
SC-CAMLR-XXX/13	Climate change and precautionary spatial protection: ice shelves Delegation of the United Kingdom (previously SC-CAMLR-XXX/BG/7)

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SC-CAMLR-XXX/BG/1	Catches in the Convention Area 2009/10 and 2010/11 Secretariat
SC-CAMLR-XXX/BG/2	Observer's Report from the 63rd Meeting of the Scientific Committee of the International Whaling Commission (Tromsø, Norway, 30 May to 11 June 2011) CCAMLR Observer (K.-H. Kock, Germany)
SC-CAMLR-XXX/BG/3	Antarctic krill and climate change Delegation of the European Union
SC-CAMLR-XXX/BG/4	Summary of scientific observation programs undertaken during 2010/11 Secretariat
SC-CAMLR-XXX/BG/5	Marine debris, entanglements and hydrocarbon soiling at Bird Island and King Edward Point, South Georgia, Signy Island, South Orkneys and Goudier Island, Antarctic Peninsula, 2010/11 Delegation of the United Kingdom
SC-CAMLR-XXX/BG/6	On the management of Antarctic krill fisheries in the CCAMLR Area Delegation of Ukraine
SC-CAMLR-XXX/BG/7	See SC-CAMLR-XXX/13
SC-CAMLR-XXX/BG/8	Report on the Data Centre's activities in 2010/11 Secretariat
SC-CAMLR-XXX/BG/9	Proposals for study of spatial-temporal dynamics of krill distribution for management applications Delegation of Russia
SC-CAMLR-XXX/BG/10	Review of the technical recommendations for the Patagonian toothfish fishery in order to minimize by-catch Delegation of France (available in English and French)

SC-CAMLR-XXX/BG/11	On the determination and establishment of Marine Protected Area in the area of the Argentina Islands Archipelago Delegation of Ukraine
SC-CAMLR-XXX/BG/12	Committee for Environmental Protection: Annual report to the Scientific Committee of CCAMLR CEP Observer to SC-CAMLR
SC-CAMLR-XXX/BG/13	Notification of intent to participate in a fishery for *Euphausia superba* in accordance with Conservation Measures 21-03 and 10-02 in Subareas 48.1, 48.2, 48.3 and 48.4 Delegation of Ukraine
SC-CAMLR-XXX/BG/14	Calendar of meetings of relevance to the Scientific Committee in 2011/12 Secretariat
SC-CAMLR-XXX/BG/15	Announcement of 'Antarctic Krill Symposium: from Marr to Now and Beyond' Delegation of Australia
SC-CAMLR-XXX/BG/16	Progress report on the monitoring of krill larvae in the Weddell–Scotia region in January 2011 Delegation of Argentina
SC-CAMLR-XXX/BG/17	Plan of research fishing in Subarea 88.3 in season 2011/12 Delegation of Russia

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CCAMLR-XXX/1	Provisional Agenda for the Thirtieth Meeting of the Commission for the Conservation of Antarctic Marine Living Resources
CCAMLR-XXX/2	Provisional Annotated Agenda for the Thirtieth Meeting of the Commission for the Conservation of Antarctic Marine Living Resources
CCAMLR-XXX/3	Examination of the audited financial statements for 2010 Executive Secretary
CCAMLR-XXX/4 Rev. 1	Review of the 2011 budget, draft 2012 budget and forecast budget for 2013 Executive Secretary
CCAMLR-XXX/5	Report on the independent review of CCAMLR's data management systems Secretariat

CCAMLR-XXX/6	Executive Secretary's report to SCAF, 2011 Executive Secretary
CCAMLR-XXX/7	Performance Review Report: overview of practices in other multilateral organisations relating to the special needs of Developing States Secretariat
CCAMLR-XXX/8	The CCAMLR Secretariat Strategic Plan and associated Staffing Strategy Executive Secretary
CCAMLR-XXX/9	Proposal to consolidate closely related conservation measures Secretariat
CCAMLR-XXX/10	Summary of notifications for krill fisheries 2011/12 Secretariat
CCAMLR-XXX/11 Rev. 1	Summary of notifications for new and exploratory fisheries 2011/12 Secretariat
CCAMLR-XXX/12 Rev. 1	Preliminary assessments of known and anticipated impacts of proposed bottom fishing activities on vulnerable marine ecosystems (Conservation Measure 22-06) Collated by the Secretariat
CCAMLR-XXX/13	Notification of France's intention to conduct an exploratory longline fishery for *Dissostichus* spp. in 2011/12 Delegation of France
CCAMLR-XXX/14	Notifications of Japan's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of Japan
CCAMLR-XXX/15	Notifications of the Republic of Korea's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of the Republic of Korea
CCAMLR-XXX/16	Notifications of New Zealand's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of New Zealand
CCAMLR-XXX/17	Notifications of Norway's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of Norway

CCAMLR-XXX/18	Notifications of Russia's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of Russia
CCAMLR-XXX/19	Notifications of South Africa's intention to conduct an exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of South Africa
CCAMLR-XXX/20	Notifications of Spain's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of Spain
CCAMLR-XXX/21	Notifications of Ukraine's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of Ukraine
CCAMLR-XXX/22	Notifications of the United Kingdom's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2011/12 Delegation of the United Kingdom
CCAMLR-XXX/23	China's request of removal *West Ocean* and *North Ocean* from CP-IUU List Delegation of the People's Republic of China
CCAMLR-XXX/24	A proposal to report marine casualties to CCAMLR Delegations of the USA and New Zealand
CCAMLR-XXX/25	Prohibition of shark finning in the CAMLR Convention Area Delegation of the USA
CCAMLR-XXX/26	Proposal to enhance planning for inspection and enforcement missions in the CCAMLR Area Delegation of the USA
CCAMLR-XXX/27	Catch Documentation Scheme (CDS) fund proposal – amending the E-CDS to perform Member queries and reports Delegation of the USA
CCAMLR-XXX/28	Proposal to strengthen CCAMLR's port inspection scheme to prevent, deter and eliminate illegal, unreported and unregulated fishing Delegations of the USA and the European Union
CCAMLR-XXX/29	Report of the SCAF Correspondence Group Review of the CCAMLR Financial Regulations Convener, SCAF-CG

CCAMLR-XXX/30	Proposal for a general conservation measure to implement Marine Protected Areas in the CCAMLR Area by 2012, including management arrangements needed in conservation measures that will govern the MPAs in CCAMLR in the future Delegation of Australia
CCAMLR-XXX/31	Development of a compliance evaluation procedure (DOCEP) Report of 2010/11 intersessional work and proposal for a CCAMLR compliance evaluation procedure Convener, DOCEP
CCAMLR-XXX/32	Future structure of Commission meetings Delegations of France, the United Kingdom and the European Union
CCAMLR-XXX/33	Catch Documentation Scheme (CDS) Fund Proposal: Illegal, unreported and unregulated (IUU) fishing in the Convention Area – African Capacity Building Training Event 2012 Delegations of Australia, South Africa, the United Kingdom and the Secretariat
CCAMLR-XXX/34	Information on illegal fishing in Statistical Area 58 Assessment of illegal fishing in French waters around Kerguelen and Crozet Islands Report of observations and inspections in the CCAMLR Area 2010/11 season (1 July 2010–15 August 2011) Delegation of France
CCAMLR-XXX/35	EU proposal for a conservation measure concerning the adoption of market-related measures to promote compliance Delegation of the European Union
CCAMLR-XXX/36	EU proposal for amendment to the CCAMLR Conservation Measure 10-02 on rendering IMO numbers mandatory Delegation of the European Union
CCAMLR-XXX/37	EU proposal for amendment to the CCAMLR Conservation Measure 10-09 to introduce a notification system for transhipments of krill Delegation of the European Union
CCAMLR-XXX/38	EU proposal on fishing capacity and effort in CCAMLR exploratory fisheries Delegation of the European Union

CCAMLR-XXX/39	EU proposal for enhancing safety standards of vessels licensed to fish in the CAMLR Convention Area Delegation of the European Union
CCAMLR-XXX/40	Proposal for the establishment of a CEMP Fund for increased ecosystem monitoring under conditions of uncertainty Delegations of the European Union and Norway
CCAMLR-XXX/41	Access to restricted information on the CCAMLR website Secretariat
CCAMLR-XXX/42	Draft of a resolution on the transhipment of persons or crew members involving ships flagged by Member States of CCAMLR Delegation of Chile
CCAMLR-XXX/43	Reports under Articles X, XXI and XXII of the Convention and Conservation Measures 10-06 and 10-07 – IUU fishing and IUU vessel lists 2010/11 Secretariat
CCAMLR-XXX/44	Report of the Standing Committee on Administration and Finance (SCAF)
CCAMLR-XXX/45	Report of the Standing Committee on Implementation and Compliance (SCIC)

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CCAMLR-XXX/BG/1 Rev. 1	List of documents
CCAMLR-XXX/BG/2	List of participants
CCAMLR-XXX/BG/3	Vacant
CCAMLR-XXX/BG/4	Description of the General Fund budget Secretariat
CCAMLR-XXX/BG/5	Executive Secretary's summary report of the Twenty-ninth FAO Committee on Fisheries (Rome, Italy, 31 January to 4 February 2011) Executive Secretary
CCAMLR-XXX/BG/6	Summary of the Thirty-fourth Antarctic Treaty Consultative Meeting (Buenos Aires, Argentina, 20 June to 1 July 2011) Secretariat

CCAMLR-XXX/BG/7	Management of the CCAMLR Staff Termination Fund Secretariat
CCAMLR-XXX/BG/8	Implementation of fishery conservation measures in 2010/11 Secretariat
CCAMLR-XXX/BG/9	The bilateral cooperation between France and Australia in the Southern Ocean Delegations of France and Australia
CCAMLR-XXX/BG/10	CCAMLR Vessel Monitoring System Secretariat
CCAMLR-XXX/BG/11	The CAML/SCAR-MarBIN Biogeographic Atlas of the Southern Ocean Submitted by SCAR
CCAMLR-XXX/BG/12 Rev. 1	Summary of progress made in respect of Performance Review recommendations which relate to the work of SCIC Secretariat
CCAMLR-XXX/BG/13	The Southern Ocean Observing System (SOOS): an update A joint submission by SCAR and SCOR
CCAMLR-XXX/BG/14	Antarctic Climate Change and the Environment – 2011 update Submitted by SCAR
CCAMLR-XXX/BG/15	Annual Report from SCAR to CCAMLR Submitted by SCAR
CCAMLR-XXX/BG/16	Calendar of meetings of relevance to the Commission in 2011/12 Secretariat
CCAMLR-XXX/BG/17	Implementation of Conservation Measure 10-08 (2006) in Chile Delegation of Chile (available in English and Spanish)
CCAMLR-XXX/BG/18	Heard Island and McDonald Islands Exclusive Economic Zone 2010/11 IUU catch estimate for Patagonian toothfish Delegation of Australia
CCAMLR-XXX/BG/19	30 years of krill fisheries management – challenges remain Submitted by ASOC
CCAMLR-XXX/BG/20	Demonstrating global leadership in marine spatial protection Submitted by ASOC

CCAMLR-XXX/BG/21	Unhappy feet: the reduction of Adélie and chinstrap penguin populations in the West Antarctic Peninsula/Scotia Sea Submitted by ASOC
CCAMLR-XXX/BG/22	CCAMLR's next steps to stop IUU fishing Submitted by ASOC
CCAMLR-XXX/BG/23	The case for a Ross Sea marine reserve Submitted by ASOC
CCAMLR-XXX/BG/24 Rev. 3	Implementation and operation of the Catch Documentation Scheme in 2010/11 Secretariat
CCAMLR-XXX/BG/25	Memorandum of Understanding on the Conservation of Migratory Sharks Secretariat
CCAMLR-XXX/BG/26 Rev. 1	Reports submitted under Conservation Measure 31-02 – closure of fisheries Secretariat
CCAMLR-XXX/BG/27	Implementation of the System of Inspection and other CCAMLR compliance-related measures in 2010/11 Secretariat
CCAMLR-XXX/BG/28	Report from the CCAMLR Observer (European Union) to the 17th Special Meeting of the International Commission for the Conservation of Atlantic Tunas (ICCAT) CCAMLR Observer (European Union)
CCAMLR-XXX/BG/29	Report from the CCAMLR Observer (European Union) to the FAO Technical Consultation on Flag State Performance, 2–6 May 2011 CCAMLR Observer (European Union)
CCAMLR-XXX/BG/30	Report from the CCAMLR Observer (European Union) to the 15th Session of the Indian Ocean Tuna Commission (IOTC) held in Colombo, Sri Lanka, from 18 to 22 March 2011 CCAMLR Observer (European Union)
CCAMLR-XXX/BG/31	Report from the CCAMLR Observer (European Union) to the 82nd Meeting of the Interamerican Tropical Tuna Commission (IATTC) CCAMLR Observer (European Union)

CCAMLR-XXX/BG/32	Report from the CCAMLR Observer (European Union) to the 33rd NAFO Annual Meeting, 19–23 September 2011, Halifax, Canada CCAMLR Observer (European Union)
CCAMLR-XXX/BG/33	Report of the IWC Observer from the 63rd Annual Meeting of the IWC, 3–14 July 2011, St Helier, Jersey, UK IWC Observer (Sweden)
CCAMLR-XXX/BG/34	Follow-up information regarding the capsizal incident of the *Insung No. 1* Delegation of the Republic of Korea
CCAMLR-XXX/BG/35	Report of actions taken by Spain regarding IUU fishing in the CAMLR Convention Area Delegation of the European Union
CCAMLR-XXX/BG/36	Report on transhipment of krill in 2010 Delegation of Japan
CCAMLR-XXX/BG/37	Summary of progress made in respect of Performance Review recommendations Secretariat
CCAMLR-XXX/BG/38	Korea's report on sanctions imposed on the *Insung No.7* Delegation of the Republic of Korea
CCAMLR-XXX/BG/39	Report from the CCAMLR Observer to the Meeting of the Extended Commission for the 18th Annual Session of the Commission for the Conservation of Southern Bluefin Tuna (10–13 October 2011, Bali, Indonesia) CCAMLR Observer (Australia)
CCAMLR-XXX/BG/40	Report on VMS data for the *Yangzi Hua 44* (Ex *Paloma V*, *Trosky*) Secretariat
CCAMLR-XXX/BG/41	Observer's report from the Second Preparatory Conference of the South Pacific Regional Fisheries Management Organisation CCAMLR Observer (New Zealand)
CCAMLR-XXX/BG/42	Observer's Report from the Seventh Session of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean CCAMLR Observer (New Zealand)
CCAMLR-XXX/BG/43	New and revised conservation measures recommended by SCIC for adoption by the Commission

CCAMLR-XXX/BG/44	Proposals for new and revised conservation measures forwarded by SCIC to the Commission for further consideration
CCAMLR-XXX/BG/45	Conservation measures revised in accordance with the advice from the Scientific Committee

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WG-FSA-11/11	Cetacean observation during krill fishing cruise (48.1, 48.2 Statistical Subareas, 2011) K. Vyshniakova (Ukraine)
WG-FSA-11/32	The Ross Sea toothfish fishery: proposal for conditional transition of classification from exploratory to established C. Jones (USA) and S. Hanchet (New Zealand)
WG-FSA-11/41	By-catch observation during krill fishing cruise (48.1, 48.2 Statistical Subareas, 2011) K. Vyshniakova (Ukraine)

ANNEX 3

AGENDA FOR THE THIRTIETH MEETING OF THE SCIENTIFIC COMMITTEE

AGENDA FOR THE THIRTIETH MEETING OF THE SCIENTIFIC COMMITTEE

1. Opening of meeting
   (i) Adoption of agenda
   (ii) Chair's Report

2. Advances in statistics, assessments, modelling, acoustics and survey methods
   (i) Statistics, assessments and modelling
   (ii) Acoustic survey and analysis methods
   (iii) Advice to Commission

3. Harvested species

   (i) Krill resources
      (a) Status and trends
      (b) Ecosystem effects of krill fishing
      (c) Advice to Commission

   (ii) Fish resources
      (a) Status and trends
      (b) WG-FSA advice
      (c) Advice to Commission

   (iii) Crab resources
      (a) Status and trends
      (b) WG-FSA advice
      (c) Advice to Commission

   (iv) Fish and invertebrate by-catch
      (a) Status and trends
      (b) WG-FSA advice

   (v) New and exploratory finfish fisheries
      (a) New and exploratory fisheries in 2010/11 season
      (b) Notifications for new and exploratory fisheries in 2011/12 season
      (c) Advice to Commission

4. Incidental mortality arising from fishing operations
   (i) Marine debris
   (ii) Incidental mortality of seabirds and marine mammals associated with fisheries
   (iii) Future consideration of incidental mortality of seabirds and marine mammals associated with fisheries
   (iv) Advice to Commission

5. Spatial management of impacts on the Antarctic ecosystem

(i) Bottom fishing and vulnerable marine ecosystems
(a) Status and trends
(b) Advice to Commission

(ii) Marine Protected Areas
(a) Scientific analysis of proposals for MPAs
(b) Advice to Commission

6. IUU fishing in the Convention Area

7. CCAMLR Scheme of International Scientific Observation

(i) Scientific observations
(ii) Advice to Commission

8. Climate change

9. Scientific research exemption

10. Cooperation with other organisations

(i) Cooperation with Antarctic Treaty System
(a) Committee for Environmental Protection
(b) Scientific Committee for Antarctic Research

(ii) Reports of observers from other international organisations

(iii) Reports of representatives at meetings of other international organisations

(iv) Future cooperation

11. Performance Review
(i) CCAMLR Scientific Scholarship Scheme

12. Budget for 2012 and forecast budget for 2013

13. Advice to SCIC and SCAF

14. Secretariat supported activities

15. Scientific Committee activities
(i) Priorities for work of Scientific Committee and its working groups
(ii) Intersessional activities
(iii) Invitation of observers to next meeting
(iv) Invitation of experts to meetings of working groups
(v) Next meeting

16. Election of Chair and Vice-Chair

17. Other business

18. Adoption of report of Thirtieth Meeting

19. Close of meeting.

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT
(Busan, Republic of Korea, 11 to 22 July 2011)

CONTENTS

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT

(Busan, Republic of Korea, 11 to 22 July 2011)

INTRODUCTION

Opening of the meeting

1.1 The 2011 meeting of WG-EMM was held at the Lotte Hotel, Busan, Republic of Korea, from 11 to 22 July 2011. The meeting was convened by Dr G. Watters (USA) and local arrangements were coordinated by Mr J. Ahn, Ministry for Food, Agriculture, Forestry and Fisheries (MIFAFF) in association with staff from the National Fisheries Research and Development Institute (NFRDI).

1.2 The meeting opened in a joint session with WG-SAM to receive an opening welcome from Mr Youngman Kim (President of NFRDI). Mr Kim welcomed all participants and underlined the importance placed by the Republic of Korea on sustainable fisheries in the Antarctic. In thanking Mr Kim for his welcome, Mr A. Wright, CCAMLR Executive Secretary, recalled the commitment shown by Korea to research in the Antarctic and hoped that these meetings would provide a strong basis for continued Korean engagement in the scientific work of CCAMLR.

1.3 Dr Watters welcomed the participants (Appendix A) and thanked the Korean hosts for their work in preparing for meeting. Dr Watters recalled the tragic events surrounding the sinking of the Korean longline vessel *Insung No. 1* on 13 December 2010, noting that a Korean scientific observer was among the 22 people who lost their lives; the meeting observed a period of silence.

Adoption of the agenda and organisation of the meeting

1.4 The provisional agenda was adopted without change (Appendix B).

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 In this report, paragraphs that provide advice to the Scientific Committee and its working groups have been highlighted. A list of these paragraphs is provided in Item 4.

1.7 The report was prepared by various people: Drs A. Constable (Australia), L. Emmerson (Australia), H. Flores (EU), S. Hill (UK), S. Kasatkina (Russia), S. Kawaguchi (Australia), M. Kiyota (Japan), A. Makhado (South Africa), G. Milinevsky (Ukraine), K. Reid (Science Officer), B. Sharp (New Zealand), V. Siegel (Germany), C. Southwell (Australia), P. Trathan (UK) and X. Zhao (People's Republic of China).

Feedback from previous meetings of the Commission, the Scientific Committee and its working groups

1.8 Dr Watters outlined the background to the agenda for this year's meeting and provided an overview of each agenda item and the desired outcomes associated with providing advice to the Scientific Committee.

1.9 In particular, he emphasised the importance of Item 2 and the symposium on 'Feedback management approaches in the krill fishery' as this was an important opportunity to consider the views of Members on what constitutes feedback management and how it might be implemented in the krill fishery. He encouraged participants to engage in discussion and to seek clarification where required as there was a need to ensure a common understanding of terminology and concepts in the deliberations of the Working Group.

THE KRILL-CENTRIC ECOSYSTEM AND ISSUES RELATED TO MANAGEMENT OF THE KRILL FISHERY

Issues for the present

Krill fishing activity and CPUE

2009/10

2.1 Ten vessels from five Members fished for krill in Area 48 during 2009/10 and reported a total catch of 211 974 tonnes. The largest catch of krill was taken from the Antarctic Peninsula Bransfield Strait West (APBSW) SSMU in Subarea 48.1 (85 764 tonnes), followed by 37 650 tonnes from the Antarctic Peninsula Bransfield Straight East (APBSE) SSMU and 17 295 tonnes from the Antarctic Peninsula Drake Passage West (APDPW) SSMU. The remainder of the catch was taken predominantly in Subarea 48.2, notably 48 444 tonnes from the South Orkney West (SOW) SSMU. The catches of krill reported from the APBSE, APBSW and Antarctic Peninsula West (APW) SSMUs in 2009/10 were the highest catches reported from those SSMUs in the history of the fishery (WG-EMM-11/5, Table 5).

2.2 Three vessels used the continuous fishing system and accounted for approximately 50% of the total catch. Norway (119 401 tonnes) and the Republic of Korea (45 648 tonnes) reported the largest catches of krill respectively. Japan reported a catch of 29 919 tonnes, Russia reported 8 065 tonnes, Poland reported 6 995 tonnes and the People's Republic of China reported 1 946 tonnes.

2.3 Catches of krill in 2009/10 reached the apportioned limit for Subarea 48.1 (25% of the trigger level: 155 000 tonnes) and on 10 October 2010 the subarea was closed to krill fishing for the remainder of the season. At the time of the closure, the total catch reported in Subarea 48.1 from the in-season catch and effort reports was 154 736 tonnes (WG-EMM-11/5, Table 3). The final verified catch was 153 262 tonnes based on STATLANT data.

2010/11

2.4 Fifteen fishing vessels licensed by five Members (People's Republic of China, Japan, Republic of Korea, Norway and Poland) have fished in Area 48 up to May 2011. The total catch reported to May 2011 was 110 949 tonnes, most of which has been taken from Subarea 48.2 since February. Approximately 55% of the catch reported so far this season has been taken by two vessels using the continuous fishing system (*Saga Sea* and *Thorshøvdi*).

2.5 The cumulative trajectory of catch is similar to that from last year, however, the bulk of this was taken from Subarea 48.2 whereas in 2009/10, the bulk of the catch was taken from Subarea 48.1. The reported catch at the time of WG-EMM-11 was 129 533 tonnes.

2.6 Based on the catch of krill reported to May 2011, the equivalent catch reported to May in the previous five seasons and the total catches in those seasons, the forecast total catch of krill for the current season falls in the approximate range from 153 000 to 214 000 tonnes. Although the current trajectory of the cumulative catch in 2010/11 is similar to the trajectory observed in 2009/10, it is difficult to make an accurate prediction of the total catch for the current season due to the absence of knowledge on how the fishery might operate for the remainder of the season.

2.7 The Working Group noted that during 2010, Bransfield Strait was free of ice until late into the winter, allowing fishing operations in Subarea 48.1 to continue later into the winter compared to previous years. Furthermore, almost no catch was recorded in Subarea 48.3, suggesting that the dynamics of sea-ice may play a significant role in distribution of the fishery. In contrast, during 2011 there was early ice development in the Bransfield Strait, and so far the fishery has predominantly operated in Subarea 48.2.

2.8 The Working Group agreed that the effects of sea-ice on the fishery will include those arising from the changes in access to different areas, as well as the well-documented and potential changes in krill population dynamics associated with changing sea-ice distribution.

Notifications for 2011/12

2.9 Six Members submitted notifications for a total of 15 vessels intending to participate in krill fisheries during 2011/12. The notifications are for trawl fisheries for krill in Subareas 48.1, 48.2, 48.3 and 48.4. No notifications were submitted for exploratory krill fisheries in Subarea 48.6 or elsewhere. The total catch notified for 2011/12 was 391 000 tonnes, slightly less than the notified amount of 410 000 tonnes for 2010/11.

2.10 The Working Group noted a two-fold increase in the notified catch, compared to last year, by the People's Republic of China, which notified the second-largest amount (70 000 tonnes) following 175 000 tonnes of Norway. The Republic of Korea notified 67 000 tonnes.

2.11 The Working Group noted reports on details of methods for estimation of green weight that were provided in response to the new requirement under CM 21-03. The methods of estimation varied among vessels and included use of flow scales (continuous system), direct codend estimation and estimation using conversion factors. Direct codend estimation is based on volume estimated by the dimension of the codend when hauled up the deck and its density.

When conversion factors were used to estimate green weight, the conversion factors were derived using combined information from codend estimation, volume measurements in fishponds and actual product weights. The level of accuracy in estimated green weight may differ between these methods and seasons.

2.12 The Working Group acknowledged that the conversion factors to be used for the coming season will only be available once fishing begins and can only be estimated at sea. Therefore Members should report updates of this information every year.

2.13 The Working Group noted that the name of one vessel from Chile is yet to be advised. It was clarified that if the vessel is to participate in the fishery it will be advised by Chile at the annual meeting of the Scientific Committee in 2011. It was also clarified that configuration of the vessel is expected to be very similar to the other vessel notified by Chile (*Betanzos*).

Data reporting

Fine-scale catch and effort (C1) data

2.14 At its meeting in 2010, the Commission amended CM 23-06 so that the periodicity of reporting should apply to the subarea-specific trigger levels, and that once catches reach 80% of the catch limit (50% for all the subsequent years), a five-day reporting interval is required (CCAMLR-XXIX, paragraph 4.9). The Working Group noted that the Secretariat's forecasting of the closure in Subarea 48.1 was facilitated by the voluntary reporting of catches at five-day intervals by the vessels which were fishing in that subarea.

2.15 All vessels are submitting haul-by-haul catch and effort (C1) data in accordance with CM 23-06, and data have been received up to May 2011 for 2010/11.

Catching capacity

2.16 The daily catching capacity of vessels in the krill fishery has increased markedly since 2003/04 (Figure 1). Vessels using conventional trawls are now capable of catching and processing up to 450 tonnes of krill per day, with an average of 100 tonnes per day. Vessels using the continuous fishing system have, on recent occasions, exceeded catches of 900 tonnes of krill per day with an average in the region of 300 tonnes per day. Increased catching capacity is likely to have resulted from an increase in the catching power of vessels, with some vessels now using two nets simultaneously, and a greater efficiency in processing the catch.

Analysis of data from the krill fishery

2.17 WG-EMM-11/14 compared the size composition of krill caught by conventional and continuous trawling systems on the Russian krill trawler, *Maxim Starostin*, and did not find any significant differences in net selectivity. The authors suggested that difference in size composition arose as a function of variation in time and space rather than different selectivity between fishing techniques.

2.18 The Working Group recalled that variability in size composition of krill populations occurred between aggregations which makes comparison of size selectivity between fishing techniques difficult. The sampling must be well designed in time and space at an appropriate scale.

2.19 WG-EMM-11/28 reported on the spatial–temporal dynamics of standardised abundance indices of krill in Area 48 using GLMMs with Tweedie's distribution; a principal-components analysis was also undertaken. The results revealed considerable interannual variation in CPUE, with lesser degrees of variation contributed by such variables as country and month. The work demonstrated that CPUE has increased in recent years in Subareas 48.1 to 48.3.

2.20 WG-EMM-11/44 presented analyses of diagnostics from fitting GLMMs to standardise the CPUE series using C1 data reported between 1986 and 2008 in Area 48. The results revealed that the GLMM with Tweedie's distribution satisfactorily describes this set of fishery data. However, many hauls which might be interpreted as 'outliers' resulted from extremely high CPUE values resulting from converting high catch values obtained from short-duration hauls (5–10–15 minutes) into catches per hour.

2.21 Given that the analysis presented in WG-EMM-11/44 indicated that very high catches from short-duration tows leads to positively biased values of CPUE at an hourly timescale, the Working Group suggested it would be important to check the data and ensure the validity of extreme outliers.

2.22 In considering WG-EMM-11/28 and 11/44, the Working Group noted the importance of exploring the utility of CPUE in the krill fishery to improve understanding of trends and characteristics of krill stocks in space and time.

2.23 The Working Group noted implications of swarm structure and fishing strategy to CPUE analysis. For example, if a vessel targets a discrete high-density swarm, the CPUE is expected to be very high. On the other hand, if a vessel tows through a dispersed aggregation and must conduct longer-duration hauls, the CPUE is expected to be low. In either case, however, regional krill density itself could be the same.

2.24 CPUE may also be affected by other factors such as gear type, product type and factory processing capacity. There might also be alternative ways of incorporating fixed and random effects into mixed models. For example, year could be treated as a random effect and fishing area (subarea or SSMU) could be treated as a fixed effect. Further, different swarm structures may also have implications to analyses of CPUE. Workers undertaking further analyses of CPUE in the krill fishery were encouraged to take these points into account and submit the results to future meetings.

2.25 WG-EMM-11/P3 reported on a statistical method for discriminating environmental effects on krill fishery CPUE and indicates that atmospheric pressure may have significant effects on CPUE at a 12-month time lag.

2.26 The Working Group noted the relevance of this paper, however, since the paper was written in Spanish it was not possible for the Working Group to consider the contents in detail. The authors of the paper were encouraged to re-submit the paper in English for further consideration.

2.27 WG-EMM-11/39 reported on spatio–temporal variability in the size composition of krill and in fish by-catch (numbers) using an hierarchical Bayesian analysis of Japanese krill fishery data from 1995 to 2008. The paper showed that increased haul coverage ranging from 0 to 50% had marked effects in improving precision in estimates of mean krill size and numbers of fish in the by-catch.

2.28 The Working Group noted that analyses of krill fishery data, such as that provided in WG-EMM-11/39, is valuable for considering the sampling scheme of scientific observers. The Working Group encouraged further analysis using larger datasets that include wider seasonal and vessel variability.

Data from Soviet krill fishing expeditions

2.29 In 2009, Drs Milinevsky and L. Pshenichnov (Ukraine) initiated a project to digitise haul-by-haul catch and effort data from 54 Soviet krill fishing research, as well as exploratory and commercial expeditions, and the data were submitted to the Secretariat and uploaded to the CCAMLR database in 2011.

2.30 The second part of this project is to digitise the krill length-frequency data from these expeditions. This part of the project is currently under way and has received generous support from the Norwegian Krillsea Group. The Working Group looked forward to seeing the results that were expected to be submitted to the CCAMLR Secretariat by the end of 2011.

Scientific observer coverage

2.31 The Working Group noted the increasing observer coverage and the amount and quality of observer data being submitted to the Secretariat in recent years. This is a substantial achievement and greatly assists the Scientific Committee in understanding the status of this fishery and fishery operations. The Working Group thanked all scientific observers for their hard work and congratulated the Members involved for their great efforts in this regard. The Working Group looked forward to further achievement and success of the observer program.

2.32 The Working Group recalled that the purpose of the two-year experimental observer program (SC-CAMLR-XXIX, paragraphs 3.16 and 3.17) was the collection of high-quality data, especially on the priority areas that are required to understand the ecosystem effects of the krill fishery. In particular, understanding the overall impact of the fishery requires data on the mortality of krill and by-catch species and would require systematic spatial and temporal coverage by scientific observers (SC-CAMLR-XXVI, paragraphs 3.7 to 3.9).

2.33 The Working Group noted that the observed percentage of total hauls reported in Tables 1 and 2 in WG-EMM-11/11 was based on recorded entries in the 'Observed' field of the scientific observer logbook form K3. However, comparison of the 'number of hauls observed' with the 'number of hauls where information was collected' in Table 2 of WG-EMM-11/11 indicated that the 'Observed' field in the K3 form does not accurately capture the total number of hauls for which information was collected in all cases, particularly for vessels using the continuous fishing system. This meant that those vessels that actually had observers on board 100% of the time appeared to have the lowest level of observer coverage.

2.34 The Working Group requested that Tables 1 and 2 of WG-EMM-11/11 be resubmitted to the forthcoming meeting of the Scientific Committee, with the columns of the 'number of hauls observed' renamed 'number of hauls sampled' to be directly comparable to target observer coverage rates in CM 51-06, and calculated according to the definition in paragraph 2.36.

2.35 The Working Group noted the lack of clarity in the definition of a 'haul' and what constitutes an 'observed haul'. It was not clear whether 'observed' referred to a haul during which a specific type of observer data was collected (e.g. collection of length-frequency data), any types of observation were made or that there was an observer on board the vessel regardless of whether the data were collected or not. This definition is of particular importance since the target coverage rate in CM 51-06, paragraph 3(ii), is of '20% of observed hauls set by a vessel per fishing season being sampled'.

2.36 The Working Group therefore recommended that a sampled haul should be defined as a haul from which krill length-frequency data, fish by-catch or incidental mortality (*Scientific Observers Manual*, 2011) data were collected. The target sampling rate should be at least 20% of hauls set during the period that an observer is on board the vessel.

2.37 The sampling protocol for fish by-catch was revised in 2010 in order to collect quantitative by-catch data for fish of all size classes, to allow estimation of total fish by-catch. However, in its current configuration, the observer logbook form K12 does not allow the recording of length of individual fish caught. Therefore the Working Group recommended revision of the K12 form to include the collection of information on individual fish length.

2.38 The aim of the data collected through the 'fish sampling protocol' is to allow the Working Group to estimate rates of by-catch of fish of all size/age classes (and associated confidence interval) in the krill fishery. These estimates could then be reviewed by WG-FSA to assess the potential implication of the fish by-catch to the entire fish population at current and future levels of the krill fishery.

2.39 The Working Group agreed that sample collection for measurement of krill length frequency and fish by-catch must be taken before any other sorting of the catch has taken place (i.e. before any large fish are removed). As it is difficult to define the position on the vessel where sampling should occur, the Working Group specified the requirements of that sampling location (rather than the location itself) in order to provide advice that can be applied to a range of vessel configurations.

2.40 In considering the finfish by-catch, the Working Group recalled that the by-catch of fish is required to be reported by vessels in the haul-by-haul data submitted to CCAMLR, therefore this provides a means to highlight any biases in the sampling procedures used to quantify the by-catch of finfish in the krill fishery.

2.41 Data reporting from the krill fishery has increased during the last decade. As a result, information related to fishery operations is becoming increasingly available and there may no longer be a need to rely on scientific observations as the source of this information. For example, the reporting of haul-by-haul data in the krill fishery might provide a more appropriate source of data to examine fisheries dynamics than continuing to request observers to provide data from the krill fishing questionnaire.

2.42 The Working Group reviewed each logbook form used by observers on krill fishing vessels. The results of this review are summarised in Table 1, and the Working Group recommended that the forms K3, 4, 5, 6, 7, 9, 10, 11, 12 should be revised, noting the requests for advice from SCIC and WG-IMAF included in this table.

2.43 In reviewing the *Scientific Observers Manual* (2011), the Working Group agreed the importance of observer priorities being clearly articulated in Section 2, Part I of the manual so that observers can understand the current priorities identified by the Scientific Committee. It agreed that the paragraphs listing priorities for krill observers in Section 2 be revised as follows:

(i) Krill length measurement using 'Krill biological data form' to:

- understand the differences in gear selectivity between different fishing techniques and gear configurations
- collect length-frequency data from all regions.

(ii) Fish by-catch data collection using 'fish sampling protocol' to:

- determine the level of by-catch of fish, including fish larvae.

(iii) Incidental mortality data collection using 'Incidental mortality and warp strike forms' to:

- determine the level of warp strikes and incidental mortality of seabirds and seals.

2.44 The Working Group requested that all technical coordinators ensure that observers are made aware of these priorities rather than waiting until the next revision of the *Scientific Observers Manual*.

2.45 During the meeting, the Secretariat produced length-frequency distribution plots by subarea by month (Figure 2), as well as a table describing the number of all hauls undertaken for each specific observation, by subarea by month (Table 2), in order to assess the spatial and temporal coverage of observer data. The Working Group agreed that these plots and the table are helpful and should be provided in the future.

2.46 Table 2 describes the temporal and spatial coverage by scientific observers in 2009/10. Scientific observers were deployed for all subareas and months where fishing activities took place in Area 48. All three priority observations were undertaken in most combinations of month and subarea. The Working Group agreed that the table provides valuable information to understand the overall level of observer coverage achieved in the most recent season.

2.47 In order to clarify the difference between a haul on a conventional trawler and the two-hour period used to record catch on vessels using the continuous fishing system, the Working Group suggested that the two-hour catch reporting period be referred to as a haul-unit to clearly distinguish these periods from the conventional understanding of a haul.

2.48 In the continuous fishing system, there will be 12 haul-units in a day, and in the case when the vessel is towing two nets simultaneously, there will be 24. In conventional trawlers, the number of hauls per day could usually vary from 4–5 up to 18. Therefore, if the coverage requirement is based on the percentage of hauls or haul-units, large amounts of data may be collected from vessels undertaking continuous fishing operations or vessels with a conventional trawling system with a large number of hauls with significant consequence for observer workload, to the extent that it may not be possible to achieve the required minimum sampling rate. There will be less data being collected from vessels conducting a small number of hauls. However, the Working Group was not able to decide on a minimum requirement for sampling frequency that would apply to all vessels due to the unpredictable nature of the fishing operation in the Southern Ocean environment.

2.49 The Working Group recognised that the variability in achievable observer sampling rates discussed above, and the sampling flexibility allowed in the instructions in the *Scientific Observers Manual*, may be in conflict with the precise requirements of CM 51-06, and referred this matter to the Scientific Committee.

2.50 The Working Group requested the Secretariat to produce maps of where the fishery occurred, number of hauls, and coverage by quarterly period for krill biological sampling and fish sampling in 2009/10 and 2010/11, in order to visualise the spatial and temporal coverage of the observation, for use by the Scientific Committee at its next meeting.

2.51 The Working Group noted that it is unlikely that the fishery operation for the second year of the two-year experimental period would be completed in time for WG-EMM to review and analyse the results and to provide advice to the Scientific Committee in 2012. It further noted that observer data and reports are required to be submitted within one month after the observers return to their home port. The Working Group agreed that only those data for months where 80% of the observer logbooks have been submitted to the Secretariat should be included in the analysis. To achieve this, the Secretariat will need to know how many observers were active in the fishery in order to know the proportion of completed logbooks that had been submitted. Therefore, the Working Group recommended that the Members deploying national observers report the dates of deployments to the Secretariat prior to the deployment period.

2.52 The Working Group agreed that the following analyses need to be undertaken prior to WG-EMM-12 in order to make recommendations to the Scientific Committee on future requirements for observations in the krill fishery:

(i) analysis of observer coverage in time and space

(ii) trends and variations across fishing area in space, time and by vessel, for krill length composition, fish by-catch and interactions with birds and mammals

(iii) simulation studies to explore appropriate longer-term scientific observer plans to ensure data collection to achieve the CCAMLR objectives based on the data obtained through the two-year experimental period.

2.53 The Working Group also noted that there may be advantages to having a more dynamic/adaptive system for managing scientific observation in the krill fishery in the future. If there was real-time monitoring by the Secretariat of the data being collected, then it may be possible for vessels to consult the Secretariat as to what observation requirements are needed in areas they wish to fish in the near future. This could allow the observation requirements on a vessel to be flexible during a season. Such a sampling strategy could be investigated using the simulation approaches indicated in paragraph 2.52(iii).

Escape mortality and green weight

2.54 In 2010, the Scientific Committee encouraged pilot studies into escape mortality and that potential methods be trialled before being requested as routine activity by observers (SC-CAMLR-XXIX, paragraphs 3.12 and 3.13). Escape mortality is calculated as the amount of krill escaping through the trawl mesh multiplied by the proportion of animals that die as a result of this process.

2.55 Two papers presented pilot studies using alternative methods to estimate escape mortality. These included the use of patches (chafers) on the outside of nets to retain krill that pass through the mesh during towing (WG-EMM-11/15) and net-mounted video cameras (WG-EMM-11/36). Preliminary results from the patch trials, conducted when the catch rate was approximately 8.5 (tonnes per hour), suggested that the equivalent of 2 to 3% of the retained catch passed through the net and 60 to 70% of these were killed or non-viable. Chafers were placed on net sections with mesh sizes 100, 60 and 5 mm. No krill were found in the chafers attached to the 5 mm mesh. The chafer method would be time-consuming for an observer to deploy and analyse and requires knowledge of trawl construction and trawling technology. The Working Group noted that this method also requires an agreed process for extrapolating results from chafers to the whole net surface and to different net designs. Extrapolation is associated with uncertainty. The actual areas covered by the chafers and the actual area of the trawl net surface depend on the mesh opening angles which are affected by the trawling process. There is also the potential to overestimate damage to krill retained in chafers installed on the top panels of the trawl if they contact hard surfaces during lifting. The camera method is currently only feasible with natural illumination and is therefore restricted to a narrow part of the usual fishing depth range. Analysis of this method is also likely to be time consuming. The Working Group encouraged the submission of further results from both studies, noting that it would be valuable to both combine results from the two methods and standardise approaches.

2.56 The Scientific Committee recommended that standardisation of methods for estimating the green weight of the catch is urgently required to achieve more accurate estimates of actual catches (SC-CAMLR-XXIX, paragraph 3.9). WG-EMM-11/29 presented back-conversion factors from products to green weight and explained their derivation from operations on the FV *Fukuei-Maru*. Low-precision estimates of catch weight and volume are routinely obtained from net sensors and fish bins respectively. Several product lines (whole, meal, peeled, boiled) might be produced from a single catch. High-precision estimates of product weight are also routinely obtained. The Working Group welcomed this engagement from the fishing industry and requested variability estimates for the conversion factors and in the relative estimates from net sensors and fish bins.

2.57 WG-EMM-11/29 also discussed the bucket phenomenon whereby trawl nets can generate leading pressure waves when water cannot efficiently pass through the mesh (e.g. when filled with catch or towed at higher than optimal speed for the net structure). The Working Group noted that interactions between the pressure wave and animals outside the net could be an additional source of mortality.

2.58 The Working Group noted that all green-weight estimation processes have associated uncertainty and that the absolute uncertainty in catch estimates increases in proportion to catch. It noted that this uncertainty is not accounted for in the current management process which uses a point estimate of total catch without an uncertainty estimate. It recommended that the Scientific Committee consider whether this uncertainty should be taken into account when comparing catch estimates with catch limits.

Recruitment variation, B_0 and precautionary yield

2.59 WG-EMM-11/20 provided details about the parameter values used in the reanalysis of the CCAMLR-2000 Survey data by SG-ASAM and presented transect- and stratum-specific krill density estimates. The Working Group noted that the relationship between krill length and target strength is not monotonic at 200 kHz. It noted that the implications of this had been considered by SG-ASAM, but it was still difficult for WG-EMM to understand these implications.

2.60 Dr Reid informed the Working Group that the background to the methods and technical details of the SG-ASAM reanalysis are documented in Calise and Skaret (2011).

2.61 Dr Kawaguchi informed the Working Group that Australia is making progress towards a revised B_0 estimate for Divisions 58.4.1 and 58.4.2 (SC-CAMLR-XXIX, Annex 6, paragraph 2.71), taking account of the approach recommended by SG-ASAM, and indicated that the revised estimate should be available in the next one to two years.

2.62 WG-EMM-11/17 used the GYM to estimate the fishing mortality (F:median = 0.0159) and the reduction in spawning stock biomass (median SSB trigger/SSB_0 = 97.7%) with an annual catch equal to the current trigger level, B_0 for Area 48 and a krill recruitment standard deviation (SD) of 0.126. A higher recruitment SD (0.164) resulted in a median F of 0.0163 and a median SSB trigger/SSB_0 of 97.1%. In response to the request from WG-EMM (SC-CAMLR-XXIX, Annex 6, paragraphs 2.76 and 2.77), the authors of WG-EMM-11/17 examined the reasons why the GYM terminates when recruitment SD is above 0.1764 with an average recruitment proportion of 0.557.

2.63 The Working Group noted that in the GYM the trial-specific average recruit proportion and its variability are used to parameterise a beta distribution from which a recruit proportion is drawn for each year of the trial. If the trial-specific average recruit proportion falls outside the range 0 to 1, the GYM re-samples from a normal distribution. However, the repeated use of this resampling can bias the realised average recruit proportion across trials, and the GYM is designed to terminate when this ‘fix’ has been used a critical number of times.

2.64 The Working Group recalled that the degree of recruitment variability presently used in the GYM could be an underestimate (SC-CAMLR-XXIX, Annex 6, paragraph 2.74) and that in stocks that experience high interannual variability in abundance arising from recruitment, the probability of biomass falling below 20% of the initial biomass might be greater than 0.1 even in the absence of fishing (SC-CAMLR-XXIX, Annex 6, paragraph 2.78). In these circumstances it would be impossible to satisfy the part of the decision rule designed to limit the probability of biomass falling below the 20% reference point to a maximum of 0.1.

2.65 The Working Group reiterated that the implications of krill recruitment variability, and how this might change as a result of climate change, on the specification of the current decision rule relating to the maintenance of stable recruitment should be investigated (SC-CAMLR-XXIX, Annex 6, paragraph 2.74).

Distribution of the trigger limit among statistical subareas

2.66 The Working Group recalled that CM 51-07 will expire this year and should be reviewed and revised in 2011 with the intent of ensuring the implementation of Article II of the Convention, and taking into account the resource requirements of land-based predators.

2.67 The Working Group noted that several papers contained information relevant to discussions on the subdivision of the trigger level among statistical subareas in Area 48 and to the revision of CM 51-07.

2.68 WG-EMM-11/5 reported that CM 51-07 came into effect in 2009/10 when the fishery was closed after being concentrated mostly in Subarea 48.1. In October 2010, the reported total catch of krill for that subarea was 153 262 tonnes, representing 98.9% of the subarea’s catch limit (155 000 tonnes), which triggered closure of the fishery in this subarea for the remainder of the fishing season.

2.69 WG-EMM-11/16 reported on the outcomes of the ‘Workshop on Antarctic Krill and Climate Change’, including the workshop’s conclusion that the precautionary management measures in CM 51-07 should be maintained until an agreement on the subdivision of the overall catch limit in Area 48 into SSMUs has been achieved.

2.70 WG-EMM-11/27 recommended that, in connection with the need to review CM 51-07, more scientific information is still required on the distribution, abundance and variability of krill and on land-based predator demands to provide future management advice on the spatial distribution of the precautionary catch limit amongst SSMUs.

2.71 As a result of the need for more scientific information, the authors of WG-EMM-11/27 further proposed that the interim subdivision of the trigger level in CM 51-07 be extended for two more fishing seasons. The authors also noted that, as the subdivision of the trigger level in CM 51-07 does not take into account that the krill fishery mostly concentrates in coastal areas and potentially can affect land-based predators, the trigger level should be further subdivided between coastal and pelagic areas to be suitably precautionary to take account of the needs of krill-dependent predators.

2.72 In considering the requirements for reviewing and revising the subdivision of the trigger level (CM 51-07, paragraph 2), the Working Group recalled its agreement in 2009 on the rationale that formed the foundation for the recommendation of the subdivision of the trigger level (SC-CAMLR-XXVIII, Annex 4, paragraph 3.127; see also SC-CAMLR-XXVIII, paragraphs 4.26 to 4.28).

2.73 The Working Group considered two main questions that would be pertinent to this review, and focused these questions on the situation in Subarea 48.1 where the interim catch limit of 155 000 tonnes was reached in 2009/10:

(i) Was the current subdivision effective in limiting the impact on predators in Subarea 48.1 in 2009/10?

(ii) Is the cap in Subarea 48.1 at an appropriate level if the fishery is going to be concentrated in Subarea 48.1, perhaps regularly, in the future?

2.74 The Working Group agreed that the answers to these questions need to be developed bearing in mind the statistical power of current monitoring to detect effects (see Figure 3) and the expectations of the effects of fishing on monitored parameters in years when concentrated fishing might arise. It noted that it would not be possible to have fishing continue and use CEMP to detect when a cap is needed before an effect occurs.

Evidence for effectiveness of current subdivision

2.75 The Working Group examined data from krill fishing and CEMP to see whether there was any evidence that the spatial subdivision of the trigger level between subareas did or did not provide suitable protection to krill predators in Subarea 48.1 in 2009/10.

2.76 Details of krill fishing activity and the application of CM 51-07 are given in WG-EMM-11/5. With respect to the distribution of the catches during 2009/10 and the part of the current season for which the Secretariat has data, the Working Group noted that:

(i) in 2009/10 and part of the current season, catches from SSMUs in Subarea 48.3 and around Elephant Island in Subarea 48.1 were lower than usual

(ii) in 2009/10, catches from SSMUs in the Bransfield Strait in Subarea 48.1 were about 20 times greater than the average historical catch in these SSMUs

(iii) in the current season, catch from the northeast coastal SSMU in Subarea 48.2 was approximately twice as much as in the previous 10 years, but not more than the long-term average.

2.77 The Working Group noted that the catch of krill in 2009/10 in two SSMUs in the Bransfield Strait (APBSW and APBSE) was 80% of the total catch in the whole of

Subarea 48.1. In the previous 10 years, 22% of the Subarea 48.1 catch has been taken in these two SSMUs, although there have recently been two years in which this proportion has been 40% (in 2005/06) and 60% (in 2008/09) (WG-EMM-11/5).

2.78 The Working Group agreed that it would be useful for the Convener to work with the Secretariat to provide, in its report on fishing activities to the Scientific Committee, maps of catches during both the 2009/10 and current season by fine-scale rectangle in Area 48 (similar to Figure 3 of WG-EMM-11/5), along with maps of the average annual catches in each fine-scale rectangle over the entire time series and of the average annual catches by fine-scale rectangle during the last 10 years. It would also be useful if the boundaries of the SSMUs could be overlaid on those maps.

2.79 The Working Group agreed that during 2009/10, the fishery did concentrate its operations in a manner that was not typical of the distribution of catches during either the previous 10 years or over the whole history of the fishery. Thus, it was further agreed that application of the subdivision of the trigger level in CM 51-07 had been successful, capping the catches in Subarea 48.1 during 2009/10, while maintaining flexibility in where vessels could fish up to that point. After the fishery in Subarea 48.1 was closed, flexibility was limited to the other subareas.

2.80 To consider possible ecosystem effects of the aggregation of the fishery in the Bransfield Strait during 2009/10, the Working Group examined the data submitted by Argentina and the USA on 23 CEMP parameters covering three CEMP sites and three species which forage in the Bransfield Strait during 2010/11 (WG-EMM-11/6). It noted that monitoring at CEMP sites in the Bransfield Strait did not substantially overlap in time with the fishery. The fishery in the Bransfield Strait occurred between April and October while CEMP monitoring started in October and continued through the 2010/11 austral summer. None of the CEMP monitoring included observations of arrival mass, which would be expected to reflect the conditions of animals whose foraging distributions would most likely overlap in time and space with fishing in the Bransfield Strait. As a result, the CEMP data are unlikely to reflect the immediate impact of the fishery, had such an impact occurred.

2.81 Furthermore, significant difficulties have previously been encountered in interpreting general ecosystem impacts from consideration of individual CEMP parameter trends which are often noisy and contain contradictory signals and may require more detailed statistical analysis to enable correct interpretation (Boyd and Murray, 2001; Reid et al., 2005).

2.82 Given the chronology of fishing and CEMP monitoring, and the difficulty of interpretation of raw CEMP data, the Working Group was unable to determine from the available data whether the aggregated fishing in the Bransfield Strait during 2009/10 had impacted the predators in that area.

2.83 The Working Group noted that the concentration of the fishery during 2009/10 occurred partly as a result of less sea-ice in the west Antarctic Peninsula (WG-EMM-11/5). The Working Group also noted that, in the future, concentrated fishing in Subarea 48.1 during winter is expected to occur more frequently due to the expected continuing decline in sea-ice in the region.

2.84 The Working Group also noted that in 2009/10 the fishery operated in Admiralty Bay, which is ASMA No. 1. After reviewing the Management Plan for that ASMA, the Working

Group was unsure if this fishing activity would be considered compatible with the Code of Conduct for that ASMA, as described in point 8.2 of its Management Plan. Accordingly, the Working Group suggested the Scientific Committee consider advising the Commission of this overlap of commercial fishing operations with the ASMA. Such information may need to be communicated to the ATCM, as it could indicate potential development of fishing activity within ASMA No. 1.

Futher consideration of the subdivision

2.85 The Working Group noted that no data were available to evaluate the likely impact of other catch levels for the Subarea 48.1 allocation of a subdivision of the trigger level. To do this effectively, the relative performance of monitored parameters would need to be measured under different catch conditions, expected to be around the levels of the current catch subdivisions. The development of such a relationship would require all relevant parameters to be monitored with high statistical power.

2.86 The Working Group agreed that to determine whether or not the performances of predators had significantly departed from their usual state due to the impacts of concentrated fishing in an area, a monitoring program would be required in the area of fishing and designed to have high statistical power (see Figure 3).

2.87 The Working Group agreed the following points would need to be addressed by the Scientific Committee to investigate whether the spatial subdivision of the trigger level is effective for protecting predators:

(i) advance notice of the areas in which the fishery will/could be concentrated so that monitoring can occur relative to those areas

(ii) an assessment of abundance of krill in the area before fishing begins and the flux of krill through the area

(iii) an assessment of the requirements of predators in the area to be fished

(iv) an assessment of whether the requirements of predators were affected by fishing.

2.88 It was also noted that consideration of the effects of fishing, and how to determine those effects with high confidence, is discussed in the symposium on feedback management procedures (paragraphs 2.149 to 2.152).

2.89 In the absence of knowing where fishing might become concentrated in future, the Working Group noted that advance warning would be needed to focus monitoring into relevant areas. The Working Group agreed that such a scenario is part of the consideration of a spatially structured feedback management procedure.

Other considerations

2.90 The Working Group noted that the trigger level is doing as intended and catches at this level are unlikely to have an effect on the krill population as a whole (across Area 48), while the spatial management strategy is being developed. However, it agreed that, should all the trigger level be taken from a concentrated area, then it may have effects on local predators.

2.91 Furthermore, it noted that the assessment of precautionary krill catch levels had assumed that the size of krill caught by the fishery would remain the same as in historical catches. The impact of the fishery on the krill population itself may be larger if the fishery targets younger krill than considered in the assessment of the catch limit.

2.92 The Working Group agreed that calculations of a subdivision can be improved by the use of acoustic biomass assessments of the distribution of krill, as well as estimates of consumption by krill predators in different areas. Available recalculations of krill abundance and predator requirements by subarea are given in Table 3.

2.93 The Working Group noted that a new synoptic survey of krill would be useful for revising the subdivision in the future.

2.94 Anticipating that there may be future similar concentration events in the Bransfield Strait, the Working Group recommended that the CEMP data relevant to the overlap of predator foraging and the Bransfield Strait fisheries be examined to determine the statistical power of available data and what field programs might be needed to detect the effects of fishing in the region in the future. It encouraged Members collecting relevant CEMP data to undertake this work. These analyses may be able to be supported by the Secretariat, depending on the priorities of the Scientific Committee and available resources in the Secretariat.

Advice

2.95 The Working Group recalled its advice of 2009 (SC-CAMLR-XXVIII, Annex 4, paragraphs 3.127 to 3.138) that, to be consistent with the precautionary approach and to avoid concentration of the catch as the trigger level is approached, a spatial allocation of the trigger level (620 000 tonnes) by subarea (CM 51-07) is required.

2.96 The Working Group was unable to determine, based on available scientific evidence, whether the subdivision between subareas according to CM 51-07 is precautionary enough or over-precautionary.

2.97 Therefore the Working Group could not advise the Scientific Committee on the adoption of any alternative allocation scheme. Accordingly, it advised the Scientific Committee that the precautionary subarea allocation scheme for the trigger level described in CM 51-07 should be retained until sufficient information is acquired for its revision.

Other issues related to spatial management of the krill fishery

2.98 WG-EMM has previously established an initial framework of SSMUs in Subareas 48.1 to 48.4 with a first-order division of the subareas into coastal and pelagic areas and a second-order division of coastal areas into smaller units (SC-CAMLR-XXI, Annex 4, Appendix D, paragraph 5.22). There was no corresponding subdivision of pelagic areas. However, pelagic areas are the location of the majority of the krill biomass, most of its consumption by predators, and 10% of the historical catch. WG-EMM-11/18 described a proposal to assess ecosystem structure as the basis for identifying finer-scale SSMUs for pelagic areas in Subareas 48.1 to 48.3. Finer-scale pelagic SSMUs would allow a greater range of options for the subdivision of catches, afford pelagic predators a greater level of protection from localised fishery impacts, and allow more realistic evaluation of management strategies for both the fishery and the ecosystem.

2.99 The Working Group suggested that, further to the information presented in WG-EMM-11/18, appropriate data for characterising the structure of pelagic areas includes observation and tracking data for seabirds and mammals, and continuous plankton recorder data.

2.100 WG-EMM-11/22 presented a GIS that has been developed to store and deliver data on CCAMLR's spatial management units and spatially resolved conservation measures. The GIS files are available at the British Antarctic Survey website (ftp://ftp.nerc-bas.ac.uk/pub/ptf/ccamlr) for evaluation by CCAMLR and its Members. The GIS facilitates easy mapping of CCAMLR's spatial management framework at any scale and by a variety of attributes, including catch limits for specific species. It allows rapid access to spatial data that may be useful in developing and implementing conservation measures, including seabed areas, distances between features and proportions of management units with particular characteristics.

2.101 The Working Group agreed that the GIS is a useful repository of conservation measures and mapping tool. It requested the provision of data files in ASCII format. The Working Group noted that the British Antarctic Survey's mapping expertise is a valuable resource which could potentially be used to assist the Secretariat. It encouraged the Secretariat to work with the UK Delegation to identify CCAMLR mapping requirements and potential delivery.

Views of the ecosystem

Other systems

2.102 Dr Makhado gave presentations describing the links between the population collapse of the African penguin (*Spheniscus demersus*) and commercially fished prey species in southern Africa (WG-EMM-11/P8) and on the results from ongoing seabird and seal monitoring conducted by South Africa at the Prince Edward Islands (WG-EMM-10/P1 to 10/P5, 10/P15 and 10/P16).

2.103 The Working Group thanked Dr Makhado for his excellent presentations and agreed that, even though the changes in the African penguin population were remote from the CCAMLR area, there were a number of potential synergies with the work of CCAMLR. In particular, the presentations showed that the effects on predators of changes in the abundance and distribution of commercially fished species is dependent on the availability of suitable alternative prey, recognising that the ability to utilise alternative prey sources will depend on species-specific aspects of foraging ecology. In some cases the reduction in the availability of the primary prey species may be reflected in a change in the population of a predator that cannot access alternative prey, whereas in other species it may be reflected in a change in dietary composition.

2.104 The results from monitoring on Prince Edward Islands highlight the value of multi-species monitoring, especially where contrasts in the response of different species may provide an enhanced understanding of the ecosystem response to change. The Working Group noted that this had important potential implications for CEMP monitoring and should be considered in the discussion of the future role of ecosystem monitoring in CCAMLR.

Krill predators

2.105 WG-EMM-11/6 summarised trends and anomalies in biological CEMP indices. The number of parameters reported has decreased since the mid-1990s but the number of sites has remained relatively stable over that period, with commencement of data collection at some new sites balancing cessation at other sites.

2.106 The Working Group noted that some aspects of CEMP data submission and reporting may need to change as CEMP is modified to meet the needs of feedback management. The need for additional data may place further demands on the Secretariat which will need to be reconciled in relation to other tasks and the resources available to the Secretariat.

2.107 A comprehensive survey of Adélie penguin (*Pygoscelis adeliae*) breeding site distribution and population abundance along 3 000 km of coastline of East Antarctica found 44 unreported breeding sites, increasing the number of known sites by 42%, and estimated that the population had approximately doubled over the past 30 years (WG-EMM-11/31, 11/32 and 11/34). The surveys provide data from sites and regions not currently covered by CEMP and suggest significant large-scale changes in the ecosystem in recent decades in these regions, but the causes are currently unclear.

2.108 WG-EMM-11/P1 examined long-term declines in krill, sea-ice and Adélie and chinstrap penguin (*P. antarctica*) populations in the West Antarctic Peninsula and updated previous work that suggested both Adélie and chinstrap penguins would show contrasting responses to changing environmental conditions. The authors proposed a mechanism for changes in penguin populations relating to changes in the abundance of their main prey, Antarctic krill (*Euphausia superba)*, that includes the effects of historical over-exploitation and the recovery of harvested species, as well as more recent effects on sea-ice extent from climate change.

2.109 The Working Group welcomed work such as WG-EMM-11/P1 that aims to synthesise data and provide advice on mechanisms for change in predator populations. It encouraged the authors and others interested in such studies to consider how the different datasets could be combined statistically to provide signals of change.

2.110 A 16-year Adélie penguin mark-recapture program at Béchervaise Island using implanted transponders indicated that penguin survival was associated with different aspects of sea-ice and its variability for penguins at different life-history stages (WG-EMM-11/P4). The Working Group recalled that long-term Adélie penguin survival data have now been collected at a number of sites around Antarctica, and agreed that a combined analysis of these data could provide insights into the factors affecting survival. Such an analysis would need to take into account different methods for marking birds, as published studies have shown that flipper banding can reduce penguin survival.

2.111 A survey of minke whales around the Antarctic Peninsula found that while Antarctic minke whales (*Balaenoptera bonaerensis*) were numerically dominant, the survey provided the first records of dwarf minke (*B. acutorostrata* subsp.) from the area (WG-EMM-11/P2). Furthermore, both species remain in the Antarctic during the austral winter, which may have significant implications for the estimation of krill consumption by predators. The Working Group agreed that information on the distribution and abundance of baleen whales in the Antarctic would be important in understanding potential demand for krill, especially in pelagic areas.

Krill and fish

2.112 WG-EMM-11/40 presented results on fish by-catch data collected by scientific observers on board Japanese commercial krill fishing vessels to the north of South Georgia during austral winters from 2002 to 2008. A total of 19 species were recorded from 1 173 net hauls, including icefish (*Champsocephalus gunnari*) and myctophid species. *Electrona antarctica* was not a major component of the recent mesopelagic ichthyofauna. In contrast, *Protomyctophum choriodon*, which is known as a south temperate species, dominated the recent samples. The authors argued that the unimodal size distribution of *P. choriodon* could indicate that the species probably migrated from northern warmer areas to South Georgia. They concluded that since the distribution patterns and biological peculiarity of fish are related to oceanographic conditions, the shifts in species and size composition may demonstrate oceanographic and climatic changes in the Antarctic Ocean. The authors, therefore, recommended a long-term monitoring of ichthyofauna through the scientific observer program.

2.113 The Working Group noted with interest the shift in species composition for myctophids with a sub-Antarctic species replacing a typical Antarctic species in the vicinity of South Georgia. It was also noted that at the same time the species *E. carlsbergi*, a species of the Polar Front and managed by a CCAMLR conservation measure in the past, was almost absent from the samples. Unfortunately, no observer data are available from the very warm 2009 season, because the krill fishery moved away from South Georgia due to very low krill abundance.

2.114 Dr T. Iwami (Japan) informed the Working Group that similar analyses of observer data are currently in progress for Subareas 48.1 and 48.2. The Working Group encouraged further long-term analyses by other Members who collect fish by-catch data from the commercial krill fishery to improve the knowledge about the impact of the fishery on fish stocks and detect potential changes in the fish species composition.

2.115 The Working Group noted that predator diet samples collected at South Georgia, especially from fur seals, showed a similar species composition and length-frequency distribution to those reported in WG-EMM-11/40, particularly with respect to the increased occurrence of *P. choriodon* in warmer years.

2.116 The Working Group encouraged additional studies on *C. gunnari* on size and age composition, and comparison of observer data from the krill fishery, with data obtained from UK bottom trawl surveys around South Georgia. This analysis could extend the database into the winter season and may result in additional information of icefish cohort strength.

2.117 WG-EMM recommended that WG-FSA consider WG-EMM-11/40 during its 2011 meeting in its deliberations about potential impacts of the fish by-catch in the krill fishery and its potential impacts on fish stocks. WG-EMM will review its work plan over the next two years and will discuss the possibilities of how the information of by-catch data from the observer program can be better used, and how to assess the by-catch rates and CV, as well as the total amount of fish taken by the krill fishery. It is planned to carry out such an assessment in the near future, and WG-EMM will inform WG-FSA about the outcomes of this assessment. The Working Group encouraged myctophid specialists to continue this work and to be involved in the assessment when it arises.

2.118 The Working Group acknowledged a presentation by Dr Iwami on the 'ICEFISH Exhibition Project' by the Tokyo Sea Life Park. The public aquarium exhibits polar fish (e.g. *Harpagifer* spp. and in future, e.g. icefish (*Chionodraco rastrospinosus*)) to make the public aware of the great polar fish diversity.

Krill biology and survey results

2.119 WG-EMM-11/P7 described for the first time the entire process of krill mating behaviour. The only reported observation of reproductive behaviour made in the wild was by Naito et al. (1986), who observed the mating behaviour of surface swarms of krill. Observations of the current study were conducted by using an autonomous submersible video camera lowered near the seafloor at depths of 400–700 m. The traditional view is that post-larval krill are typically confined to the top 150 m of the water column with reproduction occurring in surface waters. This study showed the existence of krill at 400–720 m depth where mating can take place. This confirms increasing evidence that krill are also present in summer time in water layers deeper than 200 m (Schmidt et al., 2011). The authors of WG-EMM-11/P7 argued that these observations are challenging the assumption that only an insignificant portion of the krill population lives below 200 m.

2.120 The Working Group noted the most recent results on krill vertical distribution and encouraged further studies on the vertical extent of krill distribution and the epibenthic habitat, as well as its significance on the overall population. It was noted that such studies require development of new sampling methods, because net sampling at these depths close to the bottom will be difficult, and ship-borne acoustic systems are limited due to the depth range of the used frequencies.

2.121 Dr Constable indicated that acoustic towed bodies could be a potential method to record data from deeper layers. He also noted that the autonomous submersible video camera used for the study presented in WG-EMM-11/P7 is relatively small and robust and can easily be used. Since krill was observed to be attracted by the light of the camera, the time to saturation might be a possible way to be used as an indicator of krill density in the vicinity of the camera.

2.122 WG-EMM-11/24 presented data of 18 expeditions carried out by AtlantNIRO between 1970 and 2000 in the central and eastern part of the Area 48 (Subareas 48.4 and 48.6). Distribution of krill was analysed with reference to the structure and dynamics of the water masses in the area of the South Sandwich Islands, Bouvet Island, Maud Rise seamount in the southern part of the Lazarev Sea and up to the coastal zone of the continent. The hauls were made with a research Isaacs-Kidd trawl and different types of commercial midwater trawls.

2.123 According to their results, the authors of WG-EMM-11/24 concluded that:

(i) in the Atlantic sector of the Antarctic Ocean the main features of the water dynamics and structure are determined by interaction of the ACC and the Weddell Circulation (WC)

(ii) results from the surveys in Subareas 48.4 and 48.6 indicate high krill density in the Frontal Zone of the WC, the Antarctic near-shore current zone and near Bouvet Island

(iii) krill aggregations (above 1.0 tonne per 1 hour trawling) were recorded in the central part of the WC (South Sandwich Islands), near Bouvet Island, in the coastal area in Subarea 48.6 and at Maud seamount

(iv) the quasi-stationary pattern of circulations and eddies associated with these zones allows the development of potential krill fishing grounds in Subareas 48.4 and 48.6.

2.124 The Working Group welcomed the analysis of historic survey data from areas where little or no commercial fishing has occurred in the past. The Working Group noted that there are obviously pelagic areas in Subareas 48.1 to 48.3 (WG-EMM-11/18; paragraphs 2.122 and 2.123) outside the southwest Atlantic sector where potentially fishable areas exist, and which leave the option for the fishery to spread its fishing effort. The existence of such potential areas should certainly be considered in the development of a feedback management system.

2.125 The Working Group considered whether the areas currently fished for krill will always be the favourite fishing grounds for the commercial fishery, or whether the fishery is flexible in its strategy and decision process such that if it encounters poor krill conditions in Subareas 48.1 to 48.3 it would move into the pelagic areas such as the ones in the southeast Atlantic.

2.126 Dr Kiyota responded that in the past, the Japanese fishery acted as a fleet exchanging information on potential krill concentrations. With only a single vessel left in the krill fishery, there is little opportunity to search for new fishing grounds with high krill concentrations, but the fishery tends to rely on past experience and fish in areas with known and predictable concentrations.

2.127 It was noted that currently there is no ecosystem monitoring in place in Subareas 48.4 or 48.6 at the fishing ground proposed in WG-EMM-11/24. The need to establish appropriate monitoring of potential impacts on ecosystems was emphasised for the case of a developing fishery in Subarea 48.6. It was further noted that the pelagic krill in the Southeast Atlantic are partly located in regions with very long seasonal ice cover, or are remote and far from port facilities, as well as in areas with little shelter, which would limit the fishing season and increase the logistic difficulties at the same time. The Working Group concluded that a feedback management system will consequently also have to consider cost-benefit aspects and realise that moving into areas such as Subareas 48.4 and 48.6 could have an influence on the efficiency/viability of the fishery.

2.128 WG-EMM-11/26 reanalysed the US AMLR acoustic biomass time series from 1996 to 2011 using the recently (SG-ASAM-10) corrected SDWBA model. It also presented an updated, but simplified, proportional recruitment time series and net-based abundance time series for the Elephant Island region of the South Shetland Islands.

2.129 The Working Group noted:

(i) Proportional recruitment (the number of age-1 animals to the total number of animals in an area) is generally calculated using the CMIX software. For this paper, the authors have simply calculated the proportion of krill ≤ 35mm in an area for each survey. The authors stated that no significant differences in the proportional recruitment time series were evident. Proportional recruitment of *E. superba* in the Elephant Island region showed peaks in 1993, 1996, 2002/03, 2008 and 2011.

(ii) Net-based mean abundance of krill in the Elephant Island region fluctuated between <1 and ~10 krill m^{-2} between 1992 and 2011 during the January survey. Highest values were observed in 2003. Over the last three years, krill density has averaged around 1 m^{-2} suggesting rather lower abundance of krill over this time period.

(iii) Acoustic biomass of *E. superba* in the South Shetland Islands has varied by more than an order of magnitude since the mid-1990s. The highest biomass recorded was around Elephant Island in 1997. Krill biomass was high during the late 1990s and declined to lows in the early 2000s, before increasing again since 2006. These updates, corrected estimates of krill biomass, are weakly correlated with previous estimates. This result is especially important because the differences in acoustic biomass will influence the correlation between krill biomass, environmental drivers and other species.

2.130 The Working Group wished to recognise the great value of the long-term US AMLR dataset and especially the effort that is carried out to update the work and biomass estimates using the most recent accepted methods. The Working Group also recognised the great value of the UK time series from South Georgia, which is also up-to-date. Together, they form a very important set of data for understanding historical change in Area 48 and form an essential foundation for considering management of the krill fishery.

2.131 The Working Group suggested that an analysis of the combined data from the Antarctic Peninsula and South Georgia should be carried out, and possible correlations should be examined between areas across the Scotia Sea.

2.132 The Working Group noted the simplified recruitment index introduced by WG-EMM-11/26. Although the authors stated that no significant differences in the proportional recruitment time series were evident, the Working Group thought that applying the size range up to 35 mm would result in an inclusion of almost half the age group 2+, which usually has a mean size-at-age around 36 mm in summer. It was therefore suggested that this index should be renamed to avoid confusion with the R1 estimated according to the index established by de la Mare (1994). It was further suggested that, in case results are presented using the simplified index, these should be accompanied by the established R1 to allow comparison with results from the published time series and used by the CCAMLR GYM.

2.133 WG-EMM-11/13 presented results of a joint German–USA krill net sampling survey west of the Antarctic Peninsula in January 2011. The intention was to collect data on krill distribution, abundance, demography, spawning and recruitment success. The results represent the most complete survey of the krill stock on the western side of the Antarctic Peninsula conducted since the late 1980s.

2.134 The results of WG-EMM-11/13 indicated that:

(i) In the southern part the mean krill density was higher than in the northern area. Overall adult krill abundance was below the long-term average.

(ii) Hot spots of krill larvae concentrations occurred in the southwest (northern Bellingshausen Sea), and smaller spots north of Livingston Island. According to the distribution maps, it can be assumed that the distribution range of krill larvae extended well beyond to the north of the currently chosen station grid, whereas the adult krill population was well inside the station grid. In combination with the adult female maturity stage composition (mainly gravid and spent), there is indication for an early and successful spawning in 2011.

(iii) Salps (*Salpa thompsoni*) were studied as an important component of the Antarctic zooplankton because of their potential ability to outcompete other zooplankton grazers such as krill. In contrast to krill, salp abundance was substantially higher in the northern area compared to the south.

(iv) Overall krill length-frequency distribution was bimodal with a dominance of juvenile krill and a second peak for adult 50 mm large krill. Krill size and age composition showed a clear onshore–offshore distribution pattern, with juveniles inshore, and the spawning stock along the continental slope and in oceanic waters. Proportional krill recruitment was high in 2011, although absolute recruitment was still below the values observed during the 1990s.

(v) Near-surface temperature and salinity showed variability associated with the presence of ACC water and Weddell Sea water. The intrusion of relatively warm ACC water masses with unusually high SST north of the South Shetland

Islands was probably responsible for differences in distribution of large krill, in larvae abundance, and salp density between the southern and the northern part of the survey area.

2.135 The authors of WG-EMM-11/13 concluded that the example of the larger-scale 2011 survey demonstrates how the size of the survey area may affect the R1 index. Smaller/younger krill of age-class 1 in the coastal zone may be more affected by retention in the southern regions of the Peninsula and be responsible for a reduced recruitment index in the northern section of the Bransfield Strait–South Shetland Elephant Island region.

2.136 The Working Group welcomed the joint effort to collaboratively carry out two national surveys and combine the two datasets in WG-EMM-11/13 as this allows a much larger area to be covered, it also provides a better understanding of the spatial heterogeneity in krill distribution and abundance along the Antarctic Peninsula.

2.137 The Working Group advised the Scientific Committee to take note of the results that juvenile krill of age-class 1+ is predominately concentrated in near-shore areas along the entire Peninsula from Marguerite Bay (Adelaide Island) in the south up to, and including, Bransfield Strait in the north. Fishing in nursery areas will have a different impact on the stock than fishing on adults. Management of the krill fishery will need to account for this.

2.138 WG-EMM-11/16 presented the report of the workshop 'Antarctic krill in a changing ocean'. The one-week workshop was co-sponsored by the EU and the Netherlands on Texel Island (NL) (EU–Netherlands Workshop) in April 2011. The intention was to bring together krill specialists from CCAMLR Members and countries usually not involved in CCAMLR meetings, to discuss krill biology under the scenario of climate change and the implications for management of krill stocks, including past and future trends in ocean warming, sea-ice decline and ocean acidification. The authors:

(i) concluded that climate change adds to uncertainties that surround krill fisheries management

(ii) urged, among other recommendations, maintenance of the current precautionary trigger in Area 48 (CM 51-07)

(iii) emphasised that the most rapid changes (e.g. ocean warming, sea-ice decline) have been occurring in the southwest Atlantic sector, where major parts of the *E. superba* population and the krill fishery concentrate and a decline of krill populations has been observed at least during the period from 1976 to 2003

(iv) noted that the impact of climate change is predicted to increase considerably throughout the Southern Ocean during the present century and that these environmental changes will act in concert to modify the abundance, distribution and life cycle of krill

(v) concluded that most of the anticipated changes are likely to negatively impact krill and that synergistic effects would also probably be negative

(vi) concluded that among the population parameters determining the distribution and biomass of krill, recruitment, driven by the winter survival of larval and juvenile krill, was considered to be most susceptible to climate change (see also WG-EMM-11/P6)

(vii) noted that changes in the distribution and population size of krill would probably have far-reaching ramifications in Antarctic ecosystems, and in addition, direct effects of climate change on other parts of the ecosystem will also be important

(viii) concluded that, because the assessment of catch limits using the GYM does not account for trends in the ecosystem resulting from climate change, management methods should be enhanced to account for such changes, such as recruitment variability, plasticity of habitat use, as well as top predator population consumption

(ix) made several recommendations with respect to CCAMLR's ecosystem-based management approach:

(a) the impact of climate change on krill demands an adaptive management approach

(b) controlling fisheries pressure is the only realistic way to mitigate effects of fisheries and climate change on ecosystems

(c) current precautionary management measures need to be continued

(d) effects of fisheries on krill and ecosystems need to be considered at appropriate spatial scales

(e) monitoring of key population parameters of krill needs to be intensified and improved

(f) there is an urgent need to integrate the plasticity of habitat use of krill in population estimates

(g) population sizes and food demand of krill predators must be better quantified

(h) CEMP needs to be expanded and intensified

(i) valuable data for management should be provided by the krill fishery itself

(j) scientific participation in SC-CAMLR working groups needs to be broadened.

2.139 The Working Group thanked the EU and the Netherlands for taking the initiative of this workshop. The workshop was considered a valuable contribution to WG-EMM and CCAMLR, and particularly the significant contribution by scientists outside the usual CCAMLR community was greatly appreciated.

2.140 The Working Group agreed that the recommendations listed by the specialist workshop (WG-EMM-11/16) reflect key issues of the work in progress of WG-EMM, and recommended that the Scientific Committee consider the report of the workshop.

2.141 With regard to the recommendation of the EU–Netherlands Workshop regarding scientific participation in SC-CAMLR working groups, the Working Group highlighted efforts to build scientific capacity in SC-CAMLR (e.g. SC-CAMLR-XXIX, paragraphs 15.10 to 15.12) and encouraged continued involvement of scientists from krill fishing nations.

2.142 With respect to future impacts of climate change, the Working Group agreed to develop approaches suitable for distinguishing between climate change-induced and fisheries-induced effects on krill populations. The Working Group acknowledged the value of CEMP for monitoring ecosystem changes and potential perturbations caused by the fishery and emphasised that issues of the sensitivity of CEMP to distinguishing these effects would be considered in the development of feedback management procedures. The 2003 review of CEMP indicated that it was unable to distinguish between these effects at the low levels of fishing at that time. To be successful, monitoring was likely to be needed across all areas where fishing was occurring.

2.143 WG-EMM-11/19 reported on recent progresses with updating the KRILLBASE analysis. The original KRILLBASE database (including records from 1926 to 2003) was expanded with extensive recent data covering mainly the 2003–2009 period in the southwest Atlantic sector. Provisional analysis of potential artefacts (e.g. net mouth area, proportion of day and night hauls, sampling depth) showed no obvious directional change in sampling method that could have influenced the results observed. A more rigorous analysis of long-term trends based on a fully updated KRILLBASE is expected in the near future and will be reported to CCAMLR.

2.144 WG-EMM-11/41 presented a preliminary analysis of possible inter-connections between decadal variability of winter air temperatures and *E. superba* density variations. Temperature anomaly showed oscillations with an 8-year period. Highest krill densities were observed during transition periods from negative to positive temperature anomalies. Krill densities were significantly correlated with temperature anomalies in the preceding year. The 8-year periodicity in krill and air temperatures probably reflected ENSO effects and sea-ice change.

2.145 The Working Group emphasised the value of this study and encouraged similar investigations to help understand the large interannual variability of krill abundance in the Southern Ocean.

2.146 WG-EMM-11/P5 analysed the structure of marine ecosystems in the Argentine Islands Archipelago with a focus on pollution effects. During a multi-year study, high concentrations of cadmium and other hazardous heavy metals found in sediments were mirrored in both benthic and pelagic biota. The authors concluded that the effect of pollution may explain observed low zooplankton abundances and the absence of krill larvae, indicating in particular the susceptibility of krill recruitment to local environmental contamination.

2.147 WG-EMM-11/P6 reported on an experimental study of the effect of increasing pCO_2 on krill embryos and larvae. The study demonstrated that krill embryos developed normally under up to 1 000 µatm pCO_2, but their development was almost totally inhibited at

2 000 μatm. Model-projected pCO_2 within the wide depth range in which krill occur is likely to range in between these two values by the year 2100. These results emphasised the urgent need for understanding the response of different ontogenetic stages of krill to increasing pCO_2. In order to predict the possible fate of krill in a changing Southern Ocean, interactive effects with other agents of climate change (e.g. warming, sea-ice decline) should be explored, and a mechanistic understanding of the effect of increased pCO_2 on krill should be developed.

2.148 The Working Group noted that in future scenarios of ocean acidification local extreme pCO_2 values may impact krill before mean values reach critical levels.

Issues for the future

Symposium on Feedback Management of Krill

2.149 Dr Watters introduced the Symposium on Feedback Management of Krill by recalling that the Scientific Committee had identified this as a priority area of work (SC-CAMLR-XXIX, paragraph 15.1 and Table 7). He emphasised that the symposium should facilitate the development of a broad understanding of what feedback management means and the identification of components that it might include. Dr Watters indicated that the current focus of work for developing the feedback management approach should be the existing krill fishery in Area 48; however, he emphasised that the concepts developed during the symposium should be applicable to other areas, as the krill fishery expands in future years. Dr Watters noted that the symposium would allow the Working Group to produce a plan of work for the future, which included defined components, with clear time scales for delivery.

2.150 The Working Group noted that work on feedback management had a long history in CCAMLR with many aspects considered at WG-EMM since its inception in 1995. Particular discussions of direct relevance include:

(i) feedbacks in approaches to the conservation of Antarctic marine living resources (CCAMLR-VII, paragraphs 136 to 150)

(ii) the Commission determining that feedback management is to be preferred as a long-term strategy (CCAMLR-X, paragraphs 6.13 to 6.17)

(iii) development of methods to combine CEMP indices for use in management and to analyse time series of CEMP data to detect anomalies (SC-CAMLR-XVI, Annex 4, paragraphs 6.6 to 6.11, 6.58 to 6.79, 7.10 and 7.11)

(iv) consideration of further approaches to ecosystem assessments (SC-CAMLR-XIX, Annex 4, paragraphs 4.86 to 4.137)

(v) requirements for considering management approaches for the krill fishery (SC-CAMLR-XX, Annex 4, paragraphs 5.1 to 5.36)

(vi) designation of SSMUs (SC-CAMLR-XXI, Annex 4, Appendix D)

(vii) review of CEMP (SC-CAMLR-XXII, Annex 4, Appendix D)

(viii) plausible ecosystem models for testing approaches to krill management, including discussion on what is required in an evaluation (SC-CAMLR-XXIII, Annex 4, Appendix D)

(ix) evaluation of approaches to subdivide the catch limit amongst SSMUs, including the development of modelling tools (SC-CAMLR-XXIV, Annex 4, Appendix D; SC-CAMLR-XXV, Annex 4, Appendix D; SC-CAMLR-XXVI, Annex 7, paragraphs 5.7 to 5.51)

(x) risk assessment for Stage 1 subdivision of the precautionary catch limit among SSMUs in Area 48, including further development of ecosystem assessment methods (SC-CAMLR-XXVII, Annex 4, paragraphs 2.1 to 2.102)

(xi) consideration of the requirements in developing feedback management strategies (SC-CAMLR-XXVIII, Annex 4, paragraphs 3.139 to 3.155).

2.151 Dr Watters indicated that he had invited a number of individuals to prepare presentations that would help facilitate discussion and understanding about the necessary components of feedback management. Presentations were given by Drs Constable, Kasatkina, Kiyota, Milinevsky, Trathan and Watters; copies are available in the Members area of the CCAMLR website.

2.152 Individual abstracts, together with a summary describing the six presentations, are given in Appendix D. The presentations gave different perspectives on feedback management, each providing specific details and objectives. The presentations highlighted many areas of broad agreement. The presenters agreed that feedback management includes monitoring, assessment and decision-making, and that a feedback management approach should use decision rules to adjust activities in response to the state of indicators to achieve the objectives of Article II of the CAMLR Convention. Presenters agreed that there are a wide range of potential indicators of ecosystem state; that uncertainties in understanding the ecosystem and its state must be addressed in the use of these indicators; and that the range of activities that could be adjusted include research activities as well as the distribution and intensity of fishing effort and catch.

2.153 During subsequent discussion of the six presentations, the Working Group identified a number of fundamental principles, together with an associated set of defined components. The following fundamental principles were agreed:

(i) The objectives of Article II must be achieved in the context of a changing ecosystem.

(ii) There is a need to maintain the precautionary approach in managing the krill fishery.

(iii) A feedback management approach should be developed collaboratively amongst Members of CCAMLR, making efficient use of the available skills and resources, but drawing on appropriate expertise outside CCAMLR where necessary.

(iv) A feedback management approach for krill will use decision rules to adjust selected activities (distribution and level of krill catch and/or research) in response to the state of monitored indicators.

(v) Indicators will typically be derived from multiple approaches and platforms (including fishing vessels, research vessels and land-based monitoring), and analysed and assessed by the Scientific Committee to provide advice to the Commission.

(vi) Monitoring and management should reflect the spatial scale of the fishery and should take account of spatial ecosystem structure.

(vii) Candidate feedback management systems should be robustly evaluated by the Scientific Committee in order to provide advice on the efficacy of the procedure to the Commission before implementation.

2.154 The Working Group agreed that at all stages during the development and implementation of any feedback management approach, it would be necessary to provide regular advice to the Scientific Committee (and the Commission), as well as seeking their guidance whenever appropriate. The Working Group also recognised that consultation with fishery practitioners and other stakeholders would be beneficial to a successful outcome.

2.155 The Working Group agreed the following components as the basis for future work:

1. Development of a list of candidate feedback management approaches, including consideration of any operational implications for the fishery and for monitoring.

2. Identification of an agreed suite of indicators appropriate to candidate feedback management approaches.

3. Review of spatial and temporal structure in the ecosystem in which the current Area 48 fishery operates and consideration of the implications for monitoring and management.

4. Development of agreed decision-making mechanisms for the candidate feedback management approaches, including decision rules which identify how fishing strategies and/or monitoring are to be adjusted on the basis of the indicators.

5. Provision of advice on operationalising the objectives of Article II in the context of a changing ecosystem.

6. Evaluation of candidate feedback management approaches.

2.156 The Working Group noted that each of the components must be considered in the context of the whole process of developing a candidate feedback management approach, as development of any particular component may be dependent on the trade-offs with other components. As a result, the process may be iterative.

2.157 The Working Group agreed that the six components should be considered over the next three years, with focus on components 1 to 3 in 2012, components 4 and 5 in 2013 and component 6 in 2014. The Working Group also agreed that fully developed candidate feedback management approaches should be evaluated earlier than 2014 if they were available.

2.158 The Working Group reviewed a number of issues in relation to each of the six components.

Component 1: Development of a list of candidate feedback management approaches, including consideration of any operational implications for the fishery and for monitoring

2.159 The Working Group recognised that there were different candidate feedback management approaches that could be used for managing the krill fishery. Four classes of candidate approaches are shown in Table 4 as illustrations of what might be done, showing some of the consequences for decision-making and the importance of trade-offs; other approaches are also possible. The implications for the fishery differ, principally because each approach relies on different indicators; thus, the type of indicators needed, and their geographic coverage, will depend on the future flexibility required for the fishery by the Commission.

2.160 Some feedback management approaches could be implemented relatively quickly, while others may take longer. For example, CCAMLR may be able to develop a feedback management system almost immediately using the existing CEMP monitoring available in Area 48. Such an approach may require a highly precautionary catch and/or a spatially restricted catch, focused in those areas where existing monitoring occurs. Alternatively, if the fishery wished to operate over a much wider spatial scale, including areas where no CEMP monitoring was available, harvesting might need to be extremely precautionary, particularly until such factors as flux were understood more completely. The Working Group therefore noted that the catch and distribution of the fishery would need to match CCAMLR's ability to detect change.

2.161 The Working Group noted that it will be important to develop a framework for comparing different feedback management approaches. This would need to include developing a common set of performance measures, diagnostic outputs or plots that may be examined and evaluated for each candidate approach. Outputs may include empirical analyses, simulation outputs, or even behavioural metrics describing fishing activity or ecosystem actions.

Component 2: Identification of an agreed suite of indicators appropriate to candidate feedback management approaches

2.162 The Working Group agreed that it would be necessary to undertake a gap analysis of appropriate indicators for each candidate feedback management approach in order to identify which indicators are needed, which are available and which are missing. Potential indicators include fishery-based indices, fishery-independent krill indices, land-based predator indices, pelagic predator indices and environmental indices. It will be necessary to determine which indicators to monitor, how to monitor them and where to monitor them.

2.163 The Working Group recognised that some indicators were expensive to collect, placing financial burdens and responsibilities on either fishing companies or national programs. It therefore agreed that a cost-benefit analysis of candidate indicators would be necessary; some indicators may provide only marginal ecological or management information, others may be critical to the successful implementation of a particular candidate feedback management approach. A proper analysis of costs and benefits will therefore be necessary in order to determine realistic trade-offs amongst parts of the management procedure.

2.164 The Working Group recalled that at current harvesting levels, it is unlikely that the existing design of CEMP, with the data available to it, will be sufficient to distinguish between ecosystem changes due to harvesting of commercial species and changes due to environmental variability, whether physical or biological (SC-CAMLR-XXII, paragraph 3.12i). The Working Group recognised that as the fishery increased, it may eventually become possible to detect the impacts of fishing with existing data series, but it would be essential to ensure the fishery operated in areas in which the effects could be detected. It may also be necessary to increase the types of indicators available for feedback management if changes were to be detected more rapidly. The Working Group recognised that, in particular, an increased range of indicators from the fishery would be valuable. For example, it considered that acoustic information collected systematically by fishing vessels would be of great value.

2.165 The Working Group further agreed that a review of CEMP in the context of feedback management would be valuable as it would almost certainly be appropriate to employ a number of new methods for monitoring dependent predators. For example, it may be useful to use remote cameras, aerial surveys, satellite remote sensing, or opportunistic visits to penguin breeding colonies using ships of opportunity, to provide broad-scale geographic information on regional predator population trends.

2.166 The Working Group noted that one important consideration was that existing datasets may form the future basis of important indicators for monitoring. Such data require careful cost-benefit evaluation as they may carry with them a number of important caveats, but with appropriate decision-making mechanisms and decision rules, they may still be feasible to use. Thus, there is a potential trade-off between a small number of precise indicators versus a diverse range of less precise indicators. Part of the cost-benefit analysis may also need to consider the opportunity cost if some datasets were ended because they were not considered important for candidate feedback management approaches.

Component 3: Review of spatial and temporal structure in the ecosystem in which the current Area 48 fishery operates and consideration of the implications for monitoring and management

2.167 The Working Group recognised that in developing a feedback management approach, it would be valuable to create a spatial subdivision of the fishery. This would allow approaches to be used whereby some areas would be closed to fishing (reference areas) while others would be open to area-specific levels of fishing intensity. Such a spatial subdivision could have the potential to allow the effects of harvesting to be clearly identified, particularly if reference and fished areas were used in a way that response to harvesting in the fished areas could be easily identified. Reference and fished areas would not have to be ecologically identical, but they would need to maintain the same set of relative ecological relationships across sites, even if some ecological factors were to change in absolute terms.

2.168 The Working Group noted that there were a number of alternative approaches that could be employed with regard to spatial subdivision of the fishery. It also noted that fishing effort could be focused spatially or temporally and/or in a structured manner in order to determine the impacts of harvesting on predators and other ecosystem components, or to learn about ecosystem processes that may be critical for management procedures (SC-CAMLR-XXVI, Annex 7, paragraphs 5.12 to 5.14).

2.169 The Working Group noted that the candidate feedback management approaches described in Table 4 used the terms 'reference area monitoring' and 'structured fishing'. Reference area monitoring is defined as the use of monitored reference areas (in which no fishing occurs) to provide the basis for understanding effects in fished areas. Structured fishing is defined as the manipulation of fishing effort (distribution and/or intensity) to help achieve management objectives and/or for providing information about ecological responses. The Working Group noted that these two forms of spatial subdivision might allow revisions to overall management as understanding of the ecosystem increases.

2.170 The Working Group noted that spatial subdivision of the fishery would also have the potential to provide information about the operation of important components of the ecosystem, including oceanographic connection and krill flux between areas. It would also allow management on the basis of area-specific catch limits, which would provide more options for balancing fishery and ecosystem objectives, than would the use of large-scale catch limits alone.

2.171 The Working Group recognised that subdivision of the fishery would provide a great deal of management information about the ecosystem effects of fishing. However, it also noted that there would be a number of other factors that would need to be considered. For example, natural spatial and temporal variability in krill distribution and abundance could mean that focused fishing activity in a particular area was not possible in a particular season. Recognition of such variability in the design of structured fishing trials might help to increase understanding of the ecosystem. However, such variability may have economic implications for the fishery, as well as management implications for interpreting the results of reference area monitoring or structured fishing.

2.172 Although the Working Group noted that spatial subdivision of the fishery may impact on the flexibility of fishing operations as well as having economic implications, it recognised that it was not yet possible to evaluate the magnitude of any such impacts, including on the future development of the krill fishery. The Working Group also noted that determining such impacts would require a fully detailed cost-benefit analysis, including possible trade-offs, of specific candidate feedback management approaches, including implications for specific monitoring requirements.

2.173 The Working Group noted that reference area monitoring or structured fishing could take place close to existing CEMP sites. However, it agreed that these sites were scientifically important for a variety of research priorities, including climate change research; further, any spatial subdivision of fishing effort close to such a site might confound the use of the site in relation to these other priorities. Consequently, the Working Group recognised that alternative monitoring programs should be established in areas likely to be fished in order to provide baseline monitoring before reference area monitoring or structured fishing began. The experience at existing sites shows that developing baseline information on land-based predators could require monitoring for a number of years and this may mean that it could take more than 10 years to provide clear results from a fishing trial.

2.174 The Working Group agreed that the design of any feedback management procedure would need detailed consideration of the statistical power of the monitoring for interpreting results, or for extrapolating results to the wider Antarctic ecosystem.

Component 4: Development of agreed decision-making mechanisms for the feedback management approaches, including decision rules which identify how fishing strategies and/or monitoring are to be adjusted on the basis of the indicators

2.175 The Working Group noted that there were different ways to implement decision-making mechanisms for different candidate feedback management approaches; some might depend on projection models based on a general theoretical understanding, while others might be focused on empirical observations and comparisons.

2.176 The Working Group noted that the level of accuracy and precision reflected in ecological monitoring methods would have important implications for management decisions. However, it recognised that detection and measurement of any impacts from fishing may be better facilitated by using a spatially structured feedback management approach, using either reference area monitoring or structured fishing.

2.177 The Working Group noted that there may be benefits in producing a risk management framework to evaluate different feedback management approaches. It noted that any decision-making mechanism should maintain the precautionary approach by not only protecting against Type I errors (an incorrect conclusion that the effects of fishing are greater than the actual effect, i.e. reduce the fishery when not necessary) but also by reducing Type II errors (an incorrect conclusion that the effects of fishing are less than the actual effect, i.e. not reduce the fishery when necessary) so that the risks of each are balanced.

2.178 The Working Group noted that the interaction of spatial and temporal scales was important in the Southern Ocean and that this will result in lags in indicators. It recognised that dealing with such lags was critical to the successful implementation of any feedback management approach. The Working Group also noted that there was potential to cause adverse reactions in the ecosystem if management actions were not implemented in a timely manner.

2.179 The Working Group noted that a staged implementation of the feedback management approach would offer many benefits as it would allow the management procedure to be tested in a controlled way and changed if necessary before the fishery becomes fully developed. Decision rules could be used to facilitate this process by setting catches, spatially distributing catches, adjusting the monitoring program and/or setting limits on the fishery.

2.180 The Working Group noted that use of reference area monitoring and/or structured fishing would increase understanding about fishery impacts which could allow an increased rate of fishery development in the future. Approaches that incorporate reference area monitoring could potentially facilitate gradual increases in catch limits in monitored open areas as these methods are designed to identify fishery effects. Advances in understanding structured fishing could facilitate stepwise increases in catch limits. Without the use of reference area monitoring and/or structured fishing, progress beyond the existing catch trigger level could be more restricted.

2.181 The Working Group noted that the time scales and the magnitude of adjustments made by a feedback management approach (from minor tactical adjustment to major strategic revision) depend on the details of the approach and the information required.

2.182 Possible decision rules include models that scale management actions (for instance, adjusting catch limits) in response to indicator values (for instance, predator performance or krill density). In designs using reference area monitoring, the indicator could represent the effect that the fishery is having on the system since the reference area could allow this to be determined (i.e. the indicator is a function of the difference between the state of the fished and reference areas). In monitoring designs which do not facilitate attribution of state changes to fishing effects, a general indicator of ecosystem state (e.g. krill stock biomass) would be used.

2.183 WG-EMM-11/25 suggested a class of indicator for use in feedback management based on trends in the difference between the observed state of predator populations in fished areas and contrasting reference areas where fishing is not permitted. This approach detects deviations from a baseline empirical relationship between the temporal patterns of abundance in the two areas. The magnitude of such deviations or the degree of confidence that they constitute real changes could be used as input variables in a decision model.

2.184 The additional uncertainty associated with less specific indicators implies a need for greater precaution (paragraphs 2.80 to 2.82) and is likely to lead to a slower development of understanding of the effects of fishing and whether these are compatible with Article II. This is illustrated in Figure 4. At present, our knowledge of the system is limited. As a result, the catch trigger level of 620 000 tonnes has been set to avoid substantial impacts on predators while appropriate management approaches are developed. There is also little knowledge about the likely limits of impacts that the ecosystem can sustain. In the situation where neither reference areas nor structured fishing is used, it may be possible to obtain sufficient information about the system to allow catches to increase beyond the trigger level, but the impacts of the fishery and the resilience of the ecosystem to these impacts are likely to remain poorly understood. Where a design includes monitoring of structured fishing, reference areas, or both, the management system is likely to be able to improve knowledge on the impacts of the fishery and the resilience of the ecosystem more quickly, allowing the catch to rise further and faster whilst maintaining a precautionary approach that ensures that the impact is sustainable.

2.185 Structured fishing approaches, designed to increase the understanding of ecosystem responses, may lead to a revised understanding of management needs which might also require revision of the overall management strategy. This level of decision would require the active involvement of the Scientific Committee and the Commission.

Component 5: Provision of advice on operationalising the objectives of Article II in the context of a changing ecosystem

2.186 The Working Group agreed that when operationalising Article II in the context of feedback management, it would be necessary to consider trends in the Southern Ocean ecosystem resulting from climate change, particularly when formulating decision rules. The Working Group also agreed that other directional drivers of ecosystem change that result in trends in ecosystem signals will need to be considered, these include changes in predator populations following ecosystem recovery after historical harvesting (WG-EMM-11/P1).

2.187 The Working Group recognised that analyses and decision rules could use the 'current' system as a reference point (e.g. productivity levels for a given year in the absence of fishing), rather than using a historical reference point (i.e. productivity levels prior to the commencement of historical harvesting), noting that this would provide valuable insight into how the ecosystem operates. Similarly, the Working Group noted that simulation results comparing outcomes in the presence and absence of fishing would provide additional insight into ecosystem operation.

Component 6: Evaluation of candidate feedback management approaches

2.188 The Working Group recommended that the Scientific Committee should evaluate candidate feedback management approaches in order to provide robust advice on the potential performance of candidate approaches to the Commission before implementation.

2.189 The Working Group noted that a simulation environment may prove helpful for this, for example, by using a management strategy evaluation framework (i.e. testing the candidate approach in a model representation of the ecosystem which includes appropriate levels of uncertainty). Such a framework could lead to iterative improvements in the design of candidate approaches, through examination of the robustness of the approach and reference points to different assumptions of system state and response. The Working Group noted that ecosystem models can be difficult to develop but agreed that even simple models may significantly inform the Scientific Committee about the robustness of a particular approach.

2.190 The Working Group agreed that a complete candidate feedback management approach would have to incorporate the outcomes of various cost-benefit analyses, including possible trade-offs for the monitoring indicators, as well as the outcomes of a cost-benefit analysis of how resources were allocated between monitoring, assessment and decision-making.

2.191 The Working Group recognised that development of a feedback management system may require investment in new methods of monitoring, assessment and decision-making. Historically, costs for such activities have been met by fishing companies and/or by national programs. The Working Group noted that the options for feedback management may be limited by the resources available to monitoring. The Working Group noted that, in order to implement some desirable management procedures, it may be necessary in the future to explore burden-sharing options, both within existing funding sources, but also by considering new sources of funds. The Working Group therefore advised the Scientific Committee that one important trade-off would be detailed consideration of the value of the fishery, against the infrastructure needed to manage it.

2.192 WG-EMM-11/21 noted that the concept of Ecosystem Services, which is widely used to articulate the objectives of natural resource management, particularly when there are multiple objectives (such as conservation and rational use), might be a useful tool for communicating CCAMLR's objectives and achievements to the wider international community.

CEMP and STAPP

2.193 WG-EMM-11/42 used a simulation approach in a GIS to explore a number of sample survey design options for undertaking a regional-scale survey of Adélie penguin breeding populations in the Mawson region of East Antarctica, with the aim of optimising the trade-off between bias, efficiency and disturbance. The Working Group noted this important study that could guide the design of large-scale penguin population surveys, and that should be considered for its potential input into the CEMP standard methods in relation to minimising disturbance.

2.194 WG-EMM-11/37 explored the utility of an automated camera system for cost-effective land-based predator monitoring in Antarctica. Camera images are used to attain measurements of breeding success and phenology events, or proxies for them, and a preliminary assessment for this purpose was very successful. The cameras are being used to expand the spatial extent of Adélie penguin monitoring in East Antarctica at less accessible sites, and to extend monitoring to other above-ground nesting seabird species. The cameras are being trialled at lower latitudes in Antarctica by the US and UK in 2011/12. The Working Group welcomed the development of the camera system for monitoring and helping to meet the recommendations of WG-EMM-11/16, which include the need to increase coverage of CEMP. The Working Group also noted that the CEMP standard methods may need to be revised in the future to incorporate new monitoring technologies such as cameras, and that new technologies could feed into monitoring programs such as CEMP, SOOS and Sentinel. The Working Group encouraged future consideration of using camera images to monitor late-season activities when chicks become mobile and move out of the field of view, to assess bird condition, and to download images remotely to allow timely data retrieval. The Working Group encouraged researchers using cameras as monitoring tools to link with other researchers who have expertise in image analysis to develop methods of efficiently processing the broad suite of images that can be obtained from cameras.

2.195 WG-EMM-11/38 is a response to a request from the Working Group in 2009 to consider incorporation of the photographic method in WG-EMM-09/38 into CEMP Standard Method A3 (penguin breeding population size). The paper reviewed CEMP Standard Methods A3a, A3b and A9 (penguin breeding chronology) and outlined some difficulties in the application of these methods, particularly with regard to a lack of flexibility in the timing of A3 counts and the amount of effort required to collect A9 data. These difficulties may be restricting the amount of A3 data that are being submitted to CEMP. The paper outlined some specific modifications that could be made to A3.

2.196 The Working Group noted that modifications to Method A3 would be required if the penguin count database developed by WG-EMM-STAPP were to be incorporated into CEMP. It supported the proposal to draft modifications to Methods A3 and A9 for consideration by the Working Group at WG-EMM-12.

2.197 WG-EMM-11/12 presented a simulation study to determine how frequently data on penguin attendance at their breeding sites need to be collected to adequately represent attendance functions. The study showed that sampling at intervals of six days did not adequately recover simulated attendance data and was not recommended. For intervals less than six days, higher frequency in data collection improved the precision of estimated attendance ratios.

2.198 WG-EMM-11/33 reviewed the potential underlying drivers for phenological change for Adélie penguins, described shifts in Adélie penguin breeding phenology reported at different locations around Antarctica, and presented results from long-term monitoring at the Béchervaise Island CEMP site. Explanations for contrasting shifts in phenology highlight difficulties in distinguishing between direct responses to changes in the environment compared with indirect responses through changes in the underlying food web. The paper recommended that phenology data collected under Method A9 be used for monitoring purposes as well as adjustment purposes, and provided a description of factors which can influence data collected by the methodology in WG-EMM-11/37 and 11/38. The Working Group noted that because phenological changes can be a response to changes in krill abundance, further understanding of the factors driving phenology and their demographic consequences would be useful. In this context, a comparison of all available datasets is important to better understand long-term changes in different regions of Antarctica.

2.199 WG-EMM-11/30 provided a summary of progress of WG-EMM-STAPP to estimate abundance and consumption of krill by pack-ice seals, fur seals, penguins and flying seabirds in Area 48, and to partition the overall foraging effort by these predator groups into SSMUs. Work has been completed for pack-ice seals, and work on estimating overall abundance and krill consumption for fur seals and penguins is expected to be completed within the next few years. The remaining components of the work plan, which involve estimating overall abundance and consumption for flying seabirds, and partitioning the foraging effort by fur seals, penguins and flying seabirds across SSMUs, is expected to take at least another five years. The work on partitioning foraging effort will require strategic collection of foraging tracking data across species, sites and seasons to add to existing data, and the development of predictive foraging-environment distribution models, which together comprises a substantial body of work. The work on estimating flying seabird abundance will require further collation and analysis of at-sea survey data, which is also a substantial body of work.

2.200 The Working Group thanked Dr Southwell for convening WG-EMM-STAPP and guiding its progress to this point, and noted that, with the exception of flying seabirds, the initial phase of work in estimating overall abundance and krill consumption is nearing completion and a second phase focused on foraging distribution is now required (Table 5). The Working Group also noted that products and outcomes of WG-EMM-STAPP in regard to estimates of penguin population size and trends will be very useful to CCAMLR in providing a larger-scale context for the detailed measurements made locally at CEMP sites.

2.201 The Working Group recommended that WG-EMM-STAPP liaise with the Secretariat during the coming year to develop a plan for consideration by the Scientific Committee on how these products may be submitted to, and managed by, the Secretariat in a similar way that CEMP data are currently submitted and managed.

2.202 Given the potential importance of flying seabirds in overall krill consumption, the Working Group discussed ways in which the work on estimating their abundance and consumption could progress. While SCAR has previously provided CCAMLR with information on the status and trends of bird populations through SCAR-GEB, this information was mainly focused on penguin abundance due to the scarcity of data on flying seabird abundance at the large scales required by CCAMLR. As SCAR-GEB has recently been integrated into a predator group, the Expert Group on Birds and Marine Mammals (SCAR-EGBAMM) focusing on foraging distribution, any collaboration with SCAR on flying seabird abundance data is unlikely in the medium-term future.

2.203 The Working Group recognised there is a significant knowledge gap for flying seabird status and trend information for birds in the CAMLR Convention Area, and considered that CCAMLR, through the Scientific Committee, needs to find a means of engaging with the broader community of scientists working on flying seabirds to fill this gap.

2.204 Progressing the work on foraging distribution models may also require engagement with the broader scientific community. In particular, developing links with SCAR-EGBAMM, which is focused on foraging distribution data, and with organisations such as BirdLife International, will be important. It may also be necessary to engage a new, or broader, group of CCAMLR scientists to work on this issue.

2.205 The Working Group recommended that WG-EMM-STAPP maintain its focus over the next few years on completing its work on estimating abundance and krill consumption by fur seals and penguins, but also recognised that it is important to progress work on foraging distribution as quickly as possible.

2.206 As an initial step, Dr Trathan agreed to liaise with scientists within SCAR and BirdLife International who are working on predator foraging distribution to assess areas of common interest and expertise that may help expedite CCAMLR's work. The Working Group also considered the formation of a subgroup within WG-EMM, specifically focused on modelling foraging distribution, could help maintain progress.

2.207 The Working Group noted the increasing evidence that krill consumption by fish and benthic organisms might exceed that by land-based predators, and recognised that fish and benthic organisms are important dependent and related species. It recognised the important contribution that both CEMP and WG-EMM-STAPP have made to understanding interactions between krill and land-based predators and that similar concerted efforts might help to clarify the role of fish and benthic organisms.

2.208 The Working Group discussed the implications of recent work on new methods and technologies for CEMP. There was agreement that approaches developed in WG-EMM-STAPP in relation to regional-scale estimation of status and trends in penguin populations could be transferred to CEMP after consideration of how these data could be used in a monitoring program. This would provide a hierarchy of Method A3 data collection within CEMP, with frequent monitoring at a small number of sites set within less-frequent surveillance monitoring across a larger number of sites. This hierarchical approach may also be appropriate for some other parameters. Such a tiered structure of data collection would allow different questions to be addressed.

2.209 Some consideration would need to be given to how data collected at different spatial scales might be made available to the Secretariat. Method A3 data collected at the scale of the breeding site is in a suitable format to be directly included in the CEMP database, while the format of data collected at a regional scale may not be suitable and some other means of submission may be necessary. The VME registry may be a useful model for developing a submission or archiving process of regional-scale A3 data. The Working Group noted that these arrangements were unlikely to be appropriate for regional-scale population survey data with other taxa, such as pack-ice seals, because of the fundamentally different nature of data.

2.210 The Working Group agreed that CEMP Standard Methods A3 and A9 should be modified to facilitate future submission of A3 data collected at sub-optimal times of the breeding season and A3 data collected at both local and regional scales (paragraph 2.196). Given that a variety of methods are involved, this would require methods to be described in terms of general principles or as 'best-practice' guidelines rather than in a case-specific manner as is currently done in the CEMP standard methods. The Working Group noted that deviation from the standard methods was not a recommended practice unless data quality and standardisation were maintained, as was achieved in the recommended modification to Method A3.

2.211 The development of the automated camera system described in WG-EMM-11/37 provided the potential to collect data on some CEMP parameters at new sites in a cost-effective way. The Working Group encouraged further evaluation of the utility of this and possibly other technologies as a means of expanding the spatial extent of monitoring in the future. These developments enhance the feasibility of CEMP being designed specifically to the requirements of a future feedback monitoring and management system and more broadly for contributing to an assessment of the state of the ecosystem. The Working Group emphasised the importance of maintaining standardisation and comparability where new methods and technologies are used for collecting data as part of CEMP in the future. As such, proposed new methods and approaches, including those for Method A3, will need to be reviewed by the Working Group and adopted before inclusion in CEMP.

2.212 The Working Group also recalled that the value of time-series data collected under prescribed CEMP methodologies increases as the time series grows, and that reducing or stopping existing CEMP programs will severely compromise the ability to monitor change in the ecosystem. However, rising costs and funding restrictions are making it increasingly difficult for Members to continue long-term work as individual national programs. The Working Group therefore encouraged the development of multi-national CEMP programs wherever possible. The Working Group also considered that fishers could make a valuable contribution to CEMP through activities such as routine acoustic sampling.

2.213 The Working Group recognised that CEMP needs to focus on information required by the Commission to make management decisions. The development of a feedback monitoring and management system may require CEMP to change or evolve from its present form to include greater spatial coverage, to monitor at different spatial and temporal scales, and to include more or different parameters and revised methods for existing parameters.

2.214 The Working Group also noted that any changes to CEMP need to take into account the implications for the work of the Secretariat, and therefore agreed that any decisions to expand the scope of CEMP should be made judiciously and be prioritised to the needs of the Commission.

Integrated assessments for krill

2.215 The Working Group welcomed the development of an integrated assessment model for krill as presented in WG-EMM-11/43 Rev. 1 and noted that the model uses the combined time series of net-derived length-frequency data and acoustic biomass estimates from the US AMLR Program in Subarea 48.1. Currently the model can be fitted to either the biomass series or to the net data but does not provide a consistent link between the two series.

2.216 The Working Group considered the structural assumptions underlying the integrated model construction, in particular:

(i) the model provides a means to identify those parameters that can be estimated and those that may need to be measured directly. For example, the exploration of krill movement scenarios may help to highlight areas of future research

(ii) recognising the importance of krill recruitment dynamics, it may be important to ensure that the choice of stock–recruit relationship does not mask important underlying dynamics and prevent these dynamics from being fully explored

(iii) given the difficulty in determining the age of krill, the developers could consider the potential for using a length-based, rather than an age-based, approach.

2.217 The development of an integrated assessment model for krill is an important part of the work required to manage the krill fishery in the future and would also provide an opportunity to explore some of the structural assumptions about krill dynamics in Subarea 48.1 and in other areas.

Fishing vessel research

2.218 The Working Group considered the research undertaken in Subarea 48.2 in 2011 by the *Saga Sea* (WG-EMM-11/23), the proposal for integrated land- and ship-based research in Subarea 48.2 to be undertaken by Norway, UK and the USA (WG-EMM-11/4 Rev. 1) and the proposal from Japan for a pilot study to collect acoustic data from the *Fukuei-Maru* during fishing operations (WG-EMM-11/35).

2.219 The *Saga Sea* survey (WG-EMM-11/23) was carried out by two scientists from 4 to 8 February according to the design agreed by WG-EMM-10. Acoustic data for krill distribution and biomass estimation was collected with a calibrated two-frequency (38 kHz and 120 kHz) Simrad EK60 scientific echosounder along six transects around the South Orkney Islands; biological samples and hydrographical data were also collected and preliminary results presented. In addition, systematic observation on the occurrence of apex predators (marine mammals and penguin) was also documented. This is the first of the planned five-year surveys, which represents the first effort of this kind from the krill fishing industry in the Convention Area.

2.220 In considering the recommendations in WG-EMM-11/23, the Working Group noted the proposal to change the transect layout for next year's survey and recommended to Norway that it was desirable to optimise the survey design as quickly as possible in order that changes in the spatial coverage do not compromise subsequent data analysis. In noting the desire of Norway to extend the northern section of the transects to fully cover a major topographical feature, the Working Group agreed that this was an improvement, but cautioned that discontinuing the westernmost transect could limit linkages to ongoing and proposed surveys in Subareas 48.1 and 48.2.

2.221 The potential value of collecting data from vessels operating in the krill fishery has long been recognised by CCAMLR and therefore the developments described in WG-EMM-11/4 Rev. 1, 11/23 and 11/35 were warmly welcomed by the Working Group. It is important to recognise the position CCAMLR is in by having this level of engagement from fishing vessels, and there is a need to maximise this opportunity to learn about the fishery and krill dynamics in areas and times where other sources of data are often very limited.

2.222 WG-EMM-11/4 Rev. 1 reported the outcomes of a fruitful workshop convened at the Institute of Marine Research (IMR), Bergen, Norway, in April 2011, to investigate the basis for integrated investigations and evaluation of krill resources in Subarea 48.2. The workshop was attended by 11 participants from Norway, UK and the USA. It is noted that a Norwegian research survey with RV *G.O. Sars* in 2013/14 is under consideration with an aim to repeat part of the CCAMLR-2000 Survey, and wider international involvement is called for to repeat that entire survey. The feasibility of collecting acoustic data from commercial krill vessels was also discussed during the workshop, and the acoustic data sampling strategies outlined in the *ICES Cooperative Research Report*, No. 287 (Collection of acoustic data from fishing vessels) was put forward for consideration by CCAMLR.

2.223 In recognising the importance of the opportunity to use fishing vessels to collect acoustic data on krill, the Working Group agreed that it was important to provide clear guidance on the process for collecting such data under an appropriate design framework in order that the data can be used in the work of CCAMLR. In particular, it will be important to recognise that data would need to be collected in a directed manner in order to ensure the maximum utility of the data collected.

2.224 The Working Group noted that, while in the proposed pilot study in WG-EMM-11/35, data would only be collected at 38 kHz, the addition of data from 120 kHz would greatly improve the utility of the research. There would be need to specify the sampling methods to collect length-frequency data during the acoustic survey (noting the potential different selectivity of research versus commercial trawls) and that there may be advantages in repeating existing acoustic transects in Subareas 48.1, 48.2 and 48.3, but that the implications of the choice of survey design would have implications for estimation of variance in acoustic estimates.

2.225 Recognising that the use of acoustics on fishing vessels was primarily designed to provide qualitative information on krill biomass and distribution to locate fishable aggregations, whereas acoustic systems on scientific research vessels are designed to provide quantitative information, the Working Group agreed that, in order to ensure that CCAMLR is able to obtain the maximum benefit from fishing-vessel-based acoustic data on krill, SG-ASAM would need to provide advice on how best to collect and evaluate the data collected using different methods. In particular, SG-ASAM is requested to provide advice on:

(i) Survey design –

The implications of directed and undirected survey design, including the location and timing of transects, and the desirability of using existing acoustic transects in Subareas 48.1, 48.2 and 48.3 (including those used in the CCAMLR-2000 Survey). The potential for collection of acoustic data between and at trawl stations during fishing operations. The collection of biological data required to interpret acoustic data and assist in target identification.

(ii) Acoustic data collection –

Define the minimum requirements for acoustic data collection that could provide quantifiable estimates of krill biomass/distribution from fishing vessels, recognising that the vessels may not be configured to collect acoustic data at 38, 120 and 200 kHz as per the CCAMLR protocol (assuming appropriate survey design). This should include details of calibration, vessel sound characteristics and acoustic frequencies available on the vessel and whether the data are to be collected in a supervised (e.g. by scientists or suitably qualified observers on the vessel) or unsupervised (by vessel crew) manner. Where data are to be collected in an unsupervised manner, SG-ASAM should be requested to provide a detailed set of instructions to ensure that acoustic data are properly collected and stored.

(iii) Acoustic data processing –

Provide advice on the most appropriate way to process the acoustic data arising from fishing vessels, including target identification, biomass estimation and associated uncertainty. This should include advice on the most appropriate data formats and data management implications of collection of acoustic data.

2.226 The Working Group noted that in seeking advice from SG-ASAM, while it was important to provide clear guidance on the issues to be addressed, it recognised that the experts within SG-ASAM could provide advice on other relevant issues not identified in paragraph 2.225.

VULNERABLE MARINE ECOSYSTEMS

3.1 The Working Group considered WG-EMM-11/7 which summarised VME notifications received by the Secretariat under CMs 22-06 and 22-07. The Working Group recognised that assessing notifications made under CM 22-06 was the responsibility of WG-EMM, whereas notifications made under CM 22-07 would be considered by WG-FSA. To date (excluding new notifications in 2011, see WG-EMM-11/10) there have been 32 notifications in three subareas under CM 22-06, all of which were in areas where bottom fishing activities were already restricted. Under CM 22-07, there have been 112 notifications, with 46 VME Risk Areas identified, and six fine-scale rectangles within which most of the notifications are contained. The Working Group recommended that in the course of updating this paper for resubmission to the Scientific Committee, the Secretariat should characterise these fine-scale rectangles in greater detail, for example, reporting what VME taxa have been observed and the number of observations in each.

3.2 WG-EMM-11/17 also described the level of reporting of VME by-catch data at the scale of individual line segments, as required 'to the extent possible' under CM 22-07. Segment-level reporting has increased in recent years but there are substantial differences in the level of VME data reporting provided from different vessels.

3.3 The Working Group considered WG-EMM-11/10 which described a proposal to designate two VMEs to protect areas of dense stalked crinoid communities observed on isolated knolls in the vicinity of Admiralty Seamount (in SSRU 881G) using towed camera deployments as part of the New Zealand IPY survey in 2008. Stalked crinoids are identified as a VME taxon on the basis of rarity/uniqueness, fragility, lack of adult motility and longevity (SC-CAMLR-XXVIII, Annex 10, Table 1). The paper included supplemental information in the form of a peer-reviewed publication (Bowden et al., 2011) describing the extreme uniqueness of these assemblages (similarly dense communities of stalked crinoids have never before been observed) and their potential high significance for scientific understanding of the evolutionary and biogeographic history of Southern Ocean benthic invertebrate fauna (i.e. these areas are thought to be persistent remnants of a formerly widespread archaic benthic assemblage, with indications of great age). The observed communities bear closer resemblance to fossil strata from the later Paleocene and Eocene eras than to any observed extant community.

3.4 The Working Group agreed that WG-EMM-11/10 described what appear to be extraordinarily rare or unique benthic communities of high scientific significance. The Working Group recalled the advice of WG-EMM-10 regarding appropriate spatial scales and sampling designs on which characterisation of anomalously high abundance/importance/rarity should be based when evaluating VME proposals (SC-CAMLR-XXIX, Annex 6, paragraphs 3.46 to 3.48), and agreed that the area surveyed in the IPY and previous surveys was sufficiently large and sufficiently well stratified to draw meaningful conclusions as to the rarity of the observed communities. The Working Group recommended that the areas proposed be approved by the Scientific Committee for inclusion on the VME registry.

ADVICE TO THE SCIENTIFIC COMMITTEE AND ITS WORKING GROUPS

4.1 The Working Group provided advice to the Scientific Committee and other working groups on the following topics:

(i) Scientific observer coverage –

(a) increasing observer coverage and amount and quality of observer data (paragraph 2.31)

(b) clarification of target coverage rate for sampled hauls in CM 51-06 (paragraphs 2.35 and 2.36)

(c) specification for the requirements of sampling locations on krill vessels (paragraph 2.39)

(d) recommendation for observer logbook form updates and requests for advice from SCIC and WG-IMAF (paragraph 2.42)

(e) technical coordinators to ensure that observers are aware of priorities for krill observers (paragraphs 2.43 and 2.44)

(f) potential conflict between sampling flexibility allowed in the instructions in the *Scientific Observers Manual* and precise requirements of CM 51-06 (paragraph 2.49)

(g) Members deploying national observers report the dates of deployments to the Secretariat prior to the deployment period (paragraph 2.51).

(ii) Escape mortality and green weight –

(a) consider whether uncertainty in catch estimates should be taken into account when comparing catch estimates with catch limits (paragraph 2.58).

(iii) Recruitment variation, B_0 and precautionary yield –

(a) implications of variability in krill recruitment on the decision rules for setting catch limits (paragraphs 2.64 and 2.65).

(iv) Distribution of the trigger limit among statistical subareas –

(a) krill fishing operations in ASMA No. 1 (paragraph 2.84)

(b) factors to be investigated to determine whether the spatial subdivision for protecting predators is effective (paragraph 2.87)

(c) spatial allocation of the trigger level (620 000 tonnes) by subarea in CM 51-07 should be retained until sufficient information is acquired for its revision (paragraphs 2.95 to 2.97).

(v) Krill and fish –

(a) assessment of fish by-catch rates and CV including informing WG-FSA about the outcomes of this assessment (paragraph 2.117)

(b) management of the krill fishery will need to account for spatial concentration of age-class 1+ which is predominately concentrated in near-shore areas (paragraph 2.137)

(c) recommendations from the EU–Netherlands krill workshop reflect key issues of the work in progress of WG-EMM (paragraph 2.140).

(vi) Symposium on Feedback Management of Krill –

(a) schedule to address components for future work to deliver feedback management approaches by 2014 (paragraphs 2.155 and 2.157)

(b) time scales of implementation of feedback management approaches require the catch and distribution of the fishery to match CCAMLR's ability to detect change (paragraph 2.160)

(c) a feedback management approach with some areas closed to fishing (reference areas) and others open to area-specific levels of fishing intensity would allow clearer identification of effects of harvesting (paragraph 2.167)

(d) need for cost-benefit analysis, including possible trade-offs, of specific candidate feedback management approaches, including implications for specific monitoring requirements (paragraphs 2.163 and 2.172)

(e) developing baseline monitoring data with sufficient statistical power from new sites could take more than 10 years to provide clear results from a fishing trial (paragraphs 2.173 and 2.174)

(f) benefits of a staged implementation of the feedback management approach, including choice of indicators and the need to consider long-term changes in the ecosystem (paragraphs 2.179, 2.182 and 2.186).

(vii) CEMP and STAPP –

(a) draft modifications to Methods A3 and A9 for consideration at WG-EMM-12 (paragraph 2.196)

(b) progress of WG-EMM-STAPP to estimate abundance and consumption of krill by pack-ice seals, fur seals, penguins and flying seabirds in Area 48 (paragraph 2.199)

(c) need to find a means of engaging with the broader community of scientists on status and trend flying seabirds (paragraph 2.203)

(d) the value of time-series data collected in CEMP programs and encouragement for new approaches to funding to develop new programs (paragraphs 2.212 and 2.213).

(viii) Fishing vessel research –

(a) need to ensure that CCAMLR is able to obtain the maximum benefit from fishing-vessel-based acoustic data on krill, including request for advice from SG-ASAM (paragraphs 2.225 and 2.226).

(ix) Vulnerable marine ecosystems –

(a) the areas proposed in WG-EMM-11/10 be approved by the Scientific Committee for inclusion on the VME registry (paragraph 3.4).

(x) Secretariat's Strategic Plan –

(a) revised Strategic Plan is very useful in clarifying the roles in providing science support from the Secretariat across all working groups and the Scientific Committee (paragraph 6.3).

(xi) Observers at working group meetings –

(a) issues considered in discussion by the Working Group that the Scientific Committee might include in its consideration of this subject (paragraphs 6.5 and 6.6)

(b) benefit of a non-technical summary of the outcomes of working group meetings and the discussions in the Scientific Committee (paragraph 6.7).

(xii) WG-EMM Convener

(a) new Convener to be found to co-convene WG-EMM-12 with Dr Watters (paragraph 6.11).

FUTURE WORK

5.1 The Working Group noted that it had embarked on an ambitious plan of work and that the developments to build science capacity in the Secretariat, along with the opportunities available from the CCAMLR General Science Capacity Special Fund, could provide important support in progressing this work subject to the priorities agreed by the Scientific Committee.

5.2 Dr D. Agnew (Scientific Committee Chair) reminded the Working Group of the CCAMLR Scientific Scholarship Scheme and encouraged participants to review the priorities for future work and relay these to prospective applicants to the scheme.

5.3 The Working Group agreed that advice from SG-ASAM on the potential costs and logistical support required for processing of acoustic data collected from fishing vessels would be helpful in determining if this could be a suitable area of work to be supported by the General Science Capacity Special Fund.

5.4 The following items of future work were identified during the course of the meeting:

(i) Notifications for 2011/12 –

(a) Members to report each year updates on conversion factors to be used for the coming season (paragraph 2.12)

(b) Chile to advise the Scientific Committee in 2011 of the name of the vessel notified for krill fishing in 2012 (paragraph 2.13).

(ii) Analysis of data from the krill fishery –

(a) CPUE analysis, including checking validity of extreme outliers and choice of fixed and random effects (paragraphs 2.20, 2.22 and 2.24)

(b) authors of WG-EMM-11/P3 encouraged to re-submit the paper in English for further consideration (paragraph 2.26)

(c) wider seasonal and vessel coverage analysis of krill length and fish by-catch (paragraph 2.28).

(iii) Scientific observer coverage –

(a) provide observer coverage data in format directly comparable to target observer coverage rates in CM 51-06 (paragraph 2.33)

(b) revisions to observer logbook forms (paragraphs 2.37 and 2.42)

(c) production of maps of fishery and observation coverage distribution for use by the Scientific Committee in 2011 (paragraph 2.50)

(d) analyses prior to WG-EMM-12 on future requirements for observations in the krill fishery (paragraph 2.52).

(iv) Distribution of the trigger limit among statistical subareas –

(a) production of maps of fishery by fine-scale rectangle in Area 48 (paragraph 2.78)

(b) examination of CEMP data relevant to the overlap of predator foraging and fisheries in the Bransfield Strait (paragraph 2.94).

(v) Other issues related to spatial management of the krill fishery –

(a) Secretariat to work with the UK Delegation to identify CCAMLR mapping requirements and potential delivery (paragraph 2.101).

(vi) Views of the ecosystem –

(a) Krill predators:

- combined analysis Adélie penguin survival data taking into account different methods for marking birds (paragraph 2.110)

(b) Krill and fish:

- comparison of size and age composition of *C. gunnari* in krill by-catch and bottom trawl surveys around South Georgia (paragraph 2.116)

(c) Krill biology and survey results:

- examination of correlations in monitoring data from the Antarctic Peninsula and South Georgia (paragraph 2.131)

- comparison of the use of different recruitment indices (paragraph 2.132).

(vii) Symposium on feedback management of krill –

(a) schedule for considering components to fully developed candidate feedback management approaches by 2014 (paragraph 2.157).

(viii) CEMP and STAPP –

(a) draft modifications to Methods A3 and A9 for consideration at WG-EMM-12 (paragraph 2.196)

(b) liaise with scientists within SCAR and Birdlife International on predator foraging distribution to assess areas of common interest (paragraph 2.206).

(ix) Integrated assessments for krill –

(a) development of an integrated assessment model for krill (paragraph 2.217).

(x) Fishing vessel research –

(a) addition of data from 120 kHz and choice of survey design in pilot study to use krill fishing vessel to collect acoustic data (paragraph 2.224)

(b) request for advice from SG-ASAM in 2012 (paragraph 2.225).

5.5 The Working Group recalled its decision last year (SC-CAMLR-XXIX, Annex 6, paragraph 5.11) to consider the following items at WG-EMM-12:

(i) MPAs – by 2012, submit proposals on an RSMPA to the Commission

(ii) krill and krill predators –
(a) integrated assessment
(b) feedback and spatial management
(c) decision rules and climate change.

It also recalled that consideration of these issues would be contingent on the progress made on other items during 2011 and the priorities of the Scientific Committee.

OTHER BUSINESS

Secretariat's Strategic Plan

6.1 Mr Wright introduced WG-EMM-11/9 which provided an update on the development of a revised Strategic Plan for the CCAMLR Secretariat. He noted that the process to revise the Strategic Plan had been informed by the Independent Review of the Secretariat's Data Management Systems which was approved by the Commission last year (CCAMLR-XXIX, paragraphs 3.5 and 3.10). He outlined the key outcomes of the review which was completed in early 2011 (CCAMLR-XXX/5). The outcomes of the two reviews included proposals to enhance science and data management support from the Secretariat to address priority areas in the work of the Scientific Committee.

6.2 The Working Group noted the

- proposal to change the job titles of the Science Officer to the 'Science Manager' and Scientific Observer Data Analyst to the 'Scientific Observer Program Coordinator' to better reflect the roles and responsibilities of these positions
- terms of reference for an Analytical Support Officer position within Science Services
- restructuring and revised administrative processes for the Data Centre.

6.3 The Working Group agreed that the revised Strategic Plan provided a clear and concise description of the structure and function of the Secretariat and was very useful in clarifying the roles in providing science support from the Secretariat across all working groups and the Scientific Committee. It agreed that the Analytical Support Officer would be very useful to the work of the Working Group.

Participation of Observers in working group meetings

6.4 Following the request of the Scientific Committee (SC-CAMLR-XXIX, paragraph 15.19), Dr Watters presented a potential mechanism to facilitate the engagement of Observers (e.g. NGOs) in working group meetings. This mechanism would provide for a single representative of those international organisations that are invited to attend the Scientific Committee to attend working group meetings. That representative would contribute to discussion only at the direct request of a Member and would not provide written statements for the report of the meeting. The submission of papers to working group meetings would be subject to the agreement of the Convener and the Chair of the Scientific Committee that the paper is scientifically relevant. All Observers would be bound by a confidentiality agreement and any breach of that agreement would result in permanent disbarment of that Observer organisation from all working group meetings.

6.5 The Working Group thanked Dr Watters for this presentation that provided a good basis for discussing this issue. In the subsequent discussion the Working Group considered:

(i) the inclusion of fishing industry representatives in some delegations had brought important insights into the operation of fisheries that provided important context for scientific discussions

(ii) the potential positive contribution that the presence of Observers might bring to the work of the working groups, including increasing transparency and awareness of processes in those groups

(iii) the long history of positive engagement by Observers at the Scientific Committee has demonstrated interest in, and knowledge of, CCAMLR

(iv) an acknowledgement that understanding the discussion of science issues at the Scientific Committee in the absence of participation in the working groups is challenging

(v) whether there should be any requirement for academic qualification for the Observer representatives attending working group meetings

(vi) increasing the understanding of meetings by Observers that have a genuine interest in CCAMLR would be beneficial

(vii) while the science used by CCAMLR is robust to external review, there were sometimes sensitive issues under discussion (including both data and analyses) that require confidentiality and discretion and the involvement of Observers at those times would need to be carefully considered.

6.6 In the discussion of these issues, the Working Group did not seek to find consensus on each issue but simply highlighted them as items that the Scientific Committee might include in their consideration of this subject.

6.7 The Working Group agreed that providing a non-technical summary of the outcomes of working group meetings would be useful in informing a wider audience of the scientific discussions undertaken in the subsidiary bodies of the Scientific Committee and asked the Scientific Committee to consider a mechanism to produce such a summary.

ICED and SCAR

6.8 Dr Constable provided an update to the Working Group on work being undertaken in the IMBER program on Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED). Three main projects of interest to CCAMLR include the development of ecosystem models, consideration of regional differences in food webs and the development of monitoring climate change impacts on the Southern Ocean ecosystems. In the case of the latter, the ICED project on the Southern Ocean Sentinel aims to develop a program of multinational assessments of current and future ecosystem change in the region arising from climate change. A second workshop is to be held in Hobart, Australia, from 7 to 13 May 2012, to further discuss a collective approach to the Southern Ocean Sentinel, including optimal locations for routine monitoring and places where integrated studies might be useful for this task. The expectation is that these discussions will further add to the development of the biological monitoring envisaged for the SOOS.

6.9 The Working Group noted that the work of CEMP could be an important contributor of integrated studies and time series to any programs to monitor and measure change in the Southern Ocean.

6.10 Dr Reid provided an update to the Working Group on the establishment of a SCAR–CCAMLR Action Group, including an enhancement of the role of SCAR in providing advice to CCAMLR on climate change through the SCAR ACCE report and the proposed annual updates (SC-CAMLR-XXIX, paragraph 10.5). The SCAR Open Science Conference will be held from 13 to 25 July 2012, Portland, Oregon, USA, and CCAMLR has been invited to provide input into planning of a plenary session on science and policy.

Succession planning

6.11 Dr Watters reiterated his position as stated last year (SC-CAMLR-XXIX, Annex 6, paragraph 6.14) that 2012 would be his final year as the Convener of WG-EMM. He offered to co-convene the meeting next year with a potential successor should anyone wish to engage in this process. At the time of the meeting there was no indication of a potential successor.

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

7.1 The report of the meeting of WG-EMM was adopted.

7.2 In closing the meeting, Dr Watters thanked all participants for their contributions to the meeting that had set in place the exciting prospect of making tangible progress towards a feedback management procedure for the krill fishery. He also extended the gratitude of all participants to the local organisers, to NFRDI and MIFAFF, and thanked them for their efficiency and generosity leading up to and during the meeting. He thanked the Secretariat for its support and, in particular, thanked those Secretariat staff who provided remote support for the meeting.

7.3 Dr Constable, on behalf of the participants, thanked Dr Watters for the amount of thought and preparation that he put into the meeting and how this had allowed some challenging issues to be addressed in a manner that successfully engaged all participants.

7.4 The meeting was closed.

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Table 1: Comments and actions recommended to be taken on the krill observer data e-forms.

Form	Comments	Action taken, or to be taken
K1		Retain as is.
K2	This information duplicates the information provided through the krill fishery notification process.	Retain the format. Observers still need to collect the details on board.
K3	Use of term 'Haul Number' is unclear for continuous trawlers. Haul number required here is number of 2-hour segments for observation and C1 data reporting. Sequence of fishing detail to be entered is not consistent with C1 form. Clarify why horizontal opening of nets is required here as it is already in K2. Necessity of K3(ii) form given the application of fish by-catch sampling protocol, however, we need to somehow record invertebrate by-catch.	Introduce a new term 'Haul ID Number'. One haul ID Number would be allocated to a haul for conventional haul, and one 2-hour reporting period (haul unit) for continuous fishing system. Revise the sequence of data entry on the form consistent with the C1 form.
K4	Weighing individual krill at sea is difficult to deliver reliable data. The term sample number is unclear. The term 'Krill colouration' is not an accurate description of this specific observation, and has been translated incorrectly into other languages.	Weighing individual krill should not be required. Use new term 'Haul ID Number' and 'Sample ID Number'. Translation of 'Krill colouration' to other languages needs to be checked. Insert pictures of krill with green stomach and clear stomach. Remove species code column. A new flow chart for maturity/stage identification in the *Scientific Observers Manual*.
K5	Does not allow collection of quantitative data.	Remove this form.
K6	Information on fleet dynamics can be obtained from other means (VMS, fishing operators).	Remove
K7	Could be combined with K11.	Request WG-IMAF's advice how K7 and K11 can be combined to give an IMAF form.
K8	Many of the descriptions are not relevant to krill fishery.	Retain as is. This format needs to be consistent with other fisheries.
K9	Is it important to retain this form? Should the observer register all vessels or only IUU vessels? Is it necessary to report the vessel more than once per day (it may be time consuming)?	Request advice from SCIC on the specific information that it needs to be reported by observers, as well as advice on how the observers show/determine if a vessel is an IUU vessel?
K10	What is the utility of this form?	Analysis of K10 data to review its utility.
K11	Could be combined with K7.	Request WG-IMAF's advice how K7 and K11 can be combined to give an IMAF form.
K12	Information on length of individual by-catch fish needs to be included.	Add length column to each of the sub-sampling rows.

Table 2: Number of hauls undertaken for each specific observation by subarea and by month during 2009/10. Percentage coverage is based on number of hauls for conventional, or numbers of 2-hour reporting periods used in the continuous fishing system, and is presented in brackets. Explanation for the column headers: Total number of hauls – number of hauls or 2-hour reporting periods for continuous fishing system; Hauls with observer on board vessel – number of hauls for both conventional and continuous fishing system; Number of hauls where observers collected data – number of hauls or 2-hour reporting periods for continuous fishing system that were sampled by observers; Hauls with krill length measured – number of hauls or 2-hour reporting periods for continuous fishing system sampled for krill length-frequency data; Hauls with IMAF data – number of hauls or 2-hour reporting periods for continuous fishing system sampled for seabird/marine mammal mortality; Hauls with warp strike data – number of hauls or 2-hour reporting periods for continuous fishing system sampled for warp strike; K5 finfish by-catch – number of hauls or 2-hour reporting periods for continuous fishing system observed for finfish by-catch using K5 form; Fish sampling form 2009 or 2010 – number of hauls or 2-hour reporting periods for continuous fishing system observed for fish using fish sampling form 2009 or 2010.

Season	Subarea	Month	Total number of hauls	Hauls with observer on board vessel	Number of hauls where observer collected data	Hauls with krill length measured	Hauls with IMAF data	Hauls with warp strike data	K5 finfish by-catch	Fish sampling form 2009 or 2010
2010	48.1	12	37	37	36 (97)	5 (14)	37(100)	36 (97)	8 (22)	0 (0)
		1	26	28	21 (75)	18 (64)	18 (64)	13 (46)	3 (11)	0 (0)
		2	141	114	71 (62)	2 (2)	57 (50)	13 (11)	0 (0)	2 (18)
		3	807	555	308 (55)	63 (11)	228 (41)	41 (7)	42 (8)	66 (12)
		4	1716	1224	436 (36)	149 (12)	165 (13)	127 (10)	57 (5)	109 (9)
		5	1535	530	219 (41)	88 (17)	38 (7)	54 (10)	39 (7)	65 (12)
		6	1945	761	255 (34)	64 (8)	82 (11)	119 (16)	74 (10)	136 (18)
		7	1746	855	152 (18)	50 (6)	72 (8)	127 (15)	84 (10)	142 (17)
		8	868	661	7 (1)	24 (4)		44 (7)	9 (1)	59 (9)
		9	908	833	23 (3)	38 (5)	18 (2)	65 (8)	14 (2)	74 (9)
		10	145	145	17 (12)	7 (5)	16 (11)	22 (15)	2 (1)	17 (12)
	48.2	1	508	502	36 (7)	28 (6)	35 (7)	105 (21)	32 (6)	33 (7)
		2	1152	855	156 (18)	77 (9)	95 (11)	231 (27)	44 (5)	58 (7)
		3	1130	886	217 (24)	59 (7)	72 (8)	203 (23)	40 (5)	85 (10)
		4	220	220	2 (1)	4 (2)	0 (0)	37 (17)	7 (3)	16 (7)
		10	176	175	1 (1)	20 (11)	0 (0)	25 (14)	7 (4)	17 (10)
	48.3	5	293	293	28 (10)	11 (4)	0 (0)	56 (19)	6 (2)	35 (12)
		6	122	121	3 (2)	4 (3)	0 (0)	10 (8)	2 (2)	11 (9)
Percent coverage	Average				(27.6)	(10.5)	(18.6)	(20.7)	(5.7)	(9.8)
	Median				(18.0)	(6.3)	(8.3)	(15.0)	(4.6)	(9.3)
	Minimum				(0.6)	(1.8)	(0.0)	(6.7)	(0.0)	(0.0)
	Maximum				(97.3)	(64.3)	(100.0)	(97.3)	(21.6)	(17.9)

Table 3: Illustrative estimates of SSMU- and subarea-specific krill consumption by fish, whales, penguins and fur seals, and krill biomass calculated from listed source papers. SSMU-specific krill biomass is calculated as the relevant stratum density from WG-EMM-11/20 multiplied by SSMU area following Hewitt et al. (2004).

Subarea	SSMU		Krill consumption (10^6 t.y^{-1})			Krill biomass (10^6 t)		
	No.	Name	SSMU	Subarea	Subarea (coastal only)	SSMU	Subarea	Subarea (coastal only)
			Hill et al. (2007)			WG-EMM-11/20		
48.1	1	APPA	8.04			8.27		
48.1	2	APW	1.48			4.77		
48.1	3	APDPW	0.49			2.05		
48.1	4	APDPE	0.96			2.12		
48.1	5	APBSW	1.17			2.86		
48.1	6	APBSE	1.00			3.73		
48.1	7	APEI	1.37			4.80		
48.1	8	APE	3.10	17.61	9.57	7.98	36.58	28.31
48.2	9	SOPA	10.06			25.46		
48.2	10	SOW	0.27			4.97		
48.2	11	SONE	0.56			3.27		
48.2	12	SOSE	1.61	12.51	11.34	4.78	38.49	13.02
48.3	13	SGPA	11.06			28.94		
48.3	14	SGW	5.40			1.43		
48.3	15	SGE	1.24	17.70	14.60	1.82	32.18	3.24

Table 4: Four possible classes of candidate feedback management approaches for the krill fishery in Area 48.

The table gives a preliminary assessment of some of the costs and benefits associated with these classes of feedback management but this assessment might change as more information becomes available.

The four classes of feedback management approach identified in the table are the four possible combinations of two ways of managing fishing effort and catches in a management procedure and for gaining insight into ecosystem responses. These are:

(i) STRUCTURED FISHING: the manipulation of fishing effort (distribution, catch and/or intensity) for learning about ecological responses and/or to achieve management objectives.

(ii) REFERENCE AREA MONITORING: the use of monitored *reference* areas in which no fishing is permitted as the basis for understanding effects in contrasting *fished* areas.

<table>
<tr><th></th><th></th><th>FULLY FLEXIBLE FISHING</th><th>STRUCTURED FISHING</th><th>REFERENCE AREA MONITORING</th><th>REFERENCE AREA MONITORING with STRUCTURED FISHING</th></tr>
<tr><td>1</td><td>REFERENCE AREA MONITORING</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td></tr>
<tr><td>2</td><td>STRUCTURED FISHING</td><td>No</td><td>Yes</td><td>No</td><td>Yes</td></tr>
<tr><td>3</td><td>Attribution of change to likely causes</td><td>Attribution impossible</td><td>Attribution possible but less likely</td><td>Attribution possible and likely</td><td>Attribution possible and most likely</td></tr>
<tr><td colspan="6">The potential for evidence-based attribution of observed changes in ecosystem state to fishery impacts depends on the indicators, the field monitoring design and analytical methods used. It is most likely to increase with the use of either structured fishing or reference area monitoring but would be highest when both methods are used. The power of attribution is likely to increase with replication of the reference areas.</td></tr>
<tr><td>4</td><td>Allows krill assessment</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td colspan="6">Each of the classes allow assessment of the krill stock if they incorporate suitable data collection and analyses.</td></tr>
<tr><td>5</td><td>Areas that could potentially provide fishery-dependent indicators</td><td>All areas</td><td>All areas</td><td>Fished areas</td><td>Fished areas</td></tr>
<tr><td colspan="6">Fishery-dependent indicators (e.g. CPUE) are derived from commercial fishing activities and, as such, can only be obtained from areas where fishing is permitted. This excludes reference areas and may also exclude other areas subject to short- to medium-term restrictions under some structured fishing designs.</td></tr>
<tr><td>6</td><td>Areas that could potentially provide fishery-independent indicators and assessments</td><td>All areas</td><td>All areas</td><td>All areas</td><td>All areas</td></tr>
<tr><td colspan="6">Fishery-independent indicators can be obtained from all areas, including those subject to restrictions on fishing. These data might be collected using fishing vessels as platforms.</td></tr>
</table>

(continued)

Table 4 continued

<table>
<tr><th></th><th></th><th>FULLY FLEXIBLE FISHING</th><th>STRUCTURED FISHING</th><th>REFERENCE AREA MONITORING</th><th>REFERENCE AREA MONITORING with STRUCTURED FISHING</th></tr>
<tr><td>7</td><td>Basis for diagnosis of effects of fishing</td><td>Model expectation – fished area comparisons</td><td>Model expectation – fished area comparisons</td><td>Model expectation – fished area and fished area to reference area comparisons</td><td>Model expectation – fished area and fished area to reference area comparisons</td></tr>
<tr><td colspan="6">Comparisons between model projections of the ecosystem state and observations of the actual state might be used to indicate fishing impacts in each class. Those classes that incorporate reference areas allow comparisons of the actual state in fished and contrasting reference (unfished) areas. Reference areas can also be used to test model predictions.</td></tr>
<tr><td>8</td><td>Can detect long-term change in krill productivity relative to what it would be without fishing</td><td>No</td><td>No</td><td>Maybe
(if some krill is isolated from the effects of fishing)</td><td>Maybe
(if some krill is isolated from the effects of fishing)</td></tr>
<tr><td colspan="6">Empirical measurements of long-term change in krill productivity must be obtained from areas that are mostly unaffected by fishing. Reference areas can provide these conditions only if they are not influenced over time by fishing elsewhere in the system.</td></tr>
<tr><td>9</td><td>Environmental indicators for estimating krill productivity relative to what it would be without fishing</td><td>Yes
(proxies would need to be estimated from pre-fishing baseline)</td><td>Yes
(proxies would need to be estimated from pre-fishing baseline)</td><td>Yes
(proxies from pre-fishing baseline and possible direct estimates using comparisons between fished and reference areas)</td><td>Yes
(proxies from pre-fishing baseline and possible direct estimates using comparisons between fished and reference areas)</td></tr>
<tr><td colspan="6">Indicators of environmental conditions (e.g. temperature, pH) could be obtained in each of the classes. These indicators could be used as proxies to judge whether the ecosystem has changed independently of fishing. Models of the relationship between environmental indicators and krill and/or its predators will be needed to establish the significance of such changes. Those relationships could be identified through comparison with data from the pre-fishing reference period (i.e. from the 'current' system, paragraph 2.187). However, reference area monitoring would be needed to determine if the identified relationships have changed over time.</td></tr>
<tr><td>10</td><td>Potential basis for decision rules</td><td>Cumulative changes</td><td>Cumulative changes</td><td>Cumulative plus attributed changes</td><td>Cumulative plus attributed changes</td></tr>
<tr><td colspan="6">The different classes have the potential to provide different levels of information for use in decision-making. Reference area monitoring facilitates observation-based comparisons between fished and unfished ecosystem states. It therefore has the potential to attribute change to fishing impacts and potentially allows decision rules that use the 'current' unfished state as a reference point, depending on the degree of connectivity among areas. Without reference area monitoring it is not possible to attribute change to fishery impacts, but it is still possible to detect the cumulative change in the system due to all drivers. In this case, an appropriate reference point may be the 'expected' state of the unfished system from model projections. Structured fishing could help to reduce uncertainty in these reference points.</td></tr>
</table>

(continued)

Table 4 continued

		FULLY FLEXIBLE FISHING	**STRUCTURED FISHING**	**REFERENCE AREA MONITORING**	**REFERENCE AREA MONITORING with STRUCTURED FISHING**
11	**Potential impact on fishery flexibility**	Low	Moderate: requirement to participate in structured fishing	Moderate: long-term closed areas	High: long-term closed areas, requirement to participate in structured fishing
Feedback management implies trade-offs between the flexibility of the fishery to operate anywhere in the managed area versus objectives relating to conservation, orderly development and the costs of monitoring. The use of structured fishing and restricted area monitoring limits this flexibility. However this trade-off must be balanced against other potential costs of fully flexible fishing associated with the continuing uncertainty in the indicators that this class can provide.					

Table 5: Projected progress in work by WG-EMM-STAPP towards estimation of krill consumption by predator groups in SSMUs.

	Pack-ice seals	Fur seals	Penguins	Flying seabirds
Breeding population	2009	2012	2012	2016
Non-breeding population	2009	2012	2013	2016
Diet	2009	2012	2011	2016
Energetics	2009	2012	2013	2016
Total krill consumption	2009	2012	2013	2016
Foraging distribution	2009	2016	2016	2016

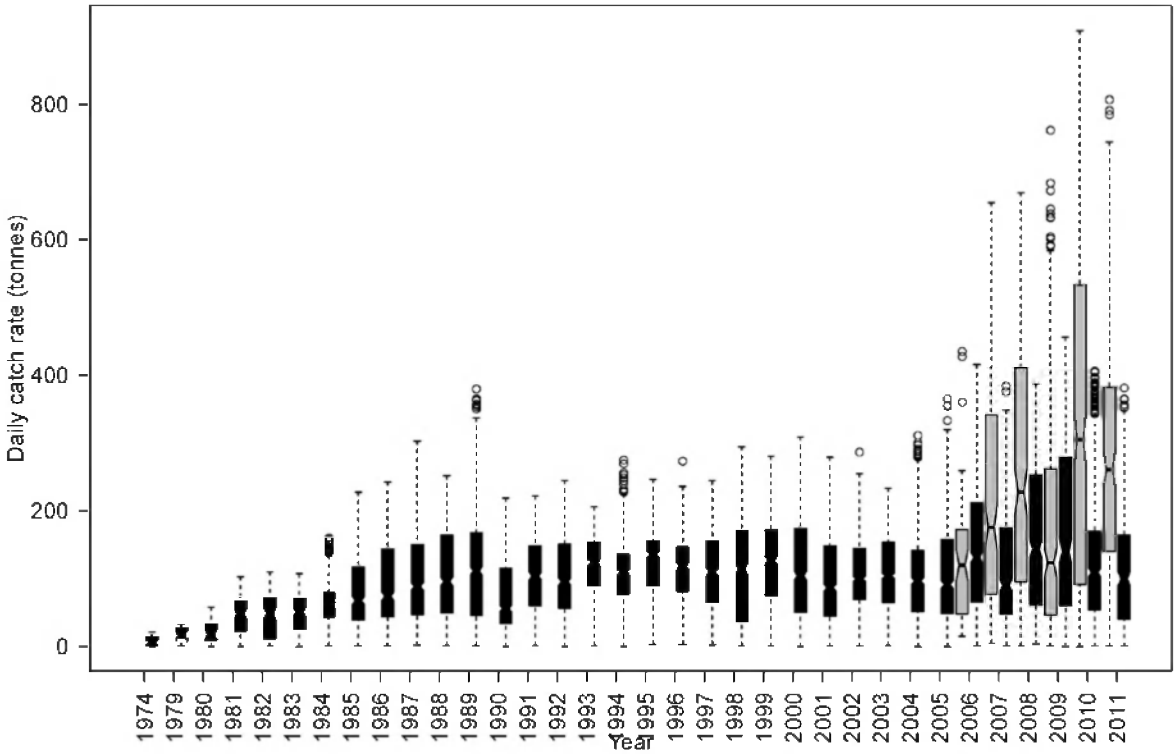

Figure 1: Daily catch of krill (tonnes per vessel) reported from Area 48 since 1980/81. Source: C1 data. Box plot – 75 percentile, solid dot – mean, vertical dotted line – 95 percentile, open circles – data points outside 95 percentiles. Black – conventional trawl, grey – continuous fishing system.

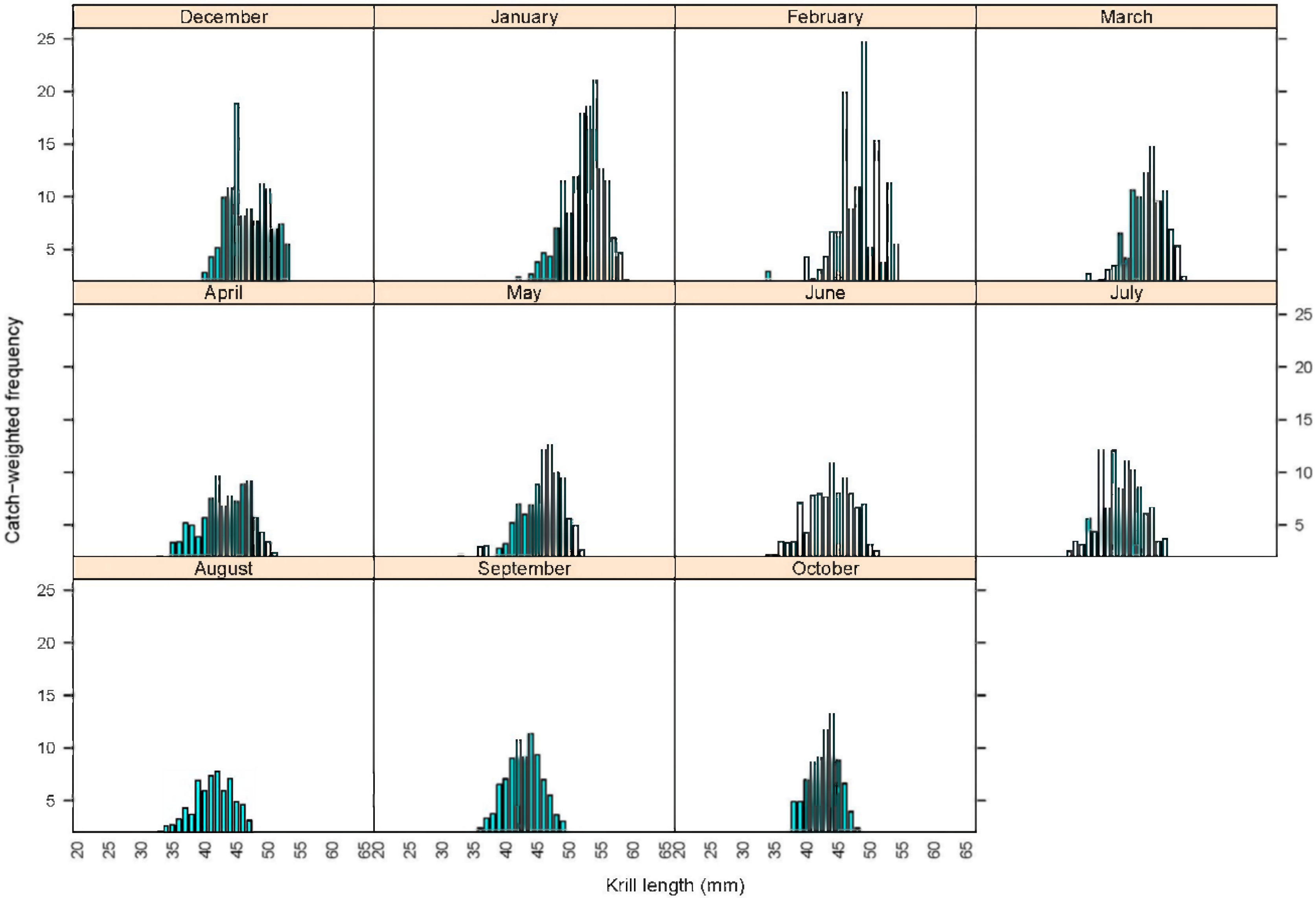

Figure 2(a): Length-frequency distribution by month in Subarea 48.1 for 2009/10.

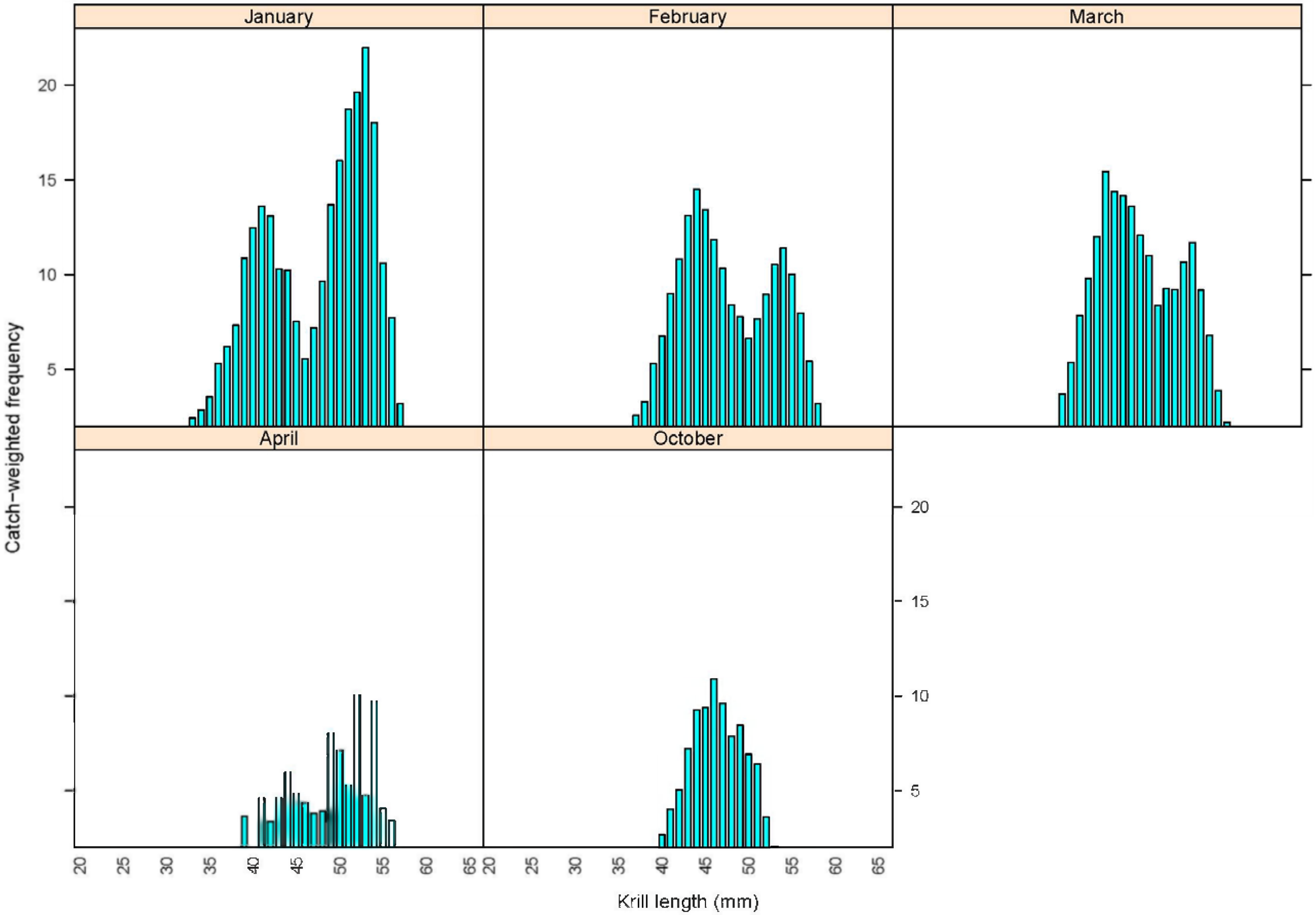

Figure 2(b): Length-frequency distribution by month in Subarea 48.2 for 2009/10.

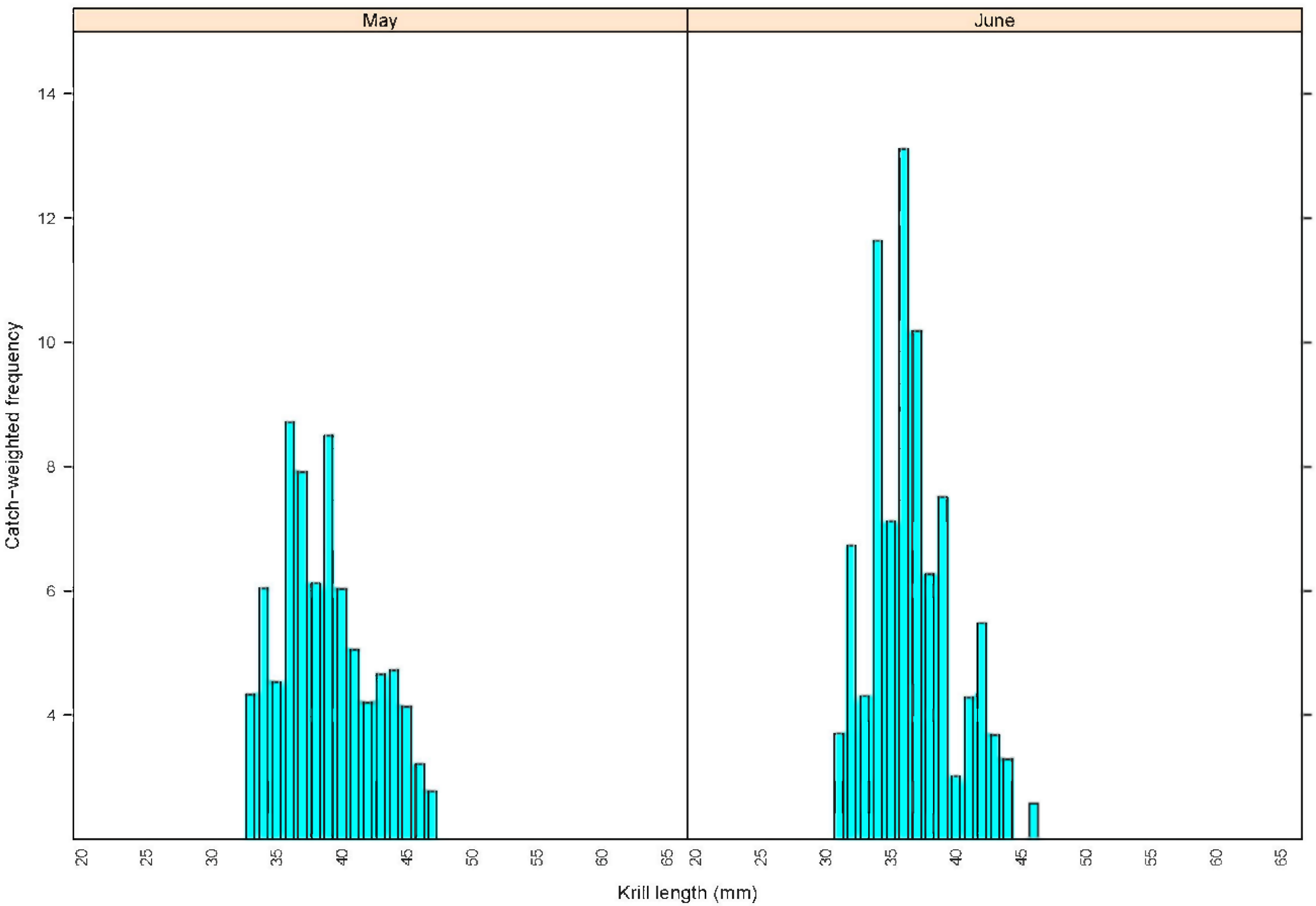

Figure 2(c): Length-frequency distribution by month in Subarea 48.3 for 2009/10.

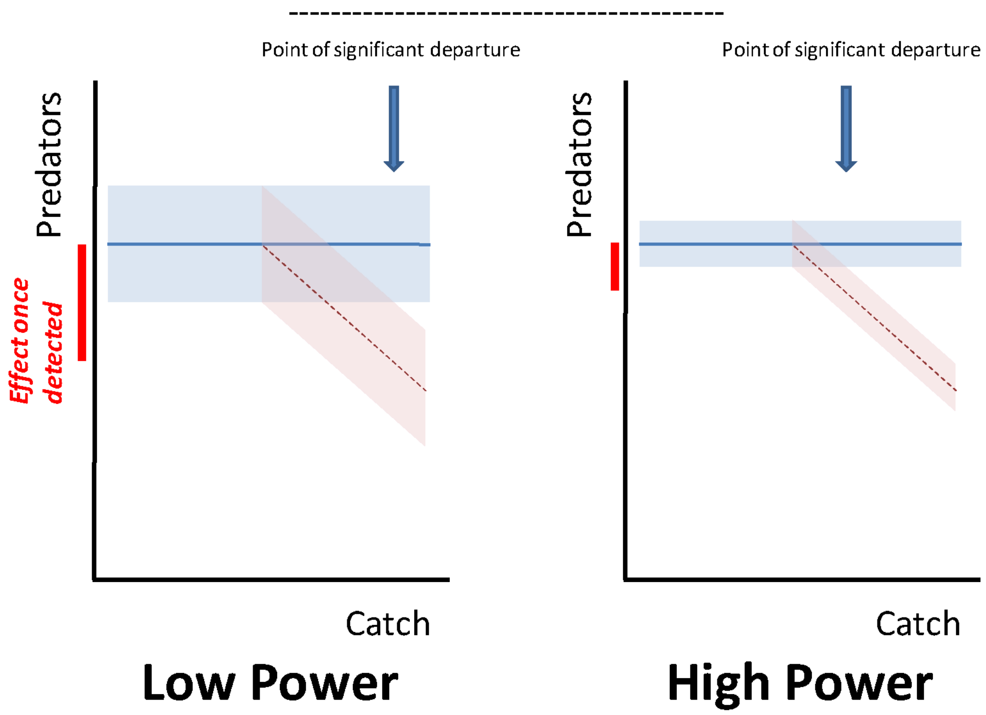

Figure 3*: Illustration of the effects of statistical power on detecting a significant change in a predator parameter given a level of catch and the error in estimating the predator parameter. Solid blue line indicates a scenario of no effect of catch. Solid red line indicates an effect of catch after a threshold is reached. The blue and red shading reflects the confidence intervals surrounding estimates of the predator parameter. The arrow indicating the point of significant departure is where a significant effect of the catch is likely to be detected. The red bars indicate the effect of the catch once detected. Statistical power for correctly determining that no effect has occurred increases as confidence intervals are reduced. This is illustrated by comparing the left and right plots.

* This figure is available in colour on the CCAMLR website.

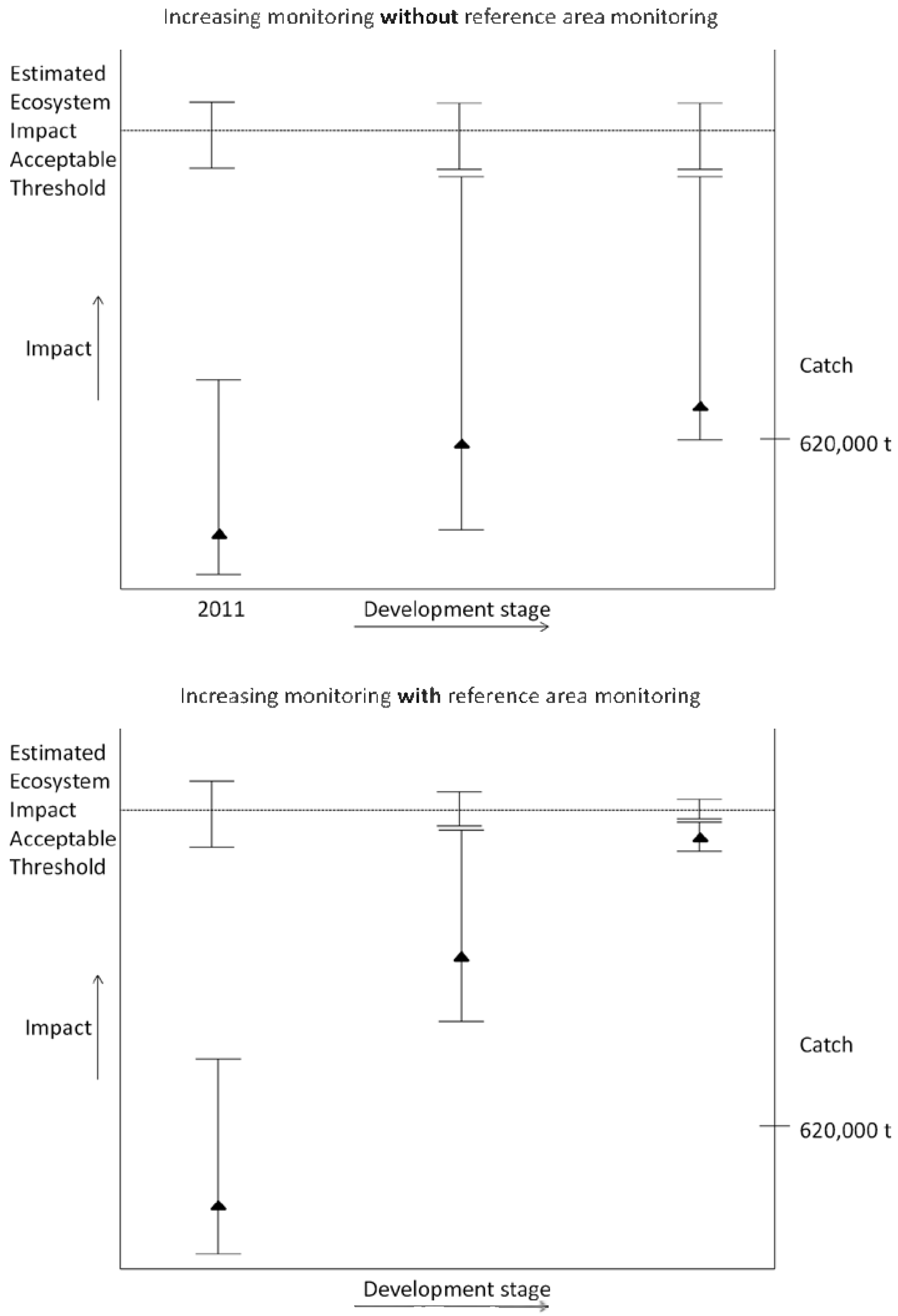

Figure 4: Potential revisions to catch limits and uncertainty under feedback management. The x-axis characterises possible stages in the development of a feedback management approach. The left axis shows the level of impact of a stage in the fishery, which also corresponds to a catch limit (right axis)*. Triangles show the estimate of impact with error bars. The horizontal line shows a putative limit of acceptable impacts. The error bars reflect the degree of understanding as to what this might be and how well it is estimated. Learning more about the system could allow revision of catch limits over time as our understanding increases. Reference area monitoring could allow attribution of ecosystem change to fishery versus other effects. This could reduce the uncertainty in assessments of fishery impacts, potentially allowing the catch to rise further and faster while maintaining a precautionary approach.

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* The relationship between impact and catch limit may not be a simple linear relationship as indicated here.

APPENDIX A

LIST OF PARTICIPANTS

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(Busan, Republic of Korea, 11 to 22 July 2011)

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APPENDIX B

AGENDA

Working Group on Ecosystem Monitoring and Management
(Busan, Republic of Korea, 11 to 22 July 2011)

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: recruitment variation, B_0, and precautionary yield; data from the fishery and scientific observer system; escape mortality; green weight; distribution of the trigger limit among statistical subareas; 'Views of the Ecosystem'
   2.2 Issues for the future: Symposium on Feedback Management, CEMP and STAPP; integrated assessment; 'fishing vessel science and surveys'

3. Vulnerable marine ecosystems – review of notifications made under Conservation Measure 22-06

4. Advice to the Scientific Committee and its working groups

5. Future work

6. Other business

7. Adoption of the report and close of the meeting.

LIST OF DOCUMENTS

Working Group on Ecosystem Monitoring and Management
(Busan, Republic of Korea, 11 to 22 July 2011)

WG-EMM-11/1	Draft Preliminary Agenda for the 2011 Meeting of the Working Group on Ecosystem Monitoring and Management (WG-EMM)
WG-EMM-11/2	List of participants
WG-EMM-11/3	List of documents
WG-EMM-11/4 Rev. 1	Report from the WS: integrated krill monitoring in the CCAMLR Subarea 48.2
WG-EMM-11/5	Krill fishery report: 2011 update Secretariat
WG-EMM-11/6	CEMP indices: 2011 update Secretariat
WG-EMM-11/7	Summary of VME notifications made under Conservation Measures 22-06 and 22-07 Secretariat
WG-EMM-11/8	Summary of krill notifications for krill fisheries 2011/12 Secretariat
WG-EMM-11/9	The Secretariat review of the Strategic Plan, associated activities and outcomes Secretariat
WG-EMM-11/10	Dense stalked crinoid dominated assemblages on admiralty seamount in the northern Ross Sea (SSRU 881G): two potential VMEs C.D. Jones (USA), D.A. Bowden (New Zealand) and S. Schiaparelli (Italy)
WG-EMM-11/11	Summary of observations aboard krill trawlers operating in the Convention Area Secretariat
WG-EMM-11/12	A simulation study to determine the relationship between sampling intensity and precision when estimating availability functions for breeding Adélie penguin colonies J. McKinlay and C. Southwell (Australia)

WG-EMM-11/13	Antarctic krill demography and population dynamics west of the Antarctic Peninsula in 2010/11 V. Siegel (Germany), C. Reiss (USA), K. Dietrich (USA), M. Haraldsson (Sweden) and G. Rohardt (Germany)
WG-EMM-11/14	Selectivity of conventional and continuous techniques of krill fishery D. Sologub (Russia)
WG-EMM-11/15	Preliminary results of the experiment on definition of Antarctic krill mortality rate in fishery L. Pshenichnov and K. Vyshniakova (Ukraine)
WG-EMM-11/16	Antarctic krill and climate change H. Flores (Netherlands), A.S. Atkinson (UK), E. Bravo Rebolledo (Netherlands), V. Cirelli (Argentina), J. Cuzin-Roudy (France), S. Fielding (UK), J.A. van Franeker (Netherlands), J.J. Groeneveld (Netherlands), M. Haraldsson (Sweden), S. Kawaguchi (Australia), B.A. Krafft (Norway), A. Lombana (USA), E. Marschoff (Argentina), B. Meyer (Germany), G. Milinevsky (Ukraine), S. Nicol (Australia), E.A. Pakhomov (Canada), A.P. Van de Putte (Belgium), C. Reiss (USA), E. Rombolá (Argentina), K. Schmidt (UK), V. Siegel (Germany), G.A. Tarling (UK), M. Teschke (Germany), H. Tonkes (Netherlands), J.-Y. Toullec (France), P.N. Trathan (UK), N. Tremblay (Germany), R. Werner (AKCP) and T. Werner (Germany)
WG-EMM-11/17	Estimation of management reference points consistent with the catch trigger level for the Antarctic krill fishery in Area 48 T. Peatman, J. Moir Clark and D.J. Agnew (UK)
WG-EMM-11/18	Using ecosystem structure to identify finer-scale SSMUs for oceanic areas in Subareas 48.1 to 48.3 S.L. Hill and J. Silk (UK)
WG-EMM-11/19	Progress with updating of the KRILLBASE analysis A. Atkinson (UK)
WG-EMM-11/20	The ASAM 2010 assessment of krill biomass for Area 48 from the Scotia Sea CCAMLR 2000 Synoptic Survey S. Fielding and J. Watkins (UK) and ASAM participants: A. Cossio, C. Reiss and G. Watters (USA), L. Calise and G. Skaret (Norway), Y. Takao (Japan), X. Zhao (People's Republic of China), D. Agnew (UK) and D. Ramm and K. Reid (CCAMLR Secretariat)
WG-EMM-11/21	Ecosystem services of the Southern Ocean S.M. Grant, S.L. Hill and P.N. Trathan (UK)

WG-EMM-11/22	A GIS of CCAMLR spatial management areas and conservation measures P. Fretwell, S.M. Grant and S.L. Hill (UK) and S. Parker (New Zealand)
WG-EMM-11/23	Preliminary results from the first survey season of Antarctic krill and apex predators with the commercial fishing vessel *Saga Sea* in the South Orkney Islands area 2011 B.A. Krafft, G. Skaret and L. Calise (Norway)
WG-EMM-11/24	Structure of the water masses and krill distribution in the central and eastern parts of the Atlantic Antarctic Area V.N. Shnar and S.M. Kasatkina (Russia)
WG-EMM-11/25	Comparing CEMP indices to inform feedback management of the Antarctic krill fishery J.T. Hinke and G.M. Watters (USA)
WG-EMM-11/26	A re-analysis and update of the Antarctic krill biomass in the South Shetland Islands, through 2011 A. Cossio, C. Reiss and R. Driscoll (USA)
WG-EMM-11/27	Revision of the Conservation Measure 51-07 (2009) interim distribution of the trigger level in krill fishery in Statistical Subareas 48.1, 48.2, 48.3 and 48.4 L. Pshenichnov and G. Milinevsky (Ukraine)
WG-EMM-11/28	Assessment of spatial–temporal dynamics of standardised CPUE for krill fishery in the Area 48 S.M. Kasatkina and P.S. Gasyukov (Russia)
WG-EMM-11/29	Operation pattern of a Japanese commercial krill fishing vessel in the Antarctic Ocean F. Matsumoto and M. Suito (Japan)
WG-EMM-11/30	Update on intersessional work by the Subgroup on Status and Trends Assessment of Predator Populations (WG-EMM-STAPP) C. Southwell, L. Emmerson (Australia), J. Forcada (UK), M. Goebel, J. Hinke, H. Lynch (USA), P. Lyver (New Zealand), J. McKinlay (Australia), N. Ratcliffe (UK), D. Ramm, K. Reid (CCAMLR Secretariat), C. Reiss, W. Trivelpiece, S. Trivelpiece (USA) and P. Trathan (UK)
WG-EMM-11/31	Current abundance of Adélie penguin breeding populations along the Kemp and Mac.Robertson Land coasts, East Antarctica: application of new survey and estimation methods for broad-scale population assessment C. Southwell, J. McKinlay, K. Newbery, L. Emmerson, M. Low, R. Pike, D. Wilson, D. Southwell and L. Einoder (Australia)

WG-EMM-11/32	New regional-scale surveys of the Adélie penguin breeding population in Prydz Bay: a step towards improved estimation of krill consumption in East Antarctica C. Southwell, J. McKinlay, K. Newbery, L. Emmerson and J. Lieser (Australia)
WG-EMM-11/33	Potential phenological responses to environmental variability and change for Adélie penguins L. Emmerson and C. Southwell (Australia)
WG-EMM-11/34	A large-scale survey of Adélie penguin breeding distribution in East Antarctica C. Southwell and L. Emmerson (Australia)
WG-EMM-11/35	Proposal of acoustic survey of Antarctic krill using fishing vessel K. Abe, M. Kiyota, F. Matsumoto and Y. Takao (Japan)
WG-EMM-11/36	Research plan and results of preliminary observation about the possibility of Antarctic krill escapement from a trawl net K. Fujita and S. Hasegawa (Japan)
WG-EMM-11/37	Using automated cameras as a cost-effective means of extending land-based predator monitoring C. Southwell, L. Emmerson and K. Newbery (Australia)
WG-EMM-11/38	Some possible modifications to CEMP Standard Methods A3a, A3b and A9 to allow greater flexibility in the collection and interpretation of breeding population count data C. Southwell (Australia)
WG-EMM-11/39	Analysis of variability of krill size and fish by-catch in Japanese krill fishery based on scientific observer data T. Okuda and M. Kiyota (Japan)
WG-EMM-11/40	Annual changes in species composition and abundance of by-catch fish collected by Japanese krill scientific observers in the north of South Georgia (CCAMLR Subarea 48.3), during austral winter from 2002 to 2008 T. Iwami, K. Taki and M. Kiyota (Japan)
WG-EMM-11/41	Antarctic Peninsula decadal winter temperature anomalies and Antarctic krill variability in the South Atlantic region: preliminary results G.P. Milinevsky, A.V. Grytsai and L.K. Pshenichnov (Ukraine)
WG-EMM-11/42	Optimising the design of large-scale ground surveys of Adélie penguin abundance using virtual simulation in a geographic information system C. Southwell, R. Driessen and S. Candy (Australia)

WG-EMM-11/43 Rev. 1	Modelling Antarctic krill: scale, movement and age-structure D. Kinzey, G. Watters and C. Reiss (USA)
WG-EMM-11/44	Some properties of diagnostics of GLMM model tuning for standardising CPUE indices in the Area 48 using the CCAMLR fishery statistics database P. Gasyukov and S. Kasatkina (Russia)

Other documents

WG-EMM-11/P1	Variability in krill biomass links harvesting and climate warming to penguin population changes in Antarctica W.Z. Trivelpiece, J.T. Hinke, A.K. Miller, C.S. Reiss, S.G. Trivelpiece and G.M. Watters (*Proceedings of the National Academy of Sciences of the United States*, 108 (18) (2011): 7625–7628; published ahead of print 11 April 2011, doi:10.1073/pnas.1016560108)
WG-EMM-11/P2	Occurrence of dwarf minke whales (*Balaenoptera acutorostrata* subsp) around the Antarctic Peninsula J. Acevedo, C. Olavarría, J. Plana, A. Aguayo-Lobo, A. Larrea and L.A. Pastene (*Polar Biol.*, 34 (2011): 313–318, doi: 10.1007/s00300-010-0884-y)
WG-EMM-11/P3	Discrimination of environmental variables that influence the catch per unit effort: the case of the Antarctic krill fishery J.C. Quiroz, R. Wiff, M.A. Barrientos and F. Contreras (*Lat. Am. J. Aquat. Res.*, 39 (1) (2011): 71–81, doi: 10.3856/vol39-issue1-fulltext-7)
WG-EMM-11/P4	Adélie penguin survival: age structure, temporal variability and environmental influences L. Emmerson and C. Southwell (*Oecologia*, in press)
WG-EMM-11/P5	The structure and functioning of marine ecosystem in Argentine Islands waters E.Z. Samyshev (*J. Mar. Ecol.*, 10 (2) (2011): 5–25)
WG-EMM-11/P6	Will krill fare well under Southern Ocean acidification? S. Kawaguchi, H. Kurihara, R. King, L. Hale, T. Berli, J.P. Robinson, A. Ishida, M. Wakita, P. Virtue, S. Nicol and A. Ishimatsu (*Biol. Lett.*, 7 (2) (2011): 288–291, doi:10.1098/rsbl.2010.0777)

WG-EMM-11/P7	Ocean-bottom krill sex S. Kawaguchi, R. Kilpatrick, L. Roberts, R.A. King and S. Nicol (*J. Plankton Res.*, 33 (7) (2011): 1134–1138, doi:10.1093/plankt/fbr006)
WG-EMM-11/P8	Collapse of South Africa's penguins in the early 21st century R.J.M. Crawford, R. Altwegg, B.J. Barham, P.J. Barham, J.M. Durant, B.M. Dyer, D. Geldenhuys, A.B. Makhado, L. Pichegru, P.G. Ryan, L.G. Underhill, L. Upfold, J. Visagie, L.J. Waller and P.A. Whittington (*Afr. J. Mar. Sci.*, 33 (1) (2011): 139–156)
CCAMLR-XXX/5	Report on the independent review of CCAMLR's data management systems Secretariat
WG-SAM-10/10	Factors to consider in designing a systematic observer program for the krill fishery S. Kawaguchi and A. Constable (Australia)
WG-EMM-10/P1	Recent trends in numbers of four species of penguins at the Prince Edward Islands R.J.M. Crawford, P.A. Whittington, L. Upfold, P.G. Ryan, S.L. Petersen, B.M. Dyer and J. Cooper (*Afr. J. Mar. Sci.*, 31 (3) (2009): 419–426)
WG-EMM-10/P2	Recent trends in numbers of Crozet shags breeding at the Prince Edward Islands R.J.M. Crawford, P.G. Ryan, B.M. Dyer and L. Upfold (*Afr. J. Mar. Sci.*, 31 (3) (2009): 427–430)
WG-EMM-10/P3	A tale of two islands: contrasting fortunes for sub-Antarctic skuas at the Prince Edward Islands P.G. Ryan, P.A. Whittington and R.J.M. Crawford (*Afr. J. Mar. Sci.*, 31 (3) (2009): 431–437)
WG-EMM-10/P4	Recent population estimates and trends in numbers of albatrosses and giant petrels breeding at the sub-Antarctic Prince Edward Islands P.G. Ryan, M.G.W. Jones, B.M. Dyer, L. Upfold and R.J.M. Crawford (*Afr. J. Mar. Sci.*, 31 (3) (2009): 409–417)
WG-EMM-10/P5	Estimates of numbers of kelp gulls and Kerguelen and Antarctic terns breeding at the Prince Edward Islands, 1996/97–2008/09 P.A. Whittington, R.J.M. Crawford, B.M. Dyer and P.G. Ryan (*Afr. J. Mar. Sci.*, 31 (3) (2009): 439–444)

WG-EMM-10/P15	Summer survey of fur seals at Prince Edward Island, southern Indian Ocean M.N. Bester, P.G. Ryan and J. Visagie (*Afr. J. Mar. Sci*., 31 (3) (2009): 451–455)
WG-EMM-10/P16	Intra-archipelago moult dispersion of southern elephant seals at the Prince Edward Islands, southern Indian Ocean W.C. Oosthuizen, M.N. Bester, P.J.N. de Bruyn and G.J.G. Hofmeyr (*Afr. J. Mar. Sci*., 31 (3) (2009): 457–462)

APPENDIX D

SUMMARY OF PRESENTATIONS GIVEN AS PART OF THE WG-EMM SYMPOSIUM ON FEEDBACK MANAGEMENT APPROACHES

SUMMARY

1. Six participants gave presentations that provided various perspectives on feedback management with some specific details and objectives. The presentations highlighted that there were many areas of broad agreement between these perspectives. The presenters agreed that feedback management includes monitoring, assessment and decision-making, and that a feedback management approach should use decision rules to adjust activities in response to the state of indicators to achieve the objectives of Article II of the CAMLR Convention. They agreed that there are a wide range of potential indicators of ecosystem state, that uncertainties in understanding of the ecosystem and its state must be addressed in the use of these indicators, and that the range of activities that could be adjusted include research activities as well as the distribution and intensity of fishing effort. The presenters also agreed that feedback management is a valid goal and focus for the Working Group's efforts over the next few years.

INTRODUCTION

2. At the Convener's, Dr G. Watters, request, presentations on feedback management were given by Drs A. Constable (Australia), S. Kasatkina (Russia), M. Kiyota (Japan), G. Milinevsky (Ukraine), P. Trathan (UK) and Watters (USA). Copies of the presentations are available in the Members area of the CCAMLR website (www.ccamlr.org/prm/sc/emm11/emm11info.htm) and the details are summarised below.

PRESENTATION SUMMARIES

3. Dr Constable presented views on feedback management in a risk management system on behalf of himself and Drs S. Kawaguchi, C. Southwell, L. Emmerson, D. Welsford and S. Doust and Prof. S. Nicol from the Australian Antarctic Division. Previous work presented to WG-EMM was summarised, covering requirements (objectives) for feedbacks in managing the krill fishery, progress towards a risk management system in CCAMLR, including work over the last 10 years, points to consider in formulating decision rules for explicit management of Type I and II statistical errors, the need to identify and deal with critical sources of bias in feedback indices, factors to consider in designing field programs to address bias in feedbacks and the value of a staged approach to development of the fishery and the risk management system in order to resolve critical uncertainties in the structure and function of the ecosystem and to test the possible effects of fishing prior to a fully developed fishery. The authors emphasised that there are a number of trade-offs in developing a feedback management procedure to achieve the objectives in Article II. These trade-offs involve choices about the flexibility of the fishery, spatially distributed catch limits, ability to monitor the effects of fishing and the costs of management and fishing versus the value of the fishery.

Prospective evaluation of candidate procedures is needed so that the costs and benefits of different options can be understood and appropriate choices made for achieving the objectives of CCAMLR.

4. Dr Kasatkina compared krill fishing activity with available data on krill-dependent predator requirements. She noted that the annual catch in each year of the fishery has been significantly less than the uncertainty in B_0 estimates from the CCAMLR-2000 Survey and predator demands for krill; the total abundance of predators and their krill consumption are currently not known and it may never be possible to completely specify krill consumption by predators; it may never be possible to correctly describe the krill-centric ecosystem and the variability of ecosystem components influenced by the krill fishery. Given these issues, an appropriate way to develop a feedback management approach might be to identify critical processes and their indicators, and then develop decision rules based on monitoring these indicators. There are important uncertainties in understanding the overlap of fishing activities with krill-dependent predator requirements. It is important to address the following questions:

(i) Is the overlap between krill-dependent predators spatial, functional, or both?

(ii) Do predators and the fishery have distinct krill density requirements?

(iii) Is it possible to manage the fishery based on the critical density for predators?

(iv) Is it possible to avoid fleet localisation in small areas taking into account the spatial–temporal distributions of krill fishable biomass?

(v) Does spatial segregation of fishing grounds and predator foraging areas exist for most fishing and breeding seasons?

Feedback management procedures would require consideration of the spatial–temporal variability of krill biomass distribution and investigation of fishable biomass characteristics, including threshold density, the relationships between fishable biomass and total biomass, relationships between krill aggregation characteristics and fishery performance, and flux effects on krill distribution. Acoustic surveys may provide important information and the presenter discussed how to maximise the utility of research and fishing vessel acoustic data to support developing feedback management procedures.

5. Dr Kiyota gave a presentation pointing out several of the key elements of feedback management and demonstrated possible roles for the commercial fishery in developing the feedback process. His presentation showed that the application of negative feedback control to the management of krill-centred Antarctic ecosystems was challenging, due in part to difficulties related to data collection and the complexity of the system, but also because of our limited ability to control the state of the system, our only control being through fishery manipulation. He also noted that a delay in applying a control signal might pose a risk of making the system unstable. In this context, expanded monitoring is the key element for feedback management, and the fishery can play an important role in this through 'learning by doing' and by 'learning from the past', both of which are key components of systematic

conservation planning. He proposed that reducing uncertainty around fishing operations, timely data collection, and better use of long-term fisheries data, would help in monitoring the impacts of both fishing and of environmental change on krill-based ecosystems.

6. Dr Milinevsky gave a presentation on behalf of himself and Dr L. Pshenichnov (Ukraine). He noted that ecosystem changes are produced by climate variability and sometimes by fishery impacts. Exploitation of the ecosystem can result in negative changes. This is why precautionary management is needed, which is usually applied in the absence of information about the state of krill-dependent predators. In general terms, a system exhibits negative feedback when it acts to reduce the level of a perturbation. Management of the krill-based ecosystem should use negative feedback. We can provide scientifically based advice if we see a negative impact of the krill fishery on ecosystem state (species populations) but one of the key questions is how to separate natural variations from fishery impact. A feedback management scheme includes the following steps: (i) a change is detected in the state of an ecosystem indicator; (ii) we reduce impact on that indicator; and (iii) the ecosystem returns to a previous (undisturbed) state. To provide such a scheme, we need indicators of spatial and temporal differences in ecosystem state, indicators of environmental changes, and methods for diagnosing fishery impacts. The difficult issue of separating natural variations from changes produced by the fishery could be addressed using contrasting areas with different levels of fishing pressure, including reference areas without. A system of reference (unfished) areas and harvest (fished) areas (e.g. based on the current system of SSMUs) would help to distinguish natural impacts from fishery impacts and allow determination (or prediction) of predator population responses to harvesting. Comprehensive information would include: (i) CEMP; (ii) full coverage of the krill fishery by international scientific observers; (iii) data on krill escape mortality; (iv) reliable green-weight measurements. Items (iii) and (iv) provide necessary information about how much krill is removed from the ecosystem. One of the important sources of information, in addition to research surveys, is data from fishing vessels. Until enough scientific information is available, we need to be precautionary enough to protect the krill population as whole.

7. Dr Trathan gave a presentation on behalf of himself and Dr S. Hill (UK). This presentation gave an overview of uncertainties in current understanding of the ecosystem in Subareas 48.1 to 48.4 and suggested monitoring approaches that could provide appropriate indicators in the face of such uncertainty. In particular, it identified fishing vessels as appropriate platforms for fine-scale and meso-scale monitoring of krill stocks and their response to localised fishing impacts. It also suggested that CEMP data, in conjunction with an understanding of predator foraging distributions, is a useful basis for understanding ecosystem response. It discussed evaluation frameworks, including simulation, and noted that there are multiple trade-offs between the costs and benefits of various processes and objectives. It considered the roles and capabilities of the different institutional components of CCAMLR, concluding that feedback management is a complex process and that engagement and cooperation from all of these institutional components is necessary for successful development and implementation. It also emphasised the need to engage with the community of stakeholders, together with scientific linkages to a number of international scientific programs, and it noted that timely demonstration of the benefits of investment in data collection would help reinforce collaboration across CCAMLR.

8. Dr Watters presented various concepts related to feedback management and related these concepts to several practical choices and approaches that could be used to implement a management strategy for the krill fishery. The presentation was co-authored by Mr J. Hinke

(USA), and both authors benefitted from many previous discussions with other scientists within CCAMLR and the US AMLR Program. Dr Watters argued that a feedback strategy should be founded on CEMP, which already provides decades-long baseline time series (thus characterising trends and covariations that already exist in the ecosystem) and useful contrasts across areas and species. Several CEMP indicators are both relevant to the potential for competition between krill-dependent predators and the fishery and are sensitive to changes in the marine ecosystem (e.g. series that indicate predator abundance and condition). It is feasible to expand CEMP (e.g. to include regional estimates of predator abundance) and thereby lessen assumptions that trends at CEMP sites are representative at larger scales. A feedback strategy can use CEMP indicators to adjust the catch limit of krill and the spatial distribution of fishing activity. 'Hockey-stick' models that define decision rules for such adjustments can be parameterised from globally accepted standards (e.g. IUCN criteria for assessing population status) and empirical observations collected at CEMP sites (e.g. relationships between animal condition and subsequent survival). If a feedback strategy for the krill fishery includes no-fishing areas, these decision rules can help the Commission respond to changes that are attributable to fishing. If fishing occurs everywhere, these decision rules can facilitate responses to cumulative changes in the ecosystem.

9. There was broad agreement amongst presenters on the following points:

(i) The components of a feedback management approach are monitoring, assessment and decision-making.

(ii) A feedback management approach should use decision rules to adjust activities in response to the state of indicators to achieve the objectives of Article II of the CAMLR Convention.

(iii) The objectives of Article II must be achieved in the context of a changing ecosystem.

(iv) Management and monitoring should be spatially structured.

(v) A candidate feedback management strategy should be robustly evaluated before implementation.

CONCEPTS

10. The presentations identified a number of key concepts relevant to the development of a feedback management approach, including:

(i) Feedback occurs when the current state of a system influences its future state. Feedback can be negative if it opposes inputs that contributed to the current state, or positive if it reinforces them.

(ii) Indicators are characteristics of the system which give information about the state of a part of the system of interest in the management procedure. They should be able to be repeatedly measured using standardised methods. Some indicators must be analysed in conjunction with others to provide this information.

(iii) Bias and error – measurements of indicators have associated sampling error. The relationship between the indicators and the state of the ecosystem will also have associated uncertainty, including the potential for giving a biased view of the state of the ecosystem.

(iv) Risk management is the coordinated and economical use of resources to minimise, monitor and control the likelihood of undesirable events.

(v) Before-after-control-impact (BACI) is a standard environmental impact assessment design in which the site of a putative impact, and that of an impact-independent control site are monitored before and after the impacting event.

(vi) Learning – there was broad agreement that a feedback management approach includes learning about the ecosystem and its response to change.

FEEDBACK MANAGEMENT

11. The presenters identified a range of views about what constitutes feedback management. There was broad agreement that feedback management includes monitoring, assessment and decision-making, and that a feedback management approach should use decision rules to adjust activities in response to the state of indicators to achieve the objectives of Article II of the CAMLR Convention. Candidate feedback systems included those which restrict fishing in response to indications of a negative impact, those which also relax fishing restrictions in response to indications of positive conditions, and those which control research activities based on the state of the system. It was suggested that a passive feedback system lacks a pre-defined relationship between the state of indicators and the management response whereas an active feedback system incorporates a decision model that provides this relationship. Also, that the current krill management system is a possible feedback system which determines a catch limit based on a synoptic survey of the krill stock. The current assessment model does not include means for (i) taking account of previous states of the krill stock, or (ii) incorporating information about the state of the wider ecosystem into the decision-making process. Most presenters agreed that autonomous decision-making based on pre-defined rules would be extended in a future feedback management system.

INDICATORS

12. One of the main requirements of a feedback management system is a set of indicators of the status of the krill stock. Such indicators do not necessarily need to be direct measurements of the krill stock itself. Some presenters noted the low correspondence between acoustic, survey net-based and CPUE-based estimates of krill density. They identified the krill fishery as a major potential source of information, especially acoustic survey data. They proposed several potential acoustic survey designs to complement existing monitoring programs. These include latitudinal transects and meso-scale grids in the main shelf and shelf-break areas currently used by the fishery. Presenters noted that between-transect variability is not a complete estimate of uncertainty in krill biomass estimates, and that this uncertainty can arise from various sources, including the target identification

approach, the target strength model and the spatial interpolation method. It was suggested that feedback management will require a more detailed assessment of uncertainty in krill biomass.

13. Several presenters identified CEMP as a valuable source of potential indicators. They noted that CEMP has limited spatial coverage and does not currently provide information about the state of some major groups of krill predators, including fish and many flying seabirds. Nonetheless, CEMP time-series might provide appropriate baseline data for a feedback management approach. One presenter suggested that land-based predator abundance and foraging area were important candidate indicators.

14. The presenters discussed possible ways of selecting indicators for a feedback management approach. They noted the importance of existing monitoring data and suggested that the final suite of indicators should be an extension of existing time series, including long-term fishery data. They identified various potentially useful sources of additional information, including science programs such as SOOS, Oceanites and the Southern Ocean Sentinel component of ICED, which include a monitoring component but are not currently linked to CCAMLR. They also discussed the use of recent technologies, including satellite imagery and autonomous/remote control aircraft for collecting data on the abundance of land-based predators.

15. It was suggested that indicators could be selected on their ability to match the following criteria: relevance to making decisions, relationship to the area expected to be impacted, precision, length of existing time series and ease of implementation.

16. Identifying an appropriate suite of indicators will involve trade-offs between the scale versus resolution of monitoring (e.g. the precision of predator abundance estimates is likely to decline as the spatial scale increases), the cost of monitoring and analysis versus the value of the fishery, the utility value of innovation versus that of maintaining time series and the degree to which the indicators are needed in the management procedure.

STATE

17. Presenters noted the dynamic nature of the ecosystem, including the effects of climate variability and change and the recovery of species from over-exploitation. They also noted the uncertainty in many potential indicators. They agreed that these issues would need to be accounted for in developing a feedback management procedure and that some work is needed to interpret Article II in relation to the dynamics of the ecosystem.

18. The presenters recognised that a feedback management system must remain precautionary to minimise the risk of undesirable impacts of the fishery on the krill stock and the ecosystem. It was suggested that decision rules should minimise both Type I (reducing fishing activities based on false identification of an impact) and Type II (not reducing fishing activities due to failure to detect a real impact) errors.

19. The presenters recognised that response times can affect feedback management in a number of ways. Leading indicators are those which respond before more pertinent but slower indicators of ecosystem state (e.g. changes in reproductive output might precede changes in population size). There might be some advantage in using such indicators

although there might be a trade-off between response time and relevance to required ecosystem state. Relying on indicators with slower response times might limit the range of available management options. There is also a risk that delays which are not adequately accounted for might result in ineffectual or counterproductive management responses.

SPATIAL DESIGN

20. The presenters suggested that the spatial structure of the ecosystem and of fishing operations would be key influences on the design of a feedback management approach. It would be appropriate to limit an initial approach to Subareas 48.1 to 48.3 (or 48.4) to match the spatial scale of the current fishery and the main ecological datasets. However, an appropriate objective is to develop an approach that can be expanded to other areas as required. Some subdivision of the overall area into management units (such as the existing SSMUs) is necessary. A spatially structured approach would use indicators of the local state of the system and could allow spatial fishing restrictions. It could also be used to coordinate the spatial distribution of fishing and research effort to study ecosystem response to fishing pressure. Presenters discussed several designs based around contrasting fished and reference areas which are respectively open or closed to fishing. These are variations on the BACI design and require baseline data from both fished and reference areas to detect an impact occurring after the baseline period. The pattern of fished and reference areas could be fixed so that spatial contrasts in ecosystem state provide an indication of fisheries impacts. The pattern could also be manipulated over shorter time-periods, and could incorporate pulse fishing, to actively investigate the system's response to fishing.

21. Some presenters highlighted flux as a major issue, which either must be addressed in the design phase of a feedback management approach or which could be investigated through the use of a feedback management approach.

22. It was suggested that a system of spatial contrasts will limit the spatial flexibility of the fishery and that the cost of maintaining a flexible fishery is a monitoring system which is less able to detect fishing effects and must therefore be more precautionary. However, it was suggested that a contrast-based system requires at least one indicator per area and is therefore sensitive to the loss of indicators, whereas a precautionary system without contrasts could theoretically operate with just one appropriate indicator.

DESIGN QUESTIONS

23. Some presenters considered the form of decision models (the relationship between ecosystem state and management response). Suggestions included an approach based on measuring trends in the difference between the observed state of predator populations in fished and reference areas. This approach detects deviations from a baseline empirical relationship between the temporal patterns of abundance in the two areas. The degree of confidence that a deviation constitutes a real change could be used as one of the input variables in a decision model. While decision models might include a linear region where permitted fishing activity is proportional to ecosystem state, they should also include an asymptote representing a cap on permitted activity. They might also include thresholds below which no activity is permitted.

24. It was suggested that the implementation of feedback management could be staged to ensure that the fishery expansion does not proceed faster than the development of understanding of the ecosystem.

25. Presenters recognised the need to evaluate candidate feedback management systems before implementation. One potentially useful approach is simulation in a management strategy evaluation framework (i.e. testing the approach in a model representing the ecosystem, with appropriate accounting for uncertainty). It is likely that any evaluation framework could lead to iterative improvements in the design of candidate feedback management frameworks, including the collection and use of data. It was suggested that management strategy evaluation can be useful for demonstrating the value of data to data providers such as the fishing industry.

26. Presenters recognised that some of the proposed forms of feedback management require substantial investment of resource and the development of new capabilities by many parts of the CCAMLR community, including the national programs, the fishing industry, the Scientific Committee and its working groups, and the Commission. It was suggested that a concerted community effort, including engagement with appropriate organisations outside CCAMLR, is the most appropriate way to achieve a coordinated and economical use of resources to develop a feedback management approach.

ANNEX 5

REPORT OF THE WORKING GROUP ON STATISTICS, ASSESSMENTS AND MODELLING

(Busan, Republic of Korea, 11 to 15 July 2011)

CONTENTS

REPORT OF THE WORKING GROUP ON STATISTICS, ASSESSMENTS AND MODELLING
(Busan, Republic of Korea, 11 to 15 July 2011)

INTRODUCTION

Opening of the meeting

1.1 The 2011 meeting of WG-SAM was held in Busan, Republic of Korea, from 11 to 15 July 2011 and concurrently with the meeting of WG-EMM. The meeting was co-convened by Drs A. Constable (Australia) and C. Jones (USA) and local arrangements were coordinated by Mr J. Ahn, Ministry for Food, Agriculture, Forestry and Fisheries (MIFAFF) in association with staff from the National Fisheries Research and Development Institute (NFRDI).

1.2 The meeting was formally opened by Mr Youngman Kim, President of NFRDI. On behalf of the Co-conveners of WG-SAM and WG-EMM, meeting participants and the Secretariat, Mr A. Wright, Executive Secretary, thanked Mr Kim for his warm welcome, and MIFAFF and NFRDI for hosting the meetings. Later, during an initial joint session of WG-EMM and WG-SAM, participants paused in memory of those lost during the tragic sinking of the longliner *Insung No. 1* in the Ross Sea in December 2010.

1.3 Dr Constable welcomed participants (Appendix A) and outlined the work ahead. In 2010, the Scientific Committee had discussed the current exploratory fisheries for *Dissostichus* spp. and had considered further the development of a research framework for data-poor fisheries (SC-CAMLR-XXIX, Annex 8, paragraphs 5.1 to 5.12). The Scientific Committee recommended that some specific elements of the work plan be considered as a high priority focus topic for WG-SAM in 2011. Specifically, WG-SAM was requested to consider (SC-CAMLR-XXIX, paragraph 3.133):

(i) methods for evaluating the capability of vessels and gear types to contribute to research outcomes and for calibrating vessels and gears, including specific case studies relevant to current exploratory fisheries such as in tag-recapture programs

(ii) proposed research designs and data collection protocols for estimating stock status in data-poor fisheries

(iii) methods for assessing stock status in data-poor fisheries.

Adoption of the agenda and organisation of the meeting

1.4 The agenda, as amended, was adopted (Appendix B). Item 2 was the focus topic which considered a work plan for implementing research proposals for data-poor fisheries[1] (SC-CAMLR-XXIX, paragraph 3.126).

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[1] The term 'data-poor fisheries' refers to fisheries for which a robust stock assessment that provides advice on catch limits according to CCAMLR decision rules has not been developed due to a lack of information. The term includes fisheries which have been closed or had the catch limit set to zero.

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 the authors of papers for their valuable contributions to the work presented to the meeting.

1.6 In this report, paragraphs that provide advice to the Scientific Committee and its working groups have been highlighted. A list of these paragraphs is provided in Item 7.

1.7 The report was prepared by Drs Constable, S. Hanchet (New Zealand), Jones, Mr T. Peatman (UK), Drs D. Ramm (Data Manager), B. Sharp (New Zealand), D. Welsford (Australia) and P. Ziegler (Australia).

FOCUS TOPIC: WORK PLAN FOR IMPLEMENTING RESEARCH PROPOSALS FOR DATA-POOR FISHERIES[1]

2.1 The Working Group agreed to structure the focus topic on data-poor fisheries (paragraph 1.4) by reviewing a summary of available data, a historical progression of catch limits, current activities in data-poor fisheries, previous examples of methods and approaches to achieve robust assessments for CCAMLR fisheries, general approaches toward advancing assessments for data-poor fisheries and area-specific considerations. It was agreed that general principles could be applied to specific areas in order to provide advice.

Summary of available data types

2.2 To assist Members with developing research proposals, the following section outlines a summary of the current knowledge of the stock structure, the spatial distribution of the various length classes, and the hypothetical life histories of the two *Dissostichus* species within the three ocean sectors.

Dissostichus mawsoni

2.3 The stock structure of *D. mawsoni* was reviewed in WG-FSA-10/24. Three studies using a variety of genetic techniques, including mitochondrial DNA (mtDNA), nuclear DNA introns, and nuclear and mitochondrial single nucleotide polymorphisms (SNPs), have been carried out on samples of muscle tissue from *D. mawsoni* in the Indian, Atlantic and Pacific Ocean sectors in the past 10 years (e.g. Kuhn and Gaffney, 2008). All studies found broadly similar results and that, despite the generally weak genetic diversity in *D. mawsoni*, there was some evidence for significant genetic differentiation between the three ocean sectors but limited evidence for differentiation within ocean sectors. Results of tagging studies have produced results consistent with the genetic studies.

2.4 The spatial distribution of *D. mawsoni* by length was reviewed in WG-FSA-10/24. Sub-adult toothfish (<100 cm TL) are generally found on parts of the Antarctic shelf and upper slope, with known concentrations in the southern Ross Sea, Subareas 88.2 and 88.3 and the west of SSRUs 5842B–D. Maturing toothfish (100–135 cm TL) are typically found on the continental slope all around the Antarctic continent. The largest fish (>135 cm TL) are typically found in deeper parts of the continental slope and on the banks, ridges and seamounts to the north of the continental slope, with known concentrations in Subareas 48.4, 48.6, 88.1 and 88.2, and Division 58.4.3b.

2.5 A hypothetical life cycle of *D. mawsoni* in the Pacific Ocean sector was developed by Hanchet et al. (2008). Several alternate hypotheses for *D. mawsoni* in the Indian Ocean sector were summarised in 2009 by WG-FSA (SC-CAMLR-XXVIII, Annex 5, Figure 5). No equivalent hypothetical life history has been developed for the Atlantic Ocean sector. However, the adult concentrations found in the north of Subareas 48.4 and 48.6 probably originate from the Antarctic shelf and slope between the Antarctic Peninsula and eastern boundary of Subarea 48.6.

Dissostichus eleginoides

2.6 Genetic analyses (Appleyard et al., 2002; Shaw et al. 2004; Appleyard et al., 2004) and tagging studies (e.g. WG-FSA-03/72) indicate that, similar to *D. mawsoni*, *D. eleginoides* stocks are isolated at the scale of ocean basins. It is likely that the *D. eleginoides* caught in the fisheries in the northern areas of Subarea 88.1, Divisions 58.4.3a and 58.4.3b, and Subarea 48.4, are vagrants from the nearby populations around Macquarie Island, the Kerguelen Plateau and Subarea 48.3 respectively. Recent evidence from Ob and Lena Banks (Divisions 58.4.4a and 58.4.4b) indicate that a self-sustaining population may exist in that area (WG-SAM-11/6).

2.7 The Working Group summarised the historic longline fishing catch and effort (including research fishing) by division/subarea and SSRUs in Tables 1 to 3 on:

- seabed area in fishable depths (600–1800 m)
- total catch
- proportion of species
- depth range and mean
- mean and CV of catch rates (by length of line)
- mean and CV of fish size (catch weighted)
- proportion of fish above 100 cm (*D. mawsoni*) and 80 cm (*D. eleginoides*)
- total tags released
- total tags recaptured.

2.8 In addition, maps were generated that examined the spatial distribution of catch and effort (e.g. Figure 1). The Working Group requested the Secretariat to finalise the following maps for consideration by WG-FSA on:

- fishing locations
- total catch
- proportion of species
- mean of catch rate (by length of line)
- mean of fish size
- proportion of fish above 100 cm (*D. mawsoni*) and 80 cm (*D. eleginoides*).

2.9 WG-SAM-11/4 described the deployment of research hauls in the exploratory fisheries in Subareas 48.6 and 58.4 in 2010/11. The Working Group recalled that the original objective of requiring research hauls was to assess the distribution and relative abundance of toothfish across fished SSRUs. It requested WG-FSA to evaluate whether research hauls have provided a different perspective of the stock to that provided by commercial hauls, e.g. in terms of fish distribution. It recommended that WG-FSA review the data derived from this method, and assess if other research methods would be more appropriate to achieve the goals of stock assessments in data-poor fisheries.

Summary of historical progression of catch limits in data-poor fisheries

2.10 The Working Group agreed that it would be useful to have a summary of how historical catch limits in data-poor fisheries were derived and the evidence supporting current estimates of stock status where applicable, and recommended that these summaries be incorporated into the Fishery Reports. These historical summaries should include a description of the method by which catch limits were generated, the advice provided to the Scientific Committee, and how this advice was used by the Commission (Table 4). The Working Group requested that the Secretariat complete these summaries and provide the information in the draft Fishery Reports for the next WG-FSA meeting.

Reports of current activities

2.11 WG-SAM-11/5 and 11/6 summarised research fishing activities for the closed *Dissostichus* spp. fisheries on BANZARE Bank (Division 58.4.3a) and Ob and Lena Banks (Divisions 58.4.4a and 58.4.4b) respectively.

2.12 Both papers included a comparison of fish condition between the trotlines and Spanish longlines. The Working Group noted that fish caught on trotline gear were generally in poorer condition than those caught on Spanish longlines, and that the poor condition was especially pronounced for fish smaller than 70 cm in both methods. The Working Group agreed that the difference in fish condition between fish caught at BANZARE Bank and Ob and Lena Banks was likely to be caused by a consequence of these observed differences. It expressed concern that the increased use of trotline gear may decrease the ability to complete tagging programs in many parts of the Convention Area.

2.13 The Working Group thanked Japan for its efforts in implementing and presenting the data collected through these research activities. In 2010/11, the *Shinsei Maru No. 3* used standardised fishing methods, the tag overlap statistic was very high in both regions, the spatial overlap between locations at which previously tagged fish were released and locations at which subsequent catches were taken was high, fish condition was considered at release of tagged fish, and information on depredation rates on research hauls on which fish were tagged was provided.

2.14 The Working Group requested that Japan present information to WG-FSA on the frequency of single or multiple hook wounds sustained by trotline-caught fish as a function of their assessed condition, higher-resolution data indicative of the actual proportion of released fish that were released in the presence of depredating predators, and the average abundance of those predators when tagged fish were released.

2.15 The Working Group discussed the merits of reporting CPUE as a function of length of line rather than as a function of number of hooks, to inform more robust comparisons between methods (e.g. Spanish longlines versus trotlines). It recognised that the 'fished area' is a function of the length of the line, the number of hooks and the attraction distance. WG-SAM requested that in future, CPUE from longline research catches be reported in terms of both number of hooks and length of line.

2.16 The Working Group reviewed analysis for Ob and Lena Banks additional to that provided in WG-SAM-11/7, which included biomass estimates based on a simple Petersen estimator. The method used was the same as that applied when developing the assessment for the *Dissostichus* spp. fishery in Subarea 48.4 (WG-FSA-09/17), including estimation of confidence intervals using the method developed by Chapman (1948). The natural mortality, tag-induced mortality and tag-shedding rates used were also drawn from WG-FSA-09/17. Median estimates of current biomass were similar to those derived from the analyses conducted at WG-FSA in 2010 (SC-CAMLR-XXIX, Annex 8, paragraphs 5.116 and 5.117), however, because the analyses were conducted on two separate years of tag recaptures (each with two recaptures), the confidence intervals were wide.

2.17 The Working Group recommended that a preliminary assessment for Ob and Lena Banks be explored by using standardised CPUE tagging data, length-at-age and -maturity data and commercial and IUU catch history. The Working Group encouraged an assessment that would enable application of CCAMLR decision rules to estimate precautionary catch limits and a presentation of this assessment in the near future.

2.18 WG-SAM-11/5 confirmed that BANZARE Bank is a spawning ground for *D. mawsoni*, and that fish stocks here are likely linked to those in Division 58.4.1 and potentially other regions within the southern Indian Ocean. Therefore, any fishery is likely to have an impact on other parts of the stock outside BANZARE Bank. The Working Group recommended that the different hypotheses about the stock structure will need to be considered when attempting an assessment or designing new research to collect the necessary data to achieve an assessment. The Working Group also recommended further analyses in regard to interactions between the condition of fish with fish size and gear type.

2.19 WG-SAM-11/9 presented preliminary results of research fishing for the closed *Dissostichus* fishery in Subarea 88.3 undertaken in 2010/11. These results appeared to be broadly consistent with earlier longline surveys conducted by Chilean vessels (SC-CAMLR-XVII/BG/7) and New Zealand (WG-FSA-05/53), indicating that the density of toothfish in this area is likely to be low and that the fish are mostly small. WG-SAM-11/9 reported that 256 *D. mawsoni* were caught, of which 30 were tagged during the course of the survey. The Working Group requested that additional information regarding the spatial distribution of tag releases be presented at WG-FSA-11. The Working Group recommended that information on catch rates by line length and number of hooks, and the size distribution of catch, be provided to WG-FSA-11. It was also recommended that a description of the proposed analysis of otoliths and genetic samples be submitted to WG-FSA-11.

2.20 WG-SAM-11/19 provided a summary of crab research fishing efforts on the Patagonian shelf (Division 41.3.1), South Orkney Islands shelf (Subarea 48.2) and the North Scotia Ridge (Division 41.3.2). The Working Group noted Russia's intention to produce an identification guide for crabs in the southern Atlantic Ocean. It was suggested that crabs should be tagged in the future and experiments conducted to estimate post-release mortality for crabs that are released. In addition, any further research fishing should be conducted in such a way to achieve an assessment in the future.

General approaches

2.21 Previous Scientific Committee reports (e.g. SC-CAMLR-XXVIII and SC-CAMLR-XXIX) have outlined a range of considerations for the development of proposals for CCAMLR-sponsored research. There have been a few case studies where a consistent well-designed approach has led to a successful outcome in terms of assessment for either *D. mawsoni* or *D. eleginoides*. The key elements that contributed to the success of the low information assessments in SSRU 882E and Subarea 48.4 North were:

(i) The research was guided by clearly stated research objectives focused on questions of highest priority for the achievement of an assessment, i.e. to achieve: (a) an index of stock abundance; (b) a hypothesis of relationship of fish in the area to the overall stock; (c) estimates of biological parameters relating to productivity (i.e. maturity, growth and recruitment).

(ii) The research was focused within a relatively small area that was consistent between years.

(iii) The observational data were collected by vessels that had proven experience in conducting and providing high-quality research fishing within the CCAMLR region.

(iv) Observational data were collected using a robust experimental design (a pre-designed grid in the case of Subarea 48.4) that was carried out over a sequence of years with a multi-year commitment to the research design.

(v) The data collected were annually reviewed and the information compared with the objectives of the data collection.

(vi) The research was robust to a set of expected deviations from the research design (for example, missing years where the area might not be accessible due to ice coverage).

(vii) Catch removals were able to be estimated accurately because of an absence of IUU activities in the area.

2.22 The Working Group agreed that these successful examples of the progression of data-poor fisheries to fully assessed fisheries provide valuable guidance as to the overall approaches to research in data-poor fisheries. Papers describing these examples are included in Table 5.

2.23 WG-SAM-11/8 developed a set of principles that could be used for evaluating data collection plans in data-poor fisheries. The Working Group agreed that such principles would greatly assist the Scientific Committee in developing a framework to evaluate research proposals in data-poor fisheries, and would assist Members in designing and implementing proposals that have a high likelihood of achieving the Commission's goals.

2.24 The Working Group recalled similar discussions between 1992 and 1993 (CCAMLR-XI, paragraph 4.28; SC-CAMLR-XII, paragraph 7.4) and from 1997 to 2000 (SC-CAMLR-XIX, paragraphs 7.2 to 7.20) as appropriate approaches to developing assessments in exploratory fisheries.

2.25 It was agreed that to achieve the objectives of Article II of the Convention, research in data-poor fisheries should follow these principles:

(i) The primary purpose of research in data-poor fisheries is data collection that will lead to a robust estimate of stock status and enable the estimation of precautionary catch limits consistent with CCAMLR decision rules.

(ii) A detailed plan of proposed fishing operations, data collection and analyses needs to be submitted for review by the Scientific Committee and the Commission. The intention of data collection is to ensure that adequate information is made available to the Scientific Committee to achieve the objectives of the research.

2.26 Any research proposal should provide details on how these principles will be addressed, to enable the Scientific Committee to evaluate, inter alia, the likelihood that the proposal will satisfy CCAMLR-sponsored research as detailed in Table 6.

2.27 The Working Group noted that the first requirement of any new research proposal is that the objectives of the research be clearly stated and that the research be designed appropriately to achieve its stated objectives. The Working Group further noted the three pieces of information required for an assessment of stock status and to apply the CCAMLR decision rules to estimate precautionary yield, i.e.:

(i) an index of stock abundance
(ii) a hypothesis of relationship of fish in the research area to the overall stock
(iii) estimates of biological parameters relating to productivity (i.e. maturity, growth and recruitment).

2.28 The Working Group agreed that the highest priority for data-poor fisheries was to achieve an index of abundance, but that an index of abundance (i) for any particular area is only biologically meaningful in the context of a hypothesis of relationship of fish in the area to the overall stock (ii). Consequently, the requirement to achieve (i) and test (ii) would most strongly drive the design of a research proposal. It was agreed that simulations assuming alternative stock hypotheses would strengthen research proposals, although it was acknowledged that not every country had the experience to conduct simulations.

2.29 Estimates of biological parameters relating to productivity for requirement (iii) can in the first instance be derived from observations in other areas, and then improved over time using location-specific observations. Consequently, the collection of biological samples to address requirement (iii) would not in itself constitute sufficient justification to carry out new research in the absence of information meeting requirements (i) and (ii), and would not strongly drive the choice of research design. Nevertheless, these biological samples should be collected routinely and analysed in the course of the research.

2.30 WG-SAM-11/13 reported on the development of a generic operating model framework designed to evaluate data collection plans, assessment methods and management strategies. The Working Group encouraged further development of this operating model framework, as it could have a wide variety of applications for both data-poor and assessed fisheries in the CCAMLR area.

2.31 WG-SAM-11/15 compared tagging and other potential sources of stock assessment information between assessed and unassessed SSRUs. It calculated the numbers of additional tagged fish required to match the tag densities of assessed SSRUs for each currently unassessed SSRU and ranked the latter based on this metric in terms of the potential for assessment. The Working Group agreed that the compiled summaries of the current status of exploratory toothfish fisheries were very useful. The tag deficit statistic provided a consistent approach to compare tagging effort in assessed and unassessed areas. The Working Group noted that the likelihood of achieving a tag-based stock assessment was dependent on the number of toothfish that are tagged and available for capture as a proportion of total stock and scanning rate (i.e. catch) of that stock (i.e. see WG-SAM-08/6). When considering tagging effort, the poor performance of previous tagging effort in some areas needs to be accounted for, as there may be actually very few tagged fish available for recapture despite large numbers of tagged fish having been released. The Working Group agreed that the increased statistical power achieved by increasing the number of fish scanned (caught) needs to be balanced against consideration of the likely impact of the catch, given current understanding of stock status, including potentially depleted stocks.

Summary of main methods

2.32 The Working Group identified a list of papers describing methods that have been used by CCAMLR in assessing data-poor fisheries (Table 5). The Working Group identified four assessment approaches that have been attempted: CPUE, depletion experiments, tagging programs and areal survey approaches.

2.33 CPUE alone is not used in assessed fisheries as it is seen to be a poor index of abundance in isolation. The Working Group therefore agreed that catch rates should be de-emphasized as an index of abundance in data-poor fisheries, though it was stressed that there is a distinction between using a CPUE time series of an index of abundance and the use of catch rates with seabed area to provide an initial estimate of biomass in unassessed areas. With respect to depletion approaches, there was agreement that the use of depletion experiments in data-poor fisheries was unlikely to lead to a robust assessment that satisfies the CCAMLR decision rules. It was agreed that these two approaches on their own have shown not to be successful, and further will likely not lead to assessments in the future. However, both tagging programs and areal surveys have led to robust assessments for several stocks of *Dissostichus* in the Convention Area.

2.34 The Working Group recalled that tagging studies have led to stock assessments of toothfish in fisheries in Subareas 48.4 and 88.1 and SSRU 882E. It also recalled that trawl surveys have been important, resulting in precautionary by-catch limits for *Macrourus* spp. in Division 58.4.3b (van Wijk et al., 2000) and Subarea 88.1 (WG-FSA-08/32).

2.35 The Working Group agreed that it would be useful to provide guidance as to general aspects of research designs, standardised methods, performance metrics for a tagging program and areal survey approaches that would have the greatest potential to lead to an assessment in the near future. The Working Group agreed that data-poor areas should be prioritised in such a way that the potential for an assessment of the area within a reasonable timeframe is maximised. For example, areas more likely to have a fishable stock biomass, areas where there are already fish tagged that have a good chance of being recaptured, and areas where some tags have already been recaptured, should be considered higher-priority areas.

2.36 The Working Group compiled a list of recommended performance metrics by which the quality of research efforts could be evaluated, and recommendations for research designs and standardised methods. These are detailed below for both tagging and areal survey approaches. The Working Group noted that methods could be combined, e.g. tagging and areal methods could be conducted in a single research program (fish caught in a trawl survey could also be tagged and released).

Tagging approaches

A. Standards to be met

2.37 The Working Group noted that the success of previous research leading to assessments in exploratory fisheries in Subareas 88.1 and 88.2, and the fishery in Subarea 48.4 North, was in large part due to dedicated efforts by particular Members or vessels to adhere to robust and consistent multi-year experimental designs, and to execute the required tagging program with a high standard of quality. Conversely, the Working Group recognised that the failure to develop assessments in other data-poor fisheries despite several years' research in which tagging was conducted, may be due to problems with research implementation or tagging performance, and not due to any shortcoming with respect to the actual research design, sampling intensity, or analytical methods (SC-CAMLR-XXIX, Annex 8, paragraphs 5.5 and 5.18 to 5.20).

2.38 To ensure that future research in data-poor fisheries is implemented to a high standard, the Working Group recommended development and use of the following performance metrics for tag-based research, to be used in the annual review and evaluation of research programs in progress. Members proposing to conduct new research should also include in their research proposals descriptions of the means by which they will ensure high levels of performance with regard to these metrics, to aid evaluation by WG-FSA and the Scientific Committee of the likelihood that the research will achieve its objectives:

(i) Tag overlap statistic – this performance metric is already defined and required under Conservation Measure 41-01.

(ii) Spatial overlap statistic – a metric to express the extent to which tagging and subsequent catches to scan for recaptures have occurred in a consistent spatially constrained location.

(iii) Temporal overlap statistic – a metric to express the extent to which the research is carried out at the same time each year.

(iv) Trauma index – a measure of the injuries to the fish associated with the capture and tagging process, and their vitality prior to release.

(v) Depredation index – a metric of the risk or extent to which depredation of tagged and released fish by predators (i.e. sperm whales and killer whales) may be affecting the survival of tagged and released fish. Such a metric could represent the proportion of tagged fish that were released at times and locations at which predators were observed, and the abundance of those predators and/or the observed level of depredation on hauls in the proximity of releases (e.g. proportion of caught fish that were damaged).

2.39 The Working Group encouraged Members to develop and propose these metrics for use in the evaluation of proposals by WG-FSA.

B. Research design and standardised methods

2.40 The Working Group recommended applying the following research design for data-poor fisheries:

(i) Choose an SSRU or some other spatially constrained area:

(a) the area should be chosen with a reference to the stated objective of the research

(b) priority areas include those where catch rates indicate that a viable toothfish fishery may be present depending on catch rates, catch history and size of fishable seabed areas

(c) consideration should also be given to the likely role of a particular SSRU in the plausible stock hypothesis (i.e. is it only juveniles in the area?).

(ii) Develop an initial estimate of the plausible biomass for the unassessed area:

(a) the ratio of CPUE and seabed areas for a reference area (where an assessment exists) might be considered to estimate the biomass that might be present in the unassessed area

(b) CPUE between the reference and experimental area should be standardised for gear type, vessel, time of year, target species and size distribution of fish present

(c) the effects from catch history (i.e. depletion prior to the experiment) needs to be considered

(d) appropriate reference areas may include SSRUs in Subarea 88.1 and SSRU 882E (*D. mawsoni*) or Subarea 48.4 North (*D. eleginoides*) for which current biomass estimates are available.

(iii) Use an appropriate method (e.g. WG-SAM-08/6) to:

(a) determine an appropriate combination of catches, tag releases and research duration (years) to achieve a target CV for a tag-based biomass estimate, given the preliminary biomass estimate (e.g. scenarios see Figures 2 and 3).

(iv) Apply a discount factor to the estimate of biomass to account for uncertainty and evaluate the likely impact of the research catch on the stocks (see e.g. SC-CAMLR-XXIX, Annex 8, paragraphs 5.116 and 5.117).

2.41 The Working Group noted that the number of fish tagged and released will increase throughout the course of a multi-year tag-release program, but that not all released fish will be available for recapture due to the effects of tagging mortality, natural mortality and tag loss.

2.42 Dr Sharp noted that the number of tagged fish available for recapture in year t can be approximated by:

$$
\begin{aligned}
T_t = {} & X_{t-1}\, C_{t-1}\, (1 - M_x)\, (e^{-\lambda})\, (e^{-M}) \\
& + X_{t-2}\, C_{t-2}\, (1 - M_x)\, (e^{-2\lambda})\, (e^{-2M}) \\
& + X_{t-3}\, C_{t-3}\, (1 - M_x)\, (e^{-3\lambda})\, (e^{-3M}) \\
& \ldots \quad \text{etc.}
\end{aligned}
$$

where T_t = tagged fish available for recapture in year t
X_t = tagging rate (fish per tonne) in year t
C_t = (catch) in year t
M_x = tagging mortality
λ = annual tag loss rate approximation
M = natural mortality.

2.43 Dr Sharp noted that by applying this formula, it is possible to estimate the number of tags available for recapture (Figure 2) as a function of the tagging rate used in the survey. By superimposing the tagging rate in Figure 2 it is possible to examine the incremental improvement in the CV of the biomass estimate across multiple years of a tag-recapture experiment, as a function of tagging rate and annual catch. Alternately it is possible to set a target CV and derive multiple options for different combinations of tagging rate, annual catch and experiment length (number of years) to achieve that target CV under an assumed initial biomass. Figure 3 illustrates this relationship for a range of tagging rates in a four-year experiment, assuming constant annual catches and constant tagging rates in all years.

2.44 The Working Group noted that the number of tags available for recapture is contingent on high standards of tagging performance with respect to the performance metrics identified in paragraph 2.38. For areas in which tagging performance has been of consistently low quality (e.g. SC-CAMLR-XXIX, Annex 8, paragraphs 5.5 and 5.18 to 5.20), it may be necessary to assume very low numbers of available tagged fish despite a high number of historical releases. The Working Group recommended that WG-FSA examine this in further detail.

Areal survey approaches

2.45 The Working Group identified several potential means by which areal surveys can be undertaken, including trawl, longline and pot surveys. It was agreed to focus on trawl and longline surveys for the purposes of providing guidance on research designs and standardised methods.

Trawl surveys

A. Standards to be met

2.46 To ensure that future research in data-poor fisheries is implemented to a high standard, the Working Group recommended development and use of the following performance metrics for trawl surveys, to be used in the annual review and evaluation of research programs in progress:

(i) Spatial overlap statistic: a metric to express the extent to which hauls and survey strata have occurred in a consistent spatially constrained location.

(ii) Temporal overlap statistic: a metric to express the extent to which the research is carried out at the same time each year.

(iii) If tagging is carried out, see tagging metrics (paragraph 2.38).

B. Research design, standardised methods and assessments

2.47 The Working Group recommended following the guidelines detailed in the Draft Manual for Bottom Trawl Surveys in the Convention Area (SC-CAMLR-XI, Annex 5, Appendix H, Attachment E, paragraph 4) for research trawl surveys in data-poor fisheries.

Longline surveys

A. Standards to be met

2.48 To ensure that future research in data-poor fisheries is implemented to a high standard, the Working Group recommended development and use of the following performance metrics for longline surveys, to be used in the annual review and evaluation of research programs in progress:

(i) Spatial overlap statistic: a metric to express the extent to which hauls and survey strata have occurred in a consistent, spatially constrained location.

(ii) Temporal overlap statistic: a metric to express the extent to which the research is carried out at the same time each year.

(iii) If tagging is carried out, see tagging metrics (paragraph 2.38).

(iv) Depredation index: a metric of the risk or extent to which depredation may have influenced estimates of catch rates or catch.

B. Research design and standardised methods

2.49 The Working Group recommended applying the following research design for data-poor fisheries:

(i) Choose an SSRU or some other spatially constrained area:

(a) the area should be chosen with a reference to the stated objective of the research

(b) consideration should also be given to the likely role of a particular SSRU in the plausible stock hypothesis (i.e. is it only juveniles in the area?).

(ii) Develop an initial estimate of the plausible biomass for the unassessed area:

(a) the ratio of CPUE and seabed areas for a reference area (where an assessment exists) might be considered to estimate the biomass that might be present in the unassessed area

(b) CPUE between the reference and experimental area are needed to be standardised for gear type, vessel, time of year, target species and size distribution of fish present

(c) the effects from catch history (i.e. depletion prior to the experiment) needs to be considered

(d) appropriate reference areas may include SSRUs in Subarea 88.1 and SSRU 882E (*D. mawsoni*) or Subarea 48.4 North (*D. eleginoides*) for which current biomass estimates are available.

(iii) Develop a survey design:

(a) determine what component of the population will be surveyed

(b) determine survey area and strata (taking into account bathymetry) and generate set locations. The set locations should be random and stratified by depth with a specified minimum distance between lines

(c) determine the number of longlines based on a power analysis and a target CV

(d) calculate nominal catch limit based on number of longlines and appropriate catch rates from historical data.

(iv) Survey standardisation:

(a) all aspects of the survey should be consistent within and between surveys, including:

- vessel
- gear type and configurations (e.g. Spanish longline or trotline, line specifications)
- number of hooks per survey line (at least 3 500 hooks and no more than 5 000 hooks)
- hook type and size
- bait type
- distance between hooks and length of leaders
- soak time
- location of survey strata
- time of year that the survey is conducted.

(v) Evaluate the likely impact of the catch on the fish stocks.

Area-specific considerations

2.50 The Working Group agreed that general principles could be applied to different areas, but that each area has its own specific attributes that may have an important influence on how these principles would be applied. However, the Working Group considered that the issues covered in paragraphs 2.32 to 2.49 were sufficiently comprehensive to cover area-specific considerations.

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

Tagging

3.1 WG-SAM-11/14 reported on work undertaken by the Secretariat to coordinate data arising from CCAMLR toothfish tagging programs, as endorsed by CCAMLR-XXV (CCAMLR-XXV, paragraph 4.50). Typical problems that may arise in the data when attempting to correctly match and code tag-recapture events are described and categorised. The Working Group thanked the Secretariat for this work, and recommended that:

(i) a record in the database be kept for tracking how tag categorisations have changed over time

(ii) the Secretariat identify a consistent schedule on which the status of tags in category 7 'no link' are reviewed and potentially updated in light of new information. Additional minor technical recommendations to improve the definition of the categories were conveyed from Mr A. Dunn (New Zealand) to the Secretariat in his absence.

3.2 WG-SAM-11/12 and 11/18 were initiated in response to comments by Dr S. Candy (Australia) at the 2010 meeting of WG-FSA. Dr Candy commented that using the methods of WG-FSA-SAM-05/10 and Hillary et al. (2006) to approximate loss rates of double-tagged fish in CASAL's tag-loss model for single tagged fish (Kirkwood and Walker, 1984) could introduce significant bias in estimates of stock status.

3.3 WG-SAM-11/12 and 11/18 provided different approaches to improve the approximation of loss rates of double-tagged fish in CASAL. WG-SAM-11/12 presented an explicit calculation of CASAL's parameter for annual tag-loss rate, l', to approximate loss of double tagged-fish for a specified range of time at liberty, derived from the estimate of the observed annual tag-loss rate, l, and the mid-point of the range of time at liberty specified.

3.4 The approach of WG-SAM-11/18 was first to estimate instantaneous and annual tag-loss rates for *Dissostichus* spp. tagged in the Ross Sea using recaptures of double-tagged *Dissostichus* spp. with one or two tags remaining. The parameter of annual tag-loss rate for CASAL's single-tag model was then set to approximate the loss rate of double-tagged fish, given the estimated instantaneous and annual tag-loss rates referred to above, for a maximum time at liberty. The report noted that the combination of the previous incorrect double-tag model and tag-loss rate parameter had very little impact on the estimates of biomass in the assessment models.

3.5 The Working Group noted that both papers provided methods that can be used to ensure the CASAL tag-loss model can be parameterised to approximate annual loss rates of double-tagged fish, although for both approaches the approximation is only appropriate for a specified time at liberty.

3.6 The Working Group recommended that tag-loss rates used in CASAL assessments conducted at the forthcoming meeting of WG-FSA should be adjusted in order to best approximate true tag-loss rates over the range of times at liberty of the mark-recapture data.

Assessments

3.7 WG-SAM-11/17 presented the results of simulations in which data was withheld from the existing (2009) stock assessment models for Subarea 88.1 and SSRU 882E (WG-FSA-09/40 and 09/41). The Working Group noted that the simulations were a good illustration of the stability of these models and the rate at which data collected in data-poor exploratory fisheries may accumulate to yield plausible estimates of biomass. WG-SAM further noted that in order to illustrate the true accumulation of knowledge as a fishery progressed from data-poor to assessed (i.e. incorporating structural as well as statistical uncertainty), it would be useful to plot B_0 and current B (with associated uncertainty) as they were estimated in every year of the exploratory fishery, noting changes arising from different assessment methods, new model inputs and/or altered structural assumptions over time.

3.8 The following WG-SAM participants notified their intention to submit updated stock assessments to WG-FSA in 2011:

(i) Dr Welsford indicated that an update of the Division 58.5.2 toothfish assessment (WG-FSA-09/20) will be presented using updated survey data from 2010/11 and a new estimate of M as in WG-FSA-10/41, and incorporating uncertainty in M. He also indicated plans to update the preliminary assessment for *Champsocephalus gunnari* in Division 58.5.2.

(ii) Dr Hanchet indicated that there are plans to update the Ross Sea region toothfish assessment (WG-FSA-09/40 Rev. 1) in Subarea 88.1 and SSRUs 882A and 882B using two additional years' tag-recapture and catch-at-age data, and an updated tag-loss estimate as in WG-SAM-11/18. There are also plans for a similar update of the toothfish assessment in SSRU 882E (WG-FSA-09/41), including a new sensitivity in which SSRUs 882C–G are assessed in combination.

(iii) Mr Peatman indicated that there are plans to update the toothfish assessment in Subarea 48.3 (WG-FSA-09/28 Rev. 1), including two seasons of additional survey data, tag-recapture data and catch-at-age data, and updated tag-loss parameters estimated as in WG-SAM-11/18. There are also plans for a similar update of the toothfish assessment in Subarea 48.4 North (WG-FSA-09/17). He also indicated that there are plans to update the preliminary assessment of *C. gunnari* in Subarea 48.3 (WG-FSA-09/27).

3.9 The Working Group noted that WG-SAM-11/15 identified several SSRUs in which some tag recaptures have occurred and recommended that WG-FSA consider undertaking preliminary estimates of biomass for these areas during the forthcoming WG-FSA meeting, using methods endorsed by WG-SAM or following successful examples of research in data-poor fisheries as listed in Table 5.

3.10 The Working Group encouraged Members to collaborate during the intersessional period to progress preliminary assessment work, especially during years in which WG-FSA will not be updating assessments for the assessed fisheries.

3.11 A preliminary population status model for *D. eleginoides* on the Kerguelen Plateau, Divisions 58.5.1 and 58.5.2, was presented to the Working Group (WG-SAM-11/20). The model was an age-structured, multi-fishery, single-area and -sex model.

3.12 The Working Group thanked Australia and France for their collaboration in producing this study. It noted that continued ageing of fish from the POKER survey and development of methods to incorporate tagging data that take account of the spatial distribution of tags, fishing effort and the movement of toothfish, would be beneficial. The Working Group requested that the report be submitted to the forthcoming meeting of WG-FSA, along with provision of the CASAL input files. The Working Group also noted the different signals in the commercial CPUE data from the Kerguelen Island fishery and the Heard and McDonald

Islands fishery. The Working Group noted the importance of understanding the spatial distribution of biomass and age classes in the Kerguelen Plateau. Dr Welsford commented that this would be an aim for future work.

Scientific research to inform assessments

3.13 WG-SAM-11/16 described a proposal to carry out CCAMLR-sponsored research to provide a fishery-independent index of relative abundance for pre-recruit *D. mawsoni* in the stock in Subareas 88.1 and 88.2, as requested by the Scientific Committee in 2010 (SC-CAMLR-XXIX, paragraph 3.185). The proposed research would use a standardised longline survey within defined survey strata in the southern Ross Sea shelf (SSRUs 881J and L) which collectively are thought to contain the bulk of the toothfish population of the target size classes.

3.14 The Working Group welcomed the research proposal and agreed that it had a high likelihood of achieving its objectives and fulfilling the request of the Scientific Committee. It endorsed the choice of main survey strata locations, but suggested extending the exploratory survey strata to depths shallower than the currently proposed 500 m. It further suggested that full sampling, ageing and biological analysis be extended to fish smaller than the target 80–100 cm size range. The Working Group noted that in the short term, tagging is not a necessary component to estimate relative abundance and that the proposed high tagging rate could possibly be relaxed; however, tagging can provide valuable additional information pertaining to fish life-cycle movement, and over time may inform estimates of absolute, rather than relative abundance for the survey strata in question.

STRATEGIES FOR ACQUIRING DATA AND SETTING CATCH LIMITS IN DATA-POOR FISHERIES

4.1 The Working Group noted that the substance of this agenda item had been covered in the focus topic under Item 2, and in particular its advice on:

(i) principles for data collection in data-poor fisheries and research fishing in closed areas (paragraph 2.25)

(ii) guidelines for developing research proposals consistent with these principles (paragraphs 2.26 to 2.29 and Table 6)

(iii) standardised research design, analysis and assessment methods, including estimating the minimum catch required to complete a research plan for tagging studies (paragraphs 2.37 to 2.44) and areal surveys using trawls (paragraphs 2.46 and 2.47) or longlines (paragraphs 2.48 and 2.49).

DESIGNS FOR SCIENTIFIC RESEARCH ON COMMERCIAL FISH STOCKS IN CLOSED AREAS WITH ZERO CATCH LIMITS

Review of research proposals

5.1 Three proposals to continue research fishing were considered under this agenda item (WG-SAM-11/5, 11/7 and 11/10). The Working Group reflected on the general principles and guidelines developed under Item 2 when reviewing the proposals and agreed that all three proposals need to be developed further to take into account the advice contained under Item 2 and summarised under Item 4.

5.2 The Working Group also made some specific recommendations for each of the separate proposals.

5.3 WG-SAM-11/7 provided the details of a proposal to continue research fishing in two SSRUs in Divisions 58.4.4a and 58.4.4b. The Working Group recommended the proposal be revised taking into account the main principles and guidelines discussed above (paragraph 5.1). The proposal should focus, in particular, on the following three points:

(i) A stock assessment should be attempted based on the tag-recapture, biological and fishery data to enable an evaluation of the impact of the proposed research catch on stock status.

(ii) A higher proportion of Spanish longlines should be considered because this will assist in achieving higher survival rates of tagged fish and will provide more comparisons in standardised CPUE between Spanish longlines and trotlines.

(iii) The proposal should consider explicitly ways to address potential problems with depredation of tagged toothfish by toothed whales.

5.4 Dr K. Taki (Japan) noted that the vessel carrying out the research had some operational difficulties in repeatedly switching between trotlines and Spanish longlines and that Japan would explore the possibility of just using Spanish longlines for the duration of the research fishing. However, the Working Group agreed that the data arising from the comparative fishing trials between trotlines and Spanish longlines made by Japan had been very informative and encouraged further trials if possible.

5.5 WG-SAM-11/5 provided the details of a proposal to continue research fishing in Division 58.4.3b. The Working Group recommended the proposal be revised taking into account the main principles and guidelines discussed above (paragraph 5.1). The proposal should focus, in particular, on the following points:

(i) An assessment of stock biomass for this area should be made using the seabed area × CPUE calculation and/or tag-recapture data to enable an evaluation of the impact of the proposed research catch on stock status.

(ii) A higher proportion of Spanish longlines should be considered because this is likely to assist in achieving higher survival rates of tagged fish and will provide more comparisons in standardised CPUE between Spanish longlines and trotlines.

(iii) A power analysis should be conducted to determine the ability of the current survey design to detect changes in CPUE.

(iv) A sensitivity analysis should be conducted to determine the impact of recapturing a small number of tags on the assessment of stock size in the survey area.

5.6 WG-SAM-11/10 provided the details of a proposal to continue research fishing in Subarea 88.3. The Working Group recommended the proposal be revised taking into account the main principles and guidelines discussed above (paragraph 5.1). The proposal should focus, in particular, on the following points:

(i) The research program should focus on the western SSRUs and in particular SSRU 883B where catch rates were generally higher and most tagged fish had been released.

(ii) An assessment of stock biomass for SSRU 883B should be made based on seabed area × CPUE, as this will help the Scientific Committee understand the effect of the proposed catch on stock status. The proposed catch limits greatly exceed the catch achieved in 2010/11, even when adjusted for increased numbers of longline sets.

(iii) Additional data should be provided in the revised proposal including the spatial distribution of tag releases in 2010/11 so that the effectiveness of the proposed research fishing in the second season to recapture tagged fish can be evaluated.

(iv) Some consideration also needs to be given to the likely condition of the fish on release, because studies in other areas have shown that a large proportion of small (<70 cm TL) *D. eleginoides* caught by Spanish longline and trotline are in poor condition, and it is believed that most of the fish in this subarea are small fish.

(v) The Working Group endorsed the proposal to increase the tagging level to 10 tags per tonne.

5.7 The Working Group noted that some locations in the Convention Area are unlikely to support a viable toothfish fishery and that even research fishing in closed areas or exploratory fishing in these locations may not be sustainable. It requested that WG-FSA consider developing guidelines to assist with deciding when an area could not support a viable fishery and when research or exploratory fishing should cease.

OTHER BUSINESS

Review of the Secretariat's Strategic Plan and Data Management Systems

6.1 The Working Group noted the outcomes of the independent review of the Secretariat's data management systems (CCAMLR-XXX/5) and the Secretariat's progress in reviewing its strategic plan (WG-EMM-11/9).

6.2 The independent review recommended changes to the Secretariat's organisational structure, the development of IT and data strategies, the further development of procedures for data processing and quality assurance, improvements to application systems, including the CCAMLR website, and upgrades to the Secretariat's IT infrastructure and services. The reviewers proposed that these recommendations be implemented as part of the Secretariat's review of its Strategic Plan and through the phased implementation of 10 specific projects. Three of these projects were initiated in 2011 – redevelopment of the Secretariat's document archive, development of an Enterprise Data Model and redevelopment of the CCAMLR website. The remaining projects are scheduled for implementation in 2012 and 2013, funding permitting.

6.3 The Secretariat's revised Strategic Plan has addressed the review recommendations dealing with improvements to the organisational structure. In addition, the revised Strategic Plan includes a staffing and salary strategy for consideration by the Commission in 2011 (CCAMLR-XXIX, paragraphs 3.5 and 3.10). The revised Strategic Plan covers the period from 2012 to 2014 and makes recommendations related to the Secretariat's support to the Scientific Committee and its working groups, including:

(i) re-titling of the Science Officer post to Science Manager, and re-titling of the Scientific Observer Data Analyst post to Scientific Observer Program Coordinator

(ii) establishing an Analytical Support Officer post to strengthen the Secretariat's scientific analytical capacity (see SC-CAMLR-XXVIII, Annex 5, paragraphs 15.2 to 15.8)

(iii) strengthening the role of the Data Centre through restructuring, revised administrative processes and improved coordination of existing personnel resources

(iv) establishing a Data Assistant post within the Data Centre to mitigate the risk of a single-point failure related to the current concentration of the Secretariat's data processing capacity in a single staff position.

6.4 The Secretariat's cost projections to the end of 2014 indicate that these recommendations can be implemented within the Commission's existing policy of a zero-real growth budget and through the restructuring of the Secretariat's organisational structure.

6.5 The Working Group endorsed the recommendations related to the Secretariat's support to the Scientific Committee and its working groups, including the establishment of the new posts (paragraphs 6.3(ii) and (iv)).

ADVICE TO THE SCIENTIFIC COMMITTEE

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

7.2 WG-SAM provided advice to the Scientific Committee and WG-FSA on the following items:

(i) Evaluation of research hauls in exploratory fisheries (paragraph 2.9)
(ii) CPUE in longline fisheries (paragraphs 2.15 and 2.33)
(iii) Preliminary assessment in Divisions 58.4.4a and 58.4.4b (paragraph 2.17)
(iv) Research fishing (paragraphs 2.19, 2.25 and 2.26; see also paragraphs 5.3 to 5.6)
(v) Performance metrics for surveys and tag-based research (paragraphs 2.38, 2.46 and 2.48)
(vi) Research design for data-poor fisheries (paragraphs 2.40, 2.44, 2.47 to 2.49)
(vii) Tag-loss rates used in CASAL (paragraph 3.6)
(viii) Pre-recruit survey in Subareas 88.1 and 88.2 (paragraph 3.14)
(ix) Research fishing in areas which cannot support a viable fishery (paragraph 5.7)
(x) Review of the Secretariat's Strategic Plan (paragraph 6.5)
(xi) Convener of WG-SAM (paragraph 8.3).

7.3 WG-SAM requested that the Secretariat summarise the spatial distribution of fishery characteristics (paragraph 2.8) and the historical progression of catch limits in data-poor fisheries (paragraph 2.10 and Table 4).

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

8.1 The report of the meeting of WG-SAM was adopted.

8.2 In closing the meeting, Dr Jones, on behalf of both Co-conveners, thanked the participants for their contributions to the meeting and their work during the intersessional period, and the rapporteurs for bringing together a focused report. Dr Jones also thanked Mr Ahn, his local organising team and the Korean fishing industry for their kind hospitality and assistance during the meeting, and the Secretariat for its support.

8.3 Dr Welsford, on behalf of the Working Group, thanked Drs Constable and Jones for facilitating discussions which led to a successful meeting. This was Dr Constable's last year as Convener of WG-SAM and the Working Group thanked him for his leadership in developing methods in statistics and assessments, and for guiding the group from its beginning as a subgroup of WG-FSA. The Working Group hoped that a new convener would be appointed by the Scientific Committee at its next meeting.

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Table 1: Overall characteristics in fisheries for *Dissostichus* spp. in Subareas 48.4, 48.6, 88.1, 88.2 and 88.3 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4a and 58.4.4b in all seasons. TOP – *D. eleginoides*, TOA – *D. mawsoni*, TOT – *Dissostichus* spp.

Subarea/ division	No. of sets	Catch (tonnes)			Proportion in catch		CPUE (tonnes/km of line)						Fishing depth (m)		
		TOP	TOA	TOT	TOP	TOA	TOP			TOA			Mean	Min.	Max.
							Mean	SD	CV (%)	Mean	SD	CV (%)			
48.4	798	403	130	533	0.76	0.24	0.058	0.064	112	0.022	0.064	290	1 335	355	1 931
48.6	1 361	343	1 070	1 413	0.24	0.76	0.026	0.032	119	0.076	0.145	190	1 333	383	2 902
58.4.1	1 900	97	2 464	2 562	0.04	0.96	0.003	0.016	475	0.095	0.131	138	1 476	554	3 773
58.4.2	806	2	1 050	1 052	0.00	1.00	0.000	0.001	608	0.131	0.191	146	1 353	563	2 245
58.4.3a	418	231	10	242	0.96	0.04	0.028	0.031	108	0.002	0.008	478	1 347	941	1 895
58.4.3b	948	133	1 044	1 177	0.11	0.89	0.013	0.031	241	0.072	0.084	117	1 495	643	2 293
58.4.4a	277	80	0	80	1.00	0.00	0.039	0.027	69	0.000	-	-	414	250	1 645
58.4.4b	98	69	0	69	1.00	0.00	0.049	0.030	61	0.000	-	-	819	345	1 920
88.1	12 759	131	26 384	26 515	0.00	1.00	0.001	0.010	797	0.237	0.284	120	1 155	232	2 450
88.2	2 296	0	3 538	3 539	0.00	1.00	0.000	0.000	2 664	0.189	0.252	133	1 370	513	2 260
88.3	21	0	0	0	0.05	0.95	0.000	0.001	458	0.002	0.004	170	1 039	622	1 700

Table 2: SSRU characteristics in fisheries for *Dissostichus* spp. in Subareas 48.4, 48.6, 88.1, 88.2 and 88.3 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4a and 58.4.4b in all seasons. TOP – *D. eleginoides*; TOA – *D. mawsoni*; TOT – *Dissostichus* spp.

SSRU	No. sets	Catch (tonnes)			Proportion in catch		CPUE (tonnes/km of line)						Fishing depth (m)			No. fish tagged and released			No. tagged fish recaptured			Seabed area (km^2) fishable depth range 600–1800 m
							TOP			TOA												
		TOP	TOA	TOT	TOP	TOA	Mean	SD	CV (%)	Mean	SD	CV (%)	Mean	Min.	Max.	TOP	TOA	TOT	TOP	TOA	TOT	
484N	519	368	2	370	0.99	0.01	0.080	0.067	83	0.001	0.002	365	1308	355	1931	1522	12	1534	72	0	72	7 710
484S	279	35	128	163	0.22	0.78	0.017	0.031	184	0.061	0.096	156	1384	895	1812	425	394	819	14	24	38	11 033
486A	336	128	41	169	0.76	0.24	0.038	0.030	77	0.013	0.027	212	1210	525	2043	274	55	329	3	0	3	10 582
486B	32	0	104	104	0.00	1.00	0.000	0.001	411	0.362	0.208	57	1424	1177	1579	0	312	312	0	1	1	6 242
486C	52	0	92	92	0.00	1.00	0.000	-	-	0.198	0.097	49	1426	922	1933	0	275	275				12 527
486D	50	0	100	100	0.00	1.00	0.000	-	-	0.224	0.163	73	1557	1248	1970	0	298	298				11 630
486E	85	0	299	299	0.00	1.00	0.000	-	-	0.250	0.263	105	1676	859	2902	1	862	863				14 544
486F	[a]																					10 169
486G	806	215	434	649	0.33	0.67	0.029	0.033	114	0.056	0.115	206	1325	383	1985	558	700	1258	9	5	14	10 727
5841A	[a]																					47
5841B	[a]																					16 544
5841C	795	71	1067	1138	0.06	0.94	0.006	0.022	395	0.092	0.132	143	1549	575	2939	193	1964	2157	0	11	11	33 107
5841D	13	0	10	10	0.00	1.00	0.000	-	-	0.057	0.033	58	1287	1192	1414	0	33	33	0	1	1	43 805
5841E	316	7	532	539	0.01	0.99	0.002	0.007	403	0.120	0.203	169	1551	740	2618	28	1319	1347	0	1	1	39 249
5841F	10	0	7	7	0.00	1.00	0.000	-	-	0.033	0.018	54	1330	830	1961	2	7	9				34 589
5841G	759	20	838	858	0.02	0.98	0.002	0.009	513	0.089	0.087	98	1374	554	3773	88	2186	2274	1	11	12	29 397
5841H	7	0	10	10	0.03	0.97	0.003	0.005	180	0.091	0.026	29	1318	1000	1572	3	70	73				18 255
5842A	221	0	236	236	0.00	1.00	0.000	0.000	1487	0.106	0.244	230	1345	599	1910	5	735	740				34 947
5842B	[a]																					12 598
5842C	75	1	72	73	0.01	0.99	0.001	0.002	300	0.109	0.097	89	1152	579	2245	5	180	185				11 188
5842D	38	0	21	21	0.00	1.00	0.000	-	-	0.108	0.100	92	1207	661	1931							11 044
5842E	472	1	721	722	0.00	1.00	0.000	0.001	587	0.149	0.178	120	1400	563	2000	23	1427	1450	0	2	2	38 962
5843aA	418	231	10	242	0.96	0.04	0.028	0.031	108	0.002	0.008	478	1347	941	1895	466	0	466	10	0	10	18 605
5843bA	314	91	151	242	0.38	0.62	0.032	0.046	142	0.053	0.070	130	1202	643	1814	249	286	578				33 476
5843bB	334	27	644	671	0.04	0.96	0.004	0.012	321	0.101	0.112	110	1733	1133	2293	30	432	462	0	8	8	19 549
5843bC	84	0	46	47	0.01	0.99	0.001	0.003	481	0.052	0.029	57	1519	1159	1887	2	79	81	0	1	1	25 724
5843bD	108	6	119	125	0.05	0.95	0.006	0.018	309	0.061	0.045	73	1580	1125	2019	27	162	189				20 831
5843bE	108	9	84	92	0.10	0.90	0.003	0.007	246	0.056	0.041	73	1506	1076	1738	46	172	218	1	1	2	31 388
5844aA	277	80	0	80	1.00	0.00	0.039	0.027	69	0.000	-	-	414	250	1645	104	0	104				2 090
5844bB	53	9	0	9	1.00	0.00	0.033	0.018	55	0.000	-	-	542	345	1040	188	0	188				7 533
5844bC	10	13	0	13	1.00	0.00	0.067	0.029	43	0.000	-	-	1414	1002	1920	148	0	148	1	0	1	5 070
5844bD	35	48	0	48	1.00	0.00	0.070	0.031	44	0.000	-	-	1068	910	1265	140	0	140				8 031

(continued)

Table 2 continued

SSRU	No. sets	Catch (tonnes)			Proportion in catch		CPUE (tonnes/km of line)						Fishing depth (m)			No. fish tagged and released			No. tagged fish recaptured			Seabed area (km^2) fishable depth range 600–1800 m
		TOP	TOA	TOT	TOP	TOA	TOP			TOA			Mean	Min.	Max.	TOP	TOA	TOT	TOP	TOA	TOT	
							Mean	SD	CV (%)	Mean	SD	CV (%)										
881A	37	15	1	16	0.97	0.03	0.058	0.064	110	0.004	0.016	362	1484	1000	2276	27	8	35				4 158
881B	731	90	799	889	0.10	0.90	0.016	0.035	220	0.136	0.227	167	1538	597	2450	819	439	1258	43	6	49	2 905
881C	1268	12	3802	3814	0.00	1.00	0.001	0.004	387	0.402	0.553	138	1519	863	2210	222	2906	3137	16	106	122	245
881D	[a]																					47 404
881E	197	7	104	112	0.07	0.93	0.003	0.011	315	0.046	0.059	128	1135	279	2389	25	35	60	1	4	5	12 392
881F	6	0	2	2	0.00	1.00	0.000	-	-	0.063	0.069	109	868	444	1336	0	15	15				14 782
881G	452	3	261	264	0.01	0.99	0.001	0.003	330	0.087	0.116	133	1117	391	1917	28	96	124	2	4	6	4 417
881H	3672	1	9021	9023	0.00	1.00	0.000	0.001	1612	0.264	0.275	104	1222	343	2096	33	8496	8529	1	636	639	21 825
881I	3478	1	6065	6067	0.00	1.00	0.000	0.001	1186	0.221	0.190	86	1085	480	2156	11	5449	5460	1	226	229	26 637
881J	674	0	1268	1268	0.00	1.00	0.000	0.000	997	0.145	0.119	82	799	309	1404	1	1463	1465	0	13	13	22 330
881K	1417	1	3490	3491	0.00	1.00	0.000	0.001	1102	0.274	0.248	90	1010	257	1755	4	4059	4064	0	33	33	28 215
881L	423	0	597	597	0.00	1.00	0.000	0.000	1568	0.094	0.062	65	645	473	1058	0	575	575	0	2	2	6 914
881M	404	0	972	972	0.00	1.00	0.000	0.000	2010	0.261	0.199	76	975	232	1262	1	1090	1091	0	70	70	32 511
882A	89	0	229	229	0.00	1.00	0.000	0.001	943	0.233	0.221	95	1134	608	1843	1	205	206				19 907[c]
882B	4	0	1	1	0.00	1.00	0.000	-	-	0.040	0.032	81	635	609	671	0	1	1				15 928[c]
882C	4	0	5	5	0.00	1.00	0.000	-	-	0.100	0.060	59	1074	646	1521	0	11	11				8 702
882D	189	0	245	245	0.00	1.00	0.000	0.000	1029	0.154	0.169	110	1369	721	1854	0	206	206	0	8	8	26 438
882E	1698	0	2671	2671	0.00	1.00	0.000	0.000	2447	0.202	0.273	135	1392	680	2004	5	2625	2630	3	268	274	28 392
882F	283	0	365	365	0.00	1.00	0.000	-	-	0.143	0.154	108	1386	748	2260	0	441	441	0	8	8	58 485
882G	13	0	7	7	0.00	1.00	0.000	-	-	0.028	0.013	48	869	513	1160	0	15	15				30 392
883A	[b]															0	7	7				25 441
883B	11	0	0	0	0.00	1.00	0.000	-	-	0.004	0.005	117	1004	622	1700	0	11	11				33 773
883C	6	0	0	0	0.00	1.00	0.000	-	-	0.000	0.001	125	992	719	1622	0	20	20				36 110
883D	4	0	0	0	0.70	0.30	0.001	0.001	200	0.000	0.001	200	1205	837	1541							8 816

[a] No fishing reported
[b] Research fishing (data not yet processed)
[c] Seabed areas for sector north of 80°S

Table 3: Catch-weighted mean length of *Dissostichus* spp. (with weighted std dev and CV) and proportion of large individuals caught in SSRUs in fisheries for *Dissostichus* spp. in Subareas 48.4, 48.6, 88.1, 88.2 and 88.3 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4a and 58.4.4b in all seasons. Large individuals: *D. eleginoides* > 80 cm; *D. mawsoni* > 100 cm.

Subarea/ division	SSRU	*D. eleginoides*				*D. mawsoni*			
		Weighted mean length (cm)	Weighted SD	CV (%)	Proportion large individuals	Weighted mean length (cm)	Weighted SD	CV (%)	Proportion large individuals
48.4	484N	112	17	15	0.96	148	21	14	1.00
	484S	122	17	14	0.98	155	14	9	1.00
48.6	486A	102	23	22	0.83	146	17	12	0.99
	486B	149	23	16	1.00	147	19	13	0.96
	486C	-	-	-	-	141	25	18	0.91
	486D	-	-	-	-	154	11	7	1.00
	486E	-	-	-	-	152	16	11	0.99
	486G	108	24	22	0.89	143	18	12	0.99
58.4.1	5841C	139	21	15	0.99	138	18	13	0.96
	5841D	-	-	-	-	141	14	10	0.99
	5841E	143	15	10	1.00	142	17	12	0.98
	5841F	-	-	-	-	135	20	14	0.94
	5841G	133	25	18	0.99	136	20	15	0.94
	5841H	105	10	10	1.00	142	16	12	0.98
58.4.2	5842A	116	-	-	1.00	142	25	17	0.91
	5842C	90	18	20	0.65	106	37	34	0.50
	5842D	-	-	-	-	107	34	31	0.55
	5842E	96	25	27	0.70	127	24	19	0.85
58.4.3a	5843aA	92	28	31	0.60	147	8	5	1.00
58.4.3b	5843bA	108	23	21	0.89	140	15	11	0.99
	5843bB	143	17	12	1.00	141	14	10	0.99
	5843bC	114	26	23	0.82	140	14	10	1.00
	5843bD	105	21	20	0.88	139	15	11	0.99
	5843bE	108	34	32	0.74	140	14	10	1.00
58.4.4a	5844aA	87	19	22	0.56	-	-	-	-
58.4.4b	5844bB	75	13	18	0.39	-	-	-	-
	5844bC	97	22	23	0.76	-	-	-	-
	5844bD	93	17	18	0.76	-	-	-	-
88.1	881A	97	19	19	0.81	144	14	10	1.00
	881B	98	23	23	0.80	142	18	12	0.97
	881C	108	25	24	0.85	146	13	9	1.00
	881E	99	21	21	0.83	119	29	24	0.73
	881F	-	-	-	-	114	15	13	0.84
	881G	105	24	22	0.87	144	16	11	0.99
	881H	115	21	18	0.96	123	22	18	0.83
	881I	114	21	19	1.00	130	23	17	0.89
	881J	115	16	14	1.00	108	22	20	0.62
	881K	120	27	22	0.91	120	24	20	0.80
	881L	113	4	4	1.00	102	22	21	0.49
	881M	-	-	-	-	106	18	17	0.68
88.2	882A	123	14	11	1.00	120	30	25	0.74
	882B	-	-	-	-	96	19	20	0.34
	882C	-	-	-	-	99	34	35	0.38
	882D	142	20	14	1.00	114	35	31	0.57
	882E	115	2	2	1.00	145	19	13	0.97
	882F	-	-	-	-	96	33	35	0.34
	882G	-	-	-	-	87	42	49	0.30
88.3	883C	-	-	-	-	42	-	-	0.00
	883D	82	13	16	0.50	79	-	-	0.00

Table 4: A summary of catches, catch limits and the methods for setting catch limits (1997/98 season onwards) in Subareas 48.4 and 48.6.

Subarea 48.4

Season	Target species	Method	Catch limit (tonnes)	Total reported catch (tonnes)	IUU catch (tonnes)	Total removals (tonnes)	Catch limit by SSRU	Other catch limitations	Method for setting catch limit	Research requirements
1997/98	*D. eleginoides*	Longline	28	0		0			Leslie method to estimate local density, YPR analysis from 48.3 to estimate precautionary catch (SC-CAMLR-XII, Annex 5, paragraph 6.3)	
1998/99	*D. eleginoides*	Longline	28	0		0				
1999/00	*D. eleginoides*	Longline	28	0		0				
2000/01	*D. eleginoides*	Longline	28	0		0				
2001/02	*D. eleginoides*	Longline	28	0		0				
2002/03	*D. eleginoides*	Longline	28	0		0				
2003/04	*D. eleginoides*	Longline	28	0		0				
2004/05	*D. eleginoides*	Longline	28	27		27				
2005/06	*D. eleginoides*	Longline	100	19		19			100 tonnes to allow establishment of mark-recapture program in 48.4 N (SC-CAMLR-XXIV, paragraph 4.118)	
2006/07	*D. eleginoides*	Longline	100	54		54				
2007/08	*D. eleginoides*	Longline	100	98		98				
2008/09	*Dissostichus* spp.	Longline	150	133		133		75 tonnes of *D. eleginoides* in 48.4 N, 75 tonnes of *Dissostichus* spp. in 48.4 S	75 tonnes in N and S to allow establishment of tag-recapture program in 48.4 (SC-CAMLR-XXVII, paragraph 4.97)	
2009/10	*Dissostichus* spp.		116	114		114		Finfish by-catch move-on rules (CM 41-03). 41 tonnes of *D. eleginoides* in 48.4 N, 75 tonnes of *Dissostichus* spp. in 48.4 S	41 tonnes in 48.4 N using CASAL assessment of stock using tag data, 75 tonnes in 48.4 S carried forward (SC-CAMLR-XXVIII, paragraphs 4.93 and 4.94)	

(continued)

Table 4 (continued)

Subarea 48.6

Season	Target species	Method	Catch limit (tonnes)	Total reported catch (tonnes)	IUU catch (tonnes)	Total removals (tonnes)	Catch limit by SSRU	Other catch limitations	Method for setting catch limit	Research requirements
1997/98	*Dissostichus* spp.	Longline	1536	0		0		888 tonnes north of 60°S, 648 tonnes south of 60°S	Based on GYM precautionary catch estimates using parameters from 48.3 and seabed area under consideration relative to 48.3 (SC-CAMLR-XVI, paragraph 9.60)	
1998/99	*Dissostichus* spp.	Longline	1202	0		0		707 tonnes north of 60°S, 495 tonnes south of 60°S	Unknown	
1999/00	*Dissostichus* spp.	Longline	910	0		0		455 tonnes north of 60°S, 455 tonnes south of 60°S	Maximum catch of 100 tonnes per fine-scale rectangle and discounted by 50% (SC-CAMLR-XVIII, paragraph 9.49)	
2000/01	*Dissostichus* spp.	Longline	910	0		0		As above		
2001/02	*Dissostichus* spp.	Longline	910	0		0		As above		
2002/03	*Dissostichus* spp.	Longline	910	0		0		As above		
2003/04	*Dissostichus* spp.	Longline	910	7		7		As above		
2004/05	*Dissostichus* spp.	Longline	910	51		51		As above		
2005/06	*Dissostichus* spp.	Longline	910	163		163		As above		
2006/07	*Dissostichus* spp.	Longline	910	112		112		As above		
2007/08	*Dissostichus* spp.	Longline	400	24		24		200 tonnes north of 60°S, 200 tonnes south of 60°S	Commission. SC-CAMLR noted previous catch limit calculations no longer valid (SC-CAMLR-XXVI, paragraph 4.127)	
2008/09	*Dissostichus* spp.	Longline	400	282		282		As above		
2009/10	*Dissostichus* spp.	Longline	400	295		295		As above	Recommendation that existing CMs remain in force (SC-CAMLR-XXVIII, paragraph 4.174)	

Table 5: List of papers with assessment methods that have been applied in data-poor fisheries to be considered for WG-FSA.

Working Group papers:

Agnew, D.J., C. Edwards, R. Hillary, R. Mitchell and L.J. López Abellán. 2008. Analysis of the potential for an assessment of toothfish stocks in Divisions 58.4.1, 58.4.2. Document *WG-SAM-08/4*. CCAMLR, Hobart. Australia.

Delegation of the United Kingdom. 2005. Proposal for a mark-recapture experiment to estimate toothfish population size in Subarea 48.4. Document *WG-FSA-05/57*. CCAMLR, Hobart. Australia.

Hillary, R.M. 2008. Exploratory assessment methods for exploratory fisheries: an example case using catch, IUU catch and tagging data for Subarea 58.4.3a. Document *WG-SAM-08/5*. CCAMLR, Hobart. Australia.

Hillary, R.M. 2008. Defining tag rates and TACs to obtain suitably precise abundance estimates for new and exploratory fisheries in the CCAMLR Convention Area. Document *WG-SAM-08/6*. CCAMLR, Hobart. Australia.

McKinlay, J.P. and D.C. Welsford. 2008. Expected tag-recapture rates from new and exploratory fisheries for *Dissostichus* spp. Document *WG-FSA-08/63*. CCAMLR, Hobart. Australia.

Welsford, D.C. 2010. Evaluating the impact of multi-year research catch limits on overfished toothfish populations. Document *WG-FSA-10/42 Rev. 1*. CCAMLR, Hobart. Australia.

Ziegler, P.E., D.C. Welsford and A.J. Constable. 2010. Evaluating length-frequency data and length-based performance indicators in new and exploratory fisheries. Document *WG-FSA-10/43*. CCAMLR, Hobart. Australia.

***CCAMLR Science* papers:**

Agnew, D.J., C. Edwards, R. Hillary, R. Mitchell and L.J. López Abellán. 2009. Status of the coastal stocks of *Dissostichus* spp. in East Antarctica (Divisions 58.4.1 and 58.4.2). *CCAMLR Science*, 16: 71.

de la Mare, W.K. 1994. Estimating confidence intervals for fish stock abundance estimates from trawl surveys. *CCAMLR Science,* 1: 203–207.

Hillary, R.M. 2009. Assessment and tag program adaption methods for exploratory fisheries in the CAMLR Convention Area: an example application for Division 58.4.3a. *CCAMLR Science*, 16: 101–113.

McKinlay, J.P., D.C. Welsford, A.J. Constable and G.B. Nowara. 2008. An assessment of the exploratory fishery for *Dissostichus* spp. on BANZARE Bank (CCAMLR Division 58.4.3b) based on fine-scale catch and effort data. *CCAMLR Science*, 15: 55–78.

Parkes, G., C.A. Moreno, G. Pilling and Z. Young. 1996. Use of the Leslie stock depletion model for the assessment of local abundance of Patagonian toothfish (*Dissostichus eleginoides*). *CCAMLR Science*, 3: 55–77.

Table 6: Any research proposal in data-poor fisheries should provide details on each point to enable the Scientific Committee to evaluate the likelihood the proposal will, inter alia, satisfy the requirements of Conservation Measure 21-02, paragraphs 1(ii)(a–c).

Category	Information
1. Main objective	(a) Objectives for the research and why it is a priority for CCAMLR. (b) Description how performance measures will be accounted for. (c) Relevant existing information on the target species from this region, and information from other fisheries in the region or similar fisheries elsewhere.
2. Fishery operations	(a) Fishing nation (b) Fishing vessels (c) Target species (d) Fishing methods (e) Fishing regions and locations (f) Timing and duration.
3. Data collection	(a) Objectives of the data collection. (b) Types and quantities of catch, effort and related biological, ecological and environmental data (e.g. sample size by location) that will be collected and how sampling/fishing gear has been calibrated. (c) Methods for data collection (how and where these data types will be collected). (d) Methods for data analysis (description of methods by data type). (e) How and when will the data lead to a robust estimate of stock status and precautionary catch limits. Include evidence that the proposed methods are highly likely to be successful. (f) Nominated research provider for data analysis and evaluations of stock status and precautionary catch limits.
4. Proposed catch limits	(a) Proposed catch limits and justification. (Note that the catch limits should be at a level not substantially above that necessary to obtain the information specified in the plans for data collection and required to undertake the evaluations of stock status and precautionary catch limits.) (b) Evaluation of the impact of the proposed catch on stock status: • rationale that proposed catch limits are consistent with Article II of the Convention • evaluation of time scales involved in determining the responses of harvested, dependent and related populations to fishing activities. • Information on estimated removals, including IUU activities. (c) Details of dependent and related species and the likelihood of their being affected by the proposed fishery.
5. Research capability	(a) Evidence that the proposed fishing vessels and nominated research providers have the resources and capability to fulfil all obligations of the proposed data collection plan.
6. Reporting for evaluation and review	(a) List dates by which specific actions leading to the design and implementation of the data collection plan, and the provision of a robust assessment and precautionary catch limits, will be concluded and reported to CCAMLR. (b) Where the research is for more than one year, undertake an annual review of the research, including a review of the performance of the research program, preliminary analyses to evaluate how well the research will meet the research objectives, and determine if adjustments are required or whether the program should cease. (c) Description of performance measurers to allow SC-CAMLR to evaluate whether the research has been successful in achieving its objectives.

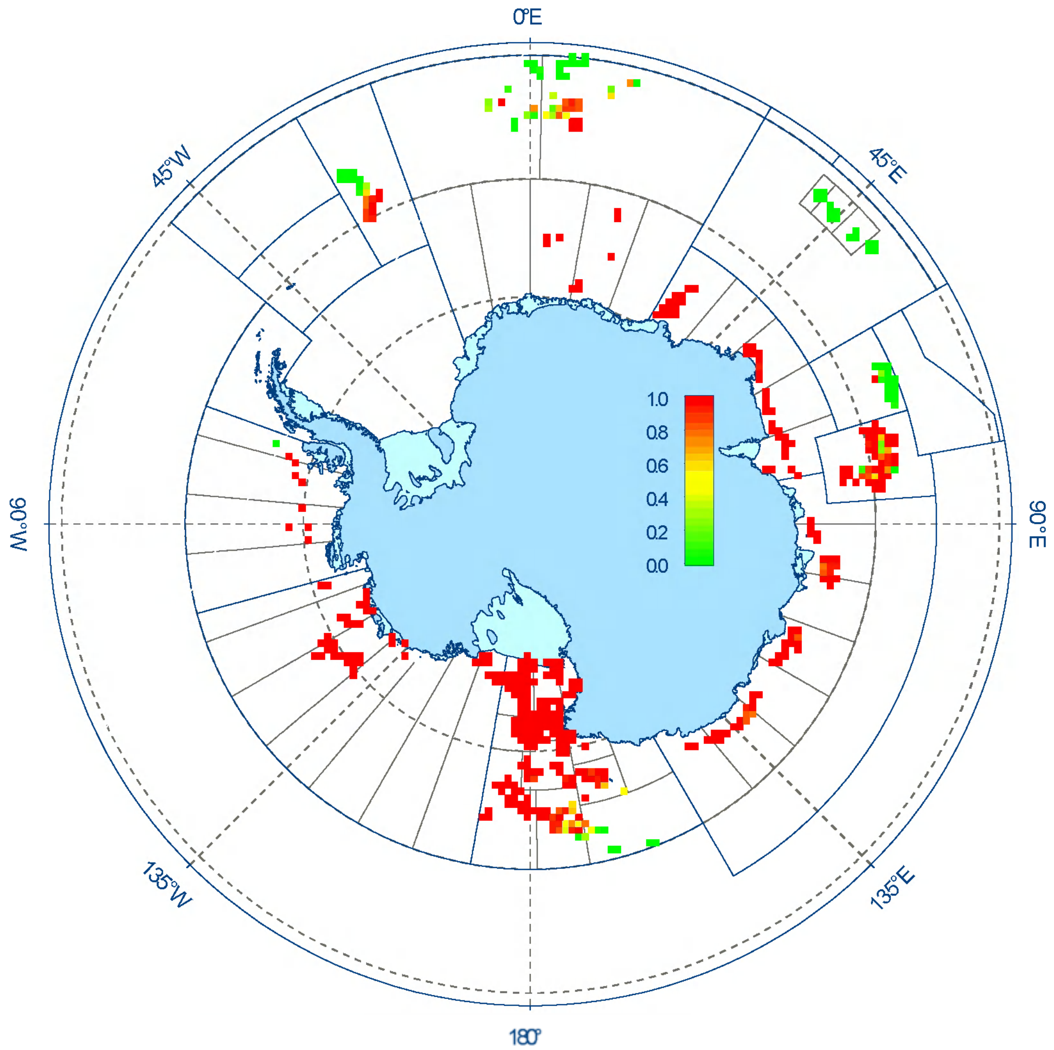

Figure 1*: Proportion of *Dissostichus mawsoni* in the total *Dissostichus* spp. catch by number in longline catches by fine-scale rectangles for all sets up to and including 2009/10.

* This figure is available in colour on the CCAMLR website.

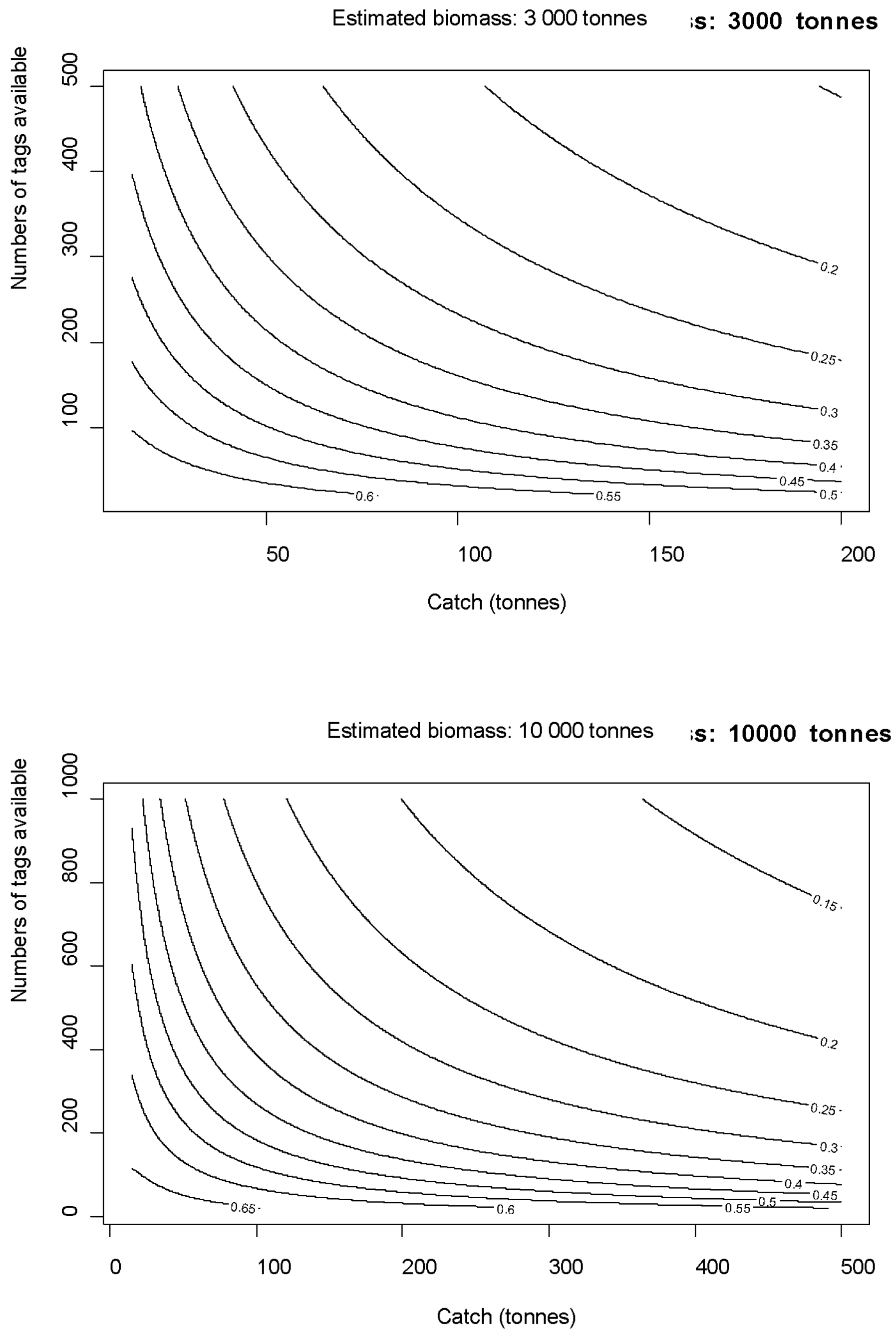

Figure 2: Estimated CVs to be achieved for an estimate of biomass as determined by the Petersen estimator (WG-SAM-08/6) applied to a multi-year tag-recapture survey. The estimated CV is a function of the number of tagged fish in the population available for recapture and the amount of fish scanned for tags per year (i.e. tonnes of catch), for a given initial biomass estimate (in this case 3 000 tonnes and 10 000 tonnes) derived by other means (e.g. relative CPUE with an analogous assessed SSRU, modified by an estimate of fishable seabed area).

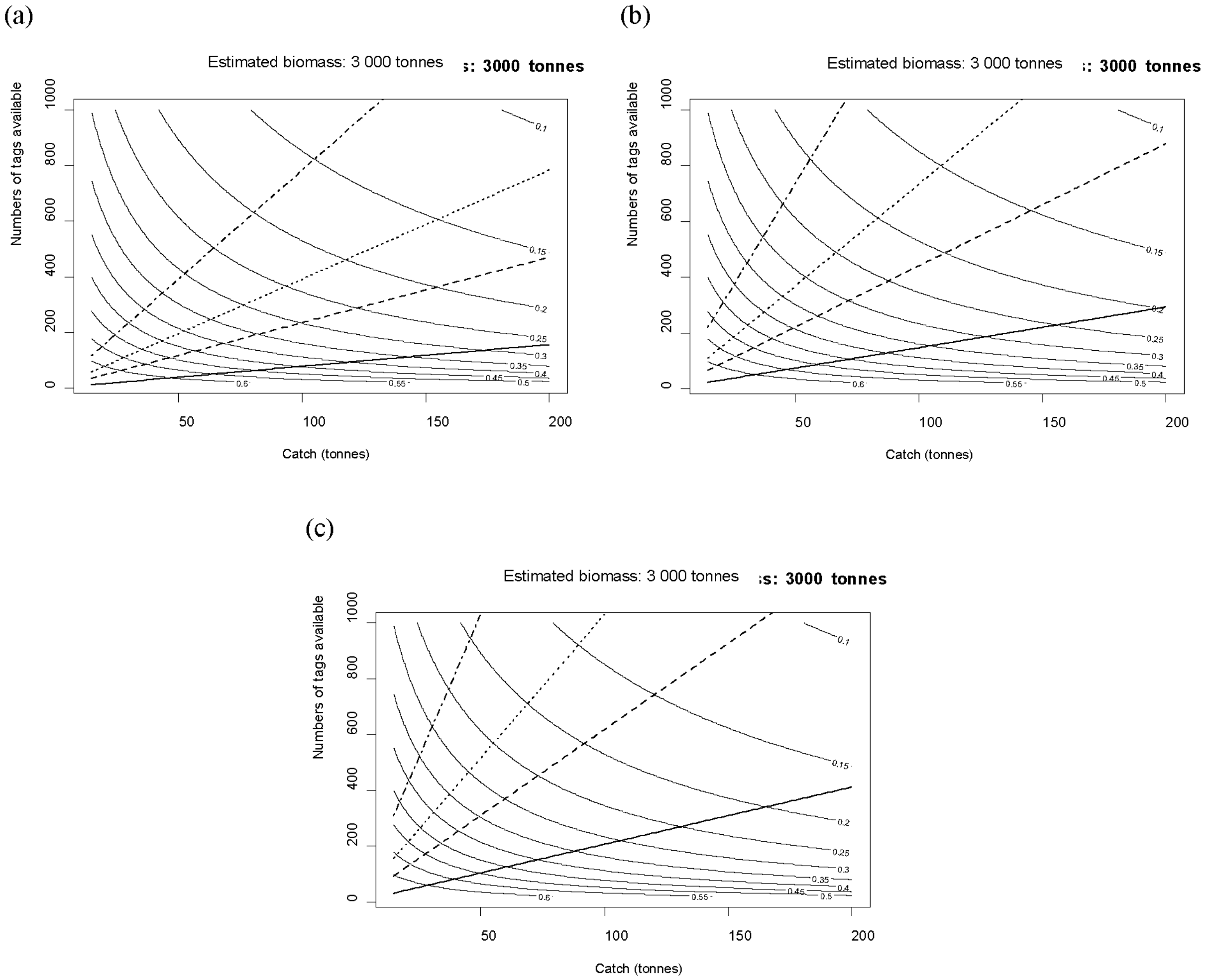

Figure 3: Estimated CVs to be achieved for an estimate of biomass as determined by the Petersen estimator (WG-SAM-08/6) applied to a multi-year tag-recapture survey. The estimated CV is a function of the number of tagged fish in the population available for recapture and the amount of fish scanned for tags per year (i.e. annual catch in tonnes), for a given initial biomass estimate (in this case 3 000 tonnes) derived by other means. Heavy lines are based on the formula developed by Dr Sharp (paragraphs 2.42 and 2.43) and indicate the estimated number of tags available for recapture in (a) year 2, (b) year 3 and (c) year 4, as a function of the tagging rate in fish per tonne, assuming constant catches and tagging rates in all years of the survey. Heavy lines correspond to tagging rates of 1 (solid), 3 (dashed), 5 (dotted) and 10 (alternating) fish per tonne, under the following asumptions: tagging mortality = 0.1 (WG-FSA-05/19); annual tag-loss rate approximation = 0.0084 (WG-FSA-11/18); natural mortality = 0.13 (WG-FSA-09/40 Rev. 1).

APPENDIX A

LIST OF PARTICIPANTS

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(Busan, Republic of Korea, 11 to 15 July 2011)

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APPENDIX B

AGENDA

Working Group on Statistics, Assessments and Modelling
(Busan, Republic of Korea, 11 to 15 July 2011)

1. Introduction
   1.1 Opening of the meeting
   1.2 Adoption of the agenda and organisation of the meeting

2. Focus topic: work plan for implementing research proposals for data-poor fisheries

3. Methods for assessing finfish stocks in established fisheries, notably *Dissostichus* spp.
   3.1 Tagging
   3.2 Assessments
   3.3 Scientific research in support of assessments

4. Strategies for acquiring data and setting catch limits in data-poor fisheries

5. Designs for scientific research on commercial fish stocks in closed areas and areas with zero catch limits

6. Other business

7. Advice to the Scientific Committee
   7.1 WG-FSA
   7.2 General

8. Adoption of report and close of meeting.

APPENDIX C

LIST OF DOCUMENTS

Working Group on Statistics, Assessments and Modelling
(Busan, Republic of Korea, 11 to 15 July 2011)

WG-SAM-11/1	Draft Agenda for the 2011 Meeting of the Working Group on Statistics, Assessments and Modelling (WG-SAM)
WG-SAM-11/2	List of participants
WG-SAM-11/3	List of documents
WG-SAM-11/4	Deployment of research hauls in the exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in 2010/11 Secretariat
WG-SAM-11/5	Reports on abundance and biological information of toothfish in Division 58.4.3b by *Shinsei Maru No.3* in the 2010/11 and proposal of the consecutive survey in the 2011/12 seasons K. Taki, T. Iwami and M. Kiyota (Japan)
WG-SAM-11/6	Reports on abundance and biological information on toothfish in Divisions 58.4.4a and b by *Shinsei Maru No. 3* in the 2010/11 season K.Taki, T. Iwami and M. Kiyota (Japan)
WG-SAM-11/7	Research plan for toothfish in Divisions 58.4.4a and b by *Shinsei Maru No. 3* in 2011/12 Delegation of Japan
WG-SAM-11/8	Principles for evaluating data collection plans in data-poor exploratory fisheries P.E. Ziegler, D.C. Welsford and A.J. Constable (Australia)
WG-SAM-11/9	Brief results of research fishing in Subarea 88.3 in the 2010/11 season Delegation of the Russian Federation
WG-SAM-11/10	Plan of research fishing in Subarea 88.3 in the 2011/12 season Delegation of the Russian Federation
WG-SAM-11/11	See WG-EMM-11/44
WG-SAM-11/12	Models of tag shedding for double tagging as a function of time at liberty and approximate solutions for the single tagging model in CASAL S.G. Candy (Australia)

WG-SAM-11/13	Development of a generic operating model framework for data collection, assessment method and management strategy evaluations P.E. Ziegler (Australia)
WG-SAM-11/14	Developments in the CCAMR tagging program relating to tag linking Secretariat
WG-SAM-11/15 Rev. 1	Research standards for exploratory fisheries D. Kinzey (USA)
WG-SAM-11/16	Proposal for a CCAMLR sponsored research survey to monitor abundance of pre-recruit Antarctic toothfish in the southern Ross Sea S.M. Hanchet, S. Mormede, S.J. Parker and A. Dunn (New Zealand)
WG-SAM-11/17	Investigation of the sensitivity of the Ross Sea toothfish assessment to withholding subsets of the available data S. Mormede (New Zealand)
WG-SAM-11/18	Estimates of the tag loss rates for single and double tagged toothfish (*Dissostichus mawsoni*) fishery in the Ross Sea A. Dunn, M.H. Smith (New Zealand), D.J. Agnew (UK) and S. Mormede (New Zealand)
WG-SAM-11/19	Report on the results of exploratory research fishing for crabs in Subarea 48.2 on board FV *Tamango* in the 2009/10 season V.A. Bizikov and S.E. Anosov (Russia)
WG-SAM-11/20	A preliminary population status model for the Patagonian toothfish, *Dissostichus eleginoides*, on the Kerguelen Plateau (Divisions 58.5.1 and 58.5.2) using CASAL S.G. Candy (Australia), A. Relot, G. Duhamel (France), D.C. Welsford, A.J. Constable, T.D. Lamb (Australia), P. Pruvost and N. Gasco (France)

Other documents

WG-SAM-11/P1	Estimates of sustainable yield for 50 data-poor stocks in the Pacific coast groundfish fishery management plan E.J. Dick and A.D. McCall (*NOAA-TM-NMFS-SWFSC-460* (2010))
WG-SAM-11/P2	Depletion-based stock reduction analysis: a catch-based method for determining sustainable yields for data-poor fish stocks E.J. Dick and A.D. McCall (*Fish. Res.* (2011), in press, doi:10.1016/j.fishres.2011.05.007)

WG-SAM-11/P3	Depletion-corrected average catch: a simple formula for estimating sustainable yields in data-poor situations A.D. McCall (*ICES J. Mar. Sci.* (2009), 66: 2267–2271)
WG-EMM-11/9	The Secretariat review of the Strategic Plan, associated activities and outcomes Secretariat
WG-EMM-11/44	Some properties of diagnostics of GLMM model tuning for standardising CPUE indices in the Area 48 using the CCAMLR fishery statistics database P. Gasyukov and S. Kasatkina (Russia)
CCAMLR-XXX/5	Report on the independent review of CCAMLR's data management systems Secretariat

REPORT OF THE WORKSHOP ON MARINE PROTECTED AREAS

(Brest, France, 29 August to 2 September 2011)

CONTENTS

REPORT OF THE WORKSHOP ON MARINE PROTECTED AREAS
(Brest, France, 29 August to 2 September 2011)

INTRODUCTION

Opening of the meeting

1.1 The Workshop on Marine Protected Areas (WS-MPA) was held at the Institut Paul Emile Victor (IPEV), Brest, France, from 29 August to 2 September 2011. The Workshop was co-convened by Dr P. Penhale (USA) and Prof. P. Koubbi (France) and was hosted by IPEV and the Agence des Aires Marines Protegées (AAMP).

1.2 The Co-conveners welcomed all participants (Appendix A) and, in particular, the invited experts: Dr M. Lombard (Nelson Mandela Metropolitan University and University of Pretoria, South Africa), Prof. A. Rogers (University of Oxford, UK) and Dr B. Smith (University of Kent, UK).

1.3 Dr Y. Frenot (Director of IPEV and Chair of CEP) welcomed participants to IPEV and introduced the infrastructure and resources of the French Antarctic Program. In his role as Chair of the CEP, he emphasised the strong links between the CEP and SC-CAMLR with respect to MPAs and noted that the CEP has included consideration of the outcomes of this Workshop at its next meeting.

1.4 Dr F. Gauthiez (AAMP) noted that welcoming participants to a meeting on MPAs in Brest was particularly appropriate as it is adjacent to the Mer d'Iroise MPA; the largest MPA in France.

1.5 Mr J. Ringelstein (Terres Australes et Antarctiques Françaises (TAAF)) provided a review of the development of the 22 700 km^2 marine reserve in the French EEZs around Crozet and Kerguelen Islands.

Adoption of the agenda and organisation of the meeting

1.6 The Workshop agenda was prepared based on the terms of reference as agreed by the Scientific Committee (SC-CAMLR-XXIX, paragraph 5.22). The adopted agenda is in Appendix B.

1.7 Documents submitted to the Workshop are listed in Appendix C.

1.8 In providing an introduction to the Workshop, Dr Penhale reviewed the development of discussions in CCAMLR on MPAs, in particular, the 2005 MPA Workshop and the 2007 Bioregionalisation Workshop. She also recalled the discussion at the Scientific Committee in 2010, including the agreed recommended outcomes for the Workshop (SC-CAMLR-XXIX, paragraph 5.23).

1.9 The report of the meeting was prepared by Drs J. Arata (Chile), A. Constable (Australia), Ms A. Dahood (USA), Ms K. Delord (France), Drs S. Grant (UK), M. Kiyota (Japan), E. Marschoff (Argentina), K. Reid (Science Officer), B. Sharp (New Zealand), P. Trathan (UK) and G. Watters (USA).

1.10 In this report, paragraphs that provide advice to the Scientific Committee, its working groups and the Commission have been highlighted. A list of these paragraphs is provided in Item 8.

BIOREGIONALISATION AND SYSTEMATIC CONSERVATION PLANNING

2.1 The Workshop recalled the advice of the Scientific Committee that a number of methods could be used for designing a representative system of MPAs, including, inter alia, bioregionalisation and/or systematic conservation planning (SCP) (SC-CAMLR-XXVII, paragraph 3.55).

Existing spatial protection and management

2.2 Dr Grant introduced two papers summarising existing marine spatial protection and management in the Southern Ocean. WS-MPA-11/19 provided updated information on the status of protected areas currently designated in the Southern Ocean, including MPAs designated by CCAMLR, ASPAs and ASMAs designated by the ATCM, and additional MPAs not designated under the Antarctic Treaty System. The total marine area under these types of protection within the Convention Area is currently 179 889 km^2 (equivalent to around 0.5% of the total Convention Area). This compares to 66 671 km^2 (0.19% of the total Convention Area) in 2005. Although some progress has been made since 2005, the geographic coverage, habitat representation and range of values being protected by the existing range of MPAs, remain poor.

2.3 WS-MPA-11/20 described a GIS and accompanying database which has been developed by the UK to store and deliver data on CCAMLR's management units and spatially resolved conservation measures. The GIS can help to inform the development of MPAs as part of an SCP process, by providing information on the location and extent of existing spatial management, and allowing analysis of management measures in relation to the distribution of bioregions and other environmental characteristics or biological distributions. It also provides a central repository for data on the location and status of designated MPAs.

2.4 The Workshop welcomed the development of the GIS, which allows Members to access standardised information and provides a common foundation for spatial analyses. Summary statistics generated by the database, such as those illustrated in WS-MPA-11/20, may help to inform development of the representative system of MPAs, although it was noted that some spatial management measures, such as catch limits, are not resolved at a fine spatial scale, for example, in relation to features such as fishable depth ranges, and caution is therefore necessary when generalising such information across different spatial scales.

2.5 The Workshop endorsed the further development of this GIS tool and encouraged the UK to work with the CCAMLR Secretariat to further develop and maintain this GIS tool for the use of all Members, including incorporation of the results of bioregionalisation work that has been endorsed by the Scientific Committee and its working groups. The Workshop also recommended that a standard protocol should be developed for the submission of data to the GIS database.

Regionalisation analyses

2.6 WS-MPA-11/6 described an updated circumpolar pelagic regionalisation of the Southern Ocean, based on sea-surface temperature, depth and sea-ice information. The results show a series of latitudinal bands in open areas, consistent with the meridional zonation of the ACC. Around islands and continents, the spatial scale of the patterns is finer, and is driven by variations in depth and sea-ice. The Workshop welcomed this updated analysis, which is broadly consistent with the earlier circumpolar pelagic regionalisation (Grant et al., 2006), as well as finer-scale regional results from the Ross Sea region (Sharp et al., 2010).

2.7 The updated pelagic regionalisation can be used to demonstrate representativeness at a circumpolar scale, and can be used to identify gaps in the representation of pelagic habitats, for example, outside the current priority areas. It can also be used to identify areas of particular importance, such as polynyas, in the absence of more detailed regional analyses.

2.8 The Workshop agreed that the synoptic satellite-derived datasets on sea-surface temperature and sea-ice can summarise broad-scale changes in the pelagic environment, and recommended that periodic updates to the regionalisation analysis should be undertaken to monitor such change. It was further recommended that such updated regionalisation results could be made available as part of the GIS database developed by the UK (paragraph 2.5).

2.9 Prof. Koubbi introduced WS-MPA-11/15 on the CAML/SCAR-MarBIN 'Biogeographic Atlas of the Southern Ocean' which is currently in preparation. This will constitute a major scientific output of CAML and SCAR-MarBIN, and will include a collection of maps and synthetic texts presenting key biogeographic patterns and processes of Antarctic marine biodiversity (benthos, plankton, nekton, birds and seals) south of 40°S.

2.10 It was noted that information useful for incorporation into bioregionalisation analyses would also be the uncertainty associated with the projected species distributions, and on where ecological barriers to connectivity may disrupt the distribution of populations across the estimated habitat space.

2.11 It was further noted that species distribution data are not only relevant to the particular species being modelled, but that such information, if appropriately selected, can be useful for indicating variation in other species, as well as capturing complex variation in the pelagic environment which may not be achieved so well using only physical information.

2.12 Prof. Rogers introduced WS-MPA-11/23 and 11/16 on behalf of the authors. These papers update circumpolar analyses previously presented to WG-EMM, incorporating advice received from the Working Group.

2.13 A hierarchical classification of benthic biodiversity in the Southern Ocean (WS-MPA-11/23) identified benthic ecoregions, bathomes and geomorphic seabed features, and used these to define 846 unique environmental types. Spatial protection of these environmental types were assessed against current protected areas in the CCAMLR area. The full range of environmental types were not represented within MPAs in any ecoregions, and 12 ecoregions contained no protected areas. The authors further recommended that 119 locations with spatially restricted or rare environmental types should be considered for inclusion in future MPAs.

2.14 WS-MPA-11/16 described a revised SCP process using a variety of physical datasets, updated pelagic regionalisation (WS-MPA-11/6), the benthic classification produced in WS-MPA-11/23, and species distributions modelled from Aquamaps (www.aquamaps.org), to identify potential areas in offshore areas of the Southern Ocean that would contribute to a representative system of MPAs. The preliminary results identified 22 potential areas to capture conservation features including benthic ecoregions and environmental types, pelagic regions, rare features, VMEs and biological features around the entire CCAMLR area.

2.15 Overall, the Workshop welcomed the concept of addressing representativeness at a circumpolar scale. It was suggested that further development of the methodology would be valuable, in particular incorporating refinements to the benthic classification (as described in paragraphs 2.13 and 2.14). Dr M. Eléaume (France) asked how, given the circumpolar distribution of many species, could the source and sink populations be taken into account.

2.16 The Workshop welcomed the updated analysis, but noted that some concerns remained (reiterating the advice of WG-EMM-10 (SC-CAMLR-XXIX, Annex 6, paragraph 3.66)), regarding the use of modelled biological distributions without expert validation, and the need to limit the number of correlated input variables. It was also noted that a smaller number of output classes would have more utility for incorporation into SCP processes. Benthic terrain analysis may also improve the geomorphological classification used in the study.

2.17 The Workshop recommended that the authors could further refine the benthic analysis, and, as a second stage, could collaborate with other approaches to incorporate biological data into a synthesised product.

2.18 More generally, the Workshop noted that in undertaking regionalisation analyses, it is important to consider the extent to which it is expected that the environment be subdivided, and also to consider how ecoregions might be defined differently in shelf and sub-Antarctic areas.

2.19 Despite the need for further work to develop the methods and results presented in WS-MPA-11/16, the Workshop noted that the preliminary results provided in the paper indicate important gaps in the coverage provided by the ‘priority areas’ previously identified by WG-EMM to further work on the development of MPAs in the Convention Area (SC-CAMLR-XXVII, Annex 4, Figure 12). In particular, WS-MPA-11/16 indicated potential heterogeneity in the spatial distribution of bioregions occurring in the Bellingshausen and Amundsen Seas, and this heterogeneity was not apparent at the time WG-EMM identified the priority areas.

Data for systematic conservation planning in the southern Indian Ocean

2.20 Prof. Koubbi and members of the French Delegation introduced three papers on the estimation of biodiversity of the sub-Antarctic Indian Ocean for ecoregionalisation (WS-MPA-11/8 to 11/10), noting that this work was initiated following a working group held in May 2011. Three additional background papers on databases, benthic biodiversity and the status of fish stocks around Kerguelen Islands (WS-MPA-11/P2 to 11/P4) were also presented. The Workshop agreed that this work provided a sound basis for the further development of an SCP process for MPAs in this region.

2.21 WS-MPA-11/10 demonstrated how existing information on marine pelagic species (plankton and fish) can be used to achieve a pelagic ecoregionalisation of the Crozet Basin and northern Kerguelen Plateau region. Three types of methodology were used: (i) a taxonomic approach based on communities only; (ii) a physiognomic approach for bioregionalisation based on abiotic factors; and (iii) a mixed approach termed 'ecoregionalisation' which incorporates taxonomic, ecological and physiognomic data.

2.22 The ecoregionalisation approach models potential preferred habitats of species and communities based on relationships between the presence/absence of species and environmental factors. It allows for the prediction of species or community presence/absence in areas where sampling has not been undertaken, but where environmental information is available from remote sensing or model data. The approach was tested only for mesopelagic fish at this stage. It was concluded that this methodology represents an objective and repeatable approach, which can be improved using expert knowledge and new data.

2.23 Dr Constable noted that mapping the distribution of relative abundances arising from this estimation procedure may be more appropriate for modelling patterns of species' spatial distributions to inform MPA planning rather than predicting absolute abundances in a time-varying seascape.

2.24 WS-MPA-11/8 described a preliminary analysis of tracking data for 19 species of seabirds and seals breeding in Crozet, Kerguelen and Amsterdam Islands, to identify areas of ecological significance in the Southern Ocean. These higher predators were found to be widely distributed across the southern Indian Ocean, and to overlap extensively with other EEZs and areas managed by other international organisations.

2.25 The results highlighted the need to consider different scales of ecological processes, particularly with regard to higher predators. Certain life-history stages (e.g. breeding stages) may be focused on small areas, whereas other stages (especially non-breeding, but also breeding winter migration) occur across very large areas according to the species, and analyses therefore need to be scaled appropriately.

2.26 The Workshop agreed on the importance of collaboration with other international organisations on the conservation of higher predators, and noted that further discussion is required on how to measure the success of MPAs for such predators when they are also foraging outside the CCAMLR area.

2.27 WS-MPA-11/9 described the use of information on the biodiversity and distribution of benthos and demersal fish for ecoregionalisation in the northern part of the Kerguelen Islands slope, shelf and shelf-break. This study provided a first overview of optimal habitats for indicator species (including one VME target species) and the benthic assemblages of the Kerguelen Plateau. Further work will determine essential fish habitat for dominant species. Biodiversity data available in the Système d'Information des Milieux et Peuplements Aquatiques (SIMPA) and Pêcherie de Kerguelen (Pecheker) databases (WS-MPA-11/P2), long-term data on fisheries in the Kerguelen region (WS-MPA-11/P4), and information on benthic biodiversity off Kerguelen Islands (WS-MPA-11/P3) will also provide important input to the project.

2.28 The Workshop endorsed the ecoregionalisation approach employed in these studies, as a valuable and informative way to combine taxonomic and environmental data in delineating ecoregions. It encouraged the use of similar approaches in other regions, where appropriate.

2.29 Prof. Koubbi noted that the next step will be to define a strategy for the translation of this ecological information into candidate MPAs in the Southern Indian Ocean region, and that this will require consideration of appropriate methodologies, as well as the different conservation tools available for protection.

Systematic conservation planning – experiences from outside the CCAMLR area

2.30 Dr Lombard gave an overview of the SCP process, and introduced WS-MPA-11/11 and 11/12 which described practical experiences of SCP in South Africa.

2.31 WS-MPA-11/11 described systematic biodiversity planning to identify a potential offshore MPA network for South Africa. The objectives of the process were designed to meet the needs of biodiversity as well as fishery and non-fishery interests. Targets were defined to evaluate achievement of objectives. Marxan (a software tool designed to aid SCP) was used to generate a range of different MPA scenarios, each with specific objectives. The transparency of this process also allowed measurement of the impacts of different conservation scenarios on the achievement of the targets desired by different stakeholders.

2.32 The Workshop discussed issues surrounding the inclusion of cost layers in SCP processes. It was noted that:

(i) cost can be defined by a simple measure of area size, although additional information on human activities may be useful in considering impacts on rational use, for example, fishing effort data or modelled fish distributions (as noted by the Scientific Committee; SC-CAMLR-XXIX, paragraph 5.34)

(ii) data on costs may need to be normalised for incorporation into the SCP process

(iii) instead of choosing between different cost metrics, it may be beneficial to use all available metrics in the first instance, to clarify how specific costs affect the achievement of different targets. Individual cost layers can be combined into an integrated analysis at a later stage.

2.33 Dr Lombard next presented the results of multi-resolution conservation planning to design MPA networks linking inshore and offshore ecosystems in South Africa (WS-MPA-11/12). To address this challenge, a spatially nested system of planning units was designed to select priority areas for conservation using Marxan software, reflecting the multi-scalar nature of marine ecosystem patterns and processes, contributing to better connectivity between inshore and offshore systems, and towards more resilient and efficient MPA networks. Lessons from this work which may be of use to CCAMLR include (i) the importance of setting appropriate scales of analysis for different contexts, (ii) the importance of setting clear protection objectives and targets for performance metrics by which achievement of those targets will be assessed, (iii) the importance of a scientific basis for setting targets, and (iv) the need to provide clear and simple guidance on zonation within MPAs.

2.34 The Workshop noted that the question of multiple resolutions and scales is relevant to the division of interests between CCAMLR and the ATCM, and the scales at which different human activities operate in the Southern Ocean, particularly between offshore and coastal areas.

2.35 Dr Lombard also drew the Workshop's attention to the del Cano Collaboration initiative being pursued by WWF-South Africa and the Department of Environment Affairs, South Africa. The initiative was begun by WWF in 2008, and the intention is to work toward a jointly-managed MPA on the del Cano plateau, between South Africa's Prince Edward Islands and France's Crozet Islands. The first step is promulgation of the Prince Edward Islands MPA which is currently under review by the Department of Environment Affairs, South Africa. Dr C. Bost (France) indicated that this collaborative project has been extremely productive with respect to science.

2.36 Dr Smith presented WS-MPA-11/22 on designing MPA networks using SCP as part of the Channel Habitat Atlas for Marine Resource Management (CHARM3) Project in the English Channel. Setting targets is a key aspect of SCP. Targets must always be context-specific, fitting into the objectives of a particular region. Habitat targets should reflect patterns of species richness and species turnover, as well as other relevant conservation factors. Species area curves may be useful in setting marine habitat targets, and there is a need to develop approaches that account for differences in sample effort to ensure that targets are objective and scientifically defensible. Once targets have been set, software such as Marxan can be used to identify networks of MPAs that meet targets, minimise impacts on fishing, and meet spatial constraints on minimum MPA size and spacing. The CHARM3 Project has investigated the use of MinPatch software in conjunction with Marxan, and initial results show that including additional constraints on MPA size produces a much less fragmented MPA network.

2.37 Dr Constable noted that estimations of species–area relationships were poorly known for the Southern Ocean, and that alternative methods for setting objectives may therefore be required. Dr Watters noted that simplifying the boundaries of MPA proposals generated by the use of MinPatch might increase the practicality of MPAs (e.g. by providing boundaries that are easy to communicate and enforce).

2.38 The Workshop agreed that insights from the South African and English Channel experiences could assist in the development of SCP processes in the Southern Ocean. It was noted that the Antarctic situation has significant differences to most other parts of the world, in terms of the absence of complex human activities and interactions, and (in many regions) a lack of data. It may not always be appropriate to use mathematical software for Antarctic SCP processes, or to incorporate the same type of cost metrics that have been employed elsewhere. However, taking account of best-practice on matters such as defining appropriate scales, setting clear and scientific objectives, and maintaining transparency, will help to ensure that MPA planning for the Southern Ocean is systematic and effective.

2.39 Dr A. van de Putte (Belgium) presented some background information on connectivity and genetics for consideration as part of MPA planning processes (Volckaert et al., submitted). It was noted that large areas would be required to incorporate genetic diversity and to maintain viability. However, it may also be advantageous to design many smaller and well-connected areas in order to accommodate different life-history stages. The design of MPA systems will therefore require areas to be designated with a diversity of sizes and spacing.

2.40 Prof. Rogers noted that it is important to consider the unique evolutionary history of the Antarctic region, especially in the context of climate change. Evolutionary history may constrain the ability of species to adapt, and MPA systems will therefore need to consider refugia areas. Dr Eléaume also noted that important differences exist between broadcaster and brooder life styles and that MPAs should be designed so as to consider these differences.

Systematic conservation planning methodology
for the Ross Sea region used by New Zealand

2.41 Dr Sharp presented the methods used by New Zealand in WS-MPA-11/25 describing the SCP process used by New Zealand in developing MPA scenarios for the Ross Sea (the remainder of WS-MPA-11/25 was considered under Item 3; see paragraphs 3.26 to 3.51). New Zealand maintained a procedural separation between the science process (Phase 1, summarised in Sharp et al., 2010) and the planning process (Phase 2). The planning process used had the following steps:

(i) define protection objectives that will contribute towards the achievement of the overall management aims

(ii) for each protection objective, identify target areas, the protection of which will contribute to the achievement of the objective

(iii) for each target area, assign a numerical protection target reflecting the desired level of protection for that area

(iv) define spatially explicit representation of the cost of MPA designation to competing objectives such as rational use

(v) define additional constraints (if any) on MPA scenario design

(vi) develop and evaluate MPA scenarios that meet protection targets for each identified target area to the extent possible while minimising cost and being mindful of other constraints

(vii) develop an associated management plan, research and monitoring plan, and legal framework for a proposal to implement the MPA scenario designed in Phase 2 (this is a subsequent phase of work not described in WS-MPA-11/25).

2.42 Dr Sharp further explained that, following this process, different MPA scenarios were iteratively developed, evaluated and adjusted based on scientific review and consultations with domestic stakeholders, and discussions with the USA. This process was aided by the use of a custom-designed MPA planning tool in ArcGIS, allowing rapid evaluation of user-defined MPA boundary scenarios against standard performance metrics. Unlike Marxan, this tool does not use an optimisation function, however, it allows the user to perform a basic manual optimisation, by altering proposed MPA boundaries based on the extent to which protection targets are being achieved at each iteration.

2.43 Dr Sharp indicated that the resulting MPA scenario was retrospectively validated by comparison with a Marxan analysis that used the actual protection levels achieved in the New Zealand scenario as targets; differences between the two scenarios were observed to be minimal. It was therefore concluded in the New Zealand process that the iterative user-driven MPA planning tool and methodology was successful at identifying an optimal spatial design to achieve the desired level of protection while minimising cost to rational use.

2.44 The Workshop supported the use of the MPA planning tool in helping transparent and efficient consultation with stakeholders, and some Members expressed an interest in trialling the tool for other regions. Dr Sharp noted that the MPA planning tool could be made available to Members on request.

REVIEW OF DRAFT PROPOSALS FOR MPAs OR A REPRESENTATIVE SYSTEM OF MPAs IN THE CAMLR CONVENTION AREA

3.1 The Workshop considered a number of papers in order to review progress on draft proposals for the development of MPAs, or representative systems of MPAs, in the Convention Area.

Circumpolar analyses

3.2 Prof. Rogers introduced WS-MPA-11/16 which provided a circumpolar analysis designed to help identify areas within the high seas of the Southern Ocean that would contribute to a representative system of MPAs (paragraphs 2.12 to 2.19).

3.3 The Workshop noted that it would be valuable if the authors were able to convene a workshop to address a number of issues with the analysis, including the fact that some environmental information used in the analysis was potentially correlated across different datasets and that this was likely to result in over-fitting of information (SC-CAMLR-XXIX, Annex 6, paragraph 3.66). It also expressed an opinion that it would be useful to see some of the Marxan outputs from the analysis and also how various datasets (e.g. the data from Aquamaps and the predator tracking data) were used in the synthesis. The application of benthic terrain modelling may also improve the geomorphological classification used in the study. The Workshop noted that the inclusion of cost layers would enhance the SCP process but recognised that there may be particular issues in accessing such data.

3.4 The Workshop encouraged the authors to continue their work in consultation with other scientists, particularly the biogeographers associated with the 'Biogeographic Atlas of the Southern Ocean' and scientists with appropriate technical expertise and prior experience in the CCAMLR bioregionalisation process, and to submit revisions to WG-EMM in the future.

Regional sea-ice and ice shelf features

3.5 WS-MPA-11/17 considered the issues of habitats under ice shelves and how they may be subjected to special conservation requirements as they recede due to climate change. Ice-shelf collapse is now known to lead to new marine habitats and to subsequent biological colonisation. Colonists may be local or may come from distant areas as water temperatures and currents change. Importantly, altered ecosystem dynamics may also allow new alien species to invade as ocean warming potentially removes physiological barriers that have previously led to the isolation of the Antarctic benthos. Given the complexity of the possible interactions and the need to study these in the absence of other human-induced perturbations in order to understand management requirements, WS-MPA-11/17 recommended that areas under existing ice shelves should be protected as reference areas for scientific study. This would be consistent with the types of objectives for protection identified at the 2005 Workshop (paragraph 5.1). The paper further argued that there would be negligible impacts on rational use as these areas are not accessible or utilised by fisheries.

3.6 The Workshop agreed that newly exposed benthic habitats created by ice-shelf collapse warrant special consideration, particularly in relation to the need to understand the processes that govern change and recovery in benthic habitats and for protection from invasion by alien species. It encouraged the authors to develop proposals for consideration by the Scientific Committee, noting the need to develop boundaries that are practical in designating and managing MPAs.

3.7 The Workshop also agreed that the protection of invasion from alien species would require consideration of controls for all vessels in these areas, including those for science, tourism and fisheries. It noted that how to manage vessel activities for this purpose is a matter for the Commission to consider.

Climate change effects

3.8 WS-MPA-11/18 and 11/24 presented initial thoughts on issues related to achieving conservation of marine biodiversity in the sea-ice zone under climate change. The implications of climate change for sea-ice communities remain poorly understood, with a growing recognition that multiple stressors from climate change could result in compounding effects in the region. Understanding these effects will require areas that are not impacted by human activities.

3.9 WS-MPA-11/18 developed an approach for achieving this and recommended that the krill fishery should not be allowed to move into areas currently covered by sea-ice should sea-ice extent reduce in the future. These areas should be protected as reference areas for scientific study and to increase ecosystem resilience. The paper recommended that the Weddell Sea be given special attention as this is one of the least known areas in the Southern Ocean, there has been no historical exploitation, except along the northern margin. It is, however, thought to be extremely important in the life cycle of krill. In the context of climate change, it will be important to protect the sources of krill, not only for dependent species, but also for the fishery.

3.10 The Workshop encouraged Members to continue to consider options for spatial protection in the Weddell Sea. It agreed that approaches similar to the analysis undertaken for East Antarctica might be useful. One possible approach may be to consider protection of the southern Weddell Sea as a means for monitoring change in these ecosystems, as well as for providing climate change refugia.

3.11 The Workshop noted the importance of monitoring for the effects of climate change, utilising data from a variety of sources. For example, fishing vessels may provide a platform for gathering data for monitoring.

3.12 WS-MPA-11/24 provided some clear signals of climate-change impacts on pack-ice seals in the region, some of which are krill-dependent. It reported, with reasonable certainty, that the Western Antarctic Peninsula is a region of high importance for several species of seal. It shows that these seals have a habitat preference for pack-ice and that regional directional changes in climate are reducing this habitat which will potentially result in stress on these seal populations. Pack-ice seals, particularly crabeater seals, have a high proportion of krill in their diet, and increasing fishing in the region is likely to further stress the predator–prey dynamics in the region.

3.13 The Workshop noted that there may need to be some safeguards other than just relying on the feedback management procedure and that spatial measures will be very important to reduce the overlap of predator foraging and the fishery for stressed populations. It may be that management could be achieved through the use of SSMUs. It encouraged Members to consider how MPAs might be used to help reduce stress on pack-ice seals and other components of the pack-ice dependent community, perhaps through the use of different zones and in the light of the work currently undertaken by WG-EMM.

East Antarctica

3.14 Dr Constable introduced WS-MPA-11/5, the object of which was to identify areas in data-poor regions of East Antarctica that would conserve biodiversity, and act as reference areas for measuring ecosystem change and for estimating the effects of fishing in neighbouring areas. The Workshop welcomed the study, recognising that it built on earlier related work described in WG-EMM-10/26, SC-CAMLR-XXIX/11 and BG/9, which used the CAR (comprehensiveness, adequacy, representativeness) principles for developing a representative system of MPAs. Supplemental material provided to complement this body of work provides summary data and consideration of potential rational use in the region and consideration of how the candidate MPAs would be unlikely to impact on rational use.

3.15 During discussion of the paper, Dr Constable clarified a number of issues. He emphasised that the spatial extent of the planning area for East Antarctica had been limited so as to remove any potential overlap with any other SCP initiatives undertaken elsewhere in the Antarctic by other Members, particularly the initiatives being undertaken in adjacent areas.

He also noted that the East Antarctic region was data-poor, which meant that data-intensive software, such as Marxan, would be inappropriate to use. He also noted that a particular difficulty with Marxan was that it is very difficult to account for ecological connectivity.

3.16 The Workshop noted that despite the paucity of data available in East Antarctica, the design was a credible one, and the subdivision of the region into provinces was supported by subsequent regionalisation and biogeographic analyses indicated in WS-MPA-11/23.

3.17 Dr Constable emphasised that all of the candidate protected areas (Figure 1) had been selected for their benthic values; however, some had also been selected for the important combination of benthic values and pelagic values, including information on top predators. He noted that the combined benthic–pelagic areas were the most important reference areas for measuring long-term ecosystem change and for monitoring the effects of krill fishing.

3.18 The Workshop noted that the areas identified in WS-MPA-11/5 solely for protection of benthic habitat may need to be considered for their pelagic values as well, because of the increasing evidence of benthic–pelagic coupling over shelf areas.

3.19 Dr Constable noted that selections of the Gunnerus and Enderby areas in the west were based only on their benthic values, but that the definition of pelagic values for these candidate areas may be necessary in the future, when more data were available, as the adjacent region to the west in the Weddell Gyre, was a region where pelagic values may be extremely important, especially for Antarctic krill (*Euphausia superba*). He also noted that the candidate Mertz protected area in the east had specific conservation values, including the fact that it is an important site of bottom-water formation, benthic–pelagic coupling and as a reference area for monitoring long-term ecosystem change. Consequently, he considered that it was unlikely that the values of the Mertz area (see paragraph 3.21) would be found in areas further to the east, which were being considered as part of the Ross Sea region conservation planning process (WS-MPA-11/25).

3.20 Prof. Koubbi introduced WS-MPA-11/7 and 11/P1, which presented results from surveys undertaken by France, Australia and Japan during the Collaborative East Antarctic Marine Census. These surveys provide results for the shelf and offshore waters coincident with the Mertz candidate MPA proposed by Australia for East Antarctica (WS-MPA-11/5). A regional synthesis with pelagic and benthic ecoregions was proposed utilising information from a biodiversity census of fish, benthos, plankton and top predators. The synthesis highlighted the importance of spawning grounds of Antarctic silverfish (*Pleurgramma antarcticum*) which occurred in coastal canyons and areas of ecological significance for Adélie penguins (*Pygoscelis adeliae*), emperor penguins (*Aptenodytes forsteri*) and Weddell seals (*Leptonychotes weddellii*).

3.21 The Workshop welcomed the reports and recognised that one important result from this project, which assembled available biological data for the area, was that analyses supported the characterisation of the Mertz candidate MPA identified in WG-EMM-10/16 and 11/5. This result therefore provided direct support for the planning process undertaken more broadly for East Antarctica. An additional important result described in WS-MPA-11/7 was a proposed change in the boundaries of the Mertz candidate MPA based on topographic, oceanographic and biodiversity patterns, moving the western boundary from 140°E to 136°E and the eastern boundary from 150°E to 148°E; the northern limit remained at 60°S. Two VMEs have been declared in this area and this work further identified the importance of this region. The Workshop noted that there was a probability that other VME-type habitats existed in the area and that they would be detected along the continental shelf, should demersal fishing activities continue.

3.22 Dr Constable presented SC-CAMLR-XXIX/BG/9 which provided a compilation of materials for considering rational use in the context of designing CCAMLR's representative system of MPAs in East Antarctica.

3.23 The Workshop noted that krill fishing in East Antarctica had not taken place for many years and that information on krill fishing effort and catch were out of date, especially in the context of environmental change which had been recorded in the region. In that respect, the use of the results of the BROKE East and BROKE West krill surveys provided the most current indication of the densities of krill in the region.

3.24 Dr Constable noted that juvenile toothfish reported from the candidate Gunnerus area are most probably related to populations living to the west, but that considerable uncertainty remained over the spatial geographic separation of stocks, including ontogenetic separation. He also noted that the toothfish population found to the east of Enderby Land to the Mertz area was probably a separate stock which is likely to be related to the BANZARE Bank stock. Dr Constable indicated that toothfish moved over considerable distances during different parts of their life cycle/seasonal cycle and therefore the populations would be accessible to fisheries operating in the candidate open areas outside the candidate closed areas. He indicated that long-term remotely sensed data on sea-ice distribution indicated that the physical environment was unlikely to restrict access in those areas.

3.25 The Workshop noted that WS-MPA-11/5 provided different levels of scientific explanation and justification for the individual candidate MPAs in East Antarctica and considered that it would be valuable to expand the explanations detailing the ecological values and conservation objectives for each MPA. Similarly, it suggested that it would be useful to provide further details of the stakeholder consultation process. The Workshop also noted that it would be useful to consider the ecological connections that linked East Antarctica with the adjacent areas to the north, particularly for species such as higher-trophic level predators that may forage or commute over large distances, or fish with ontogenetic life-cycle stages in different areas.

The Ross Sea region

3.26 Dr Watters introduced WS-MPA-11/25, particularly focusing on the scenario developed by the USA. The Workshop welcomed the study, recognising that it built on earlier related work described in WG-EMM-10/11, 10/12 and 10/30.

3.27 Dr Watters identified three overarching protection objectives by which the US scenario was designed; achievement of these objectives was assessed with reference to biological distributions defined in this paper and to the modelling outputs of WG-EMM-10/12, and a benthic and pelagic bioregionalisation. Dr Watters noted that planning objectives included: (i) providing a high level of protection to the Ross Sea shelf ecosystem at all levels, including top predators and benthic invertebrates; (ii) the existence of ecologically comparable areas of the Ross Sea slope both inside and outside the candidate MPA, as a reference area to distinguish between the effects of fishing and of climate change; and (iii) the value of the MPA for science and monitoring activities.

3.28 The Workshop noted that a number of stakeholders had been consulted during the development of the analysis and that the project outcomes were intended to balance the interests of a variety of interest groups. The Workshop recognised that scientists may have a dual role in the development of spatial planning. Firstly, they provide scientific evidence for decision makers; however, some scientists may represent the interests of the wider scientific community, particularly their involvement in the future of science in a particular area.

3.29 The Workshop also noted that stakeholders included individuals and groups interested in rational use. Such interests might relate to the sustainable harvest of living resources, but may include other activities.

3.30 The Workshop recognised that benthic communities in the Antarctic were generally dependent on depth and that information about deeper benthic communities would potentially provide additional valuable information for the development of the candidate Ross Sea region MPA. The Workshop also noted that the seamounts along the Pacific–Antarctic Ridge may have unique or important ecological value, as well as being important spawning areas for Antarctic toothfish (*Dissostichus mawsoni*). The Workshop therefore suggested that the authors of WS-MPA-11/25 consider the ecological values associated with these features.

3.31 Dr Sharp introduced WS-MPA-11/25, particularly focusing on the scenario developed by New Zealand. The Workshop welcomed the study, recognising that it built on earlier related work described in WG-EMM-10/11 and 10/30. The SCP method by which the scenario was developed is described above in paragraphs 2.41 to 2.44.

3.32 Dr Sharp described eight ecosystem protection objectives for which the New Zealand scenario was designed, and summarised achievement of these objectives with reference to quantitative performance metrics for each of the 27 identified target areas of particular ecosystem importance; and a benthic and pelagic bioregionalisation. He identified the following key protection outcomes achieved by both the New Zealand and US scenarios: (i) full protection for polynyas and identified rare or vulnerable benthic habitats; (ii) very high protection for *P. antarcticum*; (iii) full protection for toothfish key life cycle areas utilised by sub-adult and pre-recruit toothfish; and (iv) very high protection for the summer foraging areas of top predators that may experience direct trophic competition with fisheries.

3.33 Dr Sharp noted that the New Zealand scenario would involve displacement of 21% of historical fishing effort in the Ross Sea region fishery. The New Zealand scenario was designed to minimise effort displacement while achieving protection targets, and bearing in mind the need to ensure viable fishery access as affected by ice cover, and the continuity of data from tag returns to inform the toothfish stock assessment.

3.34 Dr Sharp reported that the northeastern part of the New Zealand scenario was included to protect a portion of the presumed eastern toothfish spawning area. He noted that tag returns from the exploratory toothfish fishery in the Ross Sea region were inadequate to provide a fully resolved life cycle, but that the best evidence available (Hanchet et al., 2008) suggests that only spawning areas east of the Ross Gyre divergence will supply recruits to the Ross Sea shelf.

3.35 The Workshop noted that there were potentially important ecological connections between the seamounts of the Pacific–Antarctic Ridge and the Ross Sea shelf, principally through *D. mawsoni* life-history connections.

3.36 Prof. Rogers reported that it was probably not possible to separate stock identity in this region using genetic techniques, as even the movement of a few individuals between populations was sufficient to maintain genetic homogeneity between populations. Given the proximity of toothfish from the two areas, at least a low level of migration was likely.

3.37 The Workshop noted that an alternative approach to the designation of an MPA over the putative spawning grounds along the Pacific–Antarctic Ridge would be to have seasonal closures of the areas during spawning. It recognised that this may already occur in a de facto manner as spawning may occur under sea-ice in winter. The Workshop recognised that scientific surveys to determine spawning grounds and the location of pre-recruits would be valuable, but potentially difficult. Such surveys would be important for verifying the locations of life-history stages.

3.38 The Workshop noted that the eastern part of the candidate MPA (New Zealand version), south of the presumed spawning areas, was included as it contributed to the achievement of representativeness targets. It noted that the area included for its representative contribution could be allocated in a number of different locations, but that the current position achieved a single spatially contiguous candidate MPA. The Workshop recognised that deciding on the appropriate level of representativeness to be included in MPAs was an issue where advice from the Scientific Committee and Commission would be necessary.

3.39 Dr Sharp reported that there would be considerable ecological benefits if fishing (for *D. mawsoni*) was eliminated from the candidate Ross Sea MPA. This would eliminate potential resource competition for *P. antarcticum* and risks to the shelf community dependent on silverfish. Off the shelf there is little evidence of direct trophic coupling between toothfish and the silverfish-dominated Ross Sea shelf ecosystem. He also highlighted that removing the *D. mawsoni* fishery from the shelf would mitigate the potential for direct trophic competition with toothfish predators (*L. weddellii* and Type 'C' killer whales (*Orcinus orca*) and eliminate the risk that Type 'C' *O. orca* would learn to depredate longlines catching toothfish; given the high number of Type 'C' *O. orca* over the Ross Sea shelf, learned depredation behaviour could have significant impacts on harvesting rates and the economic viability of the fishery. Dr Sharp also suggested that protecting pre-recruit toothfish on the shelf would safeguard future fishery viability and allow scientists to monitor toothfish recruitment (e.g. WG-SAM-11/16) unconfounded by fishery impacts. He concluded that there would be strong ecosystem and scientific benefits from excluding the fishery from this area, and benefits to the fishery itself.

3.40 The Workshop agreed that there was a strong rationale for achieving high levels of protection for *P. antarcticum* and dependent communities; for eliminating spatial overlap between the area occupied by the toothfish fishery and the preferred foraging areas of toothfish predators; for protecting pre-recruit settlement areas and spawning areas for toothfish; and for protecting VMEs.

3.41 The Workshop recognised that Table 1 in WS-MPA-11/25 provided valuable information about protection objectives, target areas, and protection targets as used by New Zealand in its Ross Sea MPA planning process, and that the comparison table on page 31 of that paper clearly demonstrated the levels of protection achieved for those targets, and associated costs. The Workshop noted that this was useful for summarising results for review of proposals, and that it would benefit from the addition of an analysis of how different activities may potentially compromise the values of the conservation objectives within each target area identified in Table 1 of WS-MPA-11/25.

3.42 Dr Sharp noted that IUU vessels attempting to gain access to the protected slope and shelf areas within the candidate Ross Sea region MPA would need to pass through areas occupied by the legal toothfish fishery, and therefore the probability of detection of IUU vessels in this area was high. In the northern seamount areas the potential attraction of IUU vessels to closed areas remains a cause for concern, warranting careful consideration.

Joint considerations from the US and New Zealand Ross Sea region analyses

3.43 Dr Sharp and Dr Watters both emphasised the value of the collaboration between the USA and New Zealand in the development of their respective planning scenarios for a candidate no-take MPA (Figure 2), and the commitment of both countries to continue to work together and with other Members to achieve a system of MPAs in the Ross Sea region.

3.44 The Workshop noted that the western boundary of the Ross Sea region candidate MPA may benefit from further consideration in the context of the outcomes of the conservation planning initiative for East Antarctica (see WS-MPA-11/5).

3.45 The Workshop noted that the planning objectives of the US Ross Sea region planning process and the New Zealand planning process were different, and that these were the basis for some of the different scenario outcomes. The Workshop noted that the two planning processes reflected a similar scientific understanding of the Ross Sea region ecosystem and similar conservation protection priorities, including the intact trophic functioning of the Ross Sea shelf, the protection of top predator foraging areas and the utility of the MPA scenarios for science. The differences in the scenario outcomes arose from different levels of accommodation of fishery outcomes.

3.46 The Workshop identified that there were many similarities between the candidate Ross Sea MPA (US scenario) and the candidate Ross Sea MPA (New Zealand scenario), with a major difference being the eastern and northeastern part of the MPA (New Zealand version). The Workshop considered that it would be extremely valuable if a single proposal could be developed which also included elements from the Italian Terra Nova Bay candidate MPA (WS-MPA-11/14). The Workshop suggested that one plausible way forward would be to consider the area of overlap as a primary candidate MPA, and that other areas outside this could be considered as secondary candidate MPAs, noting that only the latter areas would include presumed spawning areas supplying recruits to the Ross Sea stock. Progress with the primary candidate MPA could then be made whilst further work was undertaken in support of the secondary MPAs. The Workshop recognised that this approach was similar to the Conservation Zone approach used in Australia in systematic MPA planning (see WS-MPA-05/6).

3.47 The Workshop noted that the USA and New Zealand had tried to develop a joint proposal and would continue working to achieve this, but that the absence of a single agreed scenario was attributable to differences in policy aims that may benefit from discussion at the Commission level.

Terra Nova Bay

3.48 Dr M. Vacchi (Italy) introduced WS-MPA-11/14, summarising the significant research effort at Terra Nova Bay encompassing the collection of both physical and biological data. A significant finding of the study was the description of the first known spawning ground for *P. antarcticum*, which has been highlighted as a key species in the sea-ice community over the Ross Sea shelf (see also WS-MPA-11/25).

3.49 The Workshop encouraged continuation of the research on the spawning habitat of *P. antarcticum* which may also aid in helping determine other potential spawning areas. The Workshop noted that the study also described benthic communities in Terra Nova Bay which appear to be different to other communities described in East Antarctica (see WS-MPA-11/7).

3.50 Dr Vacchi noted that, should future fishing activity occur in the area, targeting either *D. mawsoni* or *P. antarcticum*, it was likely that important trophic cascade effects would occur (due to the high density of top predators in the area foraging on these fish species).

3.51 The Workshop recognised the value of the Terra Nova Bay studies, documenting important levels of biodiversity, which also provided additional and important support for the Ross Sea candidate MPA suggested by New Zealand and the USA (WS-MPA-11/25). Given the spatial scale of Terra Nova Bay and its apparent unique ecological values, the Workshop also suggested that the authors of WS-MPA-11/14 should consider whether it would be appropriate to develop a proposal for an ASMA for the area, as such an ASMA could allow coordination of activities and could protect the special ecological values of the area, but nested within the larger Ross Sea region MPA.

Reference areas, research and monitoring

3.52 The Workshop recognised that the Southern Ocean offered important opportunities to study a wide range of ecosystem processes, including the effects of climate change and the effects of harvesting on ecosystem components. Consequently, one use of protected areas was as reference areas to study such ecosystem effects. Where the impacts of fisheries are to be considered, careful selection of reference and fished areas will be important and selected areas must take regard of historical harvesting impacts.

3.53 The Workshop noted that, where candidate protected areas were to be used as reference areas to help understand climate change or the ecosystem effects of fishing, only research fishing consistent with the objectives of the MPA and approved by the Scientific Committee should occur in the MPA.

3.54 The Workshop recognised that the values of MPAs as reference areas could be compromised should there be IUU fishing activity in that area.

3.55 The Workshop noted that further consideration of research and monitoring plans was needed for MPA proposals, potentially including any contributions from research fishing activities. The Workshop requested that the Scientific Committee consider how best to monitor individual MPAs.

Fishing capacity in relation to systematic conservation planning

3.56 The Workshop noted that one of the important planning issues that had been considered in the preparation of the Ross Sea candidate MPA had been the displacement of fishing effort which may cause vessel crowding (WS-MPA-11/25). The Workshop recognised that such considerations were important for both economic and safety reasons, especially in the Olympic-style fishery that operated in the Ross Sea region. It also recognised that vessel crowding was a different issue to being able to access catch limits. The Workshop considered that increased flexibility in MPA planning would be possible if fisheries were managed in ways that limited fleet capacity to levels commensurate with the fishable area or the catch limit. It therefore requested that the Scientific Committee and Commission consider alternative management approaches that may facilitate the MPA planning process, whilst maintaining economic and safety considerations.

PROGRESS WITHIN PREVIOUSLY IDENTIFIED PRIORITY AREAS

4.1 The Workshop reviewed progress toward the development of a system of MPAs within the 11 priority regions identified in 2008 (see Table 1) (SC-CAMLR-XXVII, Annex 4, Figure 12). The following papers presented to the Workshop describe work with particular relevance to MPA planning in these areas:

- priority area 1 – WS-MPA-11/24
- priority areas 2 to 6 – no papers
- priority area 7 – WS-MPA-11/5
- priority areas 8 and 9 – WS-MPA-11/8 to 11/10
- priority area 10 – WS-MPA-11/5, 11/7, 11/25
- priority area 11 – WS-MPA-11/14, 11/25.

4.2 The Workshop also discussed work in progress that was not presented in the tabled papers, but is nonetheless relevant to the development of MPAs both inside and outside the identified priority areas. The following ongoing research and/or MPA planning efforts were noted, with reference to the corresponding priority area, where applicable.

(i) Plans by Argentina to develop a proposal for an MPA, or system of MPAs, in the Weddell Sea and similar interest by the UK in seeing progress in this area. Noting that German researchers worked in this area for a long time, it was noted that any kind of cooperation would be helpful. The Workshop encouraged Members to work together to coordinate MPA planning in this area.

(ii) While a single MPA had been designated at the South Orkney Islands (priority area 2), additional work is required to achieve a representative system of MPAs in this region. Many of the environmental features and biological distributions of particular importance to planning (e.g. fronts or preferred foraging areas for wide-ranging top predators, e.g. marine important bird areas) occur at a larger scale than was considered in the planning exercise by which the South Orkneys MPA was designed (SC-CAMLR-XXVIII/14). Such features are not represented in the existing MPA and this area would therefore benefit from inclusion in a broader-scale planning process. The Workshop noted that work was under way in the UK to progress MPA planning around South Georgia and the South Sandwich Islands (priority areas 3 and 4 respectively).

(iii) Considerable amounts of biological distribution data from radio-tracked animals, as well as environmental data collected from sensors attached to the tracked animals, were being collected in the area of Bouvet Island (priority area 5) and could be useful for MPA planning.

(iv) Work is under way by scientists in the USA that can progress MPA planning in the Antarctic Peninsula, including strong interest in doing ‘ecoregionalisation’, i.e. the use of biological data and modelled biological distributions to directly characterise environmental patterns (as in WS-MPA-11/7 to 11/10), as well as to define areas of particular priority for inclusion within MPAs. These approaches are particularly useful in the Antarctic Peninsula due to the availability of large amounts of high-quality biological distribution data, for example, in the US AMLR study area. The Workshop noted that these efforts would benefit from collaboration from different Members and encouraged Members with data or particular interests in the region to participate in the fine-scale analyses and MPA planning process. Dr G. Milinevsky (Ukraine) noted that Ukraine had data to contribute to this process in the vicinity of Vernadsky Station, and would participate in MPA planning in this area.

4.3 The Workshop noted that it may be useful to undertake larger-scale MPA planning in a unified way across all of Area 48 (from 70°W to 30°E, including priority areas 1 to 6), to ensure representative protection of larger-scale features in this region, and in parallel to address smaller patterns and processes particular to each individual priority area using finer-scale analyses embedded within the larger planning domain.

4.4 The Workshop further noted that a harmonised approach in the Antarctic Treaty System to spatial protection may result in having ASPAs and ASMAs designated by the ATCM within CCAMLR MPAs (paragraph 3.51).

Updated priority areas for MPA development

4.5 The Workshop noted that the priority regions agreed in 2008 (SC-CAMLR-XXVII, Annex 4, Figure 12) were developed with the aim of encouraging the initiation of MPA planning projects, and focusing limited resources on regions that were likely to be of ecological interest and where appropriate data were considered to be available. While these original priority areas had been useful in encouraging fine-scale analyses to progress MPA planning, the Workshop agreed that an updated mechanism was now required to facilitate planning and reporting on the development of a representative system of MPAs throughout the Convention Area. Such a revision would also incorporate new information and to acknowledge finer-scale MPA planning efforts that are already under way in different regions, including those presented at the Workshop. The Workshop therefore identified possible gaps in the definition of priority areas and recommended that additional areas be defined consistent with current knowledge and under-way efforts. In particular, the Workshop noted the following omissions for which new priority areas should be defined:

(i) Prince Edward Island, del Cano and Crozet Island – An SCP approach to designate MPAs in the Prince Edward Island area is described in Lombard et al. (2007). Efforts to implement a system of MPAs based on this work are ongoing, and new work has been initiated by France in the Crozet Island area (see WS-MPA-11/7 to 11/10, 11/P1 and 11/P2). Collaborative efforts are planned between South Africa and France to coordinate planning for a system of MPAs between these areas.

(ii) The Amundsen Sea and Bellingshausen Seas – The Workshop noted the existence of a large gap in the designation of priority areas and the lack of work currently under way to develop MPAs in Subareas 88.2 and 88.3 east of the Ross Sea region, reflecting very low data availability in this area. The Workshop noted that the planned annual passage of the Korean research vessel *Araon* was a valuable opportunity to collect otherwise unobtainable oceanographic and biological data in this region. In particular, the routine deployment of a CPR and use of acoustic echosounders would be valuable to fill gaps in existing circumpolar datasets. The Workshop encouraged the Republic of Korea to collaborate with other interested Members to develop research programs to utilise the vessel in this way. Information on these areas might also be collected from remote sensing or sampling platforms (e.g. satellites and gliders) and from platforms deployed on animals like southern elephant seals (*Mirounga leonina*). The Workshop also noted the availability of data from benthic sampling by BAS in the UK, to inform MPA design in this area.

4.6 The Workshop recommended that research vessels that navigate CAMLR Convention waters should cooperate in data collection or research activities, including collection of biological, ecological and oceanographic information as required to meet the needs of CCAMLR, as determined by the Scientific Committee.

4.7 The Workshop agreed that it would be useful to define a planning schedule to progress MPAs in these areas (see paragraphs 6.19 to 6.23).

4.8 The Workshop encouraged development of a staged and nested approach, under which environmental data (i.e. bioregionalisation) are used primarily to define a representative system of MPAs in large planning domains, within which finer-scale planning processes are nested that rely more strongly on biological data and the identification of target areas of particular importance for inclusion within MPAs. This nested approach is consistent with the advice of the Scientific Committee that bioregionalisation occur separately within oceanographic provinces corresponding to statistical area boundaries, but that biological data be used at smaller scales where there is sufficient finer-scale data available and sufficient understanding of ecological processes (SC-CAMLR-XXIX, paragraph 5.16 and Annex 6, paragraph 3.124). The Workshop further noted that in the latter instance the use of target areas and protection targets within an SCP framework can reflect variable levels of data availability in different portions of the planning domain. This may be achieved because the use of targets tightly constrains MPA scenario solutions in areas of high data availability and high priority for protection, but relies on bioregionalisation to achieve representativeness in data-poor areas where there are no identified target areas of particular priority for protection.

4.9 The Workshop agreed that the circumpolar pelagic bioregionalisation in WS-MPA-11/6 could be useful for analyses across larger planning domains, and noted that a comparable benthic bioregionalisation at a similar scale and resolution could be developed using currently available data layers.

IDENTIFICATION OF CONSERVATION OBJECTIVES IN PRIORITY REGIONS

Conservation objectives for MPAs

5.1 The Workshop recalled the outcomes of the 2005 MPA Workshop which considered the use of MPAs to further the objectives of CCAMLR (SC-CAMLR-XXIV, Annex 7, paragraphs 27 to 70) and that the following paragraphs from SC-CAMLR-XXIV were pertinent to this discussion:

> '3.53 The Scientific Committee noted that:
>
> (i) Article II establishes the basic objective of CCAMLR as the conservation of Antarctic marine living resources (where conservation includes rational use) and sets out the principles by which harvesting and associated activities shall be carried out (Annex 7, paragraph 28).
>
> (ii) Article IX further specifies the ways to give effect to the objective and principles of Article II. This article relates particularly to the development and use of conservation measures, specifically including the opening and closing of areas, regions or sub-regions for purposes of scientific study or conservation, including special areas for protection and scientific study (Annex 7, paragraph 29).
>
> 3.54 The Scientific Committee endorsed advice that:
>
> (i) MPAs had considerable potential for furthering CCAMLR's objectives in applications ranging from protection of ecosystem processes, habitats and biodiversity, and protection of species (including population and life-history stages) (Annex 7, paragraph 126).
>
> (ii) Overall, when viewed in relation to the IUCN categories of protected areas, that the Convention Area as a whole would qualify as Category IV (Habitat/Species Management Area: protected area managed mainly for conservation through management intervention). This is defined as an area of land and/or sea, subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species (Annex 7, paragraph 127).

(iii) Conservation outcomes appropriate for achieving the objectives of Article II would include the maintenance of biological diversity as well as the maintenance of ecosystem processes (Annex 7, paragraph 129).

(iv) Attention may need to be given to the need for, inter alia, protection of:

(a) representative areas – a system of representative areas would aim to provide a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine systems, to maintain ecological processes and systems, and to protect the Antarctic marine biological diversity at all levels

(b) scientific areas to assist with distinguishing between the effects of harvesting and other activities from natural ecosystem changes as well as providing opportunities for understanding the Antarctic marine ecosystem without interference

(c) areas potentially vulnerable to impacts by human activities, to mitigate those impacts and/or ensure the sustainability of the rational use of marine living resources (Annex 7, paragraph 130).

(v) The process for establishing a system of protected areas will need to have regard for the objective of the Commission to achieve satisfactory fishery outcomes in terms of sustainable rational use (Annex 7, paragraph 132).

3.55 The Scientific Committee noted workshop views on the potential importance of making provision in protected area systems for the protection of spatially predictable features (such as upwellings and fronts) that are critical to the function of local ecosystems (Annex 7, paragraph 131).'

5.2 Three invited independent experts to the MPA workshop, Prof. Rogers, Dr Smith and Dr Lombard, provided a statement addressing the following sub-points of Item 5. This statement is provided in Appendix D:

(i) identifying conservation objectives appropriate to different regions with reference to particular data layers and metrics against which achievement of objectives might be assessed

(ii) identification of the value of particular areas for rational use

(iii) methods for identifying and prioritising candidate sites for protection, including the means by which conservation and rational use objectives might be addressed.

5.3 The Workshop thanked the experts for their substantial contributions to the work of the Workshop.

5.4 The Workshop noted the invited experts' statement and that it reflects many views expressed throughout the meeting. The Workshop noted the importance of (i) defining clear objectives for MPAs, (ii) having clear approaches and methods to determine how the objectives will be achieved by designating MPAs, (iii) providing explicit consideration of rational use, and (iv) devising a method for showing the trade-offs, if any, between possible MPAs and rational use.

5.5 Mr L. Yang (People's Republic of China) indicated that:

(i) MPAs should be based on scientific evidence available that clearly demonstrates the necessity for establishment of MPAs. The establishment of MPAs should not be based on a presumed basis

(ii) scientific activities and the passage of ships should be able to occur without being limited within the MPAs

(iii) the stakeholders should be fully consulted, and the cost to stakeholders (e.g. fishing), should be fully considered all the way through the MPA development.

Rational use

5.6 In order to achieve a representative system of MPAs, the Workshop noted that:

(i) the interests of rational use need to be accounted for in the process of establishing a network of MPAs

(ii) the objectives of each MPA need to be stated explicitly and the system of MPAs needs to take account of achieving the objectives over the region, noting that individual MPAs may have differing specific objectives to other MPAs, such as protection of vulnerable communities from fishing, reference areas for managing fisheries or for understanding impacts of climate change, or for providing protection to predators from direct competition with fishing

(iii) when an MPA is designed to include protection of spawning areas as part of stock management, then it would be beneficial for the Scientific Committee and, as appropriate, the working groups to review the implications for the stocks

(iv) individual MPAs may have zones within them to regulate different activities in different locations

(v) MPAs can be established using the precautionary approach and the performance of any of the MPAs with respect to their values need to be reviewed, based on monitoring or other data, to determine if the values of the MPAs are likely to have remained in the MPAs, particularly in light of the effects of climate change, and whether the MPA is still required and/or whether its boundaries should be revised or moved

(vi) the approach put forward by the experts has merit but that a variety of approaches can be used to develop a sound rationale and scientific support for establishing MPAs

(vii) in presenting a proposal for an MPA, an analysis, which may include an optimisation analysis, needs to be presented on the degree to which the objectives for an MPA have been met along with the degree to which rational use may be affected

(viii) stakeholder consultation is expected through the processes of the Scientific Committee and Commission.

5.7 The Workshop recognised that potential impacts of fishing included, inter alia:

(i) resource competition between fisheries and species dependent on the targeted species, possibly leading to impacts on other trophic levels – so-called trophic cascades

(ii) by-catch of non-targeted species and other habitat impacts

(iii) disturbance caused by shipping activity.

It recalled that such effects should be managed in a precautionary manner taking into account the state of available knowledge of the direct and indirect impact of harvesting.

5.8 The Workshop noted that where the impacts of fishing described in paragraph 5.7 may prevent the achievement of objectives for which the MPA is to be established, the prevention of those impacts provides a strong rationale for that MPA designation.

5.9 The Workshop noted that, in CCAMLR, the term 'conservation' includes rational use and that the term 'rational use' has never been defined, although it has received discussion in the Commission from time to time, including in 2010 (CCAMLR-XXIX, paragraphs 7.2 and 7.3). Nevertheless, it considered a number of issues related to rational use and the designation of MPAs.

5.10 Mr T. Kawashima (Japan) suggested that, during the development process for an MPA, it would be necessary to conduct an analysis on the effects of fishing activity in relation to the specified objectives and values of the MPA, in order to determine whether the effects from fishing activity would prevent the achievement of objectives and values of the MPA. He noted that fishing activity should not necessarily be stopped in an MPA, depending on the magnitude of the effect of fishing activity. He suggested that when the effects of fishing activity are limited, other types of regulatory tools, such as a reduction in the catch limit and/or seasonal closure, would be useful while continuing fishing activity in the MPA. He considered that the process by which regulation of fishing in an MPA should be determined should be based on the analysis of the effects of fishing activity.

5.11 The Workshop noted that conservation values in a particular protected area might not be seriously eroded if a small amount of fishing was allowed to take place inside that area. It would be useful to determine thresholds for activities that would not be expected to erode the values of the MPAs. It recognised that as effects from individual boats would almost certainly be cumulative, it may be difficult to determine in practice when the effects of an activity would have accumulated to the point that the values were about to be impacted. A possible approach is to assess thresholds of activity that do not require further studies for their determination. If activities were to be greater, then a two-part approach could be applied:

(i) studies on possible effects to increase the threshold; and/or (ii) monitoring during the activities to better assess whether cumulative effects may result in impacts on the values. Advice on these strategies would be useful.

5.12 The Workshop noted that the analysis required to determine whether the effects from fishing activity would prevent the achievement of objectives and values of the MPA also needs to assess the degree to which rational use will be enhanced by fishing in the MPA.

5.13 The Workshop recognised that candidate protected areas were intended to provide long-term protection and/or to act as long-term reference areas. Consequently, only activities consistent with the values of each MPA would be acceptable.

5.14 The Workshop noted that bentho-pelagic coupling would mean that multi-use candidate protected areas, such as Gunnerus in East Antarctica, would need careful consideration about where fishing activities were allowed. For example, the importance of benthic and/or deep habitat use by *E. superba* was becoming more apparent. Consequently, if krill are consumed by bottom-dwelling fish, then understanding food-web connections and bentho-pelagic coupling would be particularly important (see Belchier and Collins, 2008).

5.15 Prof. Rogers reminded the Workshop that the objective of CCAMLR was conservation, which also included rational use. He noted that MPAs should be considered as an integral part of the rational use of Antarctic marine ecosystems, as they were a tool that could be used to prevent changes, or minimise the risk of changes, to the marine ecosystem brought about by direct or indirect impacts of harvesting. He suggested that they could also help reduce effects associated with the introduction of alien species, protect genetic diversity and provide ecosystem resilience and buffering to environmental change. He noted that we are currently in a period of considerable environmental uncertainty and therefore MPAs are critical management tools.

5.16 In reflecting on the concept of rational use, Prof. Rogers suggested a definition for rational use might be

> 'The use of the resources of an ecosystem in such a way that the goods and services provided by that ecosystem are maintained in perpetuity along with the biological diversity and ecosystem structure on which they depend.'

DEVELOPMENT OF WORKPLANS FOR PRIORITY REGIONS

Papers and background documents

6.1 WS-MPA-11/21 drew the Workshop's attention to the recent publication of 'A Toolbox of Marine Protected Area Management Techniques for the Area Covered by the Antarctic Treaty and by CCAMLR'. This toolbox will be updated regularly and may be of use to individuals considering spatial management and protection issues throughout the Antarctic Treaty System.

6.2 Dr Milinevsky summarised WS-MPA-11/13 and drew the Workshop's attention to three main points from the paper. First, the paper suggested that it is very important to develop a procedure for submitting proposals and this procedure should define what must be included in a proposal. The proposals should also state how long the MPA will remain in force and describe a review and revision process. Secondly, the paper suggested that the lack of a clear procedure for MPA designation means that there is a lack of management. Thirdly, the paper asserted that all proposals should include a management plan which states management objectives and how activities will be regulated. The paper also noted that MPAs can serve as valuable reference areas to study the impacts of fishing. Finally, the authors of WS-MPA-11/13 expressed their interest in seeing further development of a Ross Sea MPA proposal and further developments in management for the South Orkneys MPA.

6.3 The Workshop noted the paper's point that it would be useful if MPA proposals clearly indicate the activities for which management actions might be required. Some topics related to this issue were addressed in WS-MPA-11/13, but several of the suggestions presented in that paper were considered to be beyond the scope of the Workshop. It was also noted that the discussions occurring in the Commission include consideration of the types of activities that might be managed within MPAs. It was agreed that many of the suggestions made in the paper would be better addressed by the Scientific Committee and/or Commission.

6.4 The Workshop advised the Scientific Committee that WS-MPA-11/21 may provide useful information relevant to the conduct of future work. Discussion of issues raised in WS-MPA-11/13 might also be useful in the future.

6.5 The Workshop discussed the continued utility of the 11 priority areas designated in 2008. These priority areas were originally identified as areas where work could be focused and progress achieved in the short term, but work relevant to the areas outside the priority areas was also encouraged. Work conducted since 2008 has improved general understanding of the circumpolar distribution of bioregions and suggests that the 11 priority areas are not sufficient for ensuring comprehensive spatial planning throughout the Convention Area. Further, much of the work that has progressed to date does not fit neatly into the priority areas.

6.6 The Workshop agreed that an updated mechanism by which to plan and report on the development of MPAs was now required. As a result, it defined nine large-scale planning domains that cover the entire Convention Area (Table 2 and Figure 3). These planning domains also cover all 11 priority areas, and work to develop MPAs within the priority areas was still encouraged. The planning domains better reflect the scale and location of current and planned research efforts and, therefore, can be helpful as reporting and auditing units. Additionally, the planning domains provide comprehensive coverage of bioregions in the Southern Ocean and allow for effectively nesting fine-scale analyses of biological data within larger-scale analyses to help ensure that the system of MPAs developed for the Convention Area is representative as well as comprehensive.

6.7 The boundaries of the planning domains are not intended to confine or restrict research or other work to develop MPAs. The objectives and values for MPAs sited within each planning domain would still be determined on a case-specific basis, but comparison of such objectives and values across all MPAs within any single planning domain can provide a method for assessing the degree to which the MPAs are representative and comprehensive.

6.8 The Workshop recommended that the Scientific Committee consider the use of the nine planning domains as reporting and auditing units for work related to the development of MPAs and as a means to organise future activities related to this effort.

6.9 Workshop participants noted that some planning domains, particularly Planning Domain 9 which covers the Amundsen and Bellingshausen Seas, are data-poor. Supply vessels and other vessels may transit through these areas and may thus serve as platforms of opportunity to collect several types of data (e.g. CPR data, XBT data and hydroacoustics data).

6.10 The Workshop encouraged Members to investigate possibilities for collecting data from ships of opportunity and other platforms developed through SOOS. Meetings such as the SCAR Open Science Conference may provide particularly good opportunities for such interactions.

6.11 The Workshop encouraged Ms H. Kwon (Republic of Korea) to consult with her colleagues about collecting such data during transits that the new Korean icebreaker, *Araon*, may make between stations in the South Shetland Islands and the Ross Sea.

6.12 The Workshop recognised the value of creating a central repository for data, particularly GIS data layers, related to SCP and other work supporting the development of MPAs. The Workshop recalled its discussion of WS-MPA-11/20 (paragraphs 2.3 to 2.5) and noted that the GIS and accompanying database under development by the UK might provide an appropriate repository. The Workshop recommended that Members or organisations submitting papers to inform MPA planning also submit relevant data layers in GIS format, including outputs (e.g. candidate MPA boundaries), as well as inputs used in the planning process (e.g. bioregionalisations or identified target areas), for access by other Members and for possible inclusion in a CCAMLR GIS. Access to this data would facilitate transparent evaluation of candidate MPAs and of MPA planning methods. The Working Group noted that it would be necessary to establish a standard format for all submitted data and dealing with confidential information would be challenging and require careful consideration.

6.13 The Workshop also recognised that SCAR-MarBIN might provide a useful data repository for information supporting the development of MPAs in the Convention Area. Scientists can consult SCAR-MarBIN on data standards for biodiversity information and are encouraged to publish metadata and occurrence data to SCAR-MarBIN. Occurrence data can contribute to the development of biogeographical atlases for the Southern Ocean. SCAR-MarBIN contributors can control the release of data when requested. Metadata[1] will be openly available through SCAR-MarBIN to facilitate collaboration.

6.14 It was acknowledged that data used to underpin MPA proposals must be included in official CCAMLR documents and be available to Members according to the Rules for Access and Use of CCAMLR Data. This may require that key elements of a data repository are archived by the Secretariat.

6.15 The Workshop recommended that the CCAMLR Secretariat develop a set of options for establishing a data repository to support the establishment of MPAs in the Convention Area. In developing these options, the Secretariat should consider standardised formatting and links to other data-management efforts (e.g. the GIS being developed by the UK and SCAR-MarBIN). The options should subsequently be reviewed by the Scientific Committee, and, if a preferred option is ultimately identified, the MPA Special Fund should be considered as a source of funds to support the development of the data repository.

[1] Metadata is defined as a description of how, when and by whom a particular set of data was collected.

6.16 The Workshop noted that the potential development of MPAs under ice shelves might be of interest to the CEP. Following the collapse of ice shelves, benthic communities would be particularly vulnerable to invasion by non-native species. Understanding and addressing potential threats to biodiversity from tourism and other activities in these areas might require cooperation between the CEP and SC-CAMLR.

6.17 The Workshop noted that in the Ross Sea region and the Western Antarctic Peninsula, it would be worthwhile to consider ASMAs and ASPAs within any proposed MPA. This would provide a multi-level approach to area management, harmonise decisions made at the ATCM and CCAMLR, and allow for detailed consideration of activities not normally considered by CCAMLR; thus more comprehensive protection might be provided for such areas. The objectives for, and activities within, ASMAs and ASPAs inside MPAs would need to be compatible with the objectives of the overlying MPAs.

6.18 The Workshop recommended that the Scientific Committee consider how to address the protection of habitats underlying ice shelves and the options of having special protection areas within MPAs. It suggested that the CEP may wish to consider the concepts of ASMAs and ASPAs within MPAs.

6.19 The Workshop summarised the planning activities that have been reported to CCAMLR in the MPA planning domains in Table 2, including the status of future planning for developing proposals for MPAs in each domain in the future.

6.20 While evaluating progress made towards the development of a representative system of MPAs across the 11 priority areas and the new planning domains, the Workshop noted the WSSD deadline of 2012 and acknowledged that a large amount of work remains to be completed in a short amount of time. Although timelines for future work relative to several planning domains were not available to the Workshop (Table 2), it is unlikely that MPAs can be proposed for all planning domains by 2012. Fortunately, the work presented to this Workshop has demonstrated that work to develop MPAs can be progressed relatively quickly if there is a dedicated effort to do so.

6.21 The Workshop agreed that future work focused on the Western Antarctic Peninsula–South Scotia Arc domain, the del Cano–Crozet domain, and an SCP effort for all domains simultaneously would be particularly useful for progressing towards the 2012 deadline. The focus and intensity needed to advance this work in a short amount of time could be provided by holding new workshops to advance each of these efforts (Table 2).

6.22 The Workshop recommended that the Scientific Committee consider supporting three new workshops to focus work on the Western Antarctic Peninsula–South Scotia Arc domain, the del Cano–Crozet domain, and an SCP effort for all domains simultaneously. Such workshops may not need to be official CCAMLR workshops (thus eliminating requirements for Secretariat support and translation), but they would likely benefit from financial support (e.g. for experts and/or infrastructure support) provided through the CCAMLR MPA Special Fund. The new workshops could synthesize their work to provide background papers for discussion and review by WG-EMM.

6.23 The Workshop acknowledged that the Scientific Committee and WG-EMM have several other work priorities (e.g. the development of a feedback management strategy for the krill fishery), and advised that new workshops to progress the development of MPAs should be considered within a larger prioritisation of the future work for these two groups. The Workshop requested that the Scientific Committee identify one or more coordinators for any workshop that it endorses.

APPROACHES TO THE DEVELOPMENT OF MPA MANAGEMENT PLANS

7.1 There were no papers tabled under this agenda item and there was no general discussion of the subject. Specific issues relating to the monitoring and management requirements of the specific proposals for MPAs are reported in Item 3 (paragraphs 3.52 to 3.55).

ADVICE TO THE SCIENTIFIC COMMITTEE, ITS WORKING GROUPS AND THE COMMISSION

8.1 Advice to the Scientific Committee is included in the following paragraphs:

(i) Bioregionalisation and SCP –

(a) development of a GIS tool, including a standard protocol for the submission of data to the GIS database and the need for periodic updates of bioregionalisation layers (paragraphs 2.5 and 2.8)

(b) the need for collaboration with other international organisations to measure the success of MPAs for predators when they are also foraging outside the CCAMLR area (paragraph 2.26)

(c) endorsement of ecoregionalisation to combine taxonomic and environmental data in delineating ecoregions (paragraph 2.28).

(ii) Review of draft proposals for MPAs or a representative system of MPAs in the CAMLR Convention Area –

(a) Regional sea-ice and ice-shelf features:

- the need for proposals to protect newly exposed benthic habitats created by ice-shelf collapse (paragraphs 3.6 and 3.7)
- consideration of the spatial protection in the Weddell Sea, including protection of the southern Weddell Sea as a means for monitoring change in these ecosystems as well as for providing climate change refugia (paragraph 3.10).

(b) East Antarctica:

- the proposed design for a representative system of MPAs in East Antarctica was supported by regionalisation and biogeographic analyses (paragraph 3.16)

- analysis of detailed studies in the Mertz region, including likely presence of VMEs (paragraph 3.21)

- request to expand the explanations detailing the ecological values and conservation objectives for each candidate MPA (paragraph 3.25).

(c) Ross Sea region:

- alternative approaches to the designation of an MPA over the Pacific–Antarctic Ridge and value of scientific surveys to determine spawning grounds of toothfish (paragraph 3.37)

- advice from the Scientific Committee and Commission necessary on appropriate level of representativeness to be included in MPAs (paragraph 3.38)

- identification of a strong rationale for achieving high levels of protection of particular ecosystem processes in the Ross Sea region (paragraph 3.40)

- protection objectives, target areas, and protection targets as used by New Zealand in its Ross Sea region MPA planning process (paragraph 3.41)

- consideration of the western boundary of the Ross Sea candidate MPA and planning initiative for East Antarctica (paragraph 3.44)

- different objectives of the US and New Zealand planning process in the Ross Sea region arising from different levels of accommodation of fishery outcomes (paragraph 3.45)

- potential development of a primary candidate MPA in areas of overlap in proposals, noting that the absence of a single agreed scenario was attributable to differences in policy aims that may benefit from discussion at the Commission level (paragraphs 3.46 and 3.47).

(d) Terra Nova Bay:

- recognition of importance of Terra Nova Bay potential to develop a proposal for an ASMA within a larger Ross Sea region MPA (paragraphs 3.49 and 3.51).

(e) Reference areas, research and monitoring:

- research and monitoring plans needed for MPAs (paragraph 3.55).

(f) Fishing capacity and SCP:

- alternative management approaches for fleet capacity levels (paragraph 3.56).

(iii) Progress within previously identified priority areas –

(a) a harmonised approach in the Antarctic Treaty System to spatial protection may result in having ASPAs and ASMAs designated by the ATCM within CCAMLR MPAs (paragraph 4.4)

(b) cooperation in data collection or research activities in the CAMLR Convention Area to meet the needs of CCAMLR, as determined by the Scientific Committee (paragraph 4.6)

(c) use of a nested design consistent with availability of data and ecological understanding (paragraph 4.8)

(d) utility of the revised circumpolar pelagic bioregionalisation and potential development of comparable benthic bioregionalisation (paragraph 4.9).

(iv) Identification of conservation objectives in priority regions –

(a) Rational use:

- request for advice on approaches to determine threshold levels for activities that might erode values of an MPA and the degree to which rational use will be enhanced by fishing in the MPA noting that only activities consistent with the values of each MPA would be acceptable (paragraphs 5.11 to 5.13)

- proposal for fishing activities in multi-use candidate protected areas to consider issues such as bentho-pelagic coupling and deep habitat use by *E. superba* (paragraph 5.14).

(v) Development of work plans for priority regions –

(a) information relevant to the conduct of future work by the Scientific Committee (paragraph 6.4)

(b) recommendation to use nine planning domains as reporting and auditing units for work related to the development of MPAs (paragraph 6.8)

(c) CCAMLR Secretariat to develop a set of options for establishing a data repository to support the establishment of MPAs in the Convention Area (paragraph 6.15)

(d) consideration of how to address the protection of habitats underlying ice shelves and the options of having special protection areas within MPAs (paragraph 6.18)

(e) request to include workshops to focus work on the Western Antarctic Peninsula–South Scotia Arc domain, the del Cano–Crozet domain, and an SCP effort for all domains simultaneously in the priorities for the Scientific Committee (paragraphs 6.22 and 6.23).

CLOSE OF THE WORKSHOP

9.1 The report of the workshop was adopted.

9.2 Dr Penhale and Prof. Koubbi congratulated all participants on the successful conclusion of the workshop and thanked them for their contributions. They especially thanked the rapporteurs for producing the Workshop report.

9.3 The participants joined Dr Constable in thanking Dr Penhale and Prof. Koubbi for their work in preparation for, and during, the workshop and in thanking IPEV for the excellent facilities provided to support the Workshop.

9.4 The Workshop was closed.

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Table 1: Summary of progress towards the development of a system of MPAs within the 11 priority areas identified in 2008 (SC-CAMLR-XXVII, Annex 4, Figure 12). For each priority area, progress is described in terms of the achievement of work on the collation of data, fine-scale analyses, systematic conservation planning and the development of proposals. (Work in progress is denoted by 'P' and work completed is denoted by 'Y'.) The requirements for completion of individual steps is dependent on MPA planning processes defined on a case-specific basis, and the same set of steps may not necessarily be required for all planning processes.

Subarea/division	Priority area	Environment data	Biological data	Biogeographic provinces	Rational use data	Objectives	Fine-scale analysis	SCP process	MPA scenario designs	Proposal	Values
48.1, 88.3	1	P	P	P	P						
48.1, 48.2	2	Y	Y		Y	Y	Y	Y	Y	Y	Y
48.2, 48.3, 48.4	3	Y	Y		P	P		P	P		P
48.3	4	Y	Y		P	P		P	P		P
48.6	5	P	P								
48.6	6	P	P								
58.4.1, 58.4.3a, 58.4.3b	8	Y	P	Y	Y						
58.5.1, 58.5.2	9	Y	Y	Y	Y	Y	Y	P			
58.4.1, 58.4.2	7	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
58.4.1, 88.1, 88.2	10	Y	Y	Y	Y	Y	Y	Y	Y		Y
88.1, 88.2	11	Y	Y	Y	Y	Y	Y	Y	Y		Y

Table 2: Summary of MPA planning domains and the planning activities that have been reported to CCAMLR and the status of future planning for developing proposals for MPAs in each domain in the future. At the time of adoption it was acknowledged that additional information would be added to this table.

Domain	Subarea/division (whole or part)	Name	Submitted papers and relevant report paragraphs (to be filled in for the Scientific Committee)	Activities
1	48.1, 48.2, 88.3	Western Antarctic Peninsula–South Scotia Arc	South Orkney Islands southern shelf: WG-EMM-08/49 WG-EMM-08 report (SC-CAMLR-XXVII, Annex 4), paragraphs 3.49 to 3.59 WG-EMM-09/22 WG-EMM-09 report (SC-CAMLR-XXVIII, Annex 4), paragraphs 5.17 and 5.20 to 5.24 SC-CAMLR-XXVIII/14 SC-CAMLR-XXVIII, paragraphs 3.16 to 3.23 and 3.26 CCAMLR-XXVIII, paragraphs 7.1 to 7.8 and 7.14 to 7.17 WG-EMM-10 report (SC-CAMLR-XXIX, Annex 6), paragraphs 3.111 and 3.113 CCAMLR-XXIX, paragraph 7.7	Workshop proposed for 2011/12 to develop and progress MPA proposals for this domain (likely conclusion of process post-2012).
2	48.3, 48.4	North Scotia Arc		Active process to develop MPA proposals (timeline not available at Workshop).
3	48.5	Weddell Sea		Progress encouraged for this region based on science by Argentina, Germany, UK.
4	48.6	Bouvet–Maud	Relevant paper: Nost et al. (in press)	Unknown at the Workshop, although circumpolar analyses could contribute to the progression of representative MPAs in this domain. CEMP monitoring data is available.
5	58.6, 58.7, 58.4.4	del Cano–Crozet	WS-MPA-11/8, 11/10 WS-BSO-07/P1	Active process to develop MPA proposals (timeline not available at Worskhop).
6	58.5, 58.4.3	Kerguelen Plateau	WS-MPA-11/8 to 11/10	Active process to develop MPA proposals (timeline not available at Workshop).
7	58.4.1, 58.4.2	East Antarctica	WS-MPA-11/5, 11/7 WG-EMM-10/26, SC-CAMLR-XXIX/11and BG/9	Proposals can be developed based on work to date and comments at Workshop.
8	88.1, 88.2	Ross Sea Region	WS-MPA-11/14, 11/25 WG-EMM-10/11, 10/12, 10/30	Proposals can be developed based on work to date and comments at Workshop.
9	88.2, 88.3	Amundsen–Bellingshausen		Unknown at the Workshop, although circumpolar analyses could contribute to the progression of representative MPAs in this domain.
All domains			WS-MPA-11/6, 11/16 to 11/18, 11/23	

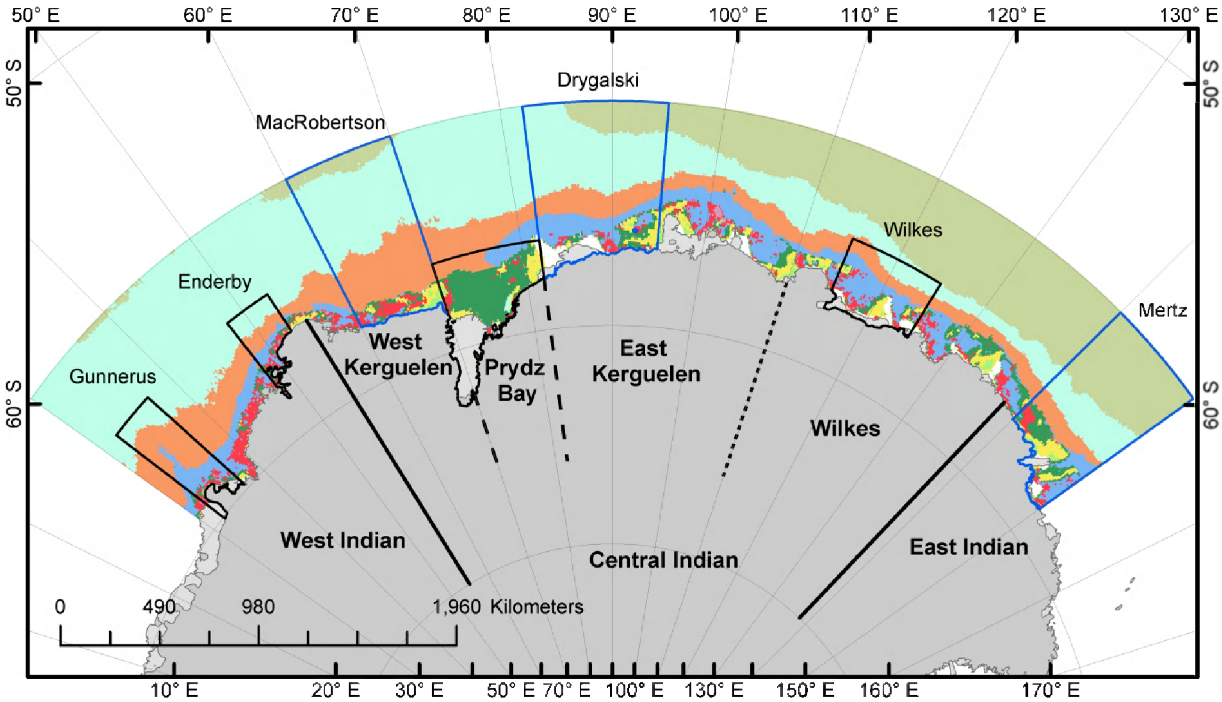

Figure 1[1]: Location of proposed MPAs in East Antartica (for details see Figure 7 in WS-MPA-11/23).

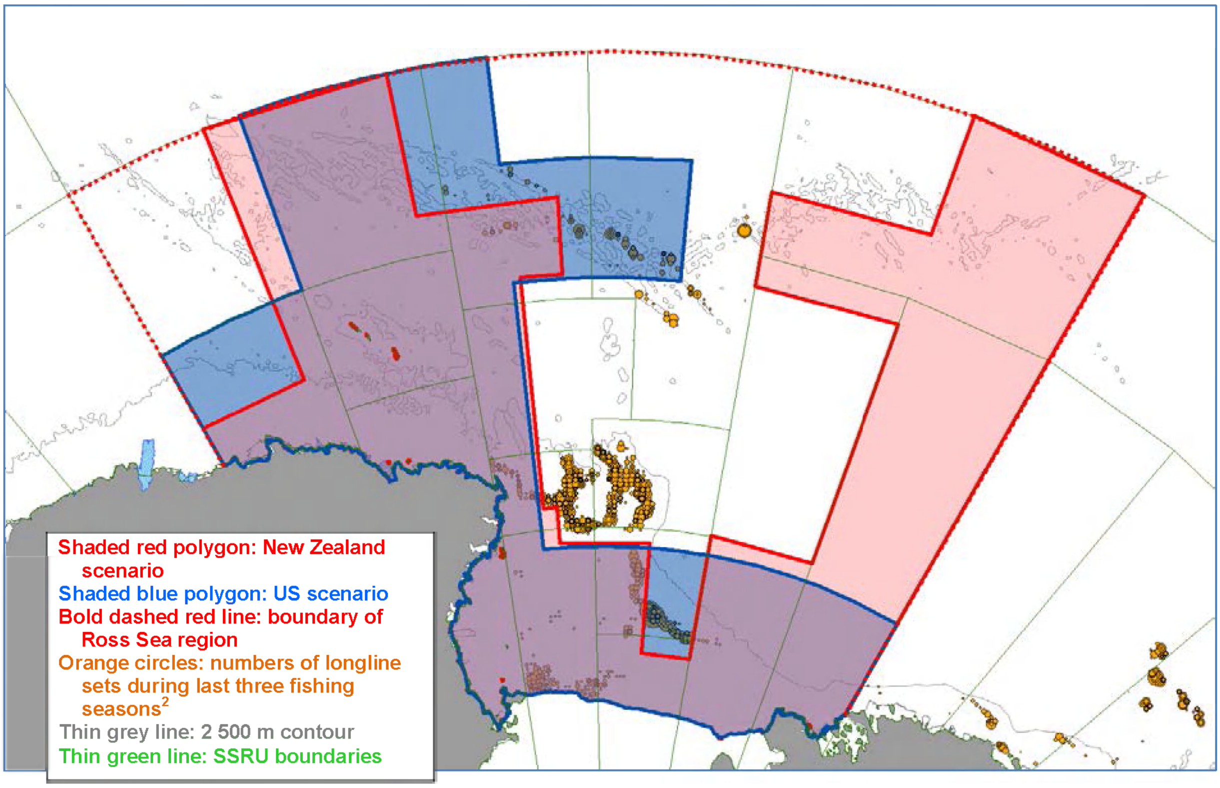

Figure 2[1]: A comparison of the MPA scenarios developed by New Zealand and the USA. [2]Data for the 2010/11 season are preliminary.

[1] These figures are available in colour on the CCAMLR website

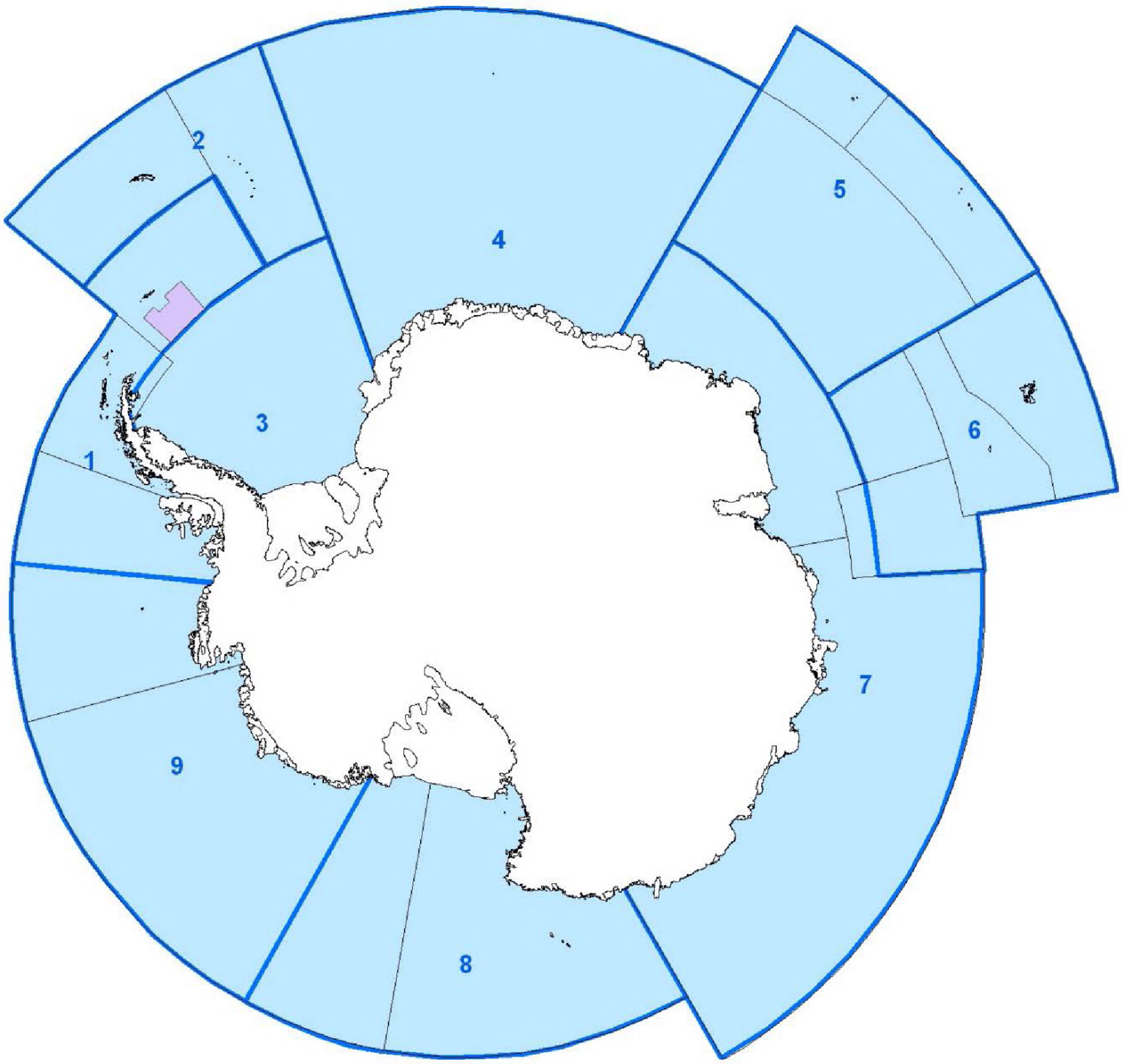

Figure 3: Planning domains defined by the Workshop to provide an updated mechanism by which to plan and report on the development of MPAs across the Convention Area. (1: Western Antarctic Peninsula–South Scotia Arc; 2: North Scotia Arc; 3: Weddell Sea; 4: Bouvet–Maud; 5: del Cano–Crozet; 6: Kerguelen Plateau; 7: East Antarctica; 8: Ross Sea region; 9: Amundsen–Bellingshausen.) Planning domain boundaries (thick lines) follow subarea boundaries (thin lines) where possible. The existing South Orkney Islands southern shelf MPA (shaded) is also shown.

APPENDIX A

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Workshop on Marine Protected Areas
(Brest, France, 29 August to 2 September 2011)

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APPENDIX B

AGENDA

Workshop on Marine Protected Areas
(Brest, France, 29 August to 2 September 2011)

1. Introduction and opening of the meeting

2. Bioregionalisation and systematic conservation planning

3. Review of draft proposals for MPAs or a representative system of MPAs in the CAMLR Convention Area

4. Progress in developing MPAs in priority regions

5. Identification of conservation objectives in priority regions

6. Development of workplan for priority regions

7. Approaches to the development of MPA management plans

8. Advice to the Scientific Committee, its working groups and the Commission

9. Preparation and adoption of the report.

APPENDIX C

LIST OF DOCUMENTS

Workshop on Marine Protected Areas
(Brest, France, 29 August to 2 September 2011)

WS-MPA-11/1	Draft Agenda for the 2011 Meeting of the Workshop on Marine Protected Areas (WS-MPA)
WS-MPA-11/2	List of participants
WS-MPA-11/3	List of documents
WS-MPA-11/4	Summary of the work of the CEP on Marine Protected Areas Antarctic Treaty Secretariat, c/o Dr P. Penhale, CEP Representative to the CCAMLR MPA Workshop
WS-MPA-11/5	Identifying marine protected areas (MPAs) in data-poor regions to conserve biodiversity and to monitor ecosystem change: an Antarctic case study A.J. Constable, B. Raymond, S. Doust, D. Welsford (Australia), P. Koubbi (France) and A.L. Post (Australia)
WS-MPA-11/6	A circumpolar pelagic regionalisation of the Southern Ocean B. Raymond (Australia)
WS-MPA-11/7	Estimating the biodiversity of the shelf and oceanic zone of the d'Urville Sea (East Antarctica) for ecoregionalisation using the CEAMARC (Collaborative East Antarctic Marine Census) CAML surveys P. Koubbi (France), G. Hosie, A. Constable, B. Raymond (Australia), M. Moteki (Japan), N. Améziane, R. Causse (France), V. Fuentes (Spain), K. Heerah, F. Penot, D. Vincent, A. Ancel, C.A. Bost, M. Eléaume (France), D. Lindsay (Japan), M. Lindsay (Australia), M. Cottin, J.B. Charrassin, Y. Ropert-Coudert (France), R. Toda, M. Grossmann (Japan), R. Hopcroft (USA), C. Ozouf-Costaz (France), I. Zimmer (Germany) and CEAMARC experts
WS-MPA-11/8	Estimating the biodiversity of the sub-Antarctic Indian part for the ecoregionalisation of CCAMLR areas 58.5.1 and 58.6: Part II. Foraging habitats of top predators from French Antarctic Territories – areas of ecological significance in the Southern Ocean K. Delord, C. Bost, C. Guinet and H. Weimerskirch (France)

WS-MPA-11/9	Estimating the biodiversity and distribution of the northern part of the Kerguelen Islands slope, shelf and shelf-break for ecoregionalisation: benthos and demersal fish N. Améziane, M. Eléaume, P. Pruvost, G. Duhamel and Kerguelen group (France)
WS-MPA-11/10	Estimating the biodiversity of the sub-Antarctic Indian part for ecoregionalisation: Part I. Pelagic realm of CCAMLR areas 58.5.1 and 58.6 P. Koubbi (France), P.A. Hulley (South Africa), B. Raymond (Australia), F. Penot, S. Gasparini, J.P. Labat, P. Pruvost (France), S. Mormède (New Zealand), J.O. Irisson, G. Duhamel and P. Mayzaud (France)
WS-MPA-11/11	Systematic Biodiversity Planning to identify a potential offshore Marine Protected Area network for South Africa K. Sink, M. Lombard (South Africa), H. Grantham (Australia), C. Attwood, R. Leslie, T. Samaai, S. Kerwath, T. Fairweather, C. van der Lingen, L. Atkinson, T. Wolf and P. Majiedt (South Africa)
WS-MPA-11/12	Focal areas for marine biodiversity protection in KwaZulu-Natal, South Africa. Marine Systematic Conservation Plan Analyses (SeaPLAN): Summary of Results 2011 T. Livingstone, J. Harris, M. Lombard and E. Lagabrielle (South Africa)
WS-MPA-11/13	On marine protected areas in the Southern Ocean G.P. Milinevsky and S.B. Kovalonok (Ukraine)
WS-MPA-11/14	Terra Nova Bay: hot spot in marine and terrestrial biodiversity, knowledge and functioning of the ecosystem S. Torcini, M. Vacchi, S. Aliani, G. Bavestrello, A. Bergamasco, G. Budillon, B. Calcinai, G. Catalano, R. Cattaneo-Vietti, C. Cerrano, M. Chiantore, S. Corsolini, R. Bargagli, A. Dell'Anno, G. di Prisco, G. Fusco, S. Focardi, L. Gugliemo, G. Lauriano, P. Luporini, O. Mangoni, S. Olmastroni, F. Pezzo, E. Pisano, L. Ghigliotti, P. Povero, S. Puce, A. Pusceddu, E. Rusciano, M. Saggiomo, V. Saggiomo, M.C. Gambi, S. Schiaparelli, G. Spezie, C. Verde, P. Del Negro (Italy)
WS-MPA-11/15	The 'CAML/SCAR-MarBIN Biogeographic Atlas of the Southern Ocean' C. De Broyer (Belgium) and P. Koubbi (France)
WS-MPA-11/16	An identification of areas within the high seas of the Southern Ocean that would contribute to a representative system of marine protected areas L.L. Douglass, D. Beaver, J. Turner and R. Nicoll (WWF–ASOC)

WS-MPA-11/17	Climate change and precautionary spatial protection: ice shelves P.N. Trathan and S.M. Grant (UK)
WS-MPA-11/18	Climate change and precautionary spatial protection: seasonal sea ice P.N. Trathan and S.M. Grant (UK)
WS-MPA-11/19	Marine Protected Areas in the Southern Ocean: update on current status of designated areas S.M. Grant and P.N. Trathan (UK)
WS-MPA-11/20	CCAMLR spatial management GIS: potential applications for informing the development of a representative system of MPAs S.M. Grant, S.L. Hill and P.T. Fretwell (UK)
WS-MPA-11/21	A toolbox of Marine Protected Area management techniques for the area covered by the Antarctic Treaty and by CCAMLR WWF and UK Foreign and Commonwealth Office
WS-MPA-11/22	Designing Marine Protected Area networks: insights from the CHARM3 project R.J. Smith and K. Metcalfe (UK)
WS-MPA-11/23	A hierarchical classification of benthic biodiversity and assessment of protected areas in the Southern Ocean L.L. Douglass, J. Turner, H.S. Grantham, S. Kaiser, R. Nicoll, A. Post, A. Brandt and D. Beaver (WWF–ASOC)
WS-MPA-11/24	Conservation of Antarctic pack-ice seals with increasing krill fishing and environmental change J. Forcada, P.N. Trathan (UK), P.L. Boveng (USA), I.L. Boyd (UK), D.P. Costa (USA), M. Fedak (UK), T.L. Rogers and C.J. Southwell (Australia)
WS-MPA-11/25	Marine Protected Area planning by New Zealand and the United States in the Ross Sea region B.R. Sharp (New Zealand) and G.M. Watters (USA)

Other documents

WS-MPA-11/P1	CEAMARC, the Collaborative East Antarctic Marine Census for the Census of Antarctic Marine Life (IPY # 53): An overview G. Hosie, P. Koubbi, M. Riddle, C. Ozouf-Costaz, M. Moteki, M. Fukuchi, N. Ameziane, T. Ishimaru, A. Goffart (*Polar Science*, 5 (2011): 75–87)

WS-MPA-11/P2	PECHEKER-SIMPA – A tool for fisheries management and ecosystem modeling P. Pruvost, A. Martin, G. Denys and R. Causse (In: *The Kerguelen Plateau Marine Ecosystem and Fisheries*. Duhamel, G. and D. Welsford (Eds), Société Française d'ichtyologie publ. (2011): 259–266)
WS-MPA-11/P3	Biodiversity of the benthos off Kerguelen Islands: overview and perspectives N. Améziane, M. Eléaume, L.G. Hemery, F. Monniot, A. Hemery, M. Hautecoeur and A. Dettaï (In: *The Kerguelen Plateau Marine Ecosystem and Fisheries*. Duhamel, G. and D. Welsford (Eds), Société Française d'ichtyologie publ. (2011): 1–11)
WS-MPA-11/P4	Major fishery events in Kerguelen Islands: *Notothenia rossii*, *Champsocephalus gunnari*, *Dissostichus eleginoides* – current distribution and status of stocks G. Duhamel, P, Pruvost, M. Bertignac, N. Gasco and M. Hautecoeur (In: *The Kerguelen Plateau Marine Ecosystem and Fisheries*. Duhamel, G. and D. Welsford (Eds), Société Française d'ichtyologie publ. (2011): 1–11)

APPENDIX D

EXPERT COMMENTARY ON OBJECTIVES, RATIONAL USE AND METHODS FOR IDENTIFYING MPAs

by Invited Experts to the Workshop:
Prof. A. Rogers, University of Oxford, UK
Dr B. Smith, DICE, University of Kent, UK
Dr M. Lombard, Nelson Mandela Metropolitan University and University of Pretoria, South Africa

5.1 Identify conservation objectives appropriate to different regions with reference to particular data layers and metrics against which achievement of objectives might be assessed

Conservation objectives for any planning domain need to be translated into a list of conservation features such as important species, important habitats, biogeographic regions, areas with important ecological processes, etc. These features then need to be mapped and in some cases extra data might need to be collected to address data gaps. In addition, spatial and intensity data of rational use within the region need to be compiled (for example, the area and intensity of a particular fishing activity).

Comprehensiveness and representation can be assessed by setting quantitative targets for each conservation feature and compare current protection levels with these targets, as this provides transparency and scientific defensibility. In some cases there may be disagreement over target values for particular features, and in such situations we recommend undertaking sensitivity analyses (i.e. using a range of targets for different features) to investigate the impacts of different targets on conservation scenarios (e.g. a scenario for a 20%, or 40% protection of all benthic habitats). The systematic conservation planning approach attempts to meet all conservation targets, while minimising the impact on patterns of rational use. It is also possible to set targets for rational use, for example, a conservation scenario may wish to meet all biodiversity targets while NOT impacting by more than 10% on a particular form of rational use.

Measures of MPA design (size, shape, spacing) are an important metric of network adequacy. Where data exist on species-specific habitat requirements (e.g. penguin foraging areas), or on the spatial and temporal occurrence of nutrient-rich fronts or eddies, these data can also inform MPA design principles.

5.2 Identify the value of particular areas for rational use

The SCP process should begin with an assessment of how each conservation feature is affected by each form of rational use. Once particular areas have been identified for protection, then this general information should be supplemented with site-specific assessments, based on expert knowledge and literature reviews, of how each feature that it contains is affected by known patterns of rational use at that site.

5.3 Discuss methods for identifying and prioritising candidate sites for protection, including the means by which conservation and rational use objectives might be addressed

The systematic conservation planning approach is an adaptive process that is most successful when applied within an appropriate management framework. This framework should operate in a way that allows it to respond in a timely fashion to changes in availability of new information, patterns of rational use, policy frameworks, and other anthropogenic and natural environmental changes, as well as opportunities for collaborative management.

Currently the most common practice is to develop MPA networks informed by optimisation software outputs which can help to minimise impacts on rational use, although other GIS-based methods that account for targets and costs can also be used, particularly if they capture important implementation considerations (e.g. compliance issues). These approaches can be limited by a general lack of data or differences in the quantity and quality of data across different parts of a planning domain.

Prioritisation of spatial management measures within a network of proposed MPAs should be based on ease of implementation, vulnerability to current and future threats, and the contribution of the area to meeting targets. Zonation scenarios should be clearly defined with respect to which zone contributes to which target (i.e. which rational use activities are appropriate within each zone).

ANNEX 7

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 10 to 21 October 2011)

CONTENTS

[1] Appendices D to R are published only in electronic format (www.ccamlr.org/pu/e/e_pubs/fr/drt.htm).

APPENDIX N: Fishery Report: Exploratory fishery for *Dissostichus* spp. in Division 58.4.1

APPENDIX O: Fishery Report: Exploratory fishery for *Dissostichus* spp. in Division 58.4.2

APPENDIX P: Fishery Report: Exploratory fishery for *Dissostichus* spp. in Division 58.4.3a

APPENDIX Q: Fishery Report: Exploratory fishery for *Dissostichus* spp. in Division 58.4.3b

APPENDIX R: Fishery Report: Exploratory fishery for *Dissostichus* spp. in Subareas 88.1 and 88.2

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT
(Hobart, Australia, 10 to 21 October 2011)

OPENING OF THE MEETING

1.1 The meeting of WG-FSA was held in Hobart, Australia, from 10 to 21 October 2011. The Convener, Dr C. Jones (USA), opened the meeting and welcomed participants (Appendix A). Mr A. Wright (Executive Secretary) extended his welcome and wished the meeting success in its current round of deliberations.

1.2 Participants paused in memory of those lost during the tragic sinking of the longliner *Insung No. 1* in the Ross Sea in December 2010.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1 In accordance with the advice of the Scientific Committee (SC-CAMLR-XXIX, Table 7), this year's agenda of WG-FSA focused on fisheries, research plans and assessments, including the biennial review of assessments for *Dissostichus* spp. in Division 58.5.2 and Subareas 48.3, 88.1 and 88.2. Consideration of other long-standing items, including by-catch, depleted and recovering stocks, biology and ecology, and ecosystem interactions was deferred to the meeting in 2012. It was also recognised that WG-FSA's annual agenda would continue to reflect the work and priorities of the Scientific Committee.

2.2 The agenda of the meeting was discussed and WG-FSA agreed to move Subitem 5.4 ('Research plans to inform current and future assessments') to a separate agenda item which would follow Item 4; with this change the agenda was adopted (Appendix B).

2.3 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.

2.4 WG-FSA-11/11, 11/19 and 11/41 dealt specifically with matters of interest to WG-EMM and were referred to the 2012 meeting of WG-EMM, while consideration of WG-FSA-11/P1, 11/P2 and 11/P3 was deferred to the 2012 meeting of WG-FSA.

2.5 Paragraphs dealing with advice to the Scientific Committee and other working groups have been highlighted. A list of these paragraphs is provided in Item 11.

2.6 Components of WG-FSA's work were developed during the meeting by the following subgroups:

- Subgroup on Assessments (coordinator: Dr M. Belchier, UK)
- Subgroup on New and Exploratory Fisheries (coordinator: Drs R. Mitchell, UK and S. Hanchet, New Zealand)

- Subgroup on Research Plans (coordinator: Dr B. Sharp, New Zealand)

- Subgroup on the Scientific Observer Program (coordinator: Dr R. Leslie, South Africa)

- Subgroup on VMEs (coordinator: Dr S. Parker, New Zealand).

2.7 The report was prepared collectively by the Working Group participants. The information used in developing the assessments is provided in the Report on Bottom Fisheries and VMEs (Appendix D) and the Fishery Reports (Appendices E to R). These reports will be published on the CCAMLR website (www.ccamlr.org – go to 'Publications', see 'Fishery Reports').

REVIEW OF AVAILABLE INFORMATION

Data requirements specified in 2010

3.1 Since WG-FSA-10 the Secretariat has continued to develop procedures, databases and data forms at the request of WG-FSA, as well as the Commission and the Scientific Committee. This work has included:

(i) updating fishery and scientific observer data forms and associated guidelines prior to the start of the 2010/11 fishing season, and consequential updates to database tables, queries and entry forms (WG-FSA-11/8)

(ii) developing a tag overlap statistic calculator for use in 2010/11 (see COMM CIRC 10/123 and SC CIRC 10/69; see also, e.g., WG-FSA-11/54)

(iii) processing fishery and observer data from 2010/11, including data from the fisheries at Prince Edward and Marion Islands (South African EEZ in Subareas 58.6 and 58.7 and Area 51), Kerguelen Islands (French EEZ in Division 58.5.1) and Crozet Islands (French EEZ in Subarea 58.6) – these data have undergone limited and preliminary validation prior to the meeting, and further validation will be conducted in the forthcoming intersessional period

(iv) allocating starting positions of research hauls in the exploratory fisheries in Subareas 48.6 and 58.4 (WG-SAM-11/4; see also Item 5)

(v) updating fishery and observer information reported in the Fishery Reports (see Item 6) and report on VMEs and bottom fishing (Item 7).

3.2 The Secretariat validated the preliminary CASAL assessments using the assessment input files and results reported in papers submitted to WG-FSA. The validations confirmed the parameter files and MPD estimates of the B_0 estimate in each model run for the preliminary assessments for *Dissostichus eleginoides* in Subarea 48.3 (WG-FSA-11/33 Rev. 1, two- and three-fleet models), Subarea 48.4 (WG-FSA-11/38, catch-at-age and catch-at-length models), Division 58.5.2 (WG-FSA-11/24, base-case), *Dissostichus* spp. in the Ross Sea (WG-FSA-11/42, runs R1, R2.3 and R3), SSRU 882E (WG-FSA-11/44, runs R1, R2.3

and R3) and SSRUs 882C–G combined (WG-FSA-11/43, runs R1, R2.3, R3, R4 and R5). The input files for the preliminary assessment for *D. eleginoides* in Division 58.5.1 failed to produce the B_0 estimate reported in WG-FSA-11/28 (paragraph 6.44).

3.3 The input files for the preliminary assessments in the Ross Sea and Subarea 88.2 also included the MCMC data. The Secretariat's projections based on these data and the CCAMLR decision rule confirmed the yield estimates.

3.4 The Working Group noted that the three groups of researchers involved in preliminary assessments in Areas 48, 58 and 88 used slightly different implementations of the decision rule related to depletion and escapement. The Working Group tasked Dr S. Candy (Australia) and the Secretariat to coordinate a small group to address this issue intersessionally with the aim of submitting a combined/standard method (with associated R code) which could be used in future validations.

3.5 At the request of WG-SAM, the Secretariat mapped the spatial distribution of fishery characteristics for the exploratory longline fisheries for *Dissostichus* spp., including catch, proportion of species caught, mean of catch rate (by length of line and per hook), mean of fish size and proportion of fish above 100 cm (*D. mawsoni*) and 80 cm (*D. eleginoides*) (Annex 5, paragraph 2.8). WG-FSA agreed to include data from all longline fisheries in the Convention Area and all research fishing.

3.6 The Working Group also agreed that these maps provided comprehensive information of the spatial characteristics of the fisheries for *Dissostichus* spp. However, these maps had not been included in the Working Group's reports because of concern over the publication of fishery distribution data at such fine-scale spatial resolution (0.5° latitude × 1.0° longitude) used in the maps. The Working Group sought advice from the Scientific Committee and Commission on whether maps that show data at this scale may be published in future.

3.7 Secretariat staff met with Korean government officials and fishing industry representatives in Seoul in November 2010 to discuss background information on CCAMLR and data requirements, and facilitate improvements in the quality of data collected on board Korean-flagged fishing vessels.

3.8 Mr T. Jung (Republic of Korea) informed the Working Group that the information provided by the Secretariat during its visit to Seoul had been summarised and translated into Korean and sent to vessel captains to explain the importance of complying with the requirements of CCAMLR fisheries, particularly those conservation measures that had proved problematic in the past.

3.9 The Secretariat investigated the use of the length–weight relationship of *D. eleginoides* and *D. mawsoni* to separate the two species using scientific observer data (WG-FSA-11/21). Although a general discriminant function using length and weight measurements did not provide a means to separate the two species, the process provided an opportunity to examine the variation in biometrics of both species by sex and by area, and indicated the possibility of large-scale coherence in variation in length–weight relationship parameters.

3.10 The Secretariat is continuing to develop and improve its processes for data receipt, processing, integrity checking, validation and quality assurance. This work is being guided by the findings and recommendations arising from the independent review of the Secretariat's data management systems (CCAMLR-XXX/5; see Item 10), and ongoing data uses and analyses (e.g. WG-FSA-11/21).

3.11 The Working Group acknowledged the important role of fishing crews, scientific observers and Members in collecting CCAMLR data.

Fisheries information

Catch and effort in 2010/11

3.12 The 2010/11 fishing season started on 1 December 2010 and will end on 30 November 2011, and fishing was still in progress in some areas at the time of the meeting. Members' fishing vessels operated in the fisheries targeting icefish (*Champsocephalus gunnari*), toothfish (*D. eleginoides* and/or *D. mawsoni*) and krill (*Euphausia superba*), and catches reported to 24 September 2011 are summarised in Table 1; no directed fishing occurred on crabs (*Paralomis* spp.) during the season (see also SC-CAMLR-XXX/BG/1).

3.13 The Secretariat monitored a total of 130 non-zero catch limits for target species and by-catch species in SSRUs (see CM 41-01), SSRU groups, management areas (see CMs 41-02 and 41-03), divisions and subareas (CCAMLR-XXX/BG/8). This included forecasting fishery closures once the catch of a managed species exceeded 50% of its catch limit. As of 24 September 2011, 16 fishing areas including five fisheries, had been closed by the Secretariat in 2010/11 (CCAMLR-XXX/BG/8, Table 2), and all of these closures were triggered by catches of *Dissostichus* spp. approaching their respective catch limits.

3.14 Catch limit overruns (i.e. the catch exceeded the catch limit) occurred for *Dissostichus* spp. in Division 58.4.1 (SSRU E: overrun 6 tonnes, total catch 113% of the limit; whole fishery: overrun 6 tonnes, total catch 103% of the limit), Division 58.4.2 (SSRU E: overrun 96 tonnes, total catch 339% of the limit; whole fishery: overrun 66 tonnes, total catch 194% of the limit), Subarea 88.1 (SSRUs J and L: overrun 54 tonnes, total catch 114% of the limit; whole fishery: overrun 32 tonnes, total catch 101% of the limit), and Subarea 88.2 (SSRUs C, D, F and G, overrun 2 tonnes, total catch 101% of the limit).

3.15 The Working Group noted that the Secretariat continued to experience difficulties in monitoring small catch limits (e.g. limits less than 100 tonnes) where vessels may, on occasions, report daily catches of similar size to the total limit.

3.16 Vessels fishing in the exploratory fisheries for *Dissostichus* spp. in 2010/11 were required to conduct fishery-based research in accordance with the data collection plan and tagging protocol described in CM 41-01. In addition, vessels fishing in Subareas 48.6 and 58.4 were required to deploy research hauls in accordance with the research plan in CM 41-01 and at locations determined by the Secretariat (WG-FSA-11/8 and 11/25; see also WG-SAM-11/4). Five vessels (*Hong Jin No. 701, Insung No.7, Koryo Maru No. 11, Shinsei Maru No. 3* and *Tronio*) completed a total of 124 research hauls.

3.17 Members also conducted research fishing on *Dissostichus* spp. in Divisions 58.4.3b and 58.4.4 and Subareas 88.2 (SSRU A) and 88.3 (WG-FSA-11/9).

3.18 Scientific observers appointed under the CCAMLR Scheme of International Scientific Observation were deployed on all vessels targeting finfish in the Convention Area, and some vessels targeting krill, in 2010/11 (WG-IMAF-11/5 Rev. 2; see also Item 8).

3.19 WG-FSA briefly considered finfish by-catch taken in krill fisheries, as recommended by WG-EMM (Annex 4, paragraph 2.117). Finfish by-catch is currently sampled by scientific observers on krill fishing vessels using two protocols; as part of the finfish by-catch biological data form (K5) and the fish sub-sampling protocol (K12 form, since 2010). The K5 protocol records biological information on finfish by-catch such as species, length range, weight and sex. The K12 protocol was developed to sample small/larval fish that may go undetected in the K5 protocol.

3.20 The Secretariat undertook a preliminary analysis of the by-catch of finfish in the krill fishery (WG-FSA-11/5). Substantial differences occurred in the composition of finfish by-catch between the three vessels from which K12 data are currently available. The Working Group noted that the identification of larval fish of some of the species recorded was not straightforward and that these may be reflected in the apparently extralimital records for some species.

3.21 WG-FSA noted that if these preliminary results indicated that the estimated total by-catch for the krill fishery in Subarea 48.1 in 2009/10 included 6.8 tonnes of *Pleuragramma antarcticum* and 4.7 tonnes of *C. gunnari*. However, as the length of these fish is not currently recorded in the K12 form, it is difficult to evaluate the realisable biomass and the potential impact of this catch on the population of those species. Therefore the Working Group recommended that the K12 form be modified to include details of the length of fish sampled.

3.22 WG-FSA also noted that the by-catch observed using the K5 protocol on board the *Dalmor II* fishing in 2010/11 in Subareas 48.1 and 48.2 was dominated by notothenids and myctophids respectively (WG-FSA-11/41).

3.23 WG-FSA welcomed the presentation of quantitative information on the finfish by-catch in the krill fishery and agreed that it was important to establish what fish species were being caught in that fishery and what the implications of the level of this by-catch might be for target species (e.g. *C. gunnari* in Subarea 48.3) and other species that may be depleted as a result of historic fishing.

Estimates of effort from IUU fishing

3.24 In 2010, the Scientific Committee noted WG-FSA's advice on IUU fishing, and agreed that, for the purposes of tracking the progress in eliminating IUU fishing, the Secretariat should monitor trends in IUU effort rather than estimate IUU catch, but that estimates of total removals are needed for stock assessments (SC-CAMLR-XXIX, paragraph 6.5). The Working Group recommended that the Scientific Committee task appropriate experts to develop methodologies to generate these estimates for IUU removals.

3.25 Information available to the Secretariat indicated that five vessels (*Kuko, Koosha 4, Xiong Nu Baru 44*, *Sima Qian Baru 22* and *The Bird*) had engaged in IUU fishing for *Dissostichus* spp. in the Convention Area in 2010/11 (WG-FSA-11/10 Rev. 1). These vessels were sighted in Divisions 58.4.1 and 58.4.4. Three other IUU fishing vessels (*Lana*, *Yangzi Hua 44* and *Seabull 22*) were sighted outside the Convention Area. With the exception of the *Sima Qian Baru 22* (longliner) and *Koosha 4* (cargo vessel), these vessels were fishing using gillnets.

3.26 Sighting information for the last nine seasons indicated a change in the area of operations of IUU fishing vessels, from a concentration of activity in the Western Indian Ocean sector to Division 58.4.1.

3.27 In addition, the Secretariat had received two sightings of abandoned fishing gear, one each in Divisions 58.4.1 and 58.5.2. WG-FSA noted that the gear sighted in Division 58.5.2 was a longline which may have been in the water for a number of years, as indicated by the growth of benthic invertebrates, and catches associated with this gear may have been taken into account in previous estimates of catch.

3.28 The Working Group discussed the time series of IUU fishing activities in the Convention Area (WG-FSA-11/10 Rev. 1, Table 4), and agreed that there were sufficient data available to begin a statistical analysis of the trends in IUU fishing. The Working Group recalled the work from JAG (CCAMLR-XXV, Annex 6) and requested that the Scientific Committee and WG-SAM advise on how this work can be further developed in order to provide information on trends in IUU fishing and estimates of IUU catches.

Catch data for toothfish fisheries in waters adjacent to the Convention Area

3.29 Catches of *D. eleginoides* from fisheries outside the Convention Area and reported in the CDS in the calendar years 2010 and 2011 (to 26 September) are summarised in Table 2 (see also CCAMLR-XXX/BG/24). The total catch of *D. eleginoides* taken outside the Convention Area was 12 441 tonnes in 2010 and 9 190 tonnes in 2011, and most of this catch came from Areas 41 (Southwest Atlantic) and 87 (Southeast Pacific).

3.30 The Working Group noted that scientific samples of *Dissostichus* spp., such as otoliths and tissue samples, are currently required to be reported to the CDS. The submission of DCDs for these small samples seemed unnecessary, and WG-FSA requested that the Scientific Committee consider excluding small scientific samples (e.g. up to 10 kg in 'product' weight) from the requirements of the CDS.

3.31 WG-FSA reviewed information on catches reported by the Ukrainian-flagged vessel *Simeiz* which fished for *D. eleginoides* in the high-seas areas of Divisions 41.3.1 and 41.3.2 (southwestern Atlantic Ocean) from January to August 2011 (WG-FSA-11/12). Fishing activities were conducted using trotlines in depths of 800–1 900 m and 122 tonnes of *D. eleginoides* were caught. There was no recapture of tagged fish.

Incidental mortality arising from fishing

3.32 Mr J. Moir Clark (Convener, WG-IMAF) summarised the findings and recommendations from the meeting of WG-IMAF which was held concurrently with

WG-FSA from 10 to 12 October 2011 (Annex 8). WG-FSA noted WG-IMAF's advice on the likely reduction in the requirements for data on the effectiveness of established mitigation measures, and consequential implications for data collection priorities for scientific observers. This matter was further considered under Item 8.

3.33 WG-FSA also considered WG-IMAF's advice that future meetings of WG-IMAF would be held on an ad hoc basis, as directed by the Scientific Committee's priorities and requirements to review risk assessments and levels of incidental mortality. WG-FSA noted that the future terms of references for WG-IMAF may be focused on the individual needs of each meeting, such as the current practice for SG-ASAM.

3.34 WG-FSA congratulated WG-IMAF on its significant accomplishments in reducing the incidental mortality of seabirds and marine mammals in CCAMLR fisheries.

PREPARATION FOR ASSESSMENTS AND ASSESSMENT TIMETABLE

Report from WG-SAM

4.1 The report of WG-SAM-11 (Annex 5) was presented to the Working Group by Dr Jones (Co-convener, WG-SAM). It noted that WG-SAM was requested to undertake a focus topic on data-poor toothfish fisheries in the Convention Area, the terms of reference of which were set out in SC-CAMLR-XXIX, paragraph 3.133. The Working Group noted the advice to the Scientific Committee and WG-FSA on the following items (Annex 5):

- (i) evaluation of research hauls in exploratory fisheries (paragraph 2.9)
- (ii) CPUE in longline fisheries (paragraphs 2.15 and 2.33)
- (iii) preliminary assessment in Divisions 58.4.4a and 58.4.4b (paragraph 2.17)
- (iv) research fishing (paragraphs 2.19, 2.25 and 2.26; see also paragraphs 5.3 to 5.6)
- (v) performance metrics for surveys and tag-based research (paragraphs 2.38, 2.46 and 2.48)
- (vi) research design for data-poor fisheries (paragraphs 2.40, 2.44, 2.47 to 2.49)
- (vii) tag-loss rates used in CASAL (paragraph 3.6)
- (viii) pre-recruit survey in Subareas 88.1 and 88.2 (paragraph 3.14)
- (ix) research fishing in areas which cannot support a viable fishery (paragraph 5.7)
- (x) review of the Secretariat's Strategic Plan (paragraph 6.5)
- (xi) Convener of WG-SAM (paragraph 8.3).

4.2 The Working Group endorsed the advice regarding performance metrics by which the quality of research efforts could be evaluated, as well as recommendations for research designs and standardised methods for mark-recapture programs (Annex 5, paragraphs 2.37 to 2.44) and areal survey methods (Annex 5, paragraphs 2.45 to 2.49). This matter was further considered under Item 5.

Review of preliminary stock assessment papers,
including inputs for assessments

4.3 The Working Group discussed preliminary assessment papers for *C. gunnari* in Subarea 48.3 and Division 58.5.2, for *D. eleginoides* in Subareas 48.3 and 48.4 and Divisions 58.5.1 and 58.5.2 and for *D. mawsoni* in Subareas 48.4, 88.1 and 88.2 in preparation for the final stock assessments conducted at the meeting and reported under Item 5.1.

4.4 Papers containing new information on specific input data to be used for assessments were discussed by the Working Group alongside the preliminary assessment papers for each species under consideration within a subarea/division rather than as a separate agenda item. This included information on trawl surveys, tagging data inputs and estimates of unaccounted fishing mortality.

4.5 The Working Group discussed three papers containing information on the reproductive biology of *D. mawsoni* in Subarea 88.1 (WG-FSA-11/4, 11/18 and 11/27) and recommended that these be carried forward to next year's meeting for consideration by the Subgroup on Biology, Ecology and Demography.

C. gunnari South Georgia (Subarea 48.3)

4.6 WG-FSA-11/29 reported on the annual groundfish survey conducted in Subarea 48.3 carried out in January–February 2011. Survey design was similar to that employed for previous years, noting that sampling effort was allocated to five areas and two depth strata. The mean biomass estimated for *C. gunnari* was slightly lower than observed in 2010 but the lower one-sided 95% CL for 2011 was higher than for all years from 2007 to 2010. Small fish (14–20 cm) were dominant in the population around South Georgia, whereas larger fish (27–37 cm) dominated at Shag Rocks. There was a high availability of krill to *C. gunnari* in the area in 2011 evidenced by dietary analysis.

4.7 The survey also identified evidence of *D. eleginoides* recruitment at Shag Rocks, with fish 40–45 cm (age 3+ fish) in many hauls. This is assumed to be the cohort that was identified in the 2010 survey as age 2+ fish. There was also evidence of a smaller cohort of age 2+ toothfish in the 2011 survey.

4.8 WG-FSA-11/30 Rev. 1 reported on an updated preliminary assessment of *C. gunnari* in Subarea 48.3 using the length-based projection model. The Working Group recalled that the use of the length-based model to set catch limits for *C. gunnari* in Subarea 48.3 was endorsed at the 2010 meeting (SC-CAMLR-XXIX, Annex 8, paragraph 5.164). The assessment uses survey data on length densities and biomass density without the need to identify age-specific cohorts.

4.9 The Working Group also noted the importance of the length transition matrix on model productivity, and of the dependence of this transition matrix on specific von Bertalanffy parameters arising from a growth model. The Working Group recalled that there has been considerable discussion of the utility of the length transition matrix at the WG-SAM meeting in 2010 (SC-CAMLR-XXIX, Annex 4, paragraphs 3.34 and 3.35). It was noted that the growth parameters used were the same as had previously been used in the age-based model. The Working Group noted the well-documented difficulties in ageing meant that it was unlikely that validating the growth curves would be achievable in the near future (Fish WG/1986/Doc. 11; WG-FSA-06/7). The Working Group requested that sensitivity tests be considered to evaluate the impact of uncertainty in icefish growth on the length-based assessment.

C. gunnari Heard and McDonald Islands (Division 58.5.2)

4.10 WG-FSA-11/23 reported the results of three random stratified trawl surveys which were completed in September 2010, March 2011 and May 2011 which added to the time series of annual surveys in Division 58.5.2 that commenced in 1997. Catches of *C. gunnari* in the May 2011 survey were less than 0.5 tonnes. A comprehensive summary of fish and invertebrate catch composition was also provided.

4.11 Details of the length composition of *C. gunnari* obtained in the three surveys were provided in WG-FSA-11/22. An unusual multi-modal cohort structure was observed where at least four contiguous age classes were present simultaneously in the survey samples. This is different from the usual situation observed in *C. gunnari* in Division 58.5.2 in which a single cohort is seen to dominate before disappearing from the population with a frequency of around three years. The cause of this change in population structure is uncertain but may relate to a change in mortality associated with spawning.

4.12 The Working Group noted that having three surveys conducted within a short timeframe of 18 months provided useful data relating to the population dynamics of *C. gunnari*. Of particular note was the observed rapid decline in abundance of the oldest cohort of fish over a five-month period in 2010 (WG-FSA-11/22, Table1).

4.13 Following an examination of the spatial distribution of survey catches of *C. gunnari*, the Working Group was satisfied that the spatial stratification used in the survey was appropriate.

4.14 A preliminary stock assessment of *C. gunnari* in Division 58.5.2 was provided in WG-FSA-11/22. Using the May 2011 survey data and growth parameters used in the 2010 assessment, the density of fish in each age class was estimated using the CMIX procedure and the estimate of yield was obtained using the GYM.

4.15 The Working Group noted a proposal by Australia (WG-FSA-11/34) to introduce a limit reference point in the *C. gunnari* fishery in Division 58.5.2. It recalled that the population on the plateau around Heard Island and McDonald Islands had historically undergone large periodic fluctuations in stock size, and hence the catch limit recommended using the decision rules also fluctuated widely. The Working Group noted that a strict application of the decision rules could result in a commercial catch limit even at relatively low levels of stock biomass. It was agreed that a limit reference point for such stocks may be recommended in the interim pending development of a more formal assessment of the likelihood that the decision rules will achieve CCAMLR's objectives.

4.16 The Working Group agreed that, where the stock assessment of *C. gunnari* in Division 58.5.2 indicated a stock biomass of less than 1 000 tonnes, or the decision rules indicated a catch limit of less than 100 tonnes, a commercial catch limit would not be set.

Instead, a 30 tonne combined research and by-catch limit would apply, which would allow the annual trawl survey to continue to monitor the stock, and accommodate by-catch of icefish that may occur in the *D. eleginoides* trawl fishery in this division. The Working Group recommended that the conservation measures applying to the fisheries in Division 58.5.2 be modified accordingly.

4.17 The Working Group noted that the rationale for limit reference points was not based on detailed analyses and would be strengthened by an evaluation of the performance of the CCAMLR decision rules, as recommended by the Workshop on Approaches to Managing Icefish (SC-CAMLR-XX, Annex 5, Appendix D) taking into account stock-specific biology and ecosystem roles. The Working Group encouraged Members to conduct such evaluations, and that limit reference points should be revised accordingly.

D. eleginoides South Georgia (Subarea 48.3)

4.18 WG-FSA-11/33 Rev. 1 presented an updated assessment of *D. eleginoides* in Subarea 48.3. The input data for the model were updated with data from 2009/10 and 2010/11. Model runs with alternative fleet hypotheses were used to explore fits to commercial catch-at-age data in response to the request for further work into this by WG-FSA in 2009 (SC-CAMLR-XXVIII, Annex 5, Appendix L, paragraph 39).

4.19 In the updated assessment, fits to observations were adequate, with improvements of fits to commercial catch-at-age and tag recaptures compared to the 2009 assessment model. The Working Group noted the poor fits to survey abundance observations from 2005 onwards. It was also noted that, whilst there are alternative approaches to the weighting of fishery-independent pre-recruit surveys in integrated assessment models, the current approach to data weighting is believed to weight the survey data appropriately, given the variability in survey-haul-specific catch-at-length proportions and catch densities.

4.20 The Working Group noted that there is still uncertainty surrounding the strength of the 2001 cohort, although the consistent tracking of this cohort through the groundfish survey and commercial catch-at-age both suggest the cohort was relatively strong. The Working Group noted the importance of the assumptions of fleet structure on estimates of YCS, and the effects of this on long-term yield estimates for the models.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

4.21 WG-FSA-11/31 Rev. 2 presented initial results for Subarea 48.4 South from a three-year tagging experiment that was initiated by the UK in 2008/09. Standardised CPUE trends indicated a slight decline in catch rates over the three-year study, with greater declines in catch rates from 2010 to 2011. Two years of mark-recapture data generated estimates of vulnerable biomass for *D. mawsoni* between 589 to 660 tonnes for 2010 and 2011 recapture years, similar to those estimated in 2010 with one year of data.

4.22 WG-FSA-11/38 presented an updated assessment of *D. eleginoides* in Subarea 48.4 North. The CASAL integrated assessment model was updated with data from 2010/11. Additionally, age data from randomly sampled otoliths from 2008/09 were included in the model. These data were used to provide catch-proportions-at-age or size-at-age data for a variety of models. Estimates of yield resulting from the different model configurations were discussed by the Working Group.

4.23 Proportions-at-age in commercial catches in 2008/09 confirmed that catches from the fishery are dominated by fish of a restricted age range. The introduction of size-at-age data into the model, estimation of the von Bertalanffy parameter t_0 and the use of double-normal selectivity, resulted in a 50% increase in estimated SSB_0. The Working Group noted that the increase in SSB_0 is likely due to the decreasing right-hand limb of the selectivity ogive.

D. eleginoides Kerguelen Islands (Division 58.5.1)

4.24 WG-FSA-11/28 presented a preliminary assessment of *D. eleginoides* in Division 58.5.1. The CASAL integrated assessment model uses catch, CPUE and length-frequency data from the commercial fishery (1979–2011), IUU estimates, abundance estimates from scientific surveys and tagging data to derive estimates of yield.

4.25 The Working Group commended the considerable progress made in the development of the assessment model and recognised the cooperative work between France and Australia during the intersessional period. The Working Group encouraged further development of this assessment along with continued collection and analysis of data on catch and effort, tagging data, and other data that could be used to progress understanding of fish stocks and fishery dynamics on the Kerguelen Plateau.

4.26 The Working Group recommended that the presentation of fishery and tag characterisation of the Division 58.5.1 fishery, analogous to that presented for Subareas 88.1 and 88.2 (WG-FSA-11/45 and 11/46), would provide useful information to assist with the continuing development of an assessment for this fishery.

4.27 The Working Group encouraged the participation of a French stock assessment scientist at future meetings.

4.28 The Working Group noted the close scientific cooperation between France and Australia in Divisions 58.5.1 and 58.5.2 and welcomed their proposal seeking to fund two post-doctoral researchers to work on the further development of the assessment for *D. eleginoides* on the Kerguelen Plateau.

D. eleginoides Heard Island (Division 58.5.2)

4.29 A preliminary stock assessment for *D. eleginoides* in Division 58.5.2 was presented in WG-FSA-11/24. The assessment included updated total removals data by sub-fishery and updated catch-at-age and catch-at-length proportions. Random stratified trawl survey abundance-at-age data for 2010 and 2011 (see paragraph 6.9) were included along with those from 2008 and 2009.

4.30 It was noted that the 2011 integrated assessment used a value for M of 0.155 whereas a value of 0.13 was used previously. The consequence of using a higher M in the integrated assessment was a reduction in the estimate of B_0 with a compensatory increase in R_0. Sensitivity tests requested by the Working Group are detailed in paragraph 6.37.

D. mawsoni Ross Sea (Subareas 88.1 and 88.2)

4.31 WG-FSA-11/45 provided an updated characterisation of the Subareas 88.1 and 88.2 toothfish fisheries from 1997 to 2011. This report summarised the timing, depth and location of fishing together with the catch of *Dissostichus* spp. and by-catch species by year. The paper concluded that, from the data examined from the fishery data to date, there is no evidence for substantial changes in population structure or abundance at the regional (subarea) or local (SSRU) level.

4.32 The Working Group agreed that such characterisations of the fishery are very useful in providing a synopsis of the dynamics of the fishery over time. It was noted that other measures, such as changes to fleet composition with respect to gear type over time, would be a useful addition to these characterisations.

4.33 WG-FSA-11/46 provided an update on the descriptive analysis of the toothfish tagging program in Subareas 88.1 and 88.2, including summaries of data for the 2011 season.

4.34 An analysis of the tagging performance of two Korean vessels fishing in Subarea 88.1 during the 2011 season was reported in WG-FSA-11/54. The Working Group noted that tag overlap statistics for both vessels were high and a large increase on previous seasons. A considerable amount of data on toothfish catch rates, length and sex composition, and a characterisation of the by-catch and VMEs was reported. The Working Group noted that such reports were highly valuable and thanked the authors for their contribution.

4.35 WG-FSA-11/48 reported on the development of a method to estimate unaccounted fishing mortality from lost fishing lines in the Ross Sea region and Subarea 88.2 *D. mawsoni* fisheries. Estimates suggest that on average 175–244 tonnes (5.3–7.4% of the 2011/12 recommended catch limit) of *D. mawsoni* may be killed annually due to lost gear in the two areas. Outputs from this analysis were incorporated as sensitivities into model runs of the preliminary assessments carried out for Subareas 88.1 and 88.2.

4.36 The Working Group acknowledged that estimation of fishing mortality due to lost gear was a useful development and should be estimated for other fishery regions and considered for use in other assessment models. The Working Group recommended that the Scientific Committee remind Members of the requirement to complete C2 fields, including zeros if no hooks attached to sections of the main line were lost.

4.37 WG-FSA-11/42 and 11/43 presented updated assessments of toothfish in the Ross Sea (Subarea 88.1) and Subarea 88.2 (SSRUs 882C–G) respectively. The major development in the assessment of Subarea 88.2 since 2009 was the move from an assessment of SSRU 882E (see WG-FSA-11/44) to an assessment of SSRUs 882C–G combined. Other changes were the revised tag-loss rate (WG-SAM-11/18) and inclusion of updated data since 2009.

4.38 The Working Group noted that the assessments of the Ross Sea and SSRUs 882C–G are currently undertaken independently. The Working Group recognised the need to combine these assessments at some stage in the future, on the basis that the hypothetical life history and ocean circulation in this region indicated links between these areas.

Progress on assessments for data poor fisheries

4.39 Dr D. Welsford (Australia) presented WG-FSA-11/35, describing GAMs of catch rate (kg per hook) and mean weight per line of *D. mawsoni* in the exploratory fishery in Divisions 58.4.1 and 58.4.2, using vessel, year, gear type, whether hauls were commercial or research, soak time, depth and location. During the meeting, these models were updated to include other factors, including hook type, line length and bait type. The Working Group noted that such analyses have the potential to assist with standardising catch rates within fished areas, locate areas where research could be focused, and with refining hypotheses regarding population structures across this region.

4.40 It was noted that the catch rate model estimated that standardised catch rates were higher in fished areas between 50° and 100°E than sampled areas elsewhere in Divisions 58.4.1 and 58.4.2, and that mean weights were lowest in the Prydz Bay region, and that these conclusions are consistent with patterns inferred from maps of unstandardised catch rates and toothfish sizes in this region (see also paragraph 3.6).

4.41 The Working Group recalled the advice of WG-SAM in 2008 in reviewing another spatial modelling application using BRTs (SC-CAMLR-XXVII, Annex 7, paragraphs 4.13 to 4.19), and noted, in particular, that the extent to which spatial models can be used to make predictions in locations outside those locations where data exist should be tested using spatial validation (SC-CAMLR-XXVII, paragraph 4.16). The Working Group further noted that the use of fishery-dependent data in spatial modelling may make spatial prediction difficult if the fished areas are not well spread across the range of environmental variation in multivariate space, as represented by the 'environmental overlap statistic' in WG-SAM-08/12.

4.42 The Working Group agreed that comparisons between the estimates and predictions derived from GAMs and other spatial modelling approaches, such as BRTs, may be useful for identifying appropriate methods to develop predictive models of toothfish or by-catch species, e.g. across Divisions 58.4.1 and 58.4.2, and for identification of regions where ground-truthing may be required.

Assessments to be carried out and assessment timetable

4.43 Assessment approaches used to assess fisheries were based on the preliminary assessment submissions, issues identified during the course of WG-FSA and subgroup discussions. The Working Group agreed to undertake updated assessments for the following fisheries:

(i) *D. eleginoides* in Subarea 48.3
(ii) *C. gunnari* in Subarea 48.3
(iii) *D. eleginoides* in Subarea 48.4

(iv) *D. mawsoni* in Subarea 48.4
(v) *D. eleginoides* in Division 58.5.2
(vi) *C. gunnari* in Division 58.5.2
(vii) *D. mawsoni* in Subarea 88.1 and SSRUs 882A–B (Ross Sea management area)
(viii) *D. mawsoni* in Subarea 88.2 and SSRUs 882C–G.

4.44 The Working Group considered the preliminary assessments for the fisheries for *C. gunnari* in Subarea 48.3 (WG-FSA-11/30 Rev. 1) and Division 58.5.2 (WG-FSA-11/22). It was agreed that these assessments would be reviewed during the meeting and the information used to develop the management advice for these fisheries.

4.45 The Working Group considered the preliminary assessments for the fisheries for *Dissostichus* spp. in Subareas 48.3 (WG-FSA-11/33 Rev. 1), 48.4 (WG-FSA-11/31 Rev. 2 and 11/38), 88.1 and 88.2 (WG-FSA-11/42 to 11/44) and Division 58.5.2 (WG-FSA-11/24). It was agreed that these assessments would be reviewed during the meeting and the information used to develop the management advice for these fisheries.

4.46 The Working Group did not update assessments for *D. eleginoides* fisheries in Division 58.5.1, Subarea 58.6 (Crozet) and Subareas 58.7/58.6 (Prince Edward Island). The Working Group discussed the developments towards an assessment for Division 58.5.1 (WG-FSA-11/28), in paragraphs 6.44 to 6.46.

4.47 All assessment work was undertaken by primary authors of preliminary assessments and reviewed independently. The tasks of independent reviewers were to:

(i) validate that the data in the assessment files were the same as the data in the documentation of the assessment in the fishery report

(ii) confirm that the general assessment structure was sensible and did not deviate substantially from that discussed

(iii) confirm that the results of the assessment were accurately documented in the Working Group's report.

4.48 The outcomes of the assessments were reported in the Fishery Reports (Appendices E to R).

RESEARCH PLANS TO INFORM CURRENT OR FUTURE ASSESSMENTS

5.1 The Working Group reviewed three proposals for research fishing under CM 24-01 in closed fisheries or fisheries with zero catch limits:

- in the closed *Dissostichus* spp. fishery in Division 58.4.3b (BANZARE Bank) submitted by Japan (WG-FSA-11/13 Rev. 1)

- in the closed *D. eleginoides* fishery in Divisions 58.4.4a and 58.4.4b submitted by Japan (Ob and Lena Banks) (WG-FSA-11/15 Rev. 1)

- in the closed *Dissostichus* spp. fisheries in Subarea 88.3 submitted by Russia (WG-FSA-11/37).

5.2 The Working Group recalled the principles to be followed when developing CCAMLR-sponsored research (SC-CAMLR-XXVII, paragraphs 8.9 to 8.11). The Working Group further noted that the focus topic at WG-SAM-11 had provided further advice based on these principles to use in evaluating research plans for research in data-poor fisheries, including:

- principles and recommended designs for research in data-poor fisheries (Annex 5, paragraphs 2.25 and 2.40)
- the need for a detailed research plan describing how the principles are to be addressed (Annex 5, paragraph 2.26)
- the need to generate an index of abundance, a stock hypothesis and biological parameters to estimate stock status and apply the CCAMLR decision rules to drive the development of research plans (Annex 5, paragraphs 2.27 to 2.29)
- avoiding reliance on interpreting unstandardised CPUE as an index of stock abundance (Annex 5, paragraph 2.33)
- for proposals aimed at tag-based assessments, the importance of high performance with respect to: (i) the length-frequency overlap between the catch and tagged fish; (ii) a consistent spatial area within which research occurs between years; (iii) consistent timing of the research fishing between years; (iv) minimising the trauma (condition and injury) state of released fish; and (v) minimising loss of tagged fish to depredation (Annex 5, paragraph 2.38).

5.3 The Working Group noted that these three proposals had also been presented at WG-SAM-11, and WG-SAM had provided specific recommendations for revisions to each proposal (Annex 5, paragraphs 5.3 to 5.6).

5.4 The Working Group developed a table (Table 3) summarising its evaluation of to what extent each proposal addressed the general principles for CCAMLR-sponsored research and the advice and specific recommendations provided by WG-SAM. Where changes have been made to the research design arising from discussions in WG-FSA, the evaluation results (denoted by *) refer to the amended design, and changes are described in the text.

Subarea 88.3

5.5 The Working Group noted that the research described in WG-FSA-11/37 focused primarily on the collection of biological data to understand spatial and temporal life-cycle patterns, rather than to produce an index of stock abundance (as recommended in Annex 5, paragraph 2.27). The Working Group further noted that the proposed research catch limit of 65 tonnes is inconsistent with catch rates reported in WG-FSA-11/36 and is unlikely to be caught on the 50 trotline sets proposed in the research design.

5.6 The Working Group concluded that the research described was unlikely to lead to a robust estimate of stock status, and provided recommendations to modify the research proposal. The Working Group recommended that the research be spatially constrained within the area in which toothfish are most abundant and tag recaptures are most likely (i.e. SSRUs 883B–C), and that the research proposal utilise the process outlined in Annex 5, paragraph 2.40, to estimate appropriate research catch levels. The Working Group reiterated the specific advice of Annex 5, paragraph 5.6. It further requested that a modified research proposal should provide the following specific information:

(i) the size-frequency distributions of both the catch and the tagged portion of the catch (i.e. the data underlying the tag overlap statistic) should be shown for the research fishing that has already been completed

(ii) a spatial analysis of local and regional ice conditions is desirable, which could aid in illustrating the extent to which different potential survey areas are likely to be ice-free and available for survey in different years (http://nsidc.org/)

(iii) a description of the proposed otolith sampling and ageing analysis should be included.

5.7 Dr A. Petrov (Russia) provided the following statement:

> 'In our opinion the results of previous surveys and investigations could not show the real situation in the distribution of Antarctic toothfish in Subarea 88.3 because of the difficult ice conditions in this area. This shows the necessity of continuing our investigations and covering the large shelf and continental slope area during the second stage of the Russian survey in Subarea 88.3 in the next season. We hope that the weather and the ice conditions will be favourable for research fishing, and we can investigate the areas which were covered with ice last year. From this research program we could get new data on the age of target species and to carry out planned investigations and other important research activity.
>
> The declared catch of 65 tonnes for scientific research is intended not as a target catch level but to ensure that all 50 trotlines can be set in this area. In this way we will explore a larger area than we explored last year.'

5.8 The Working Group noted that a notification for scientific research under CM 24-01 was received from Russia, proposing to catch up to 10 tonnes of toothfish in SSRU 882A (for which the catch limit is currently zero), but no associated research proposal was received for review by WG-SAM or WG-FSA. The notification states that the purpose of the research is to collect biological and spatial distribution information. The Working Group noted that toothfish in SSRU 882A are part of the currently assessed Ross Sea stock. The research notification does not include an indication of how data collected in the research will be analysed and used to inform the management of the Ross Sea fishery. The Working Group also noted that the results of the previous years' research fishing in the same SSRU have not been submitted for review by the CCAMLR scientific working groups. The results of a two-year program of Russian investigations will be presented at the next WG-FSA meeting.

Ob and Lena Banks

5.9 WG-FSA-11/14 and 11/15 Rev. 1 described research conducted in the 2011 season in Divisions 58.4.4a and 58.4.4b (Ob and Lena Banks) and a proposal to continue the survey in 2012. The Working Group agreed that the purpose and design of the proposed research were consistent with the advice of WG-SAM for data-poor fisheries and that the research was likely to achieve its aims, subject to the adoption of changes recommended by the Working Group, below. The following recommendations refer directly to the advice of WG-SAM for data-poor fisheries in particular paragraphs, as summarised in Table 3.

5.10 With respect to Annex 5, paragraph 2.27(iii), the Working Group recommended that GSI (i.e. gonad weight in proportion to total weight) be recorded for biologically sampled fish, in addition to gonad stage. The Working Group further recommended that otolith collection and ageing work continue in this area.

5.11 With respect to five performance metrics for tag-based research identified in Annex 5, paragraph 2.38, the Working Group:

(i) noted the high tag overlap statistic achieved by the research in 2011

(ii) endorsed the spatial design of the proposed research, noting consistency between years to achieve maximum likelihood of tag recaptures

(iii) noted that the survey has in past years occurred at different times of year, and recommended seasonal consistency in future, if possible

(iv) discussed fish condition and injury status (see below) and agreed that supplemental data presented by Japanese researchers indicate that the proposed research is likely to capture sufficient numbers of fish suitable for tagging to achieve the requirements of the proposed tagging program

(v) expressed concern about the level of killer whale depredation observed by the research vessel, but noted that proposed mitigation measures to be employed by the *Shinsei Maru No. 3* were likely to be effective to ensure sufficient numbers of fish survive to achieve the requirements of the proposed tagging program.

Suitability of fish to be tagged

5.12 The Working Group noted that the use of the term 'condition' as an indicator of the suitability for tagging may be confused with the relationship between fish length and weight. The Working Group agreed that the terms 'condition', 'injury' and 'trauma' all refer to factors that affect the suitability of a fish to be tagged. The aim of tagging fish in 'good condition' as required under CM 41-01, paragraph 2(ii), is to release tagged fish that have a high probability of survival and are therefore suitable for tagging. The Working Group recommended that the terminology in CM 41-01, paragraph 2(ii), be modified this year to refer to tagging fish with a high probability of survival.

5.13 The Working Group further recommended that the best practices for evaluating the suitability of a fish for tagging be developed intersessionally and terminology be clarified.

5.14 In response to concerns by the Working Group about the rate of multiple-hooking injuries and the general poor condition of toothfish caught on trotlines (see below), Dr K. Taki (Japan) provided supplemental information regarding the condition status of fish captured and tagged in the research on Ob and Lena Banks using a set of prescribed criteria (WG-FSA-11/15 Rev. 1). These data showed that only 11.7% of the trotline-caught fish on Ob and Lena Banks were in good condition and hooked by only one hook, hence suitable for tagging under the recommended updated tagging requirements (below); nonetheless, 77% of the tagged and released fish were in this category. These numbers reflect a deliberate effort by the on-board Japanese researchers to assess the condition and injury status of each fish and to select only the best fish for tagging, paying close attention also to the requirements of the tag overlap statistic. Dr Taki noted that the on-board scientists monitor the tag overlap statistic in real time during the research and notify crew of what size classes are required for tagging to achieve a high overlap statistic; this is necessary because random tagging using the 'pre-select method' (as in WG-FSA-11/50) is clearly not possible when a high proportion of fish are not suitable for tagging. The effort to tag appropriately was also aided by the simultaneous availability of Spanish-line-caught fish from the experimental mixed-gear sets, of which a much greater proportion were suitable for tagging.

5.15 Figure 1 reveals that in order to achieve representative tagging rates in all size classes it was necessary for the *Shinsei Maru No. 3* on Ob and Lena Banks to tag and release some fish with multiple hook wounds, and in some instances to release fish in poor condition, because there were insufficient numbers of large fish available from trotlines that were only single-hooked and in good condition. The Working Group noted the vessels' dedication to achieving a high tag overlap statistic but recommended that in future only single-hooked fish in good condition should be tagged and released. If for particular gear types there are insufficient numbers of fish suitable for tagging in all size classes to achieve a high tag overlap statistic, then tag-based research will require increased use of gear types for which multiple-hooking injury rates are lower (e.g. autoline or Spanish line).

5.16 The Working Group noted that the paired deployment of mixed Spanish line and trotline sets described in WG-FSA-11/13 Rev. 1 and 11/14 provides valuable information and recommended that it should be continued.

Depredation

5.17 In tag-based research for which CPUE is not used as an index of abundance, the reduction in catch from depredation reduces the quantity but not the quality of available data (i.e. by reducing scan rates and numbers of recaptures); of greater concern is that predation by whales of newly tagged and released fish can bias subsequent tag-based assessment methods such as Petersen biomass estimates. Japanese researchers clarified that the *Shinsei Maru No. 3* actively avoided killer whales to the extent practical (i.e. tying off lines and switching between SSRUs when whales first appeared). In addition, they use a holding tank on board the vessel to retain tagged toothfish until no killer whales are present.

5.18 The Working Group noted that there appears to be a seasonal pattern of occurrence for killer whales in some parts of the CCAMLR area, and recommended that the Japanese researchers re-examine available data from previous seasons in Divisions 58.4.4a and 58.4.4b to see if it may be possible to minimise depredation risk by conducting the research at times of the year when killer whales are least likely to be present.

Preliminary estimate of plausible biomass

5.19 The Working Group used 2010/11 tag recaptures to generate Petersen biomass estimates for Divisions 58.4.4a and 58.4.4b. The Working Group noted that to date all four tags recaptured in 2011 were from SSRU C, but that the approximation that all released tags had an equal probability of recapture was valid because the spatial distribution of effort has been consistent between years. The number of recaptured tagged fish in Divisions 58.4.4a and 58.4.4b is much lower than the number of released tagged fish. Consequently, the number of tags available for recapture for a given year of release was approximated as:

$$n1^* = n1\ (1 - t)\ (e^{-\lambda^* Y})\ (e^{-M^* Y})$$

where:

$n1^*$ = tags available for recapture
$n1$ = number of tagged and released fish
t = post-tagging mortality rate = 0.2
λ = annual tag loss rate approximation = 0.0084
M = natural mortality = 0.13
Y = years at liberty between the tag release and tag recapture.

5.20 The Working Group assumed a higher post-tagging mortality rate (0.2 instead of 0.1) to reflect the fact that some fish released in previous years (e.g. 23% of released fish in 2010/11) were multiple-hooked or in poor condition (Table 4).

Target CVs for tag-based biomass estimates

5.21 The cumulative Petersen biomass estimate of 1 928 tonnes (i.e. using all four tag recaptures from the pooled total of available tags) was used to estimate CVs for future Petersen biomass estimates as a function of future catches and tagging rates (as in Annex 5, Figure 3) as shown below in Figure 2. The non-zero intercepts on the y-axis reflect that there are an estimated 314 previously tagged fish already available for recapture in 2011/12. Figure 2 indicates that CVs of 20% may be achieved within two years with an annual research catch of 45 tonnes, or within three years with an annual research catch of 39 tonnes.

Precautionary research catch limit

5.22 The Working Group recalled the GYM scenarios run in 2010 in WG-FSA (SC-CAMLR-XXIX, Annex 8, paragraph 5.117), which estimated the likely trajectory of a *D. eleginoides* stock that had been (i) at a median SSB of 20% SSB_0 in 2006 (when the fishery in Ob and Lena Banks was closed), or (ii) was at a median SSB of 20% in 2009. These scenarios were rerun (including the catch of 35.4 tonnes taken in the most recent survey by the *Shinsei Maru No. 3*) to estimate current status and corresponding constant catch rates under which the stock is expected to recover to 50% B_0 within two decades from the date of the fishery closure (as in WG-FSA-10/42). Under the first scenario, the median current status was estimated to be 36.5% SSB_0 in 2010; the corresponding precautionary research catch is 1.25% B_0, or 115 tonnes per year. Under the second scenario the median status was estimated to be 23% SSB_0 in 2010; the corresponding precautionary research catch is 0.074% B_0, or 58 tonnes per year. The actual current status of the stock is unknown, but these scenarios are thought to be conservative. On this basis, the Working Group advised that research catches up to 115 tonnes per year could be appropriate for this stock.

5.23 The Working Group noted that there was value in maintaining a consistent survey design over time, and recommended that that the survey be effort-limited in 2012, using the spatial design and level of research effort proposed in WG-FSA-11/15 Rev. 1 (i.e. 71 sets in an allocated spatial grid including SSRUs B–C). The Working Group endorsed the proposal to deploy at least 14 mixed Spanish line/trotline sets, to provide an increased number of single-hooked fish in good condition suitable for tagging, and to continue to provide data to examine the effects of different gear types on fish condition and gear selectivity. The Working Group noted that in 2011 using an identical survey design the catch was 35.4 tonnes, and it is unlikely that catch rates in 2012 will be more than double the observed catch rates in 2011. The Working Group recommended that the research proceed subject to the advice in paragraphs 5.10 to 5.18 with a catch limit of 70 tonnes for this research, noting that actual catches are expected to be lower.

Division 58.4.3b (BANZARE Bank)

5.24 WG-FSA-11/13 Rev. 1 described research conducted in 2010/11 in Division 58.4.3b and a proposal to continue the survey in 2011/12. The Working Group agreed that the purpose of the proposed research was consistent with the advice of WG-SAM for data-poor fisheries and recommended changes to the research design (detailed below). The following recommendations refer directly to the advice of WG-SAM for data-poor fisheries in particular paragraphs, as summarised in Table 3. Information on this fishery is summarised in Appendix Q.

5.25 With respect to five performance metrics for tag-based research identified in Annex 5, paragraph 2.38, the Working Group:

(i) noted the high tag overlap statistic achieved by the research in 2010/11

(ii) proposed an amended spatial sampling design to cover a wider area and increase the probability of tag recaptures (see below)

(iii) encouraged seasonal consistency between survey years

(iv) expressed concern about the condition and injury status of tagged and released fish (see below) and recommended changes to the survey design to increase the proportion of fish caught that are suitable for tagging

(v) noted that depredation on BANZARE Bank has not been a problem in the past but recommended continued monitoring and reporting of predators in the vicinity of the research vessel.

Spatial design

5.26 The Working Group noted that the spatial extent of the survey completed by the *Shinsei Maru No. 3* in 2011 was only one quarter of what was intended to be a larger multi-vessel survey. The Working Group agreed that in the absence of participation by other vessels, and relying on a tag-recapture experimental design as recommended by WG-SAM-11, a modified spatial survey design would be more appropriate to increase the probability of tag recaptures under expected levels of toothfish movement in 2–3 years (i.e. 19–24 n miles; see WG-FSA-11/46). The agreed design is shown in Figure 3.

Suitability of fish to be tagged

5.27 Dr Taki presented supplemental information (Figure 4) revealing that only 2.9% of the trotline-caught *D. mawsoni* on BANZARE Bank were single-hooked and in good condition, hence suitable for tagging under the updated tagging recommendations. Only 31% of *Dissostichus* spp. actually tagged in 2010/11 were single-hooked and in good condition; the Working Group recommended that any analysis of future recaptures of these fish should consider their trauma status at the time of release, and that future Petersen biomass estimates may need to assume a high post-tagging mortality in the estimate of tag numbers available for recapture. On this basis, the Working Group judged that the original proposed survey design in WG-FSA-11/15 Rev. 1 (i.e. 5 mixed-line sets and 19 trotline-only sets) was unlikely to capture enough single-hooked fish in good condition to enable achievement of the proposed tagging rate of five fish per tonne with a high tag overlap statistic.

5.28 The Working Group noted that the higher proportion of multiple-hooked and poor-condition fish on BANZARE Bank relative to Ob and Lena Banks is apparently a consequence of the larger fish size; the data indicate that large fish caught on trotlines suffer multiple hook wounds more often than do small fish. The Working Group agreed that the primary requirement of tag-based research in data-poor fisheries is to achieve high performance with respect to the tagging performance metrics identified in Annex 5, paragraph 2.38. Tagging and releasing injured fish or fish in poor condition will increase the post-tagging mortality of released fish by an unknown amount, undermining the ability to interpret subsequent tag-recapture rates to estimate stock status. The Working Group noted the advice of WG-SAM (Annex 5, paragraph 2.12) that high levels of post-tagging mortality of released fish may account for the failure to develop stock assessments in some exploratory fisheries despite large numbers of tag releases over many years. On this basis it may be that some fishing gears are incompatible with the requirements of tag-based research in some areas.

5.29 The Working Group recommended that Members undertaking tag-based research in data-poor fisheries under CM 24-01 be required to evaluate and report the effects of their fishing gear on fish condition and injury status, as in WG-FSA-11/13 Rev. 1 and 11/14 and Figures 1 and 4, and modify their research design and/or choice of fishing gear configuration accordingly to ensure that the requirements of an effective tagging program are met. Where particular gear types are incapable of capturing sufficient fish suitable for tagging, alternate sampling tools should be used.

Recommended gear configuration

5.30 In the research on BANZARE Bank, the Working Group recommended that a higher proportion of mixed Spanish line/trotline be deployed to capture higher numbers of single-hooked fish suitable for tagging on the Spanish line segments. The Working Group noted the particular trotline gear configuration utilised by the *Shinsei Maru No. 3*, in which each dropline includes five hook bundles spaced 40 cm apart, each comprised of five hooks with 50 cm snoods (Figure 5). The Working Group recommended that the research on BANZARE Bank use one or more modified trotline gear configurations to achieve lower rates of multiple-hooking injury. The following changes to the gear configuration shown in Figure 5 were suggested: (i) eliminate alternate bundles on each dropline, yielding three bundles, spaced 80 cm apart, with five hooks each; and (ii) retain the existing number and spacing of the bundles but reduce each bundle from five hooks to three hooks. Deployment of mixed lines containing segments of both of the alternate trotline configurations, and/or segments of a single modified trotline configuration mixed with Spanish line segments, can be expected to provide data to evaluate fish trauma and condition as affected by gear type, as well as gear type selectivity.

5.31 The Working Group emphasised that the primary objective of the research is to achieve the requirements of the tagging program, as follows: (i) five tagged fish per tonne; (ii) a high tag overlap statistic; and (iii) only single-hooked fish in good condition are tagged and released. So long as tagging performance is monitored on a continual basis during the survey, the proportional deployment of alternate gear configurations can be adjusted as required. If the vessel is not capturing sufficient numbers of single-hooked fish in good condition to meet the tagging requirements, then the number of sets including Spanish line segments should be increased until the tagging requirements are met. So long as the tagging requirements are being met, then the number of (modified) trotline-only sets may be increased.

5.32 The Working Group recommended that a detailed analysis of the distribution of tags, the effect of different gear types on trauma and condition and tagging rates across the survey area be provided by Japan at next year's meeting.

Preliminary estimate of biomass

5.33 Because Petersen biomass estimates from tag recaptures are not available for this area, the Working Group estimated initial biomass using the CPUE * seabed area comparison as recommended by Annex 5, paragraph 2.40(ii), using the formula $B_x = (I_x\ A_x\ B_R) / (I_R\ A_R)$ where B = current biomass in tonnes, A = fishable seabed area (600–1 800 m) in km^2, and I = CPUE (tonnes of catch per km of longline, all gear types) for the target stock X and an assessed reference stock R respectively. The target stock area A_x was defined as the fishable depths in Division 58.4.3b SSRUs A, C and E, which contain a topographically continuous feature with roughly uniform CPUEs (SSRUs B and D contain a topographically separate feature with contrasting CPUE, and may contain a distinct stock unit). SSRU 882E was selected as a reference area; B_R = 8 300 tonnes (see WG-FSA-11/44).

$I_x = 0.0841$ tonnes/km; $I_R = 0.1638$ tonnes/km; $A_x = 90\,588$ km^2; $A_R = 28\,392$ km^2.

Applying the formula above, the preliminary estimate of target stock biomass is 13 592 tonnes.

Precautionary research catch limit

5.34 The Working Group noted that preliminary biomass estimates based on CPUE and seabed area are highly uncertain, and recalled the advice in Annex 5, paragraph 2.40(iv), to apply a discount factor in estimating precautionary research catch limits. The Working Group adopted the discount factor used by WG-FSA in 1998 for the Ross Sea, i.e. 0.30 for *D. mawsoni* (SC-CAMLR-XXVII, Annex 5, paragraphs 4.58, 4.67 and 4.68) for a precautionary adjusted biomass of 4 078 tonnes. Applying a precautionary exploitation rate of 0.01 (consistent with assuming that the current status of this potentially depleted stock is 30% B_0 under the GYM application described in WG-FSA-10/42 Rev. 1) results in a precautionary research catch limit of 41 tonnes. The actual status of the stock is unknown, but these assumptions are thought to be precautionary.

5.35 The Working Group noted that models that could be used to develop a robust assessment based on the data collected from the proposed survey on BANZARE Bank have not been developed. It recommended that such models be developed as a priority, and that they should account for the existing hypotheses regarding the relationship between the populations of *D. mawsoni* in Divisions 58.4.1, 58.4.2 and 58.4.3b, and the IUU and exploratory fishing that has occurred in those areas.

5.36 The Working Group recommended that the proposed research using the *Shinsei Maru No. 3* on BANZARE Bank proceed in 2012, limited to 48 sets in locations shown in Figure 3, with a catch limit of 40 tonnes, subject to the recommendations in paragraphs 5.27 to 5.32 above.

Advice for tag-based research in other areas

5.37 The Working Group evaluated WG-FSA-11/13 Rev. 1 and 11/14, describing research carried out in 2010/11 by the *Shinsei Maru No. 3* on BANZARE and Ob and Lena Banks respectively, and developed advice to inform the design of effective tag-based research programs more generally. The research described in these papers included deployment of sets containing both Spanish line and trotline sections on the same lines, enabling comparison of the condition/injury status of toothfish caught using these different methods, and their suitability for tagging. The Working Group thanked Japan for providing additional information regarding rates of multiple-hooking injuries on trotline-caught toothfish, as requested by WG-SAM-11. The Working Group noted that determining which fish are of a suitable physical and physiological state for tagging is an important component of a successful tagging program (Annex 5, paragraph 2.38), and that the data collected by Japan in this research effort will contribute to developing that guidance.

5.38 The Working Group recommended that the tagging requirements in CM 41-01, Annex C, be updated to require that only *single-hooked fish with a high probability of survival* be tagged and released. It also recommended operational guidance for tagging programs be developed to achieve CCAMLR's objectives in the intersessional period (paragraph 6.89).

5.39 The Working Group noted that there are differences between trotline gear configurations utilised by different vessels, and that some of these differences, for example, numbers of hooks per bundle, bundle spacing or snood length, are likely to substantially influence the rate of multiple-hooking injury and the corresponding suitability of fish for tag and release. It is important, therefore, to distinguish between different trotline configurations when evaluating the suitability for tagging of fish caught using different gear types. The Working Group encouraged Members using trotline gear to provide detailed descriptions of their gear configuration and setting and hauling procedures (e.g. Figure 5, or see WG-FSA-11/53 for Spanish longlines) to enable informed discussion of the likely effects of different fishing gears, consistent with the advice of the Scientific Committee in 2010 to have all gear types described in the CCAMLR gear library (SC-CAMLR-XXIX, Annex 8, paragraphs 9.19 and 9.20).

5.40 The Working Group noted that detailed description of fishing gears used are essential in understanding how target and by-catch species interact with the fishing gear and enhance the selection of the most appropriate gear for the experimental design of the research.

5.41 The Working Group requested that all vessels participating in data-poor exploratory fisheries provide detailed information from all research hauls to assess the suitability for tagging of fish caught using different gear types, similar to the information provided to WG-FSA-11 by the *Shinsei Maru No. 3* (e.g. Figures 2 and 4).

5.42 The Working Group recommended that depredation avoidance and mitigation practices be developed as much as possible into clearly defined protocols, and that the use of a holding tank to retain tagged fish until predators are absent be considered on board vessels undertaking tag-based research in areas where depredation is known to occur.

5.43 The Working Group further requested that Members conducting tag-based research under CM 24-01 collect and present data indicative of predator prevalence and abundance and associated depredation levels.

Research in fisheries with assessments

5.44 WG-FSA-11/47 described a proposed survey to monitor the relative abundance of pre-recruit *D. mawsoni* in the Ross Sea. The Working Group noted that this research is not proposed in a data-poor area, so its purpose is not to provide information to achieve an estimate of stock status, but rather to provide information to improve the management of a stock for which a robust stock assessment already exists (SC-CAMLR-XXIX, paragraph 3.129). Some of the advice of the focus topic on data-poor fisheries may not be applicable to CCAMLR-sponsored research proposals in fisheries with assessments. However, the Working Group agreed that much of the advice of WG-SAM to guide research design in data-poor fisheries (e.g. as in Table 3) is also relevant to the design of this survey, and that the research described in WG-FSA-11/47 was in all relevant categories consistent with the advice of WG-SAM-11. The Working Group also noted that the proposal had incorporated the specific recommendations of WG-SAM-11 (Annex 5, paragraph 3.14).

5.45 The Working Group noted that this research was requested by the Scientific Committee (SC-CAMLR-XXIX, paragraph 3.185), and agreed with the conclusions of WG-SAM-11 that the proposed survey design is likely to achieve its objectives. On this basis WG-FSA endorsed the research design proposed in WG-FSA-11/47, and recommended annual reporting and review of interim research results by WG-FSA, as recommended by WG-SAM-11.

ASSESSMENTS AND MANAGEMENT ADVICE

Fisheries with assessments

C. gunnari South Georgia (Subarea 48.3)

6.1 The fishery report for *C. gunnari* at South Georgia (Subarea 48.3) is contained in Appendix E.

6.2 In 2010/11, the catch limit set for *C. gunnari* in Subarea 48.3 was 2 305 tonnes. Limited commercial fishing was conducted by one vessel in February and one vessel in September/October 2011 but with zero catches. A total catch of 10 tonnes was reported from the research survey.

6.3 In January/February 2011, the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-11/29; see also paragraphs 4.6 and 4.7).

6.4 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-11/30 Rev. 1.

6.5 The growth parameters were those used by CCAMLR in previous years (SC-CAMLR-XXVI, Annex 5, Appendix O, Table 5). The length–weight parameters were, however, updated according to the 2011 survey results (WG-FSA-11/29).

Management advice

6.6 The Working Group recommended that the catch limit for *C. gunnari* should be set at 3 072 tonnes in 2011/12 and 2 933 tonnes in 2012/13 based on the outcome of the short-term assessment.

C. gunnari Heard Islands (Division 58.5.2)

6.7 The fishery report for *C. gunnari* in Division 58.5.2 is contained in Appendix F.

6.8 The catch limit of *C. gunnari* in Division 58.5.2 for the 2010/11 season was 78 tonnes and the catch reported for this division as of 9 October was 1 tonne.

6.9 The results of three bottom trawl surveys undertaken between April 2010 and May 2011 were summarised in WG-FSA-11/24 (see also paragraphs 4.29 and 4.30). The Working Group noted that the 2008 to 2011 Australian bottom trawl surveys had sampled a large cohort, which dominated the population structure in 2010 as the 4+ year class, but this appears to have declined rapidly over the past year. A new 1+ and 2+ cohort was also detected. Unusually for this stock, four or five consecutive year classes are present in the population simultaneously.

6.10 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass of 983 tonnes from the 2011 survey and using the revised growth parameters described in WG-FSA-10/12. Other fixed parameters remained unchanged from previous assessments.

6.11 The projection of fish of 1+ to 3+ age classes from 2010/11 gives a projected yield of 101 tonnes in 2011/12 and 82 tonnes in 2012/13.

6.12 The Working Group noted a proposal by Australia to introduce a limit reference point in the *C. gunnari* fishery in Division 58.5.2 (WG-FSA-11/34). As the assessment for catch in 2011/12 indicated a lower one-sided 95% of biomass less than 1 000 tonnes, it was recommended that the limit reference point be applied pending the results of a planned survey in 2012.

Management advice

6.13 The Working Group recommended that the Scientific Committee consider a catch limit for *C. gunnari* in 2011/12 of 0 tonnes, with a 30 tonne research and by-catch limit.

D. eleginoides South Georgia (Subarea 48.3)

6.14 The fishery report for *D. eleginoides* in Subarea 48.3 is contained in Appendix G. The catch limit for *D. eleginoides* in 2010/11 was 3 000 tonnes, and the recorded catch was 1 788 tonnes.

6.15 Two CASAL assessment models were presented in WG-FSA-11/33 Rev. 1: a two-fleet model, with an initial fleet 1985–1997 and a new fleet 1998–2011; and a three-fleet model, with an initial fleet 1985–1997, an intermediate fleet 1998–2003, and a new fleet 2004–2011.

6.16 The Working Group expressed concern that the tagging datasets used in the two- and three-fleet models were inconsistent, with no rationale presented in WG-FSA-11/33 Rev. 1

for the removal of 2003 and 2004 tag-releases and associated recaptures for the three-fleet model. To address these concerns, an MPD run for the three-fleet model was presented to the Working Group using the tagging dataset from the two-fleet model. The results confirmed that the removal of the 2003 and 2004 tag-releases and associated recaptures in the three-fleet model had a negligible effect on model output for the three-fleet model structure.

6.17 The Working Group recommended that in the future any removal of historic data be accompanied with an explicit justification of why the data should be removed, along with presentation of analyses of the impact on the change in data on model estimates.

6.18 Analysis of the depth distribution of effort by year in the fishery was presented to the Working Group. This analysis identified a gradual shift in effort to deeper waters with time which does not support the higher selectivity of younger fish in recent years estimated by the three-fleet model. Consequently, the Working Group agreed that the assessment model should be based on the two-fleet model presented in WG-FSA-11/33 Rev. 1.

6.19 Likelihood profiles for the two-fleet model (Appendix G, Figure 13) demonstrated that catch-at-length data from the early fleet and the survey abundance index were relatively uninformative. The tagging dataset as a whole was most informative on SSB_0. Adequate fits were achieved, with improvements in model fits to tag-recapture and catch-at-age observations compared to the 2009 assessment model (SC-CAMLR-XXVIII, Annex 5, Appendix L).

6.20 Historical catch-weighted survey densities from the Subarea 48.3 groundfish survey and plots of commercial proportions-at-age were also presented to the Working Group as requested. Both datasets indicate that the 2001 cohort was likely to have been strong, although uncertainty around the relative strength of the 2001 cohort persists. In addition, data from the 2010 and 2011 surveys indicate a potentially strong 2007 cohort.

6.21 The yield satisfying the CCAMLR decision rules is 3 200 tonnes, using future recruitment with lognormally distributed YCS with a mean equal to the long-term average YCS estimate and a CV of 0.6 based on YCS estimates from 1985 to 2003. WG-FSA-11/33 Rev. 1 noted that CASAL model estimates of recent YCS are lower than the long-term average, with the exception of 2001. Consequently, WG-FSA-11/33 Rev. 1 suggested that a catch limit of 3 200 tonnes would not be appropriate at this time. Instead, projections were undertaken using recruitment with empirical lognormally distributed YCS with a mean and CV set using a truncated range of YCS estimates from the CASAL model.

6.22 The Working Group agreed that YCS from 1991 to 2003 would provide an appropriate mean and CV of YCS for this purpose, which includes mostly below-average YCS, although with some strong cohorts. This resulted in a yield of 2 600 tonnes that satisfies the CCAMLR decision rules, using the CASAL model's estimate of SSB_0 in the decision rule.

6.23 With regard to future developmental work for the stock assessment model used for this stock, the Working Group noted the importance of the assumptions of fleet structure on estimates of YCS, and the effects of this on long-term yield estimates. Consequently, the Working Group recommended further examination of historical changes in fleet selectivity to be completed intersessionally.

Management advice

6.24 The Working Group noted the advice of WG-IMAF that the 2011/12 season for longline fishing operations may be extended in two periods: (i) to start on 16 April and (ii) to end on 14 September for any vessel which has demonstrated full compliance with CM 25-02 in the previous season (Annex 8, paragraph 8.11).

6.25 The Working Group recommended a catch limit of 2 600 tonnes for 2011/12 and 2012/13.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

6.26 The Fishery Report for *Dissostichus* spp. South Sandwich Islands (Subarea 48.4) is contained in Appendix H.

6.27 A tagging experiment has been conducted in Subarea 48.4 North over the last six years. This experiment was extended to Subarea 48.4 South in 2008/09.

6.28 The catch limits for *D. eleginoides* and *D. mawsoni* in Subarea 48.4 North in 2010/11 were 40 tonnes and 0 tonnes (except for scientific purposes) respectively, with recorded catches of 36 tonnes and 1 tonne respectively. The catch limit for *Dissostichus* spp. in Subarea 48.4 South in 2010/11 was 30 tonnes, with a recorded catch of 17 tonnes.

6.29 The Working Group noted that an integrated assessment model for *D. eleginoides* in Subarea 48.4 North incorporating both catch-at-age and catch-at-length data would incorporate more observations from the fishery, compared to the models presented in WG-FSA-11/38. The yield satisfying the CCAMLR decision rule using projections with randomised lognormal YCS with a mean of the long-term average of the stock and a CV of 1 was 48 tonnes.

6.30 A three-year tagging experiment was completed in 2010/11 in Subarea 48.4 South. No full assessment is currently available. Due to reduced catches and low tag returns realised in the last year of the experiment, the UK proposed to extend the tagging experiment for a fourth year in Subarea 48.4 South in 2011/12, carrying forward the original proposal objectives from 2009 as detailed in WG-FSA-09/18. The proposed tagging experiment has the objective of providing the data required for assessments of the population structure, size, movement and growth of both *D. eleginoides* and *D. mawsoni* in Subarea of 48.4 South. It also provides an opportunity to investigate the degree of mixing of *D. eleginoides* populations between the north and south and, therefore, validate the stock assessment of this species in the northern area.

6.31 The Working Group discussed the proposal and noted that detailed discussion and a review of the research had been undertaken when this research was first proposed. The proposal to extend the research for a further year was discussed in reference to the new research criteria as proposed in WG-SAM (Annex 5, paragraphs 2.48 and 2.49), and the Working Group was satisfied that the research met all the relevant criteria. It was recommended that all the conservation measures related to this fishery be carried over into 2011/12.

6.32 Petersen estimates from tag recaptures to date suggest a vulnerable population of approximately 600 tonnes for *D. mawsoni*. Limited tag recaptures of *D. eleginoides* suggest a vulnerable biomass in the region of 150 to 350 tonnes. This is consistent with the estimate made in 2010 (SC-CAMLR-XXIX, Annex 8). Application of γ from the most recent Subarea 48.3 assessment (0.038) to the current estimates of vulnerable biomass results in a yield estimate of 33 tonnes.

Management advice

6.33 The Working Group recommended the following limits for toothfish and by-catch in Subarea 48.4:

Subarea 48.4 North –

(i) a catch limit of 48 tonnes for *D. eleginoides*

(ii) the continued prohibition of the taking of *D. mawsoni* other than for scientific research purposes

(iii) maintenance of catch limits for by-catch species, with a limit for macrourids of 7.5 tonnes (16% of the catch limit for *D. eleginoides*) and a limit for rajids of 2.5 tonnes (5% of the catch limit for *D. eleginoides*).

Subarea 48.4 South –

(i) a catch limit of 33 tonnes for *Dissostichus* spp. (*D. eleginoides* and *D. mawsoni* combined)

(ii) maintenance of a move-on rule for by-catch species, with a macrourid trigger of 150 kg and 16% of the catch of *Dissostichus* spp., and a trigger for rajids set at 5% of the catch of *Dissostichus* spp.

D. eleginoides Heard Island (Division 58.5.2)

6.34 The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Appendix I.

6.35 The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E was 2 550 tonnes (CM 41-08) for 2009/10 and 2010/11. The catch of *D. eleginoides* reported for this division for 2009/10 was 2 459 tonnes. The catch of *D. eleginoides* reported for 2010/11 up to 10 October was 1 676 tonnes. Of this, 1 122 tonnes was taken by longline, 521 tonnes by trawl and 33 tonnes by pot.

6.36 A preliminary stock assessment was presented in WG-FSA-11/24. Catch-at-length proportions for the commercial fisheries, both trawl and longline, were used for 2009 to 2011 since there were few fish aged for these years. The total number of aged otoliths used to construct age–length keys was 10 230. The total number of length-frequency samples applied to the age–length keys over all sub-fisheries, surveys and years was 350 064. A revised value of M of 0.155 was used in the current assessment, whereas a value of 0.13 was used previously. The value of 0.155 was estimated externally to CASAL from catch-at-age and aged mark-recapture data as described in Candy et al. (2011).

6.37 The Working Group suggested a number of sensitivity CASAL runs be carried out in addition to the model run presented in the preliminary assessment (WG-FSA-11/24). These runs are given in Table 5. The preliminary assessment model is denoted a2-2011-alkpool-PE described in WG-FSA-11/24. Discussions focused on the consequence of (1) applying the higher value of M and (2) removing the ageing error matrix (AEM) (i.e. assuming no ageing error). The results of the five sensitivity runs, shown in Table 5, are as follows:

(i) The effect of (1) is seen most clearly by comparing results in Table 5 for models a2-2011-alkpool-noPE and a2-2011-alkpool-noPE-M13. Model a2-2011-alkpool-noPE uses an M of 0.155, but differs from a2-2011-alkpool-PE by not down-weighting commercial catch-at-age data for process error.

(ii) Model a2-2011-alkpool-PE-M13 is the same as a2-2011-alkpool-PE but applies an M of 0.13. The fit to the data of the former model is substantially worse and gives an estimate of B_0 that is unrealistically high (Table 5).

(iii) The effect of (2) was greatest on the coefficient of variation of recruitment (CV_R) which was reduced from 0.78 to 0.24.

6.38 The Working Group noted the high degree of variation prior to 1996 in estimated YCS in the model presented in WG-FSA-11/24. Removing the AEM reduced this variation. However, it was agreed that the AEM was well estimated and ageing error should continue to be included.

6.39 To investigate the effect of dropping the AEM on long-term yield, projections were run using model a2-2011-alkpool-PE-NoAEM and it was found that the escapement decision rule, which was the trigger for both models, gave a long-term yield that was close to identical for each model. It was suggested that consideration should be given in future versions of CASAL of allowing YCS parameters to be estimated as random effect parameters and to allow estimation of an autocorrelation covariance structure between these parameters.

6.40 The preliminary stock assessment described in WG-FSA-11/24 was considered suitable to provide advice on long-term yield. The estimated current stock status in 2011 was 63% of B_0. The long-term annual yield that meets the decision rules was calculated to be 2 730 tonnes.

6.41 The Working Group noted the program of future work, including plans to:

(i) continue regular surveys across Division 58.5.2

(ii) re-estimate the von Bertalanffy growth function using the additional length–age data obtained from 2008 to 2011

(iii) investigate simplification of the spatial structuring of fishing selectivity functions

(iv) investigate whether the model could be developed as a two-sex model

(v) investigate improvements in the model structure that can be made to allow the inclusion of tagging data to assist the estimation of parameters in the model using CASAL; in order to provide some confidence that significant progress in understanding key uncertainties that occur in this division, common to all toothfish assessments, can be made before it is forecast that stock trajectory of SSB reaches the target level.

Management advice

6.42 The Working Group recommended that the catch limit for *D. eleginoides* in Division 58.5.2 west of 79°20'E should be 2 730 tonnes for 2011/12 and 2012/13.

D. eleginoides Kerguelen Islands (Division 58.5.1)

6.43 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Appendix J. The catch of *D. eleginoides* reported for this division to October 2011 was 2 906 tonnes.

6.44 The Working Group noted that the data files used to produce the assessment results reported in WG-FSA-11/28 required zero catches in 2011 for several fisheries in order to produce the reported B_0 of 200 722 tonnes. When catches in all fisheries up to 2011 were included in the data, the estimate of B_0 hit the upper bound of 205 000 tonnes and produced errors when the boundaries for the estimate of B_0 were widened. As a result, the model as it is currently configured could not be used for management advice. The Working Group agreed that a model that uses all the data through the current year for all fisheries and also avoids parameter estimates at the estimation boundaries is required to assess these fisheries.

6.45 The Working Group further requested that more complete documentation of the data sources used in the assessment be reported, and that a description of the historical development of the fishery be provided (paragraph 4.26).

6.46 The Working Group agreed that this assessment could benefit from an otolith ageing program. The main priority would be to estimate a growth curve for Division 58.5.1 as well as to estimate proportion-at-age for the two POKER surveys. It would also be very useful to determine proportion-at-age for catches from the longline fishery.

Management advice

6.47 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 outside areas of national jurisdiction for *D. eleginoides*, described in CM 32-13, remain in force.

Dissostichus eleginoides Crozet Islands (Subarea 58.6)

6.48 The Fishery Report for *D. eleginoides* in Subarea 58.6 (French EEZ) is contained in Appendix K.

6.49 The catch of *D. eleginoides* reported for this subarea to October 2011 was 551 tonnes. Only longlining is currently permitted in the fishery. IUU catch for 2010/11 had not been estimated.

6.50 The CPUE series for this fishery was not updated by the Working Group.

Management advice

6.51 The Working Group encouraged the estimation of biological parameters for *D. eleginoides* in Subarea 58.6 (French EEZ), and the development of a stock assessment for this area. The Working Group encouraged France to continue its tagging program in Subarea 58.6.

6.52 The Working Group recommended that avoidance of zones of specific high by-catch abundance should also be considered.

6.53 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 32-11, remain in force.

Dissostichus eleginoides Prince Edward and Marion Islands (Subareas 58.6 and 58.7)

6.54 The Fishery Report for *D. eleginoides* in Subareas 58.6 and 58.7 inside the South African EEZ is contained in Appendix L.

6.55 The catch limit of *D. eleginoides* in the South African EEZ for 2010/11 was 440 tonnes for the period from 1 December 2010 to 30 November 2011. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2011 was 76 tonnes, all of which was taken by trotlines.

6.56 The CPUE series was not updated by the Working Group.

6.57 South Africa has licensed five operators to fish at the Prince Edward Islands, each with a fixed proportional allocation of the catch limit. Since 2006 only one operator (with 27% of the catch limit) has been active in the fishery. However, a second vessel licensed to catch the remaining 73% of the catch limit entered the fishery in late 2010.

6.58 The catch limit of *D. eleginoides* in the South African EEZ for 2011/12 is likely to be 320 tonnes.

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

6.59 The Working Group noted that a revised operational management procedure to form the basis for management advice is under development by national scientists.

6.60 The Working Group 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

6.61 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 Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CMs 32-10, 32-11 and 32-12, remain in force.

New and exploratory fisheries

6.62 Seven exploratory longline fisheries for *Dissostichus* spp. were agreed for 2010/11 (CMs 41-04 to 41-07 and 41-09 to 41-11). Activities in these fisheries are summarised in Table 1.

6.63 Nine Members notified for exploratory longline fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b for 2011/12 (Table 6).

6.64 The Working Group noted the exceptionally high CPUEs recorded in SSRU 5841E in the last two seasons and in SSRU 5842E in 2010/11, which were over five times greater than those recorded in previous seasons for the same SSRUs. The Working Group did not investigate potential reasons for these outliers.

6.65 Unstandardised CPUE data for *Dissostichus* spp. caught in exploratory longline fisheries between 1996/97 and 2010/11 are summarised in Table 7. The Working Group noted the advice from WG-SAM on the caution required in interpreting unstandardised CPUE as an index of stock abundance.

6.66 Under CM 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in 2010/11 was required to tag and release *Dissostichus* spp. at a specified rate per tonne (Table 8).

6.67 Consideration of the cumulative tag-releases prepared by the Secretariat showed that in exploratory fisheries most vessels released tags continuously, at or above the required rates, throughout their fishing trips. The Working Group recommended that a performance metric to reflect the deviations away from the required tag-to-tonne ratio line be developed during the intersessional period.

6.68 Length-frequency overlap statistics showed that in all subareas/divisions all vessels had achieved the required overlap statistic of at least 50% between tag-release length frequency and catch-weighted length frequency under CM 41-01 (Table 9). The Working Group was encouraged to see that almost all vessels had improved their performance over the last three years, some significantly. The marked improvement from last year is encouraging, and shows that vessels can achieve the required overlap statistic of 60% in 2011/12. The Working Group noted that it had initially recommended a tagging overlap statistic of 70% at its 2010 meeting, and that the impact of a lower overlap statistic on the stock assessment results should be evaluated at its next meeting in 2012.

6.69 In 2010/11, 6 279 *Dissostichus* spp. were reported to have been tagged and released in the exploratory longline fisheries (Table 10), and 285 tags were recovered (Table 11). As in previous years, most tags have been recaptured from Subareas 88.1 and 88.2. Out of a total of almost 14 000 tags reported to have been released in Subareas 48.6 and 58.4, there have been only 69 (0.5%) recaptures. Only seven tags were recaptured from these subareas in 2010/11: two from Subarea 48.6 and five from Division 58.4.1. This is the lowest number of tags recaptured since the start of the tagging program even though catches in 2010/11 in these subareas were higher than in the previous two years.

6.70 To determine whether the spatial mismatch between tags and subsequent fishing effort was a possible reason for the lack of tag recaptures in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, the Working Group reviewed the annual distribution of tags and subsequent fishing effort in these areas. The results suggested that at the broad scale there was a moderately good overlap of where the tags were released and where the effort was subsequently carried out, suggesting that spatial overlap was not the primary problem. However, this analysis did not take into account overlap at smaller spatial scales or movement of fish since release.

6.71 Each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in 2010/11 was required to complete 10 research hauls on entering an SSRU in the exploratory fishery. The Secretariat allocated starting positions for research hauls in the exploratory fisheries in Subareas 48.6 and 58.4 (except in Division 58.4.3b where positions were specified in CM 41-07). Although Members generally adhered to the requirements, there were a number of cases in 2010/11 (WG-SAM-11/4), and in previous years (SC-CAMLR-XXIX, Annex 8, paragraphs 5.25 to 5.28), where hauls had not been made in the allocated position, had been made in very deep water, or had not been completed before the vessel left the fishery.

Progress on assessments in data-poor exploratory fisheries (Subareas 48.6 and 58.4)

6.72 The Working Group reviewed the unstandardised CPUE from the research hauls summarised in WG-FSA-11/25. The estimates were highly variable between SSRUs, fishing strata and gear types and there were no significant differences in catch rates of research hauls between fished and lightly fished strata or between different gear types. The Working Group noted that the power of these tests was probably low due to the low sample size and high variance and that an increased number of research hauls would likely be necessary to detect significant trends over time. The Working Group recalled the advice from WG-SAM that CPUE by itself was unlikely to lead to an assessment of stock abundance (Annex 5, paragraph 2.33).

6.73 The Working Group recalled the advice of WG-SAM that failure to acquire the data necessary to develop assessments in data-poor fisheries may be a consequence of poor tagging implementation rather than poor research design (Annex 5, paragraphs 2.37 and 2.38) and that the success of tagging programs may be undermined in a number of different ways, including a low tag overlap statistic, lack of spatial overlap between fishing effort and previous release of tags, depredation of tagged fish, release of fish in poor condition (i.e. high mortality of tagged fish), and capture of tagged fish by IUU vessels (SC-CAMLR-XXIX, Annex 8, paragraphs 5.19 to 5.24). The requirement to meet a tag overlap statistic of 50% has only been in place for one year and the number of recaptures could be expected to increase in future years. There was also new evidence from research fishing in Divisions 58.4.3b and 58.4.4 that there was a high incidence of multiple hooking associated with trotlines (paragraphs 5.37 to 5.43) which could lead to the release of fish in poor condition throughout the Convention Area where this gear type is used. Depredation by killer whales in these studies was also identified as a potential problem.

6.74 The Scientific Committee considered the assessment of *Dissostichus* spp. in data-poor fisheries to be of a high priority (SC-CAMLR-XXIX, paragraphs 3.125 to 3.145). The Working Group noted that no progress had been made in the assessment of the data-poor exploratory toothfish fisheries over the past few years. It also agreed that the research being conducted under the existing research plan in CM 41-01, Annex B, is unlikely to lead to assessments in these fisheries in the next 3–5 years.

6.75 The Working Group therefore agreed that the number of research hauls and the tagging rates should be increased to increase the amount of data and number of tags coming back from the fishery. Increasing the number of research hauls in previously fished strata would increase the likelihood of tagged fish being recaptured. 2010/11 was the first season that all vessels achieved the 50% tag overlap statistic, so vessels should be required to fish in locations fished in 2010/11 to increase the chance of recapturing these larger fish. Vessels should also increase the number of research sets in unfished strata to increase our knowledge of the distribution of toothfish in the SSRU.

6.76 Because of the generally low number of tag recaptures in these fisheries, it would be difficult to predict the likely increase in tag recaptures for a given increase in the number of research hauls. However, the Working Group agreed that a substantial increase would be necessary to provide enough tag recaptures for a stock assessment. To test the extent to which tag-recapture rates can be improved by increasing spatial overlap in fishing effort between years, it recommended that, sea-ice conditions permitting, at least 40 research hauls should be made in the group of fine-scale rectangles (0.5° latitude × 1.0° longitude) which had been fished with three or more sets in the last two years, and that an additional 10 research hauls should be made in unfished/lightly fished strata in each SSRU (see Figure 6). An alternative option would be to require all fishing carried out in these SSRUs to be research hauls.

6.77 To test the extent to which low tag recapture rates may be a consequence of releasing fish with a low probability of survival, the Working Group recommended that vessels be required on all research hauls to collect data characterising the suitability of captured fish for tagging, including number of hooking injuries (paragraph 5.41).

6.78 The Working Group also noted that an increase in the tagging rate and the tagging of fish in only good condition should also lead to an increase in tag recaptures in the future. Although these are not exploratory fisheries, tagging rates of five fish per tonne have been achieved in Subarea 48.4 and Division 58.4.3b (WG-FSA-11/8). The Working Group therefore recommended that the tagging rate be increased to five fish per tonne. It also recommended that only single-hooked good-condition fish be tagged and released (paragraph 5.38).

6.79 The Working Group also considered the focus topic on implementing research proposals in data-poor fisheries held by WG-SAM (Annex 5, paragraph 2.21). It noted that there were a number of key elements which had led to assessments of toothfish in SSRU 882E and Subarea 48.4 North (Annex 5, paragraph 2.21), including a robust experimental design with a well-coordinated multi-year tagging program focused on repeatedly visiting a relatively small area and a commitment by vessels to achieving high tagging performance. It further noted that research proposals incorporating these elements could potentially be applied in data-poor exploratory fisheries to provide the data necessary to assess the stocks.

6.80 The Working Group recommended that the Scientific Committee consider a change to the requirements in the fishery notification whereby Members are required to submit a research proposal when notifying to fish in a data-poor exploratory fishery (CM 21-02). The research proposal would have the key elements identified in Table 6 of Annex 5. A well-designed multi-annual research proposal should focus on an appropriate area within Subareas 48.6 and 58.4 and could include research in open and in closed SSRUs. The Working Group noted that worked examples could be provided for particular areas to make it clearer over what would be expected.

6.81 The Working Group recalled its discussions on ageing toothfish otoliths in 2010 (SC-CAMLR-XXIX, Annex 8, paragraphs 8.18 to 8.24) and the importance of reliable and validated age data in assessing toothfish stocks. The Working Group agreed that the inventory of otoliths available from the various fisheries, the number of otoliths read, and the location of the otoliths collated by the Secretariat (WG-FSA-11/7) was a useful resource and should be updated. The Working Group noted that Ukraine had begun ageing *D. mawsoni* otoliths collected by Members from Subarea 48.6 and Divisions 58.4.1 and 58.4.2 (WG-FSA-10/13). Dr L. Pshenichnov noted that Ukraine proposes to continue this work during the intersessional period. The Working Group also noted that preliminary otolith ageing had been carried out on fish caught in research surveys in Subarea 88.3 (by Russia) and in Division 58.4.4 (by Japan). It recommended that a coordinated plan to read otoliths from all the data-poor exploratory fisheries in Subareas 48.6 and 58.4 needs to be developed.

6.82 Dr Welsford offered the use of the laboratory facilities at the AAD for inter-laboratory ageing comparisons of *D. mawsoni* during the 2012 meeting of WG-FSA. The Working Group thanked Dr Welsford for his offer and requested Members bring prepared otolith material (including reference collections) which could be read and exchanged at the meeting. The Working Group agreed that an afternoon during the first week of WG-FSA should be set aside to facilitate this otolith reading work and encouraged Members with an interest in ageing *D. mawsoni* to be involved. Drs Petrov, Pshenichnov and Hanchet agreed to bring aged otolith material for this informal workshop.

Tagging

6.83 The Secretariat presented WG-FSA-11/6 which outlined a methodology developed by the Secretariat to assess the level of confidence in the links made between a recaptured tag and its tagging event. The link status included those where the link could be made immediately based on the tag number details, where links could be made but there were inconsistencies in the associated data, and those where no tagging event exists in the database.

6.84 The Working Group requested that an analysis be done to determine whether the majority of errors were occurring when the tags were being released or recovered and noted that one source of error may come from measuring and weighing live toothfish prior to tagging which was not always easy or practical. To allow for the potential errors arising from measuring live and dead fish, the Working Group recommended that a threshold value be developed to determine whether such differences would affect the tag-linking status.

6.85 WG-FSA-11/50 reviewed the current tagging objectives, procedures and vessel performance metrics and provided suggestions on how observer and vessel crew guidelines might be improved. The paper reviewed these items from a user perspective noting that, while in general CCAMLR tagging protocols were working well, there were a number of areas where changes could improve the tagging program.

6.86 Simulations carried out and presented in the paper indicated that under certain circumstances, specifically related to discrete differences in length-frequency distributions within a subarea or division, or where tagging rates varied within a subarea or division, a degraded tag overlap statistic could result despite the vessels following all measures correctly, but in no instance was this effect strong enough to generate a tag overlap statistic lower than 70%. Simulations also indicated that the 2-tonne trigger level currently set to activate Annex 41-01/C was too low and could result in an unintentional breach of the conservation measure. Some issues in respect to the proportional tagging by species could be solved by a change to this trigger level.

6.87 The Working Group recommended that Annex 41-01/C, paragraph (ii), be modified as follows: 'Each vessel catching more than 10 tonnes of *Dissostichus* spp. in a fishery shall achieve a minimum tag overlap statistic of 60% from 2011/12 onward'.

6.88 WG-FSA-11/50 also noted that instances where tags were not initially seen by crew appeared to be related to the colour currently used by CCAMLR in *Dissostichus* fisheries and suggested the use of a more contrasting colour when the existing pool of CCAMLR tags had been deployed. The Working Group recommended a change to the use of more contrasting-coloured tags for toothfish to improve tag detection rates.

6.89 The Working Group recommended that the CCAMLR tagging protocols be reviewed, updated and translated into other languages intersessionally. This process would include the development and provision of a training module for use on vessels.

Update Fishery Reports for new and exploratory fisheries

Development of advice on catch limits for *Dissostichus* spp.

Dissostichus spp. Subarea 48.6

6.90 Three Members (Japan, South Africa and the Republic of Korea) and four vessels fished in Subarea 48.6 SSRUs A, B, C and G in 2010/11. The precautionary catch limit for *Dissostichus* spp. was 200 tonnes north of 60°S (SSRUs A and G) and 200 tonnes south of 60°S (SSRUs B–F). Information on this fishery is summarised in Appendix M.

6.91 The combined SSRUs B, C, D, E and F were closed on 7 February 2011 (catch limit for *Dissostichus* spp.: 200 tonnes; final reported catch: 197 tonnes). The combined SSRUs A and G (catch limit for *Dissostichus* spp.: 200 tonnes; reported catch to date: 196 tonnes) were closed on the 19 April 2011. There was no evidence of IUU fishing in 2010/11.

6.92 The number of tag recaptures was very low in Subarea 48.6 in 2010/11. The Working Group noted that in total there have been very few tag recaptures from this subarea, and that no progress could be made on assessments of *D. eleginoides* in Subarea 48.6. The Working Group noted all vessels fishing in Subarea 48.6 in 2010/11 achieved a tag overlap statistic greater than 50% (range 53 to 95%). It also noted that this improved performance indicated that vessels can achieve the required overlap statistic of 60% in the 2011/12 fishing year.

6.93 Five Members (Japan, Republic of Korea, Norway, Russia and South Africa) and a total of seven vessels notified for toothfish in Subarea 48.6 in 2011/12.

6.94 The Working Group agreed that it could provide no new advice on catch limits for this subarea and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

6.95 The Working Group requested the Secretariat examine the possibility of obtaining a Petersen estimate of *Dissostichus* spp. biomass from tag recaptures in Subarea 48.6 in the intersessional period.

Dissostichus spp. Division 58.4.1

6.96 Three vessels from two Members (Spain and the Republic of Korea) fished in the exploratory fishery in Division 58.4.1 in 2010/11. The precautionary catch limit for toothfish was 210 tonnes in three SSRUs (C: 100 tonnes, E: 50 tonnes and G: 60 tonnes), and 216 tonnes were taken between 1 December 2010 and 12 March 2011. Information on this fishery is summarised in Appendix N.

6.97 High levels of IUU fishing have been reported in 2005/06 and 2006/07 and an estimated IUU catch of 910 tonnes was taken in 2009/10. The IUU catch of *Dissostichus* spp. in 2010/11 was not estimated.

6.98 Vessels were required to tag and release *Dissostichus* spp. at a rate of three fish per tonne of green weight caught and all vessels achieved the target rate. A total of 5 759 *D. mawsoni* and 314 *D. eleginoides* have been tagged and released in Division 58.4.1, and 26 *D. mawsoni* and one *D. eleginoides* have been recaptured in that division. In 2010/11, 747 *D. mawsoni* and no *D. eleginoides* were tagged with five *D. mawsoni* and no *D. eleginoides* recaptured. The Working Group noted all vessels fishing in Division 58.4.1 in 2010/11 achieved a tag overlap statistic greater than 50% (range 52 to 74%). The Working Group noted that this improved performance indicated that vessels can achieve the required overlap statistic of 60% in 2011/12.

6.99 Six Members (Japan, Republic of Korea, New Zealand, Russia, South Africa and Spain) and a total of 11 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2011/12.

6.100 The Working Group agreed that it could provide no new advice on catch limits for this division and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

Dissostichus spp. Division 58.4.2

6.101 In 2010/11, the exploratory fishery for *Dissostichus* spp. in Division 58.4.2 was limited to Japanese, Korean, New Zealand, South African and Spanish vessels using longlines only. Only one Member (the Republic of Korea) fished in the division and reported a catch of 136 tonnes. SSRU E was closed on 24 February 2011 (SSRU E catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 136 tonnes) and SSRU A, and consequently the fishery, was closed on 25 February 2011 (SSRU A catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 0 tonnes. The other SSRUs (B, C and D) were closed to fishing. Information on this fishery is summarised in Appendix O.

6.102 The fishery targeted *D. mawsoni* and operated in SSRU E in 2010/11. The total removal of *Dissostichus* spp. in 2010/11 was estimated at 136 tonnes and well in excess of the catch limit of 40 tonnes. The IUU catch of *Dissostichus* spp. in 2010/11 was not estimated.

6.103 The vessel in Division 58.4.2 achieved the target tagging rate of 3 tags per tonne of green weight and achieved a tag overlap statistic greater than 60% (Table 9). A total of 408 toothfish were tagged and released in 2010/11 and no tagged toothfish were recaptured (Tables 10 and 11).

6.104 Five Members (Japan, Republic of Korea, New Zealand, South Africa and Spain) and a total of five vessels notified their intention to fish for toothfish in Division 58.4.2 in 2011/12.

6.105 The Working Group noted the greatly exceeded catch in SSRU E (catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 136 tonnes) and expressed the concern that this severely compromises the ability to conduct research in this division and develop adaptive management strategies and stock assessments.

6.106 Some participants requested that the Scientific Committee consider reducing the recommended catch limit in SSRU E to zero for a period of time to reflect the overrun of catches.

6.107 The Working Group agreed that it could provide no new advice on catch limits for this division and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

Dissostichus spp. Division 58.4.3a

6.108 In 2010/11, the exploratory fishery for *Dissostichus* spp. in Division 58.4.3a was limited to one Japanese vessel using longlines only. The precautionary catch limit for toothfish was 86 tonnes. The vessel fished and reported a total catch of 4 tonnes of *D. eleginoides*. Information on this fishery is summarised in Appendix P.

6.109 There was no evidence of IUU fishing in 2010/11.

6.110 Fourteen toothfish were tagged and released in 2010/11 and no tagged toothfish were recaptured during that season.

6.111 Three Members (France, Japan and South Africa) notified their intention to fish for toothfish in Division 58.4.3a in 2011/12.

6.112 The Working Group agreed that it could provide no new advice on catch limits for this division and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

Dissostichus spp. Subareas 88.1 and 88.2

6.113 In 2010/11, five Members and 16 vessels fished in the exploratory fishery in Subarea 88.1 between December 2010 and January 2011. The fishery was closed on 14 January 2011 and the total reported catch of *Dissostichus* spp. was 2 882 tonnes (101% of the limit) (CCAMLR-XXX/BG/8, Table 2). The following SSRUs were closed during the course of fishing:

- SSRUs B, C and G closed on 10 December 2010, triggered by the catch of *Dissostichus* spp. (total catch 349 tonnes; 94% of the catch limit)
- SSRUs J and L closed on 9 January 2011, triggered by the catch of *Dissostichus* spp. (total catch 428 tonnes; 114% of the catch limit)
- SSRUs H, I and K closed on 14 January 2011, triggered by the catch of *Dissostichus* spp. (total catch 2 105 tonnes; 100% of the catch limit).

6.114 Five Members and 12 vessels fished in the exploratory fishery in Subarea 88.2 between December 2010 and February 2011. The fishery closed on 8 February 2011 and the total reported catch of *Dissostichus* spp. was 576 tonnes, including 10 tonnes taken during research fishing in SSRU A (100% of the limit) (CCAMLR-XXX/BG/8, Table 2). The following SSRUs were closed during the course of fishing:

- SSRUs C, D, F and G closed on 8 February 2011, triggered by the catch of *Dissostichus* spp. (total catch 216 tonnes; 101% of the catch limit)

- SSRU E closed on 8 February 2011, triggered by the catch of *Dissostichus* spp. (total catch 350 tonnes; 97% of the catch limit).

6.115 Details of notifications of intentions to fish in 2011/12 are summarised in CCAMLR-XXX/11. For Subarea 88.1, notifications were submitted by seven Members with a total of 20 vessels. For Subarea 88.2, notifications were submitted by six Members with a total of 19 vessels.

6.116 The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is in Appendix R.

6.117 Within Subarea 88.2, SSRUs 882C–G were assessed as a single stock unit for the first time, and two fisheries were identified; north of 70°50'S and south of 70°50'S.

6.118 In all seasons, there was a broad mode of adult fish at about 120–170 cm in Subarea 88.2. In years when fishing occurred in the south of Subarea 88.2, there was also a strong mode at about 60–70 cm. These fish were predominantly caught at the edge of the continental shelf.

6.119 Dr Petrov informed the Working Group that Russia had read over 6 000 otoliths from Subarea 88.1 collected between 2002/03 and 2007/08. The Working Group considered that it would be very useful to conduct inter-laboratory comparisons to evaluate the ageing methodologies and recommended these be initiated during its meeting in 2012 (paragraph 6.82).

6.120 Under CM 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. is required to tag and release *Dissostichus* spp. at a rate of one fish per tonne of green weight caught throughout the season.

6.121 A high-quality tag dataset for the assessment of *D. mawsoni* was selected on the basis of data-quality metrics for individual trips (WG-FSA-11/42). The method first selected an initial informative dataset comprising trips with (i) high (above median) rates of recovery of previously released tags, or (ii) where tags released on the trip were subsequently recaptured at a high rate. The method then used these trips to define the upper and lower bounds of data-quality metrics that were informative with respect to tagging data. Other trips with data-quality metric values within these ranges were then added to the initial informative dataset.

6.122 Since 2000/01, more than 29 000 *Dissostichus* spp. have been tagged in Subareas 88.1 and 88.2, with more than 26 000 and 2 600 *D. mawsoni* in the Ross Sea and SSRUs 882C–G respectively (WG-FSA-11/46). A total of 19 514 releases and 962 recaptures were used in the assessment of the Ross Sea (WG-FSA-11/42), and 2 187 releases and 267 recaptures were used in the assessment for SSRUs 882C–G (WG-FSA-11/43).

6.123 The CASAL model, using catch-at-age and tag-recapture data and *D. mawsoni* biological parameters, was used to estimate the current and initial population size, and to calculate the long-term annual yield that would satisfy the CCAMLR decision rules (model R1 for the Ross Sea in WG-FSA-11/42, and model R3 for SSRUs 882C–G in WG-FSA-11/43).

6.124 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 3 282 tonnes. At this yield, there is a less than 10% chance of spawning biomass dropping to less than 20% of the initial biomass. A yield of 3 282 tonnes is therefore recommended.

6.125 The Working Group noted that the estimated catch associated with the 65 prescribed sets in WG-FSA-11/47 is 40 tonnes (range 22–71 tonnes). The Working Group recommended that a research catch of 40 tonnes should be set aside to allow the pre-recruit survey to be conducted immediately following the closure of the fishery in Subarea 88.1. The Working Group noted that the proposal suggested that if the catch on these hauls exceeds 40 tonnes, then the excess catch could be deducted from the catch limit in the following year.

6.126 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 SSRUs 882C–G was 530 tonnes. At this yield, there is a less than 10% chance of spawning biomass dropping to less than 20% of the initial biomass. A yield of 530 tonnes for these SSRUs combined is therefore recommended.

6.127 The Working Group noted that the Subarea 88.2 fishery had been modelled as two fisheries with a split at 70°50'S, and considered that this was also an appropriate way to allocate catch limits. Over the last three seasons 76% of the catch was taken from the north of 70°50'S and 24% of the catch was taken from the south. The Working Group therefore recommended that 76% of the yield (406 tonnes) be assigned to the region north of 70°50'S and the remainder (124 tonnes) be assigned to the region south of 70°50'S. It recommended that the SSRUs in Subarea 88.2 be renumbered in accordance with Figure 7, noting that a catch limit of 406 tonnes should be applied to the new SSRU 882H and the catch limit of 124 tonnes should be amalgamated across the new SSRUs 882C–G. It further recommended that the proportional allocation and SSRUs should be reviewed in two years' time when this subarea is next assessed.

6.128 The Working Group recommended that the allocation method used to set the 2009/10 catch limits for SSRUs in Subarea 88.1 be continued for 2011/12. This would result in 428 tonnes in the north (SSRUs 881B, C, G), 2 423 tonnes on the slope (SSRUs 881H, I, K) and 431 tonnes on the shelf (SSRUs 881J, L).

6.129 The Working Group agreed that the catch limits for *Dissostichus* spp. in Subarea 88.1 should be 3 282 tonnes and for *Dissostichus* spp. in Subarea 88.2 should be 530 tonnes.

6.130 The Working Group agreed that other measures in the research and data collection plans, including the tagging requirement for one fish per tonne, be retained for the exploratory fisheries in Subareas 88.1 and 88.2.

Assessment and management advice for other fisheries

Antarctic Peninsula (Subarea 48.1) and South Orkney Islands (Subarea 48.2)

6.131 There was no new information available to the Working Group for 2010/11 for these subareas.

Management advice

6.132 The Working Group recommended that the existing CMs 32-02 and 32-04 on the prohibition of finfishing in Subareas 48.1 and 48.2 respectively, remain in force.

Crabs (*Paralomis* spp. Subarea 48.3)

6.133 Crabs were not harvested during 2010/11, and no notifications of intention to fish for crabs in 2011/12 have been received by CCAMLR.

6.134 WG-FSA-11/26 reviewed the information currently available on the biology and ecology of the lithodid crabs at South Georgia and provided an overview of the development of a management regime for them. Considerable gaps in knowledge of the biology, ecology and demography of the lithodid species at South Georgia are highlighted with uncertainty surrounding estimates of biomass, growth rates and survivorship of discards of the targeted species.

6.135 The review reported that recent analyses suggest that the current precautionary catch limit may not be sustainable in the long term if it were reached consistently. It was noted that apart from 2009/10, there has been very little commercial interest in the fishery. Low market value and interest, coupled with the very high level of discarding, are likely to render the fishery commercially unviable.

Management advice

6.136 Reflecting on the high level of discarding and uncertainty surrounding discard mortality, the Working Group recommended that the crab fishery in Subarea 48.3 be closed.

BOTTOM FISHING ACTIVITIES AND VULNERABLE MARINE ECOSYSTEMS (VMEs)

7.1 Following the work plan endorsed by the Scientific Committee (SC-CAMLR-XXIX, paragraph 15.4), the Working Group discussions related to bottom fishing and VMEs in 2011 were restricted to three main topics: (i) reviewing notifications of new VMEs under CM 22-06 and notifications of Risk Areas under CM 22-07, (ii) reviewing the preliminary assessments of bottom fishing impacts by Members, and (iii) updating the bottom fishing activities in the VME report. Most of the information required to conduct the review was provided by the Secretariat in CCAMLR-XXX/12 and BG/8. As part of this work, three papers related to Members' impact assessments were discussed (WG-FSA-11/51 Rev. 1, 11/53 and 11/54).

Risk Areas and VME Registry

7.2 The Working Group reviewed two new notifications of VMEs made under CM 22-06 (WG-EMM-11/10). The Working Group agreed with the recommendation of WG-EMM that the Scientific Committee include the two areas on the VME registry (Annex 4, paragraphs 3.3 and 3.4).

7.3 These two areas are the first notified VMEs occurring in an area currently open to *Dissostichus* spp. bottom fishing within the area applicable to CM 22-06. Therefore, while other registered VMEs are protected through other conservation measures currently in force in those areas, no specific protection mechanism for registered VMEs exists in areas open to bottom fishing for *Dissostichus* spp. The proposal (WG-EMM-11/10) provided information showing that these areas were isolated from similar habitats and proposed two boxes, of approximately 17 km^2 and 19 km^2, that could be closed to fishing.

7.4 The Working Group recommended that a single point and a defined radius for each location could protect the same area while making administration and management of these areas simpler, and conforming to the typical approach used to prohibit fishing near Risk Areas. The Working Group recommended prohibiting fishing within the areas of two circles, centred at –66.934°S 170.861°W and –67.169°S 171.171°W, with radii of 1.25 n miles (2.32 km) to provide protection from direct effects of interactions with fishing gear.

7.5 The Working Group noted that a total of 112 notifications of encounters with potential VMEs have been received by the Secretariat, resulting in the designation of 46 Risk Areas (WG-EMM-11/7). Thirty-one of these risk areas were generated in 2011 in SSRU 881K.

Review of preliminary impact assessments

7.6 WG-FSA-11/51 Rev. 1 presented additional software development of PlotImage, presented in WG-SAM-10/22. The development, termed PlotImpact, uses the framework of PlotImage and the impact assessment method described in Appendix D, to translate gear-specific impact assessments into composite % impact maps and summary tables for applicable subareas and divisions. The Working Group recommended that the locations of notified VMEs and Risk Areas be overlaid on the PlotImage map outputs to visualise their locations relative to fishing effort density and estimated cumulative impact levels (Appendix D, Figure 6(i)).

7.7 WG-FSA-11/53 and 11/54 were presented by the Republic of Korea and described the Spanish longline gear configuration used by some Korean vessels in *Dissostichus* spp. fisheries. The description of the gear was welcomed by the Working Group and future descriptions of other fishing gear types, especially trotline and trawl, was encouraged, especially noting that variations within a class of gear configuration may exist which could influence gear performance or catchability and that terminology may vary among Members for similar components of gear (e.g. the 'main line' of the a gear refers to different components between Spanish and Korean industries, and hook spacing may be easily varied within a set depending on how the snoods are attached). The Working Group commended the authors for considering gear modifications (i.e. transition to smaller smooth steel weights that do not require mesh holders) to reduce impacts to benthic habitats.

7.8 The Working Group noted that the description of gear configuration and operation is useful in refining preliminary impact assessments. It is especially important to estimate the potential frequency and extent of lateral longline movement in contact with the sea floor. The Working Group requested all Members to produce detailed descriptions of gear performance and to incorporate them into the impact assessment procedures endorsed by the Scientific Committee.

7.9 The Working Group recommended that the Spanish gear description (WG-FSA-11/53) and trotline configuration (Figure 5) should be added to the CCAMLR gear library for reference and use by other Members. It also recommended that previous papers (WG-FSA-05/26, 06/5 and 06/15) may provide useful information on gear configurations and could be added to the gear library with author permission. As these papers were prepared before aspects of gear performance such as gear footprint were required, they do not provide the level of detail needed for preliminary assessments of bottom impact, but are a useful starting point in describing the various ways longline gears, especially Spanish and trotline gears, have been configured.

7.10 The Secretariat provided updated total fishing effort summaries by gear type and subarea and division, showing the relative amount of fishing effort in each subarea or division and highlighting how the gear types used vary by subarea and division (Appendix D, Table 1).

7.11 The Working Group conducted reviews of the preliminary bottom fishing impact assessments provided by Members under CM 22-06. The pro forma describing the required information was updated at WG-FSA-10 and noted by the Commission (CAMLR-XXIX, paragraph 5.2). The Working Group therefore developed an updated report card format to match the sections of the new pro forma for review (Annex 22-06/A). The Working Group noted that several Members had not used the new pro forma, and therefore had not provided some of the information needed for a meaningful review. However, with reference to the preliminary assessments submitted in 2010, the 2011 preliminary assessments were much improved, more detailed, and provided a better scientific basis for estimating proposed effort density in the upcoming fishing year.

7.12 In summarising the preliminary assessments to a single table format, several categorical assignments were made. First, the use of the correct pro forma is indicated with a check mark, as information needed was not always provided if the old pro forma was used. Sections 2.1(ii) and 2.1(iii) information was summarised as 'D' if gear description and performance were described in the notification, or 'R' if they referred to an existing document. The estimated footprint and impact indices, if they could be calculated with the information provided, and typically with more information provided by Member representatives attending WG-FSA, were specified for the gear types notified. An estimate of the total proposed effort (in km of longline) was calculated if possible to show proposed effort in 2012 relative to the cumulative effort to date (Appendix D, Table 1).

7.13 The Working Group recommended that, as the information provided by Members in the preliminary assessments becomes more streamlined, the Secretariat may provide some initial review of the information provided and work with Members to correct any minor issues prior to review by WG-FSA.

7.14 Preliminary assessments were provided by 10 Members, some providing separate assessments for different vessels or gear types. The total proposed effort results in 24 vessels, in 33 vessel/subarea combinations and 68 vessel*subarea combinations (Appendix D, Table 2). For most Members, an estimate of the footprint index and the impact index was generated, which, when combined with the proposed effort levels (or past effort levels), provides estimates of the total spatial effort density for each subarea/division. If Members' preliminary assessments provided documents that evaluated new gear modifications that may minimise benthic impacts further, these documents can be identified under Item 3.

7.15 The summary of estimated gear footprints for the different gear types shows that although the footprint estimates can be strongly influenced by assumptions of the frequency and magnitude of lateral movement, the largest estimates were only six times the smallest. However, even within a gear type, estimates were different and because no documents were provided describing how the gear may interact with the benthos, the Working Group could not review and develop composite estimates of the parameters needed to estimate impact for each gear type. The Working Group recommended that Members should provide or reference a document describing the gear to be used, along with the supporting rationale for how that gear configuration may interact with the sea floor. This supporting evidence can be derived from existing literature, new research and expert knowledge.

7.16 To estimate impact of cumulative longline effort by subarea and division, the descriptive statistics agreed in 2010 by WG-FSA were used for all longline gear types to generate the impact plots in Appendix D, Figures 6(a) to 6(k).

7.17 The spatial maps of impact estimates within the Ross Sea, with Risk Areas and proposed VMEs overlaid, show that Risk Areas fall into two main clusters, and that these clusters do not occur where the highest levels of cumulative impacts have been estimated (Appendix D, Figure 6(i)).

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

8.1 In accordance with CCAMLR's Scheme of International Scientific Observation, scientific observers were deployed on all vessels in all finfish fisheries in the Convention Area. Information collected by scientific observers was summarised in WG-IMAF-11/5 Rev. 2 and 11/6.

8.2 WG-FSA-11/21 developed length–weight relationships for toothfish (paragraph 3.9) and noted a number of errors in these data within the observer database. Noting that the length–weight relationships could be built into the observer logbook to provide data validation and error flagging during data input, the Working Group recommended that this be implemented for 2012/13.

8.3 The Working Group noted that there is some confusion in the way that vessels and observers are reporting position information, and the current format (e.g. *Scientific Observers*

Manual, p. 12) is still occasionally being misinterpreted. The Working Group agreed that all positions should be reported as DD (whole degrees) and MM.mm (minutes and fractions of minutes), using two separate fields in data forms to remove any ambiguity.

8.4 WG-FSA-11/39 Rev. 1 presented an excellent visual guide to macroscopic maturity staging of *D. eleginoides* gonads. The Working Group recommended that this guide be included in the *Scientific Observers Manual* and agreed that this guide could also be applied to *D. mawsoni*, and recommended that similar guides be developed for other target species and common by-catch species.

8.5 The Working Group supported the initiative to develop a comprehensive photographic field guide to Antarctic fishes (WG-FSA-11/40). Members are encouraged to collaborate with this initiative by making additional images and distributional data available to the authors, and especially information useful for field identification.

8.6 Three papers contained potential tasks that could be assigned to observers (but see paragraph 8.7):

(i) WG-FSA-11/5 and 11/41 reported on fish by-catch in krill fisheries (see discussion in paragraphs 3.12 to 3.17). The Working Group recognised the importance of these data and recommended that the collection of length data would be more important than the weight in determining the part of the fish population most impacted by the krill fishery. In reviewing the species composition reported in WG-FSA-11/5, it was recognised that the identification of some species of fish (particularly the younger specimens) is a difficult task, therefore, where possible, observers are requested to continue to photograph and retain samples to validate identification of some fish species.

(ii) WG-FSA-11/11 reported observations of baleen whales during krill fishing trips. The Working Group recognised that it may be possible to record cetacean activities from krill fishing vessels in a more quantitative manner but that this would require a restructuring of the observer's tasks and that it may be useful to consult with the IWC on appropriate methodologies.

8.7 In 2010 the Working Group recommended that the sampling requirements for observers be clarified and that the requirements listed in various conservation measures and in the observer logbook be aligned (SC-CAMLR-XXIX, Annex 8, paragraphs 10.4 to 10.6). Noting the summary presented in WG-FSA-11/25 and the discussion of observer tasking in WG-EMM (Annex 4, paragraphs 2.42 to 2.44) and WG-IMAF (Annex 8, paragraphs 7.8 and 7.9), the Working Group requested the Scientific Committee to constitute a task group with representation from all interested parties (including WG-FSA, WG-EMM, WG-IMAF and SCIC) to review observer sampling requirements across all fishing sectors and conservation measures. In this regard the Working Group noted that:

(i) CM 41-01 was revised in 2010 in response to a recommendation from WG-FSA-10 (SC-CAMLR-XXVII, Annex 5, paragraphs 11.4(ii)(c) and (d) and SC-CAMLR-XXIX, Annex 8, paragraph 10.5) to determine the maximum number of fish sampled per line based on the number of hooks set. However, CM 41-01 omits guidance on the minimum sampling requirement. The Working Group recommended that CM 41-01, Annex B, be revised as follows: 'In the exploratory fisheries in Statistical Subareas 88.1 and 88.2, all data specified in the Data Collection Plan (Annex 41-01/A) of this conservation measure shall be collected for every haul: all fish of each *Dissostichus* species in a haul (at a rate of 7 fish per 1 000 hooks up to a maximum of 35 fish for each species) are to be measured and randomly sampled for biological studies (paragraphs 2(iv) to (vi) of Annex 41-01/A)'

(ii) the operating model development outlined in WG-FSA-11/20 could aid in the evaluation of data collection and sampling requirements

(iii) some vessels provide a more suitable working area, facilities and assistance for observer tasks enabling observers to complete tasks more efficiently and effectively. Cognisance should be taken of this when assessing the workload of observers.

FUTURE WORK

9.1 The Working Group noted the three-year tasking for the working groups undertaken at the Scientific Committee meeting last year (SC-CAMLR-XXIX, Table 7) and recognised that despite this process there were still a large number of issues for consideration next year. In order to produce a tractable agenda for its meeting in 2012 that would facilitate broad participation, the Working Group recommended that focus on a smaller number of high-priority issues may be required. This could take the form of a focus topic in the Working Group meeting or, following the example of SG-ASAM, if there is a requirement to address a particular high-priority issue, the Scientific Committee could consider the possibility of holding a meeting with clearly defined terms of reference rather than remit additional tasks to the working groups.

9.2 The Secretariat informed the meeting that it hoped that the changes proposed in the revised Strategic Plan (CCAMLR-XXX/8) would strengthen the Secretariat's role in facilitation of successful completion of priority intersessional tasks.

9.3 The Working Group agreed that the review of VMEs, research fishing in data-poor fisheries and by-catch (including results from the Year-of-the-Skate and fish by-catch in krill fisheries), ageing *D. mawsoni* otoliths (paragraphs 6.81 and 6.82) were priority issues for consideration, but noted that this did not include all of the items indicated in SC-CAMLR-XXIX, Table 7, for consideration by WG-FSA in 2012.

9.4 Four notifications in accordance with CM 24-01 for scientific research activities in 2011/12 were received by the Secretariat and presented in WG-FSA-11/9:

(i) Scientific research notifications (CM 24-01, paragraph 2) –
Germany: Subareas 48.1 (March–April 2012), fish research

(ii) Research fishing notifications (CM 24-01, paragraph 3) –
Russia: Subareas 88.2 and 88.3 (January–March 2012), toothfish
Chile: Subarea 48.3 (August 2012), toothfish.

9.5 A notification from New Zealand to conduct a survey in Subarea 88.1 is considered in paragraphs 5.44 and 5.45.

9.6 In respect of the proposal from Chile, Dr M. Collins noted that the UK was undertaking similar research in the same region and offered to work intersessionally with Chile to develop a collaborative proposal.

9.7 The Working Group also noted that the UK and Australia will be conducting research surveys in 2012 in Subarea 48.3 and Division 58.5.2 respectively, and that the USA will be conducting a survey for pelagic fish in Subarea 48.1 in early 2012.

General matters

9.8 The Working Group identified the following items of future work (not including recommendations for modifications to research fishing provided in section 5):

(i) implementations of the decision rule related to depletion and escapement (paragraph 3.4)

(ii) fish by-catch in krill fisheries (paragraph 3.21)

(iii) methods for the estimation of IUU catch for use in assessments (paragraph 3.28)

(iv) evaluation of the performance of decision rules and the use of limit reference points (paragraph 4.17)

(v) development of metrics for use in evaluating research proposals (paragraph 4.2)

(vi) approaches to modelling data from data-poor fisheries (paragraphs 4.41 and 4.42)

(vii) progress on assessment for French EEZ in Division 58.5.1 (paragraphs 4.25 to 4.27 and 6.45)

(viii) further examination of historical changes in fleet selectivity (paragraph 6.23)

(ix) coordination of ageing of otoliths of *D. mawsoni* (paragraphs 6.81, 6.82 and 6.119)

(x) development of threshold levels for tag-linking status (paragraph 6.84)

(xi) review and update of CCAMLR tagging protocols (paragraph 6.89)

(xii) update information in the CCAMLR gear library (paragraph 7.9)

(xiii) pre-review of preliminary impact assessments by the Secretariat (paragraph 7.13)

(xiv) data validation based on length and weight of toothfish (paragraph 8.2)

(xv) include visual guide to macroscopic maturity staging of *D. eleginoides* gonads in the *Scientific Observers Manual* and develop similar guides for other target species and common by-catch species (paragraph 8.4)

(xvi) review of observer tasks (paragraph 8.7).

OTHER BUSINESS

Review of the Secretariat's Strategic Plan and data management systems

10.1 The Working Group noted the outcomes of the independent review of the Secretariat's data management systems (CCAMLR-XXX/5) and the review of the Secretariat's Strategic Plan (CCAMLR-XXX/8). The independent review of the Secretariat's data management systems recommended restructuring of existing functions and associated staffing arrangements in the Secretariat in relation to data management and IT support, including the use and management of the Secretariat's website, increased attention to risk management and data quality assurance, harmonisation of internal data administration policies and procedures, consideration of end-of-life matters relating to software applications and rationalisation of IT hardware. The review provided expert input to the review of the Strategic Plan, and a summary of the key recommendations was also presented to WG-SAM and WG-EMM (Annex 5, paragraphs 6.1 to 6.5; Annex 4, paragraphs 6.1 to 6.3).

10.2 The review of the Strategic Plan included contributions from external stakeholders, in-house workshops comprising all Secretariat staff and advice from external experts in relation to staffing matters. The outcomes included a revised Strategic Plan for 2012 to 2014 and associated Staffing and Salary Strategy. The key areas of relevance to the Scientific Committee and its working groups are:

- six functional services each headed by a Manager reporting to the Executive Secretary. Previously there were nine direct reports to the Executive Secretary and a mix of titles of 'Manager' and 'Officer' had been used to designate section heads. The staff complement at the Secretariat will be reduced from 28 to 26 staff

- establishment of an Analytical Support Officer position within Science Services and a Data Assistant post within the Data Centre

- re-titling of the Scientific Observer Data Analyst post to Scientific Observer Scheme Coordinator

- support to development of IT and data strategies (structured and unstructured) focusing on risk management and addressing concerns relating to potential single-point failures.

10.3 The Working Group noted that much of the restructuring work associated with the implementation of the review had been implemented in 2011. Work in 2012 is required in relation to processes, procedures and internal coordination and collaboration. It was also noted that the implementation of the revised Strategic Plan can be supported through to 2014 within the Commission's policy of a zero growth budget in real terms.

10.4 The Working Group endorsed the recommendations related to the Secretariat's support to the Scientific Committee and its working groups, noting that the establishment of the new posts of Analytical Support Officer and Data Assistant would enhance the Secretariat's ability to support the work of WG-FSA, including data processing, validation and grooming and assessment analysis.

Conditional transition of the fishery for *Dissostichus* spp. in the Ross Sea

10.5 The Working Group noted the proposal for a conditional transition of the fishery for *Dissostichus* spp. in the Ross Sea from an exploratory fishery to an established fishery (WG-FSA-11/32). The proposal outlined the criteria of the exploratory classification set out in CM 21-02 (paragraph 1), and the key advancements in the Ross Sea fishery which address each of these, including:

- the advancements with respect to the current state of knowledge on the biology, life history characteristics, distribution, abundance and demography of *D. mawsoni*
- progress in understanding the fishery's potential impacts on dependent and related species, including the review undertaken at FEMA2, studies of the trophic status of *D. mawsoni* and estimates of yield for key by-catch taxa (macrourids and rajids)
- the establishment of the integrated assessment of long-term precautionary yield for *D. mawsoni* in the Ross Sea.

10.6 The Working Group agreed that the current state of knowledge in this exploratory fishery adequately addresses the criteria set out in CM 21-02 (paragraph 1).

Electronic satellite tags

10.7 The Working Group noted that four pop-off satellite transmitters will be deployed on *D. mawsoni* along the continental slope of the Ross Sea in January 2012 (WG-FSA-11/49). The tags have a bulbous float, a whip antenna, a cylindrical body with solar cells wrapped around the top half, and are approximately 24 cm in length and 2 cm in diameter. The tags will be attached externally with a single tether to a dart embedded in the dorsal musculature of the fish, and will be obvious if the fish is recaptured. The tags will be programmed to pop-off the fish and float to the surface for transmission of data in December 2012.

10.8 The Working Group noted that the following procedure should be followed by vessels, crews and observers operating in the Ross Sea in 2011/12 if a tag is recovered:

> If a tag is found attached to a fish, the fish is alive, healthy and in good condition, and the tag is still firmly attached to the fish (i.e. capture and landing have not damaged the tag, the tether attachment, or the fish), please note the tag number from the label and fish length, and immediately release the fish. Also, note the date, location and haul number, and let the observer know to report the tag sighting to s.parker@niwa.co.nz.

If the tag or tag attachment site has been damaged, or the fish is injured or in poor condition, please retain the fish for full biological sampling. Note the date, haul number and location, and notify the observer. The observer can remove and retain the tag for return to NIWA[2] for a future deployment.

Please record the date, observer name, vessel name, latitude and longitude, haul number and fish length.

If the tag is retained, please also record the fish weight, otolith tracking number, stomach contents and the reason why the fish was not released.

10.9 The Working Group, through the Scientific Committee and Commission, encouraged Members to communicate this information to their vessels and observers operating in the Ross Sea in the forthcoming season, and requested that the information contained in WG-FSA-11/49 be posted on the CCAMLR website.

Participation of observers in working group meetings

10.10 The Working Group noted that following the request of the Scientific Committee (SC-CAMLR-XXIX, paragraph 15.19), WG-EMM had considered a potential mechanism to facilitate the engagement of observers (e.g. ASOC, COLTO etc.) in working group meetings. This mechanism would provide for a single representative of those international organisations that are invited to attend the Scientific Committee to attend working group meetings. That representative would contribute to discussion only at the direct request of a Member and would not provide written statements for the report of the meeting. The submission of papers to working group meetings would be subject to the agreement of the Convener and the Chair of the Scientific Committee that the paper is scientifically relevant. All observers would be bound by a confidentiality agreement and any breach of that agreement would result in permanent disbarment of that observer organisation from all working group meetings (Annex 4, paragraphs 6.4 to 6.7).

10.11 WG-FSA agreed with WG-EMM in recognising that, inter alia:

(i) the inclusion of fishing industry representatives in some delegations had brought important insights into the operation of fisheries that provided important context for scientific discussions

(ii) the potential positive contribution that the presence of observers might bring to the work of the working groups included increasing transparency and awareness of processes in those groups

(iii) the long history of positive engagement by observers at the Scientific Committee has demonstrated interest in, and knowledge of, CCAMLR

(iv) understanding the discussion of science issues at the Scientific Committee in the absence of participation in the working groups is challenging

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(v) increasing the understanding of meetings by observers that have a genuine interest in CCAMLR would be beneficial.

10.12 The Working Group also considered two alternative ways of enhancing transparency and communicating with observer groups:

- participation in public fora where working group scientists and observers and other interested parties (e.g. students, media) may discuss current issues and research
- development of the Secretariat's role in outreach and communication (see CCAMLR-XXX/8).

ICES Training Programme

10.13 The Working Group noted that ICES recently conducted a course on trawl survey design and evaluation, and requested that the Secretariat contact ICES about the feasibility of providing course material to CCAMLR Members involved in conducting surveys.

World Fisheries Congress

10.14 The Working Group noted that the Sixth World Fisheries Congress will be held from 7 to 11 May 2012 in Edinburgh (http://www.6thwfc2012.com). Dr I. Everson (Chair of the local organising committee and former Convener of WG-FSA) encouraged CCAMLR fishery scientists and managers to participate in the congress. Thematic sessions include sustainable fisheries under a changing climate regime, and adaptive management and tools to cope with changing environments.

ADVICE TO THE SCIENTIFIC COMMITTEE

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

(i) Development of assessments –

- development and use of performance metrics (paragraph 4.2).

(ii) Research plans –

- research fishing in Subarea 88.3 (paragraph 5.6)
- research fishing in Divisions 58.4.4a and 58.4.4b, Ob and Lena Banks (paragraphs 5.16 and 5.23)
- research fishing in Division 58.4.3b, BANZARE Bank (paragraphs 5.29 and 5.36)
- tag-based research in other areas (paragraphs 5.38, 5.39, 5.41 and 5.42)
- pre-recruit survey in the Ross Sea (paragraphs 5.45 and 6.125).

(iii) Requirements for exploratory fisheries –

- tagging in exploratory fisheries (paragraphs 5.12, 6.67, 6.68, 6.74 and 6.87 to 6.89)
- development of assessments in data-poor fisheries (paragraphs 6.76, 6.78, 6.80 and 6.81)

(iv) Fishery management advice –

- *C. gunnari* in Subarea 48.3 (paragraph 6.6)
- *C. gunnari* in Division 58.5.2 (paragraph 6.13)
- *D. eleginoides* in Subarea 48.3 (paragraphs 6.24 and 6.25)
- *Dissostichus* spp. in Subarea 48.4 (paragraph 6.33)
- *D. eleginoides* in Division 58.5.1 (paragraph 6.47)
- *D. eleginoides* in Division 58.5.2 (paragraph 6.42)
- *D. eleginoides* in Subarea 58.6, Crozet Islands (paragraphs 6.51 to 6.53)
- *D. eleginoides* in Subareas 58.6 and 58.7, Prince Edward and Marion Islands (paragraphs 6.60 and 6.61)
- *Dissostichus* spp. in Subarea 48.6 (paragraphs 6.94 and 6.95)
- *Dissostichus* spp. in Division 58.4.1 (paragraph 6.100)
- *Dissostichus* spp. in Division 58.4.2 (paragraph 6.107)
- *Dissostichus* spp. in Division 58.4.3a (paragraph 6.112)
- *Dissostichus* spp. in Division 58.4.3b (paragraphs 5.29 and 5.36)
- *Dissostichus* spp. in Subareas 88.1 and 88.2 (paragraphs 6.124 to 6.130)
- finfish in Subareas 48.1 and 48.2 (paragraph 6.132)
- *Paralomis* spp. in Subarea 48.3 (paragraph 6.136).

(v) Bottom fishing and VMEs –

- preliminary impact assessments (paragraphs 7.8, 7.9, 7.13 and 7.15)
- development of the fishing gear library (paragraphs 5.39 and 7.9)
- VMEs (paragraph 7.4).

(vi) Scientific observers –

- modification of data form K12 (krill by-catch sampling) to include details of the length of fish sampled (paragraph 3.21)
- reporting of position information (paragraph 8.3)
- review of sampling requirements and priorities (paragraph 8.7).

(vii) Other –

- requirement for maps of spatial characteristics of fisheries for *Dissostichus* spp. (paragraph 3.6)
- information on IUU fishing activities, trends in effort and estimates of catch (paragraphs 3.24 and 3.28)
- exclusion of small scientific samples of *Dissostichus* spp. from the requirements of the CDS (paragraph 3.30)
- completion of the C2 data form and inclusion of zeros if no hooks attached to sections of the main line were lost (paragraph 4.36)

- terminology related to fish condition, injury and trauma, and suitability for tagging (paragraph 5.12)
- pop-up tags (paragraph 10.9)
- review of the Secretariat's strategic plan (paragraph 10.4).

(viii) Meeting arrangements –

- future work plan and focus topics (paragraphs 9.1 and 9.3)
- Convener of WG-FSA (paragraph 13.2).

ADOPTION OF THE REPORT

12.1 The report of the meeting was adopted.

CLOSE OF MEETING

13.1 In closing the meeting, Dr Jones thanked the subgroup coordinators, rapporteurs, all participants and all Secretariat staff for their contributions and involvement in the work of WG-FSA, which had collectively supported detailed discussions and another productive meeting.

13.2 This was Dr Jones' last year as Convener of WG-FSA, and the group warmly welcomed the incoming Convener, Dr Belchier, to the position.

13.3 Drs Welsford and K.-H. Kock (Germany), on behalf of the Working Group, thanked Dr Jones for convening the Working Group during a formative period of development in assessments for the exploratory fisheries and consideration of the impacts of bottom fishing on VMEs. This period had embraced a large and diverse body of work, and Dr Jones' leadership had expertly guided WG-FSA in its deliberations and formulation of scientific advice.

REFERENCES

Candy, S.G., D.C. Welsford, T. Lamb, J.J. Verdouw and J.J. Hutchins. 2011. Estimation of natural mortality for the Patagonian toothfish at Heard and McDonald Islands using catch-at-age and aged mark-recapture data from the main trawl ground. *CCAMLR Science*, 18: 29–45.

Table 1: Total reported catches (tonnes) of target species in fisheries in the Convention Area in 2010/11. **Bold**: fishery closed; CM: conservation measure. (Source: catch and effort reports to 24 September 2011 unless otherwise indicated.)

Target species	Region	Fishery	Fishing period*		CM	Catch (tonnes) of target species		Reported catch (%limit)
			Start	End		Limit	Reported	
Champsocephalus gunnari	48.3	Trawl	01-Dec-10	30-Nov-11	42-01	2 305	10	<1
	58.5.2	Trawl	01-Dec-10	30-Nov-11	42-02	78	1	1
Dissostichus eleginoides	48.3	Longline, pot	01-Dec-10	30-Nov-11[a]	41-02	3 000	1 788	60
	48.4 north	Longline	01-Dec-10	30-Nov-11	41-03	40	36	90
	58.5.1 French EEZ[b]	Longline	ns	ns	ns	ns	2 906	-
	58.5.2	Longline, trawl, pot	01-Dec-10	30-Nov-11[a]	41-08	2 550	1 614	63
	58.6 French EEZ[b]	Longline	ns	ns	ns	ns	551	-
	58 South African EEZ[c]	Longline	ns	ns	ns	ns	85	-
Dissostichus spp.	48.4 south	Longline	01-Dec-10	30-Nov-11	41-03	30	17	57
	48.6	**Longline**	01-Dec-10	30-Nov-11	41-04	400	393	98
	58.4.1	**Longline**	01-Dec-10	30-Nov-11	41-11	210	216	103
	58.4.2	**Longline**	01-Dec-10	30-Nov-11	41-05	70	136	194
	58.4.3a	Longline	01-May-11	31-Aug-11	41-06	86	4	4
	58.4.3b	Research fishing	01-May-11	31-Aug-11	41-07	-	11	-
	58.4.4a, 58.4.4b	Research fishing	01-Dec-10	30-Nov-11	24-01	-	35	-
	88.1	**Longline**	01-Dec-10	31-Aug-11	41-09	2 850	2 882	101
	88.2	**Longline**	01-Dec-10	31-Aug-11	41-10	575	576	100
	88.3	Research fishing	01-Dec-10	30-Nov-11	24-01	-	5	-
Euphausia superba	48.1, 48.2, 48.3, 48.4	Trawl	01-Dec-10	30-Nov-11	51-01	620 000	179 131	29
	58.4.1	Trawl	01-Dec-10	30-Nov-11	51-02	440 000	No fishing	-
	58.4.2	Trawl	01-Dec-10	30-Nov-11	51-03	452 000	No fishing	-
Paralomis spp.	48.3	Pot	01-Dec-10	30-Nov-11	52-01	1 600	No fishing	<1[d]

[a] Longline fishery is closed
[b] Reported in fine-scale data to 12 August
[c] Inside the Convention Area
[d] Taken as by-catch
* Fishing may occur outside the prescribed season
ns Not specified by CCAMLR

Table 2: Catches of *Dissostichus eleginoides* reported in the CDS for fisheries operating outside the Convention Area in the calendar years 2010 and 2011 (to 26 September 2011).

Ocean sector	Area	Calendar year	
		2010	2011
Southwest Atlantic	41.2.3	448	146
	41.3	299	41
	41.3.1	1 819	1 126
	41.3.2	3 967	3 609
	41.3.3	-	79
Southeast Atlantic	47	27	-
	47.4	51	196
Western Indian	51	238	466
Southwest Pacific	81	276	379
Southeast Pacific	87	5 316	3 148
Total		12 441	9 190

Table 3: Evaluation of research proposals as set out in WG-FSA-11/13 Rev. 1, 11/15 Rev. 1 and 11/37. Evaluation criteria are as agreed by the focus topic on data-poor fisheries (Annex 5, paragraph 1.4).

WG-SAM-11 paragraph (Annex 5)	WG-FSA-11/37 – 88.3	WG-FSA-11/15 Rev. 1 – 58.4.4a+b	WG-FSA-11/13 Rev. 1 – 58.4.3b
Generic advice			
2.25 – primary purpose of research: achieve estimate of stock status	N*	Y	Y
2.25 – detailed survey/data collection plan	Y	Y	Y
2.27 – requirements for estimate of stock status	(Does the research adequately address these three requirements for an estimate of stock status?)		
(i) index of abundance	N	Y	Y
(ii) stock hypothesis	N	Y	Y*
(iii) biological parameters	Y*	Y*	Y*
2.38 – tagging performance metrics	(Will the research achieve high levels of performance with respect to five tag-based research performance metrics?)		
(i) tag overlap	Y	Y	Y
(ii) spatial overlap	N	Y	Y*
(iii) temporal overlap	Y	Y	Y
(iv) fish trauma	N	Y*	Y*
(v) depredation	Y	Y*	Y
2.40 – initial design for data-poor area	(Does the proposed research follow the recommended design process?)		
(i) appropriate spatially restricted area	N	Y	Y*
(ii) preliminary plausible estimate of B	N	Y*	Y*
(iii) catch and tag rates to achieve a target CV	N	Y*	N
(iv) evaluate effects on stock/set safe catch limits	N	Y*	Y*
Detailed description of data analyses/future planned research leading to an assessment	N	N	N

(continued)

Table 3 (continued)

	WG-FSA-11/37 – 88.3	WG-FSA-11/15 Rev. 1 – 58.4.4a+b	WG-FSA-11/13 Rev. 1 – 58.4.3b
Specific advice Does the (revised) proposal to WG-FSA incorporate the specific advice of WG-SAM-11? (paragraphs in Annex 5)	5.6(i) N 5.6(ii) N 5.6(iii) Y 5.6(iv) N 5.6(v) Y	5.3(i) N 5.3(ii) Y* 5.3(iii) Y*	5.5(i) Y* 5.5(ii) Y* 5.5(iii) N 5.5(iv) Y*

* Indicates criteria based on revisions to the proposal that were developed during WG-FSA 2011. Relevant changes with respect to each evaluated criterion are noted in the text.

Table 4: 2011 tag recaptures, Petersen biomass estimates, Ob and Lena Banks.

Release year	Released tags (n_1)	Available tags	Recaptured tags in 2011 (n_2)	Petersen B (tonnes)	95% CI
2008	145	76.6	2	1 409	216–7 950
2009	0	0	-	-	
2010	191	133.1	2	2 448	376–13 812
Cumulative in 2011	336	209.6	4	1 928	531–5 628

Table 5: Results of assessments of stock status of *Dissostichus eleginoides* in Division 58.5.2 using CASAL. B_0 is the MPD estimate of the pre-exploitation median spawning stock biomass (SSB), SSB status 2011 is the ratio of the CASAL prediction of SSB in 2011 to B_0, and R_0 is the MPD estimate of mean age-1 recruitment prior to exploitation (1981), and CV_R is the coefficient of variation of the annual recruitment series (1996–2008 except for a2-2011-alkpool-PE-NoAEM of 1984–2008).

Model	Description	B_0 (tonnes) (SE)	M	SSB status 2011	R_0 (million)	CV_R	Objective function value
a2-2011-alkpool-PE	WG-FSA-11/24	86 400 (1 915)	0.155 (-)	0.629	5.765	0.78	7 646[a]
a2-2011-alkpool-noPE-M13	ignore process error	109 659 (2 281)	0.130 (-)	0.544	3.968	0.59	15 340[b]
a2-2011-alkpool-noPE	ignore process error	79 952 (1 782)	0.155 (-)	0.585	5.335	0.57	15 620[b]
a2-2011-alkpool-PE-M13	a2-2011-alkpool-PE	181 151 (2 975)	0.130 (-)	0.718	6.555	1.22	7 922[a]
a2-2011-alkpool-PE-NoAEM	assume zero ageing error	79 191 (1 363)	0.155 (-)	0.568	5.284	0.24	7 773[a]

[a, b] Minimum of –2 log-likelihood, comparable values share same letter while lower values represent improved fit.

Table 6: Number of vessels notified in exploratory longline fisheries for *Dissostichus* spp. in 2011/12 (a), and corresponding number of participating Members and vessels, and catch limits agreed in *Conservation Measures in Force in 2010/11* (b).

Member notifications	Number of vessels notified by subarea/division						
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
(a) Exploratory longline fisheries for *Dissostichus* spp. in 2011/12							
France				1			
Japan	1	1	1	1	1	1	
Korea, Republic of	2	3	1			6	6
New Zealand		3	1			4	4
Norway	1					1	1
Russia	2	2				5	5
South Africa	1	1	1	1			
Spain		1	1			1	1
UK						2	2
Nos Members	5	6	5	3	1	7	6
Nos Vessels	7	11	5	3	1	20	19
(b) Limits in force in 2010/11							
Nos Members	3	5	5	1	1	7	6
Nos vessels	1*	10	5	1	1	19	17
Target species catch limit (tonnes)	400	210	70	86	0**	2850	575

* Only one vessel per Member permitted to fish at any one time
** Excluding research fishing

Table 7: Unstandardised CPUE (kg/hook) of *Dissostichus* spp. in exploratory longline fisheries since 1996/97. (Source: fine-scale data from commercial and fishery-based research hauls.)

Subarea/ division	SSRU	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
48.6	486A								0.04	0.07	0.11	0.15			0.07	0.17
	486B															0.81
	486C															0.44
	486D											0.05			0.61	
	486E									0.08		0.13		0.46	0.51	
	486G								0.02	0.07	0.16	0.07	0.12	0.23	0.17	0.28
58.4.1	5841C									0.13	0.18	0.15	0.19	0.22	0.36	0.1
	5841D												0.09			
	5841E									0.22	0.1	0.14	0.12	0.13	0.74	1.27
	5841F											0.07	0.05			
	5841G									0.2	0.22	0.24	0.12	0.1	0.12	0.09
	5841H												0.15			
58.4.2	5842A									0.08	0.08	0.13	0.2	0.2	1.22	
	5842C							0.1		0.07	0.17		0.42			
	5842D							0.19	0.06							
	5842E							0.21	0.11	0.14	0.22	0.15	0.21	0.23	0.14	1.07
58.4.3a	5843aA									0.05	0.05	0.02	0.08	0.08		0.1
58.4.3b	5843bA								0.04	0.08		0.15	0.17	0.22	0.14	
	5843bB								0.14	0.23	0.17	0.12				
	5843bC									0.07		0.04	0.12		0.1	
	5843bD									0.08	0.18	0.03	0.12	0.18	0.1	
	5843bE									0.1	0.08	0.05		0.21	0.17	
88.1	881A	0.01				0.02		0.16			0.08	0.05				
	881B	0.05	0.03			0.17	0.25	0.26	0.11	0.55	0.07	0.33	0.15	0.39	0.02	0.22
	881C					0.44	0.87	0.59	0.31	0.53	1.06	0.71	0.36	0.46	0.88	0.51
	881E		0	0.06		0.03		0.05	0.08	0.28		0.02				
	881F		0					0.03				0.16				
	881G		0.06	0.02		0.13	0.12	0.12	0.12	0.15						
	881H		0.17	0.26	0.38	0.41	0.74	0.46	0.22	0.77	0.59	0.37	0.4	0.33	0.31	0.52
	881I		0.37	0.23	0.29	0.29	0.43	0.19	0.15	0.43	0.4	0.34	0.43	0.52	0.36	0.47
	881J			0.12	0.18	0.04			0.11	0.19	0.21	0.32	0.18	0.25	0.2	0.26
	881K		0.32	0.15	0.4		0.45		0.01	0.34	0.51		0.28	0.49	0.79	0.39
	881L					0.12			0.1	0.14	0.19		0.17	0.1	0.19	0.25
	881M			0.08		0.08				0	0.58	0.39	0.31			
	882									0.14	0.06					
88.2	882A						0.82		0.11	0.47	0.54					0.28
	882B								0.06							
	882C															0.15
	882D										0.43	0.31	0.19	0.14	0.26	0.32
	882E							0.35	0.42	0.7	0.33	0.22	0.49	0.2	0.29	0.2
	882F										0.26	0.02	0.39	0.16	0.23	0.22
	882G										0.03				0.06	

Table 8: Number of individuals of *Dissostichus* spp. tagged and released and the tagging rate (fish per tonne of green weight caught) reported by vessels operating in 2010/11 in fisheries for *Dissostichus* spp. which have tagging requirements outlined in the conservation measures. The required tagging rate (required rate) for *Dissostichus* spp. is listed for each subarea and division, and does not include any additional requirements when conducting research fishing in closed SSRUs. The number of *D. eleginoides* tagged is indicated in parentheses. (Source: observer data and catch and effort reports.)

Subarea/division (required rate)	Flag State	Vessel name	TOT tagged and released	
			Number of fish	Tagging rate
48.4 (5)	New Zealand	*San Aspiring*	135 (110)	5.8
	UK	*Argos Georgia*	173 (115)	5.7
48.6 (3)	Japan	*Shinsei Maru No. 3*	594 (0)	3.0
	Korea, Republic of	*Hong Jin No. 701*	493 (52)	4.0
		Insung No. 7	132 (5)	3.0
	South Africa	*Koryo Maru No. 11*	89 (79)	3.1
58.4.1 (3)	Korea, Republic of	*Hong Jin No. 701*	180 (0)	4.5
		Insung No. 7	335 (0)	3.3
	Spain	*Tronio*	232 (0)	3.1
58.4.2 (3)	Korea, Republic of	*Insung No. 7*	408 (0)	3.0
58.4.3a (3)	Japan	*Shinsei Maru No. 3*	14 (14)	3.9
58.4.3b (5)	Japan	*Shinsei Maru No. 3*	62 (16)	5.8
88.1 (1)	Korea, Republic of	*Hong Jin No. 707*	252 (34)	1.1
		Insung No. 1	Vessel sunk	1.1*
		Insung No. 7	46 (0)	1.0
		Jung Woo No. 2	285 (0)	1.1
		Jung Woo No. 3	157 (0)	1.0
	New Zealand	*Antarctic Chieftain*	238 (0)	1.0
		Janas	172 (0)	1.0
		San Aotea II	323 (2)	1.1
		San Aspiring	202 (3)	1.1
	Russia	*Chio Maru No. 3*	196 (0)	1.4
		Gold Gate	99 (1)	1.3
		Ostrovka	18 (0)	1.0
		Sparta	110 (0)	1.2
	Spain	*Tronio*	430 (1)	1.0
	UK	*Argos Froyanes*	332 (0)	1.1
		Argos Georgia	213 (0)	1.0
88.2 (1)	Korea, Republic of	*Hong Jin No. 707*	40 (0)	0.9
		Jung Woo No. 3	35 (0)	1.1
	New Zealand	*Antarctic Chieftain*	46 (0)	1.0
		Janas	30 (0)	1.1
		San Aspiring	190 (0)	1.1
	Russia	*Chio Maru No. 3*	90 (0)	2.2
		Gold Gate	44 (0)	1.1
		Sparta	50 (0)	1.2
	UK	*Argos Froyanes*	68 (0)	1.0
		Argos Georgia	58 (0)	1.1
	Uruguay	*Ross Star*	16 (0)	1.2

* Based only on data reported in the five-day catch and effort reports

Table 9: Time series of the tag overlap statistic (CM 41-01) for *Dissostichus mawsoni* (a) and *D. eleginoides* (b) tagged by vessels actively fishing in the exploratory fisheries in 2010/11. The statistic was implemented in 2010/11, and comparative values were calculated for previous seasons. Values were not calculated for total catches of less than 2 tonnes (*) and length data were aggregated by 10 cm length intervals.

(a) *Dissostichus mawsoni*

Flag State	Vessel name	Subarea/ division	2007	2008	2009	2010	2011
Japan	*Shinsei Maru No. 3*	48.6	33	31	65	68	95
		58.4.1			*	56	
		58.4.2			36		
		58.4.3a	*		*		
		58.4.3b	29	48	36	55	*
		58.4.4b		*			
Korea, Republic of	*Hong Jin No. 701*	48.6					84
		58.4.1					74
	Hong Jin No. 707	88.1		18	25	50	63
		88.2			36		73
	Insung No. 7	48.6					54
		58.4.1					70
		58.4.2					64
		88.1					66
	Jung Woo No. 2	48.6	11				
		58.4.2	29				
		88.1	29	25	19	26	93
	Jung Woo No. 3	88.1			21	42	88
		88.2				15	84
New Zealand	*Antarctic Chieftain*	88.1			57	61	96
		88.2			61		92
	Janas	88.1	69	80	43	79	85
		88.2			73		82
	San Aotea II	88.1	52	69	77	79	88
	San Aspiring	88.1	76	74	81	88	90
		88.2					77
Russia	*Chio Maru No. 3*	88.1					78
		88.2					54
	Gold Gate	88.1					88
		88.2					76
	Ostrovka	88.1					65
	Sparta	88.1					63
		88.2					78
South Africa	*Koryo Maru No. 11*	48.6					53
Spain	*Tronio*	58.4.1	31	21			52
		58.4.3b	65				
		88.1		22	19	69	69
		88.2			17	49	
UK	*Argos Froyanes*	88.1		46	43	53	75
		88.2		31	54	54	75
	Argos Georgia	88.1	55	65		47	69
		88.2			56	*	50
Uruguay	*Ross Star*	88.1	19	21	48		
		88.2		10	64		68

Table 9 (continued)

(b) *Dissostichus eleginoides*

Flag State	Vessel name	Subarea/ division	2007	2008	2009	2010	2011
Japan	*Shinsei Maru No. 3*	48.6	36	45	26	40	*
		58.4.1			*	43	
		58.4.2			*		
		58.4.3a	*		45		84
		58.4.3b	36	36	21	*	*
		58.4.4a		*		*	
		58.4.4b		*		*	*
Korea, Republic of	*Hong Jin No. 701*	48.6					75
		58.4.1					*
	Hong Jin No. 707	88.1			21	*	*
	Insung No. 7	48.6					*
		88.1					*
	Jung Woo No. 2	48.6	42				
		58.4.2	*				
		88.1	56	42			
New Zealand	*Antarctic Chieftain*	88.1					*
	Janas	88.1	*	*	*		*
	San Aotea II	88.1	*	*	*	*	*
	San Aspiring	88.1	*	*	*	*	*
Russia	*Chio Maru No. 3*	88.1					*
	Gold Gate	88.1					*
	Ostrovka	88.1					*
	Sparta	88.1					*
		88.2					*
South Africa	*Koryo Maru No. 11*	48.6					81
Spain	*Tronio*	58.4.1	*	*			*
		58.4.3a	*				
		88.1		76	*	*	*
		88.2				*	
UK	*Argos Froyanes*	88.1			*		
		88.2				*	
	Argos Georgia	88.1	*	*			*
Uruguay	*Ross Star*	88.1	*	*			

Table 10: Number of *Dissostichus* spp. tagged and released in exploratory longline fisheries. (Source: scientific observer data)

Subarea/ division	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
48.6				4	62	171	129		941	1 213	1 308	3 828
58.4.1					462	469	1 507	1 134	1 127	627	747	6 073
58.4.2					342	136	248	673	277	291	408	2 375
58.4.3a					199	104	9	41	113		14	480
58.4.3b					231	175	289	417	356	60	62	1 590
88.1	326	960	1 068	2 250	3 209	2 972	3 608	2 574	2 943	3 066	3 073	26 049
88.2		12	94	433	355	444	278	389	603	325	667	3 600
Total	326	972	1 162	2 687	4 860	4 471	6 068	5 228	6 360	5 582	6 279	43 995

Table 11: Number of tagged *Dissostichus* spp. recaptured in exploratory longline fisheries. (Source: scientific observer data)

Subarea/ division	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
48.6						3	2		2	10	2	19
58.4.1							4	6	8	4	5	27
58.4.2									1	1		2
58.4.3a						6		2	2			10
58.4.3b					1	6	1	1	1	1		11
88.1	1	4	13	32	59	71	206	216	103	250	218	1173
88.2				18	17	28	33	36	56	44	60	292
Total	1	4	13	50	77	114	246	261	173	310	285	1534

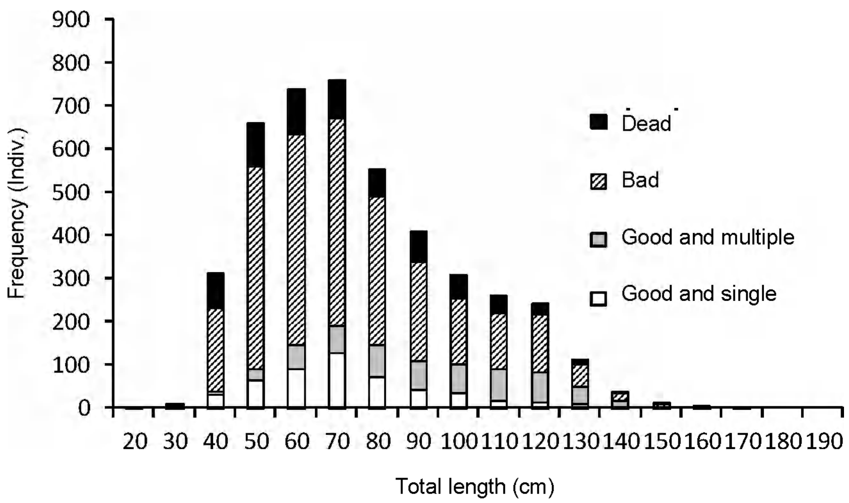

Figure 1: Fish condition and number of hook injuries as a function of size, for fish caught by trotlines in Divisions 58.4.4a and 58.4.4b (Ob and Lena Banks) by the *Shinsei Maru No. 3* in 2011. 11.7% of fish are single-hooked and in good condition.

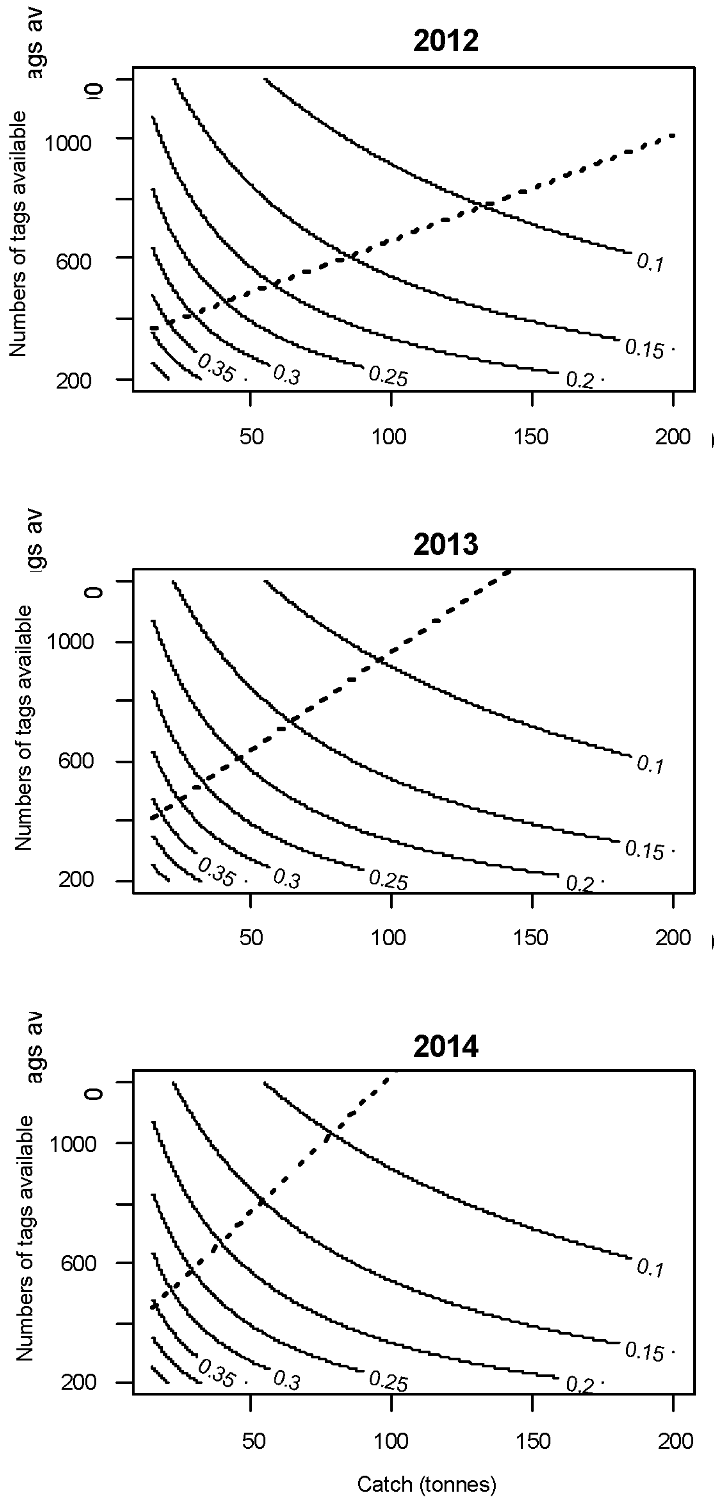

Figure 2: Estimated CVs achievable from Petersen biomass estimates as a function of research catch and number of tags available for 2012, 2013 and 2014 in Divisions 58.4.4a and 58.4.4b (Ob and Lena Banks), assuming an initial biomass of 1 928 tonnes. Note that accounting for natural mortality and post-tagging mortality, there are an estimated 314 previously tagged fish available for recapture in 2012. Dashed lines represent a tagging rate of five fish per tonne.

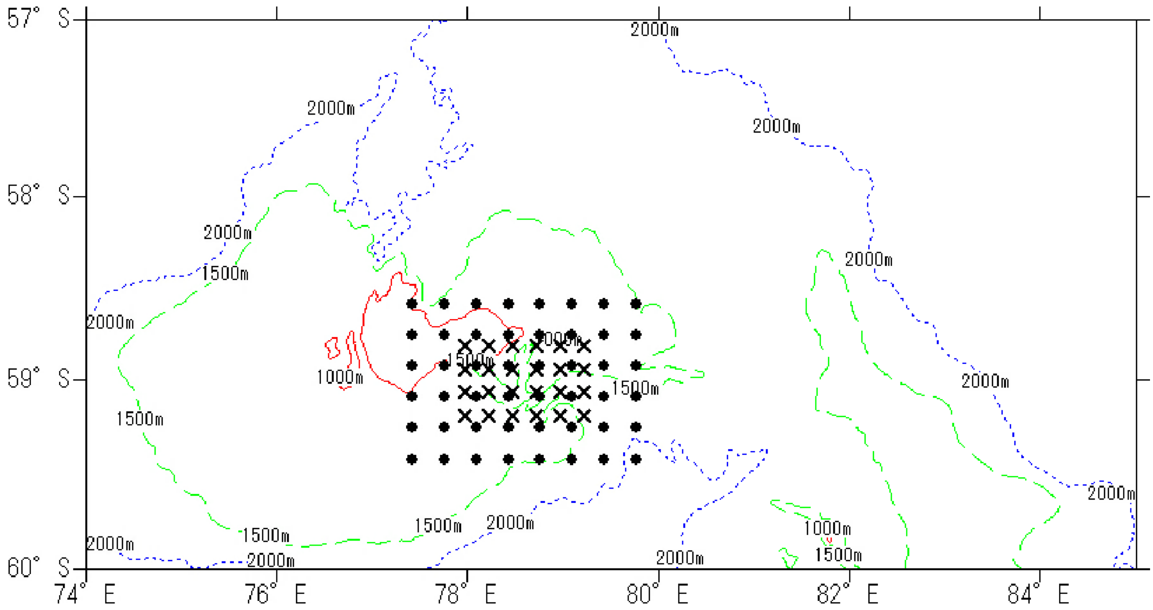

Figure 3: Proposed spatial configuration for research by the *Shinsei Maru No. 3* on BANZARE Bank in 2012. Forty-eight sets are proposed in a regular grid pattern with spacing of 10 n miles between adjacent sets.

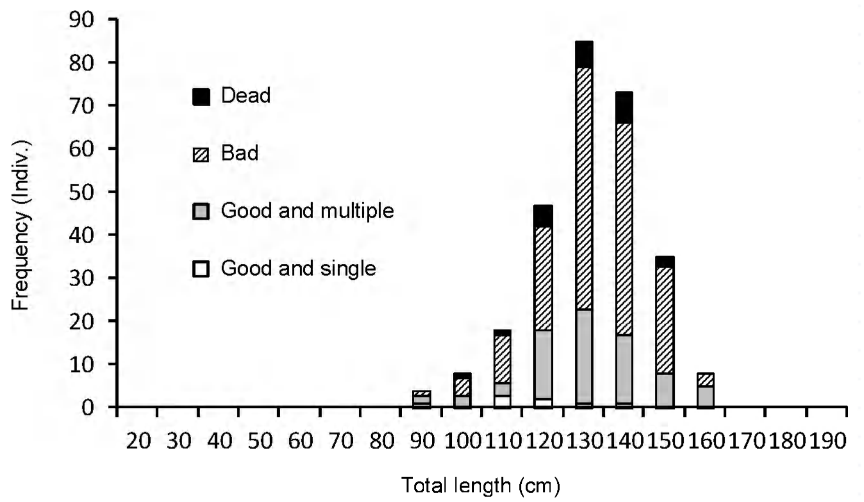

Figure 4: Fish condition and number of hook injuries as a function of size for *D. mawsoni* caught by trotlines in Division 58.4.3b (BANZARE Bank) by the *Shinsei Maru No. 3* in 2011. 2.9% of fish are single-hooked and in good condition.

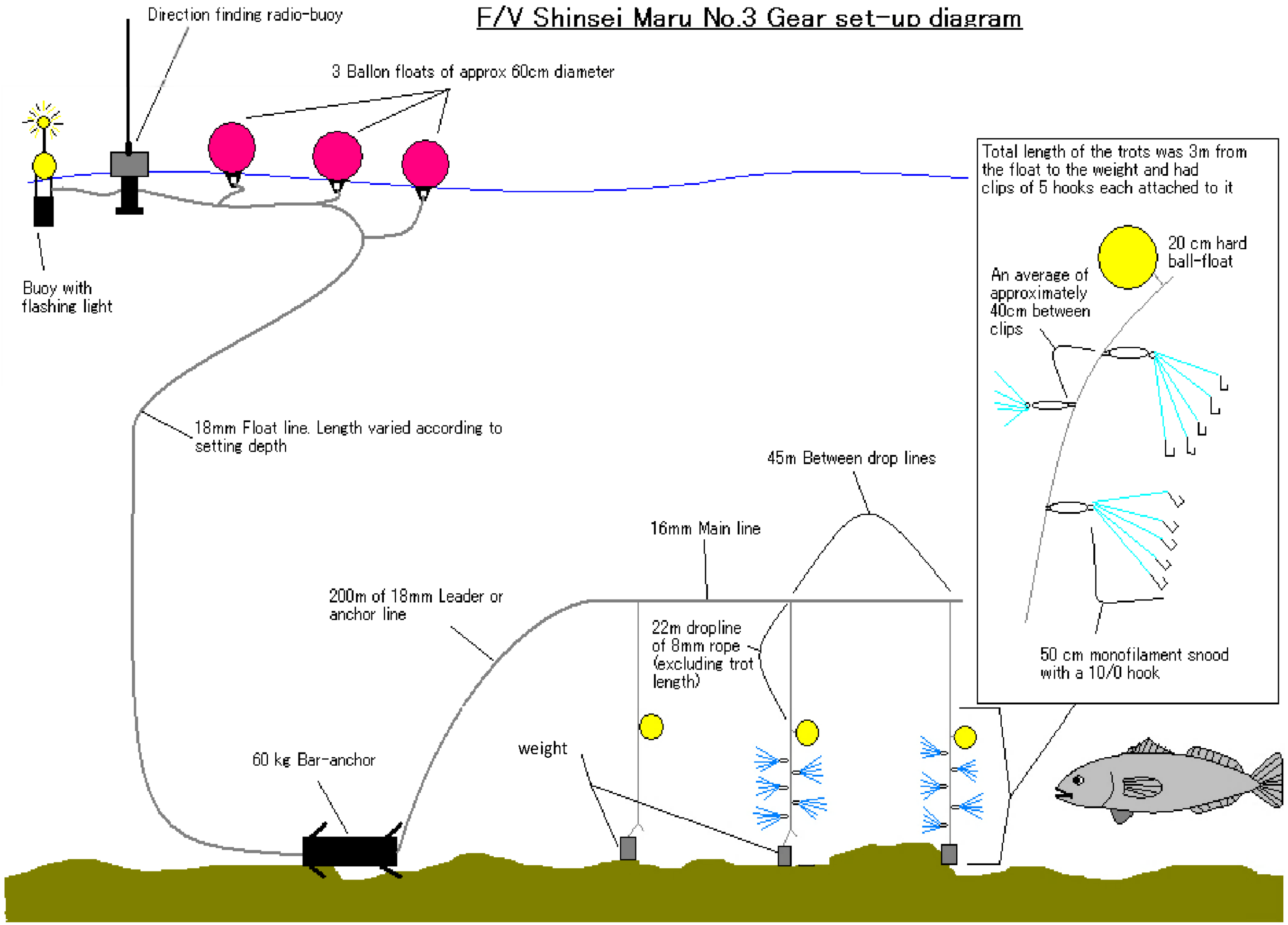

Figure 5: Gear configuration diagram for trotline gear deployed in research fishing by the *Shinsei Maru No. 3* in 2011 in Divisions 58.4.3b, 58.4.4a and 58.4.4b. Amendments to this gear configuration have been recommended by WG-FSA-11 for research in the same areas in 2012.

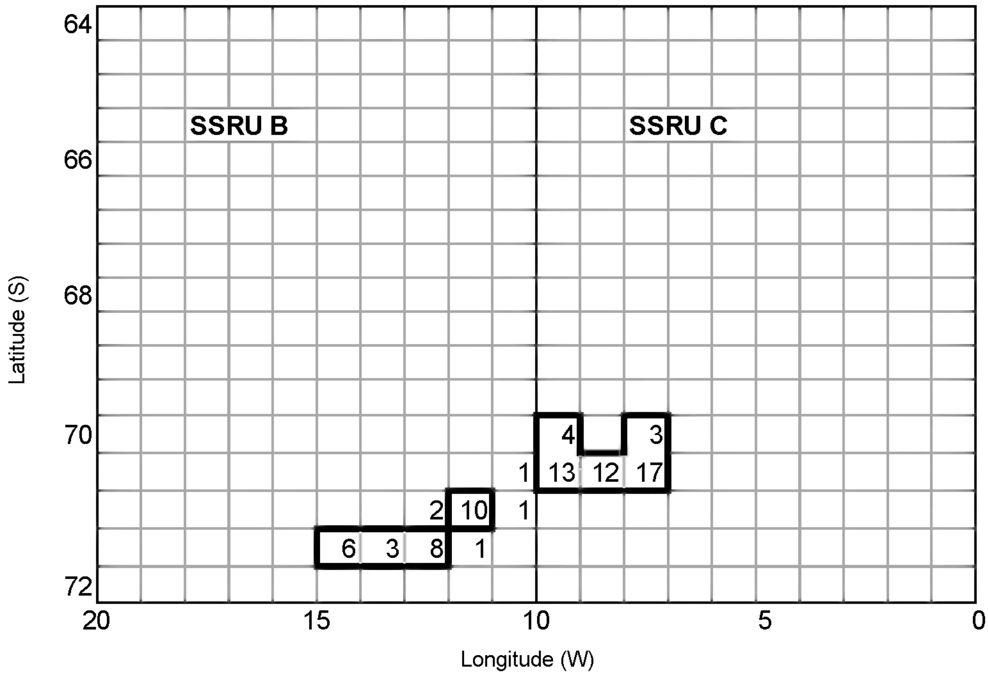

Figure 6: Fishing effort (number of sets per fine-scale rectangle) in the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 SSRUs B and C in 2009/10 and 2010/11, and example of research areas for 2011/12 (black boxes with ≥3 sets per fine-scale rectangle).

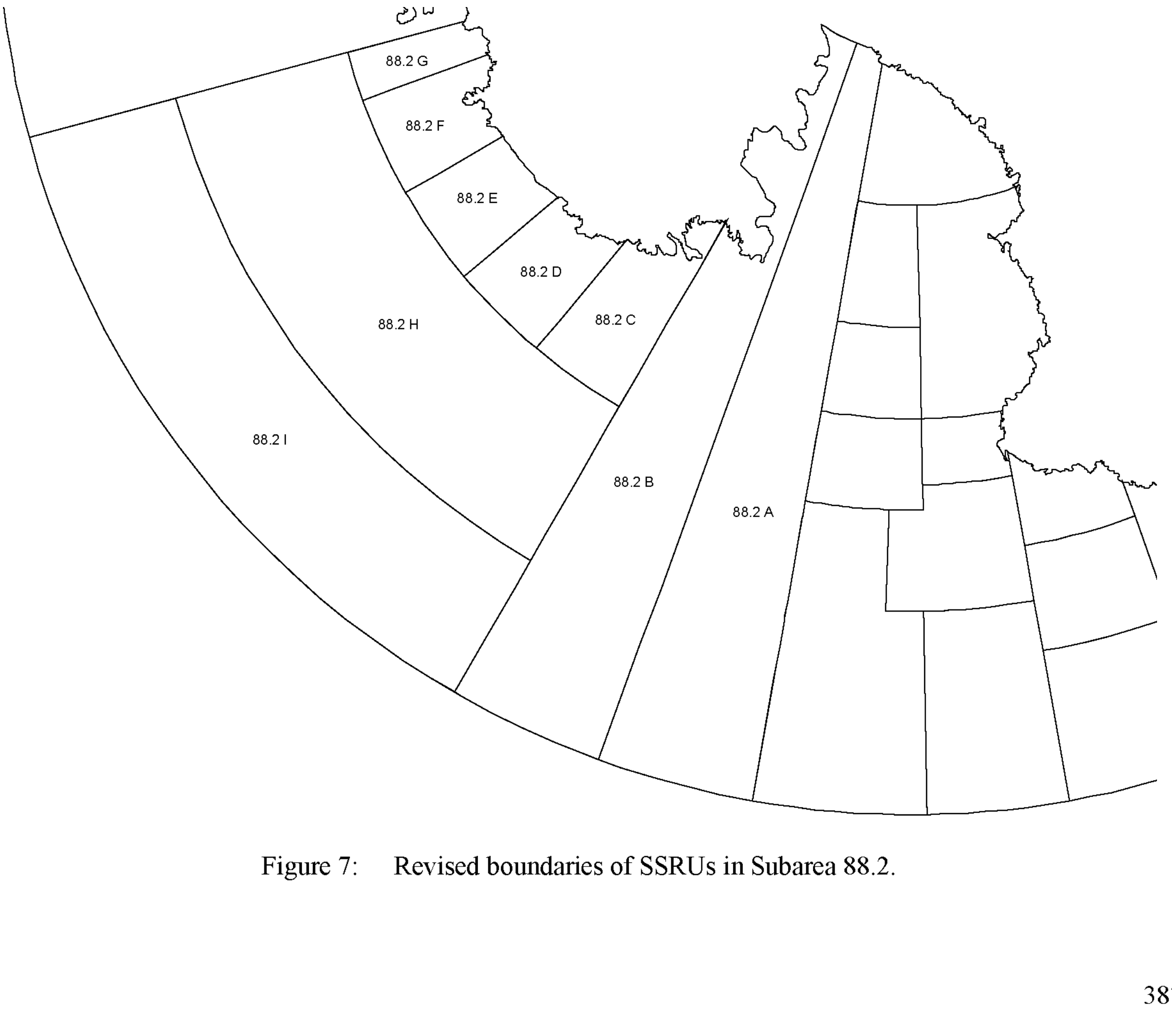

Figure 7: Revised boundaries of SSRUs in Subarea 88.2.

APPENDIX A

LIST OF PARTICIPANTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2011)

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APPENDIX B

AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2011)

1. Opening of the meeting

2. Organisation of the meeting and adoption of the agenda

   2.1 Organisation of meeting
   2.2 Subgroup organisation and coordination

3. Review of available information

   3.1 Data requirements specified in 2010
   3.2 Fisheries information

4. Preparation for assessments and assessment timetable

   4.1 Report from WG-SAM
   4.2 Review of preliminary stock assessment papers
   4.3 Progress on assessments for data poor fisheries
   4.4 Assessments to be carried out and assessment timetable

5. Research plans to inform current or future assessments

   5.1 New and exploratory fisheries
   5.2 Closed fisheries or fisheries with zero catch limits
   5.3 Research in fisheries with assessments

6. Assessments and management advice

   6.1 Update Fishery Reports for assessed fisheries

   6.2 New and exploratory fisheries
      6.2.1 New and exploratory fisheries in 2010/11
      6.2.2 New and exploratory fisheries notified for 2011/12
      6.2.3 Update Fishery Reports for new and exploratory fisheries

   6.3 Assessment and management advice for other fisheries

7. Bottom fishing activities and VMEs

8. Scheme of International Scientific Observation

    8.1 Summary of information extracted from observer reports and/or provided by technical coordinators
    8.2 Implementation of the observer program

9. Future work

    9.1 Organisation of intersessional activities in subgroups
    9.2 Intersessional meetings
    9.3 Notification of scientific research

10. Other business

11. Advice to Scientific Committee

12. Adoption of the report

13. Close of the meeting.

APPENDIX C

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2011)

WG-FSA-11/1	Provisional Agenda and Provisional Annotated Agenda for the 2011 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-11/2	List of participants
WG-FSA-11/3	List of documents
WG-FSA-11/4	Data on reproduction biology of *Dissostichus mawsoni* from the Ross Sea (Statistical Subarea 88.1) A.K. Zaytsev (Russia)
WG-FSA-11/5	Finfish by-catch in the krill fishery for the 2010 and 2011 seasons Secretariat
WG-FSA-11/6	Developments in the CCAMLR tagging program Secretariat
WG-FSA-11/7	Developments in the CCAMLR otolith program Secretariat
WG-FSA-11/8	CCAMLR fishery information 2011 Secretariat
WG-FSA-11/9	Scientific research notifications (Conservation Measure 24-01) Secretariat
WG-FSA-11/10	IUU fishing activity during the 2010/11 fishing season Secretariat
WG-FSA-11/11	Cetacean observation during krill fishing cruise (48.1, 48.2 Statistical Subareas, 2011) K. Vyshniakova (Ukraine)
WG-FSA-11/12	Information on Patagonian toothfish (*Dissostichus eleginoides*) fishery (Statistical Area 41 outside the zone of CCAMLR responsibility) Delegation of Ukraine

WG-FSA-11/13 Rev. 1	Revised reports on abundance and biological information of toothfish in Division 58.4.3b by *Shinsei Maru No.3* in 2010/11 and proposal of the consecutive survey in 2011/12 K. Taki, T. Iwami and M. Kiyota (Japan)
WG-FSA-11/14	Revised reports on abundance and biological information on toothfish in Division 58.4.4 a and b by *Shinsei Maru No. 3* in 2010/11 season K. Taki, T. Iwami and M. Kiyota (Japan)
WG-FSA-11/15 Rev. 1	Revised research plan for toothfish in Division 58.4.4 a and b by *Shinsei Maru No. 3* in 2011/12 K. Taki, T. Iwami and M. Kiyota (Japan)
WG-FSA-11/16	Preliminary studies on age, growth and size at sexual maturity of *Dissostichus eleginoides* in the Ob-Lena Bank in the 2007/08 season K. Taki, T. Iwami and M. Kiyota (Japan)
WG-FSA-11/17	Distribution and biological characteristics of two toothfish species of genus *Dissostichus* (family Nototheniidae) off Bouvet Island A.F. Petrov (Russia)
WG-FSA-11/18	To the problem of spawning character for certain fish species V. Prutko and A. Petrov (Russia)
WG-FSA-11/19	Connectivity and population structure in *Pleuragramma antarcticum* J. Ferguson, J. Ashford, A. Piñones, J. Torres, W. Fraser, C. Jones (USA) and M. Pinkerton (New Zealand)
WG-FSA-11/20	Development of a generic operating model framework for data collection, assessment method and management strategy evaluations P. Ziegler (Australia)
WG-FSA-11/21	A preliminary examination of the length–weight relationship in *Dissostichus eleginoides* and *D. mawsoni* using data from the CCAMLR Scheme of Scientific Observation Secretariat
WG-FSA-11/22	Data from recent trawl surveys in the vicinity of Heard Island and McDonald Islands (Division 58.5.2), reveal an unusual cohort structure in the mackerel icefish (*Champsocephalus gunnari*) population D.C. Welsford (Australia)

WG-FSA-11/23	Results from the random stratified trawl surveys to estimate distribution and abundance of *Dissostichus eleginoides* and *Champsocephalus gunnari* in the Heard Island region (Division 58.5.2) for 2010 and 2011 G.B. Nowara, S.G. Candy and T. Lamb (Australia)
WG-FSA-11/24	Update of the integrated stock assessment for the Patagonian toothfish (*Dissostichus eleginoides*) for the Heard and McDonald Islands (Division 58.5.2) S.G. Candy and D.C. Welsford (Australia)
WG-FSA-11/25	Fishery-based research in exploratory fisheries Secretariat
WG-FSA-11/26	The biology, ecology and development of fishery management advice for the anomuran crabs of South Georgia (CCAMLR Subarea 48.3) M. Belchier, T. Peatman and J. Brown (United Kingdom)
WG-FSA-11/27	Preliminary review of Antarctic toothfish maturity in the Ross Sea S.V. Piyanova and A.F. Petrov (Russia)
WG-FSA-11/28	Stock assessment of the Patagonian toothfish, *Dissostichus eleginoides*, harvested by the French fishery at Kerguelen Islands (division 58.5.1 of the CCAMLR) A. Relot-Stirnemann (France) (Available in English and French)
WG-FSA-11/29	Results from the groundfish survey conducted in CCAMLR Subarea 48.3 in January/February 2011 J. Brown, S. Gregory, K. Brigden, R. Benedet, O. Hogg, P. Brewin and L. Featherstone (United Kingdom)
WG-FSA-11/30 Rev. 1	Preliminary assessment of mackerel icefish, *Champsocephalus gunnari*, in Subarea 48.3 using a length based population dynamics model R.E. Mitchell and S.M. Martin (United Kingdom)
WG-FSA-11/31 Rev. 2	Summary of a three year mark-recapture experiment to estimate population size of Antarctic toothfish (*Dissostichus mawsoni*) in Southern Area of Statistical Subarea 48.4 R.C. Wakeford, T. Peatman, J. Roberts and R.E. Mitchell (United Kingdom)
WG-FSA-11/32	The Ross Sea toothfish fishery: proposal for conditional transition of classification from exploratory to established C. Jones (USA) and S. Hanchet (New Zealand)

WG-FSA-11/33 Rev. 1	Preliminary assessment of toothfish in Subarea 48.3 T. Peatman, R.E. Mitchell, G. Parkes and D.J. Agnew (United Kingdom)
WG-FSA-11/34	Recommendation for an explicit limit reference point for the mackerel icefish (*Champsocephalus gunnari*) fishery in CCAMLR Statistical Division 58.5.2 Delegation of Australia
WG-FSA-11/35	Estimation of catch rate and mean weight in the exploratory *Dissostichus* fisheries across Divisions 58.4.1 and 58.4.2 using generalised additive models D.C. Welsford (Australia)
WG-FSA-11/36	Results of phase I of the Russian research program for toothfish fishery in Subarea 88.3 during the 2010/11 season Delegation of Russia
WG-FSA-11/37	Plan of research fishing in Subarea 88.3 in the 2011/12 season Delegation of Russia
WG-FSA-11/38	Population assessment of Patagonian toothfish in Subarea 48.4 – 2011 update J. Roberts, R. Mitchell and R. Wakeford (United Kingdom)
WG-FSA-11/39 Rev. 1	New gonad identification guides for *Dissostichus eleginoides* N. Gasco (France), J. Brown (United Kingdom) and G. Duhamel (France)
WG-FSA-11/40	Comprehensive field guide of Antarctic fishes N. Gasco (France)
WG-FSA-11/41	By-catch observation during krill fishing cruise (48.1, 48.2 Statistical Subareas, 2011) K. Vyshniakova (Ukraine)
WG-FSA-11/42	Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea for the years 1997–98 to 2010–11 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-11/43	Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.2 SSRUs 88.2C–G for the years 2002–03 to 2010–11 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)

WG-FSA-11/44	Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.2 SSRU 88.2E for the years 2002–03 to 2010–11 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-11/45	A characterisation of the toothfish fishery in Subareas 88.1 and 88.2 from 1997–98 to 2010–11 M.L. Stevenson, S.M. Hanchet, S. Mormede and A. Dunn (New Zealand)
WG-FSA-11/46	Descriptive analysis of the toothfish (*Dissostichus* spp.) tagging programme in Subareas 88.1 & 88.2 for the years 2000–01 to 2010–11 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-11/47	Revised proposal for a CCAMLR sponsored research survey to monitor abundance of pre-recruit Antarctic toothfish in the southern Ross Sea S.M. Hanchet, S. Mormede, S.J. Parker and A. Dunn (New Zealand)
WG-FSA-11/48	Estimating unaccounted fishing mortality in the Ross Sea and 88.2C–G bottom longline fisheries targeting Antarctic toothfish D.N. Webber and S.J. Parker (New Zealand)
WG-FSA-11/49	Pilot study using electronic satellite tags to determine movements of Antarctic toothfish in the Ross Sea region S. Parker (New Zealand)
WG-FSA-11/50	CCAMLR measures regulating the tagging of *Dissostichus* species, metrics used to assess vessel tagging performance, the potential for some anomalous results, and general recommendations on tagging; a view from the hauling room J.M. Fenaughty (New Zealand) and J. Brown (United Kingdom)
WG-FSA-11/51 Rev. 1	plotImpact – software for producing image plots of spatially referenced impact assessments D.N. Webber (New Zealand) and J.P. McKinlay (Australia)
WG-FSA-11/52	Summary of otoliths held in Cape Town that were collected within the CCAMLR area R. Leslie, C. Heinecken and P. Mullins (South Africa)
WG-FSA-11/53	Description of fishing gear and procedures of setting / hauling of Spanish longline system for toothfish in CCAMLR area T. Jung and H.J. Choi (Republic of Korea)

WG-FSA-11/54	The results of performance of tagging programs of the Korean exploratory fishery for *Dissostichus* spp. in 88.1 in the 2010/11 season T. Jung and H.J. Choi (Republic of Korea)

Other documents

WG-FSA-11/P1	Lead-radium dating provides a framework for coordinating age estimation of Patagonian toothfish (*Dissostichus eleginoides*) between fishing areas A.H. Andrews, J.R. Ashford, C.M. Brooks, K. Krusic-Golub, G. Duhamel, M. Belchier, C.C. Lundstrom and G.M. Cailliet (*Mar.Freshw. Res.*, 62 (2011): 781–789)
WG-FSA-11/P2	New data on depths inhabited by striped-eyed rock cod *Lepidonotothen kempi* (Norman) (Nototheniidae) off Bouvet Island A.F. Petrov (*J. Ichthyol.*, 51 (8) (2011): 683–685)
WG-FSA-11/P3	The diet of toothfish species *Dissostichus eleginoides* Smitt and *D. mawsoni* Norman with overlapping distributions around the South Sandwich Islands, Southern Ocean J. Roberts, J. Xavier and D. J. Agnew (*J. Fish Biol.*, 79 (2011): 138–154)

Appendices D to R are only available electronically at: www.ccamlr.org/pu/e/e_pubs/fr/drt.htm

REPORT OF THE WORKING GROUP ON INCIDENTAL MORTALITY ASSOCIATED WITH FISHING

(Hobart, Australia, 10 to 12 October 2011)

CONTENTS

REPORT OF THE WORKING GROUP ON INCIDENTAL MORTALITY ASSOCIATED WITH FISHING
(Hobart, Australia, 10 to 12 October 2011)

OPENING OF THE MEETING

1.1 The meeting of WG-IMAF was held in Hobart, Australia, from 10 to 12 October 2011.

1.2 The Convener, Mr J. Moir Clark (UK), opened the meeting and welcomed participants, including the invited expert from ACAP (Mr B. Baker).

Organisation of the meeting and adoption of the agenda

1.3 The provisional agenda for the meeting was discussed and adopted (Appendix A).

1.4 The participants thanked Mr Moir Clark for his work in preparing for the meeting and in taking over the duties of Convener following the non-availability of the former Co-conveners of the Working Group.

1.5 The report was prepared by the participants and includes a list of participants (Appendix B) and a list of documents considered at the meeting (Appendix C).

1.6 In this report, paragraphs that provide advice to the Scientific Committee have been highlighted. A list of these paragraphs is provided in Item 11.

INTERSESSIONAL WORK OF WG-IMAF

2.1 The Convener reported on progress made in addressing the intersessional tasks of WG-IMAF according to the agreed plan of intersessional activities for 2008/09 (SC-CAMLR-XXVIII, Annex 7, Table 1), noting in particular the material provided to the observer accreditation process and advice on materials that should be available to observers to assist in the data collection relating to seabirds and marine mammals (including identification, activity data and sample collection).

2.2 The Working Group noted that CCAMLR Members have reported data on incidental mortality of seabirds in fisheries adjacent to the Convention Area to ACAP, and that the reporting formats for this data are currently under development by ACAP. Members are encouraged to continue this provision of data to ACAP, especially where Convention Area seabirds may be involved.

2.3 Dr K. Reid (Science Officer) reported on discussions between the Secretariats of ACAP and CCAMLR to further enhance the integration of their work, especially in light of the MOU signed between ACAP and CCAMLR two years ago. This included the presentation of the reports of relevant working groups of ACAP to SC-CAMLR.

2.4 Other issues raised in Table 1 of SC-CAMLR-XXVIII, Annex 7, are addressed in the appropriate sections of this report.

INCIDENTAL MORTALITY OF SEABIRDS AND MARINE MAMMALS IN FISHERIES IN THE CONVENTION AREA

Seabirds

Seabirds in longline fisheries

3.1 Data were available from all longline cruises conducted in the Convention Area during the 2010/11 season (WG-IMAF-11/5 Rev. 2, Table 2).

3.2 The proportions of hooks observed ranged from 16 to 100%, with an average of 53% (WG-IMAF-11/5 Rev. 2, Table 2).

3.3 The total extrapolated seabird mortalities due to interactions with fishing gear during longline fishing for *Dissostichus* spp. in the Convention Area in 2010/11 were estimated to be 220 (all within the French EEZs) (WG-IMAF-11/5 Rev. 2, Table 4). These consisted of 82% white-chinned petrels (*Procellaria aequinoctialis*), 12% grey petrels (*P. cinerea*), 4% northern giant petrels (*Macronectes halli*) and 2% rockhopper penguins (*Eudyptes chrysocome*).

3.4 The total number of seabirds observed caught and released uninjured was 32 (WG-IMAF-11/5 Rev. 2, paragraph 5, Tables 2 and 3), all caught during hauling. Of these, seven were caught within Subarea 48.3, and 24 within the French EEZs in Subarea 58.6 (2 birds) and Division 58.5.1 (22 birds). All vessels, except one fishing in Subarea 58.7, recorded the use of a haul scaring device (WG-IMAF-11/5 Rev. 2, paragraph 11).

Seabird incidental mortality in the French EEZs in Subarea 58.6 and Division 58.5.1

3.5 Data were available from eight cruises in Subarea 58.6 and 15 cruises in Division 58.5.1 in 2010/11. All vessels in the French EEZs were autoliners using at least 50 g m^{-1} IWLs. The proportion of hooks observed was 26% in Subarea 58.6 and 25% in Division 58.5.1, the total observed seabird incidental mortality was 7 and 49 birds respectively (sum of dead and injured birds) (WG-IMAF-11/5 Rev. 2, Table 3). The corresponding incidental mortality rates were 0.009 and 0.015 birds/thousand hooks and the extrapolated total seabird mortalities for Subarea 58.6 and Division 58.5.1 were 27 and 193 respectively (WG-IMAF-11/5 Rev. 2, Table 4).

3.6 The observed captures in Subarea 58.6 comprised seven white-chinned petrels. The observed catches for Division 58.5.1 were 39 (80%) white-chinned petrels, seven (14%) grey petrels, two (4%) northern giant petrels and one (2%) rockhopper penguin (WG-IMAF-11/5 Rev. 2, paragraph 8).

3.7 The Working Group noted that when comparing the seabird incidental mortality rates provided by France, there was a reduction of 74% and 40% for Subarea 58.6 and Division 58.5.1 respectively from the previous season; a reduction of 47% from the combined total estimated incidental mortality from these areas.

Review of progress made to reduce seabird mortality in the French EEZs

3.8 The Working Group thanked Mr A. Falguier (France) for the comprehensive report on progress made to reduce seabird mortality in the French EEZs (WG-IMAF-11/10 Rev. 1), noting that this demonstrated that a significant reduction in by-catch could be achieved with improved mitigation measures, while also identifying the areas where further reductions can be made.

3.9 The analysis provided in WG-IMAF-11/10 Rev. 1 showed high variability in seabird by-catch between vessels; this was attributed to differences in the level and effectiveness of the implementation of by-catch mitigation. The increase in number of birds caught in Subarea 58.6 between 2009 and 2010 was due to a single vessel.

3.10 The highest numbers of white-chinned petrels were caught immediately before and after the period of closure (1 February to 15 March), however, some vessels that fished during these periods caught very few birds. Accordingly, the approach taken by France is to ensure that all vessels fully implemented the required measures rather than increasing the period of the closure.

3.11 Mr Falguier explained that the approach taken by France to further reduce seabird by-catch is to have all vessels achieving the by-catch rates of the best performing vessels. As an incentive to do this, those vessels that caught the largest number of birds receive a reduced allocation of quota for toothfish in subsequent seasons.

3.12 Mr Falguier noted that the work done in conjunction with WG-IMAF has allowed France to lower its incidental mortality of seabirds over the last three years and he confirmed France's will and commitment to achieve a level of near-zero in coming years, adding its intention is to work individually with vessels, especially those with the highest catch rates to ensure best-practice guidelines are followed.

3.13 The Working Group noted that France intends to undertake a demographic study on the white-chinned petrel at Kerguelen Island and that a new survey on Crozet Island, planned for November 2011, will provide a comparison with data from surveys conducted in 2005.

3.14 The Working Group applauded the substantial progress made by France and reiterated its previous advice (SC-CAMLR-XXVIII, Annex 7, paragraph 3.54) that full implementation of best-practice would further reduce seabird by-catch.

3.15 During the meeting it was noted that there were some differences in the numbers of total extrapolated mortality of seabirds in the French EEZs presented in WG-IMAF-11/5 Rev. 2 and WG-IMAF-11/10 Rev. 1. Some of these numerical inconsistencies between the two reports were attributed to differences in the reporting periods used in the analyses. However, full reconciliation of the differences was not possible at the meeting. The Working

Group requested that the Secretariat and appropriate French officials liaise in the intersessional period to ensure that future updates of incidental mortality data are consistent.

Seabirds in trawl fisheries

Subarea 48.3 icefish

3.16 Observer data were available from one trawl cruise (data from one cruise was not available at the time the report was compiled) conducted within Subarea 48.3 in 2010/11 (WG-IMAF-11/5 Rev. 2); 100% of all tows were observed (WG-IMAF-11/5 Rev. 2, Table 10).

3.17 For 2010/11, no seabird mortalities were reported in Subarea 48.3 (WG-IMAF-11/5 Rev. 2, Table 8).

3.18 This represents a decrease in the level of seabird mortality in 2009/10 where two were recorded dead and 16 recorded released alive. The rate of mortality in Subarea 48.3 in 2011 was 0 birds per trawl, compared to 0.07, 0.07, 0.024, 0.07 and 0.07 in 2010, 2009, 2008, 2007 and 2006 respectively (WG-IMAF-11/5 Rev. 2, Table 11).

Division 58.5.2 toothfish/icefish

3.19 Data were available from one vessel, *Southern Champion*, which conducted one trawl cruise within Division 58.5.2 in 2010/11 (WG-IMAF-11/5 Rev. 2, Table 7). The Working Group noted that 390 trawls were undertaken and that 100% of these were observed.

3.20 No seabird mortality was reported, however, there were six instances of interaction with gear observed with all birds uninjured and released alive (WG-IMAF-11/5 Rev. 2, paragraph 34).

Krill

3.21 Data were available from 19 trawl cruises conducted within Area 48 in 2010/11 (WG-IMAF-11/5 Rev. 2), with two more observer reports still due. In the krill fishery, 20% of vessels fishing in Subarea 48.1, 57% of vessels fishing in Subarea 48.2 (two cruises) and 100% of vessels fishing in Subarea 48.3 had observers on board at some time during their trips. There were four reported incidents of seabird incidental mortality (all Cape petrels (*Daption capense*)) in Subarea 48.2, giving a calculated total observed seabird mortality rate for Area 48 of 0.002 birds per trawl (WG-IMAF-11/5 Rev. 2, Table 10). This mortality rate is the same as in the previous season. A further six birds were released alive uninjured (WG-IMAF-11/5 Rev. 2, Table 8).

3.22 Net cleaning was reported by observers on all the vessels except for the *Juvel* and *Saga Sea* in Area 48. Due to the nature of the continuous trawl system, it was considered that the *Saga Sea* net was self-cleaning. The *Saga Sea* continued to use bow thrusters which helped to maintain vessel speed while the vessel turned, and limited seabird exposure to the nets. Net weighting was used by all vessels except for the *Fukuei Maru* (WG-IMAF-11/5 Rev. 2, paragraph 25).

Seabirds in pot fisheries

3.23 During pot fishing in 2010/11, no seabird mortalities were recorded during the single cruise targeting *Dissostichus eleginoides* in Division 58.5.2 (WG-IMAF-11/7, paragraph 40).

Marine mammals

Marine mammals in longline fisheries

3.24 No marine mammal incidental mortalities were recorded in the Convention Area in 2010/11 (WG-IMAF-11/5 Rev. 2, paragraph 10). There was one reported entanglement of a sperm whale (*Physeter macrocephalus*) in the fishing line of the *Argos Froyanes* in Subarea 48.3, which freed itself.

Marine mammals in trawl fisheries

Krill

3.25 A single marine mammal incidental mortality (fur seal) was recorded in the krill trawl fishery in 2010/11 from the *Dalmor II* in Subarea 48.1 (WG-IMAF-11/5 Rev. 2, Table 8).

3.26 Observers reported the use of marine mammal exclusion devices on all vessels. There were no reports of other marine mammal mortalities or entanglements.

Finfish

3.27 No marine mammal incidental mortalities were observed in finfish trawl fisheries (WG-IMAF-11/5 Rev. 2, paragraph 30 and Table 8).

Marine mammals in pot fisheries

3.28 No marine mammal incidental mortalities were reported for pot fisheries in the Convention Area (WG-IMAF-11/5 Rev. 2).

Information relating to the implementation of CMs 26-01, 25-02, 25-03 and 51-01

3.29 Information from observer reports relating to the implementation of CMs 26-01, 25-02, 25-03, 24-02 and 51-01 in 2010/11 was provided by the Secretariat (WG-IMAF-11/6).

CM 26-01 'General environmental protection during fishing'

Plastic packaging bands

3.30 There were no reports of bait box packaging bands on board vessels this season. All other types of packaging bands were either retained on board for disposal on shore or incinerated (WG-IMAF-11/6, Table 1).

Gear debris and garbage

3.31 The Working Group noted one vessel had disposed of fishing gear (snoods) at sea (WG-IMAF-11/6, Table 1).

CM 25-02 'Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area'

Line weighting

3.32 In 2010/11, full compliance with line weighting for Spanish longline systems (6 kg every 20 m or 8.5 kg every 40 m or hydrodynamic-shaped solid steel weights of at least 5 kg every 40 m) was achieved for all but one vessel in Subarea 58.4 (WG-IMAF-11/6, Table 3). It was noted that this vessel also used an IWL system with 200 g m^{-1} and achieved the minimum sink rate.

3.33 For autoliners, all vessels fishing in Subareas 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, met the requirement to achieve a consistent minimum line sink rate as described in CM 24-02 (WG-IMAF-11/6, Table 5).

Night setting

3.34 There was 100% compliance with night setting in all areas where this was required (Subareas 48.3, 58.6 and 58.7) (WG-IMAF-11/6, Table 3).

3.35 Vessels fishing in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b and 58.5.2, may set longlines during daylight hours providing they can demonstrate a consistent minimum line sink rate of 0.3 m s^{-1}, or use an IWL of at least 50 g m^{-1} and achieve a sink rate of 0.2 m s^{-1}. All vessels fishing in these areas fully implemented one or both of these requirements (WG-IMAF-11/6, Table 5).

Offal discharge

3.36 All longline vessels fully implemented the requirement to retain offal on board in all areas where this was required (Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b and 58.5.2) during the 2010/11 season (WG-IMAF-11/6, Table 3).

Discard of hooks

3.37 Hooks were reported by the observer in the offal discards on rare occasions in Subareas 58.6 and 58.7 (WG-IMAF-11/6, Table 1).

Streamer lines

3.38 The overall compliance with streamer line design was lower this season than in 2009/10, with six vessels failing to meet the minimum specifications with all aspects of streamer line design (WG-IMAF-11/6, Table 2). The Working Group noted that these small deviations from full implementation with streamer line configuration had not led to any observed seabird incidental mortality. Nevertheless, the Working Group encouraged vessels to strive for full implementation.

3.39 The Working Group recommended that recording of aerial extent of streamer lines should be discontinued for night setting.

Haul mitigation

3.40 In all required areas (Subareas 48.3, 58.6, 58.7 and Division 58.5.2), a bird exclusion device designed to discourage birds from accessing baits during the hauling of a longline was used 100% of the time by all but two vessels (WG-IMAF-11/6, Table 2).

CM 25-03 'Minimisation of the incidental mortality of seabirds and marine mammals in the course of trawl fishing in the Convention Area'

3.41 A range of mitigation measures was used on board icefish vessels in Subarea 48.3 and Division 58.5.2 (WG-IMAF-11/5 Rev. 2) and implementation of CM 25-03 was good.

Net sonde cables

3.42 There were no reports of net monitoring cables (net sonde cables) being used in 2010/11.

Offal discharge

3.43 Several observers on board krill trawl vessels reported the discharge of 'stickwater', a liquid containing pigments and oil naturally excreted from krill. The Working Group recommended that a clarification be added to CM 25-03 on the definition of offal, distinguishing it from stickwater, and that a note needed to be added to the observer logbooks informing them not to record stickwater.

CM 51-01 'Precautionary catch limitations on *Euphausia superba*'

3.44 Paragraph 7 of CM 51-01 requires the use of marine mammal exclusion devices on trawls in Subareas 48.1, 48.2, 48.3 and 48.4 and observers reported the use of marine mammal exclusion devices on all vessels.

Summary of conservation measure implementation

3.45 The Working Group recalled SC-CAMLR-XXVIII, paragraph 5.6, and agreed that SCIC should review WG-IMAF-11/6 in respect of the implementation of CMs 26-01, 25-02, 25-03 and 51-01, noting that any deterioration in the implementation of conservation measures relating to the mitigation of incidental mortality may have implications for seabird conservation.

INCIDENTAL MORTALITY OF SEABIRDS AND MARINE MAMMALS IN FISHERIES OUTSIDE THE CONVENTION AREA

4.1 The Working Group recalled the CCAMLR standing request to Members to report on the details and magnitude of seabird mortality for species breeding within the Convention Area, but arising from fisheries conducted outside the Convention Area (SC-CAMLR-XXVII, Annex 6, paragraph 4.3).

4.2 A written report was provided by Dr R. Leslie (South Africa) (WG-IMAF-11/11) noting the level of seabird incidental mortality within the five South African fishing sectors most likely to impact on seabirds and South Africa's progress to reduce it. The report highlighted high levels of Cape petrel warp captures in the demersal trawl fishery which were traced to the warp manufacturer using bitumen-based warp grease. The bitumen-based grease was found to stick to the warps for longer periods than other greases and was more prone to capturing smaller seabirds such as Cape petrels. The report went on to describe, inter alia, the banning of bitumen-based grease on trawl warps in the South African offshore hake and horse mackerel fisheries initiated by the Responsible Fisheries Alliance (RFA), made up of WWF South Africa and four of the major demersal trawl fishing companies.

4.3 The Working Group thanked South Africa for submitting the information and supported the action taken by South Africa in banning bitumen-based warp grease. It encouraged South Africa to continue to take actions in the future to reduce incidental mortality, and urged Members not to use bitumen-based grease on warps.

4.4 WG-IMAF-11/13 recognised the relevance of a recently published global assessment of seabird by-catch in longline fisheries conducted by BirdLife (Anderson et al., 2011), which had been carried out by reviewing the extent of seabird by-catch in all longline fisheries for which data are available. Despite the limitations of such data, the published estimate indicated at least 160 000 (and potentially in excess of 320 000) seabirds are killed annually. Most frequently caught are albatrosses, petrels and shearwaters, with current levels of mortality liable to be unsustainable for many species and populations.

4.5 Where realistic comparisons could be made with data from the 1990s, there was evidence of substantially reduced by-catch in some key fisheries, including CCAMLR fisheries. Reductions stemmed from decreased fishing effort, and wider and more effective use of mitigation measures, notably in demersal longline fisheries. Fisheries with previously unidentified by-catch problems were also identified. The authors noted that significant data gaps (e.g. in the Asian distant-water fleet) prevented more precise and comprehensive assessments of the global scale of by-catch impacts. Future assessments will only achieve greater precision when minimum standards of data collection, reporting and analysis are implemented by longline fishing fleets, relevant national fishery managers and RFMOs. Those fisheries where by-catch has been substantially reduced demonstrated that the problem of seabird by-catch can be reduced to negligible proportions by enforced implementation of appropriate best-practice mitigation devices and techniques.

4.6 Mr Baker reported that over the last two years ACAP has been working on a prioritisation framework to guide the work of the ACAP Agreement (WG-IMAF-11/13 and 11/14). While this has been completed for land-based threats, final conclusions from the at-sea prioritisation framework were unlikely to be available until the end of 2011. In the interim, ACAP's Seabird Bycatch Working Group (SBWG) and the Population and Conservation Status Working Group (PaCSWG) acknowledged the clear advantage of highlighting particularly strong cases on which ACAP might focus its efforts.

4.7 An examination of the available data on population size and trends in the ACAP database identified five populations representing sizeable proportions (>10% of the global total) that were declining rapidly (>3% per annum), for which a major underlying cause was incidental mortality in fisheries. These were the wandering albatross (*Diomedea exulans*) and black-browed albatross (*Thalassarche melanophrys*) populations at South Georgia, the Tristan albatross (*D. dabbenena*) at Gough Island and the sooty albatross (*Phoebetria fusca*) at the Crozet and Prince Edward Islands. These were all considered to be of high-priority, and ACAP agreed that addressing threats to their population required urgent and coordinated international action.

4.8 Necessary actions include: (i) gathering new and existing by-catch data in relevant fisheries and submitting those data to ACAP; (ii) specifically highlighting the conservation threat to these species/populations to RFMOs and others managing fisheries within the foraging distribution of those populations; and (iii) requesting that those fisheries implement best-practice seabird by-catch mitigation measures. The Working Group endorsed these recommendations and requested all Members to comply with this request where relevant to fisheries within their jurisdiction.

4.9 Mr Baker also reported that by-catch and fishing effort data have recently been provided by ACAP Parties for the purpose of determining global estimates of by-catch for albatrosses and petrels. These data have been provided in summary format, rather than on a shot-by-shot basis, and are currently awaiting analysis. An intersessional working group has been formed to determine the best analytical approaches to apply to the data, and to consider the extent to which the original objectives of the by-catch data collection process are able to be fulfilled by the data.

4.10 Given that considerably greater levels of mortality of Convention Area seabirds continue to occur in areas north of the Convention Area, compared to levels within the Convention Area, the Working Group again urged all Members to comply with the request to report on incidental mortality of Convention Area seabirds and marine mammals arising from fisheries conducted outside the Convention Area (Resolution 22/XXV, paragraph 3; SC-CAMLR-XXV, Annex 5, Appendix D, Table 20, item 3.2). Members submitting reports in 2012 are encouraged to give emphasis to information on incidental mortality, numbers by species wherever possible, and the use of mitigation measures and management approaches similar to those used in CCAMLR fisheries or potentially relevant to such fisheries.

4.11 No data were received relating to fisheries' incidental mortality of Convention Area marine mammals outside the Convention Area.

INCIDENTAL MORTALITY OF SEABIRDS DURING IUU FISHING IN THE CONVENTION AREA

5.1 As no information is available on rates of incidental mortality of seabirds from the IUU fishery, estimation of the incidental mortality of seabirds during IUU fishing within the Convention Area presents a number of difficulties requiring various assumptions to be made. Notwithstanding this, in previous years the Working Group has prepared estimates of seabird incidental mortality in IUU longline fisheries using both the average catch rate for all cruises from the appropriate period of the regulated fishery in a particular area and the highest catch rate for any cruise in the regulated fishery for that period. The method used to prepare estimates of the incidental mortality of seabirds during IUU fishing within the Convention Area is described in full in SC-CAMLR-XXV/BG/27 and in SC-CAMLR-XXII, Annex 5, paragraphs 6.112 to 6.117.

5.2 Estimates of IUU seabird incidental mortality in longline fisheries were prepared every year from 1996 to 2007. The most recent estimates (2007) of potential IUU seabird incidental mortality in the Convention Area for longline vessels are provided in SC-CAMLR-XXVI/BG/32.

5.3 The Working Group noted that, given the absence of baited hooks, the risks to seabirds posed by gillnetting were quite different to those from longlining and, because of the reasons described in 2008 (SC-CAMLR-XXVII, Annex 6, paragraph 5.3), reiterated its view that there were insufficient data to estimate seabird incidental mortality caused by IUU gillnetting.

5.4 The Working Group encouraged Members that conducted gillnet fishing in areas outside the Convention Area to investigate factors affecting the incidental mortality of marine mammals and seabirds.

RESEARCH INTO AND EXPERIENCE WITH MITIGATION MEASURES

6.1 Mr Baker introduced WG-IMAF-11/13 which presented key outcomes of the Fourth Meeting of ACAP's SBWG (22 to 24 August 2011). Of relevance to WG-IMAF and this agenda item were the regular reviews of mitigation measures available for both demersal and pelagic trawl, and demersal longline gear types, based on published literature and expert opinion, and the best-practice scientific advice statements for these gears.

Trawl gear

6.2 ACAP's best-practice advice noted that the causes of incidental mortality in trawl fisheries are varied and dependent on the nature of the fishery (pelagic or demersal), the species targeted and fishing area. Mortalities may be categorised into two broad types: (i) cable-related mortality, including collisions with net monitoring cables, warp cables and paravanes; and (ii) net-related mortality, which includes deaths caused by net entanglements. Seabird interactions have been demonstrated to be significantly reduced by the use of mitigation measures that include protecting the warp cable, managing offal discharge and discards, and reducing the time the net is exposed on the surface of the water. The following measures have been demonstrated to be effective at reducing seabird by-catch in trawl fisheries and are recommended:

Cable strike –

(i) deploy bird-scaring lines while fishing to deter birds away from warp cables and net monitoring cables.

Net entanglement –

(ii) clean nets after every shot to remove entangled fish ('stickers') and benthic material to discourage bird attendance during gear shooting

(iii) minimise the time the net is on the water surface during hauling through proper maintenance of winches and good deck practices

(iv) for pelagic trawl gear, apply net binding to large meshes in the wings (120–800 mm), together with a minimum of 400 kg weight incorporated into the net belly prior to setting.

6.3 In all cases, the presence of offal and discards is the most important factor attracting seabirds to the stern of trawl vessels, where they are at risk of cable and net interactions. Managing offal discharge and discards while fishing gear is deployed has been shown to reduce seabird attendance. The following management measures are recommended:

(i) avoid any discharge during shooting and hauling

(ii) where possible and appropriate, convert offal into fish meal and retain all waste material with any discharge restricted to liquid discharge/sump water to reduce the number of birds attracted to a minimum

(iii) where meal production from offal and full retention are not feasible, batching waste (preferably for two hours or longer) has been shown to reduce seabird attendance at the stern of the vessel. Mincing of waste has also been shown to reduce the attendance of large albatross species.

6.4 The Working Group noted that currently there is no single solution to reduce or avoid incidental mortality of seabirds in trawl fisheries, and that the most effective approach is to use the measures listed above in combination. Net entanglements during the haul remain the most difficult interactions to mitigate. Further measures include avoiding fishing operations in areas and periods of peak seabird foraging activity.

6.5 Many of the measures recommended by ACAP are already included in CM 25-03. In view of the low level of mortality associated with CCAMLR trawl fisheries, the Working Group agreed there was no need to review this measure at present.

Demersal longline gear

6.6 Two ACAP papers on interactions with demersal longline gear are described in WG-IMAF-11/13 but the results of these studies were consistent with ACAP's previous review and advice on best-practice mitigation for demersal longline operations. As a consequence, it was not necessary to update ACAP's review table and summary advice statement (WG-IMAF-11/13, Annexes 6 and 7).

6.7 In summary, ACAP's best-practice advice is that the most effective measures to reduce incidental take of seabirds in demersal longline fisheries are (i) use of an appropriate line-weighting regime to reduce the time baited hooks are near or on the surface and thus available to birds; (ii) actively deterring birds from baited hooks by means of bird-scaring lines; and (iii) setting longlines at night. Further measures include bird-deterrent curtains at the hauling bay, responsible offal management and avoiding peak areas and periods of seabird foraging activity. It is important to note that there is no single solution to reduce or avoid incidental mortality of seabirds in demersal longline fisheries, and that the most effective approach is to use the recommended measures in combination.

6.8 All of the measures recommended by ACAP are already included in CM 25-02.

6.9 Following a request from ad hoc TASO (SC-CAMLR-XXIX, Annex 7, paragraph 4.32) to investigate the use of electronic monitoring technology, the UK discussed a trial that had taken place in Subarea 48.3 last season where line setting could be monitored remotely using a fixed video camera. The footage could either be viewed in real time by the observer from the cabin or recorded and viewed at a later date. The footage showed the streamer line being deployed and the line being set, and the Working Group hoped that in the future this technology could be applied to reduce the workload on observers.

6.10 Mr K. Ramm (New Zealand) outlined video monitoring trials that are being carried out by the Department of Conservation in New Zealand to monitor a selection of inshore demersal longline fisheries. The vessels were carrying multiple cameras which monitored, inter alia, the setting and hauling of longlines and offal discharge.

6.11 Mr I. Hay (Australia) gave a verbal report on a trial of video monitoring and surveillance in three Australian fisheries, including pelagic longline fishery, trawl fishery and gillnet hook fishery. The trials, using multiple cameras on each vessel, have been successful and cost-effective, and the use of cameras has been expanded to the whole fleet in two of the three fisheries where trials have occurred.

6.12 The potential to use video technology in CCAMLR fisheries was discussed and the Working Group agreed that it may be suitable for augmenting the duties of the observer and would provide additional flexibility in observer tasking.

OBSERVER REPORTS AND DATA COLLECTION

Reports of marine debris

7.1 The Working Group considered WG-IMAF-11/12, presented by Dr K.-H. Kock (Germany), that reported on sightings of marine debris during aerial surveys for marine mammals throughout the austral summer of 2010/11 west of the Antarctic Peninsula in Subarea 48.1.

7.2 In relation to WG-IMAF-11/12, the Working Group concluded that, while there were a number of items of fishing gear found in areas where fishing has been prohibited for over two decades, this gear could have originated outside the Convention Area. Members that conduct at-sea surveys are encouraged to provide information on any marine debris sighted to the Secretariat.

7.3 WG-IMAF-11/4 Rev. 1 provided a review of marine debris surveys in the Convention Area which have been reported to the Secretariat as part of the CCAMLR marine debris monitoring program. It was noted that data had been submitted by three Members in 2011. The monitoring sites were located in Subareas 48.1, 48.2, 48.3 and 58.7. Results indicate that the types of debris found are generally non-fishing items such as packaging items and wood. A decrease in the number of plastic packaging bands found in beach surveys was recorded. The amount of debris in colonies of grey-headed albatrosses (*T. chrysostoma*) and black-browed albatrosses at Bird Island has increased recently, although the major category of items found were plastics. The amount of fishing-related items (fishing lines and hooks) found in wandering albatross colonies remains the most numerous debris item found in each season. The number of marine mammal entanglements increased in 2011 with packaging bands and fishing gear the main entangling materials. There were no reports of hydrocarbon soiling in 2011.

7.4 The Working Group also reviewed SC-CAMLR-XXX/BG/5 that described marine debris surveys undertaken by the UK in Area 48, and expressed concern that there was no long-term decline in the number of hooks found in seabird colonies, particularly the wandering albatross, on Bird Island in Subarea 48.3.

7.5 The Working Group noted that the data for the marine debris collection in the Convention Area over the last 10 years showed no consistent decline in the amount of debris on beaches, in bird colonies and in the incidence of marine mammal entanglement.

7.6 A comparison of the numbers of hooks reported lost in the C2 data submitted by the vessel (WG-IMAF-11/4 Rev. 1) and that reported by observers, revealed some discrepancies. The Working Group noted that, while the issue of gear loss posed potential risk of incidental mortality to marine mammals and birds, the analysis presented in WG-FSA-11/48 also indicated the potential impact of such gear on target species.

Reporting hydrocarbon soiling on seabirds reported by observers

7.7 The Working Group considered the advice from ad hoc TASO on recording seabirds with hydrocarbon soiling (SC-CAMLR-XXIX, Annex 7, paragraph 4.3). The Working Group recommended that observers be trained on how to identify seabirds with hydrocarbon soiling, and to report any sightings using the CCAMLR marine debris hydrocarbon soiling form (http://www.ccamlr.org/pu/e/sc/deb/forms-inst.htm), and submit this with their observer cruise report.

Priorities for data collection by observers

7.8 The Working Group considered the priorities for observer data collection, noting that due to the complexity of this task it would best be undertaken intersessionally. The Working Group considered the request from WG-EMM to combine the observer forms K7 (Incidental Mortality of Seabirds and Marine Mammals) and K11 (Trawl Warp Strike Protocol) (Annex 4, paragraph 2.42). The Working Group recommended that the Scientific Committee write to ACAP and request it to provide advice on how best to combine the reporting of incidental mortality and warp strike data, including on vessels using a continuous trawl system.

7.9 The Working Group reiterated its praise for the valuable work of observers and the importance of observer data to the success of CCAMLR in addressing seabird incidental mortality.

ASSESSMENT OF RISK IN CCAMLR SUBAREAS AND DIVISIONS

8.1 As there was no additional information provided this year on the at-sea distribution of seabirds, the assessments and advice provided in SC-CAMLR-XXVI/BG/31 were again endorsed by the Working Group (SC-CAMLR-XXVIII, Annex 7, Tables 13 and 14 and Figure 2).

8.2 The Working Group considered three papers containing proposals to vary the mitigation measures in a fishery; these were WG-IMAF-11/8 and 11/9 concerning Subarea 48.3, and WG-IMAF-11/7 concerning Division 58.5.2. The Working Group recalled the Scientific Committee's advice that the ultimate aim in managing seabird by-catch in the Convention Area is to allow fishing at any time of day without seasonal closure of fishing grounds (SC-CAMLR-XIX, paragraphs 4.41(iv) and 4.42), and that any relaxation of closed seasons should proceed in a step-wise fashion and the results of this be carefully monitored and reported (SC-CAMLR-XXI, paragraph 11.7).

8.3 WG-IMAF-11/9 contained a proposal to change the pre-season extension start date of the fishery for *D. eleginoides* in Subarea 48.3 in two annual steps of five days each from 21 April to 16 April in 2011/12 and to 11 April in 2012/13, and to also change the main season start date from 1 May, as set out in CM 41-02, to 21 April.

8.4 The Working Group noted that three birds had been killed during the last two seasons during the pre-season extension period; two albatrosses (1 black-browed, 1 grey-headed) in 2009/10 when the extension period started on 26 April and one white-chinned petrel in 2010/11 when the extension started on 21 April. In some cases this was clearly due to poor implementation of prescribed mitigation measures.

8.5 Noting that albatrosses have been caught in the pre-season extension period, the Working Group agreed that the main season start date should remain unchanged from 1 May; this would also increase the incentive for fishers to avoid seabird by-catch in the pre-season extension period.

8.6 The Working Group supported the proposed trial of five-day changes to the start of the pre-season extension in 2011/12 and 2012/13 on the basis that they would only be open to vessels which had fully complied with CM 25-02 in the previous fishing season and that any vessel that had three or more seabird mortalities during the extension would be required to suspend fishing operations until 1 May.

8.7 The Working Group agreed that the following decision rules should be used by the Scientific Committee in respect of an extension in 2012/13, based on the level of seabird incidental mortality during the extension period in 2011/12. Thus, in addition to the expected changes to update season references – from '2009/10' to '2011/12' and from '2010/11' to '2012/13' seasons in the title and paragraphs 2 and 3 (in two places) of CM 41-08 – the Working Group recommended that paragraphs 5, 6 and 7 of CM 41-02 be modified as follows (new text in bold):

> 5. For the purpose of the longline fishery for *Dissostichus eleginoides* in Statistical Subarea 48.3, the **2011/12 and 2012/13** season**s are** defined as the period from 1 May to 31 August in each season, or until the catch limit is reached, whichever is sooner. For the purpose of the pot fishery for *Dissostichus eleginoides* in Statistical Subarea 48.3, the **2011/12** and **2012/13** seasons are defined as the period from 1 December to 30 November, or until the catch limit is reached, whichever is sooner. The **2011/12** season for longline fishing operations may be extended in two periods: (i) to start on **16 April** and (ii) to end on 14 September for any vessel which has demonstrated full compliance with Conservation Measure 25-02 in the previous season.
>
> 6. The following decision rule shall apply to the extension of the **2012/13** season:
>
> (i) if, on average, less than one bird per vessel is caught during the two extension periods in the **2011/12** season, the **2012/13** season **extension** shall start on **11 April 2013**;

(ii) if, on average, between one and three birds per vessel, or more than 10 and fewer than 16 birds in total, are caught during the extension periods in the **2011/12** season, the **2012/13** season **extension** shall start on **16 April 2013**; or

(iii) if, on average, more than three birds per vessel, or more than 15 birds in total, are caught during the extension periods in the **2011/12** season, the **2012/13** season shall start on **21 April 2013**.

7. The extensions to the seasons in **2011/12** and **2012/13** shall be subject to a combined catch limit of three (3) seabirds per vessel per season. If a total of three seabirds is caught **by one vessel** during the two extension periods in any one season, fishing shall cease immediately for that vessel **in the extension periods**. In the case of the extension at the start of the season, fishing shall not resume until 1 May of the corresponding season and the extension at the end of that season shall not apply.

8.8 Prior to 2013/14, the incidental mortality for the trial season extensions in 2011/12 and 2012/13 would need to be reviewed before any recommendations on season extensions could be made.

8.9 WG-IMAF-11/8 contained a proposal to trial daylight setting on longliners fishing for *D. eleginoides* in Subarea 48.3. The proposed trials were for 10-day periods of daylight setting between 1 July and 15 August and would be open to vessels that have shown excellent compliance with conservation measures in previous seasons. Participating vessels would be required to carry an extra observer to monitor setting during the trial period and there would be a three-bird total by-catch limit where vessels catching more than this limit would revert to night setting only. The proposal also noted the risk that daylight setting posed to albatrosses and that the proposed dates of the trial would minimise the risk to grey-headed and black-browed albatrosses which were largely absent from Subarea 48.3 at this time. However, the Working Group noted that the proposal did not consider that wandering albatrosses, which breed in the area, would still be attending large chicks at this time.

8.10 During its discussion of the proposal in WG-IMAF-11/8, the Working Group expressed concern at the potential for by-catch of albatrosses, particularly from the breeding population of wandering albatross on South Georgia. The Working Group noted that ACAP, at its 2011 meeting, had identified this wandering albatross population as a high conservation priority because it comprised a significant portion of the global species population and was experiencing a long-term serious population decline. The Working Group also noted that night setting was the single most effective measure to reduce by-catch of this and other species of albatross in longline fisheries, and that albatrosses were regularly present on the fishing grounds. After considerable discussion of the level of risk and possible risk mitigation strategies, the Working Group recommended that this proposed trial not proceed.

8.11 WG-IMAF-11/7 contained a proposal to allow daylight setting on longliners fishing for *D. eleginoides* in Division 58.5.2 during the pre-season extension period of 15 to 30 April. The Working Group supported the proposal on the basis that it would be a two-year trial; that other mitigation measures would remain unchanged, including that a three-bird total by-catch limit would remain for the season extension periods; and that the trial results would be reviewed before any recommendation on their future status could be made. The Working Group recommended that, in addition to the expected changes to update season references –

from '2009/10' to '2011/12' and from '2010/11' to '2012/13' seasons in the title and paragraphs 2 and 3 (in two places) of CM 41-08 – paragraphs 5 and 6 of CM 41-08 be modified for the 2011/12 and 2012/13 seasons as follows (new text in bold):

> 5. The operation of the trawl fishery shall be carried out in accordance with Conservation Measure 25-03 so as to minimise the incidental mortality of seabirds and mammals through the course of fishing. The operation of the longline fishery shall be carried out in accordance with Conservation Measure 25-02, except paragraph 5 (night setting) shall not apply for vessels using integrated weight lines (IWLs) during the period **15 April**~~1 May~~ to 31 October in **the 2011/12 and 2012/13**~~each season~~ **seasons**. Such vessels may deploy IWL gear during daylight hours if, prior to entry into force of the licence, each vessel shall demonstrate its capacity to comply with experimental line-weighting trials as approved by the Scientific Committee and described in Conservation measure 24-02.
>
> During the period 15 April to 30 April in ~~each season~~**the 2011/12 and 2012/13 seasons**, vessels shall use IWL gear in conjunction with ~~night setting and~~ paired streamer lines.
>
> 6. Each vessel participating in this fishery shall have at least one scientific observer, and may include one appointed in accordance with the CCAMLR Scheme of International Scientific Observation, on board throughout all fishing activities within the fishing period, with the exception of the period 15 April to 30 April in ~~each season~~**the 2011/12 and 2012/13 seasons** when two scientific observers shall be carried.

INCIDENTAL MORTALITY OF SEABIRDS IN RELATION TO NEW AND EXPLORATORY FISHERIES

9.1 The Working Group noted the Scientific Committee request that WG-IMAF and WG-FSA review the prohibition on offal and discarding of dead fish in Subarea 88.1 and exploratory fisheries south of 60°S and determine if it continues to be required, given the risk status of those areas and the much improved compliance with other mitigation measures (SC-CAMLR-XXVIII, paragraph 5.12).

9.2 The Working Group also noted that the prohibition of offal discharge during fishing operations is currently applied to all finfish fisheries south of 60°S (CM 26-01, paragraph 6) and offal retention has been proven to be one of the most effective methods of minimising the attraction of fishing vessels to seabirds and minimising the risk of seabird interactions and by-catch. Both the Working Group and the ACAP SBWG consider it constitutes part of 'best-practice mitigation measures' and it was noted that the incidental mortality in these areas remains at, or near, zero. The prohibition of offal discharge may also serve to reduce the attractiveness of fishing vessels to some marine mammals.

9.3 The Working Group understood that some fishing vessels are able to store all offal from a single trip while other vessels interrupt a fishing trip and leave the fishing grounds to discharge offal outside the Convention Area. No data on the extent of this practice nor any specific proposal for an alternative approach were presented to the Working Group.

9.4 In the absence of appropriate research and the current ability of vessels to comply with the requirement to retain all offal and the lack of a specific proposal for an alternative approach, the Working Group considered that the current prohibition on the discard of offal and dead fish should continue.

9.5 The Working Group recommended that if a proposal were to be developed, changes to the current prohibition on offal discharge should be undertaken on an incremental and trial basis, with consideration given to the likelihood of all adverse impacts, including on marine mammals as well as on seabird by-catch, noting any such proposals should take into account the advice provided by ACAP in paragraph 6.3.

OTHER BUSINESS

The future of WG-IMAF

10.1 The Working Group discussed the primary core functions of WG-IMAF as identified in WG-FSA-08/65, paragraph 28:

(1) annual review and monitoring of incidental mortality of seabirds and marine mammals in Convention Area fisheries

(2) annual review and monitoring of information relating to the performance of implementation of specific conservation measures

(3) research into and experience with fishing gears and mitigation methods

(4) evaluate and advise on changing needs for observer reports and data collection

(5) conduct assessments of risk to seabirds in CCAMLR areas and subdivisions

(6) coordination with ACAP.

10.2 In respect of (1), the Working Group agreed that this review could be undertaken by the Secretariat and presented as a summary paper to the Scientific Committee or one of its working groups. In respect of (2), the Working Group agreed that reviewing the effectiveness of specific conservation measures addressing seabird by-catch could be addressed in the review of incidental mortality, while any review of the implementation or compliance with these measures was an issue more appropriate to SCIC.

10.3 The ongoing coordination with ACAP, including the presentation of the report of the SBWG (WG-IMAF-11/13) addresses (3) and (6).

10.4 Given the ongoing population changes experienced by Convention Area seabird species, as well as the continued development of telemetry and tracking data, the Working Group agreed that there would be a requirement for periodic review of risk assessments (5). Such a review could be undertaken every three years (or when new data, likely to change the risk category of a fishery, became available) and could be done intersessionally in collaboration with BirdLife International and ACAP.

10.5 In considering (4), the Working Group agreed that a review of the data collection and reporting requirements for IMAF-related issues could be reviewed, as the data required during the development phase of CCAMLR mitigation measures may not be required in the future, given the current levels of incidental mortality and hence the effectiveness of those mitigation measures (SC-CAMLR-XXVIII, Annex 7, Table 12, reviewed the requirement for data collection and the use of such data).

10.6 When considering the medium-term tasks, as developed in WG-FSA-08/56, paragraph 30, the Working Group agreed that issues related to seabird incidental mortality outside the Convention Area, and for gear types other than those currently permitted in the Convention Area, may be progressed in collaboration with ACAP.

10.7 The Working Group agreed that, while there may not be a requirement for WG-IMAF to meet regularly, it would be essential for CCAMLR to have a mechanism to retain the importance of incidental mortality issues on its annual agenda and to ensure annual review of data and implementation of mitigation, consistent with 'Best Practice Technical Guidelines' (FAO, 2009). This would provide an opportunity for Members to report on progress in addressing incidental mortality, for example, noting that while the situation in the French EEZ was improving, these fisheries still have a higher level of incidental mortality than other fisheries in the CAMLR Convention Area.

10.8 The Working Group requested the Scientific Committee to consider how best to maintain the importance of issues associated with incidental mortality in CCAMLR fisheries, including through continued engagement with ACAP. The Working Group noted the model of operation of SG-ASAM, where a meeting is called when a requirement for the group to meet has been identified by the Scientific Committee. Such a requirement for a meeting could be triggered by the introduction of a new fishery/gear type into the Convention Area and/or a substantial change in the risk status of a fishery.

ADVICE TO THE SCIENTIFIC COMMITTEE

11.1 The Working Group identified the following advice to the Scientific Committee.

Incidental mortality of seabirds in longline fisheries in the Convention Area:

(i) A total of 220 seabird mortalities due to interactions with longline fishing gear (all within the French EEZs), four seabird mortalities due to interactions with krill trawl gear and no seabird mortality in finfish trawl fisheries (paragraphs 3.3, 3.17, 3.20 and 3.21).

Review of progress made to reduce seabird mortality in the French EEZs:

(ii) Progress made by France in reducing seabird mortality, discussion of measures to further reduce mortality rates and advice on data reporting (paragraphs 3.14 and 3.15).

Streamer lines:

(iii) Discontinue recording of aerial extent of streamer lines for night setting (paragraph 3.39).

Offal discharge:

(iv) Definition of stickwater to be added to CM 25-03 (paragraph 3.43).

Incidental mortality of seabirds and marine mammals in fisheries
outside the Convention Area:

(v) Members are urged not to use bitumen-based grease on warps (paragraph 4.3).

(vi) Data submission for fisheries adjacent to the Convention Area (paragraphs 4.8 to 4.10).

Incidental mortality of seabirds during IUU fishing in the Convention Area:

(vii) Members that conducted gillnet fishing in areas outside the Convention Area to investigate factors affecting the incidental mortality of marine mammals and seabirds (paragraph 5.4).

Research into and experience with mitigation measures:

(viii) The potential to use video technology in CCAMLR fisheries (paragraph 6.12).

Observer reports and data collection:

(ix) Members conducting at-sea surveys are encouraged to provide information on any marine debris sighted to the Secretariat (paragraph 7.2).

(x) Data for the marine debris collection in the Convention Area over the last 10 years showed no consistent decline (paragraph 7.5).

(xi) Observers should be trained to identify seabirds with hydrocarbon soiling and submit CCAMLR hydrocarbon soiling form along with their observer cruise reports (paragraph 7.7).

(xii) Request ACAP to provide advice on how best to combine the reporting of incidental mortality and warp strike data, including on vessels using a continuous trawl system (paragraph 7.8).

(xiii) Praise for the valuable work of observers and the importance of observer data to the success of CCAMLR in addressing seabird incidental mortality (paragraph 7.9).

Assessment of risk in CCAMLR subareas and divisions:

(xiv) No revision to risk assessments for CCAMLR fisheries (paragraph 8.1).

(xv) Season extensions and changes to mitigation requirements in Subarea 48.3 and Division 58.5.2 (paragraphs 8.7, 8.10 and 8.11).

Incidental mortality of seabirds in relation to new and exploratory fisheries:

(xvi) Recommendation to retain all offal south of 60°S (paragraphs 9.4 and 9.5).

Future of WG-IMAF:

(xvii) Recommendations for future consideration by the Scientific Committee of incidental mortality associated with fishing (paragraphs 10.2 to 10.8).

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

12.1 The report of the meeting of WG-IMAF was adopted.

12.2 In closing the meeting, Mr Moir Clark thanked all participants for their work during the meeting.

12.3 Mr Hay, on behalf of the participants, thanked Mr Moir Clark for his relaxed and helpful guidance during the meeting.

12.4 The meeting closed.

REFERENCES

Anderson, O.R.J, C.J. Small, J.P. Croxall, E.K. Dunn, B.J. Sullivan, O. Yates and A. Black. 2011. Global seabird bycatch in longline fisheries. *Endang. Species Res.*, 14: 91–106.

FAO. 2009. Fishing operations. 2. Best practices to reduce incidental catch of seabirds in capture fisheries. *FAO Technical Guidelines for Responsible Fisheries*, 1, Suppl. 2: 49 p. FAO, Rome.

APPENDIX A

AGENDA

Working Group on Incidental Mortality Associated with Fishing
(Hobart, Australia, 10 to 12 October 2011)

1. Appointment of 2011 Convener

   1.1 Opening of the meeting
   1.2 Welcome
   1.3 Adoption of the agenda, appointment of rapporteurs and subgroups

2. Intersessional work of WG-IMAF

3. Incidental mortality of seabirds and marine mammals in fisheries in the Convention Area

   3.1 Seabirds
   3.2 Marine mammals

4. Incidental mortality of seabirds and marine mammals in fisheries outside the Convention Area

5. Incidental mortality of seabirds during IUU fishing in the Convention Area

6. Research into and experience with mitigation measures

7. Observer reports and data collection

8. Assessments of risk in CCAMLR subareas and divisions

9. Incidental mortality of seabirds in relation to new and exploratory fisheries

10. Other business

11. Advice

12. Adoption of the report and close of the meeting.

APPENDIX B

LIST OF PARTICIPANTS

Working Group on Incidental Mortality Associated with Fishing
(Hobart, Australia, 10 to 12 October 2011)

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Systems Analyst	Ian Meredith
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	Lucy DeVries

APPENDIX C

LIST OF DOCUMENTS

Working Group on Incidental Mortality Associated with Fishing
(Hobart, Australia, 10 to 12 October 2011)

WG-IMAF-11/1	Agenda for the 2011 Meeting of the Working Group on Incidental Mortality Associated with Fishing (WG-IMAF)
WG-IMAF-11/2	List of participants
WG-IMAF-11/3	List of documents
WG-IMAF-11/4 Rev. 1	Review of activities in monitoring marine debris in the CAMLR Convention Area Secretariat
WG-IMAF-11/5 Rev. 2	Summary of scientific observations in the CAMLR Convention Area for 2010/11 Secretariat
WG-IMAF-11/6	Summary of scientific observation related to Conservation Measures 24-02 (2008), 25-02 (2009) and 26-01 (2009) Secretariat
WG-IMAF-11/7	Proposal to allow daytime setting of longlines between 15 and 30 April in the Patagonian toothfish longline fishery in CCAMLR Statistical Division 58.5.2 I. Hay (Australia)
WG-IMAF-11/8	Proposal to trial daylight setting on longliners fishing for *Dissostichus eleginoides* for a 10 day period during the middle of winter during the fishing season in Subarea 48.3 J. Brown (United Kingdom)
WG-IMAF-11/9	Proposal to amend the fishing season for longline vessels fishing for *Dissostichus eleginoides* in Subarea 48.3 and trial two further 5 day season extensions J. Brown (United Kingdom)
WG-IMAF-11/10 Rev. 1	Assessment of the Action Plan aimed at reducing incidental catch of seabirds in the French EEZ included in the CCAMLR Division 58.5.1 and Subarea 58.6 C. Marteau (France) (Original was available in English and French, Revision in English only)

WG-IMAF-11/11	Report on seabird by-catch outside the CCAMLR Convention Area recorded in the South African fisheries C. Heineken and P. Mullins (South Africa)
WG-IMAF-11/12	Sighting of marine debris during aerial marine mammal surveys conducted in Antarctic waters in austral summer 2010/11 L.S. Lehnert, K.-H. Kock and U. Siebert (Germany)
WG-IMAF-11/13	Report of the Fourth Meeting of the Seabird Bycatch Working Group, Guayaquil, Ecuador, 22–24 August 2011 ACAP
WG-IMAF-11/14	Report of the Breeding Sites Working Group and Status and Trends Working Group – Joint BSWG4/STWG6, Guayaquil, Ecuador, 25–26 August 2011 ACAP

ANNEX 9

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	Monte Carlo Markov Chain
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
UNEP	UN Environment Programme
UNEP-WCMC	UNEP World Conservation Monitoring Centre
UNCLOS	UN Convention on the Law of the Sea
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)