**SCIENTIFIC COMMITTEE FOR THE CONSERVATION
OF ANTARCTIC MARINE LIVING RESOURCES**

REPORT OF THE TWENTY-EIGHTH MEETING
OF THE SCIENTIFIC COMMITTEE

HOBART, AUSTRALIA
26–30 OCTOBER 2009

Abstract

This document presents the adopted report of the Twenty-eighth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, from 26 to 30 October 2009. 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 and Statistics, Assessments and Modelling, are appended

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REPORT OF THE TWENTY-EIGHTH MEETING
OF THE SCIENTIFIC COMMITTEE
(Hobart, Australia, 26 to 30 October 2009)

OPENING OF MEETING

1.1   The Scientific Committee for the Conservation of Antarctic Marine Living Resources met from 26 to 30 October 2009 at the CCAMLR Headquarters in Hobart, Tasmania, Australia.   The meeting was chaired by the Vice-Chair of the Scientific Committee, Mr S. Iversen (Norway).

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

1.3   The Chair also welcomed to the meeting observers from ACAP, ASOC, CEP, COLTO, IWC and SCAR, and encouraged them to participate in the meeting to the extent possible.

1.4   The Scientific Committee conveyed its best wishes to Prof. C. Moreno (Chile) who had resigned from his position as Chair of the Scientific Committee in March 2009 due to ill health, and thanked him for his many years working on the Committee.   Mr Iversen (senior Vice-Chair of the Scientific Committee) had agreed to take on Prof. Moreno's role in 2009, with the assistance of Dr V. Bizikov (Russia, second Vice-Chair).

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

1.6   The report of the Scientific Committee was prepared by Drs D. Agnew (UK) and A. Constable (Australia), Mr A. Dunn (New Zealand), Drs S. Grant (UK), S. Hanchet (New Zealand), R. Holt (USA), C. Jones (USA), S. Kawaguchi (Australia), S. Nicol (Australia), D. Ramm (Data Manager) and K. Reid (Science Officer), Ms K. Rivera (USA), Mr N. Smith (New Zealand), Dr P. Trathan (UK), Mr N. Walker (New Zealand), Drs G. Watters (USA) and D. Welsford (Australia).

1.7   The Scientific Committee agreed to highlight sections of the report summarising its advice to the Commission.   It noted that this method was used by the working groups to highlight their primary advice to the Scientific Committee and that this had proved to be a useful way of shortening the reports and allowed advice to be considered in a more efficient way within the context of the overall discussions. The Scientific Committee agreed that this practice should continue in future and that it would use the same practice in its report. The Scientific Committee noted that this system of highlighting was simply designed to facilitate the shortening of the report and recognised that all of its report provides important information for the Commission.

Adoption of agenda

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

Chair's report

Intersessional meetings of working groups and other groups
of the Scientific Committee

1.9   The following meetings took place in 2009:

(i)   A Joint SC-CAMLR–CEP Workshop took place in Baltimore, Maryland, USA, on 3 and 4 April 2009. The Workshop was co-convened by Drs Bizikov, Y. Frenot (France, CEP Vice Chair), N. Gilbert (New Zealand, CEP Chair) and G. Watters (WG-EMM Convener).

(ii)   SG-ASAM met in Ancona, Italy, from 25 to 28 May 2009, to consider models of krill target strength and classification of volume backscattering strength. Drs R. O'Driscoll (New Zealand) and J. Watkins (UK) co-convened the meeting which was attended by 18 participants from seven Members. Three invited experts attended – Drs D. Demer (USA), R. Kloser (Australia) and G. Lawson (USA).

(iii)   Three meetings took place in Bergen, Norway, in June–July 2009:

•   WG-SAM met from 29 June to 3 July. It was convened by Dr Constable. Twenty-one participants from seven Member countries attended.

•   Ad hoc TASO met on 4 and 5 July. It was co convened by Mr C. Heinecken (South Africa) and Dr Welsford and was attended by 18 participants from nine Member countries.

•   WG-EMM met from 6 to 17 July. It was convened by Dr Watters and was attended by 39 participants from 12 Member countries. Discussion of the Focus Topic 'Second Workshop on Fisheries and Ecosystem Models in the Antarctic (FEMA2)' was chaired by Drs Jones and Watters.

(iv)   A Workshop on VMEs (WS-VME) was held from 3 to 7 August in La Jolla, California, USA. It was convened by Dr Jones and attended by 15 participants from six Member countries. Three invited experts attended – Drs D. Bowden (New Zealand), J. Gutt (Germany) and S. Schiaparelli (Italy).

(v)   WG-IMAF conducted its meeting from 12 to 16 October in Hobart. It was co-convened by Ms Rivera and Mr Walker. Attendance included 10 participants from six Member countries. Invited experts from ACAP and BirdLife International also attended (SC-CAMLR-XXVI, paragraph 5.56).

(vi) The WG-FSA meeting was held from 12 to 23 October in Hobart prior to the Scientific Committee meeting. It was convened by Dr Jones. Thirty participants from 11 Member countries attended.

ADVANCES IN STATISTICS, ASSESSMENTS, MODELLING AND SURVEY METHODS

WG-SAM advice

2.1 Dr Constable (WG-SAM Convener) presented the report of WG-SAM (Annex 6), noting that most of the report was referred to WG-EMM and WG-FSA for consideration. The attention of the Scientific Committee was drawn to the following points for consideration (Annex 6, paragraphs 7.1 to 7.5):

(i) Advice to WG-EMM –

    (a) standardising or estimating general abundance counts of seals and penguins (Annex 6, paragraphs 3.35 and 3.37);

    (b) conserving VMEs (Annex 6, paragraphs 4.9 and 4.11 to 4.14).

(ii) Advice to WG-FSA –

    (a) ALKs (Annex 6, paragraphs 2.10 and 2.15);

    (b) tagging data (Annex 6, paragraphs 2.19, 2.22 and 2.24);

    (c) estimation of stock size of *Dissostichus* spp. in new and exploratory fisheries (Annex 6, paragraphs 2.41 and 2.42);

    (d) review of the Japanese longline research survey proposal (Annex 6, paragraphs 2.54 and 2.55);

    (e) use of research hauls in the exploratory fisheries for *Dissostichus* spp. (Annex 6, paragraphs 2.59 to 2.61);

    (f) estimating biomass using commercial longline data in Divisions 58.4.1 and 58.4.2 (Annex 6, paragraph 2.65);

    (g) age-based assessments (Annex 6, paragraphs 3.10 to 3.14);

    (h) length-based assessments (Annex 6, paragraphs 3.23 and 3.29 to 3.31);

    (i) spatially structured population models (Annex 6, paragraph 4.5);

    (j) conserving VMEs (Annex 6, paragraphs 4.9 and 4.11 to 4.14);

    (k) decision rules for target species (Annex 6, paragraphs 4.28 to 4.30).

(iii)   There was no advice specific to WG-IMAF.

(iv)   General advice –

(a)   model development and validation (Annex 6, paragraphs 5.11 to 5.17);

(b)   standardisation of CPUE for different longline fishing methods (Annex 6, paragraph 2.46).

(v)   Submission of only abstracts is insufficient to undertake adequate reviews of papers and their conclusions and Members are requested to submit papers in full to future meetings (Annex 6, paragraph 7.5).

2.2   Dr Constable thanked the contributions of the members in WG-SAM, indicating that the diversity of participants enabled great progress in the development and review of new methods.

2.3   The Scientific Committee endorsed the report of WG-SAM (Annex 6), including its advice.

2.4   The Scientific Committee thanked Dr Constable for convening WG-SAM and for assisting in developing a flexible approach to the work of the Working Group.

2.5   With respect to the general advice, the Scientific Committee agreed the standardisation of CPUE across different fishing methods will need to be further considered in relation to the krill fishery, established toothfish fisheries and exploratory fisheries.

2.6   The Scientific Committee agreed that abstracts on their own are insufficient for working groups to review scientific work for use by the working groups. It agreed that conveners should use their discretion, according to past practice, on whether a full paper could be submitted after the deadline for papers but before the beginning of the working group meeting. Such discretion would involve whether data became available at a late stage or whether the paper was requested with insufficient time to meet the deadline.

Advice from SG-ASAM

2.7   The Scientific Committee considered the report of SG-ASAM (Annex 8) noting that the report had been considered at both WG-EMM and WG-FSA. The substantive discussion of these working groups is reported in sections 3(i) and 4(ii).

2.8   The Scientific Committee expressed its thanks to the Co-conveners of the SG-ASAM meeting, Drs Watkins and Dr O'Driscoll, and to Italy for hosting the meeting.

2.9   The Scientific Committee noted that the three SG-ASAM invited experts (SC-CAMLR-XXVIII/BG/7) supported CCAMLR's acoustics work and recognised the complexity of the tasks being undertaken. The Scientific Committee thanked the invited experts for their positive input into the deliberations of the subgroup meeting.

2.10   The Scientific Committee discussed the benefits of having the SG-ASAM meeting in conjunction with ICES WGFAST. It noted that half of the SG-ASAM participants, including one of the Co-conveners, would not have been able to attend the subgroup's meeting had they not also been attending ICES WGFAST. The Scientific Committee noted the potential benefits of formalising links between SG-ASAM and ICES WGFAST. It agreed that this might facilitate greater access to acoustics expertise to assist in CCAMLR's work. The Scientific Committee also noted that the current chair of ICES WGFAST, Dr Kloser, an invited expert at the meeting of SG-ASAM, had offered to assist in facilitating such links.

2.11   Taking account of the discussion of the report of SG-ASAM by WG-EMM and WG-FSA, the Scientific Committee agreed that SG-ASAM should meet in 2010 with the terms of reference as set out in Annex 11.

ECOSYSTEM MONITORING AND MANAGEMENT

WG-EMM advice

3.1   Dr Watters (WG-EMM Convener) reported that the 15th meeting of WG-EMM had been held in Bergen, Norway, from 6 to 17 July 2009. The meeting was hosted by the Norwegian Institute of Marine Research and the Norwegian Ministry of Foreign Affairs. The senior Vice-Chair of the Scientific Committee, Dr Iversen, coordinated local arrangements.

3.2   Dr Watters informed the Scientific Committee that WG-EMM had followed the agenda adopted by the Scientific Committee in 2008 (SC-CAMLR-XXVII, paragraph 3.48) and had considered reports from four intersessional meetings during its discussion, including the reports from the Joint SC-CAMLR–CEP Workshop (SC-CAMLR-XXVIII/6), SG-ASAM (Annex 8), WG-SAM (Annex 6) and ad hoc TASO (Annex 9).

Acoustic estimates of krill biomass

3.3   The Scientific Committee noted that WG-EMM had considered advice from SG-ASAM that included uncertainty associated with estimates in B_0 and the need to re-calculate B_0 for Subareas 48.1 to 48.4 (Annex 4, paragraphs 3.73 to 3.94).

3.4   The Scientific Committee endorsed the advice from WG-EMM regarding acoustic assessments, specifically with regard to: (i) uncertainty in B_0 (Annex 4, paragraph 3.75); (ii) a joint meeting between SG-ASAM and WG-SAM to combine appropriate expertise to evaluate broader aspects of uncertainty in the acoustic estimate of krill biomass (Annex 4, paragraph 3.76); and (iii) the need to recalculate B_0 for Subareas 48.1 to 48.4 (Annex 4, paragraphs 3.77 to 3.83).

3.5   The Scientific Committee noted that WG-EMM considered that any recalculation of the B_0 estimate from the CCAMLR-2000 Survey using the revised parameter set provided by SG-ASAM is unlikely to result in a krill biomass estimate that is higher than the present biomass estimate, and that the current Conservation Measures 51-01, 51-02 and 51-03 should remain as interim conservation measures until a fully validated reanalysis of the results of the CCAMLR-2000 Survey was performed (Annex 4, paragraphs 3.85 and 3.86).

3.6   The Scientific Committee endorsed the advice from WG-EMM that, in the future, if implementation errors to an agreed protocol were discovered, then WG-EMM and the Scientific Committee should be notified and these errors should be corrected as soon as possible (Annex 4, paragraph 3.87).   The Scientific Committee also endorsed the recommendation from SG-ASAM that the Secretariat work with Members to develop detailed acoustic protocols and make them available on the CCAMLR website (Annex 4, paragraph 3.88).

3.7   The Scientific Committee noted that as well as recalculation of estimates of B_0 for Subareas 48.1 to 48.4, recalculation of estimates of B_0 for Divisions 58.4.1 and 58.4.2 would also be required.

Krill-dependent predators

3.8   The Scientific Committee noted that there had been a strong ecosystem anomaly at South Georgia during 2009 (Annex 4, paragraph 3.10).   This was manifested in the lowest krill density on record, very low land-based predator breeding performance, changes in the diet of icefish and anomalous values for a range of physical parameters including sea-surface temperature.   The Scientific Committee further noted that ecosystem monitoring at South Georgia, including CEMP monitoring, had allowed the early detection of this anomaly, demonstrating the value of such monitoring for management purposes.

3.9   The Scientific Committee recognised that the ecosystem anomaly at South Georgia provided a natural experiment, the impacts of which would become evident through continued monitoring over the coming years of both the pelagic ecosystem and of land-based predators. The Scientific Committee noted that previous work undertaken by UK scientists suggested that impacts on demographic parameters of long-lived species were to be anticipated as a consequence of the anomaly.

3.10   The Scientific Committee welcomed new initiatives for CEMP monitoring at Cumberland Bay, South Georgia, and at Petermann Island on the Antarctic Peninsula (Annex 4, paragraph 3.12).   The Scientific Committee further welcomed data collected in a manner consistent with the CEMP standard methods from penguin colonies used to monitor tourism impacts on Goudier Island (Annex 4, paragraph 3.14).   The Scientific Committee congratulated Ukraine, UK and Russia on these new initiatives.

3.11   The Scientific Committee noted that a broad monitoring network would be required if the Scientific Committee and its working groups were to have the necessary information available to manage CCAMLR fisheries, particularly the krill fishery, in the face of climate change.   The Scientific Committee noted that the Joint SC-CAMLR–CEP Workshop (SC-CAMLR-XXVIII/6, paragraphs 8.1 to 8.11) had also highlighted the importance of exploring new and innovative ways to augment existing resources dedicated to ecosystem monitoring.

3.12   The Scientific Committee noted the progress made by WG-EMM-STAPP in advancing estimation of krill consumption by predators in Area 48 and noted the work program proposed for WG-EMM-STAPP during the coming intersessional period (Annex 4, Table 1).

3.13   The Scientific Committee encouraged the further development of new photographic methods by Australia to provide penguin breeding population size estimates, noting that these could be incorporated, in the future, into CEMP Standard Method A3 (penguin breeding population size) for some penguin species (Annex 4, paragraph 3.22).   The Scientific Committee encouraged Australia and other Members to investigate this and other innovative ways to augment monitoring approaches.

Management of protected areas

3.14   The Scientific Committee endorsed the advice from WG-EMM (Annex 4, paragraphs 5.15 to 5.37), noting that the establishment of a representative system of MPAs across the Convention Area is a high priority for the Scientific Committee (SC-CAMLR-XXVII, paragraph 3.55) and the Commission (CCAMLR-XXVII, paragraph 7.2).

3.15   The Scientific Committee agreed that significant further work is required to progress the establishment of a representative system of MPAs by 2012, within the timeline agreed by the WSSD, and it endorsed the advice from WG-EMM on the types of projects which would contribute towards the achievement of this target (Annex 4, paragraph 5.33).   It was agreed that the MPA Special Fund should be used to facilitate this work.

3.16   The UK presented SC-CAMLR-XXVIII/14, describing a preliminary proposal for marine spatial protection to be implemented around the South Orkney Islands, to contribute towards the conservation of biodiversity in Subarea 48.2, and the development of a representative network of protected areas across the Convention Area. The proposed area was selected on the basis of a systematic conservation planning analysis, the initial results of which were presented to WG-EMM in 2008 and 2009. It includes representative examples of two pelagic bioregions occurring in Subarea 48.2, and incorporates an area of key importance for winter penguin foraging and unique oceanographic frontal systems.

3.17   Additional areas have also been identified as important for the conservation of biodiversity in Subarea 48.2, and it was noted that further work is required to determine the requirements for spatial protection in these areas, particularly in the context of circumpolar frontal systems which extend into neighbouring regions, and VMEs which have recently been identified in the South Orkney Islands shelf region.

3.18   All types of fishing would be prohibited within the proposed area, however, scientific research activities would be permitted under conditions agreed by the Scientific Committee (and in accordance with Conservation Measure 24-01).

3.19   The Scientific Committee:

(i)   endorsed the work undertaken to date, and recommended the adoption of a protected area in the South Orkney Islands region (as defined in SC-CAMLR-XXVIII/14, Figure 3), noting that the data had been used appropriately and that the method was able to deliver robust scientific results;

(ii)   recommended that further work be undertaken in relation to the additional areas of conservation importance identified in SC-CAMLR-XXVIII/14, with a view to finalising further proposals for specific areas for protection in the South Orkney Islands region at CCAMLR-XXIX;

(iii)   recommended that the proposal should be forwarded to the Commission for consideration of procedures for implementing the proposed area.

3.20   While expressing its appreciation for the UK's continued efforts in the development of spatial management, China expressed its concern about forwarding the proposal to the Commission, as the proposal is not accompanied by any workable plans, and in particular, the management plan for potential scientific research activities.

3.21   The UK confirmed that the intention of its proposal was that advice on the requirements for, and content of, a management plan should subsequently be developed by the Commission, and that this could include a research plan.

3.22   The Scientific Committee agreed that WG-EMM consider research plans that could be used to support the management plan.

3.23   The CEP Observer noted that part of the South Orkney Islands analysis had been presented to CEP XII earlier this year, and that the CEP had endorsed the method and preliminary results and encouraged further development of this work. The CEP Observer also encouraged the submission of information on this proposal to CEP XIII in 2010.

3.24   The Convener of the MPA Special Fund Correspondence Group (Dr Grant) reported on the discussions held by this group during the intersessional period (SC-CAMLR-XXVIII/13). The group agreed that priorities for support by the MPA Special Fund are:

(i)   the collation of data to facilitate the development of MPAs, fine-scale bioregionalisation and systematic conservation planning (as endorsed by SC-CAMLR-XXVII, paragraph 3.55);

(ii)   the convening of a workshop to share experience and develop best-practice guidance on approaches to the selection of candidate sites for protection.

3.25   The group also noted the importance of a work plan to ensure progress towards the achievement of a representative system of MPAs by 2012.

3.26   The Scientific Committee noted that projects were already under way to develop marine spatial protection in several of the 11 priority regions identified by WG-EMM (Annex 4, paragraph 5.23), (including the Western Antarctic Peninsula, South Orkney Islands, Kerguelen Plateau, Prydz Bay, northern Ross Sea and Ross Sea shelf), and that further projects were planned for other priority areas. It encouraged Members to collaborate on such work, and to develop proposals for use of the MPA Special Fund as appropriate, given the priorities identified in paragraph 3.24. The Scientific Committee welcomed notification from the CEP Observer that the CEP had also endorsed the 11 priority regions for focused attention. The Scientific Committee further noted that work should not be limited to the 11 priority regions. For example, additional considerations could include regional or circumpolar features such as the fronts of the ACC.

3.27   The Scientific Committee agreed that a set of milestones would be useful in guiding its work towards the achievement of a representative system of MPAs within the Convention Area by 2012. It noted that work may progress at different rates for different priority regions, that work for some regions may be completed earlier than these milestones, and that ongoing progress was not dependent on the completion of work in each region. Projects which aim to achieve one or more of these milestones could be considered for support (either in full or in part) by the MPA Special Fund.

3.28   The Scientific Committee agreed the following milestones describing tasks which should be completed by the end of each year leading up to 2012, with relevant work presented to the Scientific Committee and its working groups during each year:

(i)   by 2010, collate relevant data for as many of the 11 priority regions as possible (and other regions as appropriate), and characterise each region in terms of biodiversity patterns and ecosystem processes, physical environmental features and human activities;

(ii)   by early 2011, convene a workshop to review progress, share experience on different approaches to the selection of candidate sites for protection, and determine a work program for the identification of MPAs in as many of the priority regions as possible (and other regions as appropriate);

(iii)   by 2011, identify candidate areas for protection in as many of the priority regions as possible (and other regions as appropriate), based on the collated data and regional characterisations, and using appropriate selection methods;

(iv)   by 2011, submit proposals for areas for protection to the Scientific Committee;

(v)   by 2012, submit proposals on a representative system of MPAs to the Commission.

3.29   To provide support for the achievement of these milestones, the Scientific Committee requested that WG-EMM should consider the following topics as part of its agenda item on spatial management to facilitate the conservation of marine biodiversity:

(i)   provision of advice on the development of a representative system of MPAs within the Convention Area by 2012;

(ii)   review of progress at each milestone towards the 2012 target, and coordination between regional projects;

(iii)   coordination with the CEP, and with groups such as SCAR-MarBIN and CAML, to ensure utilisation of the best available scientific data;

(iv)   convening of a workshop in 2011 to review progress, share experience on approaches to the selection of candidate sites for protection, and determine a work program for the identification of MPAs.

3.30   The Scientific Committee recognised the value of obtaining input from the CEP and SCAR to discussions on MPAs, to ensure harmonisation across the Antarctic Treaty System,

and to facilitate the provision and use of the best available scientific data. It agreed that experts/observers from the CEP and SCAR should be invited to attend meetings of WG-EMM, and to participate in intersessional work on the topic of MPAs, as appropriate.

3.31   The Scientific Committee agreed that the MPA Special Fund Correspondence Group should continue to work under the remit of WG-EMM, with the aim of assisting with the review of proposals for use of the MPA Special Fund if requested to do so by the Scientific Committee. The existing participants in the group are listed in SC-CAMLR-XXVIII/13, and any additional Members are also encouraged to join the group.

3.32   The Scientific Committee agreed that the proposed workshop in early 2011 should be a priority for support by the MPA Special Fund. It requested that the MPA Special Fund Correspondence Group should develop a proposal for such a workshop, and that funds could be set aside for this purpose as required.

3.33   The Scientific Committee recommended that the following guidelines should be adopted for submission and review of proposals, and allocation of funds from the MPA Special Fund:

(i)   proposals for use of funds from the MPA Special Fund may be submitted directly to the Scientific Committee, or to the Secretariat at any time of year;

(ii)   proposals may be submitted by individual Members or groups of Members;

(iii)   proposals should include information on the project objectives, justification, methodology, outputs, milestones, timelines and budget (requested funding, contributed funding, other in-kind support etc.);

(iv)   the Scientific Committee will consider any proposals received, either during its meeting, or through distribution of the relevant information to all Members via a circular if received by the Secretariat intersessionally;

(v)   proposals will be assessed by the Scientific Committee on the basis of whether they will contribute to the achievement of one or more of the milestones set out in paragraph 3.29;

(vi)   the Scientific Committee may ask the MPA Special Fund Correspondence Group to provide initial recommendations on the merits of submitted proposals;

(vii)   if the proposal is received intersessionally, an initial recommendation on whether it should be supported by the MPA Special Fund will be distributed to all Members via a circular (this initial recommendation can be made by the Secretariat, with advice from the MPA Special Fund Correspondence Group as required). Members will then have an opportunity to comment on this recommendation within a defined time limit (e.g. one month). If no objections are received during that time, then the initial recommendation will be upheld and funds will be allocated accordingly;

(viii) quarterly reports on the progress of funded projects should be submitted by the project manager to the Secretariat for circulation to all Members.

Interactions between WG-EMM and WG-FSA

FEMA2 Workshop

3.34   FEMA2 was held as a focus topic within the agenda of WG-EMM. Terms of reference and a specific task for the workshop are provided in Annex 4, paragraphs 2.1 and 2.2. Unless stated otherwise, all advice arising from the FEMA2 Workshop refers solely to the Ross Sea ecosystem and the toothfish fishery in Subarea 88.1 (Annex 4, paragraph 2.3).

3.35   The Scientific Committee agreed that FEMA2 was useful and, subject to the paragraphs below, endorsed the results of the workshop which:

(i)   advised on requirements for additional data and monitoring (Annex 4, paragraphs 2.14, 2.29, 2.43 and 2.48), as well as for additional modelling and inputs to modelling efforts (Annex 4, paragraphs 2.33, 2.43, 2.48, 2.51 and 2.53);

(ii)   concluded that there was negligible overlap of Weddell seals with the fishery and similarly negligible overlap between the fishery and killer whales (Annex 4, paragraph 2.42);

(iii) concluded that where there is overlap between the distribution of these two predators and elements of the toothfish population which may be impacted by the fishery, this is limited to shallow areas of the shelf and to the sub-adults of the toothfish population which are taken in small numbers by the fishery (Annex 4, paragraph 2.42);

(iv)   noted that a large portion of the shelf area is currently closed to fishing (Annex 4, paragraph 2.52);

(v)   demonstrated that the current status of size classes of interest are routinely monitored within regular stock assessments of the toothfish stock (Annex 4, paragraph 2.47) which currently detects no reduction in the abundance of recruiting size classes to the stock;

(vi)   were also endorsed by WG-FSA (Annex 5, paragraph 10.52).

3.36   The Scientific Committee endorsed Annex 4, paragraph 2.53, regarding the need to use food-web models and spatially structured population models prior to further field programs on these issues to:

(i)   better explore spatial overlaps and evaluate linkages between the toothfish population, the fishery and toothfish predators;

(ii)   determine the data needed to further develop a management strategy for the fishery.

3.37   The Scientific Committee also noted WG-EMM's discussion on potential revisions to the decision rule for toothfish in the Ross Sea that might accommodate effects both on toothfish predators (Annex 4, paragraph 2.49) and toothfish prey (Annex 4, paragraph 2.50) if needed.

Other considerations

3.38   The Scientific Committee noted the strong ecosystem anomaly that occurred at South Georgia in 2009 (paragraph 3.8; Annex 4, paragraph 3.10), and that, *inter alia*, this had caused low catches of krill (total catch 50 kg) and *Champsocephalus gunnari* in the fishery and scientific surveys (Annex 4, paragraph 4.8).   It was also noted that, in the relevant sections of its agenda, WG-FSA had taken up advice from WG-EMM on this issue as well as advice on VMEs (Annex 5, paragraph 10.56).

3.39   The Scientific Committee endorsed a request from WG-FSA and WG-EMM that Members provide the next meeting of WG-FSA with information that may be used to advise scientific observers in the krill fishery on key identification features for the most frequently encountered larval fish by-catch species (Annex 5, paragraph 10.58).

3.40   The Scientific Committee noted that information not currently considered by WG-EMM may provide information on the ecosystem impacts of finfish fishing.   In particular, it was noted that Argentina has collected and maintained a dataset that describes declines in the abundance of reproductively active Antarctic shags around the Antarctic Peninsula.   These birds are fish predators, and declines in their abundance may be tied to the depletion of commercially important finfish populations during the early 1980s (Casaux and Barrera-Oro, 2006).   The Scientific Committee encouraged Argentina to attend a future meeting of WG-EMM and provide information and analyses of these data to the Working Group.

HARVESTED SPECIES

Krill resources

2008/09 fishing season

4.1   Six vessels from five Members had fished for krill in 2008/09, all in Area 48 (Annex 4, Table 3).

4.2   The krill catch in 2008/09 (reported to October 2009) was 123 948 tonnes. In 2008/09 the catch was taken from Subareas 48.1 and 48.2 and there was <1 tonne caught from Subarea 48.3, which accords with reports that krill were absent from the South Georgia area during this season (paragraphs 3.8 and 3.38; Annex 4, paragraph 3.10).

4.3   It was unclear whether the shift of the fishery away from Subarea 48.3 in the 2008/09 season was the result of the absence of krill, or whether it was for other operational reasons; however, monthly catch data indicated a significantly higher than average winter catch from Subarea 48.2 so that the overall catch in Area 48 remained similar to that in 2007/08 despite the lack of a fishery at South Georgia. The Scientific Committee, however, noted that this shift in operational behaviour of the fishing fleet indicated that the historical pattern of krill fishing may not be observed in every year, and that concentration of fishing in smaller areas can occur.

Krill fishery notifications in 2009/10

4.4   Seven countries submitted krill fishery notifications for 13 vessels with a total notified catch of 363 000 tonnes which is considerably lower than the notified catch for the 2008/09 season of 629 000 tonnes. All notifications were for Area 48 but one notification also indicated fishing in Area 58.

4.5   Notifications to fish for krill were received from seven nations: China (3 vessels), Japan (1 vessel), Republic of Korea (3 vessels), Norway (3 vessels), Poland (1 vessel), Russia (1 vessel) and Ukraine (1 vessel). In addition, Chile submitted a notification for one vessel which arrived one month after the notification deadline of 1 June 2009 (CCAMLR-XXVIII/12 Rev. 1); this was therefore not considered further.

4.6   China notified its intention to fish for krill in Area 48 for the first time with three vessels and a projected catch of 9 000 tonnes.

4.7   In accordance with Conservation Measure 21-03, Norway notified its intention to participate in an exploratory krill fishery in Subarea 48.6 (paragraphs 4.215 and 4.216).

4.8   The Scientific Committee noted that some notifications had been submitted in official languages other than English this year and these were therefore unable to be examined fully by WG-EMM. The Scientific Committee recommended that translation of these and future notifications be carried out so that WG-EMM could provide scientific advice (Annex 4, paragraph 3.32).

Trends in krill fishery

4.9   The Scientific Committee noted that the projected catch for 2008/09 is likely to be similar to that in 2007/08 and that, although the notifications for fishing in 2009/10 were lower than in 2008/09, they were still considerably in excess of the current catch.

Potential trends in the krill fishery

4.10   The use of patent databases to examine potential future trends in the krill fishery was presented in SC-CAMLR-XXVIII/BG/15. The patent data show an upward trend. The Scientific Committee agreed that this could be a useful source of information to augment the Scientific Committee's data on trends in the krill fishery.

4.11   The data presented in SC-CAMLR-XXVIII/BG/15 showed there has been an increase in commercial interest in krill over the last decade as indicated by an increased rate of patent applications. Much of the increase in patent activity is in the area of medical products and human use, rather than patents for aquaculture or processing which dominated the earlier years of the krill industry. Recent patent activity has included a large number of applications from nations that are not currently fishing for krill.

4.12   The Scientific Committee agreed that a patent database could provide a valuable additional source of information about trends in the krill fishery and agreed that it would be useful if the Secretariat could maintain such a database in the future and provide annual updates on these trends.

Escape mortality

4.13   The Scientific Committee agreed that the potential mortality of krill that pass through the mesh of trawls ('escape mortality') could equal or exceed the mortality owing to catch alone and that this level of escape mortality is a matter of concern for assessments and catch allocation schemes (Annex 4, paragraph 3.4). The Scientific Committee recommended that there should be a concerted effort to estimate escape mortality in the krill fishery (Annex 4, paragraphs 3.5 and 3.6).

4.14   In SC-CAMLR-XXVIII/BG/10, Ukraine suggested the need to conduct experiments to determine escape mortality rates and provided details of designs of trawl nets with sewed-in catching patches to estimate the mortality rate.

4.15   The Scientific Committee thanked Ukraine for providing this useful information on escape mortality and recommended that the Scientific Committee ask the Members fishing for krill during the 2009/10 season to actively investigate the effects of different fishing gear on escape mortality of krill and report any information to next year's meeting of WG-EMM (Annex 4, paragraph 3.7).

Conversion factors

4.16   The Scientific Committee noted ad hoc TASO's discussion on volume-to-mass conversion factors; an issue identified as a potential problem in accurately estimating catch from volumetric measurement. Conversion factors discussed at previous meetings were limited to product-to-mass conversion, and the UK agreed to implement a trial procedure involving the collection of volume-to-mass data for krill samples from the krill fishery and to report the results to TASO and WG-EMM next year (Annex 9, paragraph 3.6; Annex 4, paragraph 3.49).

4.17   The Scientific Committee thanked the UK for undertaking this trial.

Data reporting

4.18   In 2007/08 the total catch of krill was 156 521 tonnes, all taken from Area 48; this compares with the total catch of 125 063 tonnes reported to the Scientific Committee in 2008 (SC-CAMLR-XXVII, paragraph 4.3). The Working Group noted that this discrepancy arose because the Secretariat did not receive monthly catch and effort data from one vessel for four months, a krill catch of 19 262 tonnes, due to an email failure and because the Secretariat was unaware that the vessel was engaged in fishing at that time (WG-EMM-09/6).

4.19   The Scientific Committee expressed its concern over this issue, which may have influenced the interpretation of the catch data in the Scientific Committee and Commission meetings, since the catch in 2007/08 was the highest since the 1991/92 season.

4.20   The Scientific Committee noted that the 2007/08 catch presented to SC-CAMLR-XXVII was an underestimate partly because Conservation Measure 10-04, which requires Flag States to notify the Secretariat of each entry to, exit from and movement between subareas and divisions of the Convention Area by each of its vessels, does not currently apply to krill fisheries (Annex 4, paragraph 3.67).

4.21   The Scientific Committee considered options that would allow the Secretariat to be informed if krill fishing activities were being undertaken so that it would be alerted to any missing reporting and be able to take appropriate action.

4.22   The Scientific Committee agreed that inserting a paragraph into Conservation Measure 23-06 requiring Flag States to notify the Secretariat of each entry to, exit from and movement between subareas and divisions of the Convention Area by each of its vessels would address this issue.

4.23   The Scientific Committee agreed that there is a need to make consistent the requirements of footnote 1 in Conservation Measure 21-03, which has a deadline of 1 June for the submission of notifications for exploratory fisheries for krill, and the timing of notifications under Conservation Measure 21-02 (Annex 4, paragraph 3.68).

4.24   The Scientific Committee noted (Annex 4, paragraph 3.69) that, while Conservation Measure 23-04 does not apply to the krill fishery, there were the following advantages of aligning the deadline for the submission of fine-scale catch and effort data from krill fisheries with the deadline applicable in other fisheries:

(i)   WG-EMM will be provided with improved availability of fine-scale information, including timely access to fine-scale data during preparation of the annual krill fishery report.

(ii)   It would facilitate improved data validation by enabling more timely and frequent communication between the Secretariat and data providers, and timely cross-checking with monthly catch and effort reports.

(iii)   It would improve the scheduling of data processing and validation in the Secretariat by alleviating the large amount of fine-scale data received by the Secretariat in late March each year.

4.25   The Scientific Committee recommended that Members submit fine-scale data at reporting intervals such as employed in other fisheries (Annex 4, paragraph 3.70).

Trigger level

4.26   The Scientific Committee agreed with the advice from WG-EMM that:

(i)   modelling results tabled at the meeting showed that a harvest level consistent with the current trigger level (620 000 tonnes) for the krill fishery in Subareas 48.1 to 48.3 was not as cautious as might have been thought at the time this was agreed (Annex 4, paragraph 3.122);

(ii)   status quo management may reduce the Commission's ability to achieve the objectives specified in Article II (see also the 2008 advice to the Scientific Committee in SC-CAMLR-XXVII, paragraph 3.9). This concern would be particularly important if the fishery were to become more spatially concentrated than the historical distribution of catch in areas where predators with restricted foraging ranges occur (Annex 4, paragraph 3.124).

4.27   The Scientific Committee further endorsed the recommendation by WG-EMM that the trigger level and its application in Conservation Measure 51-01 needs to be reviewed, taking account of the advice related to spatial allocation of the trigger level (Annex 4, paragraphs 3.126 to 3.132).

4.28   The Scientific Committee agreed that the results of all analyses and modelling currently conducted by WG-EMM consistently indicated that if the trigger level catch was concentrated in a single area, then this would increase the risk of significant adverse impacts on dependent predators in Area 48 (Annex 4, paragraphs 3.122 and 3.126). It also noted that distributing the catch according to the historical fishing pattern poses higher risks than other methods to distribute catch.

4.29   The Scientific Committee noted that WG-EMM had therefore advised that, at the current trigger level, the most appropriate distribution of catches would be in approximate proportion to the biomass derived in the CCAMLR-2000 Survey.

4.30   The Scientific Committee noted that the current trigger level was based on the 1970s stock state and that it was not realistic to expect fishing patterns to remain the same over this period of time, especially considering recent evidence which shows that krill stocks may have declined since the 1980s. Additionally, fishing patterns are known to change from season to season (e.g. 2008/09 season; paragraph 4.2).

4.31   Ukraine's proposal to amend Conservation Measure 51-01 (CCAMLR-XXVIII/48) suggested the subdivision of the trigger level in Area 48 into subareas in accordance with the ratio of krill biomass estimates in each subarea derived from the CCAMLR-2000 Survey and the distribution of catch limits between coastal and pelagic areas. The proposal further suggested the need for further research to identify and understand the uncertainties regarding information needed for krill fishery management.

4.32   The Scientific Committee thanked Ukraine for its effort in assembling this useful proposal.

4.33   The Scientific Committee noted that it is almost a decade since the CCAMLR-2000 Survey was conducted, and that there are uncertainties regarding the current use of the CCAMLR-2000 biomass distribution for allocating trigger levels. The Scientific Committee noted that there is an urgent need for another survey to update this information, but that this would take considerable planning, and management action was needed before such information would become available.

4.34   The Scientific Committee further noted that additional precaution is needed in the approach to manage the krill fishery because of increasing uncertainties in the overlap of fishing activities with predator requirements in specific locations and that this overlap may vary between and within years due to variation in the distribution of the krill stock as well as long-term ecological change.

4.35   It was noted that subdividing the trigger level needs to be achieved flexibly. Simply subdividing the trigger level with proportions which sum up to 100% may be equivalent to merely setting a new lower catch limit for each subarea, which is not the aim of the process.

4.36   The Scientific Committee agreed that there is a need to spatially distribute the krill fishing effort to avoid large catches being taken from restricted areas before the trigger level is reached. This could be a simple interim mechanism to manage the distribution of catch throughout Area 48.

4.37   In discussing the trigger level, the Scientific Committee noted that it should retain a focus on the ultimate aim of this series of work, which is to establish a feedback management procedure. This is intended to incorporate the SSMU concept but there is also a recognition that further research and time is still required to establish the long-term goal of feedback management and thus an interim mechanism is necessary.

4.38   The Scientific Committee agreed that mechanisms to avoid concentrating the catch before the trigger level is reached should be adopted this year, noting that the total catch possible within a year should be the total trigger level of 620 000 tonnes.

4.39   The interim mechanism should be able to distribute the catch without the need to know the exact krill distribution and the precise impact on krill predators. This approach needs to be flexible so as to avoid restricting the fishery at the current level of fishing, whilst at the same time providing the Commission with assurances that increased precaution is being exercised while WG-EMM is working on the longer-term feedback management procedure. Five models for avoiding catch concentration are given in Table 1. Discussion points on each of the models are also provided with the table.

4.40   Five models to spatially distribute the catch trigger level were discussed.

4.41   The Scientific Committee clarified the basis on which each of the models to distribute the trigger level was derived (Table 1).

4.42   The Scientific Committee noted that:

(i)   Models separating coastal and pelagic areas are the most precautionary option taking account of the needs of land-based predators; however, they are the least flexible for the current fishery and may force a change of fishing pattern at the current catch level, taking into account the potential interannual variations in krill distribution and oceanographic changes.

(ii)   The overlap models, where the sum of spatially distributed proportions can be more than 100%, allow more flexible operations for the current fishing pattern compared to non-overlap models.

4.43   The Scientific Committee noted that models with a coastal–pelagic separation can also be formulated as an overlap model if certain percentages are added to each of the sub-region percentages. The Scientific Committee noted that the 'coastal' regions in these models were defined as the 60 n mile zone around land.

4.44   The Scientific Committee noted that the trigger level is an interim measure set to ensure that the total catch limit is not concentrated in any one subarea before a management strategy is identified that will appropriately conserve dependent and related species, in this case krill predators. Under current regulations, catches equivalent to the trigger level of 620 000 tonnes of krill could be taken from any single local area. The Scientific Committee agreed that this trigger level alone will not be sufficient to prevent the concentration of catches in localised areas.

4.45   The Scientific Committee developed the candidate options in Table 1 and recommended the Commission use the options in the table as a foundation for determining how to distribute the trigger level. Figure 1 is provided to help understand Model 4.

Feedback management procedures

4.46   The Scientific Committee recalled the long history of the development of feedback management strategies for krill and how this development is required under the precautionary approach (CCAMLR-X, paragraph 6.13; SC-CAMLR-XXVI, paragraph 3.36), and further noted that the FOOSA (WG-EMM-05/13 and 06/22) model is now well developed and has established a foundation for exploring the consequences to achieving the objectives of CCAMLR given plausible models of ecosystem structure and function in the Scotia Sea.

4.47   The Scientific Committee thanked Dr Watters and his co-workers for the development of FOOSA and Dr Watters for his hard work leading the working groups to the point that the Scientific Committee is able to provide agreed precautionary advice to the Commission.

4.48   The Scientific Committee encouraged all Members to participate in the process of developing the feedback management procedure.

Fish resources

Fisheries information

Catch, effort, length and age data reported to CCAMLR

4.49   Fishing took place in 13 fisheries targeting icefish (*C. gunnari*), toothfish (*Dissostichus eleginoides* and/or *D. mawsoni*) and krill (*Euphausia superba*) under conservation measures in force in 2008/09 (CCAMLR-XXVIII/BG/6).

4.50   Three other fisheries were conducted in the Convention Area in 2008/09:

- 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 and Area 51 outside the Convention Area.

4.51   The preliminary total catch of target species by country and region reported from fisheries conducted in the CAMLR Convention Area in 2008/09 are summarised in Table 2. Catches reported in 2007/08 are summarised in Table 3.

4.52   The Scientific Committee noted the work completed by the Secretariat (Annex 5, paragraph 3.1) on:

- monitoring and closure of fisheries when catch limits were reached
- updating of Fishery Reports
- development of the CCAMLR database.

4.53   The Scientific Committee noted the estimates of catch and effort from IUU fishing (Annex 5, Table 2).

4.54   The Scientific Committee noted the catches of toothfish from waters outside the Convention Area reported in the CDS (see also paragraphs 4.138 to 4.140) (Annex 5, Table 4).

Input for stock assessment

4.55   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, and depredation.

Research surveys

4.56   The Scientific Committee noted that three Members reported on research surveys undertaken in 2008/09 (Annex 5, paragraphs 3.37 to 3.43):

(i)   A bottom trawl survey in Division 58.5.2 was carried out by Australia. The results of this survey were used to update assessments of toothfish and icefish in this division.

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

(iii)   A bottom trawl survey in the South Orkney Islands in Subarea 48.2 was carried out by the USA. Results from the survey were used to evaluate the current status of demersal finfish stocks in this subarea and to detect potential VMEs. The Scientific Committee noted that this was the first survey in the area for

10 years and results from this survey indicated that finfish species in this region are currently below a level which would allow a reopening of commercial finfish fisheries in Subarea 48.2.

4.57 The Scientific Committee thanked Australia, UK and the USA for completing very complex research surveys and for speedily providing data and results. Such data will contribute to the long-term data series.

Tagging studies

4.58 The Scientific Committee noted the detailed discussion by WG-FSA on tagging of toothfish in both exploratory and assessed fisheries (Annex 5, paragraphs 3.48 to 3.54). It welcomed both the continuing progress in this area and the significant contribution of the results to the assessments carried out by WG-FSA.

4.59 The Scientific Committee considered that the descriptive analysis of the tagging program in Subareas 88.1 and 88.2 represented a useful assessment of the available data (Annex 5, paragraph 3.48). It agreed that the associated estimates should be used in the updated assessment of the stock assessments for the Ross Sea and SSRU 882E.

4.60 The Scientific Committee endorsed WG-FSA's use of a methodology to analyse data metrics for selecting high-quality tagging data for inclusion in stock assessments (Annex 5, paragraph 3.49). It was noted that WG-FSA had provided recommendations for further developing this approach (Annex 5, paragraphs 3.49 to 3.51).

4.61 The Scientific Committee noted from tagging studies in exploratory fisheries, that there was evidence that fish were not being tagged in proportion to their size distribution in the catch (Annex 5, paragraphs 3.54 and 5.12 to 5.17). These discussions are in paragraphs 4.148 to 4.151.

Stock structure

4.62 The Scientific Committee agreed that standardised methods and data sources need to be developed for deriving bathymetric information in the Convention Area. It also encouraged the establishment of a common data repository and the contribution by other data providers of suitable bathymetric data to such a facility. Dr Welsford proposed that the Australian Antarctic Data Centre may provide an appropriate facility for storage and administration of such data.

Biology, ecology and demography of target and by-catch species

4.63 The Scientific Committee noted the work of WG-FSA on biology, ecology and demography of target and by-catch species in the fisheries and that summaries of 17 papers are provided in Annex 5, Appendix D.

4.64   The Scientific Committee noted the WG-FSA discussion provided (Annex 5, paragraphs 9.5 to 9.8) on the status of the CON, and agreed that an intersessional group should:

- prepare an inventory of those laboratories undertaking ageing of *Dissostichus* spp.
- foster an exchange of age-reading methods between laboratories
- establish a reference collection of otoliths of both species from all areas fished
- establish protocols of how otoliths are prepared for ageing and how annuli are identified.

4.65   In addition, the Scientific Committee requested that age determination based on otolith analyses of samples from *Dissostichus* spp. be included in the research plan which forms part of the notification for fishing in new and exploratory fisheries.

4.66   The Scientific Committee further suggested that the results of ageing and a detailed description of how ageing was conducted should be submitted to WG-FSA on a regular basis. Ageing data should also be submitted to the Secretariat to help develop the Secretariat's database to be used in storing ageing data for use in assessments.

Preparation of assessments by WG-FSA

4.67   The Scientific Committee noted WG-FSA had reviewed and endorsed the relevant sections of the SG-ASAM report (Annex 5, paragraphs 4.1 to 4.3).

4.68   The Scientific Committee also noted that WG-FSA had reviewed and endorsed the relevant sections of the WG-SAM report (Annex 5, paragraph 4.4).

Review of preliminary stock assessment papers

4.69   The Scientific Committee noted that WG-FSA had reviewed preliminary stock assessments developed during the intersessional period for *D. eleginoides* in Subareas 48.3 and 48.4 and Division 58.5.2, *Dissostichus* spp. in Subareas 88.1 and 88.2, and *C. gunnari* in Subarea 48.3 and Division 58.5.2. The resulting discussions and summaries are provided in Annex 5, paragraphs 4.6 to 4.26. In most cases, issues that had been raised at WG-SAM had been incorporated into revised stock assessments.

Assessments carried out and assessment timetable

4.70   Updated assessments were completed for the following fisheries:

- *D. eleginoides* in Subarea 48.3
- *D. eleginoides* in Subarea 48.4
- *D. eleginoides* in Division 58.5.2
- *D. mawsoni* in Subarea 88.1 and SSRUs 882A–B (Ross Sea management area)
- *D. mawsoni* in Subarea 88.2, SSRU E

- *C. gunnari* in Subarea 48.3
- *C. gunnari* in Division 58.5.2.

4.71   All assessments for *Dissostichus* spp. used the CASAL framework, and those for *C. gunnari* used the short-term projection approach. Specific information on input data and assessment methodologies for each assessed fishery are provided in the relevant Fishery Reports.

4.72   WG-FSA had no new information with which to review assessments for *D. eleginoides* fisheries in the French EEZs in Division 58.5.1 and Subarea 58.6 and the South African EEZ in Subareas 58.6/58.7.

4.73   All assessment work was undertaken by primary authors of the preliminary assessments, and reviewed independently at the WG-FSA meeting. Tasks of independent reviewers are listed in WG-FSA-06/6, paragraph 6.3. The outcomes of the assessments were reported in the Fishery Reports (Annex 5, Appendices E to S)[1].

Assessments and management advice

Dissostichus eleginoides South Georgia (Subarea 48.3)

4.74   The Fishery Report for *D. eleginoides* in Subarea 48.3 is contained in Annex 5, Appendix L, and the discussion by WG-FSA is in Annex 5, paragraphs 5.121 to 5.127.

4.75   The catch limit for *D. eleginoides* in the 2008/09 season was 3 920 tonnes, and the recorded catch was 3 383 tonnes.

4.76   The Scientific Committee endorsed the assessment undertaken by WG-FSA presented in Annex 5, paragraphs 5.121 to 5.127 and Appendix L (Fishery Report).

4.77   The Scientific Committee noted WG-FSA's assessment that fits to the tag, CPUE and catch-at-age data were good, with the exception of the 2009 catch-at-age data (Annex 5, paragraph 4.7). The model did not adequately predict the large proportion of young (age 7) fish caught this year. WG-FSA had agreed that there were two alternative explanations for this result; either recruitment (to the 2001 cohort) has been exceptionally high, or the pattern of the fishery has changed.

4.78   The Scientific Committee noted that WG-FSA was unable to distinguish between these two hypotheses, but this should become clearer when the 2001 cohort has fully recruited to the fishery in one or two years' time.

4.79   WG-FSA therefore considered two plausible scenarios for future recruitment in projections. The first assumes that future recruitment will be similar to the entire time series of past recruitment, and uses lognormal mean recruitment (CV 0.59) for the projections. The second assumes that future recruitment will be similar to the recent historically estimated recruitment, and uses the lognormal empirical time series of recruitments from 1991–2001 for

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[1]   The Fishery Reports are only available electronically in English at www.ccamlr.org/pu/e/e_pubs/fr/drt.htm.

the projections. This latter recruit series had both a lower overall recruitment level and lower variance (CV 0.56) than the former because of the removal of the very large 1990 cohort from the series (Annex 5, paragraph 5.125).

4.80   The calculated yields that satisfy the CCAMLR decision rules for these two scenarios were 3 950 and 2 750 tonnes respectively.

Management advice

4.81   Given the uncertainty in recent recruitment to the stock, and its implications on future recruitment levels, the Scientific Committee recommended that the catch limit should be set towards the lower end of the range 2 750–3 950 tonnes.

4.82   The catch limit can be carried over into the 2010/11 fishing season, subject to the conditions of the biennial assessment procedure for this fishery adopted in 2007, and detailed in SC-CAMLR-XXVI, paragraph 14.6.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

4.83   The Fishery Report for *D. eleginoides* in Subarea 48.4 is contained in Annex 5, Appendix M, and the discussion by WG-FSA is in Annex 5, paragraphs 5.128 to 5.138.

4.84   A tagging experiment has been conducted in the Northern Area of Subarea 48.4 over the last four years. This experiment was extended to the Southern Area of Subarea 48.4 in the 2008/09 fishing season.

4.85   The catch limits for *D. eleginoides* and *D. mawsoni* in the Northern Area of Subarea 48.4 in the 2008/09 season were 75 and 0 tonnes (except for scientific purposes) respectively, with recorded catches of 59 and 0 tonnes respectively. The northern fishery was closed when the macrourid by-catch limit was reached. The catch limit for *Dissostichus* spp. in the Southern Area of Subarea 48.4 in the 2008/09 season was 75 tonnes, with a recorded catch of 74 tonnes.

D. eleginoides in the Northern Area

4.86   The Scientific Committee noted that a single CASAL assessment model had been used for *D. eleginoides* in the Northern Area of Subarea 48.4. Discussions are presented in Annex 5, paragraphs 5.130 to 5.133. Long-term yield for the Northern Area that satisfies the CCAMLR decision rules was 41 tonnes.

4.87   The Scientific Committee noted the success of the four-year experiment in Subarea 48.4 and attributed this success to the following key factors:

(i)   the experiment was well designed and monitored closely;

(ii)   vessels undertaking the experiment had committed to it over the whole period of the experiment, allowing for consistency and high standards in the execution of the research plan;

(iii)   tags were released randomly throughout the area, with tagging of a wide range of toothfish sizes.

4.88   The Scientific Committee noted that the experimental design and proposed analyses, which would result in completion of a stock assessment, were reviewed by WG-FSA prior to undertaking the experiment.

4.89   In addition, the Scientific Committee noted the lack of IUU removals in Subarea 48.4 which provided for greater understanding of stock status.

4.90   The Scientific Committee expressed its appreciation to the vessels that participated in the four-year experiment for their dedicated and high-quality work, essential to the success of the experiment.

Dissostichus spp. in the Southern Area

4.91   A report of the first year of the experiment in the Southern Area was submitted to WG-FSA (Annex 5, paragraph 5.134). *Dissostichus mawsoni* were found throughout the area, and *D. eleginoides* only in the very northernmost part of the area.

4.92   Following comparison of CPUE and fishable area between the Northern and Southern Areas of Subarea 48.4, WG-FSA concluded that a catch of 75 tonnes, taken over the three years of the experiment, was unlikely to deplete the stock in the Southern Area.

Management advice

4.93   The Scientific Committee recommended that the catch limit for *D. eleginoides* in the Northern Area of Subarea 48.4 should be set at 41 tonnes.

4.94   The Scientific Committee recommended that the catch limit for *Dissostichus* spp. in the Southern Area of Subarea 48.4 should remain at 75 tonnes, and that the experiment should be extended for a further two years and be reviewed periodically by WG-FSA.

4.95   The Scientific Committee recommended that Conservation Measure 41-03 should be updated during the two-year tagging experiment to incorporate a threshold catch of 150 kg of *Macrourus* spp. above which the move-on rule would be triggered, and that it should be reviewed on an annual basis. The existing move-on rules for rajids in the Southern Area of Subarea 48.4 should be retained.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

4.96   The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Annex 5, Appendix N, and the discussion by WG-FSA is in Annex 5, paragraphs 5.139 to 5.145.

4.97   The catch of *D. eleginoides* reported for this division to 31 August 2009 was 3 108 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2008/09 season was zero in Division 58.5.1 (Annex 5, paragraph 5.140).

4.98   The CPUE standardisation for Division 58.5.1 was not updated by WG-FSA.

Management advice

4.99   The Scientific Committee encouraged the estimation of biological parameters for *D. eleginoides* in Division 58.5.1 and the development of a stock assessment for this area. It also encouraged cooperative work in the intersessional period between France and Australia on analyses of catch and effort data and other data that could be used to progress the understanding of fish stocks and fishery dynamics for Divisions 58.5.1 and 58.5.2 and Subarea 58.6. The Scientific Committee encouraged France to continue its tagging program in Division 58.5.1.

4.100   The Scientific Committee recommended that avoidance of fishing in zones of specific high rates of by-catch should also be considered.

4.101   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 Conservation Measure 32-13, remains in force.

4.102   The Scientific Committee noted that France had made significant progress in mitigating seabird by-catch, including area/season closures (SC-CAMLR-XXVI, Annex 6, paragraph II.23). It noted that the CPUE analysis would probably be robust to these changes so long as detailed haul-by-haul data continued to be available.

Dissostichus eleginoides Heard Island (Division 58.5.2)

4.103   The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Annex 5, Appendix O, and the discussion by WG-FSA is in Annex 5, paragraphs 5.146 to 5.152.

4.104   The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E for the 2008/09 season was 2 500 tonnes (Conservation Measure 41-08) for the period from 1 December 2008 to 30 November 2009. The catch of *D. eleginoides* reported for this division as at 11 October 2009 was 2 177 tonnes. Of this, 1 000 tonnes was taken by trawl, 1 164 tonnes by longline and the remainder by pot (<1%). The estimated IUU catch for the season was 0 tonnes.

4.105   Long-term annual yield, based on a slight revision of the preliminary assessment was estimated to be 2 550 tonnes.

4.106 The Scientific Committee noted that under this scenario, as presented in WG-FSA-09/20, the median SSB may remain below the target level for several years, before returning to the 0.5 SSB at the end of the 35-year projection period. The Scientific Committee noted the advice of WG-FSA that the stock is currently estimated to be above the target level, and that while a stock is likely to fluctuate around the target level through natural variability, this indicated a need for continued scrutiny of this stock into the future.

4.107 The Scientific Committee thanked Australia for setting out a comprehensive program of future work (Annex 5, paragraph 5.151) aimed at reducing key uncertainties in the assessment before the SSB is forecast to fall below the target level.

Management advice

4.108 The Scientific Committee recommended that the catch limit for *D. eleginoides* in Division 58.5.2 west of 79°20'E should be 2 550 tonnes for the 2009/10 fishing season.

4.109 This catch limit can be carried over into the 2010/11 fishing season, subject to the conditions of the biennial assessment procedure for this fishery adopted in 2007, and detailed in SC-CAMLR-XXVI, paragraph 14.6.

Dissostichus eleginoides Crozet Islands (Subarea 58.6)

4.110 The Fishery Report for *D. eleginoides* in Subarea 58.6 (French EEZ) is contained in Annex 5, Appendix P, and the discussion by WG-FSA is in Annex 5, paragraphs 5.153 to 5.159.

4.111 The catch of *D. eleginoides* reported for this subarea to October 2009 was 746 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2008/09 season was zero inside Subarea 58.6 (Annex 5, paragraph 5.154)

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

Management advice

4.113 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.

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

4.115 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 Conservation Measure 32-11, remain in force.

4.116 The Scientific Committee noted that France had made significant progress in mitigating seabird by-catch, including area/season closures (SC-CAMLR-XXVI, Annex 6, paragraph II.23). It noted that the CPUE analysis would probably be robust to these changes so long as detailed haul-by-haul data continued to be available.

Dissostichus eleginoides Prince Edward and
Marion Islands (Subareas 58.6 and 58.7)

4.117 The Fishery Report for *D. eleginoides* in Subareas 58.6 and 58.7 inside the South African EEZ is contained in Annex 5, Appendix Q, and the discussion by WG-FSA is in Annex 5, paragraphs 5.160 to 5.164.

4.118 The catch limit of *D. eleginoides* in the South African EEZ for the 2008/09 season was 450 tonnes for the period from 1 December 2008 to 30 November 2009. The catch reported for Subareas 58.6 and 58.7 as at 5 October 2009 was 4 tonnes, all of which was taken by longlines. There was no evidence of IUU catch in 2008/09.

4.119 The standardised CPUE series was not updated by WG-FSA in 2009.

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

4.120 South Africa is considering the adoption of an Operational Management Procedure (SC-CAMLR-XXVII, Annex 7, paragraphs 6.1 to 6.3) approach as a basis for provision of management advice, and the catch limit for 2010 is likely to be in the range of 250–450 tonnes. Details are provided in Annex 5, Appendix Q. This is proposed to address the concerns over the sensitivity of the South African assessment using ASPM to weightings used for different data sources and the estimation of recruitment levels for forward projections.

4.121 The Scientific Committee recalled its advice from 2005 that the advice on the appropriate levels of future catch provided in WG-FSA-05/58 (see also WG-FSA-06/58 and 07/34 Rev. 1) was not based on the CCAMLR decision rules. Therefore, the Scientific Committee was unable to provide management advice for the fishery in the South African EEZ at the Prince Edward Islands. The Scientific Committee recommended that CCAMLR decision rules also be used in estimating yields for this fishery.

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

4.122 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 Conservation Measures 32-10, 32-11 and 32-12, remains in force.

Champsocephalus gunnari South Georgia (Subarea 48.3)

4.123 The Fishery Report for *C. gunnari* at South Georgia (Subarea 48.3) is contained in Annex 5, Appendix R, and discussion by WG-FSA is in Annex 5, paragraphs 5.166 to 5.172.

4.124 In the 2008/09 fishing season the catch limit set for *C. gunnari* in Subarea 48.3 was 3 834 tonnes. During the 2008/09 season the fishery caught 1 837 tonnes by the end of October 2009.

4.125 The Scientific Committee noted that in 2009 the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves. A short-term assessment was implemented using the GYM to project the new biomass estimate from the survey, assuming the same parameters for the assessment as in 2008.

Management advice

4.126 The Scientific Committee recommended that the catch limit for *C. gunnari* should be set at 1 548 tonnes in 2009/10 and 949 tonnes in 2010/11 based on the outcome of the short-term assessment.

4.127 The Scientific Committee recommended that the season start date be altered to 1 December to reflect the start dates of other CCAMLR fishing seasons.

Champsocephalus gunnari Heard Island (Division 58.5.2)

4.128 The Fishery Report for *C. gunnari* in Division 58.5.2 is contained in Annex 5, Appendix S, and discussion by WG-FSA is in Annex 5, paragraphs 5.173 to 5.178.

4.129 The catch limit of *C. gunnari* in Division 58.5.2 for the 2008/09 season was 102 tonnes for the period from 1 December 2008 to 30 November 2009. The catch reported for this division as at 5 October 2009 was 99 tonnes.

4.130 The Scientific Committee noted that a large 3+ year class, probably the result of spawning by the 4+ year class dominant in 2006, was observed to dominate the population in the survey undertaken in April 2009.

4.131 The Scientific Committee recalled that the current strategy of spreading catch over two years, while meeting the escapement rule, was to provide for two years of spawning (SC-CAMLR-XVI, Annex 5). The Scientific Committee noted that the 3+ cohort had been reproductively mature for one year and that after one more year, it was likely that the cohort would disappear (SC-CAMLR-XX, Annex 5, Appendix D, Figure 1). Further, the Scientific Committee noted that the large increase in biomass of this cohort in the recent survey, relative to the 2008 survey, suggests that last year's assessment probably underestimated the precautionary yield from this cohort in 2008/09. Therefore, the escapement of these fish is likely to have been greater than 75%.

4.132   The Scientific Committee agreed that a strategy for fishing on the current 3+ year class could be similar to that applied in the 2005/06 season (SC-CAMLR-XXIII, Annex 5, Appendix M), allowing the catch to be taken in one year (2009/10) with the expectation of no exploitation of that cohort in the following year (2010/11). The Scientific Committee recalled that, due to the strong three-year cycle evident in the icefish population in Division 58.5.2, it is unlikely that there will be another sizeable cohort available to the fishery until after 2010/11. When estimated in a scenario based on all fishing in one year and no catch in the second year, the yield estimate for 2009/10 is 1 658 tonnes, with a fishing mortality of 0.288.

Management advice

4.133   The Scientific Committee recommended that the catch limit for *C. gunnari* in Division 58.5.2 should be set at 1 658 tonnes in 2009/10 and zero tonnes in 2010/11.

Assessment and management advice for other fisheries

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

4.134   The Scientific Committee noted the reported recovery of *Notothenia rossii* populations in Potter Cove, South Shetland Islands, to levels close to that of the early 1980s and that WG-FSA had (Annex 5, paragraph 5.179) cautioned that extrapolation of these findings to a subarea scale was premature.

4.135   In reference to WG-FSA-09/31, the Scientific Committee recalled that *N. rossii* has been the first overexploited fish species in the Southern Ocean and that, after three decades from the end of commercial fishery operations in Subarea 48.1 (1979/80), this species is showing signs of recovery in Potter Cove in 2008/09. This emphasised that the period required for the apparent recovery of *N. rossii* in Subarea 48.1 exceeds the limit of two to three decades established in Article II of the Convention, and that the same situation could be happening with other overexploited Antarctic fish species.

4.136   On the basis of the results of a multi-species research survey in Subarea 48.2 (Annex 5, paragraph 5.180), the Scientific Committee agreed that the populations of previously exploited species, including *C. gunnari* and *N. rossii*, show little sign of recovery in Subarea 48.2 despite the closure of the fishery after the 1989/90 season (see Annex 5, paragraph 3.41).

Management advice

4.137   The Scientific Committee recommended that the existing Conservation Measures 32-02 and 32-04 on the prohibition of finfishing in Subareas 48.1 and 48.2 respectively, remain in force.

4.138 Dr E. Barrera-Oro (Argentina) advised that approximately 2 400 tonnes of *D. eleginoides* had been caught in the Argentine EEZ in Area 41 in 2008/09, and the catch limit in that area was 2 500 tonnes. The catch had been taken by longline (approximately 55% of the catch), bottom trawl (37%) and pots (8%). Since 2007, vessels are required to tag *D. eleginoides* at a rate of two fish per tonne of green weight caught, and to date 2 520 individuals have been tagged and released. Thirteen tagged fish have been recaptured and reported.

4.139 Prof. O. Pin (Uruguay) advised that approximately 550 tonnes of *D. eleginoides* had been caught in the Uruguayan EEZ in Area 41 in 2008/09. The catch had been taken by longline (approximately 50% of the catch), trotline with cetacean exclusion devices (40%) and pots (10%).

4.140 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.

New and exploratory finfish fisheries

New and exploratory fisheries in 2008/09 and notifications for 2009/10

4.141 In 2008 the Commission agreed to seven exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season (Conservation Measures 41-04, 41-05, 41-06, 41-07, 41-09, 41-10 and 41-11), an exploratory trawl fishery for *E. superba* in Subarea 48.6 (Conservation Measure 51-05), and exploratory fisheries for crab in Subareas 48.2 and 48.4 (Conservation Measures 52-02 and 52-03). Activities in the exploratory fisheries are outlined below and summarised in Annex 5, Table 5.

4.142 Notifications for exploratory fisheries in 2009/10 are summarised in Annex 5, Table 6; no notification for a new fishery was submitted. Ten Members submitted paid notifications 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, an exploratory trawl fishery for *E. superba* in Subarea 48.6, and for exploratory pot fisheries for crab in Subareas 48.2 and 48.4.

4.143 The Scientific Committee noted that Argentina had originally notified to fish using both pots and longlines in Subarea 88.1, however, Argentina advised the Scientific Committee that it would only use longlines in this fishery in 2009/10.

Tagging in exploratory toothfish fisheries

4.144 Under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in 2008/09 was required to tag and release *Dissostichus* spp. at the rate of one toothfish per tonne of green weight caught throughout the season in

Subareas 88.1 and 88.2, and three fish per tonne in Subarea 48.6 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b (Annex 5, Table 8). All vessels achieved the required tagging rate except for the *Isla Eden*[2] in Subareas 88.1 and 88.2. In 2008/09, 6 326 *Dissostichus* spp. were reported to have been tagged and released in the exploratory longline fisheries (Annex 5, Table 9), and 172 tags were recovered (Annex 5, Table 10).

4.145 The Scientific Committee noted that recaptures of tags in Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3b, were very low, with 45 recaptures from over 7 000 fish tagged and released between 2003/04 and 2008/09. The Scientific Committee noted that there may be movements of some tagged fish over time into closed SSRUs, however, this factor alone was unlikely to provide sufficient explanation for the low number of tag-recaptures to date.

4.146 The Scientific Committee noted that the analyses of the tagging program by WG-FSA (Annex 5, paragraphs 5.9 to 5.17) suggested some improvements in the implementation of the tagging program on the 2007/08 season, with most vessels now tagging at the correct rate (Annex 5, Figure 2), and in the overlap where tagged fish had been released in relation to the locations of catches.

4.147 However, the Scientific Committee noted that one vessel initially tagged at a very high rate (including 100 fish tagged from one set) but then ceased tagging altogether during the remainder of its cruise. Although this vessel exceeded the overall required tagging rate, the Scientific Committee was concerned that such a high tagging rate over a short period of time may be detrimental to those fish that were tagged, and was not consistent with the intention to spread tagged fish throughout the area as fishing proceeds.

4.148 The Scientific Committee noted that the amount of overlap between the length of fish caught and the length of fish tagged was highly variable between vessels depending on species and areas, however, several vessels (*Isla Eden, Insung No. 1, Insung No. 22, Jung Woo No. 2, Jung Woo No. 3* and *Tronio*) showed low overlap between the two distributions in all statistical areas fished. Other vessels (*Shinsei Maru No. 3, Antarctic Chieftain, Janas, San Aotea II, San Aspiring* and *Ross Star*) achieved high overlap in at least one statistical area (Annex 5, Figure 3 and Table 11).

4.149 The Scientific Committee noted the method developed by WG-FSA to assess the level of overlap between the size of released fish and the size of retained fish was useful in summarising the implementation of the tagging program in exploratory toothfish fisheries, and recommended that the method could be used by SCIC in evaluating the implementation of the tagging program under Conservation Measure 41-01, Annex 41-01/C.

4.150 The Scientific Committee agreed that one of the main reasons for the low number of recaptures in Subareas 48.6 and 58.4 was likely to be the small size of the fish tagged compared to the overall size distribution of the fished population. It further noted with concern that these small fish were very unlikely to be recaptured, as such small fish may take 15–20 years to grow to a point where they would be representative of the size of fish taken by the fishery.

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[2] The tagging rates for the *Isla Eden* were incorrectly reported at the meeting of WG-FSA. The *Isla Eden* achieved the required tagging rates in Subareas 88.1 and 88.2. See Annex 5, Table 8 corrigendum.

4.151 The Scientific Committee noted with concern the low level of commitment to the tagging program by some Members, and that this was having a serious impact on its efficacy. It further noted that practical methods for tagging large toothfish had been available for several years (Annex 5, paragraph 5.17). The Scientific Committee therefore noted that it was incumbent on Members to ensure that the tagging program was implemented correctly, and large fish were tagged in proportion to their presence in the catch.

Research hauls in exploratory fisheries

4.152 The Scientific Committee recalled that under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in 2008/09 was required to complete 10 research hauls (each comprising 3 500–5 000 hooks and separated by a distance of at least 5 n miles) on entering an SSRU in an exploratory fishery. For the 2008/09 season, each SSRU was divided into two strata (fished and non-fished/lightly fished) and vessels were required to carry out their research hauls at randomly allocated positions which had been pre-determined by the Secretariat. If it was not possible to complete the research hauls in the allocated positions, then they were requested to complete the hauls within the appropriate strata (CCAMLR-XXVIII/BG/6).

4.153 The Scientific Committee noted that the degree of consistency between the allocated and actual research haul locations varied considerably between vessels and statistical areas (Annex 5, paragraph 5.19). Whilst most vessels set lines on, or close to, the allocated location, the *Banzare* consistently set its research hauls at a mean distance of more than 25 n miles from the allocated positions (Annex 5, Table 12). The Scientific Committee noted not all research hauls were set at their allocated locations, some research hauls were not even completed in the required stratum (Annex 5, Table 12).

4.154 The Scientific Committee also noted that comparison of the mean catch rates (catch per 1 000 hooks) from the research hauls with mean catch rates for commercial hauls indicated that there was no substantial reduction in overall catch rates from completing the 10 research hauls.

4.155 The Scientific Committee endorsed the advice from WG-SAM on the use and implementation of research hauls in exploratory fisheries (Annex 6, paragraphs 2.56 to 2.61), including that:

(i) the research set allocation approach developed for use for the exploratory fisheries in 2008/09 be retained for the 2009/10 season with the implementation outlined in Annex 6, paragraph 2.58;

(ii) the number of research hauls required to achieve a target CV for this monitoring tool should be evaluated by WG-FSA and, if appropriate, the proportion of research hauls in the non-fished/lightly fished strata could be altered accordingly.

Open and closed areas

4.156 The Scientific Committee noted the discussion on open and closed areas (Annex 5, paragraphs 5.23 to 5.28). The Scientific Committee agreed that the relative merits of the different views on harvest strategies for toothfish in new and exploratory fisheries be evaluated using simulations. It recommended that such work be submitted to WG-SAM for review of the simulation methodologies before submitting the outcomes to WG-FSA for consideration.

4.157 Dr L. Pshenichnov (Ukraine) made the following statement to the Scientific Committee:

'When, a few years ago, it was suggested that some SSRUs in Divisions 58.4.1 and 58.4.2 be closed and that, periodically, the closed SSRUs be opened to fishing and vice versa, the Ukrainian Delegation agreed with this approach. However, we can see that the experiment has lasted too long and we are losing time which could be used to research these regions. The Scientific Committee cannot assess the distribution of the target fish species and by-catch species over a large area because much of the marine area is closed to fishing and, therefore, to the acquisition of any data. It is clear that no-one is going to conduct any real scientific research to assess the resources in this region for years to come, because it is too expensive. The only way to obtain any information about the biological resources is to conduct observations on board fishing vessels, but even fishing vessels do not enter the closed SSRUs now and, given the current catch limits, the fishing vessels only stay in certain open SSRUs for a short time. Since last year, the SSRUs closed to fishing have been closed to research fishing as well.

We believe that it is this approach which is impeding the assessment of the toothfish resources in Divisions 58.4.1 and 58.4.2, i.e. estimating fish stocks and fish biomass for each SSRU separately. The biomass of the population cannot be estimated by surveying only a small part of it. This contradicts all biological rules, as we stated last year (SC-CAMLR-XXVII, paragraph 4.116) and have done repeatedly in the past. I hope that this time both the Scientific Committee and the Commission will take notice of my statement.

The concentration of fishing effort in small areas leads to depletion of fish resources in those areas, and this does not reflect the biomass status of the species in the whole area. The information on a depletion experiment (fishing operations conducted during a short period of time in one location) provided last year (WG-FSA-08/43) demonstrated that there was no significant movement of fish observed over a short period of time. An increase in catch-per-unit effort (CPUE) this year for the SSRUs in Divisions 58.4.1 and 58.4.2 that were open for fishing (Annex 5, Table 7) indicated that there was no stock depletion as had been indicated last year (in WG-FSA-08/43). The Scientific Committee agreed (paragraph 4.109 of last year's Scientific Committee Report) that, in the absence of reliable tagging information, the only other information currently available is CPUE. So, we should be consistent: an increase in CPUE means that the fishable part of the population is in good condition, even in small areas, and, consequently, it is possible to increase the level of TAC for these areas.

Last year, the Scientific Committee agreed (SC-CAMLR-XXVII, paragraph 4.108) on the need for a good spatial overlap of tags and subsequent fishing effort. Due to the lack of data from SSRUs that have been closed to fishing in recent years, we cannot recapture fish which have been tagged in the areas open to fishing. Moreover, we do not know, and we will never know, the numbers of fish that have moved into adjacent areas closed to fishing. The data presented to WG-FSA for Divisions 58.4.1 and 58.4.2 (Annex 5, Figure 8) indicated that over 10% of tagged fish recaptured in a short period of time had travelled a distance of more than 100 miles (and according to a working group document on the Ross Sea (WG-FSA-09/39), tagged fish were caught within a distance of 400 to 600 km from their tagging location). Fish are often tagged on the border between areas, and the extent of SSRUs is less than 300 miles. Figure 8 of the WG-FSA report shows that there were practically no tag returns for the whole period of the toothfish tagging program in a huge area between 30°E and 90°E. In our opinion, this is the result of an incorrect strategy adopted by the Scientific Committee with regard to research and data collection for the purposes of the rational use of biological resources in Divisions 58.4.1 and 58.4.2.

In mathematical stock assessment models it may be convenient to use a certain number of fish from a small area in which the fishery is concentrated. However, from a biological point of view, this approach is a distortion of the overall pattern of the species' spatial distribution and, as a result, misrepresents the biomass level for the species and hinders the acquisition of the best scientific data. Furthermore, from the point of view of the environmental approach used by our organisation, it is harmful and has an adverse impact on a certain proportion of the population, especially as we do not have sufficient data to determine the structure of this population. We do not think that the best scientific data is an almost complete lack of such data.

During the Scientific Committee meeting we propose to discuss the possibility of opening all SSRUs in Divisions 58.4.1 and 58.4.2 to fishing (and for the Commission this provides an opportunity to acquire data), to discuss (or refine) the procedures for conducting research work in closed SSRUs, and to provide the appropriate recommendations to the Commission for developing amendments to conservation measures.'

4.158 Dr Bizikov supported the intervention by Dr Pshenichnov, noting that fishing in closed areas would provide data on the distribution of species, and the Scientific Committee should provide advice to the Commission on a coordinated and coherent program to collect data across the entire Convention Area.

4.159 The Scientific Committee agreed that a well-designed research experiment is needed to clarify the issues on stock status in Subarea 58.4. This needs to be designed and undertaken in accordance with the guidelines developed at SC-CAMLR-XXVII (SC-CAMLR-XXVII, paragraphs 8.9 to 8.11) and endorsed by the Commission in paragraph 4.66 of CCAMLR-XXVII. Catch limits will need to be consistent with the objectives of the experiment. The aim of such an experiment would be to provide information on the status of stocks of *Dissostichus* spp. in Subarea 58.4 over a 2–3 year time period.

4.160 The Scientific Committee agreed that it was important to use simulations and MSE frameworks to address the potential bias in assessments arising from open/closed SSRUs. The Scientific Committee also recalled that New Zealand has been developing an SPM over

the past two years which could be used to assess potential issues of bias in the tagging program (WG-SAM-08/14, 09/17, 09/18). New Zealand welcomed the cooperation of other Members to further develop this work.

Development of methods for assessing new and exploratory fisheries

4.161 The Scientific Committee noted the discussion by WG-FSA on developing methods of collecting data and providing assessments for new and exploratory fisheries (Annex 5, paragraphs 5.112 to 5.120).

4.162 The Scientific Committee recalled that participation in exploratory fisheries represents a commitment towards undertaking research that will lead to a stock assessment before the stock is reduced to the target status. It further noted that research programs will have to operate in a different manner in fisheries that have not been previously exploited compared to those which have been depleted. In the latter case, the Scientific Committee agreed that the research strategy needs to be designed so as to ensure that research requirements do not impact on the ability of the fishery to recover.

4.163 The Scientific Committee agreed that in evaluating research programs in data-poor fisheries, there were three questions that need to be addressed for the provision of advice on what research would be appropriate:

(i) What research needs to be undertaken to facilitate a preliminary assessment of stock status?

(ii) What is the mortality of fish that will likely occur as a result of undertaking the research without any additional catch? For example, if all fish in good condition were tagged and released, what proportion of the tagged fish would be in poor condition and die?

(iii) What is the quantity of fish that could be taken to offset the cost of the research, noting the possible status of the stock?

4.164 The Scientific Committee agreed that the data currently provided from the new and exploratory fisheries in areas other than the Ross Sea are unlikely to provide an assessment in the near future. The Scientific Committee further noted that the lack of commitment by some vessels to implementing research plans cast doubt on the likelihood that useful data may be collected by these vessels in the future.

4.165 The Scientific Committee agreed that the lack of useful data being derived from the current approach to new and exploratory fisheries in areas other than the Ross Sea, made it urgent to develop a revised approach that will ensure the delivery of all data needed to provide assessments within these subareas within 3–4 years. The Scientific Committee noted that the lack of useful tagging data was only part of this problem, and the lack of consistency in nations, vessels and gear types fishing in new and exploratory fisheries in areas other than the Ross Sea was also an important issue.

4.166 The Scientific Committee agreed that the proposal by Japan for research on Ob and Lena Banks could provide a model for developing research plans in exploratory fisheries. It further agreed that for these plans to lead to advice, they need to be evaluated in relation to how the data would be used to assess stock status.

4.167 The Scientific Committee asked the Commission to note that research plans should take account of the fact that toothfish fisheries in Subarea 58.4 are no longer in a pristine state. The Scientific Committee asked the Commission to further consider that such programs may require a level of research catch guaranteed to those conducting the research plan, to ensure the research can be completed and an assessment can be provided.

4.168 The Scientific Committee also asked the Commission to note that the development of research plans would be difficult to resolve this year, and that the opportunity to develop research plans should be open to all Members, not just those submitting notifications this year.

Dissostichus spp. Subarea 48.6

4.169 In 2008/09, the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 was limited to Japanese and Korean flagged vessels using longlines only, and no more than one vessel per country was permitted to fish at any one time. 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 Annex 5, Appendix E.

4.170 Licensed longline vessels have fished the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 since 2003/04, and the main species caught has been *D. eleginoides*, except in 2008/09 when the dominant species in the catches was *D. mawsoni*. In 2008/09, two vessels fished in SSRUs E and G. SSRU E was closed on 12 March 2009 (catch limit for *Dissostichus* spp.: 200 tonnes; final reported catch: 189 tonnes), with a consequential closure of all other SSRUs south of 60°S.

4.171 There was no evidence of IUU fishing in 2008/09.

4.172 Vessels were required to tag and release *Dissostichus* spp. at a rate of three tags per tonne in 2008/09 and both vessels achieved the new target rate. A total of 401 *D. eleginoides* and 906 *D. mawsoni* (total 1 307 fish) have now been tagged and released, and five *D. eleginoides* and two *D. mawsoni* have been recaptured in that subarea (Annex 5, Tables 9 and 10).

4.173 Three Members (Japan, Republic of Korea and South Africa) and a total of five vessels notified their intention to fish for toothfish in Subarea 48.6 in 2009/10.

4.174 The Scientific Committee recommended the existing conservation measures for Subarea 48.6 be retained for the 2009/10 season.

Dissostichus spp. Division 58.4.1

4.175 Two Members (Republic of Korea and Uruguay) and three vessels fished in the exploratory fishery in Division 58.4.1 in 2008/09. The precautionary catch limit for toothfish was 210 tonnes, of which no more than 100 tonnes could be taken in SSRU C, 50 tonnes in SSRU E and 60 tonnes in SSRU G. The five other SSRUs (A, B, D, F and H) were closed. Fishing was prohibited in depths less than 550 m in order to protect benthic communities. Information on this fishery is summarised in Annex 5, Appendix F.

4.176 SSRU G was closed on 2 February 2009 (catch limit for *Dissostichus* spp.: 60 tonnes; final reported catch: 60 tonnes). SSRU E was closed on 27 February 2009 (catch limit for *Dissostichus* spp.: 50 tonnes; final reported catch: 54 tonnes). SSRU C, and consequently the fishery, was closed on 12 March 2009 (SSRU C catch limit for *Dissostichus* spp.: 100 tonnes; final reported catch: 108 tonnes). The catch limit for the whole fishery for *Dissostichus* spp. was 210 tonnes and the final reported catch was 222 tonnes. Information on IUU activities indicated that 152 tonnes of toothfish were taken in 2008/09.

4.177 A total of 1 127 toothfish were tagged and released in the 2008/09 season, and seven tagged toothfish were recaptured during that season (Annex 5, Tables 8 and 10).

4.178 Five Members (Japan, Republic of Korea, New Zealand, Spain and Uruguay) and a total of 11 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2009/10.

4.179 The Scientific Committee noted that Russia had begun research on *Dissostichus* spp. in this division (Annex 5, paragraphs 4.17 and 4.18). The Scientific Committee encouraged the continuation of the work during the intersessional period and for the otolith readings to be verified by CON (Annex 5, paragraphs 9.4 to 9.8) and for the results to be evaluated by WG-SAM (Annex 5, paragraphs 4.15 to 4.18).

4.180 The Scientific Committee recommended that the existing catch limits and other aspects of the conservation measures for Division 58.4.1 be retained for the 2009/10 season. It noted that several SSRUs in this division have catch limits of less than 100 tonnes which posed problems with predicting fishery closures (Annex 5, paragraphs 3.13 to 3.15) considering the large number of vessels notified for this division.

Dissostichus spp. Division 58.4.2

4.181 Two Members (Japan and Republic of Korea) and two vessels fished in the exploratory fishery in Division 58.4.2 in 2008/09 and the reported catch was 66 tonnes. SSRU E was closed on 17 February 2009 (catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 61 tonnes), and the fishery was closed on 23 February 2009 (catch limit for *Dissostichus* spp.: 70 tonnes; final reported catch: 66 tonnes). The other SSRUs (B, C and D) were closed to fishing. Fishing was prohibited in depths less than 550 m in order to protect benthic communities. Information on this fishery is summarised in Annex 5, Appendix G.

4.182 The fishery targeted *D. mawsoni* and operated in SSRUs A and E in 2008/09. It was estimated that 176 tonnes of *D. mawsoni* were taken by IUU fishing in 2008/09.

4.183 A total of 277 toothfish were tagged and released in 2008/09 and one tagged toothfish was recaptured (Annex 5, Tables 9 and 10).

4.184 Five Members (Japan, Republic of Korea, New Zealand, Spain and Uruguay) and a total of nine vessels notified their intention to fish for toothfish in Division 58.4.2 in 2009/10.

4.185 The Scientific Committee recommended the existing conservation measures for Division 58.4.2 be retained for the 2009/10 season. It noted that several SSRUs in this division have catch limits of less than 100 tonnes which posed problems with predicting fishery closures (Annex 5, paragraphs 3.13 to 3.15) considering the large number of vessels notified for this division.

Dissostichus spp. Division 58.4.3a

4.186 One Member (Japan) and one vessel fished in the exploratory fishery in Division 58.4.3a in 2008/09. The precautionary catch limit for toothfish was 86 tonnes and the reported catch was 31 tonnes. Information on this fishery is summarised in Annex 5, Appendix H.

4.187 There was no evidence of IUU fishing in 2008/09.

4.188 A total of 113 toothfish were tagged and released in 2008/09 and two tagged toothfish were recaptured during that season.

4.189 Two Members (Japan and Republic of Korea) and three vessels notified their intention to fish for toothfish in Division 58.4.3a in 2009/10.

4.190 The Scientific Committee agreed that, in the absence of a new assessment, the catch limit should remain at 86 tonnes in this division.

Dissostichus spp. Division 58.4.3b

4.191 Two Members (Japan and Uruguay) and two vessels fished in the exploratory fishery in Division 58.4.3b in 2008/09. In November 2007, the division was divided into two SSRUs: A north of 60°S and B south of 60°S. In November 2008, the area north of 60°S was further subdivided into four SSRUs (A, C, D and E). The precautionary catch limit for *Dissostichus* spp. in the fishery was 30 tonnes in each of SSRUs A, C, D and E, and SSRU B remained closed to fishing. Information on this fishery is summarised in Annex 5, Appendix I.

4.192 In 2008/09, the fishery operated in SSRUs A, C, D and E. SSRU D was closed on 27 January 2009 (catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 31 tonnes). SSRU A was closed on 2 February 2009 (catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 28 tonnes). SSRU E was closed on 7 February 2009 (catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 45 tonnes). The entire fishery was closed on 9 February 2009 with a reported total catch of 104 tonnes of *Dissostichus* spp. (87% of the precautionary catch limit for the fishery).

4.193 Information on IUU activities indicated that 610 tonnes of toothfish were taken in 2008/09.

4.194 A total of 431 toothfish were tagged and released in 2008/09, including 75 *D. eleginoides* and 356 *D. mawsoni*. One tagged toothfish was recaptured during the 2008/09 season.

4.195 Four Members (Japan, Republic of Korea, South Africa and Uruguay) and six vessels notified their intention to fish for toothfish in Division 58.4.3b in 2009/10.

4.196 The Scientific Committee considered three possible scenarios for the *D. mawsoni* stock on BANZARE Bank, based on existing knowledge:

(i) Scenario 1: spawning fish have a high turnover in Division 58.4.3b, moving freely within this division between SSRUs and areas outside each year.

(ii) Scenario 2: spawning fish move sporadically to Division 58.4.3b, and then remain in the area, moving little across the area between years.

(iii) Scenario 3: there is large turnover of large fish in Division 58.4.3b, but they represent only a fraction of the spawning stock that sustains the population in East Antarctica.

4.197 The Scientific Committee noted that, due to their proximity, the fish on BANZARE Bank are likely to originate from the coastal areas of Antarctica in the southern Indian Ocean. The Scientific Committee noted that other plausible scenarios could be envisioned, however, it saw that the three scenarios captured useful alternative hypotheses for this division (Annex 5, Figure 5).

4.198 The Scientific Committee recalled that it had agreed last year (SC-CAMLR-XXVII, paragraph 4.146) that:

(i) based on fishing information until 2006/07, the fisheries across BANZARE Bank show that the preferred fishing grounds were depleted in the Southern Area (adopted by WG-FSA-07, resulted in the closure of the Southern Area);

(ii) based on the survey and fisheries across BANZARE Bank, there are very few fish apart from in the preferred fishing grounds;

(iii) the fish found in the preferred fishing grounds are large and likely spawning, there are no small fish and fish are male dominated (79%);

(iv) in the survey, the fish are large and mostly male;

(v) spawning fish in East Antarctica have only been found on BANZARE Bank (WG-FSA-07/44; Annex 5, paragraph 5.56).

4.199 The Scientific Committee agreed, on the basis of analyses undertaken by WG-FSA (Annex 5, paragraphs 5.60 to 5.62) that:

(i) depletion had occurred during fishing in Patch B in 2007/08 and Patch C in the 2008/09 season, but the results of the depletion analysis were ambiguous for Patch A and for Ground C (see Annex 5, Figure 6 for location of grounds and patches);

(ii) unstandardised CPUE for the whole of Division 58.4.3b has increased between 2003/04 and 2008/09 (Annex 5, Figure 7);

(iii) CPUE is affected by factors such as gear and bait type, vessel, season, depth fished, species and area fished, and these have serious consequences for interpreting unstandardised CPUE (SC-CAMLR-X, Annex 6, paragraphs 7.107 to 7.121; SC-CAMLR-XI, Annex 5, paragraphs 6.143 to 6.166);

(iv) of 10 tags recaptured in Division 58.4.3b, nine were released in Division 58.4.3b and one was released in Division 58.4.1 (Annex 5, Figure 8);

(v) large movements of fish have been observed for fish at liberty for two years or more, and tend to be from the east to the west in coastal Antarctica, or from the coast to BANZARE Bank;

(vi) stocks of *D. mawsoni* are likely to be distinct at the scale of ocean;

(vii) there is no evidence of recruitment of small (<60 cm) *D. mawsoni* in Divisions 58.4.1, 58.4.2 and 58.4.3b (Annex 5, Figure 9);

(viii) *D. mawsoni* are likely to move throughout Divisions 58.4.1, 58.4.2 and 58.4.3b;

(ix) smaller fish are found in the western area of Division 58.4.2 and in waters shallower than 1 000 m, and larger fish in waters deeper than 1 000 m.

4.200 Dr T. Ichii (Japan) noted that he does not believe that the stock level has been low to such an extent that the fishery should be closed in this division based on the following reasons:

(i) overall unstandardised CPUE has been increasing by about four times over the past six years (Annex 5, Figure 7);

(ii) body size compositions of catch show no decreasing trend in larger size component for the past six years, suggesting no evidence of growth overfishing;

(iii) Ground C and Patch A (WG-FSA-09/44) showed no declining trend in catch rate by the depletion analysis;

(iv) regarding Ground C and Patch B, their decreasing trends in catch rate are based on single-season data and hence could be just within-season phenomena. The repetition of analysis in the subsequent season is necessary to confirm the depletion.

Therefore, Japan supposed that a modest catch limit similar to that in 2008/09 could be allocated in this division.

4.201 Dr Constable thanked WG-FSA for its clear advice on the points of agreement and disagreement on the status of the stock on BANZARE Bank. He asked the Scientific Committee to recall that the fishery in Division 58.4.3b was an exploratory fishery, and to recall the chapeau to Conservation Measure 21-02, which states that 'exploratory fishing should not be allowed to expand faster than the acquisition of information necessary to ensure that the fishery can and will be conducted in accordance with the principles set forth in Article II'. He noted that the intent of CCAMLR exploratory fisheries was to collect data on pristine stocks to determine if a viable fishery is present in an area. He recalled that the Commission had already closed the southern area of Division 58.4.3b because it was depleted (CCAMLR-XXVI, paragraph 12.10(v)), and there are further indications that the stock may be further depleted. Despite the lack of agreement on the level of depletion, he noted that there is no debate that this stock is no longer pristine, and therefore the Scientific Committee should advise the Commission that it cannot consider that this fishery is in an exploratory phase.

4.202 Dr Constable also noted that the Scientific Committee had already agreed that the data being collected in the exploratory fishery in this division would not lead to an assessment in the near future (paragraph 4.164). As an example, he noted that the CPUE series for this division had not been able to be standardised for all the different vessels, gear types, bait types, depths and areas that had been fished in this division. Therefore, it was impossible to interpret any trend in the overall unstandardised CPUE as indicating the status of the stock. He further noted that WG-FSA had considered a plausible scenario that BANZARE Bank was a location where only large fish migrated to. Under this scenario, therefore, attempting to interpret the length-frequency distribution in the catch would also be unhelpful in understanding the status of this stock. Alternatively, if BANZARE Bank is an important spawning area for *D. mawsoni* in the southern Indian Ocean, as in one of the other scenarios considered, then the evidence for depletion of this stock dictates additional caution. Therefore, he asked that the Commission be made aware of the possible scenarios for BANZARE Bank as shown in Annex 5, Figure 5, and that it note that there is insufficient data to distinguish these scenarios. Further, as there is little prospect of collecting useful data on the status of this stock in the near future, the Commission must be advised to await a satisfactory data collection plan, considering all of the elements agreed by the Scientific Committee in paragraph 4.164, before it can allow any further fishing in this division.

4.203 The Scientific Committee was unable to provide management advice on catch limits in Division 58.4.3b, but recommended that all other aspects of Conservation Measure 41-01 be carried forward if a catch limit is set in 2009/10. It noted that several SSRUs in this division have catch limits of 30 tonnes which posed problems with predicting fishery closures (Annex 5, paragraphs 3.13 to 3.15) considering the large number of vessels notified for this division.

Dissostichus spp. Subareas 88.1 and 88.2

4.204 In 2008/09, six Members (Chile, Republic of Korea, New Zealand, Spain, UK and Uruguay) and 13 vessels fished in the exploratory fishery in Subarea 88.1. The fishery was

closed on 25 January 2009 and the total reported catch of *Dissostichus* spp. was 2 434 tonnes (90% of the limit) (Annex 5, Appendix J, Table 4). The following SSRUs were closed during the course of fishing:

- SSRUs B, C and G closed on 22 December 2008, triggered by the catch of *Dissostichus* spp. (total catch 410 tonnes; 116% of the catch limit);

- SSRUs H, I and K closed on 22 January 2009, triggered by the catch of *Dissostichus* spp. (total catch 1 957 tonnes; 98% of the catch limit).

The IUU catch for the 2008/09 season was estimated to be 0 tonnes.

4.205 Seven Members (Argentina, Republic of Korea, New Zealand, Russia, Spain, UK and Uruguay) and a total of 18 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.1 in 2009/10.

4.206 Seven Members (Chile, Republic of Korea, New Zealand, South Africa, Spain, UK and Uruguay) and seven vessels fished in the exploratory fishery in Subarea 88.2. The fishery closed on 31 August 2009 and the total reported catch of *Dissostichus* spp. was 484 tonnes (85% of the limit) (Annex 5, Appendix J). SSRU E was closed on 8 February 2009, triggered by the catch of *Dissostichus* spp. (total catch 316 tonnes; 89% of the catch limit). The IUU catch for the 2008/09 season was estimated to be 0 tonnes.

4.207 Seven Members (Argentina, Republic of Korea, New Zealand, Russia, Spain, UK and Uruguay) and a total of 18 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.2 in 2009/10.

4.208 The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is in Annex 5, Appendix J.

4.209 The Scientific Committee noted that a high-quality tag dataset for the assessment of *D. mawsoni* was selected on the basis of data-quality metrics for individual trips (Annex 5, paragraph 5.76). The method first selected an initial informative dataset comprising trips with (i) high (above median) rates of recovery of previously released tags, and (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.

4.210 Since 2000/01, more than 22 000 *Dissostichus* spp. have been tagged in Subareas 88.1 and 88.2, with almost 19 000 and 2 000 *D. mawsoni* in the Ross Sea and SSRU 882E respectively (WG-FSA-09/39). The selected trips' tag dataset contained a total of 13 308 releases and 474 recaptures that were used in the assessment of the Ross Sea (WG-FSA-09/40 Rev. 1), and 947 releases and 47 recaptures that were used in the assessment for SSRU 882E (WG-FSA-09/41).

4.211 The Scientific Committee noted that, for the first time, the assessment included data from vessels of all Members that had provided high-quality tagging data used in the assessment of the Ross Sea. The Scientific Committee thanked all vessels that provide consistently high-quality data, noting that these data are critical to the success of CCAMLR in managing the Ross Sea fishery. The Scientific Committee also thanked the New Zealand

scientists who had developed the method for objectively assessing data quality, and encouraged consideration of a 'one-sided' distribution of appropriate metrics, to ensure the best data continue to be included in future assessments.

4.212 The Scientific Committee agreed that the catch limits for *Dissostichus* spp. in Subarea 88.1 should be 2 850 tonnes and for *Dissostichus* spp. in SSRU 882E should be 361 tonnes and for SSRUs 882C, D, F and G should be 214 tonnes (Annex 5, paragraphs 5.79 to 5.81 and 5.91). The Working Group recommended that the allocation method used to set the 2005/06 catch limits for SSRUs in Subarea 88.1 be continued for the 2009/10 season.

4.213 The catch limits can be carried over into the 2010/11 fishing season, subject to the conditions of the biennial assessment procedure for this fishery adopted in 2007, and detailed in SC-CAMLR-XXVI, paragraph 14.6.

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

Exploratory krill fisheries

4.215 The Scientific Committee noted that Norway has notified an exploratory fishery for krill in Subarea 48.6 during 2009/10 (CCAMLR-XXVIII/14 Rev. 1). It thanked Norway for its consideration and contribution to further improving the research plan for this exploratory fishery. The recommendations made by the Scientific Committee in 2008 (SC-CAMLR-XXVII, paragraphs 4.163 to 4.185) and WG-EMM (Annex 4, paragraph 3.40) (see also paragraphs 4.217 to 4.219 below) were now included in the research plan provided with the notification.

4.216 The Scientific Committee also noted that Norway would be using cover nets to mitigate interactions with marine mammals during fishing activities.

4.217 The Scientific Committee recommended the following amendments to Conservation Measure 51-04:

(i)   The vessel could carry out the research plan either before or after the commercial fishery.

(ii)   If the vessel is collaborating with a research institute to conduct the research plan, it should identify the collaborating institute.

(iii) If the survey is undertaken after the commercial fishery, it should follow the current guidelines within Conservation Measure 51-04, where the measure defines the number of exploratory units to be visited as the catch divided by 2 000 tonnes. If the survey is conducted prior to the commercial fishery, then the fishing vessel must:

(a)   undertake a research plan for the exploratory units based on the area where it intends to fish;

(b) complete additional surveys to fulfil the number of exploratory units required if the number of exploratory units completed at the end of fishing is less than the catch divided by 2 000 tonnes;

(c) carry out its fishery and survey in a manner in which the research exploratory units surround and include the units where the fishery is carried out.

(iv) The echo sounder (minimum frequency 38 kHz, minimum observing depth range 200 m) should preferably be calibrated in the actual fishing grounds. However, this is often impossible due to logistical problems of identifying suitable locations for calibration. Therefore, as a minimum, the echo sounder should be calibrated prior to the vessel leaving port. Calibration data should be reported with research transect data.

(v) If a vessel is unable to calibrate its echo sounder on the fishing grounds:

(a) acoustic survey grids comparable/identical with the first survey (assuming it covers the fishing area) should be conducted on subsequent visits;

(b) vessels undertaking continuous trawling should attempt to match some acoustic observations with respective trawl catches since they may be able to trawl acoustic layers more or less immediately after they have been recorded.

4.218 The Scientific Committee recommended revision of the research plan (Conservation Measure 51-04, Annex 51-04/B) to include an option to allow conduct of a research survey prior to commercial operations. It noted that there would be advantages if fishing vessels were to conduct research operations prior to commercial operations, since:

(i) such operation will provide information of krill distribution prior to any disturbance by fishing;

(ii) vessels are likely to conduct research in the area of interest prior to commercial operation in order to find suitable fishing locations;

(iii) there would be a greater likelihood of research operations being completed.

4.219 The Scientific Committee noted that there would be a need for ongoing review of the research plans for exploratory krill fisheries.

Crabs (*Paralomis* spp.) Subareas 48.2 and 48.4

4.220 Crabs were not exploited in exploratory fisheries in 2008/09. Russia notified the Commission of its intention to fish for crabs in exploratory fisheries in Subareas 48.2 and 48.4 in 2009/10 (CCAMLR-XXVIII/23) in accordance with the requirements of Conservation Measures 52-02 and 52-03.

4.221   The Scientific Committee noted that the research plan for the exploratory crab fishery in Subareas 48.2 and 48.4, although revised last year, should be reviewed by WG-FSA next year.   The Scientific Committee further noted that MSE could be considered in refining the data collection plan for these fisheries.

4.222   The Scientific Committee recommended that the management areas defined in Conservation Measure 52-02 as part of the experimental harvest program containing VMEs (Areas A, C, E) should be closed to protect the known VMEs and likely others in similar nearby areas (Annex 5, Figure 12).

4.223   The Scientific Committee recommended that Conservation Measures 52-02 and 52-03 on crabs remain in force, noting the recommended changes to the experimental harvest block regime (paragraphs 4.222 and 4.249).

Squid and crab resources

Crabs (*Paralomis* spp.) (Subarea 48.3)

4.224   Crabs were not exploited in the 2008/09 season.   Russia notified the Commission of its intention to fish for crabs in this subarea during the 2009/10 season.   It indicated its intention to conduct fishing operations in accordance with conditions specified under Conservation Measure 52-01.

4.225   The Scientific Committee noted that the research plan outlined in Conservation Measure 52-01 had been developed in the early 1990s and that it had not been substantially reviewed since then.   The Scientific Committee also noted that there had been considerable advances in the development of research designs since that time, including, for example, the use of MSE simulations.   The design of the research plan may, therefore, no longer be optimal.   WG-FSA was requested to review the research plan at its next meeting.

Management advice

4.226   The Scientific Committee recommended that the existing Conservation Measure 52-01 on crabs should remain in force.

Squid (*Martialia hyadesi*) (Subarea 48.3)

4.227   Squid were not exploited in the 2008/09 season.   No proposal for the harvest of squid has been received by CCAMLR for the 2009/10 season.

4.228   The Scientific Committee noted that there had been no interest in fishing for squid for a number of years.   It proposed that squid be removed from the agendas of the Scientific Committee and its working groups until a notification to initiate a fishery is received.

Management advice

4.229 The exploratory fishery on squid was subject to Conservation Measure 61-01. Noting the proposal in paragraph 4.228, the Scientific Committee recommended that this fishery be considered as lapsed, and that Conservation Measure 61-01 be removed from the *Schedule of Conservation Measures in Force*.

Fish and invertebrate by-catch

Year-of-the-Skate

4.230 The Scientific Committee noted the general success of the initiatives undertaken during the Year-of-the-Skate. The Scientific Committee agreed that the Year-of-the-Skate protocols be continued for the 2009/10 season, in order to allow for sufficient data to be collected for preliminary assessments to be made in the future.

4.231 The Scientific Committee noted that some vessels had made errors recording the appropriate fate for by-caught skates, and endorsed the recommendation by WG-FSA that the Secretariat develop a one-page guide to assist vessels in recording skate data accurately.

4.232 The Scientific Committee also noted that some of the data reviewed by the Scientific Committee indicated that vessels had discarded dead by-caught skates in fisheries operating in areas south of 60°S. The Scientific Committee reviewed the definition of 'offal' and associated terms of reference (paragraphs 5.8 and 5.9) and referred this issue to the Commission (paragraph 5.10).

4.233 In order to clarify skate by-catch handling and reporting requirements in different subareas and fisheries, the Scientific Committee recommended that a slight revision be made to the Year-of-the-Skate guidelines (CCAMLR-XXVII, paragraph 4.55(iii)), as follows:

> 'all skates which are dead or with life-threatening injuries (condition 1 or 2 in the logbook) should be retained by the vessels fishing in areas where discharge of offal is not allowed, but may be discarded in other subareas.'

4.234 The Scientific Committee noted that most vessels had achieved the required tagging rate for skates in exploratory fisheries, however, there were some instances where vessels had skate by-catch but had not released any tagged skates. The Scientific Committee recommended that the relevant conservation measures be amended to 'at least one skate per five skate caught (including those released alive)'.

4.235 The Scientific Committee congratulated all Members that had conducted skate research as part of the Year-of-the-Skate initiative, and noted that it was useful to have an intensive period of data collection on such priority topics. The Scientific Committee noted that such intensive periods of research, through scientific field work in addition to research fishing conducted by Members, should be considered in the future to advance priority issues such as bottom fishing impacts on VMEs.

Move-on rule in the Southern Area of the Subarea 48.4 research fishery

4.236 The Scientific Committee noted the discussions by WG-FSA in Annex 5, paragraphs 6.28 to 6.31 and recommended that Conservation Measure 41-03 should be updated during the two-year tagging experiment in the Southern Area of Subarea 48.4 to incorporate a threshold catch of 150 kg of *Macrourus* spp. above which the move-on rule would be triggered, and that this should be reviewed on an annual basis. The existing move-on rules for rajids in the Southern Area of Subarea 48.4 should be retained.

Identification guides for benthic invertebrate by-catch

4.237 The Scientific Committee noted the publication of 'Field identification guide to Heard Island and McDonald Islands (HIMI) Benthic Invertebrates: a guide for scientific observers aboard fishing vessels' (SC-CAMLR-XXVIII/BG/12). The Scientific Committee congratulated the authors, noting that the guide had been useful for the identification of benthic invertebrates in other areas and encouraged other Members to develop similar guides for other regions of the Convention Area (see also paragraph 4.246).

Bottom fishing in CCAMLR high-seas areas

4.238 The Scientific Committee recalled its discussions and agreements on approaches to avoid significant adverse impacts on VMEs (SC-CAMLR-XXI, paragraphs 4.159 to 4.171; SC-CAMLR-XXII, paragraphs 4.207 to 4.284) and that of the Commission (CCAMLR-XXVI, paragraphs 5.9 to 5.20; CCAMLR-XXVII, paragraphs 5.4 to 5.30). It also noted the discussions this year by WG-SAM (Annex 6, paragraphs 4.7 to 4.19), WG-EMM (Annex 4, paragraphs 5.1 to 5.14), WG-FSA (Annex 5, paragraphs 10.1 to 10.51) and the outcomes of WS-VME (Annex 10).

4.239 The Scientific Committee noted that the Commission requires advice on the following:

(i) whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs and whether proposed or additional mitigation measures would prevent such impacts (Conservation Measure 22-06, paragraph 8(ii));

(ii) Risk Areas arising from the implementation of Conservation Measure 22-07, and advice on proposed research and other activities in Risk Areas (Conservation Measure 22-07, paragraph 9);

(iii) the magnitude of the existing footprint of bottom fisheries covered by Conservation Measure 22-06 (CCAMLR-XXVII, paragraph 5.15);

(iv) notifications of VMEs (CCAMLR-XXVII, paragraph 5.16);

(v) known and anticipated impacts of bottom fishing activities covered by Conservation Measure 22-06 (CCAMLR-XXVII, paragraph 5.18(i));

(vi) available knowledge on VMEs, the potential for significant adverse impacts, risk assessments and potential for impacts arising from bottom fisheries, with such advice provided in a report akin to the Fishery Reports on 'Bottom Fisheries and Vulnerable Marine Ecosystems' (CCAMLR-XXVII, paragraph 5.18(ii));

(vii) a precautionary strategy that will avoid significant adverse impacts on VMEs until impact assessments are completed and long-term mitigation strategies are developed (CCAMLR-XXVII, paragraph 5.19);

(viii) results of simulations of different management approaches (CCAMLR-XXVII, paragraph 5.21);

(ix) mitigation measures and practices when evidence of VMEs is encountered, including outcomes of reviews of scientific observer data and vessel data and the results of WS-VME (CCAMLR-XXVII, paragraph 5.22);

(x) scientific aspects of the implementation and operation of Conservation Measure 22-07 (CCAMLR-XXVII, paragraph 5.25).

4.240 The Scientific Committee also noted that Conservation Measure 22-06 will be reviewed by the Commission this year (Conservation Measure 22-06, paragraph 16). In that respect, it noted the following elements of the conservation measure had scientific components that may require reviewing:

(i) assessment by the Scientific Committee on whether individual bottom fishing activities would contribute to having significant adverse impacts on VMEs, where such reviews will include consideration of preliminary assessments by Contracting Parties (Conservation Measure 22-06, paragraph 8);

(ii) information required for evaluating notifications of VMEs (Conservation Measure 22-06, paragraph 9);

(iii) advice by the Scientific Committee on the known and anticipated impacts of bottom fishing activities on VMEs, including recommending practices when evidence of a VME is encountered in the course of fishing operations (Conservation Measure 22-06, paragraph 11);

(iv) advice on where VMEs are known to occur or are likely to occur and on potential mitigation measures (Conservation Measure 22-06, paragraph 14).

4.241 The Scientific Committee thanked the working groups and, in particular, WS-VME, for their considerable work this year. In particular, it thanked Dr Jones for convening WS-VME, which had provided great impetus to resolving many questions on this issue for the Scientific Committee. It also thanked the invited experts that attended WS-VME for their input and considered advice on this issue (SC-CAMLR-XXVIII/BG/8).

4.242 The Scientific Committee noted that, despite great progress, the magnitude of the tasks listed above are such that it will take another year to conclude the work related to reviewing the conservation measures. The following discussion provides advice to date on this issue.

4.243 The Scientific Committee noted the following with respect to bottom fisheries operating under Conservation Measure 22-06 this year:

(i) some vessels had failed to report VME indicator catch levels for any hauls (Annex 4, paragraph 5.3)

(ii) approximately 14 000 segments were deployed in the 2008/09 season. The number of reported notifications from exploratory bottom fishing under Conservation Measure 22-07, where five or more VME indicator units in a segment were recorded, totalled 30. Of these, seven notifications consisted of at least 10 VME indicator units, which resulted in seven Risk Areas being declared (see WG-FSA-09/6 and CCAMLR-XXVIII/BG/6) (Annex 5, paragraph 10.29).

4.244 On the basis of advice from WG-FSA on the preliminary assessments of bottom fisheries by Members according to Conservation Measure 22-06 (CCAMLR-XXVIII/18), the Scientific Committee:

(a) endorsed the report card for summarising the quality and quantity of information supplied in each assessment (Annex 5, paragraph 10.6) and advised the Commission of the quality of the preliminary assessments this year (Annex 5, Table 17);

(b) noted that notifications were provided in several languages, which limited the ability of WG-FSA to evaluate the proposals without significant additional translation effort by the Secretariat and requested the Commission to consider how this issue may be overcome in the future (Annex 5, paragraph 10.8);

(c) noted that no assessment was available for proposed pot fishing for crabs in Subarea 48.2, or for proposed pot fishing for toothfish in Subareas 88.1 and 88.2; that it therefore could not provide advice on the impact of this proposed fishing activity on VMEs, and that the development of pot fishing for both fish and crabs may require further consideration of gear code definitions (Annex 5, paragraph 10.9);

(d) noted the assessment of the cumulative magnitude of the bottom fishing footprint by WG-FSA (Annex 5, paragraphs 10.10 to 10.12, Table 18).

4.245 On the basis of advice from the working groups and WS-VME, the Scientific Committee noted the following points that need to be considered with respect to the implementation of Conservation Measures 22-06 and 22-07 this year:

(i) the current trigger levels (i.e. 10 kg or 10 litres) were likely to be too high for 'light' taxa, but there was insufficient information to suggest an appropriate new level, and that separate trigger levels may also need to be developed for encounters with rare and unique populations (Annex 10, paragraphs 6.8 and 6.9);

(ii) recording either weight or volume, as currently written, creates problems with data quality and limits analysis of by-catch data (Annex 5, paragraph 10.43);

(iii) segment-level VME indicator units and target species catch will be needed to analyse correlations in their distributions (Annex 5, paragraph 10.44);

(iv)   section 2 of Annex 22-06/A be simplified to obtain information, judgements or quantitative estimates that Members may have of the vulnerabilities of benthic taxa in the fishing areas to the gears, including any potential differences in vulnerabilities between components of the gear. This could be included in the guidelines for Member's Bottom Fishing Gear Assessments and included in Conservation Measure 21-02 (Annex 5, paragraphs 10.21 to 10.23).

4.246   The Scientific Committee endorsed the recommendation of WG-FSA to adopt the new 'CCAMLR VME Taxa Classification Guide' for use in the coming season (Annex 5, paragraph 10.41). It noted that the VME Invertebrate Classification Guide implemented in the 2008/09 season was very useful in aiding observers and vessels to correctly classify VME indicator taxa. It thanked the authors, WS-VME and WG-FSA for further developing this guide. The new version should be implemented in 2009/10 for the entire CCAMLR area applicable to Conservation Measure 22-06. It recommended that the guide be made available as a CCAMLR document on the website, and that funds be made available through the Secretariat to provide laminated double-sided copies for those not equipped to produce their own.

4.247   On the basis of advice from the working groups and WS-VME, the Scientific Committee recommended that the following improvements are needed in the implementation of Conservation Measures 22-06 and 22-07 this year:

(i)   the CCAMLR VME Taxa Classification Guide be used as the guide referenced in Conservation Measure 22-07, paragraph 2(ii);

(ii)   segment midpoint locations should be reported as DD.MM and fractional minutes along with the geodetic datum set in the navigation system, with care to report longitude as negative degrees in the western hemisphere (Annex 5, paragraph 10.44(i));

(iii)   from a data analysis and simplicity perspective, weight and the units used to quantify VME taxon by-catch should be reported as a minimum requirement (Annex 5, paragraph 10.44(ii));

(iv)   vessels should report sets and segments resulting in zero VME indicator units (Annex 5, paragraph 10.44(iii));

(v)   the procedure in Annex 22-06/A in Conservation Measure 22-06 be replaced by the guidelines for 'Member's Bottom Fishing Gear Assessments' in Annex 5, Table 19 (Annex 5, paragraphs 10.20 and 10.21). Subsequent notifications for fisheries using the same gear type would then only require information needed to update the notification for the proposed activities;

(vi)   the new and exploratory fisheries notification guidelines developed from Conservation Measure 21-02 (paragraph 5(ii) (Fishery Operations Plan)) be revised for Members to provide the following new information with each notification (Annex 5, paragraph 10.24):

(a)   reference to the relevant Bottom Fishing Gear Assessment that adequately describes the fishing method and gear configuration to be deployed;

(b) notification of any exceptions or changes – e.g. gear changes, alternate fishing practices, altered impact assumptions, mitigation measures adopted etc. – that may be expected to cause the actual impact of the proposed fishing activity to be different from that described in the relevant Bottom Fishing Gear Assessment;

(c) an estimate of fishing effort proposed by the Member for the upcoming fishing season, detailed by subarea and SSRU, in units compatible with the estimation of footprint size used in the relevant Member's Bottom Fishing Gear Assessment.

(vii) Conservation Measure 22-06, Annex 22-06/B, be reconfigured to reflect its use mainly for research vessels and encounters not otherwise reported under Conservation Measure 22-07 (Annex 10, paragraph 3.11; Annex 5, paragraph 10.42). Conservation Measure 22-06, Annex 22-06/B, could be revised to indicate that notifications of encounters with VMEs should be prepared as proposals/research papers to be submitted to WG-EMM for review via the Secretariat. The annex would no longer be necessary as a data form. Rather, the annex would become guidelines specifying categories of information to include in the submitted notification. If adopted, the Conservation Measure Drafting Group could consider revisions to Conservation Measure 22-06, paragraph 9, for consistency. A draft revised annex is provided in Annex 5, Figure 14.

4.248 On the basis of advice from the working groups and WS-VME, the Scientific Committee recommended that the Commission agree to give special attention to the following in the implementation of Conservation Measures 22-06 and 22-07 this year:

(i) information in Conservation Measure 22-06, Annex 22-06/A, or its equivalent (e.g. Annex 5, Table 19), is essential, for undertaking assessments of potential footprint and impacts (Annex 5, paragraphs 10.19 and 10.25);

(ii) the catch of VME indicator units must be reported by vessels for each set even if the amount is zero, and that it is very important that segment-specific data is collected, as the scale of VME patch size is likely to be much smaller than the length of a longline (Annex 5, paragraph 10.27);

(iii) with the revision of Conservation Measure 22-06, Annex 22-06/B, WG-EMM could recommend a classification of the area(s) and forward data and metadata associated with locations of VMEs, and links to the supporting review documents, to be added to the VME register (Annex 5, paragraph 10.42);

(iv) as indicated in Conservation Measure 22-07, paragraph 10, the responsibility for reporting VME indicator units is a vessel, not an observer responsibility (Annex 5, paragraph 10.43);

(v) information on gears and the vulnerabilities of benthic taxa are required for all operations but are a particularly high priority for trotlines, trotlines with cachaloteras, Spanish longlines, fish pots and crab pots (Annex 5, paragraph 10.22).

4.249 The Scientific Committee received the advice on notifications of VMEs in WG-EMM-09/32 (Annex 4, paragraphs 5.6 to 5.9; Annex 5, paragraphs 10.30 to 10.34; Annex 10, paragraphs 6.7 to 6.14) and recommended that all 28 areas notified showed compelling evidence of VMEs and should be registered in the VME registry as VMEs (Annex 5, paragraphs 10.30 and 10.31). It also endorsed the recommendation that Conservation Measure 52-02 be amended to reduce the risk that the experimental harvest regime for crabs in Subarea 48.2 will negatively impact known and likely VME distributions (Annex 10, paragraphs 5.48 to 5.50) and noted that the same restrictions should apply to other proposed fisheries in the area (Annex 10, paragraph 5.51). It therefore recommended that the management areas defined in Conservation Measure 52-02 as part of the experimental harvest program containing these VMEs (Management Areas A, C, E) should be closed to protect the known VMEs and likely others in similar nearby areas (Annex 5, paragraphs 10.32 and 10.33, Figure 12).

4.250 The Scientific Committee endorsed the amended framework proposed by WG-FSA (Annex 5, paragraph 10.37, Figure 13) in order to clarify the procedures needed to integrate the information available from Conservation Measures 22-06 and 22-07 and provide advice to the Scientific Committee. The Scientific Committee requested this be further considered by the Working Group as to how this framework would best be implemented (Annex 5, paragraph 10.38).

4.251 The Scientific Committee wished to advise the Commission that the review of Conservation Measures 22-06 and 22-07 will proceed in the intersessional period with the aim of providing advice on these measures next year. In particular, it indicated the following will be given attention:

(i) definition of Risk Areas (Annex 4, paragraph 5.3; Annex 10, paragraphs 5.38 to 5.47);

(ii) review of existing Risk Areas, including the development of a review process (Annex 5, paragraph 10.29);

(iii) development of a glossary of terms, including quantitative definitions as appropriate, to improve understanding and communication on these issues (Annex 5, paragraphs 10.36 and 10.40);

(iv) further consideration of criteria to assist the Scientific Committee in defining areas as VMEs under Conservation Measure 22-06 (Annex 10, paragraph 6.14);

(v) evaluation of the proportions of fishable areas that would comprise different benthic habitats and whether the frequency of observations of benthos in by-catch is consistent with the proportional coverage of these different habitats (Annex 4, paragraph 5.4);

(vi) development of alternate trigger levels for a range of VME taxa, including distinction between 'heavy' and 'light' taxa, along with options to enable taxon-specific weights to be collected (Annex 5, paragraph 10.44);

(vii) consideration of whether the presence of high densities of rare taxonomic groups or unique community assemblages specific to the Southern Ocean will warrant additional attention, and perhaps an increased level of precaution (Annex 4, paragraph 5.9);

(viii) further consideration of fishing footprint and its possible impacts on VMEs, taking account of the differences in the interactions of different gears with the bottom (Annex 5, paragraphs 10.20 to 10.22);

(ix) refinement of methods for creating cumulative fishery-scale footprint maps (Annex 5, paragraphs 10.14 to 10.16), including resolving technical issues for their production, in order to update the calculations annually (Annex 5, paragraphs 10.16 and 10.17);

(x) development of plausible scenarios of the types and dynamics of VMEs and the spatial and temporal interactions of the fishery with VMEs (Annex 5, paragraph 10.45);

(xi) evaluation of management strategies within the conservation measures along with other possible strategies for avoiding significant adverse impacts on VMEs (Annex 5, paragraph 10.45);

(xii) further development of risk assessment frameworks (Annex 4, paragraph 5.11; Annex 6, paragraphs 4.9 and 4.16; Annex 10, paragraphs 4.1 to 4.5) and simulation approaches, such as 'Patch' (Annex 4, paragraphs 5.11 to 5.14; Annex 5, paragraphs 10.46 to 10.48; Annex 6, paragraphs 4.10 to 4.15, 4.17 to 4.19; Annex 10, paragraphs 4.6 to 4.10);

(xiii) further assessment of benthic taxa against the seven criteria for assisting in evaluating their vulnerability (Annex 10, paragraphs 3.1 to 3.10, Table 1);

(xiv) consideration of different methods for identifying locations of VMEs (Annex 10, paragraphs 5.1 to 5.37, 6.10 to 6.13);

(xv) consideration of how the footprint estimates for different gears might be used to assess whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs (Annex 5, paragraph 10.13);

(xvi) further development of the Secretariat's capability to manage, store, process and summarise data resulting from Conservation Measures 22-06 and 22-07 is necessary (Annex 5, paragraph 10.39), including the development of a work plan and budget, prioritising the capability to provide real-time data, and to provide data for use by the Scientific Committee and its working groups;

(xvii) further develop the procedural framework for managing bottom fisheries (as in Annex 5, paragraph 10.37, and Figure 13).

4.252 With respect to the Report on 'Bottom Fisheries and Vulnerable Marine Ecosystems', the Scientific Committee noted that this will be further developed by the WG-FSA Subgroup on VMEs during the intersessional period and that a template will be provided for consideration by WG-EMM and WG-FSA next year, including the procedure for mapping the fishing footprint (Annex 5, paragraphs 10.50 and 10.51).

Advice to the Commission

4.253 The Scientific Committee noted that, despite great progress, the magnitude of the tasks (paragraphs 4.239 and 4.240) are such that it will take another year to conclude the work related to reviewing the conservation measures.

4.254 The Scientific Committee advised on a number of issues with respect to bottom fisheries operating under Conservation Measure 22-06 this year (paragraph 4.243).

4.255 On the basis of advice from WG-FSA on the preliminary assessments of bottom fisheries by Members according to Conservation Measure 22-06 (CCAMLR-XXVIII/18), the Scientific Committee provided advice on a number of general issues relevant to Conservation Measure 22-06 in paragraph 4.244.

4.256 On the basis of advice from the working groups and WS-VME, the Scientific Committee:

(i)   noted a number of points that need to be considered with respect to the implementation of Conservation Measures 22-06 and 22-07 this year (paragraph 4.245);

(ii) endorsed the recommendation of WG-FSA to adopt the new 'CCAMLR VME Taxa Classification Guide' for use in the coming season and that the guide be made available as a CCAMLR document on the website, and that funds be made available through the Secretariat to provide laminated double-sided copies for those not equipped to produce their own (paragraph 4.246);

(iii) recommended that a number of improvements are needed in the implementation of Conservation Measures 22-06 and 22-07 this year (paragraph 4.247);

(iv) recommended that the Commission agree to give special attention to a number of issues in the implementation of Conservation Measures 22-06 and 22-07 this year (paragraph 4.248).

4.257 The Scientific Committee recommended that 28 VMEs be added to the VME Register and that they be given protection in Conservation Measure 52-02 in the experimental harvest regime for crabs in Subarea 48.2 by closing the Management Areas A, C, E (paragraph 4.249).

4.258 The Scientific Committee wished to advise the Commission that the review of Conservation Measures 22-06 and 22-07 will proceed in the intersessional period with the aim of providing advice on these measures next year (paragraph 4.251), along with a report on 'Bottom Fisheries and Vulnerable Marine Ecosystems' (paragraph 4.252).

INCIDENTAL MORTALITY

5.1   The Scientific Committee reviewed the WG-IMAF report (Annex 7).   The Co-conveners of WG-IMAF presented advice to the Scientific Committee as set out below:

(i)   intersessional work of WG-IMAF (Annex 7, paragraphs 2.5 and 2.7);

(ii)   incidental mortality of seabirds and marine mammals in fisheries in the Convention Area (Annex 7, paragraphs 3.3, 3.4, 3.7, 3.10, 3.14, 3.16, 3.19 to 3.22, 3.24 and 3.25);

(iii)   implementation of conservation measures (Annex 7, paragraphs 3.35 and 3.45);

(iv)   France's action plan to reduce/eliminate seabird mortality in Subarea 58.6 and Division 58.5.1 (Annex 7, paragraphs 3.48, 3.54, 3.56, 3.58, 3.60 and 3.62);

(v)   incidental mortality of seabirds and marine mammals in fisheries outside the Convention Area (Annex 7, paragraphs 4.5 and 4.6);

(vi)   incidental mortality of seabirds during IUU fishing in the Convention Area (Annex 7, paragraphs 5.4 and 5.5);

(vii)   research into and experience with mitigation measures (Annex 7, paragraphs 6.3, 6.7, 6.8 and 6.11);

(viii) observer reports and data collection (Annex 7, paragraphs 7.1, 7.2, 7.7, 7.8, 7.10, 7.12, 7.16 and 7.17);

(ix)   research into the status and distribution of seabirds and marine mammals (Annex 7, paragraphs 8.4 and 8.8);

(x)   assessment of risk in CCAMLR subareas and divisions (Annex 7, paragraphs 9.5 and 9.6);

(xi)   incidental mortality of seabirds in relation to new and exploratory fisheries (Annex 7, paragraphs 10.3 and 10.7);

(xii)   international and national initiatives relating to incidental mortality of seabirds and marine mammals in fishing (Annex 7, paragraphs 11.2, 11.7 and 11.12);

(xiii) marine debris and its impacts on marine mammals and seabirds in the Convention Area (Annex 7, paragraphs 13.2 and 13.11 to 13.14);

(xiv)   streamlining the work of the Scientific Committee (Annex 7, paragraphs 14.4 and 14.7).

5.2   The Scientific Committee endorsed the report and its conclusions, and the plan of intersessional work (Annex 7, Table 1) subject to the comments set out below.

Incidental mortality of seabirds and marine mammals
in fisheries in the Convention Area

5.3   The Scientific Committee welcomed the reports of scientific observers submitted to the Secretariat from krill trawl vessels and queried if extrapolations of incidental mortalities of seabirds could be made to unobserved portions of the krill trawl fleet using this available

information on observed incidental mortalities of seabirds. Ms Rivera (WG-IMAF Co-convener) noted that in the longline fisheries, where all vessels carry observers, the current practice is to use observations from the sampled catch to extrapolate to the unobserved portions of the catch. It may also be possible to extrapolate incidental mortality estimates for seabirds to krill trawl vessels not carrying observers, provided that the assumptions of such extrapolations are clearly identified.

Implementation of conservation measures

5.4   The Scientific Committee noted that WG-IMAF considered implementation of Conservation Measures 26-01, 25-02, 25-03 and 51-01 (Annex 7, paragraphs 3.26 to 3.45), and acknowledged that this consideration is based on information from scientific observer reports submitted to the Secretariat.

5.5   The Scientific Committee agreed that the points identified by WG-IMAF are compliance issues only once reviewed by SCIC and endorsed by the Commission. To that end, the Scientific Committee agreed that for this year it would footnote in its report the relevant adopted outcomes of SCIC provided in the SCIC report as reviewed by the Scientific Committee (CCAMLR-XXVIII, Annex 5, paragraphs 2.31 to 2.34[3]).

5.6   The Scientific Committee agreed that, in future, working groups will advise on conservation measure implementation issues directly to SCIC and not to include the specific nature of those issues in their reports to the Scientific Committee. It agreed that the potential

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[3]   2.31 Australia provided advice to SCIC in relation to the report that the *Austral Leader II* had not deployed streamer lines during all sets. Australia advised that twin streamer lines complying with the requirements of Conservation Measure 25-02 had been deployed on all longline sets. Australia referred SCIC to the WG-IMAF Report (SC-CAMLR-XXVIII, Annex 7), paragraph 3.38, which stated that, during one night setting of an integrated weighted line, the streamer line became entangled with the main fishing line and subsequently broke. It was impractical and unsafe for the crew to attempt to retrieve or replace the broken streamer line during the night set. The broken streamer lines were retrieved during hauling on the following day. There was a minimal risk of seabird by-catch and no seabird by-catch was recorded during the setting of gear whilst the streamer line had broken. Australia therefore believed that this did not constitute an incident of non-compliance.

2.32 Australia also provided advice to SCIC in relation to the report that the *Austral Leader II* had not used haul-scaring devices on all hauls. Australia advised that a haul mitigation device had not been deployed during one longline haul due to adverse weather conditions which had caused waves to wash over the vessel's hauling bay. Australia advised that, in such conditions, haul mitigation devices could become entangled with the hauling winches or fishing line and posed a safety risk to crew, and noted that WG-IMAF had recognised that weather can affect the performance of haul mitigation devices. Given the adverse weather conditions at the time, there was minimal risk of seabird by-catch and again Australia confirmed that no seabird by-catch had been recorded during hauling whilst the mitigation device had not been deployed. Australia therefore believed that this did not constitute an incident of non-compliance.

2.33 South Africa advised that haul mitigation measures were used 98% of the time by the *Koryo Maru No. 11*. The remaining 2% of the time that they were not used was during four hauls due to poor weather.

2.34 Australia advised SCIC that it had investigated the report that the *Antarctic Chieftain* had used plastic packaging bands to secure bait boxes. Australia advised that observer coordinators from Australia and South Africa had both confirmed that an error had been made in the observer report and that bait box packaging bands had not been present on board the *Antarctic Chieftain*. The discrepancy had been resolved and an amended observer report had been submitted to the Secretariat.

implications of such issues for the conservation of Antarctic marine living resources should be presented by the working groups in their reports. The Scientific Committee requested the Commission consider whether this is an appropriate procedure for reporting on implementation issues.

5.7   Dr K. Seok (Republic of Korea) indicated concern that Korea's vessels had not fully implemented Conservation Measures 26-01 and 25-02 (Annex 7, paragraphs 3.27, 3.29 and 3.37) during fishing in the Convention Area in 2008/09. Dr Seok noted that improved communication between observers and vessel masters may aid with Korea's commitment to ensure that its vessels fully implement these conservation measures in future.

5.8   The Scientific Committee noted discrepancies between the full implementation of Conservation Measure 25-02 with regard to the discharge of offal (Annex 7, paragraph 3.33) and the discharge of dead skates recorded by WG-FSA (Annex 5, paragraph 6.11 and Table 16).

5.9   The Scientific Committee further noted that although the Commission gave a definition of 'offal' at its Twenty-third Meeting (CCAMLR-XXIII, paragraph 10.28), there remains some ambiguity in the definition of 'offal' in relation to discards and the release of live organisms. The Scientific Committee recalled that the requirement to retain all offal in high-latitude fisheries was first introduced in 2000 (Conservation Measure 210/XIX) and defined to include fish parts, bait and whole dead fish in 2004 (CCAMLR-XXIII, paragraph 10.28).

5.10   To further clarify the situation, the Scientific Committee recommended the following definitions be considered by the Commission:

   (i)   **Offal**: bait and by-products from the processing of fish and other organisms, including parts or sections of fish or organisms.

   (ii)   **Discards**: whole fish or other organisms returned to the sea dead or with low expectation[4] of survival.

   (iii)   **Releases**: fish or other organisms returned to the sea alive, with high expectation[4] of survival.

   (iv)   **Benthic Organisms**: organisms defined in the VME Invertebrate Classification Guide and other habitat forming taxa, which are excluded from definitions (i) to (iii) above.

5.11   In order to avoid confusion associated with different types of offal discard or release, the Scientific Committee further recommended that Conservation Measures 25-02, 25-03 and 26-01, and all other relevant conservation measures that reference offal, discards, and/or the release of fish or other organisms, be revised to incorporate the abovementioned definitions.

5.12   The Scientific Committee requested that WG-IMAF and WG-FSA review whether the prohibition on offal and discarding of dead fish in Subarea 88.1 and exploratory fisheries

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[4]   As described in observer logbook form L5.

south of 60°S continues to be required, given the risk status of those areas and the much-improved compliance with Conservation Measure 25-02, and the other requirements of data reporting.

Incidental mortality of seabirds and marine mammals
in fisheries outside the Convention Area

5.13   Dr Barrera-Oro noted the importance of Members using proven and effective CCAMLR practices in respective EEZs to reduce the incidental mortality of Convention Area seabirds. He noted that Argentina adheres to these CCAMLR guidelines in its EEZ fisheries.

5.14   Dr Barrera-Oro believed, however, that submission of information on any incidental mortalities of these Convention Area seabirds outside the Convention Area was more appropriately done through ACAP. ACAP could in turn share this information with CCAMLR.

5.15   The Scientific Committee encouraged a close collaboration between CCAMLR and ACAP but did note that not all CCAMLR Members are party to ACAP. Thus, consistent with CCAMLR Resolution 22/XXV, it is appropriate to request Members to submit information to CCAMLR on the incidental mortality of Convention Area seabirds that may occur in their fisheries.

5.16   Dr R. Leslie (South Africa) indicated that South Africa intends to submit a paper on incidental mortalities of seabirds in its fisheries outside the Convention Area at the next meeting of WG-IMAF.

Incidental mortality of seabirds during IUU fishing in the Convention Area

5.17   The Scientific Committee noted that WG-IMAF was not able to produce an estimate of the levels of incidental mortality of seabirds or marine mammals in IUU fishing due to a lack of information on the potential rate of interactions with IUU gillnet fisheries. However, the Scientific Committee noted that penguins and marine mammals are potentially at risk of incidental captures in gillnets depending on the depths and locations fished.

5.18   The Scientific Committee requested that Members submit reviews on the potential for gillnets to capture marine mammals and birds, based on experience in other domestic and international operations.

Observer reports and data collection

5.19   The Scientific Committee requested that ad hoc TASO consider the recommended observer coverage levels and sampling levels recommended by WG-IMAF (Annex 7, Tables 12, 13 and 14) and to report back to WG-IMAF regarding the feasibility of these recommended levels given other observer tasks.

Research into the status and distribution of seabirds and marine mammals

5.20   Prof. G. Duhamel (France) reiterated that the modelling study to evaluate the impacts of the longline fisheries on white-chinned and grey petrels in the Crozet Archipelago and Kerguelen Islands (SC-CAMLR-XXVIII/BG/13) used data from 2004 to 2006. Thus, any conclusions and recommendations based on that study (Annex 7, paragraph 8.8) must be considered in that context, particularly when France's fishery management actions following the study had succeeded in significantly reducing incidental mortality levels of the two petrel species.

5.21   The Scientific Committee noted that, whereas the incidental mortalities of both species had declined substantially with the implementation of France's action, the relative impacts of the current incidental mortality of the grey petrel in particular (estimated 25 birds and four birds in Division 58.5.1 and Subarea 58.6 respectively in 2008/09; see Annex 7, paragraphs 3.3 and 3.6), continue to be considered as a serious concern given the critical conservation status of this species.

5.22   The Scientific Committee further noted that France's commitment to assess the breeding population size of white-chinned and grey petrels in Division 58.5.1 (Annex 7, paragraph 3.52) will assist in a further understanding of the status in populations of these two species and the subsequent fishery impacts.

Assessment of risk in CCAMLR subareas and divisions

5.23   The Scientific Committee endorsed the advice from WG-IMAF with regard to the proposal for a five-day season extension for fishing into April in Subarea 48.3 under Conservation Measure 42-02 (Annex 7, paragraph 9.5).

5.24   The Scientific Committee noted that the decision rules, proposed by WG-IMAF for the Scientific Committee in 2010 with regard to the season extension proposed in Subarea 48.3 under Conservation Measure 42-02, needed a minor clarification (Annex 7, paragraph 9.6). The Scientific Committee recommended a minor change to Annex 7, paragraph 9.6(ii) to include the following text, in italics: 'or more than 10 *or fewer than 15* birds in total'.

5.25   The Scientific Committee noted that it is important to review the appropriateness of such season extensions on a regular basis (as stated in Annex 7, paragraphs 9.6 and 9.7) particularly with regard to climate change and its potential impact on breeding phenology.

Marine debris and its impacts on marine mammals
and seabirds in the Convention Area

5.26   Dr Agnew noted that the increase in the use of the trotline system mentioned in Annex 7, paragraph 13.6, does not refer to an increase in trotline use in fisheries in Subarea 48.3, but an increase in the use of trotlines within the foraging range of chick-rearing wandering albatross from South Georgia.

5.27   In response to anecdotal reports that some trotline fisheries remove by-catch fish from trotlines by the cutting of snoods (Annex 7, paragraph 13.7), Dr M. Kiyota (Japan) noted that Japan's vessel that uses the trotline longline system manually removes the hooks from all by-catch fish.

Streamlining the work of the Scientific Committee

5.28   The Scientific Committee endorsed WG-IMAF's proposal to meet on a biennial basis. The significant accomplishments of WG-IMAF are to be commended and have been extremely important to the work of CCAMLR and reducing the incidental mortality of seabirds and marine mammals in CCAMLR fisheries. These outcomes indicate a reduced workload for WG-IMAF and allow a reduced meeting frequency. A biennial meeting schedule will also allow further involvement of WG-IMAF participants in ACAP, which is aiming to address incidental mortality of albatrosses and petrels in fisheries managed by adjacent RFMOs, including Convention Area seabirds.

5.29   Following the discussion in paragraphs 5.5 and 5.6, the Scientific Committee recommended that, in the future, SCIC should evaluate implementation/compliance of conservation measures. The working groups should evaluate the efficacy of conservation measures and the implications of any non-compliance with those conservation measures for marine living resources.

5.30   Given that the relatively low levels of incidental mortality within most areas of the Convention Area, the Scientific Committee agreed that a biennial schedule for evaluating levels of incidental mortality is appropriate.

5.31   The Scientific Committee agreed that evaluation of new and exploratory fisheries by WG-IMAF could occur on a biennial basis. Therefore, if a proposal is submitted for a new fishing method or area, either the Scientific Committee can evaluate this submission in regard to the risk of incidental mortality or request WG-IMAF to evaluate the submission at its next meeting.

5.32   Based on the above conditions (paragraphs 5.29 to 5.31), the Scientific Committee endorsed a biennial schedule for WG-IMAF.

Advice to the Commission

5.33   This section distinguishes between general advice (which the Commission may wish to note and/or endorse) and specific advice which includes requests to the Commission for action.

General advice

5.34   The Commission was requested to note:

(i)   intersessional work of WG-IMAF (Annex 7, paragraph 2.5);

(ii)   incidental mortality of seabirds and marine mammals in fisheries in the Convention Area (Annex 7, paragraphs 3.3, 3.4, 3.7, 3.10, 3.14, 3.16, 3.20 to 3.22 and 3.25);

(iii)   implementation of conservation measures (Annex 7, paragraph 3.35; paragraph 5.12);

(iv)   incidental mortality of seabirds and marine mammals in fisheries outside the Convention Area (Annex 7, paragraph 4.6);

(v)   assessment of risk in CCAMLR subareas and divisions (paragraphs 5.23 to 5.25);

(vi)   incidental mortality of seabirds in relation to new and exploratory fisheries (Annex 7, paragraph 10.3);

(vii)   international and national initiatives relating to incidental mortality of seabirds and marine mammals in fishing (Annex 7, paragraph 11.12);

(viii) marine debris and its impacts on marine mammals and seabirds in the Convention Area (Annex 7, paragraphs 13.2 and 13.14).

5.35   The Commission was requested to endorse:

(i)   intersessional work of WG-IMAF (Annex 7, paragraph 2.7);

(ii)   information on incidental mortality of seabirds and marine mammals in fisheries in the Convention Area (Annex 7, paragraph 3.19);

(iii)   implementation of conservation measures (Annex 7, paragraph 3.45; paragraphs 5.5 and 5.6);

(iv)   France's action plan to reduce/eliminate seabird mortality in Subarea 58.6 and Division 58.5.1 (Annex 7, paragraphs 3.48, 3.54, 3.56, 3.58, 3.60 and 3.62);

(v)   information on incidental mortality of seabirds and marine mammals in fisheries outside the Convention Area (Annex 7, paragraph 4.5; paragraph 5.16);

(vi)   information on incidental mortality of seabirds during IUU fishing in the Convention Area (Annex 7, paragraph 5.4; paragraph 5.18);

(vii)   research into and experience with mitigation measures (Annex 7, paragraph 6.7);

(viii) observer reports and data collection (paragraph 5.19; Annex 7, paragraphs 7.1, 7.2, 7.7, 7.8, 7.10, 7.12, 7.16 and 7.17);

(ix)   research into the status and distribution of seabirds and marine mammals (Annex 7, paragraphs 8.4 and 8.8);

(x)   assessment of risk in CCAMLR subareas and divisions (paragraphs 5.23 and 5.24; Annex 7, paragraph 9.6);

(xi)   information on incidental mortality of seabirds in relation to new and exploratory fisheries (Annex 7, paragraph 10.7);

(xii)   international and national initiatives relating to incidental mortality of seabirds and marine mammals in fishing (Annex 7, paragraph 11.7);

(xiii) information on marine debris and its impacts on marine mammals and seabirds in the Convention Area (Annex 7, paragraphs 13.11 to 13.13);

(xiv)   streamlining the work of the Scientific Committee (paragraphs 5.28 to 5.32; Annex 7, paragraphs 14.4 and 14.7).

Specific advice

5.36   The Commission was requested to consider taking action in respect of:

(i)   implementation of, and compliance with, conservation measures (paragraphs 5.5, 5.6 and 5.8);

(ii)   incidental mortality of seabirds during IUU fishing in the Convention Area (Annex 7, paragraph 5.5);

(iii)   research into and experience with mitigation measures and subsequent recommendation for changes to Conservation Measures 25-02, 25-03, 26-01 and 42-01 (paragraphs 5.10 and 5.11; Annex 7, paragraphs 6.3, 6.8 and 6.11);

(iv)   assessment of risk in CCAMLR subareas and divisions and subsequent recommendation for changes to Conservation Measure 41-02 (paragraphs 5.23 to 5.25; Annex 7, paragraph 9.5);

(v)   international and national initiatives relating to incidental mortality of seabirds and marine mammals in fishing (Annex 7, paragraph 11.2).

CCAMLR SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

6.1   In accordance with the CCAMLR Scheme of International Scientific Observation, scientific observers were deployed on all vessels in all finfish fisheries in the Convention Area.

6.2   Information collected by scientific observers on board longline, finfish trawl, pot and krill trawl cruises were summarised by the Secretariat in SC-CAMLR-XXVIII/BG/2.

6.3   The Scientific Committee also noted the discussions on the observer program by WG-IMAF (Annex 7, paragraphs 7.1 to 7.18), WG-FSA (Annex 5, paragraphs 11.1 to 11.7), WG-SAM (Annex 6, paragraphs 5.1 to 5.5), WG-EMM (Annex 4, paragraphs 3.45 to 3.61) and WS-VME (Annex 10, paragraphs 5.5, 5.8 to 5.12, 6.4, 6.5 and 6.11).

Ad hoc TASO

6.4   The Co-conveners of ad hoc TASO, Mr Heinecken and Dr Welsford, presented the report from the second meeting, held in conjunction with WG-EMM and WG-SAM in Bergen, Norway, on 4 and 5 July 2009 (Annex 9).

6.5   The agenda of the second meeting of ad hoc TASO covered the design and operation of gear types used in fisheries in the Convention Area, observer priorities in the trawl, longline and pot fisheries, observer recruitment and training, and the future work plan and terms of reference of the ad hoc group.

6.6   The Scientific Committee considered and approved recommendations from ad hoc TASO concerning the aspects of the CCAMLR Scheme of International Scientific Observation discussed in Annex 9, paragraphs 2.7 to 2.8, 2.17 to 2.19, 2.22, 2.24 to 2.26, 3.5 to 3.7, 3.16 to 3.21, 4.5 and 4.10 to 4.13).

6.7   The Scientific Committee noted that with respect to the training of observers, experience in domestic fisheries and initial supervision by more experienced observers (Annex 9, paragraph 4.5(x)), although highly desirable, was not always possible. The Scientific Committee urged that such training of observers occur wherever possible.

6.8   The Scientific Committee recommended that the development of standards for all participants in the CCAMLR Scheme of International Scientific Observation via an accreditation scheme should be pursued as a core component of the work plan of ad hoc TASO (Annex 9, paragraph 5.2).

6.9   The Scientific Committee thanked the Co-conveners of ad hoc TASO for preparing SC-CAMLR-XXVIII/BG/9 on the development and implementation of an accreditation framework for participation in the CCAMLR Scheme of International Scientific Observation.

6.10   The Scientific Committee noted that the further development of an accreditation framework for participation in the CCAMLR Scheme of International Scientific Observation should consider:

(i)   the timing of the submission of documents in support of accreditation so as to ensure Members are able to maintain flexibility in rapid training and deployment of observers;

(ii)   an initial focus on accreditation of programs rather than individuals;

(iii)   an initial focus on the development of baseline requirements to accredit programs.

6.11   The Scientific Committee recommended that the development of baseline requirements to accredit observer programs be undertaken by ad hoc TASO and reported back to the Scientific Committee in 2010. On this basis, and subject to the adoption of the baseline requirements to accredit programs in 2010, ad hoc TASO would be tasked with reviewing observer programs against the baseline requirements in 2011, with a view to the Scientific Committee providing detailed advice on this matter to the Commission in 2011.

6.12   The Scientific Committee urged all Members to ensure that their technical coordinators provide the Secretariat with the detailed information required to achieve the work identified in paragraph 6.11 by May 2010 at the latest.

6.13   The Scientific Committee endorsed the work plan of ad hoc TASO as described in paragraphs to 6.10 to 6.12 and Annex 9, paragraph 5.7.

6.14   The Scientific Committee considered plans for the next meeting of ad hoc TASO. The Scientific Committee noted that, given the tasks it wished ad hoc TASO to complete in 2010, in particular the development of baseline requirements to accredit observer programs (paragraph 6.11), ad hoc TASO would require a five-day meeting. The Scientific Committee further noted that although the meeting could be held separately to other working group meetings in the future, to assist with the development of capacity building in Members' observer programs and fleets, it agreed that the meeting in 2010 be held in conjunction with WG-FSA (paragraph 14.8).

Advice from WG-FSA

6.15   The Scientific Committee considered and approved recommendations from WG-FSA concerning the aspects of the CCAMLR Scheme of International Scientific Observation discussed in Annex 5, paragraphs 11.3 to 11.6.

Advice from WG-IMAF

6.16   The Scientific Committee considered and approved recommendations from WG-IMAF concerning the aspects of the CCAMLR Scheme of International Scientific Observation discussed in Annex 7, paragraphs 7.2, 7.7, 7.8, 7.10 and 7.12.

Advice from WS-VME

6.17   The Scientific Committee considered and approved recommendations from WS-VME concerning the aspects of the CCAMLR Scheme of International Scientific Observation discussed in Annex 10, paragraphs 5.12(iv) to 5.12(vi), 6.4 and 6.5.

Advice from WG-EMM

6.18   The Scientific Committee noted discussions concerning the aspects of the CCAMLR Scheme of International Scientific Observation discussed in Annex 4, paragraphs 3.45 to 3.61, in relation to the krill fishery.

6.19   The Scientific Committee considered and approved recommendations from WG-EMM concerning the aspects of the CCAMLR Scheme of International Scientific Observation discussed in Annex 4, paragraph 3.45.

6.20   The Scientific Committee noted that although some additional observer data have been collected in krill fisheries, those data were not yet available to the Scientific Committee and its working groups (Annex 4, paragraphs 3.51 to 3.53). The Scientific Committee urged the submission of these data as soon as possible, and in advance of the WG-SAM and WG-EMM meetings in 2010 to ensure they were available to further inform the design of systematic observer coverage of the krill fishery (Annex 4, paragraphs 3.54 to 3.58), and for the work of WG-FSA in 2010 on larval by-catch (Annex 5, paragraph 10.58).

6.21   Ukraine introduced CCAMLR-XXVIII/BG/26 on the scientific observation and the management of Antarctic krill fisheries in Statistical Area 48 noting that in 2006, 2007 and 2008 they had proposed mandatory international or national scientific observers on board krill fishing vessels. In 2008, Ukraine highlighted the magnitude of the scientific uncertainties and data gaps affecting the subdivision of precautionary catch limits among SSMUs in Area 48 (CCAMLR-XXVII/43).

6.22   Ukraine suggested that a research and monitoring plan was necessary for CCAMLR to fill these information gaps, together with developing in the future a funding mechanism to support the data collection process. Because CCAMLR's Scheme of International Scientific Observation is the basic source of data that covers these uncertainties, Ukraine encouraged those delegations which reserved their position at CCAMLR-XXVII to design and to support at this meeting, the adoption of a conservation measure that provides systematic coverage by international/national scientific observers for the krill fishery in accordance with the CCAMLR scheme.

6.23   Prof. B. Fernholm (Sweden) noted that CCAMLR-XXVIII/47 included a proposal for a conservation measure that would ensure systematic krill observer coverage at a high level consistent with the Scientific Committee advice, including 100% coverage where necessary, and in addition would require vessels to report biological data from the fishery.

6.24   Dr Agnew drew attention to the analysis of data from Subarea 48.3 discussed at WG-EMM (Annex 4, paragraph 3.55) which supported the value of a high level of systematic observer coverage in the krill fishery.

6.25   Argentina noted its support for the proposals of Ukraine, and its views that:

(i)   Members who have collected data from observation in the krill fishery need to submit these data to CCAMLR;

(ii)   Members participating in the krill fishery need to send experts to the relevant working groups and in particular WG-EMM;

(iii)   international scientific observers are required in the krill fishery;

(iv)   the ASOC paper CCAMLR-XXVIII/BG/27 provides a good summary of the issues associated with observation in the krill fishery.

6.26   ASOC noted that, as it has previously identified, it continues to consider systematic observer coverage a minimum standard for the krill fishery. ASOC greatly appreciated the efforts undertaken by several CCAMLR Members to make progress on this issue. ASOC urged all fishing nations to participate actively in the work to be undertaken in the context of WG-SAM and WG-EMM, especially in the design of a scientific observer program for krill. ASOC thought that it is imperative that Members not only participate in the meetings, but also that they contribute actively to the discussions. For that reason, it is essential that representatives from all Members with the adequate expertise are present at those meetings. Finally, having been part of the process to design the observer program for krill, ASOC hopes that Members will be able to endorse the recommendations resulting from the next WG-EMM meeting with regard to observers, when the Scientific Committee meets next year, which would allow the Commission to finally adopt a conservation measure on this matter at CCAMLR-XXIX.

6.27   Dr Kiyota noted that Japan was currently working through issues associated with the submission of observer data collected by national observers on board Japanese krill vessels.

6.28   Recalling its advice from SC-CAMLR-XXVII, paragraphs 6.22 to 6.34, the Scientific Committee agreed the need for, and importance of, systematic coverage of all Members' vessels participating in the krill fishery. The Scientific Committee agreed that such observer coverage is a high priority. The Scientific Committee recommended that, following consideration at WG-SAM and WG-EMM of technical issues in 2010, a well-designed program for systematic observer coverage in the krill fishery be adopted at SC-CAMLR-XXIX.

6.29   The Scientific Committee noted that irrespective of plans for the future systematic collection of data by scientific observers in the krill fishery, a number of priority working group tasks in 2010 would rely on scientific observer data from the 2009/10 krill fishery and strongly urged participants in the fishery to deploy scientific observers on all vessels possible.

6.30   The Scientific Committee noted that its ability to conduct its work was contingent on the efforts of scientific observers in collecting data, and requested that Members ensure that this gratitude be conveyed to all scientific observers after the meeting.

FISHERIES MANAGEMENT AND CONSERVATION UNDER CONDITIONS OF UNCERTAINTY

Estimation of IUU catches

7.1   The Scientific Committee noted the advice of WG-FSA (Annex 5, paragraphs 8.1 to 8.7) on IUU fishing trends in the 2008/09 fishing season. It also noted that the estimated IUU catches had declined from 1 168 tonnes in 2007/08 to 938 tonnes in 2008/09 (Annex 5, Tables 2 and 3).

7.2   The Scientific Committee noted that information on IUU activities had been received for six vessels fishing in the Convention Area, and the vessels were assumed to be fishing using gillnets (Annex 5, paragraph 8.3).

7.3   The Scientific Committee noted that new information had been submitted by inspectors for gillnet vessels in the Convention Area (Annex 5, paragraph 8.4). The Scientific Committee thanked Australia for undertaking this work as it was very important for allowing preliminary gillnet catch rates to be estimated. Consequently, the Working Group used this information to refine the estimated IUU catches in Division 58.4.3b. For other divisions where IUU was detected (Divisions 58.4.1 and 58.4.2), mean daily catch rates from licensed longline vessels were applied.

7.4   The Scientific Committee agreed that the information provided was an improvement over information used to calculate estimates in past years. However, it recognised that estimates made using this information were highly conservative and, in reality, gillnet IUU catches are likely to be much greater. In consequence, there were very high levels of uncertainty about the estimate of IUU catch for 2008/09. Further, gillnets are less selective, the by-catch of fish and birds and impact on benthos are virtually unknown. Nets continue to fish if abandoned or lost. The Scientific Committee agreed that gillnets are a destructive fishing method. Every effort should be made to end gillnet IUU activity in the Convention Area.

7.5   The Scientific Committee endorsed the Secretariat's method for estimating IUU catches using the available information on gillnets, again noting that catches from gillnets may be greatly underestimated. The Scientific Committee noted the reduction in the number of IUU fishing vessels sighted in recent seasons, and agreed that this may have been due to several factors. However, it reiterated concerns over the number of uncertainties in the process of developing IUU estimates.

7.6   The Scientific Committee agreed that it would be useful, where possible, for the Secretariat to provide an estimate of the catch allocation between *D. eleginoides* and *D. mawsoni* based on the known location of sightings of IUU activities.

7.7   The Scientific Committee agreed that estimates of IUU fishing (Annex 5, Table 3) made during the last few years, when gillnets were known to be utilised in the Convention Area, should be recalculated using data on catch rates, net fishing duration etc., acquired this year, and updated in the future as new data become available.

7.8   Dr Pshenichnov noted that WG-FSA-09/5 Rev. 1 indicated that in the high seas of Indian Ocean sector (Divisions 58.4.1 and 58.4.2), IUU fishing vessels have been observed until the beginning of February only. He considered that the principal reason of the absence of data with respect to IUU vessels from these areas was that there has been an absence of licensed vessels due to early completion of fishing as a result of low catch limits in these SSRUs. During this time, fishing vessels were absent in closed SSRUs, which represents a greater part of areas of these divisions.

7.9   Dr Pshenichnov believed that most companies that manage IUU vessels are familiar with CCAMLR conservation measures (for example, through the CCAMLR website), which

provide explicit details of in which areas of the Southern Ocean it would be possible to encounter licensed ships in the upcoming year, and in which areas it would be unlikely to encounter them.

7.10   Dr Pshenichnov also believed that the use by IUU vessels of technologies that allow for distant detection would allow them to observe the position of legal vessels in the area. One such method is the use of powerful radars for distant surface searching. Another method would be the use of radar in passive mode.

Climate change

7.11   The Scientific Committee endorsed the conclusions of WG-EMM that:

   (i)   climate change has the potential to induce rapid change within ecosystems and may impact on how indices generated by CEMP might be used to detect fisheries impacts (Annex 4, paragraph 3.99);

   (ii)   the detection of climate impacts is likely to benefit from data that are not currently collected under CEMP, and aligning CEMP with a broader suite of parameters collected under multiple programs would allow integrated datasets to be analysed and may be useful for management purposes (Annex 4, paragraph 3.101);

   (iii) identifying parameters that would be most relevant for distinguishing fisheries impacts from climate impacts is important for future work, and that it would be desirable if such parameters were broadly relevant to a larger scientific and management community (Annex 4, paragraph 3.102).

7.12   The Scientific Committee also endorsed the conclusions in Annex 4, paragraph 3.103, which specifies that detection and attribution of climate change impacts at established monitoring sites remains problematic and may require reference (control) sites, noting that:

   (i)   the data currently reported to CEMP are often a component part of research by individual Members, and procuring resources for additional data collection, particularly if new CEMP sites are required, will pose challenges for national programs;

   (ii)   for new CEMP and reference sites, a number of years of monitoring will be needed for establishing baselines that are suitable for comparison with data from current monitoring sites;

   (iii) there is uncertainty as to how the fishery will respond to climate change (Annex 4, paragraph 3.106), and information on how the fishery might respond to different scenarios of climate change would be helpful to identify potential fishery impacts on krill-dependent predators in the future.

7.13   The Scientific Committee advised that reviewing CEMP, including the requirements for reference sites for the purposes of monitoring the effects of the krill fishery in an era of rapid climate change, is now a priority issue (Annex 4, paragraph 3.104). Such a review

would provide a useful Focus Topic for WG-EMM and would be timely given forthcoming meetings such as the United Nations Climate Change Conference and the Antarctic Treaty Meeting of Experts (ATME) on Climate Change.

7.14   The Scientific Committee noted that SC-CAMLR-XXVIII/BG/17 summarised the outcomes of a workshop on the Southern Ocean Sentinel program. That workshop recognised that reference areas will be critical for monitoring changes in the Antarctic marine ecosystem and for attributing which of these changes are climate change impacts. The workshop also recognised that the chances of successfully measuring climate change impacts on marine ecosystems are high in the Southern Ocean, where rapid changes with substantial climate change impacts are likely to occur and where there is a long tradition of international collaborative research. The Scientific Committee noted that this program would be of benefit to CCAMLR and encouraged Members to help facilitate this work through ICED and SOOS.

7.15   The Scientific Committee endorsed advice on climate change provided by the Joint SC-CAMLR–CEP Workshop (SC-CAMLR-XXVIII/6, paragraphs 4.3 to 4.6).

Fishing outside the Convention Area

7.16   The Scientific Committee noted catches of *D. eleginoides* from fisheries outside the Convention Area, which are summarised in Annex 6, Table 4. The total CDS-reported catch from outside the Convention Area for 2008/09 to October 2009 was 10 065 tonnes. The Scientific Committee noted that most of the catch of *D. eleginoides* taken outside the Convention Area was from Areas 41 and 87. Further information on catches outside the Convention Area is provided in paragraphs 4.138 and 4.139.

7.17   The Scientific Committee agreed that WG-FSA should continue to consider catches outside the Convention Area within the work required by its regular agenda. Information provided by Members who regularly collect data or conduct assessments for stocks that are of interest to the Commission but outside the Convention Area can be useful to WG-FSA, and those Members were encouraged to submit such information for consideration by the Working Group. The Scientific Committee also encouraged these Members to have their scientists participate in the work of WG-FSA.

NOTIFICATIONS TO CONDUCT RESEARCH SURVEYS
USING COMMERCIAL VESSELS

8.1   The Scientific Committee discussed one notification of intent to conduct toothfish longline research in 2010 using commercial vessels under the provisions of Conservation Measure 24-01.

8.2   Japan proposed to continue research on the distribution and population structure of toothfish in Divisions 58.4.4a and 58.4.4b started in 2007/08 (Annex 5, paragraphs 5.97 to 5.111 and 13.7; see also SC-CAMLR-XXVII, Annex 5, paragraphs 5.116 and 5.117; and CCAMLR-XXVII/BG/15).

8.3　The Scientific Committee agreed that in evaluating research programs in data-poor fisheries, there were three questions that need to be addressed for the provision of advice on what research would be appropriate (Annex 5, paragraph 5.114), taking account of the issues in paragraphs 4.163 to 4.168:

(i)　What research needs to be undertaken to facilitate a preliminary assessment of stock status?

(ii)　What is the mortality of fish that will likely occur as a result of undertaking the research without any additional catch? For example, if all fish in good condition were tagged and released, what proportion of the tagged fish would be in poor condition and die?

(iii)　What is the quantity of fish that could be taken to offset the cost of the research, noting the possible status of the stock?

8.4　Dr Ichii made the following statement:

'The research proposal has been considered by WG-SAM and WG-FSA and agreement had been reached on the survey design, with the exception of the sample size. To obtain an agreeable sample size, Japan has made a recalculation by applying an Australian scenario that the current stock level is at 40% of SSB_0 (initial spawning stock biomass) and hence the precautionary sustainable harvest rate should be 1.6%. Under this scenario SSB_0 is estimated as about 6 000 tonnes. Multiplication of this SSB_0 with a harvest rate of 1.6% results in a precautionary sustainable sample size of 95 tonnes. It should be noted that during the meeting of WG-FSA, Japan had inadvertently multiplied the harvest rate by the SSB and this had resulted in an incorrect estimate of sample size (81 tonnes).

This sample size is necessary to obtain reliable stock estimate parameters and complete coverage of the survey area as follows:

(i)　it would be possible to utilise the previous tagging experiment conducted in 2008. The number of recaptured fish tagged in the previous experiment would provide useful information for population estimates;

(ii)　in future annual tagging experiments, the number of recaptured tagged fish would provide useful information for reliable population estimates;

(iii)　the possibility for complete coverage of whole grid survey points would be as high as 80%.

Japan expressed a strong commitment to continue this scientific research for 3–5 years. The research plan proposal for 2010 will be repeated in each of at least two subsequent years to release and recapture tags with the intention of developing a stock assessment.'

8.5　Dr Welsford recalled that over 6 000 tonnes of toothfish are estimated to have been removed by IUU fishing from this stock between 1996/97 and 2007/08. Hence, if Japan's

revised estimate of SSB_0 of around 6 000 tonnes is assumed to be correct, the stock would evidently have been rapidly depleted by IUU fishing, and is highly unlikely to have recovered to a level that could sustain research fishing at the level proposed by Japan.

8.6   The Scientific Committee recommended that progress of any experiment be reviewed by WG-FSA annually and modified as appropriate, based on that advice.

8.7   The Scientific Committee noted that in its discussions, WG-FSA (Annex 5, paragraphs 5.97 to 5.111) was unable to reach consensus on an appropriate level of catch for the survey.

8.8   The Scientific Committee noted that further development of this research proposal, in line with previous comments, has been undertaken. The main point is what level of catch is appropriate to help offset the cost of the research in order not to impact on the recovery of the stock. As a result, the proposal needs to be considered by the Commission in light of the agreed approach in SC-CAMLR-XXVII, paragraphs 8.10 and 8.11.

8.9   The Convener of WG-SAM (Dr Constable) offered to include a review of this research program and how it might improve the advice to the Commission on the status of stocks in this area and to facilitate intersessional work in this regard.

Notifications to conduct scientific surveys using research vessels

8.10   The Scientific Committee noted that the following Members would be conducting scientific research activities in 2010 and in accordance with Conservation Measure 24-01:

Australia: Research on the vulnerability of habitats in high latitudes to impacts by bottom fishing gear (December 2009 to January 2010, Divisions 58.4.1 and 58.4.2);

Possible survey for *C. gunnari* in Division 58.5.2 in early 2010;

Demersal fish survey in Division 58.5.2 in May–June 2010;

UK: Demersal fish survey in Subarea 48.3 in January–February 2010;

Deeper-water demersal fish survey on the slope in Subarea 48.3 in February 2010.

COOPERATION WITH OTHER ORGANISATIONS

9.1   The Scientific Committee was chaired during this section by Dr Bizikov, Vice-Chair of the Scientific Committee.

Cooperation with the Antarctic Treaty System

Report of the Joint SC-CAMLR–CEP Workshop

9.2   On behalf of the Joint Steering Committee, the CEP Observer (Dr Gilbert) introduced SC-CAMLR-XXVIII/6, the report of the Joint SC-CAMLR–CEP Workshop, held in Baltimore, USA (3 and 4 April 2009). The Workshop was convened by Drs Bizikov, Frenot, Gilbert and Watters (paragraph 1.9(i)).

9.3   The Scientific Committee recalled the terms of reference of the Joint Workshop (contained in SC-CAMLR-XXVIII/6) and noted that the discussions were focused on the following six topics:

- key objectives, priorities and challenges for the CEP and SC-CAMLR
- climate change and the Antarctic marine environment
- biodiversity and non-native species in the Antarctic marine environment
- Antarctic species requiring special protection
- spatial marine management and protected areas
- ecosystem and environmental monitoring.

9.4   As a first meeting between the two committees, Dr Gilbert noted that the Joint Workshop had been most successful in achieving its objectives. Dr Gilbert summarised the following outcomes from the discussions:

(i)   on climate change, the Joint Workshop recognised the significance of a changing Antarctic climate to the respective management interests of the two committees and made several recommendations with regard to ongoing cooperation on the matter. In this regard, the CEP Observer drew the Scientific Committee's attention to the ATME on Climate Change planned to be held in Norway (6 to 9 April 2010) (ATCM Decision 1 (2009) refers), and suggested that SC-CAMLR may wish to give consideration as to its involvement in that Meeting of Experts;

(ii)   on non-native species, the Joint Workshop had recommended that the CEP take the lead on the matter keeping the Scientific Committee informed of progress;

(iii) on species requiring special protection, the Joint Workshop recognised the common interest of the two committees in the conservation status of seals, penguins and seabirds south of 60°S termed 'overlap species' by the Joint Workshop. The Joint Workshop made a number of observations and recommendations on the importance of sharing data and information on the status and trends of such overlap species as well as on management actions that may be taken by the respective bodies;

(iv)   on spatial marine management, the Joint Workshop recommended that the Scientific Committee would generally take the lead in addressing the issue with the CEP continuing to examine options for using protected and managed area provisions of the Environmental Protocol as appropriate. Dr Gilbert noted in this regard that on the recommendation of the Joint Workshop, the CEP had

considered, and subsequently endorsed, the 11 priority marine areas of the Southern Ocean that had been identified by the Scientific Committee as being worthy of primary attention for spatial management action;

(v) on ecosystem monitoring, the Joint Workshop had recognised the need for further cooperation to ensure monitoring effort is harmonised to the extent possible and that this matter might form the basis of a future joint meeting between the two committees.

9.5 Dr Gilbert noted that the Joint Workshop report had been considered by the CEP at its 12th meeting and that the CEP had welcomed the report, endorsed the recommendations and commended the report to the Scientific Committee. In doing so, the CEP had stressed the importance of maintaining momentum on the issues identified by the Joint Workshop.

9.6 As Convener of WG-EMM, Dr Watters thanked the CEP Observer for introducing the Joint Workshop report and noted that WG-EMM had also considered the report and endorsed the recommendations it contained. With reference to the ATME on Climate Change (paragraph 9.4(i)), Dr Watters suggested that improved ways need to be found for coordinating intersessional meetings between CCAMLR and the ATCM in order to facilitate attendance at those meetings.

9.7 The Scientific Committee thanked those involved in organising what was a very successful and productive workshop and agreed that recommendations from the workshop be considered by the Scientific Committee under the relevant agenda items and that consideration also be given to ensuring that momentum is maintained in cooperating with the CEP, including the consideration of when future meetings might occur.

9.8 The Scientific Committee endorsed the recommendations of the Joint SC-CAMLR–CEP Workshop report.

9.9 The Scientific Committee recommended that the Chairs of the respective committees should liaise during the intersessional period in order to consider and suggest to their respective committees:

- options for making progress on the various recommendations from the Joint Workshop;

- options for further joint meetings and workshops, and possible timing of such meetings;

- how to improve coordination on other intersessional meetings and workshops that may be of common interest;

- in doing so, take into account the recommendations from the CCAMLR Performance Review Panel on how to improve coordination with the Antarctic Treaty System.

CEP

9.10   Dr Gilbert drew the Scientific Committee's attention to SC-CAMLR-XXVIII/BG/16 that contained the CEP's annual report to the Scientific Committee. Dr Gilbert noted that the report had been shortened this year to focus only on the topics of common interest that had been recommended by the Joint Workshop.

9.11   The Scientific Committee thanked the CEP Observer for the annual CEP report and agreed that its format provided a useful means for exchanging information on the topics of common interest.

Boundary of the IMO's Antarctic Special Area

9.12   Dr Watters introduced the proposal in CCAMLR-XXVIII/32, describing an initiative to extend the boundary of the International Maritime Organization's Antarctic Special Area northward to the boundary of the CAMLR Convention Area.

9.13   The Scientific Committee recognised that the aim of the proposal in CCAMLR-XXVIII/32 was to extend the protection of the Antarctic marine ecosystem to a boundary that reflected the boundary of that ecosystem and that this was consistent with its custom and practice in defining other such boundaries.

SCAR

9.14   The SCAR Observer (Prof. M. Hindell) introduced CCAMLR-XXVIII/BG/34, noting that there have been a large number of activities conducted by, or involving, SCAR that relate directly to CCAMLR or are of potential interest to CCAMLR. Prof. Hindell summarised the activities of particular interest to CCAMLR.

9.15   The major Life Sciences projects, and SCAR Action Groups and Expert Groups of direct relevance to CCAMLR, and which also provide opportunities for direct collaboration between SCAR and CCAMLR, are CAML, SO-CPR and its Expert Group, SCAR-MarBIN and the new Expert Group on Birds and Marine Mammals (EG-BAMM).

CAML activities

9.16   CAML is both a major IPY initiative and a key SCAR activity. Its objectives are to develop a robust benchmark of the distribution and abundance of marine biodiversity in Antarctic waters, against which future change in the marine environment can be assessed.

9.17   CAML has completed its major fieldwork. Eighteen vessels were involved. These ranged from voyages fully dedicated to CAML or had major CAML-related components through to other IPY project voyages that will provide data to CAML.

9.18   The Census research voyages during the IPY have provided a comprehensive inventory of marine species: over 6 000 verified species of animals at each pole and

251 species that occur at both poles. At the molecular level, DNA sequences are showing differences in some species that were previously thought to be the same. The analyses showed a close connection between the species and their physical environment at various spatial scales.

SCAR-MarBIN

9.19   SCAR-MarBIN compiles and manages existing and new information generated by CAML on Antarctic marine biodiversity by coordinating, supporting, completing and optimising database networking. SCAR-MarBIN is the Antarctic Regional Node of the Ocean Biogeographic Information System (OBIS: www.iobis.org), and also contributes to the Global Biodiversity Information Facility (GBIF).

9.20   SCAR-MarBIN continues to develop its Register of Antarctic Marine Species (RAMS), which is a fully operable, browsable/searchable online list of Antarctic marine species, and is maintained by a board of taxonomic editors. SCAR-MarBIN also offers the possibility to visualise through a WebGIS and to download baseline data on the occurrence and abundance of marine organisms.

9.21   SCAR-MarBIN is the foundation for CAML's assessment of Antarctic marine life. It will be a powerful information tool, which will provide a baseline reference for establishing a State of the Antarctic Environment, and predicting the future of marine communities around Antarctica, which are currently, or may in the future be, challenged by global change. SCAR-MarBIN will continue to prove useful in the development of monitoring and conservation strategies, in particular facilitating the designation of CAML Legacy Sites. It will also serve as an important biodiversity component of the Southern Ocean Observing System (SOOS) (see paragraph 9.23).

Expert Group on Birds and Marine Mammals

9.22   SCAR's Expert Groups on Seals and Birds have been merged to become the Expert Group on Birds and Marine Mammals, under the leadership of Prof. Hindell. The group met in July 2009, at the 10th SCAR Biology Conference in Sapporo, Japan, and identified some long-term research objectives. The most relevant of these is the compilation of all existing bird and mammal tracking data. These data will form the basis of multi-species 'hot-spot' analysis as well as a gap analysis to indicate species and regions where future tracking efforts should be focused. A long-term objective will be to build on this retrospective analysis to launch a new Southern Ocean predator community study.

Southern Ocean Observing System

9.23   The SCAR/SCOR Oceanography Expert Group is developing a scientific design plan for a Southern Ocean Observing System (SOOS) covering the physics, chemistry and biology of the system. A SOOS meeting was held during XXX SCAR in July 2008, and another was

held at the time of writing of this report (26 September 2009, in Venice, Italy). Before the end of 2009, a version of the plan will be made available to the wider community for comment before being finalised. Input will be actively sought from CCAMLR.

9.24   Inputs from AGCS, ACCE and SOOS were fed into the Southern Ocean Sentinel workshop held in Hobart, Australia (20 to 24 April 2009). It is intended that outputs from the Sentinel program will feed into the SOOS when it is in place. SOOS will make a direct contribution to the Global Ocean Observing System (GOOS) and through that to the Global Earth Observing System of Systems (GEOSS).

9.25   In conclusion, Prof. Hindell identified that SCAR is seeking to enhance its engagement with CCAMLR, and would gratefully receive suggestions on ways to facilitate this. For example, the formation of EG-BAMM was to a large degree intended to provide data for WG-EMM and the MPA subgroup.

9.26   The Scientific Committee welcomed the report from Prof. Hindell and welcomed the desire for SCAR to forge closer links with CCAMLR. In particular, the Scientific Committee noted the potential for productive linkages between the SCAR EG-BAMM and WG-EMM-STAPP, especially noting the plans for SCAR to develop a tracking database of birds and mammals in the Convention Area.

Reports of observers from other international organisations

    ASOC

9.27   Dr R. Werner (ASOC Observer) drew attention to the papers tabled by ASOC (CCAMLR-XXVIII/BG/27, BG/28, BG/30 and BG/33).

9.28   With regard to Antarctic krill, CCAMLR-XXVIII/BG/27 referenced ASOC's concerns for discussion at this year's meeting on the management of this fishery, and particularly interim protective measures and the need to improve monitoring of krill predators. Other priorities for further action include systematic scientific observer coverage, and concerns over uncertainty on krill removals as a result of problems with data reporting and krill escape mortality. CCAMLR-XXVIII/BG/27 focused on what ASOC regards a particularly urgent call, which is the adoption of interim protective measures for predators in Subareas 48.1, 48.2 and 48.3. In particular, the most recent report of WG-EMM showed that the trigger levels in place for the krill fishery are not sufficiently precautionary to achieve the objectives of the Convention. It is therefore evident that the time has come for this Committee to make a clear recommendation to the Commission aimed at reducing the risks for predators as a result of krill fishing. The last WG-EMM meeting considered that an interim subdivision of the trigger level between subareas would be a pragmatic approach until SSMU allocations are in place. ASOC supported this approach and hoped that the Scientific Committee can agree on such a recommendation. ASOC also thought that additional measures should be adopted this year to limit concentration of fishing in coastal areas, following a similar rationale to that applied in Subarea 48.6.

9.29   With regard to MPAs, in CCAMLR-XXVIII/BG/30 ASOC noted that CCAMLR is faced with a three-year challenge to meet the WSSD commitments on the implementation of a representative system of MPAs and marine reserves by 2012. In order to meet this challenge,

expansion and intensification of efforts are needed, as highlighted by the key recommendations in the CCAMLR Performance Review Panel Report. This can be achieved if Members commit the required scientific and management expertise, and funding, and apply their efforts against a well-designed work plan. The UK's proposal for marine protection in Subarea 48.2 is valuable step in the right direction. ASOC hoped that the Scientific Committee can provide a clear recommendation to the Commission to endorse this proposal. In addition, this initiative should be matched by other Members' efforts in the coming three years across and beyond all 11 areas prioritised for marine spatial protection and management.

9.30   With regard to MPAs in the Ross Sea (CCAMLR-XXVIII/BG/28), already identified by CCAMLR as a priority for protection, ASOC noted that, according to a recent study (Halpern et al., 2008), this area is the least damaged shelf sea on the planet. Unlike most of the world's oceans, the Ross Sea still retains its top predators and as such it constitutes a unique 'living laboratory'. Designation of the Ross Sea as a marine reserve would enable scientists to continue studying the ecosystem and the impacts of climate change unconfused by the effects of fishing.

9.31   With regard to climate change (CCAMLR-XXVIII/BG/33), ASOC noted that it is well known to the Scientific Committee that climate-related changes to Southern Ocean ecosystems are accelerating, with adverse impacts on species and ecosystem dynamics. Predicted future reductions in sea-ice overall will lead to major alterations in the distribution and abundance of Antarctic marine species. In meeting its obligations for ecosystem-based management of Antarctic fisheries, CCAMLR needs to develop tools and methodologies that take into account the cumulative impacts of fishing and climate change.

9.32   ASOC encouraged the Scientific Committee to intensify its efforts to provide the Commission with advice for sound management decisions aimed at reducing non-climate stresses. This should include: establishing a series of MPAs of ecologically significant size to increase the resilience of the ecosystem to cope with the stresses of climate change; applying further precaution in the establishment of maximum catch limits, especially in those areas where it is known that ocean climate is changing rapidly (such as in Areas 48 and 88); and using flexible, adaptive approaches through improved ecosystem monitoring and the integration of monitoring indices and management rules.

9.33   As a final remark, ASOC highlighted the importance of the work of this Committee for the achievement of CCAMLR objectives. Science is one of CCAMLR's fundamental pillars and as such it needs to be constantly nurtured and considered. In this context, ASOC welcomed the calls made by several Members to improve the work of the Scientific Committee and its working groups. In particular, ASOC encouraged all CCAMLR Members to increase the participation of qualified scientists in CCAMLR working groups so as to ensure that working group recommendations represent the best scientific advice and that, as such, it is accepted by Members.

Reports of representatives at meetings of other international organisations

Tuna RFMOs

9.34   In considering the discussion of CCAMLR-XXVIII/BG/10 in the report of WG-IMAF (Annex 7, paragraphs 11.10 to 11.12), the Scientific Committee noted that many of the organisations that were invited to be observers to its meeting are RFMOs listed in Appendix 1 of CCAMLR Resolution 22/XXV and recalled that it had endorsed Annex 7, paragraph 11.12, encouraging CCAMLR Members that also attend these RFMOs to engage in internal communications to give better effect to CCAMLR Resolution 22/XXV in those RFMOs.

9.35   The Scientific Committee recalled that the Secretariat had provided briefing materials to CCAMLR observers to these RFMOs on issues relating to the incidental mortality of seabirds associated with fishing and noted that these same materials are available to all CCAMLR Members and may be useful as they prepare for these other RFMO meetings where seabird by-catch issues are on the agenda.

International Observer Conference

9.36   The Scientific Committee noted the consideration of electronic data capture methods for use by observers in the report of the attendance of the Scientific Observer Data Analyst at the 6th International Fisheries Observer and Monitoring Conference (SC-CAMLR-XXVIII/BG/6) and suggested that this might be considered by ad hoc TASO in respect of the request from WG-IMAF for advice on such procedures (Annex 7, paragraph 7.17).

IWC

9.37   The 61st Meeting of the SC-IWC was held in Funchal, Madeira, Portugal, from 31 May to 12 June 2009. Japan took 680 minke whales and one fin whale in its whaling under a special scientific permit. Catches of 1 926 large whales were reported to the IWC in 2008. The SOWER cruise 2008/09 was conducted in Whaling Area IV from 105° to 115°E. The abundance estimate for minke whales was 4 887 whales (CV = 0.2). Some stocks of southern hemisphere humpback whales have increased to 80–90% of their initial size. A second workshop on climate change and its effect on cetaceans was held at the University of Siena, Italy, from 21 to 25 February 2009. Results of the workshop underlined the need for close international and multidisciplinary collaboration efforts and the SC-IWC recommended that collaborative work with other relevant bodies (e.g. CCAMLR, SO-GLOBEC) continues and is expanded. The Southern Ocean Research Partnership (SORP) took place in Sydney, Australia, from 23 to 26 March 2009, where IWC members (and others) were invited to discuss and direct the initiative that was first proposed in the IWC. SORP is an integrated, collaborative, non-lethal whale research consortium that aims to maximise conservation outcomes of Southern Ocean whales through an understanding of the status, health, dynamics and environmental linkages of their populations and the threats they face.

SO GLOBEC

9.38   The third, and final, Open Science Meeting (OSM) for the GLOBEC program was held at the Victoria Conference Centre in Victoria, British Columbia, Canada, from 22 to 26 June 2009. The OSM consisted of seven theme sessions including ecosystem structure and functioning, and ecosystem management and approach. The first two days were devoted to various workshops addressing specific topics. The purpose of this final OSM was to contribute to the synthesis and integration of GLOBEC's activities.

9.39   One of the workshops during the first two days was on 'Krill biology and ecology in the world's oceans'. Thirty-three presentations, including 17 posters, were made which summarised national programs on krill research of Australia, Canada, Chile, China, Germany, Japan, Republic of Korea, Mexico, Peru, UK and the USA. The second day was devoted to discussions surrounding recent developments and issues in krill biology and improving our understanding of how this group fits into the ecosystem.

Future cooperation

9.40   The list of meetings of potential relevance to the Scientific Committee was divided into those meetings of other bodies with which CCAMLR has common interests and science conferences/symposia where the subject material is likely to be of relevance to CCAMLR.

9.41   The Scientific Committee is aware that there are a large number of meetings of potential relevance to its work, including those to which CCAMLR is invited to observe, and requested that where Members are aware of, or attending, such meetings that they notify the Secretariat in order that arrangements can be made to ensure that the Scientific Committee and its working groups are kept informed of current scientific developments relevant to their work.

9.42   The Scientific Committee noted a number of international meetings of relevance to its work and nominated the following observers and representatives:

Meetings of other bodies –

• 12th Session of the IOTC Scientific Committee, 30 November to 4 December 2009, Seychelles – to be advised;

• ATME on Climate Change, 6 to 9 April 2010, Svolvœr, Norway – to be advised;

• ACAP Advisory Committee, 13 to 17 April 2010, Mar Del Plata, Argentina – to be advised;

• ICES WGFAST, 27 to 30 April 2010, San Diego, California, USA – to be advised;

• CEP XIII, 3 to 7 May 2010, Punta del Este, Uruguay – Scientific Committee Chair and CCAMLR Science Officer;

• 62nd Annual Meeting of the SC-IWC, 30 May to 11 June 2010, Agadir, Morocco – to be advised;

- Sixth Regular Session of the WCPFC Scientific Committee, 9 to 20 August 2010 (Nukualofa, Tonga) – to be advised;

- 15th Meeting of the CCSBT Scientific Committee, 11 September 2010, Narita, Japan – New Zealand;

- 5th Annual Meeting of the SEAFO Scientific Committee, 4 to 8 October 2010 (venue not yet known) – to be advised;

- Meeting of the ICCAT Standing Committee on Research and Statistics (SCRS), 4 to 8 October 2010, Madrid, Spain – to be advised.

Science conferences and symposia

- Climate Impacts on Oceanic Top Predators (CLIOTOP) mid-term workshop, 8 to 11 February 2010, Paris, France – to be advised.

- Symposium on the Ecosystem and Fisheries of the Kerguelen Plateau, 14 to 16 April 2010, Concarneau, France – Prof. Duhamel.

- International Polar Year Oslo Science Conference (OSC), 8 to 12 June 2010, Oslo, Norway – Mr Iversen.

- 31st Open Conference of SCAR, 30 July to 11 August 2010, Argentina – Dr E. Marschoff (Argentina).

9.43   The Scientific Committee encouraged other representatives to participate, where possible, in these meetings, and report back to the 2010 meeting of the Scientific Committee.

PERFORMANCE REVIEW[5]

10.1   At its meeting in 2008 the Scientific Committee requested that the Chair form a Steering Committee to develop a 'roadmap' (plan of action) to provide direction to the various Scientific Committee working groups on how to address the three highest-priority recommendations: Items 2.4 (Protected Areas), 3.1 (Status of Living Resources) and 3.2 (Ecosystem Approach) (SC-CAMLR-XXVII, paragraphs 10.10 and 10.11).

10.2   A Steering Committee was established by the Acting Chair of the Scientific Committee, Mr Iversen, and included conveners of all working groups (WG-FSA, WG-EMM, WG-SAM, WG-IMAF and ad hoc TASO) and the CCAMLR Science Officer.

10.3   Their report, provided in SC-CAMLR-XXVIII/7, outlined a potential 'way forward' for the Scientific Committee in addressing the various Performance Review Panel (PRP) recommendations.   The PRP recommendations were grouped according to seven general

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categories, the first five being considered as general scientific issues, a sixth category of cooperation with external bodies and a seventh category of recommendations for capacity building and burden sharing.

10.4 The Scientific Committee also considered the following papers in this discussion: SC-CAMLR-XXVIII/12, CCAMLR-XXVIII/31 and BG/29.

Progressing scientific issues identified in the
Performance Review Panel (PRP) Report

10.5 The Scientific Committee agreed that the science issues, in summary, were:

(i)   spatial management and area protection;

(ii)   monitoring of the status and trends of harvested, dependent and related species;

(iii) integration of status and trend data into management;

(iv)   management requirements for CCAMLR fisheries categories, as well as for the transition between categories;

(v)   requirements for the orderly development of the krill fishery.

10.6 In respect of item (i), the Scientific Committee agreed that all recommendations relating to MPAs were being adequately addressed in its work program on MPAs (paragraphs 3.14 to 3.33).

10.7 In respect of monitoring of the status and trends of harvested, dependent and related species, the Scientific Committee agreed that consideration should be given to:

(i)   how CEMP may be expanded to satisfy the needs of feedback management of the fisheries;

(ii)   developing indicators for assessing status and trends in different components of the ecosystem, undertaking coordinated activities with the CEP, SCAR and other international research programs;

(iii) given the ecosystem modelling being developed in support of CCAMLR, developing recovery targets and recovery plans for depleted stocks using available tools;

(iv)   monitoring and assessments of depleted stocks, including non-target species. It is recommended that a risk assessment be undertaken for depleted stocks to ensure that current management practices, including fishing, do not negatively impact on such stocks;

(v)   how such a risk assessment of the impacts of fishing may be undertaken and how a long-term program for monitoring status might be developed;

(vi)   a review being undertaken to identify whether the Scientific Committee has the facilities and mechanisms to provide advice to initiate actions on emerging issues before problems arise.

10.8   Accordingly, the Scientific Committee formulated the following tasks for WG-EMM, WG-FSA and WG-SAM:

Task 1 (WG-EMM, WG-SAM and WG-FSA):

Identify standard status and trend indicators that could be developed and be of use to SC-CAMLR, including those utilising data from other programs such as SCAR and ACAP.

Task 2 (WG-EMM, WG-SAM and WG-FSA in respect of larval fish by-catch):

(i)   develop candidate feedback management systems for the krill fishery;

(ii)   advise on what development of the CEMP system will be required to satisfy the needs of each feedback management candidate;

(iii)   advise on the most appropriate system to practically develop, and mechanisms to support it.

Task 3 (WG-FSA, WG-EMM and WG-SAM as appropriate):

(i)   develop a list of species which appear to be depleted;

(ii)   identify factors that may have contributed to their current status, including changes to ecosystem dynamics and productivity, through observation, analysis of historical data and modelling;

(iii)   develop a risk assessment of these stocks to ensure that current management practices, including fishing, do not negatively impact on such stocks and will not inhibit their recovery.

10.9   In relation to the integration of status and trend data into management, the Scientific Committee asked the following question of WG-SAM:

Task 4 (WG-SAM):

Consider how risk-based assessments of status and trends of target and non-target species, habitat and ecosystems could be regularly made and reported to SC-CAMLR.

10.10 In respect of CCAMLR fishery categories, the Scientific Committee agreed that this was primarily a matter for the Commission, but considered that the Commission's debate could be informed by some advice from the Scientific Committee. Accordingly, it defined the following task:

Task 5 (WG-EMM and WG-FSA):

> Provide advice on whether the current classification and transition system for CCAMLR fisheries compromises the ability of the Scientific Committee to provide advice on, and CCAMLR to manage, fisheries according to the requirements of Article II.

10.11 In respect of the orderly development of the krill fishery, the Scientific Committee noted that the recommendations of the PRP are consistent with the work plan of the Scientific Committee. Although some of the recommendations are not currently implemented by CCAMLR – for instance, data reporting requirements from the krill fishery, feedback management strategies, and an increased frequency of fishery-independent surveys – all recommendations of the PRP are currently being considered by WG-EMM, or will be satisfied in the execution of Task 2 above.

Coordinating the work of CCAMLR with external bodies

10.12 The Scientific Committee noted that the relationship between itself and the CEP is a mandatory one because of the responsibilities in the Antarctic Treaty and the Convention of CAMLR. This is different from other bodies. It was also noted that there is a need to continue receiving advice from bodies such as SCAR and ACAP, even though the relationship is more of an advisory one.

10.13 The Scientific Committee noted the need to continue developing its positive relationship with the CEP, as had occurred at the Joint Workshop in April 2009, which provided a major advance in establishing a joint understanding of how these two bodies might work together in the future. In the work of developing indicators for assessing status and trends in different components of the ecosystem, CCAMLR should coordinate the activities with the CEP, SCAR and other international research programs as appropriate.

10.14 Enhanced coordination with ICED, SOOS and Sentinel would also be useful to the Scientific Committee's work.

Capacity building and burden sharing

10.15 One of the most important institutional issues identified by the PRP and the Steering Committee is that of burden sharing. Achieving a more appropriate distribution of the scientific burden in a voluntary process requires appropriate incentives. The three essential steps in a process to identify such incentives are to:

> (i)   identify difficulties that Members may have in contributing to the scientific process;

> (ii) identify potential mechanisms to facilitate burden sharing amongst Members;

> (iii) building capacity amongst Members to participate in the work of SC-CAMLR.

10.16 One approach that has a precedent in CCAMLR is to establish a Scientific Capacity Fund, payment into which could either be voluntary or pro rata with catches, to be utilised to address Scientific Committee priority science to be undertaken by cross-Member consortia.

10.17 The Scientific Committee further considered the proposals for burden sharing and capacity building in SC-CAMLR-XXVIII/12, CCAMLR-XXVIII/31 and BG/29. The key issues to be overcome are presented below:

(i) understanding and communication of the work of SC-CAMLR amongst scientists within SC-CAMLR and its working groups;

(ii) participation by scientists in the work of SC-CAMLR;

(iii) achieving tasks of SC-CAMLR.

10.18 Understanding and communication of the work of SC-CAMLR amongst scientists within SC-CAMLR could be addressed by:

(i) inclusion on the website under *Understanding CCAMLR's Approach to Management* of details of the tasks and procedures of the SC-CAMLR working groups and other groups;

(ii) consideration of how to present reports to SC-CAMLR, including:

(a) during its meeting, projecting document numbers and working group report paragraphs pertaining to an agenda item being considered by SC-CAMLR;

(b) mechanisms for presenting concepts/decisions/recommendations during discussions of working group reports.

10.19 Regarding enhanced participation by Member scientists at workshops and working groups, a number of things could be implemented immediately to build capacity:

(i) meeting support, including training in managing meetings and preparing reports
(ii) mentoring (Annex 4, paragraph 8.8)
(iii) co-facilitation of small groups
(iv) co-rapporteuring
(v) tutorials at working group meetings
(vi) more time for small group discussions.

10.20 A number of longer-term capacity building suggestions were also made:

(i) New Zealand has offered to run an intensive training course for users of CASAL and SPM in 2010;

(ii) scholarship schemes (Annex 4, paragraph 8.7);

(iii) sharing/exchange of readers/manuals within the CON, rather than just otoliths;

(iv) exchange of scientists in field programs, analytical and modelling work.

10.21 SC-CAMLR-XXVIII/7 included a proposal for a Scientific Capacity Fund, which would contribute to burden sharing and capacity building, and could be used for a variety of purposes, such as those considered in paragraphs 10.19 and 10.20.

10.22 The Scientific Committee endorsed the concept of this fund, and agreed that the mechanism in which contributions are made to such a fund should be discussed by the Commission.

10.23 To take these issues further, the Scientific Committee created an *ad hoc correspondence group to develop options to build SC-CAMLR capacity in science to support CCAMLR*. It was agreed that this group, which should have a wide membership, would make use of web-based communication systems and two telephone conferences over the forthcoming intersessional period (May and August), and would work to the following terms of reference:

> To develop options for consideration by SC-CAMLR on approaches and mechanisms for:
>
> (i)   increasing participation in the work of SC-CAMLR working groups and developing an increased awareness and understanding of the work of SC-CAMLR;
>
> (ii)   resourcing and delivering scientific activities, including field programs, needed for providing advice by SC-CAMLR to the Commission;
>
> (iii) improving the flow and availability of information in the work of SC-CAMLR and its working groups, including the manner in which information may be presented in meetings;
>
> (iv)   the objective, rules of operation and administrative mechanisms of the Scientific Capacity Fund, and the criteria whereby funds should be allocated to tasks and projects;
>
> (v)   the proposal for a focus discussion, to be held during the Scientific Committee meeting in 2010, on the intersessional working group timetable and priorities.

It was agreed that the group would be convened by the Chair of the Scientific Committee with the assistance of Dr Constable.

Reporting progress

10.24 The Scientific Committee agreed that it would retain an item on its agenda for reporting progress against the recommendations of the PRP, and that a summary of this progress should be reported on the CCAMLR website.

10.25 The Scientific Committee agreed that it will review the plan and the tasks raised above, and revise or add to these tasks as necessary depending on progress made.

BUDGET FOR 2010 AND FORECAST BUDGET FOR 2011

11.1   The agreed budget of the Scientific Committee for 2010 and the forecast budget for 2011 are summarised in Table 4. The notes in Table 4 refer to the following budget items:

(1)   Preparation and support for the annual meeting of WG-EMM, report editing, translation and publication as an annex to the report of the Scientific Committee, and participation costs (airfares and subsistence) for Secretariat staff (full meeting).

(2)   Preparation and support for the annual meeting of WG-SAM, report editing, translation and publication as an annex to the report of the Scientific Committee, and participation costs of Secretariat staff. Costing here is based on the assumption that the meeting will be held in association with the meeting of WG-EMM, therefore the cost burden is not equally shared between the meetings.

(3)   Preparation and support for the annual meeting of WG-FSA, computing facilities, report editing, translation, Secretariat support and publication as an annex to the report of the Scientific Committee.

(4)   Assuming that the Scientific Committee agrees to the recommendation from WG-IMAF to meet biennially, there will be no meeting of WG-IMAF in 2010.

(5)   Preparation and support for the meeting of SG-ASAM, report editing, translation and publication as an annex to the report of the Scientific Committee, and participation costs for one Secretariat staff member.

(6)   Preparation and support for the meeting of ad hoc TASO, report editing, translation and publication as an annex to the report of the Scientific Committee, and participation costs for Secretariat staff based on the assumption that the meeting will be held in association with the meeting of WG-FSA.

(7)   Participation costs for invited experts at working group meetings and workshops in 2010.

(8)   Estimated cost of producing waterproof colour posters for VME taxa identification and skate injury categorisation.

11.2   The Scientific Committee noted that in order for the working groups to fully consider the information provided in association with

- Annex 21-03/A of Conservation Measure 21-03 'Notifications of intent to participate in a fishery for *Euphausia superba*';

- Conservation Measure 21-02 'Exploratory fisheries';

- the pro forma for submitting preliminary assessments of the potential for proposed bottom fishing activities to have significant adverse impacts on VMEs as set out in Annex 22-06/A of Conservation Measure 22-06;

where those documents are not submitted in English, would require funding for full translation of those notifications.

11.3   The Scientific Committee also noted that there would be an associated translation requirement to facilitate the intersessional discussions described in section 10. However, this was not expected to be extensive and would be kept to a minimum, noting the aim of ensuring full participation in those discussions.

11.4   The Scientific Committee noted that the Special Science Fund currently holds an amount for part of the review of the *Scientific Observers Manual*, and the Scientific Committee agreed to carry this amount forward.

11.5   The Scientific Committee agreed that the publication of papers arising from the Joint CCAMLR–IWC Workshop should be funded from the monies transferred to the Special Science Fund last year (SC-CAMLR-XXVII, paragraph 11.3).

11.6   The Scientific Committee noted the discussion for the use of the funds in the MPA Special Fund (paragraph 3.32).

11.7   The Scientific Committee endorsed the following expenditures under the Commission's budget for 2009:

(i)   editorial support for the production of *CCAMLR Science*;

(ii)   level funding of A$12 000 for language support for *CCAMLR Science*;

(iii)   electronic dissemination of *CCAMLR Science* via the CCAMLR website;

(iv)   translation (from one language to English), on a case-by-case basis, of key paper(s) submitted by French, Russian or Spanish-speaking scientists to working groups. It is estimated that approximately 10 pages of text may require translation each year;

(v)   participation cost for the Chair of the Scientific Committee and the Science Officer at the 2010 meeting of the CEP.

ADVICE TO SCIC AND SCAF

12.1   The Chair presented the Scientific Committee's advice to SCIC and SCAF during the meeting. The advice to SCAF is summarised in section 11.

12.2   The advice to SCIC was derived from the Scientific Committee's consideration of information provided by WG-EMM, WG-FSA, WG-IMAF and ad hoc TASO and is contained in sections 3, 4, 5, 6 and 7. The Scientific Committee agreed that the points identified by the working groups were not necessarily compliance issues (see also paragraphs 5.5 and 5.6).

12.3   The Scientific Committee agreed that, in future, its working groups will focus on issues of implementation of conservation measures which have implication for the conservation of Antarctic marine living resources.

12.4   The Scientific Committee also advised SCIC that WG-IMAF would now meet every second year and that the next meeting of WG-IMAF was scheduled for 2011. As a result, the annual summaries of scientific observations prepared by the Secretariat (e.g. WG-IMAF-09/4, 09/5 and 09/6) will be forwarded directly to SCIC for evaluation in years when WG-IMAF was not meeting.

12.5   The Chair reported that SCIC had noted this advice.

SECRETARIAT SUPPORTED ACTIVITIES

Data Management

13.1   The Scientific Committee noted the Data Manager's report on recent work in support of the Secretariat's Data Management Function, and measures taken to maintain the integrity of the CCAMLR database (SC-CAMLR-XXVIII/BG/3 and CCAMLR-XXVIII/BG/12).

13.2   The CCAMLR database provides a secure long-term repository for data used in the Commission's and Scientific Committee's decision-making processes, including stock assessment, ecosystem monitoring and compliance evaluation.   The operation and development of this database involves staff from across the Secretariat's functional entities, and tasks include: maintenance and development of the database infrastructure; data processing, validation and quality control; analysis and reporting; processing data requests; and maintenance of the database documentation.

13.3   The Scientific Committee noted the Secretariat's data management activities in 2008/09 (SC-CAMLR-XXVIII/BG/3).

13.4   The Scientific Committee noted that SCAR-MarBIN may provide a valuable source of information for CCAMLR's work on bioregionalisation, MPAs and VMEs. It therefore encouraged development of suitable links with SCAR-MarBIN, and other related data sources (e.g. GBIF).

13.5   The Scientific Committee encouraged the Data Manager to consider additional ways in which selected CCAMLR data may be disseminated to the broader scientific community, subject to the CCAMLR Rules for Access and Use of CCAMLR Data.

13.6   The Scientific Committee noted that the volume and complexity of CCAMLR's holding database continue to expand (e.g. the volume of fishery data has increased 40-fold since 1993). This increase in the volume of data and requirements for detailed, accurate and up-to-date data are placing greater demands on the Secretariat's human and physical resources, including data processing, validation, reporting, correspondence and storage. Some resources have reached full capacity, and regular review is required in order to ensure that adequate resources (human and financial) are available to continue full support of the Secretariat's data management function and the CCAMLR database (see also CCAMLR-XXVIII/BG/9).

13.7   The Scientific Committee noted various other Secretariat documents produced at the Commission's request. These reviewed Secretariat Professional Staff post gradings/functions (including the Data Manager) (CCAMLR-XXVIII/6), outlined a staff succession strategy (CCAMLR-XXVIII/8) and described the pressures associated with CCAMLR's translation requirements (CCAMLR-XXVIII/10 Rev. 1). It agreed that these documents provide useful insights into the Secretariat's day-to-day work in general as well as into its data management needs. It also noted that all the matters concerned were being considered by SCAF.

13.8   The Scientific Committee noted that Ukraine has implemented a research project to digitise haul-by-haul catch and effort data from former Soviet krill fishing expeditions (CAMLR-XXVIII/BG/18). Data from 56 research and exploratory trips and two commercial trips (representing 5 160 hauls) between 1972 and 1991 have been transferred manually from the data logbooks to CCAMLR data forms (C1). These data have been submitted to the Secretariat and will be entered in the CCAMLR database in 2010.

13.9   The Scientific Committee thanked Ukraine for digitising these data and submitting this valuable historic dataset to CCAMLR.

13.10 Dr G. Milinevsky (Ukraine) advised that further work is under way to digitise krill biological data. The project was funded by the Pew Charitable Trusts' Antarctic Krill Conservation Project.

Publications

13.11 The Scientific Committee noted the various documents published in 2009 in support of its work:

(i)   Report of the Twenty-seventh Meeting of the Scientific Committee
(ii)   *CCAMLR Science*, Volume 16
(iii)   *CCAMLR Scientific Abstracts 2008*, available on the CCAMLR website
(iv)   *Statistical Bulletin*, Volume 21.

CCAMLR Science

13.12 The Scientific Committee noted the *CCAMLR Science* Editor's report (SC-CAMLR-XXVIII/BG/11). *CCAMLR Science* has been published since 1994 and has become a successfully established journal. It has an ISI citation index, is listed by Current Contents and is cited by the ISI Web of Science. The journal now has an impact factor of 1.389 and is ranked 19th out of the 40 journals in the Fisheries subject category in Thomson Reuters *Journal Citation Reports*, Science Edition.

13.13 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.

13.14 The Scientific Committee recognised the limited time available during its own, and working group, meetings for the Editorial Board to conduct the initial review of papers

submitted for publication to *CCAMLR Science*. It endorsed the Editor's proposal that such reviews be conducted by correspondence. The Scientific Committee also agreed that the Editor should expand the membership of the Editorial Board in order to alleviate the workload on Board members and provide greater participation in the journal's activities.

13.15 The Scientific Committee encouraged the Editor to consider ways of simplifying the current procedure required for authors to cite CCAMLR meeting documents, taking account of intellectual property requirements as well as the Rules for Access and Use of CCAMLR Data.

13.16 The Scientific Committee considered a proposal to establish a *CCAMLR Science Supplement*, noting that such a publication may provide a platform for communicating recent advances in CCAMLR's work. The Scientific Committee urged Members and the Editor to further consider this proposal along with possible budgetary implications.

13.17 In respect of the publication of Secretariat papers that provide a description of the work of the Scientific Committee in the peer-reviewed literature, the Scientific Committee agreed that such papers should receive editorial scrutiny from the Chair of the Scientific Committee and the working group conveners.

SCIENTIFIC COMMITTEE ACTIVITIES

Coordination of work of the Scientific Committee and its working groups

14.1 The Scientific Committee agreed that the current pace and demands of work within the working groups is not sustainable. To address this issue, and as capacity is built, it was agreed that work on important topics within WG-EMM and WG-SAM should be conducted sequentially rather than in parallel (as is the current practice). Conducting work sequentially will cause advice to the Commission to be delayed, and, therefore, the Scientific Committee advised that additional precaution in the approach to managing the living marine resources typically addressed by these working groups (e.g. krill, icefish, toothfish, VMEs and by-catch) would be needed.

14.2 To begin the process of prioritising topics in the work of WG-EMM and WG-SAM, the Scientific Committee agreed the following proposed agenda for WG-EMM next year. It also indicated that this agenda should form the basis of a three-year work plan for WG-EMM:

> Focus Topic – to be postponed until the Scientific Committee agrees that capacity is sufficiently well built for such discussions to be added back into WG-EMM's agenda.

> Ecosystem Effects of Fishing for Krill –

> > (i) Conduct reviews and evaluations related to:

> > > (a) krill fishery notifications
> > > (b) trends in the krill fishery
> > > (c) results from the exploratory krill fishery in Subarea 48.6
> > > (d) revising estimation of B_0 and precautionary catch limits.

      (ii)   Postpone review and evaluation of:

          (a)   data collected by CEMP, review of CEMP, and work conducted by WG-EMM-STAPP;

          (b)   information related to climate change;

          (c)   development of feedback management strategies;

          (d)   questions posed to WG-EMM as a result of the Performance Review (section 10).

Ecosystem Effects of Fishing for Finfish – postpone all work under this agenda item.

Spatial Management to Facilitate the Conservation of Marine Biodiversity –

      (i)   Conduct reviews and evaluations related to:

          (a)   VMEs;

          (b)   protected areas, with particular emphasis on work needed to achieve the first milestone in the agreed plan to work towards a network of MPAs in 2012 (paragraph 3.15). (Issues related to harmonisation of spatial management approaches across the ATS will naturally be addressed as part of this work.)

14.3   Noting that the agenda of WG-SAM is intended to be responsive to the requests from other working groups, the Scientific Committee identified the following as key issues for consideration by WG-SAM in 2010:

- systematic observer coverage for krill fisheries (high priority);

- ecosystem models for developing feedback management in krill fisheries (postponed);

- VME assessment and/or evaluation methodologies (high priority)
  – footprint calculations
  – simulations and assessment methods;

- MPA assessment and/or evaluation methodologies (other work program);

- Subarea 58.4 exploratory fisheries and recovery plans for closed fisheries (high priority)
  – research designs for data-poor toothfish fisheries
  – review of TSVPA assessment for Division 58.4.1;

- otolith subsampling (postponed);

- optimal observer sampling (postponed);

- skate assessments (postponed);

- data requirements for assessments (cut-off dates for data) (postponed).

14.4   The Scientific Committee considered a proposal to set aside two days of its meeting next year to hold a symposium on its future work priorities. It agreed that this matter should be considered by the ad hoc correspondence group (paragraph 10.23).

Intersessional activities during 2009/10

14.5   The Scientific Committee noted that it had not received any offer from Members to host the 2010 meetings of WG-SAM and WG-EMM. China informed the meeting that it was undertaking internal discussions to consider the possibility of hosting future meetings of the working groups. The Scientific Committee warmly welcomed this offer from China.

14.6   The Scientific Committee noted that Dr Watkins would be available to continue as Convener for the SG-ASAM meeting in 2010 but that Dr O'Driscoll was not able to continue as a Co-convener.

14.7   The Scientific Committee also noted that the meeting of ICES WGFAST will be held from 27 to 30 April 2010 in San Diego, California, USA and that the USA had offered to host SG-ASAM in association with this meeting. However, some Members indicated that, due to budgetary constraints, the timing and venue of the subgroup meeting might limit attendance. In response to the concerns of those Members, and in an attempt to facilitate greater participation of those Members in the subgroup, the UK offered to host the meeting.

14.8   The Scientific Committee agreed to the following meetings in the 2009/10 intersessional period:

- SG-ASAM, Cambridge, UK (date to be advised) (Convener, Dr Watkins)
- WG-SAM (date and location to be advised) (Convener, Dr Constable)
- WG-EMM (date and location to be advised) (Convener, Dr Watters)
- ad hoc TASO, Hobart, Australia, 11 to 16 October 2010 (Co-conveners Dr Welsford and Mr Heinecken)
- WG-FSA at CCAMLR Headquarters, Hobart, Australia, from 11 to 22 October 2010 (Convener, Dr Jones).

14.9   The Scientific Committee expressed concern that holding ad hoc TASO and WG-FSA concurrently could likely result in a capacity reduction at WG-FSA, and strongly encouraged Members to send appropriate scientists, technical coordinators and other experts to participate in next year's meetings.

14.10 The Scientific Committee endorsed the schedule outlined in paragraph 14.8 for the working group meetings in the coming year, noting that it would be useful to involve scientists interested in the work of CCAMLR not only from non-Members but also from institutions not normally associated with SC-CAMLR.

CCAMLR-IPY projects

14.11   The Scientific Committee noted its previous consideration of the results of Members' participation in a range of IPY surveys and activities (SC-CAMLR-XXVII, paragraph 14.6). It agreed that the results from this work would provide an appropriate legacy of the CCAMLR involvement in IPY. The Scientific Committee also encouraged Members to participate in the IPY OSC in Oslo, Norway, from 8 to 12 June 2010.

Invitation of observers to the next meeting

14.12   The Scientific Committee agreed that all observers invited to the 2009 meeting would be invited to participate in SC-CAMLR-XXIX.

Invitation of experts to the meetings of working groups

14.13   The Scientific Committee agreed that appropriate experts should be invited to working groups and subgroups through consultation with the conveners of those meetings and the Secretariat in respect of budgetary matters.

Next meeting

14.14   The next meeting of the Scientific Committee is scheduled at the CCAMLR Headquarters in Hobart, Australia, from 25 to 29 October 2010.

ELECTION OF CHAIR AND VICE-CHAIR OF THE SCIENTIFIC COMMITTEE

15.1   The Scientific Committee sought nominations for a new Chair. Two candidates were nominated by Dr Bizikov (Vice-Chair) and the Scientific Committee unanimously elected Dr Agnew to the position for a term of two regular meetings (2010 and 2011). A very warm welcome was extended to the incoming Chair.

15.2   Mr Iversen's term as Vice-Chair in 2008 and Chair in 2009 (paragraph 1.4) ended with this meeting and the Scientific Committee sought nominations for a new Vice-Chair. Dr Bizikov nominated Dr Jones. This nomination was seconded by Dr Agnew and the Scientific Committee unanimously elected Dr Jones to the position for a term of two regular meetings (2010 and 2011). A very warm welcome was extended to the incoming Vice-Chair.

15.3   The Scientific Committee thanked Mr Iversen for his significant contribution to its work (see also paragraph 18.7).

OTHER BUSINESS

16.1   The Scientific Committee recalled paragraph 16.10 of SC-CAMLR-XXVII and noted that VMEs would be the subject of a focus topic at the next meeting of WG-FSA and would remain a priority area of work but would not be labelled the Year-of-the-VME consistent with the recommendations in paragraph 4.235.

Advance the understanding of reports of working groups by those
participants who do not have English as their first language

16.2   The Scientific Committee agreed that during working group meetings from 2010 onwards:

(i)   reports should start to be developed in report language comparatively early in order to facilitate understanding of the final outcome from the meetings by those who do not have English as their first language;

(ii)   discussions on matters of substance in the different working groups should be finalised early to provide members of the working groups who do not have English as their first language with additional time before adoption of the report to study pre-final versions of the report.

16.3   Noting that the Commission was examining ways to address its substantial translation burden, SCAF had requested the Scientific Committee and its working groups to consider what components of their reports were required to be translated. Following the discussion of the need to develop capacity and understanding of the work of the Scientific Committee, there was agreement that continued efforts should be made to reduce the size of reports but that there was a continued need for those reports to be translated.

16.4   The Scientific Committee recognised that substantially reducing the length of reports of its working groups was limited by the need for those reports to be understood as a single document, however, it was noted that the updating of background material on *Understanding CCAMLR's Approach to Management*, available on the CCAMLR website, as well as the training and development of rapporteurs, could contribute to the delivery of more concise reports.

Additional resources to address priority
science areas of the Scientific Committee

16.5   The Scientific Committee considered the proposal from WG-FSA (Annex 5, paragraphs 15.1 to 15.8) that an assessment scientist should be recruited to join the Secretariat staff in order to address, *inter alia*, the questions set out in Annex 5, paragraph 5.114, regarding the assessments of exploratory fisheries in Divisions 58.4.1 and 58.4.2.

16.6   The Scientific Committee recognised that it was important to determine the priority requirements from all of its working groups in order to establish what work needs to be done so that the Scientific Committee can undertake its work. Once the priority work items have

been determined, then a mechanism could be identified to have this work completed, noting that there are several options available to acquire additional resources, including those linked to issues of capacity building.

Best available science

16.7   In noting CCAMLR-XXVIII/39, which contained a draft resolution on the use of the best available science in CCAMLR, the Scientific Committee reaffirmed that it was committed to Article IX of the Convention and to the precautionary approach and recognised that the consistent use of the best available science was fundamental to achieving this.

ADOPTION OF THE REPORT

17.1   The report of the Twenty-eighth meeting of the Scientific Committee was adopted.

CLOSE OF THE MEETING

18.1   The Scientific Committee reflected on the career of one of its stalwarts, Dr Denzil Miller, who is due to retire as Executive Secretary in early 2010. Dr Miller joined CCAMLR on the South African Delegation in 1984, the third meeting of CCAMLR and the year of the first full meeting of the ad hoc Working Group on Fish Stock Assessment. Since then, he has participated in all of the working groups of the Scientific Committee as well as the Commission's Working Group on Developing Approaches to Conservation (1987–1990), was the Convener of the Working Group on Krill for its duration from 1989 to 1994, Chair of the Scientific Committee from 1997 to 2000 and Executive Secretary since 2002. Dr Miller's first recorded intervention in the Scientific Committee (SC-CAMLR-IV, paragraph 4.40) was indicative of his attention and dedication to implementing Article II throughout his career with CCAMLR. The Scientific Committee is indebted to his dedication, honesty and integrity in helping CCAMLR fulfil its potential and for that, the Scientific Committee expressed its deepest appreciation.

18.2   In recognition of the work of Dr Miller in promoting the ecosystem approach to fisheries, especially in the management of the krill fishery, the Scientific Committee presented him with a selection of gifts that, as an ensemble, reflected 'an ecosystem in a bag'. The Scientific Committee also presented Dr Miller with a large photographic portrait of a krill.

18.3   Dr Miller thanked the Scientific Committee, noting that he was very proud to have been associated with CCAMLR for such a long part of his career. He recalled that what made CCAMLR special was that it was made up of very special people who had also committed a great deal of their time and energies to the organisation. There was no doubt in his mind that working in CCAMLR required a positive attitude and that this was one of the critical attributes that also made it so enjoyable, if somewhat addictive! He thanked his very many friends in the Committee noting that he would miss them all.

18.4   In pondering upon his long involvement with the Scientific Committee, Dr Miller recognised that while on occasion his interventions in CCAMLR meetings may have involved a 'mangling of the English language', he felt sure that there was no doubt as to positive intention and sincerity of his contributions.

18.5   Dr Miller presented Mr Iversen with an engraved gavel, as is traditional for the outgoing Chair of the Scientific Committee.

18.6   Mr Iversen thanked Dr Miller and all of the participants in the meeting for their support and hard work. He also asked that when delegates returned home that they pass on the thanks of the Scientific Committee to all those who have contributed data and papers to the working groups as these are the fundamental building blocks on which the success of the Scientific Committee is based.

18.7   On behalf of the Scientific Committee, Dr Agnew expressed his thanks to Mr Iversen for expertly chairing the meeting through what has become a very full and complex agenda.

18.8   The meeting was closed.

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Table 1: Candidate options for proportions of trigger in percentages. Tonnages equivalent to these percentages of the current trigger level are shown in the parentheses, but these are not expected to be part of the measure.

Subarea	Historical models*			Flexible models arising from discussion			
	(1) FIBEX biomass	(2) Survey area	(3) Biomass proportion	(4)** Biomass proportion coastal-pelagic (Ukraine proposal including 20% flexibility)			(5) Overlap even model
				Coastal		Pelagic	
48.1	28 (173 600)	25 (155 000)	20 (124 000)	6.3 (38 971)	17.0 (105 365)		40 (248 000)
48.2	49 (303 800)	27 (167 400)	37 (229 400)	13.0 (80 432)	35.1 (217 465)		40 (248 000)
48.3	24 (148 800)	26 (161 200)	37 (229 400)	13.1 (81 476)	35.5 (220 290)		40 (248 000)
48.4	5 (31 000)	22 (136 400)	6 (37 200)	0	0		40 (248 000)
Total %	106	100	100	32.4	87.6		160

* These historical models could be made more flexible by multiplying the percentages by 1.2.
** A detailed explanation of the methods which were used to derive the figures is described in section 4(i).

(1) Based on biomass estimated using data from the FIBEX survey conducted in 1982, and on the proportion of the biomass as detailed in SC-CAMLR-XI (1992). This is an overlap model, and the sum of the proportion for all subareas exceeds 100%, but the total catch in Area 48 should not exceed 620 000 tonnes in any one season. This model allows some flexibility for fishery operations, however the proportion is based on old data, and there are considerable uncertainties in its proportional distribution.

(2) Based on the proportion of survey area from the CCAMLR-2000 Survey as presented in SC-CAMLR-XIX. This proportion is used in allocating the precautionary catch limit for Area 48. Sum of proportions equals 100%.

(3) Based on the proportion of biomass from the CCAMLR-2000 Survey. There are uncertainties due to age of the dataset. Sum of proportions equals 100%.

(4) Based on the proportion of biomass from the CCAMLR-2000 Survey, and also a distribution of the biomass between coastal and pelagic areas, with added flexibility by 20% for each of the subdivisions. Sum of proportions exceeds 100%. The total catch in Area 48 should not exceed 620 000 tonnes in any one season.

(5) An even proportion allocation model allowing the sum of proportions to exceed 100%. The total catch in Area 48 should not exceed 620 000 tonnes in any one season.

Discussion points on each of the models
• Models (1), (2), (3) and (5) do not take into account coastal versus pelagic distributions, and are maybe less precautionary for land-based predators compared to Model (4).
• Model (4) is the most precautionary option taking account of the needs of land based predators, but it is less flexible for the current fishery and may force a change of fishery pattern at the current catch level.
• Overlap models (which the sum of proportions can be more than 100%) allows more flexible operation for current fishing pattern compared to non-overlap model.
• Non-overlap models with no coastal versus pelagic division (Models 2 and 3) allow less flexibility the fishery. If the distribution of proportions reflects the actual current biomass distribution, this will be more precautionary compared to the overlap model. However, these models fix the allowable catch distribution, therefore if the proportion of allocations does not reflect the current krill distribution (given the uncertainty of the data due to its age, as well as interannual variation (paragraph 4.42)), there is a possibility of this model being less precautionary compared to the overlap models (Model 1 and 5). As for Model 4, these models could be made more flexible by multiplying the percentages by 1.2.

Table 2: Preliminary total catch (tonnes) of target species reported in 2008/09 (December 2008 to September 2009) (source: catch and effort reports unless indicated otherwise). Note: the 2008/09 season closes on 30 November 2009; catches in this table are those reported to the Secretariat to 25 September 2009.

Species	Country	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	Total
Icefish	Australia													99					99
Champsocephalus gunnari	Korea, Republic of			499															499
	UK			1 338															1 338
Total (icefish)		0	0	1 837	0	0	0	0	0	0	0	0	0	99	0	0	0	0	1 936
Toothfish	Australia													2 026					2 026
Dissostichus eleginoides	Chile			370															370
	EC – Spain			810													<1		810
	France*												3 108		746				3 854
	Japan					17		<1	31	15									63
	Korea, Republic of			176			<1	<1									16		192
	New Zealand			389	47												<1		436
	South Africa			145												4		<1	149
	UK			1 336	27												<1		1 363
	Uruguay			157						<1									157
Subtotal (*D. eleginoides*)		0	0	3 383	74	17	<1	<1	31	15	0	0	3 108	2 026	746	4	16	<1	9 420
Dissostichus mawsoni	Chile																98	4	103
	EC – Spain																372	13	384
	Japan					93		19	<1	25									137
	Korea, Republic of					173	171	47									630	13	1 034
	New Zealand			0	27												734	90	851
	South Africa																	118	118
	UK				32												532	208	773
	Uruguay						51			64							51	38	204
Subtotal (*D. mawsoni*)		0	0	<1	59	265	222	66	<1	89	0	0	0	0	0	0	2 418	484	3 604
Total (toothfish)		0	0	3 383	133	282	222	66	31	104	0	0	3 108	2 026	746	4	2 434	484	13 025
Krill	EC – Poland	3 350	4 800																8 150
Euphausia superba	Japan	8 897	12 123																21 020
	Korea, Republic of	17 848	23 283																41 131
	Norway	2 111	41 882	<1															43 993
	Russian Federation		9 654																9 654
	UK			<1															<1
Total (krill)		32 206	91 742	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	123 948

* Catch reported in fine-scale data

Table 3: Catches (tonnes) of target species reported in 2007/08 (December 2007 to November 2008) (source: STATLANT data).

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													199					199
Champsocephalus gunnari	Chile			503															503
	Japan			1															1
	Korea, Republic of			249															249
	UK			1 739															1 739
	Ukraine		<1																<1
Total (icefish)		0	<1	2 491	0	0	0	0	0	0	0	0	0	199	0	0	0	0	2 690
Toothfish	Argentina																<1		<1
Dissostichus eleginoides	Australia									1				2 280					2 281
	Chile			388															388
	EC – Spain			814			<1										2		817
	France												4 850		823				5 673
	Japan					12				36	18	58							126
	Korea, Republic of			53			<1										5		59
	Namibia						<1	<1		<1									1
	New Zealand			457	49												1		507
	Russian Federation																<1	<1	<1
	South Africa			316											55	69	<1		440
	UK			1 585	49														1 634
	Uruguay			251					9	4							<1		264
Subtotal (*D. eleginoides*)		0	0	3 864	98	12	<1	<1	9	41	18	58	4 850	2 280	878	69	8	<1	12 188
Dissostichus mawsoni	Argentina																<1		<1
	Australia									3									3
	EC – Spain						66										44		110
	Japan					11				72		<1							83
	Korea, Republic of						274	82									420		776
	Namibia						60	134		21									214
	New Zealand				<1												717	345	1 063
	Russian Federation																250	26	276
	South Africa																120		120
	UK																637	35	672
	Uruguay						10		<1	5							61	10	85
Subtotal (*D. mawsoni*)		0	0	0	<1	11	410	216	0	101	0	<1	0	0	0	0	2 250	416	3404
Total (toothfish)		0	0	3 864	98	24	410	216	9	142	18	58	4 850	2 280	878	69	2 258	416	15 592

(continued)

Table 3 (continued)

Species	Country	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	Total
Krill	Chile			2															2
Euphausia superba	EC – Poland		4 686	3 349															8 035
	Japan	435	18 423	19 945															38 803
	Korea, Republic of		23 121	14 912															38 033
	New Zealand																<1		<1
	Norway	2 449	39 022	21 822															63 293
	Russian Federation			222															222
	UK			<1															<1
	Ukraine		8 133																8 133
Total (krill)		2 884	93 384	60 253	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	156 521

Table 4:   Scientific Committee budget for 2010 and forecast budget for 2011.

2009 Budget A$		Item	2010 Budget A$		2011 Forecast A$		Notes *
		WG-EMM *Costs dependent on location of meeting*					(1)
86 000		Secretariat support and participation costs	88 600		89 400		
42 000		Report completion and translation	43 300		43 700		
	128 000			131 900		133 100	
		WG-SAM					(2)
6 200		Secretariat support and participation costs	6 400		6 600		
21 000		Report completion and translation	21 700		22 300		
	27 200			28 100		28 900	
		WG-FSA					(3)
5 900		Computing facilities	6 000		6 100		
20 400		Secretariat support	21 000		21 000		
60 400		Report completion and translation	62 200		62 000		
	86 700			89 200		91 800	
		WG-IMAF					(4)
12 000		Secretariat support	0		13 000		
27 000		Report completion and translation	0		28 600		
	39 000			0		41 600	
		SG-ASAM *Provision included for one participant*					(5)
6 000		Secretariat support and participation costs	6 200		6 300		
8 400		Report completion and translation	8 600		8 900		
	14 400			14 800		15 200	
		Workshop on VMEs					
36 000		Secretariat support and participation costs	0		0		
8 400		Report completion and translation	0		0		
	44 400			0		0	
		Ad hoc TASO					(6)
2 000		Secretariat support and participation costs	12 500				
4 000		Report completion and translation	27 500				
	6 000			40 000			
		Other Expenses for Scientific Committee Program					
32 500		External experts invited to meetings	32 500		32 500		(7)
6 000		Education and outreach materials	6 000		6 000		(8)
8 000		International Fishery Observer Conference	0		8 000		
1 200	**Contingency**		5 000		5 000		
393 400			347 500		368 100		

*   The notes refer to the items described in paragraph 11.1.
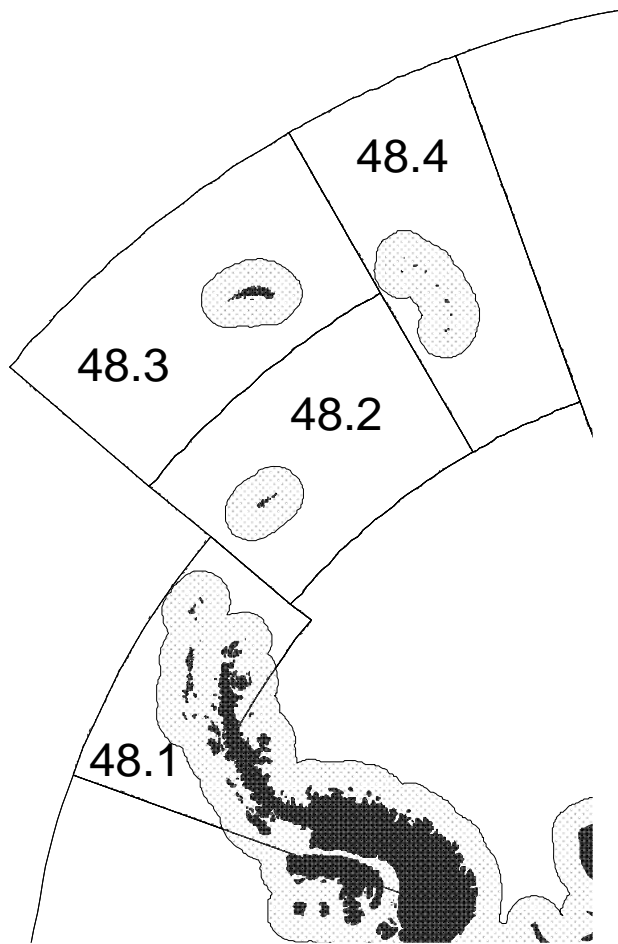
Figure 1:   Coastal (grey) and pelagic (white) zones in Subareas 48.1, 48.2, 48.3 and 48.4. The coastal zone is defined as the 60 n mile zone around land.

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CCAMLR-XXVIII/BG/30	CCAMLR's 3-year challenge: delivering a comprehensive and representative protected areas network in the Southern Ocean Submitted by ASOC
CCAMLR-XXVIII/BG/31 Rev. 1	Port visits of vessels on CCAMLR's IUU vessel lists: lessons on port state performance Submitted by ASOC

CCAMLR-XXVIII/BG/32	A renewed strategy to combat IUU fishing in the Southern Ocean Submitted by ASOC
CCAMLR-XXVIII/BG/33	The need for global and regional responses to climate change Submitted by ASOC
CCAMLR-XXVIII/BG/34	Annual report from SCAR to CCAMLR Submitted by SCAR
CCAMLR-XXVIII/BG/35	Results of ICCAT 16th Annual Meeting (17 to 24 November 2008, Marrakesh) CCAMLR Observer (European Community)
CCAMLR-XXVIII/BG/36	Results of 6th SEAFO Annual Meeting (5 to 9 October 2009, Swakopmund, Namibia) CCAMLR Observer (European Community)
CCAMLR-XXVIII/BG/37	Implementation of Conservation Measure 10-08 (2006) Delegation of Australia
CCAMLR-XXVIII/BG/38	Information on CCAMLR and its links to the Antarctic Treaty – CCAMLR Review Panel recommendation (CCAMLR-XXVII/8, Item 2.1) Delegation of Australia
CCAMLR-XXVIII/BG/39	Report of the SCIC Chair to the Commission
CCAMLR-XXVIII/BG/40	New and revised conservation measures recommended by SCIC for adoption by the Commission
CCAMLR-XXVIII/BG/41	Proposals for new and revised conservation measures submitted by SCIC to the Commission for further consideration
CCAMLR-XXVIII/BG/42	Report of the Scientific Committee Chair to the Commission
CCAMLR-XXVIII/BG/43	Report from the CCAMLR Observer to the 2009 Annual Meeting of the Northwest Atlantic Fisheries Organisation (NAFO) CCAMLR Observer (European Community)

**AGENDA FOR THE TWENTY-EIGHTH MEETING
OF THE SCIENTIFIC COMMITTEE**

AGENDA FOR THE TWENTY-EIGHTH MEETING
OF THE SCIENTIFIC COMMITTEE

1. Opening of meeting
    (i)   Adoption of agenda
    (ii)   Chair's report
    (iii)   Preparation of advice to SCAF and SCIC

2. Advances in statistics, assessments, modelling and survey methods
    (i)   WG-SAM advice
    (ii)   SG-ASAM advice
    (iii)   Advice to Commission

3. Ecosystem monitoring and management
    (i)   WG-EMM advice
    (ii)   Management of protected areas
    (iii)   Interactions between WG-EMM and WG-FSA
    (iv)   Advice to Commission

4. Harvested species

    (i)   Krill resources
            (a)   Status and trends
            (b)   WG-EMM advice
            (c)   Advice to Commission

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

    (iii)   New and exploratory fisheries
            (a)   New and exploratory fisheries in 2008/09 season
            (b)   Notifications for new and exploratory fisheries in 2009/10 season
            (c)   Revision of boundaries
            (d)   Advice to Commission

    (iv)   Squid and crab resources
            (a)   Status and trends
            (b)   WG-FSA advice
            (c)   Advice to Commission

    (v)   Fish and invertebrate by-catch
            (a)   Status and trends
            (b)   WG-FSA advice
            (c)   Advice to Commission

(vi) Bottom fishing in CCAMLR high-seas areas
   (a) Identification and protection of vulnerable marine ecosystems
   (b) Advice to Commission

5. Incidental mortality
   (i) Incidental mortality of seabirds and marine mammals associated with fisheries
   (ii) Advice to Commission

6. CCAMLR Scheme of International Scientific Observation
   (i) Scientific observations
   (ii) Advice to Commission

7. Fisheries management and conservation under conditions of uncertainty

8. Scientific research exemption

9. Cooperation with other organisations
   (i) Cooperation with the Antarctic Treaty System
   (ii) Reports of observers from other international organisations
   (iii) Reports of representatives at meetings of other international organisations
   (iv) Future cooperation

10. Performance Review

11. Budget for 2010 and forecast budget for 2011

12. Advice to SCIC and SCAF

13. Secretariat supported activities

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

15. Election of Chair and Vice-Chair

16. Other business

17. Adoption of Report of Twenty-eighth Meeting

18. Close of meeting.

**REPORT OF THE WORKING GROUP ON
ECOSYSTEM MONITORING AND MANAGEMENT**
(Bergen, Norway, 6 to 17 July 2009)

CONTENTS

REPORT OF THE WORKING GROUP ON
ECOSYSTEM MONITORING AND MANAGEMENT
(Bergen, Norway, 6 to 17 July 2009)

INTRODUCTION

Opening of the meeting

1.1   The fifteenth meeting of WG-EMM was held in Bergen, Norway, from 6 to 17 July 2009. The meeting was convened by Dr G. Watters (USA) and local arrangements were coordinated by Mr S. Iversen (Norway).

1.2   Dr Watters opened the meeting and welcomed the participants (Appendix A). He thanked Mr Iversen, the Institute of Marine Research (IMR) and the Ministry of Foreign Affairs, Norway, for hosting the meeting.

1.3   The Working Group conveyed its best wishes to Prof. C. Moreno (Chile), who had resigned from his position as Chair of the Scientific Committee in March 2009 due to ill health. The Working Group noted that Mr Iversen (senior Vice-Chair of the Scientific Committee) had agreed to take on Prof. Moreno's role, with the assistance of Dr V. Bizikov (second Vice-Chair and Russia) in 2009.

1.4   The Working Group recognised Dr D. Miller's long service within the CCAMLR community and noted that he will be retiring as Executive Secretary in February 2010. The Working Group thanked him for all of his contributions to the Working Group and to CCAMLR over many years.

Adoption of the agenda and organisation of the meeting

1.5   The Working Group reviewed the provisional agenda and agreed to include consideration of by-catch in the review of removals by the commercial fishery and methods of characterising predator and *Dissostichus* spp. fishery overlap (Item 2.5). The Working Group also agreed to remove subitems under Item 4 and develop subheadings as required by the content of papers submitted under that item. The adopted agenda is in Appendix B.

1.6   The agenda included a focus topic (Item 2) entitled 'Second Workshop on Fisheries and Ecosystem Models in the Antarctic' (FEMA2). This focus topic was co-chaired by Drs C. Jones (USA and Convener of WG-FSA) and Watters.

1.7   The Working Group considered discussions from four meetings held during the 2008/09 intersessional period:

- Joint SC-CAMLR–CEP Workshop (SC-CAMLR-XXVIII/6)
- meeting of SG-ASAM (Annex 8)
- meeting of WG-SAM (Annex 6)
- meeting of ad hoc TASO (Annex 9).

1.8   Documents submitted to the meeting are listed in Appendix C.

1.9   The Working Group noted the Secretariat's high translation workload and discussions at CCAMLR-XXVII (CCAMLR-XXVII, paragraph 3.13), and agreed to make every effort to reduce the overall size of its report and subsequent translation. The report captured essential background, discussion and advice, and made full use of CCAMLR's archive of publications and meeting documents.

1.10   The Working Group agreed to follow WG-SAM's initiative and highlight sections of the report dealing with advice to the Scientific Committee and its working groups, and list these paragraphs in both Advice (Item 6) and Future Work (Item 7).

1.11   The report was prepared by Drs D. Agnew (UK), A. Constable (Australia), M. Goebel (USA), S. Grant (UK), S. Hanchet (New Zealand) and S. Hill (UK), Mr J. Hinke (USA), Drs Jones, S. Kawaguchi (Australia), P. Penhale (USA), D. Ramm (Data Manager), K. Reid (Science Officer), C. Reiss (USA), G. Skaret (Norway), C. Southwell (Australia), P. Trathan (UK), W. Trivelpiece (USA), J. Watkins (UK) and Watters.

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

1.12   Dr Watters outlined the feedback from previous meetings of the Commission, Scientific Committee and other working groups which had been used to structure WG-EMM's agenda, and highlighted key requirements for advice on:

- scientific observation of the krill fishery
- SSMUs and management strategies for the krill fishery
- research and data collection plan for the exploratory krill fishery in Subarea 48.6
- B_0 and precautionary yield estimates
- FEMA2
- VMEs
- protected areas
- CCAMLR Performance Review.

SECOND WORKSHOP ON FISHERIES AND ECOSYSTEM MODELS
IN THE ANTARCTIC (FEMA2)

Introduction

2.1   The terms of reference for FEMA2 were initially drafted by the Conveners of WG-EMM and WG-FSA, and further developed in consultation with the two working groups. The Scientific Committee reviewed the terms of reference and agreed that FEMA2 be structured in a manner that treats fisheries for toothfish in the Ross Sea (Subareas 88.1 and SSRUs 882A–B) as a case study of how ecosystem considerations can be used to advise on the management of fisheries that target finfish (SC-CAMLR-XXVII, paragraph 3.58). The terms of reference for FEMA2 were to (SC-CAMLR-XXVII, paragraph 3.60):

(i)   Review existing information on predator species (Weddell seals, toothed whales etc.) in the Ross Sea known to consume *Dissostichus* spp. This may be aided through a comparative analysis of the importance of *Dissostichus* spp. as prey in different regions throughout the Southern Ocean.

(ii)   Consider the current estimates of biomass, distribution and productivity of *Dissostichus* spp. in the Ross Sea, as well as annual removals by the fishery.

(iii) Review rationale for existing escapement level of 0.5 for *Dissostichus* spp., and determine if 0.5 is an appropriately precautionary level of escapement in the Ross Sea, given the predator requirements, foraging ranges, toothfish stock biomass, distribution and productivity.

(iv)   Review other methods or options for mitigating risks in the Ross Sea toothfish fishery.

(v)   Development of methods to monitor changes in predators in the Ross Sea.

2.2   The Scientific Committee also agreed that it would be useful for FEMA2 to conduct a general discussion about appropriate escapement levels when the age (or size) at which fish recruit to a fishery is contrasted with the age (or size) at which the fish are vulnerable to predation by other predators (SC-CAMLR-XXVII, paragraph 3.61).

2.3   The information and deliberations undertaken in this agenda item refer solely to Ross Sea ecosystem components and the toothfish fishery in Subarea 88.1, unless otherwise stated. The Working Group noted that papers tabled under this agenda item included WG-EMM-09/13 to 09/16, 09/40 to 09/42 and 09/P1 to 09/P4. In reviewing these papers, it was agreed that WG-EMM-09/13, 09/14 and 09/P4 would more appropriately be considered under Item 5. The Conveners of WG-EMM and WG-FSA also brought WG-SAM-09/18 forward for consideration within FEMA2.

2.4   The Working Group noted work in other areas of the Southern Ocean on the food-web interactions of toothfish, including studies at Heard Island and Macquarie Island (He and Furlani, 2001).

Review of information on historical and current biomass,
productivity, distribution and ontogenetic movement
patterns of *Dissostichus* spp. in the Ross Sea

2.5   WG-EMM-09/40 provided a synthesis of information on the distribution and abundance of Antarctic toothfish (*Dissostichus mawsoni*) from commercial and research fishing in the Ross Sea region. Dr Hanchet presented the findings of the paper together with a brief outline of the hypothetical life history of *D. mawsoni*, including its ontogenetic movements.

2.6   The Working Group noted the synthesis and concluded that:

(i)   toothfish generally do not move far in the short term (1–2 years) but that, over time, are likely to disperse across the Ross Sea region;

(ii) the CASAL assessment model provided an estimate of abundance for the entire Ross Sea region and that catch limits for subregions were based on the seabed area and CPUE calculations. Further, that a spatial population modelling approach (such as the SPM) would be needed to derive model-based local abundance estimates;

(iii) there appeared to be high spatial and temporal (both within- and between-year) variability in catch rates from commercial and research fishing on the shelf;

(iv) there had been observations of toothfish in midwater, but that the spatial and temporal extent of this was unknown.

2.7   WG-EMM-09/41 presented a circulation model for the Ross Sea region, which identified two gyres to the north of the Ross Sea itself. The Working Group noted that the circulation model had been used to simulate the drift of toothfish eggs and larvae in the development of the hypothetical life history of *D. mawsoni* (Hanchet et al., 2008).

2.8   WG-SAM-09/18 outlined the development of spatially explicit ASPMs for *D. mawsoni* in the Ross Sea (see also Annex 6, paragraph 4.1). Mr A. Dunn (New Zealand) noted that the SPM program was not toothfish-specific but could be used to model other fish species, and could be further developed to model interactions with one or more predator or prey species as a Minimum Realistic Model (MRM). The Working Group thanked the authors for providing this paper and noted that it would be useful for evaluating alternative scenarios using different spatial assumptions. This was considered further in paragraphs 2.44 to 2.53.

The diet of *Dissostichus* spp. in the Ross Sea

Size and species composition of prey

2.9   The Working Group noted data on the size and species composition of prey in *D. mawsoni* contained in WG-EMM-09/16, 09/40 and 09/42. On the basis of these analyses, toothfish appear to be generalist predators, with diet varying as they grow and change habit and habitat (Table 1). The Working Group recalled that diet analyses of *D. eleginoides* also support this hypothesis (SC-CAMLR-XXI/BG/30).

2.10   The Working Group recalled that stable isotope analyses of *D. mawsoni* (WG-EMM-08/27) support the conclusion that toothfish occupy a high trophic level, with large toothfish caught in the longline fishery in Subarea 88.1 having a trophic level equivalent to that of Weddell seals and killer whales.

2.11   The Working Group noted that there was evidence that *D. mawsoni* changes from negatively to neutrally buoyant as they grow and accumulate lipid stores (Near et al., 2003), and that understanding the relative importance of pelagic versus demersal prey to toothfish would assist with understanding the ecosystem role of toothfish and food webs in the Ross Sea.

2.12   The Working Group noted that mixture analyses to disaggregate stable isotope signals in toothfish tissues may assist in evaluating the relative importance of different prey for different life stages and in different habitats, although uncertainties due to the unknown rates of tissue turnover in toothfish, as well as the assumptions of proposed disaggregation algorithms such as IsoSource[1], need to be considered when ascribing sources of isotopes to specific prey types.

2.13   The Working Group noted that scientific observers in the Ross Sea have been monitoring stomach contents of toothfish in the catch for several years, and that this dataset has the potential to detect changes in toothfish diet through time.

2.14   The Working Group encouraged continued monitoring of stomach contents of toothfish, and recommended that such monitoring should include measures of the size of toothfish analysed, the size of the prey, as well as the species composition.

Distribution and abundance of prey species

2.15   The Working Group noted that the majority of information on the distribution of toothfish demersal fish prey is derived from by-catch in the toothfish fishery in the Ross Sea; however, the recent IPY survey by New Zealand had provided some valuable fishery-independent data on fish distribution and abundance, including biomass estimates of Whitson's rattail (*Macrourus whitsoni*) (SC-CAMLR-XXVII, Annex 5, paragraphs 6.16 to 6.22).

2.16   The Working Group also noted that preliminary analyses had been performed by New Zealand scientists to estimate distribution and abundance of Antarctic silverfish (*Pleuragramma antarcticum*) from the IPY survey in the Ross Sea (SG-ASAM-09/5).

2.17   The Working Group noted that a comparison of rates of toothfish catch and by-catch of toothfish prey species may assist with understanding patterns and detecting changes in the distribution and abundance of prey. However, the quality of by-catch data identification, availability of size distribution data for by-catch (where size as well as presence determines availability of prey), and the effect of by-catch move-on rules would need to be considered in such analyses.

Consumption rates of prey by *Dissostichus* spp.

2.18   The Working Group recalled that comprehensive reviews of the trophic structure of the Ross Sea ecosystem, including toothfish and their key prey taxa, had been considered previously by WG-EMM (WG-EMM-07/18), and noted that a mass-balance model had been successfully constructed based on this review (WG-EMM-09/42).

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[1]   www.epa.gov/wed/pages/models/stableIsotopes/isotopes.htm

2.19   The Working Group noted that the analyses presented in WG-EMM-09/42 indicate that large toothfish are the dominant large fish predator in the Ross Sea, and may consume a large proportion of the production of medium-sized fish (representing taxa such as macrourids and blue antimora (*Antimora rostrata*)).

Information on *Dissostichus* spp. predator species in the Ross Sea

2.20   The Working Group reviewed the available information contained in WG-EMM-09/15, 09/42 (and associated website) and 09/P1 to 09/P4 that concerned predators of *Dissostichus* spp. in the Ross Sea. The Working Group focused its discussions on Weddell seals (*Leptonychotes weddellii*), killer whales (*Orcinus orca*) and Arnoux's beaked whales (*Berardius arnuxii*). The Working Group also considered a number of more general points.

Current and historical abundance/biomass of predator species

2.21   The Working Group noted that point estimates of killer whale occurrence from Cape Crozier in WG-EMM-09/P1 reflected a small part of their population, range and habitat. Consequently, scaling-up to a regional scale from these sightings was not possible; the Working Group also noted that the negative trend in sightings reported in WG-EMM-09/P1 was not statistically significant.

2.22   Dr Southwell reported that unpublished results from APIS suggest that populations of Weddell seals in the Ross Sea region may be much more abundant than population estimates used in WG-EMM-09/42 and 09/P2. The Working Group encouraged the publication of these results.

Temporal and spatial extent of predator foraging ranges

2.23   The Working Group noted that Weddell Seals regularly forage within localised areas, but that satellite telemetry has also revealed long-distance movements of both adults and weaned juveniles. WG-EMM-09/P2 reported on a telemetry dataset that shows that Weddell seals migrate northwards from McMurdo Sound, apparently preferring coastal areas and shallow shelf areas with submarine banks.

2.24   No data were available to examine the spatial or temporal distribution of killer whales or Arnoux's beaked whales, although both are known to occur in the pack-ice zone which makes determining population size and distribution problematic.

Consumption rates of *Dissostichus* spp. by predators

2.25   The Working Group noted that the most comprehensive consumption rate data available were contained in WG-EMM-09/42.

2.26   The Working Group noted that visual observations of toothfish-eating Weddell seals suggest that seals consume large toothfish without ingesting the head, vertebrae or skin, which means that hard-part remains are under-represented in scat analyses. However, both WG-EMM-09/42 and 09/P2 indicated that stable isotope analyses suggests that *Dissostichus* spp. are not large/frequent components of the diet of Weddell seals. These analyses also suggest that *D. mawsoni* is at a trophic level that is approximately equivalent to Weddell seals.

2.27   WG-EMM-09/42 and 09/P1 both reported on stable isotope analyses indicating that *Dissostichus* spp. are not obligate components of the diet of killer whales; indeed, WG-EMM-09/42 suggested that toothfish may only represent 5.9% of their diet.

2.28   The Working Group agreed that the speculation in WG-EMM-09/15 that Arnoux's beaked whales may consume both toothfish and macrourids was interesting but no conclusion could be drawn from this.

Size composition of *Dissostichus* spp. consumed by predators

2.29   The Working Group noted that size-specific data on *Dissostichus* spp. consumed by marine mammals in the Ross Sea are not available and are likely to be difficult to obtain in the future. The Working Group recommended that any size-specific data on *Dissostichus* spp. consumed by predators, collected by non-lethal sampling methods, be submitted for review by WG-EMM in order to better address the term of reference outlined in SC-CAMLR-XXVII, paragraph 3.61.

Proportion of predator population targeting *Dissostichus* spp.

2.30   The Working Group noted that no data were submitted that would enable the proportion of predator populations that prey on *Dissostichus* spp. to be assessed and recognised that there may be important temporal and spatial variation in the consumption of *Dissostichus* spp.

Development of methods to monitor changes
in *Dissostichus* spp. predators

2.31   The Working Group recalled WG-EMM's discussion in 2008 concerning the monitoring of predator species preying on *Dissostichus* spp. (SC-CAMLR-XXVII, Annex 4, paragraphs 6.28 to 6.36).

General discussion

2.32   WG-EMM-09/42 emphasised that a balanced ecosystem model for the Ross Sea provided no support for the hypothesis that depletion of toothfish stocks would greatly change the diet of toothfish predators. The authors noted that further work would be done on the dynamics of the food web in future.

2.33   The Working Group encouraged Members to contribute to, provide comments on, and review the background documents of, the different compartments of the trophic model described in WG-EMM-09/42 (www.niwa.co.nz).

2.34   The Working Group thanked the authors for all papers considered in this section. It noted that the ecosystem framework that CCAMLR used to manage fisheries required considerable ecological information and insight. It noted that such insights were important to successful management practice, particularly for new and exploratory fisheries and where ecological links were poorly documented. The Working Group also agreed that, where new ecological ideas and links were hypothesised, it was critically important that these hypotheses were evaluated in the context of management questions.

Removals from the fishery and overlap between the fishery and predators

2.35   The Working Group agreed that consideration of overlap between the fishery and predators should take the following into account:

(i)   the horizontal distribution of the toothfish population, as well as predators and the fishery;

(ii)   the vertical (depth) and spatial distribution of different life-history stages of both toothfish and predators, and the depth distribution of the fishery;

(iii)   the size classes of toothfish that are likely to be important to predators.

2.36   Information from WG-EMM-09/40 showed that the fishery has concentrated on the slope, where larger (sub-adult and adult) toothfish are encountered and fishing is primarily in depths greater than 800 m. Fishing over the shelf has taken place in three areas:

(i)   The deep gully off Terra Nova Bay, in the west of SSRU M which was fished mostly between 2006 and 2008. This area was closed in 2009. A bimodal distribution of fish was encountered here, with modal lengths of 80 and 125 cm.

(ii)   The deep-water area north of Ross Island at the southern boundary of SSRUs M and J, which was fished in 1999, 2007 and 2008. The early fishery encountered fish of modal length 80 cm and the later two years, fish of modal length 110 cm.

(iii)   An area to the south of SSRU L, which was fished in 2001, 2004 and 2008, and encountered fish of modal lengths between 100 and 110 cm.

2.37   The hypothetical life history for toothfish (Hanchet et al., 2008) suggests that juvenile fish are distributed on the shelf in nursery, and later in sub-adult feeding grounds, then move to the slope. The spatial distribution of median fish lengths, recorded from the fishery, is largely consistent with this hypothesis.

2.38   Information from predators on the overlap with toothfish is sparse. The mass balance model of Pinkerton (WG-EMM-09/42) suggests that there is sufficient toothfish production to satisfy 6.6% of the diet of Weddell seals and 5.9% of the diet of killer whales. Nevertheless, the possibility that toothfish may be locally important to these predators, and therefore that the overlap between the fishery and predators may be important, was considered by the Working Group.

2.39   Killer whales are regularly observed foraging close to the ice edge, and have been observed eating toothfish (WG-EMM-09/P1), but they have not been observed interacting with vessels fishing either on shelf or slope areas (information from the CCAMLR Scheme of International Scientific Observation). The distributional extent of killer whale overlap with the toothfish population is therefore uncertain, but their overlap with the fishery appears to be negligible. Vertically, killer whales do not forage deeper than about 300 m, and the fishery is limited to waters deeper than 550 m, suggesting again that the overlap between killer whale distribution and the fishery is minimal. However, toothfish are known to occur in midwater and may, in this situation, become available to air-breathing predators such as killer whales.

2.40   Toothfish are eaten by Weddell seals (WG-EMM-09/P2) although they are probably not obligate components of their diet. Some information on the distribution of Weddell seals was available from satellite tracking of individuals at McMurdo Station, which indicated that those adults and weaned juveniles that were tracked, foraged in areas that had negligible overlap with the fishery. Information on the wider distribution of Weddell seals, obtained during the APIS surveys, was not available for analysis by the Working Group.

2.41   Weddell seals can dive deeper than killer whales (up to 750 m, although depths of <350 m are more common – WG-EMM-08/43), and WG-EMM-09/P2 reported photographed encounters with toothfish at up to 363 m in shelf waters of 575 m depth. While there is a possibility for them to vertically overlap with toothfish on the slope, this would depend on toothfish undergoing vertical migrations to shallow waters. Furthermore, the evidence from the fishery is that sub-adult and adult toothfish are primarily demersal in habit and Weddell seals have not been recorded by scientific observers from the area of the main fishery.

2.42   The Working Group concluded that the evidence suggests that the overlap of Weddell seals and killer whales with the fishery is negligible. There is overlap between the distribution of these two predators and elements of the toothfish population which may be impacted by the fishery, but this is limited to shallow areas of the shelf and to the sub-adults of the toothfish population which are taken in small numbers by the fishery.

2.43   The Working Group noted that the information currently available addressed the distribution of predators (and toothfish) only during the summer. Information on toothfish distribution, and the distribution and behaviour of predators in the winter may assist this analysis of potential overlap. Models such as the SPM could be used to help evaluate whether this would be important.

Focus group – Assessment and management approaches
for *Dissostichus* spp. in the Ross Sea

Review historical and current assessment methods

2.44   WG-EMM noted the evolution of approaches to establishing catch limits for *Dissostichus* spp. in the Ross Sea:

(i)   Assessment of yield for *Dissostichus* spp. evolved from the method encapsulated in the KYM (WG-Krill-92/4; Butterworth et al., 1994) to that encapsulated in the GYM (Constable and de la Mare, 1996) resulting in estimates of yield for Subarea 48.3 in 1995 (SC-CAMLR-XIV, paragraphs 4.37 to 4.61) and Division 58.5.2 in 1996 (SC-CAMLR-XV, paragraphs 4.100 to 4.110).

(ii)   WG-FSA used comparative CPUE and seabed areas along with a discount factor to provide advice on possible catch limits in new and exploratory fisheries for *Dissostichus* spp. in 1998. This practice was discontinued in 2003 when it was deemed unsatisfactory (SC-CAMLR-XXII, paragraphs 4.182 to 4.186).

(iii) Integrated assessments of the status of *Dissostichus* spp. began for the Ross Sea with the introduction of CASAL in 2005 (SC-CAMLR-XXIV, paragraphs 4.150 to 4.166). This method has been used as the basis for assessments of yield since that time (see Fishery Report in SC-CAMLR-XXVII, Annex 5, Appendix I).

Review of rationale for existing escapement level
of 0.5 for *Dissostichus* spp.

2.45   WG-EMM noted the development of the decision rules began in discussions in the CCAMLR Working Group on Developing Approaches to Conservation (1987–1989) and later in SC-CAMLR's WG-Krill and WG-FSA (see Kock, 2000; Constable et al., 2000). The decision rules aim to set catch limits that will achieve operational definitions of Article II despite uncertainties in stock status and the dynamics of the stock and fishery. It was also noted that, where target species are important prey of predators, such as krill, the escapement level of 0.75 is to be used until further information is available to better determine the required escapement level (an example study is Thomson et al., 2000). If a target species is a top predator, and less important as a prey species in its own right, then an escapement level of 0.5 has been used. The 0.5 escapement level of the spawning stock has been regarded in the past as being the escapement level when predator requirements are not taken into account, while no fishing would imply only consideration of predators. However, this needs to be understood in the context of the selectivity functions of the predators of the target species compared to the fishery (see paragraph 2.46).

Approaches to mitigating risks to predator populations
from the Ross Sea toothfish fishery

2.46   WG-EMM noted that the escapement level in the decision rule for the spawning biomass may need to be modified upwards if the size/age classes of *Dissostichus* spp. that are

important prey for predators are reduced below a suitable escapement level for those classes. It noted the work presented in WG-EMM-97/42 investigating the escapement of juvenile *Dissostichus* spp., which may be prey of elephant seals, and found escapement likely to be above 0.8 for those classes when there is an escapement level of 0.5 for the spawning stock.

2.47　The Working Group reviewed the mean results from CASAL projections from the Ross Sea integrated assessment for *Dissostichus* spp. showing the current escapement levels of juvenile toothfish from that assessment in 2007 and projected future escapement (Figure 1). It was also noted that the results for escapement at the end of the projection are dependent on the stock-recruitment relationship in the assessment, which may change in future assessments. The results in Figure 1 demonstrate that the current status of size classes of interest can be routinely monitored as part of the assessment.

2.48　WG-EMM recommended that WG-FSA consider whether other strategies for monitoring important prey size classes might be employed, noting that their efficacy would best be evaluated using simulation models such as SPM.

2.49　WG-EMM noted that an additional part to the decision rule could be developed regarding finding a catch that would achieve a target level of escapement of the size classes of toothfish that are important prey. The current two parts concerned with escapement of the spawning biomass and the avoidance of depletion of the spawning biomass need to be retained for maintaining the productivity of the stock. The last part of the decision rule would then choose the lower of the catches in all of the parts.

2.50　WG-EMM noted that escapement levels designed to maintain 'ecological relationships' may need to accommodate the effects on prey, as well as the effects on predators, particularly if the predators control superior competitors at lower trophic levels.

2.51　WG-EMM encouraged further modelling of the Ross Sea food web, such as that proposed in WG-EMM-09/42, to help evaluate the possible ecosystem effects of fishing in the region.

2.52　WG-EMM noted that the areas over the shelf, where evidence of overlap between toothfish and predators of toothfish occurs, may comprise mostly small fish (paragraph 2.37). With respect to these predators, a large portion of the shelf area is contained in SSRU 881M, or less than 550 m depth, which is currently closed to fishing. It also noted that seasonal closures to fishing would be no different to area closures because of a short time period of fishing due to sea-ice.

2.53　The Working Group encouraged Members to undertake research to determine relevant spatial and temporal overlaps of *D. mawsoni* with different components of the Ross Sea ecosystem, which could include:

(i)　development of plausible alternative hypotheses of the life history of *D. mawsoni*, and simulation studies of how these alternatives may impact its spatial distribution and abundance;

(ii)　investigation of the functional relationships and associated parameters, including investigation of alternative hypotheses about predator dynamics and movement,

that could be important to develop MRMs of *D. mawsoni* as predators and prey. Further, that simulation studies be carried out using these models to compare food-web effects under alternate exploitation assumptions;

(iii) simulation studies to investigate the relative importance of density-dependent processes on movements of toothfish;

(iv) simulation studies to identify and develop indices that could be used in monitoring population and trophic effects under alternate exploitation assumptions.

ECOSYSTEM EFFECTS OF FISHING FOR KRILL

Krill

3.1 WG-EMM-09/11 indicated that:

(i) the catch efficiency of some Soviet krill trawls operating in the Area 48 fishery was between 10 and 20% (i.e. only 10–20% of the krill that entered the trawls are landed on board the vessel), and that the mortality rate of krill that escape through the net was between 0 and 100%;

(ii) these mortality rates were also related to fishing vessel speed and trawl mouth dimensions, and the Working Group noted that:

(a) the start and end positions, and times, are already recorded on the C1 form (thus average tow speed can be computed from the information available);

(b) trawl net dimensions are now required to be specified in the notifications of intent to participate in the fishery (Conservation Measure 21-03).

3.2 The Working Group also noted existing research that indicated that mortality of escaped krill from some trawls in the Soviet krill fishery did not exceed 1% (Kasatkina and Latogursky, 1990; Kasatkina and Ivanova, 2003; Zimarev et al., 1990). However, studies on German commercial-sized pelagic trawls indicated a mortality rate of krill passing through the net of between 5 and 35% depending on haul duration (WG-EMM-07/28).

3.3 The Working Group noted the FAO discussions concerning the impact on target fish populations of mortality of escaped catch (Surronen, 2005). It agreed that the total mortality of krill arising from escapement through the net would be termed 'escape mortality', which is calculated as the amount of krill escaping through the mesh × the proportion of those krill that die.

3.4 The Working Group agreed that there is the potential that the escape mortality could equal or exceed the mortality owing to catch alone, and it was concerned about this potential level of escape mortality given the importance of the total amount of krill killed by fishing operations to any assessment and to catch allocation schemes.

3.5   Given the discrepancy between the estimates of mortality of escaped krill, together with the lack of data on the rates at which krill escape from nets in different fishing gear, the Working Group recommended that there should be a concerted effort to estimate escape mortality in the krill fishery, including through the evaluation of existing results and the continued development of existing models (e.g. WG-Krill-93/34).

3.6   The Working Group agreed that such studies could also include acoustic, video and physical sampling of krill within and outside the net. Specific experiments could include:

- attachment of small-mesh plankton nets at a variety of locations around the trawl net
- video analysis of damage to krill escaping from the net
- acoustic estimate of krill at the head of the net versus the catch in the net to estimate efficiency.

3.7   The Working Group further recommended that the Scientific Committee ask the Members fishing for krill in the 2009/10 season to actively investigate the effects of different fishing gear on 'escape mortality' of krill.

3.8   The Working Group considered two papers (WG-EMM-09/44 Rev. 1 and 09/47) on the potential causes for the variability in the availability of krill to the krill fishery owing to oceanography and climate forcing. Noting that there were multiple potential influences on the operation of the fishery, the Working Group agreed that these analyses could be improved by the use of a standardised CPUE index before correlations are performed.

3.9   The Working Group noted that data on krill length and maturity stage collected in Subarea 48.2 on board the *Maksim Starostin* (WG-EMM-09/29) and *Saga Sea* (WG-EMM-09/10) indicated that the size and stage composition did not differ between conventional and continuous trawls on the same vessel, but that there were differences in length and maturity stage between vessels. The differences potentially arose from differences in net selectivity and the use of fresh versus preserved samples. There were also differences in sampling size. The Working Group thanked the authors of these reports and looked forward to receiving further information on the integration of these results with the under-way acoustic data collected by fishing vessels.

Krill-dependent predators

Strong anomaly at South Georgia in 2009

3.10   The Working Group acknowledged that three papers (WG-EMM-09/23, 09/27 and 09/28) described a strong anomaly at South Georgia in 2009 that was manifest in the lowest krill density on record, very low land-based predator performance, changes in the diet of icefish and anomalous values for a range of physical parameters including sea-surface temperature.

3.11   The Working Group thanked the authors for providing these results to the meeting in such a timely manner and noted the potential of using rapid assessments such as this in a feedback monitoring context (see additional considerations of feedback management under Item 3.6).

New CEMP monitoring sites

3.12   The Working Group welcomed the establishment of a new CEMP monitoring site by the UK at Cumberland Bay, South Georgia (WG-EMM-09/28) and plans for a new site at Petermann Island on the Antarctic Peninsula through collaboration between Ukraine and Russia (described to the Working Group by Dr G. Milinevsky (Ukraine)), noting that these new sites would provide monitoring data from within SSMUs for which there is currently no CEMP data.

Tourist impacts

3.13   WG-EMM-09/P7 described a 12-year study of the impacts of tourism on gentoo penguins (*Pygoscelis papua*) at Goudier Island on the Antarctic Peninsula. Data from this study, and that reported by Dr Southwell from studies at Béchervaise Island, suggest that the recruitment may be lower at colonies that are frequently visited by scientists and/or tourists.

3.14   The Working Group agreed that colony counts and breeding success data from Goudier Island control colonies that were collected in a manner consistent with the CEMP standard methods, would be a welcome addition to CEMP. It urged the UK to submit these data to the Secretariat for inclusion in CEMP, noting that this would extend the spatial coverage of CEMP.

3.15   The Working Group noted the CEP proposal to examine the environmental impacts of tourism and non-governmental activities in Antarctica (ACTM XXXII) and recognised the potentially similar requirements for monitoring the impacts of fisheries and tourism. It was agreed that both CEP and CEMP would benefit from coordination between the two groups in the future (see Item 5.3 for additional discussion).

Trends in predator populations; environmental and ecological variability

3.16   The Working Group discussed two papers that examined population dynamics of penguins in the Scotia Sea (WG-EMM-09/17 and 09/43) and from three sites around Antarctica (WG-EMM-09/34).

3.17   From the discussion of these papers, the Working Group noted that:

(i)   the populations of both Adélie penguins (*P. adeliae*) and chinstrap penguins (*P. antarctica*) were declining at a range of sites in the Antarctic Peninsula and Scotia Sea region and that there was convincing evidence to suggest that the paradigm of reciprocal changes in the population of these two species in this region (e.g. McClintock et al., 2008) was no longer valid;

(ii)   the variability in the breeding success in Adélie penguins at the South Shetland Islands was primarily driven by failure during the incubation stage that was linked to winter sea-ice and spring weather conditions, although there was no long-term trend in breeding success;

(iii)   in contrast to the Antarctic Peninsula, variability in breeding success of Adélie penguins in East Antarctica was primarily driven by the extent of fast-ice during the chick-rearing period;

(iv)   there were differences in the population trajectories and demographic parameters (e.g. age-at-first breeding) between Adélie penguin populations in the Ross Sea and the Antarctic Peninsula.

3.18   The Working Group recognised that this suite of papers (and WG-EMM-09/P9) highlighted an increased understanding of the factors affecting penguin population dynamics across the Antarctic and helped to better understand how they are responding to changes in the ecosystem.

3.19   Dr Southwell (Convener, WG-EMM-STAPP) outlined continued progress in estimating krill consumption in Area 48 by air-breathing predators (pack-ice seals, fur seals, penguins and flying seabirds) initiated by the Predator Survey Workshop (WG-EMM-08/8), and indicated anticipated intersessional progress up to WG-EMM-10 (WG-EMM-09/39 and Table 2). The Working Group noted that:

(i)   the newly completed estimate of krill consumption by crabeater seals (*Lobodon carcinophagus*) (WG-EMM-09/21) for all SSMUs combined is likely to be robust, but estimates for individual SSMUs are dependent on habitat conditions (pack-ice extent), which can change substantially between and within years;

(ii)   aerial surveys of fur seals in Subarea 48.3 were completed in 2008/09 and analysis of the data has commenced. It is expected that analyses of abundance, at-sea distribution, diet and energetics data will be well advanced by WG-EMM-10;

(iii) collation of penguin count data into an agreed standard database structure (Appendix to WG-EMM-09/39) is well advanced, an estimation method using a parametric bootstrap model written in R (ICESCAPE, WG-EMM-09/20) has been developed, Members were requested to provide data to WG-EMM-STAPP for adjusting raw penguin count data, and work on abundance estimation will commence prior to WG-EMM-10;

(iv)   the collation of at-sea data for flying seabirds to examine the extent and utility of using these data to estimate population size will continue over the intersessional period.

3.20   The Working Group acknowledged the substantial progress made by WG-EMM-STAPP in advancing estimation of krill consumption by predators in Area 48, and endorsed the work program proposed for the coming intersessional period as a matter of priority. In addition, the Working Group requested WG-EMM-STAPP to investigate ways of addressing potential biases in penguin abundance estimates arising from breeding sites with very old count data, and to consider estimation of prey consumption by fish predators.

3.21   Dr Goebel (Convener, Subgroup on Methods) reported on the continued refinement, validation and quality testing of CEMP data. This included a review of the application and reporting of the standard methods for A2 (penguin incubation shift duration), A3 (penguin

breeding population size), A6c (penguin breeding success, chicks fledged per chicks hatched), and a simplified presentation for A8 (penguin chick diet) to a single dietary index based on an index of importance.

3.22   The Working Group noted that no new CEMP methods were proposed and thanked the subgroup and the Secretariat for its ongoing work on CEMP data validation. It noted that the photographic method used in WG-EMM-09/38 in penguin breeding population estimates could be incorporated as a modification to CEMP Standard Method A3 (penguin breeding population size) for some penguin species. Dr Southwell offered to further review the utility of this system with a view to developing a modification to A3 for WG-EMM-10.

The krill fishery and scientific observation of the fishery

Fishing activity

Current season

3.23   Five Members (six vessels) fished for krill in Area 48 in 2008/09, and have taken 82 849 tonnes of krill to date (Norway 33 482 tonnes, Republic of Korea 23 522 tonnes, Japan 13 515 tonnes, Russia 9 654 tonnes and Poland 2 676 tonnes). Most of this catch was taken in Subarea 48.2 (51 316 tonnes) with the remainder in Subarea 48.1 (31 533 tonnes). The forecast total catch of krill for the current season falls in the range 109 000–147 000 tonnes (WG-EMM-09/6).

3.24   The Working Group noted that if the situation of low krill abundance in Subarea 48.3 remains as described in paragraphs 3.10 and 3.11, and the fishery is unable to increase its catches in Subareas 48.1 and 48.2, the forecast catch could be an overestimate if the fishery follows the same spatio–temporal pattern as in previous years.

2007/08 season

3.25   Norway reported the largest catches of krill in 2007/08 with a total catch of 63 293 tonnes. Japan and the Republic of Korea also reported large catches (38 803 tonnes and 38 033 tonnes respectively). Ukraine, Poland and Russia reported catches of 8 133, 8 035 and 222 tonnes respectively (WG-EMM-09/6).

3.26   In 2007/08 all of the total krill catch of 156 521 tonnes was taken from Area 48; this compares with the total catch of 125 063 tonnes reported to the Scientific Committee last year (SC-CAMLR-XXVII, paragraph 4.3). The Working Group noted that this discrepancy arose because the Secretariat did not receive monthly catch and effort data for four months, totalling a krill catch of 19 262 tonnes, due to an email failure (WG-EMM-09/6). This problem arose in part because the Secretariat was unaware that the vessel in question was actually fishing and was therefore not expecting to receive monthly catch and effort data.

3.27   The Working Group expressed its concern over this problem since it may have influenced the interpretation of the catch data in the Scientific Committee and Commission meetings, as the catch last year was the highest since the 1991/92 season.

Notifications for 2009/10

3.28   Seven Members (13 vessels) have notified their intention to fish for krill in 2009/10 in Subareas 48.1, 48.2, 48.3 and 48.4, and Divisions 58.4.1 and 58.4.2 (Table 3). The People's Republic of China has notified, for the first time, its intent to harvest a total of 9 000 tonnes of krill with three vessels (WG-EMM-09/7). In addition, Norway has notified for an exploratory fishery for krill in Subarea 48.6 (CCAMLR-XXVIII/14) (paragraphs 3.33 to 3.36). The total notified catch for 2009/10 is 363 000 tonnes compared to a notified catch of 629 000 tonnes for 2008/09 (Figure 2).

3.29   The Secretariat received an additional notification for a krill fishery in 2009/10 from Chile after the deadline in Conservation Measure 21-03; the Working Group did not consider this notification.

3.30   The notifications in respect to the three Chinese vessels did not include information on the use of marine mammal exclusion devices. The Working Group was informed that China will provide amended notifications to include all the necessary information to the Scientific Committee for its consideration.

3.31   In their notifications, Japan and the Republic of Korea indicated the use of streamer lines on their vessels. Japan clarified that streamer lines are used when conducting other fishing operations outside the Convention Area where streamer line use is required; streamer lines are not used in the Convention Area when fishing for krill. The Republic of Korea informed the Working Group of its occasional use of streamer lines within the Convention Area while fishing for krill. The Working Group also noted that Japan and the Republic of Korea had not presented diagrams of their seal exclusion devices. It requested both Members to provide those diagrams to the Scientific Committee for its consideration.

3.32   The Working Group noted that some notifications were prepared in official CCAMLR languages other than English, and therefore were not able to be assessed fully at the Working Group meeting. The Working Group recommended that notifications in official languages other than English may need to be translated in order to be assessed at its meeting. This may require an earlier notification deadline in order for translations to be completed in time for review at the meeting.

Exploratory krill fisheries

3.33   The Working Group noted that, although Norway had proposed the use of a new marine mammal exclusion device in its notification for an exploratory krill fishery, the operator had notified the Secretariat that this device will be replaced with a mesh-type device similar to the design used by other continuous trawlers operating in the Convention Area.

3.34   The Working Group agreed the need for acoustic instruments on vessels undertaking exploratory krill fisheries to be calibrated within a year prior to their operation to enable the data to be used at least as a relative index of krill density. Calibration data would need to be reported with data from research transects.

3.35   The Working Group agreed that the design of the research program to accompany exploratory krill fisheries should be kept under review, particularly in relation to how the

results can be used in assessments of precautionary yield for these fisheries. It was noted that continual review and development had been required in the exploratory longline fisheries. It was suggested that WG-SAM be asked to review how acoustic data might be used as relative indices of abundance in these fisheries.

3.36 The Working Group thanked Norway for its commitment to develop and refine the exploratory krill fishery survey plan.

Data collection plans for exploratory krill fisheries

3.37 Norway notified the meeting that it is not conducting an exploratory krill fishery in Subarea 48.6 in the 2008/09 season, but that it did intend to do so in 2009/10 (CCAMLR-XXVIII/14). In considering the plan by Norway to conduct this exploratory fishery, the Working Group noted that this request is to undertake an acoustic survey for krill prior to fishing rather than as specified in Conservation Measure 51-04 for it to be done after fishing.

3.38 WG-EMM recognised that this was a reasonable request and recommended amendments to Conservation Measure 51-04 to account for this change to the research plan.

3.39 The Working Group currently requests that notifications identify the research plan that the vessel will undertake in order that the Working Group can evaluate the notification. The Working Group recommended that the notification should also include the details of any research institute that the fishing company is collaborating with, including who will provide results of the research, and advice on how these results will be used to meet Conservation Measure 51-04.

3.40 The Working Group advised that the following amendments should be made to Conservation Measure 51-04:

(i) The vessel could carry out the research plan either before or after the commercial fishery.

(ii) If the vessel is collaborating with a research institute to conduct the research plan, it should identify the collaborating institute.

(iii) If the survey is undertaken after the commercial fishery, it should follow the current guidelines within Conservation Measure 51-04, where the measure defines the number of exploratory units to be visited as the catch divided by 2 000 tonnes. If the survey is conducted prior to the commercial fishery, then the fishing vessel must:

(a) undertake a research plan for the exploratory units based on the area where it intends to fish;

(b) complete additional surveys to fulfil the number of exploratory units required if the number of exploratory units completed at the end of fishing is less than the catch divided by 2 000 tonnes;

(c)   carry out its fishery and survey in a manner in which the research exploratory units surround and include the units where the fishery is carried out.

(iv)   The echo sounder (minimum frequency 38 kHz, minimum observing depth range 200 m) should preferably be calibrated in the actual fishing grounds, however, this is often impossible due to logistical problems of identifying suitable locations for this. Therefore, as a minimum, the echo sounder should be calibrated prior to the vessel leaving the harbour. Calibration data would need to be reported with data from research transects.

(v)   If a vessel is unable to calibrate its echo sounder within the fishing grounds:

(a)   acoustic survey grids comparable/identical with the first survey (assuming it covers the fishing area) should be conducted on subsequent visits;

(b)   vessels undertaking continuous trawling should attempt to match some acoustic observations with the respective trawl catches since they have the possibility to trawl acoustic layers more or less immediately after they have been recorded.

3.41   WG-EMM recommended that relevant expert groups consider appropriate methods for data collection and reporting for each of the research plans identified by Conservation Measure 52-04 as they are selected within exploratory fishery notifications.

Data reporting

Fine-scale data

3.42   All Members that fished for krill have submitted complete sets of fine-scale haul-by-haul data for 2007/08 (WG-EMM-09/6).

3.43   With regard to fine-scale haul-by-haul data reporting by vessels using the continuous trawling method, the Working Group noted the improvements made in the last 12 months. Reporting now occurs independently for every two-hour interval compared to previous reports based on daily totals being allocated equally across the two-hour intervals fished.

Historical data

3.44   The Working Group noted that a research project to digitise former Soviet krill fishing research, as well as exploratory and commercial expedition data, has been started by Ukraine (WG-EMM-09/30) and looked forward to seeing the results, noting that Russia may have additional data from the same period.

Technical Group for At-Sea Operations

3.45   The Working Group noted the following advice to WG-EMM in the ad hoc TASO-09 report (Annex 9):

(i)   Krill trawling methods (Annex 9, paragraphs 2.1 to 2.8) –

Details of vessel gear types should be catalogued to provide a reference for the *Scientific Observers Manual*, and the general terms in use for all trawl types operating in the Antarctic krill fishery as summarised in Annex 1 of TASO-09/5 should be put on the CCAMLR website.

(ii)   Methods of estimating green-weight removals in krill trawl fisheries (Annex 9, paragraphs 3.1 to 3.7) –

Further assessment is needed of the implications of using variable and fixed conversion factors, noting the need for the implementation of an accurate, repeatable volume-to-mass conversion for krill where volumetric measures are used.

(iii)   Revision of the *Scientific Observers Manual* (Annex 9, paragraphs 3.14 to 3.21) –

Agreement on a new method to quantify finfish by-catch (both larvae and finfish), which would involve the collection of one 50 kg random sample of krill catch for analysis, as well as requesting the crew to retain all the remaining large fish from the haul.

Members are requested to review the proposed changes in the *Scientific Observers Manual* (TASO-09/4) and provide feedback to the Secretariat prior to the meeting of WG-FSA-09.

(iv)   Observer recruitment and training (Annex 9, paragraph 4.5) –

Training of observers should include the areas outlined in the TASO-09 report, paragraph 4.5.

Scientific observation

Observer deployment

3.46   Eight scientific observer logbooks were submitted to the Secretariat for the 2007/08 season, and six notifications of the placement of CCAMLR international scientific observers on krill fishing vessels in Area 48 for the 2008/09 season have been received.

By-catch

3.47   There were no reported incidents of seabird mortality, but four Antarctic fur seals were reported to have been killed by krill trawler operations in Subarea 48.3. It was noted that all vessels have reported use of seal exclusion devices.

3.48   The Working Group advised the Scientific Committee and WG-IMAF that although fur seals are now rarely killed in the krill fishery in Subarea 48.3, seal exclusion devices may not all be 100% effective for avoiding by-catch of these animals.

Conversion factors

3.49   The Working Group drew attention to the discussion related to a volume-to-mass conversion factor (catch volume including seawater-to-mass of krill) which has for the first time been identified as a potential problem in estimating catch. Conversion factors discussed in previous meetings were limited to product-to-mass conversion. The UK agreed to implement a trial procedure involving the collection of volume-to-mass data for krill samples from the krill fishery and to report the results to TASO and WG-EMM next year (Annex 9, paragraph 3.6).

Observer coverage in the krill fishery

3.50   WG-EMM-09/18, 09/25 and TASO-09/7 were presented to facilitate discussion over appropriate observer coverage to address the CCAMLR objectives. The Working Group noted that all three documents identified the importance of having a high level of coverage by scientific observers in order to design an observer program for the long term.

3.51   The Working Group noted the intention of Japan to voluntarily deploy Japanese government-appointed observers in areas other than Subarea 48.3. The Working Group also noted that observer coverage on Japanese fishing operations has mainly been in Subarea 48.2 in 2008/09.

3.52   The Working Group further noted that Japan is not currently submitting observer data collected by their government-appointed observers.

3.53   The Working Group requested the Secretariat to determine whether it would be possible to develop a suitable mechanism to have the data submitted for use when needed in work of the Scientific Committee, in a manner consistent with any sensitivities surrounding those data.

3.54   The Working Group agreed that systematic coverage will generate a rich dataset and allow for detailed examination of future observation strategies.

3.55   The Working Group agreed that, to address one of the objectives agreed by the Scientific Committee in 2007, i.e. to understand the overall behaviour and impact of the fishery, it is first necessary for all krill fishing vessels participating in the krill fishery to have systematic deployment of scientific observers to be able to collect the relevant data. The

results reported in WG-EMM-09/25 suggest that in Subarea 48.3 about four years of systematic partial observer coverage was required before the characteristics of the observer data were sufficiently well understood to develop an efficient sampling program. It was noted that a partial coverage program, such as that being used in Subarea 48.3, requires a high level of coordination that would be complex to implement in Subareas 48.1 and 48.2. Consideration would need to be given to how partial coverage could deliver the required information in Subareas 48.1 and 48.2.

3.56   WG-EMM noted that the purpose of designing an observer program for the krill fishery is to determine an efficient observer program that can provide reliable data to accurately estimate the total mortality (in biomass) of krill and by-catch species (e.g. larval fish, seals and birds) in the krill fishery, as well as the krill length composition in different areas, e.g. SSMUs and seasons. It is expected that the length composition of the krill catch will be used in integrated assessments of krill (SC-CAMLR-XXVI, Annex 4, paragraphs 2.52 to 2.54), the by-catch of larval fish be used in assessments of finfish, and the by-catch of birds and seals be considered in advice by WG-IMAF.

3.57   WG-EMM-09/25 showed how the precision of estimated parameters (i.e. the CV of mean krill length and larval fish catch) would vary as functions of the proportion of vessels that were sampled and the proportion of hauls within vessels that were sampled. Increasing proportions of sampling will increase precision, although the relative improvement in precision declines at high levels of sampling. The Working Group welcomed this analysis.

3.58   The Working Group recommended that WG-SAM consider this issue further with the aim of providing advice on how the accuracy and precision of these quantities influence assessment outputs, and hence the extent to which different levels of observer coverage will improve assessments. Following the format in WG-EMM-09/25 and noting possible additional sources of variation (e.g. variation between subareas), the Working Group encouraged Members to investigate the observer deployment strategies that would deliver data at appropriate spatial and temporal scales. It was noted that observer data need to be stratified in space and time in a way appropriate to the ecology of krill (spatial and depth segregation and/or patchiness of life stages and the chronology of its life history) and the management strategy.

3.59   The Working Group noted that estimates of levels of total krill removal, by-catch and krill length composition from these data will need to be robust to other potential sources of variation, including:

(i)   between-haul variation (noting that catch of the haul may need to be a covariate);

(ii)   gear deployment (including method, e.g. conventional trawl versus continuous, mesh size, configuration and deployment strategy, such as speed and targeting, e.g. product type);

(iii)   vessels;

(iv)   other factors, e.g. depth of hauls.

3.60   The Working Group recommended that WG-SAM be asked to advise on:

(i)   an appropriate estimation structure of an integrated krill assessment that might utilise observer-derived data on krill length, which could be used to evaluate the efficacy of the observer program;

(ii)   how the accuracy and precision of quantities estimated in the observer program influence assessment outputs, and hence the extent to which different levels of observer coverage will improve assessments, taking note of the considerations in paragraphs 3.58 and 3.59;

(iii)   a provisional observer program that could be used in the interim and to help design the observer program in the longer term.

3.61   WG-EMM agreed that this issue is a high priority and recommended that a provisional program for observer coverage be adopted next year, following consideration at WG-SAM and WG-EMM.

Fishery dynamics

3.62   The Working Group noted the efforts to characterise fishery dynamics in WG-EMM-09/18, 09/P5 and 09/P10.

3.63   The Working Group noted the usefulness of fine-scale haul-by-haul data as a data source to derive movement patterns of krill fishing fleets, i.e. Levy-type random walk (WG-EMM-09/18), and updates of some parameters used in the krill fishery model developed in the late 1980s (WG-EMM-09/P5).

3.64   The Working Group noted that these analyses may help develop fishery models to allow simulation of various fishing patterns for operating models to evaluate the effects of alternative management strategies on the performance and operation of the krill fishery.

Regulatory issues

3.65   The Working Group reviewed conservation measures that apply to krill fisheries, and agreed to advise the Scientific Committee on Conservation Measures 10-04, 21-03 and 51-04.

3.66   With regard to Conservation Measure 10-04, in all CCAMLR fisheries other than the krill fishery, Flag States are required to notify the Secretariat of 'each entry to, exit from and movement between subareas and divisions of the Convention Area by each of its fishing vessels' (Conservation Measure 10-04, paragraph 13). However, this requirement currently does not apply to krill fisheries (Conservation Measure 10-04, footnote 4) and this was part of the reason why the Secretariat was not aware of a significant amount of catch being made during the 2007/08 fishing season until receiving fine-scale data after the end of the fishing season.

3.67   The Working Group advised the Scientific Committee that problems with catch reporting, however they may arise, may be resolved if the krill fishery was not excluded from the requirements of paragraph 13 of Conservation Measure 10-04.

3.68   With regard to Conservation Measure 21-03, the Working Group agreed the need to clarify footnote 1 with respect to the deadline of 1 June for the submission of notifications for exploratory fisheries for krill made under Conservation Measure 21-02.

3.69   The Working Group noted that, while Conservation Measure 23-04 does not apply to the krill fishery, there were the following advantages of aligning the deadline for the submission of fine-scale catch and effort data from krill fisheries with the deadline applicable in other fisheries:

(i)   WG-EMM will be provided with improved availability of fine-scale information, including timely access to fine-scale data during preparation for the annual krill fishery report;

(ii)   it would facilitate improved data validation by enabling more timely and frequent communication between the Secretariat and data providers, and timely cross-checking with monthly catch and effort reports;

(iii) it would improve the scheduling of data processing and validation in the Secretariat by alleviating the large amount of fine-scale data received by the Secretariat in late March each year.

3.70   The Working Group recommended that Members submit fine-scale data at reporting intervals such as employed in other fisheries.

3.71   With regard to Conservation Measure 51-04, the Working Group noted that there would be advantages if fishing vessels were to conduct research operations prior to commercial operations since:

(i)   it will provide information of krill distribution prior to any disturbance by fishing;

(ii)   vessels are likely to conduct research in the area of interest prior to commercial operation in order to find suitable fishing locations;

(iii) there would be a greater likelihood that research operations be completed.

3.72   The Working Group recommended revision of the research plan (Conservation Measure 51-04, Annex 51-04/B) to include an option to allow conduct of a research survey prior to commercial operations and other considerations listed in paragraph 3.40.

Krill surveys and monitoring

Acoustic estimates of krill biomass

3.73   The report from the recent meeting of SG-ASAM (Annex 8) was considered with respect to the determination of the levels of uncertainty in acoustic estimates, the definition of an agreed protocol for the acoustic estimation of krill biomass and the use of ancillary surveys in assessing krill biomass.

3.74   The Working Group noted that present published estimates of B_0 only include uncertainty attributed to sampling design, i.e. variation between transects (Annex 8, paragraph 31).

3.75   The Working Group agreed (Annex 8, paragraphs 30 to 32) that in the future, other elements of uncertainty in the B_0 estimate should be included, particularly with regard to uncertainty due to target strength estimation and target identification. It was recommended that, in addition to an estimate of total uncertainty associated with B_0, this estimate should be subdivided into uncertainty associated with survey design and sampling, and uncertainty associated with other processes in the assessment procedure, such as krill availability to the survey.

3.76   The Working Group recommended that the Scientific Committee consider a joint meeting between SG-ASAM and WG-SAM to combine appropriate expertise to evaluate broader aspects of uncertainty in the acoustic estimate of krill biomass.

3.77   The Working Group noted that some of the coefficients used in the simplified SDWBA had been omitted when the analysis to estimate the precautionary catch limit for Area 48 was undertaken in 2007 (Annex 8, paragraph 51), and that correct coefficients had been provided by SG-ASAM (Annex 8, Table 3).

3.78   The Working Group agreed that B_0 should be recalculated using the coefficients given in the SG-ASAM report.

3.79   The Working Group further noted that, given the complexity of the steps to calculate B_0, the outline protocol given in Appendix 3 of Annex 8, which is to be completed by the Secretariat, would be a valuable step in provision of a detailed protocol for the analysis of the CCAMLR-2000 and other acoustic data. Such a protocol should exhibit sufficient detail so that Member countries are themselves able to implement the protocol in their own post-processing systems.

3.80   The Working Group agreed that the ideal next step to recalculate B_0 would be for Members to undertake, independently, reanalyses of the CCAMLR-2000 data utilising the protocols outlined in Appendix 3 of Annex 8. Such an approach would provide a method of validating individual calculations of B_0 and such validation is recommended.

3.81   The Working Group noted that, at the current time, the only Member with the complete set of code to reprocess the CCAMLR-2000 dataset is the USA. Other Members were utilising the simplified SDWBA model to analyse their own datasets but would have to invest a substantial amount of time and effort to undertake a complete analysis of the CCAMLR-2000 dataset.

3.82   The Working Group agreed that simply distributing and utilising existing Matlab computer code held by the USA would not constitute a full independent recalculation and would not achieve the aim of having independent validation of an individual calculation of B_0.

3.83   The Working Group therefore agreed that it would not be possible to have a fully validated reanalysis of the CCAMLR-2000 dataset in time for the 2009 meeting of the Scientific Committee. Nevertheless, any Member that may be able to provide an updated biomass estimate was encouraged to do so.

3.84   The Working Group considered whether other krill acoustic datasets would provide insight into the likely result of a reanalysis of CCAMLR-2000 B_0. The US AMLR time series in the South Shetland and Elephant Island regions, and the BAS time series in the South Georgia region, have been analysed using the simplified SDWBA with the most up-to-date SDWBA model parameter values and the three-frequency krill identification protocol. The Working Group noted that these analyses generated biomass values comparable in magnitude to the earlier analyses based on the Greene et al. (1991) TS model, and the CV was generally higher when using the simplified SDWBA.

3.85   The Working Group considered that, on the basis of US AMLR and BAS results, a recalculation of B_0 (see paragraph 3.90) was unlikely to be higher than the biomass estimate presently in use (SC-CAMLR-XXVI, paragraph 3.21).

3.86   On this basis, the Working Group recommended that the current Conservation Measures 51-01, 51-02 and 51-03 are adequate interim conservation measures until the fully validated reanalysis is performed.

3.87   The Working Group agreed that, in the future, if implementation errors to an agreed protocol were discovered, then these should be corrected as soon as possible and WG-EMM and the Scientific Committee notified.

3.88   The Working Group endorsed the recommendation of SG-ASAM (Annex 8, paragraph 50) that the Secretariat work with Members to develop detailed acoustic protocols and make them available on the CCAMLR website, this would include any computer code developed to implement the protocol. Such computer code should be submitted to the Secretariat as soon as possible.

3.89   The Working Group recognised that, at present, a single estimate of absolute acoustic biomass for a CCAMLR area or division is utilised in the estimation of a precautionary catch limit. It was agreed that, in the future, it may be appropriate to consider how both large-scale and regional acoustic survey time series, might be combined to form an integrated assessment of krill biomass. The Working Group suggested that a joint meeting of SG-ASAM and WG-SAM may be an appropriate forum to consider such integrated analyses.

3.90   The Working Group recommended the following work plan for SG-ASAM prior to, and during, its next meeting:

      (i)   Review documentation of the acoustic protocol to be prepared by the Secretariat (Annex 8, Appendix 3).

(ii)   Undertake a reanalysis of CCAMLR-2000 data:

    (a)   confirm steps of analysis by correspondence prior to the next meeting;

    (b)   independent calculations of B_0 undertaken by Members during the intersessional period prior to the next SG-ASAM meeting, with correspondence between Members as appropriate to clarify pertinent issues;

    (c)   submit documented results to SG-ASAM for review;

    (d)   discuss results and add clarification to protocols if necessary;

    (e)   agree validated B_0 estimate and submit to the 2010 meeting of WG-EMM.

3.91   The Working Group advised that the work plan specified in paragraph 3.90 should be considered a high priority and that the plan would require SG-ASAM to meet in 2010.

Other krill surveys

3.92   WG-EMM-09/45 presented a krill density estimate from Subarea 48.6 from the Norwegian 2008 AKES survey. The Working Group noted that parts of the method used for estimation of biomass differed from the present CCAMLR protocol. The Working Group further noted that SG-ASAM recommended that any departures from the CCAMLR acoustic protocol and associated uncertainties and influences on results should be documented. The Working Group agreed that this was an important analysis and looked forward to a more detailed presentation of results and associated levels of uncertainty at SG-ASAM with follow-up reporting to WG-EMM.

3.93   The analysis presented in WG-EMM-09/45 is a first step in generating a combined B_0 estimate for Subarea 48.6 using acoustic data collected during the AKES survey and the German LAKRIS survey. The proposed production and submission of such a combined estimate was welcomed by the Working Group, particularly given that this subarea is likely to be the focus of an exploratory krill fishery. The Working Group noted the large size of this subarea and that any estimate would need to take account of the appropriate area of coverage and degree of stratification. The Working Group encouraged that details of a proposed stratification for these survey data be presented to WG-SAM.

Acoustic results from IPY surveys in 2008

3.94   New Zealand carried out an IPY survey to the Ross Sea in 2008. Acoustics results from the survey were discussed at SG-ASAM. The main target species of the survey was silverfish, but preliminary biomass estimates for krill and ice krill were presented to SG-ASAM. The krill biomass estimates were not calculated according to the standard CCAMLR protocol and New Zealand agreed to recalculate them using the CCAMLR protocol. The Working Group looked forward to receiving the recalculated estimates.

Climate change

3.95   The Working Group noted summaries of the proceedings of the first Southern Ocean Sentinel (SOS) Workshop (WG-EMM-09/37) and the joint SC-CAMLR–CEP workshop (SC-CAMLR-XXVIII/6), both held in 2009.   Both reports indicate broad international consensus that:

(i)   climate change impacts in the Antarctic are of major concern
(ii)   qualitative assessments of the effects of climate change are possible now
(iii)   management decisions will need to consider how climate change will affect Southern Ocean ecosystems.

3.96   The SOS program is intended to be a long-term monitoring program that can be complementary to CEMP and is a project within the ICED program.

3.97   The Working Group noted that the full report of the SOS Workshop will be provided to the Scientific Committee in 2009, along with qualitative assessments of the current understanding of climate impacts on the Southern Ocean. Dr Constable noted that identifying monitoring objectives was a topic for the next meeting of the SOS program and encouraged Members to participate to ensure the alignment of CEMP and SOS monitoring work. The Working Group encouraged Members to become involved in the development of the SOS program and in the ICED program overall.

3.98   WG-EMM-09/24 reported on how current management in the Antarctic might be impacted by climate change and provided a concise overview of the potential impacts of climate change on the biota and management approaches in the Antarctic, specifically noting that:

(i)   the precautionary approach to management will need to be examined in the context of climate change;

(ii)   harvest strategies may need to be modified to meet the objectives of Article II of the Convention.

The Working Group agreed with this paper that climate change has important implications for management approaches to the krill fishery.

3.99   The Working Group agreed that climate change has the potential to induce rapid change within ecosystems and may impact on how indices generated by CEMP might be used to detect fisheries impacts.

3.100 The Working Group noted that CEMP was designed with an emphasis on detecting fishery impacts and that climate change has implications for how such data are interpreted.

3.101 The Working Group agreed that the detection of climate impacts is likely to benefit from data that are not currently collected under CEMP. It was also agreed that the alignment of CEMP with a broader suite of scientific research would allow integrated datasets to be analysed, and that the broad suite of parameters collected under multiple programs may be useful for management purposes.

3.102 The Working Group agreed that identifying parameters that would be most relevant for distinguishing fisheries impacts from climate impacts is important for future work, and that it would be desirable if such parameters were broadly relevant to a larger scientific and management community.

3.103 The Working Group acknowledged that detection and attribution of climate change impacts at established monitoring sites remains problematic and that the development of monitoring schemes to distinguish between climate and fisheries may require reference (control) sites and/or additional parameters, noting in particular that:

(i) the data currently reported to CEMP are often a component part of research by individual Members and that procuring resources for additional data collection, particularly if new CEMP sites are required, will pose challenges for national programs;

(ii) for new CEMP and reference sites, a number of years of monitoring will be needed for establishing baselines suitable for comparison with data from current monitoring sites;

(iii) there is uncertainty as to how the fishery will respond to climate change (paragraph 3.106), and information on how the fishery might respond to different scenarios of climate change would be helpful to identify potential fishery impacts on krill-dependent predators in the future.

3.104 The Working Group noted that a useful alternative to overcome limitations on data availability is to use qualitative and/or simulation modelling to identify important parameters for monitoring. The Working Group agreed that reviewing CEMP, including the requirements for reference sites for the purposes of monitoring the effects of the krill fishery in an era of rapid climate change, is now a priority issue, noting the comments in paragraph 3.103.

3.105 The Working Group suggested that a review of CEMP and a designation of reference sites be a Focus Topic for its next meeting (paragraph 8.1).

Climate impacts on the fishery

3.106 The Working Group reviewed two papers: one that discussed the impacts of climate change on the krill fishery through the direct effect of sea-ice on the seasonal distribution of the fishery (WG-EMM-09/P6), and one that examined the effect of UV irradiation on the distribution of krill catches (WG-EMM-09/36).

3.107 The Working Group noted the initiation of the project to examine large-scale physical factors, such as ozone depletion, on the Scotia Sea ecosystem and agreed that future results would be important for the Working Group to examine. Dr Milinevsky requested assistance in the analysis of fine-scale fisheries data, noting a difficulty in producing a suitable index for integration with ozone data from the raw catch data.

Climate impacts on predators

3.108 The Working Group reviewed WG-EMM-09/P9 which reviewed evidence for climate effects on penguins, demonstrating a strong correlation between the Southern Annular Mode and population trends of penguins in the Scotia Sea.

3.109 The Working Group noted that identifying the effects of climate change on top predators is a complex problem. The Working Group agreed that climate change has affected predators over a variety of temporal and spatial scales via direct and indirect pathways and will continue to do so. The Working Group also noted that identifying population responses due to climate change may be simplified if appropriate indicator species are selected.

3.110 The Working Group noted substantial evidence for climate-related changes in reproductive performance of predators, but noted that disentangling the effects of long-term climate change and previous harvesting of predator species would be important for a full understanding of predator population dynamics in Area 48.

Feedback management strategies

3.111 The Working Group noted the discussion of the Scientific Committee in 2008 on 'Stage 1 allocation of the precautionary krill catch limit among SSMUs in Subareas 48.1 to 48.3' (SC-CAMLR-XXVII, paragraphs 3.3 to 3.21). It was further noted that the Scientific Committee did not reach consensus, thus could not provide advice to the Commission on this issue.

3.112 The Working Group recalled its advice to the 2008 meeting of the Scientific Committee (SC-CAMLR-XXVII, paragraphs 3.5 and 3.6) concerning the overall conclusions drawn from the risk assessment of three different options to subdivide the precautionary catch limit for krill in Area 48 among statistical subareas (SSMU allocation).

3.113 The Working Group also recalled the history of this work detailed in its report last year (SC-CAMLR-XXVII, Annex 4, paragraphs 2.1 to 2.7), noting the work had been progressed since 2004 (see also paragraph 3.139). The Working Group noted that the six options for consideration in Stage 1 have been (SC-CAMLR-XXVII, Annex 4, paragraph 2.3):

1. the spatial distribution of historical catches by the krill fishery;

2. the spatial distribution of predator demand;

3. the spatial distribution of krill biomass;

4. the spatial distribution of krill biomass minus predator demand;

5. spatially explicit indices of krill availability that may be monitored or estimated on a regular basis;

6. structured fishing strategies in which catches are rotated within and between SSMUs.

Option 1 is equivalent to status-quo management when recent catches are used to inform the SSMU allocation.

3.114   Options 1 to 4 are discussed in this report.

3.115   WG-EMM-09/12 expanded the assessment of risks to predators, krill and the fishery of the three SSMU allocation options (2, 3 and 4) considered in 2008 (WG-EMM-08/30; SC-CAMLR-XXVII, Annex 4, paragraphs 2.40 to 2.57) along with Option 1. The updated risk assessment includes a detailed consideration of harvest levels up to the equivalent of the precautionary catch limit, including the current trigger level. The paper also proposed three alternative approaches for managing future risks to krill-dependent predators.

3.116   The Working Group divided its discussion on this item into the following:

(i)   consideration of the risks of fishing up to the current trigger level; a point of consideration last year (SC-CAMLR-XXVII, paragraph 3.36);

(ii)   further development of feedback management procedures using simulations;

(iii)   consideration of monitoring in support of feedback management strategies.

Current trigger level

3.117   The Working Group recalled the establishment of the original precautionary catch limit for krill in 1991 (Conservation Measure 32/X) and the outcomes of the discussion of the Commission in establishing that measure (CCAMLR-X, paragraphs 6.13 to 6.17), noting the following points:

(i)   The Commission endorsed the advice of the Scientific Committee that:

(a)   reactive management is not a viable long-term strategy for the krill fishery
(b)   feedback management is to be preferred as a long-term strategy
(c)   a precautionary approach is desirable.

(ii)   The Commission expected that the distribution of fishing in the coming years would generally follow historical patterns.

(iii)   The Commission established the trigger level in response to advice from the Scientific Committee that, with respect to the precautionary catch limit:

(a)   the limit needs to be divided into statistical subareas to allow for the possible interaction between krill populations in these subareas;

(b)   this limit may need to be supplemented by other management measures to ensure that the catch is not entirely concentrated in the foraging range of vulnerable land-breeding predators;

(c)   this limit has not involved an allowance for possible unaccounted mortality (paragraphs 3.4 and 3.49) of krill associated with fishing operations (although there was very limited information on the matter).

(iv)   The Commission requested advice on subdividing the catch limit amongst subareas or at finer scales to be considered in the following year.

3.118   In 1992, the Commission agreed to an SSMU allocation according to the following percentages (CCAMLR-XI, paragraph 9.7), noting that the explanation of why the percentages sum to greater than 100% is provided in SC-CAMLR-XI, paragraphs 2.72 to 2.79):

Subarea 48.1	28
Subarea 48.2	49
Subarea 48.3	24
Subarea 48.4	5
Subarea 48.5	5
Subarea 48.6	20

3.119   The Working Group also recalled that the precautionary catch limit was based on an assessment of long-term annual yield, where the yield was determined as a proportion (γ) of the estimate of krill biomass prior to exploitation (B_0) (SC-CAMLR-XIII, paragraphs 5.15 to 5.26).   Gamma is determined using the KYM to take account of uncertainties in the estimate of biomass along with uncertainties in model parameters and natural variability.   It is chosen to satisfy the decision rules for targeted prey species.

3.120   The Working Group noted that WG-EMM-09/12 presented results on anticipated impacts of different harvest levels on krill, krill predators and the krill fishery, where harvesting levels are expressed as a fraction (the 'yield multiplier') of the precautionary catch limit, which in the model equates to a fraction of γ, set for Subareas 48.1 to 48.3.   The relative performance of predators and the fishery for Options 1 to 4 are indicated in Figures 2 and 4 of the paper respectively.   The Working Group also noted, for WG-EMM-09/12, that:

(i)   the assessment of the long-term annual yield is simulated by multiplying an estimate of biomass in the model by the current γ for Area 48 from the krill yield calculations;

(ii)   these results followed those of last year (SC-CAMLR-XXVII, Annex 4, paragraphs 2.95 to 2.102) but included Option 1 'historical fishing strategy' as well;

(iii)   there is a clear order of increasing impact on predators of the four SSMU allocation options considered: Option 2, Option 3, Option 4, and finally Option 1 (Figure 3).   The options are ranked in the reverse order (1, 4, 3, 2) in terms of the implied degree of change to current fishing patterns represented in Option 1 (Figure 4);

(iv)   the yield multiplier (Y) that relates to a trigger level is determined by dividing the trigger level catch in tonnes (*TLC*) by the catch limit in tonnes (*TAC*), $Y = TLC/TAC$, e.g. 0.62 million tonnes/3.47 million tonnes in Conservation Measure 51-01.

3.121   The Working Group noted that the high risks to predators implied by Option 4 occur because this option concentrates fishing into a small number of coastal SSMUs.

3.122   The meeting agreed that the results in WG-EMM-09/12 showed that the specification of a trigger level of 620 000 tonnes for the krill fishery in Subareas 48.1 to 48.3 was not as cautious a measure as might have been thought at the time this specification was agreed (see paragraph 3.126).

3.123   The Working Group also noted that WG-EMM-09/12 evaluated risks to krill, the predators and the krill fishery at harvest levels equivalent to the existing trigger level (paragraph 3.115). The current trigger level is a fixed value, while the estimate of B_0 is subject to change pending the results of ongoing analysis (paragraphs 3.77 to 3.80). Any changes to the B_0 estimate would also change the yield multiplier, which is equivalent to the trigger level, as in the formula in paragraph 3.120(iv).

3.124   The Working Group agreed that Option 1 may reduce the Commission's ability to achieve the objectives specified in Article II (see also the 2008 advice to the Scientific Committee – SC-CAMLR-XXVII, paragraph 3.9). This concern would be particularly important if the fishery were to become more spatially concentrated than the historical distribution of catch in areas where predators with restricted foraging ranges occur.

3.125   The Working Group recognised that the results displayed in Figures 3 and 4 summarise anticipated performance of predators and the krill fishery under different levels of krill catch and represent the best scientific evidence currently available.

3.126   The Working Group recommended that the Scientific Committee review the trigger level and its application in Conservation Measure 51-01, taking account of the advice in paragraphs 3.131 and 3.132.

3.127   On the basis of decisions of the Commission (paragraphs 3.117 and 3.118) and deliberations in the Working Group and the Scientific Committee, the Working Group agreed that:

(i)   the advice from Members fishing for krill is that the fishery will maintain the distribution of catches according to the historical distribution across Subareas 48.1, 48.2, 48.3 and 48.4;

(ii)   the trigger level was set on the understanding that:

(a)   the historical fishing pattern would be retained up to the trigger level;

(b)   in order for the fishery to proceed beyond the trigger level towards the catch limit, a management procedure needed to be in place that provided for finer-scale management of the krill fishery to achieve the objectives in Article II;

(iii)   if the catch by the fishery was near to, but remained less than, the trigger level, it could have an impact on land-based predators if it were to become concentrated into one 'coastal' SSMU or coastal portion of a statistical subarea.

3.128   With respect to the current state of knowledge, the Working Group agreed that:

(i)   the distribution of historical catches is mostly known;

(ii)   while individual consumption rates of krill predators are mostly understood, the total abundance of krill-dependent predators is currently not known, which means that the total krill consumption by predators cannot be determined at present;

(iii) the CCAMLR-2000 Survey can be used to provide an estimate of relative abundances of krill in SSMUs, although this may be revised following the current review of the estimate of B_0 in Area 48;

(iv)   based on the results of the last fishing season, the reported catch of the fishery is currently at 24% of the trigger level, noting that the total mortality of krill may be higher (paragraphs 3.4 and 3.49);

(v)   the fishery has the capacity to fish down the krill abundance in a local area before it moves to a new area within a season (SC-CAMLR-XI, paragraphs 5.24 to 5.27; Agnew and Phegan (1995));

(vi)   the total catch specified in the notifications is greater than the actual catch taken at present (WG-EMM-09/7, Figure 1; SC-CAMLR-XXVII, paragraph 4.8);

(vii) the catch in any given year, as well as the local distribution of catches, can vary because of oceanographic, climatological, environmental and biological factors, seasonal variation and economic considerations which could give rise to different catches in different local areas (paragraph 3.152).

3.129   The Working Group recalled that:

(i)   the trigger level represents the aggregate of the highest catches from each subarea during the 1980s;

(ii)   that, prior to the current work program of WG-EMM (2004 to 2009) the assumptions surrounding the trigger level were not evaluated against current understanding of ecosystem parameters, processes and variability;

(iii) Atkinson et al. (2004) have shown a decline in krill abundance (in the order of up to 80%) in Area 48 since the 1980s;

(iv)   Adélie and chinstrap penguin populations in the Antarctic Peninsula region have declined over the same period (paragraph 3.17(i));

(v)   climate change is known to be impacting ecosystem components in the region and is likely to continue to do so (paragraphs 3.95 to 3.110).

3.130 The Working Group agreed that, together, this evidence indicated the precautionary approach agreed by the Commission (paragraph 3.117(i)) will need to include a precautionary spatial allocation of the trigger level in Conservation Measure 51-01.

3.131 The Working Group also agreed that in applying such a spatial allocation:

(i) the catch from a smaller area[2] in any year could be up to a set proportion of the trigger level;

(ii) the sum of the proportions across the smaller areas could be greater than the trigger level overall, recognising the consideration of the Scientific Committee and Commission in 1992 (paragraph 3.118);

(iii) the distribution of catches across the smaller areas need not be the same as the historical distribution in every year, provided that the trigger level and the proportions of that trigger level are not exceeded;

(iv) these proportions would be replaced by the management procedure to be adopted for the fishery to expand beyond the overall trigger level.

3.132 The Working Group also agreed that the following options could be used for spatially allocating the trigger level:

(i) the proportions of historical krill catches in each smaller area, which would require a lower trigger level relative to the biomass (Table 4);

(ii) the proportions of krill biomass in each smaller area estimated from the CCAMLR-2000 Survey (Table 4);

(iii) the spatial allocations between smaller areas used previously in the conservation measure (paragraph 3.118).

3.133 Options based on estimates of predator abundance were currently considered inappropriate because of the incomplete data on predator abundances.

3.134 Some Members expressed concern that there is currently insufficient information to spatially allocate the trigger level amongst SSMUs.

3.135 The Working Group agreed that a spatial allocation of the trigger level could be made amongst statistical subareas considered in Conservation Measure 51-01 according to the procedure in paragraphs 3.130 and 3.132 to take account of the need for a precautionary approach as the trigger level is approached.

3.136 The Working Group encouraged Members to collaborate and contribute information and strategies that could be used to spatially allocate catches amongst SSMUs (paragraph 3.147).

3.137 The Working Group agreed that an audit or compilation of information related to elements involved in the development of feedback management strategies would assist in

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[2] At present, smaller management areas inside Area 48 are statistical subareas and SSMUs.

addressing concerns raised about uncertainties involved in the risk assessment. Audits of the modelling approaches, the types of data being collected and the field work programs were suggested as useful (see also paragraph 3.141). It was noted that Hill et al. (2007) and the ongoing work arising from the Joint CCAMLR-IWC Workshop meets most of the requirements of a data audit.

3.138 Members were encouraged to contribute any pertinent information beyond that which is routinely submitted to CCAMLR, in order to assist in further characterising risk to the fishery.

Developing feedback management strategies

3.139 The Working Group recalled the long history of the development of feedback management strategies for krill and how this development is required by the precautionary approach (CCAMLR-X, paragraph 6.13; SC-CAMLR-XXVI, paragraph 3.36). The Working Group also noted that the FOOSA (WG-EMM-05/13 and 06/22) model was well developed and suitable for the task of providing management advice on a Stage 1 SSMU allocation (SC-CAMLR-XXVII, Annex 7, paragraphs 6.5 to 6.25). The Working Group recognised that FOOSA had therefore been endorsed and adopted for work during previous meetings of WG-SAM (SC-CAMLR-XXVII, Annex 7, paragraphs 6.5 to 6.25) and WG-EMM (SC-CAMLR-XXVII, Annex 4, paragraphs 2.1 to 2.102).

Documentation

3.140 The Working Group agreed that documentation of the methods, validation and the manner in which results are presented should be enhanced to improve communication with both the Scientific Committee and the Commission with regard to the advice given by WG-EMM on options for allocating the precautionary catch limit for krill amongst the SSMUs in Subareas 48.1 to 48.3 and on feedback management strategies as well.

3.141 One suggestion was to produce a paper or manual, which would describe technical developments in modelling approaches in terms that would inform the non-specialist, so that management advice could be understood as it moves from the Working Group to the Scientific Committee to the Commission. This type of paper or manual, which would be appropriately referenced to technical papers, and updated annually, would document the history of model development in one place. The Working Group noted that this should be straight forward given the documentation already available on the current procedures.

3.142 The Working Group noted that models and their use of data need to be validated and developed for use by the Working Group according to the procedure recommended by WG-SAM (Annex 6, paragraphs 5.11 to 5.18) and taking account of its conclusions last year (SC-CAMLR-XXVII, Annex 4, paragraph 8.16).

Feedback management strategies and their performance

3.143 The Working Group agreed that the design of a feedback management system will require consideration of data collection, analysis and decision rules for adjusting the harvest strategy. Members were invited to consider the designs of such systems, including the feasibility of different data collection and monitoring programs.

3.144 The Working Group noted that an important part of evaluating management strategies is to use metrics of their performance that relate to the objectives in Article II. It noted that WG-EMM-09/12 used a performance measure of the risk of depleting predator populations to 75% or less than the abundances that might occur in the absence of fishing. The Working Group agreed that this was reasonable and that it may be useful to also examine median plots and the distribution of risk.

3.145 The Working Group noted that besides performance measures which characterise the risk of depleting populations, it is important to also consider Article II.3(c), which aims to prevent or minimise the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades.

Data

3.146 The Working Group noted that, with regard to Options 2 and 4, WG-EMM-STAPP and others were collating existing krill-dependent predator population survey data with a view to revising abundance estimates and estimating krill consumption.

Provision of advice

3.147 The Working Group noted that during its 2008 meeting it developed advice from two separate models (FOOSA and SMOM). It was agreed that results which are robust to differences between models (as were the results provided last year) generally provide greater confidence. Members were therefore encouraged to continue developing alternative models to better explore the consequences of management strategies under different scenarios.

3.148 The Working Group also recognised the need to increase participation and expertise in this work in order to reach the level of scientific understanding for communicating the advice arising from this work. Future inquiry into potential mechanisms to support such capacity building would be welcome (paragraphs 8.6 to 8.9).

Considerations of monitoring in support of feedback management

3.149 WG-EMM-09/31 recommended that WG-EMM develop a research and monitoring plan with the aim to progressively reduce the scientific uncertainties and data gaps

affecting the SSMU allocation in Area 48. Additionally, it was suggested the implementation of this plan would benefit from the development of a mechanism which would create the funds available for the needed tasks in scientific research and monitoring.

3.150 WG-EMM-09/26 reviewed a range of methods for detecting an impact that could be used with some CEMP or CEMP-like data as part of a feedback management system for the krill fishery. The paper evaluated the ability of each method to detect a known non-fisheries impact on fur seal pup production at Bird Island. The preferred method, which assesses the frequency of values below a fixed reference point, detected this impact with no time lag. It is relatively easy to evaluate the various risks (type I and type II error and late detection of an impact) associated with the preferred method. This facilitates specification of the criteria for declaring an impact based on trade-offs between these risks. The Working Group noted that many of the monitoring time series are now long enough to be amenable to these methods and looked forward to further application with appropriate datasets.

3.151 The Working Group noted that these issues have been considered in the past (SC-CAMLR-XII, Annex 4, paragraphs 6.5 and 6.6 and Appendix D; SC-CAMLR-XIX, Annex 4, paragraphs 3.45 to 3.54; SC-CAMLR-XX, Annex 4, paragraphs 3.58 to 3.83), and recommended that further consideration be given to scaling results to populations, taking account of spatial and temporal variability and the influence of density-dependent processes. Caution was raised that there is a trade-off between the preference for the use of various types of data in analyses and the costs associated with obtaining such data.

3.152 WG-EMM-09/23 reported an extreme event at South Georgia in early 2009 within a few months of it occurring (paragraph 3.10). The krill shortage that was central to this event affected the reproductive output of krill predators, the performance of the mackerel icefish (*Champsocephalus gunnari*) fishery and, ultimately, the performance of the krill fishery when vessels arrived at South Georgia in June 2009.

3.153 Early detection and reporting of such extreme events may be useful in a feedback management context and to provide advanced information on the likely performance of the fishery. Data which are routinely collected as part of long-term monitoring programs at South Georgia, the South Orkney and the South Shetland Islands could be used to assess krill availability over short time scales. Some of these data are submitted to CCAMLR as part of CEMP. The deadline for CEMP data submission is currently in June. Selected data from these monitoring programs and indicative availability dates are given in Table 5. The full suite of potential indices is reported in WG-EMM-09/23, Reid et al. (2005) and US AMLR Field Season Reports.

3.154 With appropriate coordination and prioritisation, data can generally be made available within a few days of collection. For datasets which require a high degree of processing (e.g. diet composition and length frequency), the data made available shortly after a breeding season will be based on gross analysis but may be appropriate for assessing krill availability. This implies that an indication of krill availability could be provided from 1 February each season, and that a broad suite of krill availability indicators (providing the most robust indication of krill availability) could potentially be provided by mid-May.

3.155 The Working Group agreed that analysis of diet data as an indirect measure of the abundance of prey in specific locations is useful for predators that are constrained to

feeding at small scales. For example, it might be usefully applied to icefish and fur seals diets. Changes in feeding locations indicated by tracking data are expected to be more appropriate indicators for widely ranging taxa such as whales and pack-ice seals.

ECOSYSTEM EFFECTS OF FISHING FOR FINFISH

4.1 The Working Group noted that this is a new agenda item and relatively new topic within the work plan of WG-EMM, and was requested by the Scientific Committee as a means to promote further collaboration between WG-EMM and WG-FSA (SC-CAMLR-XXVII, paragraph 3.56). The Working Group recognised that further deliberations during this and future meetings might lead to further refinement of the elements of this agenda item.

Dissostichus mawsoni trophic considerations

4.2 The Working Group noted many of the discussions about *D. mawsoni* as both predator and prey (within the Ross Sea) were taken under Item 2 of this report.

(i) Prey species: papers on prey of Antarctic toothfish include WG-EMM-09/16, 09/40 and 09/42. There have been several instances reported where colossal squid (*Mesonychoteuthis hamiltoni*) had been consumed by toothfish, based on the evidence of squid beaks in toothfish stomachs.

(ii) Predators: papers on potential toothfish predators were WG-EMM-09/15, 09/42, 09/P1 and 09/P2.

The Working Group also noted WG-FSA-06/P3, which provided evidence of a colossal squid and toothfish interaction. The Working Group agreed that such interactions may be more common than previously thought, but the few stable isotope data that exist suggest different relative trophic positions of squid and toothfish in different areas. The Working Group suggested that collecting more stable isotope data on toothfish predators and prey would assist in resolving these issues.

4.3 The Working Group noted WG-FSA-08/50, which identified medium-term (5–7 year) research objectives for examining ecosystem effects of the Ross Sea toothfish fishery. The paper identified two main objectives which were to address the maintenance of ecological relationships (i.e. predator/prey relationships) and to characterise wider potential ecosystem effects (e.g. by-catch and trophic cascades/keystone predator effects etc.).

4.4 The Working Group suggested that Members consider these objectives and provide feedback to New Zealand scientists who are working to develop an MRM for toothfish and macrourids on the Ross Sea slope, as well as developing monitoring techniques for the two main by-catch taxa (macrourids and skates). The Working Group encouraged continued progress on these research projects.

Other ecosystem considerations

4.5   The majority of the discussion with respect to climate impacts was considered by the Working Group under Item 3.5. Consideration of climate impacts under this agenda item was restricted to those papers or topics therein pertaining explicitly to finfish.

4.6   The SOS Workshop Report (WG-EMM-09/37) recognised 'harvested species, including icefish and krill' as one of several categories of ecosystem components vulnerable to climate change. The Working Group noted and endorsed the conclusions and future work as outlined in the SOS program relative to finfish.

4.7   WG-EMM-09/27 examined the spatial distribution of prey types implied by icefish stomach contents. The Working Group agreed that this represents a useful method for indirectly examining the spatial patterns of several prey taxa. The utility of this approach is further considered in paragraph 3.155.

4.8   The Working Group noted that the low CPUEs of *C. gunnari* (WG-EMM-09/23) in the fishery, and scientific surveys in 2009, could in part be due to a heterogeneous distribution and distributional shifts due to environmental conditions (WG-SAM-09/20). The Working Group also noted that these same conditions could cause a potentially severe perturbation to the *C. gunnari* population due to decreased condition and increased predation mortality (Everson et al., 1999). The Working Group encouraged WG-FSA to include these ecosystem considerations in their deliberations when providing advice on precautionary catch levels of *C. gunnari* in Subarea 48.3.

4.9   The Working Group noted that Italy and New Zealand had provided SG-ASAM with new information on TS relationships of *P. antarcticum* relative to length (SG-ASAM-09/5 and 09/10). There was good agreement between the results for adult fish, but the results for juveniles in both studies were more uncertain. The relationship was used along with data from the New Zealand IPY cruise to derive the first-ever estimate of *P. antarcticum* biomass in the Ross Sea (paragraphs 2.16 and 3.94). The Working Group agreed that these studies have considerably advanced our knowledge about TS and abundance of *P. antarcticum*.

SPATIAL MANAGEMENT TO FACILITATE THE CONSERVATION
OF MARINE BIODIVERSITY

Vulnerable Marine Ecosystems

5.1   Conservation Measures 22-06 and 22-07 acknowledge the urgent need to protect VMEs from bottom fishing activities and require the Scientific Committee to advise the Commission on the effectiveness of management measures currently implemented within them this year. Previous discussions on VMEs are summarised in CCAMLR-XXVII, paragraphs 5.4 to 5.30 and SC-CAMLR-XXVII, paragraphs 4.207 to 4.284, Annex 4, paragraphs 3.21 to 3.44 and Annex 5, paragraphs 10.3 to 10.109.

5.2   WG-EMM-09/8 presented a summary of VME notifications and related data received by the Secretariat for the period to June 2009. The Working Group noted that:

(i)   the Secretariat had received 30 VME indicator notifications, resulting in the declaration of seven Risk Areas in Subareas 88.1 and 88.2, and the identification of one VME fine-scale rectangle in Subarea 88.2;

(ii)   30 notifications were also made during the course of research surveys conducted by the USA in Subareas 48.1 and 48.2, and by Australia in Division 58.4.1;

(iii)   fine-scale data on VME indicator units were reported by 13 out of 18 vessels engaged in exploratory longline fisheries for *Dissostichus* spp. in 2008/09;

(iv)   the Secretariat is developing a web-based registry, including digital maps, of all known VMEs in the Convention Area. The registry will contain information on the location of VMEs, Risk Areas and VME fine-scale rectangles and composition of VME indicator taxa. An update on the status of the registry will be provided to WG-FSA.

5.3   The Working Group noted that it had been requested by the Scientific Committee to review and provide comments on VME notifications. However, although WG-EMM-09/8 provided information on numbers of indicator units encountered in each location (Table 2 of the paper), this is based only on by-catch data, and it is therefore difficult to assess whether the locations defined as Risk Areas should be given an alternative categorisation. The Working Group noted that, while reporting of benthos by-catch improved substantially in the current season and that the thresholds had been reached on some sets, it was difficult to assess the effectiveness of interim Conservation Measure 22-07 without data on the relationship between the by-catch and the habitats on which the sets had fished. However, the Working Group also noted that some vessels failed to report VME indicator catch levels for any hauls (WG-EMM-09/8, Table 7). It was also noted that WG-FSA is the appropriate body to provide information on how to mitigate the risks to VMEs.

5.4   The Working Group requested that the VME Workshop should consider what proportions of fishable areas would comprise different benthic habitats. It further requested that WG-FSA should consider whether the frequency of observations of benthos in by-catch is consistent with the proportional coverage of these different habitats.

5.5   WG-EMM-09/32 described the detection of VMEs in the southern Scotia Arc (Subareas 48.1 and 48.2) during the 2006 and 2009 US AMLR surveys, using research bottom trawl sampling and underwater imagery. High densities of VME indicator taxa were encountered in 17 areas off the northern Antarctic Peninsula and 11 areas off the South Orkney Islands, and these areas have been proposed for inclusion in the CCAMLR VME Registry.

5.6   WG-EMM-09/32 noted that Conservation Measure 22-06 does not provide a threshold level for the abundance of VME taxa that is sufficient to trigger designation of the sampled location as a VME. Annex 22-06/B provides a notification form for Contracting Parties to notify the Secretariat when evidence of VMEs has been encountered, and has not otherwise been reported under Conservation Measure 22-07. The authors proposed a standardised measure of VME indicators per unit area (10 kg/1 200 m^2 of swept area in the trawl) for consistency with the requirements of Conservation Measure 22-07, to differentiate between areas where VME indicator species might be found at very different levels of abundance.

5.7   The Working Group agreed that relevant data can be collected and systematically collated from research surveys to provide information on VMEs. Such data could provide proxies to forecast other locations in which these habitats might occur. Historical datasets may also be useful in providing information on VMEs, and Members were encouraged to examine such data in this context.

5.8   The Working Group recommended that WG-EMM-09/32 should be forwarded to WG-FSA for commentary on its proposals, and on operational considerations including the overlap of some VME areas with the experimental harvest regime for crabs in Subarea 48.2 (Conservation Measure 52-02, Annexes 52-02/B and 52-02/C).

5.9   The Working Group also agreed that the following points should be considered by the VME Workshop:

(i)   Data collected from the Scotia Arc suggest that the current minimum depth limit applied by CCAMLR in measures to protect benthic habitats is appropriate, but that there may be deeper locations which also require attention. The VME Workshop should consider whether it is possible to define a depth range suitable for application in such measures throughout the Convention Area.

(ii)   In certain locations, there was insufficient evidence of indicator taxa in the catch to trigger the 10 kg/1 200 m^2 threshold, although the video transect provided ample evidence of a VME. In particular, the substantial difference in mass between 'heavy' and 'light' indicator taxa means that 'light' taxa are much less likely to occur in sufficient mass to trigger the presence of a VME at the current threshold. It is proposed that a lower threshold for 'light' indicator taxa should be considered, and that the level of this threshold should be discussed further.

(iii)   The presence of high densities of rare taxonomic groups or unique community assemblages specific to the Southern Ocean may warrant additional attention, and perhaps an increased level of precaution. In addition, high densities of unique and potentially endemic taxonomic groups not listed in Annex 22-06/B or the CCAMLR Benthic Invertebrate Classification Guide (e.g. Pterobranchia) had been encountered off the South Orkney Islands, and could be considered for inclusion as VME indicator taxa.

5.10   The Working Group noted two additional papers that will be useful in informing further work to model the vulnerability and resilience of benthic habitats:

(i)   WG-EMM-09/35 described a method to predict the vulnerability of benthic organisms to disturbance, using relationships between life-history characteristics and physical and chemical habitat variables. These relationships can be used as predictive tools to provide values for life-history parameters, and suggest that many of these taxa will show low resilience to disturbance, with recovery trajectories predicted to be in the orders of many decades or centuries.

(ii)   WG-SAM-09/21 developed a simulation model to capture key properties of the benthic system, such as rates of decay, recovery and connectedness between areas (Annex 6, paragraphs 4.8 to 4.19).

5.11   The Working Group agreed that there was a need to further develop plausible bounds for parameters used in the models described in WG-SAM-09/21 and WG-EMM-09/35 for consideration by the VME Workshop and WG-FSA. It also agreed that it would be useful to expand the approach set out in WG-EMM-09/35 to other taxonomic groups.

5.12   With reference to WG-SAM-09/21, the Working Group noted the conclusions of WG-SAM concerning the model itself (Annex 6, paragraphs 4.7 to 4.15) and model evaluation and validation (Annex 6, paragraphs 4.11 to 4.17), in particular the recommendations that WG-EMM and the VME Workshop should:

(i)   discuss ecologically appropriate parameterisations and functional forms for use in the simulation model;

(ii)   distinguish, as far as possible, between appropriately interpreted empirical observations and subjective expert knowledge to inform the parameterisation and selection of functional forms.

5.13   The Working Group provided the following advice for further development of the model described in WG-SAM-09/21, for the VME Workshop and WG-FSA:

(i)   Map –

(a)   data layers that would be of value for modelling the dynamics of habitats, fish and fishery include depth, proximity to glaciers and ice shelves as well as data that could drive fish or habitat distributions;

(b)   the development of example maps by Members that could be imported into the simulations, for areas where adequate data exists (e.g. portions of the Ross Sea slope), based on bathymetry, satellite data, geomorphology or bioregionalisations, would be valuable for including in the evaluations.

(ii)   Fish –

(a)   fish may or may not have distributions related to habitats, depending on their habit and locations and the different spatial scales at which fish can be expected to respond to environmental variation. Options to vary these dependencies will be helpful.

(iii)   Habitats –

(a)   there is a need to identify what each habitat layer represents, whether that be broad biophysical classification, spatial patch type, species or population, noting that the opportunity for many layers in the model means that many different levels of biological/ecological resolution can be included within a single simulation;

(b)   there may not be a need to have a decay function if the recovery and disturbance models can be developed to be independent of that requirement;

(c)   options for considering rare species and local endemism would be useful in the model but this is likely to be best represented in user-defined maps and inputs of habitat data;

(d)   using available data and bioregionalisation work, some consideration could be given to how to characterise the spatial variation and covariation of habitat layers within cells and between habitats and how fish may be related to these.

(iv)   Natural disturbance –

(a)   disturbance by ice scour is likely to be the most important natural disturbance to represent, but that this should be restricted to cells in shallow areas of maps that are eventually constructed, although a further consideration may be the proximity to iceberg sources.

(v)   Fishery –

(a)   the use of an ideal free distribution to model the fishery (i.e. the intensity of fishing effort is directly proportional to the abundance of the fish) seems sensible with variation in its performance in individual cells, subject to (b) below;

(b)   it was suggested that it is important to be able to represent spatial limitations of a fishery when this occurs, such as could occur when constrained by the seasonal advance and retreat of sea-ice (as in the Ross Sea), taking account of interannual variation if needed;

(c)   taking account of previous fishery disturbances would be useful;

(d)   the observations of benthic by-catch should be scaled by the degree of impact;

(e)   it is important to account for both footprint width and the degree of impact within the footprint when calculating the impact of fishing on VMEs.

5.14   The Working Group requested that the author of WG-SAM-09/21 provide the VME Workshop with a summary table of the parameters and questions to be addressed for the model to be appropriately configured for evaluating strategies for conserving VMEs at the meeting of WG-FSA. The Working Group encouraged Members to contribute information to the workshop that could be used as inputs to the model and to help construct scenarios for these evaluations.

Protected areas

5.15   The Working Group recalled its previous deliberations on protected areas, noting the conclusions of the Scientific Committee last year (SC-CAMLR-XXVII, paragraph 3.55) and that WG-EMM-09/9 provided a useful summary of approaches within CCAMLR and the Antarctic Treaty on this issue, as well as outlining how a range of tools for spatial

management can be used to help the Commission achieve its objectives on MPAs. It also noted that the Commission had 'urged the Scientific Committee to proceed with this work as a matter of priority. The Commission reaffirmed the need to develop advice on MPAs which was commensurate with Articles II and IX of the Convention' (CCAMLR-XXIII, paragraph 4.13).

5.16   The Working Group noted the endorsement by the Scientific Committee of the priority areas (SC-CAMLR-XXVII, Annex 4, paragraph 3.77 and Figure 12) on which focus should be given for developing a representative system of MPAs (SC-CAMLR-XXVII, paragraph 3.55(iv)). It also noted that these areas are not expected to become MPAs in their entirety, but that smaller areas within, but not limited to, the priority areas may be identified for designation as MPAs. The Working Group also noted that the priority areas had been endorsed by the Committee on Environmental Protection (CEP XII Report[3], paragraph 163).

5.17   The Working Group noted that a number of papers are pertinent to further consideration of protected areas in the following four priority areas:

(i)   Priority Area 1 – Antarctic Peninsula, including the spatial distribution of whales being determined by distribution of life stages of krill (WG-EMM-09/33). It also noted:

(a)   the predictable spatial segregation of different whale species and how this was likely to apply for other krill predators around the South Shetlands;

(b)   the potential for ships of opportunity, such as tourist vessels, to be used to identify distributions of predators;

(c)   the potential to use spatial distributions of predators as data layers in analyses of potential areas for MPAs.

(ii)   Priority Area 2 – South Orkney Islands, including collation of data for the area and analyses within a systematic conservation planning framework (WG-EMM-09/22), which is discussed further below.

(iii)   Priority Areas 10 and 11 – Ross Sea and adjacent area, including consideration of oceanography (WG-EMM-09/41), food webs (WG-EMM-09/42), toothfish dynamics (WG-EMM-09/40) and the ecosystem as a whole (WG-EMM-09/13, 09/14 and 09/P3). It also noted that many of these papers are consistent with the identification of these areas as priority areas.

5.18   With respect to Priority Area 11, Dr B. Sharp (New Zealand) presented preliminary outcomes from a New Zealand workshop on bioregionalisation and spatial ecosystem processes in the Ross Sea region, held in June 2009. He noted the main outcomes for the Ross Sea region were:

(i)   a fine-scale pelagic bioregionalisation
(ii)   a fine-scale benthic/demersal bioregionalisation
(iii)   a list/map of important ecosystem processes that may be amenable to protection using spatial management tools.

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[3]   www.ats.aq/documents/ATCM32/att/atcm32_att084_rev2_e.doc

5.19   The Working Group noted that the Ross Sea bioregionalisations will make a significant contribution to the work of the Scientific Committee and looked forward to the results being submitted in the near future.

5.20   WG-EMM-09/22 described an updated method and preliminary results for the selection of benthic and pelagic areas of conservation importance in Subarea 48.2, noting that the work was now at a stage that a preliminary assessment on MPAs in this area can be provided for consideration by the Scientific Committee this year.

5.21   The Working Group noted the following points about this assessment using MARXAN in Subarea 48.2:

(i)   the objectives used as inputs to the MARXAN analysis were given values at the lower end of the ranges typically used in such analyses. It was noted that increasing these values tended not to significantly increase the size or locations of the core areas identified for inclusion in MPAs;

(ii)   the data layers included in the analysis accommodated a range of scales of ecological processes expected to operate in the vicinity of the South Orkney Islands;

(iii)   increasing the number of data layers would potentially result in the inclusion of highly correlated data, which would tend to bias the results towards those data that are over-represented in the analysis;

(iv)   more selective use of data may provide a refined result but potentially would not reflect appropriate ecological processes.

5.22   The Working Group noted that the use of fishery data appears not to take account of socio-economic requirements, which were identified as a factor that had been considered at WSSD. However, the Working Group agreed that the analysis of the fishery requirements was sufficient given the following:

(i)   the economics of fishing activities is not currently considered by the Commission and therefore cannot be incorporated into the analysis unless this policy is changed;

(ii)   information provided to the Working Group in section 3.6 indicates that the fishery already concentrates on a number of favoured areas and, as a result, the analysis incorporates adequate knowledge of fishing operations. Further, no new information is available that would result in changes to preferred fishing areas.

5.23   The Working Group agreed that the data used in WG-EMM-09/22 have been used appropriately and that the analyses are likely to yield a conservative and unbiased estimate of target areas for MPAs in the South Orkney Islands region. It therefore recommended that the Scientific Committee consider these results (see Figures 5 and 6) and any extension to the analysis in WG-EMM-09/22 to identify MPAs in Subarea 48.2 for inclusion in a representative system of MPAs.

5.24   The Working Group thanked the authors of WG-EMM-09/22 for providing their analysis and the procedure for identifying areas for inclusion in a representative system of MPAs which should be easily understood by scientists, fishers and policy makers. The Working Group encouraged Members to continue the application of this approach (SC-CAMLR-XXVII, Annex 4, paragraph 3.59), and other approaches, within the priority areas (paragraphs 5.16 and 5.32).

Harmonisation of approaches (both within CCAMLR and across the ATS)

5.25   SC-CAMLR-XXVIII/6 is the report of the Joint SC-CAMLR–CEP Workshop held in Baltimore, USA, on 3 and 4 April 2009. Two papers that were provided to the workshop were also submitted to WG-EMM and have been discussed in other sections – WG-EMM-09/9 (see paragraph 5.15) and WG-EMM-09/24 (see paragraph 3.98). It was noted that both papers were well received by the Joint Workshop and the authors were congratulated for their work.

5.26   WG-EMM noted that the CEP had accepted all of the recommendations of the workshop report and, in commending it to SC-CAMLR, the CEP had stressed the importance of maintaining momentum on the issues identified (CEP XII Report, paragraph 267).

5.27   The Working Group agreed with the recommendations of the Joint Workshop (SC-CAMLR-XXVIII/6), noting the five areas of common interest:

(i)   climate change and the Antarctic marine environment
(ii)   biodiversity and non-native species in the Antarctic marine environment
(iii)   Antarctic species requiring special protection
(iv)   spatial marine management and protected areas
(v)   ecosystem and environmental monitoring,

and it recommended that the report of the Joint Workshop be published as an annex to the Scientific Committee's report in order to make the recommendations readily available to Members.

5.28   WG-EMM-09/46 described how Conservation Measure 91-02 (2004) affords protection of the Cape Shirreff CEMP site. Cape Shirreff is also protected as ASPA 149 through the Antarctic Treaty. The management plans for Cape Shirreff are due for review by CCAMLR in 2009 and by the ATCM in 2010. Both plans recognise the importance of the CEMP site and associated scientific research and afford area protection.

5.29   The Working Group agreed with the recommendation in WG-EMM-09/46 that, to assist with harmonising protection under CCAMLR and the Antarctic Treaty, and to avoid duplication of effort on the part of researchers, national governments and the secretariats of CCAMLR and the ATS, Conservation Measure 91-02 be allowed to lapse with the protection of Cape Shirreff continuing under the management plan of ASPA 149.

5.30   The Working Group noted that with the lapsing of Conservation Measure 91-02, there would be no sites afforded additional protection under the provision of Conservation

Measure 91-01. It recommended that, where sites from which CEMP data are currently collected and afforded protection as ASPAs or ASMAs, they be listed in an annex to Conservation Measure 91-01.

5.31 The Working Group noted that a Special Fund had been established by Belgium in 2005 to support work on MPAs (CCAMLR-XXIV, paragraph 3.29). The Secretariat confirmed that additional funds had been contributed by the UK in 2009, and that the total amount now available in the Special Fund is approximately A$58 000. The Working Group expressed its appreciation to Belgium and the UK for making these funds available.

5.32 The Working Group agreed that significant further work is required to progress the establishment of a representative system of MPAs across the Convention Area by 2012, within the timeline agreed by the WSSD. It also noted the high priority afforded to this work by the Scientific Committee (SC-CAMLR-XXVII, paragraph 3.55) and the Commission (CCAMLR-XXVII, paragraph 7.2), and recalled that the issue of MPAs had been identified as one of the Scientific Committee's priority items in its consideration of the Performance Review Panel Report (SC-CAMLR-XXVII, paragraph 10.10).

5.33 It was agreed that work to progress the establishment of a representative system of MPAs across the Convention Area could include projects which aimed to:

(i) collate physical and biological datasets to support bioregionalisation and systematic conservation planning analyses across the Convention Area and/or for specific region(s);

(ii) identify areas for protection, focusing on the 11 priority areas defined by the Working Group (SC-CAMLR-XXVII, Annex 4, Figure 12), and endorsed by the Scientific Committee (SC-CAMLR-XXVII, paragraph 3.55(iv)) and CEP (CEP XII Report, paragraph 163);

(iii) build capacity among Members to contribute towards systematic conservation planning and other analyses relevant to the development of MPAs;

(iv) work within existing or future research groups to achieve these objectives.

5.34 The Working Group recognised that the MPAs Special Fund could be utilised to facilitate such work, and recommended that a correspondence group should be convened immediately following WG-EMM to expedite the development of coordinated proposals for use of the available funds. The terms of reference for this correspondence group would be to:

(i) consider the types of proposal(s) which might be appropriate for further development, based on the aims outlined in paragraph 5.33;

(ii) elaborate the details of specific proposal(s), as appropriate;

(iii) outline any further work which may be required to facilitate the development of proposals and/or the allocation of funds;

(iv) submit a paper to SC-CAMLR-XXVIII summarising the discussions on (i) to (iii), and requesting specific advice from the Scientific Committee on the next steps, as appropriate.

5.35   The correspondence group would not be responsible for reviewing proposals or making recommendations on the allocation of funds, and the Working Group noted that the Scientific Committee would provide advice on these decisions as required.

5.36   It was agreed that Dr Grant would coordinate the correspondence group. The Working Group requested the Secretariat to communicate details of the correspondence group and its terms of reference to all Members as soon as possible, and to encourage Members to participate in its discussions.

5.37   The Working Group also noted that, if they wish to do so, Members are able to submit individual proposals to the Secretariat for use of the MPA Special Fund, in addition to any coordinated proposals that might be developed by the correspondence group (see CCAMLR-XXVII, paragraph 7.7).

ADVICE TO THE SCIENTIFIC COMMITTEE AND ITS WORKING GROUPS

6.1   The Working Group identified the following advice to the Scientific Committee and its Working Groups:

(i)   overlap with toothfish fishery and predators (paragraph 2.42);

(ii)   mitigating risks to predator population from the Ross Sea toothfish fishery (paragraphs 2.46 to 2.50 and 2.52);

(iii)   potential mortality rate of krill in the fishery (paragraphs 3.4 and 3.7);

(iv)   ecosystem anomaly at South Georgia (paragraph 3.10);

(v)   new CEMP sites (paragraphs 3.12 and 3.14);

(vi)   progress and work plan for WG-EMM-STAPP (paragraph 3.20);

(vii)   revised total krill catch in 2007/08 (paragraphs 3.26 and 3.27);

(viii)   translation requirements for krill notifications (paragraph 3.32);

(ix)   research requirements in exploratory krill fisheries (paragraphs 3.34, 3.35 and 3.38 to 3.41);

(x)   efficacy of seal exclusion devices in the krill fishery (paragraph 3.48);

(xi)   requirements for observer coverage in the krill fishery (paragraphs 3.54, 3.55, 3.58, 3.60 and 3.61);

(xii)   conservation measures relevant to the krill fishery (paragraphs 3.67 to 3.72);

(xiii)   acoustic estimation of krill biomass (paragraphs 3.75 to 3.78, 3.80, 3.82, 3.83, 3.85 to 3.88, 3.90 and 3.91);

(xiv)   impacts of climate change (paragraphs 3.99, 3.101, 3.102 and 3.104);

(xv)   trigger level in Conservation Measure 51-01 (paragraphs 3.122 to 3.126 and 3.130 to 3.137);

(xvi)   developing feedback management strategies (paragraphs 3.140 and 3.142);

(xvii)   inclusion of ecosystem considerations of icefish by WG-FSA (paragraph 4.8);

(xviii) advice to the VME Workshop (paragraphs 5.4 to 5.9, 5.13 and 5.14);

(xix)   representative system of MPAs in Subarea 48.2 (paragraph 5.23);

(xx)   report of the Joint SC-CAMLR–CEP Workshop (paragraph 5.27);

(xxi)   recommendations with respect to Conservation Measures 91-01 and 91-02 (paragraphs 5.29 and 5.30);

(xxii)   development of proposal for projects and access to MPA Special Fund (paragraphs 5.35 to 5.37);

(xxiii) capacity building and burden sharing (paragraphs 8.7 to 8.9).

FUTURE WORK

7.1   The Working Group identified the following future work:

(i)   stomach contents of toothfish (paragraph 2.14);

(ii)   size-specific data on toothfish consumed by predators (paragraph 2.29);

(iii)   models of the Ross Sea ecosystem (paragraphs 2.33, 2.51 and 2.53);

(iv)   distribution of toothfish and predators in winter (paragraph 2.43);

(v)   potential mortality rate of krill in the fishery (paragraphs 3.5 and 3.6);

(vi)   coordination of monitoring with the CEP (paragraph 3.15);

(vii)   photographic census methods (paragraph 3.22);

(viii)   diagrams of seal exclusion devices from Japan and the Republic of Korea (paragraph 3.31);

(ix)   krill conversion factors and volume-to-mass estimation (paragraphs 3.45(ii) and 3.49);

(x)   revision of the CCAMLR *Scientific Observers Manual* (paragraph 3.45(iii);

(xi)   submission of Japanese observer data to CCAMLR (paragraph 3.53);

(xii)   stratification of Subarea 48.6 (paragraph 3.93);

(xiii) characterising risk to the krill fishery (paragraph 3.138);

(xiv)   model validation procedures (paragraph 3.142);

(xv)   development of alternative models (paragraph 3.147);

(xvi)   MRM of toothfish and macrourids (paragraph 4.4);

(xvii) collection of stable isotope data on toothfish predators and prey (paragraph 4.2(ii));

(xviii) data collation to map VMEs and parameterise models (paragraphs 5.7, 5.11 and 5.13);

(xix)   application of systematic conservation planning tools in priority areas (paragraph 5.24);

(xx)   development of proposal for projects and access to MPA special funds (paragraphs 5.33 and 5.34).

OTHER BUSINESS

Consideration of potential future Focus Topics for WG-EMM

8.1   The Working Group discussed the potential for future Focus Topics on the development of an observer scheme for krill (paragraph 3.61) and the future design of the monitoring requirements to deliver feedback management of krill, especially considering climate change and including the concept of reference sites (paragraph 3.105). In recognising the role of Focus Topics to provide flexibility to address the priorities of the Scientific Committee, the Working Group agreed to await the recommendation of the Scientific Committee meeting this year before determining the requirement for, and potential theme of, any Focus Topic at WG-EMM in 2010.

8.2   The Working Group also noted that it is important to recognise that workshops and Focus Topics often represent the initiation of a longer-term work plan (e.g. the work of WG-EMM-STAPP arising from the Predator Workshop in 2008 (paragraph 3.19)) and that this should be considered in managing future workload and expectation.

CCAMLR Performance Review

8.3   The Working Group discussed the priorities identified by the Scientific Committee arising from the report of the CCAMLR Performance Review Panel (SC-CAMLR-XXVII, paragraphs 10.1 to 10.11) that were relevant to its work.

8.4   The Working Group recognised the importance of the Report of the CCAMLR Performance Review Panel and that the positive nature of the report had been widely acknowledged and provided an opportunity to continue to promote the work of CCAMLR.

8.5   In considering the mechanism to address the priority areas outlined by the Scientific Committee, the Working Group noted that it already had a very full workload and the issues of capacity building and burden sharing provided an overarching theme that would influence its ability to address these in the future. These latter issues were also highlighted as priorities in the Performance Review Panel Report.

Capacity building and burden sharing

8.6   In recognising the issues raised in paragraph 8.5, the Working Group agreed that addressing the issue of capacity building was an important precursor to address burden sharing and discussed a potential mechanism to achieve greater active engagement in its work.

8.7   The Working Group agreed that one potential mechanism to achieve greater participation might be to create a funding mechanism to support the attendance at Working Group meetings of young scientists from Members who otherwise would not have been able to engage in the work of WG-EMM. This would involve the Member nominating a young scientist and providing a CV and an abstract for a paper to be provided to the Working Group. Following the outcomes of the selection process, the successful nominee would be invited to submit their paper to the next meeting of the Working Group. In order to maximise the opportunity to develop an area of work based on the feedback from the Working Group, the successful nominee would be funded to attend their first Working Group meeting through the Special Fund, and there would be a commitment from the Member to fund their attendance at the next meeting of the Working Group (such a commitment would be a prerequisite).

8.8   In addition to the facilitation of attendance at its meeting, the Working Group recognised the potential value of adopting an active mentoring scheme, possibly including collaboration between the successful nominee and an established participant in the Working Group, and being tied to the meeting scholarship program outlined above.

8.9   The Working Group advised the Scientific Committee to consider various mechanisms for capacity building, including those outlined above, as a matter of priority.

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

9.1   The report of the meeting of WG-EMM was adopted.

9.2   In closing the meeting, Dr Watters thanked all of the rapporteurs, participants and the Secretariat for their helpful engagement and high level of scientific input into the meeting, in particular he thanked Dr Jones for chairing those parts of the meeting during which his own papers were considered. On behalf of the meeting Dr Watters also thanked Mr Iversen, and through him the IMR and Norwegian Foreign Ministry, for providing excellent facilities and meeting arrangements. Dr Watters also thanked the Secretariat for its support.

9.3   Dr Constable, on behalf of the participants, thanked Dr Watters for his good humour, spirit and enthusiasm throughout the meeting.

9.4   The meeting closed.

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Table 1: Progress by WG-EMM-STAPP in estimating krill consumption by air-breathing predators in Area 48. Italics: progress up to WG-EMM-09; bold: likely progress to WG-EMM-10; X: work commenced; XX: work well progressed; XXX: work completed.

Tasks required for estimating krill consumption	Pack-ice seals (at sea)	Fur seals (on land)	Penguins (on land)	Flying seabirds (on land)	Flying seabirds (at sea)
Collection/collation data	*XXX*	*XXX*	*XX**X**	*XXX***	*X***X**
Develop estimation procedure	*XXX*	*X***X**	*XX*	*XXX***	
Estimate abundance: breeders	*XXX*	*X***X**	*XX*	*XXX***	
Estimate abundance: non-breeders	*XXX*	*X***X**	**X**		
At-sea distribution	*XXX*	**XX**			
Diet and energetics	*XXX*	*X***X**	*XX*		*X***X**
Estimate krill consumption	*XXX*				

* For white-chinned petrels in Subarea 48.3 only.

Table 2: Ontogenetic patterns in diet of *Dissostichus mawsoni* in the Ross Sea, based on information in WG-EMM-09/16, 09/40 and 09/42.

Life stage	Size	Habit	Habitat	Main prey
Post-larvae	<15 cm	Nektonic	Oceanic	Krill, zooplankton
Juvenile	15~60cm	Demersal	Shelf	Silverfish, crustaceans
Pre-adult	60~100cm	Bathypelagic	Slope	Icefish, macrourids, squid
Adult	100+ cm	Bathypelagic	Slope, seamounts	Squid, macrourids, *Antimora*

Table 3:   Summary of notifications for krill fisheries in 2009/10.

Member	Name of vessel	Expected level of catch (tonnes)	Months during which fishing will proceed 2009	2010											Subareas and/or divisions where fishing will take place Subarea				Division		Fishing technique
			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	
China	*An Xing Hai*	3 000	x	x	x	x									x	x	x	x			T
	Kai Li	3 000	x	x	x	x									x	x	x	x			T
	Kai Xin	3 000	x	x	x	x									x	x	x	x			T
Japan	*Fukuei Maru*	30 000		x	x	x	x	x	x	x	x				x	x	x				T
Korea, Republic of	*Insung Ho*	12 000			x	x	x	x	x	x	x				x	x	x				T
	Kwang Ja Ho	18 000			x	x	x	x	x	x	x				x	x	x				T
	Dongsan Ho	35 000		x	x	x	x	x	x	x	x	x	x		x	x	x				T
Norway	*Juvel*	50 000	x	x	x	x	x	x	x	x	x	x			x	x	x				T
	Saga Sea	50 000	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	C
	Thorshøvdi[1]	65 000	x	x	x	x	x	x	x	x	x				x	x	x				CPB
Poland	*Dalmor II*	9 000					x	x	x	x	x	x			x	x	x				T
Russia	*Maksim Starotsin*	75 000	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			TCPB
Ukraine	*Konstruktor Koshkin*	10 000			x	x	x								x	x					T
Total	13 vessels	363 000	7	9	12	13	10	9	9	9	9	5	3	2	13	13	12	4	1	1	

Fishing technique: T – traditional; C – continuous fishing system; P – pumping to clear codend; B – beam trawling
[1]   *Thorshøvdi* has notified its intent to fish in the exploratory fishery in Subarea 48.6 – total of 15 000 tonnes included above.

Table 4: Proportional subdivision of recent krill catches and krill biomass from the CCAMLR 2000 Survey among the 15 SSMUs in Statistical Areas 48.1–48.3. Subdivisions of the historical catches are derived from SSMU-specific catches for the last five fishing seasons (see WG-EMM-09/6, Table 8). Subdivisions of krill biomass are from Hill et al. (2007). Pelagic SSMUs are highlighted in bold type, and the total subdivision to these SSMUs is reported in the row marked 'pelagic'. The total subdivision to coastal SSMUs is reported in the row marked 'coastal'. Totals are also provided by Subarea. Antarctic Peninsula (AP) SSMUs: Pelagic Area (APPA); Bransfield Strait East (APBSE); Bransfield Strait West (APBSW); Drake Passage East (APDPE); Drake PassageWest (APDPW); Antarctic Peninsula West (APW); Antarctic Peninsula East (APE); Elephant Island (APEI). South Orkney Islands (SO) SSMUs: Pelagic Area (SOPA); North East (SONE); South East (SOSE); West (SOW). South Georgia (SG) SSMUs: Pelagic Area (SGPA); East (SGE); West (SGW).

Subarea	SSMU	Proportion of catch	Proportion of biomass
48.1	**APPA**	**0.0006**	**0.0729**
	APBSE	0.0387	0.0160
	APBSW	0.0254	0.0122
	APDPE	0.0250	0.0091
	APDPW	0.1038	0.0088
	APW	0.0009	0.0204
	APE	0.0000	0.0341
	APEI	0.0188	0.0205
48.2	**SOPA**	**0.0036**	**0.3058**
	SONE	0.0099	0.0238
	SOSE	0.0003	0.0347
	SOW	0.4448	0.0361
48.3	**SGPA**	**0.0004**	**0.3475**
	SGE	0.1933	0.0326
	SGW	0.1343	0.0255
48.1		0.2132	0.1940
48.2		0.4587	0.4004
48.3		0.3281	0.4056
Pelagic		**0.0047**	**0.7262**
Coastal		0.9953	0.2738

Table 5: Parameters indicating krill availability with indicative availability dates derived (where possible and indicated *) from the CEMP standard methods.

CEMP method	Parameter	Species	Location	Indicative availability date
A6	Penguin breeding success	Adélie	South Orkney and South Shetland Islands	06-Feb*
		Chinstrap	South Orkney and South Shetland Islands	01-Mar*
		Gentoo	South Orkney and South Shetland Islands	01-Feb
		Gentoo	South Georgia	01-Feb
		Macaroni	South Georgia	25-Feb*
A7	Penguin fledging mass	Adélie	South Orkney Islands	06-Feb*
		Adélie	South Shetland Islands	25-Jan*
		Chinstrap	South Orkney Islands	01-Mar*
		Chinstrap	South Shetland Islands	25-Feb*
		Gentoo	South Georgia	23-Feb*
		Macaroni	South Georgia	25-Feb*
A8	Penguin chick diet	Adélie	South Orkney and South Shetland Islands	01-Feb*
		Chinstrap	South Orkney and South Shetland Islands	01-Mar*
		Gentoo	South Georgia	15-Mar*
		Macaroni	South Georgia	01-Mar*
B2	Flying seabird breeding success	Black-browed albatross	All	16 April OR the date when all birds have fledged*
-	Krill acoustic density estimate	Krill	South Georgia	01-Feb
		Krill	South Shetland Islands	01-Feb
-	Mackerel icefish diet	Mackerel icefish	South Georgia	01-Mar
-	Weaning mass	Fur seal	South Georgia	01-Jan
-	Pup survival	Fur seal	South Georgia	01-Jan
-	Early diet	Fur seal	South Shetland Islands	01-Feb
C1	Foraging trip duration	Fur seal	South Shetland Islands	01-May
		Fur seal	South Georgia	01-May

(a) End of 2007
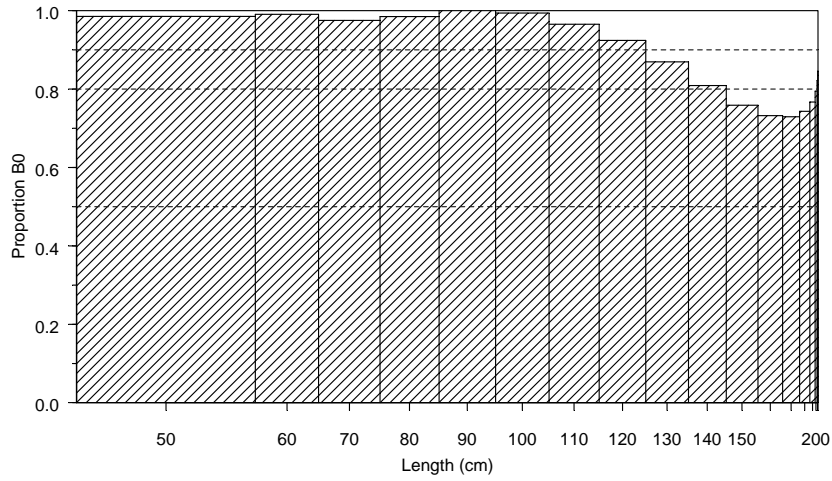
(b) End of the projection period (2042)
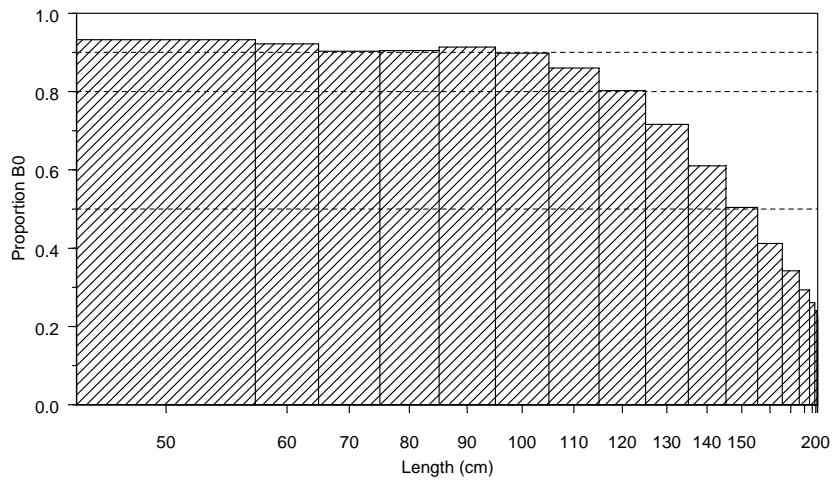
Figure 1:   Estimated median relative abundance by size class from the 2007
assessment for *Dissostichus* spp. in Subarea 88.1. Relative abundance is
determined as the ratio of the abundance in the size class in the year
relative to the initial (B_0) abundance. Bar widths are proportional to the
relative abundance of each size class in the population.
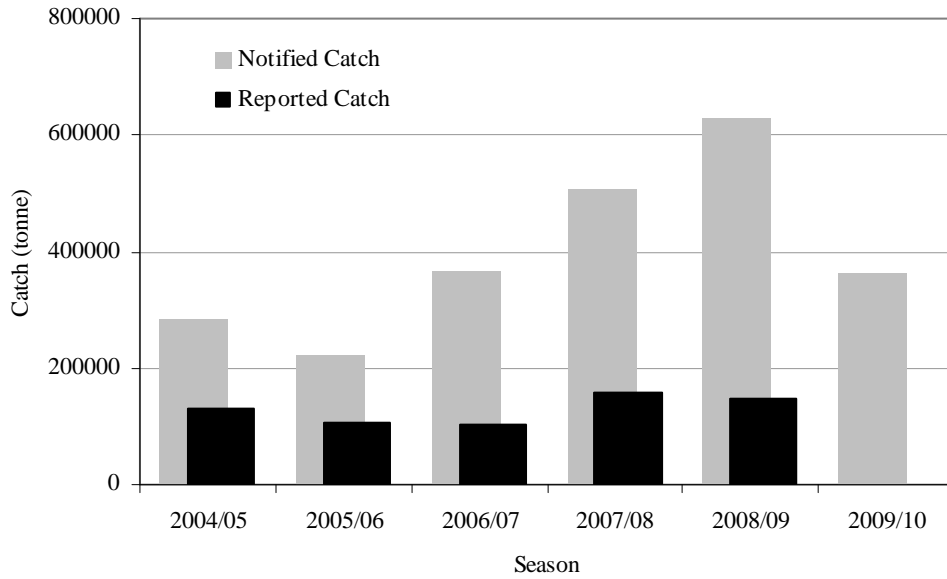
Figure 2:   Notified and realised catches in the krill fishery in 2009/10.

seals (red), pengs (blue), whales (green), fish (black)
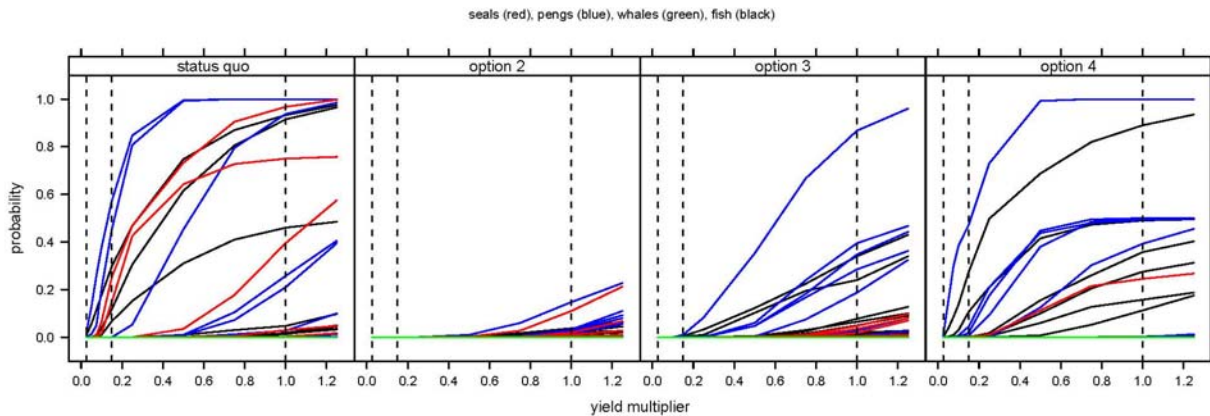
Figure 3*:   Effects on predators. Model-averaged, fishing-option-specific probabilities that, at the end of the fishing period, the abundances of predators will be reduced to values less than or equal to 75% of abundances from comparable no-fishing trials. Probabilities are averaged (using equal weights) across parameterisations that are intended to characterize plausible bounds on the flux of krill through the SSMUs and the relationship between foraging success and reproductive success for krill-dependent predators. The x-axis is harvest rate, labelled 'yield multiplier'. Status quo is allocation proportional to the historical distribution of krill catch; Option 2 is the SSMU allocation proportional to predator abundance; Option 3 is the SSMU allocation proportional to the abundance of krill from the CCAMLR-2000 Survey; and Option 4 is the SSMU allocation proportional to predator abundance minus krill abundance. The vertical dotted lines mark yield multiplier values of 0.026 (indicating the harvest rate at recent catch levels), 0.15 (indicating the harvest rate at the present trigger level), and 1.0 (indicating the harvest rate at the full precautionary catch limit).

*   This figure is available in colour on the CCAMLR website.

Figure 4*: Effects on the fishery. Model-averaged, fishing-option-specific log of mean catches. The trend lines are SSMU-specific; coastal SSMUs are indicated in blue and pelagic SSMUs are indicated in red. Fishery performance was averaged (using equal weights) across parameterisations that are intended to characterize plausible bounds on the flux of krill through the SSMUs and the relationship between foraging success and reproductive success for krill-dependent predators. Note, many SSMU-specific, model-averaged catches predicted from the implementation of Fishing Option 4 were low compared to other options because all the parameterisations implicitly describe initial conditions that would prohibit fishing in many SSMUs. The x-axis is harvest rate, labelled 'yield multiplier'. Status quo is allocation proportional to the historical distribution of krill catch; Option 2 is the SSMU allocation proportional to predator abundance; Option 3 is the SSMU allocation proportional to the abundance of krill from the CCAMLR-2000 Survey; and Option 4 is the SSMU allocation proportional to predator abundance minus krill abundance. The vertical dotted lines mark yield multiplier values of 0.026 (indicating the harvest rate at recent catch levels), 0.15 (indicating the harvest rate at the present trigger level), and 1.0 (indicating the harvest rate at the full precautionary catch limit).

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*   This figure is available in colour on the CCAMLR website.

Figure 5*: Output from MARXAN analysis undertaken as part of a systematic conservation planning process for the South Orkney Islands (from WG-EMM-09/22, Figure 4b). Map shows the selection frequency of planning units within Subarea 48.2, when MARXAN analysis was run using input data on albatross and petrel foraging areas, penguin foraging areas, pelagic bioregions, chlorophyll concentration, sea ice concentration, and ocean front buffers (see WG-EMM-09/22 for full description of methods and results). Planning units selected most frequently are considered to have the highest importance for conservation, based on the defined conservation objectives.
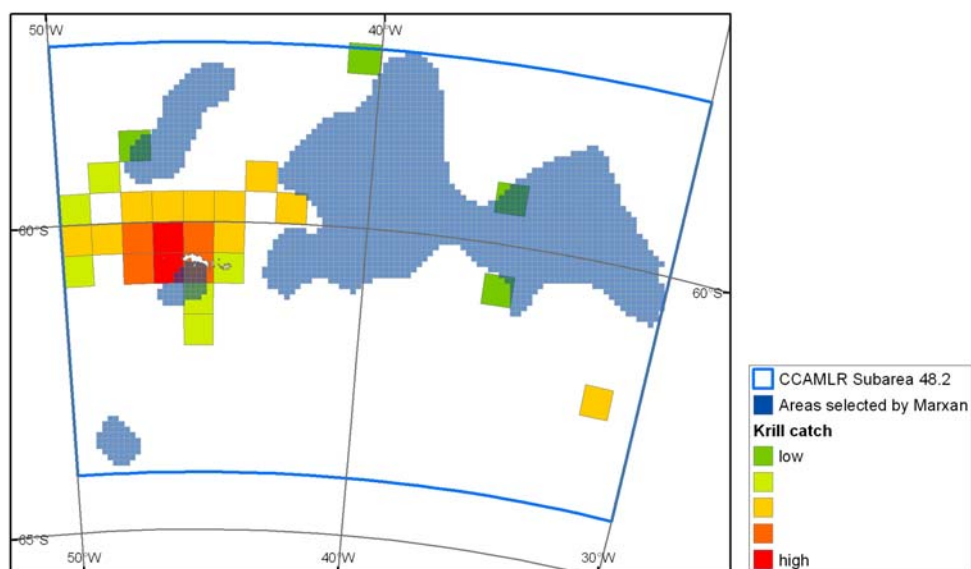
Figure 6*: Output from MARXAN analysis showing areas selected when an additional 'cost' factor was introduced for planning units in which krill fishing occurs (other input data are the same as in Figure 5) (from WG-EMM-09/22, Figure 4c; see WG-EMM-09/22 for full description of methods and results).

* These figures are available in colour on the CCAMLR website.

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AGENDA

Working Group on Ecosystem Monitoring and Management
(Bergen, Norway, 6 to 17 July 2009)

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.   Focus Topic: Second Workshop on Fisheries and Ecosystem Models in the Antarctic

3.   Ecosystem effects of fishing for krill
     3.1   Krill
     3.2   Krill-dependent predators
     3.3   The krill fishery and scientific observation of the fishery
     3.4   Krill surveys and monitoring
     3.5   Climate impacts
     3.6   Feedback management strategies
     3.7   Advice to the Scientific Committee and collaboration with its other working
           groups

4.   Ecosystem effects of fishing for finfish

5.   Spatial management to facilitate the conservation of marine biodiversity
     5.1   Vulnerable marine ecosystems
     5.2   Protected areas
     5.3   Harmonisation of approaches (both within CCAMLR and across the Antarctic
           Treaty System)

6.   Advice to the Scientific Committee and its working groups

7.   Future work

8.   Other business

9.   Adoption of the report and close of the meeting.

LIST OF DOCUMENTS

Working Group on Ecosystem Monitoring and Management
(Bergen, Norway, 6 to 17 July 2009)

WG-EMM-09/1   Draft Preliminary Agenda for the 2009 Meeting of the Working Group on Ecosystem Monitoring and Management (WG-EMM)

WG-EMM-09/2   List of Participants

WG-EMM-09/3   List of Documents

WG-EMM-09/4   Summary of observations aboard krill trawlers operating in the Convention Area
Secretariat

WG-EMM-09/5   CEMP Indices: 2009 update
Secretariat

WG-EMM-09/6   Krill fishery report: 2009 update
Secretariat

WG-EMM-09/7   Summary of notifications for krill fisheries in 2009/10
Secretariat

WG-EMM-09/8   Encounters with vulnerable marine ecosystems in the Convention Area
Secretariat

WG-EMM-09/9   Spatial protection and management of Antarctic marine biodiversity
S. Grant (United Kingdom)

WG-EMM-09/10   Demographic studies of Antarctic krill in the South Orkney Islands area 2009, fieldwork and preliminary results
B.A. Krafft and G. Skaret (Norway)

WG-EMM-09/11   On incidental mortality of Antarctic krill at krill fishery
L. Pshenichnov (Ukraine)

WG-EMM-09/12   The risks of not deciding to allocate the precautionary krill catch limit among SSMUs and allowing uncontrolled expansion of the krill fishery up to the trigger level
G.M. Watters (USA), S. Hill (United Kingdom), J.T. Hinke (USA) and P. Trathan (United Kingdom)

WG-EMM-09/13   The Ross Sea as a unique evolutionary site
J.T. Eastman and D.G. Ainley (USA)

WG-EMM-09/14   Workshop Report – The Ross Sea: Science, Policy and the Public
                  in a Pristine Marine Environment
                  J. Weller and D.G. Ainley (USA)

WG-EMM-09/15   Antarctic toothfish and macrourids are likely important prey of
                  Arnoux's beaked whales in the Ross Sea region
                  R.L. Brownell Jr and D.G. Ainley (USA)

WG-EMM-09/16   The diet of the Antarctic toothfish in the Ross Sea
                  J.T. Eastman and A.L. DeVries (USA)

WG-EMM-09/17   Chinstrap penguins: misunderstood and vulnerable monitors of
                  ecosystem changes in the Scotia Sea region of Antarctica
                  W.Z. Trivelpice, J.T. Hinke, A.K. Miller, C. Reiss,
                  S.G. Trivelpiece and G.M. Watters (USA)

WG-EMM-09/18   Characterising krill fishery dynamics using a random walk model
                  S. Kawaguchi, S. Candy and A. Constable (Australia)

WG-EMM-09/19   Japanese scientific observer activities for krill fishery in
                  CCAMLR Convention Area from 2003/04 to 2007/08 fishing
                  seasons
                  M. Kiyota and T. Iida (Japan)

WG-EMM-09/20   Integrating Count Effort by Seasonally Correcting Animal
                  Population Estimates (ICESCAPE): A method for estimating
                  abundance and its uncertainty from count data using Adélie
                  penguins as a case study
                  J. McKinlay, C. Southwell and R. Trebilco (Australia)
                  (*CCAMLR Science*, submitted)

WG-EMM-09/21   Krill consumption estimates for crabeater seals at the Antarctic
                  Peninsula and the western Weddell Sea with special reference to
                  SSMUs of Area 48.1
                  J. Forcada and P.N. Trathan (United Kingdom)

WG-EMM-09/22   Towards a system of marine spatial protection for the South
                  Orkney Islands
                  S. Grant, P.N. Trathan, J. Tratalos and J. Silk (United Kingdom)

WG-EMM-09/23   Multiple indicators suggest a strong ecosystem anomaly at South
                  Georgia in 2009
                  S. Hill, M. Belchier, M. Collins, S. Fielding, E. Murphy,
                  P. Trathan, H. Venables and C. Waluda (United Kingdom)

WG-EMM-09/24   Climate change and the Antarctic marine environment:
                  management implications
                  P.N. Trathan and D. Agnew (United Kingdom)

WG-EMM-09/25	Analysis of krill observer coverage in Subarea 48.3 D.J. Agnew, P. Grove, T. Peatman, R. Burns and C. Edwards (United Kingdom) (*CCAMLR Science*, submitted)
WG-EMM-09/26	Options for using unreplicated ecosystem monitoring data to detect impacts S. Hill, J. Forcada, P. Trathan and C. Waluda (United Kingdom) (*CCAMLR Science*, submitted)
WG-EMM-09/27	Spatial patterns in mackerel icefish diet provides insights into krill abundance and distribution M.A. Collins and C.E. Main (United Kingdom)
WG-EMM-09/28	Development of a new higher predator monitoring program at Cumberland Bay, South Georgia J. Ashburner and M. Belchier (United Kingdom)
WG-EMM-09/29	Analysis of scientific observer data from the Russian krill trawler *Maxim Starostin* in the South Orkney Islands region (Subarea 48.2) during the season 2008/09 D. Sologub (Russia)
WG-EMM-09/30	The research project to digitise historical Soviet krill fishing expedition data L. Pshenichnov and G. Milinevsky (Ukraine)
WG-EMM-09/31	Relevant issues in regards to the management of Antarctic krill fisheries in Area 48 L. Pshenichnov and G. Milinevsky (Ukraine)
WG-EMM-09/32	Detection of vulnerable marine ecosystems in the southern Scotia Arc (CCAMLR Subareas 48.1 and 48.2) through research bottom trawl sampling and underwater imagery S.J. Lockhart and C.D. Jones (USA)
WG-EMM-09/33	Demographic patterns of Antarctic krill (*Euphausia superba*) explain the spatial segregation of baleen whales (Mysticeti) around the South Shetland Islands, Antarctica J.A. Santora, C.S. Reiss, V.J. Loeb and R.R. Veit (USA)
WG-EMM-09/34	Rapid climate change and life history: how plastic is the Adélie penguin? J. Hinke, S. Trivelpiece and W. Trivelpiece (USA)
WG-EMM-09/35	Predicting the vulnerability of benthic, habitat-forming organisms to disturbance using life-history characteristics K. Martin-Smith (Australia)

WG-EMM-09/36   On the stratosphere ozone distribution asymmetry possible impact
                    on krill based ecosystem
                    G. Milinevsky (Ukraine)

WG-EMM-09/37   Southern Ocean Sentinel: Report of the First International
                    Workshop in 2009
                    A.J. Constable

WG-EMM-09/38   Improving estimates of Adélie penguin breeding population size:
                    developing factors to adjust one-off population counts for
                    availability bias
                    C. Southwell, J. McKinlay, L. Emmerson, R. Trebilco and
                    K. Newbery (Australia)
                    (*CCAMLR Science*, submitted)

WG-EMM-09/39   Update on progress in intersessional work from the Predator
                    Survey Workshop
                    C. Southwell (Australia), J. Forcarda (United Kingdom),
                    M. Goebel, J. Hinke, H. Lynch (USA), P. Lyver (New Zealand),
                    J. McKinlay (Australia), N. Ratcliffe (United Kingdom),
                    D. Ramm, K. Reid (CCAMLR Secretariat), C. Reiss,
                    W. Trivelpiece, S. Trivelpiece (USA) and P. Trathan
                    (United Kingdom)

WG-EMM-09/40   Distribution and abundance of Antarctic toothfish in the Ross Sea
                    S.M. Hanchet, S. Mormede and A. Dunn (New Zealand)
                    (*CCAMLR Science*, submitted)

WG-EMM-09/41   Circulation in the Ross Sea sector of the Southern Ocean:
                    representation in numerical models
                    G.J. Rickard (New Zealand), M. Roberts (United Kingdom),
                    M.J.M. Williams, A. Dunn, M.H. Smith and M. Pinkerton
                    (New Zealand)

WG-EMM-09/42   A balanced model of the food web of the Ross Sea, Antarctica
                    M.H. Pinkerton, J.M. Bradford-Grieve and S.M. Hanchet
                    (New Zealand)

WG-EMM-09/43   Strong effects of environmental conditions on reproductive
                    success of penguins at King George Island
                    J. Hinke, C. Reiss and W. Trivelpiece (USA)

WG-EMM-09/44 Rev. 1 Properties of water dynamics and krill distribution in the South
                    Sandwich Islands subarea
                    S.M. Kasatkina and V.N. Shnar (Russia)

WG-EMM-09/45   Krill density estimates in CCAMLR Subarea 48.6 based on
                    acoustic data collected during January–March 2008
                    G. Skaret, B.A. Krafft and R. Korneliussen (Norway)

WG-EMM-09/46	Area protection afforded to Cape Shirreff through CCAMLR and the Antarctic Treaty P.A. Penhale (USA) and V. Vallejos Marchant (Chile)
WG-EMM-09/47	Krill catches indicate the impact of the El-Niňo – Southern Oscillation related processes on the distribution of krill biomass between subareas of the Atlantic sector of Antarctic Vassily Spiridonov (Russia)

Other Documents

WG-EMM-09/P1	An apparent decrease in the prevalence of 'Ross Sea killer whales' in the southern Ross Sea D.G. Ainley, G. Ballard and S. Olmastroni (*Aquat. Mamm.*, in press)
WG-EMM-09/P2	The importance of Antarctic toothfish as prey of Weddell seals in the Ross Sea: a review D.G. Ainley and D.B. Siniff (*Ant. Sci.*, in press)
WG-EMM-09/P3	A history of the exploitation of the Ross Sea, Antarctica D.G. Ainley (*Polar Rec.*, in press)
WG-EMM-09/P4	Impacts of cetaceans on the structure of Southern Ocean food webs D. Ainley, G. Ballard, L.K. Blight, S. Ackley, S.D. Emslie, A. Lescroël, S. Olmastroni, S.E. Townsend, C.T. Tynan, P. Wilson and E. Woehler (*Mar. Mamm. Sci.*, in press)
WG-EMM-09/P5	Quantifying movement behaviour of vessels in the Antarctic krill fishery S. Kawaguchi and S.G. Candy (*CCAMLR Science*, Vol. 16 (2009): 131–148)
WG-EMM-09/P6	Direct effects of climate change on the Antarctic krill fishery S. Kawaguchi, S. Nicol and A.J. Press (*Fisheries Manag. Ecol.*, in press)
WG-EMM-09/P7	Population assessments of gentoo penguins (*Pygoscelis papua*) breeding at an important Antarctic tourist site, Goudier Island, Port Lockroy, Palmer Archipelago, Antarctica P.N. Trathan, J. Forcada, R. Atkinson, R.H. Downie and J.R. Shears (*Biol. Cons.*, 141 (2008): 3019–3028)

WG-EMM-09/P8   Modeling predation by transient leopard seals for an ecosystem-based management of Southern Ocean fisheries
J. Forcada, D. Malone, J.A. Royle and I.J. Staniland
(*Ecol. Model.*, 220 (2009): 1513–1521)

WG-EMM-09/P9   Penguin responses to climate change in the Southern Ocean
J. Forcada and P.N. Trathan
(*Glob. Change Biol.*, 15 (2009):1618–1630, doi: 10.1111/j.1365-2486.2009.01909.x)

WG-EMM-09/P10   The risk to fishery performance associated with spatially resolved management of Antarctic krill (*Euphausia superba*) harvesting
S. Hill, P. Trathan and D. Agnew
(*ICES J. Mar. Sci.*, doi:10.1093/icesjms/fsp172)

**REPORT OF THE WORKING GROUP
ON FISH STOCK ASSESSMENT**
(Hobart, Australia, 12 to 23 October 2009)

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[1]   Appendices E to S have been published only in electronic format. For these reports, please refer to
www.ccamlr.org/pu/e/e_pubs/fr/drt.htm.

REPORT OF THE WORKING GROUP
ON FISH STOCK ASSESSMENT
(Hobart, Australia, 12 to 23 October 2009)

OPENING OF THE MEETING

1.1   The meeting of WG-FSA was held in Hobart, Australia, from 12 to 23 October 2009. The Convener, Dr C. Jones (USA), opened the meeting and welcomed participants (Appendix A).

1.2   Dr D. Miller (Executive Secretary) joined in welcoming participants to the CCAMLR Headquarters. He reflected on the history of WG-FSA and wished the meeting success in its current round of deliberations.

1.3   The Convener noted that the following meetings and workshop in 2008/09 had provided information and advice to WG-FSA:

- meeting of SG-ASAM (Annex 8)
- meeting WG-SAM (Annex 6)
- meeting of ad hoc TASO (Annex 9)
- meeting of WG-EMM including FEMA2 (Annex 4)
- Workshop on VMEs (Annex 10)
- meeting of WG-IMAF (Annex 7; see Item 7).

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1   The agenda of the meeting was discussed and it was agreed to modify the agenda as follows:

- consider the research plan for *Dissostichus* spp. at Ob and Lena Banks (Division 58.4.4) under subitem 5.1 (new and exploratory fisheries);

- restructure subitem 10.1 (bottom fishing activities and VMEs) to include risk assessments (10.1.1), review of fishery- and research-based notifications submitted in 2008/09 (10.1.2), review of conservation measures (10.1.3) and advice to the Scientific Committee (10.1.4).

The revised Agenda was adopted (Appendix B).

2.2   The Working Group agreed to follow WG-SAM's initiative and highlight sections of the report dealing with advice to the Scientific Committee and its working groups, and list the relevant references to paragraphs in advice to the Scientific Committee (Item 14). The Working Group also agreed to make every effort to reduce the overall size of its report and subsequent translation. The report captured essential background, discussion and advice, and made full use of CCAMLR's archive of publications and meeting documents.

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

2.4   The report was prepared by Drs D. Agnew (UK), M. Belchier (UK) and A. Constable (Australia), Messrs A. Dunn (New Zealand) and N. Gasco (France), Drs S. Hanchet (New Zealand), R. Holt (USA), K.-H. Kock (Germany) and R. Leslie (South Africa), Mr J. McKinlay (Australia), Drs R. Mitchell (UK) and S. Parker (New Zealand), Mr T. Peatman (UK), Dr D. Ramm (Data Manager), Mss K. Rivera (WG-IMAF Co-convener) and N. Slicer (Compliance Officer), Mr N. Walker (WG-IMAF Co-convener) and Dr D. Welsford (Australia).

2.5   Selected components of WG-FSA's work were developed intersessionally and during the meeting by the following subgroups:

- Subgroup on Assessments (coordinator: Dr Agnew)
- Subgroup on New and Exploratory Fisheries (coordinators: Drs Belchier and Hanchet)
- Subgroup on By-catch (coordinators: Drs Belchier and Mitchell)
- Subgroup on Biology and Ecology (coordinator: Dr Kock)
- Subgroup on Tagging (coordinator: Dr Welsford)
- Subgroup on the Scientific Observer Program (coordinator: Dr Leslie)
- Subgroup on VMEs and Ecosystem Management (coordinator: Dr Constable)
- Subgroup on IUU Fishing (coordinator: Dr Holt).

2.6   The information used in developing the assessments is provided in the Fishery Reports (Appendices E to S). 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 2008

Development of the CCAMLR database

3.1   The Data Manager, Dr Ramm, provided an update on recent developments in managing the CCAMLR database and associated work. During the intersessional period, the Secretariat had further developed procedures, databases and data forms at the request of the Commission and the Scientific Committee and its working groups. Work relevant to WG-FSA was highlighted (WG-FSA-09/4).

3.2   In November 2008, the Secretariat revised the longline data form for fine-scale catch and effort data (C2) in order to capture variability in trotline configuration (SC-CAMLR-XXVII, paragraph 13.5). Revisions were also made to the scientific observer logbook (SC-CAMLR-XXVII, paragraph 5.28). Consequential changes were made to the CCAMLR database and the revised data forms were posted on the CCAMLR website for use in 2008/09.

3.3   The Working Group noted that the volume and complexity of the CCAMLR database continues to expand rapidly (e.g. the volume of fishery data has increased at an average rate of 25–30% per annum and 40-fold since 1993; CCAMLR-XXVIII/BG/12). It also noted that the increasing volume of data and requirements for detailed, accurate real-time/continuously updated data are placing greater demands on the Secretariat's resources, some of which have reached full capacity. The Working Group recognised the large amount of work involved in the preparation of data for its assessments, and thanked the Secretariat for its professionalism and timeliness in processing data and managing the CCAMLR database.

3.4   The Working Group recognised that part of the Secretariat's work involved the validations of preliminary assessments submitted to WG-FSA (WG-FSA-06/6, paragraphs 6.1 and 6.2). This work is an essential step in the development of the assessments and further, more quantitative, validations and analyses are anticipated (see sections 12 and 13). The Working Group recommended that the Scientific Committee explore the potential of placing an assessment scientist on the Secretariat staff to assist with this work (paragraphs 15.2 to 15.8).

3.5   The Working Group agreed that updated information on the operation, development and documentation of the CCAMLR database (CCAMLR-XXVIII/BG/12, including Appendix 1) should continue to be provided at its annual meetings. The Working Group advised the Scientific Committee of the need for a regular review of the data requirements and the Secretariat's resources in order to ensure that adequate resources were always available to fully support the operation and development of the CCAMLR database (see also sections 12 and 13).

3.6   The Working Group recognised the important role of fishing crews, scientific observers and Members in collecting and processing CCAMLR data, and the essential role of the Secretariat in managing these data, including the development of quality assurance for data used in stock assessments.

3.7   In considering the workflow associated with fine-scale data and scientific observer data, from collection on board the vessels to input to stock assessments (Figure 1), the Working Group recognised various pressure points associated with data submission deadlines, data processing and validation by the Secretariat, and the preparation of preliminary assessments for the Working Group. Further, in developing the preliminary assessments, researchers took account of advice provided by WG-SAM, as well as new developments and implications which may arise from the addition of data from the current season. The Working Group sought advice from the Scientific Committee on ways to alleviate pressure points in future assessments (see also sections 12 and 13).

Data processing

3.8   The Secretariat had processed fishery and observer data from 2008/09 which had been submitted up to approximately one week prior to the start of the meeting. In addition, the Secretariat had processed available fishery and observer data from the fishery at Prince Edward and Marion Islands (South African EEZ in Subareas 58.6 and 58.7 and Area 51), the fishery at Kerguelen Islands (French EEZ in Division 58.5.1) and the fishery at Crozet Islands

(French EEZ in Subarea 58.6). Data from 2008/09 had undergone preliminary validation prior to the meeting, and further validation will be conducted in the forthcoming intersessional period.

Fishery Plans

3.9   The Secretariat has maintained the Fishery Plans and has added data from 2008/09 to the time series.

Fisheries information

Catch, effort, length and age data reported to CCAMLR

3.10   In accordance with conservation measures in force in 2008/09, Members' fishing vessels operated in the following fisheries (Table 1, see also CCAMLR-XXVIII/BG/6):

- fisheries for icefish (*Champsocephalus gunnari*) in Division 58.5.2 and Subarea 48.3;

- fisheries for toothfish (*Dissostichus eleginoides* and/or *Dissostichus mawsoni*) in Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b and 58.5.2 and Subareas 48.3, 48.4, 48.6, 88.1 and 88.2;

- fishery for krill (*Euphausia superba*) in Subareas 48.1, 48.2 and 48.3.

3.11   Three other fisheries targeting toothfish were conducted in the Convention Area in 2008/09:

- fishery at Prince Edward and Marion Islands (South African EEZ[2] in Subareas 58.6 and 58.7);

- fishery at Kerguelen Islands (French EEZ in Division 58.5.1);

- fishery at Crozet Islands (French EEZ in Subarea 58.6).

3.12   The Working Group noted that in 2008/09 the Secretariat had monitored 154 catch limits for species groups (target and by-catch species) in SSRUs, SSRU groups, management areas, divisions and subareas (CCAMLR-XXVIII/BG/6). This work included forecasting fishery closures once the catch of a managed species exceeded 50% of its catch limit. So far in 2008/09, 21 fishing areas and five fisheries have been closed on the advice of the Secretariat (CCAMLR-XXVIII/BG/6, Table 2). The closures were generally triggered by catches of *Dissostichus* spp. approaching their respective catch limits. Some closures required the consequential closure of other areas, and one closure was triggered by the catch of *Macrourus* spp. approaching its limit in the Northern Area of Subarea 48.4.

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[2]   The EEZ also extends to Area 51 outside the Convention Area.

3.13　Catch limit overruns (i.e. the catch exceeded the catch limit) occurred for *D. eleginoides* in Subarea 48.3 (Management Area B: overrun of 7 tonnes, total catch was 101% of the limit) and *Dissostichus* spp. in Division 58.4.1 (SSRU C: 8 tonnes, 108% of the limit; SSRU E: 4 tonnes, 108% of the limit; whole fishery: 12 tonnes, 106% of the limit), Division 58.4.3 (SSRU E: 21 tonnes, 153 % of the limit), Division 58.4.3b (SSRU D, 1 tonne; 102 % of the limit; SSRU E: 15 tonnes, 148% of the limit) and Subarea 88.1 (SSRUs B, C, G: 58 tonnes, 116% of the limit). In addition, the fishery in Subarea 88.1 closed 266 tonnes below the catch limit (90% of the limit) due to bad weather, extensive sea-ice and vessels exiting the fishery within 2–3 days of notification of the closure.

3.14　The Working Group noted that the minimum monitoring period is five days (Conservation Measure 23-01) and the current catch and effort reporting system is not well suited to the monitoring of small catch limits (e.g. below approximately 100 tonnes in longline fisheries for *Dissostichus* spp.). In recent seasons, SSRUs with small catch limits in exploratory fisheries have been combined to ensure that the minimum catch limit for *Dissostichus* spp. was approximately 100 tonnes (CCAMLR-XXVIII/BG/6, Figure 1). However, in 2008/09, there were 12 catch limits for *Dissostichus* spp. below 100 tonnes and the smallest limit was 30 tonnes (5 occurrences). These catch limits were set for fishing areas and fisheries in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, and four catch limit overruns occurred.

3.15　The Working Group advised the Scientific Committee that additional data on catches and gear deployed, provided daily by fishing vessels, would likely improve the Secretariat's ability to forecast closures, in situations where the catch limits were small or as catches approach the limit. The Working Group recognised that daily reporting of catch and effort, if implemented, would place considerable additional demands on vessels and the Secretariat, and would have budget implications for the Secretariat.

3.16　The Working Group noted the Secretariat's implementation of the new procedure for allocating the starting positions of research hauls in the exploratory fisheries in Subareas 48.6 and 58.4, and the level to which this allocation had been implemented by vessels in 2008/09 (WG-SAM-09/6). The implementation of this procedure is discussed under Item 5.1.

3.17　Fishery and scientific observer information, including tables and figures, in WG-FSA's Fishery Reports were updated by the Secretariat immediately prior to the 2009 meeting. Fishery Reports are discussed under Item 5.

Estimates of catch and effort from IUU fishing

3.18　WG-FSA reviewed estimates of IUU catches in the Convention Area prepared by the Secretariat based on information submitted by 30 September 2009 (Table 2, see also WG-FSA-09/5 Rev. 1). As in previous years, the agreed deterministic method used by the Secretariat to estimate IUU fishing effort was based solely on reports submitted by Members of sightings by surveillance operations and legal fishing vessels. No reports of undocumented landings were received during the current season. Additional information on catch rates was derived from CCAMLR data on licensed vessels. The estimated catch history of *Dissostichus* spp. taken by IUU longlining and gillnetting activities in the Convention Area is summarised in Table 3.

3.19   During 2008/09 there were six sighting reports of five identified IUU vessels and one unidentified vessel in the Convention Area. Additionally, one gillnet from an unknown IUU vessel was hauled by Australia. It has been assumed that at least six of the vessels were fishing with gillnets (WG-FSA-09/5 Rev. 1, Table 1).

3.20   A limited amount of new information had been submitted by inspectors in respect of gillnet vessels in Division 58.4.3b (one report from Australia and three reports from France). This information indicated the recovered gillnets may have achieved catch rates of up to 5 tonnes per day, with an unweighted mean catch rate of 1.85 tonnes per day. By comparison, the mean daily catch rate for licensed longline vessels in that division in 2008/09 was 1.89 tonnes per day. Consequently, the Secretariat used a mean daily catch rate of 1.9 tonnes per day in the estimation of IUU catches in Division 58.4.3b. Mean daily catch rates from licensed longline fishing vessels were applied to the other divisions where IUU fishing was detected (Divisions 58.4.1 and 58.4.2).

3.21   The Working Group reiterated its concern about IUU fishing and the use of gillnets in the Convention Area. Further, gillnets are less selective than longlines and may result in greater catches of by-catch, and continue to fish if abandoned or lost (see also Item 8).

3.22   The Working Group endorsed the Secretariat's estimates of IUU catches for use in stock assessment and by WG-IMAF, noting that catches from gillnets may be underestimated (see Items 5, 7 and 8). The Working Group noted the reduction in the number of IUU fishing vessels sighted in recent seasons (Table 3). Such reduction may be as a result of several factors, including those potentially related to economic factors, the impact of IUU fishing on stocks, increased fishery surveillance and the effect of CCAMLR measures to deter IUU fishing.

3.23   The Working Group agreed that it would be useful, where possible, for the Secretariat to provide an estimate of the catch allocation between *D. eleginoides* and *D. mawsoni* based on the known location of sightings of IUU activities.

3.24   The evaluation of the threats arising from IUU fishing activities was discussed under Item 8.

Catch and effort data for toothfish fisheries in waters
adjacent to the Convention Area

3.25   Catches of *D. eleginoides* from fisheries outside the Convention Area and reported in the CDS in 2007/08 and 2008/09 are summarised in Table 4. The total CDS-reported catch from outside the Convention Area for 2008/09 to October 2009 was 10 065 tonnes.

3.26   The Working Group noted that most of the catch of *D. eleginoides* taken outside the Convention Area was from Areas 41 and 87. The Working Group also noted that the CDS records only processed weights and that the figures provided by the Secretariat were converted to estimated green weight using a standard set of conversion factors.

Scientific observer information

3.27   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 2008/09 (WG-IMAF-09/4, 09/5 and 09/7). Scientific observations were discussed under Items 7 and 11.

Inputs for stock assessment

3.28   The Working Group agreed that a short summary of specific input data to be used for stock assessments will be considered under this agenda item, and that the stock assessments themselves will be considered under Item 4.2.

Catch-at-length/age from fisheries

3.29   WG-FSA-09/20 and 09/21 presented input data for the update of the integrated assessment for Division 58.5.2, and WG-FSA-09/22 Rev. 1 investigated general issues of applying ALKs in assessments. The Working Group noted the inclusion of new age data in the assessment for Division 58.5.2, development of a two-stage model for accounting for reader error when incorporating age data into the assessment, and methods for optimising sample sizes of fish selected for measurement for age and length.

3.30   Since 2007, substantial ageing work of *Dissostichus* spp. (~7 400 specimens) has been undertaken in the HIMI fisheries, including ageing of recaptured tagged fish. The Working Group noted that this work was based on discussion in WG-SAM (Annex 6, paragraph 3.12; WG-SAM-09/9), and incorporated recommendations requested by that group.

3.31   The Working Group noted that one result from the work presented in WG-FSA-09/21 suggested a propensity for a greater degree of negative reader errors in fish below 10 years, with positive error more likely for fish aged 12–22 years, and queried how possible ageing biases affecting the accuracy of ALKs would be incorporated and propagated into an assessment.

3.32   The Working Group noted the results of WG-FSA-09/22 Rev. 1 on the different sampling methods for optimising the number of fish selected for measurement, that the length-bin random sampling (LBRS) methodology improved precision of older age classes but with loss of precision for younger age classes, however that this may be a desirable improvement due to the relatively low frequency of larger fish in catches. The Working Group noted that the relative merit of these approaches would depend on practical issues relating to the collection of samples at sea, the relative costs and tradeoffs of alternative biological sampling strategies, and the performance of assessment models that use data with different levels of precision in the catch-at-age proportions (i.e. using management strategy evaluations and simulation experiments).

3.33   WG-FSA-09/36 provided an update of the catch-at-age frequencies for the Subarea 88.1 and 88.2 fisheries. On average, about 800 *D. mawsoni* otoliths collected by observers were selected for ageing each year and used to construct annual area and

sex-specific ALKs. Age data were available for the 1998/99 to 2007/08 seasons, but were not yet available for the 2008/09 season. In the Ross Sea, sex-specific ALKs were applied to the shelf/slope fisheries, and the north fishery. The ALKs were applied to the catch-weighted length-frequency distributions for each year to produce catch-at-age distributions (WG-FSA-09/36). However, in SSRU 882E, otoliths were only available from the New Zealand fleet which did not fish that SSRU in every year. Therefore, for SSRU 882E, a single sex-specific ALK from otoliths from all available years from New Zealand vessels was used to construct annual age frequencies (WG-FSA-09/36).

3.34   WG-FSA-09/17 provided a description of the distribution of catch, effort, proportions of fish-at-length and catch-at-age frequencies for the period 2005–2009 in Subarea 48.4 and concluded that the fishery appeared to be dominated by a single cohort of older fish, spawned in 1992. The Working Group thanked the authors for the considerable work that had gone into developing the paper and noted that the descriptive analyses provided a comprehensive overview of the fishery.

3.35   WG-FSA-09/28 provided an update of the catch-at-age and CPUE indices for *D. eleginoides* in Subarea 48.3. The CPUE indices rose in 2000 in response to the strong 1990 year class entering the fishery, but the paper also noted that the indices had declined in recent years. The Working Group noted that, in this fishery, CPUE indices appeared to reflect changes in abundance, and that this was due, in part, to the presence of the same vessels in the fleet in the fishery since 1998.

3.36   The Working Group discussed the issue of how necessary age–length data from processing otoliths can be acquired without relying on the current small number of Members that have access to otolith ageing facilities and are actively engaged in producing assessments. The Working Group noted that this was an important input into stock assessments because it can reduce uncertainty in toothfish assessments. The Working Group noted that Australia has developed a standardised manual for ageing *D. eleginoides*, which would be made available on request. The Working Group noted the importance of optimisation of sampling programs for determining fish ages, and the necessity to increase the capability (either through capacity or resources) of Members to have otoliths efficiently sampled and read. The latter issue was addressed further under Item 9.3.

Research surveys

3.37   WG-FSA-09/9 presented a report on the results of a UK groundfish survey at South Georgia in January 2009. Biomass estimates and CIs for *C. gunnari* were presented for all survey years since 2000. The mean estimate of biomass was the second lowest since 2000. The Working Group noted that the observed low biomass coincided with a strong ecosystem anomaly at South Georgia in early 2009 (see WG-EMM-09/23). Elevated sea-surface temperatures and associated reduction in krill abundance is likely to have led to a reduction in *C. gunnari* biomass and associated changes in their spatial distribution in Subarea 48.3. The survey indicated that icefish were less aggregated than typically observed in the austral summer, leading to a reduction in the variance of *C. gunnari* catch weight in hauls. This, coupled with an increase in haul numbers, led to a more precise estimate of mean icefish biomass than obtained in surveys since 2000.

3.38   The Working Group noted that the survey showed no further evidence of recruitment of juvenile *D. eleginoides* on the shelf areas within Subarea 48.3. The strong cohort of toothfish juveniles observed in the survey data since 2003 was not evident during the 2009 survey. It is likely that these fish have moved into deeper water and were unavailable to the trawl survey. There was evidence that some of these fish had started to recruit to the longline fishery (WG-FSA-09/28).

3.39   The Working Group noted that the considerable interannual variability in krill abundance at South Georgia, and subsequent impacts on *C. gunnari* abundance and behaviour, were known to be linked to large-scale climatic variability. The Working Group encouraged that further research be undertaken to better assess the relationships that exist between environmental variability and *C. gunnari* abundance.

3.40   WG-FSA-09/19 provided a report of the results of a demersal finfish survey of the South Orkney Islands undertaken in 2009; the first survey in the area for 10 years. The Working Group concluded that the survey estimates of standing stock biomass of demersal finfish indicated that biomass of several species remains extremely depressed, at only a fraction of the level available during the years that the commercial fishery operated in the South Orkney Islands.

3.41   The Working Group noted that the survey may have some limitations for determining biomass of *C. gunnari*, as it assumes a catchability equal to 1, which may, in practice, result in conservative estimates of biomass. The Working Group agreed that collection of acoustic data for all bottom trawl surveys of *C. gunnari*, along with further investigation of target strength of this species, may assist in adjusting for biases in survey estimates due to catchability assumptions. The Working Group concluded that the survey followed typical CCAMLR protocols for estimating fish biomass using swept areas, and that the design has been kept constant between survey times. Given that consistency, the Working Group considered it reasonable to conclude that there is insufficient biomass for the stock to be considered as recovered (see also paragraphs 5.180 and 5.181).

3.42   WG-FSA-09/34 provided results from stratified random trawl surveys using consistent methodology examining the distribution and abundance of toothfish in Division 58.5.2. The Working Group noted that the low abundance of toothfish and icefish in 2008, which was difficult to attribute to stock status, may have been due to unusual oceanographic conditions and very poor weather in the area. Information from fishers in the area suggested that catch rates in commercial hauls were also low around the time of the survey in 2008.

3.43   The Working Group noted that CVs were not reported along with biomass estimates and that they should be included in future reports detailing survey results.

Catch and effort data

3.44   The Working Group noted that WG-FSA-09/14 used CPUE data in age-structured and production models to estimate stock biomass and population parameters for toothfish in Division 58.4.1, but that the estimates of CPUE used in the paper were not tabulated or described, and urged the authors to submit both the CPUE data and analyses so that these could be evaluated by WG-FSA.

3.45   WG-FSA-09/36 provided a characterisation of the Subarea 88.1 and 88.2 toothfish fisheries from 1997 to 2009.

3.46   The Working Group noted that, in the Ross Sea fishery, half of the vessels had fished for only one year, and only eight vessels have had a presence for more than three years. The Working Group noted that the inconsistent presence of vessels in the fishery over time precluded WG-FSA from developing consistent time series and hindered the interpretation of catch and effort data.

3.47   The Working Group noted that 2009 was the first time that fishing effort had been concentrated on the slope of Subarea 88.2, resulting in landings of small fish, and perhaps indicating a need to reflect the fishery structure in the assessment for this area.

Tagging studies

3.48   The Working Group considered that the descriptive analysis of the tagging program in Subareas 88.1 and 88.2 in WG-FSA-09/39 represented a useful assessment of the available data and agreed that these estimates should be used in the updated assessment of the stock assessments for the Ross Sea and SSRU 882E.

3.49   WG-FSA-09/35 presented an analysis of data metrics for selecting high-quality tagging data for inclusion in stock assessments. The method first selected an initial informative dataset comprising trips with (i) high (above median) rates of recovery of tagged fish, and (ii) where tags released on the trip were subsequently recaptured at a high rate. The method then used these trips to define 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. The Working Group endorsed the methodology as suitable for providing an objective way of determining high-quality data for inclusion in stock assessment models.

3.50   The Working Group noted that both tails of distributions of metrics of interest were used as the basis for excluding data. That is, when selecting data for inclusion in assessments, records with data quality values that were 'too high' were excluded equally with values that were 'too low'. The Working Group suggested considering only using one-tailed tests for exclusion might be appropriate in future refinements of the method.

3.51   The Working Group noted that, although this had not been formally examined, there did appear to be agreement in quality between the accuracy of observer- and vessel-derived data and that this could be useful for further refinement of the data-quality metrics used in future developments of the method.

3.52   WG-FSA-09/P1 described observations on migration of *D. mawsoni* obtained during tagging of fish arising from the longline fishery in the D'Urville Sea in 2008/09. The main observation concerned the recovery of a tagged small toothfish inside the gut of a larger individual recovered at some distance (~200 km) from the tagging position of the small fish.

3.53   The Working Group noted that there were no records of a tagged fish detected within the stomach contents of a larger toothfish in the Ross Sea toothfish fishery, although small toothfish were sometimes observed in stomach contents of larger fish. The Working Group noted that tag loss by this mechanism was likely to be a rare event.

3.54   The Working Group also noted that the paper indicated that only smaller toothfish (<100 cm) were tagged in this tagging program, since these could be landed without being gaffed. The Working Group emphasised that this practice is at variance with the conservation measure and previous recommendations by the Scientific Committee and its working groups, which require that fish be tagged by length in proportion to their size distribution in the catch. While the Working Group recognised there may be a reluctance of commercial fishers to tag and release large fish, it stressed the importance of tagging the full size range of fish, and that it is a requirement under the conditions of access to the fishery (paragraphs 5.12 to 5.17).

Biological parameters

3.55   WG-FSA-09/37 examined the length- and age-at-spawning of *D. mawsoni* in the Ross Sea. The paper summarised the method for determining age-at-spawning by hindcasting from the presence of post-ovulatory follicles in the ovaries or forecasting from the assessment of oocyte developmental stage. The hindcasting and forecasting methods gave similar results. The Working Group noted that the estimates were based on samples from the slope, which included mature fish that were not spawning.

3.56   The Working Group adopted the revised estimates of the length and age of maturity for male and female *D. mawsoni* presented in WG-FSA-09/37, but noted that if the estimates had included fish from the northern part of the fishery, then the resulting ogives might have a lower age and length at 50% spawning. Revised estimates for the mean age and length at 50% spawning for females on the Ross Sea slope region were 16.6 years and 133.2 cm and for the mean age and length at 50% maturity for males were 12.8 years and 120.4 cm.

3.57   The Working Group agreed that these estimates should be used in *D. mawso ni* assessments for Subareas 88.1 and 88.2, and the sampling of reproductive parameters during winter months (when toothfish are spawning) may assist with understanding age/size-at-maturity and spawning dynamics, and hence help reduce the uncertainty in estimates of SSB in assessments.

Stock structure and management areas

3.58   WG-FSA-09/38 presented an assessment of methods for deriving the best available bathymetry data for fisheries management of the Ross Sea. This work has arisen through a need to standardise and make transparent the data and algorithms used for deriving seabed areas and bathymetry, which are increasingly being incorporated into management rules (e.g. for assessing bottom fishing impacts). The Working Group agreed that it would be desirable to develop standardised methods and data sources for deriving bathymetric information for the Convention Area.

3.59   The Working Group encouraged the development of a common repository and for other data providers to contribute suitable bathymetric data to such a facility. Dr Welsford proposed the Australian Antarctic Data Centre may provide an appropriate centre for storage and administration of such data.

Depredation

3.60   WG-FSA-09/16 presented a study on cetacean depredation of toothfish around South Georgia and implications for toothfish stock assessments. Results indicated amounts of catch lost to depredation are relatively small, typically in the order of 3% per year with interannual variation in the range 2–6%. Differential rates of depredation were apparent between killer whales (3–5% of lines affected) and sperm whales (in excess of 10% of lines). Interaction rates with lines were noted to be similar to those over the 2003–2009 study period.

3.61   The Working Group suggested monitoring cetacean presence by hydrophones to measure an index of relative abundance as a possible means of determining night-time rates of depredation.

3.62   The Working Group noted that depredation was variable from area to area, and that while depredation on an individual line may be high, taking the fishery as a whole shows only a small amount of total depredation on catch (~3%). The Working Group noted that differences in methods used by vessels to mitigate depredation would have to be accounted for in any such assessment of regional variation.

PREPARATION FOR ASSESSMENTS AND ASSESSMENT TIMETABLE

Report of SG-ASAM

4.1   SG-ASAM met in 2009, primarily considering issues related to the estimation of krill target strength and biomass (Annex 8).

4.2   In response to the request from WG-FSA to consider the application of the adjustment factor for trawl headline height used in icefish bottom trawl surveys (SC-CAMLR-XXVII, Annex 5, paragraphs 3.26 and 13.20), SG-ASAM considered one paper (SG-ASAM-09/7) which indicated that due to icefish occurring above the headline of a bottom trawl, the difference between a 6 m and 8 m headline height could lead to a 1.8-fold difference in biomass estimates, although this adjustment factor varied greatly over space and time scales.

4.3   No further advice on icefish surveys was provided by SG-ASAM. However, two other papers were considered by SG-ASAM (SG-ASAM-09/5 and 09/6) that WG-FSA agreed would have a bearing on discussions under Item 10.

Report from WG-SAM

4.4   Dr Constable (WG-SAM Convener) presented the report of its meeting in 2009 (Annex 6). The Working Group had considered a number of issues associated with stock assessment models for toothfish (in Subarea 48.3, Division 58.5.2 and Subarea 88.1/88.2 (Ross Sea)) and icefish. WG-SAM provided advice to WG-FSA on the use of age–length keys, tagging data, estimation of stock size in new and exploratory fisheries, longline research surveys, age- and length-based assessments, and spatially structured models (Annex 6, paragraph 7.2).

Review of preliminary stock assessment papers

4.5   The Working Group discussed a number of preliminary stock assessment papers, in preparation for the final stock assessments conducted at the meeting and reported under Item 5.3

Toothfish

4.6   WG-FSA-09/28 presented an updated assessment of *D. eleginoides* in Subarea 48.3. The major changes to the model from the previous 2007 assessment were that survey data for 1999–2008 were included, and that the catch-at-length proportions were replaced by catch-at-age proportions derived from direct random sampling of fish from the fishery. WG-FSA noted that WG-SAM had considered an earlier version of this model (WG-SAM-09/13) and results of the additional work that had been requested by WG-FSA in 2007 (SC-CAMLR-XXVI, Annex 5, paragraph 5.115 and Appendix J, paragraph 43).

4.7   In the updated assessment, fits to the tag, CPUE and catch-at-age data were good, with the exception of the 2009 catch-at-age data. The model, which included statistically optimal multinomial weighting for the catch-at-age and survey data, did not adequately predict the large proportion of young (age 7) fish caught this year. Two alternative explanations for the lack of fit to the 2009 catch-at-age data were offered by the paper; either recruitment (to the 2001 cohort) has been exceptionally high, or the behaviour of the fishery has changed. Regarding the latter, Dr Agnew reported that several features of the Subarea 48.3 fishery had been different in 2009, including the lack of krill (see WG-EMM-09/23), reported large numbers of small fish and a change in the market value of small and large fish. The Working Group agreed that distinguishing between these two hypotheses was difficult at the moment but will become clearer when the 2001 cohort has fully recruited to the fishery in one or two years' time.

4.8   WG-FSA-09/17 presented a new CASAL assessment of the northern Subarea 48.4 stock of *D. elegino ides* following the conclusion of the comprehensive tag-based research program in the northern part of Subarea 48.4. Catch-at-length data indicate the vulnerable biomass may be composed of one cohort, with biometric data suggesting that growth parameters for *D. eleginoides* in Subarea 48.4 are similar to those in Subarea 48.3. Evidence of gonad development in *D. elegin oides* suggests that spawning may occur in the north of Subarea 48.4. The CASAL model fits to data were good.

4.9   The Working Group commended the success of the four-year experiment in Subarea 48.4, in particular development of the CASAL-based model presented in the preliminary assessment. The Working Group also noted the current stock structure for the population, with vulnerable biomass seemingly dominated by a few, or even one, cohort.

4.10   WG-FSA-09/20 presented an updated CASAL assessment of *D. e leginoides* in Division 58.5.2. Following discussions at WG-SAM, the catch-at-length proportions used in the 2007 assessment were replaced by catch-at-age proportions derived applying ALKs to sub-fishery and year-specific length-frequency data.

4.11   Compared to the assessment that did not incorporate catch-at-age or abundance-at-age data, the aged-based assessment dramatically lowered the CV for the recruitment series, from around 1.8 down to approximately 0.6. The Working Group noted that this latter recruitment CV is consistent with that used for the Ross Sea and Subarea 48.3 assessments. It also noted that the fits to the survey abundance-at-length and abundance-at-age data, and catch-at-age data were good, but the fits to the CPUE series were not; where the CPUE series indicates a declining trend, the model prediction is for a steady or rising CPUE in recent years. Dr Welsford commented that although there was a discrepancy between these trends, the predicted CPUE lay for the most part within the 95% confidence intervals of observed CPUE. The Working Group further noted that this model was very complex, involving 10 sub-fisheries, and that reducing this complexity may improve the model structure. Age data were unavailable for the most recent year, and the incorporation of length-based catches in an otherwise age-based model may increase uncertainty in parameter estimates.

4.12   WG-FSA-09/40 and 09/41 presented updated assessments of toothfish in the Ross Sea and SSRU 882E respectively. The major developments in these assessments since 2007 (Ross Sea) and 2006 (SSRU 882E), were the inclusion of tag-recapture data from a wider range of trips than before, selected on overall data quality metrics using the methodology of WG-SAM-09/19, and the revision of the maturity ogive (WG-FSA-09/37), based on a reanalysis of data from the fishery and separated by sex.

4.13   The Working Group noted that model fits to the data were adequate. Although the estimate of B_0 has declined slightly from the 2007 assessment, the perception of current status remains at about 85% of B_0. The impact of the new maturity ogive was to reduce estimates of spawning biomass, and of the larger tag dataset from selected trips was to increase estimates of spawning biomass in the Ross Sea and reduce estimates of spawning biomass in SSRU 882E.

4.14   Assessments of the Ross Sea and SSRU 882E are currently undertaken independently for convenience, and because they are separated considerably in space by closed SSRUs. The Working Group recognised the need to combine these assessments in future, on the basis of tag movements between areas and circulation in this region indicating links between these areas.

4.15   WG-FSA-09/14 Rev. 1 presented an assessment of *D. mawsoni* in Division 58.4.1 using an age-structured TISVPA model and a dynamic Schaefer-production model. The analysis suggested that current biomass in the division was about 12 000 tonnes and initial stock biomass was 19 000 tonnes. The paper used these results to calculate yield, based on a proportion of 3.75% of initial biomass, as being 724 tonnes.

4.16   The Working Group welcomed this further look at the data from Division 58.4.1, recalling that the preliminary assessment that it carried out last year identified several inconsistencies in the data from this division which required further investigation (SC-CAMLR-XXVII, Annex 5, paragraphs 5.21 to 5.29). However, the Working Group recalled that neither it nor WG-SAM has yet been able to validate the use of TISVPA as an assessment method for CCAMLR (SC-CAMLR-XXVII, Annex 7, paragraph 3.21). Further, from the information presented in the report of WG-SAM, WG-FSA was unable to determine how key inputs to the assessment, such as CPUE and catches-at-age, had been calculated and whether the fits to CPUE data and other assumptions of the model justified the conclusions of the report. Of particular concern was the apparent generation by the model of a population age structure that did not appear to agree with biological information from the fishery.

4.17   Dr K. Shust (Russia) noted that the TISVPA model had been described in WG-FSA-06/50 and had been submitted to WG-SAM in 2007 and 2008 (WG-SAM-07/9 and 08/8). He further noted that age–length data used in WG-FSA-09/14 Rev. 1 had been provided and considered by WG-FSA as requested during the meeting. Therefore, Dr Shust considered that the results in WG-FSA-09/14 Rev. 1 could be recommended to the Scientific Committee for setting precautionary catch limits in Division 58.4.1. He also recalled that the B_0 and catch limits estimated last year in Divisions 58.4.1 and 58.4.2 used data from the Ross Sea (Subareas 88.1 and 88.2) which are not applicable for these divisions.

4.18   Dr Shust further noted the comments by WG-SAM and WG-FSA on the TISVPA assessment for Division 58.4.1 and undertook to encourage the authors of WG-FSA-09/14 Rev. 1 to present an updated copy of the TISVPA manual, model examples and simulations to allow WG-SAM to validate the package at a future meeting.

4.19   The Working Group reiterated its advice (e.g. SC-CAMLR-XXVI, Annex 5, paragraph 4.27; SC-CAMLR-XXVII, Annex 7, paragraph 3.21) about the detail that is required for it to interpret the results of assessments that are presented to it, particularly when they use new or unvalidated methods, specifically:

(i)   the need to provide a full model description;

(ii)   the need to present all source data used in the model, and to describe how these were derived from data available either to the authors or, preferably, available in the CCAMLR databases;

(iii)   the need to provide software, manuals and input files to CCAMLR;

(iv)   the need to present a full suite of diagnostics in the results, including particularly the goodness of fit, and plots, of observed and fitted parameters as well as confidence intervals bounding results, including stock trajectories;

(v)   the need to present assessments that structurally differ from previous assessments, or are based on new assessment methods, to WG-SAM for validation prior to their submission at WG-FSA.

4.20   The Working Group noted that the use of an assumed harvest rate based on the experience from fully assessed fisheries was only useful if the assumptions in its derivation were stated explicitly, if the current state of the stock was taken into consideration, and that it

was used only as a very preliminary indication of likely yield. The Working Group agreed that the CCAMLR decision rules should be used explicitly with the assessment results to determine yields, rather than relying on harvest rate proxies. It was noted that harvest rates consistent with the CCAMLR decision rule would be dependent on stock dynamics and the state of the stock.

4.21 Since many CASAL assessments are now using catch-at-age data and are capable of estimating year-class strength more accurately, the Working Group recommended that all future assessments include presentation of bubble plots of catch-at-age proportions, which will assist with identification of strong and weak cohorts. The Working Group also recommended that likelihood profiles should be included in all assessment results.

Icefish

4.22 WG-FSA-09/33 presented an assessment of *C. gunnari* in Division 58.5.2 based on the 2009 survey results. The strong year class detected in the last two surveys (the current 3+ cohort) now dominates the population. Two scenarios were considered when calculating yields for the following two seasons: a two-year projection, based on the assumption that the 3+ cohort will survive into 2010/11; and a single-year projection, based on the assumption that the 3+ cohort will disappear at the end of 2009/10.

4.23 The Working Group recognised that the 3+ cohort currently dominating the population is unlikely to survive until 2010/11 as 5+ fish have rarely been present in significant numbers in previous surveys of the division.

4.24 The CCAMLR assessment method for *C. gunnari* uses CMIX to disaggregate length-density data into age density before applying CCAMLR decision rules in GYM. An alternative methodology which works entirely on length data and utilises a growth transition matrix was presented in WG-FSA-09/27, and applied to Subarea 48.3. The method was tested on 2006, 2007, 2008 and 2009 data, and gave similar yields to the traditional assessment method.

4.25 The Working Group recognised the importance of the transition matrix, and its determination, for the correct application of the method. The Working Group also recognised that growth rates in the CMIX/GYM model are not well estimated.

4.26 The Subarea 48.3 assessment model currently recognises the possibility of variable natural mortality and accounts for this uncertainty by using a high natural mortality rate. Ideally, external information, such as availability of krill or evidence of ecosystem anomalies (see WG-EMM-09/23), could be used to modify *M* in the model. The Working Group noted that there have been repeated efforts to do this with limited success. However, the issue of ensuring sufficient icefish escapement for predators under conditions of variable natural mortality and ecosystem productivity warrants further consideration.

Assessments to be carried out and assessment timetable

4.27 Assessment approaches taken for the assessed fisheries were based on the preliminary assessment submission, issues identified during the course of WG-FSA, as well as subgroup discussions. The Working Group agreed to undertake updated assessments for the following fisheries:

- *D. eleginoides* in Subarea 48.3
- *D. eleginoides* in Subarea 48.4
- *D. eleginoides* in Division 58.5.2
- *D. mawsoni* in Subarea 88.1 and SSRUs 882A–B (Ross Sea management area)
- *D. mawsoni* in Subarea 88.2, SSRU E
- *C. gunnari* in Subarea 48.3
- *C. gunnari* in Division 58.5.2.

4.28 The Working Group agreed that all assessments for *Dissostichus* spp. will use the CASAL framework, and *C. gunnari* will use the short-term projection approach. Specific information on input data and assessment methodologies for each assessed fishery are provided in Item 5.

4.29 The Working Group did not have new information with which to update assessments for *D. eleginoides* fisheries in Division 58.5.1, Subarea 58.6 (Crozet) and Subareas 58.6/58.7 (Prince Edward Island).

4.30 All assessment work was undertaken by primary authors of preliminary assessments, and reviewed independently. Tasks of independent reviewers are listed in WG-FSA-06/6, paragraph 6.3. The outcomes of the assessments were reported in the Fishery Reports (Appendices E to S).

ASSESSMENT AND MANAGEMENT ADVICE

New and exploratory fisheries in 2008/09 and notifications for 2009/10

5.1 In 2008 the Commission agreed to seven exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season (Conservation Measures 41-04, 41-05, 41-06, 41-07, 41-09, 41-10 and 41-11), an exploratory trawl fishery for *E. superba* in Subarea 48.6 (Conservation Measure 51-05), and exploratory fisheries for crab in Subareas 48.2 and 48.4 (Conservation Measures 52-02 and 52-03). Activities in the exploratory fisheries are outlined below and summarised in Table 5.

5.2 Notifications for new and exploratory fisheries in 2009/10 are summarised in Table 6. Ten Members submitted paid notifications 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, an exploratory trawl fishery for *E. superba* in Subarea 48.6, and for exploratory pot fisheries for crab in Subareas 48.2 and 48.4.

5.3 In addition, one Member notified its intention to fish for crabs in Subarea 48.3 in 2009/10 in accordance with Conservation Measure 52-01.

5.4   The notifications for crabs are dealt with further under Item 5.4.3 (paragraphs 5.182 and 5.183).

5.5   The Working Group agreed, as in previous years, that it would not attempt to determine whether the notifications for exploratory fisheries satisfied the requirements of the notification procedure (Conservation Measure 21-02); this, it believed, should be done by SCIC. It did, however, note that many of the notifications provided very little information on the research to be undertaken as part of the exploratory fishery and the assessment of impacts of the fishing activities on VMEs. These issues are considered further under Items 5.2 and 10 respectively (paragraphs 5.112 to 5.120 and 10.1 to 10.51).

5.6   The Working Group noted that Argentina had notified to fish using both pots and longlines in Subarea 88.1. It also noted that this would be the first time that pots had been used in this fishery and that this would provide a number of potential issues for analysis of data from the fishery. Firstly, the fishing selectivity of the pots was unknown and therefore a large number of fish would need to be measured per line so that the selectivity of the pot could be reliably estimated. The Working Group agreed that as many toothfish as possible should be measured from each pot with a minimum of at least 100 fish randomly sampled and measured per line.   The Working Group noted that potting toothfish may introduce uncertainty and/or biases into the tagging program because parameters such as tag shedding and initial mortality may differ between longline- and pot-caught fish. Although CPUE is not currently used in the Subarea 88.1 and 88.2 assessments, the Working Group was also concerned that the CPUE characteristics of the potting system for toothfish and by-catch species was poorly understood.

5.7   Unstandardised CPUE data for *Dissostichus* spp. caught in exploratory longline fisheries between 1996/97 and 2008/09 are summarised in Table 7.

5.8   Under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in 2008/09 was required to tag and release *Dissostichus* spp. at the rate of one toothfish per tonne of green weight caught throughout the season in Subareas 88.1 and 88.2, and three fish per tonne in Subarea 48.6 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b (Table 8). All vessels achieved the required tagging rate except for the *Isla Eden*[3] in Subareas 88.1 and 88.2. In 2008/09, 6 326 *Dissostichus* spp. were reported to have been tagged and released in the exploratory longline fisheries (Table 9), and 172 tags were recovered (Table 10).

5.9   The Working Group noted that there had been a total of 45 tag recaptures (including 33 which had been at liberty for at least one year) in the exploratory fisheries in Subareas 48.6 and 58.4. The Working Group also noted that over 7 000 tags have been released in these fisheries, and reviewed possible reasons for the low recapture rate including time at liberty, distance moved, location of tagging and subsequent fishing effort, and size distribution of fish tagged. Ten fish had been at liberty for at least two years with one fish being recaptured after four years, suggesting good retention of the tags and survival of at least some of the tagged fish. There was concern from some members that tagged fish may move into adjacent closed SSRUs. However, the majority of tagged toothfish were recaptured less than 50 km from

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[3]   The tagging rates for the *Isla Eden* were incorrectly reported at the meeting. The *Isla Eden* achieved the required tagging rates in Subareas 88.1 and 88.2. See Table 8 corrigendum.

their release position, both in these subareas as well as in Subareas 88.1 and 88.2 (WG-FSA-09/39), suggesting that movement to adjacent closed SSRUs was unlikely to be the main reason for the low recapture rates.

5.10   Tagging rate per vessel was plotted against time to check whether tagging was carried out throughout the fishing period (in accordance with Conservation Measure 42-01). The results suggested an improvement on the 2007/08 season with most vessels now tagging at the correct rate throughout fishing. However, the Working Group noted one vessel which initially tagged at a very high rate (including 100 fish tagged in one set) but then ceased tagging altogether (Figure 2). Although the vessel exceeded the overall required tagging rate, the Working Group was concerned that such a high tagging rate over a short period of time may be detrimental to those fish that were tagged, and was not consistent with the intention to spread tagged fish throughout the area as fishing proceeds.

5.11   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 reasonably 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.

5.12   The length-frequency distribution of the tagged fish was compared to the length-frequency distribution of the fish caught to check whether the full size range of fish was being tagged in accordance with Conservation Measure 41-01. The results show that for every vessel * statistical area * species combination, the size of fish being tagged was not representative of the length-frequency distribution of the fish caught (Figure 3). Indeed, for *Insung No. 22* in Subarea 48.6, the two distributions did not even overlap, with every fish less than 100 cm being tagged and released and every fish over 100 cm being retained.

5.13   To evaluate the degree of mismatch between the length-frequency distribution of the tagged fish and that of the fish caught, the Working Group developed a metric based on the overlap between the two distributions. The metric (θ) was

$$\theta = \left(1 - \frac{\sum\limits_{i=1}^{n} |P_t - P_c|}{2}\right) \times 100$$

where P_t was the proportion of all fished tagged in length bin i, P_c was the proportion of all fish caught (i.e. the sum of all the fish caught and either landed or tagged and released), for 20 cm length bins. θ is therefore one minus half the sum of the absolute differences in the proportions-at-length in 20 cm length bins, over the range of the data, expressed as a percentage. A value of 0% represents no overlap, and 100% represents perfect agreement between the two distributions. The metric was then converted to a descriptive rating based on the degree of overlap: High ($\geq$60% overlap), Medium ($\geq$30 to <60% overlap) and Low (<30% overlap). Examples of the degree of overlap and the corresponding descriptive rating are shown in Figure 3.

5.14   The results were highly variable between vessels depending on species and areas (Table 11). However, several vessels (*Isla Eden, Insung No. 1, Insung No. 22, Jung Woo No. 2, Jung Woo No. 3* and *Tronio*) showed low overlap between the two distributions in all statistical areas fished. Other vessels (*Shinsei Maru No. 3, Antarctic Chieftain, Janas, San Aotea II, San Aspiring* and *Ross Star*) achieved high overlap in at least one statistical area. The Working Group noted that this was a method by which consistency with Conservation Measure 41-01 can be assessed and referred this to SCIC for further consideration.

5.15   The Working Group agreed that one of the main reasons for the lack of recaptures in these subareas was likely to be the small size of the fish tagged compared to the size distribution of the fished population.

5.16   The Working Group agreed that tagging large numbers of small fish in these exploratory fisheries, whilst potentially providing useful information on growth and movement in the medium to long term, would have very limited use for the estimation of abundance. This is because small fish are not commonly caught in these longline fisheries (i.e. have very low selectivity), and it would be many years before they are fully selected in the fishery. (For example, in the example mentioned in paragraph 5.12 it may take 15–20 years for the tagged fish to be fully selected by the longline gear.) During this time period the tags could be shed, grown over, or covered by fouling organisms, and many of the tagged fish (over 80%) would be estimated to die due to natural mortality.

5.17   The Working Group recalled that a paper had been submitted to WG-FSA in 2007 which outlined methods by which large toothfish could be tagged in good condition (WG-FSA-07/36). The Working Group noted that it would be useful for the methods described in this paper to be considered by ad hoc TASO. The Working Group agreed that some vessels showed a very low level of commitment to the tagging program and that this was having a serious impact on the efficacy of the tagging program. The Working Group recommended that the Scientific Committee once again strongly urge Members to request their vessels to fully comply with all aspects of Conservation Measure 41-01, in particular with respect to the size of toothfish being tagged.

5.18   Under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in 2008/09 was required to complete 10 research hauls (each comprising 3 500–5 000 hooks and separated by a distance of at least 5 n miles) on entering an SSRU in an exploratory fishery. For the 2008/09 season, each SSRU was divided into two strata (fished and non-fished/lightly fished) and vessels were required to carry out their research hauls at pre-determined randomly allocated positions. If it was not possible to complete the research hauls in the allocated positions, then the vessels were requested to complete the hauls within the appropriate strata. The implementation of the research hauls by fishing vessels was summarised in WG-SAM-09/6 and CCAMLR-XXVIII/BG/6.

5.19   The Working Group noted that the degree of consistency between the allocated and actual research haul locations varied considerably between vessels and statistical areas (WG-SAM-09/6). Most hauls were separated by the required minimum distance of 5 n miles, although three vessels had set lines closer together than the minimum required distance (Table 12). Whilst most vessels set lines on or close to the allocated location, the *Banzare* consistently sets its research hauls at a mean distance of more than 25 n miles from the allocated positions (Table 12). An example of the allocated hauls and actual hauls for the

Banzare is shown in SSRU 5843bE (Table 12 and Figure 4). Although not all research hauls were always set at the allocated location, some research hauls were not even completed in the required stratum (Table 12). Several reasons were given by vessels for being unable to reach the allocated positions, including the presence of sea-ice, other vessels having set lines in those allocated positions and fishery closure.

5.20   The Working Group also compared mean catch rates (catch per 1 000 hooks) from the research hauls with mean catch rates from subsequent commercial hauls made by the same vessel in that division or subarea and concluded that there was no substantial reduction in overall catch rates from completing the 10 research hauls.

5.21   The Working Group noted that the use and implementation of research hauls had been reviewed by WG-SAM (Annex 6, paragraphs 2.56 to 2.61) and that it had provided the following comments and recommendations that:

(i)   the research set allocation approach developed for use for the exploratory fisheries in 2008/09 be retained for the 2009/10 season with the implementation outlined in Annex 6, paragraph 2.58;

(ii)   the number of research hauls required to achieve a target CV for this monitoring tool should be evaluated by WG-FSA and, if appropriate, the proportion of research hauls in the non-fished/lightly fished strata could be altered accordingly;

(iii)   WG-FSA be more specific over how this may lead to, or improve, an assessment.

5.22   The Working Group endorsed this advice and noted that this is considered further under Item 5.2.

Open and closed SSRUs

5.23   Some members expressed the opinion that the closed SSRUs in the new and exploratory fisheries throughout the Convention Area should be reopened to fishing. They considered that there was a paucity of data on the distribution and size composition of toothfish and on the rate of by-catch (catch composition) in those SSRUs. They also noted the inability to recapture tagged fish which had moved to closed SSRUs, and the inability to tag fish in closed SSRUs. They considered that this may result in underestimation of toothfish biomass and catch limits in the new and exploratory fisheries. Taking all this into account, they suggested that the Scientific Committee consider the possibility of reopening some of the closed SSRUs in order to distribute the exploratory effort across more of the Convention Area and provide better estimates of the toothfish stock in those subareas.

5.24   Other members considered that the network of open and closed SSRUs should be retained because they considered that progress in stock assessments had been assisted by the concentration of effort within the open SSRUs. They agreed that it was important to have a good understanding of the distribution and abundance of *Dissostichus* spp. throughout the Convention Area, but noted that this had to be balanced against developing assessments for the fisheries which was best achieved by concentrating effort on a subset of areas within the

Convention Area. They noted the success that had been achieved in this regard in Subareas 48.4, 88.1 and 88.2 where a staged approach to data collection and fishery developments had been adopted and regularly evaluated. They considered that it was premature to consider reopening the closed SSRUs until the simulation work that was requested in 2008 by the Scientific Committee (SC-CAMLR-XXVII, paragraph 4.158) had been completed.

5.25 The Working Group was unable to provide consensus advice on the issue of maintaining the network of open and closed SSRUs in these subareas.

5.26 The Working Group agreed that a well-designed research experiment in accordance with the guidelines developed at SC-CAMLR-XXVII (SC-CAMLR-XXVII, paragraphs 8.9 to 8.11) and endorsed by the Commission in paragraph 4.66 of CCAMLR-XXVII, with catch limits consistent with the objectives of the experiment, could provide information on the distribution and abundance of *Dissostichus* spp. within a closed SSRU over a 2–3 year time period.

5.27 The Working Group agreed that it was important to use simulations and MSE frameworks to address the potential bias in assessments arising from open/closed SSRUs and that there were several possible approaches to this. For example, potential biases in Divisions 58.4.1 and 58.4.2 were evaluated by comparing observed and expected tag-recapture rates under different tag-movement assumptions in WG-FSA-08/63, which indicated that movement of fish into closed SSRUs did not explain the current low levels of tag-recapture rates. The Working Group also recalled that New Zealand has been developing an SPM over the past two years which could be used to assess potential issues of bias in the tagging program (WG-SAM-08/14, 09/17, 09/18). The SPM was endorsed by WG-SAM for this purpose at the 2009 meeting (Annex 6, paragraphs 4.1 to 4.5). New Zealand welcomed the cooperation of other Members to further develop this work.

5.28 The Working Group reiterated its recommendation from last year that the relative merits of the different views on harvest strategies for toothfish in new and exploratory fisheries be evaluated using simulations. It recommended that such work be submitted to WG-SAM for review of the simulation methodologies before submitting the outcomes to WG-FSA for consideration.

Progress towards assessments of exploratory fisheries

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

Dissostichus spp. Subarea 48.6

5.29 In 2008/09, the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 was limited to Japanese and Korean flagged vessels using longlines only, and no more than one vessel per country was permitted to fish at any one time. 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 E.

5.30 Licensed longline vessels have fished the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 since 2003/04, and the main species caught has been *D. eleginoides*, except in

2008/09 when the dominant species in the catches was *D. mawsoni*. In 2008/09, two vessels fished in SSRUs E and G. SSRU E was closed on 12 March 2009 (catch limit for *Dissostichus* spp.: 200 tonnes; final reported catch: 189 tonnes), with a consequential closure of all other SSRUs south of 60°S.

5.31   There was no evidence of IUU fishing in 2008/09.

5.32   Vessels were required to tag and release *Dissostichus* spp. at a rate of one fish per tonne of green weight caught, and a limit of 500 fish tagged per vessel applied until the end of 2006/07. The tagging rate was increased to three tags per tonne in 2008/09 and both vessels achieved the new target rate. A total of 401 *D. eleginoides* and 906 *D. maws oni* (total 1 307 fish) have now been tagged and released, and five *D. eleginoides* and two *D. mawsoni* have been recaptured in that subarea (Tables 9 and 10).

5.33   Three Members (Japan, Republic of Korea and South Africa) and a total of five vessels notified their intention to fish for toothfish in Subarea 48.6 in 2009/10.

5.34   The Working Group recommended the existing conservation measures for Subarea 48.6 be retained for the 2009/10 fishing year.

Dissostichus spp. Division 58.4.1

5.35   Two Members (Republic of Korea and Uruguay) and three vessels fished in the exploratory fishery in Division 58.4.1 in 2008/09. The precautionary catch limit for toothfish was 210 tonnes, of which no more than 100 tonnes could be taken in SSRU C, 50 tonnes in SSRU E and 60 tonnes in SSRU G. The five other SSRUs (A, B, D, F and H) were closed. Fishing was prohibited in depths less than 550 m in order to protect benthic communities. Information on this fishery is summarised in Appendix F.

5.36   SSRU G was closed on 2 February 2009 (catch limit for *Dissostichus* spp.: 60 tonnes; final reported catch: 60 tonnes). SSRU E was closed on 27 February 2009 (catch limit for *Dissostichus* spp.: 50 tonnes; final reported catch: 54 tonnes). SSRU C, and consequently the fishery, was closed on 12 March 2009 (SSRU C catch limit for *Dissostichus* spp.: 100 tonnes; final reported catch: 108 tonnes). The catch limit for the whole *Dissostichus* spp. fishery was 210 tonnes and the final reported catch was 222 tonnes. Information on IUU activities indicated that 152 tonnes of toothfish were taken in 2008/09.

5.37   A total of 1 127 toothfish were tagged and released in the 2008/09 season, and seven tagged toothfish were recaptured during that season (Tables 8 and 10).

5.38   Five Members (Japan, Republic of Korea, New Zealand, Spain and Uruguay) and a total of 11 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2009/10.

5.39   The Working Group noted that Russia had begun research on *Dissostichus* spp. in this division (WG-FSA-09/14 Rev. 1). The Working Group encouraged the continuation of the work during the intersessional period and for the otolith readings to be verified by CON (paragraphs 9.4 to 9.8) and for the results to be evaluated by WG-SAM (Annex 6, paragraph 3.18).

5.40   The Working Group recommended that the existing catch limits and other aspects of the conservation measures for Division 58.4.1 be retained for the 2009/10 season. It noted that several SSRUs in this division have catch limits of 30 tonnes which posed problems with predicting fishery closures (paragraphs 3.13 to 3.15) considering the large number of vessels notified for this division.

Dissostichus spp. Division 58.4.2

5.41   Two Members (Japan and Republic of Korea) and two vessels fished in the exploratory fishery in Division 58.4.2 in 2008/09 and the reported catch was 66 tonnes. SSRU E was closed on 17 February 2009 (catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 61 tonnes), and the fishery was closed on 23 February 2009 (catch limit for *Dissostichus* spp.: 70 tonnes; final reported catch: 66 tonnes). The other SSRUs (B, C and D) were closed to fishing. Fishing was prohibited in depths less than 550 m in order to protect benthic communities. Information on this fishery is summarised in Appendix G.

5.42   The fishery targeted *D. mawsoni* and operated in SSRUs A and E in 2008/09. It was estimated that 176 tonnes of *D. mawsoni* were taken by IUU fishing in 2008/09.

5.43   A total of 277 toothfish were tagged and released in 2008/09 and one tagged toothfish was recaptured (Tables 9 and 10).

5.44   Five Members (Japan, Republic of Korea, New Zealand, Spain and Uruguay) and a total of nine vessels notified their intention to fish for toothfish in Division 58.4.2 in 2009/10.

5.45   The Working Group recommended the existing conservation measures for Division 58.4.2 be retained for the 2009/10 season. It noted that several SSRUs in this division have catch limits of 30 tonnes which posed problems with predicting fishery closures (paragraphs 3.13 to 3.15) considering the large number of vessels notified for this division.

Dissostichus spp. Division 58.4.3a

5.46   One Member (Japan) and one vessel fished in the exploratory fishery in Division 58.4.3a in 2008/09. The precautionary catch limit for toothfish was 86 tonnes and the reported catch was 31 tonnes. Information on this fishery is summarised in Appendix H.

5.47   There was no evidence of IUU fishing in 2008/09.

5.48   A total of 113 toothfish were tagged and released in 2008/09 and two tagged toothfish were recaptured during that season.

5.49   Two Members (Japan and Uruguay) and three vessels notified their intention to fish for toothfish in Division 58.4.3a in 2009/10.

5.50   The Working Group agreed that, in the absence of a new assessment, the catch limit should remain at 86 tonnes in this division.

Dissostichus spp. Division 58.4.3b

5.51   Two Members (Japan and Uruguay) and two vessels fished in the exploratory fishery in Division 58.4.3b in 2008/09. In November 2007, the division was divided into two SSRUs: A north of 60°S and B south of 60°S. In November 2008, the area north of 60°S was further subdivided into four SSRUs (A, C, D and E). The precautionary catch limit for *Dissostichus* spp. in the fishery was 30 tonnes in each of SSRUs A, C, D and E, and SSRU B remained closed to fishing. Information on this fishery is summarised in Appendix I.

5.52   In 2008/09, the fishery operated in SSRUs A, C, D and E. SSRU D was closed on 27 January 2009 (catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 31 tonnes). SSRU A was closed on 2 February 2009 (catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 28 tonnes). SSRU E was closed on 7 February 2009 (catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 45 tonnes). The entire fishery was closed on 9 February 2009 with a reported total catch of 104 tonnes of *Dissostichus* spp. (87% of the precautionary catch limit for the fishery).

5.53   Information on IUU activities indicated that 610 tonnes of toothfish were taken in 2008/09.

5.54   A total of 431 toothfish were tagged and released in 2008/09, including 75 *D. eleginoides* and 356 *D. mawsoni* . One tagged toothfish was recaptured during the 2008/09 season.

5.55   Four Members (Japan, Republic of Korea, South Africa and Uruguay) and six vessels notified their intention to fish for toothfish in Division 58.4.3b in 2009/10.

5.56   Dr Welsford presented WG-FSA-09/44, including revised analyses of the catch and effort data for BANZARE Bank. The authors noted evidence of depletions in areas where fishing has concentrated, and the lack of large numbers of fish outside these areas, as shown in the surveys conducted by Australia in 1999 and 2008, indicate that the stock of *D. mawsoni* is depleted and the fishery should be closed. For a range of scenarios of initial biomass, and fishery and IUU catches in this division, the GYM was then used to assess foregone yields and to estimate (i) the probability of being depleted below $0.2 B_0$ and (ii) the time to recovery to $0.5 B_0$. The authors of WG-FSA-09/44 noted that these scenarios also confirmed that this stock is likely to be depleted, and in the absence of fishing it is likely that it will be at least five years before it is sufficiently low risk to survey this stock to determine if recovery is occurring. They propose a recovery strategy, with a survey to be undertaken in five years' time to determine comparative catch rates and age structure and establish a mark-recapture program. The stock should then be surveyed two years later to determine the rate of recovery and a full recovery strategy to help the stock recover to target levels, at which time the fishery could be reopened. The authors further noted that this strategy could be used to develop a recovery strategy for *D. eleginoides* on Ob and Lena Banks and other depleted stocks.

5.57   The Working Group considered three possible scenarios for the *D. mawsoni* stock on BANZARE Bank, based on existing knowledge:

(i)   Scenario 1: spawning fish have a high turnover in Division 58.4.3b, moving freely within this division between SSRUs and areas outside each year.

(ii) Scenario 2: spawning fish move sporadically to Division 58.4.3b, and then remain in the area, moving little across the area between years.

(iii) Scenario 3: there is large turnover of large fish in Division 58.4.3b, but they represent only a fraction of the spawning stock that sustains the population in East Antarctica.

5.58 It further noted that due to their proximity, the fish on BANZARE Bank are likely to originate from the coastal areas of Antarctica in the Southern Indian Ocean. The Working Group noted that other plausible scenarios could be envisioned, however, it saw that the three scenarios captured useful alternative hypotheses for this division (Figure 5).

5.59 The Working Group recalled that it had agreed last year (SC-CAMLR-XXVII, Annex 5, paragraph 5.57) that:

(i) Based on fishing information until 2006/07, the fisheries across BANZARE Bank show that the preferred fishing grounds were depleted in the Southern Area (adopted by WG-FSA-07, resulted in the closure of the Southern Area).

(ii) Based on the survey and fisheries across BANZARE Bank, there are very few fish apart from in the preferred fishing grounds.

(iii) The fish found in the preferred fishing grounds are large and likely spawning, there are no small fish and fish are male dominated (79%).

(iv) In the survey, the fish are large and mostly male.

(v) Spawning fish in East Antarctica have only been found on BANZARE Bank (WG-FSA-07/44 and paragraph 5.56).

5.60 The Working Group then considered the data and analyses on CPUE, size distribution and tagging data from Division 58.4.3b (WG-FSA-09/44). The Working Group agreed that CPUE data indicated that:

(i) depletion had occurred during fishing in Patch B in 2007/08 and Patch C in the 2008/09 season, but the results of the depletion analyses were ambiguous for Patch A and for Ground C (see Figure 6 for location of grounds and patches);

(ii) unstandardised CPUE for the whole of Division 58.4.3b has increased between 2003/04 and 2008/09 (Figure 7);

(iii) CPUE is affected by factors such as gear and bait type, vessel, season, depth fished, species and area fished, and these have serious consequences for interpreting unstandardised CPUE (SC-CAMLR-X, Annex 6, paragraphs 7.107 to 7.121; SC-CAMLR-XI, Annex 5, paragraphs 6.143 to 6.166).

5.61 The Working Group also agreed that tagging data indicated that:

(i) of 10 tags recaptured in Division 58.4.3b, nine were released in Division 58.4.3b and one was released in Division 58.4.1 (Figure 8);

(ii) large movements of fish have been observed for fish at liberty for two years or more, and tend to be from the east to the west in coastal Antarctica, or from the coast to BANZARE Bank;

(iii) stocks of *D. mawsoni* are likely to be distinct at the scale of ocean basins (see also Smith and Gaffney, 2005).

5.62 The Working Group further agreed that size distribution data and maturity data indicated that:

(i) there is no evidence of recruitment of small (<60 cm) *D. ma wsoni* in Divisions 58.4.1, 58.4.2 and 58.4.3b (Figure 9);

(ii) *D. mawsoni* are likely to move throughout Divisions 58.4.1, 58.4.2 and 58.4.3b;

(iii) smaller fish are found in the western area of Division 58.4.2 and in waters shallower than 1 000 m, and larger fish in waters deeper than 1 000 m.

5.63 The Working Group noted that the observed size distribution and location of tag recaptures of *D. ma wsoni* from Subarea 58.4 suggested a life-history pattern that was analogous to that proposed for *D. mawsoni* in the Ross Sea by Hanchet et al. (2008). Hence the size distribution of *D. mawsoni* on BANZARE Bank would be expected to be similar to that in the north of the Ross Sea (Figure 10).

5.64 The Working Group noted that the development of this hypothetical lifecycle for the Ross Sea had been useful in understanding population dynamics in this region. The Working Group encouraged Members to develop a similar detailed review of data to develop a hypothetical lifecycle for *D. mawsoni* in the Indian Ocean sector of the Convention Area for Subarea 58.4, including consideration of oceanographic features in the area.

5.65 The Working Group noted that analysis of otoliths would assist in understanding population dynamics of *D. mawsoni* in this area.

5.66 The Working Group was unable to provide management advice on catch limits in this division, but recommended that all other aspects of Conservation Measure 41-01 be carried forward if a catch limit is set in 2009/10. It noted that several SSRUs in this division have catch limits of 30 tonnes which posed problems with predicting fishery closures (paragraphs 3.13 to 3.15) considering the large number of vessels notified for this division.

Dissostichus spp. Subareas 88.1 and 88.2

5.67 In 2008/09, six Members (Chile, Republic of Korea, New Zealand, Spain, UK and Uruguay) and 13 vessels fished in the exploratory fishery in Subarea 88.1. The fishery was closed on 25 January 2009 and the total reported catch of *Dissostichus* spp. (excluding research fishing) was 2 434 tonnes (90% of the limit) (Appendix J, Table 3). The following SSRUs were closed during the course of fishing:

• SSRUs B, C and G closed on 22 December 2008, triggered by the catch of *Dissostichus* spp. (total catch 410 tonnes; 116% of the catch limit);

- SSRUs H, I and K closed on 22 January 2009, triggered by the catch of *Dissostichus* spp. (total catch 1 957 tonnes; 98% of the catch limit).

The IUU catch for the 2008/09 season was estimated to be 0 tonnes.

5.68   Seven Members (Argentina, Republic of Korea, New Zealand, Russia, Spain, UK and Uruguay) and a total of 18 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.1 in 2009/10.

5.69   Seven Members (Chile, Republic of Korea, New Zealand, South Africa, Spain, UK and Uruguay) and seven vessels fished in the exploratory fishery in Subarea 88.2. The fishery closed on 31 August 2009 and the total reported catch of *Dissostichus* spp. was 484 tonnes (85% of the limit) (Appendix J). SSRU E was closed on 8 February 2009, triggered by the catch of *Dissostichus* spp. (total catch 316 tonnes; 89% of the catch limit). The IUU catch for the 2008/09 season was estimated to be 0 tonnes.

5.70   Seven Members (Argentina, Republic of Korea, New Zealand, Russia, Spain, UK and Uruguay) and a total of 18 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.2 in 2009/10.

5.71   The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is in Appendix J. In 2005 the Working Group recommended that Subareas 88.1 and 88.2 be split into two areas for stock assessment purposes: (i) the Ross Sea (Subarea 88.1 and SSRUs 882A–B), and (ii) SSRU 882E.

5.72   The catch limits for Subarea 88.1 and 88.2 SSRUs in the Ross Sea were changed as part of a three-year experiment (SC-CAMLR-XXIV, paragraphs 4.163 to 4.166). To assist administration of the SSRUs, the catch limits for SSRUs 881B, C and G were amalgamated into a 'north' region and those for SSRUs 881H, I and K were amalgamated into a 'slope' region. SSRU J was split at 170°E into two SSRUs – M and J.

5.73   Within Subarea 88.2, SSRU 882E was treated as a separate SSRU with its own catch limit, whilst SSRUs 882C, D, F and G were amalgamated with a single catch limit.

5.74   In all seasons, there was a broad mode of adult fish at about 120–170 cm. In 2005/06, there was a strong mode at about 60 cm in Subarea 88.2. These fish were predominantly caught at the edge of the continental shelf in SSRUs 882F and G. This mode was not apparent in 2006/07, as there was no fishing on the shelf in these SSRUs in 2006/07. This mode was again apparent in 2008/09, due to fishing on the shelf and slope in SSRUs 882D, E and F in 2008/09.

5.75   Under Conservation Measure 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 toothfish per tonne of green weight caught throughout the season.

5.76   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-09/35). The method first selected an initial informative dataset comprising trips with (i) high (above median) rates of recovery of previously released tags, and (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.

5.77 Since 2000/01, more than 22 000 *Dissostichus* spp. have been tagged in Subareas 88.1 and 88.2, with almost 19 000 and 2 000 *D. mawsoni* in the Ross Sea and SSRU 882E respectively (WG-FSA-09/39). The selected trips' tag dataset contained a total of 13 308 releases and 474 recaptures that were used in the assessment of the Ross Sea (WG-FSA-09/40 Rev 1.), and 947 releases and 47 recaptures that were used in the assessment for SSRU 882E (WG-FSA-09/41).

5.78 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.

5.79 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 2 850 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 2 850 tonnes is therefore recommended.

5.80 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 SSRU 882E was 361 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 361 tonnes is therefore recommended.

5.81 For SSRUs 882C, D, F and G the Working Group could provide no new advice, but noted that the catches in these areas had provided some useful biological data for toothfish. Therefore, the Working Group recommended the current catch limits in these SSRUs be continued for the 2009/10 season.

5.82 The Working Group recommended that the allocation method used to set the 2005/06 catch limits for SSRUs in Subarea 88.1 be continued for the 2009/10 season.

5.83 The Working Group recalled its advice that the current designations of SSRUs in Subareas 88.1 and 88.2 are almost certainly not optimal, but a detailed revision of these would require, at least, a consolidated movement model for fish in these subareas, which is not yet available. Such a revision should take account not only of the principal target species, but also of by-catch species and ecosystem considerations.

5.84 The Working Group noted that the method for selecting high-quality tag datasets still needs to be refined, and that potential biases caused by vessel preferences for localised fishing grounds are likely to require further investigation using the SPM.

5.85 The Working Group considered WG-FSA-09/7 on climate change, longevity, overfishing and management of the Area 88 toothfish fishery. The Working Group expressed concern that there were substantive errors of fact as well as an incorrect attribution of statements to references of the work of CCAMLR and its scientists in the paper. For example, including, but not restricted to, the following:

(i) The statement by the authors that CCAMLR's management strategy was to reduce the total biomass of toothfish to 50% of the virgin biomass is incorrect. Importantly, the reduction in biomass in the CCAMLR management strategy refers only to the spawning stock and is therefore quite a different consideration both for toothfish and in relation to ecosystem interaction.

(ii) The cited paper by de Vries et al. (2008) (WG-EMM-08/21) was reviewed by WG-EMM in 2008, which concluded that there was insufficient evidence to support the authors' assertions and requested that the full dataset be provided to the Secretariat for analysis and review (SC-CAMLR-XXVII, Annex 4, paragraphs 6.24 to 6.26). The Secretariat has still not received these data.

(iii) The primary climate change paper cited by the authors (Cheung et al., 2008) did not use CCAMLR catch data on the distribution of *D. mawsoni* throughout the Convention Area. Thus, for example, the largest fishery for this species, and probably the greatest density, is on the slope of the Ross Sea, but according to Cheung et al. (2008) this area currently has one of the lowest densities of *D. mawsoni* around the Antarctic continent. Furthermore, although the authors assert elsewhere that little is known about the early life history of *D. mawsoni*, they propose, with no evidence whatsoever, that *D. mawsoni* spawning and juvenile survival are dependent on sea-ice.

(iv) Papers by Hanchet and Pinkerton are extensively cited, however, many of the statements from these papers are taken out of context or are factually incorrect. For example, in the first sentence of the introduction there is a statement that 'most of the older fish were removed in the first several years of the fishery'. However, the data shown in the paper by Hanchet et al. (2007) (WG-FSA-07/28) provides no evidence to support this. Likewise, the authors of the paper make the claim on page 5 that 'without a change in the overall TAC in Area 88, vessels have increased their proportional concentration on the Ross Sea continental slope and they have also been fishing deeper in this habitat'. However, the current fishing pattern is a deliberate consequence of the separate catch limit for the shelf, slope and northern regions of the Ross Sea. Furthermore, the depth fished by vessels has been remarkably constant over the past five years.

(v) There are also a number of conclusions developed in the paper which do not bear closer scrutiny. For example, the authors conclude that 'Antarctic toothfish are likely to spawn episodically, or recruitment is likely to be episodic (on a decadal, not necessarily annual scale)'. However, recent studies suggest that there is low year-class strength variability (e.g. WG-FSA-07/28, 09/36), and that once fully mature, individual fish are likely to spawn in most years (e.g. WG-FSA-09/37).

5.86 In light of these obvious inconsistencies, the Working Group was unable to fully evaluate the conclusions reached by the authors of the paper.

Management advice to the Scientific Committee

5.87   The Working Group recommended that the catch limits for Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a be retained for 2009/10.

5.88   The Working Group recalled that the five-day catch and effort reporting system used in exploratory fisheries is not well suited to the monitoring of catch limits below 100 tonnes, and recommended that the Scientific Committee consider this matter further (paragraphs 3.14 and 3.15).

5.89   The Working Group was unable to provide management advice for the catch limits in Division 58.4.3b.

5.90   The Working Group agreed that measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne and the requirement for research hauls as used in 2008/09, be retained for the exploratory fisheries in Subareas 48.6 and 58.4.

5.91   The Working Group agreed that the catch limits for *Dissostichus* spp. in Subarea 88.1 should be 2 850 tonnes and for *Dissostichus* spp. in SSRU 882E should be 361 tonnes and for SSRUs 882C, D, F and G should be 214 tonnes (paragraphs 5.79 to 5.81). The Working Group recommended that the allocation method used to set the 2005/06 catch limits for SSRUs in Subarea 88.1 be continued for the 2008/09 season (paragraph 5.82).

5.92   The Working Group agreed that other measures in the research and data collection plans, including the tagging requirement for one tag per tonne, be retained for the exploratory fisheries in Subareas 88.1 and 88.2.

5.93   The Working Group agreed that some vessels showed a very low level of commitment to tagging larger toothfish and that this was having a serious impact on the efficacy of the tagging program. It recalled that a paper had been submitted to WG-FSA in 2007 which outlined methods by which large toothfish could be tagged in good condition (WG-FSA-07/36). The Working Group recommended that the Scientific Committee once again strongly urge Members to request their vessels to fully comply with all aspects of Conservation Measure 41-01, Annex C.

5.94   The Working Group discussed the network of open and closed SSRUs in the new and exploratory fisheries (paragraphs 5.23 to 5.27). It agreed that it was important to have a good understanding of the distribution and abundance of *Dissostichus* spp. throughout the Convention Area, but noted that this had to be balanced against developing assessments for the fisheries which was best achieved by concentrating effort on a subset of SSRUs within the Convention Area. The Working Group was unable to provide consensus advice on the issue of maintaining the network of open and closed SSRUs in these subareas.

5.95   The Working Group reiterated its recommendation from last year that the relative merits of the different views on harvest strategies for toothfish in new and exploratory fisheries be evaluated using simulations. It recommended that such work be submitted to WG-SAM for review of the simulation methodologies before submitting the outcomes to WG-FSA for consideration.

5.96   The Working Group noted that the method developed to evaluate the degree of mismatch between the length-frequency distribution of the tagged fish and that of the fish caught, as outlined in paragraphs 5.12 to 5.14, could be used to assess consistency with Conservation Measure 41-01, Annex C, and referred this to SCIC for further consideration.

Closed fishery – Ob and Lena Banks Division 58.4.4

5.97   The longline fishery for *Dissostichus* spp. in Divisions 58.4.4a and 58.4.4b began as a new fishery in 1997/98 (Conservation Measure 138/XVI). These divisions were managed as a single area and a catch limit for *Dissostichus* spp. applied to fishing north of 60°S, and in waters outside areas of national jurisdiction. In 1999, the divisions were subdivided into SSRUs A, B, C and D.

5.98   In 2002, the Commission expressed concern regarding the low levels of stocks of *Dissostichus* spp. in Divisions 58.4.4a and 58.4.4b and the high levels of IUU fishing in that region (CCAMLR-XXI, paragraph 11.36). Consequently, the Commission prohibited directed fishing for *Dissostichus* spp. in these divisions and the fishery for *Dissostichus* spp. was closed (Conservation Measure 32-10). The Commission agreed that such prohibition should apply at least until further scientific information is gathered and reviewed by the Scientific Committee and WG-FSA.

5.99   Two licensed longline vessels operated the exploratory fishery for *Dissostichus* spp. in Divisions 58.4.4a and 58.4.4b in 1999/2000 and reported a total catch of 156 tonnes of *D. eleginoides*. The following season, a single vessel fished briefly, reporting a total catch of 8 tonnes of *D. elegino ides*. The fishery was closed in December 2002 (Conservation Measure 32-10). Most of the reported catch of *D. eleginoides* was taken in SSRUs A and D.

5.100 In 2007/08, one Japanese-flagged longliner conducted research fishing in accordance with a research plan submitted under Conservation Measure 24-01. The vessel caught 77 tonnes of *D. eleginoides* and <1 tonne of *D. mawsoni*.

5.101 In 2008, a Japanese proposal to carry out research fishing in Division 58.4.4 was submitted to the Scientific Committee, which recommended that before conducting additional research in this area, the results of the recent longline survey be reported to WG-FSA, the design of a future survey be discussed and agreed at WG-SAM, and that comparable fishing trials be carried out in areas other than Division 58.4.4, to attempt the calibration of the trotline gear with the other longline gear (SC-CAMLR-XXVII, paragraph 8.8).

5.102 This work has been completed with the Japanese survey results and revised research proposal being reviewed by WG-SAM (Annex 6, paragraphs 2.47 to 2.55). After taking into account the comments of WG-SAM-09, the proposal was submitted to WG-FSA for review as WG-FSA-09/12.

5.103 During the WG-FSA-09 meeting, Japan further revised the research proposal to survey *Dissostichus* spp. in 2009/10 as part of a 3–5 year tagging experiment.

5.104 Dr K. Taki (Japan) recalculated the necessary sample size as 81 tonnes for toothfish for this division that includes four SSRUs, taking into account the latest information on spawning stock biomass indices of the reference area (Subarea 48.4). To apply the mark and recapture studies, a tagging rate of five fish per tonne will be used. A total of 117 research hauls are allocated on a 10-minute latitude × 20-minute longitude grid point. A trotline system will be employed for 88 research hauls. In 29 hauls (25% of total sets), the experimental gear, which consists of three segments of trotline system and Spanish line system respectively within one fishing line, will be used. He indicated that the sample size of 81 tonnes is necessary to obtain reliable stock estimate parameters and complete coverage of the survey area.

5.105 The Working Group agreed on the following points:

(i) The Commission recalled the Scientific Committee's concern regarding the low levels of stocks of *Dissostichus* spp. in Division 58.4.4 and Subarea 58.6 and the high levels of IUU fishing (SC-CAMLR-XXI, paragraphs 4.106 and 4.108). The Commission agreed that directed fishing for *Dissostichus* spp. should be prohibited in these regions, and that such prohibition shall apply until at least such time that further scientific information is gathered and reviewed by the Scientific Committee and WG-FSA. Accordingly, Conservation Measures 32-10 (2002) and 32-11 (2002) were adopted to prohibit directed fishing for *Dissostichus* spp. in Division 58.4.4 and Subarea 58.6 respectively (CCAMLR-XXI, paragraph 11.36).

(ii) Information on IUU activities indicated high levels of IUU fishing, and the estimated annual catch of *Dissostichus* spp. exceeded 1 000 tonnes in each season between 1997/98 and 2000/01. An estimated total of 7 116 tonnes of *Dissostichus* spp. has been removed by IUU fishing. There was no evidence of IUU fishing in 2003/04, 2007/08 and 2008/09 (Appendix K).

(iii) The Working Group noted that the majority of fish captured in the survey in Divisions 58.4.4a and 58.4.4b were between 55 and 150 cm in length. However, due to the lack of information on the selectivity of the gear, it was not possible to infer absolute abundance of size classes based on these data alone.

(iv) The Working Group noted that the authors of WG-FSA-09/12 used a harvest rate of 3.8% of initial spawning stock biomass to estimate sustainable yields for the stock in Divisions 58.4.4a and 58.4.4b. The Working Group recalled that this figure was not derived from a stock-specific application of the CCAMLR decision rules for toothfish, but rather derived from analyses in WG-FSA-08/43, which estimated a harvest rate based on the ratio between the sustainable yield and SSB_0 estimated in the Ross Sea (Subarea 88.1) in 2007. The Working Group agreed that the apparent harvest rate, derived from a stock where the CCAMLR decision rules were applied, would depend on the stock-specific biological characteristics of toothfish, the selectivity of the gear used in fishing the stock and also the status of the stock relative to its unfished state.

5.106 Dr Welsford noted that it was inappropriate to apply a harvest rate of 3.8% to the stock in Divisions 58.4.4a and 58.4.4b, when this rate is derived from the Ross Sea, as the Ross Sea stock is estimated to be in a fish-down phase, and well above the target of 0.5 median SSB_0.

He also noted that the productivity of *D. mawsoni* in the Ross Sea and of *D. eleginoides* in Divisions 58.4.4a and 58.4.4b is likely to be substantially different. He further noted that, as the stock in Divisions 58.4.4a and 58.4.4b had been depleted by IUU fishing, and is unlikely to have fully recovered to a pristine state in the six years since it was closed, any removal rate must be significantly lower than 3.8% to be precautionary. Preliminary modelling using the GYM indicates that a *D. eleginoides* stock at 40% SSB_0 could sustain a harvest rate of ~1.6% if it is expected to recover to 0.5 SSB_0 over 25 years. Dr Welsford undertook to present the details of this analysis in a paper at the next meeting of WG-SAM.

5.107 Dr T. Ichii (Japan) noted that the proposed catch limit of 81 tonnes would not only be necessary to obtain reliable stock estimate parameters but would also be conservative so as not to impede the stock recovery of the division for the following reasons:

(i)   The sample size was calculated using a precautionary exploitation rate of 2.7 %, which is an average of the value of 3.8%, which was applied for Divisions 58.4.1 and 58.4.2 (WG-FSA-08/43), and 1.6% which was recommended by Dr Welsford. Considering that 3.8% is the sustainable exploitation rate when the current stock level is 50% of B_0, while 1.6% is the sustainable exploitation rate when the stock size is 40% of B_0, Dr Ichii believed that the value of 1.6% may be overly precautionary.

(ii)   Length-composition data showed young and adult toothfish in abundance.

(iii)   This division was closed to fishing based not on scientific data, but on the belief that the stock might have been depleted by IUU fishing (SC-CAMLR-XXI, paragraph 4.106), suggesting that it is unclear whether the stock was actually depleted at the time of closure of the fishery in 2002/03.

(iv)   Division 58.4.4 is considered to have been less attractive for IUU fishing since 2003/04 (SC-CAMLR-XXVII, Annex 5, Table 3) because a much higher catch rate has been obtained in adjacent divisions in the Indian Ocean, implying a possibility that the former division has not recently been subject to high levels of IUU fishing.

5.108 The Working Group agreed that the revised proposal had addressed most of the issues raised by WG-SAM, and that the spatial distribution of the sets would spread effort and tags evenly across the survey area, and that the proposed tagging rate of five tags per tonne would be a minimum rate. It noted that there was also an expectation that otoliths collected during the 2010 survey and the previous 2008 survey would be read using protocols developed by CON and presented to future meetings of WG-FSA. It also noted that there should be some longer-term commitment to the experiment and that, subject to the review of the 2010 survey, the vessel would be expected to return to the area in a future year (or years) to recapture the tagged fish.

5.109 The Working Group considered that if sufficient tags were recaptured, then an assessment could be carried out on the stock. However, it cautioned that the assessment of stock status would be uncertain because of the large unknown IUU catch and the likely sensitivity of the stock status to these estimates. The Working Group anticipated that the data could be collated for input into an integrated assessment framework such as CASAL and be submitted to WG-SAM for review by 2011 to 2012.

5.110 However, som e m embers of the Working Group were concerned that the stock had been severely depleted and that the proposed leve l of catch m ay be del eterious to the stock. They noted that the req uired lev el of catch could be reduced, for example, by surveying a subset of the tota l ar ea, setting shor ter lines, or tagging and releasi ng a higher proportion of the fish.

5.111 The W orking Group was unable to reach con sensus on an appropria te level of catch for the survey.

Development of methods to assess exploratory fisheries

Data requirements for assessing exploratory fisheries

5.112 The Working Group noted the discussions at WG-SAM on:

(i) using longline data in estimating stock size (Annex 6, paragraphs 2.28 to 2.42);

(ii) standardisation of CPUE for diffe rent longline fishing m   ethods (Annex 6, paragraphs 2.43 to 2.46);

(iii) use of research hauls in the exploratory fisheries for *Dissostichus* spp. (Annex 6, paragraphs 2.56 to 2.61);

(iv) estimating biom ass us ing comme rcial longline data in Divisions 58.4.1 and 58.4.2 (Annex 6, paragraphs 2.62 to 2.65);

(v) spatially structured population mode ls for use in evaluating m   anagement strategies (Annex 6, paragraphs 4.1 to 4.6).

5.113 The Working Group considered how research hauls can be implemented such that they will lead to , or im prove, an asses sment (p aragraph 5.21) recalling that particip   ation in exploratory fisheries represents a commitment towards undertaking research that will lead to a stock assessm ent before the stock is reduced to   the target status. It   noted tha t research programs will have to operate in a different manner in fisheries that have not been previously exploited compared to those which have been depl   eted. In the latter case, care need to be taken so th at the research strategy ensures th at research requirem ents do not im pact on the ability of the fishery to recover.

5.114 The Working Group agreed that in evaluating research programs in data-poor fisheries, there were three questio ns that need to be   addressed for the provision of advice on what research would be appropriate:

(i) What research needs to be undertaken to facilitate a preliminary assessm ent of stock status?

(ii) What is the mortality of fish that will likely occu r as a result of undertaking the research without any additional catch? For example, if all fish in good condition were tagged and released, what proportion of the tagg ed fish would be in poor condition and die?

(iii)   What is the quantity of fish that could be taken to offset the cost of the research, noting the possible status of the stock?

5.115   The Working Group further noted the successful development of the exploratory fishery in the Ross Sea following research to develop the stock assessments in that area. The evolution of that work has led to the development of the SPM (Annex 6, paragraphs 4.4 to 4.6). The Working Group agreed that strategies for acquiring information for data-poor stocks should be evaluated with the spatially structured population models, such as the SPM, in order to give confidence that pristine stocks are not reduced to below their target level and that the recovery of closed stocks is not impeded by research activities. The Working Group agreed that such work is now urgent for exploratory fisheries in Area 58. Members were encouraged to collaborate with this work.

5.116   The Working Group noted that some Members may not have expertise in stock assessment models but that there were opportunities for capacity building in this area. In particular, Mr Dunn offered the opportunity for scientists to spend time at NIWA in New Zealand to develop expertise in using CASAL and the SPM. The Working Group welcomed this offer and encouraged Members to participate, noting also that there are other mechanisms for building capacity in this area, including mentoring arrangements and web seminars. It also encouraged Members to correspond on how their work is proceeding in order to advance the outcomes for consideration next year.

5.117   The Working Group recalled that the development of assessments was compromised when vessels failed to comply with conservation measures specifying research conditions such as tagging rates.

5.118   The Working Group noted that notifications for exploratory fisheries included information on research plans but that this information was not always sufficient to assist in developing assessments (paragraph 5.5). The Working Group requested that the Scientific Committee provide standards and specifications on what was required for inclusion of proposed research activities in exploratory fishery notifications and the extent that these should be reviewed by WG-FSA.

5.119   The Working Group noted the importance of obtaining time series of catch-at-age data for *Dissostichus* spp. for exploratory fisheries as inputs to stock assessments. For example, otolith ages were not available for *D. mawsoni* for SSRUs in Subareas 88.1 and 88.2 for years in which New Zealand had not fished (paragraphs 3.33 to 3.36) and that some unvalidated ageing data for *D. mawsoni* are available from Division 58.4.1 (paragraph 4.15). The Working Group, therefore, recommended that Members fishing in exploratory fisheries should:

(i)   provide a historical inventory of their otoliths to the Secretariat
(ii)   provide to the Secretariat a dataset of fish ages for years and statistical areas in which Members had fished, and further that the ages be read in accordance with the validated ageing protocols developed by CON (paragraphs 9.4 to 9.8).

5.120   The Working Group further recommended that, in collaboration with other Members, Members fishing in exploratory fisheries should provide a characterisation of the fishery including catch, by-catch, tag and biological data, including length, sex and age-frequency distribution of the catch, and indicate how these data may lead to an assessment.

Dissostichus eleginoides South Georgia (Subarea 48.3)

5.121 The Fishery Report for *D. eleginoides* in Subarea 48.3 is contained in Appendix L. The catch limit for *D. eleginoides* in the 2008/09 season was 3 920 tonnes, and the recorded catch was 3 383 tonnes.

5.122 The Working Group agreed on a single CASAL assessment model, structurally similar to that presented in WG-FSA-09/28.

5.123 Likelihood profiles for the model (Appendix L, Figure 13) demonstrated that catch-at-length data from the early fleet, tag data from 2003 and the survey abundance index were relatively uninformative. Tag data from 2004 onwards and the catch-at-age data were highly informative. Good fits were achieved, with the exception of fits to catch-at-age in the 2009 season. Tag fits have improved considerably compared to those in the 2007 assessment model (SC-CAMLR-XXVI, Annex 5, Appendix J).

5.124 There are several possible explanations for the lack of fit to the 2009 catch-at-age data. Either recruitment (to the 2001 cohort) has been exceptionally high, or sampling from the fishery has not been representative, or the behaviour of the fishery has changed. The Working Group agreed that distinguishing between these hypotheses was difficult at the moment but will become clearer when the 2001 cohort has fully recruited to the fishery in one or two years' time.

5.125 The Working Group therefore considered two plausible scenarios for future recruitment in projections. The first assumes that future recruitment will be similar to the entire time series of past recruitment, and uses lognormal mean recruitment (CV 0.59) for the projections. The second assumes that future recruitment will be similar to the recent historically estimated recruitment, and uses the lognormal empirical time series of recruitments from 1991–2001 for the projections. This latter recruit series had both a lower overall recruitment level and lower variance (CV 0.56) than the former because of the removal of the very large 1990 cohort from the series.

5.126 The calculated yields that satisfy the CCAMLR decision rules for these two scenarios were 3 950 and 2 750 tonnes respectively.

Management advice

5.127 Given the uncertainty in recent recruitment to the stock, and its implications on future recruitment levels, the Working Group recommended that the catch limit should be set towards the lower end of the range 2 750–3 950 tonnes.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

5.128 A tagging experiment has been conducted in the Northern Area of Subarea 48.4 over the last four years. This experiment was extended to the Southern Area of Subarea 48.4 in the 2008/09 fishing season.

5.129 The catch limits for *D. eleginoides* and *D. mawsoni* in the Northern Area of Subarea 48.4 in the 2008/09 season were 75 and 0 tonnes (except for scientific purposes) respectively, with recorded catches of 59 and 0 tonnes respectively. The northern fishery was closed when the macrourid by-catch limit was reached. The catch limit for *Dissostichus* spp. in the Southern Area of Subarea 48.4 in the 2008/09 season was 75 tonnes, with a recorded catch of 74 tonnes. The Fishery Report for *D. eleginoides* in Subarea 48.4 is contained in Appendix M.

D. eleginoides in the Northern Area

5.130 The Working Group agreed on a single CASAL assessment model for *D. eleginoides* in the Northern Area of Subarea 48.4. This was based on the catch-at-length based CASAL model developed in 2007 for Subarea 48.3 (Hillary et al., 2006) and utilised catch-at-length and tag data. Good fits were achieved even with the relatively low levels of available data. The model confirmed that the fishery has been dominated by a single (1992) cohort, and that another cohort (2001) is just entering the fishery.

5.131 Stock status and the long-term yield for *D. eleginoides* in the Northern Area of Subarea 48.4 were calculated using MCMC samples for the assessment model. Long-term yield for the Northern Area that satisfies the CCAMLR decision rules was 41 tonnes, assuming lognormal mean recruitment (CV 1.07).

5.132 The Working Group commented on the success of the four-year experiment in Subarea 48.4 and attributed this success to the following key factors:

(i)   the experiment was well designed and monitored closely;

(ii) vessels undertaking the experiment had committed to it over the whole period of the experiment, allowing for consistency and high standards in the execution of the research plan;

(iii) tags were released randomly throughout the area, with a wide range of tagged toothfish sizes.

5.133 The Working Group expressed its thanks to the vessels that participated in the Subarea 48.4 four-year experiment for their dedicated and high-quality work, essential to the success of the experiment.

Dissostichus spp. in the Southern Area

5.134 A report of the first year of the experiment in the Southern Area was given in WG-FSA-09/18. *Dissostichus mawsoni* were found throughout the area, and *D. eleginoides* only in the very northernmost part of the area.

5.135 Following comparison of CPUE and fishable area between the Northern and Southern Areas of Subarea 48.4, the Working Group concluded that a catch of 75 tonnes, taken over the three years of the experiment, was unlikely to deplete the stock in the Southern Area to the point where it would require recovery.

Management advice

5.136 The Working Group recommended that the catch limit for *D. eleginoides* in the Northern Area of Subarea 48.4 should be set at 41 tonnes.

5.137 The Working Group recommended that the catch limit for *Dissostichus* spp. in the Southern Area of Subarea 48.4 should remain at 75 tonnes, and that the experiment should be extended for a further two years.

5.138 The Working Group recommended that Conservation Measure 41-03 should be updated during the two-year tagging experiment to incorporate a threshold catch of 150 kg of *Macrourus* spp. above which the move-on rule would be triggered, and that it should be reviewed on an annual basis. The existing move-on rules for rajids in the Southern Area of Subarea 48.4 should be retained.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

5.139 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Appendix N.

5.140 The catch of *D. eleginoides* reported for this division to 31 August 2009 was 3 108 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2008/09 season was zero inside the French EEZ. Some IUU fishing may have occurred outside the EEZ as reported in WG-FSA-08/10 Rev. 2.

5.141 The CPUE standardisation for Division 58.5.1 was not updated by the Working Group.

Management advice

5.142 The Working Group encouraged the estimation of biological parameters for *D. eleginoides* in Division 58.5.1 and the development of a stock assessment for this area. It also encouraged cooperative work in the intersessional period between France and Australia on analyses of catch and effort data and other data that could be used to progress understanding of fish stocks and fishery dynamics for Divisions 58.5.1 and 58.5.2 and Subarea 58.6. The Working Group encouraged France to continue its tagging program in Division 58.5.1.

5.143 The Working Group recommended that avoidance of fishing in zones of specific high rates of by-catch should also be considered.

5.144 No new information was available on the state of fish stocks in Division 58.5.1 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in Conservation Measure 32-13, remain in force.

5.145 The Working Group noted that France had made significant progress in mitigating by-catch, including area/season closures (SC-CAMLR-XXVI, Annex 6, paragraph II.23). It noted that the CPUE analysis would probably be robust to these changes so long as detailed haul-by-haul data continued to be available.

Dissostichus eleginoides Heard Island (Division 58.5.2)

5.146 The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Appendix O.

5.147 The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E for the 2008/09 seasons was 2 500 tonnes (Conservation Measure 41-08) for the period from 1 December 2008 to 30 November 2009. The catch of *D. eleginoides* reported for this division to 11 October 2009 was 2 177 tonnes. Of this, 1 000 tonnes was taken by trawl, 1 164 tonnes by longline and the remainder by pot (<1%). The estimated IUU catch for the season was 0 tonnes.

5.148 The Working Group endorsed the scenario used in the preliminary assessment presented in WG-FSA-09/20, however, it requested that the model should assume catches to the end of the 2008/09 season. Including these catches, allocated in proportion to expected catches in sub-fisheries to the end of 2008/09, resulted in a minor alteration to the estimated B_0 and status relative to that shown in WG-FSA-09/20.

5.149 Long-term annual yield under the revised scenario was estimated to be 2 550 tonnes.

5.150 The Working Group noted that under this scenario, as presented in WG-FSA-09/20, the median SSB appears to remain below the target level for several years, before returning to the 0.5 SSB at the end of the 35-year projection period. The Working Group recalled that the stock is currently estimated to be above the target level, and that while a stock is likely to fluctuate around the target level through natural variability, this indicated a need for continued scrutiny of this stock into the future.

5.151 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 in 2008 and 2009;

(iii) investigate simplification of the spatial structuring of fishing selectivity functions;

(iv) use aged recaptures and catch-at-age data to estimate natural mortality, *M*, either independently of CASAL or within the current CASAL estimation framework,

(v)   investigate whether the model could be developed as a two-sex model;

(vi)   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, besides *M* given in (iv) above, using CASAL;

in order to provide it with some confidence that significant progress in understanding key uncertainties, common to all toothfish assessments, that occur for this division before it is forecast that stock trajectory of SSB reaches the target level.

Management advice

5.152 The Working Group recommended that the catch limit for *D. eleginoides* in Division 58.5.2 west of 79°20'E should be 2 550 tonnes for the 2009/10 fishing season.

Dissostichus eleginoides Crozet Islands (Subarea 58.6)

5.153 The Fishery Report for *D. eleginoides* in Subarea 58.6 (French EEZ) is contained in Appendix P.

5.154 The catch of *D. eleginoides* reported for this subarea to October 2009 was 746 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2008/09 season was zero inside Subarea 58.6 as reported in WG-FSA-09/5 Rev. 1.

5.155 The CPUE series for this fishery was not updated by the Working Group.

Management advice

5.156 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.

5.157 The Working Group recommended that avoidance of zones of high by-catch abundance should also be considered.

5.158 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 Conservation Measure 32-11, remain in force.

5.159 The Working Group noted that France had made significant progress in mitigating by-catch, including area/season closures (SC-CAMLR-XXVI, Annex 6, paragraph II.23). It noted that the CPUE analysis would probably be robust to these changes so long as detailed haul-by-haul data continued to be available.

Dissostichus eleginoides Prince Edward and Marion Islands
(Subareas 58.6 and 58.7)

5.160 The Fishery Report for *D. eleginoides* in Subareas 58.6 and 58.7 inside the South African EEZ is contained in Appendix Q.

5.161 The catch limit of *D. eleginoides* in the South African EEZ for the 2008/09 season was 450 tonnes for the period from 1 December 2008 to 30 November 2009. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2009 was 4 tonnes, all of which was taken by longlines. There was no evidence of IUU catch in 2008/09.

5.162 The CPUE series was not updated by the Working Group in 2009.

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

5.163 Dr Leslie noted that South Africa is considering the adoption of an Operational Management Procedure (SC-CAMLR-XXVII, Annex 7, paragraphs 6.1 to 6.3) approach as a basis for provision of management advice, and a catch limit for 2010 has not been set as yet, but it is likely to be in the range of 250–450 tonnes. Details are provided in Appendix Q.

5.164 In 2005 the Scientific Committee noted that the advice on the appropriate levels of future catch provided in WG-FSA-05/58 (see also WG-FSA-06/58 and 07/34 Rev. 1) was not based on the CCAMLR decision rules. Therefore, the Working Group was unable to provide management advice for the fishery in the South African EEZ at the Prince Edward Islands. The Working Group recommended that CCAMLR decision rules also be used in estimating yields for this fishery. It noted that an Operational Management Procedure is proposed to address the concerns over the sensitivity of the ASPM to weightings used for different data sources and the estimation of recruitment levels for forward projections.

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

5.165 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 Conservation Measures 32-10, 32-11 and 32-12, remain in force.

Champsocephalus gunnari South Georgia (Subarea 48.3)

5.166 The Fishery Report for *C. gunnari* at South Georgia (Subarea 48.3) is contained in Appendix R.

5.167 In the 2008/09 fishing season the catch limit set for *C. gunnari* in Subarea 48.3 was 3 834 tonnes. During the 2008/09 season the fishery caught 1 837 tonnes by the end of October 2009.

5.168 In January 2009 the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-09/9). The survey employed the same trawl gear and survey design as previous UK surveys in Subarea 48.3.

5.169 The Working Group agreed that a short-term assessment should be implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the 2009 survey.

5.170 The fixed parameters for the assessment remained unchanged from 2008.

Management advice

5.171 The Working Group recommended that the catch limit for *C. gunnari* should be set at 1 548 tonnes in 2009/10 and 949 tonnes in 2010/11 based on the outcome of the short-term assessment.

5.172 The Working Group recommended that the season start date be altered to 1 December to reflect the start dates of other CCAMLR fishing seasons.

Champsocephalus gunnari Heard Island (Division 58.5.2)

5.173 The Fishery Report for *C. gunnari* in Division 58.5.2 is contained in Appendix S.

5.174 The catch limit of *C. gunnari* in Division 58.5.2 for the 2008/09 season was 102 tonnes for the period from 1 December 2008 to 30 November 2009. The catch reported for this division as of 5 October 2008 was 99 tonnes.

5.175 A large 3+ year class, probably the result of spawning by the 4+ year class dominant in 2006, was observed to dominate the population in the survey undertaken in April 2009.

5.176 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the 2009 survey. All other parameters were the same as in previous years.

5.177 The Working Group recalled that the current strategy of spreading catch over two years, while meeting the escapement rule, was to provide for two years of spawning (SC-CAMLR-XVI, Annex 5). The Working Group noted that the 3+ cohort had been reproductively mature for one year and that following another year, it was likely that the cohort would disappear (SC-CAMLR-XX, Annex 5, Appendix D, Figure 1). Further, the Working Group noted that due to the large increase in biomass of this cohort in the recent survey, relative to the 2008 survey, suggests that last year's assessment is likely to have underestimated the precautionary yield from this cohort in 2008/09. Therefore, the escapement of these fish is likely to have been greater than 75%.

Management advice

5.178 The Working Group agreed that a strategy for fishing on the current 3+ year class could be similar to that applied in the 2005/06 season (SC-CAMLR-XXIII, Annex 5, Appendix M), allowing the catch to be taken in one year (2009/10) with the expectation of no exploitation of that cohort in the following year (2010/11). The Working Group recalled that, due to the strong three-year cycle evident in the icefish population in Division 58.5.2, it is unlikely that there will be another sizeable cohort available to the fishery until after 2010/11. When estimated in a scenario based on all fishing in one year and no catch in the second year, the yield estimate for 2009/10 is 1 658 tonnes, with a fishing mortality of 0.288.

Assessment and management advice for other fisheries

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

5.179 The Working Group noted that WG-FSA-09/31 reported the recovery of *Notothenia rossii* populations in Potter Cove, South Shetland Islands, to levels close to that of the early 1980s, however, it cautioned that extrapolation of these findings to a subarea scale was premature.

5.180 On the basis of the results of a multi-species research survey in Subarea 48.2 (WG-FSA-09/19), the Working Group agreed that the populations of previously exploited species, including *C. gunnari* and *N. rossii*, show little sign of recovery despite the closure of the fishery after the 1989/90 season (see paragraph 3.41).

Management advice

5.181 The Working Group recommended that the existing Conservation Measures 32-02 and 32-04 on the prohibition of finfishing in Subareas 48.1 and 48.2 respectively, remain in force.

Crabs (*Paralomis* spp. Area 48)

5.182 Crabs were not exploited in the 2008/09 season. Russia notified the Commission of its intention to fish for crabs in Subareas 48.2, 48.3 and 48.4 in 2009/10 (CCAMLR-XXVIII/23) in accordance with the requirements of Conservation Measures 52-01, 52-02 and 52-03.

Management advice

5.183 The Working Group recommended that Conservation Measures 52-01, 52-02 and 52-03 on crabs remain in force, noting the recommended changes to the experimental harvest block regime detailed in paragraph 10.33.

Squid (*Martialia hyadesi*) (Subarea 48.3)

5.184 Squid were not exploited in 2008/09 and no proposals for fisheries of squid were received for the 2009/10 season.

Management advice

5.185 The Working Group recommended that Conservation Measure 61-01 remain in force. Noting that this advice had not changed for a number of years, the Working Group agreed to remove this item from its agenda until such time as a research notification was received.

FISH AND INVERTEBRATE BY-CATCH

6.1 The Working Group discussed the following:

(i) review of by-catch in trawl and longline fisheries in the CAMLR Convention Area;

(ii) review of the 2008/09 Year-of-the-Skate in new and exploratory fisheries, including:

(a) numbers of skates tagged and tag rates
(b) biological data collection rates
(c) continuation of Year-of-the-Skate methods;

(iii) by-catch mitigation:

(a) review of move-on rule in Subarea 48.4;

(iv) identification guides for benthic invertebrate by-catch.

By-catch rates in trawl fisheries

6.2 By-catch in trawl fisheries for icefish (Subarea 48.3 and Division 58.5.2) and toothfish (Division 58.5.2) derived from fine-scale (C2) data was similar to levels observed in 2007/08. The by-catch in the trawl fishery for *C. gunnari* in Subarea 48.3 was negligible (<0.5% of target species). The Working Group noted that the latter fishery is still open and additional low levels of by-catch are possible before the end of the season. In Division 58.5.2 trawl fisheries, the by-catch of *Channichthys rhinoceratus* was 47 tonnes (31% of the catch limit). The catch for all other by-catch species was less than 12% of their catch limit in Division 58.5.2.

By-catch rates in longline fisheries

6.3   Fine-scale (C2) data detailing total removals of by-catch species reported from longline fisheries within the CAMLR Convention Area during the 2008/09 season are shown in Table 13.

Rajids

6.4   Reported rajid by-catch (as a percentage of *Dissostichus* spp. catch) in longline fisheries within the Convention Area in 2008/09 was low (<2% *Dissostichus* spp.), except in those areas where a high proportion of rajids caught are retained and processed (French EEZs: Division 58.5.1 and Subarea 58.6, which constituted 9% and 6% of *Dissostichus* spp. respectively) (Table 13).   Rajid catches did not approach the limits for these species in any subarea.

6.5   During the 2008/09 season, numbers of rajids caught (i.e. those retained or discarded) were slightly greater in a number of subareas compared with numbers caught in the 2007/08 season (Table 14).   The Working Group considered that this higher catch is most likely to be a result of changes to guidelines for handling rajid by-catch and the associated reporting requirements implemented throughout the 2008/09 Year-of-the-Skate (see paragraph 6.10). In Division 58.5.2, higher numbers of released rajids in 2008/09 were also likely to result partly from the inclusion of an additional longline vessel in the fishery, in which previously only one longline vessel and one trawl vessel have operated.   As in the 2007/08 season, very few skate were caught in Subarea 48.6, Subareas 58.6 and 58.7 South African EEZ, Division 58.4.1 and Division 58.4.2 during the 2008/09 season.

Macrourids

6.6   By-catch rates for macrourids (as a percentage of *Dissostichus* spp. catch) for the 2008/09 fishing season ranged from 1.6 to 22.8%.   By-catch limits were reached in one Subarea 48.4 (Northern Area), resulting in the closure of the fishery for toothfish in the Northern Area on 18 May 2009 at a time when 79% of the catch limit of toothfish had been taken.   The highest catch rates (as a percentage of *Dissostichus* spp.) were in the French EEZs (Division 58.5.1 and Subarea 58.6) and in Subarea 48.4.

6.7   Overall levels of macrourid by-catch in longline fisheries (as a percentage of *Dissostichus* spp. catch) were broadly similar to those observed in 2007/08.   Two subareas (48.3 and 88.2) reached greater than 50% of their by-catch limits for macrourids.   The Working Group noted that the higher catches in Subarea 88.2 might be a result of more fishing on the slope and shelf than in previous years.

Other species

6.8   By-catch of other species was generally low (<3% *Dissostichus* spp.). The 33 tonnes attributed to other species in Subarea 48.3 was largely *Antimora rostrata* .   Other species comprised 10% of the toothfish catch in Subarea 58.6 and also comprised mainly *A. rostrata*.

CCAMLR Year-of-the-Skate

6.9   During CCAMLR-XXVII (CCAMLR-XXVII, paragraph 4.55), the Commission recommended that during the Year-of-the-Skate:

   (i)   all skates should be brought on board or alongside the hauler to be correctly identified, scanned for tags and for their condition to be assessed;

   (ii)   all skates that are likely to survive if released (condition 3 or 4) should be released by cutting the snood as close to the hook as possible or cutting the snood and removing the hook from the skate, providing this does not further injure the skate;

   (iii)   all skates which are dead or with life-threatening injuries (condition 1 or 2 in the logbook) should be retained by the vessels;

   (iv)   skates released alive should be doubled-tagged (i.e. two tags per skate) at a rate of one skate in every five skates caught in exploratory fisheries, up to a maximum of 500 skates per vessel;

   (v)   tagged skates should be identified to species, measured before they are released and that, where possible, tagging experiments be undertaken to compare different tag types and estimate tag-shedding rates;

   (vi)   the tagging program will be coordinated by the Secretariat, which will be the repository for skate tagging kits;

   (vii)   when skates are caught on a line, they should be randomly sampled by observers at a rate of three skates per thousand hooks for the purpose of collecting biological measurements;

   (viii) skates should not be sacrificed for biological sampling, and female maturity stage should only be recorded if the skate is dead or has sustained life-threatening injuries (conditions 1 and 2);

   (ix)   all live skates which are part of the biological sampling, which have not sustained life-threatening injuries, should be handled with care and released after biological information has been recorded, if they are still suitable for release (i.e. still in condition 3 or 4).

6.10   Of these recommendations, (i) and (iii) may have contributed to increases in numbers of skate caught (discarded or retained, see data map in CCAMLR-XXVI/BG/17) during 2008/09, as previously skates in condition 2 (i.e. with life-threatening injuries) might have been cut from the line and included in numbers released in fine-scale (C2) data.

6.11   Discharge of offal is not permitted in areas south of 60°S (Conservation Measure 26-01) or in other new and exploratory fisheries (Conservation Measures 41-04 and 41-11). However, the Working Group noted that some skates have been reported as discarded for Divisions 58.4.3a and 58.4.3b and Subareas 88.1 and 88.2 in the 2008/09 season. This indicates that further clarification is needed for vessels with respect to the fate of skates caught in different conditions and the corresponding reporting requirements.

6.12   The Working Group noted that this could be achieved through provision of a one-page laminated guide for vessel crew clarifying which skates should be retained/discarded or released along with corresponding reporting guidelines and recommended this be developed by the Secretariat prior to the 2009/10 season. The Working Group also recommended that the Scientific Committee remind Members to ensure that their vessels are aware of the appropriate fields in which to record data on skates caught in the different conditions, and are aware of the prohibition of discharging offal (discarding) in new and exploratory fisheries.

6.13   In order to explore whether skate tag rates had been met within new and exploratory fisheries, fine-scale (C2) data for numbers of skate caught were used to generate total numbers of skate hauled (i.e. combining numbers retained, discarded and released) from which a tag rate could be estimated using scientific observer data on numbers of skates tagged. Tables 14(a) and (b) detail these data for both the 2007/08 and 2008/09 seasons to explore whether improvements to tag rates for skates had been achieved through implementation of the Year-of-the-Skate.

6.14   In new and exploratory fisheries, rates of skate tagging increased in Divisions 58.4.3a and 58.4.3b and in Subareas 88.1 and 88.2 where the target tagging rate of 20% of skates caught was exceeded. Tagging rates were also higher in 2008/09 when compared with 2007/08 in a number of other subareas, including Subareas 48.3 and 48.4 (Northern Area) and Division 58.5.2.

6.15   Tag recaptures did not increase in 2008/09 relative to 2007/08; the Working Group noted that increases in tag returns might be expected in forthcoming years.

6.16   The Working Group also explored whether tag rates had been consistent between all vessels operating within new and exploratory fisheries; details are given in Table 15. For those vessels which had reported rajid by-catch in these areas, most vessels met or exceeded the required tagging rate. However, in Division 58.4.3b one vessel caught >400 skates, but no skates were reported as tagged. In Division 58.4.3a another vessel caught >600 skates but the tagging rate was 5% of skates caught.

6.17   The Working Group requested that the Scientific Committee seek advice from Members on reasons for the low tagging rates observed or specific difficulties experienced with implementing the tagging requirements in new and exploratory fisheries under the relevant conservation measures. In order to avoid confusion with interpretation of the

required tagging rate for skates, the Working Group also recommended that the relevant conservation measures be amended to 'at least one skate per five skates caught (including those released alive)'.

6.18   The Working Group noted that the use of T-bar tags for tagging skates during the Year-of-the-Skate appears to have been successful.

6.19   Observers are required to record the condition of skates caught during their standard observation periods under the following options in the L5 form: discarded dead, released in poor health, released in average health, released in good health, released in unknown condition, released but predated on, released with tags, retained with tags and retained without tags. This fine-scale level of fate data is expected by the Working Group to be used in future assessments of skate populations in order to infer potential survivorship of released skates. A summary of these data collected by observers across all subareas is provided in Table 16(a) and in Table 16(b) the number of skates recorded in each field is given as a proportion of all skates observed.

6.20   The Working Group noted that these data illustrate the variation among subareas in proportions of skates released by condition and the difficulties in assessing skate condition during observations and agreed to review condition categories for skates at WG-FSA in 2010. These data also highlight potential errors in reporting skate discards in subareas where this activity is prohibited.

6.21   In 2008 the Scientific Committee recommended that WG-FSA review the required biological sampling rate for skates during the Year-of-the-Skate in 2009. Numbers of skates measured for length and numbers of skates sexed were collated by subarea from observer data reported in Table 7 of WG-IMAF-09/4 Rev. 2 and Table 5 of WG-FSA-08/5 Rev. 1. Numbers of skates measured or sexed increased within Subareas 88.1 and 88.2 (combined) from 281 and 311 in 2007/08 to 1 076 and 1 111 in 2008/09 respectively, representing an almost four-fold increase in sampling. However, across new and exploratory fisheries within Subarea 58.4, numbers of biological measurements taken on skates were lower in 2008/09 than those collected in 2007/08.

6.22   The Working Group recommended that in order to determine whether the sampling rate of three skates per thousand hooks had been adhered to, analyses of haul-by-haul data should be carried out intersessionally, taking into account the numbers of skates released in good health which could not contribute to the numbers available for biological sampling. The Working Group agreed to review the sample rate next year.

6.23   The Working Group agreed that the introduction of the Year-of-the-Skate in 2008/09 had largely been successful and recognised that in order for the full benefits of its implementation to be realised, tagging and sampling requirements should be continued for a further year.

6.24   The Working Group therefore recommended to the Scientific Committee that the Year-of-the-Skate protocols be continued for the 2009/10 season at least, in order to allow for sufficient data to be collected for preliminary assessments to be made in the future.

6.25 In order to clarify skate by-catch handling and reporting requirements in different subareas and fisheries, the Working Group recommended that a slight revision be made to the Year-of-the-Skate guidelines (CCAMLR-XXVII, paragraph 4.55(iii)), as follows:

'all skates which are dead or with life-threatening injuries (condition 1 or 2 in the logbook) should be retained by the vessels fishing in areas where discharge of offal is not allowed, but may be discarded in other subareas.'

Skate biology

6.26 WG-FSA-09/43 presented new information on the ecology of three species of rajid, *Bathyraja eatonii*, *B. irrasa* and *B. murrayi* which are widely distributed over the Kerguelen Plateau and are commonly taken as by-catch in the longline and trawl fisheries operating in the region. Different spatial and bathymetric distributions for the three species were observed. Analysis of CPUE data from Division 58.5.2 showed that there was currently no evidence of depletion of rajids. Current CCAMLR conservation measures and the establishment of marine reserves in Division 58.5.2 appear to provide effective protection for rajid species. The authors recommended ongoing monitoring of by-catch levels and further research on the life-history parameters of these species.

6.27 The Working Group congratulated Australia and France on their work and further encouraged such collaborative work to be conducted in the Kerguelen Plateau region.

Mitigation measures

Move-on rule in Subarea 48.4

6.28 The Working Group reviewed the current move-on rule for by-catch species in the Southern Area of Subarea 48.4 (Conservation Measure 41-03) (SC-CAMLR-XXVII, paragraph 4.198) which currently triggers a move-on rule if the catch of skates and rays exceeds 5% of the catch of *Dissostichus* spp. in any one haul or set, or if the catch of *Macrourus* spp. exceeds 16% of the catch of *Dissostichus* spp. in any one haul or set.

6.29 The Working Group noted that the move-on rule was triggered 52 times from a total of 106 (49%) hauls made. It was noted that the move-on rule was frequently triggered when catches of *Dissostichus* spp. were very low, i.e. <3 fish.

6.30 The Working Group agreed that the high frequency with which the move-on rule was triggered made it difficult to tag sufficient numbers of toothfish in some areas and had the potential to compromise the experimental design and put unnecessary constraints on the vessels operating in the fishery. The Working Group agreed that a threshold level of 150 kg of *Macrourus* spp., above which the move-on rule would be triggered, was precautionary and would reduce the high frequency with which the move-on rule is triggered. Application of a 150 kg threshold level of *Macrourus* spp. in 2008/09 would have reduced the frequency of the by-catch trigger from 49% to 26% of hauls.

6.31   The Working Group recommended that Conservation Measure 41-03 should be updated during the two-year tagging experiment to incorporate a threshold catch of 150 kg of *Macrourus* spp. above which the move-on rule would be triggered, and that this should be reviewed on an annual basis. The existing move-on rules for rajids in the Southern Area of Subarea 48.4 should be retained.

Identification guides for benthic invertebrate by-catch

6.32   The Working Group noted the 'Field identification guide to Heard Island and McDonald Islands (HIMI) benthic invertebrates: a guide for scientific observers aboard fishing vessels' (SC-CAMLR-XXVIII/BG/12) and congratulated the authors, noting that the guide had been useful for the identification of benthic invertebrates in other areas and encouraged other Members to develop similar guides for other regions of the Convention Area.

INCIDENTAL MORTALITY OF MAMMALS AND SEABIRDS
ASSOCIATED WITH FISHING (WG-IMAF)

7.1   The Co-conveners of WG-IMAF presented a summary of items of interest to WG-FSA. In response, the Working Group discussed the following items.

Fishing methods in use in the Convention Area

7.2   The Working Group queried whether seabird entanglement in paravanes is a new issue or if entanglements have been observed in the past, as paravanes have been commonly used since the prohibition of net monitoring cables (net sonde cables). The WG-IMAF Co-conveners noted that the historic level of entanglements in paravanes was unclear, however, one seabird was observed entangled in a paravane in 2008/09 (Annex 7, paragraph 3.14). Accordingly, WG-IMAF has requested further information from observers on the use of, and descriptions of, paravanes in the Convention Area (Annex 7, paragraph 7.8) in order to better understand the risk to seabirds from paravanes.

7.3   The Working Group noted the continued concern regarding fishing practices which result in the discarding of hooks in offal or by-catch, given that a high number of hooks were found in the nests of wandering albatrosses at Bird Island (Annex 7, paragraphs 3.34, 3.35 and 13.7). Noting the potential link between increased frequency of hooks in wandering albatross nests and the use of trotlines within their foraging range during chick-rearing, the Working Group sought clarification about the method used to remove by-catch fish from the trotlines used in the Convention Area. Japan noted that the cutting of snoods to remove by-catch from trotlines before bringing by-catch on board does not occur on its vessels in the Convention Area.

Streamlining the work of the Scientific Committee

7.4   The Working Group noted that WG-IMAF recommended that it now only needs to meet on a biennial basis. The Working Group queried the implications for WG-FSA of WG-IMAF meeting biennially in future. The Working Group agreed that those items of the WG-IMAF agenda where there was a requirement to provide advice on an annual basis, i.e. summary of incidental mortality (Items 3.1 and 3.2), implementation of Conservation Measures (Item 3.3) and notifications for new and exploratory fisheries (Item 10), have become largely mechanistic and could readily be completed by WG-FSA with support from the Secretariat (Annex 7, paragraph 14.7). The Working Group noted that other core WG-IMAF tasks would be addressed by that Working Group on a biennial basis.

7.5   On the basis of this advice, and noting that the small amount of additional work for WG-FSA would occur in those years when WG-FSA was not conducting assessments, the Working Group endorsed the recommendation to the Scientific Committee that WG-IMAF meet biennially in future and that its next meeting should be in October 2011.

EVALUATION OF THREATS ARISING FROM IUU ACTIVITIES

8.1   The Working Group reviewed the catch history of *Dissostichus* spp. taken by IUU fishing in the Convention Area (paragraphs 3.18 to 3.24, Table 3). This time series had been updated using estimates reported in WG-FSA-09/5 Rev. 1.

8.2   The Working Group noted that the number of IUU fishing vessels observed in the Convention Area had decreased from nine in 2007/08 to six in 2008/09. The level of surveillance coverage by Members, particularly in respect to Division 58.4.3b, appears to be at similar levels to previous years and may have increased in Division 58.4.1 (WG-FSA-09/5 Rev. 1).

8.3   The Working Group noted that information on IUU activities had been received for six vessels fishing in the Convention Area. All six were assumed to be fishing using gillnets.

8.4   Some data regarding catch in gillnets was provided for the first time. This resulted from the hauling of an abandoned gillnet, one boarded and inspected gillnet vessel and interviews of two IUU vessel captains (paragraph 3.20). This information was used to calculate preliminary catch rates, trip duration etc. (Table 2), noting there is very high uncertainty regarding catch rates and IUU fishery operations using gillnets.

8.5   The Working Group agreed that the provided information was an improvement over information used to calculate estimates in past years, however, it recognised that estimates made using this information result in highly conservative estimates and in reality IUU catches using this method are likely to be much greater.

8.6   The Working Group agreed that estimates on IUU fishing (Table 3) made during the last few years when gillnets were known to be utilised in the Convention Area should be recalculated using data on catch rates, net fishing duration etc., acquired this year and updated in the future as new data becomes available.

8.7   Impacts of using gillnets are unknown. Gillnetting is more indiscriminate than longlining and gillnets have the ability to fish for long durations and, if abandoned, may continue to catch fish for years. In addition, gillnets potentially have large by-catches. The Working Group agreed that the use of gillnets is an abhorrent fishing method and should be eliminated from the Convention Area.

BIOLOGY, ECOLOGY AND DEMOGRAPHY
OF TARGET AND BY-CATCH SPECIES

9.1   A full account of section 9 of the report can be found in Appendix D.

Papers submitted to the Working Group

9.2   Seventeen papers containing information on the biology, ecology and demography of target and by-catch species in the fishery were submitted to the Working Group (Appendix D, section 9.1) (WG-FSA-09/9, 09/10, 09/11, 09/13, 09/15, 09/18, 09/19, 09/21, 09/24, 09/25, 09/26, 09/27, 09/29, 09/32, 09/37, 09/43, 09/P1).

Species profiles

9.3   WG-FSA agreed in 2005 to produce a new set of species profiles for *D. eleginoides*, *D. mawsoni* and *C. gunnari* (Appendix D, section 9.2). While work on *D. mawsoni* and *C. gunnari* was completed in 2006 and 2007, work on *D. eleginoides* had not been completed by October 2009. Drs Welsford, Belchier and Hanchet agreed to complete the species profile of *D. eleginoides* by October 2010. The two existing species profiles on *D. mawsoni* and *C. gunnari* will undergo revision in 2009/10.

CCAMLR Otolith Network

9.4   Considering the development of length-based assessment techniques for the fisheries of *C. gunnari* at South Georgia (Appendix D, section 9.3), the Working Group concluded that further work on the ageing of otoliths was considered unnecessary for use in these assessments.

9.5   In order to advance the work of CON, the Working Group recommended that an intersessional group should:

- prepare an inventory of those laboratories undertaking ageing of *Dissostichus* spp.
- foster an exchange of age-reading methods between laboratories
- establish a reference collection of otoliths of both species from all areas fished
- establish protocols of how otoliths are prepared for ageing and how annuli are identified.

In addition, it was requested that age determination based on otolith analyses of samples from *Dissostichus* spp. be included in the research plan as part of the notification for fishing in new and exploratory fisheries (Item 5.2).

9.6   The Working Group recommended that the Scientific Committee request Members to submit to the Secretariat an inventory of *Dissostichus* spp. otoliths collected from CCAMLR fisheries, indicating the number of otoliths collected and the number read by fishery, season and Flag State of the fishing vessel (see also paragraph 5.119).

9.7   Results of ageing and a detailed description of how ageing was conducted need to be submitted to the Working Group on a regular basis. Ageing data should be submitted to the Secretariat to help develop its database that will be used to store ageing data for use in assessments.

9.8   Quality control of the otolith ageing readings, including validation of ageing and cross-validation between laboratories, will be of great importance to ensure consistency in ageing *Dissostichus* spp. Close collaboration of CON with WG-SAM should be sought with respect to the development of efficient sampling schemes for otolith collection and subsampling for reading.   Dr Belchier volunteered to establish an intersessional correspondence group to initiate the work outlined above.

CONSIDERATIONS OF ECOSYSTEM MANAGEMENT

Bottom fishing activities and VMEs

10.1   The Working Group recalled the Scientific Committee's discussions and agreements on approaches to avoid significant adverse impacts on VMEs (SC-CAMLR-XXI, paragraphs 4.159 to 4.171; SC-CAMLR-XXII, paragraphs 4.207 to 4.284) and Commission (CCAMLR-XXVI, paragraphs 5.9 to 5.20; CCAMLR-XXVII, paragraphs 5.4 to 5.30). It also noted the discussions this year by WG-SAM (Annex 6, paragraphs 4.7 to 4.19), WG-EMM (Annex 4, paragraphs 5.1 to 5.14) and the outcomes of WS-VME (Annex 10).

10.2   The Working Group noted that the Commission requires advice on the following:

   (i)   whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs and whether proposed or additional mitigation measures would prevent such impacts (Conservation Measure 22-06, paragraph 8(ii));

   (ii)   Risk Areas arising from the implementation of Conservation Measure 22-07, and advice on proposed research and other activities in Risk Areas (Conservation Measure 22-07, paragraph 9);

   (iii)   the magnitude of the existing footprint of bottom fisheries covered by Conservation Measure 22-06 (CCAMLR-XXVII, paragraph 5.15);

   (iv)   notifications of VMEs (CCAMLR-XXVII, paragraph 5.16);

(v) known and anticipated impacts of bottom fishing activities covered by Conservation Measure 22-06 (CCAMLR-XXVII, paragraph 5.18(i));

(vi) available knowledge on VMEs, the potential for significant adverse impacts, risk assessments and potential for impacts arising from bottom fisheries, with such advice provided in a report akin to the Fishery Reports on 'Bottom Fisheries and Vulnerable Marine Ecosystems' (CCAMLR-XXVII, paragraph 5.18(ii));

(vii) a precautionary strategy that will avoid significant adverse impacts on VMEs until impact assessments are completed and long-term mitigation strategies are developed (CCAMLR-XXVII, paragraph 5.19);

(viii) results of simulations of different management approaches (CCAMLR-XXVII, paragraph 5.21);

(ix) mitigation measures and practices when evidence of VMEs is encountered, including outcomes of reviews of scientific observer data and vessel data and the results of the VME workshop (CCAMLR-XXVII, paragraph 5.22);

(x) scientific aspects of the implementation and operation of Conservation Measure 22-07 (CCAMLR-XXVII, paragraph 5.25).

10.3 The Working Group also noted that Conservation Measure 22-06 will be reviewed by the Commission this year (Conservation Measure 22-06, paragraph 16). In that respect, it noted the following elements of the conservation measure had scientific components that may require reviewing:

(i) assessment by the Scientific Committee on whether individual bottom fishing activities would contribute to having significant adverse impacts on VMEs, where such reviews will include consideration of preliminary assessments by Contracting Parties (Conservation Measure 22-06, paragraph 8);

(ii) information required for evaluating notifications of VMEs (Conservation Measure 22-06, paragraph 9);

(iii) advice by the Scientific Committee on the known and anticipated impacts of bottom fishing activities on VMEs, including recommending practices when evidence of a VME is encountered in the course of fishing operations (Conservation Measure 22-06, paragraph 11);

(iv) advice on where VMEs are known to occur or are likely to occur and on potential mitigation measures (Conservation Measure 22-06, paragraph 14).

Assessment of bottom fishing

10.4 The Working Group noted that the Commission requires advice with respect to Conservation Measure 22-06, paragraph 8:

     (i)   submissions of preliminary assessments by Contracting Parties

     (ii)   whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs.

10.5   The Working Group reviewed the summarised assessments by Contracting Parties of known and anticipated impacts of proposed bottom fishing activities on VMEs as required by Conservation Measure 22-06 and described by the Secretariat in CCAMLR-XXVIII/18. Of nine Members submitting notifications for new and exploratory fisheries in 2009/10, only seven included the required assessments of proposed bottom fishing activities relative to VMEs. Two Members' notifications provided no preliminary assessments at all (Republic of Korea and Russia). The Secretariat received a preliminary assessment from Korea after the deadline in Conservation Measure 21-06; the Working Group did not consider this assessment. This is an improvement compared to the 5 of 11 submissions in 2008 (SC-CAMLR-XXVII, paragraph 4.276), but still poses challenges in the provision of comprehensive advice.

10.6   As part of its comments on the submitted assessments, the Working Group developed a report card approach to summarising the quality and quantity of information supplied in each assessment (Table 17).

10.7   The Working Group noted that the quality of information provided in accordance with the requirements of Conservation Measure 22-06 varied greatly among notifications. In some cases the pro forma was incomplete or contained minimal detail. For example, although fishing gear diagrams were typically provided, the estimated footprint of that gear type, and potential severity of impact within the footprint, were not addressed. Members providing detailed information interpreted the instructions differently; as a consequence it was difficult to extract and assemble consistent information across fisheries that could be used in an assessment of known and anticipated impacts.

10.8   The Working Group noted that notifications were provided in several languages, which limited its ability to evaluate the proposals without significant additional translation effort by the Secretariat. The Working Group requested that the Scientific Committee consider how this issue may be overcome in the future.

10.9   The Working Group further noted that no assessment was available for proposed pot fishing for crabs in Subarea 48.2, or for proposed pot fishing for toothfish in Subareas 88.1 and 88.2. The development of pot fishing for both fish and crabs may require further consideration of gear code definitions.

10.10   The Working Group noted that WG-SAM-09/P1 described an impact assessment framework to estimate the footprint and impact of bottom fishing activity for a fishery. The approach has been designed to facilitate standardised application by fisheries in different areas and employing different fishing gear types. To date, the framework has been tested in estimating impacts from some fleets utilising the autoline longline method. The Working Group agreed that acquiring the data for assessing the footprint and potential impacts on VME taxa by other bottom fishing methods, i.e. Spanish longlines, trotlines and pots, is a high priority.

10.11   The Working Group noted the comments on the use of this method by WG-SAM (Annex 6, paragraph 4.9) and the VME workshop (Annex 10, paragraph 4.3), and

commended the authors for further developing this method. It noted that it will be useful for WG-SAM to review how this method might best be applied under circumstances where VMEs may be locally concentrated within the area for which the footprint is being calculated, such as has been proposed for combining the method with the approach outlined in WG-FSA-09/42 (Annex 10, paragraph 4.4).

10.12 Consistent with SC-CAMLR-XXVII (paragraph 4.228) and the recommendations of the VME Workshop (Annex 10, paragraphs 4.3 to 4.5), the Working Group applied the WG-SAM-09/P1 framework, using historical effort data from the Secretariat databases, to estimate a cumulative historical footprint for all bottom longline fishing methods in areas where Conservation Measure 22-06 applies. Although specific assumptions regarding footprint width remain subject to great uncertainty (Annex 10, paragraph 4.3), the Working Group represented the upper and lower bounds of estimated footprint size by assuming footprint widths of 25 or 1 m per line respectively (as in SC-CAMLR-XXVII, paragraph 4.228), and noted that the validity of the 1 and 25 m estimates requires additional work and may vary among fishing methods. The results summarise the fishing effort by subarea and gear type (Table 18(a)), and provide an estimate of cumulative footprint size as a proportion of total fishable area within the bounds defined (Table 18(b)). The data in Table 18(a) do not yet include fishing with pot gear, historical bottom trawl, footprints from non-fishery (e.g. research) vessels, or from IUU fishing. The relative contribution from different longline method types to total estimated footprint in each subarea/division is shown in Figure 11. The Working Group noted that these results provide an indication of relative total footprint among areas, and that corresponding estimates of impact on VMEs will be subject to uncertainty, particularly in relation to locally concentrated VMEs, and will likely change as new data becomes available (SC-CAMLR-XXVII, Annex 7, paragraph 4.18).

10.13 The Working Group noted that the estimates in Table 18(b) are of total footprint, not total impact. The Working Group agreed that further consideration is needed of how these estimates might be used to assess whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs.

10.14 The Working Group noted that because not all preliminary assessments were available, and proposed effort in standard units were not available for all preliminary assessments provided, fishery-scale estimates of the increase in footprint for proposed activities could not yet be determined. The Working Group noted that work conducted to date on bottom fishing activities at the fishery scale (with associated uncertainties) involves only retrospective analyses. The Working Group recognised that future work will need to take into account proposed fishing activities to avoid significant adverse impacts on VMEs when formulating advice to the Scientific Committee.

10.15 Data are available through the Secretariat to show the spatial distribution of bottom fishing gear for each subarea or division, and have been provided previously on the basis of total hooks deployed (SC-CAMLR-XXVII, Annex 5, Figure 7). The Working Group agreed that the appropriate measure of effort to index the footprint of bottom longline and pot gear is the total length of line deployed (Table 19(iii)) in each 0.25° latitude × 0.50° longitude pixel, noting that the exact area of impact will need to take account of the different interactions from the different gear types (paragraphs 10.19 to 10.23). The Working Group also agreed that the total cumulative line length deployed by gear type, SSRU or subdivision, should be extracted on an annual basis and utilised to inform the review of proposed bottom fishing activities

required under Conservation Measure 22-06. In an effort to automate this procedure in the future and adopt the appropriate measure of footprint, development of the code to generate these maps will be done intersessionally.

10.16 The Working Group recommended that the technical issues of creating a cumulative fishery-scale footprint map at a fine scale be resolved intersessionally to facilitate standardised estimation of cumulative footprint as required by CCAMLR-XXVII, paragraph 5.15, in map form. Higher-resolution representations of footprint and impact are likely to be more valuable than summaries at the scale of an entire subarea as in Table 18(b), as they may allow habitat-specific or depth-stratum specific estimates of footprint and impact.

10.17 The Working Group recommended that, as appropriate data become available to update the footprint assessments, Tables 18(a) and (b) and the footprint maps should be updated on an annual basis and provided as part of the 'Bottom Fisheries and VMEs' report (SC-CAMLR-XXVII, paragraph 4.243).

10.18 In summarising preliminary assessments, reviewing data, Risk Areas and notifications, the Working Group developed several tables, figures and summary data that would be useful in developing an annual report on 'Bottom Fisheries and VMEs'. However, because of the lack of information, and the need to synthesise information by fishery, these reports will be developed next year pending the provision of appropriate assessment information.

10.19 Given the lack of detail in notifications in accordance with Annex 22-06/A of Conservation Measure 22-06 (paragraph 10.7), the Working Group requested that the Scientific Committee reinforce to the Commission the need for this information to undertake its work. At present, it is difficult for the Working Group to review whether proposed fishing activities will contribute to significant adverse impacts on VMEs. The Working Group agreed that section 1.2 of Annex 22-06/A is essential information for the review. It also agreed that other information concerning deployment of the gear needs to be included to understand the differences between gears in the area that might be impacted. This is detailed in Table 19.

10.20 The Working Group considered whether the procedure in Annex 22-06/A could be simplified so that Members only need provide new and updated information in each notification. Table 19 is developed as a set of guidelines, which would result in only requiring information needed to update the notification for the proposed activities. The Working Group recommended that the Scientific Committee consider whether these guidelines, 'Members' Bottom Fishing Gear Assessments', could be included in Conservation Measure 22-06 and replace section 1.2 of Annex 22-06/A.

10.21 The Working Group further considered the information needed to review the impacts of the gears. It recommended that section 2 of Annex 22-06/A be simplified to obtain information, judgements or quantitative estimates that Members may have of the vulnerabilities of benthic taxa in the fishing areas to the gears, including any potential differences in vulnerabilities between components of the gear. This could be included in the guidelines for Members' Bottom Fishing Gear Assessments.

10.22   The Working Group wished to advise the Scientific Committee that collection of this information on gears and the vulnerabilities of benthic taxa are required for all operations but are a particularly high priority for trotlines, trotlines with cachaloteras, Spanish longlines, fish pots and crab pots.

10.23   The Working Group noted that, should the Members' Bottom Fishing Gear Assessments pro forma be adopted in Conservation Measure 21-02, then Members submitting notifications under that measure would, following their first submission of the assessment form for their particular gear configuration, only need to provide effort estimates for their proposed fishing activities in the upcoming season.   This approach should provide all information necessary to estimate their proposed spatial footprint and potential impact for the coming season.

10.24   The Working Group recommended that the Scientific Committee consider a revision to the new and exploratory fisheries notification guidelines developed from Conservation Measure 21-02 (paragraph 5(ii) (Fishery Operations Plan)) for Members to provide the following new information with each notification:

   (i)   reference to the relevant Bottom Fishing Gear Assessment that adequately describes the fishing method and gear configuration to be deployed;

   (ii)   notification of any exceptions or changes – e.g. gear changes, alternate fishing practices, altered impact assumptions, mitigation measures adopted etc. – that may be expected to cause the actual impact of the proposed fishing activity to be different from that described in the relevant Bottom Fishing Gear Assessment;

   (iii) an estimate of fishing effort proposed by the Member for the upcoming fishing season, detailed by subarea and SSRU, in units compatible with the estimation of footprint size used in the relevant Member's Bottom Fishing Gear Assessment.

10.25   The Working Group noted that if all notifications provided the required standardised information (Table 19), estimates of future footprint based on expected effort deployment in the upcoming season could be derived and added to the cumulative historical effort in a template table such as Table 18(b). If Bottom Fishing Gear Assessments are available for all relevant methods, only the estimated incremental effort would need to be updated on an annual basis.

2008/09 fishing season review

10.26 Following   advice   from   the   Scientific   Committee   (SC-CAMLR-XXVII, paragraphs 4.268 and 4.281(ii)(c)), the Working Group reviewed the observer and vessel VME indicator taxa by-catch data as supplied by the Secretariat in WG-EMM-09/8, WG-FSA-09/6 and CCAMLR-XXVIII/BG/6, taking account of the results of WS-VME. The Working Group noted that although almost all vessels (30 of 33) reported total benthos for each five-day reporting period as required in Conservation Measure 23-01, the response to reporting VME indicator taxa by line segment was much more variable.   Only 19 of 33 vessels reported any line segment data, nine reported line segment data for more than 50% of sets, and only four reported line segment data for every set (CCAMLR-XXVIII/BG/6,

Table 6). Some vessels did not report VME indicator taxa unless the amount exceeded the notification trigger level of five VME indicator units. The Workshop on VMEs recommended (Annex 10) that segment-specific VME taxa weight, and to the extent possible, segment-specific fish weight data could be used to develop advice on the scale, distribution and association of VMEs with specific taxa and habitats (Annex 10, paragraphs 5.9, 5.11, 5.12, 5.26 and 6.10).

10.27 The Working Group agreed that the catch of VME indicator units must be reported by vessels for each set even if the amount is zero. The Working Group also emphasised the importance of collecting segment-specific data, as the scale of VME patch size is likely to be much smaller than the length of a longline.

10.28 The Working Group joined the Workshop on VMEs in commending those vessel skippers and observers who collected detailed and high-quality data in the first year of implementing Conservation Measure 22-07, and in demonstrating that observers can accurately classify VME taxa given the appropriate materials and training (TASO-09/8; SC-CAMLR-XXVIII/BG/12; Annex 10, paragraph 5.5; WG-FSA-09/23).

10.29 The Working Group noted that approximately 14 000 segments were deployed in the 2008/09 season and that the number of reported notifications from exploratory bottom fishing under Conservation Measure 22-07, where at least five VME indicator units in a segment were landed, totalled 30. Of these, seven notifications consisted of at least 10 VME indicator units, which resulted in seven Risk Areas being declared (see WG-FSA-09/6 and CCAMLR-XXVIII/BG/6). Risk Areas identified through Conservation Measure 22-07 remain closed to bottom fishing as a precautionary measure until reviewed and management actions are determined by the Commission. However, no process for review or evaluation of the area as a VME is specified in the measure. The Working Group requested that the Scientific Committee clarify the process for reviewing Risk Areas as required in Conservation Measure 22-07.

10.30 The Working Group noted that 28 notifications of evidence of encounters with VMEs were received under Conservation Measure 22-06 and described in WG-EMM-09/32. WG-EMM noted that thresholds adapted in WG-EMM-09/32 from longline by-catch trigger levels in Conservation Measure 22-07 appeared to be too high when compared to video observations of VME taxa on the sea floor (Annex 4, paragraphs 5.6 to 5.9), suggesting that lower thresholds, taxon-specific thresholds, or alternative approaches be developed to classify areas as VMEs. WG-EMM referred the proposal to WG-FSA for comments and operational considerations (Annex 4, paragraph 5.8), and to WS-VME to consider the appropriate depth range, trigger levels for 'light' taxa, and the treatment of rare or endemic taxa (Annex 4, paragraph 5.9).

10.31 The Working Group agreed that all 28 areas notified in WG-EMM-09/32 (areas with supporting video observations and areas based on trawl by-catch only) showed compelling evidence of VMEs and recommended that they are registered in the VME registry as VMEs.

10.32 The Working Group noted that these VMEs were relatively close together, and that the total distribution of patches of vulnerable communities was not known. The small scale of notified areas and their patchy distribution suggests that larger areas should be protected while further information is collected and analysed.

10.33 The Working Group recommended that the Scientific Committee consider whether the management areas defined in Conservation Measure 52-02 as part of the experimental harvest program containing these VMEs (Areas A, C, E) should be closed to protect the known VMEs and likely others in similar nearby areas (Figure 12).

10.34 The Working Group noted that the quantities of VME taxa recovered in several areas sampled did not reach the derived threshold used in WG-EMM-09/32. The Working Group agreed there are many approaches and ecological reasons available for proposing areas as VMEs, and noted that 'trigger levels' apply to longline by-catch rather than non-fishery data, and that specific sampling abundance thresholds, although useful, are not required to propose a VME based on non-fishery data. The Working Group encouraged additional analyses of the data collected. The Working Group also commended the authors for giving priority to VME-related research and implementing the conservation measures.

10.35 The Working Group reviewed the recommendations provided by WG-SAM (Annex 6, paragraphs 4.16 to 4.19), WG-EMM (Annex 4, paragraphs 5.3, 5.8, 5.11 and 5.14) and WS-VME (Annex 10, paragraph 7.1).

10.36 The Working Group noted that the development of Conservation Measures 22-06 and 22-07 has generated several new terms and that the process for information flow and review has not been clearly defined. The Working Group also noted that, although a generalised process for information flow and review by working groups was adopted in SC-CAMLR-XXVI, paragraph 4.171, the Scientific Committee had recognised that the process will need to be refined as experience is gained (SC-CAMLR-XXVI, paragraph 4.165).

10.37 The Working Group requested the Scientific Committee clarify the procedural framework for notification and the review of notifications under Conservation Measure 22-06, the review of data collected under Conservation Measure 22-07 (SC-CAMLR-XXVII, paragraphs 4.240 and 4.268; Conservation Measure 22-07, paragraph 10), as well as the integration of this information with notifications of proposed fishing impacts reviewed annually under new and exploratory fishery notifications. The Working Group proposed amending the framework adopted in 2007 (SC-CAMLR-XXVI, paragraph 4.164) to include the requirements in Conservation Measures 22-06 and 22-07, and to clarify the procedures needed to integrate the information and provide advice to the Scientific Committee. The proposed amended procedure is shown in Figure 13.

10.38 The Working Group requested the Scientific Committee provide advice regarding which working group is to provide review and evaluation of data, notifications and proposals generated under Conservation Measures 22-06 and 22-07 as shown in Figure 13, noting previous advice in CCAMLR-XXVII, paragraph 5.16.

10.39 The Working Group reviewed Secretariat papers WG-FSA-09/6 and 09/45. The Working Group agreed that further development of the Secretariat's capability to manage, store, process and summarise data resulting from Conservation Measures 22-06 and 22-07 is necessary. The Working Group noted that some data may be linked through SCAR-MarBIN and/or other organisations in order to expand analytical opportunities in the use of these data. The Working Group recommended that a work plan and budget be developed, prioritising the capability to provide real-time data, and to provide data for use by the Secretariat and its working groups (WG-FSA-09/6, paragraphs 16(a) and (c)). The Working Group also agreed

that the review of CCAMLR's approach to managing bottom fishing impacts on VMEs (WG-FSA-09/45) would be a valuable contribution to the development of management approaches to avoid significant adverse impacts to VMEs by other organisations. The Working Group recommended that a process for the publication of Secretariat papers should be considered by the Scientific Committee.

10.40 To aid in clarifying the process and terminology associated with Conservation Measures 22-06 and 22-07, the Working Group discussed developing a glossary to minimise confusion in the use of terminology with the many new concepts related to VMEs. The Working Group agreed to work intersessionally to develop succinct, simple and functional definitions for selected terms through a correspondence group.

10.41 The Working Group noted that the VME Invertebrate Classification Guide implemented in the 2008/09 season was very useful in aiding observers to correctly classify VME indicator taxa. Upon review by WS-VME (Annex 10), the guide has been edited and updated to include new taxa. The new version could be implemented in 2009/10 for the entire CCAMLR area applicable to Conservation Measure 22-06. The Working Group recommended that the guide be called the 'CCAMLR VME Taxa Classification Guide' and be made available as a CCAMLR document on the website, and that funds be made available through the Secretariat to provide laminated double-sided copies for those not equipped to produce their own.

10.42 WS-VME reviewed Conservation Measure 22-06, Annex B, and recommended that it be reconfigured to reflect its use mainly for research vessels and encounters not otherwise reported under Conservation Measure 22-07 (Annex 10, paragraph 3.11). The Working Group recommended that Annex 22-06/B be revised to indicate that notifications of encounters with VMEs should be prepared as proposals/research papers to be submitted to WG-EMM for review via the Secretariat. Further, WG-EMM could recommend a classification of the area(s) and forward data and metadata associated with locations of VMEs, and links to the supporting review documents, to be added to the VME register. The annex would no longer be necessary as a data form. Rather, the annex would become guidelines specifying categories of information to include in the submitted notification. If adopted, the Conservation Measure Drafting Group could consider revisions to Conservation Measure 22-06, paragraph 9, for consistency. A draft revised annex is provided in Figure 14.

10.43 The Working Group reviewed the implementation of Conservation Measure 22-07 and advice of WS-VME (Annex 10, paragraphs 5.12, 6.8 and 6.9; Conservation Measure 22-07, paragraph 10) and noted the responsibility for reporting VME indicator units is a vessel, not an observer, responsibility. The Working Group also noted that recording either weight or volume as currently written, creates problems with data quality and limits analysis of by-catch data.

10.44 The Working Group recommended that:

(i) segment midpoint locations should be reported as DD.MM and fractional minutes along with the geodetic datum set in the navigation system, with care to report longitude as negative degrees in the western hemisphere;

(ii) from a data analysis and simplicity perspective, weight and the units used to quantify VME taxon by-catch should be reported as a minimum requirement;

(iii)   vessels should report sets and segments resulting in zero VME indicator units;

(iv)   segment-level VME indicator units and target species catch will be needed to analyse correlations in their distributions;

(v)   development of trigger levels for a range of VME taxa should be considered intersessionally, along with options to enable taxon-specific weights to be collected to provide advice for next year.

Review of conservation measures

10.45   The Working Group had insufficient time to review the conservation measures or to provide advice on the points expected by the Commission (paragraph 10.2). It agreed that the following program of work for the intersessional period will assist in reviewing Conservation Measures 22-06 and 22-07 next year:

(i)   developing plausible scenarios of the types and dynamics of VMEs and the spatial and temporal interactions of the fishery with VMEs;

(ii)   evaluating management strategies within the conservation measures along with other possible strategies for avoiding significant adverse impacts on VMEs.

10.46   WG-FSA-09/42 described the simulation model, 'Patch', which has been developed for use by CCAMLR to evaluate, using computer simulations, proposed within-season and post-season assessment and fisheries management strategies for avoiding significant adverse impacts on VMEs. It is designed to capture important properties of benthic habitats, including patch heterogeneity, decay, recovery and connectivity between areas, and interactions of fisheries with those habitats. Most importantly, the model enables uncertainties to be evaluated in a straightforward manner to assist CCAMLR in maintaining its precautionary approach in managing Antarctic fisheries. The model is ready for use by WG-FSA to begin evaluating management strategies to conserve VMEs having been updated according to the recommendations of WG-SAM, WG-EMM and WS-VME. The manual is included as an attachment to the paper.

10.47   The Working Group noted the developments of the simulation software, Patch, and that the author had undertaken the work requested by WG-SAM, WG-EMM and WS-VME. It also noted that it is designed to assist in:

(i)   assessing whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs and whether proposed or additional mitigation measures would prevent such impacts;

(ii)   evaluating management strategies to avoid significant adverse impacts on VMEs.

10.48   The Working Group welcomed the development of this software and recommended that it be used to develop evaluations of VME management strategies for review by WG-SAM next year. It encouraged Members to participate in this work through the Subgroup on VMEs.

Future work

10.49 The Working Group wished to advise the Scientific Committee that the review of Conservation Measures 22-06 and 22-07 should proceed in the intersessional period with the aim of providing advice on these measures next year.

10.50 With respect to the report on 'Bottom Fisheries and VMEs', the Working Group noted that WS-VME had insufficient time to provide a draft template for this report (SC-CAMLR-XXVII, paragraph 4.243) or recommendations on how it be compiled and updated. The Working Group had insufficient time to develop such a template as well, but recommended that the work undertaken at this meeting be further developed by the Subgroup on VMEs during the intersessional period and that a template be provided for consideration by WG-EMM and WG-FSA next year.

10.51 As part of developing the bottom fisheries report, the Working Group agreed that the methodology, including the code for generating maps, for presenting the cumulative footprint should be reviewed and refined by the Subgroup on VMEs in the intersessional period.

Development of ecosystem models

10.52 The Working Group noted the report and endorsed the recommendations of the Second Workshop on Fisheries and Ecosystem Models in the Antarctic (FEMA2), which was held during the first two days of WG-EMM (Annex 4, paragraphs 2.1 to 2.53).

10.53 In particular, the Working Group:

(i) encouraged Members to participate in collating literature and to further develop the documentation on the food web in the Ross Sea (Annex 4, paragraph 2.33);

(ii) encouraged Members to develop spatially structured population and food-web models to better explore the spatial overlaps between the toothfish population, the fishery and predator requirements (Annex 4, paragraphs 2.43, 2.48, 2.51 and 2.53);

(iii) agreed that these simulation models should be used to determine the data needed to refine the management strategy for the fishery.

Depredation

10.54 The Working Group noted the work undertaken by France on depredation in the toothfish fishery in Subarea 58.6, as described in WG-IMAF-09/12, and noted that an average estimate of 41% of the toothfish catch from 2003 to 2008 may be taken by cetaceans in this subarea. Trials with fish pots in 2010 will be initiated to address this issue.

10.55 The Working Group noted the discussion of WG-FSA-09/16 in paragraphs 3.60 to 3.62.

Other interactions with WG-EMM

10.56 The Working Group noted that the advice from WG-EMM on a number of matters common to both working groups, such as VMEs and *C. gunnari*, has been taken up in the relevant agenda items.

10.57 The Working Group noted that the text of the Russian guide to identification of larval fish (SC-CAMLR-XXVI, paragraph 11.5 and Annex 5, paragraph 10.10) had now been translated and was available from the Secretariat. Dr Shust thanked the Secretariat for this translation and suggested that the utility of the guide would be greatly increased if the figure legends were also available in English.

10.58 The Working Group also noted the request from WG-EMM (SC-CAMLR-XXVI, Annex 4, paragraph 4.37) to provide information to observers in the krill fishery on the available information for the identification of larval fish by-catch, and that there are a number of Members who have developed identification guides of larval fish in the Southern Ocean. It requested Members to provide details of the relevant information for review by WG-FSA next year. The aim of this review would be to provide advice to scientific observers on the key identification features of the most frequently encountered by-catch species in order to facilitate the routine collection of these data from the krill fishery.

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

11.1 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.

11.2 Information collected by scientific observers was summarised in WG-IMAF-09/4 Rev. 2, 09/5 Rev. 2, 09/6 Rev. 2 and 09/7.

11.3 The Working Group reviewed the report of the second meeting of ad hoc TASO held in Bergen, Norway, on 4 and 5 July 2009 (Annex 9), and considered the various questions referred to it by TASO:

(i) The Working Group endorsed ad hoc TASO's recommendation that a reference library of all the different types of gear used in the different fisheries in the Convention Area be developed and included in the *Scientific Observers Manual* and on the webpage using standard nomenclature for the various gear items (paragraph 10.40). Members' technical coordinators and the Secretariat should be tasked with this work.

(ii) The Working Group noted ad hoc TASO's comments with respect to IUU gillnet fishing and VMEs. These points are considered in more detail elsewhere in this report (sections 8 and 10 respectively).

(iii) Ad hoc TASO recommended that a photographic maturity staging guide for toothfish be developed and included in the *Scientific Observers Manual*. The Working Group noted that:

(a) photographic maturity guides for toothfish and other species exist in the observers manuals developed by various Members and recommended that this material be drawn upon. The guide should contain a series of photographs, especially of the transitions between maturity stages, not just a single photograph of the 'ideal case' of each maturity stage;

(b) the maturity scale for toothfish be simplified to only three maturity stages: immature, developing and mature, and actively spawning (ripe running).

11.4 The minimum sampling requirements recommended by the Working Group at CCAMLR-XXVII as an interim level still apply (see SC-CAMLR-XXVII, Annex 5, paragraph 11.8 for the recommended reduction in *Dissostichus* spp. sampling in the coming season to accommodate the additional requirements associated with the Year-of-the-Skate). The Working Group noted that New Zealand has indicated its intention to submit a paper on the optimum sampling requirements for toothfish in Subareas 88.1 and 88.2 to WG-SAM in 2010.

11.5 The Working Group noted that there may be cases where toothfish have been incorrectly identified to species. It recommended that the relevant section of the *Scientific Observers Manual* be improved to enable observers and crew to better distinguish between *D. eleginoides* and *D. mawsoni*.

11.6 Recognising that data collected by observers is an important source of information used by the Scientific Committee to assess the status of resources in the CCAMLR region, the Working Group encouraged the efforts made by ad hoc TASO towards developing guidelines for accrediting CCAMLR observer programs (outlined in SC-CAMLR-XXVIII/BG/9). The Working Group agreed that this would help to standardise and improve the accurate collection of data across all fisheries.

Future work

11.7 The Working Group noted that, to assist the creation of the accreditation program, areas need to be defined in which data collected by observers are not of sufficient quality to be used in analyses conducted by working groups. The Working Group suggested that the following steps be considered:

(i) identify the subset of the data collected by observers that are used in the development of management advice;

(ii) develop data metrics that can be used to assess the quality of those data;

(iii) identify the specific aspects of the data collected by observers where the quality or standard across vessels is not sufficient, and document the data standard required.

FUTURE ASSESSMENTS

12.1 The Working Group noted that the Year-of-the-Skate had been successfully implemented and recommended that a continuation of the Year-of-the-Skate protocols should be extended for at least another year (paragraphs 6.9 to 6.25). The Working Group noted that the increased levels of rajid data (particularly from tag returns) that were becoming available from *Dissostichus* spp. fisheries should facilitate the move towards more formal assessments for rajids in some subareas and divisions as outlined by WG-SAM (SC-CAMLR-XXVI, Annex 7, paragraph 3.20). The Working Group recommended that WG-SAM consider the most appropriate methods to progress rajid assessments.

12.2 The Working Group discussed the development of a length-based assessment model for icefish in Subarea 48.3 (WG-FSA-09/27 and paragraphs 4.24 and 4.25) and recalled that a number of areas for further consideration were raised during WG-SAM (Annex 6, paragraphs 3.29 to 3.31). The Working Group recommended that further investigation into alternative methods of estimating the growth-transition matrix is undertaken before the length-based assessment method could be used to develop assessment advice for *C. gunnari* in Subarea 48.3.

12.3 The Working Group endorsed the recommendations of WG-SAM and WG-EMM (FEMA2 in Annex 4, paragraphs 2.1 to 2.53) to continue the use and development of spatially explicit assessment models.

12.4 The Working Group recommended that the development of formal assessments of *Dissostichus* spp. in subareas and divisions where exploratory fisheries operate should be continued. Further research fishing surveys planned for the 2009/10 season should assist with the future development of advice for the assessment of fisheries in these areas.

12.5 The Working Group noted the need for the continued development of models, including Patch, to advance assessments of VMEs (paragraph 10.46).

Frequency of assessments

12.6 The Working Group reviewed the move to a biennial assessment cycle for three stocks (Subarea 48.3, Division 58.5.2 and the Ross Sea management area) following a full cycle of this process. The Working Group recalled that at last year's meeting (SC-CAMLR-XXVII, Annex 5, paragraph 12.6) the move to biennial assessments was considered highly successful, and allowed time at the meeting to consider a wide range of other issues. The Working Group further endorsed this view and noted that the change to biennial assessments of some stocks had not changed the ability of the Working Group to provide assessment advice to the Scientific Committee.

12.7 The Working Group noted that the timing of the provisions of datasets could constrain the ability to undertake assessments that include the most recent year's observational data at WG-FSA.

12.8   The Working Group recommended that WG-SAM consider the impact on assessment advice of the non-inclusion of subsets of the latest year's observations on assessment results, and make recommendations as to the extent that the latest year's observations may be safely omitted without significantly impacting advice.

FUTURE WORK

Organisation of intersessional activities of subgroups

13.1   The Working Group thanked all subgroups for their contributions and encouraged each one to continue its work in the forthcoming intersessional period, focusing, where possible, on key issues identified below. The Working Group re-emphasised that the membership to the subgroups was open to all participants, and new participants are encouraged to contact the Secretariat for further information on the subgroups (see also paragraph 2.5 for a list of subgroups and coordinators).

13.2   The Working Group noted the following subgroup work planned for the intersessional period:

- complete the species profile for *D. elegin oides* and revise the profiles for *D. mawsoni* and *C. gunnari* (paragraph 9.3);

- advance the work of CON (paragraph 9.5) and verify otolith readings (paragraph 5.39);

- advance the work on VMEs (paragraphs 10.49 to 10.51), including further development and use of Patch (paragraph 12.5).

13.3   The Working Group also thanked Mr Dunn for undertaking to coordinate a correspondence group to further develop and facilitate use of the SPM (paragraph 5.116).

13.4   The Working Group briefly reviewed progress in the development of a larval and juvenile fish guide for use in the krill fishery. The Russian guide had been translated by the Secretariat and further work was required to develop a compilation of all available information (paragraphs 10.57 and 10.58). The Working Group requested that Dr S. Kawaguchi (Australia) continue to coordinate a small group to collate the available information and develop a proposal for consideration by WG-FSA in 2010.

13.5   Dr Jones agreed to contact subgroup coordinators two weeks prior to the next meeting of the Working Group in order to review subgroup work plans for that meeting in light of the Working Group's priorities, meeting agenda and submitted papers.

Intersessional meetings

13.6   During the course of its meeting, the Working Group identified a number of matters which it referred to WG-SAM, ad hoc TASO and SG-ASAM:

(i)   WG-SAM –

- review of the simulation methodologies to assess harvest strategies for toothfish in exploratory fisheries (paragraph 5.28);

- consider the most appropriate methods to progress rajid assessments (paragraph 12.1);

- further investigate alternative methods of estimating the growth-transition matrix for *C. gunnari* in Subarea 48.3 (paragraph 12.2);

- review developments of the SPM and Patch (paragraphs 13.2 and 13.3);

- optimum sampling requirements for *Dissostichus* spp. in exploratory fisheries (paragraph 11.4);

(ii)   ad hoc TASO –

- development of guidelines for accrediting CCAMLR observer programs (paragraph 11.7);

- development of gear profiles (paragraphs 11.3(i) and section 10, also includes technical coordinators and the Secretariat);

- methods by which large toothfish could be tagged in good condition (paragraph 5.17);

(iii) SG-ASAM –

- further development of quantitative methods to include acoustic estimates in the assessments for *C. gunnari*;

- development of automated procedures to estimate large-scale spatial and seasonal variability in the relative abundance of mesopelagic fish assemblages and *C. gunnari*, using opportunistic platforms (e.g. commercial fishing vessels), towed transducers and moored arrays. Dr Constable agreed to submit a paper to SG-ASAM and ICES WGFAST to outline the concept, and its potential application to the work of working groups, including ecosystem monitoring and the assessment of *C. gunnari*.

Notification of scientific research activities

13.7   The Working Group noted that the following Members would be conducting scientific research activities in 2010 and in accordance with Conservation Measure 24-01:

Australia: research on the vulnerability of habitats in high latitudes to impacts by bottom fishing gear (December 2009 to January 2010, Divisions 58.4.1 and 58.4.2)
possible survey for *C. gunnari* in Division 58.5.2 (early 2010)
bottom fish survey in Division 58.5.2 (May–June 2010)

Japan: research fishing in Division 58.4.4 (paragraphs 5.101 to 5.111; see also WG-FSA-09/12)

UK: bottom fish survey in Subarea 48.3 (January–February 2010)
          deeper-water bottom fish survey on the slope in Subarea 48.3 (February 2010).

13.8   The Working Group noted that Members participating in scientific research activities which fall under Conservation Measure 24-01 are required to submit the following to the Secretariat:

- a notification of research vessel activity (Conservation Measure 24-01, Annex A, Format 1 or Format 2);

- five-day catch and effort reports during the research activity;

- annual STATLANT returns which include catches taken during the research activity;

- a summary report within 180 days of the completion of the research activity and a full report within 12 months.

General matters

13.9   The Working Group identified the following general items of future work:

(i)   CCAMLR database operation, development and documentation (paragraph 3.5);

(ii)   development of IUU catch estimates (paragraphs 3.23 and 8.6);

(iii)   increase capability to have otoliths effectively sampled and read (paragraph 3.36);

(iv)   relationship between environmental variability and *C. gunnari* abundance (paragraph 3.39);

(v)   include CVs when reporting biomass estimates derived from surveys (paragraph 3.43);

(vi)   submission of CPUE data and analyses of *Dissostichus* spp. in Division 58.4.1 (paragraphs 3.44 and 4.19);

(vii)   development of standardised methods and data sources for deriving bathymetric information for the Convention Area and establishment of a common data repository (paragraphs 3.58 and 3.59);

(viii) presentation of catch-at-age proportions by year-class and likelihood profiles in CASAL assessments (paragraph 4.21);

(ix)   biological sampling rate of skates (paragraph 6.22);

(x)   include selected items from the WG-IMAF agenda in the agenda of WG-FSA in alternate years when WG-IMAF does not meet (paragraph 7.4);

(xi)   inventory of *Dissostichus* spp. otoliths (paragraph 9.6);

(xii)   development of map routine for bottom fishing footprint (paragraph 10.16);

(xiii) development of a work plan and budget for further developing the VME registry (paragraph 10.39);

(xiv)   development of a glossary on VME terminology (paragraph 10.40);

(xv)   revisions to the *Scientific Observers Manual* (paragraph 11.5);

(xvi)   quality of scientific observer data used in analyses conducted by working groups (paragraph 11.7);

(xvii) continued development of models, including Patch, to advance assessments of VMEs (paragraph 12.5).

13.10 The Working Group recommended that the Scientific Committee request Members to submit to the Secretariat an inventory of otoliths from *Dissostichus* spp. collected from CCAMLR fisheries, indicating the number of otoliths collected and the number read by fishery, season and Flag State of the fishing vessel (see also paragraph 5.119).

13.11 The Working Group urged authors of working group documents to clearly annotate all graphs presented, particularly the scales and relevant attributes of the axes, for example, where ambiguous measures of abundance should specify the relevant sample unit such as count per set or count per thousand hooks.

ADVICE TO THE SCIENTIFIC COMMITTEE AND ITS WORKING GROUPS

14.1   The Working Group identified the following advice to the Scientific Committee and its working groups:

(i)   Development of assessments –

(a)   alleviation of workflow pressure points in the development of stock assessments (paragraph 3.7 and Figure 1);

(b)   use of data-quality metrics to select high-quality data used in stock assessments (paragraphs 3.48, 3.49 and 5.84);

(c)   use of assumed harvest rates based on experience from fully assessed fisheries (paragraph 4.20);

(d)   development of research plans in exploratory fisheries (paragraph 5.118);

(e)   development of characterisation of exploratory fisheries (paragraph 5.120);

(f)   further work on ageing of *C. gunnari* using otoliths was considered unnecessary for use in assessments (paragraphs 9.4 to 9.8);

(g)   biennial assessment cycle in assessed fisheries (paragraph 12.6);

(h)   Secretariat-based assessment scientist (paragraph 15.6).

(ii)   IUU fishing –

(a)   IUU fishing (paragraphs 3.21 and 8.6).

(iii)   Fishery management advice –

(a)   fishery for *D. eleginoides* in Subarea 48.3 (paragraph 5.127);

(b)   fishery for *D. eleginoides* (Northern Area) and *Dissostichus* spp. (Southern Area) in Subarea 48.4 (paragraphs 4.9 and 5.136 to 5.138);

(c)   fishery for *D. eleginoides* in Division 58.5.1 (paragraphs 5.142 to 5.145);

(d)   fishery for *D. eleginoides* in Division 58.5.2 (paragraph 5.152);

(e)   fishery for *D. eleginoides* in Subarea 58.6, Crozet Islands (paragraphs 5.156 to 5.159);

(f)   fishery for *D. eleginoides* in Subareas 58.6 and 58.7, Prince Edward and Marion Islands (paragraphs 5.163 to 5.165);

(g)   fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 (paragraphs 5.87 to 5.96);

(h)   fisheries for *Dissostichus* spp. in Subareas 88.1 and 88.2 (paragraphs 5.79 to 5.84);

(i)   fishery for *C. gunnari* in Subarea 48.3 (paragraphs 5.171 and 5.172);

(j)   fishery for *C. gunnari* in Division 58.5.2 (paragraph 5.178);

(k)   other fisheries (paragraphs 5.181, 5.183 and 5.185);

(l)   implementation of the tagging program for *Dissostichus* spp. (paragraphs 5.10, 5.14 and 5.17);

(m)   implementation of research hauls in exploratory fisheries in Subareas 48.6 and 58.6 (paragraph 5.19);

(n)   open and closed SSRUs (paragraphs 5.25, 5.28 and 5.94).

(iv)   By-catch –

(a)   extend the Year-of-the-Skate (paragraph 6.24);

(b) clarify skate tagging rate in the conservation measures and revise guidelines for the Year-of-the-Skate (paragraphs 6.17 and 6.25);

(c) implementation of the tagging program for skates (paragraphs 6.12 and 6.17);

(d) one-page guide for vessels with respect to the fate of skates caught, corresponding reporting requirements and limitations on discards (paragraphs 6.11 and 6.12);

(e) Members' advice on difficulties in implementing tagging requirements in new and exploratory fisheries (paragraph 6.17);

(f) introduction of a threshold level in the move-on rule for macrourids in the Southern Area of Subarea 48.4 (paragraphs 5.138 and 6.31).

(v) VMEs –

(a) development of bottom fishing footprints (paragraphs 10.16 and 10.17);

(b) development of Bottom Fishing Gear Assessments (paragraphs 10.20 and 10.24);

(c) Conservation Measure 22-06 and notifications of encounters with VMEs, (paragraphs 10.8, 10.31, 10.37, 10.38 and 10.42);

(d) Conservation Measure 22-07 and review and evaluation of risk areas, (paragraphs 10.29, 10.37, 10.38, 10.43 and 10.44);

(e) consideration of a paper on CCAMLR's approach to managing bottom fishing impacts on VMEs (paragraph 10.39);

(f) CCAMLR VME Taxa Classification Guide (paragraphs 6.32 and 10.41).

(vi) Scientific observers –

(a) revisions to the *Scientific Observers Manual* (paragraphs 11.3 and 11.5);

(b) reference library of fishing gear types (paragraph 11.3(i));

(c) guidelines for accrediting CCAMLR observer programs (paragraphs 11.6 and 11.7).

(vii) Other –

(a) implications for WG-FSA of WG-IMAF meeting biennially in future (paragraphs 7.4 and 7.5);

(b) implementation of daily reporting of catches and gear deployed in situations where catch limits are small or reach a minimum threshold (paragraph 3.15);

(c)   regular review of the Secretariat resources required to develop and operate the CCAMLR database (paragraph 3.5);

(d)   development of standardised methods and data sources for deriving bathymetric information for the Convention Area and establishment of a common data repository (paragraphs 3.58 and 3.59);

(e)   research fishing in Divisions 58.4.4a and 58.4.4b (paragraph 5.111);

(f)   report adoption (paragraph 15.1);

(g)   report preparation and translation (paragraph 15.12).

OTHER BUSINESS

Adoption of report

15.1   The Working Group noted that, in recognition of concerns raised by non-native English-speaking participants from France, Germany, Japan, Russia and Ukraine at the time of adoption of the report, adopting extended and important sections of the report (such as section 10) at short notice would be problematic in future meetings. The Working Group requested the Scientific Committee provide advice on how this issue should be addressed at future meetings of the Working Group.

Assessment scientist

15.2   The Working Group recognised that its work in developing and conducting assessments is placing ever-increasing demands on participants and Secretariat staff. It also noted that substantial future work is required to develop assessments including those for exploratory fisheries in Subareas 48.6 and 58.4, and to address fisheries management requirements identified by the Performance Review.

15.3   The Working Group agreed that is was essential that new steps be implemented to:

(i)   alleviate the workload of Working Group participants and the Secretariat
(ii)   share the burden of future work
(iii)   facilitate documentation and archiving of assessment methodologies
(iv)   provide greater transparency and transfer of knowledge
(v)   provide expertise and continuity in developing assessments.

15.4   The Working Group considered a proposal to establish a new Secretariat-based position for an assessment scientist in order to:

(i)   conduct detailed validation of preliminary assessments submitted to WG-FSA;

(ii)   assist with developing and archiving documentation on assessment methodologies;

(iii)   participate in the development of assessments methodologies and provide training in their use;

(iv)   conduct preliminary assessments;

(v)   provide additional transparency and impartiality in the assessment procedures.

15.5   The Working Group recognised that the appointment of an assessment scientist based in the Secretariat would require careful consideration, including:

(i)   the terms of employment and budget implications;

(ii)   development of a detailed position description and a review of related, existing positions within the Secretariat including the Data Manager's role in assessment validation and support;

(iii)   options for providing support and maintenance of assessment expertise within the Secretariat's environment;

(iv)   long-term requirements of WG-FSA, other working groups and the Scientific Committee.

15.6   The Working Group proposed the following draft terms of reference for an assessment scientist:

(i)   Administration and maintenance of stock assessments –

(a)   validation of input data and assessment results submitted to working groups;

(b)   collation and development of documentation of methodologies used in assessments;

(c)   development and maintenance of a registry of assessment codes and programs.

(ii)   Research and development –

(a)   provide advice and assistance in developing assessments in areas of interest to the Scientific Committee and Commission;

(b)   develop assessment methodologies, including methodologies for assessing exploratory fisheries in Subareas 48.6 and 58.4;

(c)   facilitate the use of assessment methodologies, including training.

(iii)   Assessment support –

(a)   Conduct preliminary assessments prior to working group meetings.

15.7   The Working Group recommended that the Scientific Committee consider this proposal for a Secretariat-based assessment scientist and seek the advice of all working

groups on the nature and extend of work which may be conducted under the new position. The Scientific Committee may also wish to consider the role and position description of assessment scientists employed by other Secretariats (e.g. IATTC) and other international organisations (e.g. ICES).

15.8   Dr Miller proposed that the incoming Executive Secretary be tasked with formulating a position description and terms of appointment based on the advice of the Scientific Committee and its working groups in 2010. He also proposed that, as far as practicable, such work should be available by CCAMLR-XXIX and should take into account the various requirements outlined by the Scientific Committee and the respective working groups.

Report preparation and translation

15.9   The Working Group recalled the efforts made in recent years to reduce the size of its reports and alleviate the workload and cost associated with the preparation, translation and publication of these reports.   Significant changes had been implemented, including the introduction of web-based fishery reports in 2005 to provide concise reference documents for use principally by participants (SC-CAMLR-XXIV, Annex 5, paragraph 13.12).

15.10   Nonetheless, the Working Group's annual reports continue to increase in size and cost as assessments are developed and refined. In addition, new work has emerged following the implementation of initiatives including tagging programs in exploratory fisheries and the consideration of the impact of fishing on VMEs. Further work was also identified by the Performance Review in 2009.

15.11   The Working Group advised the Scientific Committee and the Commission that it is doing the best it can to produce reports which were both concise and provided long-term documentation of its work. The development of concise text was an arduous task which is shared by many during the meetings, and the Working Group is unable to further reduce the volume of its reports given its workload and time constraints during meetings.

15.12 The Working Group requested that the Scientific Committee and Commission consider ways of assisting WG-FSA in the preparation, translation and publication of its reports, including the use of a dedicated report writer/editor and a review of the Secretariat's budget for publishing annual reports.

ADOPTION OF THE REPORT

16.1   The report of the meeting was adopted.

CLOSE OF MEETING

17.1   Dr Jones thanked the subgroup coordinators, rapporteurs, all other participants and the Secretariat staff for their contributions and involvement in the work of WG-FSA, including the intersessional activities.   The contributions were outstanding and had led to a very productive meeting.

17.2   The Working Group noted that Dr Miller will be retiring as Executive Secretary in February 2010.   Dr Jones, on behalf of the Working Group, thanked Dr Miller for his long-standing expert contribution and dedication to the work of CCAMLR, including WG-FSA. The Working Group presented Dr Miller with a small gift.

17.3   Dr Constable, on behalf of the Working Group, thanked Dr Jones for convening the Working Group.   The Working Group's deliberations had been challenging at times, and Dr Jones had led the meeting with insight and calm determination.

17.4   The meeting was closed.

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Table 1:   Total reported catches (tonnes) of target species in fisheries in the Convention Area in 2008/09. **Bold**: fishery closed. (Source: catch and effort reports to October 2009 unless otherwise indicated.)

Target species	Region	Fishery	Fishing season		Conservation measure	Catch (tonnes) of target species		Reported catch (% limit)
			Start	End		Reported	Limit	
Champsocephalus gunnari	48.3	Trawl	15-Nov-08	14-Nov-09[a]	42-01 (2008)	1 837	3 834	48
	58.5.2	Trawl	01-Dec-08	30-Nov-09[a]	42-02 (2008)	99	102	97
Dissostichus eleginoides	48.3	**Longline**, pot	01-Dec-08	30-Nov-09[a]	41-02 (2008)	3 383	3 920	86
	48.4 Northern Area	**Longline**	01-Apr-09	20-May-09	41-03 (2008)	59	75	79
	58.5.1[b]	Longline	ns	ns	ns	3 108	ns	
	58.5.2	longline, trawl	01-Dec-08	30-Nov-09[a]	41-08 (2008)	2 026	2 500	81
	58.6 French EEZ[b]	Longline	ns	ns	ns	746	ns	
	58 South African EEZ	Longline	ns	ns	ns	4	ns	
Dissostichus spp.	48.4 Southern Area	**Longline**	01-Apr-09	11-Apr-09	41-03 (2008)	74	75	99
	48.6	Longline	01-Dec-08	30-Nov-09[a]	41-04 (2008)	282	400	71
	58.4.1	**Longline**	01-Dec-08	12-Mar-09	41-11 (2008)	222	210	106
	58.4.2	**Longline**	01-Dec-08	23-Feb-09	41-05 (2008)	66	70	95
	58.4.3a	**Longline**	01-May-09	31-Aug-09	41-06 (2008)	31	86	36
	58.4.3b	**Longline**	01-May-09	09-Feb-09	41-07 (2008)	104	120	87
	88.1	**Longline**	01-Dec-08	25-Jan-09	41-09 (2008)	2 434	2 700	90
	88.2	**Longline**	01-Dec-08	31-Aug-09	41-10 (2008)	484	567	85
Euphausia superba	48.1, 48.2, 48.3, 48.4	Trawl	01-Dec-08	30-Nov-09	51-01 (2008)	123 948	620 000	20
	48.6	Trawl	01-Dec-08	30-Nov-09	51-02 (2002)	No fishing	15 000	-
	58.4.1	Trawl	01-Dec-08	30-Nov-09	51-02 (2008)	No fishing	440 000	-
	58.4.2	Trawl	01-Dec-08	30-Nov-09	51-03 (2008)	No fishing	452 000	-
Lithodidae	48.2	Pot	01-Dec-08	30-Nov-09	52-02 (2008)	No fishing	250	-
	48.3	Pot	01-Dec-08	30-Nov-09	52-01 (2008)	1 (by-catch)	1 600	<1
	48.4	Pot	01-Dec-08	30-Nov-09	52-03 (2008)	No fishing	10	-
Martialia hyadesi	48.3	Jig	01-Dec-08	30-Nov-09	61-01 (2008)	No fishing	2 500	-

[a]   Under review
[b]   Reported in fine-scale data
ns Not specified by CCAMLR

Table 2: Estimated effort, catch rates and total catches from IUU fishing for *Dissostichus* spp. in the Convention Area in 2008/09. The estimates are derived from information on gillnetters, using the deterministic method and information submitted by Members of sightings by surveillance operations and legal fishing vessels to 30 September 2009. No reports of undocumented landings were received in 2008/09. (Source: WG-FSA-09/5 Rev. 1)

Division	Estimated start of unregulated fishery	No. of vessels sighted[1]	Estimated number of days fished	Mean catch rate per day (tonnes)	Estimated IUU catch
58.4.1	2005	1	80	1.9	152
58.4.2	2002	1	80	2.2	176
58.4.3b	2003	4	320	1.9	608
58.4.3b (hauled gillnet)	2003	1			2
Total					938

[1] Division 58.4.1: *Bigaro*; Division 58.4.2: Unknown gillnet vessel; Division 58.4.3b: *Constant*, *Trosky*, *Typhoon-1*, *Draco-1*, unknown gillnet vessel.

Table 3: Catch history of *Dissostichus* spp. taken by IUU fishing in the Convention Area. IUU fishing was first detected in 1988/89, and estimates are derived from longlining and gillnetting activities. Blank: no estimate; zero: no evidence of IUU fishing. (Source: WG-FSA-09/5 Rev. 1 and SC-CAMLR reports)

Season	Subarea/division													All areas
	Unknown	48.3	58.4.1	58.4.2	58.4.3a	58.4.3b	58.4.4	58.5.1	58.5.2	58.6	58.7	88.1	88.2	
1988/89		144						0		0				144
1989/90		437						0	0	0				437
1990/91		1 775						0	0	0				1 775
1991/92		3 066						0	0	0				3 066
1992/93		4 019						0	0	0				4 019
1993/94		4 780						0	0	0				4 780
1994/95		1 674						0	0	0				1 674
1995/96		0						833	3 000	7 875	4 958			16 666
1996/97		0					375	6 094	7 117	11 760	7 327	0		32 673
1997/98		146					1 298	7 156	4 150	1 758	598	0		15 106
1998/99		667					1 519	1 237	427	1 845	173	0		5 868
1999/00		1 015					1 254	2 600	1 154	1 430	191	0		7 644
2000/01		196					1 247	4 550	2 004	685	120	0		8 802
2001/02		3		295			880	6 300	3 489	720	78	92	0	11 857
2002/03		0		98			110	5 518	1 274	302	120	0	0	7 422
2003/04		0		197		246	0	536	531	380	48	240	0	2 178
2004/05	508	23		86	98	1 015	220	268	265	12	60	23	0	2 578
2005/06	336	0	597	192	0	1 903	104	144	74	55	0	0	15	3 420
2006/07		0	612	197	0	2 293	109	404	0	0	0	0	0	3 615
2007/08		0	93	0	0	247	0	489	0	153	0	186	0	1 168
2008/09		0	152	176	0	610	0	0	0	0	0	0	0	938
All seasons	844	17 945	1 454	1 241	98	6 314	7 116	36 129	23 485	26 975	13 673	542	15	135 830

Table 4: Catch (tonnes) of *Dissostichus* spp. reported from licensed fishing, and estimated from IUU fishing in the Convention Area, and reported in the CDS in areas outside the Convention Area in 2007/08 and 2008/09. (Source: reported catch – past season from STATLANT data, and current season from catch and effort reports and fine-scale data reported by France; IUU catch – WG-FSA-09/5 Rev. 1; CDS catch – data to October 2009.)

2007/08 season

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	*Catch limit**
	48.3	3 864	0	3 856	*3 920*
	48.4	98		98	*100*
	48.6	24		24	*400*
	58.4.1	410	93	503	*600*
	58.4.2	217	0	217	*780*
	58.4.3	151	247	398	*450*
	58.4.4	76**		76	*0*
	58.5.1	4 850	489	5 339	*0 outside EEZ*
	58.5.2	2 280	0	2 280	*2 500*
	58.6	878	153	1 031	*0 outside EEZs*
	58.7	69	0	69	*0 outside EEZ*
	88.1	2 259	186	2 445	*2 700*
	88.2	416	0	416	*567*
	88.3	0		0	*0*
	Total inside	15 813	1 168	16 981	

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR	
	41	4 292	3 349	7 641	
	47	13	187	200	
	51	26	192	218	
	57			0	
	81	378		378	
	87	3 785	129	3 913	
	Total outside	8 494	3 857	12 351	

| Global total | | | | 29 332 | |

* Includes catch limits for research fishing, limits for Divisions 58.4.3a and 58.4.3b are combined.
** Research fishing/survey

2008/09 season

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	*Catch limit**
	48.3	3 383	0	3 383	*3 920*
	48.4	133		133	*150*
	48.6	282		282	*400*
	58.4.1	222	152	374	*210*
	58.4.2	66	176	242	*70*
	58.4.3	135	610	745	*206*
	58.4.4	0		0	*0*
	58.5.1	3 108	0	3 108	*0 outside EEZ*
	58.5.2	2 177	0	2 177	*2 500*
	58.6	746	0	746	*0 outside EEZs*
	58.7	4	0	4	*0 outside EEZ*
	88.1	2 434	0	2 434	*2700*
	88.2	484	0	484	*567*
	88.3	0	0	0	*0*
	Total inside	13 223	938	14 161	

(continued)

Table 4 (continued)

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR
	41	2 888	2 170	5 058
	47		74	74
	51	18	59	77
	57			0
	81	503		503
	87	4 292	62	4 354
	Total outside			10 065
Global total				24 226

*   Limits for Divisions 58.4.3a and 58.4.3b are combined.

Table 5:   Reported catch of *Dissostichus* spp. in exploratory fisheries. (Source: STATLANT data for past seasons, and catch and effort reports for current season.)

Season	Reported catch (tonnes) of *Dissostichus* spp. in exploratory fisheries							
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2	All exploratory fisheries
1996/97						<1	<1	<1
1997/98						42	<1	42
1998/99						297		297
1999/00						751	<1	751
2000/01			<1			660	<1	660
2001/02						1 325	41	1 366
2002/03			117			1 831	106	2 055
2003/04	7	<1	20	<1	7	2 197	375	2 605
2004/05	51	480	126	105	297	3 105	411	4 575
2005/06	163	421	164	89	361	2 969	514	4 680
2006/07	112	634	124	4	251	3 091	347	4 562
2007/08	24	410	217	9	142	2 259	416	3 476
2008/09	282	222	66	31	104	2 434	484	3 624
Total	639	2 167	834	238	1 162	20 961	2 693	28 693

Table 6: Summary of Members and vessels notified in 2009/10 in (a) exploratory longline fisheries for *Dissostichus* spp. (with corresponding number of participating Members, number of vessels and catch limits agreed in conservation measures in force in 2008/09), (b) exploratory trawl fisheries for krill, and (c) exploratory pot fisheries for crab. (Source: CCAMLR-XXVIII/13)

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) Notifications for exploratory longline fisheries for *Dissostichus* spp. in 2009/10							
Argentina[1]						1	1
Japan	1	1	1	1	1		
Korea, Republic of	3	5	4	2	3	6	5
New Zealand		3	2			4	4
Russia						2	2
South Africa	1				1		
Spain		1	1			1	1
UK						3	3
Uruguay		1	1		1	1	1
Number of Members	3	5	5	2	4	7	7
Number of vessels	5	11	9	3	6	18	17
Corresponding conservation measures in force in 2008/09							
Number of Members	2	6	4	1	3	9	9
Number of vessels	1*	13	7	1	1*	21	19
Target species catch limit (tonnes)	400	210	70	86	120**	2 700	567

Member notifications	Number of vessels notified by subarea/division
	48.6
(b) Notifications for exploratory trawl fisheries for krill in 2009/10	
Norway	1
Total	1
Corresponding conservation measures in force in 2008/09	
Target species catch limit (tonnes)	15 000

Member notifications	Number of vessels notified by subarea/division	
	48.2	48.4
(c) Notifications for exploratory pot fisheries for crab in 2009/10		
Russia	1	1
Total	1	1
Corresponding conservation measures in force in 2008/09		
Target species catch limit (tonnes)	250	10

* Maximum number per Member at any one time
** Excluding research fishing
[1] The notification includes a proposal for pot fishing if approved.

Table 7: Unstandardised CPUE (kg/hook) of *Dissostichus* spp. in exploratory longline fisheries reported between 1996/97 and 2008/09. (Source: fine-scale data from commercial and fishery-based research hauls, with SSRUs as defined in Conservation Measure 41-01 (2008).)

Subarea/division	SSRU	Season												
		1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
48.6	A								0.04	0.07	0.11	0.15		
	D											0.05		
	E									0.08		0.13		0.46
	G								0.02	0.07	0.16	0.07	0.12	0.23
58.4.1	C									0.13	0.18	0.15	0.19	0.22
	D												0.09	
	E									0.22	0.10	0.14	0.12	0.13
	F											0.07	0.05	
	G									0.20	0.22	0.24	0.12	0.10
	H												0.15	
58.4.2	A									0.08	0.08	0.13	0.20	0.20
	C							0.10		0.07	0.17		0.42	
	D							0.19	0.06					
	E							0.21	0.11	0.14	0.22	0.15	0.21	0.23
58.4.3a	A									0.05	0.05	0.02	0.08	0.08
58.4.3b	A								0.04	0.08		0.15	0.17	0.22
	B								0.14	0.23	0.17	0.12		
	C									0.07		0.04	0.12	
	D									0.08	0.18	0.03	0.12	0.18
	E									0.10	0.08	0.05		0.21
88.1	A	0.01				0.02		0.16			0.08	0.05		
	B	0.05	0.03			0.17	0.25	0.26	0.11	0.55	0.07	0.33	0.15	0.39
	C					0.44	0.87	0.59	0.31	0.53	1.06	0.71	0.36	0.46
	E		0.07	0.06		0.03		0.05	0.08	0.28		0.02		
	F		0.00					0.03				0.16		
	G		0.06	0.02		0.13	0.12	0.12	0.12	0.15				
	H		0.17	0.26	0.38	0.41	0.74	0.46	0.22	0.77	0.59	0.37	0.40	0.34
	I		0.37	0.23	0.29	0.29	0.43	0.19	0.15	0.43	0.40	0.34	0.43	0.52
	J			0.12	0.18	0.04			0.11	0.19	0.21	0.32	0.18	0.25
	K		0.32	0.15	0.40		0.45			0.01	0.34	0.51		0.28	0.49
	L					0.12			0.10	0.14	0.19		0.17	0.10
	M			0.08		0.08				0.00	0.58	0.39	0.31	
88.2	A									0.14	0.06			
	B						0.82		0.11	0.47	0.54			
	D								0.06					
	E										0.43	0.31	0.19	0.14
	F							0.35	0.42	0.70	0.33	0.22	0.49	0.20
	G										0.26	0.02	0.39	0.16

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 2008/09 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. Vessels which tagged more than 500 fish are indicated (see Conservation Measure 41-01, Annex C). 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	*Dissostichus* spp. tagged and released		
			Number of fish		Tagging rate
48.4 (5)	New Zealand	*San Aspiring*	432	(309)	5.84
	UK	*Argos Georgia*	319	(249)	5.36
	Total		751	(558)	
48.6 (3)	Japan	*Shinsei Maru No. 3*	421	(79)	3.83
	Korea, Republic of	*Insung No. 22*	520	(0)	3.01
	Total		941	(79)	
58.4.1 (3)	Korea, Republic of	*Insung No. 1*	418	(0)	3.77
		Insung No. 2	533	(14)	8.89
	Uruguay	*Banzare*	176	(0)	3.44
	Total		1127	(14)	
58.4.2 (3)	Japan	*Shinsei Maru No. 3*	60	(1)	3.12
	Korea, Republic of	*Insung No. 22*	217	(7)	4.61
	Total		277	(8)	
58.4.3a (3)	Japan	*Shinsei Maru No. 3*	113	(113)	3.65
	Total		113	(113)	
58.4.3b (3)	Japan	*Shinsei Maru No. 3*	126	(74)	3.15
	Uruguay	*Banzare*	230	(1)	3.58
	Total		356	(75)	
88.1 (1)	Chile	*Isla Eden*	93	(0)	0.95*
	Korea, Republic of	*Hong Jin No. 707*	237	(84)	1.22
		Insung No. 1	158	(15)	1.29
		Jung Woo No. 2	242	(0)	1.09
		Jung Woo No. 3	164	(0)	1.52
	New Zealand	*Antarctic Chieftain*	185	(0)	1.09
		Janas	166	(0)	1.09
		San Aotea II	186	(0)	1.1
		San Aspiring	271	(1)	1.12
	Spain	*Tronio*	507	(13)	1.36
	UK	*Argos Froyanes*	307	(1)	1.13
		Argos Helena	338	(1)	1.3
	Uruguay	*Ross Star*	54	(0)	1.05
	Total		2908	(115)	
88.2 (1)	Chile	*Isla Eden*	3	(0)	0.7*
	Korea, Republic of	*Hong Jin No. 707*	17	(0)	1.27
	New Zealand	*Antarctic Chieftain*	78	(0)	1.84
		Janas	58	(0)	1.22
	South Africa	*Ross Mar*	120	(0)	1.02
	Spain	*Tronio*	15	(0)	1.18
	UK	*Argos Froyanes*	54	(0)	2.32
		Argos Georgia	182	(0)	1.06
		Argos Helena	24	(0)	1.94
	Uruguay	*Ross Star*	53	(0)	1.4
	Total		604	(0)	

* Corrigendum: The *Isla Eden* tagged and released 139 fish in Subarea 88.1 (tagging rate: 1.41) and 5 fish in Subarea 88.2 (tagging rate: 1.17).

Table 9: Number of *Dissostichus* spp. tagged and released in exploratory longline fisheries. (Source: scientific observer data submitted to CCAMLR)

Subarea/ division	Season									Total
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	
48.6				4	62	171	129		941	1 307
58.4.1					462	469	1 507	1 134	1 127	4 699
58.4.2					342	136	248	673	277	1 676
58.4.3a					199	104	9	41	113	466
58.4.3b					231	175	289	417	356	1 468
88.1	326	960	1 068	2 251	3 223	2 972	3 608	2 574	2 908	19 890
88.2		12	94	433	341	444	278	389	604	2 595
Total	326	972	1 162	2 688	4 860	4 471	6 068	5 228	6 326	32 101

Table 10: Number of tagged *Dissostichus* spp. recaptured in exploratory longline fisheries. (Source: scientific observer data submitted to CCAMLR)

Subarea/ division	Season									Total
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	
48.6						3	2		2	7
58.4.1							4	6	7	17
58.4.2									1	1
58.4.3a						6		2	2	10
58.4.3b					1	6	1	1	1	10
88.1	1	4	13	32	59	71	206	216	103	705
88.2				18	17	28	33	36	56	188
Total	1	4	13	50	77	114	246	261	172	938

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Table 11: Overlap between the catch-weighted length frequency of *Dissostichus* spp. reported by vessels in the exploratory fisheries in 2008/09, and the length frequency of individuals tagged and released. High ≥60% overlap, Medium ≥30 to <60%, Low <30%. - – Overlap not calculated where less than 30 fish were caught.

Species	Flag State	Vessel name	Subarea/division						
			48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
D. mawsoni	Chile	*Isla Eden*						Low	Low
	Japan	*Shinsei Maru No. 3*	High		Medium	-	Medium		
	Korea, Republic of	*Hong Jin No. 707*						Low	Medium
		Insung No. 1		Low				Low	
		Insung No. 22	Low	Low	Low				
		Jung Woo No. 2						Low	
		Jung Woo No. 3						Low	
	New Zealand	*Antarctic Chieftain*						Medium	High
		Janas						Medium	High
		San Aotea II						High	
		San Aspiring						High	
	South Africa	*Ross Mar*							Medium
	Spain	*Tronio*						Low	Low
	UK	*Argos Froyanes*						Medium	Medium
		Argos Georgia							Medium
		Argos Helena						Medium	Medium
	Uruguay	*Banzare*		Medium			Medium		
		Ross Star						Medium	High
D. eleginoides	Japan	*Shinsei Maru No. 3*	Low		-	Medium	Low		
	Korea, Republic of	*Hong Jin No. 707*						Low	
		Insung No. 1		-				-	
		Insung No. 22		-	-				
	New Zealand	*Janas*						-	
		San Aotea II						-	
		San Aspiring						-	
	South Africa	*Ross Mar*							-
	Spain	*Tronio*						Medium	
	UK	*Argos Froyanes*						-	
		Argos Helena						-	
	Uruguay	*Banzare*					-		

Table 12: Summary of proximity of vessel haul locations to allocated haul locations for research hauls carried out in Subareas 58.4 and 48.6 during the 2008/09 season. [#] – mean minimum distance (n miles) between the start positions for allocated and actual research lines; * – mean distance (n miles) between the geographic mid-points of the research lines, and number of lines less than the required minimum of 5 n miles; [$] – research haul location (F – Fished; L – lightly fished; U – unfished). Comments – reasons why allocated positions could not be reached.

Vessel	SSRU	Mean minimum distance (n miles)[#]	Mean distance between mid-points (n miles)*	No. lines <5 n miles apart	Number of actual (and allocated) research hauls in stratum[$]			Number of hauls in allocated locations	% hauls in allocated location	Comments
					F	L	U			
Banzare	5841C	28	11	6	10 (5)	0	0 (5)	5	50	Sea-ice + vessel
	5843bD	74	15	0	0 (5)	10 (5)	0	5	50	
	5843bE	53	14	0	0 (5)	3 (5)	7	3	30	
Insung No. 1	5841C	49	15	2	10 (5)	0	(5)	5	50	Sea-ice + vessel
	5841E	2	35	0	5 (5)	0	5 (5)	10	100	
Insung No. 22	486E	2	34	0	5 (5)	0	5 (5)	10	100	
	5841G	1	34	0	5 (5)	5 (5)	0	10	100	
	5842E	0	51	0	5 (5)	5 (5)	0	10	100	
Shinsei Maru No. 3	486E	6	23	2	6 (5)	0	5 (5)	10	100	Sea-ice
	486G	0	45	0	5 (5)	5 (5)	0	10	100	
	5842A	0	53	0	5 (5)	0	(5)	5	50	Fishery closure
	5842E	0	60	0	5 (5)	5 (5)	0	10	100	
	5843aA	0	44	0	5 (5)	5 (5)	0	10	100	
	5843bA	0	48	0	5 (5)	5 (5)	0	10	100	
	5843bE	1	30	0	5 (5)	5 (5)	0	10	100	

Table 13: Catches for macrourids, rajids and other species taken as by-catch from longline fisheries in 2008/09, and reported in fine-scale (C2) data. Catches are given in tonnes and as a percentage of the catch of *Dissostichus* spp. (TOT) reported in fine-scale data. (Rajids released from longlines are not included in these estimates.)

Subarea/division	Toothfish catch (tonnes)	Macrourids				Rajids				Other species		
		Catch (tonnes)	% TOT	Catch limit	% Catch limit	Catch (tonnes)	% TOT	Catch limit	% Catch limit	Catch (tonnes)	% TOT	Catch limit
48.3	3382	110	3.3	196	56.1	22	0.7	196	11.2	33	1	-
48.4 Northern Area	59	12	20.2	12	100.0	1	1.7	4	25.0	0	0.7	-
48.4 Southern Area	74	14	19	na	-	1	0.9	na	-	1	1.2	-
48.6	282	5	1.6	64	7.8	0	0	100	0.0	2	0.6	140
58.4.1	222	8	3.4	33	24.2	0	0	50	0.0	0	0.2	60
58.4.2	66	1	2.1	20	5.0	0	0	50	0.0	0	0.2	60
58.4.3a	31	2	5	26	7.7	2	6	50	4.0	2	8	20
58.4.3b	104	4	3.5	80	5.0	1	1.4	50	2.0	0	0.4	80
58.5.1 French EEZ*	3108	473	15.2	na	-	273	8.8	na	-	19	0.6	na
58.5.2***	1159	110	9.5	360	30.6	15	1.3	120	12.5	9	0.7	50
58.6 French EEZ**	746	170	22.8	na	-	42	5.6	na	-	75	10	na
58 South African EEZ	2	0	6.8	na	-	0	0	na	-	0	1.5	na
88.1	2448	183	7.5	430	42.6	7	0.3	135	5.2	16	0.6	160
88.2	484	58	12.1	90	64.4	0	0	50	0.0	14	2.9	100

* Data to 9 August 2009
** Data to 10 July 2009
*** Longline only, does not include trawl data.

Table 14: Numbers of rajids retained, discarded and released as reported in fine-scale (C2) data in (a) the 2007/08 season and (b) the 2008/09 season and calculated total numbers of rajids hauled on lines; and numbers of rajiids tagged and recaptured as reported in scientific observer data submitted to CCAMLR in (a) the 2007/08 season and (b) the 2008/09 season, and calculated tag rates across subareas.

(a)

Subarea/division	Retained (n)	Discarded (n)	Released (n)	Tagged (n)	Total hauled (n)	Tag rate	Tags recaptured (n)
48.3	12	1 586	19 558	885	21 156	0.04	29
48.4 Northern Area	0	724	8 276	112	9 000	0.01	0
48.6	0	0	0	0	0	0.00	0
58 South African EEZ	0	0	0	0	0	0.00	0
58.4.1	11	0	0	0	11	0.00	0
58.4.2	74	0	0	0	74	0.00	0
58.4.3a	332	0	0	0	332	0.00	0
58.4.3b	151	1	157	0	309	0.00	0
58.5.1	65 133	18 829	3 593	0	87 555	0.00	0
58.5.2	1 903	0	6 125	1 115*	8 028	0.13	0
58.6 French EEZ	1 186	11 422	11 397	0	24 005	0.00	0
88.1	416	15	7 190	1 301	7 621	0.17	36
88.2	0	0	0	0	0	0.00	0

* Tags released as part of a national tagging program, not reported in scientific observer data submitted to CCAMLR.

(continued)

Table 14 (continued)

(b)

Subarea/division	Retained (n)	Discarded (n)	Released (n)	Tagged (n)	Total hauled (n)	Tag rate	Tags recaptured (n)
48.3	108	2 869	23 709	1 596	26 686	0.06	32
48.4 Northern Area	0	188	6 501	254	6 689	0.04	0
48.4 Southern Area	0	120	3 266	0	3 386	0.00	0
48.6	1	0	0	6	1	0.00	0
58 South African EEZ	0	0	0	0	0	0.00	0
58.4.1	1	0	0	0	1	0.00	0
58.4.2	0	0	0	0	0	0.00	0
58.4.3a	0	586	57	34	643	0.05	0
58.4.3b	4	400	102	5	506	0.01	0
58.5.1	43 939	13 562	2 729	0	60 230	0.00	0
58.5.2	1 824	0	8 204	858*	10 028	0.09	6
58.6 French EEZ	2 128	14 600	16 843	0	33 571	0.00	0
88.1	864	46	7 088	1 907	7 998	0.24	23
88.2	10	4	265	99	279	0.35	0

* Tags released as part of a national tagging program, not reported in scientific observer data submitted to CCAMLR.

Table 15: Individual vessels' rajid tagging rates calculated from total numbers of rajids tagged (source: scientific observer data submitted to CCAMLR) and total numbers of rajids caught (source: fine-scale (C2) data) for vessels in new and exploratory fisheries during the 2008/09 season.

Subarea/division	Nationality	Vessel	Total caught*	Total tagged	Tagging rate
48.6	JPN	*Shinsei Maru No. 3*	0	0	na
	KOR	*Insung No. 22*	7	6	0.86
58.4.1	KOR	*Insung No. 1*	0	0	na
	KOR	*Insung No. 22*	0	0	na
	URY	*Banzare*	0	0	na
58.4.2	JPN	*Shinsei Maru No. 3*	0	0	na
	KOR	*Insung No. 22*	0	0	na
58.4.3a	JPN	*Shinsei Maru No. 3*	646	34	0.05
58.4.3b	JPN	*Shinsei Maru No. 3*	16	5	0.31
	URY	*Banzare*	489	0	0
88.1	CHL	*Isla Eden*	440	38	0.09
	KOR	*Hong Jin No. 707*	153	32	0.21
	KOR	*Insung No. 1*	201	16	0.08
	KOR	*Jung Woo No. 2*	90	24	0.27
	KOR	*Jung Woo No. 3*	18	0	0
	NZL	*Antarctic Chieftain*	1327	261	0.2
	NZL	*Janas*	2569	505	(>500 fish)
	NZL	*San Aotea II*	1339	376	0.28
	NZL	*San Aspiring*	1016	262	0.26
	ESP	*Tronio*	7	6	0.86
	GBR	*Argos Froyanes*	764	350	0.46
	GBR	*Argos Helena*	35	21	0.6
	URY	*Ross Star*	115	16	0.14
88.2	CHL	*Isla Eden*	0	0	na
	KOR	*Hong Jin No. 707*	0	0	na
	NZL	*Antarctic Chieftain*	2	1	0.5
	NZL	*Janas*	35	11	0.31
	ZAF	*Ross Mar*	0	0	na
	ESP	*Tronio*	0	0	na
	GBR	*Argos Froyanes*	110	55	0.5
	GBR	*Argos Georgia*	0	0	na
	GBR	*Argos Helena*	81	25	0.31
	URY	*Ross Star*	44	7	0.16

* Total caught includes those fish tagged and released.

Table 16: Fate of rajid by-catch caught during scientific observation periods as reported in scientific observer data (L5) reported to CCAMLR for the 2008/09 season, given in (a) numbers and (b) as a percentage of all rajids observed.

(a)

Subarea/division	Discarded dead	Released in good health	Released in average health	Released in poor health	Released, condition unknown	Released, but predated on	Retained without tags	Retained with tags	Released with tags	Total caught not released with tags	Total caught
48.3	318	1554	1887	243	2032	196	43	9	1596	6282	7878
48.4	29	2241	672	187	720	18	21	-	254	3888	4142
48.6	-	4	-	-	-	-	-	-	6	4	10
58.4.3a	95	30	-	-	-	-	-	-	34	125	159
58.4.3b	3	8	76	-	-	-	-	-	5	87	92
58.5.2	629**	538	150	90	1773	2	1343	1	*	4526	4526
88.1	97	4214	1278	308	90	14	933	22	1907	6956	8863
88.2	-	102	10	-	14	-	12	-	99	138	237

* Tagging not reported to CCAMLR in L5 forms.
** This figure is likely to include large numbers of skates, incorrectly coded by observers, that were actually retained without tags. Australia has undertaken to resubmit the observer data for rajid by-catch used to generate this table.

(b)

Subarea/division	Discarded dead	Released in good health	Released in average health	Released in poor health	Released, condition unknown	Released, but predated on	Retained without tags	Retained with tags
48.3	4.0	19.7	24.0	3.1	25.8	2.5	0.5	0.1
48.4	0.7	54.1	16.2	4.5	17.4	0.4	0.5	0.0
48.6	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0
58.4.3a	59.7	18.9	0.0	0.0	0.0	0.0	0.0	0.0
58.4.3b	3.3	8.7	82.6	0.0	0.0	0.0	0.0	0.0
58.5.2	13.9**	11.9	3.3	2.0	39.2	0.0	29.7	0.0
88.1	1.1	47.5	14.4	3.5	1.0	0.2	10.5	0.2
88.2	0.0	43.0	4.2	0.0	5.9	0.0	5.1	0.0
Average	10.3	30.5	18.1	1.6	11.2	0.4	5.8	0.0

** This figure is likely to include large numbers of skates, incorrectly coded by observers, that were actually retained without tags. Australia has undertaken to resubmit the observer data for rajid by-catch used to generate this table.

Table 17: Evaluation report card of assessments of bottom fishing activities submitted under the pro forma in Conservation Measure 22-06, Annex A. NA – unknown, NR – information not provided, L – minimal detail or summary information, M – some detailed information provided, some discussion, H – detailed data provided, detailed discussion of potential impacts, - – no, + – yes.

Member/gear	Argentina	Japan	Korea, Republic of	New Zealand	Russia	South Africa	Spain	UK	Uruguay	Total
Number of vessels	1	1	6	4	3	2	1	3	2	23
Number of subareas/divisions	2	5	7	4	3	2	4	2	5	
Notifications (vessel × fishery)	2	5	28	13	5*	2	4	6	5	70
Assessment submitted	+	+	-	+	-	+	+	+	+	7/9
1.1 Scope										
1.2 Proposed fishing activity										
1.2.1 Detailed description of gear	M	M		H		M	M	L	M	
1.2.2 Scale of proposed activity (number of sets)	170	400		500		NA	110	471	NA	
1.2.3 Spatial distribution of activity	L	L		L		L	L	L	L	
1.3 Mitigation measures to be used	+	+		+		+	+	+	+	
Effectiveness	NA	NA		NA		NA	NA	NA	NA	
2.1 Assessment of known/ anticipated impacts on VMEs	L	M		H		NR	NA	M	L	
2.1.1 Estimated spatial effort footprint *Please provide details of % area covered by fishing effort.*	1.2 km^2	NR		NA		<20%	0.37%	0.0035%	NA	
2.1.2 Summary of potential VMEs present within areas of activity	L	L		H		NR	M	H	NR	
2.1.3 Probability of impacts	L	L		H		L	M	H	NR	
2.1.4 Magnitude/severity of the interaction of the proposed fishing gear with VMEs	L	L		H		L	H	M	NR	
2.1.5 Physical and biological/ecological consequences of impact	L	L		H		L	H	L	NR	
2.2 Estimated cumulative footprint	NR	L		0.0088%		NR	NR	0.12%	NR	
2.3 Research activities related to provision of new information on VMEs										
2.3.1 Previous research	L	L		H		L	M	M	NR	
2.3.2 In-season research	L	L		L		L	M	M	L	
2.3.3 Follow-on research	L	L		H		L	M	L	NR	
Cumulative assessment quality	L	L		H		L	M	M	L	

* Includes Subarea 48.2 but not Subarea 48.4.

Table 18(a): Total historical fishing effort for all bottom longline methods, within subareas/divisions with new and exploratory fisheries, and proposed additional effort by new and exploratory fisheries. tbd – to be determined; na – not applicable.

Fishing method	Historical fishing effort, by subarea/division							
	48.2	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
Autoliner	0	1 840 214	226 240	1 325 478	237 800	2 647 200	56 000 000	10 000 000
Not reported	0	0	0	0	0	0	221 100	0
Spanish longline	23 749	4 377 160	22 000 000	6 594 434	7 062 076	10 000 000	36 000 000	3 591 511
Trotline	0	1 233 000	923 115	185 400	902 371	1 470 557	355 800	0
Total length (m)	23 749	7 450 374	23 149 355	8 105 312	8 202 247	14 117 757	92 221 100	13 591 511
Historical non-fishery or IUU effort	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
	New and exploratory fishery notifications							
Number of vessels	1	5	11	9	3	6	18	17
Number of Members	1	3	5	5	2	4	7	7
Proposed line length for upcoming season	na	na	na	na	na	na	na	na
Estimated total (incl. upcoming season)	na	na	na	na	na	na	na	na

Table 18(b): Estimated cumulative historical footprint for all bottom longline methods combined, as a proportion of total fishable area, within subareas for exploratory fisheries.

Total cumulative line length (m) – (from Table 18(a))	23 749	7 450 374	23 149 355	8 105 312	8 202 247	14 117 757	92 221 100	13 591 511
Total fishable area (km^2) 600–1 800 m	na	84 116	210 314	115 258	18 605	130 678	238 148	31 285
Line per fishable area (m/km^2)	na	88.5726	109.128	70.3232	440.863	108.197	389.37	437.326
% footprint per area (1 m width)	na	0.00886	0.01091	0.00703	0.04409	0.01082	0.03894	0.04373
% footprint per area (25 m width)	na	0.22143	0.27282	0.17581	1.10216	0.27049	0.97343	1.09332

Table 19:   Guidelines for the preparation of Members' Bottom Fishing Gear Assessments.

(i)	A detailed description of the physical fishing gear and its deployment process (as in WG-FSA-05/54) with relevant diagrams and a detailed breakdown of the different functional components of the gear – including weight, size, material properties (e.g. breaking strain), sink rates in water etc. – so that impact estimates can be derived separately for each gear component if necessary. If possible and appropriate, this description can cross-reference gear descriptions to be included in the developing CCAMLR gear library.
(ii)	A detailed description of the fishing process and the known or expected behaviour of the gear with emphasis on the extent and nature of contact between fishing gear and the sea floor, including gear movement during the setting, soaking and hauling process.
(iii)	A numerical estimate of the fishing activity 'footprint' (in m^2) – i.e. the maximum spatial extent within which contact with the ocean floor can occur – per unit of fishing effort. Effort should be reported in units used in the relevant Bottom Fishing Gear Assessment. An explicit discussion of uncertainty regarding the assumptions used in estimating the standard gear footprint is an essential component to be included in the discussion.
(iv)	A description of non-standard gear deployment scenarios (e.g. line breakage, gear loss) that can be expected to change the footprint size or impact level associated with fishing activity, with numerical estimates of their frequencies of occurrence and associated spatial extent as in (iii) above.
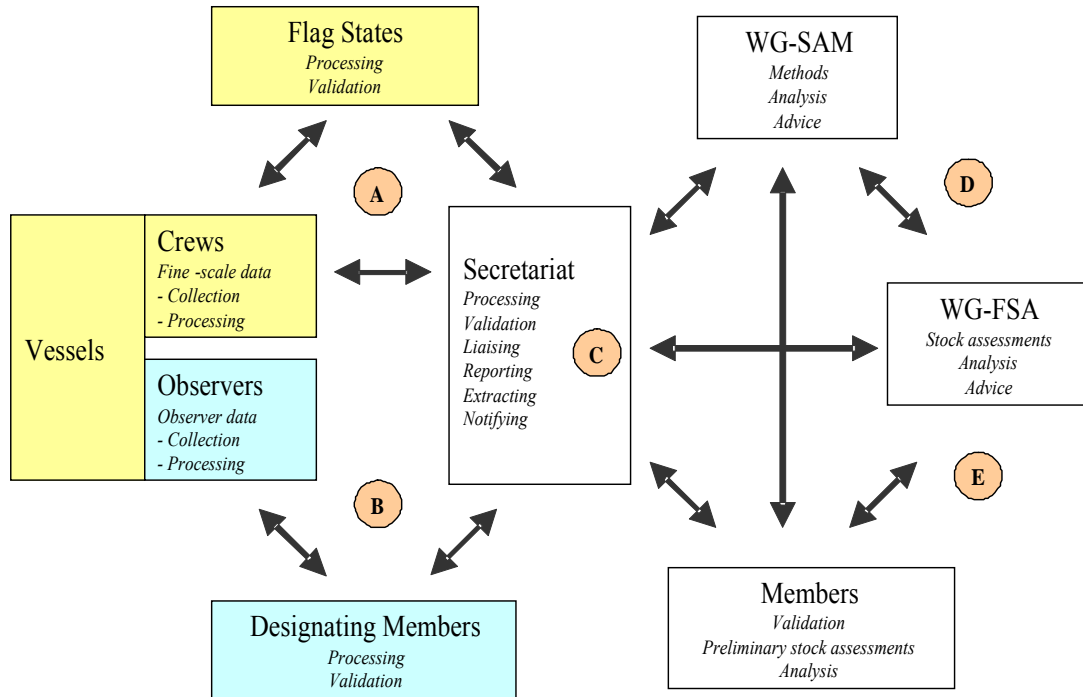
Figure 1:   Workflow associated with fishery fine-scale data and scientific observer data, from collection on board the vessels to input to stock assessments, with potential pressure points A–E. A: fine-scale data are submitted to the Secretariat either from the vessel or via the Flag State (submission deadline: end of the month following the month of data collection). B: scientific observer data are submitted to the Secretariat via the Designating Members' technical coordinators (submission deadline: within one month of the observer returning to their home port). C: Data are usually processed within 2–3 weeks of receipt, validation is usually done within 2–4 months of processing. D: WG-SAM usually meets 2–3 months prior to WG-FSA. E: The deadline for the submission of meeting documents, including preliminary assessments, is two weeks prior to the meeting.
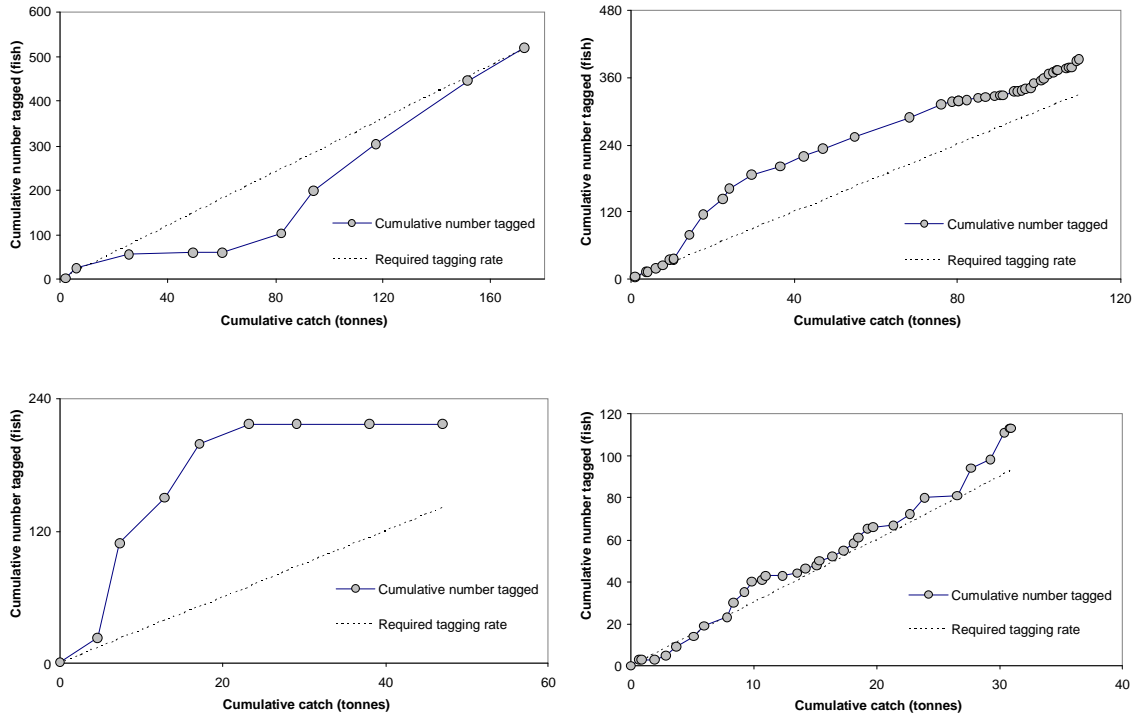
Figure 2:   Cumulative ca tch of *Dissostichus* sp p. versus c umulative number of *Dissostichus* s pp. tagged f or selected vessels engaged in the exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 (top) and 58.4 (bottom) i n 2008/09. Left -hand panels a re e xamples of ves sels t agging at variable rates throughout t he fi shing peri od wi th ri ght-hand panels sh owing exam ples whe re t agging eff ort was more constant (source: catch – C2 data; number tagged – observer data).
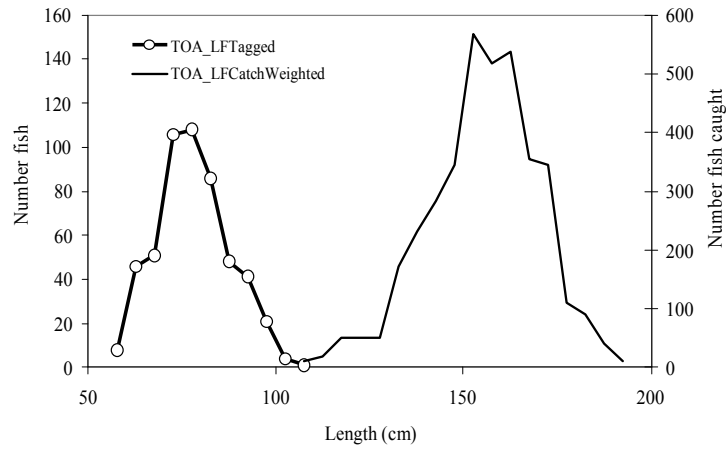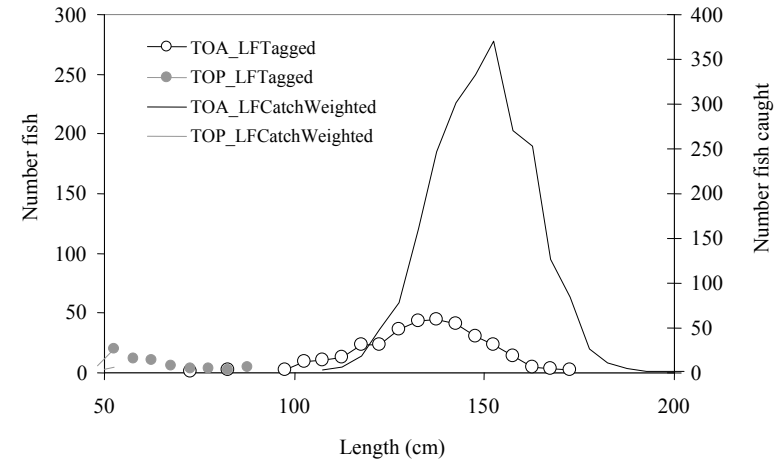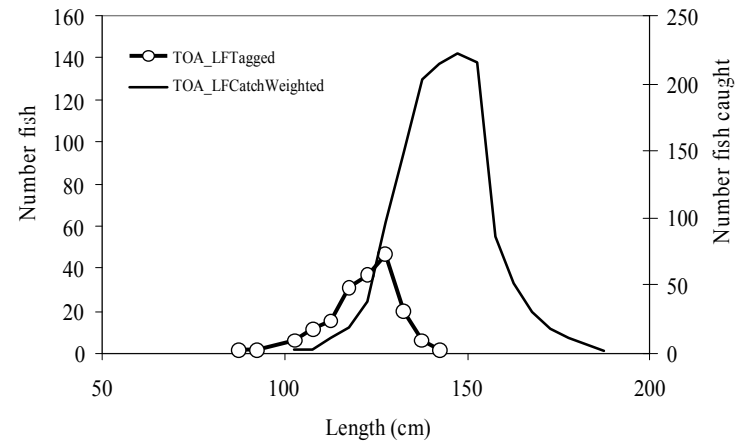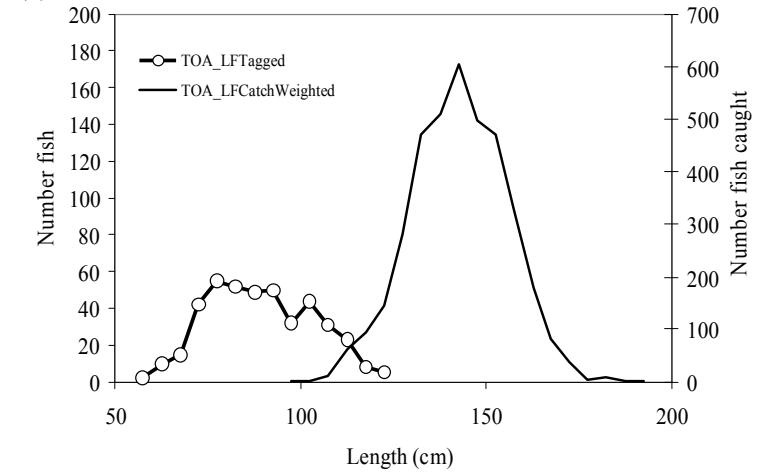
Figure 3: Plots of distributions of the length frequency of catch and length frequency of fish tagged for selected vessels fishing in areas where overlap data metrics were (a) Low, (b) High, (c) Medium and (d) Low respectively (see paragraph 5.13 and Table 11).
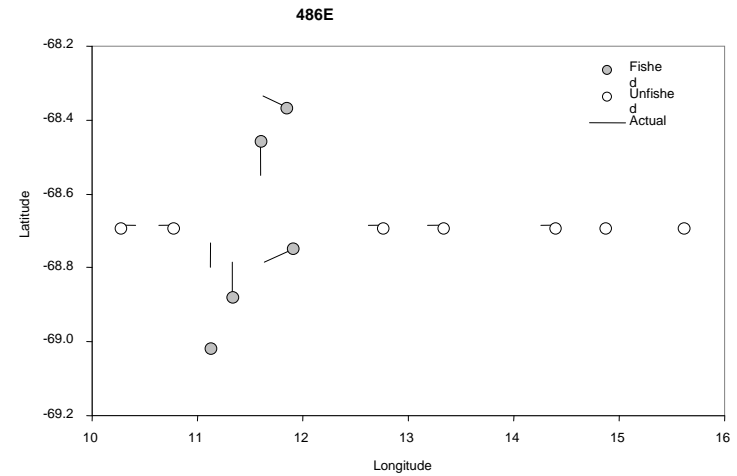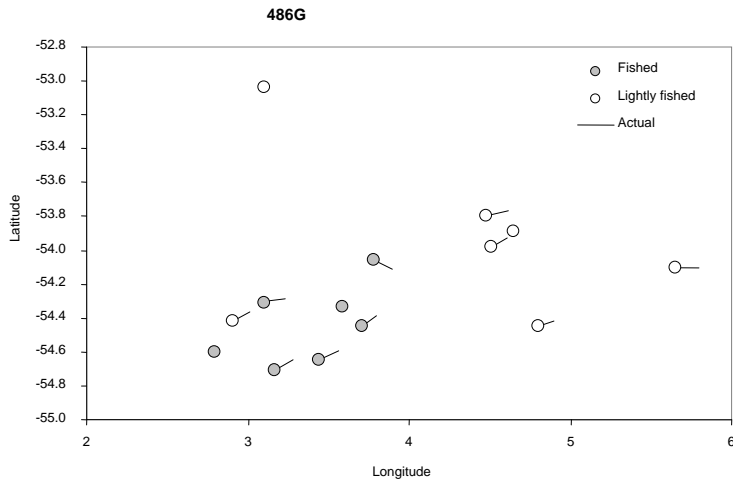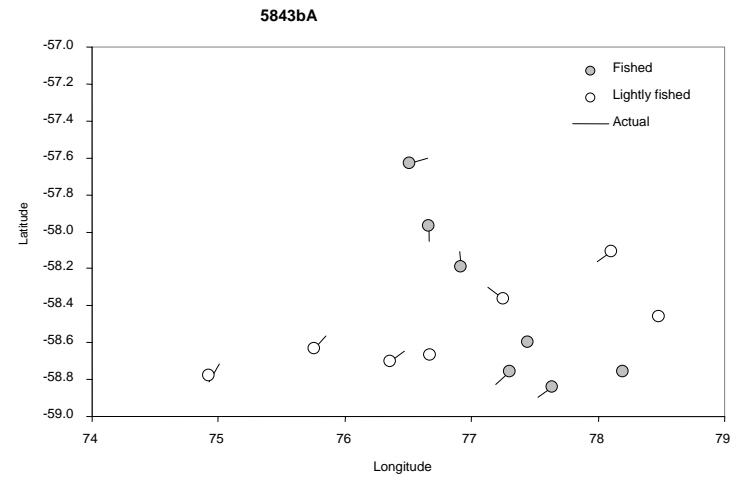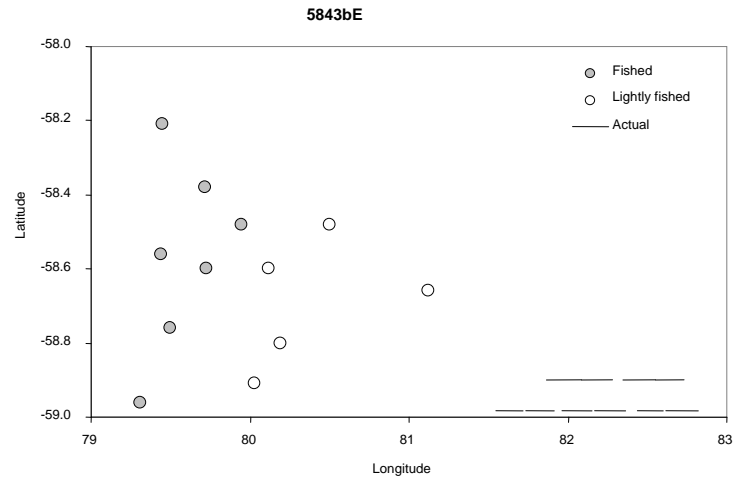
Figure 4:   Plots of start positions of research hauls allocated in each stratum (fished, lightly fished, unfished) and the position of research hauls deployed (actual) by selected vessels in Division 58.4.3 (top panels) and Subarea 48.6 (bottom) illustrating the variability in the level of consistency with designation of research hauls. Figures from WG-SAM-09/6.

Scenario 1 – Regular movement, Division 58.4.3b main spawning area

Indian Ocean Sector, Coastal Antarctica → spawners → 58.4.3b

eggs and larvae
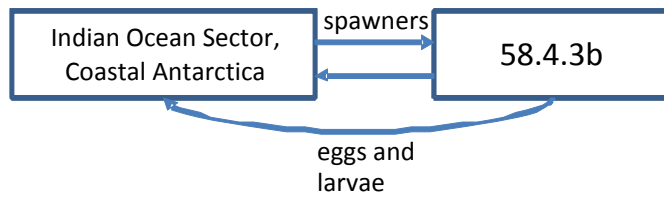
Scenario 2 – Sporadic movement, Division 58.4.3b main spawning area

Indian Ocean Sector, Coastal Antarctica → spawners → 58.4.3b

eggs and larvae
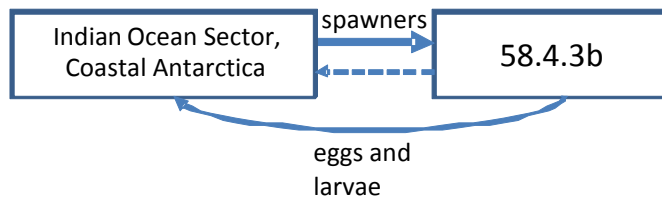
Scenario 3 – Regular movement, only large fish move to Division 58.4.3b

eggs and larvae

Indian Ocean Sector, Coastal Antarctica → large fish → 58.4.3b

eggs and larvae
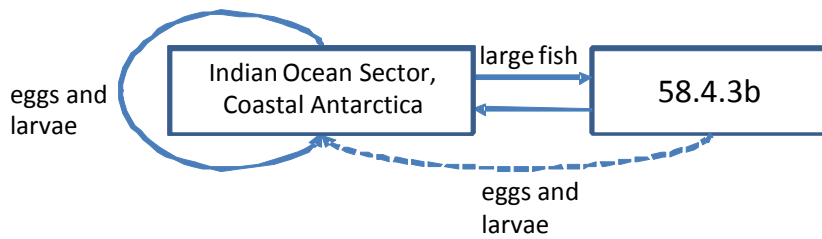
Figure 5: Diagram illustrating possible scenarios for the *Dissostichus mawsoni* stock on BANZARE Bank (Division 58.4.3b). Solid arrows indicate regular movements of fish, dashed arrows indicate sporadic movement of fish.
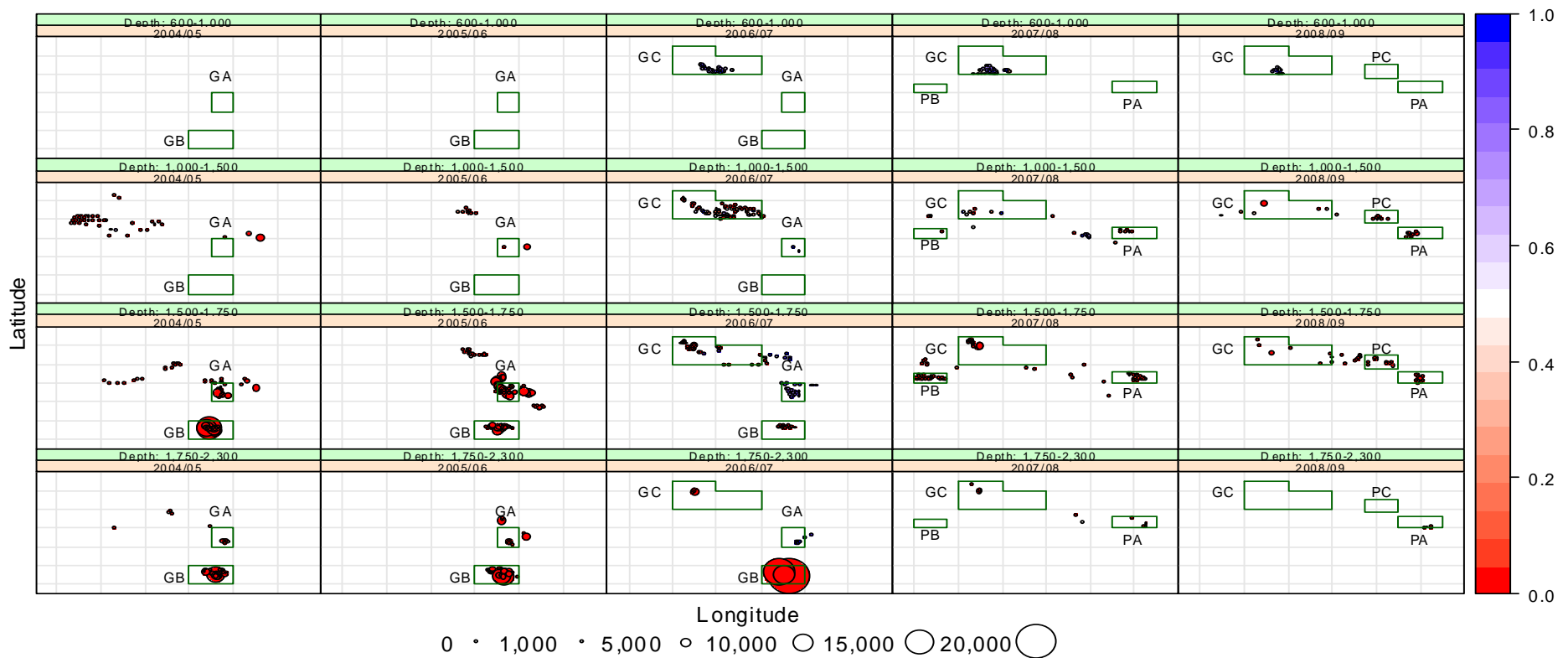
Figure 6*: Bubbleplot showing total toothfish removals (kg) proportional to symbol size for individual longlines fished in BANZARE Bank, showing different panels for season and depth fished. Colour on a red-blue gradient represents *Dissostichus eleginoides* catch as a proportion of total catch (i.e. blue = *Dissostichus eleginoides*, red = *Dissostichus mawsoni*). Also shown are Grounds A–C defined in McKinlay et al. (2008) and Patches A–C defined in WG-FSA-09/44, and the seasons in which they were analysed.

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* This figure is available in colour on the CCAMLR website.
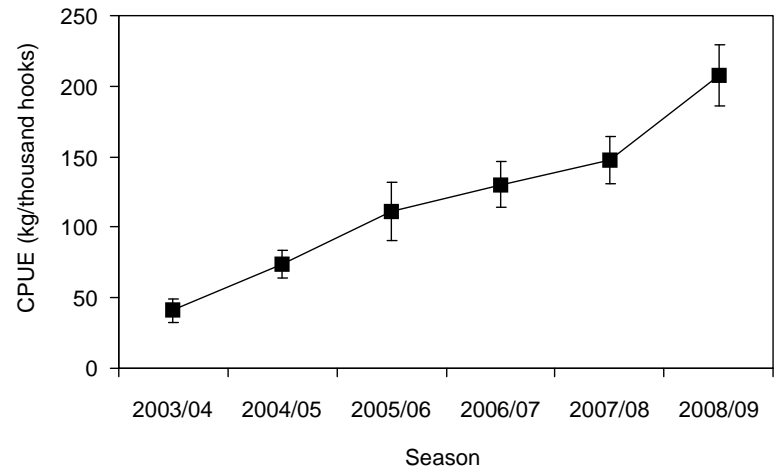
Figure 7: Unstandardised CPUE (kg/thousand hooks) of *Dissostichus* spp. in the exploratory longline fishery in Division 58.4.3b (source: fine-scale catch and effort data). Error bars: 95% confidence limits.
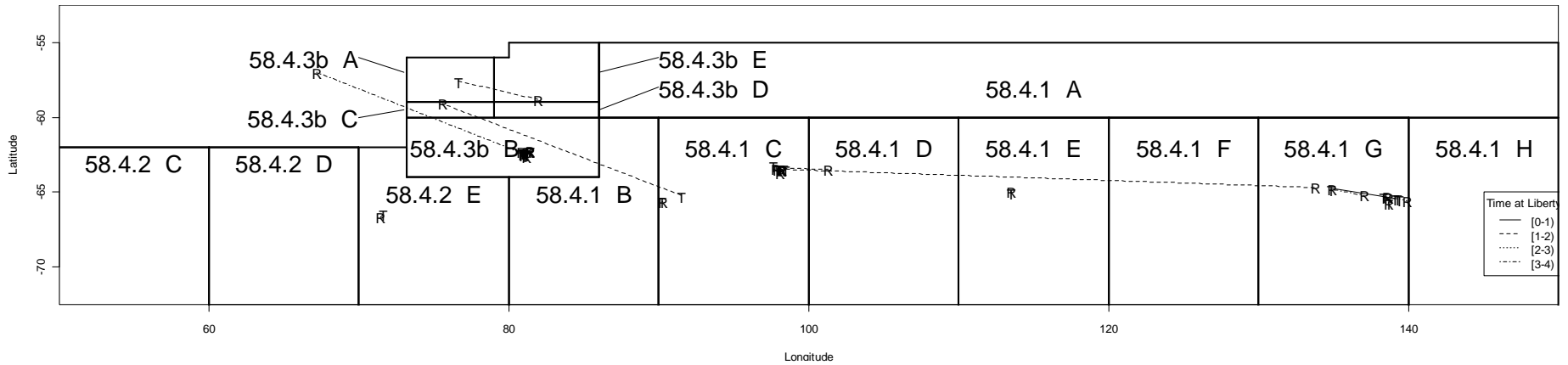
Figure 8: Plot of tag recaptures in Divisions 58.4.1, 58.4.2 and 58.4.3b recorded between 2003/04 and 2008/09. 'T' indicates the release location and 'R' indicates the recapture location.
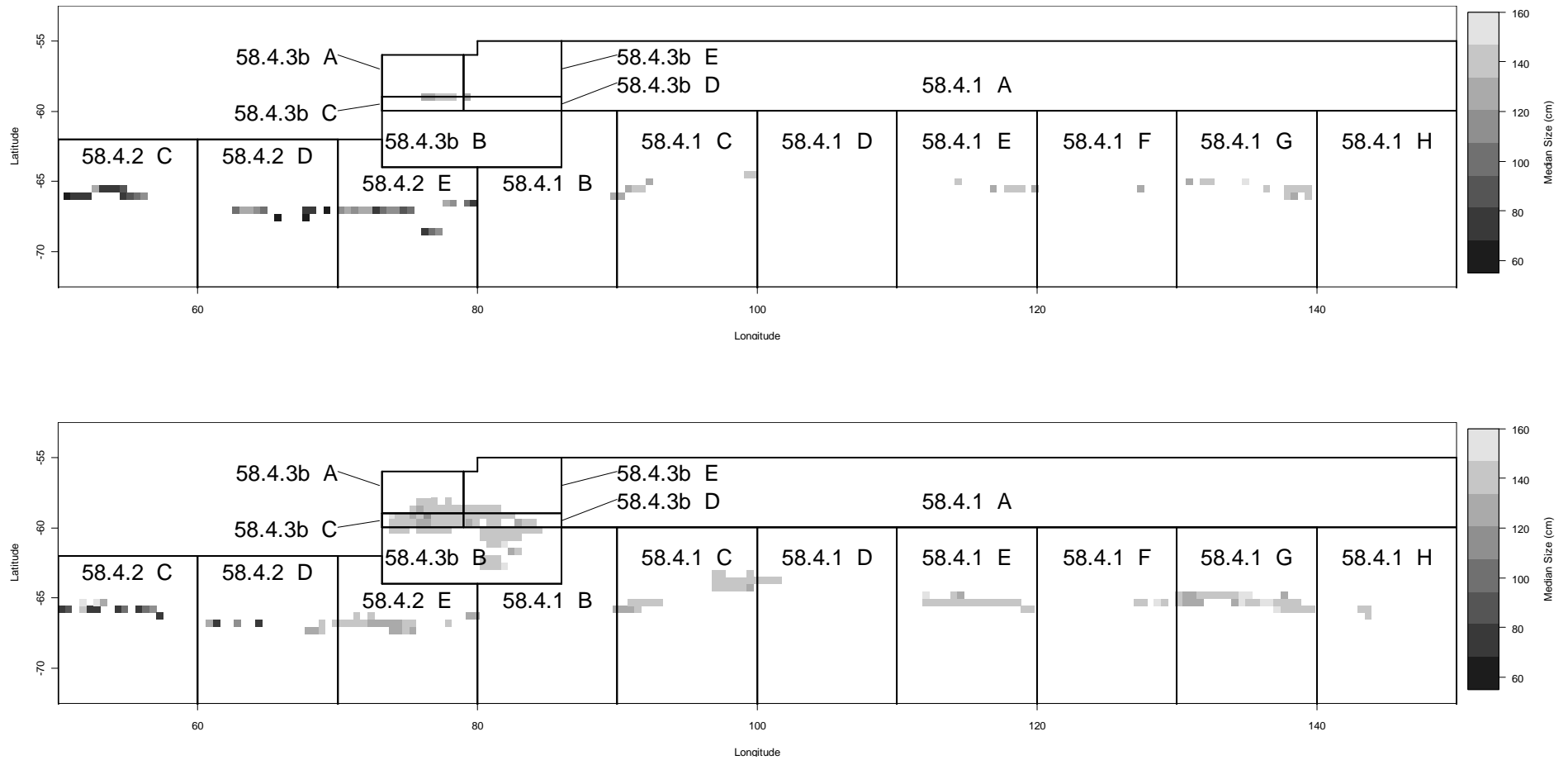
Figure 9: Plot of median lengths for longlines sampled in Divisions 58.4.1, 58.4.2 and 58.4.3b between 2003/04 and 2008/09, aggregated into 0.5° latitude × 0.5° longitude boxes. The upper panel shows data for fishing in depths shallower than 1 000 m, the lower panel for fishing in depths deeper than 1 000 m. Note darker squares indicate smaller median length; lighter squares indicate larger median length.
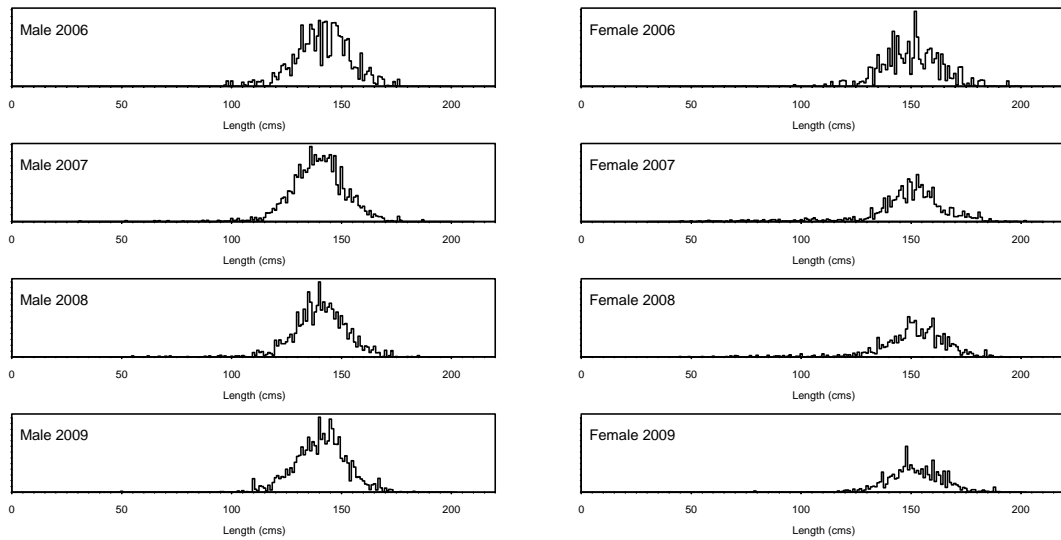
Figure 10: Scaled length frequency of male and female *Dissostichus mawsoni* in the north fishery of the Ross Sea (WG-FSA-09/36), for the years 2006–2009.
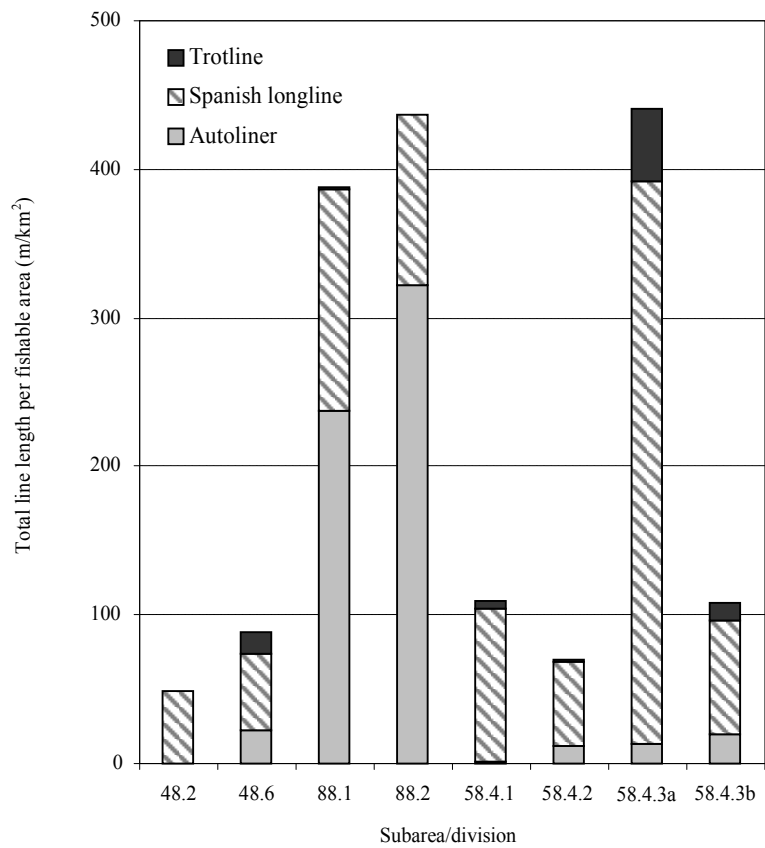
Figure 11: Cumulative to tal lin e len gth p er k m² of fishable are a in each subarea/division, summed by recorded longline gear type.
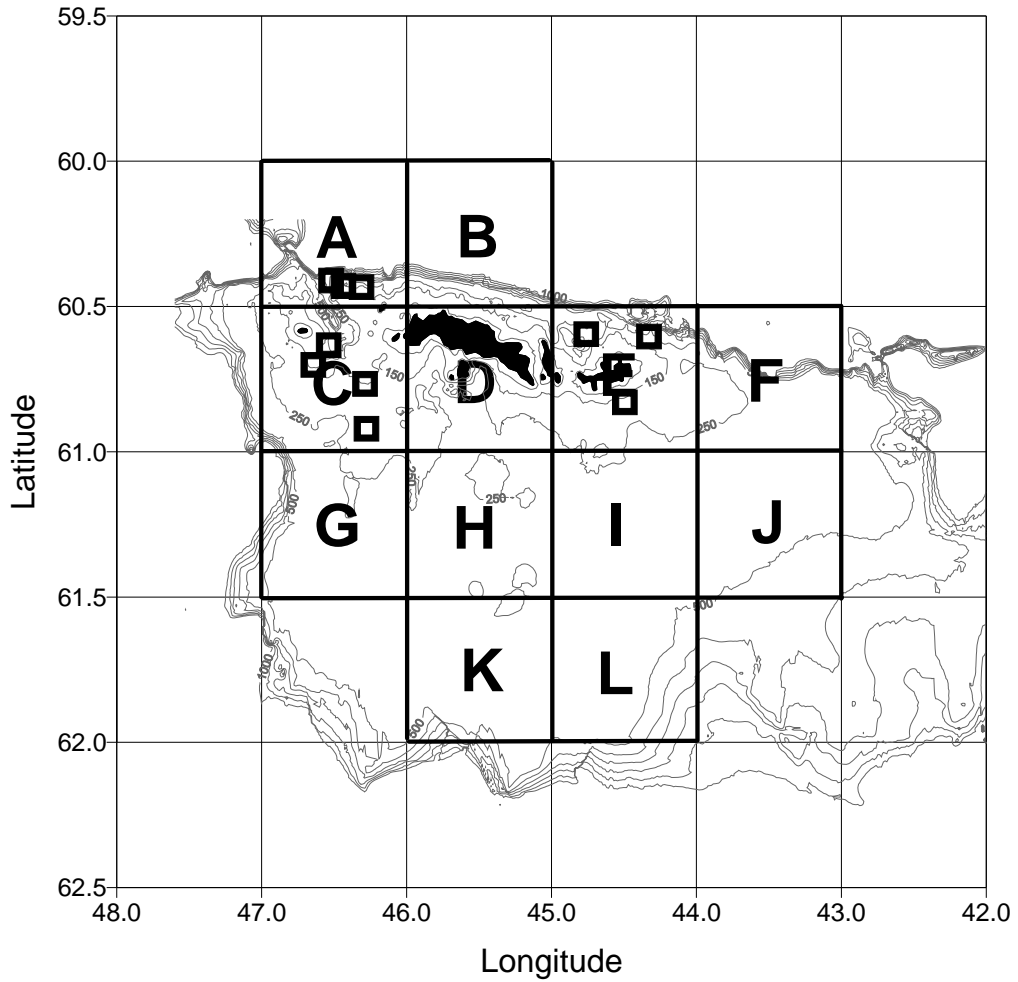
Figure 12:   Operational area of phase I of the expe   rimental harvest regim e for the crab fis   hery in
Subarea 4 8.2 (C onservation M easure   52-02,   Annex B)   with V MEs n otified u nder
Conservation Measure 22-06 (see WG-EMM-09/32) indicated by squares.
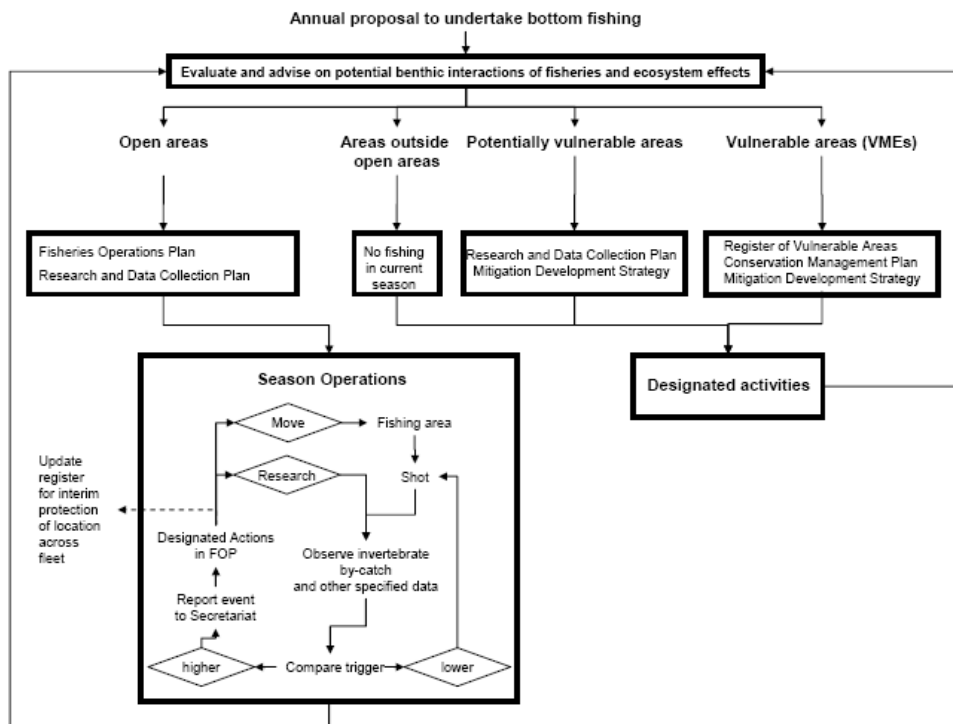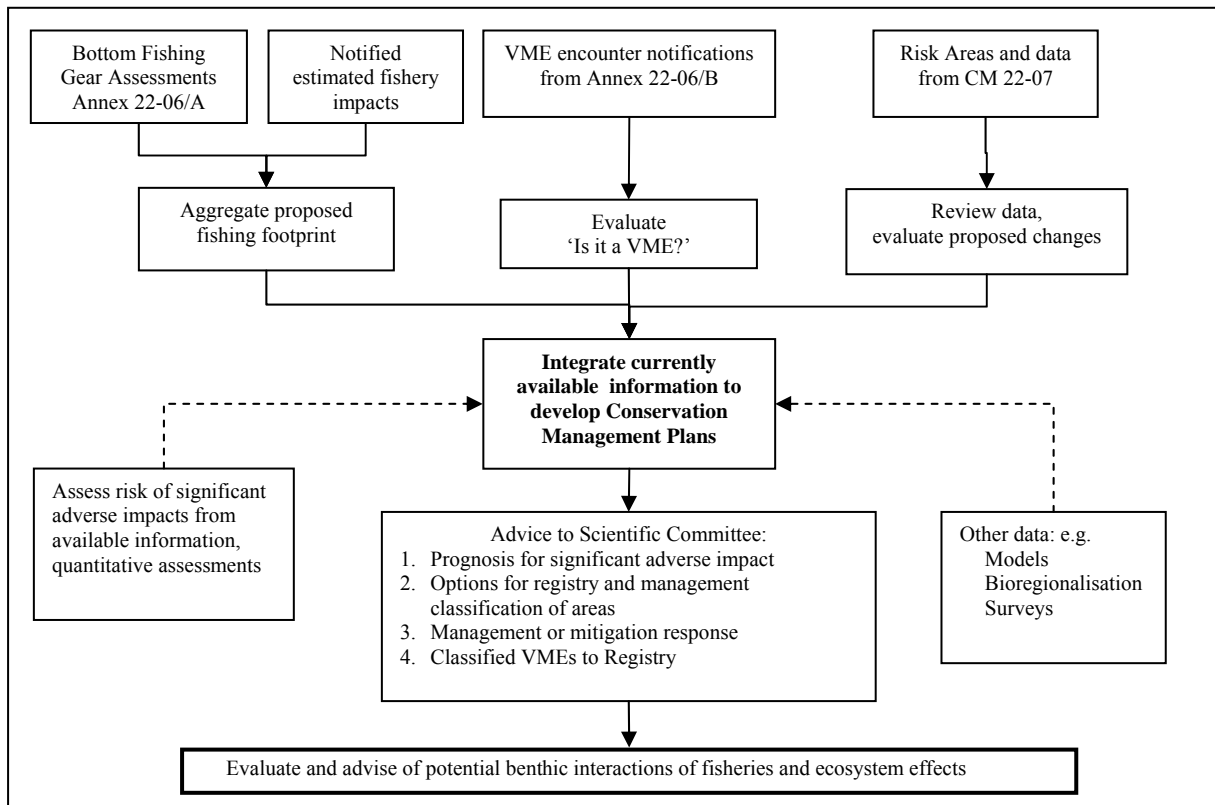
Figure 13: Proposed framework for managing flow and review of information resulting from implementation of Conservation Measures 22-06 and 22-07 (top panel) leading to the evaluation and advice on potential benthic interactions of fisheries and ecosystem effects (from SC-CAMLR-XXVII, Figure 1, bottom panel).

1. General information
Include contact information, nationality, vessel name(s) and dates of data collection.
Preferably, the notification should be prepared as a proposal, using these guidelines and submitted as a meeting document to WG-EMM for review.
2. VME location
Start and end positions of all gear deployments and/or observations.
Maps of sampling locations, underlying bathymetry or habitat and spatial scale of sampling.
Dept   h(s) sampled.
3. Sampling gear
Indicate sampling gears used at each location.
4. Additional data collected
Indicate additional data collected at or near the locations sampled.
Data such as multibeam bathymetry, oceanographic data such as CTD profiles, current profiles, water chemistry, substrate types recorded at or near those locations, other fauna observed, video recordings, acoustic profiles etc.
5. Supporting evidence
Provide supporting evidence, rationale, analysis, and justification to classify the indicated areas as vulnerable marine ecosystems.
6. VME taxa
For each station sampled, provide details of all the VME taxa observed, including their relative density, absolute density, or number of organisms if possible.

Figure 14: Proposed guidelines for preparation and submission of notifications of encounters with VMEs under Conservation Measure 22-06.

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AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 12 to 23 October 2009)

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 2008
           3.1.1   Development of the CCAMLR database
           3.1.2   Data processing
           3.1.3   Fishery plans

     3.2   Fisheries information
           3.2.1   Catch and effort data reported to CCAMLR
           3.2.2   Estimates of catch and effort from IUU fishing
           3.2.3   Catch and effort data for toothfish fisheries in waters adjacent to the
                   Convention Area
           3.2.4   Scientific observer information

     3.3   Inputs for stock assessment
           3.3.1   Catch-at-length/age from fisheries
           3.3.2   Research surveys
           3.3.3   CPUE analyses
           3.3.4   Tagging studies
           3.3.5   Biological parameters
           3.3.6   Stock structure and management areas
           3.3.7   Depredation

4.   Preparation for assessments and assessment timetable

     4.1   Report from the Subgroup on Acoustic Survey and Analysis Methods
           (SG-ASAM)
     4.2   Report from the Working Group on Statistics, Assessments, and Modelling
           (WG-SAM)
     4.3   Review of preliminary stock assessment papers
     4.4   Assessments to be carried out and assessment timetable

5. Assessments and management advice

   5.1 New and exploratory fisheries
       5.1.1 New and exploratory fisheries in 2008/09
       5.1.2 New and exploratory fisheries notified for 2009/10
       5.1.3 Progress towards assessments of exploratory fisheries
       5.1.4 Update Fishery Report for Subarea 48.6
       5.1.5 Update Fishery Reports for Divisions in Subarea 58.4
       5.1.6 Update Fishery Report for Subareas 88.1 and 88.2
       5.1.7 Research plan for *Dissostichus* spp. Ob and Lena Banks
             (Division 58.4.4)

   5.2 Development of methods to assess exploratory fisheries
       5.2.1 Data requirements for assessing exploratory fisheries
       5.2.2 Research designs in exploratory toothfish fisheries

   5.3 Update Fishery Reports for the following assessed fisheries
       5.3.1 *Dissostichus eleginoides* South Georgia (Subarea 48.3)
       5.3.2 *Dissostichus* spp. South Sandwich Islands (Subarea 48.4)
       5.3.3 *Dissostichus eleginoides* Kerguelen Islands (Division 58.5.1)
       5.3.4 *Dissostichus eleginoides* Heard Island (Division 58.5.2)
       5.3.5 *Dissostichus eleginoides* Crozet Islands (Subarea 58.6)
       5.3.6 *Dissostichus eleginoides* Prince Edward and Marion Islands
             (Subareas 58.6 and 58.7)
       5.3.7 *Champsocephalus gunnari* South Georgia (Subarea 48.3)
       5.3.8 *Champsocephalus gunnari* Heard Island (Division 58.5.2)

   5.4 Assessment and management advice for other fisheries
       5.4.1 Antarctic Peninsula (Subarea 48.1) and South Orkney Islands
             (Subarea 48.2)
       5.4.2 Crabs (*Paralomis spinosissima* and *P. formosa*) (Subareas 48.2, 48.3
             and 48.4)
       5.4.3 *Martialia hyadesi* (Subarea 48.3)

6. Fish and invertebrate by-catch

   6.1 Year-of-the-Skate activities
   6.2 Estimation of by-catch levels and rates
   6.3 Assessment of by-catch species
   6.4 Mitigation measures

7. Incidental mortality of mammals and seabirds associated with fishing
   (WG-IMAF Report)

8. Evaluation of the threats arising from IUU fishing activities

   8.1 Development of approaches for estimating total removals of toothfish
   8.2 Review of historical trends in IUU fishing activity

9. Biology, ecology and demography of target and by-catch species

   9.1 Review information available to the meeting
       9.1.1 Target species
       9.1.2 By-catch species

   9.2 Species profiles

   9.3 CCAMLR Otolith Network

10. Considerations of ecosystem management

    10.1 Bottom fishing activities and vulnerable marine ecosystems (VMEs)
         10.1.1 Risk assessments
         10.1.2 Review of fishery- and research-based notifications for 2008/09
         10.1.3 Review of conservation measures
         10.1.4 Advice to Scientific Committee

    10.2 Development of ecosystem models

         10.2.1 Report of the Second Workshop on Fisheries and Ecosystem Models (FEMA2)
         10.2.2 Other modelling approaches

    10.3 Depredation

    10.4 Other Interactions with WG-EMM

11. Scheme of International Scientific Observation

    11.1 Report from the ad hoc Technical Group for At-Sea Observations (TASO)

    11.2 Summary of information extracted from observer reports and/or provided by technical coordinators

    11.3 Implementation of the Scheme of International Scientific Observation
         11.3.1 *Scientific Observers Manual*
         11.3.2 Sampling strategies and priorities

12. Future assessments

    12.1 Generic and specific work for developing assessments
    12.2 Frequency of future assessments

13. Future work

    13.1 Organisation of intersessional activities in subgroups

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 12 to 23 October 2009)

WG-FSA-09/1	Provisional Agenda and Provisional Annotated Agenda for the 2009 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-09/2	List of participants
WG-FSA-09/3	List of documents
WG-FSA-09/4	CCAMLR fisheries: 2009 update Secretariat
WG-FSA-09/5 Rev. 1	Estimation of IUU catches of toothfish inside the Convention Area during the 2008/09 fishing season Secretariat
WG-FSA-09/6	Development of a registry of vulnerable marine ecosystems in the Convention Area Secretariat
WG-FSA-09/7	Climate change, longevity overfishing and precautious management of the Area 88 toothfish fishery D. Ainley (USA), M. Massaro, G. Ballard (New Zealand) and J.T. Eastman (USA)
WG-FSA-09/8	First experimental settings of deepwater vertical longlines in the Antarctic toothfish fishery *Dissostichus mawsoni* Norman, 1937 (Perciformes, Nototheniidae) in the Amundsen Sea N.V. Kokorin (Russia) and V.V. Serbin (Ukraine)
WG-FSA-09/9	Report of the UK groundfish survey at South Georgia (CCAMLR Subarea 48.3) in January 2009 M. Belchier, R.E. Mitchell, M.A. Collins, L. Kenny, M. Taylor, J. Nelson and L. Featherstone (United Kingdom)
WG-FSA-09/10	Book review: *In the seas of Antarctic Region and Southern Ocean* by V.L. Juhov Delegation of Ukraine

WG-FSA-09/11	Book review: *Whales of the Southern Hemisphere: biology, whaling, and perspectives of population recovery* by Y.A. Mikhalev Delegation of Ukraine
WG-FSA-09/12	Revised research plan for toothfish in Division 58.4.4a and b by *Shinsei Maru No. 3* in 2009/10 Delegation of Japan
WG-FSA-09/13	Information on spawning and fecundity of icefish *Chionobathyscus dewitti* V. Prutko and D. Chmilevsky (Russia) (*CCAMLR Science*, submitted)
WG-FSA-09/14 Rev. 1	Antarctic toothfish stock assessment in Division 58.4.1 on the basis of catch and CPUE data D. Vasilyev, K. Shust, A. Petrov, V. Tatarnikov and I. Istomin (Russia)
WG-FSA-09/15	Skate diet at South Georgia indicates benthic habit of krill C.E. Main and M.A. Collins (United Kingdom)
WG-FSA-09/16	Depredation around South Georgia and the implications on stock assessment of *D. eleginoides* J. Moir Clark, D.A. Agnew, P. McCarthy and M. Unwin (United Kingdom) (*CCAMLR Science*, submitted)
WG-FSA-09/17	Assessment of Patagonian toothfish population in the north of Subarea 48.4 using data from a four-year tagging experiment J. Roberts and D.J. Agnew (United Kingdom)
WG-FSA-09/18	Proposal for an extension to the mark–recapture experiment to estimate toothfish population size in the South of Subarea 48.4 J. Roberts and D.J. Agnew (United Kingdom)
WG-FSA-09/19	Standing stock, spatial distribution, and biological features of demersal finfish from the 2009 US AMLR bottom trawl survey of the South Orkney Islands (Subarea 48.2) C.D. Jones (USA) and K.-H. Kock (Germany)
WG-FSA-09/20	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-09/21	Otolith-based ageing of the Patagonian toothfish (*Dissostichus eleginoides*) for the Heard and McDonald Islands: modelling fixed and random reader error using multiple readings of a reference collection S.G. Candy, G.B. Nowara, D.C. Welsford and J.P. McKinlay (Australia)
WG-FSA-09/22 Rev. 1	Comparison of the precision of direct versus age–length key methods of estimating catch-at-age proportions S.G. Candy (Australia)
WG-FSA-09/23	Accuracy of benthic invertebrate by-catch identification by observers operating in the Heard Island and McDonald Islands Patagonian toothfish longline fishery T. Hibberd (Australia)
WG-FSA-09/24	Comparative characteristics of Patagonian (*Dissostichus eleginoides*) and Antarctic (*D. mawsoni* Norman) toothfish inhabiting different sectors of the Southern Ocean K.V. Shust, I.P. Zarikhin, I.G. Istomin, A.F. Petrov, V.A. Tatarnikov and N.S. Demina (Russia)
WG-FSA-09/25	Results of investigations on Antarctic toothfish (*D. mawsoni* Norman, 1937) (Perciformes, Nototheniidae) feeding in Subarea 48.6 SSRU E during the 2008/09 season A.F. Petrov and V.A. Tatarnikov (Russia)
WG-FSA-09/26	The histological analysis of oogenesis and maturity of Antarctic toothfish from the Ross Sea S.V. Piyanova and A.F. Petrov (Russia)
WG-FSA-09/27	Length-based assessment for mackerel icefish (*Champsocephalus gunnari*) in Subarea 48.3 R.M. Hillary (Australia), C.T.T. Edwards, R.E. Mitchel and D.J. Agnew (United Kingdom)
WG-FSA-09/28 Rev. 1	Preliminary assessment of toothfish in Subarea 48.3 D.J. Agnew and T. Peatman (United Kingdom)
WG-FSA-09/29	New fish species for Southern Ocean – *Lepidion schmidti* L. Pshenichnov (Ukraine)
WG-FSA-09/30	Distribution and biology on Antarctic king crab *Paralomis formosa* caught as by-catch in fishery for toothfish (*Dissostichus eleginoides*) on Patagonian continental slope Yu.V. Korzun (Ukraine)

WG-FSA-09/31	Observed recovery of *Notothenia rossii* and further decline of *Gobionotothen gibberifrons* in scientific catches at Potter Cove, South Shetland Islands E. Marschoff, E. Barrera-Oro, N. Alescio and E. Moreira (Argentina)
WG-FSA-09/32	Temporal clarification of the transition from blue phase fingerling to early juvenile brown phase in *Notothenia rossii* from the South Shetland Islands E. Barrera-Oro, E. Moreira, N. Alescio and E. Marschoff (Argentina)
WG-FSA-09/33	Preliminary assessment of mackerel icefish (*Champsocephalus gunnari*) in the vicinity of Heard Island and McDonald Islands (Division 58.5.2), based on a survey in April 2009, using the generalised yield model D.C. Welsford (Australia)
WG-FSA-09/34	Report on a random stratified trawl survey to estimate distribution and abundance of *Dissostichus eleginoides* and *Champsocephalus gunnari* in the Heard Island region (Division 58.5.2) for 2008 and 2009 G.B. Nowara (Australia)
WG-FSA-09/35	The selection of trips based on data metrics for the assessment of Antarctic toothfish in the Ross Sea D.A.J. Middleton (New Zealand)
WG-FSA-09/36	A characterisation of the toothfish fishery in Subareas 88.1 and 88.2 from 1997/98 to 2008/09 S.M. Hanchet, A. Dunn and S. Mormede (New Zealand)
WG-FSA-09/37	Length and age at spawning of Antarctic toothfish (*Dissostichus mawsoni)* in the Ross Sea S.J. Parker and P.J. Grimes (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-09/38	Developing a 'best available science' bathymetric data framework for fisheries management in the Ross Sea S.J. Parker, S.M. Hanchet, B. Wood and A. Dunn (New Zealand)
WG-FSA-09/39	Descriptive analysis of the toothfish (*Dissostichus* spp.) tagging program in Subareas 88.1 and 88.2 for the years 2000/01 to 2008/09 A. Dunn, S.M. Hanchet and J. Devine (New Zealand)

WG-FSA-09/40 Rev. 1   Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea for the years 1997/98 to 2008/09
A. Dunn and S.M. Hanchet (New Zealand)

WG-FSA-09/41   Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.2 SSRU E for the years 2002/03 to 2008/09
A. Dunn and S.M. Hanchet (New Zealand)

WG-FSA-09/42   Further developments of a simulation model, 'Patch', for evaluating management strategies to conserve benthic habitats (vulnerable marine ecosystems) which are potentially vulnerable to impacts from bottom fisheries
A.J. Constable (Australia)

WG-FSA-09/43   Distribution and abundance of skates on the Kerguelen Plateau (CCAMLR Divisions 58.5.1 and 58.5.2)
G.B. Nowara, D.C. Welsford, T. Lamb (Australia), N. Gasco, P. Pruvost and G. Duhamel (France)

WG-FSA-09/44   Development of recovery plans for depleted toothfish stocks in the Indian Ocean sector of the Southern Ocean
D.C. Welsford, A.J. Constable and J.P. McKinlay (Australia)

WG-FSA-09/45   Conserving Antarctic from the bottom up: Implementation of UN General Assembly Resolution 61/105 by the Commission for the Conservation of the Antarctic Marine Living Resources (CCAMLR)
Secretariat

BIOLOGY, ECOLOGY AND DEMOGRAPHY
OF TARGET AND BY-CATCH SPECIES

The following papers contained information on the biology, ecology and demography of target and by-catch species in the fishery (WG-FSA-09/9, 09/10, 09/11, 09/13, 09/15, 09/18, 09/19, 09/21, 09/24, 09/25, 09/26, 09/27, 09/29, 09/32, 09/37, 09/43, 09/P1).

9.1 Review of information available to the meeting

9.1.1 Target species

9.1.1.1 *Champsocephalus gunnari* (mackerel icefish)

Diet of *C. gunnari* at South Georgia (CCAMLR Subarea 48.3) in January 2009 was dominated by the hyperiid *Themisto gaudichaudii* with very low levels of krill, usually the main prey item found (WG-FSA-09/9). This was likely to have been the result of the anomalous hydrographical conditions experienced around the island at that time.

9.1.1.2 *Dissostichus eleginoides* (Patagonian toothfish)

A two-stage approach of modelling ageing error using otolith readings for ageing *D. eleginoides* made efficient use of the data in that only half the number of combination of error class by readability by age are required compared to modelling Integer Error classes directly (WG-FSA-09/21). This approach differs from other studies of ageing error in that it takes into account the otolith readability score and the integer nature of ring count data. It demonstrated that ageing error decreases as readability improves.

9.1.1.3 *Dissostichus mawsoni* (Antarctic toothfish)

Two papers (WG-FSA-09/10 and 09/11) provided information primarily on whaling in the Southern Ocean which is outside the remit of CCAMLR. One of the papers (WG-FSA-09/10), however, provided some early findings on *D. mawsoni* and its role in the diet of sperm whales (*Physeter macrocephalus*), much of which was published in Yukhov (1982).

Information on the feeding of *D. mawsoni* in the eastern Lazarev Sea (Subarea 48.6) suggested that the icefish *Chionobathyscus dewitti* was a more important food item than in other parts of the Southern Ocean. This species, together with the grenadier *Macrourus whitsoni* and the Antarctic giant squid *Mesonychotheuthis hamiltoni*, formed the bulk of the diet (WG-FSA-09/25). The mass of stomach contents in males was larger than in females.

Histological analyses of *D. mawsoni* caught in December–February 2005/06 in the Ross Sea revealed that fish had developing gonads (WG-FSA-09/26). These observations were in line with previous findings that *D. mawsoni* spawns from June to August.

The oogenesis of *D. mawsoni* was described in WG-FSA-09/37. Oocytes accumulate at the cortical alveoli stage at least a year prior to spawning. Individual oocytes are then recruited into the vitellogenic phase over at least a 6–12 month period, resulting in a developed batch of oocytes accumulating at the final maturation stage by May (paragraph 3.56). The authors noted that the spawning ogive includes females on the slope which do not appear to spawn every year. Because all southern fish sampled appear to have spawned, the overall population ogive would be shifted towards younger fish depending on the proportion of mature fish in the northern area.

A 63 cm long *D. mawsoni* was tagged in the D'Urville Sea and was recovered largely digested in the stomach of a 162 cm long *D. mawsoni* 36 days later (WG-FSA-09/P1). From the location the small *Dissostichus* was tagged, and the location the large *Dissostichus* was caught, the authors anticipated a migration speed of the small individual of 6 km per day. This was questioned by the Working Group as digestion time and other parameters had not been taken into consideration by the authors (see discussion under Agenda Item 3.3.4).

Dissostichus mawsoni have long been known, from stomach contents of sperm whales and Soviet midwater trawl catches in various areas of the high-Antarctic, to occur regularly off the bottom (230–950 m above the bottom) (WG-FSA-09/8). Using vertical longlines, *M. whitsoni* were caught more than 500 m above the bottom in the Amundsen Sea in Subarea 88.2 in the last season. *Dissostichus mawsoni* were taken as high as 146 m above the bottom. The occurrence of both benthic and bentho-pelagic species in sperm whale stomachs suggests that *D. mawsoni* undertake regular vertical migrations to feed in the water column.

9.1.1.4 Both *Dissostichus* species

Gonad development was very much more advanced in *D. mawsoni* than in *D. eleginoides* caught around the South Sandwich Islands in April 2009, both in terms of relative weight of gonads to body weight (GSI) and maturity index (GMI) (WG-FSA-09/18). *Dissostichus mawsoni* gonads tended to be mainly GMI stage III (developed), whilst *D. eleginoides* gonads were mostly stage II (developing/resting).

WG-FSA-09/24 compared information on the life cycle and differences in diet composition of *D. eleginoides* and *D. mawsoni* from different areas of the Southern Ocean. The comparative analyses of fish from different areas revealed considerable differences in food spectra both in the early pelagic stage and later during the period of their habituation on the shelf and continental slope in the different areas. *Dissostichus eleginoides* off South Georgia (Subarea 48.3) have a more abundant food base. The individuals are much larger on average than in the Kerguelen Islands area (Division 58.5.1). In turn, *D. mawsoni* individuals in the Indian Ocean sector (Subarea 58.4) are larger than in the Ross Sea (Subarea 88.1). This is largely determined by the much more abundant food resources in pelagic waters of the shelves and slopes of the Indian Ocean sector.

9.1.1.5 Other species

The diet of 33 species of finfish (including *C. gunnari* and *D. mawsoni*) was studied in the course of a bottom trawl survey conducted around the South Orkney Islands (Subarea 48.2) in February/March 2009 (WG-FSA-09/19). Icefish and nototheniids (in part) fed primarily on krill. Fish formed the secondary food items in many species (see also Agenda Item 5.4.1).

WG-FSA-09/13 summarised information on reproductive characteristics of the deep-water icefish *C. dewitti* taken as by-catch in longline fisheries on *D. mawsoni* in the Ross Sea. A substantial part of the information contained in this paper was already contained in Kock et al. (2006) which was not cited in WG-FSA-09/13.

The diet of the skate, *Amblyraja georgiana*, was studied at South Georgia (WG-FSA-09/15). Preferred prey included fish (particularly for larger individuals) and *Euphausia superba* (Antarctic krill), as well as amphipods, polychaetes and other benthic fauna. The species appears to be an opportunistic predator and the presence of *E. superba* in this skate's diet indicates the regular occurrence of krill at, and/or close to, the bottom.

Three species of skate occur regularly as by-catch in longline and trawl fisheries for *D. eleginoides* and trawl fisheries for *C. gunnari* on the Kerguelen Plateau (WG-FSA-09/43). The species show a different spatial distribution which was primarily linked with different depth preference. *Bathyraja eatonii* and *B. irrrasa* occurred down to depths of 1 100 and 2 300 m respectively. The much smaller *B. murrayi* is restricted to shallower waters down to 700 m.

For the first time *Lepidion schmidti* was recorded in the Southern Ocean (WG-FSA-09/29).

Ageing of the scales and otoliths of blue-phase pelagic fingerlings (7–7.6 cm total length) and small demersal *Notothenia rossii* (8.5–20.9 cm total length) from Potter Cove, King George Island (South Shetland Islands), confirmed that they belonged to age classes 0, 1 and 2 (WG-FSA-09/32). A von Bertalanffy growth curve was fitted to age–length data of the juvenile *N. rossii* from this and a previous study at Potter Cove, and literature data from the offshore adult population, and resulted in $L_t = 86.9 \; (1\text{-e}^{-0.091(t-0.668)})$ which is very similar to results obtained by Freytag (1980) (see also Agenda Item 5.4.1).

9.2 Species profiles

WG-FSA agreed in 2005 to produce a new set of species profiles for *D. eleginoides*, *D. mawsoni* and *C. gunnari* (SC-CAMLR-XXIV, Annex 5, paragraph 9.2). Work on *D. mawsoni* was completed in 2006 (WG-FSA-06/26), that on *C. gunnari* in 2007 (WG-FSA-07/11). Work on *D. eleginoides*, however, had still not been completed by the meeting of WG-FSA in October 2009, delaying the publication of the species profiles.

In order to speed up the process of completion of the *D. eleginoides* profile, the Working Group agreed to hand over the task of completion to Drs D. Welsford (Australia), M. Belchier (UK) and S. Hanchet (New Zealand). The two existing species profiles on *D. mawsoni* and *C. gunnari* will undergo revision during the 2009/10 interesessional period. It is hoped that the complete set of species profiles will be available for adoption by the Working Group at its meeting in 2010.

The Working Group encouraged Members to start work on species profiles of by-catch species such as *Gobionotothen gibberifrons*, *Chaenocephalus aceratus*, skates and macrourids.

9.3 CCAMLR Otolith Network (CON)

CON was established following:

- the Workshop on Estimating Age in Patagonian Toothfish in July 2001 (SC-CAMLR-XX, Annex 5, paragraphs 3.94 to 3.97);

- the WAMI Workshop in October 2001 when otoliths of *C. gunnari* were exchanged between several laboratories and read comparatively (SC-CAMLR-XXI, Annex 5, paragraph 7.7).

Initial results were promising, however, limited progress within CON has been made recently with respect to the ageing of *D. eleginoides*.

A second workshop on ageing *C. gunnari*, this time restricted to material of the South Georgia population, was conducted in June 2006 (SC-CAMLR-XXV, Annex 5, paragraphs 9.9 to 9.17). The workshop noted the plausible methods that exist for age validation in the species which had either already been used or needed more detailed exploration in the future. Otoliths were read comparatively by several laboratories in the UK, Spain and Russia subsequent to the workshop.

In 2008, the Working Group requested that calibration work on otoliths of *C. gunnari* should be completed in 2008/09 and a report on the outcome of the otolith exchange be submitted to the meeting of the Working Group in October 2009 (SC-CAMLR-XXVII, Annex 5, paragraph 9.23). No such report has been received.

The Working Group reviewed what activities would be needed in the future to arrive at validated ageing for these target species.

Noting that fishing is currently restricted to primarily 2–4-year-old *C. gunnari* and the development of length-based assessment techniques for the fisheries of *C. gunnari* at South Georgia (WG-FSA-09/27), the Working Group therefore concluded that age determination from otoliths for use in the assessments was unnecessary.

With the exception of the ageing workshop on *D. eleginoides* in 2001, activities with respect to ageing *Dissostichus* spp. have been conducted mostly on a national basis with little coordination by CCAMLR. With the extension of the fisheries to more nations, it is likely that more Members will start ageing these species.

In order to better coordinate the age determination of *Dissostichus* spp., the Working Group recommended that an intersessional group should:

- prepare an inventory of those laboratories undertaking ageing of *Dissostichus* spp.
- foster an exchange of age-reading methods between laboratories
- establish a reference collection of otoliths of both species

- establish protocols of how otoliths are prepared for ageing (target number of otoliths to be collected, as set out in the *Scientific Observers Manual*, sagittal or longitudinal cutting, burning etc.) and how annuli are identified.

In addition, it was requested that ageing of *Dissostichus* spp. be included in the research plan as part of the notification for fishing in new and exploratory fisheries.

Results of ageing and a detailed description of how ageing was conducted need to be submitted to the Working Group on a regular basis. The Secretariat has produced a database to store these data in the future. Quality control of the readings, including validation of ageing and cross-validation between laboratories, will be of great importance to ensure consistency in ageing of *Dissostichus* spp. Close collaboration of CON with WG-SAM should be sought with respect to the development of efficient sampling schemes for otolith collection and subsampling for reading. Dr Belchier volunteered to establish an intersessional correspondence group to initiate the work outlined above.

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Yukhov, V.L. 1982. *The Antarctic Toothfish*. Nauka Press, Moscow: 113 pp. (in Russian).

Appendices E–S (Fishery Reports) are only available electronically at:
www.ccamlr.org/pu/e/e_pubs/fr/drt.htm

**REPORT OF THE WORKING GROUP ON
STATISTICS, ASSESSMENTS AND MODELLING**
(Bergen, Norway, 29 June to 3 July 2009)

CONTENTS

REPORT OF THE WORKING GROUP ON
STATISTICS, ASSESSMENTS AND MODELLING
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INTRODUCTION

Opening of the meeting

1.1   The third meeting of WG-SAM was held in Bergen, Norway, from 29 June to 3 July 2009. The meeting was convened by Dr A. Constable (Australia) and local arrangements were coordinated by Mr S. Iversen (Norway). The meeting was opened by Mr T. Nepstad, Director of the Institute of Marine Research (IMR), Norway.

1.2   Dr Constable thanked Mr Nepstad for his warm welcome, and IMR for hosting the meeting. Dr Constable also welcomed the participants (Appendix A).

1.3   The Working Group conveyed its best wishes to Prof. C. Moreno (Chile), who had resigned from his position as Chair of the Scientific Committee in March 2009 due to ill health. The Working Group noted that Mr Iversen (senior Vice-Chair of the Scientific Committee) had agreed to take on Dr Moreno's role, with the assistance of Dr V. Bizikov (second Vice-Chair) in 2009.

Adoption of the agenda and organisation of the meeting

1.4   The Working Group agreed to restructure its draft agenda to better reflect the papers and information available at the meeting, along with items referred from other working groups for consideration by WG-SAM. Items 2 to 6 of the draft agenda were restructured as follows:

- use of data in assessments (new Item 2)
- assessments (new Item 3)
- management strategies and their evaluation (new Item 4)
- other advice for the Scientific Committee (new Item 5).

1.5   As there was no other business, Item 7 from the draft agenda was deleted.

1.6   The remaining items of the draft agenda were retained, and the agenda was adopted (Appendix B).

1.7   The Working Group noted the Secretariat's high translation workload and discussions at CCAMLR-XXVII (CCAMLR-XXVII, paragraph 3.13). The Working Group agreed to restructure its report in an effort to reduce the overall size of the report and subsequent translation. The new structure attempted to capture essential background, discussion and advice, while making full use of CCAMLR's archive of publications and meeting documents.

1.8   The Working Group agreed to place a two-page limit, where possible, for the reporting of each subitem of its agenda, and that each subitem would be reported as follows:

- task/objectives
- relevant references (papers, other material)
- background/justification
- discussion of outcomes of work
- conclusions, including notes, advice and recommendations.

1.9   While the report has few references to the contributions of individuals and co-authors, the Working Group thanked all the authors of the papers for their valuable contributions to the work presented to the meeting.

1.10   In preparing its report, the Working Group agreed to highlight text that provides advice to the Scientific Committee and its working groups without repeating it in full in Item 7, which now comprises only a summary of paragraph references.

1.11   Documents submitted to the meeting are listed in Appendix C; WG-SAM-09/12 was only available as an abstract.

1.12   The report was prepared by Drs D. Agnew (UK) and Constable, Mr A. Dunn (New Zealand), Drs C. Edwards (UK), S. Hanchet (New Zealand), R. Hillary (UK), C. Jones (USA), D. Middleton (New Zealand), D. Ramm (Data Manager), K. Reid (Science Officer), G. Watters (USA) and D. Welsford (Australia).

USE OF DATA IN ASSESSMENTS

Age–length keys

2.1   This item on the agenda discussed issues surrounding the use of ALKs for constructing catch-at-age data to be used in assessments.

Ageing error

Background and papers

2.2   WG-SAM-09/7 and 09/8 dealt with the question of how ageing error can be incorporated into stock assessments when using ALKs to construct catch-at-age data by appropriately accounting for the measurement error associated with otolith-based ageing techniques, and then using this information to inform estimates of the multinomial effective sample size.

Discussion

2.3   WG-SAM-09/7 developed a model to predict the error structure around otolith-based age measurements.   This is used to construct an ageing-error matrix which allows the

predicted catch-at-age to be compared to observed catch-at-age within CASAL. The statistical model attempted to account for inter-reader variability and the readability of the otoliths themselves in predicting error. To determine ageing error, the 'true' age was first obtained from the average age over repeated reads. Multiple readings of a reference set of otoliths were then used to quantify the frequency of integer ageing errors (0, 1, 2, 3, 4 and 5+ years) as a function of the nearest integer (NI) to the true age, accounting for average readability of the otolith.

2.4   The Working Group noted that trends in the proportion of negative errors with age may be an artefact of non-random 'tie' breaks (when the mean age is an integer plus exactly 0.5) which were always rounded up in the model as first presented; this was resolved by breaking ties randomly and a revised model featuring a cubic trend with age in the proportion of negative errors was presented during the meeting.

2.5   In WG-SAM-09/8 the ageing-error matrix was used further to inform estimation of the multinomial effective sample size for likelihood-based fitting to the catch-at-age data within CASAL. The error matrix was predicted using the model developed in WG-SAM-09/7 assuming a single otolith readability value.

2.6   The effect of incorporating different assumed otolith readabilities on the ageing-error matrix and assessment results is discussed further under Item 3.1.

2.7   Dr S. Candy (Australia) proposed that an advantage of this statistical modelling approach is that there is usually not enough data to construct the ageing-error matrix directly from pooled age samples and that a modelling approach should be considered for future work.

Future work

2.8   WG-SAM recommended further work to validate whether it is more appropriate to use a model, as opposed to an empirical estimate, of ageing error by directly comparing results from each approach. If the modelling approach is to be adopted, an issue that needs to be addressed is how to combine estimates from otoliths with different readability when constructing the error matrix.

Constructing catch-at-age data

Background and papers

2.9   This item dealt with the question of what is the 'best' way to construct catch-at-age data for use in assessment models: direct ageing or the use of ALKs applied to catch-at-length data. The Working Group considered when catch-at-age proportions would be better estimated from an ALK compared to using a direct age estimate that ignores any additional length-frequency data.

Discussion

2.10 The Working Group noted that, although both ALK and direct ageing can provide adequate catch-at-age estimates, it may be more efficient to construct catch-at-age data using an ALK-based approach. The Working Group also noted that either approach is dependent on representative sampling, but the ALK-based approach can be applied to age data collected either by simple or length-bin random sampling. Although the ALK estimator has lower variance than the direct age estimator, the degree of improvement may only be slight in some situations.

Otolith sample size

2.11 The determination of an appropriate otolith sample size for estimating catch-at-age from direct ageing, a method that is utilised in the assessment presented in WG-SAM-09/13, was discussed under Item 5.1 'Observer sampling requirements'.

Spatial considerations for ALKs

Background and papers

2.12 As otolith data are sampled in a spatially disaggregated fashion from the Ross Sea, the Working Group considered whether it is better to use ALKs developed using data collected at the same spatial scale as the catch-at-length data when constructing catch-at-age data.

2.13 Mr Dunn raised the issue of whether this data should be combined to construct a single ALK for the entire Ross Sea or kept in a disaggregated form (WG-SAM-07/6). This is particularly relevant for population models that operate at a spatially disaggregated scale. He presented the catch-at-age distributions for the Ross Sea shelf, slope and north fisheries, and compared the age distributions constructed using a single aggregated ALK and those constructed from area-specific ALKs. For the shelf area, an area-specific ALK produced a catch-at-age distribution similar to that with an area-combined ALK. For the slope area there was an over-representation of the older age classes, while for the north area there was an under-representation of older age classes when using the combined ALK.

2.14 WG-SAM-09/9 compared integrated assessments using CASAL when separate ALKs were constructed for each fishery by year combination (disaggregated ALKs) to the alternative approach of constructing ALKs from length–age samples pooled across fisheries (aggregated ALKs). It was observed that the fit of the model to the catch-at-age proportions for the longline fishery improved significantly when the aggregated ALKs were used (see discussion under Item 3.1). It should be noted that the effective sample sizes (ESS) for the catch-at-age proportions applied in the assessment with aggregated ALKs overstate the amount of independent information in the fisheries-specific proportions-at-age data for estimation of parameters in the age-structured assessment model.

2.15 The Working Group recommended that it is appropriate to use ALKs constructed from data applied at the level of disaggregation that the model employs in analyses.

Tagging data

> Determine the most appropriate way of creating reliable
> tagging datasets for use in assessments

Background and papers

2.16   WG-FSA has asked WG-SAM to consider ways of incorporating unmatched tag-recaptures into assessments of toothfish that utilise mark–recapture data (SC-CAMLR-XXVII, Annex 5, paragraph 3.58). WG-SAM-09/4 reported that within the Secretariat databases, linkage rates are variable between fishing areas and species.

2.17   Problems with the reliability of tag-release and recapture scanning have also been suspected in exploratory fisheries, and led to the selection of tags released and recaptured only by New Zealand vessels in the assessment of Subareas 88.1 and 88.2 in 2007, and the inability to use tag data in the assessment of Divisions 58.4.1 and 58.4.2 in 2008 (SC-CAMLR-XXVI, Annex 5, paragraph 5.99; SC-CAMLR-XXVII, Annex 5, paragraph 5.21). WG-SAM-09/19 presented a revised procedure for analysing the quality of data from individual vessel trips and proposed a method for using quality metrics to identify trips considered to have reliable tag-release and recapture data.

Discussion

2.18   During the meeting several sequences of unmatched tags were identified. The relatively low proportion of matched tags in some fisheries may result from difficulties in the early stages of a tagging program, such as skate tagging prior to the Year-of-the-Skate. In the case of the skate tag returns, separation of tag-releases/recaptures before and after the Year-of-the-Skate is recommended. In some cases, national programs have identified matches for tags that are not apparent from the Secretariat database. Continued liaison between the Secretariat and those programs should fix many of the problems.

2.19   The Working Group recommended that when using mark–recapture within assessment models, the impact of unmatched tags (see paragraph 2.18) on the result should be minimised by undertaking the following procedure:

    (i)   removing all tag-recaptures from non-standard tagging events;

    (ii)   when tags are clearly derived from a single tagging program but cannot be matched exactly, matches should be made to the extent possible that are consistent with the assessment requirements (e.g. create a temporary link with a release event that matches by year of release, and length and/or sex where the assessment model requires length or sex);

    (iii)   if there are still a large number of unmatched tags, simulation studies of the impact of these losses should be undertaken.

2.20   The approach adopted in WG-SAM-09/19 for selecting a tagging dataset used the following method:

(i)   a subset was created of all vessel trips in a single year whose tags were subsequently recovered at a rate above the median rate for all trips undertaken in that year;

(ii)   a subset was created of all vessel trips in a single year which recovered tags at a rate above the median rate for all trips undertaken in that year;

(iii)   all trips that met both criteria (i) and (ii) (the 'informative' initial dataset, 19 out of 103 trips) were analysed and the upper and lower bounds of data-quality metrics were established for them;

(iv)   any other trips that are within the established bounds for these data-quality metrics were added to the dataset of informative tag-release and tag-recovery trips to create a final subset of informative trips.

2.21   The method allowed for the inclusion of non-New Zealand vessels, both in the initial identification of reliable trips and the subsequent addition of trips according to the data-quality metrics. Individual vessels had, on occasion, trips that were included or excluded from the dataset depending on their data-quality metrics.

2.22   WG-SAM noted that although under the tag data selection method (paragraph 2.8) some of the New Zealand trips will be excluded from the final informative dataset, the addition of other trips should increase the total size of the dataset. WG-SAM recommended that the method in WG-SAM-09/19 be modified to include, in the 'informative' initial dataset, all trips which satisfied item 1 OR item 2. This will further increase the size of the dataset, which will be important to improve the precision of the assessment.

2.23   An important feature of using this dataset in assessments is that the trips in the dataset would be assumed to carry common values of tagging parameters, such as tagging mortality, tag loss and scanning efficiency. Although excluded trips might contain useful information, this assumption may not hold for them.

2.24   WG-SAM recommended that two assessments should be undertaken for Subareas 88.1 and 88.2 in 2009, the main assessment using the final reliable trip dataset following the recommended modifications to the methodology given in WG-SAM-09/19 and, as a sensitivity run, one using only the New Zealand vessels.

Future work

2.25   The Secretariat is requested to continue its liaison with national programs to link as many of the problem tags as possible and eliminate extraneous tagging events.

2.26   In the case of the skate tag returns, separation of tag-releases/recaptures before and after the Year-of-the-Skate is recommended (paragraph 2.18).

2.27   The Working Group noted that because the method described in paragraph 2.19 selects trips based on their performance relative to a population median, application of the method in future years may result in different trips from past years being included. This would change the mark–recapture estimates of population size over time. Further work is needed to address this issue.

Research longline data in estimating stock size

2.28   WG-SAM considered five items under this agenda item:

(i)   estimating stock size of *Dissostichus* spp. in data-poor areas;

(ii)   standardising CPUE for different longline fishing methods;

(iii)   reviewing the longline research survey proposal by Japan;

(iv)   reviewing the use of research hauls in the exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 completed as part of the Research and Data Collection Plan;

(v)   estimating biomass using commercial longline data in Divisions 58.4.1 and 58.4.2.

2.29   Four papers were discussed under this agenda item. WG-SAM-09/10 summarised the results of a Japanese research survey completed in Divisions 58.4.4a and 58.4.4b in the 2007/08 season. WG-SAM-09/11 outlined a proposal for a Japanese vessel to carry out a research survey in Divisions 58.4.4a and 58.4.4b in the 2009/10 season. WG-SAM-09/6 summarised the implementation of research hauls in the exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in the 2008/09 season. WG-SAM-09/12 provided an abstract only of using an ASPM to estimate biomass in Divisions 58.4.1 and 58.4.2. Reference was also made to the recent work outlined in SC-CAMLR-XXVII (Annex 5 including the Fishery Report for Subarea 48.4 (Appendix Q) and Annex 7).

Use of longline operations in assessing toothfish
in data-poor areas

Background

2.30   There is an ongoing need to develop robust stock assessments for *Dissostichus* spp. in new and exploratory fisheries in Subareas 48.6 and 58.4. Two sets of data have been used for this purpose to date: tag data and longline CPUE data.

2.31   At the WG-FSA-08 meeting it was recognised that in some SSRUs the number of tag-recaptures was very low and that it might take many years before sufficient tags were recovered to enable a stock assessment based on tag-recapture data.

2.32   It was also recognised that assessments based on longline CPUE data were problematic for a number of reasons, including the representativeness of the data in estimating fish abundance; standardisation of longline gear – both between methods (e.g. autoline, Spanish longline, trotline) and within methods (e.g. differences in the configuration of the trotline method between vessels), and estimating the catchability coefficient (q) between vessels.

Discussion

2.33   WG-SAM considered the question of what is the best way to estimate stock size (and stock status) in data-poor areas which are not currently being assessed (i.e. Subareas 48.6 and 58.4).

2.34   WG-SAM agreed that the best way to estimate current stock size in data-poor areas is to carry out a tagging program. The tagging program would require a multi-annual commitment, including tag-release and recapture phases. Although two years is the minimum timeframe, experience has shown that a period of 3–5 years is often required.

2.35   The design of the tag-release phase would need to include consideration of the number of tags to be released, the size of fish to be tagged, the location of tag-releases, potential stock sizes and potential number of fish that could be scanned. The Working Group considered that:

(i)   the range of stock sizes could be derived using available information on CPUE and available habitat area (but note the need to standardise CPUE);

(ii)   the number of tags to be released could be determined using the approach followed in Hillary (2009) with a matrix showing the number of tags to be released across a range of stock sizes from above to achieve a target CV;

(iii)   ideally, tags should be spread across the population in sufficient numbers to achieve a high probability of recapture;

(iv)   tags should be released at the highest possible rate dependent on likely survivorship characteristics of the animals concerned, and the length of tagged fish should be representative of the population in the area concerned. Because smaller fish tend to have lower rates of initial mortality, tag loss and tag shock (WG-SAM-09/13), it may be better to initially target areas containing a higher proportion of smaller fish;

(v)   tags should be spread evenly across the survey area because experience elsewhere has shown that toothfish typically move only short distances and that tagged fish may take several years to mix evenly across an area (this was a key component of the tagging program in Subareas 48.3 and 48.4);

(vi)   if the area is large and the probability of recapture is low, then it may be necessary to concentrate effort on a subset of the management area in year 1. In such a case it would be important to recognise that estimates of abundance

resulting from the work would be representative of the smaller area. The tagging effort might be extended more widely in future years, subject to review.

2.36 The design of the tag-recapture phase would need to include consideration of the location of fishing in year 2 and numbers of fish to be scanned. This should take into account the following:

    (i)   fishing in the recapture phase should be spread widely across the experimental area;

    (ii)   the number of fish needed to be scanned to achieve a target CV should be estimated;

    (iii)   gear standardisation between the release and recapture phases is important to ensure tag mortality rates and selectivity, and other parameters which could influence assessments should be standardised as much as possible.

2.37 Other details of the release and recapture phases and other general issues associated with tagging programs are considered in the Research Data and Collection Plan (Conservation Measure 41-01).

2.38 Appropriate levels of retained catch should be calculated based on conservative estimates of available biomass, harvest rates that would not hinder recovery of a depleted stock and the requirements of the tagging and recapture plans. An estimate of the likely mortality rate of the scanned fish should be provided so that an estimate of the minimum retained catch could be obtained. If a high proportion of the scanned fish were tagged and released in good condition, then this would increase the pool of tagged fish in the population.

2.39 Other data would be required before a stock assessment could be carried out. This could include the reconstruction of the catch history (including both legal and IUU catch), the reading of any existing otoliths to determine growth rates and the age composition of the catch, and the collection of other ancillary biological data important to an assessment.

2.40 WG-SAM agreed that any research program be framed as a 3–5 year experiment with annual reviews, as has been carried out for Subarea 48.4. This should include a timeline for the work to be carried out and the anticipated numbers of tags to be released and recovered (under varying assumptions of biomass, tag-release and tag-recapture rates).

2.41 WG-SAM recommended that WG-FSA use the protocols provided in paragraphs 2.33 to 2.40 to review any future research proposals to develop stock assessments in data-poor areas, and that these be further evaluated through simulations.

2.42 WG-SAM also recommended that WG-FSA consider the feasibility of using this approach to develop stock assessments in Subareas 48.6 and 58.4.

Standardisation of CPUE for different longline fishing methods

Background

2.43   Preliminary assessments of toothfish for some of the exploratory fisheries in Subarea 58.4 have relied to a large extent on comparisons of CPUE between different areas. However, this has been problematic because of the representativeness of the data and the comparability of units of effort (e.g. number of hooks), both between methods (e.g. autoline, Spanish longline, trotline) and within methods (e.g. differences in the configuration of the trotline method between vessels).

Discussion

2.44   WG-SAM noted that the relative properties of the different longline gears were still very poorly understood.   Such properties include catchability (relative attraction and efficiency), selectivity in relation to target catch, fish and invertebrate by-catch, size composition and condition of fish on capture.

2.45   Understanding these issues is important in being able to effectively standardise catch rates and other important parameters when carrying out stock assessments for *Dissostichus* spp.

2.46   WG-SAM welcomed the initial fishing trials of trotlines and Spanish longline systems conducted by Japan in Division 58.4.3b in January–February 2009 (WG-SAM-09/11) and recommended that the Scientific Committee request Members to undertake fishing trials between gear types so that their properties can be better understood.

Review of the Japanese longline research survey proposal

Background and papers

2.47   The directed fishery for *Dissostichus eleginoides* in Divisions 58.4.4a and 58.4.4b was closed in 2002/03 due to the Scientific Committee's concern regarding the low levels of the stock and the high level of IUU fishing (SC-CAMLR-XXI, paragraphs 4.106 to 4.108).

2.48   Japan carried out a research survey in these divisions in 2007/08. Japan also submitted a proposal to the Scientific Committee in 2008 to carry out a research survey in 2008/09 with the aim of determining stock status and, in particular, whether the stock has recovered since the fishery was closed in 2002/03.

2.49   The Scientific Committee requested that WG-SAM review the survey design (SC-CAMLR-XXVII, paragraphs 8.6 to 8.8). WG-SAM-09/10 and 09/11 were reviewed in this context.

2.50   WG-SAM considered three questions:

(i)   What should be the aims of the research?
(ii)   How would that best be achieved?
(iii)   What impact would that have on the stock recovery?

2.51   WG-SAM agreed that it would not be possible to determine whether the stock had recovered based on the results of a single longline survey; a research program would need to be carried out over an extensive period to address this issue. It considered that the priority short-term aim for research in this division should be to determine current stock size and this would be best carried out using a tagging program. The tagging program would require a multi-annual commitment, including tag-release and recapture phases as outlined in paragraphs 2.35 to 2.40. It noted that, for this survey, particular focus should be made on the initial number of tagged fish, their length and release location, and gear standardisation.

2.52   The research program should adopt a phased approach which should concentrate effort on a subset of the management area in year 1 and may be extended more widely in future years, subject to review.

2.53   Other data required for a stock assessment should also be collated including the reconstruction of the catch history (including both legal and IUU catch), the reading of any existing otoliths to determine growth rates and the age composition of the catch, and the collection of other ancillary biological data important to the assessment.

2.54   WG-SAM recommended that WG-FSA consider both the general protocols detailed in paragraphs 2.30 to 2.40, as well as the specific advice detailed in paragraphs 2.50 to 2.53 when reviewing the Japanese proposal for research in Division 58.4.4.

2.55   WG-SAM recommended that WG-FSA consider how the research program could be further developed to determine stock status and be used to provide estimates of yield under the CCAMLR decision rules.

Use of research hauls in the exploratory fisheries for *Dissostichus* spp.

Background

2.56   There is a need to develop robust stock assessments for *Dissostichus* spp. in Subareas 48.6 and 58.4. The issue addressed here concerns whether CPUE data from research longline hauls can be used to help develop these assessments. Until 2007/08, vessels were required to complete 10 research hauls (each comprising 3 500–5 000 hooks and being separated by a distance of at least 5 n miles) on entering an SSRU in an exploratory fishery (Conservation Measure 41-01). For the 2008/09 season, each SSRU was divided into two strata (fished and non-fished/lightly fished) and vessels were required to carry out their research hauls at randomly allocated positions.

2.57 WG-SAM considered that the aim of carrying out the research hauls in this manner needed to be more clearly defined. It noted that previous fishing in the SSRUs had often concentrated on quite localised areas within SSRUs. WG-SAM agreed that the main aim should be to develop a time series of background longline CPUE data for the non-fished/lightly fished strata.

2.58 In implementing this approach:

(i) the boundaries for the fished and non-fished/lightly fished strata should remain the same as were used for the 2008/09 season;

(ii) new locations for the research hauls for each strata should be randomised each year;

(iii) hauls completed in 2008/09 in fished and lightly fished strata should be added to the hauls available for bootstrapping in those strata. Locations for hauls in non-fished strata should be randomised on longitude as was done for 2008/09;

(iv) alternative randomised research haul locations may need to be provided for SSRUs where ice is a problem.

2.59 The number of research hauls required to achieve a target CV for this monitoring tool should be evaluated by WG-FSA and, if appropriate, the proportion of research hauls in the non-fished/lightly fished strata could be altered accordingly.

2.60 WG-SAM recommended that the research set allocation approach developed for use for the exploratory fisheries in 2008/09 be retained for the 2009/10 season with the implementation outlined in paragraph 2.58.

2.61 WG-SAM recommended that WG-FSA be more specific over how this may lead to, or improve, an assessment.

Estimating biomass using commercial longline data
in Divisions 58.4.1 and 58.4.2

Background

2.62 WG-SAM and WG-FSA have provided advice previously on estimating biomass using commercial longline data in exploratory fisheries in Divisions 58.4.1 and 58.4.2 (SC-CAMLR-XXVI, Annex 7, paragraphs 4.1 to 4.11; SC-CAMLR-XXVI, Annex 5, paragraphs 5.21 to 5.29). WG-SAM-09/12 provided an abstract only of using an ASPM to estimate biomass in these divisions.

2.63   WG-SAM noted that it was not possible to determine whether the method was appropriate to be used in the absence of a paper detailing the application of the method. Dr K. Shust (Russia) presented background to the method used, which was based on the methods of WG-FSA-06/58.

2.64   The Working Group recalled the discussions on the application of this method contained in previous reports, including needing to understand how different datasets are included and weighted in the assessment (WG-FSA-06/6, paragraphs 2.83 and 2.84), needing the source code to determine how the method had been applied (SC-CAMLR-XXV, Annex 5, paragraph 4.33), and the sensitivity of the results to changes in length composition relative to CPUE (SC-CAMLR-XXVI, Annex 7, paragraph 5.5).

2.65   The Working Group noted that an assessment of toothfish biomass in Division 58.4.1 based on commercial longline data will be provided to WG-FSA this year. It encouraged the authors to provide details of the methods and results, including diagnostics and responses to issues in paragraph 2.64. The Working Group recommended that the process for validating models (see Item 5.3) be followed for reviewing this approach and assessment.

ASSESSMENTS

Age-based assessments

Review of updated methodologies proposed for use in the assessment of toothfish in Subarea 48.3 and Division 58.5.2

Background and papers

3.1   In response to advice from WG-FSA in 2007, the assessments of toothfish in Subarea 48.3 and Division 58.5.2 have been modified. WG-SAM was asked to review the methodological aspects of these updates prior to the completion of updated assessments for these stocks. Two papers were presented related to this task: WG-SAM-09/9, updating the assessment for toothfish in Division 58.5.2 presented in Candy and Constable (2008), and WG-SAM-09/13, updating the assessment for toothfish in Subarea 48.3 presented in WG-FSA-07/29.

Updated assessment for Subarea 48.3

3.2   The Working Group noted that various length-related effects on tagged fish (mortality, tag loss, growth retardation) were investigated in the updated Subarea 48.3 assessment by discounting the number of tagged fish released in larger size classes and adjusting the proportion-at-length. This was considered a reasonable approach in a CASAL assessment.

3.3   Incorporating these effects did not obviously improve the trends in the residuals of tag-recoveries-at-length, although it was noted that this was not particularly easy to judge from the available plots, and resulted in no substantive changes on the model outputs.

3.4   A possible alternative explanation for the residual pattern is that this result arises from the method of conversion of length to age within the model.

3.5   The Working Group noted that WG-SAM-09/13 described the time series of survey abundance estimates used in the assessment. Most surveys occurred in January and the September surveys have not been useful for detecting juvenile toothfish. The Working Group agreed that the September surveys should be excluded from the series. However, catch-at-length data from all surveys should be retained in this assessment.

3.6   The Working Group noted that growth parameters were successfully estimated within the Subarea 48.3 assessment without the need to fix t_0.

Updated assessment for Division 58.5.2

3.7   The Working Group noted that much poorer fits to longline fishery catch-at-age arose in the Division 58.5.2 assessment when ALKs were applied by fishery and year, where available, than when ALKs were pooled across fisheries within a year. It was suggested that this was probably associated with the retention of catch-at-length data for fisheries where ALKs were not available.

3.8   Different ageing-error matrices, produced for various otolith readability scores, appeared to have substantial influence on the MPD estimates obtained for a number of important parameters.

3.9   It was noted that some of the calculated ESS for catch-at-length proportions exceeded the length-frequency sample size (WG-SAM-09/9, Tables A2.3 and A2.4). This arose as a result of the regression approach used in the estimation of the multinomial ESS.

General

3.10   The Working Group recommended that authors of assessments should routinely provide standardised residual plots or display confidence intervals on plotted estimates to assist WG-FSA in making a visual diagnosis of model fits (paragraph 3.3).

3.11   The updated assessment of toothfish in Subarea 48.3 had adequately addressed the matters raised by WG-FSA in 2007, and the revised model incorporating catch-at-age and survey data should be used for undertaking an assessment of the stock in 2009. It was noted that, while a sex-disaggregated model was successfully implemented for Subarea 48.3, the biomass trajectories estimated in the more complex model were similar to the aggregated model, and the sparse ageing data currently available probably do not justify the use of the disaggregated model.

3.12   The Working Group welcomed the incorporation of fishery and survey age data in the Division 58.5.2 assessment, and recommended the age-based assessment be considered by WG-FSA together with a number of model simplifications which may assist in fitting to longline catch-at-age data and exploring the influence of ageing-error assumptions (paragraph 3.7).

3.13   The Working Group noted that the use of either MPD estimates or MCMC estimates needs to be considered in assessments. While MCMC is preferred in characterising the uncertainty, computing and other constraints may result in the need to consider MPD estimates. In both cases, the Working Group noted that appropriate diagnostics would need to be presented to ensure that the estimates were appropriate.

3.14   The Working Group recommended that WG-FSA consider the choice of year classes to be estimated in each assessment, the years over which these year-class strengths (YCS) are assumed to have average recruitment, the first year of recruitment considered unknown in projections, and the years of observed recruitments to be resampled when doing projections. Further, it noted that the choice of YCS to be estimated, and the choice of YCS to be included in projections, should consider the information available from the data to allow these to be reliably estimated.

Future work

3.15   The Working Group suggested that a simulation exercise could be carried out to investigate whether trends in the residuals of tag-recoveries-at-length in the Subarea 48.3 assessment could arise as a result of length–age conversions in the CASAL model (paragraph 3.4).

3.16   The Working Group suggested investigating the removal of length observations from the Division 58.5.2 assessment model. It was considered that these observations may provide little information on cohort strength in addition to that provided by the available age data (paragraph 3.7).

3.17   It was also suggested that the recent (2002–2008) Division 58.5.2 trawl survey series be incorporated in the assessment as a biomass index and catch-at-age proportions, rather than as numbers-at-age or length, to allow fits to these data to be assessed separately. The Working Group noted that methods to incorporate uncertainty in survey q could also be revisited in the Division 58.5.2 assessment, now that age data are available.

3.18   The Working Group suggested that the effect of otolith readability and the resulting assumed ageing-error matrix could be considered further in a simpler model without length observations (paragraph 3.8).

3.19   Methods for estimating the ESS for data assumed to follow a multinomial distribution should consider the plausibility of an ESS which exceeds the number of fish sampled (paragraph 3.9; see also Candy, 2008), noting that model process error is likely to further modify these estimates.

Length-based assessments

Use of acoustic and net data to estimate abundance and distribution of *Champsocephalus gunnari*

Background and papers

3.20   The Working Group recalled that varying headline height may change the proportion of the fish population that is susceptible to gear during surveys. Currently a constant adjustment factor of 1.241 is applied to biomass estimates from recent bottom surveys in Subarea 48.3 (SC-CAMLR-XXI, Annex 5, paragraph 5.103). WG-FSA-08 recommended the evaluation of the adjustment factor for icefish surveys using acoustic methods (SC-CAMLR-XXVII, Annex 5, paragraph 3.26), and WG-SAM-09/20 was presented to address this task.

Discussion

3.21   The Working Group noted that WG-SAM-09/20 showed that acoustic data reveals high spatial heterogeneity in the distribution of icefish that was not apparent in net data from surveys conducted in 2000 and 2002 in Subarea 48.3. The analysis of acoustic data further indicates that the headline height adjustment factor would vary across and between surveys due to this heterogeneity.

3.22   The Working Group further noted that spatial heterogeneity in the icefish distribution is an important source of uncertainty in the trawl survey biomass estimates and that acoustic data collected during trawl surveys can produce important information to investigate this spatial heterogeneity and evaluate the application of the adjustment factor for trawl headline height used in icefish surveys in Subarea 48.3.

3.23   The Working Group recommended that WG-FSA consider recent acoustic data in addition to those analyses presented in WG-SAM-09/20 when evaluating the survey design and adjustment factor used in assessments of *C. gunnari* in Subarea 48.3 and noted that the UK was undertaking some of this work.

Future work

3.24   The Working Group recommended the continued collection of acoustic data during icefish surveys, and the analysis of recent acoustic data collected during *C. gunnari* surveys in Subarea 48.3.

A length-based framework for assessing *C. gunnari*

Background and papers

3.25   The Working Group recalled that the current *C. gunnari* assessment procedure requires competency in CMIX and GYM, and that the current interface to these packages may not be robust to changes in operating systems. Decomposing length frequencies into cohorts using

CMIX for survey data from Subarea 48.3 has required additional user input due to issues with distinct length structures in strata around Shag Rocks as opposed to strata adjacent to South Georgia. WG-SAM-09/15 presented a new framework for conducting assessments of icefish, incorporating a length-based population model.

Discussion

3.26 The Working group welcomed the approach presented in WG-SAM-09/15, in which a single script in R is used for the *C. gunnari* assessment. The script can be used on any computing platform and requires less user input.

3.27 The Working Group noted that implementation of a length-based growth framework also has the potential to remove the need for decomposition of length-density data into cohorts, as well as having the potential to make MSE for icefish more straightforward.

3.28 The Working Group noted that the method produced comparable results to recent assessments; however, divergence was greatest between the two models in 2008. This divergence may result from the increased spread of length classes present in the 2008 survey (SC-CAMLR-XXVII, Annex 5, Appendix O, Figure 4).

3.29 The Working Group recommended the investigation of alternative methods of estimating the growth-transition matrix, including using data on the growth of icefish cohorts from survey and commercial catch time series.

3.30 The Working Group recommended investigation to account for the divergence between the estimates of the current method and the new method, particularly in 2008.

3.31 The Working Group recommended that WG-FSA consider using the new assessment framework, with the refinements suggested in paragraphs 3.29 and 3.30, to develop assessment advice for *C. gunnari* in Subarea 48.3.

Future work

3.32 The Working Group encouraged the use of similar frameworks to conduct MSEs for *C. gunnari*.

Abundance of seals and penguins

Standardising or estimating general abundance counts of seals and penguins

Background and papers

3.33 A method to standardise or estimate general abundance counts of seals and penguins by accounting for availability bias, detection bias, and sampling fractions less than unity, was discussed (WG-SAM-09/16).

Discussion

3.34   The Working Group noted that the developments towards standardising count data would be useful for other working groups. In particular, the Working Group noted that standardisation for factors such as availability, detection and sampling fractions is an important step in the development of regional abundance estimates (and possibly time series) for analysis.

3.35   The Working Group noted that ICESCAPE (Integrating Count Effort by Seasonally Correcting Animal Population Estimates) provides a useful approach for use to undertake standardisations for count data and uses a GAM and resampling algorithm. The Working Group did not undertake validation work at this meeting. It noted that such approaches require strong assumptions about the nature of relationships between observations and therefore caution is required in interpreting estimates that are based on such adjustment methods. Further, the Working Group noted that such methods are difficult and necessarily complex, and modelling assumptions will influence results. Nevertheless, the use of the resampling or other methods that allow quantification of appropriate levels of the uncertainty to be incorporated into count data are important.

3.36   The Working Group requested information from the authors of WG-SAM-09/16 for the rationale for resampling the convolutions without replacement rather than with replacement.

3.37   The Working Group noted that the GAM approach appeared to be a reasonable method to model the chronology of penguin abundance at breeding colonies as detailed in WG-EMM-09/38, but subject to the caution noted in paragraph 3.35.

MANAGEMENT STRATEGIES AND THEIR EVALUATION

Spatially structured population models

Potential tools for use in spatial operating/assessment models
for CCAMLR fisheries

Background and papers

4.1   The Working Group recognised that the incorporation of spatially resolved data and processes in operating models used to test the robustness of current/future spatially aggregated assessments, or in spatially explicit assessments, is of key importance to CCAMLR. WG-SAM-09/17 provided a technical guide to the SPM package first presented last year and WG-SAM-09/18 presented a specific application of the SPM to the Ross Sea *Dissostichus mawsoni* fishery.

Discussion

4.2   The Working Group noted that WG-SAM-09/17 was the first time that a technical manual had been presented for this model, which greatly facilitated the consideration of this

model. The Working Group also considered that having the flexibility to work with fine-scale or coarse-scale resolutions, as well as having wide or restricted areas, is a valuable attribute in developing operating models.

4.3   Recognising that environmental data, such as sea-surface temperature and primary production, can provide useful information relating to animal distribution, the Working Group noted that their inclusion in the covariate layers of the SPM would be useful to investigate in future applications.

4.4   The Working Group noted the differences in the model-predicted distribution of mature/spawning fish and those suggested in Hanchet et al. (2008) describing the potential life-cycle of *D. mawsoni* in the Ross Sea. Given the early stage of development of the model, the Working Group reiterated that being able to address these differences with this type of model further added to their usefulness, and that the Working Group fully supported future development work of the SPM in this regard.

4.5   The Working Group recommended that, given that the data were sufficiently well described by the model, and that the data were limited in terms of both being predominantly from commercial sources and spatially limited, the SPM package could be useful for guiding future decisions with respect to data collection. Furthermore, the model may also be a useful tool for exploring which Ross Sea SSRUs might be opened or closed and other aspects of spatial management for fishing in the future.

Future work

4.6   The Working Group recommended that the SPM model be developed further, considering the issues in paragraphs 4.2 to 4.4, along with different representations of movement.

Conserving VMEs

A review of methodological approaches to advise on
management strategies for conserving VMEs

Background and papers

4.7   Conservation Measures 22-06 and 22-07 acknowledge the urgent need to protect VMEs from bottom fishing activities and require the Scientific Committee to advise the Commission on the effectiveness of management measures currently implemented this year. Previous discussions on VMEs are summarised in CCAMLR-XXVII (paragraphs 5.4 to 5.30) and SC-CAMLR-XXVII (paragraphs 4.207 to 4.284, Annex 4, paragraphs 3.21 to 3.44 and Annex 5, paragraphs 10.3 to 10.109).

4.8   WG-SAM-09/21 presented a simulation model (coded in R) for evaluating management strategies to conserve benthic habitats, and WG-SAM-09/P1 presented an impact assessment framework for bottom fishing.

Discussion

4.9   The Working Group noted that impact assessment frameworks like that presented in WG-SAM-09/P1 can help Members submit preliminary assessments of the 'known and anticipated impacts' of bottom fishing as required by Conservation Measure 22-06. The methods described in WG-SAM-09/P1, which largely summarise expert opinion, were discussed at the last meeting of WG-FSA and have been accepted for publication in *CCAMLR Science*. The results presented in WG-SAM-09/P1 are based on the assumption that fishing effort and VMEs are independently and randomly distributed throughout the fishable area, and the Working Group noted that this assumption may not be appropriate for some VME indicator taxa. The Working Group noted that two methodological issues should be addressed in future applications of the framework; these have been identified as areas of future work. The Working Group also noted that information in WG-SAM-09/P1 might be used to inform the parameterisation of fishing impacts within the model described in WG-SAM-09/21.

4.10   Noting that the process to evaluate complex models takes some time (see Item 5.3), while acknowledging that there is a need to provide advice related to the conservation of VMEs in the short term, the Working Group started to familiarise itself with, and evaluate the implementation of, the model presented in WG-SAM-09/21. This process was facilitated by interactively reviewing parts of the model code (particularly the input data file), attempting to run an example, and asking questions of the model developer.

4.11   The Working Group agreed that models like that developed in WG-SAM-09/21 help to synthesise thinking about complex issues and can be used for at least two purposes:

    (i)   to identify priority requirements for information gathering, data collection and synthesis;

    (ii)   to evaluate the effectiveness of management measures intended to conserve VMEs.

4.12   With respect to point (i), the Working Group agreed that the model presented in WG-SAM-09/21 would provide a useful framework to guide discussions at the forthcoming meeting of WG-EMM and the VME Workshop. The Working Group therefore recommended that WG-EMM and the VME Workshop discuss ecologically appropriate parameterisations and functional forms for use in the model.

4.13   The Working Group advised that, as far as possible, WG-EMM and the VME Workshop should distinguish between appropriately interpreted empirical observations and subjective expert opinion to inform the parameterisation and selection of functional forms.

4.14   With respect to point (ii), the Working Group noted its discussion under Item 5.3 'Model validation' and agreed that further review (here defined as evaluation and validation) of the model presented in WG-SAM-09/21 will be needed, as a full review of the model could not be completed by WG-SAM this year. However, the Scientific Committee must advise on Conservation Measures 22-06 and 22-07 this year, and potential application of the model to evaluate the effectiveness of current or new management measures to conserve VMEs will depend on information that WG-EMM and the VME Workshop can provide to parameterise the model and identify appropriate functional forms.

4.15   The Working Group advised that it may be possible to use the model at the forthcoming meeting of WG-FSA if advice from WG-SAM, WG-EMM and the VME Workshop are incorporated into model developments prior to WG-FSA. WG-SAM also advised WG-FSA that it should provide advice which is commensurate with the state of the model, its documentation and the need for further review (paragraph 5.17), with the need for further review being stipulated within the advice. It also advised that further evaluation and validation by WG-SAM may be needed next year if required by WG-FSA or if other developments are required.

Future work

4.16   Future development of impact assessments like that presented in WG-SAM-09/P1 should:

(i)   incorporate uncertainty (perhaps by bootstrapping);

(ii)   indicate, for each VME indicator taxon, the proportion of the taxon's distribution that is overlaid by the cumulative footprint of each fishing method (or impact source).

4.17   Further development of the model presented in WG-SAM-09/21 should continue; the model code should be further validated by demonstrating the model does what is intended; and Members should aim to collaborate on further work.

4.18   A user manual and more comprehensive documentation should be developed for the model presented in WG-SAM-09/21. A hierarchical set of simple examples that can help the Scientific Committee and its working groups to develop an increased understanding of the model (e.g. like the set used to increase understanding about the behaviour of FOOSA, WG-EMM-06/20) should also be developed.

4.19   As time allows, work to implement the model using object-oriented programming constructs, such as classes (possibly including S4 classes) and methods, should be pursued because these can increase code readability, portability etc.

Decision rules for target species

Evaluation of methods for examining robustness of current decision rules for *Dissostichus* spp. toward meeting CCAMLR objectives

Background and papers

4.20   Consideration of advancements of these methods arises from the Scientific Committee's encouragement for WG-SAM to continue development of MSE (SC-CAMLR-XXVI, paragraph 2.10), which provides a mechanism for measuring efficacy of methods toward achieving management objectives. The Working Group was requested to further develop operating models to generate simulation data for testing candidate management procedures and develop future advice on catch limits (SC-CAMLR-XXV, Annex 5,

paragraph 12.5), and advance evaluation of the assessment and harvest strategy along with the further development and evaluation of management strategies for toothfish fisheries (SC-CAMLR-XXV, Annex 5, paragraph 12.6).

4.21   Two papers were available to the Working Group, WG-SAM-09/13 and 09/14. The Working Group also noted the existing CCAMLR decision rules for toothfish.

4.22   The Working Group agreed that there were two distinct issues that needed to be dealt with separately:

(i)   the appropriateness of using reduced-complexity models as proxies in simulations for MSEs;

(ii)   the appropriateness of alternative exploitation-rate-based harvest control rules (HCRs).

Discussion

Use of reduced-complexity models as proxies
in simulations for MSEs

4.23   The Working Group noted that the use of the simple biomass dynamic model to explore the robustness of the current *Dissostichus* spp. CCAMLR decision rules to various scenarios permitted substantially less computation time, and more straightforward insight into the system from either a biological or management point of view. The Working Group noted that the assumption of this approach is that a management strategy rule that performs well for a simple system may not perform well for the more complex system, but a strategy that performs poorly for the simple system is less likely to perform well for the complex system.

4.24   The Working Group noted that some of the alternative scenarios explored in the biomass dynamic model included future productivity changes over time by adjusting the intrinsic rate of increase, r. It was agreed that it may be useful in this model to also explore the effect of changes in carrying capacity, K. The Working Group recommended that a slightly more complex cohort model should be employed as the underlying operating and assessment models to explore the robustness of the current *Dissostichus* spp. CCAMLR decision rules, which could change the dynamics, add complexity and potentially allow for more effects to be detected.

4.25   The Working Group recommended further investigation of how simplified systems could be used as proxies, noting their likely value in evaluating assessment and harvest strategies for achieving management objectives.

Alternative exploitation-rate-based HCRs

4.26   The Working Group examined a comparison of the robustness of the CCAMLR HCR with an alternative target-limit reference point HCR that uses exploitation rates, presented in WG-SAM-09/14. The HCRs were explored with respect to biomass depletion, assessment

precision, time-horizon, implementation error and future changes in productivity. The results indicated that the alternative HCR outperformed the CCAMLR HCR in some simulations, although neither did well when stocks were depleted.

4.27 The Working Group noted that the greater robustness of the HCR may be a result of the rate at which the HCR would return the stock to the target level, i.e. the HCR attempts to set a catch to return the stock to the target level over five years rather than over 35 years. The Working Group also noted that there may be differences in performance as a result of projecting with incorrect assumptions over differing time periods. However, the biennial frequency of assessment for *Dissostichus* spp. stocks will help correct these errors. An important consideration in the use of any HCR is the consequences of the strategy over a population generation, which is captured in the current CCAMLR HCR. A shorter projection period in the HCR may have differing long-term consequences for achieving the objectives.

4.28 The Working Group agreed that consideration of the length of the projection period in the yield assessments and the issues discussed in paragraphs 4.26 and 4.27 represent a valuable beginning in a process of exploring alternative HCRs, and recommended that WG-FSA include consideration of these issues in their discussion. The Working Group requested submissions to future WG-SAM meetings for additional development of methodologies and analysis of consequences of modifying current decision rules.

4.29 The Working Group briefly considered the suggestion set out in WG-SAM-09/13 that it may be worthwhile considering a modifier of the projection procedure for the *D. eleginoides* fishery in Subarea 48.3. This issue arose as a result of the apparent very low recruitments to some recent cohorts which are indicated by some survey data. The assumption that future recruitment will return to historical levels in the projections will carry some risk that the catch limits using the existing CCAMLR HCRs would allow the spawning biomass to drop below the target of 0.5 B_0. The Working Group recognised that, once the stock was fished to 50%, there would be fluctuations about the target level. The Working Group noted that this concern might be alleviated by considering using an appropriate subset of the recruitment indices and resampling from these in the Monte Carlo projections. The Working Group recommended exploring the use of a subset of recruitment indices for Subarea 48.3 by WG-FSA.

4.30 The Working Group recommended that WG-FSA consider how to manage scenarios where there are trends or significant changes in the stock dynamics, and the implications of this on the definition of B_0, as well as the objective of the decision rules. The Working Group recommended that there needs to be additional consideration given to stocks that are near or at target levels, and implications of fluctuations around target levels due to, for example, recruitment events/variability.

OTHER ADVICE FOR SC-CAMLR

Observer sampling requirements

> Impact of changing sampling priorities for observers
> on toothfish assessments

>> Background and papers

5.1   Changing research priorities, for example, due to sampling efforts for the Year-of-the-Skate, has led to changes in sampling intensity of toothfish by observers in new and exploratory fisheries. WG-FSA requested that WG-SAM consider a statistical analysis of the required sampling level of *Dissostichus* spp. by observers for the collection of biological, age and length data (SC-CAMLR-XXVII, Annex 5, paragraph 11.8(vi)). No papers were submitted on this topic.

>> Discussion

5.2   The Working Group noted that simulation frameworks and power analyses would be appropriate methods to evaluate observer sampling intensity versus the benefits from increased assessment precision.

5.3   The Working Group noted that the analysis of the optimum sampling intensity would be different if a season's data was considered in isolation, as opposed to where a time series of data exists.

5.4   The Working Group welcomed New Zealand's proposal to undertake an assessment of how changing sampling intensity for otoliths and length frequencies may impact on the CV of the annual estimates of catch-at-length and catch-at-age in the Subarea 88.1 *Dissostichus* spp. fishery.

>> Future work

5.5   The Working Group encouraged Members to develop simulation models to assist WG-FSA with prioritising observer tasks and sampling intensities.

Data quality

> Background and papers

5.6   The Working Group noted that WG-SAM-09/19 presented further development of a method for selecting a tagging dataset, initially presented in WG-SAM-08/13, and WG-SAM-09/5 provided details of the CCAMLR databases and the data-quality validation conducted by the Secretariat.

Discussion

5.7 The Working Group noted that the development of WG-SAM-09/19 (paragraph 2.20) had illustrated inconsistencies and errors in observer and vessel data that originated at the point of collection, and indicated that some errors were not detected during the Secretariat's existing data validation routines. Further, some data had been inadvertently replicated by the Secretariat following repeated data submissions; this situation was rapidly corrected through correspondence with the Secretariat.

5.8 The Working Group also noted the Secretariat's progress in developing data-quality assessment, and in ensuring that users of CCAMLR data are fully aware of the integrity procedures that have been applied to the data (WG-SAM-09/5). The CCAMLR database documentation (WG-SAM-09/5, Appendix 1) was greatly appreciated and would provide a very useful resource for data users to better understand the CCAMLR database.

5.9 The Working Group also noted the time overhead involved in the iterative process between the Secretariat and Members in the data validation process and that any failure to submit data in an accurate and timely fashion slowed the availability of data for use in assessments.

Future work

5.10 The Working Group recommended:

(i)   the sensitivity of assessments to using a subset of data from the current season should be investigated;

(ii)   a suite of standard data-quality reporting procedures (including appropriate data-quality metrics) should be developed to assist the Secretariat and data analysts to:

   (a)   identify anomalous observer and vessel data
   (b)   provide feedback to data providers
   (c)   create metadata records to assist future data users by clarifying data-quality issues.

Model development and validation

A process for validating models used in providing advice

Background

5.11 In 2008, WG-SAM (SC-CAMLR-XXVII, Annex 7, paragraphs 8.4 and 8.5) and WG-EMM (SC-CAMLR-XXVII, Annex 4, paragraph 8.16) noted the need to establish a process for validating models used in providing advice. This process should be consistent with SC-CAMLR-XXVI, Annex 7, paragraph 8.19, which indicated that scrutiny of methods,

procedures or approaches could be undertaken by other working groups where they considered they could satisfactorily do the task but, where this was not the case, the preferred process would be:

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

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

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

Discussion

5.12   In considering models, the Working Group noted that the primary aim of validation is to give the users confidence that the model is suitable for the task and that there are two components to validation:

1.   Is the model technically competent to do what it says it can do?

2.   Can the model be used for the purposes for which it was designed, including appropriately representing the systems to be modelled?

5.13   The Working Group recommended that to satisfy the first validation, a model that is to be used for a task should be accompanied by a manual for the time of use and that the manual be sufficient for a user to satisfy themselves that the model is technically competent. A manual would, ideally, provide clear and comprehensive documentation of the maths, procedures and methods of use, along with technical demonstrations and examples of proof that the model and methods work as expected.

5.14   With respect to the second validation, the Working Group noted that users will need to determine if the forms of the functions appropriately represent the processes to be modelled. WG-SAM can provide advice on mathematical and statistical methods to represent different functions and uncertainties where needed.

5.15   The Working Group noted that the validation process will need to take account of the time-scale of delivery of a proposed model being presented.

5.16   For models proposed to replace existing methods, WG-SAM recommended that the procedure in SC-CAMLR-XXVII, Annex 7, paragraph 3.21, be generalised as:

(i)   a full paper detailing the method and its implementation needs to be compiled from existing work and presented to WG-SAM with further consideration of its implementation as discussed in the following points;

(ii)   simulated (theoretical) data need to be developed for a number of scenarios and those data need to be analysed using the existing model and the proposed model in order to compare how the two methods perform using data from known attributes to be estimated or modelled;

(iii)   mathematical and statistical details of how the input data for the new model are generated from the available datasets used in the existing model, including any pooling of the data in space and/or time, need to be provided;

(iv)   comparison of the outputs of the existing and proposed models and the reasons for any differences.

5.17   For models that have been developed to meet a specific request of the Scientific Committee or Commission by a short deadline, WG-SAM noted that there may not be time available for a full evaluation and validation before they need to be used. In such a situation, WG-SAM recommended that:

(i)   advice arising from the model is commensurate with the level of evaluation and validation of the model;

(ii)   users review the model code and documentation available, including how the model performs with respect to the task for which it will be applied, noting that developments and subsequent review could increase the utility and confidence in the model.

5.18   WG-SAM noted that the development and validation of models would be enhanced by maintaining the code on a fileshare that can be accessed by model developers and reviewers to add to, revise and/or review the code and its implementation. It also noted that this would be facilitated by having software to track updates and comments on the code (SC-CAMLR-XXVII, Annex 7, paragraphs 7.1 to 7.4). In this regard, a SubVersion (SVN) client, a mostly compatible successor to the widely used Concurrent Versions System (CVS) discussed last year, was demonstrated to the Working Group. It was considered to be a useful software package to help manage versions of these models. WG-SAM recommended that the Scientific Committee consider how this process could be facilitated.

FUTURE WORK

6.1   The Working Group identified the following future work:

(i)   ALKs (paragraph 2.8);

(ii)   tagging data (paragraphs 2.25 to 2.27);

(iii)   age-based assessments (paragraphs 3.15 to 3.19);

(iv)   length-based assessments (paragraphs 3.24 and 3.29 to 3.32);

(v)   standardising or estimating general abundance counts of seals and penguins (paragraph 3.33);

(vi) spatially structured population models (paragraph 4.6);

(vii) conserving VMEs (paragraphs 4.16 to 4.19);

(viii) decision rules for target species (paragraphs 4.24, 4.25, 4.28 and 4.30);

(ix) observer sampling requirements (paragraph 5.5);

(x) data quality (paragraph 5.10);

(xi) model development and validation (paragraph 5.18).

ADVICE TO THE SCIENTIFIC COMMITTEE

WG-EMM

7.1 WG-SAM has provided advice to WG-EMM on the following items:

(i) standardising or estimating general abundance counts of seals and penguins (paragraphs 3.35 and 3.37);

(ii) conserving VMEs (paragraphs 4.9 and 4.11 to 4.14).

WG-FSA

7.2 WG-SAM has provided advice to WG-FSA on the following items:

(i) ALKs (paragraphs 2.10 and 2.15);

(ii) tagging data (paragraphs 2.19, 2.22 and 2.24);

(iii) estimation of stock size of *Dissostichus* spp. in new and exploratory fisheries (paragraphs 2.41 and 2.42);

(iv) review of the Japanese longline research survey proposal (paragraphs 2.54 and 2.55);

(v) use of research hauls in the exploratory fisheries for *Dissostichus* spp. (paragraphs 2.59 to 2.61);

(vi) estimating biomass using commercial longline data in Divisions 58.4.1 and 58.4.2 (paragraph 2.65);

(vii) age-based assessments (paragraphs 3.10 to 3.14);

(viii) length-based assessments (paragraphs 3.23 and 3.29 to 3.31);

(ix) spatially structured population models (paragraph 4.5);

(x)　conserving VMEs (paragraphs 4.9 and 4.11 to 4.14);

(xi)　decision rules for target species (paragraphs 4.28 to 4.30).

WG-IMAF

7.3　There was no advice specific to WG-IMAF.

General

7.4　WG-SAM has provided general advice on the following items:

(i)　model development and validation (paragraphs 5.11 to 5.17);

(ii)　standardisation of CPUE for different longline fishing methods (paragraph 2.46).

7.5　The Working Group advised the Scientific Committee that submission of only abstracts is insufficient to undertake adequate reviews of papers and their conclusions. It requested that papers be submitted in full to future meetings.

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 Constable thanked the participants for their open and warm approach to their work, the subgroup coordinators for motivating clear and focused discussions, and the rapporteurs for producing a succinct report. He also thanked Mr Iversen and IMR for providing excellent facilities and meeting arrangements, and the Secretariat for its support.

8.3　The Working Group noted that the development of the meeting document archive on the CCAMLR website had greatly enhanced access to past meeting documents and reports.

8.4　Dr Agnew, on behalf of the participants, thanked Dr Constable for his leadership, and for introducing a new format to the meeting and report.

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Hillary, R. 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.

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AGENDA

Working Group on Statistics, Assessments and Modelling
(Bergen, Norway, 29 June to 3 July 2009)

1.   Introduction
     1.1   Opening of the meeting
     1.2   Adoption of the agenda and organisation of the meeting

2.   Use of data in assessments
     2.1   Age–length keys
     2.2   Tagging data
     2.3   Research longline data in estimating stock size

3.   Assessments
     3.1   Age-based (toothfish)
     3.2   Length-based (icefish)
     3.3   Abundance of seals and penguins

4.   Management strategies and their evaluation
     4.1   Spatially structured population models
     4.2   Conserving VMEs
     4.3   Decision rules for target species

5.   Other advice for SC-CAMLR
     5.1   Observer sampling requirements
     5.2   Data quality
     5.3   Model validation

6.   Future work
     6.1   Long-term work plan
     6.2   Other issues

7.   Advice to the Scientific Committee
     7.1   WG-EMM
     7.2   WG-FSA
     7.3   WG-IMAF
     7.4   General

8.   Adoption of report and close of meeting.

LIST OF DOCUMENTS

Working Group on Statistics, Assessments and Modelling
(Bergen, Norway, 29 June to 3 July 2009)

WG-SAM-09/1   Draft Agenda for the 2009 Meeting of WG-SAM

WG-SAM-09/2   List of Participants

WG-SAM-09/3   List of Documents

WG-SAM-09/4   CCAMLR Tagging Program
                     Secretariat

WG-SAM-09/5   Data quality assessment in CCAMLR: requirements for minimum
                     integrity testing to ensure that data are fit for purpose
                     Secretariat

WG-SAM-09/6   Allocation of research hauls in the exploratory fisheries for
                     Dissostichus spp. in Subareas 48.6 and 58.4 in 2008/09
                     Secretariat

WG-SAM-09/7   Otolith-based ageing of the Patagonian toothfish (*Dissostichus
                     eleginoides*) for the Heard and McDonald Islands: modelling fixed
                     and random reader error using multiple readings of a reference
                     S.G. Candy, G.B. Nowara, D.C. Welsford and J.P. McKinlay
                     (Australia)

WG-SAM-09/8   Incorporating sampling variation and random reader error into
                     calculation of effective sample size in the application of age length
                     keys to estimation of catch-at-age proportions
                     S.G. Candy (Australia)

WG-SAM-09/9   Update of the integrated stock assessment for the Patagonian
                     toothfish (*Dissostichus eleginoides*) for the Heard and McDonald
                     Islands using catch-at-age data and two years of survey abundance
                     S.G. Candy (Australia)

WG-SAM-09/10   Abundance and biological information on toothfish in
                     Division 58.4.4.a and b by *Shinsei Maru No. 3* in 2007/08 season
                     K. Taki, T. Ichii, M. Kiyota and S. Kawahara (Japan)

WG-SAM-09/11   Research plan for toothfish in Division 58.4.4a and b by *Shinsei
                     Maru No. 3* in 2009/10
                     Delegation of Japan

WG-SAM-09/12	Antarctic toothfish stock assessment in Division 58.4.1 on the basis of CPUE data D. Vasilyev, K. Shust, V. Tatarnikov, I. Istomin and A. Petrov (Russia)
WG-SAM-09/13	Adding catch at age and survey data to the 48.3 toothfish CASAL assessment D.J. Agnew and M. Belchier (United Kingdom)
WG-SAM-09/14	Exploring the robustness of the current toothfish spp. harvest control rules and potential exploitation rate-based alternatives R. Hillary (United Kingdom)
WG-SAM-09/15	Length-based assessment for the mackerel icefish (*Champsocephalus gunnari*) in Subarea 48.3 R.M. Hillary, D.J. Agnew and R. Mitchell (United Kingdom) (*CCAMLR Science*, submitted)
WG-SAM-09/16	Draft software user guide for: ICESCAPE: Integrated Count Effort by Seasonally Correcting Animal Population Estimates J. McKinlay, C. Southwell and R. Trebilco (Australia)
WG-SAM-09/17	Spatial population model user manual A. Dunn and S. Rasmussen (New Zealand)
WG-SAM-09/18	Development of spatially explicit age-structured population dynamics operating models for Antarctic toothfish in the Ross Sea A. Dunn, S. Rasmussen and S. Hanchet (New Zealand)
WG-SAM-09/19	Identification of data quality metrics for tagging data selection D.A.J. Middleton and A. Dunn (New Zealand)
WG-SAM-09/20	Analysis of icefish (*Champsocephalus gunnari*) spatial distribution for optimisation of the bottom trawl survey sampling S.M. Kasatkina (Russia)
WG-SAM-09/21	A simulation model for evaluating management strategies to conserve benthic habitats (vulnerable marine ecosystems) which are potentially vulnerable to impacts from bottom fisheries A.J. Constable (Australia)

Other Documents

WG-SAM-09/P1	An impact assessment framework for bottom fishing methods in the CCAMLR Convention Area B.R. Sharp, S.J. Parker and N. Smith (New Zealand) (*CCAMLR Science*, Vol. 16 (2009): 195–210)

**REPORT OF THE WORKING GROUP ON INCIDENTAL
MORTALITY ASSOCIATED WITH FISHING**
(Hobart, Australia, 12 to 16 October 2009)

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REPORT OF THE WORKING GROUP ON INCIDENTAL
MORTALITY ASSOCIATED WITH FISHING
(Hobart, Australia, 12 to 16 October 2009)

OPENING OF THE MEETING

1.1   The meeting of WG-IMAF was held in Hobart, Australia, from 12 to 16 October 2009.

1.2   The Co-conveners, Ms K. Rivera (USA) and Mr N. Walker (New Zealand), opened the meeting and welcomed participants, including the invited experts from ACAP and BirdLife International.

1.3   Dr K. Reid (Science Officer) also welcomed the group and highlighted the significance of this first WG-IMAF meeting as a separate working group, no longer of 'ad hoc' status.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1   The agenda of the meeting was discussed and it was agreed to add a separate subitem on the review of action plans to eliminate seabird incidental mortality to address France's progress with its action plan, and to include Conservation Measure 51-01 when evaluating information relating to the implementation of conservation measures with respect to seabird and marine mammal incidental mortality. The revised agenda was adopted (Appendix A).

2.2   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).

INTERSESSIONAL WORK OF WG-IMAF

2.3   The Co-conveners reported on the intersessional activities of WG-IMAF according to the agreed plan of intersessional activities for 2008/09 (SC-CAMLR-XXVII, Annex 6, Table 1).

2.4   The Working Group thanked the Secretariat for its work on the coordination of WG-IMAF intersessional activities and the technical coordinators of national observer programs for their support. It also thanked the Secretariat for its work on the processing and analysis of data submitted to the Secretariat by international and national observers during the 2008/09 fishing season.

2.5   The Working Group concluded that most tasks planned for 2008/09 had been successfully implemented. Much of the information requested intersessionally had been presented to the Working Group in papers submitted to the meeting. The list of current intersessional tasks was reviewed and a number of changes were agreed in order to

consolidate specific tasks in future plans. The Working Group agreed that the plan of intersessional activities, compiled by the Co-conveners and the Science Officer, be appended to its report (Table 1).

2.6 The Working Group especially welcomed to the meeting Mrs E. Reid (BirdLife International) and Dr M. Favero (ACAP) who were attending for the first time.

2.7 The Working Group greatly appreciated the participation of national technical coordinators who provided invaluable experience to the Working Group as it addressed numerous observer-related and data collection issues. In addition to the continued participation of technical coordinators at future meetings, WG-IMAF would also welcome the participation of Members engaged in fishing activities in, or adjacent to, the Convention Area who have not recently participated in WG-IMAF.

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, including those within the French EEZs in Subarea 58.6 and Division 58.5.1, during the 2008/09 season (Tables 2 and 3).

3.2 The proportions of hooks observed ranged from 14 to 99% with an average of 48% (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 2008/09 (including the French EEZs) were estimated to be 521 (Table 4). These consisted of 2% albatrosses (1% grey-headed albatrosses (*Thalassarche chrysostoma*) and 1% southern black-browed albatrosses (*T. melanophrys*)) and 98% petrels (91% white-chinned petrels (*Procellaria aequinoctialis*), 5% grey petrels (*P. cinerea*), 2% northern giant petrels (*Macronectes halli*) and 1% Cape petrels (*Daption capense*). It should be noted that for the first time the data from the French EEZs has been adjusted to the CCAMLR season (1 December to 30 November).

3.4 The total number of seabirds observed caught and released uninjured was 26 (Tables 2 and 3); all caught during hauling. Of these, 10 were caught within Subarea 48.3, 2 in Division 58.5.2, and 14 from within the French EEZs in Subarea 58.6 and Division 58.5.1. All vessels recorded the use of a haul-mitigation device (WG-IMAF-09/4 Rev. 2, paragraph 6).

Seabird incidental mortality in the French EEZs
in Subarea 58.6 and Division 58.5.1

3.5   Data were available from 15 cruises in Subarea 58.6 and 15 cruises in Division 58.5.1 in 2008/09 (Table 3). All vessels in the French EEZs were autoliners using at least 50 g m^{-1} IWLs. The proportion of hooks observed was 25% in each of the areas and the total observed seabird incidental mortality was 23 and 105 birds respectively (sum of dead and injured birds) (Table 3). The corresponding incidental mortality rates were 0.015 and 0.034 birds/thousand hooks and the extrapolated total seabird mortalities for Subarea 58.6 and Division 58.5.1 were 93 and 417 respectively (Table 4).

3.6   The observed captures in Subarea 58.6 comprised 19 white-chinned petrels (83%), 3 northern giant petrels (13%) and 1 grey petrel (4%). The corresponding figures for Division 58.5.1 were 99 white-chinned petrels (94%) and 6 (6%) grey petrels (WG-IMAF-09/4 Rev. 2, paragraph 3).

3.7   The Working Group noted that when comparing the seabird incidental mortality rates provided by France, this represented reductions of 60.9% and 47% for Subarea 58.6 and Division 58.5.1 respectively, compared to the previous season; a reduction of 46% from the combined total estimated incidental mortality from these areas (Tables 3 and 4).

3.8   The Working Group noted that 13% of seabirds observed captured were caught alive, indicating that they were taken on the haul (Table 3). This compares to 24% last year and reflects the increased use and effectiveness of haul-mitigation devices compared to the previous years.

Seabirds in trawl fisheries

Subarea 48.3 icefish

3.9   Observer data were available from all seven trawl cruises (data from two cruises were not available at the time the report was compiled) conducted within Subarea 48.3 during the 2008/09 season, 82% of all tows were observed (WG-IMAF-09/5 Rev. 2, Table 2).

3.10   For 2008/09, 11 seabird mortalities (5 white-chinned petrels and 6 black-browed albatrosses) were reported in Subarea 48.3 from five vessels which results in an estimated 14 mortalities (Table 5). In addition, 31 seabirds were released alive in Subarea 48.3 (Table 5) (17 white-chinned petrels, 11 black-browed albatrosses, 2 grey-headed albatrosses and 1 southern giant petrel (*M. giganteus*)).

3.11   This represents an increase in the level of seabird mortality from the 2007/08 season where five were recorded dead and five recorded released alive. The rate of mortality in Subarea 48.3 in 2009 was 0.07 birds per trawl, compared to 0.024, 0.07, 0.07 and 0.14 in 2008, 2007, 2006 and 2005 respectively (Table 6). Eight warp strikes were observed; 3 albatrosses and 5 white-chinned petrels, all in the air.

3.12   Observers recorded a number of different mitigation measures used. These included net cleaning, streamer lines, Brady bafflers, water jets, net binding and net weighting (WG-IMAF-09/5 Rev. 2, paragraph 11). The use of net bindings was reported on all vessels

for all sets. Net bindings were spaced between 1 and 5 m apart, with the mesh sizes which were bound ranging from 96 to 800 mm. In the case of net weighting, four vessels, the *Robin M Lee, Insung Ho, New Polar* and *Sil*, reported on the use of net weights. The *Robin M Lee* attached approximately 400 kg of weights to the net. *Insung Ho* attached weights to either side of the codend with a total mass of 585 kg. *New Polar* used 96–100 kg on the codend and 130–400 kg on the belly, and the *Sil* had 400 kg attached to the belly and 70 kg of codend chains.

Division 58.5.2 toothfish/icefish

3.13   Data were available from one vessel, *Southern Champion*, which conducted two trawl cruises within Division 58.5.2 during the 2008/09 season (Table 6). The Working Group noted that there was 100% observer coverage of fishing vessels in this fishery with 100% of tows observed.

3.14   One seabird mortality was reported. A Cape petrel became entangled in a paravane (WG-IMAF-09/5 Rev. 2, paragraph 14) which gave a mortality rate of 0.002 birds per trawl. The observer reported that net cleaning did not occur before each shot and that no marine mammal mitigation devices were used, however, the vessel did employ minimal deck lighting to reduce seabird collisions (WG-IMAF-09/5 Rev. 2, paragraph 16).

Krill

3.15   Data were available from 11[1] trawl cruises conducted within Area 48 during the 2008/09 season (WG-IMAF-09/5 Rev. 2). 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.

3.16   The Working Group noted that there were 10 reported incidents of seabird incidental mortality (all Cape petrels) in Subareas 48.1 and 48.2 and none were recorded in Subarea 48.3. This gave an overall incidental mortality rate of 0.01 birds per trawl for Area 48, slightly higher than last year.   A further 35 birds were released alive uninjured (WG-IMAF-09/6 Rev. 2, Table 6).

3.17   The Working Group noted that all the mortalities were reported on the *Saga Sea* while fishing with continuous trawls in Subarea 48.2 (Table 5). The observer reported that this was due to birds swimming under the net while it was on the surface and becoming trapped when the swell caused the net to come down on top of them.

3.18   This season saw the introduction of a revised warp strike protocol for continuous trawl systems following a recommendation from last year.   As a result of this there was an increased detection of warp strikes with 73 being observed, all were in the air and there were no mortalities recorded.

3.19   The Working Group recommended the continued use of the trawl warp strike protocol.

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[1]   One logbook was submitted by a national observer on board the *Konstruktor Koshkin*.

Seabirds in pot fisheries

3.20 During pot fishing in 2008/09, no seabird mortalities were recorded during either of the cruises targeting *D. eleginoides* in Division 58.5.2 (WG-IMAF-09/7, paragraph 6). No other pot fishing took place in the Convention Area.

Marine mammals

Marine mammals in longline fisheries

3.21 Seven marine mammal incidental mortalities were recorded in the Convention Area during the 2008/09 season (WG-IMAF-09/4 Rev. 2, paragraph 5). Three elephant seals (*Mirounga leonina*) were recorded as caught in the mainline (one in Subarea 48.3, two in Division 58.5.2), and two crabeater seals (*Lobodon carcinophagus*) were recorded as having being hooked in the flipper and hauled up dead in Subarea 88.1. There were also two cetacean incidental mortalities in Subarea 48.3. A killer whale (*Orcinus orca*) was recorded as hooked on the line and was dead when it came to the surface, and a sperm whale (*Physeter macrocephalus*) was hauled up dead after being caught in discarded fishing gear on the seabed (paragraph 13.10).

Marine mammals in trawl fisheries

Krill

3.22 Twelve marine mammal incidental mortalities (all fur seals) were recorded in the krill trawl fishery in 2008/09, all from one vessel, *Dalmor II* in Subarea 48.2 (WG-IMAF-09/5 Rev. 2, paragraph 6). This is an increase over the 2007/08 season where there were six reported incidental mortalities. The *Dalmor II* was the only observed trawler not to use a seal exclusion device although it had used one in the previous year in Subarea 48.3.

3.23 A further seven seals were recorded as being caught and released alive in Subarea 48.2, four from the *Dalmor II*, two from the *Saga Sea* and one from *Juvel*.

Finfish

3.24 No marine mammal incidental mortalities were observed in finfish trawl fisheries (Tables 7 and 8; WG-IMAF-09/5 Rev. 2, paragraphs 10 and 15). This was also the case for the previous two seasons.

Marine mammals in pot fisheries

3.25 No marine mammal incidental mortalities were reported for pot fisheries in the Convention Area (WG-IMAF-09/7). This was also the case for the previous two seasons.

Information relating to the implementation of Conservation Measures 26-01, 25-02, 25-03 and 51-01

3.26   Information from observer reports relating to the implementation of Conservation Measures 26-01, 25-02, 25-03 and 51-01 in 2008/09 was provided by the Secretariat (WG-IMAF-09/6 Rev. 2).

Conservation Measure 26-01 'General environmental protection during fishing'

Plastic packaging bands

3.27   Information from observer reports indicated that plastic packaging bands to secure bait boxes were on board during two cruises: *Antarctic Chieftain* in Division 58.5.2 and *Jung Woo No. 3* in Subareas 88.1 and 88.2 (WG-IMAF-09/6 Rev. 2, Table 1). Observers reported that on all vessels where plastic packaging bands to secure bait boxes were present, they were cut and retained or incinerated. Where information was provided, there was full compliance with Conservation Measure 26-01 with respect to the use of other plastic packaging bands. There was no information provided on the disposal of plastic packaging bands from one cruise, *New Polar* in Subarea 48.3.

Gear debris and garbage

3.28   The Working Group noted the discharge of oil from the *Argos Froyanes* in Subareas 88.1 and 88.2. There was no information provided on the disposal of oil, gear debris or garbage from one cruise, *Maksim Starostin* in Subarea 48.3 (WG-IMAF-09/6 Rev. 2, Table 1).

Conservation Measure 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

3.29   For Spanish-system vessels, one vessel (the *Jung Woo No. 2* in Subarea 88.1) did not meet the line-weighting regime as specified in Conservation Measure 25-02, paragraph 3, as weights were spaced beyond the 40 m maximum spacing (WG-IMAF-09/6 Rev. 2, Figure 1).

3.30   All autoline vessels fishing in Subareas 48.4, 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, met the requirement to achieve a consistent minimum line sink rate as described in Conservation Measure 24-02 (WG-IMAF-09/6 Rev. 2, Table 7 and Figure 1). As in previous years, this line-weighting requirement has been fully achieved by all vessels. For 2008/09, the Working Group noted that one autoline vessel (*Ross Star* in Subarea 48.3) used IWL and clip-on weights to achieve the sink rate requirements. All other autoline vessels were using IWLs (WG-IMAF-09/6 Rev. 2, Figure 1).

3.31   There was 100% compliance with night setting in all areas where this was required (Subareas 48.3 and 58.7) (Table 9).

3.32   Vessels fishing in Subareas 48.4, 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-09/6 Rev. 2, Table 7).

Offal discharge

3.33   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 2008/09 season (Table 9).

Discard of hooks

3.34   Observers reported hooks being present in offal discharge from one of 37 longline cruises. The observer on board the *Shinsei Maru No. 3* in Division 58.4.3 reported that hooks were present occasionally in offal discharge, despite efforts of the crew to remove them (WG-IMAF-09/6 Rev. 2, Table 1). This compares to one of 37 cruises last year with reports of hooks in offal discharge (SC-CAMLR-XXVII, Annex 6, paragraph 2.38).

3.35   The Working Group reiterated continued concern at the discarding of hooks in offal, given that nest surveys had once again found a high level of hooks around nests of wandering albatrosses (*Diomedea exulans*) on Bird Island, South Georgia (WG-IMAF-09/10). The Working Group again stressed that hook ingestion persists as a severe impact on Convention Area seabirds; these hooks come from longline fisheries inside and outside the Convention Area.

Streamer lines

3.36   Full implementation of all elements of the streamer line specification increased from 94.5% in 2007/08 (35 of 37 cruises) to 97% in 2008/09 (36 of 37 cruises) (Table 10).

3.37   There was one cruise (*Insung No. 1* in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b) where streamer lines did not meet the specification based on streamer lengths (Table 10). The Working Group noted that this vessel has failed to meet the specification for streamer lengths for the second consecutive year.

3.38   One cruise did not have a streamer line deployed throughout all sets. The observer on the *Austral Leader II*, fishing in Division 58.5.2, noted that on one night set the streamer lines became fouled with the mainline and broke during the set and were retrieved the next day during hauling.

3.39   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.

Haul mitigation

3.40   Apart from two vessels, there was full implementation of the haul-mitigation device requirement by all other vessels. The *Koryo Maru No. 11* used haul mitigation during 98% of hauls during one cruise in Subarea 48.3; it did not use haul-mitigation devices on four hauls due to severe weather conditions. The *Austral Leader II* used its haul-mitigation device on 98% of hauls during one cruise in Division 58.5.2, and the observer did not provide any information on the reason for non-deployment of the haul-mitigation device (Table 10).

Conservation Measure 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-09/5 Rev. 2, paragraph 11) and implementation of Conservation Measure 25-03 was good.

Net sonde cables

3.42   There were no reports of net monitoring cables (net sonde cables) being used in 2008/09 (WG-IMAF-09/6 Rev. 2, paragraph 18).

Offal discharge

3.43   The trawl vessel *Dongsan Ho*, operating in Subarea 48.3, was observed discarding small quantities of offal during net shooting on two occasions (WG-IMAF-09/6 Rev. 2, Table 6). Six seabirds (4 black-browed albatrosses and 2 white-chinned petrels) were killed or injured by this vessel during this cruise (Table 5). These captures did not occur in association with the observed offal discharge events.

Conservation Measure 51-01 'Precautionary catch limitations
on *Euphausia superba*'

3.44   The observer reported that the *Dalmor II* was not using a seal exclusion device and caught 12 Antarctic fur seals (*Arctocephalus gazella*), during fishing in Subarea 48.2 (WG-IMAF-09/6 Rev. 2, paragraph 6).

Summary of conservation measure implementation

3.45   The Working Group recommended that the Scientific Committee refer to SCIC the following list of vessels which did not fully implement the requirements of Conservation Measures 26-01, 25-02, 25-03 and 51-01:

Conservation Measure 26-01 –

(i)   *Antarctic Chieftain* and *Jung Woo No. 3,* which had plastic packing bands to secure bait boxes on board during cruises in the Convention Area (paragraph 3.27);

(ii)   *Argos Froyanes,* which discharged oil (paragraph 3.28);

Conservation Measure 25-02 –

(iii)   *Jung Woo No. 2* which exceeded the maximum spacing between weights on longlines (paragraph 3.29);

(iv)   *Shinsei Maru No. 3* due to the discharge of hooks in offal (paragraph 3.34);

(v)   *Insung No. 1* which used streamers that did not meet the minimum length specified (paragraph 3.37);

(vi)   *Austral Leader II* which did not use a streamer line throughout all setting of longlines (paragraph 3.38);

(vii)   *Koryo Maru No. 11* and *Austral Leader II* which did not use haul-mitigation devices on all hauls (paragraph 3.40);

Conservation Measure 25-03 –

(viii) *Dongsan Ho* which discharged offal during net shooting while trawling (paragraph 3.43);

Conservation Measure 51-01 –

(ix)   *Dalmor II* which did not use a marine mammal exclusion device (paragraph 3.44).

Review of action plans to eliminate seabird mortality

France's action plan to reduce/eliminate seabird mortality
in Subarea 58.6 and Division 58.5.1

3.46   The Working Group reviewed the progress report submitted by France in implementing its action plan developed to reduce seabird incidental mortality in Subarea 58.6 and Division 58.5.1 (SC-CAMLR-XXVIII/11) and other papers containing relevant information and analyses on seabird incidental mortality in the French EEZs (SC-CAMLR-XXVIII/BG/13, WG-IMAF-09/4 Rev. 2 and Table 11).   As noted by France in 2007 (SC-CAMLR-XXVI, paragraph 5.7), the objective of the action plan is to halve the level of incidental mortality by 2010. The plan contains action details for the following five elements:

- prescription of conservation measures
- regulatory instruments
- education and training
- data collection
- research and development.

3.47   The Working Group noted that 2008/09 is the second year of the action plan and that France has reduced seabird incidental mortality in its EEZs by 67.3% since 2006/07; mortalities in Division 58.5.1 fell from 1 943 (0.0798 birds/thousand hooks) to 643 (0.0316 birds/thousand hooks) and, in Subarea 58.6, from 314 (0.065 birds/thousand hooks) to 94 (0.0119 birds/thousand hooks) between 2006/07 and 2008/09 (French season). Thus, the implementation of the action plan has achieved its initial objective of halving the level of incidental mortality (SC-CAMLR-XXVI, paragraph 5.7) by 2010.   The Working Group commended France on progress made to date in implementing the plan and reducing seabird incidental mortalities.

3.48   Mr C. Marteau (France) provided data showing the total extrapolated weekly fishing effort and observed seabird incidental mortality rates (Figure 1). The Working Group agreed that these data were informative to discussions about the utility and optimal timing of mitigation measures such as total and area fishery closures and requested these data be included in France's progress report on action plan implementation in 2010.

3.49   As several measures have been implemented simultaneously by France, the Working Group noted that it is not possible to quantify the contribution of each measure to reduced by-catch rates.   The Working Group reiterated its view (SC-CAMLR-XXVII, Annex 6, paragraph 3.7) that while this suite of measures may ultimately be effective in reducing the incidental mortality to low levels, the lack of understanding of the quantitative contribution of each measure to the overall mitigation outcome may create difficulties in the future should fishing practices change.

3.50   The Working Group considered that the observed reduction in incidental mortality in 2008/09 was primarily due to the longer mid-season closure of the fishery (from 1 February to 10 March 2009 instead of 15 February to 15 March in 2007/08), improved designs and increased use of haul-mitigation devices and streamer lines, and better offal management practices.

3.51   Mr Marteau noted that, as part of the third year of its action plan, France will further develop the suite of mitigation measures used, in particular by:

(i)   extending the closure of the fishery in Division 58.5.1 by five days in order to cover more of the chick-rearing period of white-chinned petrels. The closure in 2009/10 will be for 43 days from 1 February to 15 March 2010;

(ii)   making greater use of regulations, introduced in 2008/09 to close certain sectors (i.e. areas) of the fishery and to prohibit a vessel fishing within a radius of 100 n miles of a specified location, to reduce mortalities in the seabird chick-rearing period;

(iii)   improving the performance of the streamer lines, particularly achieving an aerial coverage of 100 m on all vessels. The type of streamers used will be standardised throughout the fishing fleet;

(iv)   further improving the haul-mitigation devices (i.e. bird exclusion device (BED)) to achieve a significant reduction in incidental captures during hauling;

(v)   improving on-board retention of offal;

(vi)   seeking improvements to ensure full thawing of baits and introducing line-setting devices (e.g. line shooters) on some vessels.

3.52   Mr Marteau also noted that, in order to better understand the causes of incidental mortality events, new data will be collected in 2009/10, including time-depth recorder data on line sink rates. These data will be submitted to CCAMLR in the CCAMLR format. Mr Marteau also advised that France had committed to undertaking population counts of white-chinned petrels and grey petrels in Division 58.5.1, in order to accurately determine their current population sizes, and to continuing education and training sessions with vessel operators and crews to raise awareness of seabird incidental mortality issues.

3.53   The Working Group discussed which actions proposed for 2009/10 were likely to be most effective in achieving lower total incidental mortality and near-zero incidental mortality of grey petrels. The Working Group strongly supported France's actions relating to line weighting, streamer lines and haul-mitigation devices and the implementation of regulatory instruments (e.g. seasonal closures, night setting, offal discharge practices, prevention of hook discarding and elimination of IUU fishing), education and training of fishers and improved data collection protocols. In respect of offal management, the Working Group noted that full offal retention is best practice for reducing the attractiveness of the vessel to seabirds and avoiding interactions.

3.54   The Working Group reiterated its previous advice that, were France to fully implement all elements of CCAMLR's best-practice advice for mitigation of incidental mortality of seabirds, the levels of mortality observed in the French EEZs would be substantially reduced to near-zero levels.

3.55   The Working Group expressed doubts about the efficacy of efforts to improve thawing of baits and make greater use of line-setting devices to expedite gear sink rates because:

(i)   thawing beyond the point that allows the normal functioning of an automatic baiting machine has no effect on gear sink rates;

(ii)   Robertson et al. (2008) showed that the use of line setters has no effect on gear sink rates.

3.56   The Working Group suggested that initiatives associated with bait thaw status and line setters be removed from the action plan, and that fishing operators be encouraged to focus efforts on other elements of the plan that are known to assist in reducing incidental mortality.

3.57   In respect of France's proposal to implement manual line weighting to IWLs to further increase sink rates, the Working Group recalled the results of line-weighting research on unweighted (i.e. not IW) longlines (Robertson, 2000). Added weight (6 kg) at less than 50 m spacings considerably increased sink rates between line weights, but intervals >50 m made no difference. Although the trial was based on unweighted longline − at the time of the trial IWL did not exist − a weight spacing of <50 m remains the best available advice for increasing sink rates of IWL to reduce seabird interactions.

3.58   The Working Group also recommended that France give high priority to:

(i)   actions to ensure near-zero incidental mortality of grey petrels from the Kerguelen Islands population and to further significantly reduce the incidental mortality of white-chinned petrels, especially in those areas and periods of high incidental mortality. Such actions should include proactive seasonal closures of areas frequented during chick-rearing periods, when incidental mortality from fishing has been highest;

(ii)   actions to further significantly reduce incidental catches during hauling to near-zero, including by the use of a BED (paragraph 6.3);

(iii)   standardising the design and deployment of streamer lines;

(iv)   recommendations in paragraph 8.8.

3.59   The Working Group noted that France was utilising sub-sector closures within Division 58.5.1 as a tool to reduce seabird incidental mortality. However, no information on the criteria and/or the decision-making process about when and where such closures are implemented is provided in France's action plan developed to reduce seabird incidental mortality (SC-CAMLR-XXVII/8) or the progress report on the action plan (SC-CAMLR-XXVIII/11).

3.60   The Working Group requested that in future progress reports France details the sub-sector closures and the criteria used to make such decisions in order to allow a more detailed understanding of this process.

3.61   The Working Group also noted that of the seven vessels fishing in Division 58.5.1, three vessels (Ships 3, 5 and 6) were responsible for the majority of observed mortalities (WG-IMAF-09/4 Rev. 2, Table 4). The observed catch totals (all cruises combined) for all other vessels were <10 birds/vessel.

3.62   The Working Group agreed that individual vessel seabird limits had been very effective in reducing incidental mortality in other CCAMLR fisheries and encouraged France to develop such limits as part of its action plan to reduce/eliminate seabird incidental mortality in Subarea 58.6 and Division 58.5.1.

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-XXIV/BG/28, item 3.2).

4.2   A written report was provided by New Zealand (WG-IMAF-09/16) noting the level of seabird incidental mortality within New Zealand's EEZ and its progress to reduce seabird incidental mortality. The Working Group encouraged New Zealand to undertake further actions in the near future to reduce these levels of incidental mortality.

4.3   Verbal reports were given by Mr C. Heinecken (South Africa) and Mr I. Hay (Australia) regarding the levels of incidental mortality of Convention Area seabirds within their respective country's EEZs and their progress to reduce seabird incidental mortality.

4.4   The Working Group welcomed these reports, noting that these Members had applied mitigation measures and processes that had been used by CCAMLR to significantly reduce seabird incidental mortality in the Convention Area.

4.5   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; SC-CAMLR-XXVII, paragraphs 5.12 to 5.17). Members submitting reports in 2010 are encouraged to give emphasis to information about the level and species composition of incidental mortality, wherever possible, and the use of mitigation measures and management approaches similar to those used in CCAMLR fisheries or potentially relevant to such fisheries.

4.6   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 have been 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 during the 2008/09 season, at least five of the six IUU vessels sighted in the Convention Area were reported as using gillnets (WG-FSA-09/5 Rev. 2). The Working Group welcomed the information presented by Australia (TASO-09/10) that it had hauled part of one IUU gillnet and found no evidence of seabird incidental mortality, noting that this was the only information about incidental mortality of seabirds from IUU gillnetting.

5.4   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.

5.5   Because many seabird species are facing potential extinction as a result of fisheries-related mortality, the Working Group again requested the Commission to continue to take action to prevent further incidental mortality of seabirds by IUU vessels in the forthcoming fishing season.

RESEARCH INTO AND EXPERIENCE WITH MITIGATION MEASURES

Longline

        Haul-mitigation devices

6.1   In recent years there has been an increased focus on methods to reduce incidental seabird captures that occur during longline hauling. Mrs Reid reported to the Working Group on the design and performance of BEDs placed around the hauling bay in CCAMLR longline fisheries (WG-IMAF-09/14). This review highlighted that effective BEDs had two operational characteristics:

    (i)   to deter birds from flying directly into the area where the line is being hauled
    (ii)   prevent birds that are sitting on the surface from swimming into the hauling bay area.

6.2   The Working Group agreed that a best-practice BED should comprise two booms – one forward and one aft of the hauling area – connected at their outboard ends by a rope and

trailing a line of buoys on the water surface connected to the outboard ends of both booms. Depending on weather conditions and seabird behaviour, streamers can be hung from the booms and/or the connecting rope.

6.3   The Working Group agreed that Conservation Measure 25-02 be revised to provide a description of a best-practice BED to reduce haul incidental catch on longline vessels operating in areas defined as average- to high-risk areas (levels of risk 4 or 5), where BEDs are required to be deployed. In addition, it was recommended that Conservation Measure 25-02 be revised to encourage longliners operating in low- to medium-risk areas (1–3) to adopt best-practice BEDs.

Trawl

6.4   The Working Group acknowledged the usefulness of TASO-09/5 (that described in detail the three main types of fishing for krill: conventional trawling, continuous trawling and a pumping system to clear the codend) in understanding the potential interactions with seabirds and marine mammals in the krill fishery.

6.5   WG-IMAF-09/15 reported on a review on the development of mitigation measures to reduce seabird mortality caused by net entanglement in the icefish trawl fishery in Subarea 48.3. The review clearly suggests that the adoption of net binding has been critical in reducing seabird incidental mortality caused by entanglement on the shot and net weighting appears to be largely responsible for reducing entanglements on the haul.   These two measures in combination with other operationally simple and cost-effective measures, such as net cleaning and good deck practices to minimise the surface time of the net during the haul, have resulted in a reduction of seabird entanglements in Subarea 48.3 from 0.26 birds/trawl in 2001/02 to 0.01 birds/trawl in 2008/09.

6.6   The Working Group commended the industry for its success in developing and trialling this suite of measures that have reduced seabird incidental mortality in the icefish trawl fishery in Subarea 48.3. It was agreed that the introduction of a vessel-specific 20-bird mortality limit in 2001 provided a strong commercial incentive that was the key driver that led to the development of net binding and a suite of other measures that are highly effective, simple and easily applied.

6.7   The Working Group encouraged the appropriate use of these measures (net binding, net cleaning, net weighting and good deck practices) in trawl fisheries outside the Convention Area to mitigate incidental mortality of Convention Area seabirds from net entanglement.

6.8   The Working Group recommended that best-practice mitigation advice for the icefish trawl fishery in Subarea 48.3 would be clarified if the citation in footnote 3 of Conservation Measure 42-01 (SC-CAMLR-XXV, Annex 5, Appendix D, paragraph 59), which cross-references technical advice on the application of net binding and other key mitigation measures, is substituted with the following text (in italics) which has been updated to reflect the findings of WG-IMAF-09/15:

The following guidelines are provided to assist in the uptake of best-practice mitigation measures:

(i)   *When the net is on the deck, prior to shooting, the application of 3-ply sisal string (which typically has a breaking strength of around 110 kg), or a similar inorganic material, at intervals of 5 m or less prevents the net from spreading and lofting at the surface. Net binding should be applied to mesh ranging from 120–800 mm. These mesh sizes have been shown to cause the majority of entanglements of white-chinned petrels and black-browed albatrosses, which are the species most vulnerable to this form of mortality in Subarea 48.3.*

(ii)   *When applying the 'string', tie an end to the net to prevent the string from slipping down the net and ensure that it can be removed when the net is hauled.*

(iii) *Since 2003, weights of 200–1 250 kg have been added to the codend, belly, mouth and groundrope of the net to increase the sink rate and increase the angle of the net's ascent during hauling, thus minimising surface net time. Evidence suggests that this has been effective in reducing bird entanglements during the haul. Vessels are encouraged to further experiment with appropriate net weighting.*

(iv)   *Net cleaning should be used in conjunction with added weight and net binding to reduce seabird captures during shooting operations.*

(v)   *Other additional steps should be taken to minimise the time that the net is on the water's surface during shooting and hauling.*

General

6.9   WG-IMAF-09/16 summarised ongoing developments in New Zealand's EEZ relevant to the reduction of seabird mortality in trawl fisheries. Among other items, the document summarised the results of a trial examining the effect on the number of seabirds attending a trawl vessel when discharging minced/mealed fish waste compared with when discharging unprocessed offal and whole fish. Mincing led to significant reductions in abundance of the large albatross species but did not alter the abundance of smaller seabird species. Other trials under way examine the effect of batch versus continuous discharge using offal, whole fish and minced fish waste. The Working Group welcomed this initiative, noted its relevance to trawl and longline fisheries in the Convention Area and encouraged the submission of the findings to WG-IMAF.

6.10   The Working Group discussed the potential effectiveness of different approaches to controlled offal management, including the form (minced/whole) and timing (batched versus continuous) of discharge and the location of the discharge point on the vessel, and encouraged further research on this topic.

6.11   The Working Group requested that the Scientific Committee provide a clear definition of offal and other fisheries by-catch related material discharged from the vessels at sea.

OBSERVER REPORTS AND DATA COLLECTION

Notification of observer deployment

7.1   The Working Group expressed concern that the Secretariat reported that it had not received appropriate notifications prior to some observer deployments and reiterated the requirement that all technical coordinators report them as required in the text of the Scheme of International Scientific Observation.

Banded bird observation data

7.2   The Working Group requested again that technical coordinators advise observers to report both the colour and number of all bird bands in the cruise report (SC-CAMLR-XXVII, Annex 6, paragraph 7.3).

Extrapolation of total marine mammal incidental mortality

7.3   The Working Group agreed that, as in previous years, the nature of the longline fisheries meant that all marine mammal incidental mortalities are likely to have been recorded, and no extrapolation of the number of marine mammal incidental mortalities would be undertaken (SC-CAMLR-XXVII, Annex 6, paragraph 7.4).

7.4   The Working Group agreed that marine mammal incidental mortalities in krill fisheries should be considered on a case-by-case basis owing to inconsistent levels of observer coverage across vessels.

Progress on a trawl warp strike data collection protocol
for inside the Convention Area

7.5   The Working Group noted that warp strike data were collected in 179 of 194 (92%) icefish trawls in Subarea 48.3 (up from 70% in the previous year) and that 8 strikes were observed: 3 albatrosses and 5 white-chinned petrels, all in the air. In Division 58.5.2, observation rates decreased from 14 to 6% and no strikes were recorded.

7.6   Warp strike data were collected in 234 of 1 329 (17%) of trawls in the krill fishery in Subareas 48.1 and 48.2 and a total of 73 strikes were observed: 64 petrels in the air, 8 petrels in the water and 1 petrel was dragged underwater. Data was also collected in 5 of 17 (29%) krill trawls in Subarea 48.3. In the continuous trawl system, observations are made during two 15-minute periods each day and not on the set and haul. For this reason, the coverage from the krill vessels this season cannot be compared with previous years.

7.7   Noting the similarity between the functions of paravanes and net sonde cables, the Working Group recommended that the observer logbook be updated and the term 'net sonde' be replaced by 'net monitoring cable' which should be defined as a third wire or cable running from the stern of the vessel to the net.

7.8   The Working Group recommended that the cruise report be updated to include a request to observers to describe the details of any paravanes or other equipment extending from the vessel into the water for the purposes of monitoring fishing gear.

Streamer line information

7.9   The Working Group noted that variability in the measurement of aerial extent was relatively small and that the two main factors affecting aerial extent will be the height of attachment above the water and the type of towed object.

7.10   The Working Group therefore requested that accurate measurements of the aerial extent continue to be taken at the start of a cruise and then again only if streamer line construction changes. It also requested that observers record more detail on the specifications of the towed device − including its dimensions, mass and the type of materials used in its construction − and include a photograph in the cruise report.

Marine debris data and photograph collection

7.11   The Working Group discussed its previous request for photographs of fishing gear on CCAMLR vessels for the purpose of identifying marine debris (SC-CAMLR-XXVII, Annex 6, paragraphs 12.8 and 12.9). However, it noted that the marine debris reported was predominantly from non-fishing origins (WG-IMAF-09/8, Table 2).

7.12   Following concerns over the loss of fishing gear, the Working Group recommended that observer reports be amended to include more details of lost fishing gear, such as length of lines lost (paragraph 13.11) and that observer photographs of fishing gear are no longer required.

Observer training and accreditation of observer training

7.13   The Working Group noted a request from ad hoc TASO (SC-CAMLR-XXVIII/BG/9) for guidelines and observer training standards information and agreed to include the request in its intersessional work plan (Table 1).

WG-IMAF priorities for data collection by observers

7.14   The Working Group reiterated its needs and priorities for data collection by observers in CCAMLR fisheries (Tables 12, 13 and 14).

Longline

7.15   The Working Group discussed the requirement to verify streamer line deployments on 100% of setting operations (Table 14).

7.16   The Working Group recommended that consideration should be given by ad hoc TASO to alternative methods for recording some of this information (e.g. via photographs, video, electronic monitoring (load cells)). It further noted that a reduction in the frequency of these observations, which may be hazardous in rough weather, would improve observer safety.

7.17   The Working Group also requested that ad hoc TASO investigate alternative methods (such as electronic monitoring means) of collecting data from hauling operations so that consideration of the current observer requirements may be reviewed in the future.

7.18   The Working Group reiterated its praise for the valuable work of observers and the importance of observer data to the work of WG-IMAF.

RESEARCH INTO THE STATUS AND DISTRIBUTION OF SEABIRDS
AND MARINE MAMMALS

8.1   The Working Group thanked BirdLife International for details of the most recent update to the BirdLife International Global Procellariiform Tracking Database which included information on sooty albatrosses (*Phoebetria fusca*) and Tristan albatrosses (*D. dabbenena*) from Gough Island and wandering albatrosses from South Georgia that were added in 2009 (WG-IMAF-09/13).

8.2   Dr Favero reported on progress in the work of ACAP's Status and Trends Working Group on ACAP Species Assessments which are available on the ACAP website (www.acap.aq). The Working Group noted that there are 22 species of albatross and 7 species of petrel.

8.3   The Working Group thanked France for the English translation of SC-CAMLR-XXVIII/BG/13 that summarised results of a study between 2004 and 2006 to evaluate the impact of longline fisheries on the populations of white-chinned and grey petrels breeding on Crozet Archipelago and Kerguelen Islands.

8.4   The Working Group reiterated its advice of last year (SC-CAMLR-XXVII, Annex 6, paragraph 8.7) that the authors should submit SC-CAMLR-XXVIII/BG/13 to WG-SAM in order that the population modelling of both white-chinned and grey petrels can receive expert review. The Working Group suggested that this was an appropriate process for similar studies that may be submitted in the future.

8.5   The Working Group expressed concern that between 1988 and 2005 the estimated population size of grey petrels on Kerguelen had decreased at a rate of 20 to 30% per year. This decline in population was largely attributed to an increase in adult mortality which was directly attributable to the legal and IUU longline fisheries operating in Divisions 58.5.1 and 58.5.2. It noted that mortality rates in 2007/08 and 2008/09 were 10 times lower than the maximum rates in 2004/05.

8.6   The Working Group noted that the incidental mortality of grey petrels has reduced in recent years with nine recorded killed in Subarea 58.6 and Division 58.5.1 in 2008/09, however, it is unclear to what extent this reduction is due to reduced fishing effort, improved mitigation or fewer birds in the population.

8.7   SC-CAMLR-XXVIII/BG/13 also estimated that the number of breeding white-chinned petrel pairs on Possession Island declined by 41% between 1983 and 2004 at a rate of 2.6% per year. Fisheries incidental mortality was identified as being responsible for 30% of this decrease, while the remainder was due to environmental factors. The model also highlighted that longline fisheries mainly impact on juvenile white-chinned petrels and the Working Group noted that this suggested that, even in the absence of further incidental mortality, the population will continue to decline for several years due to reduced recruitment of juveniles into the breeding population.

8.8   The Working Group noted that the study in SC-CAMLR-XXVIII/BG/13 concluded in 2006. Since then the rate of incidental mortality had declined. However, the following suite of recommendations in respect of white-chinned and grey petrels, taken directly from SC-CAMLR-XXVIII/BG/13 (in italics), are still relevant to the further development and implementation of the French action plan aimed at reducing seabird by-catch in the French EEZs in Division 58.5.1 and Subarea 58.6 (paragraphs 3.46 to 3.62):

(i)   *Conservation schemes implemented to limit seabird by-catch by longliners operating around the Kerguelen Islands need to be sustained, at least for white-chinned petrels.*

(ii)   *However, concerning grey petrels, new conservation actions need to be implemented otherwise the Kerguelen population would disappear within 30 years.*

(iii)   *Banning of* D. eleginoides *fishing during May to July would be an effective conservation action for reducing by-catch levels. Such a scheme was adopted for white-chinned petrels (fishing ban during February) and resulted in a dramatic drop in the numbers of birds accidentally killed by longliners. However, the implementation of such a conservation measure, which would benefit grey petrels without doubt, would also have some economic consequences that need to be evaluated.*

(iv)   *More data should be collected, notably on the gender and sexual maturity of killed birds recovered on fishing vessels to improve modelling of this population's evolution.*

(v)   *With these new data, an updated analysis should be conducted to elucidate the exact most critical period and areas of overlap with fisheries for grey petrels. Such an analysis would help with designing effective conservations plans while also balancing economic interests.*

ASSESSMENT OF RISK IN CCAMLR SUBAREAS AND DIVISIONS

9.1   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 (Tables 13 and 14 and Figure 2).

9.2   WG-IMAF-09/11 contained a proposal to move the start date of the fishery for *D. eleginoides* in Subarea 48.3 forward by five days from the date of 1 May as set out in Conservation Measure 41-02.

9.3   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).

9.4   The Working Group agreed that such an extension in the 2009/10 fishing season should only be open to vessels fully complying with Conservation Measure 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. The Working Group considered the additional risk was addressed by these measures.

9.5   The Working Group agreed that Conservation Measure 41-02 be modified as follows (in italics):

> *For the purpose of the longline fishery for* Dissostichus eleginoides *in Statistical Subarea 48.3, the 2009/10 season is 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 2009/10 season is defined as the period from 1 December to 30 November, or until the catch limit is reached, whichever is sooner. The season for longline fishing may be extended and start on 26 April for any vessel which has demonstrated full compliance with Conservation Measure 25-02 in the previous season. The extension to the season shall also be subject to a catch limit of three (3) seabirds per vessel. If three seabirds are caught during the season extension, fishing shall cease immediately for that vessel and shall not resume until 1 May 2010.*

9.6   The Working Group noted that WG-IMAF-09/11 contained a proposal for incremental five-day extensions to the fishing season into April in subsequent years. In the event that WG-IMAF does not meet in 2010, the Working Group agreed that the following decision rules could be used by the Scientific Committee in respect of an extension in 2010/11, based on the level of seabird incidental mortality during the extension period in 2009/10:

(i)   if, on average, less than one seabird per vessel is caught during the extension period, the Working Group would not object to an extension for 2010/11 for a 10-day period at the end of April; or

(ii)   if, on average, between one and three seabirds per vessel, or more than 10 seabirds in total, are caught during the extension period, the Working Group would not object to another extension for 2010/11 for the same five-day period; or

(iii) if, on average, more than three seabirds per vessel, or more than 15 seabirds in total, are caught during the extension period, the Working Group would recommend that there would be no extension into April for 2010/11.

9.7   Following 2010/11, results of these trial season extensions would need to be reviewed before any recommendations on further extensions could be made.

9.8   During its discussion of this proposal, the Working Group also noted that the requirement for sequential setting, as set out in Conservation Measure 41-08, paragraph 5, was unlikely to be useful in fishing season extensions in established fisheries.

INCIDENTAL MORTALITY OF SEABIRDS IN RELATION
TO NEW AND EXPLORATORY FISHERIES

New and exploratory fisheries operational in 2008/09

10.1   Of the 72 vessel by subarea/division notifications for exploratory longline fisheries for 2008/09, 33 were undertaken. No incidental seabird mortality was recorded. The strict adherence to the requirements in Conservation Measures 24-02 and 25-02 has proven successful in achieving zero incidental mortality of seabirds. Two crabeater seals were reported caught in the exploratory fishery in Subarea 88.1 (WG-IMAF-09/4 Rev. 2).

10.2   The notification for an exploratory krill trawl fishery for 2008/09 was undertaken. The two notifications for new pot fisheries in 2008/09 were not undertaken.

New and exploratory fisheries proposed for 2009/10

10.3   The assessment of the risk to seabirds posed by new and exploratory longline fisheries in the Convention Area is incorporated in SC-CAMLR-XXVI/BG/31, and is summarised in Table 14 and Figure 2. Table 14 also includes an assessment of recommended levels of observer coverage.

10.4   Sixty-nine notifications (vessels by subarea/division) for exploratory longline fisheries, submitted by nine Members, were received by CCAMLR in 2009. The areas for which longline proposals were received (CCAMLR-XXVIII/13, Table 1) were assessed in relation to the risk of seabird incidental mortality according to the approach and criteria set out in SC-CAMLR-XXVI/BG/31.

10.5   One notification for an exploratory trawl fishery for krill was received by CCAMLR in 2009.   The area for which a trawl proposal was received (Subarea 48.6, CCAMLR-XXVIII/13, Table 2) was assessed in relation to the risk of seabird incidental mortality according to the approach and criteria set out in SC-CAMLR-XXVI/BG/31.

10.6   Two notifications for new pot fisheries for crabs were received by CCAMLR in 2009. The areas for which these proposals were received (CCAMLR-XXVIII/13, Table 3) have not

been assessed in relation to the risk of seabird incidental mortality in pot fisheries. A risk assessment for pot fisheries may be possible in future, but at this time insufficient information is available to undertake such an exercise.

10.7   The Working Group agreed that in the interim, observation of pot fishing was required to collect descriptive information about the potential for seabird and marine mammal incidental mortality using this fishing method. Observation should focus on hauls for incidental mortality events and description of any entanglements.

10.8   In 2005 the Working Group developed a checklist to assist Members when completing their longline notifications (SC-CAMLR-XXIV, Annex 5, Appendix O, paragraph 193). This checklist was expanded in 2009 to also include trawl and pot fishery notifications (COMM CIRC 09/66–SC CIRC 09/31, 16 June 2009).

10.9   All longline notifications provided sufficient information to indicate that the proposals fully comply with relevant seabird incidental mortality minimisation measures (Conservation Measures 24-02 and 25-02, and the relevant measures in the 41-series), and do not conflict with the WG-IMAF risk assessment.

10.10   The Working Group welcomed the continued improvement in notifications, in particular that all longline notifications in 2008 and 2009 have provided a high standard of information compared with 15% of proposals that had insufficient information in 2007.

10.11   However, the Working Group noted that two notifications contained ambiguities that will be discussed by the Secretariat with the relevant Members and clarified prior to SC-CAMLR-XXVIII.

10.12   The Working Group noted that it had not undertaken a risk assessment for marine mammals to date and that this was an identified item of future work for WG-IMAF. Completion of such a risk assessment would allow the provision of more complete advice on incidental mortality associated with fishing.

INTERNATIONAL AND NATIONAL INITIATIVES RELATING TO INCIDENTAL MORTALITY OF SEABIRDS AND MARINE MAMMALS IN FISHING

ACAP

11.1   The ACAP representative (Dr Favero) introduced WG-IMAF-09/17 which presented key outcomes of the Third Session of its Meeting of the Parties (27 April to 1 May 2009) of relevance to WG-IMAF. Those outcomes were the adoption of the Advisory Committee's Work Programme for 2010–2012 and the granting of approval for the ACAP Secretariat to enter into a Memorandum of Understanding (MOU) with CCAMLR. The objective of this MOU is to facilitate cooperation between CCAMLR and ACAP with a view to supporting efforts to minimise incidental mortality of albatrosses and petrels listed in Annex 1 of ACAP within CAMLR's Convention Area, including exchange of data and expertise. The proposed MOU has been submitted as a background document for consideration at CCAMLR-XXVIII (CCAMLR-XXVIII/BG/19).

11.2   The Working Group strongly supported closer engagement with ACAP, noting that it would potentially benefit the work of CCAMLR in several ways, including data exchange (e.g. reporting of seabird incidental mortalities outside the Convention Area by CCAMLR Parties which are also ACAP Parties) and encouraging RFMOs adjacent to the Convention Area to reduce seabird incidental mortality in the fisheries they manage. Therefore, the Working Group supported an MOU between CCAMLR and ACAP.

11.3   Dr B. Sullivan (BirdLife International) informed the Working Group about a BirdLife/ACAP collaboration to develop fact sheets aimed at informing fisheries and vessel managers on best-practice mitigation to reduce seabird by-catch. There are currently 15 available in English[2] and they will soon be available in French, Japanese, Portuguese and Spanish. The experiences of CCAMLR feature prominently in the demersal longline and trawl fact sheets.

International initiatives

Implementation of CCAMLR Resolution 22/XXV

11.4   The Working Group noted that the work of ACAP is increasingly relevant to the implementation of Resolution 22/XXV including, in respect of ACAP, gathering data on incidental mortalities of Convention Area species in fisheries outside the Convention Area. The Working Group encouraged ACAP to report this and other relevant information to CCAMLR.

FAO IPOA-Seabirds

11.5   CCAMLR-XXVIII/BG/4 reported on the Secretariat's attendance at COFI-28 and the pending publication of best-practices technical guidelines for implementation of the *International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries* (COFI-28 Report[3], paragraph 13). The guidelines will become part of the UN FAO Technical Guideline Series under the Code of Conduct for Responsible Fisheries. As reported in 2007 (SC-CAMLR-XXVI, Annex 6, paragraph I.65(ii)) and 2008 (SC-CAMLR-XXVII, Annex 6, paragraph 11.8) the guidelines will extend the application of IPOA-Seabirds beyond longline fisheries and will provide guidance on best practice to other relevant gear (trawl and gillnet fisheries) and for regional plans developed by RFMOs.

11.6   The achievements of CCAMLR in reducing seabird incidental mortality in demersal longline and trawl fisheries featured prominently in the report of the Consultation. The Working Group thanked CCAMLR Members for their critical support for the initiative at COFI-28.

11.7   The Working Group recommended that CCAMLR Members follow the Best Practice Technical Guidelines for IPOA/NPOA-Seabirds when designing or revising their NPOA-Seabirds.

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2   www.birdlife.org/seabirds/savethealbatross.html#Simple_effect_and_cheap_solutions
3   Available from ftp://ftp.fao.org/docrep/fao/012/i1017e/i1017e00.pdf.

RFMOs and international governmental organisations

WCPFC

11.8   The Working Group noted that WCPFC is continuing its risk-assessment process and this is expected to result in further improvements to its seabird incidental mortality management measures, including those for reducing seabird incidental mortality.

ICCAT

11.9   ICCAT's Sub-committee on Ecosystems completed its initial seabird risk assessment in 2009. Information from this assessment as well as the sub-committee's recommendations, will be considered by ICCAT's Scientific Committee on Research and Statistics and the ICCAT Commission in October and November of this year.

CCSBT

11.10 In discussion of CCAMLR-XXVIII/BG/10, the Working Group noted the offers made by CCAMLR to the CCSBT ERSWG in respect of sharing knowledge and experience in issues related to seabird mitigation, including in areas of education and outreach.

11.11 Noting that the discussion of seabird by-catch by the CCSBT ERSWG was relevant to CAMLR Convention Area seabirds, WG-IMAF asked that the Secretariat request a copy of the ERSWG report from CCSBT and any other documents from that meeting that might be relevant to incidental mortality of seabirds in the fishery for southern bluefin tuna.

11.12 The Working Group noted the difference in approach to issues of seabird incidental mortality of Members of CCSBT and other relevant RFMOs, which are also Members of CCAMLR, in different fora and encouraged internal communications within these Members in order to give better effect to the commitment contained in CCAMLR Resolution 22/XXV in all of the RFMOs listed in Appendix 1 of that resolution.

IOTC

11.13 The Working Group had no further update on developments in IOTC and noted that the IOTC is presently meeting in Kenya.

Joint Tuna RFMOs Meeting

11.14 The European Community organised and hosted in 2009 the Second Joint Meeting of Tuna RFMOs. The meeting developed and adopted by consensus a Course of Actions,

including a number of elements for immediate action and the organisation of four intersessional workshops, one of them specifically addressing issues relating to by-catch, to be organised by the USA and held in 2010.

National initiatives

11.15 Since 2007, South Africa has maintained 100% observer coverage on all foreign-flagged pelagic tuna longline vessels permitted to fish within the South African EEZ and operating on adjacent high seas with South African permits. South African-flagged pelagic and demersal longline vessels have 25 and 15% observer coverage respectively.

11.16 South Africa has taken a proactive approach to mitigation measures in all sectors of its longline and trawl fisheries and these form part of the permit conditions that legally allow vessels to operate. Specific seabird mitigation measures include: (i) seasonal limits on the total seabird catch for each vessel; (ii) setting operations restricted to night-time only; (iii) the compulsory use of streamer lines for longliners during the setting operations; (iv) the compulsory use of streamer lines for demersal and midwater trawlers during the entire tow time; and (v) regulations of offal discharge for longline fisheries.

11.17 The Working Group noted that New Zealand is currently revising its 'National Plan of Action to Reduce the Incidental Catch of Seabirds in New Zealand Fisheries' (NPOA-Seabirds) and is taking into account FAO's Best Practice Technical Guidelines for IPOA/NPOA Seabirds. The revised approach uses a hierarchical risk-assessment process to determine high-risk seabird species and high-priority fisheries where additional management action may be necessary to reduce mortalities to biologically 'safer' levels. In addition, best-practice measures will likely be implemented across all fisheries that pose a risk to seabirds, with the aim of minimising seabird interactions in a safe and practical manner (WG-IMAF-09/16). The Working Group commended New Zealand for using the Best Practice Technical Guidelines for IPOA/NPOA Seabirds as a basis for the revision of its NPOA-Seabirds.

11.18 The Working Group welcomed a range of information and papers submitted by France to WG-IMAF-09 (Agenda Item 3.4).

11.19 Mr Hay reported on the third year of a trial of demersal longlining for toothfish off Macquarie Island, which lies adjacent to the Convention Area, and the seabird incidental mortality mitigation measures used during the trial (WG-FSA-07/19). No seabirds have been caught during the three years of the trial, which used mitigation measures similar to those prescribed in CCAMLR but with the addition of seabird catch limits for individual species. The trial is presently being evaluated prior to a decision about whether longlining should be an approved method in this fishery.

11.20 Mr Hay also reported that Australia is presently conducting a study of seabird incidental mortality in its major pelagic finfish trawl fishery. The study, which will be completed in mid-2010, is assessing the risks of incidental mortality from different gear types and will provide advice about how best to mitigate seabird incidental mortality.

FISHERY REPORTS

12.1   The Working Group reviewed the Fishery Reports developed by WG-FSA (Annex 5, Agenda Item 5) and the information relating to the incidental mortality of seabirds and marine mammals contained within the reports.

12.2   The Working Group updated the Fishery Reports based on the information contained in SC-CAMLR-XXVII, Annex 6, and the information contained in WG-IMAF-09/4 Rev. 2, 09/5 Rev. 2 and 09/6 Rev. 2.

MARINE DEBRIS AND ITS IMPACTS ON MARINE MAMMALS
AND SEABIRDS IN THE CONVENTION AREA

13.1   The Working Group considered WG-IMAF-09/8, 09/9 and 09/10 that provided reviews of marine debris in the Convention Area and noted that data had been submitted by four Members from five sites in 2009.

13.2   The Working Group noted that although the Secretariat had contacted six Members which may have relevant data, it had only received two responses so far from Members stating that there was no program in place. The Working Group encouraged Members with marine debris data and/or the potential to collect those data to participate in CCAMLR's marine debris monitoring program.

13.3   Data from long-term monitoring of marine debris on beaches from three sites in Area 48 indicated that in 2009 there had been an increase in the amount of debris in Subareas 48.1 and 48.2 and a slight decrease in Subarea 48.3 and that at all three sites monitored, the majority of debris was categorised as non-fishing items.

13.4   At Bird Island in South Georgia, the number of entangled seals was lower than the long-term mean. However, the number of oiled seabirds was the highest recorded since annual monitoring began in 1992. The Working Group noted that the oiling occurred in August/September, and as it involved gentoo penguins, the source of the oil was probably local, as gentoo penguins only make short foraging trips from colonies at this time of year.

13.5   The Working Group noted that the occurrence of fishing debris (longline hooks and snoods) in wandering albatross colonies at Bird Island, South Georgia, was consistently higher than in other seabird species monitored, had been high relative to the long-term mean for the last three years and showed no sign of decreasing. Reports from scientists involved in this monitoring suggest that in most cases the snoods appear to have been cut rather than snapped under load.

13.6   From an analysis of hooks found in the wandering albatross colonies at Bird Island, presented in WG-IMAF-09/10, it is apparent that determining the vessel-specific provenance of hooks is probably not possible. However, changes in the occurrence of hooks may indicate changes in the operation of a fishery. For example, the increase in the number of hooks reported in the last three years was attributed to an increase in the use of the trotline system, especially when snoods are cut to dispose of by-catch.

13.7   The Working Group noted anecdotal reports that some longline fisheries using the trotline method routinely discard by-catch fish, such as macrourids, by cutting the snood and leaving the hook in place. These fisheries are known to occur within the foraging range of chick-rearing wandering albatrosses from South Georgia.

13.8   Although the breeding success of wandering albatrosses at Bird Island remains relatively high, the Working Group noted that the digestion of hooks by chicks has the potential to compromise their long-term survival because of the likely effects of disruption of body function/development by metal contaminants from the digested hooks and this may be a contributory factor in the low rate of recruitment of birds into the breeding population.

13.9   The Working Group welcomed ACAP's offer to engage with ACAP Parties to find out where the practice of cutting snoods to dispose of by-catch fish occurred and to seek to address this issue with those Parties in their domestic fisheries.

13.10   In considering the reports by observers of gear lost from vessels, the Working Group acknowledged that there was a high degree of variability in the level of detail provided. From the available data, at least 100 km of longline had been lost in Subarea 88.1 in both 2007/08 and 2008/09. The Working Group also noted the recovery of a sperm whale entangled in lost fishing gear in 2008/09 (paragraph 3.21).

13.11   In order that WG-IMAF can consider the impacts of lost fishing gear on Convention Area seabirds and marine mammals in the future, the Working Group encouraged the improved collection of data regarding lost fishing gear by observers and in all catch and effort data. This should be reflected in an alteration in the observer reports.

13.12   The Working Group recommended that observers no longer need to collect photographs of potential marine debris from fishing vessels (paragraph 7.12).

13.13   The Working Group recommended that photos of beach debris of fisheries-origin should be submitted to CCAMLR with future marine debris reports. This may aid in tracking the provenance of the marine debris to fishery, country or vessel, in order to better target any program to reduce marine debris.

13.14   The Working Group encouraged those Members conducting marine debris surveys to continue to seek input from fishing industry experts about the potential origins of any fishing gear debris.

STREAMLINING THE WORK OF THE SCIENTIFIC COMMITTEE

14.1   In 2008, WG-IMAF held a workshop to consider its terms of reference, future work and meeting frequency required to achieve this work, and agreed to review these items on a continuing basis (SC-CAMLR-XXVII, Annex 6, paragraphs 15.1 to 15.4).

14.2   The work of WG-IMAF (including ad hoc WG-IMALF) has raised awareness of, and created a response to, seabird mortality that is widely recognised and unprecedented in fisheries management organisations. The expertise developed in WG-IMAF at successfully designing and implementing effective mitigation measures is now being applied to address seabird incidental mortality in other fisheries, particularly pelagic longlining, outside the

Convention Area (including those where Convention Area seabirds are at risk). This has also been reflected in the reduced attendance at WG-IMAF, with many current and former participants now engaged in work with other fisheries and RFMOs where the problem of incidental mortality of seabirds is a much more urgent issue.

14.3   The development of ACAP, within which WG-IMAF participants have many key roles, has provided a vehicle to address some of the issues previously on the agenda of WG-IMAF, including research into mitigation approaches and the status and distribution of seabirds.

14.4   Given these changes in circumstances, the Working Group recommended amending its meeting schedule to a biennial basis and holding its next meeting in October 2011.

14.5   The Working Group reviewed its terms of reference and core tasks that were endorsed by the Scientific Committee in 2008 (SC-CAMLR-XXVII, paragraph 5.43) and agreed that the core functions continue to be:

(i)   annual review and monitoring of incidental mortality of seabirds and marine mammals in Convention Area fisheries;

(ii)   annual review and monitoring of information relating to the performance of implementation of specific conservation measures;

(iii)   research into, and experience with, fishing gears and mitigation methods;

(iv)   evaluate and advise on changing needs for observer reports and data collection;

(v)   conduct assessments of risk to seabirds in CCAMLR areas, subareas and divisions;

(vi)   coordinate and collaborate with ACAP;

(vii)   review the level and significance of direct impacts of marine debris in the Convention Area.

14.6   The Working Group acknowledged that, with a biennial schedule of meetings, it would be necessary for the Scientific Committee and SCIC to find a mechanism to address some of these tasks during years when WG-IMAF does not meet.

14.7   The Working Group recommended that:

(i)   the Secretariat continue to summarise the incidental mortality of seabirds and marine mammals in the Convention Area, and the scientific observations related to the implementation of various conservation measures (25-02, 25-03, 26-01 and 51-01);

(ii)   the review of notifications for new and exploratory fisheries with respect to these conservation measures could be included in the work of WG-FSA in the years when that working group was not undertaking assessments;

(iii)   other core WG-IMAF tasks could be addressed on a biennial basis.

14.8   A biennial WG-IMAF meeting schedule conveys several benefits. This meeting frequency represents an efficiency and reflects a logical progression based on the successful work of this group. It further allows for WG-IMAF's enhanced coordination with ACAP as WG-IMAF participants may attend ACAP Advisory Committee meetings in off years. This schedule also represents reduced costs to Members for participation at WG-IMAF and reduced cost to CCAMLR for report production and translation.

14.9   A biennial WG-IMAF meeting schedule may present delays in addressing incidental mortality issues arising in the fishing season immediately after a WG-IMAF meeting. However, the continued production of annual reviews by the Secretariat, the increased technical interaction with ACAP and the facility to consider IMAF-related issues in WG-FSA in years when WG-IMAF does not meet, should ensure that the risks incurred by such delays are minimal.

OTHER BUSINESS

15.1   There was no other business presented for discussion.

ADVICE TO THE SCIENTIFIC COMMITTEE AND ITS WORKING GROUPS

16.1   The Working Group identified the following advice to the Scientific Committee and its working groups:

   (i)   intersessional work of WG-IMAF (paragraphs 2.5 and 2.7);

   (ii)   incidental mortality of seabirds and marine mammals in fisheries in the Convention Area (paragraphs 3.3, 3.4, 3.7, 3.10, 3.14, 3.16, 3.19 to 3.22, 3.24 and 3.25);

   (iii)   implementation of conservation measures (paragraphs 3.35 and 3.45);

   (iv)   France's action plan to reduce/eliminate seabird mortality in Subarea 58.6 and Division 58.5.1 (paragraphs 3.48, 3.54, 3.56, 3.58, 3.60 and 3.62);

   (v)   incidental mortality of seabirds and marine mammals in fisheries outside the Convention Area (paragraphs 4.5 and 4.6);

   (vi)   incidental mortality of seabirds during IUU fishing in the Convention Area (paragraphs 5.4 and 5.5);

   (vii)   research into, and experience with, mitigation measures (paragraphs 6.3, 6.7, 6.8 and 6.11);

   (viii) observer reports and data collection (paragraphs 7.1, 7.2, 7.7, 7.8, 7.10, 7.12, 7.16 and 7.17);

   (ix)   research into the status and distribution of seabirds and marine mammals (paragraphs 8.4 and 8.8);

(x)　　assessment of risk in CCAMLR subareas and divisions (paragraphs 9.5 and 9.6);

(xi)　　incidental mortality of seabirds in relation to new and exploratory fisheries (paragraphs 10.3 and 10.7);

(xii)　　international and national initiatives relating to incidental mortality of seabirds and marine mammals in fishing (paragraphs 11.2, 11.7 and 11.12);

(xiii)　marine debris and its impacts on marine mammals and seabirds in the Convention Area (paragraphs 13.2 and 13.11 to 13.14);

(xiv)　streamlining the work of the Scientific Committee (paragraphs 14.4 and 14.7).

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

17.1　The report of the meeting of WG-IMAF was adopted.

17.2　In closing the meeting, Ms Rivera and Mr Walker thanked all participants for their engagement and teamwork that characterised meetings of WG-IMAF. They particularly thanked the new participants for their input into the meeting and the Secretariat for its support. Ms Rivera noted that the ability to move to a biennial schedule should be viewed as a mark of success for the Working Group and did not diminish the importance of its work.

17.3　Mr Hay, on behalf of the participants, thanked Ms Rivera and Mr Walker for their guidance throughout the meeting and their dedication during the intersessional period.

17.4　The meeting closed.

REFERENCES

Robertson, G.G. 2000. Effect of line sink rate on albatross mortality in the Patagonian toothfish longline fishery. *CCAMLR Science*, 7: 133–150.

Robertson, G., J. Williamson, M. McNeill, S.G. Candy and N. Smith. 2008. Seabird by-catch by autoline vessels: do line setters increase the sink rate of integrated weight longlines? *CCAMLR Science*, 15: 107–114.

Table 1: Intersessional work plan for WG-IMAF.

	Task/Topic	Paragraphs of WG-IMAF report	Priority	Members	Secretariat	Delivery	Specific action
1.	**Planning and coordination of work**						
1.1	Develop advice for ad hoc TASO on observer training standards and information related to IMAF.	7.13	High	Technical coordinators		TASO 2010	Submission of curricula and accreditation procedures.
2.	**Integrate work of WG-IMAF and ACAP**						
2.1	Maintain dialogue with ACAP on issues of common interest and plan for migration of tasks as appropriate. Develop a medium- to long-term strategy to accomplish this coordination.	Ongoing	High	Co-conveners	Secretariat		ACAP
3.	**Research and development activities**						
3.1	Plan with BirdLife for more detailed multi-year review of tracking database to be provided at next IMAF meeting.	SC-CAMLR-XXVII, Annex 6, 8.2	for next WG-IMAF	Co-conveners			Co-conveners to liaise with BirdLife International with respect to multi-year review.
3.2	Report on implementation of action plan. Submit progress report of action plan. Include figures to show the overlap between the weekly fishing effort by sector and seabird incidental mortality rates. Note status of implementation with recommendations from Table 12.	3.48	High	France		Report to SC 2010	
4.	**Information from outside the Convention Area**						
4.1	Develop standard format for reporting data from outside the Convention Area about Convention Area seabird incidental mortality.	4.3	High	Co-conveners	Science Officer	Late 2010	Coordinate with ACAP

(continued)

Table 1 (continued)

	Task/Topic	Paragraphs of WG-IMAF report	Priority	Members	Secretariat	Delivery	Specific action
5.	**Cooperation with international organisations**						
5.1	Maintain/outreach and correspondence with Executive Secretaries of RFMOs listed in Appendix 1 of Resolution 22/XXV reiterating the Commission's interest in reducing the incidental mortality of Convention Area seabirds outside the Convention Area. When communicating with RFMOs and other appropriate international bodies, address marine debris discharge in, and adjacent to, the Convention Area.	Ongoing	High		Executive Secretary	Ongoing	Brief CCAMLR observers on desired feedback on IMAF matters (seabird by-catch levels and mitigating measures).
6.	**Data acquisition and analysis**						
6.1	Compile information (including observer cruise reports and commercial data) on gear reported as lost by vessels.	Ongoing	High		Secretariat	For next WG-IMAF	
6.2	Research into management and processing of all fisheries waste within the CCAMLR area.	6.10	High	Technical coordinators		For next WG-IMAF	

Table 2: Observed incidental mortality of seabirds in the longline fisheries for *Dissostichus* spp. in Subareas 48.3, 48.4, 48.6, 58.7, 88.1, 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3 and 58.5.2 during the 2008/09 season, including related mitigation information. A – auto; Sp – Spanish; T – trotline; N – night-time setting; D – daytime setting (including nautical dawn and dusk); O – opposite side to hauling; S – same side as hauling.

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			No. of birds observed caught[1]						Observed seabird mortality (includes injured birds)[1] (birds/thousand hooks)			Streamer line in use %		Offal discharge during		
			N	D	Total	%N	Obs.	Set	% observed	Dead		Injured		Uninjured		N	D	Total	N	D	Set (%)	Haul (%)	
										N	D	N	D	N	D								
Subarea 48.3																							
Argos Froyanes	2/5–31/8	A	307	0	307	100	535.8	2073.9	25	0	0	0	0	0	0	0	0	0	100		(0.0)	O	(0.0)
Tronio	1/5–24/8	Sp	204	0	204	100	476.1	1886.7	25	0	0	0	0	2	0	0	0	0	100		(0.0)	O	(0.5)
Argos Helena	3/5–30/8	A	390	0	390	100	420.2	1777.5	23	0	0	0	0	0	0	0	0	0	100		(0.0)	S	(0.0)
Koryo Maru No. 11	5/5–27/8	Sp	216	0	216	100	414.6	1651.0	25	1	0	0	0	0	0	0.002	0	0.002	100		(0.0)	O	(82.4)
Viking Bay	1/5–27/8	Sp	283	0	283	100	396.8	1598.9	24	1	0	0	0	3	0	0.003	0	0.003	100		(0.0)	O	(85.9)
San Aspiring	1/5–11/6	A	118	0	118	100	448.7	853.1	52	0	0	0	0	0	0	0	0	0	100		(0.0)	O	(0.0)
Jacqueline	7/5–31/8	Sp	297	0	297	100	508.1	1652.6	30	0	0	0	0	0	0	0	0	0	100		(0.0)	O	(98.3)
Antarctic Bay	21/5–5/8	Sp	202	0	202	100	248.9	1071.0	23	0	0	0	0	3	0	0	0	0	100		(0.0)	O	(20.3)
Ross Star	16/5–30/8	A	200	0	200	100	340.3	1119.6	30	0	0	0	0	2	0	0	0	0	100		(0.0)	O	(0.0)
Argos Georgia	28/5–13/8	A	187	0	187	100	224.0	1095.2	20	0	0	0	0	0	0	0	0	0	100		(0.0)	O	(0.0)
San Aspiring	23/6–26/8	A	151	0	151	100	340.5	1336.0	25	0	0	0	0	0	0	0	0	0	100		(0.0)	O	(0.7)
Total						100	4354.0	16115.7	27	2	0	0	0	10	0	0.0005	0	0.0005					
Subarea 48.4																							
Argos Georgia	1/3–24/3	A	25	35	60	42	74.4	342.8	21	0	0	0	0	0	0	0	0	0	100	100	(0.0)	S	(0.0)
San Aspiring	21/3–23/4	A	55	39	94	59	298.2	528.8	56	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(2.1)
Argos Georgia	4/5–17/5	A	31	10	41	76	35.1	208.3	16	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(0.0)
Total						57	407.7	1079.9	38	0	0	0	0	0	0	0	0	0					
Subarea 48.6																							
Shinsei Maru No. 3	10/11–21/12	T	24	59	83	29	213.1	415.9	51	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(0.0)
Total						29	213.1	415.9	51	0	0	0	0	0	0	0	0	0					
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b																							
Insung No. 1[2]	12/12–8/3	Sp	53	59	112	112	139.6[3]	991.4	14	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(0.0)
Insung No. 22	24/12–5/3	Sp	2	139	141	141	992.0	1006.1	98	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(0.0)
Shinsei Maru No. 3[2]	19/1–29/3	T	33	87	120	120	279.2	581.2	48	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(19.2)
Banzare	5/1–5/3	T	4	90	94	94	563.4[3]	573.1	98	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(54.3)
Shinsei Maru No. 3	26/6–30/7	T	32	27	59	59	183.7	392.2	46	0	0	0	0	0	0	0	0	0	100	100	(0.0)	O	(100)
Total						24	2157.9	3544.0	61	0	0	0	0	0	0	0	0	0					
Division 58.5.2																							
Austral Leader II	14/4–21/6	A	97	74	171	57	499.0	1019.3	48	0	0	0	0	0	2	0	0	0	99	100	(0.0)	O	(0.0)
Antarctic Chieftain	27/4–29/8	A	131	90	221	59	696.6	1562.3	44	0	1	0	0	0	0	0	0.004	0.001	100	100	(0.0)	O	(0.0)
Total						58	1195.5	2581.6	46	0	1	0	0	0	2	0	0.002	0.001					

(continued)

Table 2 (continued)

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			No. of birds observed caught[1]						Observed seabird mortality (includes injured birds)[1] (birds/thousand hooks)			Streamer line in use %		Offal discharge during	
			N	D	Total	%N	Obs.	Set	% observed	Dead		Injured		Uninjured		N	D	Total	N	D	Set (%)	Haul (%)
										N	D	N	D	N	D							
Subarea 58.7																						
Koryo Maru No. 11	11/4–11/4	Sp	2	0	2	100	12.1	22.5	54	0	0	0	0	0	0				100		(0.0)	O (100)
Total						100	12.1	22.5	54	0	0	0	0	0	0	0	0	0				
Subarea 88.1, 88.2																						
Jung Woo No. 2	29/12–25/1	Sp	0	49	49	0	640.0[3]	673.8	95	0	0	0	0	0	0	0	0	0	0	100	(0.0)	(0.0)
Jung Woo No. 3	3/1–24/1	T	0	36	36	0	134.5	135.7	99	0	0	0	0	0	0	0	0	0	0	100	(0.0)	(0.0)
San Aotea II	1/1–22/1	A	0	91	91	0	198.7	400.2	49	0	0	0	0	0	0	0	0	0	0	100	(0.0)	(0.0)
San Aspiring	3/12–24/1	A	0	74	74	0	204.8	457.6	44	0	0	0	0	0	0	0	0	0	0	100	(0.0)	(0.0)
Ross Mar	5/12–3/2	A	0	156	156	0	347.7	725.4	47	0	0	0	0	0	0	0	0	0	0	100	(0.0)	(0.0)
Argos Georgia	8/12–6/2	A	48	98	146	33	324.6	599.9	54	0	0	0	0	0	0	0	0	0	100	100	(0.0)	(0.0)
Tronio	8/12–7/2	Sp	0	107	107	0	477.8	911.2	52	0	0	0	0	0	0	0	0	0	0	100	(0.0)	(0.0)
Ross Star	9/1–16/2	A	0	64	64	0	59.5	358.0	16	0	0	0	0	0	0	0	0	0	0	100	(0.0)	(0.0)
Isla Eden	1/12–31/1	A	0	96	96	0	272.1	497.7	54	0	0	0	0	0	0	0	0	0		100	(0.0)	(0.0)
Hong Jin No. 707	7/12–10/2	Sp	4	83	87	5	668.0[3]	674.0	99	0	0	0	0	0	0	0	0	0	100	100	(0.0)	(0.0)
Janas	1/1–18/2	A	1	112	113	1	330.7	666.4	49	0	0	0	0	0	0	0	0	0	100	100	(0.0)	(0.0)
Argos Helena	4/12–30/1	A	1	162	163	1	312.8	580.2	53	0	0	0	0	0	0	0	0	0	100	100	(0.0)	(0.0)
Antarctic Chieftain	2/12–16/2	A	0	111	111	0	401.9	806.9	49	0	0	0	0	0	0	0	0	0		100	(0.0)	(0.0)
Argos Froyanes	1/12–12/2	A	5	157	162	3	356.5	706.9	50	0	0	0	0	0	0	0	0	0	100	100	(0.0)	(0.0)
Total						4	4729.6	8193.9	58	0	0	0	0	0	0	0	0	0				

[1] Bird 'caught' as defined by the Commission at CCAMLR-XXIII, paragraphs 10.30 and 10.31.
[2] These vessels also conducted some fishing in Subarea 88.1 during this cruise.
[3] Information obtained from cruise report.

Table 3: Observed incidental mortality of seabirds in the French EEZ longline fisheries for *Dissostichus* spp. in Subarea 58.6 and Division 58.5.1 during the 2008/09 season, including related mitigation information. A – autoliner; N – night-time setting; D – daytime setting (including nautical dawn and dusk).

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			No. of birds observed caught						Observed seabird mortality (includes injured birds)[1] (birds/thousand hooks)			Streamer line in use %	
										Dead		Injured		Uninjured						
			N	D	Total	%N	Obs.	Set	% observed	N	D	N	D	N	D	N	D	Total	N	D
Subarea 58.6																				
Ship 2	29/1–14/2	A	45	0	45	100	67.3	269.0	25	2	0	0	0	0	0	0.030	0	0.030	100	
Ship 2	5/6–9/8	A	97	0	97	100	128.2	567.6	22	0	0	0	0	1	0	0	0	0	100	
Ship 8	12/12–22/2	A	107	0	107	100	128.2	529.8	24	5	0	0	0	0	0	0.039	0	0.039	100	
Ship 1	28/1–9/2	A	31	0	31	100	53.6	214.5	24	1	0	0	0	1	0	0.019	0	0.019	100	
Ship 1	20/3–27/5	A	94	0	94	100	132.2	553.5	23	1	0	2	0	3	0	0.023	0	0.023	100	
Ship 2	28/4–12/5	A	42	0	42	100	76.3	291.7	26	0	0	0	0	1	0	0	0	0	100	
Ship 3	19/1–31/1	A	32	0	32	100	64.9	254.1	25	0	0	0	0	0	0	0	0	0	100	
Ship 3	11/4–19/5	A	88	0	88	100	245.7	984.8	24	1	0	0	0	0	0	0.004	0	0.004	100	
Ship 5	2/2–15/2	A	37	0	37	100	56.8	241.5	23	1	0	0	0	0	0	0.018	0	0.018	100	
Ship 5	16/5–1/6	A	56	0	56	100	89.7	363.8	24	0	0	0	0	0	0	0	0	0	100	
Ship 6	31/1–3/3	A	82	0	82	100	98.8	366.0	27	1	0	1	0	0	0	0.020	0	0.020	100	
Ship 6	19/6–14/7	A	88	0	88	100	80.8	319.5	25	0	0	0	0	0	0	0	0	0	100	
Ship 7	5/4–9/6	A	111	0	111	100	53.1	212.3	25	2	0	0	0	0	0	0.016	0	0.016	100	
Ship 7	5/2–16/2	A	37	0	37	100	128.5	537.0	23	4	0	0	0	0	0	0.075	0	0.075	100	
Ship 8	1/4–25/5	A	107	0	107	100	118.9	503.0	23	2	0	0	0	1	0	0.017	0	0.017	100	
Total						100	1 522.9	6 207.9	25	20	0	3	0	7	0	0.015	0	0.015		
Division 58.5.1																				
Ship 1	8/4–3/5	A	72	0	72	100	255.8	1 026.0	24	3	0	0	0	0	0	0.022	0	0.022	100	
Ship 1	11/12–23/1	A	102	0	102	100	138.0	561.8	24	1	0	0	0	1	0	0.004	0	0.004	100	
Ship 2	8/12–24/1	A	147	0	147	100	298.1	1 116.1	26	2	0	0	0	0	0	0.007	0	0.007	100	
Ship 2	16/6–9/7	A	87	0	87	100	236.8	933.3	25	2	0	0	0	2	0	0.017	0	0.017	100	
Ship 2	11/3–23/4	A	117	0	117	100	120.2	507.9	23	9	0	0	0	0	0	0.038	0	0.038	100	
Ship 3	14/3–5/4	A	47	0	47	100	284.4	1 120.4	25	27	0	0	0	0	0	0.162	0	0.162	100	
Ship 3	5/12–15/1	A	95	0	95	100	167.1	669.9	24	0	0	0	0	0	0	0	0	0	100	
Ship 5	2/5–14/6	A	113	0	113	100	314.1	1 251.8	25	1	0	0	0	1	0	0.004	0	0.004	100	
Ship 5	18/12–30/1	A	112	0	112	100	261.8	1 080.8	24	3	0	0	0	1	0	0.011	0	0.011	100	
Ship 5	25/3–10/5	A	124	0	124	100	253.0	1 010.3	25	28	0	0	0	0	0	0.089	0	0.089	100	

(continued)

Table 3 (continued)

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			No. of birds observed caught						Observed seabird mortality (includes injured birds)[1] (birds/thousand hooks)			Streamer line in use %	
										Dead		Injured		Uninjured						
			N	D	Total	%N	Obs.	Set	% observed	N	D	N	D	N	D	N	D	Total	N	D
Ship 6 [2]	13/1–1/4	A	78	0	78	100	231.6	789.0	29	23	0	0	0	0	0	0.099	0	0.099	100	
Ship 7	20/4–14/5	A	58	0	58	100	233.0	920.3	25	1	0	0	0	0	0	0.007	0	0.007	100	
Ship 7	19/12–29/1	A	128	0	128	100	149.2	616.5	24	4	0	0	0	1	0	0.017	0	0.017	100	
Ship 8	24/12–25/1	A	94	0	94	100	110.5	443.1	24	1	0	0	0	0	0	0.009	0	0.009	100	
Ship 8	26/4–11/5	A	51	0	51	100	56.4	232.1	24	0	0	0	0	1	0	0.022	0	0.022	100	
Total						100	3 110.0	12 279.0	25	105	0	0	0	7	0	0.034	0	0.034		

[1] Bird 'caught' as defined by the Commission at CCAMLR-XXIII, paragraphs 10.30 and 10.31.
[2] This vessel did not conduct any fishing in Division 58.5.1 during the closed season (1/2/09–10/3/09).

Table 4: Total extrapolated incidental mortality of seabirds and observed mortality rates (birds/thousand hooks) in longline fisheries in Subareas 48.3, 48.4, 48.6, 58.6, 58.7, 88.1, 88.2, Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.5.1 and 58.5.2 from 1997 to 2009 (- indicates no fishing occurred).

Area	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Subarea 48.3													
Extrapolated mortality	5 755	640	210[1]	21	30	27	8	27	13	0	0	0	8
Observed mortality rate	0.23	0.032	0.013[1]	0.002	0.002	0.0015	0.0003	0.0015	0.0011	0	0	0	0.0005
Subarea 48.4													
Extrapolated mortality	-	-	-	-	-	-	-	-	0	0	0	0	0
Observed mortality rate	-	-	-	-	-	-	-	-	0	0	0	0	0
Subarea 48.6													
Extrapolated mortality	-	-	-	-	-	-	-	0	0	0	0	-	0
Observed mortality rate	-	-	-	-	-	-	-	0	0	0	0	-	0
Subareas 58.6, 58.7													
Extrapolated mortality	834	528	156	516	199	0	7	39	76	0	0	0	0
Observed mortality rate	0.52	0.194	0.034	0.046	0.018	0	0.003	0.025	0.149	0	0	0	0
Subarea 58.6 French EEZ													
Extrapolated mortality[3]	no data	no data	no data	no data	-	1243[2]	720[2]	343[2]	242	235	314	131	94
Observed mortality rate[3]	no data	no data	no data	no data	-	0.1672	0.1092	0.0875	0.0490	0.0362	0.065	0.0305	0.0119
Extrapolated mortality													93
Observed mortality rate													0.015
Subareas 88.1, 88.2													
Extrapolated mortality	-	0	0	0	0	0	0	1	0	0	0	0	0
Observed mortality rate	-	0	0	0	0	0	0	0.0001	0	0	0	0	0
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b													
Extrapolated mortality	-	-	-	-	-	-	-	0	8	2	0	0	0
Observed mortality rate	-	-	-	-	-	-	-	0	<0.001	0.0002	0	0	0
Division 58.5.1 French EEZ													
Extrapolated mortality[3]	no data	no data	no data	no data	1 917[2]	10 814[2]	13 926[2]	3 666[2]	4 387	2 352	1 943	1 224	643
Observed mortality rate[3]	no data	no data	no data	no data	0.0920	0.9359	0.5180	0.2054	0.1640	0.0920	0.0798	0.0585	0.0316
Extrapolated mortality													417
Observed mortality rate													0.034
Division 58.5.2													
Extrapolated mortality	-	-	-	-	-	-	0	0	0	0	0	2	3
Observed mortality rate	-	-	-	-	-	-	0	0	0	0	0	0.002	0.001
Total seabird mortality	6 589	1 168	366	537	2 146	12 084	14 661	4 076	4 726	2 589	2 257	1 357	521[4]

[1] Excluding *Argos Helena* line-weighting experiment cruise.
[2] The number of hooks has not been collected and the values given are from the total number of hooks set.
[3] Data provided by France for fishing season 1 September to 31 August, not CCAMLR season (1 December to 30 November).
[4] This total excludes the extrapolated totals provided by France for 2009.

Table 5: Seabird mortality totals and rates (BPT: birds/trawl) and species composition, recorded by observers in the CAMLR Convention Area trawl fishery during the 2008/09 season. DIM – *Thalassarche melanophrys*; PRO – *Procellaria aequinoctialis*; DAC – *Daption capense*.

Area	Vessel (target species)	Cruise dates	Trawls		BPT	Dead			Total dead	Total alive
			Set	Observed		DIM	PRO	DAC		
48.1, 48.2	*Saga Sea* (KRI)[1]	28/21–2/3	1060	1037	0.01			9	9	0
	Saga Sea (KRI)[1]	6/3–5/5	774	17[2]	0.00				0	1
	Saga Sea (KRI)[1]	7/5–22/7	875	13[2]	0.08			1	1	34
	Dalmor II (KRI)	23/5–16/7	337	217	0.00				0	0
	Maksim Starostin (KRI)[1]	4/1–9/3	56	56	0.00				0	0
	Juvel (KRI)	22/3–8/8	27	25	0.00				0	0
	Total		3129	1365	0.01			10	10	35
48.3	*Robin M Lee* (ANI)	14/1–11/2	38	38	0.03		1		1	12
	Robin M Lee (ANI)	20/4–22/5	30	24	0.00				0	0
	Sil (ANI)	13/1–11/2	27	21	0.07		2		2	5
	New Polar (ANI)	31/1–11/2	22	20	0.00				0	0
	Insung Ho (ANI)	27/12–6/1	27	22	0.07	2			2	1
	Dongsan Ho (ANI)	5/2–14/2	18	11	0.33	4	2		6	13
	New Polar (ANI)	28/4–21/5	32	23	0.00				0	0
	Total		194	159	0.07	6	5		11	31
48.3	*Maksim Starostin* (KRI)[1]	9/6–16/6	16	10	0.00				0	0
	Insung Ho (KRI)	23/7–23/7	1	1	0.00				0	0
	Total		17	11	0.00				0	0
58.5.2	*Southern Champion* (TOP)	29/12–19/1	118	118	0.01			1	1	0
	Southern Champion (ANI/TOP)	23/3–19/5	440	440	0.00				0	0
	Total		558	558	0.002			1	1	0

[1] Continuous trawl method
[2] These low haul numbers are a result of continuous trawls (WG-IMAF-09/5 Rev. 2, paragraph 2).

Table 6: Seabird mortality totals and rates (BPT: birds/trawl) and species composition of by-catch, recorded by observers in the CAMLR Convention Area trawl fisheries over the last six seasons. DIC – *Thalassarche chrysostoma*; DIM – *Thalassarche melanophris*; PRO – *Procellaria aequinoctialis*; MAH – *Macronectes halli*; KPY – *Aptenodytes patagonicus*; PTZ – unknown petrel; DAC – *Daption capense*; MAI – *Macronectes giganteus*.

Season	Area	Target species	Trips observed	Trawls Set	Trawls observed	Trawls (%)	BPT	DIC	DIM	PRO	MAH	KPY	PTZ	DAC	MAI	Total dead	Total alive
2004	48	*E. superba*	1	334	258	77	<0.10									0	0
	48.3	*E. superba*	6	1145	829	72	<0.10									0	0
	48.3	*C. gunnari*	6	247	238	96	0.37	1	26	59					1	87	132
	58.5.2	*D. eleginoides C. gunnari*	5	1218	1215	100	<0.10									0	13
2005	48.2	*E. superba*	2	391	285	73	<0.10							1		1	0
	48.3	*C. gunnari*	7	337	277	82	<0.14		9	1	1					11	14
	48.3	*E. superba*	5	1451	842	58	<0.10									0	0
	58.5.2	*D. eleginoides C. gunnari*	6	1303	1301	100	<0.11		5	3						8	0
2006	48.1	*E. superba*	2	1127	839	74	0.00									0	0
	48.3	*C. gunnari*	5	585	457	78	0.07	1	11	20			1			33	89
	48.3	*E. superba*	2	395	181	46	0.00									0	0
	58.5.2	*D. eleginoides C. gunnari*	3	1086	1086	100	0.00									0	0
2007	48.1/2	*E. superba*	2	656	418	64	0.00									0	2
	48.3	*C. gunnari*	4	102	91	89	0.07	1	2	3						6	3
	48.3	*E. superba*	4	580	194	33	0.00									0	0
	58.5.2	*D. eleginoides C. gunnari*	3	1005	936	93	<0.01							2		2	0
2008	48.1/2	*E. superba*	4	2877	233	8[1]	0.00									0	0
	48.3	*C. gunnari*	6	232	206	89	0.024			3		2				5	5
	48.3	*E. superba*	4	1058	81	8[1]	0.00									0	0
	58.5.2	*D. eleginoides C. gunnari*	3	723	700	97	0.00									0	1
2009	48.1/2	*E. superba*	6	3129	1365	44[1]	0.01							10		10	35
	48.3	*C. gunnari*	7	194	159	82	0.07		6	5						11	31
	48.3	*E. superba*	2	17	11	65	0.00									0	0
	58.5.2	*D. eleginoides C. gunnari*	2	558	558	100	0.002							1		1	0

[1] These low haul numbers are a result of continuous trawls (WG-IMAF-09/5 Rev. 2, paragraph 2).

Table 7: Seal mortality totals and rates (SPT: seals/trawl) and species composition, recorded by observers in the CAMLR Convention Area trawl fishery during the 2008/09 season. SEA – *Arctocephalus gazella*.

Area	Vessel (target species)	Cruise dates	Trawls Set	Trawls Observed	SPT	Dead SEA	Total dead	Total alive
48.1, 48.2	*Saga Sea* (KRI)[1]	28/21–2/3	1060	1037	0.00		0	0
	Saga Sea (KRI)[1]	6/3–5/5	774	17[2]	0.00		0	0
	Saga Sea (KRI)[1]	7/5–22/7	875	13[2]	0.00		0	2
	Maksim Starostin (KRI)[1]	4/1–9/3	56	56[2]	0.00		0	0
	Dalmor II (KRI)	23/5–16/7	337	217	0.06	12	12	4
	Juvel (KRI)	22/3–8/8	27	25	0.00		0	1
	Total		3129	1365	0.01		12	7
48.3	*Robin M Lee* (ANI)	14/1–11/2	38	38	0.00		0	0
	Robin M Lee (ANI)	20/4–22/5	30	24	0.00		0	0
	Sil (ANI)	13/1–11/2	27	21	0.00		0	0
	New Polar (ANI)	31/1–11/2	22	20	0.00		0	0
	Insung Ho (ANI)	27/12–6/1	27	22				
	Dongsan Ho (ANI)	5/2–14/2	18	11	0.00		0	0
	New Polar (ANI)	28/4–21/5	32	23	0.00		0	0
	Total		194	159	0.00		0	0
48.3	*Maksim Starostin* (KRI)[1]	9/6–16/6	16	10[2]	0.10		0	0
	Insung Ho (KRI)	23/7–23/7	1	1	0.00		0	0
	Total		17	11	0.00		0	0
58.5.2	*Southern Champion* (TOP)	29/12–19/1	118	118	0.00		0	0
	Southern Champion (ANI/TOP)	23/3–19/5	440	440	0.00		0	0
	Total		558	558	0.00		0	0

[1]   Continuous trawl method
[2]   These low haul numbers are a result of continuous trawls (WG-IMAF-09/5 Rev. 2, paragraph 2).

Table 8: Seal mortality totals and rates (SPT: seals/trawl) and species composition of by-catch, recorded by observers in the CAMLR Convention Area trawl fisheries over the last six seasons. SLP – *Hydrurga leptonyx*; SEA – *Arctocephalus gazella*; SXX – unidentified seal.

Season	Area	Target species	Trips observed	Trawls		SPT	Dead			Total dead	Total alive
				Set	Observed		SLP	SEA	SXX		
2004	48	*E. superba*	1	334	258	0		0		0	0
	48.3	*E. superba*	6	1145	829	0.17		142		142	12
	48.3	*C. gunnari*	6	247	238	0				0	0
	58.5.2	*D. eleginoides C. gunnari*	5	1218	1215	0.002		3		3	0
2005	48.2	*E. superba*	2	391	285	0.06		16		16	8
	48.3	*C. gunnari*	7	337	277	0.00		0		0	2
	48.3	*E. superba*	5	1451	842	0.006		5		5	64
	58.5.2	*D. eleginoides C. gunnari*	6	1303	1301	0.00				0	1
2006	48.1	*E. superba*	2	1127	839	0.001		1		1	0
	48.3	*C. gunnari*	5	585	457	0.00				0	0
	48.3	*E. superba*	2	395	181	0.00				0	0
	58.5.2	*D. eleginoides C. gunnari*	3	1086	1086	0.00	1			1	0
2007	48.1/2	*E. superba*	2	656	418	0.00				0	0
	48.3	*C. gunnari*	4	102	91	0.00				0	0
	48.3	*E. superba*	4	580	194	0.00				0	0
	58.5.2	*D. eleginoides C. gunnari*	3	1005	936	0.00				0	0
2008	48.1/2	*E. superba*	4	2877	(233)[1]	0.00				0	0
	48.3	*C. gunnari*	6	232	206	0.00				0	0
	48.3	*E. superba*	4	1058	(81)[1]	0.07		5	1	6	0
	58.5.2	*D. eleginoides C. gunnari*	3	723	700	0.00				0	0
2009	48.1/2	*E. superba*	6	3129	1365[1]	0.01		12		12	7
	48.3	*C. gunnari*	7	194	159	0.00				0	0
	48.3	*E. superba*	2	17	11	0.00				0	0
	58.5.2	*D. eleginoides C. gunnari*	2	558	558	0.00				0	0

[1] These low haul numbers are a result of continuous trawls (WG-IMAF-09/5 Rev. 2, paragraph 2).

Table 9: Summary of scientific observations relating to compliance with Conservation Measure 25-02 (2008), based on data from scientific observers from the 1996/97 to the 2008/09 season. Values in parentheses are % of observer records that were complete. na – not applicable.

Area/season	Line weighting (Spanish system only) Compliance %		Median weight (kg)	Median spacing (m)	Night setting (% night)	Offal discharge (%) opposite haul		Streamer line compliance (%) Overall		Attached height		Total length		Streamers length[7]		Distance apart		Total catch rate (birds/thousand hooks) Night	Day
Subarea 48.3																			
1996/97	0	(91)	5.0	45	81	0	(91)	6	(94)	47	(83)	24	(94)	76	(94)	100	(78)	0.18	0.93
1997/98	0	(100)	6.0	42.5	90	31	(100)	13	(100)	64	(93)	33	(100)	100	(93)	100	(93)	0.03	0.04
1998/99	5	(100)	6.0	43.2	80[1]	71	(100)	0	(95)	84	(90)	26	(90)	76	(81)	94	(86)	0.01	0.08[1]
1999/00	1	(91)	6.0	44	92	76	(100)	31	(94)	100	(65)	25	(71)	100	(65)	85	(76)	<0.01	<0.01
2000/01	21	(95)	6.8	41	95	95	(95)	50	(85)	88	(90)	53	(94)	94	(94)	82	(94)	<0.01	<0.01
2001/02	63	(100)	8.6	40	99	100	(100)	87	(100)	94	(100)	93	(100)	100	(100)	100	(100)	0.002	0
2002/03	100	(100)	9.0	39	98	100	(100)	87	(100)	91	(100)	96	(100)	100	(100)	100	(100)	<0.001	0
2003/04	87	(100)	9.0	40	98	100	(100)	69	(94)	88	(100)	93	(94)	73	(100)	100	(100)	0.001	0
2004/05	100	(100)	9.5	45	99	100	(100)	75	(100)	88	(100)	88	(100)	75	(100)	100	(100)	0.001	0
2005/06	100	(100)	10.0	40	100	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2006/07	100	(100)	9.8	39	100	100	(100)	90	(100)	100	(100)	100	(100)	90	(100)	100	(100)	0	0
2007/08	100	(100)	9.5	38.5	100	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2008/09	100	(100)	9.5	39	100	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	<0.001	0
Subarea 48.4																			
2005/06	Auto only		na	na	100	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2006/07	Auto only		na	na	100	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2007/08	Auto only		na	na	100	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2008/09	Auto only		na	na	57[10]	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
Subarea 48.6																			
2003/04	100	(100)	7.0	20	41[6]	No discharge		0	(100)	100	(100)	100	(100)	0	(100)	100	(100)	0	0
2004/05	100	(100)	6.5	19.5	29[6]	No discharge		100	(100)	100	(100)	100	(100)	100	(100)	0	(100)	0	0
2005/06	Auto only		na	na	36[6]	No discharge		50	(100)	100	(100)	50	(100)	100	(100)	100	(100)	0	0
2006/07	Auto only		na	na	44[6]	No discharge		100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2008/09	Trotline		na	na	29[6]	No discharge		100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0

(continued)

Table 9 (continued)

Area/season	Line weighting (Spanish system only)			Night setting (% night)	Offal discharge (%) opposite haul	Streamer line compliance (%)					Total catch rate (birds/thousand hooks)	
	Compliance %	Median weight (kg)	Median spacing (m)			Overall	Attached height	Total length	Streamers length[7]	Distance apart	Night	Day
Division 58.4.1, 58.4.2, 58.4.3a, 58.4.3b												
2002/03	Auto only	na	na	24[5]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2003/04	Auto only	na	na	0[5]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2004/05	33[8] (100)	7.9	40	26[5]	No discharge	88 (100)	100 (100)	100 (100)	88 (100)	100 (100)	0	<0.001
2005/06	16[8] (100)	7.2	48	16[5]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	<0.001
2006/07	20[8] (100)	7.7	40	10[5]	4% by 1 vessel[9]	50 (100)	100 (100)	83 (100)	83 (100)	83 (100)	0	0
2007/08	71[8] (100)	8.5	40	10[5]	No discharge	88 (100)	100 (100)	100 (100)	88 (100)	100 (100)	0	0
2008/09	100 (100)	10	40	24[5]	60 (100)	80 (100)	100 (100)	100 (100)	80 (100)	100 (100)	0	0
Division 58.4.4												
1999/00	0[9] (100)	5	45	50	0 (100)	0 (100)	100 (100)	0 (100)	100 (100)	100 (100)	0	0
Division 58.5.2												
2002/03	Auto only	na	na	100	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2003/04	Auto only	na	na	99[8]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2004/05	Auto only	na	na	50[8]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2005/06	Auto only	na	na	53[8]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2006/07	Auto only	na	na	54[8]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2007/08	Auto only	na	na	45[8]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2008/09	Auto only	na	na	58[8]	No discharge	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0.002
Subareas 58.6 and 58.7												
1996/97	0	6	35	52	69 (87)	10 (66)	100 (60)	10 (66)	90 (66)	60 (66)	0.52	0.39
1997/98	0 (100)	6	55	93	87 (94)	9 (92)	91 (92)	11 (75)	100 (75)	90 (83)	0.08	0.11
1998/99	0 (100)	8	50	84[2]	100 (89)	0 (100)	100 (90)	10 (100)	100 (90)	100 (90)	0.05	0
1999/00	0 (83)	6	88	72	100 (93)	8 (100)	91 (92)	0 (92)	100 (92)	91 (92)	0.03	0.01
2000/01	18 (100)	5.8	40	78	100 (100)	64 (100)	100 (100)	64 (100)	100 (100)	100 (100)	0.01	0.04
2001/02	66 (100)	6.6	40	99	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2002/03	0 (100)	6.0	41	98	50 (100)	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	<0.01	0
2003/04	100 (100)	7.0	20	83	100 (100)	50 (100)	50 (100)	100 (100)	100 (100)	100 (100)	0.03	0.01
2004/05	100 (100)	6.5	20	100	100 (100)	0 (100)	100 (100)	100 (100)	100 (100)	0 (100)	0.149	0
2005/06	100 (100)	9.1	40	100	100 (100)	0 (100)	100 (100)	100 (100)	0 (100)	0 (100)	0	0
2006/07	100 (100)	10.4	40	100	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2007/08	0 (100)	11	56	100	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0
2008/09	100 (100)	12	39	100	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	0	0

Table 9 (continued)

Area/season	Line weighting (Spanish system only)			Night setting (% night)	Offal discharge (%) opposite haul	Streamer line compliance (%)										Total catch rate (birds/thousand hooks)	
	Compliance %	Median weight (kg)	Median spacing (m)			Overall		Attached height		Total length		Streamers length[7]		Distance apart		Night	Day
Subarea 88.1, 88.2																	
1996/97	Auto only	na	na	50	0 (100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
1997/98	Auto only	na	na	71	0 (100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
1998/99	Auto only	na	na	1[3]	100 (100)	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
1999/00	Auto only	na	na	6[4]	No discharge	67	(100)	100	(100)	67	(100)	100	(100)	100	(100)	0	0
2000/01	1 (100)	12	40	18[4]	No discharge	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2001/02	Auto only	na	na	33[4]	No discharge	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2002/03	100 (100)	9.6	41	21[4]	1 incidence by 1 vessel	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2003/04	89 (100)	9	40	5[4]	24% by 1 vessel	59	(100)	82	(100)	86	(100)	61	(81)	100	(100)	0	<0.01
2004/05	33 (100)	9.0	45	1[4]	1% by 1 vessel	64	(100)	100	(100)	100	(100)	60	(94)	94	(100)	0	0
2005/06	100 (100)	9.2	35	1[4]	No discharge	85	(92)	100	(92)	85	(92)	92	(92)	100	(92)	0	0
2006/07	100 (100)	10	36	4[4]	1% by 1 vessel	93	(100)	100	(100)	100	(100)	93	(93)	100	(100)	0	0
2007/08	67 (100)	10	37	11[4]	No discharge	92	(100)	100	(100)	100	(100)	92	(100)	100	(100)	0	0
2008/09	67 (100)	10	37	4[4]	No discharge	100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0

[1] Includes daytime setting – and associated seabird by-catch – as part of line-weighting experiments on *Argos Helena* (WG-FSA-99/5).

[2] Includes some daytime setting in conjunction with use of an underwater-setting funnel on *Eldfisk* (WG-FSA-99/42).

[3] Conservation Measure 169/XVII allowed New Zealand vessels to undertake daytime setting south of 65°S in Subarea 88.1 to conduct a line-weighting experiment.

[4] Conservation Measures 216/XX and 41-09, 41-10 (2002, 2003, 2004) permit daytime setting south of 65°S in Subarea 88.1 if able to demonstrate a sink rate of 0.3 m/s.

[5] Conservation Measures 41-05, 41-11 (2002, 2003, 2004, 2007) permits daytime setting in Divisions 58.4.1 and 58.4.2 if the vessel complies with Conservation Measure 24-02.

[6] Conservation Measure 41-04 (2003, 2004, 2007) permits daytime setting if the vessel complies with Conservation Measure 24-02.

[7] Conservation Measure 25-02 (2003, 2007) was updated in 2003 and the requirement for a minimum of five streamers was replaced by minimum streamer lengths.

[8] Conservation Measure 41-08 (2004, 2007) permits daytime setting if the vessel complies with Conservation Measure 24-02.

[9] The *Tronio* discharged offal on seven occasions due to mechanical problems.

[10] Conservation Measure 41-03 (2008) permits daytime setting if the vessel catches no more than three seabirds.

Table 10: Scientific observations relating to compliance with the minimum specifications set out in Conservation Measure 25-02 (2008) during the 2008/09 Season. Y – yes; N – no; - – no information; MP – Moon pool; * – conservation measure not applicable in this area.

| Vessel name | Dates of fishing | Fishing method | Compliance with CCAMLR specifications | Compliance with details of streamer line specifications | | | | Length of streamers (m) | Streamer line in use % setting | | Haul-mitigation device used % |
				Attachment, height above water (m)	Total length (m)	No. streamers per line	Spacing of streamers per line (m)		Night	Day	
Subarea 48.3											
Argos Froyanes	2/5–31/8	Auto	Y	Y (7.1)	Y (152)	11	Y (5)	Y (2–7.2)	100		100
Tronio	1/5–24/8	Spanish	Y	Y (8.1)	Y (160)	12	Y (5)	Y (1–6.6)	100		100
Argos Helena	3/5–30/8	Auto	Y	Y (8.1)	Y (162)	13	Y (5)	Y (1–7)	100		MP
Koryo Maru No. 11	5/5–27/8	Spanish	Y	Y (8.2)	Y (155)	10	Y (5)	Y (3.2–8)	100		98
Viking Bay	1/5–27/8	Spanish	Y	Y (7)	Y (155)	12	Y (4)	Y (1.2–7)	100		100
San Aspiring	1/5–11/6	Auto	Y	Y (7.9)	Y (150)	23	Y (5)	Y (1.6–9)	100		100
Jacqueline	7/5–31/8	Spanish	Y	Y (7.75)	Y (168)	7	Y (5)	Y (1.3–7)	100		100
Antarctic Bay	21/5–5/8	Spanish	Y	Y (8)	Y (160)	7	Y (5)	Y (2–7)	100		100
Ross Star	16/5–30/8	Auto	Y	Y (7.5)	Y (175)	7	Y (5)	Y (1.1– 7)	100		100
Argos Georgia	28/5–13/8	Auto	Y	Y (8)	Y (170)	8	Y (5)	Y (1–8)	100		100
San Aspiring	23/6–26/8	Auto	Y	Y (8)	Y (200)	23	Y (5)	Y (1.4–10)	100		100
Subarea 48.4											
Argos Georgia	1/3–24/3	Auto	Y	Y (8.6)	Y (165)	8	Y (5)	Y (1–8)	100	100	100
San Aspiring	21/3–23/4	Auto	Y	Y (7.9)	Y (250)	23	Y (5)	Y (1.8–9)	100	100	100
Argos Georgia	4/5–17/5	Auto	Y	Y (8)	Y (170)	8	Y (5)	Y (1–8)	100	100	100
Subarea 48.6											
Shinsei Maru No. 3	10/11–21/12	Trotline	Y	Y (7.5)	Y (162.5)	6	Y (4.7)	Y (4–6.9)	100	100	100
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b											
Insung No. 1[1]	12/12–8/3	Spanish	N	Y (7)	Y (200)	10	Y (4.5)	N (1–5)	100	100	96
Insung No. 22	24/12–5/3	Spanish	Y	Y (7)	Y (155)	14	Y (5)	Y (1–6.5)	100	100	0
Shinsei Maru No. 3[1]	19/1–29/3	Trotline	Y	Y (10)	Y (156)	6	Y (4.7)	Y (4.4–6.9)	100	100	98
Banzare	5/1–5/3	Trotline	Y	Y (7)	Y (150)	35	Y (5)	Y (6.5)	100	100	0
Shinsei Maru No. 3	26/6–30/7	Trotline	Y	Y (7.45)	Y (157.4)	6	Y (4.5)	Y (4.5–7)	100	100	100
Division 58.5.2											
Austral Leader II	14/4–21/6	Auto	Y	Y (8)	Y (200)	9	Y (5)	Y (1–7.5)	99	100	98
Antarctic Chieftain	27/4–29/8	Auto	Y	Y (7.1)	Y (173)	21	Y (4.5)	Y (1–7)	100	100	100
Subarea 58.7											
Koryo Maru No. 11	11/4–11/4	Spanish	Y	Y (8.41)	Y (163)	10	Y (4.5)	Y (3.3–8)	100		

(continued)

Table 10 (continued)

Vessel name	Dates of fishing	Fishing method	Compliance with CCAMLR specifications	Compliance with details of streamer line specifications				Length of streamers (m)	Streamer line in use % setting		Haul-mitigation device used %
				Attachment, height above water (m)	Total length (m)	No. streamers per line	Spacing of streamers per line (m)		Night	Day	
Subareas 88.1, 88.2											
Jung Woo No. 2	29/12–25/1	Spanish	Y	Y (7.8)	Y (150)	10	Y (5)	Y (1–6.8)		100	8
Jung Woo No. 3	3/1–24/1	Trotline	Y	Y (7)	Y (150)	15	Y (4.5)	Y (1–6.5)		100	0
San Aotea II	1/1–22/1	Auto	Y	Y (7)	Y (153)	21	Y (4.5)	Y (1–7.2)		100	0
San Aspiring	3/12–24/1	Auto	Y	Y (8)	Y (200)	30	Y (4)	Y (1–10)		100	0
Ross Mar	5/12–3/2	Auto	Y	Y (7.4)	Y (150)	21	Y (4.8)	Y (1–7.2)		100	0
Argos Georgia	8/12–6/2	Auto	Y	Y (7)	Y (155)	7	Y (5)	Y (1–7)	100	100	0
Tronio	8/12–7/2	Spanish	Y	Y (7.2)	Y (170)	12	Y (5)	Y (0.5–6.5)		100	100
Ross Star	9/1–16/2	Auto	Y	Y (8)	Y (160)	7	Y (5)	Y (1–7)		100	0
Isla Eden	1/12–31/1	Auto	Y	Y (7.1)	Y (150)	7	Y (5)	Y (1–7)		100	0
Hong Jin No. 707	7/12–10/2	Spanish	Y	Y (7)	Y (150)	25	Y (5)	Y (1–6.5)	100	100	100
Janas	1/1–18/2	Auto	Y	Y (9)	Y (160)	29	Y (4)	Y (1–6.5)	100	100	0
Argos Helena	4/12–30/1	Auto	Y	Y (8)	Y (157)	13	Y (5)	Y (1–8)	100	100	MP
Antarctic Chieftain	2/12–16/2	Auto	Y	Y (7.1)	Y (150)	32	Y (4.5)	Y (1–7.2)		100	0
Argos Froyanes	1/12–12/2	Auto	Y	Y (7.1)	Y (152)	11	Y (4)	Y (2.7–7)	100	100	0

[1]   These vessels also conducted a small amount of fishing in Subarea 88.1 during this cruise.

Table 11: Summary of recommendations from SC-CAMLR-XXVII/10, 12 and SC-CAMLR-XXVII/BG/8, BG/10, BG/11, BG/12, and the Scientific Committee's 2007 recommendations to France (SC-CAMLR-XXVI, paragraph 5.6) and updated progress from France.

	Scientific Committee or French recommendation	Description	Status	Comments/notes
1	SC-CAMLR-XXVI, 5.6(i)	Observer data	In progress	Additional data are being recorded: details of the deployment of a haul-mitigation device, characteristics of streamer lines and line sink rates.
2	SC-CAMLR-XXVI, 5.6(ii)	Petrel population analysis	Complete	SC-CAMLR-XXVII/BG/8 is the completed analysis; France submitted all required documents to IMAF in 2008 and will submit an English version to WG-SAM for its 2010 meeting.
3	SC-CAMLR-XXVI, 5.6(iii)	Raw by-catch data	Completed	This year, France has submitted the full set of data from the 2008/09 fishing season.
4	SC-CAMLR-XXVI, 5.6(iv)	Analysis of vessel specific issues	Completed	See SC-CAMLR-XXVII/12 and BG/10.
5	SC-CAMLR-XXVI, 5.6(v)	Broaden set of measures used, particularly during haul	In progress	Implementation of an effective Brickle curtain (haul mitigation) on all vessels; management of offal has been modified since September 2008, offal can only be discharged between hauls; offal will be retained for a longer period of time on board the new vessel operating in the French EEZ from 2009/10; improving streamer line construction to meet CCAMLR standards.
6	SC-CAMLR-XXVI, 5.6(vi)	Further research with WG-IMAF	Ongoing	Close collaboration between TAAF and IMAF. The independent working group composed of fishermen, scientists and the TAAF administration meets regularly.
7	SC-CAMLR-XXVI, 5.6(vii)	Redirection of management based on data analysis	Ongoing	Improvements to streamer lines, haul-mitigation devices, and offal management practices; additional data collection and analysis will inform other possible management options; weekly by-catch reports from vessel observers (daily reports during the breeding seasons of both the grey and the white-chinned petrel).
8	SC-CAMLR-XXVI, 5.6(viii)	Submit action plan	Completed	SC-CAMLR-XXVII/8 submitted and being implemented.
9	SC-CAMLR-XXVI, 5.6(ix)	Submit paper on regulatory requirements	Completed	SC-CAMLR-XXVII/BG/11

(continued)

Table 11 (continued)

	Scientific Committee or French recommendation	Description	Status	Comments/notes
10	SC-CAMLR-XXVII/12 (DeLord et al. study on environmental, spatial, temporal and operational effects 2003–2006)	Fishery closure during critical chick-rearing periods for both petrel species – 15 February to 15 March and 50 days in part of May and all of June	In progress	The one-month closure 15 February to 15 March (2003 to 2008) has been extended from 1 February to 10 March in 2009. The closure will be extended for the coming season from 1 February to 15 March in 2010. There is no specific fishing closure during the grey petrel's chick-rearing period. There is a possibility that certain sectors might be closed during periods when the mortality peaks in these areas (SC-CAMLR-XXVII/BG/11).
11	SC-CAMLR-XXVII/12	Controlled effort in seasons	In progress	Fishing closure from 1 February to 15 March 2009. Possibility exists to close the most sensitive sectors, move the fishing vessels, or reduce hook effort.
12	SC-CAMLR-XXVII/12	Minimise seabird access to baits (e.g. heavier IWL, 150 g m^{-1})	In progress	All vessels have been required to use IW line (50 g m^{-1}) since 2005, which allows a sink rate greater than 0.2 m s^{-1} (CCAMLR standard). IW line heavier than 50 g m^{-1} is not practicable or possible. Manual weights have been and will continue to be deployed on several vessels during periods when mortality peaks. Recording the line sink rates on all of the vessels during the next season will be done.
13	SC-CAMLR-XXVII/12	Minimum three streamer lines	Completed	Regulations are imposed to use a minimum of two streamer lines on all vessels, but in general three or more streamer lines are used.
14	SC-CAMLR-XXVII/12	Haul-mitigation device	Completed	All vessels required to use a haul-mitigation device (e.g. Brickle curtain).
15	SC-CAMLR-XXVII/BG/10 (Waugh et al. cooperative study)	*Line setting*	In progress	*Recommendations*: **Increase aerial coverage**, *increase sink rate of lines*, *add weights at high-risk times*, **reduce/eliminate fisheries waste discharge**, *underwater setting*, **batch dumping of offal**, **waste management strategies,** e.g. **storage during hauls and discharge between hauls,** mincing, mealing.
16	SC-CAMLR-XXVII/BG/10	*Haul mitigation*	In progress	*Recommendations*[1]: **improve Brickle curtain**, **use CCAMLR reporting procedures**, **reduce/eliminate waste discharge during hauling**, **batch offal dumping**, *active research program*, **study to tailor Brickle curtain design for vessels**.

Table 11 (continued)

	Scientific Committee or French recommendation	Description	Status	Comments/notes
17	SC-CAMLR-XXVII/BG/10	*Hook discards*	In progress	*Recommendations*[1]: **increase awareness**, **outreach posters**, *improve filtering/waste treatment systems.*
18	SC-CAMLR-XXVII/BG/10	*Waste management*	In progress	*Recommendations*[1]: **batch dumping**, **offal retention during hauls and discharge between hauls**, *improve factory filtering system*, *test batching regimes.*
19	SC-CAMLR-XXVII/BG/10	*Haul curtains*	In progress	*Recommendations*[1]: **install structure needed to set up haul curtain**, **use design and custom fit for vessel which resembles the New Zealand type**, **use haul curtains at all times during hauling**.
20	SC-CAMLR-XXVII/BG/10	*Information flow*	Ongoing	*Recommendations*[1]: **reinforce exchange between CCAMLR (e.g. WG-IMAF) and TAAF**, **establish working group to advise TAAF**, **continued exchange between TAAF and scientists**, *exchange of personnel between French vessels and New Zealand or Australian vessels.* **WG-IMAF scientists reviewed cooperative study proposal and several participated in study. TAAF has participated at annual WG-IMAF meetings since 2003**.
21	SC-CAMLR-XXVII/BG/10	*Strategic framework*	Ongoing	*Recommendations*[1]: **Develop a strategic action plan that includes: by-catch reduction objectives, uptake of best-practice measures, specialist by-catch working group, research program, penalty regime, and education and awareness raising programs**.
22	SC-CAMLR-XXVII/BG/10	*Proposed research program*	In progress	*Recommendations*[1]: **Develop a program to consider offal management**, **streamer line design improvements in materials and aerial extent**, **and sink rate improvements.**
23	SC-CAMLR-XXVII/BG/10	*Streamer line configuration*	In progress	*Recommendations*[1]: **revision of streamer materials**, **improve aerial extent**, **vessel-specific solutions,** *attach branch streamers with swivels*, *multiple streamer lines (five or more)*, **increase attachment height to 7 m or more**, **use of outboard booms**, *consider wind direction when setting streamer line*, **carry replacement streamer lines and materials on board**.

[1]   **Bold indicates item completed or under way.** *Italics indicates item is under consideration.* Regular font indicates no action has been taken.

Table 12:   List and priority observer tasks for WG-IMAF.

User group	Data type	Description	Use	Optimal collection	Practical limitations
IMAF	Incidental mortality (high priority)	Record mortality of seabirds and marine mammals.	Estimate seabird and marine mammal mortalities within the Convention Area caused by fishing.	Observe all krill trawl hauls and appropriate proportions of finfish trawl hauls and longline hooks hauled as defined in Tables 13 and 14.	Time constraints Safety considerations Poor weather conditions
	Seabirds and marine mammal interactions with fishing gear (high priority)	Record entanglement and injury to seabirds and marine mammals.	Estimate seabird and marine mammal mortalities within the Convention Area caused by fishing.	Observe all krill trawl hauls and appropriate proportions of finfish trawl hauls and longline hooks hauled as defined in Tables 13 and 14.	Time constraints Safety considerations Poor weather conditions
		Trawl warp strikes.	Estimate risk of trawl warp strike interactions with seabirds within the Convention Area.	At least one warp strike observation per 24-hour period.	Time constraints Safety considerations Poor weather conditions
		Interaction of marine mammals with fishing vessels and gear.	To assess ecological impact of depredation.	Once per haul observation period (in conjunction with haul observations).	Time constraints Safety considerations Poor weather conditions Poor visibility
	Implementation of mitigation measures (medium priority but also required by SCIC)	Description and specification of mitigation measures (L2 data).	To assess the performance of the measures to review attainment of minimum requirements.	Once every seven days (in conjunction with sink rate tests).	Night setting limits ability to assess aerial extent Poor weather conditions Safety considerations
		TDR and bottle tests (L10 data).	To assess sink rates.	One test per 24-hour period and four tests on a single longline once per seven-day period (in conjunction with mitigation observations).	Poor weather conditions Night setting for bottle tests Safety considerations

Table 13:   Summary of assessment of risk posed to seabirds from net entanglements in pelagic finfish trawl fisheries in the Convention Area (see also Figure 2).

Risk level[1]	Mitigation requirements	Recommended observer coverage
1 – low	• Strict compliance with standard seabird by-catch conservation measure[2]. • Vessels that catch a total of three birds in any season shall consider the use of net binding to reduce seabird captures during shooting operations. • No offal discharge during the shooting and hauling of trawl gear. Full offal retention where possible.	20% of sets 50% of hauls
2 – average to low	• Strict compliance with standard seabird by-catch conservation measure[2]. • Vessels that catch a total of three birds in any season shall consider the use of net binding to reduce seabird captures during shooting operations. • No offal discharge during the shooting and hauling of trawl gear. Full offal retention where possible.	25% of sets 75% of hauls
3 – average	• Strict compliance with standard seabird by-catch conservation measure[2]. • Vessels that catch a total of three birds in any season shall consider the use of net binding to reduce seabird captures during shooting operations. • No offal discharge during the shooting and hauling of trawl gear. Full offal retention where possible.	40% of sets 90% of hauls
4 – average to high	• Strict compliance with standard seabird by-catch conservation measure[2]. • Vessels that catch a total of three birds in any season shall use net binding, and consider adding weight to the codend to reduce seabird captures during shooting operations. • No offal discharge during the shooting and hauling of trawl gear. Full offal retention where possible.	45% of sets 90% of hauls
5 – high	• Strict compliance with standard seabird by-catch conservation measure[2]. • Use net binding, and consider adding weight to the codend to reduce seabird captures during shooting operations. • No offal discharge during the shooting and hauling of trawl gear. Full offal retention where possible.	50% of sets 90% of hauls

[1]   Where 'risk' means seabird by-catch risk if no mitigation is used for a given level of seabird abundance.
[2]   Conservation Measure 25-03.

Table 14: Summary of assessment of risk to seabirds posed by longline fisheries in the Convention Area (see also Figure 2).

Risk level	Mitigation requirements	Recommended observer coverage
1 – low	• Strict compliance with standard seabird by-catch conservation measure[1]. • No need for restriction of longline fishing season. • Daytime setting permitted subject to line sink rate requirement. • No offal dumping.	20% of hooks hauled 100% of sets[3]
2 – average to low	• Strict compliance with standard seabird by-catch conservation measure[1]. • No need for restriction of longline fishing season. • Daytime setting permitted subject to line sink rate requirements and seabird by-catch limits. • No offal dumping.	25% of hooks hauled 100% of sets[3]
3 – average	• Strict compliance with standard seabird by-catch conservation measure[1]. • Restrict longline fishing to period outside at-risk species' breeding season where known/relevant unless line sink rate requirement is met at all times. • Daytime setting permitted subject to strict line sink rate requirements and seabird by-catch limits. • No offal dumping.	40% of hooks hauled[2] 100% of sets[3]
4 – average to high	• Strict compliance with standard seabird by-catch conservation measure[1]. • Restrict longline fishing to the period outside any at-risk species' breeding season(s). • Strict line sink rate requirements at all times. • No daytime setting permitted. • No offal dumping.	45% of hooks hauled[2] 100% of sets[3]
5 – high	• Strict compliance with standard seabird by-catch conservation measure[1]. • Restrict longline fishing to period outside at-risk species' breeding season. • Closed areas as identified. • Strict line sink rate requirements at all times. • No daytime setting permitted. • Strict seabird by-catch limits in place. • No offal dumping.	50% of hooks hauled[2] 100% of sets[3]

[1] Conservation Measure 25-02 with the possibility of exemption to paragraph 5 as provided by Conservation Measure 24-02.
[2] This is likely to require the presence of two observers.
[3] Observers are requested to record whether seabird mitigation is in place at least once per set and verify that no offal is being discharged.

Fishing effort and incidental mortality rate in Division 58.5.1
2008/09
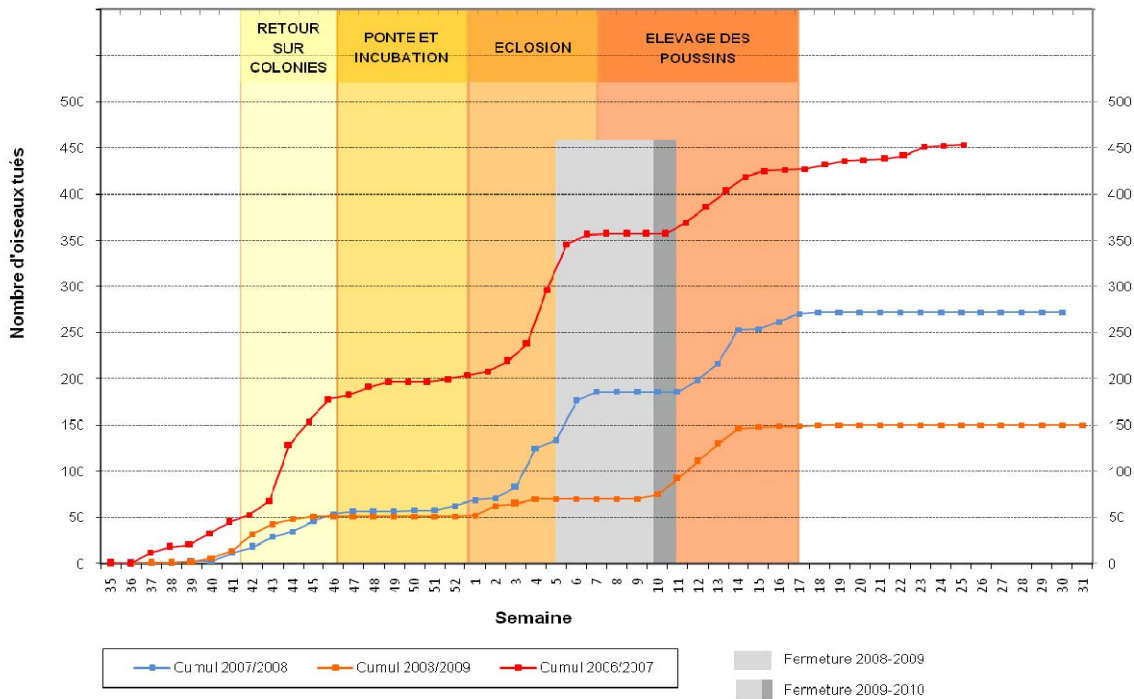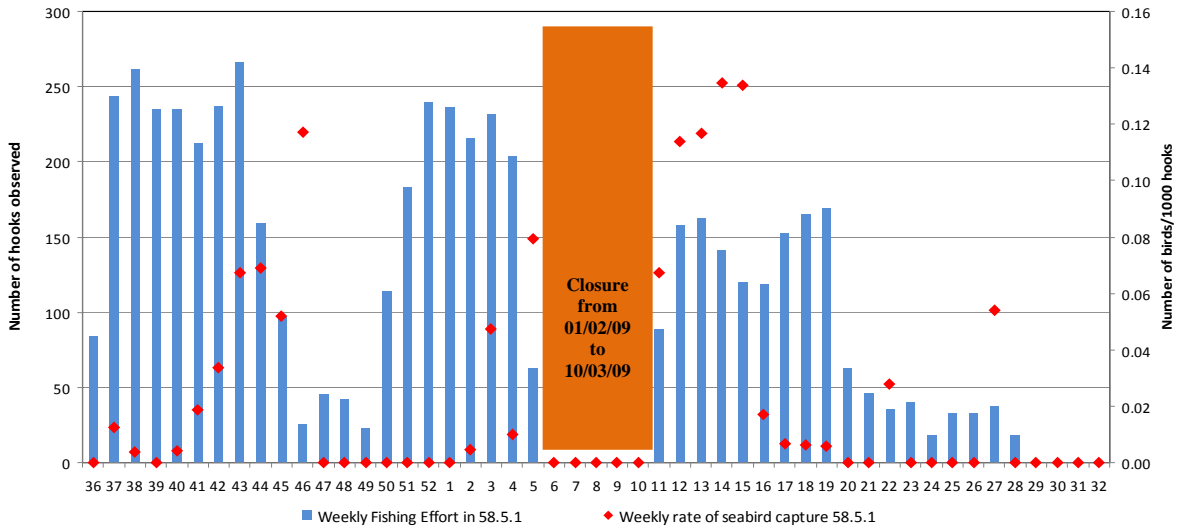
Figure 1*   Trends in incidental mortality in Division 58.5.1 over the last three years (scatter plot). The figure also shows the reproductive cycle of the white-chinned petrel (coloured histogram) and periods of fishery closure (in grey).
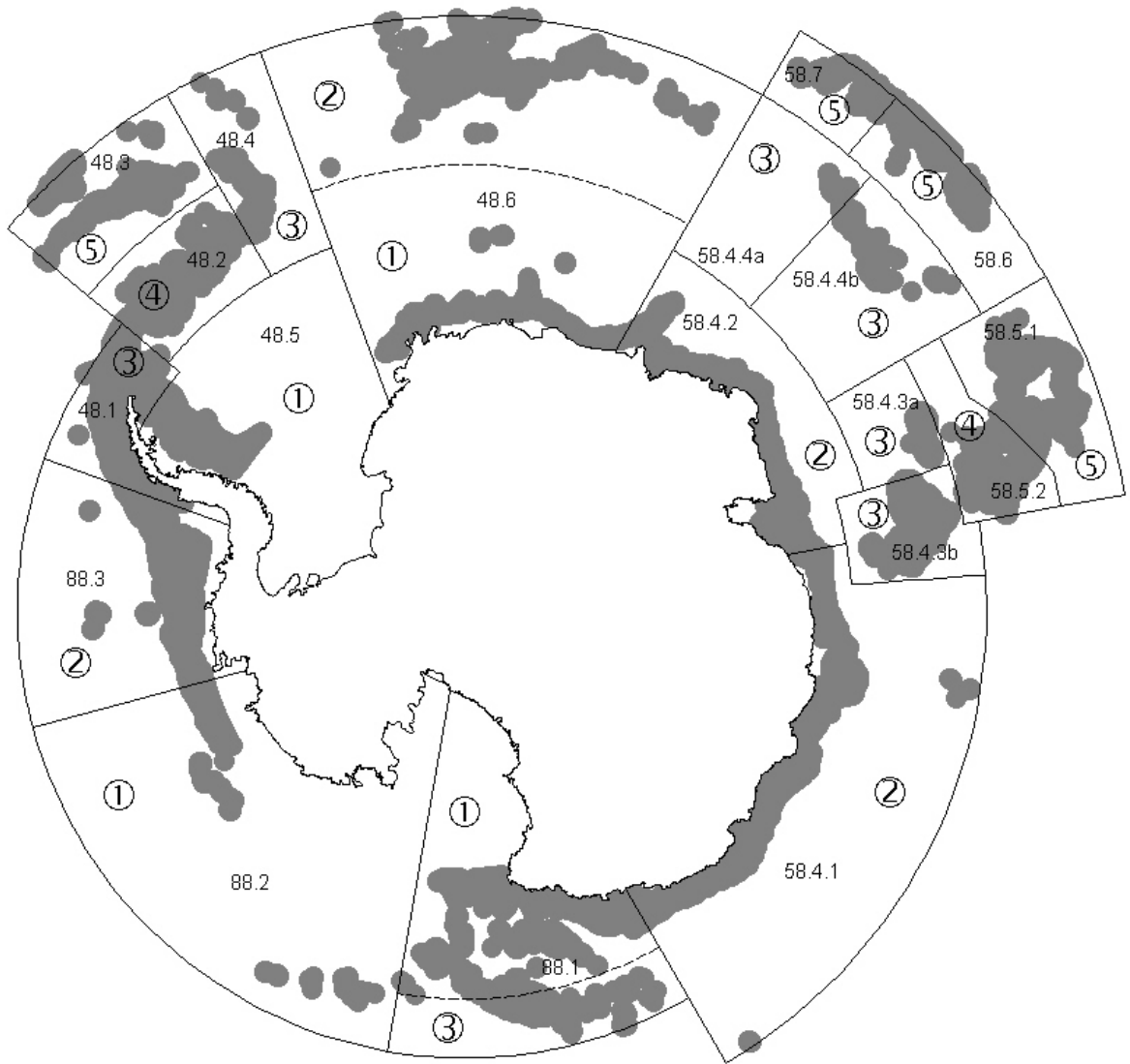
Figure 2: Assessment of the potential risk of interaction between seabirds, especially albatrosses, and longline fisheries within the Convention Area. 1: low, 2: average to low, 3: average, 4: average to high, 5: high. Shaded patches represent seabed areas between 500 and 1 800 m.

AGENDA

Working Group on Incidental Mortality Associated with Fishing
(Hobart, Australia, 12 to 16 October 2009)

1.   Introduction

     1.1   Opening of the meeting
     1.2   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
     3.3   Information relating to the implementation of Conservation
           Measures 25-02 (2008), 25-03 (2003), 26-01 (2008), 24-02 (2008) and 51-01
           (2008)
     3.4   Review of action plans to eliminate seabird mortality

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.   Research into the status and distribution of seabirds

9.   Assessments of risk in CCAMLR subareas and divisions

10. Incidental mortality of seabirds in relation to new and exploratory fisheries

     10.1   New and exploratory fisheries operational in 2008/09
     10.2   New and exploratory fisheries proposed for 2009/10

11. International and national initiatives relating to incidental mortality of seabirds in
     relation to longline fishing

     11.1   Coordination with ACAP
     11.2   International and national initiatives

12. Fishery reports

13. Marine debris

14.   Streamlining the work of the Scientific Committee

15.   Other business

16.   Advice

17.   Adoption of the report and close of the meeting.

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(Hobart, Australia, 12 to 16 October 2009)

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LIST OF DOCUMENTS

Working Group on Incidental Mortality Associated with Fishing
(Hobart, Australia, 12 to 16 October 2009)

WG-IMAF-09/1	Provisional Agenda and Provisional Annotated Agenda for the 2009 Meeting of WG-IMAF
WG-IMAF-09/2	List of participants
WG-IMAF-09/3	List of documents
WG-IMAF-09/4 Rev. 2	A summary of observations on board longline vessels operating within the CCAMLR Convention Area during the 2008/09 season Secretariat
WG-IMAF-09/5 Rev. 2	Summary of observations aboard trawlers operating in the Convention Area during the 2008/09 season Secretariat
WG-IMAF-09/6 Rev. 2	A summary of scientific observations related to Conservation Measures 25-02 (2008), 25-03 (2003) and 26-01 (2008) Secretariat
WG-IMAF-09/7	Summary of observations aboard pot vessels operating in the Convention Area during the 2008/09 season Secretariat
WG-IMAF-09/8	Review of CCAMLR activities on monitoring marine debris in the Convention Area Secretariat
WG-IMAF-09/9	Beached marine debris surveys and incidences of seabird/marine mammal entanglements and hydrocarbon soiling at Bird Island, South Georgia, and Signy Island, South Orkneys, 2008–2009 C.M. Waluda (United Kingdom)
WG-IMAF-09/10	Ingestion of fishing gear and entanglements of seabirds: implications for monitoring and management R.A. Phillips, C. Ridley, N. Harrison (United Kindom), K. Reid (Secretariat), G.N. Tuck (Australia) and P.J.A. Pugh (United Kingdom)

WG-IMAF-09/11	Proposal to move the start date of the fishery for *Dissostichus eleginoide*s in Subarea 48.3 Delegation of the United Kingdom
WG-IMAF-09/12	Interactions of Patagonian toothfish fisheries with killer and sperm whales in Crozet Exclusive Economic Zone: an assessment of depredation levels and insights on possible mitigation solutions P. Tixier, N. Gasco, G. Duhamel and C. Guinet (France) (*CCAMLR Science*, submitted)
WG-IMAF-09/13	BirdLife International Global Procellariforme Tracking Database – 2008 update B. Sullivan (BirdLife International)
WG-IMAF-09/14	Mitigation of seabird captures during hauling in CCAMLR longline fisheries E. Reid, B. Sullivan (BirdLife International), K. Reid (Secretariat) and J. Clark (United Kingdom) (*CCAMLR Science*, submitted)
WG-IMAF-09/15	Development of effective mitigation to reduce seabird mortality in the icefish (*Champsocephalus gunnari*) trawl fishery in Subarea 48.3 B. Sullivan (BirdLife International), J. Clark (United Kingdom), K. Reid (Secretariat) and E. Reid (BirdLife International)
WG-IMAF-09/16	Update on items of interest to WG-IMAF N. Walker (New Zealand)
WG-IMAF-09/17	Agreement on the Conservation of Albatrosses and Petrels – Report to ad hoc WG-IMAF Submitted by ACAP

**REPORT OF THE FOURTH MEETING OF THE
SUBGROUP ON ACOUSTIC SURVEY AND ANALYSIS METHODS**
(Ancona, Italy, 25 to 28 May 2009)

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REPORT OF THE FOURTH MEETING OF THE
SUBGROUP ON ACOUSTIC SURVEY AND ANALYSIS METHODS
(Ancona, Italy, 25 to 28 May 2009)

INTRODUCTION

The fourth meeting of the Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) was held from 25 to 28 May 2009. The meeting was convened by Dr R. O'Driscoll (New Zealand) and Dr J. Watkins (UK) and was held at the Dipartimento di Scienze del Mare (DISMAR), Università Politecnica delle Marche in Ancona, Italy. The local hosts were Dr M. Vacchi and Prof. R. Danovaro (Italy).

2. Dr Vacchi welcomed participants on behalf of the hosts and outlined local arrangements for the meeting.

3. Dr O'Driscoll reviewed the background to the meeting and the terms of reference recommended by the Scientific Committee (SC-CAMLR-XXVII, Annex 8; given in Appendix A). The following specific tasks were identified by the Scientific Committee for 2009. Points (i), (ii) and (iii) were considered to be of highest priority:

(i) to provide advice that will assist in quantifying uncertainties in krill B_0 estimates;

(ii) to document the current agreed protocols for krill B_0 assessment;

(iii) to investigate the use of ancillary acoustic data (e.g. from finfish surveys, exploratory fisheries data and commercial fisheries echo sounders) and the required analytical methods;

(iv) to evaluate acoustic results from IPY surveys in 2008;

(v) to evaluate developments in target strength modelling and other new observations of Antarctic fish species;

(vi) to resolve difficulties identified with the swept-area estimation of icefish abundance.

4. A Provisional Agenda based on these items was discussed and it was agreed to consider the Southern Ocean Sentinel Program under item 4. The agenda was adopted (Appendix B).

5. The list of participants is included as Appendix C and the list of documents submitted to the meeting is included as Appendix D.

6. This report was prepared by the participants.

PROVIDE ADVICE THAT WILL ASSIST IN QUANTIFYING
UNCERTAINTIES IN KRILL B_0 ESTIMATES

Review recent results including developments in target strength modelling
and observations on krill orientation and material properties

7.   SG-ASAM-09/8 reported on activities to acoustically identify krill and estimate size, observe behaviour, and measure target strength *in s itu*, and to verify the acoustic measurements biologically, as part of the Antarctic Krill and Ecosystem Studies (AKES) program carried out by Norway in 2008 during the International Polar Year (IPY).

8.   Krill were identified from the relative frequency response of a six-frequency hull-mounted echo-sounder system, and specimen size and orientation were estimated acoustically by inversion of several acoustic scattering models implemented in an optimised framework in the Large-Scale Server System (LSSS) post-processing program.

9.   The Subgroup discussed several points about how the LSSS post-processing works. In particular, how the training set is developed and how targets are categorised. Questions arose regarding the inability of the inversion method to correctly classify krill in some cases where the categorisation method appeared to work very well.

10.   Dr R. Korneliussen (Norway) described how the LSSS program fits the measured frequency response to model predictions, and noted that, on a pixel basis, the inversions indicated that krill exhibited a wide variety of angles within the swarms. He showed that an accurate simplified Stochastic Distorted-Wave Born Approximation (SDWBA) model with a normal orientation distribution with a mean of 15° and a standard deviation (sd) of 15° fitted best.

11.   The Subgroup believed the LSSS program was a useful tool from which to classify sound backscatter from krill and to provide estimates of krill length from inversions of scattering models.

12.   SG-ASAM-09/13 reported on a submersible multi-frequency acoustic TS-probe used to measure the target strength (TS) of *in situ* Antarctic krill (*Euphausia superba* , herein referred to as 'krill') at short range as part of the AKES cruise. The system comprises a Simrad EK60 split-beam echosounder system operating at 38, 120 and 200 kHz. A stereo-still-camera system was also mounted directly on the transducer platform with the purpose of measuring the tilt-angle orientations of the nearby organisms. From tracks of individual scatterers sensed with synchronised detections at the three frequencies, TS frequency responses were estimated for individual animals.

13.   The Subgroup noted that there was no overlap between krill photographed and krill insonified by the downward-looking TS-probe, and that there may be considerable differences between the orientation of krill around the TS-probe, and the orientation of krill under the ship during surveys owing to avoidance reactions. Attempts to measure the tilt angle by means of a downward-looking lander, while the ship was passing over, were unsuccessful.

14.   The Subgroup endorsed the target-tracking method as a means of reliably identifying individual krill targets for TS estimation of *in situ* animals. This method could also provide data about the orientation angle of tracked animals because orientation angle and swimming speed are inversely related.

15.   The Subgroup agreed that the preliminary results from the TS-probe system indicated that it is an important and promising technology that could help to estimate TS of krill and other scatterers. The authors were encouraged to further analyse their data to build a large and more complete database of TS and orientation.

16.   WG-EMM-08/56 reported on sound speed and mass density of krill measured during the Antarctic surveys conducted by the Japanese RV *Kaiyo Maru* in 1999/2000 around the South Shetland Islands, and in 2004/05 in the Ross Sea.

17.   The Subgroup welcomed these data, given the importance of measurements of density contrast (g) and sound-speed contrast (h) of krill in the determination of krill TS and therefore biomass. WG-EMM-08/56 reported high variability in g and h between regions and times of the year which led to changes in estimated krill TS by 5 dB.

18.   However, the Subgroup noted that there was insufficient information in WG-EMM-08/56 to fully evaluate the methods used to make these measurements (particularly organism volume fraction and transmitting pulse form). The Subgroup further suggested that the biological characteristics of krill (e.g. moulting stage, maturity stage) should be reported when making these estimates to further explore the causes of variability.

19.   The Subgroup noted that the new density contrast data are consistent with Foote's distribution and also that the new measurements of sound-speed contrast exceed Foote's distribution. In the absence of information about the accuracy of the krill sound-speed measurements, the Subgroup concluded that it should not change the default values currently in place when calculating krill biomass.

20.   Noting the apparent level of variability in measurements of g and h in different regions and times of year, their potential covariance (Figure 3 in WG-EMM-08/56), and the importance of these parameters within the SDWBA model, the Subgroup recommended further measurements of these parameters as a high priority.

Collate a set of net-validated acoustic data and evaluate whether
current acoustic target identification methods are biased

21.   SG-ASAM-09/4 revisited net-validated krill aggregation data initially used to validate the two-frequency classification of the volume backscattering strength (S_v) scheme used in krill identification (Watkins and Brierley, 2002), to empirically investigate the three-frequency SDWBA-derived variable S_v classification used in WG-EMM-07/30 Rev. 1. SG-ASAM-09/4 indicated that using a three-frequency identification window, calculated using SDWBA with an orientation angle $\theta = N(11, 4)$, did not correctly identify all acoustic targets as krill, but that when θ was calculated for each cruise using the inversion method of Conti and Demer (2006), the target identification was substantially improved.

22.   Dr O'Driscoll provided a further example by displaying echograms of krill and juvenile Antarctic silverfish (*Pleuragramma antarcticum*) (SG-ASAM-09/5), that non-krill targets may have a similar frequency response to krill, and that the two- or three-frequency dB-difference technique may incorrectly classify targets.

23.   The Subgroup discussed the dB-difference technique and recognised that classification errors should be minimised and that constraining the identification window according to the SDWBA (if correctly parameterised) would be one way of achieving this.

24.   The Subgroup recognised that a number of alternative target identification techniques exist, including empirically derived dB-difference techniques (Azzali et al., 2004), thresholding, scattering-model inversion techniques (Lebourges-Dhaussy, 2006, in Fernandes et al., 2006), frequency response (SG-ASAM-09/13), and statistical-spectral analysis (Demer et al., 2009). In addition, supplementary information such as time of day, depth of target in the water column and shape of target, may be useful in correctly identifying krill targets.

25.   The Subgroup noted that these alternative target identification methods may perform as well as or better than the current dB-difference technique and the Subgroup would welcome submissions examining the success of the different methods. It was noted that the comparison between these methods would be complicated by the resolution of the data on which these analyses would be undertaken, where re-sampling of data over time and space could combine scatter from multiple taxa or species.

26.   The Subgroup noted that target identification may be improved by techniques which use pre-classification of high-resolution S_v data, and then aggregate the candidate samples for comparison with empirical or theoretical scattering models. Such pre-classifications can be done using methods such as thresholding, school detection (e.g. as implemented in software such as Echoview or LSSS), or multi-frequency coherence (e.g. Demer et al., 2009).

27.   The Subgroup recommended that a library of validated echograms be created that could be used to test alternative techniques of target identification. Dr D. Ramm (Data Manager) indicated that the CCAMLR acoustic database includes a module which contains a prototype echogram library which was based on the framework adopted by the EU project on Species Identification Methods from Acoustic Multifrequency Information (Fernandes et al., 2005). The prototype library may be linked to CCAMLR's existing acoustic database, and contains two primary tables: Echogram – a description of the characteristics of a species' typical echogram; and Echotrace – photographic examples of echotraces (see SG-ASAM-07/4).

28.   The Subgroup noted the importance of validation of echograms included in the library and the need to include catch composition information and other metadata (gear type, fishing depth etc). To allow testing of various target identification methods, the validated echograms would need to be linked to acoustic data files.

29.   The Subgroup urged Members to provide validated echograms on krill and other species to help populate this library.

Provide direction towards developing a probability density function (PDF)
for the estimate of B_0 based on the current understanding of uncertainties
in various parameter values

30.   The Subgroup recognised that uncertainty in the acoustic estimation of krill biomass
has been the subject of previous investigations (Demer, 2004; SC-CAMLR-XXIV, Annex 6).
Demer (2004) concluded that the major areas of uncertainty were associated with TS
estimation and target identification.

31.   However, the Subgroup emphasised that current estimates of B_0 only included the
sampling uncertainty (usually expressed as the sampling CV).

32.   The Subgroup recognised the importance of quantifying the total uncertainty in the
biomass estimation process. It felt that it was appropriate to structure the process into:

   (i)   a consideration of uncertainty associated with the parameter values used in the
          present protocol, including possible modifications to these parameter values;

   (ii)   a brief consideration of new techniques or methods that could substantially
          reduce uncertainty;

   (iii) a brief consideration of validating the components of the acoustic estimates.

          Uncertainty associated with parameter values used in the present protocol

33.   To fully capture the uncertainty in the present estimates of B_0, the Subgroup provided
a list of the major steps in the B_0 estimation process and comments on the degree of
uncertainty associated with each of these major steps (Table 1). The Subgroup further
recognised that there are varying degrees of covariance between the parameters used in the
SDWBA which need to be assessed and quantified.

34.   The Subgroup reiterated that krill orientation is presently derived using a model
inversion of the dB difference between krill acoustic backscatter at 120 and 38 kHz. As a
result, there is a covariance between estimated krill orientation and the SDWBA model
predictions of dB differences, and hence target identification. Therefore, any estimate of
overall uncertainty will need to take this into account.

35.   The orientation distributions that were estimated from the CCAMLR-2000 Survey
data (mean scenario with mean = 11° and standard deviation = 4°) were derived by inverting
the SDWBA model using measurements of S_v (dB re 1 m^{-1}) at multiple frequencies, averaged
over 50 ping (~500 m) and 5 m intervals. By averaging over larger areas, the variance is
reduced by the inverse of the number of independent observations. The Subgroup therefore
recommended that these values should be corrected to take account of the number of
independent acoustic samples in the inversion interval and also the mean number of krill in a
sampling volume.

36.   The Subgroup also noted that measurements of krill orientation using a towed camera
system (Lawson et al., 2006) showed a greater variance to that produced from the model

inversion approach. However, there was recognition that orientation may change as a result of behavioural responses of krill to the towed-camera system and the measured distribution may not represent the behaviour of krill beneath a survey vessel.

37. With respect to acoustic target identification (Table 1, point 2), the Subgroup noted that the dB-difference ranges in the present krill size variable target-identification windows (SC-CAMLR-XXIV, Annex 6, Table 3) are based on the mean values of the SDWBA model parameter settings (Table 2). The Subgroup agreed that these target-identification windows should be recalculated to take account of the ±1 sd ranges for the SDWBA parameter settings once the orientation distribution has been corrected for the effect of averaging (see paragraph 35).

38. In addition, the Subgroup agreed that the present provision of a dB-difference window with 10 mm length classes could be refined to reduce uncertainty. A table with 1 mm size classes would be large. Dr D. Demer (Invited Expert) presented a Matlab-based Graphical User Interface (GUI) for calculating and displaying SDWBA predictions, which is intended to allow users to generate the required dB-difference windows based on user input of model parameters and a range of krill lengths. The Subgroup welcomed access to such a program.

39. With regard to sampling and calibration uncertainty (Table 1, points 3 and 4), the Subgroup agreed that these areas had been previously well characterised in the literature and CCAMLR reports.

40. With regard to uncertainty related to availability of krill to be included in a survey (Table 1, point 5), the Subgroup agreed that in certain specific circumstances, availability of krill to standard acoustic sampling techniques could increase the uncertainty of the overall biomass estimate. Specific circumstances highlighted by the Subgroup for further consideration and assessment of uncertainty include:

(i) krill in unsurveyable areas (e.g. krill under ice is frequently a problem in the Ross Sea);

(ii) environmentally driven changes in krill distribution beyond traditional survey areas;

(iii) occurrence of krill beyond the normal vertical sampling range of the acoustic sampling systems (e.g. surface, benthic and deep-water krill).

41. The Subgroup considered that in addition to the requirements to assess the uncertainty associated with individual elements described in Table 1, there were some additional ways that could provide insight into general levels of uncertainty in the krill biomass estimation process. For instance, the Subgroup recognised that calculating separate biomass estimates for each frequency can provide valuable insights into the biases and uncertainties inherent in the overall estimation process (e.g. Demer, 2004), including TS estimation and target identification. The Subgroup recognised that survey-by-survey measurements of all parameters used in the SDWBA model may not be possible, and in such cases the mean values with the associated ranges given in the present protocol could be used. It was recognised that application of the specific parameter values measured during that particular survey could reduce the overall uncertainty estimated for that survey.

42.   The Subgroup recommended that future estimations of krill biomass should explicitly state which elements of the total uncertainty had been included in the estimation process, so that the uncertainty can be considered when comparing results between studies.

New techniques or methods that could substantially reduce uncertainty

43.   The Subgroup noted that techniques utilising multi-frequency response curves in the target identification process (see for example SG-ASAM-09/8) are likely to reduce uncertainty associated with target identification and that uncertainty will reduce as more frequencies are used.   The further development of these techniques, together with an assessment of their associated levels of uncertainty, was strongly encouraged.

Validating components of the acoustic estimates

44.   The Subgroup recognised that other sampling techniques that might be used to validate acoustically estimated biomass (for example the use of net sampling to validate acoustic target identification and estimates of krill-length PDF; or photographic sampling techniques to determine *in situ* krill orientation) also include uncertainty (systematic and random components of measurement and sampling error) which should be estimated in any comparison or validation procedure.

45.   There was a recognition that there was a degree of overlap between krill and non-krill targets in the currently used multi-frequency identification procedures.   Thus, increasing the krill identification windows to ensure that all krill targets were identified as krill, increases the probability of including non-krill targets in the krill fraction.   To understand the magnitude of this problem, the Subgroup recognised that information on the potential biomass contribution of other scattering organisms would be valuable, and encouraged its collection and submission.

DOCUMENT THE CURRENT AGREED PROTOCOLS FOR KRILL B_0 ASSESSMENT

46.   The Subgroup recognised that, while CCAMLR had agreed protocols for key parts of the process of estimating B_0, in some instances there was a lack of clarity as to whether the 'recommendations' in the report of SG-ASAM in 2005 (SC-CAMLR-XXIV, Annex 6) were recommendations for immediate implementation of particular methods or for further investigation of the implications of their implementation.   This was the subject of considerable discussion during WG-EMM's Workshop to Review Estimates of B_0 and Precautionary Catch Limits for Krill, which was held in 2007 (SC-CAMLR-XXVI, Annex 4), where there was agreement to use the procedure as set out in WG-EMM-07/30 Rev 1.

47.   The Subgroup agreed that, following the discussion under subitem 2.3 of the key uncertainties associated with the estimation of B_0, it would consider the agreed current CCAMLR protocols for krill B_0 assessment in two parts:

(i)   collate the existing agreed protocols
(ii)   review and correct any errors of omission/commission and clarify method details in those protocols.

48.   The Subgroup collated the current CCAMLR protocols for the component parts of the production of an estimate of krill B_0 using the framework set out in SG-ASAM-09/12, noting that the protocols for the component parts existed principally in SC-CAMLR-XXIV, Annex 6 and SC-CAMLR-XXVI, Annex 4 (in particular Table 1) and papers describing the methods used in the conduct of the CCAMLR-2000 Survey (e.g. Trathan et al., 2001; Hewitt et al., 2004).

49.   The collation of the agreed methods/protocols for components of the process were considered, and clarifications to the material included in the documents referred to above were provided in Appendix E.

50.   The Subgroup recognised that there was great value in collating these methods and providing the clarification on the currently agreed protocols. It also recognised that the full development of Appendix E, requiring appropriate cross-referencing etc., could not be undertaken at the time of the meeting and requested that the Secretariat undertake this task and make this information available on the CCAMLR website.

51.   The Subgroup noted that several of the values in the SDWBA parameter set in WG-EMM-07/30 Rev. 1 that were used in the analysis undertaken at WG-EMM 2007 to estimate the precautionary catch limit for Area 48, were incorrect owing to the omission of the imaginary parts. Dr Demer provided a corrected parameter set for the simplified SDWBA (Table 3).

52.   The Subgroup also noted that in SC-CAMLR-XXIV, Annex 6, Table 1, the values for orientation distributions and seawater sound speed in the ±1 sd scenarios were transposed, and to clarify the process of propagating uncertainties this has been corrected (see Table 2).

USE OF ANCILLARY ACOUSTIC DATA

Review recent research results involving collection of ancillary acoustic data

53.   WG-EMM-08/26 described an acoustic estimation of krill abundance near the South Orkney Islands using data collected during a research trawl survey in 1999. Acoustic data were collected while transiting between random trawl stations and were treated as random samples of the krill distribution within the survey area. Survey uncertainty was estimated by bootstrapping within strata (divided by day and night and depth). Because krill were not sampled during the 1999 survey, krill size was estimated from net samples at Elephant Island in the same year. It was demonstrated that the length distributions of krill at Elephant Island and the South Orkney Islands were similar in 2000 and 2008. Dr C. Reiss (USA) reported that this was also the case in 2009.

Document protocols for analysing, processing
and interpreting ancillary acoustic data

54.   This item was discussed in relation to the survey design presented in WG-EMM-08/26 and SG-ASAM-09/5, which utilised acoustic data collected while transiting between random sampling stations as a basis for estimating biomass.

55.   The Subgroup agreed that such designs could be useful for estimating biomass, provided that the sampling uncertainty could be quantified. The bootstrapping method appears to provide a suitable method for estimating uncertainty, but the Subgroup did not feel that there was suitable statistical expertise within the group to fully assess the methods described.

56.   The Subgroup further noted that when estimating krill biomass, other aspects of survey analysis should adhere to currently agreed protocols to the extent possible. Where there is deviation from these protocols, the implications for uncertainty should be assessed.

Determine whether such data can provide krill biomass estimates
from areas that are not regularly surveyed

57.   This item was discussed primarily in relation to ancillary acoustic data collected from trawl surveys (e.g. WG-EMM-08/26) and IPY surveys (e.g. SG-ASAM-09/5).

58.   The Subgroup recognised that krill biomass estimates could be calculated from ancillary acoustic data and may provide useful information on krill distribution and abundance from regions that are not regularly surveyed.

59.   Dr M. Azzali (Italy) noted that the level of survey coverage may be less extensive than expected in research acoustic surveys and that, if the survey coverage was insufficient or non random, important areas for krill may be missed. He proposed a minimum coverage of 5% of the study area and this coverage should include a random component.

60.   The Subgroup recognised that this is a fundamental issue about sampling design, namely at what scale estimates of abundance can be scaled up to cover a wider area. Clearly, a survey of only a small part of a much wider region may produce a biased estimate of abundance if the survey area is not representative. The Subgroup further noted that the estimated sampling uncertainty should take account of the survey coverage if calculated appropriately (i.e. less extensive coverage should lead to higher uncertainty).

61.   The Subgroup agreed that if the acoustic survey analysis methods were applied appropriately, ancillary/opportunistic acoustic data could provide estimates of krill abundance. Estimates of biomass should be presented along with estimates of total uncertainty including systematic and random components of measurements of sampling error. The Subgroup recognised that decisions regarding the application of these estimates in management advice is not within its terms of reference.

Future needs for acoustic instrumentation in the Antarctic

62.   Dr L. Andersen (Norway) provided an overview of current acoustic technology, including multi-frequency echosounders, multi-beam broadband echosounders and matrix sonars, omnidirectional sonars, remotely controlled systems, moored systems and autonomous systems (SG-ASAM-09/9).

63.   The Subgroup discussed potential applications in relation to commercial vessels collecting ancillary acoustic data, and the use of moored systems to collect information on krill availability (close to the surface or nearshore) and for long-term monitoring.

Southern Ocean Sentinel Program

64.   Dr R. Kloser (Invited Expert) outlined a need identified during the Southern Ocean Sentinel workshop (Hobart, Australia, April 2009) for large-scale observations of the Southern Ocean and the potential for acoustic monitoring to provide relevant ecosystem indicators. This need has also been identified by other groups as needing further development within Climatic Impact on Top Predators (CLIOTOP) and the 2009–2013 ICES Strategic Plan. A large-scale monitoring of mid-trophic level prey organisms, their horizontal and vertical size-resolved distribution and abundance in the pelagic environment system could be achieved through innovative combination of existing components and expertise (e.g. ARGOS buoys, vessels of opportunity, moorings, gliders etc.). Examples of acoustic data collected from ships of opportunity at ocean-basin scale, that have provided indices of total backscatter and micronekton fish biomass to monitor changes over time, and have also provided inputs to ecosystem models and identified key regions for targeted sampling, were presented.

65.   The Subgroup noted that technical issues exist relating to calibration, data quality (noise and interference) and data processing, and suggested that data collection protocols should be as rigorous as possible (e.g. ICES, 2007). Such data are already being collected within the Ship of Opportunity Program (SOOP) and other opportunistic national initiatives (e.g. SG-ASAM-07/7 described opportunistic acoustic data collection from fishing vessels in the Ross Sea) and have some information content. However, the power of such observations to detect change has still to be demonstrated. This topic is of broad interest to large regionally focused groups including CCAMLR, the Sentinel Program (Southern Ocean), CLIOTOP (Tuna habitat region) and ICES (primarily the northern Atlantic). It was suggested that this common research area could be advanced with closer linkages between the relevant expert groups within these programs such as SG-ASAM, CLIOTOP-MAAS project (Mid-trophic Automatic Acoustic Sampler) and ICES-WGFAST (Working Group on Fisheries Acoustic Science and Technology) to potentially provide the necessary technical support for a global observing strategy.

EVALUATE RESULTS FROM IPY SURVEYS IN 2008

Review acoustic data and related metadata submitted to CCAMLR

66.   SG-ASAM-09/11 described IPY metadata submitted to the Secretariat. The following research vessels were identified by the CCAMLR-IPY Steering Committee in 2007 as

conducting CCAMLR-related activities during IPY (SC-CAMLR-XXVI/BG/3): *G.O. Sars* (Norway); *James Clark Ross* (UK); *Polarstern* (Germany); *Tangaroa* (New Zealand); and *Umitaka Maru* (Japan). Other vessels, such as *Aurora Australis* (Australia) and *L'Astrolabe* (France), were also thought to have opportunities to collect CCAMLR-related data.

67. In February 2009, the Secretariat contacted Parties identified by the Steering Committee, and sought summary information on the availability of acoustic, net and CTD data collected during IPY surveys.

68. Metadata were provided from *G.O. Sars* (Norway), *Tangaroa* (New Zealand) and *Polarstern* (Germany). In SG-ASAM-09/11, four tables were developed to capture metadata of interest to SG-ASAM: Table 1 – general summary of acoustic and related data collected by vessels during IPY surveys; Table 2 – acoustic data; Table 3 – net data; and Table 4 – CTD data. More detailed descriptions of the Norwegian (WG-EMM-08/28) and New Zealand (SG-ASAM-09/5) datasets were also available.

69. The table of acoustic data was updated at the meeting to correct errors for *G.O. Sars* and to include metadata from the US survey using RV *Yuzhmorgeologiya* (Table 4). The Subgroup requested that other Parties which have acoustic data, provide these to the Subgroup for consideration.

Presentation of new results from IPY surveys

70. Dr O'Driscoll presented preliminary acoustic results from the New Zealand IPY survey to the Ross Sea in February–March 2008 (SG-ASAM-09/5). The survey was restricted because of ice conditions. Multi-frequency acoustic data (12, 38, 70 and 120 kHz) were collected throughout the survey. Mark identification was achieved using 11 targeted midwater trawls. Nineteen additional midwater trawls and 23 demersal trawls were carried out at randomly selected locations as part of the core biodiversity survey. The main target species of the acoustic survey work was Antarctic silverfish. Preliminary biomass estimates were also presented for Antarctic krill and ice krill (*E. crystallorophias*). Data were also presented showing marks from the myctophid *Electrona carlsbergi*. The Subgroup noted that the 70 kHz system turned out to be a system well suited for the conditions in the Ross Sea.

71. The Subgroup noted that preliminary krill estimates were not calculated using standard protocols. In particular, marks were identified subjectively based on target trawls (not by dB differencing) and TS was estimated using the model of Greene et al. (1991). Dr O'Driscoll agreed to recalculate estimates using TS from the SDWBA model, and to investigate frequency-based methods of species classification.

72. New results from the Norwegian IPY survey were presented in SG-ASAM-09/8 and 09/13; these are described under subitem 2.1.

Determine whether data can provide krill biomass estimates
from areas that are not regularly surveyed

73. This item was discussed in conjunction with subitem 4.3 (see above).

EVALUATE DEVELOPMENTS IN TARGET STRENGTH MODELLING
AND OTHER NEW OBSERVATIONS ON ANTARCTIC FISH SPECIES

Target strength of mackerel icefish

74.   Dr G. Macaulay (New Zealand) presented the results of an acoustic target strength model of mackerel icefish (*Champsocephalus gunnari*) (SG-ASAM-09/6). In total, target strength estimates from six fish at 38 kHz were presented and compared to existing *in situ* estimates (WG-FSA-SAM-04/9). This model had been partially verified using inshore species from New Zealand and had also been used to generate target strength estimates for several other species, including orange roughy (*Hoplostethus atlanticus*), where it produced estimates that were consistent with *in situ* measurements. Dr Macaulay emphasised that the model has not been fully verified and the results presented here are preliminary.

75.   The Subgroup encouraged the offers from Drs Macaulay and S. Fielding (UK) to further this research, including providing CT scans of icefish at smaller and larger lengths than used in the model runs.

Target strength of silverfish

76.   Dr O'Driscoll presented target strength results for silverfish (SG-ASAM-09/5) using the same acoustic scattering model as used for the icefish estimates (SG-ASAM-09/6). The tilt-averaged target strength at 38 kHz was estimated for seven fish. The resulting length to target strength relationship was used to derive biomass estimates from acoustic data collected during the New Zealand IPY-CAML voyage in the Ross Sea in 2008 (SG-ASAM-09/5). The model gave very low target strength values for juvenile fish (<11 cm), and this resulted in very high biomass estimates for juvenile fish. The biomass estimate for adult fish appeared to be realistic. When compared to target strength estimates for other species, the values for small silverfish seem unrealistically low and Dr O'Driscoll advised that the results for juvenile fish should be treated with some caution. A comparison of the target strength estimates with the *ex situ* estimates provided by Dr Azzali was made (available in SG-ASAM-09/10). There was good agreement for fish larger than 11 cm.

77.   Dr Azzali presented the results of experiments and models to estimate the target strength of silverfish: *ex situ* experiments in the Adriatic Sea using thawed specimens, trawl density/echo integration inversion from data collected in the Ross Sea (juvenile fish only), and a theoretical model based on silverfish material properties (SG-ASAM-09/10). There was general agreement between the *ex situ* measurements and the theoretical model for adult fish, but the agreement for juvenile fish was more variable. The Subgroup noted that a normal orientation distribution with mean of 0 and sd of 15 was used in the theoretical model.

78.   The Subgroup noted that as the calibration of the EK500 echosounder used for the *in situ* measurements was carried out in the Adriatic Sea, prior to the vessel departing for the Ross Sea, there was the potential for a change in the echosounder calibration to occur due to a change in water temperature, and that this would affect the *in situ* target strength measurements. It further noted that a correction could be developed and applied to the data.

79.   The Subgroup noted that the new results presented under this agenda item significantly advanced our knowledge about the target strength of icefish and silverfish. SG-ASAM

recommended that the TS of icefish, silverfish and associated species continues to be studied using a variety of methods including *in situ* measurements, *ex situ* experiments on individuals and aggregations, and physics-based and empirical models.

ATTEMPT TO RESOLVE DIFFICULTIES IDENTIFIED WITH THE SWEPT-AREA ESTIMATION OF ICEFISH ABUNDANCE

80. In response to the request from WG-FSA to consider the application of the adjustment factor for trawl headline height used in icefish surveys (SC-CAMLR-XXVII, Annex 5, paragraphs 3.26 and 13.20), Dr S. Kasatkina (Russia) presented the findings of a comparison of trawl and acoustic data collected during bottom trawl surveys (SG-ASAM-09/7). The study considered the acoustic density of icefish in 6 m and 8 m depth bands above the bottom and indicated that a 2 m difference in headline height could produce a 1.8-fold difference in the trawl survey biomass estimate for icefish. Overall, the acoustic data revealed large spatial heterogeneity in the icefish distribution that was not apparent in the data from the trawls; furthermore the adjustment of 1.8 varied greatly over both space and time scales.

81. The Subgroup noted that the use of acoustic density data from trawl stations to bootstrap estimates of trawl survey biomass may provide a very useful means to account for this spatial heterogeneity and to improve estimates of uncertainty in the swept-area surveys for icefish.

SUGGESTIONS FOR TIMING/VENUE OF NEXT MEETING

82. The Subgroup agreed that this meeting had once again benefited from being held in conjunction with the meeting of ICES WGFAST (Ancona, Italy, 18 to 22 May 2009). It was agreed that SG-ASAM meetings would be more likely to be attended by acoustic experts if the meetings continue to be held in conjunction with the WGFAST meetings. For example, this year, approximately half of the participants including one of the Co-conveners, would likely have not attended the meeting of the Subgroup had it not been held in conjunction with a meeting of WGFAST.

83. The Subgroup noted that there had been informal discussions within WGFAST regarding the benefits of establishing formal links between WGFAST and SG-ASAM, and more generally ICES and CCAMLR.

84. The Subgroup recognised that a formal link (e.g. a memorandum of understanding) with WGFAST, and other ICES expert groups (such as the Working Group on Fish Technology and Fish Behaviour) would:

(i) enhance common efforts in developing acoustic methods, survey designs and related analyses;

(ii) facilitate attendance of experts at its meetings;

(iii) facilitate meeting arrangements.

85.   Further, the field of acoustic science is small and specialised, and established links between focus groups, including joint open science sessions would enhance collaborations and the exchange of knowledge.

86.   The Subgroup noted that any formal link with ICES expert groups would need to remain flexible and allow for stand-alone meetings, or alternative arrangements, when ICES meetings are held in non-CCAMLR Member countries.

87.   The Subgroup recommended that the Scientific Committee consider the benefits of establishing a formal link with ICES and its expert groups.

88.   The Subgroup agreed that future meetings would be required to consider the results of ongoing acoustic research and new surveys, and developments in TS modelling and measurements, mark identification and estimation of uncertainty. It was anticipated that substantial developments would be achieved within the next 12 months, particularly with *in situ* TS analyses using IPY data and estimation of total uncertainty.

89.   The Subgroup recommended that the Scientific Committee consider the requirements for the next meeting of SG-ASAM in the light of the developments achieved during the fourth meeting of SG-ASAM and feedback and advice from the working groups. The Subgroup noted that the next meeting of WGFAST was likely be held from 26 to 30 April 2010 in La Jolla, USA.

RECOMMENDATIONS TO THE SCIENTIFIC COMMITTEE

90.   The Subgroup recommended that:

(i)   measurements of density, and sound-speed contrast and krill shape and orientation be undertaken where possible during future krill surveys to further constrain these parameters for the SDWBA model (paragraphs 20 and 41);

(ii)   a library of validated echograms be created that could be used to test alternative techniques of target identification (paragraphs 27 to 29);

(iii)   the ±1 sd orientation values should be corrected to take account of the number of independent acoustic samples in the inversion interval and also the mean number of krill in a sampling volume (paragraph 35);

(iv)   the target identification windows should be recalculated to take account of the ±1 sd ranges for the SDWBA parameter settings once the orientation distribution has been corrected for the effect of averaging (paragraph 37);

(v)   future estimations of krill biomass should explicitly state which elements of the total uncertainty had been included in the estimation process so that the uncertainty can be considered when comparing results between studies (paragraphs 42, 43 and 45);

(vi) the TS of icefish, silverfish and associated species continues to be studied using a variety of methods, including measurements on *in situ* and *ex situ* individuals and aggregations, and physics-based and empirical models (paragraphs 75 and 79);

(vii) the Scientific Committee consider the benefits of establishing a formal link with ICES and its relevant expert groups, including WGFAST (paragraph 87);

(viii) the Scientific Committee consider the requirements for the next meeting of SG-ASAM in the light of the developments achieved during the fourth meeting of SG-ASAM and feedback and advice from the working groups (paragraph 89).

91. The Subgroup also requested that the Secretariat undertake full development of Appendix E, including appropriate cross-referencing, and make this information available on the CCAMLR website (paragraph 50). The Subgroup also requested that other IPY Parties which have acoustic data provide these to the Subgroup for consideration (paragraph 69).

ADOPTION OF THE REPORT

92. The report of the fourth meeting of SG-ASAM was adopted.

CLOSE OF MEETING

93. Drs O'Driscoll and Watkins thanked participants for their contribution, and Dr Vacchi, Prof. Danovaro and staff at DISMAR for their warm hospitality and assistance with meeting arrangements. Dr Korneliussen, on behalf of the Subgroup, thanked the Co-conveners for their excellent work. The Subgroup also thanked the invited experts[1] (Drs Demer, Kloser and G. Lawson) for their valuable contributions. The meeting was closed.

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[1] Dr I. McQuinn (Canada) had also been invited to attend the meeting as an invited expert, but was unable to attend.

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Watkins J.L. and A.S. Brierley. 2002. Verification of the acoustic techniques used to identify Antarctic krill. *ICES J. Mar. Sci.*, 59: 1326–1336.

Table 1: Summary of uncertainties associated with the key stages in the estimation of krill biomass.

Major steps in B_0 estimation process		Comments on level of uncertainty
Target strength estimation using the SDWBA model (see SG-ASAM-05* for further details)	Animal shape	No new data provided at meeting. Noting that there was no standard method for the measurement of krill girth.
	Density contrast (g)	New values WG-EMM-08/56 but current protocol values still considered appropriate.
	Sound speed contrast (h)	New values WG-EMM-08/56 outside current range but current protocol values still considered appropriate given concerns over regional differences and technical clarifications.
	Orientation (θ, sd)	sd of distributions to be corrected to take account of size of sampling volume and number of krill in sampling volume.
Target identification	Frequency difference window	Uncertainty in TS will drive uncertainty in frequency difference window. Current levels based on mean scenario Table 2. New window ranges will be produced to take account of ±1 sd scenarios with correction for sampling volume as detailed above.
	Krill length PDF	Sampling of krill to generate krill length PDF also subject to uncertainty. Uncertainty of overall representativeness of net sampling process needs to be incorporated.
Sampling design	Jolly and Hampton modified method	Currently only element of uncertainty routinely provided in estimates of biomass.
Calibration	See CCAMLR-2000 Survey protocols	See for instance Demer (2004).
Availability (in time and space)	Krill occurring in unsurveyed regions	• Under ice, e.g. Ross Sea • Population movements in response to environment
	Krill occurring beyond sampling range of echosounder	• In surface layer • Close to bottom • Deep krill

* SC-CAMLR-XXIV, Annex 6

Table 2: Parameters used in the SDWBA model to estimate error in the prediction of krill TS, where number of cylinders (n_0) = 14, krill length (L_0) = 38.35 mm, and phase variability (φ_0) = $\sqrt{2}/2$. Note that the orientations and sound speeds have been swapped relative to SC-CAMLR-XXIV, Annex 6, Table 1, because the SDWBA TS are inversely proportional to the mean incidence angle and the sound speed in water.

	−1 sd	Mean	+1 sd
Radius of cylinders (r_0)	1	1.4	1.7
Density contrast (g)	1.029	1.0357	1.0424
Sound-speed contrast (h)	1.0255	1.0279	1.0303
Orientation (mean θ, sd)	$N(15°, 4°)$	$N(11°, 4°)$	$N(7°, 4°)$
Sound speed in water (c; m s^{-1})	1461	1456	1451

Table 3:   Coefficients and reference length (L_0) for the simplified SDWBA model of krill TS (Equation 1), averaged over krill orientation distributions of $\theta = N(11°, 4°)$. Note the necessary imaginary parts in *A*, *B* and *C* not included in SC-CAMLR-XXIV, Annex 6, Table 2 and Conti and Demer (2006, Table 2). The coefficients can be used for values of *kL* smaller than 200, with a mean error δ in decibels between the exact and the simplified SDWBA.

	$N(11°, 4°)$
A	6.6455874521e+00 –2.3282404324e+01i
B	1.2790907635e–01 –3.7077142547e–02i
C	4.4631814583e–01 –2.0095900992e–01i
D	–1.1920959143e–11
E	7.4232471162e–09
F	–1.7391623556e–06
G	1.8632719837e–04
H	–8.6746521481e–03
I	1.3214087326e–01
J	–8.1337937326e+01
L_0	38.35e–003 m
δ	2.18 dB

Table 4:   Summary of acoustic data collected by vessels during CCAMLR-related IPY surveys.

Parameter			Date		Latitude		Longitude		Length (n mile)
			Start	End	Start	End	Start	End	
(a) *Polarstern*									
Transducer									
	Type	EK60							
	Frequency (kHz)	38, 70, 120, 200							
	Transducer depth (m)	10							
	Ping interval (s)	2.0–3.0							
	Depth range (m)	10–1000							
Calibration									
Pre-survey	Date								
	Location								
Post-survey	Date	07–08 Jan 08							
	Location	69.4S 1.0E							
Transects									
	Area	Lazarev Sea							
	1		10 Dec 07	13 Dec 07	−62.00	−70.00	1.60	−6.90	522
	2		23 Dec 07	29 Dec 07	−69.90	−62.00	−3.00	−3.00	474
	3		30 Dec 07	01 Jan 08	−62.00	−62.00	−3.00	3.00	169
	4		01 Jan 08	06 Jan 08	−62.00	−68.50	3.00	3.00	390
	5		17 Jan 08	21 Jan 08	−69.50	−62.00	0.00	0.00	450
(b) *Tangaroa*									
Transducer									
	Type	EK60							
	Frequency (kHz)	12, 38, 70, 120							
	Transducer depth (m)	6							
	Ping interval (s)	variable (1.5 on shelf)							
	Depth range (m)	0–1000							
Calibration									
Pre-survey	Date	12 Feb 2008							
	Location	near Cape Washington, Ross Sea							

Table 4 (continued)

Parameter			Date		Latitude		Longitude		Length (n mile)
			Start	End	Start	End	Start	End	
Post-survey	Date	12 kHz not calibrated							
	Location								
Transects									
	Area	Ross Sea							
		1	10 Feb 08	10 Feb 08	−73.13	−73.22	174.31	174.00	14
		2	10 Feb 08	10 Feb 08	−73.18	−73.89	174.24	171.71	112
		3	10 Feb 08	10 Feb 08	−73.89	−74.07	171.70	171.05	28
		4	11 Feb 08	11 Feb 08	−74.12	−74.58	170.83	170.46	52
		5	11 Feb 08	12 Feb 08	−74.59	−74.65	170.24	168.97	38
		6	12 Feb 08	12 Feb 08	−74.65	−74.79	168.97	167.00	60
		7	13 Feb 08	13 Feb 08	−74.74	−74.94	167.14	168.10	36
		8	13 Feb 08	13 Feb 08	−74.96	−75.61	168.20	169.70	84
		9	14 Feb 08	14 Feb 08	−75.63	−75.64	169.70	166.98	75
		10	14 Feb 08	14 Feb 08	−75.65	−76.54	167.38	167.70	100
		11	15 Feb 08	15 Feb 08	−76.56	−76.74	167.74	167.82	21
		12	15 Feb 08	15 Feb 08	−76.74	−76.58	167.94	170.29	63
		13	15 Feb 08	15 Feb 08	−76.59	−76.19	170.29	176.14	159
		14	15 Feb 08	16 Feb 08	−76.21	−76.75	176.18	179.89	61
		15	16 Feb 08	16 Feb 08	−76.81	−76.76	179.99	179.25	19
		16	16 Feb 08	16 Feb 08	−76.77	−76.62	179.33	176.62	72
		17	17 Feb 08	17 Feb 08	−76.60	−76.19	176.77	176.38	47
		18	18 Feb 08	18 Feb 08	−76.15	−75.75	176.27	176.59	46
		19	18 Feb 08	18 Feb 08	−75.74	−74.51	176.63	177.59	140
		20	18 Feb 08	18 Feb 08	−74.55	−73.27	177.51	178.76	147
		21	19 Feb 08	19 Feb 08	−73.27	−72.92	178.73	177.10	35
		22	19 Feb 08	19 Feb 08	−72.77	−72.59	177.22	175.34	66
		23	21 Feb 08	21 Feb 08	−72.59	−72.36	175.34	175.48	26
		24	21 Feb 08	21 Feb 08	−72.33	−72.08	175.53	175.52	28
		25	22 Feb 08	23 Feb 08	−72.12	−71.93	175.51	173.27	80
		26	23 Feb 08	23 Feb 08	−72.05	−71.96	173.24	173.37	11
		27	23 Feb 08	23 Feb 08	−71.98	−72.02	173.32	173.26	5

Table 4 (continued)

Parameter			Date		Latitude		Longitude		Length (n mile)
			Start	End	Start	End	Start	End	
		28	24 Feb 08	24 Feb 08	−72.03	−72.08	173.06	173.06	6
		29	24 Feb 08	25 Feb 08	−72.08	−71.89	172.90	173.75	36
		30	25 Feb 08	25 Feb 08	−71.79	−71.47	173.86	174.58	44
		31	26 Feb 08	26 Feb 08	−71.37	−70.90	174.75	176.59	46
		32	26 Feb 08	28 Feb 08	−70.90	−69.24	176.59	181.43	260
		33	29 Feb 08	29 Feb 08	−69.39	−69.31	181.35	181.40	10
		34	29 Feb 08	01 Mar 08	−69.31	−68.52	181.40	181.56	88
		35	02 Mar 08	02 Mar 08	−68.51	−68.25	181.61	181.05	37
		36	02 Mar 08	02 Mar 08	−68.22	−68.12	180.97	180.67	17
		37	04 Mar 08	04 Mar 08	−68.09	−67.85	−179.11	180.41	18
		38	05 Mar 08	05 Mar 08	−67.80	−67.60	180.45	181.15	37
		39	06 Mar 08	07 Mar 08	−67.63	−67.41	181.15	180.19	48
		40	08 Mar 08	09 Mar 08	−67.35	−66.87	180.04	170.98	395
		41	11 Mar 08	11 Mar 08	−67.14	−66.70	171.15	171.22	49

(c) *G.O. Sars*
  Transducer

	Type	EK60						
	Frequency (kHz)	18, 38, 70, 120, 200, 333	also		TS probe	EK60	38, 120, 200 kHz	
	Transducer depth (m)	8			Downward lander	EK60	38, 200 kHz	
	Ping interval (s)	variable			Upward lander		38 kHz	
	Depth range (m)	10–750 (for selected frequencies)			Sonar	M570	75–112 kHz	

  Calibration
    Pre-survey

	Date	16 Jan 08	
	Location	Stromness Bay	

    Post-survey

	Date	
	Location	

  Transects

	Area	Scotia Sea	06 Jan 08	23 Mar 08	See WG-EMM-08/28

Table 4 (continued)

Parameter			Date		Latitude		Longitude		Length (n mile)
			Start	End	Start	End	Start	End	
(d) *Yuzhmorgeologiya*									
Transducer									
	Type	EK60							
	Frequency (kHz)	38, 70, 120, 200							
	Transducer depth (m)	7							
	Ping interval (s)	2							
	Depth range (m)	7–500							
Calibration									
Pre-survey	Date	14 Jan 08				11 Jan 09			
	Location	Admiralty Bay, Ezcurra Inlet				Admiralty Bay, Ezcurra Inlet			
Post-survey	Date	09 Mar 08				07 Mar 09			
	Location	Admiralty Bay, Ezcurra Inlet				Admiralty Bay, Ezcurra Inlet			
Transects									
	Area	South Orkney Islands				South Orkney Islands			
	Start date	18 Feb 08				09 Feb 09			
	Start position	59.9970S	47.4911W	Top corner		59.9970S	47.4911W	Top corner	
	End date	26 Feb 08				04 Mar 09			
	End position	61.7530S	43.9915W	Bottom corner		61.7530S	43.9915W	Bottom corner	
	Length (n mile)	32 031 km^2	500 n miles of transects			32 031 km^2	500 n miles of transects		

TERMS OF REFERENCE

Subgroup on Acoustic Survey and Analysis Methods
(Ancona, Italy, 25 to 28 May 2009)

The Scientific Committee recommended the following terms of reference for the meeting of SG-ASAM in 2009 (SC-CAMLR-XXVII, Annex 8).

The following are general tasks for the subgroup:

   (i)   to develop, review and update as necessary, protocols on:

       (a)   the design of acoustic surveys to estimate the abundance index of nominated species, including surveys and data collection using commercial krill trawlers;

       (b)   the analysis of acoustic survey data to estimate the biomass of nominated species, including estimation of uncertainty (bias and variance) in those estimates;

       (c)   the archiving of acoustic data, including data collected during acoustic surveys, acoustic observations during trawl stations, and *in situ* target strength measurements.

The following specific tasks have also been identified by the Scientific Committee. Points (ii), (iii) and (iv) are considered to be of highest priority:

   (ii)   to provide advice that will assist in quantifying uncertainties in krill B_0 estimates, including:

       •   evaluate developments in target strength modelling and other new observations on krill (SC-CAMLR-XXVI, Annex 8, paragraph 84);

       •   validate acoustic identification techniques – by collating a set of net-validated acoustic data and evaluating whether acoustic target identification methods are biased;

       •   evaluate and consider available information and current methods for the measurement of krill orientation and material properties, and using analyses of tilt angle from recent research cruises;

       •   develop a probability density function of the estimate of B_0 based on the current understanding of uncertainties in various parameter values;

   (iii)   to document the current agreed protocols for krill B_0 assessment;

(iv) to investigate the use of ancillary acoustic data (e.g. from finfish surveys, exploratory fisheries data and commercial fisheries echo sounders) and the required analytical methods with a view to:

- documenting protocols for and analysing data from exploratory fisheries acoustic data processing and interpretation;

- providing krill biomass estimates from areas that are not regularly surveyed;

(v) to evaluate acoustic results from IPY surveys in 2008, supported by a summary of all IPY acoustic data and related metadata submitted to CCAMLR to be prepared by the Secretariat (SC-CAMLR-XXVI, Annex 8, paragraph 84; SC-CAMLR-XXVI/BG/3, paragraph 22) and to provide specific advice to the Scientific Committee on the value of IPY acoustic data, and their analysis, for krill biomass estimation (SC-CAMLR-XXVI/BG/3, paragraph 22);

(vi) to evaluate developments in target strength modelling and other new observations of Antarctic fish species, including icefish and myctophids (SC-CAMLR-XXVI, Annex 8, paragraph 84);

(vii) to resolve difficulties identified with the swept-area estimation of icefish abundance, including the application of the adjustment factor for trawl headline height used in surveys for *C. gunnari* (SC-CAMLR-XXVII, Annex 5, paragraphs 3.26 and 13.20).

AGENDA

Subgroup on Acoustic Survey and Analysis Methods
(Ancona, Italy, 25 to 28 May 2009)

1. Introduction

    1.1 Opening of meeting
    1.2 Meeting terms of reference and adoption of the agenda

2. Provide advice that will assist in quantifying uncertainties in krill B_0 estimates

    2.1 Review recent research results including developments in target strength modelling and observations on krill orientation and material properties

    2.2 Collate a set of net-validated acoustic data and evaluate whether current acoustic target identification methods are biased

    2.3 Provide direction towards developing a probability density function for the estimate of B_0 based on the current understanding of uncertainties in various parameter values

3. Document the current agreed protocols for krill B_0 assessment

4. Discuss the use of ancillary acoustic data (e.g. from finfish surveys, exploratory fisheries data and commercial fisheries echosounders)

    4.1 Review recent research results involving collection of ancillary acoustic data

    4.2 Document protocols for analysing, processing, and interpreting ancillary acoustic data (e.g. data collected during exploratory fisheries)

    4.3 Determine whether such data can provide krill biomass estimates from areas that are not regularly surveyed (link to subitem 5.3)

    4.4 Discuss future needs for acoustic instrumentation in the Antarctic

    4.5 Southern Ocean Sentinel Program

5. Evaluate results from IPY surveys in 2008

    5.1 Review acoustic data and related metadata submitted to CCAMLR

    5.2 Presentation of new results from IPY surveys

5.3 Determine whether data can provide krill biomass estimates from areas that are not regularly surveyed (link to subitem 4.3)

6. Evaluate developments in target strength modelling and other new observations on Antarctic fish species

   6.1 Presentation of new results (may be linked to subitem 5.2)

7. Attempt to resolve difficulties identified with the swept-area estimation of icefish abundance

   7.1 Discuss appropriate application of the adjustment factor for trawl headline height used in surveys for *Champsocephalus gunnari*

8. Suggestions for timing/venue of next meeting

9. Recommendations to the Scientific Committee

10. Adoption of report

11. Close of the meeting.

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(Ancona, Italy, 25 to 28 May 2009)

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LIST OF DOCUMENTS

Subgroup on Acoustic Survey and Analysis Methods
(Ancona, Italy, 25 to 28 May 2009)

SG-ASAM-09/1   Agenda

SG-ASAM-09/2   List of Participants

SG-ASAM-09/3   List of Documents

SG-ASAM-09/4   Net-based verification of acoustic techniques used to identify
                      Antarctic krill
                      J. Watkins and S. Fielding (United Kingdom)
                      (*CCAMLR Science*, submitted)

SG-ASAM-09/5   Preliminary acoustic results from the New Zealand IPY-CAML
                      survey of the Ross Sea region in February–March 2008
                      R. O'Driscoll, G. Macaulay, S. Gauthier, M. Pinkerton and
                      S. Hanchet (New Zealand)

SG-ASAM-09/6   Target strength of mackerel icefish (*Champsocephalus gunnari*)
                      from a scattering model
                      G. Macaulay (New Zealand)

SG-ASAM-09/7   Analysis of icefish (*Champsocephalus gunnari*) spatial
                      distribution for optimisation of the bottom trawl survey sampling
                      S. Kasatkina (Russia)

SG-ASAM-09/8   Acoustic identification and size estimation of euphausiids
                      R. Korneliussen and G. Skaret (Norway)

SG-ASAM-09/9   Underwater acoustic instrumentation for Antarctic applications
                      L. Andersen (Norway)

SG-ASAM-09/10   Target strength studies on Antarctic silverfish (*Pleuragramma
                      antarcticum*) in the Ross Sea
                      M. Azzali, I. Leonori, I. Biagiotti, A. De Felice, M. Angiolillo,
                      M. Bottaro and M. Vacchi (Italy)
                      (*CCAMLR Science*, submitted)

SG-ASAM-09/11   Summary of acoustic data and related data collected during IPY
                      surveys
                      Secretariat

SG-ASAM-09/12   Towards a CCAMLR protocol for the estimation of krill biomass
T. Jarvis (Australia) and K. Reid (Secretariat)

SG-ASAM-09/13   Applying a TS-probe for measuring Antarctic krill (*Euphausia superba*) target strength *in situ*: procedures and data analysis
G. Skaret, L. Calise and E. Ona (Norway)

LIST OF PROTOCOLS

This is a list of clarifications and insertions where SC-CAMLR-XXVI, Annex 4, Table 1 and SC-CAMLR-XXIV, Annex 6 were unclear. This list will form the basis for a more complete document with full cross-referencing that will be made available on the CCAMLR website.

1. Survey Design
    Random stratified parallel transects during daytime

2. Data Collection
    Frequencies – 38, 120 and 200 kHz with ping transmit interval at 2 s, pulse duration of 1 ms and power settings not to exceed the limits defined by Korneliussen et al. (2008)
    Collect net samples of krill during survey
    Collect under way ambient noise measurement
    CTD measurement in survey area

3. Acoustic data processing and analysis
    (a) Processing
        Calibration following CCAMLR-2000 Survey protocols
        Sound-speed and α measured during survey
        Noise estimation and subtraction following CCAMLR-2000 Survey protocols
        No thresholding
        Removal of unwanted/bad data according to Hewitt et al. (2004), including:
            Surface reverberation
            Bottom (seabed)
            Data beyond start/end of transects
            Noise spikes
        Quality control
    (b) Analysis
        Target identification using the SDBWA model to estimate pairwise dB difference between 120 and 38 kHz, and 200 and 120 kHz using mean size parameters.
        Examine length frequency of krill from trawls and include the range of lengths of krill that includes $\geq 95\%$ of the krill PDF and achieve the smallest δS_v window in order to define dB difference from SC-CAMLR-XXIV, Annex 6, Table 3.
        Re-sampling frequency of 50 pings at 2 s ping rate over 5 m (noting that 50 pings at 2 s at 10 knots is approx. equal 500 m)

4. Echo Integration
    120 kHz primary frequency (use other frequencies for uncertainty estimates)
    EDSU – 1 n mile horizontal normalised on-track distance
    Nominally to 500 m (or 1 m above bottom) dependent on the signal to noise ratio

5.	Conversion of acoustic backscatter to area biomass estimate
	Weight-at-length measured on survey – or use values from literature noting
	Hewitt et al. (2004) for the Scotia Sea
	Target strength – using the simplified SDBWA with the revised parameters
	(Table 2)

6.	Estimation of Total Biomass from Biomass Density
	Jolly and Hampton (1990)
	Conversion factors from the SDBWA model and the length PDF of krill sampled
	during the survey

7.	Estimation of Sampling Errors
	The Jolly and Hampton (1990) methods for estimating sampling uncertainty.

**REPORT OF THE AD HOC TECHNICAL GROUP
FOR AT-SEA OPERATIONS**
(Bergen, Norway, 4 and 5 July 2009)

CONTENTS

REPORT OF THE AD HOC TECHNICAL GROUP
FOR AT-SEA OPERATIONS
(Bergen, Norway, 4 and 5 July 2009)

INTRODUCTION

Opening of the meeting

1.1   The second meeting of ad hoc TASO was held in Bergen, Norway, on 4 and 5 July 2009. The meeting was co-convened by Mr C. Heinecken (South Africa) and Dr D. Welsford (Australia).

1.2   The Co-conveners welcomed participants (Appendix A) and thanked Mr S. Iversen and the Institute of Marine Research (Norway) for hosting the meeting.

1.3   The Technical Group noted that the Scientific Committee had endorsed the group's terms of reference which had been developed at its first meeting (SC-CAMLR-XXVII, paragraph 6.7):

> To provide advice to the Scientific Committee, its working groups and SCIC on:
>
> (i)   the practical implementation of the acquisition of data requested to be collected at sea;
>
> (ii)   the feasibility of obtaining the data specified, given stated priorities and the general requirements placed on observers, and potential opportunities for optimising the collection of data;
>
> (iii)   systems required to ensure the data collected are of consistently high quality;
>
> (iv)   any technical and logistical issues related to at-sea implementation of conservation measures, or proposed conservation measures, in the Convention Area.

1.4   The Technical Group recognised that it was the role of other Working Groups to specify data requirements, including the specific data required and the frequency of data collection, and to provide the rationale for these requirements. The Technical Group's role is limited to advising on whether or not these requirements can be met, or to provide advice on how these requirements could be achieved. It was also noted that, in view of the specific expertise gathered in the group, it may be in a position to alert other working groups to changes in fisheries and observer workloads that have implications for data collection and data quality requirements (SC-CAMLR-XXVII/BG/6, paragraph 4.3).

Adoption of the agenda and conduct of the meeting

1.5   The provisional agenda was revised and adopted (Appendix B).

1.6   Documents submitted to the meeting are listed in Appendix C.

1.7   The report was prepared by Dr D. Agnew (UK), Messrs E. Appleyard (Scientific Observer Data Analyst) and J. Clark (UK), Drs A. Constable (Australia) and S. Hanchet (New Zealand), Messrs Heinecken (Co-convener) and N. Gasco (France), Drs C. Jones (USA), S. Kawaguchi (Australia) and B. Krafft (Norway), Mr F. McEachan (Australia), Drs D. Middleton (New Zealand), D. Ramm (Data Manager), K. Reid (Science Officer), G. Watters (USA) and Welsford (Co-convener).

1.8   In preparing its report, the Technical Group agreed to highlight text that provides advice on future work to the Scientific Committee without repeating it in full in Item 5.

DESIGN AND OPERATION OF FISHING VESSELS AND GEARS
USED IN THE CAMLR CONVENTION AREA

Krill trawling methods

2.1   TASO-09/5 described in detail the three main types of fishing for krill – conventional trawling, continuous trawling and pumping system to clear the codend.

2.2   TASO-09/11 described trawl systems, discharges and systems for obtaining green weight of krill on board the three Norwegian krill fishing vessels, *Saga Sea*, *Juvel* and *Thorshøvdi*.

2.3   The *Saga Sea* employs, and the *Thorshøvdi* will employ, twin trawl systems capable of concurrently towing at different depth layers. If there is any stratification in krill length-frequency composition, then composition in each net may differ. It was clarified that samplings for scientific observations are being done before they were mixed in the holding tanks. The Technical Group noted that being able to match up relative quantity from the different nets and being able to verify acoustic scatterings with the catch would greatly contribute to the understanding of krill aggregation structures.

2.4   The Technical Group noted the importance of information on mesh size and panel configuration due to their effects on catch efficiency.

2.5   CPUE reporting in the haul-by-haul catch and effort data (C1 data) for the continuous trawling method considerably improved in last 12 months, now allowing catch for every two-hour interval with position information.

2.6   Materials presented at last year's and this year's meetings of ad hoc TASO greatly helped to understand at-sea operations of this fishery in fine detail. The Technical Group thanked members who contributed information to understand the operational nature of this fishery.

2.7   The Technical Group recommended cataloguing details of vessel gear types as a reference for the *Scientific Observers Manual*. The group further noted the need for equivalent information from other operators to make the information comprehensive.

2.8   The Technical Group further recommended that the general terms in use for all trawl types operating in the Antarctic krill fishery, summarised in Annex 1 of TASO-09/5, be put

on the CCAMLR website to help Commissioners understand the nature of this fishery (paragraph 2.25). In addition, definitions from WG-FSA-08/60, reviewing the autoline system, should be included.

IUU gillnetting methods

2.9   The Scientific Committee has requested information on the configuration of gillnets being used in IUU activities in the CAMLR Convention Area, including the types and quantities of species caught in these nets. An important question to address is whether total catch of IUU gillnetting can be estimated based on sightings of IUU nets.

2.10   TASO-09/10 presented information on the retrieval of an abandoned gillnet by an Australian vessel patrolling BANZARE Bank (Division 58.4.3b), and the toothfish and by-catch found when a number of sections of the gillnet was retrieved. A total of 8 km of net was retrieved from the 16 nets which comprised an estimated total of 130 km of net. The catch of toothfish and by-catch were documented. Complete retrieval was not possible because of weather and snagging of the nets, as well as unfamiliarity with the configuration of the net. All remaining buoys were cut from the nets in an attempt to prevent the remaining net from ghost fishing. The retrieval process is documented in the paper to allow the experience to be used by others in retrieving IUU gillnets. The observed catch was directly prorated to the whole length of net, indicating that at least 29 tonnes of toothfish would have been caught by the sets. However, these figures are likely to be underestimates of total mortality in gillnets, due to the evidence of large numbers of fish eaten by isopods in the net. Other catch included grenadiers, skates, lithodid crabs, jellyfish, featherstars and squid.

2.11   The configuration of the retrieved gillnet is documented in Appendix D.

2.12   The Technical Group thanked Australia for its efforts in recovering the gillnet and for documenting its characteristics and catch. It is the first observation of its kind in the CAMLR Convention Area and will contribute greatly to the discussions in WG-FSA and the Scientific Committee on the impacts of gillnetting in the Southern Ocean.

2.13   Mr Heinecken presented results of a survey of gillnet operations to provide background on possible gillnet operations in the Southern Ocean. The results are presented in Appendix E, including a discussion on the configurations of gillnets, the manner of deployments and the types of considerations that might be given by vessels in using gillnets as opposed to longlines.

2.14   The Technical Group thanked Mr Heinecken for undertaking this survey as this provides useful information for considering possible gillnet operations in the Southern Ocean.

2.15   The Technical Group noted that:

   (i)   reports from European fisheries indicate that deep-water gillnet operations are known to lose large quantities of gear each year, which is likely to be the case for IUU gillnet operations in the Convention Area. These reports indicated that lost gear results in ghost fishing;

(ii)   consumption of caught fish by isopods and other scavengers and predators before retrieval would result in the observed catch being less than the total mortality;

(iii)   the length of net that could be deployed per day by a vessel may be around 36 km;

(iv)   gillnetting operations are likely to be similar to longline operations, although IUU gillnetters may not be concerned about loss of fish to depredation from long soak times because they are not reliant on bait which deteriorates over short period;

(v)   the similarities between gears, described in Appendices D and E, suggest the widespread capability of using deep-sea gillnets.

2.16   On the basis of the understanding of normal commercial gillnet operations, the Technical Group agreed that gillnets could be deployed by longline vessels. Gillnetting does not need bait, so a vessel can carry more fuel on board and is less dependent on managing soak times to ensure the greatest recovery of fish caught with bait. As a result, the use of gillnets could extend a voyage of a longline vessel. Although gillnet operations seem similar to longline operations, it was unclear whether the behaviour of vessels would be the same for these two types of operation.

2.17   The Technical Group noted that the recovery of gillnet sections caught by longliners was the first indication that IUU gillnetting was taking place in the Convention Area. The Technical Group requested that the Secretariat document the time series of observations of gillnet recoveries from observer reports and other data.

2.18   The Technical Group noted that gillnet guides are visibly present on gillnet vessels which can be used to differentiate these vessels from longliners (Appendix E, Figure 2). The Technical Group recommended that explicit observations of gillnet guides should be recorded if an IUU vessel is sighted.

2.19   The Technical Group recommended that WG-FSA consider the information here in determining its advice on IUU gillnetting. It recommended that TASO-09/10 be forwarded to WG-FSA for consideration in the calculations of IUU gillnet catch.

Documenting gear types

2.20   WG-IMAF requested that ad hoc TASO consider the development of a protocol for observers to photograph fishing gear as a basis for developing a photo library of fishing gear types used in the Convention Area (SC-CAMLR-XXVII, paragraph 5.28(i)(d)), and to assist with determining the prevalence of lost gear that may impact on seabirds and mammals.

2.21   The Technical Group recalled that this request was based on the report to WG-IMAF on marine debris reported to CCAMLR (WG-FSA-08/9) and agreed a reference library of photographs of fishing gear used within the Convention Area would be feasible.

2.22   The Technical Group recommended that a practical means to obtain these photographs would be for the Secretariat to send out a circular to Members' technical coordinators requesting them to supply a detailed list of gear to observers and task them to record photographs of each item on the list.

2.23   The Technical Group noted that programs collecting debris mostly record the material component of debris found, while vessels look at the function of different gear. A detailed reference library, listing gear material and function, would cross this gap.

2.24   The Technical Group also recommended that observers be instructed to take photographs of gear or materials that may not be on a working gear list but could conceivably be lost overboard and contribute to marine debris. This would include, *inter alia*:

- hooks
- snoods
- rope materials (anchor rope, mainline, bottomline and connectors)
- net used to hold stones on longlines
- trawl net
- plastic crates
- box strapping bands.

2.25   The Technical Group requested that the Secretariat develop a reference library drawing on presentations and papers to ad hoc TASO and working groups of gear, including diagrams indicating the design and nomenclature for the different types of gear used in the different fisheries, and that a detailed list describing all gear used in the Convention Area be included in the *Scientific Observers Manual* and on the website (paragraph 3.17). As a starting point, this library should include the material and photographs provided during the meeting.

2.26   The Technical Group agreed that that these details with photographs be made available in HTML format to facilitate searching and identifying gear items by all users, and that this process could complement the FIRMS fact sheets on fishing gear and fish species which have been prepared by FAO, and which the Secretariat will review and further develop in due course.

DATA COLLECTION PRIORITIES ACROSS CCAMLR FISHERIES

Methods of estimating green-weight removals in krill trawl fisheries

3.1   TASO-09/6 provided details of the procedures used by krill vessels in Subarea 48.3 to estimate green weight of krill, this included product-specific conversion factors that were regularly measured on board the vessel, as well as fixed conversion factors supplied by the Flag State. This analysis suggests that, for krill fisheries in Subarea 48.3, the uncertainty in catch arising from uncertainty in the use of conversion factors may not be as large as suggested in WG-EMM-08/46.

3.2   Dr M. Kiyota (Japan) informed the Technical Group that the operator of the *Fukuei Maru* (formerly the *Niitaka Maru*) considered that the use of a fixed conversion factor was the most appropriate means of estimating green weight. Estimation of catch from measurements

from the fish ponds were problematic because there were three product-specific fish ponds. In one pond, catches were often mixed from consecutive hauls. The fish ponds also often held relatively little krill and access to the fish ponds for the purposes of sampling krill to calculate volume-to-mass conversions may be problematic.

3.3   The Technical Group noted that when green weight of krill was estimated without the use of conversion factors, this was achieved by visual codend mass estimation as well as from measurement of the depth of the krill in the fish pond.

3.4   The Technical Group noted that many vessels estimate the volume of krill in the fish pond and used a scaling factor to produce an estimate of weight of krill. However, no details of such volume-to-mass scaling was available.

3.5   The Technical Group agreed that the current protocol for observers to estimate conversion factors, involving taking a subsample of 500 kg of krill through processing on board a vessel, is unworkable and that a different approach to gaining a better understanding of actual green weight of krill caught is required.

3.6   The UK agreed to implement a trial procedure involving the collection of volume-to-mass data for krill samples from the krill fishery and to report on this to ad hoc TASO and WG-EMM next year.

3.7   The Technical Group suggested that WG-EMM take note of:

(i)   the findings of TASO-09/6, noting that further analysis of the implications of using variable and fixed conversion factors should be evaluated;

(ii)   the plans for future implementation of an accurate, repeatable volume-to-mass conversion for krill where volumetric measures are used.

Taxonomic resolution of invertebrate by-catch

3.8   Conservation Measure 22-07 requires that longline by-catch be monitored for VME indicator taxa. The 2008/09 fishing season was the first season during which this monitoring was required, and work presented in TASO-09/8 evaluated the ability of observers to record information related to VMEs and classify VME indicator taxa at sea. The evaluation was conducted by comparing classifications made by observers (who were untrained with respect to invertebrate taxonomy) with those made by trained taxonomists. The observers worked on four New Zealand and one South African longliners fishing in the Ross Sea. The observers collected benthic invertebrate by-catch specimens and classified them on the basis of the Benthic Invertebrate Classification Guide. The specimens were returned to New Zealand and subsequently reclassified by taxonomists.

3.9   The results in TASO-09/8 demonstrated that the observers were generally able to provide very good classifications of VME indicator taxa. Misclassifications were largely taxa-specific, and most inaccuracies were due to classifying stylasterids as stony corals. Other inaccuracies included mis-classifications of gorgonians as stony corals, hydroids as

gorgonians, and ascidians as sponges. There were also some difficulties classifying organisms that were found attached to other organisms. Regardless of these mis-classifications, over 60% of 708 specimens were correctly classified.

3.10 Despite some mis-classifications, the Technical Group agreed that the results of the work were encouraging because the observers very rarely classified non-VME taxa as VME indicator taxa, and thus there appears to be little risk that 'false positives' could cause more VME Risk Areas than should have been.

3.11 The Technical Group noted a number of conclusions from TASO-09/8:

Observer training –

(i) Update the Benthic Invertebrate Classification Guide to include better photos, clearer descriptions of organisms, and more detail to help separate confusing taxa (e.g. stlyasterids and stony corals).

(ii) Use previously collected organisms to provide hands-on identification training and testing opportunities prior to deployment on a fishing trip.

Data recording procedures –

(iii) Record longline segments that do not catch VME indicator taxa as zeros.

(iv) Record the identification of everything retained in aggregate samples.

(v) Record the total weight of animals retained in all sample buckets (and translate volumetric measurements to kg).

(vi) Use consistent segment numbering when recording data (e.g. do not use number 1 to identify the first sampled segment if data collection is started in middle of a haul).

(vii) If Conservation Measure 22-07 is revised, avoid using the term 'trigger' for both the >5 and >10 VME-indicator-unit thresholds.

3.12 The Technical Group thanked New Zealand for conducting the work and agreed it usefully demonstrated that observers can collect significant information on the by-catch of VME taxa and other benthic organisms. It was noted that the new sampling required of Conservation Measure 22-07 (as well as work conducted as part of the Year-of-the-Skate) had caused the observers to collect less biological information on toothfish and other by-catch species (e.g. macrourids). Nevertheless, the new data were considered to be a substantial improvement over that previously held in the CCAMLR database, which have been shown to be of limited use for describing and quantifying by-catch of benthic invertebrates (CCAMLR-XXVII/26).

3.13 The Technical Group recommended that TASO-09/8 and the discussion here be tabled to the VME Workshop and that the workshop should use the information in the paper to re-evaluate, among other issues, which invertebrate taxa should be monitored in the future.

The Technical Group requested that WG-FSA consider how data on invertebrate by-catch can be used to facilitate precautionary approaches to by-catch mitigation of benthic invertebrates not considered in discussions on conserving VMEs.

Revision of the *Scientific Observers Manual*

3.14   The Secretariat presented the proposed changes to the *Scientific Observers Manual* (TASO-09/4). These changes reflect the current advice from the Scientific Committee and its working groups. The revision contains general updates of material which had become out of date, with a track-change version provided in Appendix 1 of the paper. In addition, two proposals were also presented to the Technical Group for its consideration:

(i)   a revised method for recording krill feeding observations
(ii)   an updated revised fish sampling protocol for krill fisheries.

3.15   The Technical Group thanked the Secretariat for preparing the draft review of the manual.

3.16   The Technical Group noted that the current proposal for the fish sampling protocol would require observers to take a total of six 50 kg samples and keep only one. It was felt that this was unnecessarily time-consuming. The Technical Group proposed an alternative approach, which would be to collect one 50 kg random sample and ask the crew to retain all of the remaining large fish from the haul.

3.17   The Technical Group made the following recommendations for the *Scientific Observers Manual*:

(i)   inclusion of photographic maturity stage guide for toothfish
(ii)   add a reference to the Benthic Invertebrate Classification Guide
(iii)   include a section of gear identification, as discussed in paragraph 2.25
(iv)   include a mechanism to help prioritise the data collection requirements of observers.

3.18   The Technical Group noted that the section in the manual relating to the collection of fish scales for ageing purposes may no longer be needed, and recommended that WG-FSA consider removing this section from the manual.

3.19   The Technical Group also noted that the updates to the *Scientific Observers Manual* would benefit from review by observers.   It therefore recommended that technical coordinators provide the proposed changes to their observers and submit comments to the Secretariat in time for the manual to be updated for WG-FSA (no later than 15 September 2009).

3.20   It was identified that there is a need for specific advice from the working groups on the minimum observer data collection requirements needed for them to carry out their work. The Technical Group proposed that a list of observer priorities be included in the Fishery Reports, and requested WG-FSA and WG-IMAF to consider implementing this over time.

3.21   The Technical Group also recommended that the sections of this report dealing with the revision of the *Scientific Observers Manual* and other observer matters be circulated to Members for information.

Data collection workloads

3.22   Dr Hanchet presented information on the New Zealand training program and instructions to their international and national observers (TASO-09/9).

3.23   The Technical Group noted that in situations where both national and international observers are on board vessels, it is important that their respective responsibilities are well understood. The primary responsibility of an international observer must be to collect CCAMLR data, while the national observers will often have additional tasks specified by their national program.

3.24   The Technical Group also noted New Zealand's efforts to streamline and improve the quality of data collected by observers; this included the development of new tools such as waterproof touch-screen laptops, otolith label scanners and an improved VME taxa identification guide (TASO-09/9).

3.25   The Technical Group noted that WG-SAM raised concern over the possible delay in the submission of observer data and its impact on assessments. Two issues that contribute to this and their solutions were discussed:

(i)   Observers are sometimes delayed between the end of the trip and their return to their home port. In this case, observer coordinators should examine ways of acquiring observer datasets electronically prior to vessels returning to port. Most vessels now have satellite broadband, which should be capable of transmitting observer datasets which are usually no more than 2–3 Mb in size.

(ii)   Technical coordinators may not be submitting data to the Secretariat within the one-month deadline. This matter should be brought to the attention of SCIC, and technical coordinators should be reminded of their responsibilities in adhering to the data submission deadlines.

OBSERVER RECRUITMENT AND TRAINING

4.1   The Scientific Committee established ad hoc TASO as a group that reports to the Scientific Committee on discussion of issues in relation to the Scheme of International Scientific Observation. The terms of reference for TASO include providing advice on systems required to ensure the data collected are of consistently high quality. SC-CAMLR-XXVII, paragraph 6.8, requested that the long-term work program for TASO include ensuring an equivalent level of training and accreditation for observers across the Convention Area.

4.2   TASO-09/9 provided a description of New Zealand scientific observation in the CAMLR Convention Area, including recruitment and training of observers, observer quality management and Antarctic specific training and task prioritisation.

4.3 The Technical Group noted the comprehensive nature of the New Zealand scientific observer recruitment, training and performance management program, and its emphasis on measures in place to improve at-sea observation through iterative feedback and continuous improvement. In discussion, generic lists of required observer competencies, and the areas that must be covered in training, were developed.

4.4 The Technical Group also noted that observers are usually recruited with the following basic competencies:

(i)   an ability to communicate clearly (spoken and written) in one of the four CCAMLR languages;

(ii)   a good level of numerical literacy;

(iii)   use of computers;

(iv)   personal qualities required to undertake the role of an observer in a conscientious and professional manner.

4.5 The Technical Group agreed that the training of observers should include, *inter alia*, the following areas:

(i)   health and safety, including first-aid and survival-at-sea certification;

(ii)   the sampling and data collection procedures specified in the *Scientific Observers Manual*;

(iii)   familiarisation with target and by-catch species in the CAMLR Convention Area;

(iv)   the CCAMLR process, data needs and conservation measures;

(v)   vessel operations and layout;

(vi)   use of sampling equipment;

(vii)   use of on-board electronic communications;

(viii)   sensitivity to the host vessel culture;

(ix)   the observer Code of Conduct, data rules and commercial confidentiality concerns;

(x)   experience in domestic fisheries and initial supervision by more experienced observers.

4.6 The Technical Group noted that inexperienced observers may need to be accompanied by experienced observers on their first voyage in order to ensure the quality of observer data does not suffer for that voyage.

Accreditation

4.7   The Technical Group noted that similar standards should apply to all observers working in CCAMLR waters. The Technical Group recalled that a key task set for it by the Scientific Committee when it was established was to develop a minimum standard for observer programs to facilitate accreditation.

4.8   The Technical Group noted that information had been provided in its 2008 and 2009 meetings on the training and performance monitoring systems in place in the observer programs of a number of Members, but that comprehensive and comparable information on programs of all Members who deploy observers was not available.

4.9   It was also noted that WCPFC had recently agreed that all programs participating in its Regional Observer Programme should be accredited (WCPFC5-2008/16). To make progress towards accreditation, WCPFC had introduced interim standards in a number of areas (observer guides and manuals, training, code of conduct, safety, national coordinators, briefing and debriefing, equipment and materials, communication, measuring performance, dispute settlement), noting that, in respect of training, programs should be linked to the Commission's decisions, available for review, and with materials provided to the Secretariat.

4.10   The Technical Group reiterated that a benchmark for the accreditation of observers must be established (SC-CAMLR-XXVII/BG/6, paragraph 4.6). The Technical Group recommended that the Scientific Committee consider how this should be achieved, which could include:

(i)   the creation of a CCAMLR training manual, in addition to the existing *Scientific Observers Manual*. Such a training manual would include the appropriate options for delivering training as well as exercises that could be used;

(ii)   the establishment of a process for all observers to be accredited through assessment via a common testing process (e.g. a standard final exam) and the provision of an individual capability statement.

4.11   The Technical Group further recommended that observer accreditation should be subject to ongoing review through a performance and quality management procedure based on the observer's data as submitted to the CCAMLR Secretariat.

4.12   The Technical Group recommended that its Co-conveners, in conjunction with observer coordinators and the Secretariat, prepare a paper for the Scientific Committee outlining a framework for a possible accreditation scheme.

4.13   The Technical Group also recommended that all programs providing observers under the CCAMLR Scheme of International Scientific Observation should, where they have not done so already, be requested to provide summaries of their recruitment, training, quality review, and performance monitoring processes. The headings in TASO-09/9 should be considered to provide a pro-forma framework for the provision of this information. These summaries, together with giving access to the source material, would provide the information required for the Technical Group and the Scientific Committee to conduct a comparative review of training and quality management procedures in all CCAMLR observer programs, for the purpose of establishing minimum accreditation standards.

FUTURE WORK

5.1   The Technical Group agreed that the most important aspect of the work of the group was to provide advice to the Scientific Committee on the practical implementation of the recommendations of the Scientific Committee and the conservation measures of the Commission; noting that the Scientific Committee meeting last year had spent considerable time discussing practical difficulties in implementing the recommendations of WG-EMM.

5.2   The Technical Group agreed that a priority for its future work should be to advise on the development of an accreditation scheme for observers in order to bring a common standard to CCAMLR scientific observers as discussed in Item 4.

5.3   The Technical Group noted that discussion of the future work requirements and the format of future meetings were intrinsically linked. At this year's meeting there was no representation from vessel operators and only a limited number of technical coordinators. The Technical Group recognised that alternative mechanisms may need to be found to allow greater engagement from industry, technical coordinators and those with direct experience of at-sea operations in the Convention Area. It also noted that holding a meeting on the weekend in between two working group meetings made it difficult for participants to prepare adequately for the meetings.

5.4   The Technical Group noted that this was only its second meeting and that it was possible that industry representatives had yet to recognise the value of their engagement in the group.

5.5   The Technical Group considered that a potential mechanism to facilitate greater engagement in the work of the group might include enhanced intersessional correspondence.

5.6   The Technical Group asked the Scientific Committee to consider the issue of how to facilitate ad hoc TASO's work with respect to the Scientific Committee's overall work priorities.

5.7   The Technical Group's future work is summarised in the following paragraphs:

Krill trawling methods – paragraphs 2.7 and 2.8
IUU gillnetting methods – paragraphs 2.17 to 2.19
Documenting gear types – paragraphs 2.22 and 2.24 to 2.26
Estimating green weight of krill catches – paragraphs 3.5 to 3.7
Taxonomic resolution of invertebrate by-catch – paragraph 3.13
Estimating fish by-catch in krill trawls – paragraph 3.16
Revision of the *Scientific Observers Manual* – paragraphs 3.17 to 3.21
Observer recruitment and training – paragraphs 4.5 and 4.10 to 4.13.

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

6.1   The report of the second meeting of ad hoc TASO was adopted.

6.2   In closing the meeting, the Co-conveners thanked the participants for their expert contributions to the work of ad hoc TASO, and the rapporteurs for preparing the report. The

Co-conveners also thanked the CCAMLR technical coordinators and scientific observers for their dedicated work throughout the fishing seasons. The Co-conveners thanked Mr Iversen and IMR for providing excellent facilities and meeting arrangements, and the Secretariat for their support.

6.3   Dr Watters, on behalf of the participants, thanked the Co-conveners for their leadership.

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(Bergen, Norway, 4 and 5 July 2009)

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AGENDA

Ad Hoc Technical Group for At-Sea Operations
(Bergen, Norway, 4 and 5 July 2009)

1. Introduction
    1.1 Opening of the meeting
    1.2 Adoption of the agenda and conduct of the meeting

2. Design and operation of fishing vessels and gears used in the CAMLR Convention Area
    2.1 Krill trawling methods
    2.2 IUU gillnetting methods
    2.3 Documenting gear types

3. Data collection priorities across CCAMLR fisheries
    3.1 Trawl fisheries – methods for estimating green-weight removals in krill trawl fisheries
    3.2 Longline fisheries – taxonomic resolution of invertebrate by-catch
    3.3 Revision of the *Scientific Observer Manual*
    3.4 Data Collection Workloads and Managing Priorities

4. Observer recruitment and training

5. Future work
    5.1 Long-term work plan
    5.2 Format of future meetings

6. Adoption of report and close of meeting.

LIST OF DOCUMENTS

Ad Hoc Technical Group for At-Sea Operations
(Bergen, Norway, 4 and 5 July 2009)

TASO-09/1	Draft Agenda for the Ad Hoc Technical Group on At-Sea Operations (TASO)
TASO-09/2	List of Participants
TASO-09/3	List of Documents
TASO-09/4	Proposed changes to the *Scientific Observers Manual* Secretariat
TASO-09/5	A descriptive review of the trawl systems used in the Antarctic krill fishery M. Davis, J. Moir Clark and T. Peatman (UK)
TASO-09/6	Conversion factors and green weight calculation in the Antarctic krill fishery T. Peatman and J. Moir Clark (UK)
TASO-09/7	Implementation of CCAMLR observer program on krill fisheries S. Kawaguchi (Australia)
TASO-09/8	Evaluation of VME taxa monitoring by observers from five vessels in the Ross Sea region Antarctic toothfish longline fisheries during the 2008/09 season S.J. Parker, S. Mormede, D.M. Tracey and M. Carter (New Zealand)
TASO-09/9	A brief description of New Zealand scientific observer efforts in the CCAMLR Area N. Smith and D. Bilton (New Zealand)
TASO-09/10	Report on the abandoned gillnet retrieval operation conducted by Australia in CCAMLR Statistical Division 58.4.3b (BANZARE Bank) D. Snowdon, J. Hamill, F. McEachan and D. Welsford (Australia)
TASO-09/11	Technical information about the Norwegian krill fishing vessels S.A. Iversen (Norway)

**CONFIGURATION OF ABANDONED GILLNET RETRIEVED BY
AUSTRALIA ON BANZARE BANK (DIVISION 58.4.3b) IN 2009**
(from TASO-09/10)

The sets retrieved had a typical configuration of:

(i)   approximately 3–5 n miles in length, consisting of 50 m sections of net;

(ii)   two square floats, four windy buoys and a strobe light at each end of the set. One end of a set contained a radio beacon;

(iii)   the downline was green 20 mm four-strand rope weighted below the surface with rocks pursed in mesh bags (approximately four per downline) and the line was weighted on the bottom using large chain links (typically 3 links, each weighing approximately 20 kg);

(iv)   the net recovered comprised panels of 90 x 90 mm square mesh, 1 mm monofilament gillnet;

(v)   an estimated vertical net spread from 0–10 m above the sea floor;

(vi)   the ground rope was 25 mm, four-strand rope that was weighted with integrated lead beading;

(vii)   the headline was 20 mm floating rope that had no buoys attached.

The following figure provides a diagram of the net components.
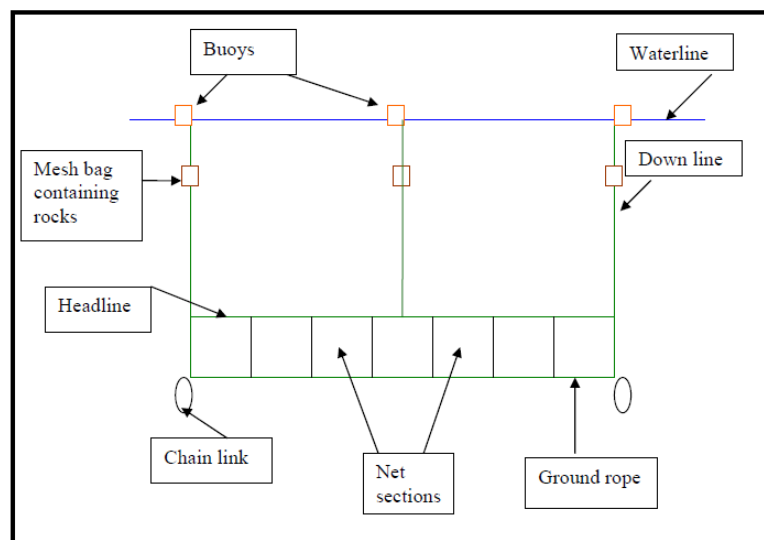
Diagram of net construction.

Chain links to weight gillnet.

SURVEY OF GILLNET OPERATIONS

In 2008, the Scientific Committee requested that Members provide information on the use of gillnets used by IUU vessels in the Convention Area (SC-CAMLR-XXVII, paragraphs 6.13 to 6.15).

2.   Gillnets have traditionally been used to target a number of different shark species in South-East Asia, around Japan, the Caribbean and West Africa as well as in the North-East Atlantic where the deep-sea gillnet fishery is conducted in depths between 200 and 1 200 m, with the main target species being anglerfish (*Lophius* spp.) and deep-water sharks.

3.   In February 2006, the European Community banned the use of fixed nets below depths of 200 m in ICES Divisions VIa, b and VIIb, c, j, k and Subarea XII. A similar prohibition has been introduced by NEAFC in its Regulatory Area.   These prohibitions were introduced because of concerns about the length of nets used, soak times, discards and ghost fishing by lost and discarded nets.   However, at the time, ICES recognised that there was limited data available on deep-water gillnet fisheries and approved a limited observer program to monitor the angler fishery in ICES Subarea VI.

4.   Following the prohibition of gillnetting in the north Atlantic, a number of vessels commenced fishing in the southern Indian Ocean (FAO Area 51) for deep-water sharks.

5.   From CCAMLR observer-reported data it appears that deep-water gillnets first appeared in CCAMLR waters at roughly the same stage as when this fishing method was banned from some of the fishing grounds in the North-East Atlantic.   It is possible that the surplus of fishing gear not being used in these fisheries, together with the sudden availability of crew members with experience in handling this type of gear, caused a shift to the IUU fleet operating in the Southern Ocean.

6.   A background paper was submitted to CCAMLR in 2007, CCAMLR-XXVI/BG/33, which provided a photographic record of IUU vessels targeting *Dissostichus* spp. with gillnets.   Although this document depicts details on the type of gear used to operate gillnets, it does not provide detail on the actual gear specifications and actual effort in the form of exactly how many nets are set and worked in a day or are deployed at any one time.

7.   The objective for discussion is to compare details of the gear specifications reported by the observers from the two trips approved by ICES (in ICES Subarea VI), together with gear details received from vessels currently targeting deep-water sharks in the southern Indian Ocean – FAO Area 51 (Table 1), and the assumption that IUU vessels are likely to use comparable gear and have similar capability to deploy and handle this gear.   From this comparison it may be possible to obtain an estimate of the daily fishing effort by IUU vessels with respect to the specifications of the gear used and the daily capabilities for setting and hauling gear.

POSSIBLE ADVANTAGES OF USING GILLNETS
IN PLACE OF LONGLINES

8.   A major advantage of operating with deep-water gillnets in place of longlines is that a vessel would not have to carry large volumes of bait. This would conceivably increase the fuel carrying capacity of the vessels by at least 70 tonnes. Savings on bait costs would further lower operating costs. Additional advantages would be that without being limited by their bait supplies, and with the possibility to carry extra fuel, the vessels would be able stay out on the fishing grounds for longer periods without having to be refuelled or tranship bait, resulting in fewer constraints on their operations. Lower catch rates that would normally be uneconomical for a vessel using conventional fishing means may still be profitable for a vessel deploying gillnets.

9.   The possibility also exists that a vessel may be able to alternate between using longlines and gillnets during a trip.

OPERATING GILLNETS

10.   Nets are hauled using an extended stainless steel winch drum (Figure 1). This replaces the heavier cast iron winch drum used to haul rope or the top line of a longline. It appears that the drums can be exchanged in a relatively short time. This indicates that a vessel could switch from longline to using nets with little effort. The possibility exists that the net winch can also be used to haul a top rope of a longline.

11.   A stainless steel guide (Figure 2) is used in place of a roller and gathers the net as it comes over side and allows the net to be hauled around the drum. This is a characteristic item of equipment that can be used to identify vessels that are using gillnets. The guide protrudes over the side and is folded inboard when not in use.

12.   The net is deployed from the stern the same as a longline. A chute or channel guides the net from the hauling point to where it is stored ready for deploying.

13.   Gear terms and specifications:

- A bottom-set gillnet can be defined as a wall of netting with a weighted groundline holding it on the seabed and kept vertical by a floatline.

- Alternative terms – bottom-set nets, gillnets, entangling nets, trammel nets.

- Net panel (skein) of net – variable length, depths, mesh sizes and materials obtainable from net manufacturers.

- Fleet – number of net panels connected together. Single working unit that is set and hauled.

- Floatline (top rope) – attached to the top row of meshes and connects net panels into a continuous fleet.

- Weightline (groundline) – weighted rope attached to the bottom row of meshes connecting fixed number of net panels of a fleet in conjunction with the float line.

- Terminal anchor and buoys – weights/anchor and marker buoys attached to the end of each fleet. Similar or the same as those used to mark the ends of a longline.

Table 1:   Comparison of reported gillnet specifications used in ICES Subarea VI and FAO Area 51.

Item	ICES Subarea VI	FAO Area 51
Net panel (length x depth)	50 m x 3.6 m	112 m x 40 m
No. panels per fleet		150 to 180
Length of single fleets deployed	7.1–12.4 km	8.33–9.26 km reported by vessel *16.80–20.16 km (calculated from no. of net panels/fleet)*
Reported number of set fleets in the water at any one time	9–14	2–3
Net mesh length	280 mm	160–180 mm
Mesh material	0.6 mm monofilament nylon	0.7 mm (green) monofilament nylon
Floatline/top line		20 mm (green) polysteel 4–strand rope
Groundline (weight line)		20–25 mm (green) polysteel rope with core of lead beads in each strand
Weights		Three links (estimated 40–50 mm) stud-link chain
No. of fleets worked per day	3.5 fleets	2–3 fleets on rotational basis/set and hauled
Soak time	46–119 hours	48–96 hours
Estimated gear lost	No gear reported lost	200 m/6 months

Figure 1:   Drum or net roller used to haul in the gillnet.

Figure 2:   Guide to haul a gillnet over the side inboard.

Figure 3:   Chain links used to anchor the net.

**REPORT OF THE WORKSHOP ON
VULNERABLE MARINE ECOSYSTEMS**
(La Jolla, CA, USA, 3 to 7 August 2009)

CONTENTS

REPORT OF THE WORKSHOP ON
VULNERABLE MARINE ECOSYSTEMS
(La Jolla, CA, USA, 3 to 7 August 2009)

OPENING OF THE MEETING

1.1   The Workshop on Vulnerable Marine Ecosystems (VMEs) was held in La Jolla, CA, USA, from 3 to 7 August 2009. The Workshop was convened by Dr C. Jones (USA) and local arrangements were coordinated by Ms A. Van Cise, Southwest Fisheries Science Center, National Marine Fisheries Service (USA). With the Workshop's agreement, Dr K. Martin-Smith (Australia) withdrew from his role as Workshop Co-convener.

1.2   Dr Jones opened the meeting and welcomed the participants, including three invited experts Drs D. Bowden (New Zealand), J. Gutt (Germany) and S. Schiaparelli (Italy) (Appendix A).

Adoption of the agenda and organisation of the meeting

1.3   The Workshop reviewed the provisional agenda and agreed to consider resistance and resilience, as well as endemism and rarity, in the discussion of life-history attributes (Item 3.1), consider the spatial extent of VMEs under Item 5 (previously Item 3.3), and consider the extent of the impact by different bottom fishing gear under Item 4. The adopted agenda is given in Appendix B.

1.4   The Workshop also considered discussions from two meetings held during the 2008/09 intersessional period:

- meeting of WG-SAM (Annex 6, paragraphs 4.12 to 4.15)
- meeting of WG-EMM (Annex 4, paragraphs 5.4 to 5.14).

1.5   The Workshop noted the Secretariat's high translation workload (COMM CIRC 09/82) and discussions at CCAMLR-XXVII (CCAMLR-XXVII, paragraph 3.13), and agreed to make every effort to limit the overall size of its report.

1.6   The Workshop agreed to follow WG-SAM's initiative and highlight sections of the report dealing with advice to the Scientific Committee and its working groups, and list the relevant references to paragraphs under Item 7 (Advice to the Scientific Committee).

1.7   While the report has few references to the contributions of individuals and co-authors, the Workshop thanked all the authors of submitted papers for their valuable contributions to the work presented to the meeting. Documents submitted to the Workshop are listed in Appendix C. Dr A. Constable (Australia) gave a teleconference presentation of WG-SAM-09/21.

1.8   The report was prepared by Drs D. Agnew (UK), Jones, S. Lockhart (USA), Martin-Smith, P. O'Brien (Australia), S. Parker (New Zealand), D. Ramm (Data Manager), K. Reid (Science Officer), A. Rogers (UK), B. Sharp (New Zealand) and G. Watters (USA).

INTRODUCTION

2.1   The Workshop reviewed the history of measures to conserve VMEs in CCAMLR, noting that benthic habitat protection measures, such as those contained in Conservation Measure 41-05, introduced in 2002, were used prior to the introduction of the term 'Vulnerable Marine Ecosystem'.

2.2   The Workshop noted efforts to conserve VMEs in the United Nations General Assembly (UNGA), particularly noting the Sustainable Fisheries Resolution 61/105 adopted by UNGA in 2006 and the provisions contained in OP83 of this resolution, and that this and Article II of the CAMLR Convention provided the basis for Conservation Measure 22-06.

2.3   The Workshop further noted the work of CCAMLR to manage bottom fishing practices to prevent significant adverse impacts on VMEs through the work of the Scientific Committee in 2007 and 2008 (SC-CAMLR-XXVI, paragraphs 4.159 to 4.171 and Annex 5, paragraphs 14.1 to 14.50; SC-CAMLR-XXVII, paragraphs 4.207 to 4.284, Annex 4, paragraphs 3.21 to 3.44 and Annex 5, paragraphs 10.3 to 10.109).

2.4   The Workshop noted that some terms, such as destructive fishing practices, the vulnerability of an ecosystem to fishing and what constitutes significant adverse impacts, were proposed in SC-CAMLR-XXVI/10.

2.5   The Workshop recognised that guidelines for the management of deep-sea fisheries, including provisions for the conservation of VMEs, were developed by FAO and presented in *FAO Fisheries and Aquaculture Report*, No. 881 (2009). The Workshop noted that these guidelines provide examples of some VMEs, including deep-sea corals and seamounts, but that this list is not exhaustive and does not encompass all potential VMEs in the Southern Ocean.

2.6   The Workshop noted that cumulative impacts, including those caused by multiple gear types, would be important when considering the effects of bottom fishing.

HABITATS AND HABITAT-FORMING TAXONOMIC GROUPS
THAT CONSTITUTE A VME

Life-history attributes, resistance, and resilience of VME taxa
in the Southern Ocean

3.1   The Workshop considered which life-history characteristics of benthic invertebrates of the Southern Ocean would be indicative of vulnerability to bottom fishing gear. The Workshop developed several criteria based on the characteristics of VMEs set out in the *FAO International Guidelines for Management of Deep Sea Fisheries on the High Seas* (2009) to classify intrinsic factors that contribute to vulnerability to physical disturbance due to bottom fishing. These criteria were then evaluated relative to the life-history attributes of organisms in each taxonomic group based on published literature and expert opinion, including through analogy with related taxa.

3.2   The Workshop agreed that functional roles of VME taxa include, *inter alia*, that they:

(i)   significantly contribute to the creation of a complex three-dimensional structure;

(ii)   create a complex surface by clustering in high densities;

(iii)   change the structure of the substratum (e.g. sponge spicule mats; Bett and Rice, 1992); or

(iv)   provide substrata for other organisms (Gutt and Schickan, 1998).

3.3   The Workshop agreed that these functional roles are not limited to creating 'large' structures, noting that encrusting organisms or organisms that create patches of structurally complex sea-floor substrata can also support the existence of additional fauna (Jones et al., 1997).

3.4   An additional intrinsic factor contributing to vulnerability to disturbance is rarity or uniqueness (the term endemism is not used here because it is scale-dependent). For example, rare dense populations of single species or communities (e.g. aggregations of stalked crinoids or chemosynthetic assemblages) could be significantly impacted by a single fishing event, and the effect exacerbated by limited potential for recovery because of isolation from recruitment sources. All of the taxa included in Table 1 were considered to be vulnerable to disturbance by bottom fishing gear.

3.5   The seven criteria included in the evaluation of benthic taxa are defined below:

1.   **Habitat-forming** – One of the main characteristics of the structural species within VMEs is the degree to which they create habitat that could be used by other organisms. Organisms that are large, with a strong three-dimensional shape, or which create a complex surface by clustering in high densities, or changing the character of the substratum (e.g. sponge spicule mats), create habitats for other organisms. The relative degree to which organisms contribute to generating this habitat was classified as Low, Medium or High.

2.   **Longevity** – Mortality of long-lived organisms can result in long recovery periods to regenerate unfished age structure (possibly more than centuries). CCAMLR's objectives under Article II cannot be achieved if recovery does not occur over a time scale of 20–30 years. Therefore, where estimates of maximum longevity for the members of the taxon were available, they were scaled as Low (<10 years), Medium (10–30 years) and High (>30 years). Thus, longevity was categorised into the three levels with respect to the length of time an ecosystem takes to recover from fishing impacts and how this recovery time relates to the objectives of the Convention.

3.   **Slow growth** – Organisms which grow slowly will take a longer time to attain a large size or reproductive maturity. Slow growth rates of organisms are correlated with high longevity, but independent of age, slow growth requires longer times to generate maximum size. Vulnerability related to growth rate was classified as Low for fast growth rates, Medium, and High for slow growth rates.

4. **Fragility** – The potential for damage or mortality resulting from physical disturbance from bottom fishing gear was classified as Low (organisms that are resistant due to their structure or behaviour), Medium, or High (tall, brittle, or otherwise easily damaged).

5. **Larval dispersal potential** – The range of dispersal by larvae and propagules influences the ability of a species to recolonise impacted areas. Species which brood larvae, or otherwise have limited dispersal abilities, are less resilient to fishing disturbance because new recruits may not be available from a nearby source, and recruitment, recolonisation and recovery could be delayed. Organisms with high dispersal potential have a higher probability of supplying larvae to a disturbed area and are therefore more resilient. The reproductive strategies of brooding versus broadcast spawning were summarised for each group. Taxa consisting of brooding species were scored High, broadcast spawners Low, and taxa with a mix of both strategies were scored Medium.

6. **Lack of adult motility** – Motility in itself should not exclude taxa from being vulnerable or less resilient to bottom fishing gear, as organisms which can move to some degree may still meet all the other criteria of vulnerability. However, the lack of motility does add some degree of vulnerability and decreases resilience because as adults those organisms cannot redistribute themselves in response to a direct disturbance, adjust their position if altered in some way, or move into a disturbed area to recolonise. Organisms that are completely sessile were classified as High; those with some limited potential for movement as Medium, and typically motile as Low.

7. **Rare or unique populations** – Vulnerable taxa containing species that create dense, isolated populations are intrinsically vulnerable because they have a more limited potential for recovery. This criterion was classified as High if populations are isolated, and Medium or Low as population patch size or frequency of occurrence increases. Further, this criterion indicates vulnerability to physical disturbance and is independent of the habitat-forming characteristics of the taxon.

3.6   The Workshop recognised that, where coarse taxonomic groups were chosen, these may contain many species with a range of life-history characteristics. In this situation, the most precautionary values were used to characterise the potential vulnerability for the taxonomic group relative to the specific criterion. Coarse taxonomic levels were used to minimise the number of groups involved and to allow the inclusion of information derived from studies from the Southern Ocean or comparable ocean environments if necessary. The Workshop agreed that general relationships derived from meta-analyses of available information, such as those presented in WS-VME-09/12 and WG-EMM-09/35, could be useful where detailed information on particular taxa were lacking.

3.7   The Workshop agreed that Table 1 is a living document that should be periodically reassessed and updated to incorporate the best available science. In cases where the appropriate information was not available for a taxon, no score was given and the Workshop agreed that this was useful in identifying important information gaps.

3.8   The Workshop agreed that the parameters listed in Table 1 relate to the intrinsic vulnerability of VME taxa and that the actual impacts on VMEs depend on fishing intensity and the gear type that is deployed. All bottom fishing gears have the potential to impact seabed communities but have different levels of impact depending on the physical shape and weight of the gear and the way it is deployed (Rogers et al., 2008). However, fishing intensity is also extremely important as impacts of fishing gear on seabed communities are cumulative. Therefore, while some fishing gears may have a moderate or low impact per deployment, the cumulative impact of multiple deployments in a single area will increase damage to seabed communities over time and also negatively influence their recovery.

3.9   The observations from a benthos disturbance experiment in the Weddell Sea in which intensive trawling of a small area did not kill or remove all macrofauna (WS-VME-09/P5) support the view that bottom fishing impacts may not result in total mortality within the area impacted and that recolonisation does not need to occur from sources outside the impacted area. Dr Gutt noted that recent modelling work suggested that the rate of recovery may be strongly influenced by the proportion of surviving organisms remaining in the disturbed area (Potthoff, 2006). However, the Workshop recognised that the population growth potential is crucial to recovery time, and that recruitment dynamics are not well known for these taxa in the Southern Ocean. Also, there is evidence from outside the Convention Area that in some situations (e.g. intensive trawling on the summits of seamounts) VMEs may be totally or near-totally removed and subsequent recovery has not been observed 20 or 30 years post impact (Clark et al., in press).

3.10   The Workshop agreed that vulnerability is a continuum, not a binary characteristic of a species or assemblage. Therefore, designating a list of coarse taxonomic groups as being vulnerable will inevitably exclude some species that are potentially vulnerable to the use of bottom fishing gear, and may include some species that are less vulnerable. Evaluating the intrinsic factors contributing to vulnerability from physical disturbance indicates a number of taxonomic groups could be significantly impacted by bottom fishing activities.

Benthic invertebrate taxa consistent with VMEs

VME habitat-forming organisms and features specified in Annex 22-06/B

3.11   The Workshop recommended that Conservation Measure 22-06, Annex 22-06/B, be restructured to collect information related more directly to research vessel encounters with VME taxa. These changes could be addressed by WG-FSA. Specifically, the Workshop recommended that:

(i)   the habitat-forming organisms should be replaced with the VME taxa listed in Table 1, and with the addition of a category for other taxa;

(ii)   more details about the type of sampling gear used, and a list of other types of information collected from the site, should be requested;

(iii)   because these encounters would likely be by research vessels, there is some potential that additional data could be collected while the vessel is at the site. A

list of the high-priority types of data, such as multibeam bathymetry, oceanographic variables, sediment types or video recordings, could be provided to encourage the collection of these additional data;

(iv)   sections 4 and 5 of the annex be combined and made less prescriptive;

(v)   the annex include a section to provide a rationale and supporting evidence for the notification (see paragraph 6.13).

Review of Benthic Invertebrate Classification Guide

3.12   The Workshop noted the guide to Heard Island and McDonald Islands (HIMI) benthic invertebrates (WS-VME-09/13).   The guide has now been finalised and will be made available to interested members.   A benthic invertebrate identification guide is also being developed for the Ross Sea (see paragraph 6.6) and will be made available when complete.

3.13   The Benthic Invertebrate Classification Guide for Potentially Vulnerable Marine Ecosystems (WG-EMM-09/8; see also WG-FSA-08/19) was reviewed by the Workshop relative to the list of vulnerable taxa listed in Table 1.   The Workshop agreed that this guide was applicable to all regions of the area defined in Conservation Measure 22-06, noting that additional VME taxa may be included in the guide in future revisions as information becomes available.   The Workshop also encouraged work to continue to identify and characterise chemosynthetic communities within the CAMLR Convention Area.

3.14   Recognising the utility of the guide described in the preceding paragraph (also see TASO-09/8), the Workshop requested a number of minor improvements, including additional VME taxa columns, additional characteristics through photographs and text to aid in identification, and better contrasting information to distinguish currently confusing taxa.   The Workshop noted that additional species codes will need to be developed to aid in recording additional VME taxa.   The Workshop also agreed that for the purposes of the guide and of identification of VMEs, all corals (live or dead) should be reported to the taxonomic resolution in the guide.   The Workshop agreed that the revised guide be titled the 'CCAMLR VME Taxa Classification Guide' and should be submitted for review by WG-EMM and WG-FSA.

3.15   The Workshop recommended that distributions of VME taxa weights and sizes recorded in both research and observer data be investigated with an aim to provide an additional characteristic to use in the CCAMLR VME Taxa Classification Guide.   This would eventually aid vessels in determining when move-on rules that depend on the by-catch of various-sized VME taxa might be triggered.

3.16   The Workshop summarised its advice from discussions under this agenda item as follows:

(i)   Scientific evaluation of the presence of vulnerable taxa or of fishery impacts to vulnerable taxa can be made using both fishery-dependent and fishery-independent data, and the vulnerable taxa encountered may be different for different sampling devices (e.g. bottom longline gear, bottom trawl or underwater video).

(ii)   Different taxonomic groups have qualitatively different degrees of intrinsic vulnerability to physical disturbance. The degree of impact and potential recovery time is influenced by the spatial overlap of the fishery footprint with the distribution of each vulnerable taxon, the intensity (cumulative effects) of fishing effort in overlapping areas, and those intrinsic factors.

(iii)   In addition to intrinsic vulnerability factors, the assessment of bottom fishing impacts should incorporate fishery specific factors, such as spatial overlap between fishing effort and VME distribution, and any correlations between VME taxa and fishery species.

(iv)   A single VME Taxa Classification Guide can be developed for use in all CCAMLR areas specified in Conservation Measure 22-06.

EXTENT OF IMPACT BY DIFFERENT BOTTOM FISHING GEAR

4.1   The Workshop acknowledged that currently all of the bottom fishing in the CAMLR Convention Area covered by Conservation Measure 22-06 was by longline. Given the limited overlap in the use of different longline gear (i.e. autoline, Spanish or trotline), there was insufficient data to compare the different impacts on VMEs of these different gear types. However, the Workshop did acknowledge that simply on the basis of the characteristics of the gear, especially the potential for movement of the mainline and hooks during the soak period, there was considerable potential for differences in the interaction of the gear with benthic organisms.

4.2   The Workshop considered WG-SAM-09/P1 which described the use of a flexible framework for estimating the impacts of bottom fishing gear on vulnerable taxa given the uncertainties that exist. The use of this framework to assess the cumulative impacts of fishing in the Ross Sea by New Zealand flagged vessels indicated that a primary factor influencing the potential impact of different longline gear types was the extent of lateral movement of the mainline in contact with the sea floor during line retrieval.

4.3   The Workshop recognised that the use of this framework to derive absolute measures of impact is subject to great uncertainty, but that the framework is valuable for making explicit the consequences of different assumptions, and for estimating the plausible upper and lower bounds of cumulative impact to date or of proposed future fishing activities, given particular assumptions about the spatial distributions of VME taxa. The Workshop noted that in response to Annex 6, paragraph 4.9, the authors of WG-SAM-09/P1 had applied the impact assessment in very small areas within which fishing effort distributions appeared uniform or random in space, in order to more closely approximate a condition in which the assumption of no systematic association between fishing distributions and VME taxa is valid. Actual distributions of VMEs remain unknown. The Workshop noted that the approach would be enhanced by efforts to validate this assumption, either by mathematically establishing the random distribution of effort at that scale or by examining actual effort distributions with reference to a range of simulated VME distributions, e.g. using the approach described in WG-SAM-09/21. The Workshop also recognised that the framework was potentially very useful to compare the relative impacts of fishing operations using different gear or operating in different locations.

4.4   Furthermore, the Workshop agreed that the combined use of this framework with that described in WG-SAM-09/21 (see paragraph 4.9) would allow the use of available data indicative of fishing effort and likely impact, and the simulation of other aspects of the risk assessment process for which data does not currently exist, i.e. the spatial distributions of VME taxa.

4.5   The Workshop suggested that the method be investigated as a tool that could be used in the routine impact assessment undertaken by Members in fulfilment of the requirements of the pro-forma notification in Conservation Measure 22-06, Annex 22-06/A. Such an investigation should consider the requirements of assessments of different gear types (Spanish longlines, autolines, droplines, trotline, pots singly, pots on strings) and the tool should operate using data requested from the Secretariat databases.

4.6   Although much of the information relating to fishing impacts to VMEs in the area included in Conservation Measure 22-06 will derive from fishery observations, a comprehensive evaluation of vulnerability might also utilise information from other sources (such as video or photographic data and geomorphologic information).

4.7   The Workshop recognised that there is currently little information available to monitor or evaluate impacts to taxa that may be vulnerable to bottom fishing but have unknown spatial distributions and are not observed in fishery by-catch. An expanded list of taxa could be considered when conducting scientific surveys and experiments using various sampling methods that efficiently collect data on a wider range of species (e.g. vent and seep taxa, or tube-building serpulid worms may not be catchable by bottom longline gear). Vulnerable taxa able to be monitored in the fishery would necessarily be a subset of the list of taxa that might be impacted by the fishery simply due to catchability constraints.

4.8   The Workshop considered additional fishery-specific factors that will modify the threat to VMEs from fishing:

(i)   Spatial distribution relative to fishery. The greater the degree of spatial concordance in three dimensions (latitude, longitude and depth) between the occurrence of benthic communities and fishing effort, the greater the impact on those communities from bottom fishing.

(ii)   Aggregation relative to fishery. If VMEs are highly aggregated, the likelihood of an encounter with bottom fishing gear may be decreased but the impact may be increased.

(iii)   Association with fishery species. A positive relationship between VMEs and fishery target species will increase the threat from bottom fishing while a negative relationship will decrease the threat.

(iv)   Gear-specific vulnerability. The proportion of individuals of different VME taxa that are dislodged, damaged or killed will vary depending on gear type, thus affecting potential rates of recovery.

(v)   VME area impacted per unit effort. Uncertainties exist concerning the area impacted by many gear types – for example lateral movement of longlines will increase the impact footprint.

4.9   WG-SAM-09/21 presented a simulation model (coded in R) for evaluating management strategies to conserve the ecological structure and function of benthic habitats that had already been considered by both WG-EMM and WG-SAM (Annex 4, paragraphs 5.12 to 5.14; Annex 6, paragraphs 4.11 to 4.15). The Workshop recognised that several of the suggestions for improvements made by the working groups had been incorporated into the model, as well as the provision of a draft manual, and congratulated the author for these developments.

4.10   The Workshop agreed that the outputs of discussions on resistance and resilience, such as Table 1, could be used as a basis to parameterise the model. Unfortunately the Workshop was unable to provide further commentary due to time constraints but urged further development of this model and its application.

METHODS FOR IDENTIFYING LOCATIONS OF VMEs

Available and potential data sources

    Fishing vessels

5.1   The Workshop agreed that longline sets by fishing vessels are the most easily accessible and widely distributed method for sampling VME indicator organisms in areas where the toothfish fishery takes place. Nevertheless, it was recognised that longlines are unlikely to be good samplers of benthic organisms, and there are significant uncertainties about the relative catchability of different taxa by different types of gear and at different depths (SC-CAMLR-XXVII, Annex 5, paragraphs 10.22 and 10.38). Thus, longlines might not be equally good at identifying different types of VME if they are indicated by taxa of varying catchability.

5.2   WS-VME-09/5 analysed vessel-reported VME data and scientific observer data to compare two different metrics for monitoring VME indicator organism catch rates. Although there was a relationship between the number of VME indicator units and the number of VME indicator organisms per thousand hooks by line section, there was a high degree of scatter partially caused by the mix of 'heavy' and 'light' VME taxa captured on longline segments. Nevertheless, there appeared to be some consistency between taxa associations, for instance triggers with high numbers per thousand hooks generally comprised stylasterids and basket stars.

5.3   The Workshop agreed that it might be important to distinguish between catch rates of different VME taxa in order to interpret what type of community might be indicated by the composition of VME indicator units (paragraphs 6.8 to 6.10).

5.4   WS-VME-09/8 examined the distribution of different VME indicator taxa in the Ross Sea using data from the NIWA Invertebrate Collection, SCAR MarBIN and CCAMLR 2009 observer data. Scientific sampling is concentrated on the shelf, whereas fishing is concentrated on the slope, meaning that data from fishing vessels is important, and often the only source of data, for understanding the overall distribution of VME indicator taxa.

5.5   TASO-09/8 examined the issue of ease of identification of VME taxa by observers and found that observers were able to easily distinguish VME from non-VME taxa using the Benthic Invertebrate Classification Guide (WG-EMM-09/8) without specific training in identification of VME taxa (Annex 9, paragraphs 3.9 and 3.10).

5.6   Vessels themselves are required under Conservation Measure 22-07 to report encounters with VME indicator organisms where the volume or weight of the organisms caught in one line segment was greater than five VME indicator units, and additionally were urged to report the VME data from all line segments to the extent possible. WG-EMM-09/8 reported that 30 VME indicator notifications were made in exploratory bottom fisheries in 2008/09 and that 13 of the 18 vessels fishing had reported the additional fine-scale VME data.

5.7   The VME notifications under Conservation Measure 22-07 for the 2008/09 season were:

- Subarea 48.6: 1 notification of >5 units
- Subarea 88.1: 18 notifications of >5 units, including 5 notifications of >10 units
- Subarea 88.2: 11 notifications of >5 units, including 2 notifications of >10 units.

In addition, one VME fine-scale rectangle (an area of 0.5° latitude by 1° longitude) was identified in Subarea 88.2, where eight notifications of >5 units had been made.

5.8   Considering that the requirement for recording and reporting VME data only came into effect this season, and that the reporting of non-trigger VME data was not mandatory, the Workshop congratulated fishing vessels and observers on the quantity of the data that they had been able to report during the season. Data provided by vessels and observers have proven useful in investigating the relationship between fishing, fish catch and VME indicator units undertaken this year (WS-VME-09/5 and 09/7).

5.9   The Workshop agreed that high-resolution data from fishing vessels and observers were necessary to fully understand key issues concerning the impact of fishing on VMEs. Different data can provide key information such as the spatial scale of VME indicator organism occurrence and interaction with gear or associations of different taxa and between VME indicator organisms and fish. Although not all vessels had reported VME data for each line segment, enough data had been reported to demonstrate its utility. Some vessels had reported these data for entire lines, which although still useful, was not directly comparable with the line-segment data.

5.10   The Workshop further agreed that the relationship between data obtained from fishing vessels and observers and actual impacts on VMEs in relation to the effects of bottom fishing remains uncertain. Uncertainty could be reduced through the use of camera gear for example (SC-CAMLR-XXVI/BG/30; WG-FSA-08/58).

5.11   The Workshop noted the importance of distinguishing between nulls (where no observations were made) and zeroes (where observations were made but no VME taxa were found) as this is particularly critical to identify the patch size of VMEs and in habitat suitability modelling (see paragraphs 5.27 to 5.37).

5.12   The Workshop made the following recommendations with respect to data collection on vessels:

(i)   vessels should only report total weight of VMEs, not volume;

(ii)   reporting of all VME data and fish catch data by line segment should be mandatory for a subset of whole lines for all vessels;

(iii) whenever whole lines are monitored, all catches of VME taxa for every segment should be recorded, including entering a zero catch if no VME taxa were caught;

(iv)   observers should be required to identify taxa for VME catches on segments from the same segments as the vessel's subset (see (ii) above);

(v)   observers should record both weight and numbers of each VME taxon at the level of the line segment when monitoring VME data (paragraph 5.3);

(vi)   vessels and observers should be careful to record geodetic datum[1] information and avoid transcription errors in location data.

Fishery-independent research

5.13   The Workshop considered other methods of locating VMEs using research data.

5.14   WS-VME-09/4 indicated how VMEs might be located by considering physical mechanisms of trophic focusing which are determined by the interactions of oceanographic dynamics and geomorphology.

5.15   WS-VME-09/9 outlined an approach to locating chemosynthetic communities using a range of data acquired through a variety of different surveys such as seismic reflection surveys. The Workshop noted that the SCAR Action Group would also compile a field guide to chemosynthetic communities to allow observers to classify them in by-catch.

5.16   WS-VME-09/10 described the development of an Antarctic-wide geomorphic map of the sea floor for use in locating potential VME sites and for bioregionalisation. The geomorphic map is based on global bathymetric datasets to provide the most uniform coverage of the entire region. The value of the approach to VME detection is that it locates seamounts over 12 km in diameter even in areas lacking ship-based data.

5.17   The Workshop agreed that geomorphic mapping should be made available via the CCAMLR Secretariat so that individual VME locations could be overlaid on it to investigate possible relationships between VME distributions and geomorphology. It was recognised that polygon data like this are difficult to include in statistical modelling exercises that use gridded data. However, the geomorphology does provide seamount locations and insights into environmental characteristics in areas where there are no other data.

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[1]   A geodetic datum is the earth model used to locate latitudes and longitudes on the earth surface. The location of a latitude-longitude pair on the earth's surface can vary by hundreds of metres for different geodetic datums. The datum used for a navigation system is specified in the system set-up of GPS units and hydrographic charts specify what datum was used as part of the legend.

5.18   WG-EMM-09/32 presented results from two surveys on the Antarctic Peninsula margin and the South Orkney Islands. The surveys used benthic trawls and video transects to collect benthic samples. VME taxa were common at almost every station so the investigators defined a threshold weight of 10 kg per 1 200 m^2 trawled to be analogous to the trigger set out in Conservation Measure 22-07.

5.19   The Workshop discussed the applicability of a threshold for defining a potential VME identified during research. Conservation Measure 22-06, Annex 22-06/B, requires only presence of VME organisms, but it was recognised that this could apply to almost every station sampled in this study, and that this was not consistent with the spirit of the conservation measure.

5.20   The Workshop recommended that CCAMLR Members develop mechanisms for acquiring non-fisheries research information from national programs and to provide information that could be useful for identifying potential VME areas.

Use of fish diversity as an indicator of VME

5.21   The Workshop noted that results from studies investigating whether the abundance and biomass of fish are enhanced by the presence of epifaunal coral and sponge communities on seamounts or in other deep-sea ecosystems are equivocal. Observations have indicated that catches of commercially valuable species may be higher in and around cold-water coral reefs (Husebø et al., 2002). Research submersibles, ROVs or other scientific methods have recorded significantly higher abundances of fish and crustaceans in coral and sponge versus non-coral and sponge habitats in some cases (Lindberg and Lockhart, 1993; Brodeur, 2001; Koenig, 2001; Krieger and Wing, 2002; Costello et al., 2005; Pirtle, 2005; Stone, 2006; Tissot et al., 2006; Ross and Quattrini, 2007), and not in others (Auster, 2005). In Alaska, 97% of juvenile rockfish and 96% of juvenile golden king crab were associated with emergent epifaunal invertebrates such as corals and sponges (Stone, 2006). In the northeastern Atlantic, visual surveys of areas of the continental margin indicated that 80% of individual fish and 92% of fish species were observed on *Lophelia pertusa* reefs in comparison to non-reef habitat (Costello et al., 2005).

5.22   The Workshop noted that in the Antarctic there are few data relating the distribution of fish species to benthic habitat, particularly VMEs. Unpublished work has identified a specific association between *Patagonotothen guntheri* and sponges, where the eggs of the fish have been repeatedly found in sponge colonies (E. Fitzcharles, BAS, UK, unpublished data). There are also observations that *Trematomus* spp. are often observed in association with sponges (Gutt and Ekau, 1996) and *Lepidonotothen nudifrons* are associated with dense aggregations of bryozoans (C. Jones, pers. obs.).

5.23   Although there is some potential for association of specific fish species and perhaps even overall fish diversity with VMEs, unless these fish were also vulnerable to capture by longlines, examination of fish by-catch rates and diversity may not provide useful indicators of VME presence.

5.24   WS-VME-09/7 described an analysis of VME indicator data reported by vessels and toothfish CPUE in the Ross Sea. The paper found little evidence for a functional relationship

between toothfish catch and VME units, and vessel was the most significant factor influencing VME units and VME units declined with depth. Further, catch rates of VME units were higher in the west of Subarea 88.1 close to Cape Adare than in the east.

5.25   The Workshop examined preliminary investigations undertaken by the Data Manager which highlighted the limitations of the current dataset to detect relationships between the catch rates of other fish species – macrourids, rays or *Antimora* – with VME taxa observations.

5.26   The Workshop concluded that, given the evidence to date, it was unknown whether the examination of fish diversity from longline samples would generate useful indicators of VME location. The Workshop agreed that this approach could be further investigated and urged Members to submit analyses to WG-FSA. These studies should consider:

   (i)   different fish parameters – size, species, density and diversity;

   (ii)   the relationship between fish catches and the occurrence of each specific VME taxon listed in Table 1;

   (iii) issues of the potential saturation of hooks at high levels of VME taxa catch;

   (iv)   scale issues – for instance, the possibility that toothfish are attracted to a longline from a wider area than the area from which VME data are being collected; and differences in size between VME patches and longline segments;

   (v)   the variation in catchability of toothfish may be influenced by different aspects of the configuration of gear and habitat compared to the aspects that influence variations in catchability of VME taxa, and these aspects may vary independently;

   (vi)   the catchability assumptions both in regard of fish and VMEs.

Spatial extent of VMEs

   Predicting the locations of VMEs in the absence of direct observations

5.27   The Workshop reviewed WS-VME-09/4, 09/9, 09/10, 09/P1, 09/P2, 09/P3 and 09/P4, as well as Tittensor et al. (2009) that included analytical and statistical options that may be useful for predicting the distributions of VMEs.

5.28   Furthermore, the Workshop noted that data-driven spatial modelling approaches (as in WS-VME-09/P1 to 09/P4) were preferable to hand-drawn geomorphology classifications, as in WS-VME-09/10, for many applications, but that geomorphology data may be better at discerning particular features of interest (e.g. seamounts) and as such may be useful as a stand-alone tool, or to modify the outputs of other modelling efforts.

5.29   The Workshop noted that the data-driven spatial modelling approaches require two kinds of data:

(i)   spatially comprehensive environmental data layers (e.g. depth, water temperature);

(ii)   biological datasets for the taxa in question (either presence-only, presence–absence, or abundance).

5.30   It was further noted that sufficient environmental data exists at present to effectively run these models (although assembling spatial datasets in useful format is not a trivial task), but that biological data are likely to be limiting. The following spatial modelling methods were judged to be appropriate (as in WS-VME-09/P1), in order of increasing power to make highly resolved predictions, but also increasing demand for quality data:

(i)   bioregionalisation (SC-CAMLR-XXVI, Annex 9)
(ii)   Environmental Niche Factor Analysis (ENFA) (Tittensor et al., 2009)
(iii)   Generalised Dissimilarity Modelling (GDM) (WS-VME-09/P3)
(iv)   Maximum Entropy modelling (MAXENT) (Tittensor et al., 2009)
(v)   Multivariate Adaptive Regression Splines (MARS) (WS-VME-09/P2)
(vi)   Boosted Regression Trees (BRT) (WS-VME-09/P4).

5.31   The Workshop noted BRT has been reviewed by WG-SAM (SC-CAMLR-XXVII, paragraph 2.1(vi)); however, it is unlikely that currently available data are adequate to inform a BRT model for VME taxa at a circumpolar scale.

5.32   The Workshop agreed that there were unavoidable trade-offs involved in the selection of any spatial modelling approach. Approaches with lower data requirements, e.g. bioregionalisation, can be implemented now and will likely produce useable results at larger scales, i.e. large-scale habitat classes within which detectable associations with VME taxa are evident. If CCAMLR requires smaller-scale outputs, i.e. actual predictions of the location of VMEs at scales comparable to VME patch size or fishing effort distributions, then methods that require larger amounts of data will be necessary, possibly requiring the allocation of additional resources to compile and prepare relevant biological datasets.

5.33   The Workshop noted that in some locations and for some environments (e.g. the Ross Sea shelf, or the South Shetland and South Orkney Islands), biological data in datasets already assembled may be adequate to allow the use of some of the more powerful methods (GDM or MARS).

5.34   The Workshop noted that extending VME spatial modelling to other regions or to some important environments (e.g. seamounts, continental slopes) may require collaborative efforts to assemble, combine and/or groom existing biological datasets. Relevant data are currently widely dispersed and stored in formats that may not currently be amenable to a global analysis.

5.35   The Workshop noted possible sources of useful biological data to inform spatial modelling for VMEs included, *inter alia*, the SCAR-MarBIN database and IPY CAML voyages.

5.36　In those areas where currently available environmental and biological data are adequate to inform the use of sophisticated spatial modelling techniques (GDM, MAXENT, MARS or BRT), the Workshop urged Member countries to pursue spatial modelling of VME distributions on smaller scales using these or similar approaches.

5.37　In areas where currently available data are inadequate, Members are encouraged to collaborate to share available environmental datasets, and to combine and assemble relevant biological datasets, to allow this work to proceed.　The Workshop advised that additional resources may be required to progress this work.

Scales of Risk Areas

5.38　The Workshop recalled that Conservation Measure 22-07 currently defines the scale of Risk Areas to be defined as circles with radii of 1 n mile (although Members may define larger Risk Areas if required by domestic law).　This scale was developed by considering the length of longline segments.

5.39　WS-VME-09/6 summarised analyses that were conducted to evaluate scale-dependent genetic connectivity among populations of benthic invertebrates.　Although the Workshop did not identify all of the taxa considered in the paper as VME taxa, animals having a range of larval stage durations were represented in the study.　In general, the results in WS-VME-09/6 were consistent with other published work (e.g. Rogers, 2007) and demonstrated that benthic invertebrates rarely demonstrate genetic connectivity across regions (e.g. between the South Shetland Islands, South Orkney Islands and Bouvet Island).　Deep water appears to be a significant barrier to gene flow, even for taxa that have long larval stages.

5.40　However, although the results of WS-VME-09/6 mostly demonstrated genetic homogeneity within regions, significant genetic structure can be found even at small spatial scales in species having a pelagic larval phase (Guidetti et al., 2006).　Conversely, some species which lack a pelagic larval stage, and therefore are predicted to have localised populations, show genetic homogeneity at regional scales (Hunter and Halanych, 2008). Therefore, inferring realised dispersal range from the duration of the larval phase may not be a reliable way to predict connectivity of populations.　It should be noted that present levels of connectivity in populations can be difficult to infer using genetic methods because of strong historical influences on molecular markers or lack of variability of available genetic markers (Rogers, 2007).

5.41　The Workshop agreed that although the results from WS-VME-09/6 and other studies on genetic connectivity are applicable to issues surrounding spatial management to conserve marine biodiversity (e.g. to the delineation of MPAs), at present these studies provide insufficient information to determine the spatial scale of VME Risk Areas.　It was noted that, if population genetics data are used to advise on broader spatial management issues, high-resolution mitochondrial markers, such as the mitochondrial control region, and nuclear markers, such as microsatellites, together are most promising for making inferences about population structure.

5.42　The Workshop agreed that taxon- or community-specific information on scales of patchiness of VME would be most useful for delivering advice on the scales of Risk Areas.

Such information might be collected in a variety of ways, including research transects with video or camera equipment or detailed by-catch information from the length of an entire longline set (paragraph 6.11), and Members were encouraged to conduct such work in the future.

5.43   Results presented in WG-EMM-09/32 indicate that VMEs may be found in clusters. The authors of the paper noted that it would be both more precautionary and more easily manageable to consider the areas within and around such clusters as potentially harbouring additional VMEs and therefore suggested that relatively large (as compared to the scale specified in Conservation Measure 22-07) Risk Areas might be defined on the basis of such clusters.

5.44   With regard to scaling Risk Areas on the basis of VME clusters (or non-random distributions of VMEs), the Workshop advised that:

(i)   clusters may be shaped such that circular areas might not circumscribe appropriate Risk Areas. For example, stylasterids sometimes occur in long, narrow bands that are located on the shelf break;

(ii)   the scales and shapes of clusters will likely depend on the community structure of particular VMEs and whether such communities are dominated by 'heavy' or 'light' taxa. For example, the authors of WG-EMM-09/32 noted an isolated patch of light-bodied *Umbellula* spp. (Cnidaria: Pennatulacea) that was distinct from larger VME clusters dominated by sponge communities;

(iii)   inferences about the size and location of VME clusters will be influenced by operational thresholds that may be used to identify VMEs from cumulative catches or collections of VME indicator taxa within sets, hauls or samples. For example, the authors of WG-EMM-09/32 standardised research trawl catches to units of kg per 1 200 m^2 and identified VMEs at locations where catches of indicator taxa were ≥10 such standard units, but the sizes and locations of VME clusters identified by this approach would have been different if catches of, say, five standard units had been used to identify VMEs;

(iv)   clusters may indicate mesoscale patchiness of VMEs and thus warrant mesoscale-sized Risk Areas.

5.45   The Workshop agreed that a number of approaches could be taken to characterise the shape and scale of VME clusters after catches or collections of VME indicator taxa have crossed thresholds signifying the likely presence of one or more VMEs. These approaches include drawing simple polygons that enclose likely VMEs (e.g. drawing convex hulls around locations where catches of indicator taxa that are greater than agreed thresholds) and using statistical models (e.g. kernel smoothers and possibly GDMs or BRTs using a variety of predictor variables) to describe local variations in the likely abundance of VMEs by including information from hauls and samples that may have been relatively close in space but yielded catches that were less than agreed thresholds (and include possible zero values). Regardless of which approach is adopted, it was also agreed that as much information as possible should be used to characterise the shape and scale of VME clusters, including environmental information. In this respect, the Workshop acknowledged its previous conclusion that there is

an inverse relationship between the data requirements for modelling and the spatial scales on which advice can be provided (paragraph 5.32). Cumulating a network of Risk Areas defined on the basis of VME clusters would be akin to the process used to designate SSRUs for exploratory longline fisheries.

5.46   Following these points, the Workshop noted that the VMEs identified in WG-EMM-09/32 (and which have been notified under Conservation Measure 22-06) occur in distinct geomorphic regions identified by the work described in WS-VME-09/10. The authors of WS-VME-09/10 provided geomorphic maps to the Workshop and these maps showed that clusters of VMEs identified along the southern portion of the Bransfield Strait often occurred in a geomorphic province classified as 'shelf bank' while those identified on the western and eastern sides of the South Orkney Islands often occurred in a geomorphic province classified as 'wave-affected bank' (Figures 1 and 2).

5.47   The Workshop agreed that it may be possible to define Risk Areas for the VMEs identified in WG-EMM-09/32 on the basis of the geomorphic provinces described in WS-VME-09/10 and other information, and that doing so would result in relatively large Risk Areas occurring along the southern Bransfield Strait and around the periphery of the South Orkney Islands.

5.48   The Workshop noted that the scale of Risk Areas which might be defined around the South Orkney Islands can impact the conduct of the exploratory crab fishery which has been notified for Subarea 48.2. Conservation Measure 52-02 currently requires the exploratory crab fishery to be conducted following an experimental harvest regime (Conservation Measure 52-02, Annex 52-02/B) in which fishing effort must be distributed among twelve 0.5° latitude by 1.0° longitude blocks (Annex 52-02/C). Within this experimental harvest regime, Blocks C and E overlap the clusters of VMEs identified in WG-EMM-09/32 and notified under Conservation Measure 22-06.

5.49   Acknowledging that Conservation Measure 52-02 was agreed with an intent to collect data that would facilitate a future assessment of potential crab stocks in Subarea 48.2, the Workshop advised that a number of options should be considered for revising Conservation Measure 52-02 in light of the overlap between Blocks C and E of the experimental harvest regime and the VME clusters identified in WG-EMM-09/32:

(i)   eliminate Blocks C and E from the experimental harvest regime;

(ii)   redefine the 0.5° latitude by 1.0° longitude blocks used in the experimental harvest regime so that overlap with the VME clusters identified in WG-EMM-09/32 is appropriately minimised;

(iii)   define a more highly resolved grid of blocks (i.e. blocks that are smaller than 0.5° latitude by 1.0° longitude) and exclude blocks that overlap with the VME clusters from the experimental harvest regime.

5.50   In advising these options, the Workshop agreed that a precautionary approach to addressing overlap between blocks in the experimental harvest regime and VME clusters is warranted because:

(i)   there are multiple ways to construct, configure and fish pots; all of these factors will influence the impact that an individual haul may have on VMEs; and it is unclear how the exploratory fishery may actually be prosecuted;

(ii)   a recent report (Edinger et al., 2007) indicated that few VME taxa are retained when pots are hauled on board despite observations demonstrating that pots do damage benthic invertebrates (Stone, 2006). Thus, it will likely be difficult to determine the degree to which such a fishery is impacting VMEs using fishery-dependent data alone.

5.51   The Workshop further acknowledged SC CIRC 09/41, which indicated that Argentina intends (subject to agreement by the Commission) to use pots to fish for *Dissostichus* spp. in Subareas 88.1 and 88.2 during the forthcoming season. It was advised that the issues identified in the preceding paragraph would pertain to this notification, and WG-FSA may wish to consider these points when evaluating the notification.

ENCOUNTERS AND INDICATORS OF VMEs IN THE SOUTHERN OCEAN

Taxonomic resolution required to describe VMEs

6.1   The Workshop agreed that the taxonomic resolution used in the Benthic Invertebrate Classification Guide for Potentially Vulnerable Marine Ecosystems was adequate for the purposes of data collection and analysis for determining potential VME Risk Areas.

6.2   The Workshop recommended that Porifera be separated into Hexactinellida and Demospongiae, but that the option be given to record unknowns at the coarser scale of Porifera. This situation may also be relevant to other groups such as Cnidaria.

6.3   The Workshop recognised the need for additional FAO code assignments. In particular, the need for codes for some of the lower taxonomic ranks already illustrated in the Benthic Invertebrate Classification Guide for Potentially Vulnerable Marine Ecosystems (e.g. Hexactinellida, Demospongiae).

6.4   The Workshop recommended that a hierarchy of codes be made available to scientific observers, who will then be encouraged to use the finest resolution code they are comfortable with. The ability of many observers to record at a finer resolution than absolutely necessary is supported by the analysis in TASO-09/8. The Workshop further recommended that scientific observers be encouraged to record at the finest resolution possible, and instructions to observers should reflect this. The Workshop noted the constraints of the current workload put on scientific observers, and recognised the increase in workload any additional request would create.

6.5   The Workshop suggested that hands-on training for scientific observers would considerably improve the identification of VME taxa. It was recommended that scientific

observer technical coordinators liaise with their respective national Antarctic research programs to acquire example material of VME indicator taxa in order to advance this training.

6.6   In addition, the Workshop recommended the distribution of alternate field guides available, such as those produced by the UK, and by Australia for the HIMI region. The Workshop was informed about a benthic invertebrate identification guide for the Ross Sea which is under development, and which will form part of the SCAR-MarBIN field guide initiative, which, when completed over the next two years, will provide an extensive online field guide of Antarctic benthic invertebrates, available and updated through the SCAR-MarBIN website. Such a field guide could be used as an online resource for training purposes.

Indicators used by fishing vessels or during research surveys
that signal when a VME is encountered

6.7   The Workshop considered the information on VME indicators from fishery-dependent and fishery-independent sources contained in WS-VME-09/5, 09/7, WG-EMM-09/8, 09/32 and TASO-09/8 (see sections 3 and 5).

6.8   The Workshop discussed the basis for determining trigger levels used to initiate management actions and noted that the VME indicator taxa reported in 2009 have different densities and therefore agreed that the trigger levels currently in use were likely to be too high for 'light' taxa; but there was insufficient information to suggest an appropriate new level. Examples using 'heavy' and 'light' categories to separate taxa were provided in WG-EMM-09/32 and WS-VME-09/5 (paragraph 5.44). The Workshop also noted that separate trigger levels may also need to be developed for encounters with rare and unique populations (paragraphs 3.4 and 3.5).

6.9   The Workshop agreed that further examination of observer and vessel data could be used to develop revised trigger levels but noted that there was no information currently available on which to make scientific recommendations on appropriate trigger levels for pot fisheries (paragraph 5.50).

6.10   The Workshop agreed that additional data on the number, weight and type of VME indicator taxa per line segment and fish catch on the same line segments (paragraph 5.12), could be used to develop advice on the occurrence and spatial scale of VMEs.

6.11   Although increased data collection adds additional burden to vessels and scientific observers, the Workshop agreed that such collection could be undertaken on a subset of all gear deployments during the course of a single season with a well designed, targeted sampling program.

6.12   The Workshop discussed VME notifications from fisheries-independent research and noted that there are many different forms of evidence that can be used to indicate the presence of a VME including, *inter alia*, photographic images, acoustics and catches from research sampling gear, and suggested that the rationale and as much supporting information as possible should be provided when a VME notification is submitted (paragraph 3.11).

6.13   The Workshop agreed that proposed notifications under Conservation Measure 22-06 should be provided to WG-EMM for assessment and the outcomes of this evaluation should be incorporated by the proposing Member before a VME notification under Conversation Measure 22-06 is submitted to the Secretariat.

6.14   The Workshop recognised that systematic, ecologically-based criteria need to be developed to assist the Scientific Committee in defining areas as VMEs under Conservation Measure 22-06 in an objective manner.

ADVICE TO THE SCIENTIFIC COMMITTEE

7.1   The Workshop identified the following advice to the Scientific Committee and WG-EMM and WG-FSA (as indicated):

(i)   Habitats and habitat-forming taxonomic groups that constitute a VME –

- life-history attributes, resistance and resilience of VME taxa (advice to WG-EMM: paragraph 3.7 and Table 1; advice to WG-FSA: paragraph 4.8);

- VME habitat-forming organisms and features specified in Conservation Measure 22-06, Annex 22-06/B (paragraph 3.11);

- review of the benthic invertebrate classification guide (paragraphs 3.13 and 3.16; advice to WG-EMM and WG-FSA: paragraph 3.14).

(ii)   Extent of the impact by different bottom fishing gear (paragraphs 4.8 and 4.10).

(iii)   Methods for identifying locations of VMEs –

- data from fishing vessels (paragraphs 5.9 and 5.12)
- data from fishery-independent research (paragraphs 5.17 and 5.20)
- fish diversity as indicator of VME (paragraph 5.26)
- scales of Risk Areas (paragraphs 5.44, 5.45, 5.47 and 5.49 to 5.51).

(iv)   Encounters and indicators of VMEs in the Southern Ocean –

- taxonomic resolution required to describe VMEs (paragraphs 6.1 to 6.6)
- indicators used by fishing vessels or during research surveys that signal when a VME is encountered (paragraphs 6.8, 6.10, 6.13 and 6.14).

(v)   Conservation Measures –

- 22-06 (paragraphs 3.11, 3.13 and 6.14)
- 22-07 (paragraphs 3.13, 5.12, 5.44, 5.45 and 5.51)
- 52.02 (paragraphs 5.49 and 5.50).

ADOPTION OF THE REPORT AND CLOSE OF THE WORKSHOP

8.1   The report of the Workshop was adopted.

8.2   In closing the meeting, Dr Jones thanked the participants and the invited experts for their scientific contributions and fruitful discussions, the rapporteurs for producing a succinct report, and the Secretariat for its support.

8.3   Dr Watters, on behalf of the participants, thanked Dr Jones for his leadership and for motivating focused discussions and resultant advice. The Workshop also thanked Ms Van Cise and the Southwest Fisheries Science Center for providing excellent facilities and Workshop arrangements.

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Tittensor, D.P., A.R. Baco, P.E. Brewin, M.R. Clark, M. Consalvey, J. Hall-Spencer, A.A. Rowdern, T. Schlacher, K.I. Stocks and A.D. Rogers. 2009. Predicting global habitat suitability for stony corals on seamounts. *J. Biogeogr*., 36: 1111–1128.

Table 1:   Intrinsic factors contributing to the vulnerability from physical disturbance of invertebrates in the Southern Ocean.

Taxon	Habitat forming	Rare or unique populations	Longevity	Slow growth	Fragility	Larval dispersion potential	Lack of adult motility
Phylum Porifera							
Hexactinellida	H	L	H	H	H	M	H
Demospongiae	H	M	H	H	H	M	H
Phylum Cnidaria							
Actiniaria	L	L	H	L	L	M	M
Scleractinia[1]	H	M	H	H	H	M	H
Antipatharia	M	L	H	H	H	L	H
Alcyonacea	M	L	M	L	M	M	H
Gorgonacea	M	L	H	H	H	M	H
Pennatulacea	L	H	H	M	H	L	M
Zoanthida	L	L			M	L	H
Hydrozoa							
Hydroidolina	L	L			L		H
Family Stylasteridae	H	L	H	M	H	H	H
Phylum Bryozoa	H	L	H	M	H	H	H
Phylum Echinodermata							
Crinoidea: Stalked crinoid orders	L	H	H		H		H
Echinoidea: Order Cidaroida	M	L	H	H	M	H	L
Ophiuroidea: Basket and snake stars	L	L			H	L	M
Phylum Chordata: Class Ascidiacea	M	L		L	L	L	H
Phylum Brachiopoda	L	H	H	L	M	M	H
Phylum Annelida: Family Serpulidae	M	L			H	L	H
Phylum Arthropoda: Infraclass Cirripedia: Bathylasmatidae	L	H	H		M	L	H
Phylum Mollusca: Pectinidae: *Adamussium colbecki*	L	H	H	M	M	L	M
Phylum Hemichordata: Pterobranchia	M	M			M	H	H
Phylum Xenophyophora	L	H			H		H
Chemosynthetic communities	H	H	H	H	H	L	H

[1]   As of 2009, almost all records of Scleractinia in the CAMLR Convention Area are of cup corals (*Desmophyllum* and *Flabellum* sp.). However, records of matrix forming scleractinians (*Madrepora oculata* and *Solenosmilia variablis*) do exist in the northernmost areas, as far south as 60°S. Cup corals are typically not habitat-forming, but Scleractinia were classified as 'high' for the habitat-forming criterion to be consistent with the approach of using the precautionary attributes of the members of each taxon.
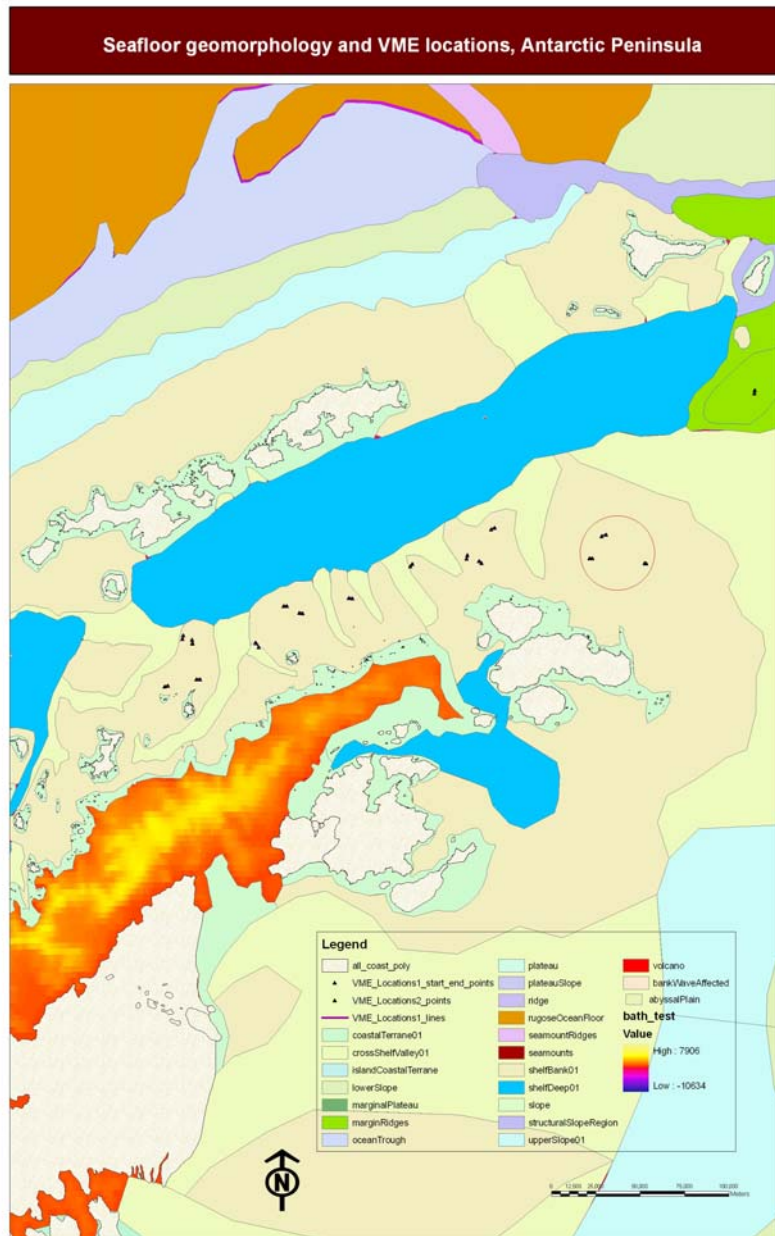
Figure 1*: Geomorphic provinces (irregular coloured polygons) around the Antarctic Peninsula and the locations of VMEs (black triangles identifying both start and end locations). The geomorphic provinces were characterised and mapped following methods described in WS-VME-09/10. The VMEs were identified in WG-EMM-09/32; start and end locations are from research trawls. VME clusters are considered loose groupings of VMEs (e.g. the grouping of VMEs on the shelf bank to the northeast of D'Urville and Joinville Islands that is annotated with a red oval).

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* This figure is available in colour on the CCAMLR website.
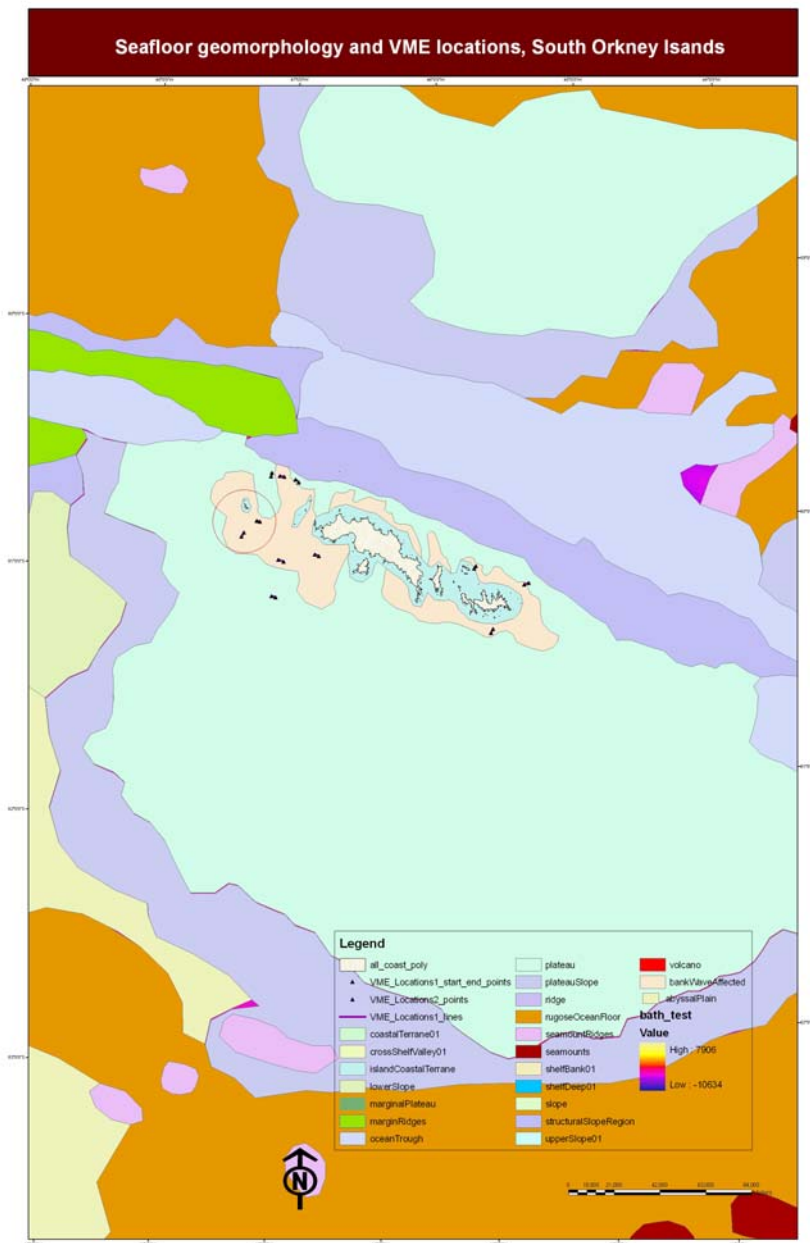
Figure 2*: Geomorphic provinces (irregular coloured polygons) around the South Orkney Islands and the locations of VMEs (black triangles identifying both start and end locations). The geomorphic provinces were characterised and mapped following methods described in WS-VME-09/10. The VMEs were identified in WG-EMM-09/32; start and end locations are from research trawls. VME clusters are considered loose groupings of VMEs (e.g. the grouping of VMEs on the shelf bank to the west of Coronation and Signy Islands that is annotated with a red oval).

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* This figure is available in colour on the CCAMLR website.

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Workshop on Vulnerable Marine Ecosystems
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AGENDA

Workshop on Vulnerable Marine Ecosystems
(La Jolla, CA, USA, 3 to 7 August 2009)

1. Opening of meeting

2. Introduction
    2.1 Review of VMEs and bottom fishing issues in CCAMLR
    2.2 Current and interim CCAMLR conservation measures (CM 22-05, 22-06
         and 22-07)

3. Habitats and habitat-forming taxonomic groups that constitute a VME
    3.1 Life-history attributes, resistance and resilience of VME taxa in the Southern
         Ocean
    3.2 Benthic invertebrate taxa consistent with VMEs
         3.2.1 VME habitat-forming organisms and features specified in Annex 22-06/B
         3.2.2 Review of Benthic Invertebrate Classification Guide
    3.3 Endemism and rarity of taxa

4. Extent of the impact by different bottom fishing gear

5. Methods for identifying locations of VMEs
    5.1 Available and potential data sources
         5.1.1 Fishing vessels
         5.1.2 Fishery independent research
    5.2 Fish diversity as indicator of VME
    5.3 Spatial extent of VMEs
         5.3.1 Predicting locations of VMEs in the absence of direct observations
         5.3.2 Scale of Risk Area designation

6. Encounters and indicators of VMEs in the Southern Ocean
    6.1 Taxonomic resolution required to describe VMEs
    6.2 Indicators used by fishing vessels or during research surveys that signal when a
         VME is encountered

7. Advice to the Scientific Committee

8. Report adoption and close of Workshop.

LIST OF DOCUMENTS

Workshop on Vulnerable Marine Ecosystems
(La Jolla, CA, USA, 3 to 7 August 2009)

WS-VME-09/1	Provisional and Provisional Annotated Agenda for the CCAMLR Workshop on Vulnerable Marine Ecosystems (VMEs)
WS-VME-09/2	List of Participants
WS-VME-09/3	List of Documents
WS-VME-09/4	Physical controls on coral communities on the George V Land slope: some working hypotheses A.L. Post, P.E. O'Brien, R.J. Beaman, M.J. Riddle (Australia) and L. De Santis (Italy)
WS-VME-09/5	Analysis of VME data collected by UK vessels fishing in the Ross Sea during the 2008/09 CCAMLR Season R.E. Mitchell, T. Peatman, J. Pearce and D. Agnew (United Kingdom)
WS-VME-09/6	Using genetic connectivity to identify vulnerable marine ecosystems (VMEs) in Antarctica - the issue of scale N.G. Wilson (USA)
WS-VME-09/7	Is the bycatch of vulnerable invertebrate taxa associated with high catch rates of fish in the Ross Sea longline fisheries? S.J. Parker and S. Mormede (New Zealand)
WS-VME-09/8	Identifying taxonomic groups as vulnerable to bottom longline fishing gear in the Ross Sea region S.J. Parker and D.A. Bowden (New Zealand) (*CCAMLR Science*, submitted)
WS-VME-09/9	Detection of cold seeps and hydrothermal vents P.E. O'Brien, A. Jones, G. Logan, N. Rollet and J. Kennard (Australia)
WS-VME-09/10	Antarctic-wide geomorphology as an aid to habitat mapping and locating Vulnerable Marine Ecosystems P.E. O'Brien, A.L. Post and R. Romeyn (Australia)
WS-VME-09/11	A database of life-history attributes for habitat-forming benthic taxa K.M. Martin-Smith (Australia)

WS-VME-09/12   Predicting the vulnerability of bryozoans and sponges to
                      disturbance using life-history characteristics
                      K. Martin-Smith (Australia)

WS-VME-09/13   Field identification guide to Heard Island and McDonald Island
                      (HIMI) benthic invertebrates: a guide for scientific observers
                      aboard fishing vessels
                      T. Hibberd and K. Moore (Australia)

Other Documents

WS-VME-09/P1   Novel methods improve prediction of species' distributions from
                      occurrence data
                      J. Elith, C.H. Graham, R.P. Anderson, M. Dudík, S. Ferrier,
                      A. Guisan, R.J. Hijmans, F. Huettmann, J.R. Leathwick,
                      A. Lehmann, J. Li, L.G. Lohmann, B.A. Loiselle, G. Manion,
                      C. Moritz, M. Nakamura, Y. Nakazawa, J.McC. Overton,
                      A.T. Peterson, S.J. Phillips, K.S. Richardson, R. Scachetti-Pereira,
                      R.E. Schapire, J. Soberón, S. Williams, M.S.Wisz and
                      N.E. Zimmermann
                      (*Ecography*, 29 (2006): 129–151)

WS-VME-09/P2   Predicting species distributions from museum and herbarium
                      records using multi-response models fitted with multivariate
                      adaptive regression splines
                      J. Elith and J. Leathwick
                      (*Diversity Distrib.*, 13 (2007): 265–275)

WS-VME-09/P3   Using generalized dissimilarity modelling to analyse and predict
                      patterns of beta diversity in regional biodiversity assessment
                      S. Ferrier, G. Manion, J. Elith and K. Richardson
                      (*Diversity Distrib.*, 13 (2007): 252–264)

WS-VME-09/P4   Variation in demersal fish species richness in the oceans
                      surrounding New Zealand: an analysis using boosted regression
                      trees
                      J.R. Leathwick, J. Elith, M.P. Francis, T. Hastie, P. Taylor
                      (*Mar. Ecol. Prog. Ser.*, 321 (2006): 267–281)

WS-VME-09/P5   Response of Antarctic benthic communities to disturbance: first
                      results from the artificial Benthic Disturbance Experiment on the
                      eastern Weddell Sea Shelf, Antarctica
                      D. Gerdes, E. Isla, R. Knust, K. Mintenbeck, S. Rossi
                      (*Polar Biol.*, 31 (2008): 1469–1480 DOI 10.1007/s00300-008-
                      0488-y)

TERMS OF REFERENCE
Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM)

TERMS OF REFERENCE

Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM)

The Scientific Committee recommended the following terms of reference for the meeting of SG-ASAM in 2010:

(i)   Review documentation of the acoustic protocol for the preparation of estimates of acoustic biomass.

(ii)   Undertake a reanalysis of CCAMLR-2000 acoustic survey data including:

    (a)   confirm steps of analysis by correspondence prior to the next meeting;

    (b)   review the independent calculations of B_0 from the CCAMLR-2000 Survey undertaken by Members including all correspondence between Members as appropriate to clarify relevant issues;

    (c)   review all the documented results of (b) submitted to SG-ASAM 2010;

    (d)   discuss results and add clarification to protocols if necessary;

    (e)   agree a validated B_0 estimate and associated uncertainty from the CCAMLR-2000 Survey and submit to the 2010 meeting of WG-EMM.

(iii)   Lodge a validated dataset, model code and model runs with the Secretariat.

**SPECIFIC TASKS IDENTIFIED BY THE SCIENTIFIC COMMITTEE
FOR THE 2009/10 INTERSESSIONAL PERIOD**

SCIENTIFIC COMMITTEE TASKS FOR THE 2009/10 INTERSESSIONAL PERIOD

No.	Paragraph references in SC-CAMLR-XXVIII	Task	Deadline	Action required Secretariat	Action required Members
1.		**SG-ASAM advice**			
1.1	2.10	Consider formal links with ICES-WGFAST.	SG-ASAM-10	Assist	SG-ASAM
1.2	2.11	SG-ASAM meet in 2010 with Terms of Reference in Annex 11.	SG-ASAM-10	Assist	Participate
2.		**Ecosystem monitoring and management**			
2.1	3.6	Document acoustic protocols.	Ongoing	Implement	SG-ASAM
2.2	3.7	Re-estimate B_0 from CCAMLR-2000 Survey.	WG-EMM-10	Assist	SG-ASAM
2.3	3.19(ii)	Further work on MPA at South Orkney Islands.	Ongoing		Participate
2.4	3.24	Procedure for use of MPA Special Fund.	Ongoing		Participate
2.5	3.28	Timetable of milestones for MPAs.	Ongoing		Participate
2.6	3.29	Further work for WG-EMM on MPAs.	Ongoing		Participate
2.7	3.32–3.33	Procedure for future work of MPA Special Fund Correspondence Group.	Ongoing		MPA Group
3.		**Harvested species**			
		Krill resources			
3.1	4.8	Request to translate krill notifications into English.*	Ongoing	Implement	
3.2	4.12	Secretariat to adopt patent database from AAD.	WG-EMM-10	Implement	Australia
3.3	4.15	Recording of data on escape mortality of krill.	Ongoing		Krill fishery
3.4	4.16	Volumetric conversion factors for krill catch.	Ongoing		UK
		Fish resources			
3.5	4.62	Develop repository of bathymetric data.		Assist	Australia
3.6	4.64–4.66	CON work plan.			CON members

* Implementation of this task will be subject to priorities and available funds and resources.

No.	Paragraph references in SC-CAMLR-XXVIII	Task	Deadline	Action required	
				Secretariat	Members
3.7	4.151	Ensure tagging of fish of correct size, frequency and location.			New and exploratory toothfish fisheries
3.8	4.168	Research plans for fisheries.			Implement
3.9	4.251	Review of Conservation Measure 22-07.			Participate
3.10	4.252	Report on 'Bottom Fisheries and Vulnerable Marine Ecosystems'.		Assist	Participate
4.		**CCAMLR Scheme of International Scientific Observation**			
		Ad hoc TASO			
4.1	6.10–6.12	TASO Observer Scheme accreditation process.		Participate	TASO
5.		**Fisheries management and conservation under conditions of uncertainty**			
5.1	7.7	Re-estimation of IUU catch data.		Assist	
6.		**Cooperation with other organisations**			
		Cooperation with the Antarctic Treaty System			
6.1	9.9	Liaison between SC-CAMLR Chair and CEP Chair.		Assist	SC Chair
		Future cooperation			
6.2	9.42	Representatives to meetings of relevance to the Scientific Committee.			Assist
7.		**CCAMLR Performance Review**			
7.1	10.8	Tasks to working groups following consideration of Performance Review Panel Report.			Working groups
7.2	10.23	Science capacity building group.			Ad hoc group
8.		**Secretariat supported activities**			
8.1	13.14–13.16	*CCAMLR Science* editorial process review and supplement.	Implement		
8.2	14.8	Timing and venue of intersessional meetings.	Ongoing		

GLOSSARY OF ACRONYMS AND ABBREVIATIONS
USED IN SC-CAMLR REPORTS

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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

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

APEI   Elephant Island (SSMU)

APEME Steering   Steering Committee on Antarctic Plausible Ecosystem Modelling
Committee   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
ATS	Antarctic Treaty System
ATSCM	Antarctic Treaty Special Consultative Meeting
AVHRR	Advanced Very High Resolution Radiometry
BAS	British Antarctic Survey
BED	Bird Excluder Device
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
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
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
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
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)
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
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
PAR	Photosynthetically Active Radiation
PBR	Permitted Biological Removal
PCA	Principal Component Analysis
PCR	Per Capita Recruitment
pdf	Portable Document Format

PDF	Probability Density Function
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-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
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
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)
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-IMALF	ad hoc Working Group on Incidental Mortality Arising from Longline Fishing (CCAMLR)
WG-IMAF	ad hoc Working Group on Incidental Mortality Associated with 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)