Abstract

This document presents the adopted report of the Twenty-fourth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, from 24 to 28 October 2005. Reports of meetings and intersessional activities of subsidiary bodies of the Scientific Committee, including the Working Groups on Ecosystem Monitoring and Management and on Fish Stock Assessment, are appended.

CONTENTS

REPORT OF THE TWENTY-FOURTH MEETING OF THE SCIENTIFIC COMMITTEE

(Hobart, Australia, 24 October to 28 October 2005)

OPENING OF THE MEETING

1.1 The Scientific Committee for the Conservation of Antarctic Marine Living Resources met from 24 to 28 October 2005 at the new CCAMLR Headquarters in Hobart, Australia. The meeting was chaired by Dr E. Fanta (Brazil).

1.2 Representatives from the following Members attended the meeting: Argentina, Australia, Belgium, Brazil, Chile, European Community, France, Germany, India, Italy, Japan, Republic of Korea, Namibia, New Zealand, Norway, Russian Federation, South Africa, Spain, Sweden, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America and Uruguay. Poland was not represented.

1.3 The Chair welcomed to the meeting observers from the Cook Islands (Instrument of Accession deposited on 20 October 2005) and Greece, Mauritius, Netherlands and Peru (Acceding States), the People's Republic of China (non-Contracting Party), along with observers from ACAP, ASOC, CCSBT, CEP, COLTO, FAO, IUCN, IWC, SCAR, SEAFO, UNEP and WCPFC, and encouraged them to participate in the meeting as much as possible.

1.4 Meeting participants are listed in Annex 1. Documents considered during the meeting are listed in Annex 2.

1.5 The following rapporteurs prepared the report of the Scientific Committee:

- Dr V. Sushin (Russia) – CCAMLR Scheme of International Scientific Observation;
- Dr K. Reid (UK) – Ecosystem monitoring and management (Advice from WG-EMM);
- Prof. J. Croxall (UK) and Dr P. Penhale (USA) – Ecosystem monitoring and management (Management of protected areas);
- Dr S. Nicol (Australia) – Krill resources;
- Drs C. Jones (USA) and K. Sullivan (New Zealand) – Fish resources;
- Dr G. Kirkwood (UK) – New and exploratory fisheries;
- Dr E. Marschoff (Argentina) – Crab resources and squid resources;
- Prof. G. Duhamel (France) – Fish and invertebrate by-catch;
- Ms K. Rivera (USA) and Mr N. Smith (New Zealand) – Incidental mortality;
- Prof. C. Moreno (Chile) and Dr Reid – Additional monitoring and management issues;
- Dr K.-H. Kock (Germany) – Management under conditions of uncertainty about stock size and sustainable yield, and scientific research exemption;
- Dr R. Holt (USA) – Scientific research exemption;
- Dr H.-C. Shin (Republic of Korea) and Prof. B. Fernholm (Sweden) – Cooperation with other organisations;
- Dr D. Ramm (Secretariat) – all other matters.

Adoption of Agenda

1.6 The Provisional Agenda had been circulated prior to the meeting (SC-CAMLR-XXIV/1). The Scientific Committee agreed to include 'Interactions between WG-FSA and WG-EMM' under Item 3 and to expand Item 13 to include consideration of the outcomes from the CCAMLR Symposium, the proposed restructure of the work of the Scientific Committee and its working groups, and future activities in relation to MPAs and the IPY. With these additions, the Agenda was adopted (Annex 3).

Report of the Chair

Intersessional meetings of working groups of the Scientific Committee

1.7 The following meetings of working groups of the Scientific Committee were held in 2005:

(i) The first meeting of SG-ASAM was held in La Jolla, USA, from 31 May to 2 June to consider models of krill target strength and classification of volume backscattering strength. It was convened by Dr R. Hewitt (USA). Eight participants representing six Members attended.

(ii) WG-FSA-SAM met from 27 June to 1 July in Yokohama, Japan, immediately prior to the WG-EMM meeting, and was convened by Dr Jones. Eighteen participants from nine Member countries participated in the subgroup meeting and Dr M. Maunder (IATTC) attended as an invited expert.

(iii) The Workshop on Management Procedures to Evaluate Options for Subdividing the Krill Catch Limit among Small-scale Management Units was held during the first week of the WG-EMM meeting, from 4 to 8 July, and was co-convened by Drs Reid and G. Watters (USA). The workshop was attended by 34 participants representing 12 Members.

(iv) The eleventh meeting of WG-EMM was held from 4 to 15 July in Yokohama, Japan. It was convened by Dr Hewitt and attended by 32 participants, representing 13 Members.

(v) A Workshop on Marine Protected Areas (WS-MPA) was held in Silver Spring, MD, USA, from 29 August to 1 September. The workshop was convened by Dr Penhale and attended by 20 participants representing 10 Members and an invited expert from IUCN-US, Ms L. Kimball.

(vi) The meeting of WG-FSA was held from 10 to 21 October 2005 in Hobart prior to the Scientific Committee meeting. It was convened by Dr S. Hanchet (New Zealand) and attended by 48 participants from 15 Member countries and a representative from ACAP. Thirteen participants representing seven Members attended an early session of WG-FSA which was held from 6 to 8 October and convened by Dr Jones.

(vii) Ad hoc WG-IMAF conducted its meeting as part of WG-FSA-05. It was co-convened by Ms Rivera and Mr Smith.

1.8 On behalf of the Scientific Committee, the Chair thanked the conveners for their significant contributions to the intersessional meetings. The report of WG-EMM (including that of its workshop) is attached as Annex 4, the report of WG-FSA (including ad hoc WG-IMAF) as Annex 5, the report of SG-ASAM as Annex 6 and the report of WS-MPA as Annex 7.

CCAMLR Scheme of International Scientific Observation

1.9 Scientific observers appointed under the CCAMLR Scheme of International Scientific Observation were deployed on all vessels in all finfish fisheries in the Convention Area. Scientific observers participated in a total of 47 cruises on board longliners (31 cruises), trawlers (14 cruises) and pot vessels (2 cruises) targeting toothfish or icefish. In addition, scientific observers working in accordance with the scheme participated in eight cruises on board krill fishing vessels.

Fisheries

1.10 Under the conservation measures in force in 2004/05, Members fished in 13 fisheries targeting icefish (*Champsocephalus gunnari*), toothfish (*Dissostichus eleginoides* and/or *Dissostichus mawsoni*) and krill (*Euphausia superba*):

- fishery for *Champsocephalus gunnari* in Subarea 48.3
- fishery for *Champsocephalus gunnari* in Division 58.5.2
- fishery for *Dissostichus eleginoides* in Subarea 48.3
- fishery for *Dissostichus eleginoides* in Subarea 48.4
- fishery for *Dissostichus eleginoides* in Division 58.5.2
- exploratory fishery for *Dissostichus* spp. in Subarea 48.6
- exploratory fishery for *Dissostichus* spp. in Division 58.4.1
- exploratory fishery for *Dissostichus* spp. in Division 58.4.2
- exploratory fishery for *Dissostichus* spp. in Division 58.4.3a
- exploratory fishery for *Dissostichus* spp. in Division 58.4.3b
- exploratory fishery for *Dissostichus* spp. in Subarea 88.1
- exploratory fishery for *Dissostichus* spp. in Subarea 88.2
- fishery for *Euphausia superba* in Area 48.

1.11 In addition, four other managed fisheries were conducted in the Convention Area in 2004/05:

- fishery for *Dissostichus eleginoides* in Division 58.5.1 (French EEZ)
- fishery for *Dissostichus eleginoides* in Subarea 58.6 (French EEZ)
- fishery for *Dissostichus eleginoides* in Subarea 58.6 (South African EEZ)
- fishery for *Dissostichus eleginoides* in Subarea 58.7 (South African EEZ).

1.12 In all, 16 Members fished: Argentina, Australia, Chile, France, Japan, Republic of Korea, New Zealand, Norway, Poland, Russia, South Africa, Spain, Ukraine, UK, Uruguay and the USA. In addition, a Contracting Party, Vanuatu, fished for krill.

1.13 As at 21 September, Members had reported a total catch of 124 535 tonnes of krill, 14 074 tonnes of toothfish and 1 991 tonnes of icefish from the Convention Area in 2004/05; fishing is continuing in some of the fisheries which remain open until 30 November 2005. A number of other species have been taken as by-catch.

1.14 Catches are detailed in CCAMLR-XXIV/BG/13 and the WG-FSA report (Annex 5).

CCAMLR SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

2.1 In the 2004/05 season, scientific observers (international and national) were deployed on all vessels conducting longline fishing for toothfish and trawl fishing for finfish. In the longline toothfish fisheries, scientific observers participated in 31 cruises, including nine cruises in the Atlantic sector of the Convention Area (Subareas 48.3, 48.4 and 48.6), 11 cruises in the Indian Ocean sector (Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3.b and 58.5.2) and 11 cruises in the Pacific sector (Subareas 88.1 and 88.2). In the trawl fisheries for finfish, scientific observers participated in 14 cruises, including seven cruises in the Atlantic sector of the Convention Area (Subarea 48.3) and seven cruises in the Indian Ocean sector (Division 58.5.2).

2.2 In the krill fishery in 2004/05, scientific observers (international and national) were present on eight cruises in the Atlantic sector of the Convention Area (Area 48). Data from two cruises were submitted at the time of the meeting.

2.3 Also, national scientific observers participated in two cruises on vessels fishing for toothfish with pots in the Indian Ocean sector of the Convention Area (South African EEZ in Subareas 58.6 and 58.7).

2.4 The Scientific Committee noted that WG-EMM and WG-FSA had discussed problems relating to the operation and improvement of the CCAMLR Scheme of International Scientific Observation (Annex 4, paragraphs 3.12 to 3.18, 3.29 to 3.35 and 3.44 to 3.48; Annex 5, paragraphs 11.1 to 11.3 and Appendix S).

2.5 The Scientific Committee considered and approved recommendations from WG-FSA to improve the following aspects of the CCAMLR Scheme of International Scientific Observation (Annex 5, paragraphs 11.3(i) and (iv)):

(i) Additional operational requirements of the scheme including, in particular, additions and modifications to the *Scientific Observers Manual* logbook data recording and reporting sheets, and instructions to scientific observers and technical coordinators, should be made in respect of:

   (a) only current versions of the cruise reports and logbook forms be used for reporting to CCAMLR (Annex 5, Appendix S, paragraph 3);

(b) collection of observer data in such a way as to distinguish between haul and set captures (Annex 5, Appendix O, paragraph 10);

(c) collection of data, at least every seven days, of streamer line characteristics including streamer line aerial extent; the height of streamer line at the stern; the length of streamer lines; and the number, spacing and length of individual branched streamers. These data should be reported on a diagram-based form to be developed by the Secretariat (Annex 5, paragraph 7.20(ii) and Appendix O, paragraph 79);

(d) the collection of data by observers on longline vessels of vessel setting speed, longline sink rate and streamer line aerial extent remain priority tasks for observers (Annex 5, Appendix O, paragraph 76);

(e) where the collection of sink rate data is required according to Conservation Measure 24-02, the streamer line data should be collected at the same time as sink rate data where possible (Annex 5, Appendix O, paragraph 79);

(f) improvement in the recording of net cleaning procedures in trawl fisheries (Annex 5, Appendix O, paragraph 205);

(g) the fishery observer(s) assigned to the Japanese vessel *Shinsei Maru* (using the bottom-line system in 2005/06) should describe how the gear is deployed and retrieved with special attention to gear and seabird behaviour during the haul and set (Annex 5, paragraph 7.21 and Appendix S, paragraph 23);

(h) accurate reporting of trawl fishery operations including number of tows per voyage, number of tows observed, number of incidental mortalities observed by species per tow and number of incidental mortalities reported from non-observed tows (Annex 5, Appendix S, paragraph 28);

(i) the continued use of the definition of the status of birds 'caught' (SC-CAMLR-XXII, Annex 5, paragraphs 6.214 to 6.217);

(j) an amendment to the krill logbook questionnaire to include a number of additional questions with diagrams of the vessel track and position of krill aggregations (Annex 4, paragraphs 3.35 to 3.53; Annex 5, Appendix S, paragraph 34);

(k) accurate reporting of fish by-catch in all data formats (Annex 5, Appendix N, paragraph 36);

(l) modification of the L5 catch composition form for observers to include 'number of hooks observed for fish by-catch' and the total estimated number and weight of each species retained and discarded for a set (Annex 5, paragraph 6.10);

(m) correct completion of L11 forms including information on rajid cut-offs. The minimum requirement would be the completion of this form for at least one observation period every 48 hours (Annex 5, paragraph 6.15);

(n) providing a report to the Secretariat on methods or strategies of fishing that minimise non-target fish by-catch (Annex 5, paragraph 6.23);

(o) advising that vessels should cut all rajids from their lines whilst still in the water, except on the request of the observer during the observer's biological sampling period (Annex 5, paragraph 6.25);

(p) adoption of a new 4-category scale for assessing the condition of rajids released by observers. These data should be accurately recorded for at least one observation period every 48 hours (Annex 5, paragraph 6.29);

(q) measurements of fish that are to be tagged and released should not be considered to be part of the observer's random length-frequency sample (i.e. if a fish is to be released as a tagged fish, then this fish should be excluded from the random sample of the catch taken by the observer) (Annex 5, Appendix T, paragraph 12);

(r) measurements of tagged fish that are recaptured should be added to the commercial catch length frequency (where they would normally be a part of the random selection of the observed catch) and landed catch weights (Annex 5, Appendix T, paragraph 12).

(ii) Instructions and logbooks from the *Scientific Observers Manual* should be compiled as separate electronic documents. The manual itself would then consist of a comprehensive range of observation guidelines and reference materials which would not necessarily require annual updates (Annex 4, Appendix S, paragraph 42).

(iii) Logbooks should be recorded and submitted in electronic format and the manual should be distributed electronically.

2.6 The Scientific Committee also endorsed a recommendation by WG-FSA regarding funding to enable two members of the CCAMLR Secretariat to participate in the 2007 International Fisheries Observer Conference (Annex 5, paragraph 11.3(ii), Annex S, paragraph 13; see also paragraph 10.1(ii)).

2.7 The Scientific Committee considered the issue of compulsory deployment of CCAMLR scientific observers on all krill fishing vessels in the Convention Area, which was raised by WG-EMM and WG-FSA (Annex 4, paragraphs 3.45 and 3.55; Annex 5, paragraph 11.3(iii)).

2.8 The Scientific Committee noted that WG-EMM agreed, in principle, that there is an urgent need for CCAMLR scientific observers on all krill fishing vessels (Annex 4, paragraph 3.45) to maximise spatial and seasonal observer coverage of the fishery and to adequately understand current developments in the krill fishery, especially given the recent changes in catching and processing technology (Annex 4, paragraphs 3.45 and 3.46). However, consensus on this issue has not been reached (Annex 4, paragraphs 3.46 and 3.55).

2.9 The Scientific Committee also noted the recommendation by WG-FSA that CCAMLR scientific observers be deployed on all krill fishing vessels (Annex 5, paragraph 11.3(iii)).

2.10 The Scientific Committee noted that data from observers on board fishing vessels in the Convention Area are used:

(i) to provide accurate catch rates used in standardising CPUE, the effect of this is most evident in the improved data following the introduction of 100% coverage of observers in the *D. eleginoides* fishery in Subarea 48.3;

(ii) to provide length frequencies for use in determining the interaction of the fishery with the caught species, the utility of this is demonstrated in the implementation of integrated assessments for *Dissostichus* spp. in Subareas 48.3 and 88.1 that help understand the changes in the stock structure during the development of the fishery;

(iii) to provide information on the differences between vessels which need to be estimated for use in standardising time series of CPUE as well as for inclusion of different integrated assessments;

(iv) to provide catch and length information as above to help determine the overlap between fisheries and predators at small scales.

The Scientific Committee agreed that these purposes are important in the assessment work being undertaken to provide advice to the Commission.

2.11 Dr Shin indicated that, while seeing the scientific merits of the observer-collected data, he does not share the same view on the magnitude of improvements the observer-collected data will bring to the assessment of the krill fishery as in other fisheries. He further noted that the krill fishery is a commercial venture and there may be constraints in having the fishery provide scientific data.

2.12 Dr Holt suggested that, from the scientific point of view, there were no doubts as to the appropriateness of deploying international scientific observers on all krill fishing vessels. However, it has not been possible to resolve this question for some years due to reasons which have little to do with scientific aspects of the matter. For example, the question of protecting the confidentiality of fishery information represents an obstacle for some countries. Dr Holt suggested that this issue be referred to the Commission for consideration since it would be difficult for the Scientific Committee to eliminate these obstacles.

2.13 Dr M. Naganobu (Japan) expressed his disagreement with compulsory deployment of international scientific observers on all krill fishing vessels, for the following reasons:

(i) Japan has signed a number of international agreements, in accordance with which foreign scientific observers already collect scientific data on Japanese vessels, and these agreements are sufficiently effective;

(ii) compliance with the requirement of compulsory 100% international scientific observer coverage of all krill fishing vessels may have significant financial implications;

(iii) there are problems arising from the need to respect the fishing companies' rights to protect the confidentiality of fishing information;

(iv) currently, the total catch of krill is at a stable level. It is significantly lower than the precautionary catch and there is therefore no urgent need to increase the amount of data being collected.

2.14 Profs J. Beddington (UK) and Croxall expressed surprise at the nature and content of some of the contributions to this discussion, and noted that:

(i) the WG-EMM report indicated that apparently all Members, except Japan, had agreed in principle that the deployment of scientific observers should be required on all krill vessels (Annex 4, paragraph 3.46); the reservation by Japan appeared solely to relate to commercial confidentiality, a matter which should be referred to the Commission for discussion;

(ii) the WG-FSA report indicated consensus amongst all Members that observer coverage should be required on all vessels participating in the Convention Area krill fishery (Annex 5, paragraph 11.3 and Appendix S, paragraph 31);

(iii) reservations now being expressed by Members, including by the same individuals who were present at the working group meetings, involve a combination of new objections, most of which relate to matters outside the competence of the Scientific Committee and old objections, which have been extensively debated in previous years.

2.15 However, Profs Beddington and Croxall did recognise that while there appeared to be consensus on the scientific merits of increased levels of observation on vessels fishing for krill in the Convention Area, there may be valid concerns about how this should be implemented in order best to achieve the desired scientific objectives.

2.16 To address any such concerns, the UK proposed a scientific study whereby, in the first year feasible, each vessel participating in the krill fishery in the Convention Area should have a scientific observer on board to carry out the tasks already requested or required by the Scientific Committee. For this single-year pilot study, protocols should be developed and the results analysed and evaluated by an appropriate group established by the relevant working groups of the Scientific Committee. This group would then recommend to the Scientific Committee, levels of observer coverage appropriate for each specified task and for the observer program for the krill fishery overall.

2.17 Dr V. Siegel (European Community) supported the UK proposal which could prove to be an acceptable option to speed up the process of improving scientific data collection in the krill fishery. He noted that CCAMLR should not be complacent just because the catch of krill has stabilised in recent years, as the fishery enters a new stage associated with the adoption of a new fishing technology. The Scientific Committee will therefore need to have sufficient information available to it to be able to provide appropriate management advice. He also noted that the majority of objections to the 100% coverage by CCAMLR scientific observers of the krill fishery (issues of confidentiality, finance etc.) do not fall within the Scientific Committee's terms of reference and should be considered by the Commission.

2.18 Mr L. Pshenichnov (Ukraine) noted that an acceptable option would be a requirement of conservation measures to deploy at least national scientific observers on all krill fishing vessels, provided that they would collect data in accordance with the CCAMLR Scheme of International Scientific Observation.

2.19 Dr Shin observed that a unanimous recommendation of 100% observer coverage on all krill fishing vessels was not likely, and did not see the utility of attempting to forward such a recommendation under the current circumstance. He further observed that krill catch varied little from year to year over a decade at a low level, while the catch limit has risen by four times in the major fishing ground. With regard to seal by-catch, solutions are being found, and the problem is far more tractable now. To his delegation's view, it is more pressing to ensure observer-collected data are analysed and the results are delivered in time, and it will be more useful to articulate where the more critical data needs are and to discuss the means to improve the situation. He further noted that krill fishing occurs over protracted periods and across large distances, and hence placing observers on such fishing platforms would incur a much greater challenge in logistics and cost.

2.20 Dr A. Constable (Australia) noted that it would be useful to introduce a process which would allow the CCAMLR Secretariat to accredit and coordinate scientific observers' activities on all krill fishing vessels.

2.21 The Scientific Committee agreed that deployment of international observers on all krill fishing vessels would allow collection of useful scientific information required to develop management advice for the krill fishery, based on the ecosystem approach.

2.22 At the same time, the Scientific Committee was unable to reach consensus as to the urgency of including this requirement in the CCAMLR Scheme of International Scientific Observation, as its appropriateness in terms of balance between scientific usefulness and costs was not clear to some participants.

2.23 The Scientific Committee has also found that the majority of problems which could become an obstacle to the introduction of compulsory scientific observer coverage of all fishing vessels (issues of costs, and confidentiality of data collected on board fishing vessels) do not fall within the Scientific Committee's responsibility and should be decided by the Commission.

2.24 The majority of Members of the Scientific Committee agreed to support the proposal put forward by the UK and to conduct an experiment during the first year feasible in organising the work of scientific observers on all krill fishing vessels during this season (paragraph 2.16).

2.25 The Scientific Committee considered the results of the review by WG-FSA of the *Scientific Observers Manual* and agreed with the following approaches and priorities developed by WG-FSA (Annex 5, Annex S, paragraphs 37 to 41).

2.26 Before any review of the *Scientific Observers Manual* is undertaken, the following three areas should be considered:

(i) a review of research priorities for different fisheries, target species and by-catch species and the type of data to be collected to allow research priorities to be met;

(ii) a review of whether existing data collection and recording protocols meet the identified data collection requirements. This phase should also include development of clear guidance on prioritisation of observer tasks where requested data collection exceeds time available to the observer at sea;

(iii) consideration of the most appropriate structure, format and contents of the manual.

2.27 The reviews in paragraphs 2.26(i) and (ii) above should be conducted annually by WG-FSA, incorporating the recommendations and advice of WG-FSA-SAM and ad hoc WG-IMAF with respect to the Scheme of International Scientific Observation. The Scientific Committee will take these recommendations into account along with requests for priority data collection from WG-EMM (and SCIC) in deciding the final list of priorities for the observer scheme.

2.28 Changes recommended annually by the Scientific Committee and its working groups (paragraph 2.26(iii) above) should continue to be implemented as appropriate by the Secretariat following the annual review process.

2.29 Consequently, the Scientific Committee agreed that a major review of the *Scientific Observers Manual* was currently unnecessary as the mechanisms for its continual update and review are already in place and work effectively.

2.30 The Scientific Committee agreed to the following procedures for reviewing the observer logbook forms, instructions, sampling procedures and observer work priorities:

(i) scientific observers should provide comments on the use of the logbooks and instructions to technical coordinators;

(ii) technical coordinators should collate and forward all relevant comments and suggested changes to the Secretariat in one concise document by 1 September on an annual basis;

(iii) the Secretariat will present a summary of all recommended changes to the working groups for consideration;

(iv) the working groups will review the proposed changes, giving consideration to existing research priorities and data collection protocols, and prepare recommendations to the Scientific Committee as required;

(v) the recommendations from working groups relating to observer research priorities and data collection requirements will be submitted as part of their advice to the Scientific Committee;

(vi) the Scientific Committee will review the advice from working groups (and, as appropriate, SCIC) together with the research priorities, and task the Secretariat with updating the logbook forms and distributing these to all Members as soon as possible.

2.31 The Scientific Committee also approved the Secretariat’s proposal that the manual’s current format could be substantially improved if paper-based observer logbooks and instructions were removed and replaced with electronic logbooks which could easily be amended as required. The manual itself would then consist of a comprehensive range of observation guidelines and reference materials which would not necessarily require annual updates (paragraph 2.5(ii) and Annex 5, Appendix S, paragraphs 42 and 43).

Advice for the Commission

2.32 The Scientific Committee recommended that:

(i) WG-FSA's recommendations regarding the work of CCAMLR scientific observers be noted (paragraph 2.5);

(ii) the approaches and priorities relating to improvement of the *Scientific Observers Manual* be endorsed (paragraphs 2.25 to 2.31);

(iii) the deployment of international scientific observers on krill fishing vessels would allow collection of useful scientific information required to develop management advice for the krill fishery, based on the ecosystem approach, be noted (paragraph 2.21);

(iv) the remaining problems hindering the introduction of the system of compulsory deployment of scientific observers on all krill fishing vessels cannot be resolved by the Scientific Committee as they are included in the Commission's responsibilities (paragraph 2.23).

2.33 The Scientific Committee noted that most Members supported a proposal to conduct, in the first appropriate season, an experiment in the organisation of the work of CCAMLR scientific observers on all krill fishing vessels during this fishing season, in order to assess the scientific usefulness and effectiveness of the introduction of a system of compulsory deployment of scientific observers on all krill fishing vessels (paragraph 2.24).

ECOSYSTEM MONITORING AND MANAGEMENT

Advice from WG-EMM

General comments

3.1 Dr Hewitt, Convener of WG-EMM, reported that the 2005 meeting of WG-EMM was held from 4 to 15 July 2005, in Yokohama, Japan. Intersessional activities included the first meeting of SG-ASAM and work by correspondence groups on preparations for this year's workshop on the design of land-based krill predator surveys and on the subdivision of CCAMLR statistical areas into ecologically based harvesting units. During the meeting the following groups met:

(i) Workshop on Management Procedures
(ii) Advisory Subgroup on Protected Areas
(iii) Subgroup on CEMP Methods
(iv) correspondence group on predator surveys
(v) subset of the Steering Group for the CCAMLR-IPY-2008 Survey.

3.2 These activities are summarised in three documents for consideration by the Scientific Committee:

(i) report of WG-EMM-05 (Annex 4) containing a listing of 'Key Points for Consideration by the Scientific Committee' at the end of each major agenda item, as well as the report of the Workshop on Management Procedures (Annex 4, Appendix D);

(ii) synopses of working papers (SC-CAMLR-XXIV/BG/9) considered at the meeting, each containing an abstract and a summary of the findings and/or conclusions as they relate to a particular agenda item;

(iii) report of the Convener of WG-EMM-05 to SC-CAMLR-XXIV (SC-CAMLR-XXIV/BG/11) containing appropriate references to paragraphs in the report of WG-EMM-05.

3.3 As in recent years, the agenda of WG-EMM-05 was structured to consider the status and trends in the krill fishery (Annex 4, section 3), the status and trends in the krill-centric ecosystem (section 4), the status of management advice arising from these considerations (section 5) and future work (section 6).

3.4 In particular, the Working Group drew the attention of the Scientific Committee to:

(i) plans for the CCAMLR-IPY-2008 Survey (Agenda Item 3);

(ii) adoption of a new model for acoustic target strength of krill and its implications (Agenda Item 3);

(iii) substantial progress in the use of ecosystem models for evaluating management procedures (Agenda Item 3);

(iv) approvals for two ATCM Management Plans (Agenda Item 3);

(v) CCAMLR Workshop on Marine Protected Areas (Agenda Item 3);

(vi) recommendation to require reporting of monthly krill catch and effort data by SSMUs (Agenda Items 3 and 4);

(vii) request for Scientific Committee communication with SCAR (Agenda Items 3 and 6);

(viii) the need to select a new convener of WG-EMM (Agenda Item 3).

Status and trends in the krill-centric ecosystem

3.5 Following the recommendations of WG-EMM, the Secretariat reported progress in validating CEMP data and summarising and reporting these data using an ordination approach. The Secretariat also reported receipt of Antarctic shag diet data (1991–2005) and development of an index based on these data (Annex 4, paragraphs 4.1 and 4.2).

3.6 The Scientific Committee noted that key challenges in the future work of CCAMLR are:

(i) the potential influences of long-term change in the physical environment that underpin biological processes;

(ii) how to detect the consequential changes in biological systems in monitoring programs;

(iii) how to incorporate these into management.

3.7 The Scientific Committee noted the following highlights from the papers reviewed by the Working Group:

(i) aerial surveys of the abundance of pack-ice seals off east Antarctica produced population estimates of 0.7–1.4 million crabeater seals, 37 000–124 000 Ross seals and 1 300–17 000 leopard seals (Annex 4, paragraphs 4.3 and 4.4);

(ii) the role of environmental forcing and climate-induced change on the population processes of Antarctic fur seals at South Georgia, over the period from 1984 to 2003, indicated that positive sea-surface temperature anomalies, showing significant lagged correlations with large-scale ENSO events in the Pacific, explained extreme reductions in pup production (Annex 4, paragraph 4.6);

(iii) the continued decline in population size and reduced reproductive performance of chinstrap penguins at Cape Shirreff, Livingston Island (Annex 4, paragraph 4.7);

(iv) an outbreak of avian cholera at Marion Island in November 2004 that killed about 2 000 macaroni penguins at one colony; other colonies and other seabird species were not affected (Annex 4, paragraph 4.12);

(v) a new approach to modelling krill growth using a large dataset of observed instantaneous growth rates and a temperature dependent model of inter-moult periods suggested that the mean length for age 6+ krill is 53 mm in the Indian Ocean sector and 57 mm in the Atlantic Ocean sector (Annex 4, paragraphs 4.19 to 4.22);

(vi) a study that summarised all available scientific net sampling involving krill in the Southern Ocean from 1926 to 2003 concluded that (Annex 4, paragraph 4.23):

   (a) the southwest Atlantic sector contains >50% of the krill in the Southern Ocean;

   (b) krill density in this sector has declined substantially since the 1970s;

   (c) during the summer, krill density is correlated spatially with chlorophyll concentrations;

(vii) preliminary results from a multi-disciplinary survey carried out in the Ross Sea that showed Antarctic krill occurred in the warmer waters north of the shelf slope while crystal krill occurred in the colder shelf waters (Annex 4, paragraphs 4.25 to 4.28).

Future surveys

3.8 The Scientific Committee endorsed the plans for the Australian BROKE-West acoustic krill biomass survey of Division 58.4.2 from January to March 2006. The Scientific Committee suggested using the new SDWBA TS (Annex 4, paragraphs 4.55 and 4.56) as well as measuring the necessary data to parameterise the TS model. The Scientific Committee welcomed the proposed comparisons with ships surveying in adjacent areas (Germany and Japan). It was recognised that the value of such comparisons would be maximised if coordinated and common protocols for equipment settings and calibrations could be agreed and used (Annex 4, paragraphs 4.68 and 4.69).

3.9 The CCAMLR-IPY-2008 Survey initiative received formal recognition by the IPY Joint Committee and was listed as EoI 148; it has become the 'lead project' for the topic 'Natural Resources, Antarctic'. A close link has also been established with CAML EoI 83, the lead project for 'Biodiversity', which also has a strong pelagic component (Annex 4, paragraphs 4.72 to 4.75). Details of the plans for further work are provided in paragraphs 13.33 to 13.43.

Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM)

3.10 SG-ASAM met in La Jolla, USA, from 31 May to 3 June 2005, to consider models of krill target strength and classification of volume backscattering strength.

3.11 The Scientific Committee recalled that although SG-ASAM was formed by the Scientific Committee, the subject matter of the first meeting was of particular importance to WG-EMM and therefore this year it had reported directly to that Working Group (Annex 4, paragraphs 4.39 to 4.60). The Scientific Committee agreed that the report of the first meeting of SG-ASAM should be appended to its report this year (Annex 6).

3.12 The Scientific Committee endorsed a change from the current empirical krill TS model towards the use of a 'theoretically-derived, empirically-validated' model and agreed that the most appropriate theoretical model for krill TS was currently the SDWBA model. The Scientific Committee therefore endorsed the WG-EMM recommendation that krill TS should be estimated using the SDWBA model and appropriate values of parameters in the model for surveys and, as appropriate, areas be applied as discussed in Annex 4, paragraphs 4.55 and 4.56.

3.13 The Scientific Committee recommended that measurement of the relevant parameter values be undertaken in all future surveys to minimise the uncertainty associated with the estimation of TS and that, where possible, parameters be estimated for past surveys and areas (Annex 4, paragraph 4.59).

3.14 In considering a request from Dr Siegel to develop a CEMP standard method for acoustic determination of krill biomass, the Scientific Committee recalled the existing recommendation for the CEMP standard method for the collection of acoustic data (SC-CAMLR-XX, Annex 4, paragraph 3.93). Furthermore, in welcoming the report of the first meeting of SG-ASAM, it encouraged Members conducting acoustic surveys for krill to follow the recommendations contained in the report.

3.15 The Scientific Committee considered the request of WG-FSA for advice on the conduct of acoustic surveys for *C. gunnari*. The plan and terms of reference for a second meeting of SG-ASAM are presented in paragraphs 13.27 to 13.31.

Workshop on Management Procedures

3.16 This was the fifth in a series of workshops held at the WG-EMM meeting designed to develop a revised management procedure for krill (Annex 4, section 2 and Appendix D). It was also the first in an anticipated future series with the intent of evaluating alternative management procedures. The specific intent of this workshop was to examine how well six candidate methods for subdividing the krill catch limit in Area 48 among SSMUs would meet the objectives of CCAMLR.

3.17 Performance measures were considered for krill, krill predators and the krill fishery. These included measures that described variability in krill spawning biomass, predator population sizes and rates of change, krill catch and fishing patterns. The intent was to use a model of the interactions between krill, their predators, and the fishery to generate frequency distributions of performance measures. These distributions would be wide or narrow depending on the uncertainty associated with assumptions about ecosystem structure and measures of critical parameters. Furthermore, performance measures could be used to evaluate trade-offs between alternative management procedures, as well as the risks associated with specific management decisions.

3.18 The workshop considered three models that were relevant to evaluating options and decided to focus its attention on the KPFM described in Annex 4, Appendix D, section 3. The KPFM was developed specifically to address the issue of subdividing the krill catch limit in Area 48. The model and its interfaces were relatively mature and contained tools for integrating across alternative ecosystem assumptions and parameter uncertainty. These tools allowed users to examine model diagnostics and compare performance measures.

3.19 The KPFM is spatially resolved to the level of SSMUs and surrounding oceanic areas, and it includes the transport of krill between these areas. Krill and predator population dynamics (of up to four predators in each SSMU, typically a generic seal, whale, penguin and fish) are implemented in a way that accommodates various assumptions about the recruitment and predation processes. Monte Carlo simulations are used to integrate the effects of numerical uncertainty. Routines are available to compare and merge results from multiple simulations helping to assess structural uncertainty. Although the model necessarily simplifies a complex system, it provides a flexible framework for investigating the roles of transport, production, predation and harvesting in the operation of the krill–predator–fishery system.

3.20 The workshop agreed that future work should continue to examine the sensitivity of performance measures to plausible ranges of model parameters and structural hypotheses (i.e. robustness to uncertainty). The Working Group agreed that at least three key aspects should be given further attention in the models and their implementation:

(i) incorporation of shorter time steps and/or seasonality
(ii) incorporation of alternative movement hypotheses
(iii) incorporation of a threshold krill density below which a fishery will not operate.

3.21 The Scientific Committee noted that a further year's work should allow the delivery of appropriate advice on the evaluation of options for the subdivision of the precautionary catch limit for krill in Area 48. The Scientific Committee also noted that the KPFM, with its extensive documentation, graphic outputs and diagnostics, had successfully engaged participants from a wide range of backgrounds, including those with and without modelling skills.

3.22 The Scientific Committee thanked the co-conveners of the workshop, the authors of the KPFM and all the contributors to the workshop who had succeeded in ensuring a high level of engagement and participation; furthermore the Scientific Committee recognised the need for this important work to continue, including the development and testing of the other two models presented at the workshop as well as additional models that might be produced, and looked forward to receiving advice from WG-EMM next year.

Status of management advice

3.23 The Scientific Committee agreed to transmit to the Commission approval of the recommendations for two ATCM management plans containing marine areas. These include the ASPA at Edmonson Point and a revised plan for the ASMA at Admiralty Bay (Annex 4, paragraph 5.5).

3.24 The Scientific Committee agreed that it was unable, at this time, to provide advice on the candidate options for subdividing the catch limit for krill in Area 48 amongst SSMUs. Nevertheless, it recognised the substantial progress in developing the tools and parameter sets required, and looked forward to receiving advice on a subdivision of the Area 48 catch limit in the near future (Annex 4, paragraph 5.18).

3.25 The Scientific Committee agreed that sufficient progress had been made with the KPFM development this year for it to believe that a further year's work should allow appropriate advice, based on runs with a revised version of the simulation model, to be provided to the Commission next year. The Scientific Committee also agreed that it would be valuable if results were also available from other models (Annex 4, paragraph 5.19).

3.26 In order to achieve monthly reporting of krill catch and effort at the resolution of SSMUs, WG-EMM recommended modification of paragraph 2 of Conservation Measure 23-06 to read:

> 'Catches shall be reported in accordance with the monthly catch and effort reporting system set out in Conservation Measure 23-03. When fishing in SSMUs in Area 48,

each Contracting Party shall report monthly catch and effort data by SSMU. When fishing in other areas, each Contracting Party shall report monthly catch and effort data by subarea/division.'

3.27 Dr Naganobu indicated that Conservation Measure 23-03 should be retained in its current form and that Japan was unwilling to submit monthly catches by SSMU.

3.28 Dr Naganobu suggested that, in order to allow the consideration of catches in each SSMU at an annual time scale, paragraph 3 of Conservation Measure 23-06 be modified to read:

> 'At the end of each fishing season each Contracting Party shall obtain from each vessel the haul-by-haul data required to complete the CCAMLR fine-scale catch and effort data form (trawl fisheries Form C1). It shall transmit those data in the specified format to the Executive Secretary not later than 1 April of the following year.'

3.29 The Scientific Committee recalled that while most Contracting Parties fishing for krill reported monthly catch and effort by subarea, some Parties reported monthly catch and effort by area only. As a result, it is not possible for the Secretariat to estimate catches by subarea or SSMU in the current season.

3.30 Furthermore, the Scientific Committee recognised that while the Commission had set catch limits for each subarea in Area 48 in Conservation Measure 51-01, there was no requirement in Conservation Measure 23-03 to report monthly catches at the subarea scale and hence there was no mechanism by which to determine if catch limits had been exceeded.

3.31 Dr Constable advised the Scientific Committee that the spatial and temporal scale at which data reporting was required from the krill fishery would determine the scales at which the fishery can be managed. For example, one of the options for allocating krill catches to SSMUs, based on the assessment of spatially explicit indices of krill availability that may be monitored or estimated on a regular basis, may not be possible if krill catches are not reported at the time for which the limit would apply. Such flexible catch arrangements require that the fishery be closed when the catch limit is reached in a given year in order to avoid over-runs that could impact on predators.

Future work of WG-EMM

Predator surveys

3.32 Following a review of the deliberations of the correspondence group on land-based predator surveys (Annex 4, paragraph 6.5), the Scientific Committee agreed that a workshop should be held to examine the utility of existing data for estimating predator abundance and associated uncertainty, to further develop estimation procedures and to identify any areas where data are absent or inadequate as priorities for future survey work. The Chair of the Scientific Committee agreed to write to SCAR informing them of the intention to hold such a workshop and to extend an invitation for SCAR representatives to attend.

3.33 The Scientific Committee recognised that one of the aims of the workshop would be to provide a much clearer definition of data requirements for its work with respect to estimates of abundance, with associated uncertainty, of land-based predators. Therefore the Scientific Committee agreed that, until these requirements are defined, no formal requests on the status and trends in marine mammal and seabird populations would be made to SCAR (see SC-CAMLR-XXIII, paragraphs 6.15 to 6.17).

3.34 The Scientific Committee drew the attention of the Commission to the potential delay that such a postponement in requesting new data from SCAR would have on the next review of the status and trends of predator populations. However, the Scientific Committee noted that such information on status and trends of some species is available from other specialist groups such as the Status and Trends group of ACAP.

3.35 The Scientific Committee agreed that the Antarctic Site Inventory (ASI) (WG-EMM-05/39) contained much information of great interest to CCAMLR, particularly with regard to counts of land-based predators and the Chair of the Scientific Committee agreed to communicate these findings to CEP at its next meeting (SC-CAMLR-XIII, paragraph 9.2(iii)).

Ecosystem models, assessments and approaches to management

3.36 In considering future work on ecosystem models, assessments and approaches to management, the Working Group noted that the main advances over the last year were in the development of operating models for evaluating management procedures. A future work program for further developing these models has been identified (Annex 4, paragraphs 6.13 to 6.19).

3.37 The Scientific Committee endorsed the establishment of a Subgroup on Development of Operating Models, according to the terms of reference in Annex 4, Appendix F, to facilitate the work program for further developing models identified in Annex 4, paragraphs 6.13 to 6.19. The Scientific Committee agreed that the primary initial function would be to establish a newsgroup as part of the subgroup with the assistance of the Secretariat (SC-CAMLR-XXIV/9). Dr Constable undertook to assist the Secretariat in establishing the newsgroup and facilitating subgroup discussion.

3.38 The Scientific Committee noted the development of Antarctic ecosystem models for providing management advice in CCAMLR and the IWC (Annex 4, paragraphs 6.33 to 6.37). This is considered further in paragraphs 13.44 to 13.53.

Long-term work plan

3.39 The Scientific Committee endorsed the long-term work plan of WG-EMM (Annex 4, paragraphs 6.38 to 6.49) and noted that the following three actions should have priority status:

(i) facilitate the continued evaluation of management procedures to allocate the precautionary krill catch limit in Area 48 among SSMUs (Annex 4, paragraphs 2.10 and 5.19);

(ii) consider revising estimates of B_0 and γ in all areas taking account of recent developments in estimating parameters used in assessments, thereby revising estimates of precautionary yield (Annex 4, paragraph 4.60);

(iii) develop SSMU-specific estimates of predator abundance and demand in Area 48 (Annex 4, paragraph 6.9).

3.40 The Scientific Committee agreed that a Second Workshop on Management Procedures, building on the work completed this year, should be held in 2006 and convened by Ms T. Akkers (South Africa) and Dr C. Reiss (USA) (Annex 4, paragraph 6.46).

3.41 The Scientific Committee agreed that provision of advice, should it be possible from work done at the Second Workshop on Management Procedures, would be consistent with CCAMLR's use of the best available scientific evidence. This does not preclude revisions in the future, as knowledge and methods improve (Annex 4, paragraph 6.43).

3.42 The Scientific Committee also agreed that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007 (Annex 4, paragraph 6.48).

Advice to the Commission

3.43 The Scientific Committee called to the attention of the Commission the following items arising from WG-EMM:

(i) Plans for the Australian BROKE-West acoustic krill biomass survey of Division 58.4.2 from January to March 2006 that will provide an updated estimate of B_0 for Division 58.4.2.

(ii) The CCAMLR-IPY-2008 Survey initiative has received formal recognition by the IPY Joint Committee and has become the 'lead project' for the topic 'Natural Resources, Antarctic'.

(iii) A change from the current empirical model towards the use of a 'theoretically-derived, empirically-validated' model for estimating krill target strength and that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007.

(iv) A second Workshop on Management Procedures is to be held in 2006 and convened by Ms Akkers and Dr Reiss and that this should provide appropriate advice on the evaluation of options for the subdivision of the precautionary catch limit for krill in Area 48.

(v) In order to allow the consideration of catches in each SSMU at an annual time-scale, paragraph 3 of Conservation Measure 23-06 should be modified to read:

'At the end of each fishing season each Contracting Party shall obtain from each vessel the haul-by-haul data required to complete the CCAMLR fine-scale catch and effort data form (trawl fisheries Form C1). It shall transmit those data in the specified format to the Executive Secretary not later than 1 April of the following year.'

(vi) While the Commission has set catch limits for each subarea in Area 48 in Conservation Measure 51-01, there is no requirement in Conservation Measure 23-03 to report catches at the subarea scale and hence there was no mechanism by which to determine if a catch limit had been exceeded (paragraph 3.30).

(vii) A proposed workshop to examine the existing data to provide abundance estimates and associated uncertainty of land-based predator populations would provide a definition of data requirements. Therefore, no formal requests for information on the status and trends of marine mammal and seabird populations would be made to SCAR at this time and such a postponement would delay the next review of the status and trends of predator populations (paragraphs 3.32 to 3.34).

(viii) The Scientific Committee also agreed that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007 (paragraph 3.42).

Marine Protected Areas

3.44 At CCAMLR-XXIII, the Commission urged the Scientific Committee to proceed with work addressing the topic of MPAs as a matter of priority and reaffirmed the need to develop advice consistent with Articles II and IX of the Convention (CCAMLR-XXIII, paragraph 4.13).

3.45 A Workshop on Marine Protected Areas, endorsed by the Scientific Committee and convened by Dr Penhale, was held from 29 August to 1 September 2005 at the NOAA National Marine Fisheries Service, Silver Spring, MD, USA.

3.46 The terms of reference for the workshop (SC-CAMLR-XXIII, paragraph 3.52) were:

(i) to review current principles and practices related to the establishment of Marine Protected Areas;

(ii) to discuss how the use of Marine Protected Areas could be used to contribute to furthering the objectives of CCAMLR;

(iii) to consider proposals that are currently under development or in a conceptual phase that relate to Marine Protected Areas in the Convention Area;

(iv) to discuss the types of scientific information that may be required for the development of Marine Protected Areas to further the objectives of CCAMLR, including the identification of biophysical regions across the Convention Area.

3.47 The Scientific Committee endorsed in full the report of the workshop (Annex 7), subject to comments below. It reviewed in detail the workshop's advice to the Scientific Committee, under each of the specific terms of reference.

3.48 The Scientific Committee regretted that the relatively short notice of the workshop had created difficulties for attendance of CCAMLR Members, especially those with particular logistic or financial constraints.

3.49 Nevertheless, it welcomed the very substantial progress made on this topic at the workshop and thanked the hosts, convener, steering committee and participants for the work that made this possible.

General

3.50 The Scientific Committee noted:

(i) that MPAs were considered in relation to a definition as 'any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment' (Annex 7, paragraph 1);

(ii) that the discussion on MPAs was facilitated by a series of excellent contributions by CCAMLR Members and invited experts. These papers focused on MPAs in the conceptual sense, as well as in practice, both worldwide and within the CCAMLR Convention Area;

(iii) specific commendation for the framework used to establish the Australian national representative system of MPAs, which underpinned the establishment in the Convention Area of the Heard Island and McDonald Islands Marine Reserve (Annex 7, paragraph 122).

Review of advice from MPA Workshop

ToR (i) to review current principles and practices related to the establishment of MPAs

3.51 The Scientific Committee endorsed the advice that:

(i) there was a need to develop a strategic approach to MPA design and implementation throughout the Southern Ocean, notably in relation to a system of protected areas (Annex 7, paragraph 124);

(ii) there was a strong need for collaboration at technical and policy levels to further develop the MPA concept in the Southern Ocean. Relevant bodies in such a dialogue would include key elements of the Antarctic Treaty System (ATS)

(CEP and the ATCM) as well as SCAR, SCOR, Observers to CCAMLR, intergovernmental organisations and non-governmental organisations (Annex 7, paragraph 124).

3.52 The Scientific Committee agreed that the primary aim is to establish a harmonised regime for the protection of the Antarctic marine environment across the ATS. This may require clarification of the roles and responsibilities of the ATCM and CCAMLR in respect of the management of different human activities in the region (Annex 7, paragraph 125).

ToR (ii) to discuss how MPAs could be used to contribute to furthering the objectives of CCAMLR

3.53 The Scientific Committee noted that:

(i) Article II establishes the basic objective of CCAMLR as the conservation of Antarctic marine living resources (where conservation includes rational use) and sets out the principles by which harvesting and associated activities shall be carried out (Annex 7, paragraph 28);

(ii) Article IX further specifies the ways to give effect to the objective and principles of Article II. This article relates particularly to the development and use of conservation measures, specifically including the opening and closing of areas, regions or sub-regions for purposes of scientific study or conservation, including special areas for protection and scientific study (Annex 7, paragraph 29).

3.54 The Scientific Committee endorsed advice that:

(i) MPAs had considerable potential for furthering CCAMLR's objectives in applications ranging from protection of ecosystem processes, habitats and biodiversity, and protection of species (including population and life history stages) (Annex 7, paragraph 126);

(ii) overall, when viewed in relation to the IUCN categories of protected areas, that the Convention Area as a whole would qualify as Category IV (Habitat/Species Management Area: protected area managed mainly for conservation through management intervention). This is defined as an area of land and/or sea, subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species (Annex 7, paragraph 127);

(iii) conservation outcomes appropriate for achieving the objectives of Article II would include the maintenance of biological diversity as well as the maintenance of ecosystem processes (Annex 7, paragraph 129).

(iv) attention may need to be given to the need for, *inter alia,* protection of:

(a) representative areas – a system of representative areas would aim to provide a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine systems, to maintain ecological processes and systems, and to protect the Antarctic marine biological diversity at all levels;

(b) scientific areas to assist with distinguishing between the effects of harvesting and other activities from natural ecosystem changes as well as providing opportunities for understanding the Antarctic marine ecosystem without interference;

(c) areas potentially vulnerable to impacts by human activities, to mitigate those impacts and/or ensure the sustainability of the rational use of marine living resources (Annex 7, paragraph 130);

(v) the process for establishing a system of protected areas will need to have regard for the objective of the Commission to achieve satisfactory fishery outcomes in terms of sustainable rational use (Annex 7, paragraph 132).

3.55 The Scientific Committee noted workshop views on the potential importance of making provision in protected area systems for the protection of spatially predictable features (such as upwellings and fronts) that are critical to the function of local ecosystems (Annex 7, paragraph 131).

3.56 Some Members expressed concern that such features and processes would need very careful definition in order to be relevant to, and applicable in, the approaches under consideration.

3.57 The Scientific Committee agreed to work toward developing a system of protected areas as set out in Annex 7, paragraphs 61 to 70, and summarised above. The general objectives for which protected areas may be established and the types of protection that could be given in accordance with Article IX are illustrated in Table 1. These types of areas could be applied anywhere within the Convention Area (Annex 7, paragraph 133).

3.58 The Scientific Committee noted that the terms used for these areas have meanings in other fora that differ from those used here. Further discussion is needed to consider the terms to be used for different types of protected areas (Annex 7, paragraph 135).

3.59 The Scientific Committee also noted that the ‘Fisheries Closed Areas’ are already considered by the Scientific Committee and Commission according to advice from working groups on individual fisheries.

ToR (iii) to consider proposals that are currently under development or in a conceptual phase that relate to MPAs in the Convention Area

3.60 The Scientific Committee noted that the workshop had received information on progress, relating to MPAs in the Convention Area currently under development or consideration, in respect of:

(i) Prince Edward Islands (WS-MPA-05/15)
(ii) Anvers Island, Antarctic Peninsula (WS-MPA-05/10)
(iii) Balleny Islands (WS-MPA-05/11, SC-CAMLR-XXIV/BG/25).

It noted the extensive discussion in respect of these topics (Annex 7, paragraphs 72 to 89 and 93 to 106).

3.61 Mr Pshenichnov informed the Scientific Committee that Ukraine is initiating research designed to identify the potential scope and extent of an MPA in the Argentine Islands (Antarctic Peninsula) (CCAMLR-XXIV/BG/19).

3.62 The Scientific Committee noted advice concerning elaboration of ATCM Decision 9 (2005) relating to guidelines for determining if an MPA will be of interest to CCAMLR (Annex 7, paragraphs 136 and 137).

3.63 It agreed that two approaches might assist in this:

(i) to request WG-EMM and WG-FSA to develop guidelines to indicate what percentage of the range of a known harvestable resource could be covered by protected areas within a statistical unit before CCAMLR would need to determine if a proposed protected area might impact on rational use;

(ii) to request each Member of CCAMLR to indicate which of the recent proposals from ATCM concerning protected areas with marine components should, in retrospect, have been required to be submitted to CCAMLR according to the criteria in ATCM Decision 9 (2005).

ToR (iv) to discuss the types of scientific information that may be required for the development of MPAs to further the objectives of CCAMLR, including the identification of biophysical regions across the Convention Area

3.64 The Scientific Committee endorsed advice that:

(i) key tasks needed to consider a system of protected areas to assist CCAMLR in achieving its broader conservation objectives are:

(a) a broad-scale bioregionalisation of the Southern Ocean;

(b) a fine-scale subdivision of biogeographic provinces, which may include hierarchies of spatial characteristics and features within regions, giving particular attention to areas identified in the bioregionalisation;

(c) identification of areas that might be used to achieve the conservation objectives;

(d) determination of areas requiring interim protection;

(ii) these tasks should involve an initial desktop study;

(iii) the types of data listed in Annex 7, Table 2, are those appropriate for this process (Annex 7, paragraphs 138 and 139).

3.65 The Scientific Committee endorsed the need for this process to be implemented:

(i) via a work program comprising the elements specified in Annex 7, paragraph 107 and in paragraph 3.66(3) below;

(ii) complemented by a workshop to advise on a bioregionalisation of the Southern Ocean, including, where possible, advice on smaller-scale delineation of provinces and potential areas for protection to further the conservation objectives of CCAMLR;

(iii) by establishing a Steering Committee, including members of the Scientific Committee and CEP. An important role of the Steering Committee will be to involve appropriate experts from outside the Scientific Committee and CEP with appropriate data or expertise (Annex 7, paragraphs 141 and 142).

3.66 The Scientific Committee endorsed the following terms of reference for the Steering Committee:

1. To facilitate collaboration between the CCAMLR Scientific Committee and CEP in this work.

2. To facilitate the involvement of appropriate experts in this work.

3. To coordinate and facilitate:

   (i) collating existing data on coastal provinces, including benthic and pelagic features and processes;

   (ii) collating existing data on oceanic provinces, including benthic and pelagic features and processes;

   (iii) determining the analyses required to facilitate a bioregionalisation, including the use of empirical, model and expert data;

   (iv) developing a broad-scale bioregionalisation based on existing datasets and other datasets possibly available prior to the workshop;

   (v) delineating fine-scale provinces within regions, where possible;

   (vi) establishing a procedure for identifying areas for protection to further the conservation objectives of CCAMLR.

4. To organise a workshop to establish a bioregionalisation for the CCAMLR Convention Area and to consolidate advice on a system of protected areas (Annex 7, paragraph 144).

3.67 It also endorsed the suggestion that CEP be invited to undertake the initial work necessary to develop a bioregionalisation of the coastal provinces, as an extension of its terrestrial bioregionalisation work, while the Scientific Committee undertakes the initial work needed to delineate the oceanic provinces. Such work would involve examination of both the benthic and pelagic systems in the respective areas (Annex 7, paragraph 143).

3.68 Notwithstanding this general agreement, Dr K. Shust (Russia) suggested that caution should be exercised in inviting outside experts and groups to attend CCAMLR workshops on this topic, believing that it would be more appropriate for these to be involved only in the intersessional correspondence and preparations for workshops and meetings.

3.69 Overall, the Scientific Committee recognised that the process summarised in paragraphs 3.64 to 3.67 has important implications in respect of budget, timetable, procedures and management.

3.70 It noted the advice of the MPA Workshop that the next workshop should be held in 2008 (Annex 7, paragraph 117). However, several Members felt that it was essential to make more rapid progress on such an important issue.

3.71 The Scientific Committee agreed that the workshop would be held independently from the working group meetings and a report provided directly to the Scientific Committee. It also agreed that the work of the Steering Committee be afforded a high priority. The Scientific Committee advised that, should the Steering Committee require preparatory meetings, it would be best for these meetings to occur in conjunction with other meetings that members of the Steering Committee may be attending, such as the meetings of the Scientific Committee or its working groups.

3.72 The Chair of the Scientific Committee was requested to consult with the Convener of the Subgroup on Protected Areas, and others as appropriate, to develop suggestions for membership of a Steering Committee and to circulate these to the Scientific Committee for approval. The Chair of the Scientific Committee was also requested to invite CEP to participate in the work of the Steering Committee and for it to nominate appropriate members.

3.73 The Commission was requested to endorse the work program, workshop and Steering Committee terms of reference outlined above. Advice was also requested on the priority (including timing) to be accorded to these undertakings (and specifically to the proposed workshop).

Interactions between WG-FSA and WG-EMM

3.74 The Scientific Committee considered the ecological interactions arising with respect to fisheries and considered papers that addressed fish by-catch in the krill fishery (Annex 4, paragraph 3.13), the fish diet of Antarctic shags (Casaux and Barrera-Oro, 2005), benthos by-catch from the trawl survey (Annex 5, paragraph 3.32), and cetacean–fisheries interactions (Kock et al., 2005) (Annex 5, Appendix R).

3.75 With respect to the possible link of a decline of certain prey species and their predators, Antarctic shags and South Georgia shags (Annex 5, Appendix R, paragraph 8), Dr E. Barrera-Oro (Argentina) further elaborated that:

(i) the monitoring of the status of these shag species in the South Shetland and South Orkney Islands started in the mid-1990s, well after the depletion of two of their main inshore fish prey species, *Notothenia rossii* and *Gobionotothen gibberifrons*. The shags' declining trend could have started earlier, closer in time to the fishery-induced decline of some of their prey species;

(ii) although almost 25 years have passed since fishing has impacted on some fish stocks, and 15 years have passed since the closure of Subareas 48.1 and 48.2 for finfishing, a recovery of the inshore populations of the mentioned fish species has not been observed;

(iii) a decrease in colony size has recently been reported for the sub-Antarctic Crozet shags at Marion Island, as being caused by an altered availability of food, which was reflected by a changed dominance in nototheniid prey in the diet (Crawford et al., 2003).

3.76 Dr Barrera-Oro added that some of these interactions may constitute cases of the potential impact of the commercial fishery on ecological interactions of components of the Antarctic ecosystem, which need to be monitored.

3.77 The Scientific Committee suggested that a system to quantify the interactions between marine mammals and the longline fishery in a systematic fashion be developed in the intersessional period. This should include direct observations of fish being removed from the line and indirect observations of depredated fish, lost hooks and broken gear, as well as systematic reporting of the presence of killer whales and sperm whales.

Dependent species and ecosystem considerations

3.78 The Scientific Committee considered the broader ecosystem approach to fisheries and in particular consideration of the effects of fisheries on non-target species, through both direct effects, such as incidental mortality, and through trophodynamic changes brought about by fishing. With respect to the ecosystem approach, the Scientific Committee considered that the management of fisheries as two complementary components would be useful:

(i) firstly, the setting of catch limits for the target species in a fishery
(ii) secondly, the implementation and conduct of that fishery.

3.79 The Scientific Committee agreed that CCAMLR had made progress on both of these components, including implementing the precautionary approach for assessing catch limits. However, beyond adopting escapement levels that endeavour to take account of dependent species, there are currently no adopted tools or assessment procedures used by the Scientific Committee to advise on catch limits according to the requirements of predators on small or large scales. Nor are there adopted tools and assessment procedures for assessing the impacts of existing harvest strategies on dependent species.

3.80 The Scientific Committee encouraged Members to participate in the work of the Subgroup on the Development of Operating Models (paragraphs 3.36 to 3.38) and for the conveners of WG-EMM and WG-FSA to work with the subgroup to provide opportunities for the development of models for use by both working groups.

HARVESTED SPECIES

Krill resources

2003/04 season

4.1 The krill harvest during the 2003/04 fishing season was 118 116 tonnes (Table 2). Most of the catch was taken within three of the 15 SSMUs (north of Livingston Island, west of Coronation Island and northeast of South Georgia).

2004/05 season

4.2 The catch for the 2004/05 fishing season reported to the Secretariat by September 2005 was 124 535 tonnes (Table 3) and had already exceeded the level of the previous season's catch (SC-CAMLR-XXIV/BG/1). For comparison, the catch reported to September 2004 at CCAMLR-XXIII was 102 202 tonnes, some 16 000 tonnes less than the finalised total for the 2003/04 season.

4.3 The relative contributions to the total catch by Members have also changed, with the catch reported by Japan and Poland declining to approximately 40% of their previous levels, and recent increases in the catch reported by the Republic of Korea and Vanuatu (Table 4).

2005/06 season

4.4 Notifications of intention to harvest krill in the 2005/06 fishing season were submitted by Russia (15 000 tonnes), Japan (25 000 tonnes), the Republic of Korea (25 000 tonnes), Ukraine (30 000 tonnes), USA (50 000 tonnes) and Norway (100 000 tonnes), for a total of 245 000 tonnes (WG-EMM-05/6). Norway further indicated that the Vanuatu-flagged vessel *Atlantic Navigator* had ceased fishing for krill in August 2005. The commercial operator had replaced this vessel by the Norwegian-flagged vessel *Saga Sea*, which will begin fishing in December under the Norwegian notification. Members pointed out that this fishing operation was based on production of krill for industrial purposes and that the economics of such a fishery were uncertain.

4.5 The Scientific Committee noted the utility of the notification procedure for krill fisheries which has been operating for the last two seasons and encouraged Members to continue to submit these notifications, pointing out that the time series of such information will be extremely valuable in discerning trends in the fishery.

Changes in the pattern of the krill fishery

4.6 An analysis of historical catches indicated that only five out of 15 SSMUs in Area 48 contributed substantially to the total krill catch (Annex 4, paragraphs 3.28 to 3.31). A shift in operations was noted in SSMUs at the South Shetland Islands, where fishing has shifted from the December–February period to fishing in March–May. In the vicinity of the South Orkney

Islands the fishery has continued in the March–May period and at South Georgia the timing of operations has also remained relatively constant (June–August). This change in the season of the fishery may mean that the level of observer coverage (mainly in winter) may not be sufficient to understand the behaviour of the fishery or issues such as the by-catch of larval fish.

Catch reporting

4.7 The Scientific Committee noted that the Secretariat had produced a Fishery Report for Krill for WG-EMM (Annex 4, paragraphs 3.28 and 3.29) and recommended that such a report should be produced annually, similar to that for finfish fisheries in the Convention Area. This would move the krill fishery into a more analytical framework and would start to bring it into line with the other fisheries.

New technology

4.8 Uruguayan observers described a continuous fishing system used on board the *Atlantic Navigator*, where krill are pumped from the codend of a pelagic trawl without recovering the gear (Annex 4, paragraphs 3.23 to 3.28). The Scientific Committee agreed that this new technology would not be considered a ‘new and exploratory fishery’ if there is an adequate description of the selectivity of the method for krill, a characterisation of the haul (or catch rate) and information on the location of krill catches. In particular, because haul duration can extend for several days, there existed the potential for single hauls to occur in several different SSMUS. The Secretariat needs to revise the format for reporting data to accommodate the information arising from the new fishing method.

4.9 There might be considerable potential for this type of fishing gear to impact other elements of the ecosystem either through by-catch, particularly of larval fish, or through incidental mortality of either immature krill or other small pelagic species. Taking into account that the new krill fishing technology during the 2005/06 season will be used by the vessel bearing the Norwegian flag, the Scientific Committee recommended that such aspects be the subject of urgent study and urged Norway to provide a report for WG-EMM in 2006 on the operation of this type of technology and on its ecological impacts so that it can be adequately described.

4.10 The utility of scientific observers’ reports in helping to characterise this new approach to krill fishing was noted. Norway was asked by the Scientific Committee to take on board the vessel, the scientific observer designated in accordance with the CCAMLR scheme. It was also pointed out that the technology was such that sampling of the catch was possible, and the use of observers allowed the assessment of the ecosystem impact of this type of operation. The use of the fisheries questionnaire in understanding the behaviour of this fishery was highlighted.

Advice to the Commission

4.11 The krill fishery is changing in its pattern of operation, in respect of the nations involved, in the composition of its products and in the harvesting technology being used. There may also be evidence of gradual increases in overall catch levels. These developments will require changes in the type of data and reporting formats required from the fishery and in the level of observer coverage (paragraph 4.8).

Fish resources

Fishery Reports

4.12 The Scientific Committee noted that WG-FSA had continued the restructuring of its report as requested. Discussion of the report structure is given in Annex 5, paragraphs 2.4 to 2.7. In the 2005 report, WG-FSA had produced six subgroup reports as appendices to the main report and also eight Fishery Reports which describe the stock assessments for the assessed fisheries. The Scientific Committee agreed that Fishery Reports are very useful as stand-alone reports, with management advice and key supporting paragraphs included in the main body of the WG-FSA report.

4.13 The Scientific Committee discussed the large size of the 2005 report of WG-FSA and endorsed a recommendation that the Fishery Reports should be published in a separate electronic volume, and that these reports would be consistent and modified each year as new data becomes available.

4.14 Dr Shust noted that the current Fishery Reports are unbalanced, with some fisheries and species given considerably more attention than others. He recommended that each Fishery Report should be brief and limited to no more than 15 pages.

4.15 Other Members felt that although a brief Fishery Report is very desirable, it should not have a restricted size limit. The lengthy nature of the current report was required to adequately document the considerable amount of work completed by WG-FSA.

Data requirements

4.16 The Scientific Committee discussed the new trial electronic version of CCAMLR's *Statistical Bulletin* (eSB). The eSB allows users to replicate the six sections published in the hard copy of the bulletin, as well as access the complete dataset of statistics which are used to summarise data, generate tables and graphics, and extract selected data. The Scientific Committee thanked the Secretariat for developing the eSB. Also considered was the revision of CCAMLR databases and data checking routines, development of tagging and ageing databases, and receiving and processing fishery and observer data in time for the meeting.

4.17 The Scientific Committee endorsed the proposal for the Secretariat to develop a manual, which can be updated each year, that specifies its procedures and equations, where appropriate, for the extraction and mathematical manipulation of data, and to make this reference information available at the start of future meetings of WG-FSA.

4.18 The Scientific Committee noted the comments of WG-FSA on the publication of aggregated fine-scale data in the *Statistical Bulletin* (paragraphs 12.24 to 12.27).

Status and trends

Fishing activity in the 2004/05 season

4.19 Twelve finfish fisheries, including seven exploratory fisheries, were conducted under the conservation measures in force in 2004/05. These included fisheries for *D. eleginoides* and *C. gunnari* in Subareas 48.3 and Division 58.5.2, and exploratory fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1, 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b. Other managed longline fisheries for *D. eleginoides* occurred in Subarea 48.4, and in the EEZs of South Africa (Subareas 58.6 and 58.7) and France (Subarea 58.6 and Division 58.5.1).

4.20 The Scientific Committee noted that catches of target species by region and gear reported from fisheries conducted in the CCAMLR Convention Area in the 2004/05 fishing season are summarised in Annex 5, Table 3.1. These had been updated to 21 September 2005 and reported in SC-CAMLR-XXIV/BG/1. The Scientific Committee noted that the Secretariat had also provided updates of the catch-weighted length frequencies (Annex 5, paragraph 3.18), catch histories of target and managed by-catch species (Annex 5, paragraph 3.21), and general maps of fishing locations (Annex 5, paragraph 3.17).

4.21 The Scientific Committee noted that catch, effort and length data were submitted for all fisheries managed under conservation measures, and that data were also submitted from fisheries operating in EEZs, albeit not all in the standard CCAMLR format.

Reported catches of *Dissostichus* spp. inside the Convention Area

4.22 Reported catches of *Dissostichus* spp. are shown in Annex 5, Table 3.1. Inside the Convention Area a total of 14 074 tonnes was reported during the 2004/05 season (Annex 5, Table 3.3) compared with 15 877 tonnes in the previous season (Annex 5, Table 3.3).

Reported catches of *Dissostichus* spp. outside the Convention Area

4.23 Catches outside the Convention Area were 8 511 tonnes during the 2004/05 season compared with 15 806 tonnes in the previous season. This information is detailed in Annex 5, Table 3.3. The Scientific Committee additionally noted that the catch of *Dissostichus* spp. outside the Convention Area, as reported in the CDS data, in 2004/05 was 4 465 and 3 873 tonnes for Areas 41 and 87 respectively, compared to 8 411 and 5 828 tonnes respectively for 2003/04.

Estimates of catch and effort from IUU fishing inside the Convention Area

4.24 The Scientific Committee reviewed estimates of IUU catches in the Convention Area prepared by the Secretariat and based on information submitted by 1 October 2005. The deterministic method presently used by the Secretariat to estimate IUU fishing effort was the same method as used in previous years. These results are set out in Annex 5, Tables 3.1 to 3.3 (paragraphs 7.4 to 7.8).

Research surveys

4.25 The Scientific Committee noted the following research surveys undertaken in 2004/05: a random stratified bottom trawl survey in Division 58.5.2 by Australia (Annex 5, paragraph 3.29), the results of which were toward updating assessments of toothfish and icefish in this division; a longline research survey in Subarea 88.3 carried out by New Zealand (Annex 5, paragraph 3.30); and a multidisciplinary research survey in Subarea 48.3 carried out by the UK (Annex 5, paragraphs 3.31 and 3.32).

Fish biology/ecology/demography

Tagging studies

4.26 The Scientific Committee noted that substantial progress has been made in fish tagging studies, and that information from these studies is becoming an increasingly important component of toothfish stock assessments in the Convention Area.

4.27 The Scientific Committee endorsed the continuation of toothfish tagging as a requirement for all new and exploratory toothfish fisheries (Conservation Measure 41-01, Annex C), and encouraged its use in all fisheries where appropriate.

4.28 Mr L. López Abellán (Spain) informed the Scientific Committee that due to lower survival, problems were encountered with the release of tagged large-size toothfish in the Division 58.4.3b exploratory fisheries (Annex 5, paragraph 3.41). The Scientific Committee requested that more information be made available as to the nature of the difficulties.

4.29 The Scientific Committee agreed that tagging studies may lead to the development of assessments for by-catch species such as skates and rays, given some of the difficulties and issues unique to tagging these species are resolved.

Biological parameters

4.30 The Scientific Committee noted new information on biological parameters (Annex 5, paragraphs 3.44 to 3.52), including a summary of biological parameters for *D. eleginoides* in Subarea 48.3; age and growth parameters for *Macrourus whitsoni* in Subarea 88.1; a summary of age and growth parameters for *C. gunnari*; a range of length–mass relationships for

D. mawsoni in Subarea 88.1; age validation of *D. eleginoides* in Division 58.5.2; age-at-maturity of *D. mawsoni* in Subarea 88.1; and estimates of growth and selectivity of *D. eleginoides* in Division 58.5.2. The Scientific Committee encouraged continued work on population parameters important for the assessment process.

General biology and ecology

4.31 The Scientific Committee noted that species profiles have not been updated since 2003. Species profiles will be updated for consideration at the 2006 meeting of WG-FSA (Annex 5, paragraph 9.4).

4.32 The Scientific Committee endorsed the recommendations of WG-FSA in matters relevant to the CCAMLR Otolith Network set out in Annex 5, paragraphs 9.5 to 9.9.

4.33 The Scientific Committee endorsed the proposed workshop on the ageing of *C. gunnari*, as described in Annex 5, paragraphs 9.10 and 9.11. Following the meeting of WG-FSA and after further discussion with the Vice-Director of AtlantNIRO (Dr Sushin) on the organisation of the workshop, the Convener of WG-FSA will write a letter to the Russian Fisheries Agency in order to seek approval to hold such a workshop at AtlantNIRO in Kaliningrad, Russia, between early April and the end of June 2006.

Developments in assessment methods

4.34 The Scientific Committee noted the substantial progress made on assessment methods by WG-FSA-SAM at its intersessional meeting held at the National Research Institute of Fisheries Science, Yokohama, Japan, from 27 June to 1 July 2005. Results of this subgroup meeting are summarised in Annex 5, paragraphs 4.1 to 4.11. The Scientific Committee noted that WG-FSA had tasked future work priorities for WG-FSA-SAM, and endorsed the recommendations for the development and evaluation of assessment methods as set out in Annex 5, paragraph 12.24. The Scientific Committee further noted the conclusion of WG-FSA-SAM that the participation of an invited outside assessment method expert (Dr Maunder) was valuable to the work of WG-FSA-SAM.

4.35 WG-FSA-SAM discussed at its intersessional meeting a number of elements contributing to assessment methods. These were noted by the Scientific Committee. The papers dealt with a wide range of issues, many of which are considered in the assessment sections of the Fishery Reports. Refinements to parameter estimates for use during the course of the assessments, including recommendations pertaining to natural mortality, recruitment, selectivity, age and growth, and movement. The Scientific Committee endorsed further evaluation of assessment methods using operating models in the intersessional period.

4.36 The Scientific Committee thanked participants of WG-FSA-SAM for their effort and considerable progress made towards advancing methods for the assessment of toothfish stocks.

4.37 The Scientific Committee noted that members of the assessment subgroup of WG-FSA met during the week prior to WG-FSA, and that a number of papers with elements contributing to assessment methods were tabled (summarised in Annex 5, paragraphs 4.18 to 4.35). Six papers provided preliminary stock assessments for active fisheries in the Convention Area. Some of these assessments involved existing 'CCAMLR approved' methods (i.e. short-term projection for icefish and recruitment-based long-term yield for toothfish), whilst others used alternative approaches (e.g. CASAL and ASPM).

4.38 The points concerning the assessment timetable this year were noted by the Scientific Committee. These are set out in Annex 5, paragraphs 4.36 to 4.39. The Scientific Committee endorsed the evaluation of assessment methods, which include:

(i) the validation of the implementing software, scripts or worksheets
(ii) examination of the methods to see that the assumptions are met
(iii) sensitivity trials to examine the robustness of consequent advice with respect to CCAMLR objectives.

4.39 The Scientific Committee noted that all the assessments undertaken by WG-FSA this year were initially based on preliminary assessment working papers that were subsequently reviewed independently by WG-FSA.

4.40 The Scientific Committee endorsed the recommendation that integrated assessments continue to be developed for toothfish fisheries in Subareas 48.3, 58.6, 58.7, 88.1 and 88.2 and Division 58.5.2 where possible.

Assessment and management advice

Assessed fisheries

4.41 The Scientific Committee welcomed the continued development of Fishery Reports and Summary of Fishery Reports compiled by WG-FSA. Fishery Reports that have been revised or developed as a result of analyses and deliberations during the course of WG-FSA are:

(i) Subarea 48.3: toothfish and icefish
(ii) Division 58.5.1: toothfish
(iii) Division 58.5.2: toothfish and icefish
(iv) Subareas 58.6 and 58.7: toothfish (South African EEZ)
(v) Subarea 58.6: toothfish (French EEZ)
(vi) Subareas 88.1 and 88.2: toothfish.

The Fishery Reports have been published in electronic format only and are available from the 'Publication' section of the CCAMLR website (www.ccamlr.org).

D. eleginoides at South Georgia (Subarea 48.3)

4.42 The fishery report for *D. eleginoides* in Subarea 48.3 is contained in Annex 5, Appendix G.

4.43 In 2004, Subarea 48.3 was subdivided into areas, one containing the South Georgia–Shag Rocks (SGSR) stock and other areas, to the north and west, that do not include the SGSR stock. Within the SGSR area, three management areas (A, B and C) were defined (Conservation Measure 41-02/A). Catch limits for the areas to the north and west were set at zero for 2004/05.

4.44 The catch limits in the 2004/05 season for Areas A, B and C were 0 (excepting 10 tonnes for research fishing), 915 and 2 135 tonnes, with an overall catch for SGSR of 3 050 tonnes. The total declared catch was 3 018 tonnes. An additional 23 tonnes were taken by a single IUU vessel reported by the UK prior to the fishery. The total removals were therefore 3 041 tonnes. Catches in Areas A, B and C were 9, 910 and 2 122 tonnes respectively. The proportion of catches in Areas A and B declined from 35% in 2003/04 to 30% in 2004/05.

4.45 The updated standardised GLMM CPUE dropped slightly between 2003/04 and 2004/05. Separate GLMM analyses of CPUE data for Shag Rocks and South Georgia confirmed a relatively constant CPUE at South Georgia in recent years compared with some variability at Shag Rocks.

4.46 During 2004/05, a further 3 944 tagged *Dissostichus* were released in SGSR, bringing the total number of tagged fish released to around 8 000 fish. Ninety-three recaptures of tagged fish were reported in 2005. Estimates of vulnerable biomass for 2005 using the modified Petersen estimator were between 53 000 and 54 000 tonnes, with 95% confidence intervals of approximately 44 000–63 000 tonnes, depending on the selectivity curve used in the analysis.

4.47 The Scientific Committee considered two separate assessments which used different modelling strategies provided in the Fishery Report. The first was an integrated assessment, implemented in CASAL, that used data on catches, standardised catch rates, catches-at-length, recruitment indices-at-age and tag–recapture data. The base case involved two fleets with separate estimated selectivity curves and separate catchability estimates for each time series of catch rates. The second assessment used an augmented ASPM, implemented in an Excel spreadsheet, which used data on catches, standardised catch rates and catches-at-length. The ASPM base case involved a single fleet with two periods of different selectivity (estimated outside the model) and a single catchability estimate across the catch rate time series plus estimation of the steepness of the recruitment relationship.

4.48 The Scientific Committee noted that although the underlying basic age-structured population dynamics models assumed in CASAL and ASPM were similar, there were considerable differences in assumptions and implementation of the two methods. The primary differences are set out in the table following paragraph 5.71 in Annex 5. The Scientific Committee agreed that differences in assessment results between the two methods could reasonably be attributed to differences in assumptions and input data, rather than fundamental differences in the assessment methods.

4.49 The Scientific Committee examined separate assessment runs that were identified by WG-FSA, set out in Annex 5, paragraphs 5.72 and 5.73, for CASAL and ASPM respectively. A full description of the models, their assumptions, their diagnostics, their fits to the data, and their results is given in Annex 5, Appendix G.

4.50 Prof. Beddington commented that information that would better allow the Scientific Committee to more critically assess the model performance was not carried forward to the assessment summary in the main body of the report. Dr Constable noted that the main body of the report directs the Scientific Committee to the detailed model description and discussions set out in Annex 5, Appendix G.

4.51 Dr Hanchet commented that although both assessment approaches were endorsed for use by WG-FSA-SAM, there was no critical discussion of the ASPM during the course of the assessment subgroup pre-meeting. Further, that on the final day of deliberations by WG-FSA, the Executive Secretary of CCAMLR reminded the Working Group that the report risked not being translated in time for the meeting of the Scientific Committee unless completed immediately, which may have curtailed additional discussions and resolution by WG-FSA.

4.52 The Scientific Committee recognised that considerable progress had been made in addressing these issues surrounding the assessment of toothfish in Subarea 48.3.

4.53 The Scientific Committee acknowledged that the divergence of opinions on modelling approaches from WG-FSA resulted in no single estimate of precautionary long-term yield under existing CCAMLR decision rules. The contrasting opinions are summarised in Annex 5, paragraphs 5.79 and 5.80.

4.54 The Scientific Committee agreed that the discussions and results provided in the fishery report were potentially useful for generating advice. The five projections of yield are set out in Annex 5, paragraph 5.76. In respect of the CASAL results, the MCMC projections of yield are as follows:

(i) base case 5 629 tonnes
(ii) low L_∞ 3 407 tonnes
(iii) low *M* 5 876 tonnes
(iv) one fleet 5 428 tonnes.

In respect of the ASPM run, the GY projections of yield are as follows:

(v) base case 696 tonnes.

4.55 The Scientific Committee agreed that these assessments represented a considerable amount of work, though there is substantially more that must be done to advance assessments in order to generate advice for a specific catch limit for *D. eleginoides* in Subarea 48.3. In addition, the Scientific Committee agreed that this assessment, as well as all other assessments of CCAMLR finfish stocks, represents work in progress.

4.56 The Scientific Committee agreed that some uncertainties remain with each approach, and that there were differences in the opinion of which model demonstrated a better fit to the available data, given the complexity of the models and assumptions. However, there was consensus that the ASPM was likely providing an underestimation of the current spawning stock biomass and a consequent underestimation of long-term yield.

4.57 The Scientific Committee further agreed that there were ample reasons that the tagging data should be included in the assessment process, and that use of these data would be more desirable than excluding them for the purposes of generating advice, together with all relevant information currently used.

4.58 Dr Shust pointed out the fits of the CASAL and ASPM models to the CPUE time series in recent years (Annex 5, paragraph 5.79). The CPUE since 1996 has been relatively stable but at a lower level than previous years. This demonstrates that the catch limit for *D. eleginoides* in Subarea 48.3 in the next season should follow a precautionary approach.

Management advice for *D. eleginoides* (Subarea 48.3)

4.59 The Scientific Committee agreed that the management advice should be based on the assessment approach that used the growth model indicating low L_∞ (Annex 5, Appendix G, Figure 10). Using this would be more desirable in this particular assessment, as it makes use of all the available data. However, the Scientific Committee agreed that it would have been desirable to examine a case with a low *M* coupled with the low L_∞.

4.60 The Scientific Committee agreed that the most appropriate approach for generating advice should be the method that uses tagging data (CASAL) employing the low L_∞ projection adjusted by the ratio of the low *M* and base case projections. This would result in a long-term yield of approximately [3407 * 5876/5629 =] 3 556 tonnes.

4.61 The Scientific Committee recommended that the catch limit for the 2005/06 season should be 3 556 tonnes.

4.62 The remaining provisions of Conservation Measure 41-02 should be carried forward for the 2005/06 season.

Future work for *D. eleginoides* (Subarea 48.3)

4.63 The Scientific Committee endorsed the future work to be conducted towards furthering assessments of toothfish in Subarea 48.3. This work is outlined in Annex 5, paragraph 12.3. The Scientific Committee agreed that further work should be undertaken during the intersessional period examining alternate scenarios for the integrated models used to generate management advice in this subarea.

D. eleginoides at Kerguelen Islands (Division 58.5.1)

4.64 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Annex 5, Appendix H. The catch reported for this division as of 1 September 2005 was 3 186 tonnes. Only longlining occurs in the fishery. The estimated IUU catch for the 2004/05 season was zero inside the French EEZ. Some IUU fishing may occur outside the EEZ as reported in SCIC-05/10 Rev. 2.

4.65 The Scientific Committee noted that GLM analyses show a general decreasing trend in the standardised CPUE with two steps (i.e. 1999–2000 and 2002–2005). Mean weight declined from 1999 to 2003, but has been stable since then. No stock assessment has been carried out.

4.66 By-catch removals are important for this toothfish fishery (longline) and the majority of the catch is processed but no stock assessment is available for evaluation of the impact on affected populations.

Management advice for *D. eleginoides* (Division 58.5.1)

4.67 The Scientific Committee encouraged WG-FSA to further work towards the estimation of biological parameters for toothfish at the Kerguelen Islands. The Scientific Committee also noted that a preliminary stock assessment could be carried out if CPUE, catch-weighted length frequencies and biological parameters were available. The Scientific Committee agreed that tag–recapture experiments and a recruitment survey planned for 2006 would be very beneficial for an assessment of toothfish stocks on the Kerguelen Plateau.

4.68 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 remain in force.

D. eleginoides at Heard and McDonald Islands (Division 58.5.2)

4.69 The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E for the 2004/05 season was 2 787 tonnes (Conservation Measure 41-08) for the period from 1 December 2004 to 30 November 2005. The catch reported for this division as of 1 October 2005 was 2 783 tonnes. Of this, 2 170 tonnes (78%) was taken by trawl and the remainder by longline. The estimated IUU catch for the 2004/05 season, 0–265 tonnes, was the lowest since IUU fishing began in 1995/96.

4.70 The Scientific Committee noted the reduction in the overall catch taken by bottom trawls from this fishery.

4.71 The Scientific Committee also noted that the use of longlines and pots in this fishery will result in the taking of larger fish because of their selectivity and because they will be operating in deeper water than the trawl fishery. Consequently, the overall vulnerability of the stock in future years is likely to include a greater proportion of larger fish than is currently the case in the trawl fishery. A vulnerability pattern that combines trawl, longline and pots was calculated for use in the assessments.

4.72 The GYM, using the updated time series of recruitment estimates and the updated length-at-age vector, was used to estimate the long-term annual yield that would satisfy the CCAMLR decision rules (Annex 5, paragraphs 5.91 to 5.96).

4.73 Three main model runs were carried out based on the parameters considered for the assessment and including the 2005 survey of juvenile fish and the revised length-at-age vector from the two-segmented linear model:

(i) $M = 0.13–0.20$ year^{-1}, trawl vulnerability in future projections — 2 303 tonnes

(ii) $M = 0.13–0.20$ year^{-1}, combined gear (trawl, longline, pot) vulnerability in future projections — 2 439 tonnes

(iii) $M = 0.13–0.165$ year^{-1}, trawl vulnerability in future projections. — 2 440 tonnes

Each of these was undertaken with IUU catch in the 2004/05 season at 265 tonnes.

4.74 The Scientific Committee discussed these alternative model runs and agreed that the overall selectivity of the fishery had changed with the increase in mainly longline and pot fishing rather than trawl fishing. Therefore it supported the second model option above. However, they considered the natural mortality values used in this run were too high based on the validated age data and corrected the GYM yield based on the ratio between the first and third model runs. The new estimate was (2 439 * 2 440/2 303) or 2 584 tonnes.

4.75 At WG-FSA, Dr P. Gasyukov (Russia) had suggested that short-term projections be used to estimate yields. However, for a long-lived species such as *D. eleginoides* this was not appropriate and it was noted that a short-term assessment will require different decision rules and appropriate assessment methods. The consequences of changes in the decision rules as well as evaluating methods for assessing yield in *D. eleginoides* would need to be evaluated in order to be confident that the advice derived from those assessments is robust to uncertainties (Annex 5, paragraphs 5.98 and 5.99).

4.76 The Scientific Committee endorsed the following Working Group recommendations on future work:

(i) further development of an integrated assessment of *D. eleginoides* in CASAL, including an evaluation of the assessment methods and overall management strategy for this division (Annex 5, Appendix I, paragraph 41);

(ii) the means by which recruitment cohort strength is estimated from toothfish survey data should be reviewed in the intersessional period, including investigating the possible effects of using the new two-segment growth model (Annex 5, Appendix I, paragraph 42);

(iii) given the lack of defined modes in the length-density data, it would be useful to use age–length keys, if possible, as an alternative method for estimating densities of cohorts (Annex 5, Appendix I, paragraph 42);

(iv) studies on optimal sampling schemes for establishing age–length keys should be encouraged (Annex 5, Appendix I, paragraph 42).

Management advice for *D. eleginoides* at Heard and McDonald Islands (Division 58.5.2)

4.77 The Scientific Committee recommended that the catch limit for Division 58.5.2 in the 2005/06 season be revised to 2 584 tonnes, representing the long-term annual yield estimate from the GYM as described in paragraph 4.74. The Scientific Committee agreed that this should apply to the trawl, longline and pot fishing gears. This catch limit is recommended to pertain only to the assessment area which is to the west of 79°20'E.

4.78 The remaining provisions of Conservation Measure 41-08 should be carried forward for the 2005/06 season.

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

4.79 The catch limit of *D. eleginoides* in the South African EEZ for the 2004/05 season was 450 tonnes for the period from 1 December 2004 to 30 November 2005. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2005 was 141 tonnes. Of this, 103.5 tonnes (73.4%) was taken by pots and the remainder by longlines. The IUU catch for the 2004/05 season was estimated to be 156 tonnes.

4.80 The total estimated removals in 2004/05 was 297 tonnes, although cetacean predation of longline catches is reported to be significant, implying that total removals are greater than just the estimated fishery catches. It was noted that the pot fishery was reported not to be subject to cetacean predation.

4.81 There was no catch-weighted length frequency information available for the 2004/05 season, although it was suggested that the pot fishery was selecting for larger fish than the longline fishery. The CPUE series was updated for the meeting.

4.82 An augmented ASPM that used catches, standardised CPUE, and catch-at-length data was used to estimate a long-term annual yield. The results from the model were sensitive to the relative weightings given to CPUE and catch-at-length data, because these two sources of data suggest different degrees of resource depletion. In addition, the model was sensitive to changes in the assumed natural mortality value and to whether or not cetacean predation was included in the calculations.

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

4.83 The Scientific Committee noted that the advice on the appropriate levels of future catch provided in WG-FSA-05/58 was not based on the CCAMLR decision rules. Therefore it 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 be used in estimating yields for this fishery and that the concerns of WG-FSA over the sensitivity of the ASPM to weightings used for different data sources be noted. As the pot fishery is reported not to be subject to cetacean predation, South Africa should consider this in formulating management measures for this fishery.

4.84 The Scientific Committee also noted the recommendations by ad hoc WG-IMAF with respect to mitigation of seabird mortalities (SC-CAMLR-XXIII, Annex 5, paragraphs 5.289 and 5.290).

D. eleginoides at Prince Edward Islands (Subarea 58.7) outside the EEZ

4.85 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 recommended that the prohibition of directed fishing for *D. eleginoides*, described in Conservation Measures 32-10, 32-11 and 32-12, remain in force.

D. eleginoides at Crozet Islands (Subarea 58.6) inside the EEZ

4.86 The catch reported for this division as of 1 September 2005 was 385 tonnes. Only longlining occurs in this fishery. The estimated IUU catch for the 2004/05 season was zero inside the French EEZ. Some IUU fishing may occur outside the EEZ as reported in SCIC-05/10 Rev. 2.

4.87 Depredation on toothfish catches by killer whales (*Orcinus orca*) is becoming a major problem for this longline fishery and total mortality is believed to double the reported catch level. National observers in the fishery have been instructed to record the loss of fish from the lines. These data will be reported to CCAMLR in 2006.

4.88 GLM analyses show a general decreasing trend in the standardised CPUE to 2002/03 with no further decrease indicated between then and the present. Mean weight declined from 1999 to 2003, but has been stable since then. No stock assessment has been carried out.

4.89 Estimated total removals have declined steadily over the last eight seasons and are at substantially lower levels than those taken before then. Standardised CPUE has fallen substantially from 1999/2000 to 2002/03 but has stabilised since then. In the absence of a stock assessment, the Working Group had not been able to recommend appropriate levels of catch for this fishery to the Scientific Committee.

4.90 The Scientific Committee complimented France on the proposal to institute tag–recapture experiments in the 2005/06 season as a first step to assessing the stock. This represents a major step forward in the determination of stock status.

Management advice for *D. eleginoides* at Crozet Islands (Subarea 58.6) inside the EEZ

4.91 The Scientific Committee was not able to provide any advice on catch limits for this fishery, but noted the proposal to institute tag–recapture experiments in the area.

Management advice for *D. eleginoides* at Crozet Islands (Subarea 58.6) outside the EEZ

4.92 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 32-13, remain in force.

C. gunnari at South Georgia (Subarea 48.3)

4.93 In the 2004/05 fishing season the catch limit set for icefish in Subarea 48.3 was 3 574 tonnes. The fishery caught 200 tonnes in December 2004 and early January 2005. The fishery will close on 14 November 2005.

4.94 There was no new bottom trawl survey for this species in Subarea 48.3 in 2005. The Scientific Committee noted that the Working Group therefore had used the results of the January 2004 biomass survey as the basis of its assessment (Annex 5, Appendix L). Additional insight into the situation of the stock was gained through consideration of the results of an acoustic research survey that covered part of Subarea 48.3 in 2005; information from the fishery in 2004/05; and a recalculation of the mixture analysis of 2004 survey data undertaken by Dr Gasyukov (WG-FSA-05/78).

4.95 Neither the acoustic research survey nor the fishery found large concentrations of fish, and possible reasons for this were discussed by the Scientific Committee.

4.96 Two alternative assessments were completed by WG-FSA (Annex 5, Appendix L) based on the following hypotheses:

(i) Through some change in behaviour or distribution, possibly related to spawning, concentrations of icefish were not available to the fishery or the acoustic research survey, but icefish were dispersed over Subarea 48.3. Periodic dispersion and re-appearance of icefish has been noted before, for instance in 1998/99–1999/2000, and spawning behaviour and factors affecting distribution are not well understood for this species. The 2005/06 yield appropriate to this hypothesis was 4 760 tonnes.

(ii) The difference in commercial length frequencies between 2003/04 and 2004/05 might indicate that most age 4+ fish were no longer present in the population at South Georgia, whether due to a mortality or other event. This event did not apply to age-3 fish (which were age 2 in the January 2004 survey). The 2005/06 yield appropriate to this hypothesis was 2 244 tonnes.

4.97 The Scientific Committee noted that there are additional hypotheses consistent with the observation from the fishery and research survey in 2004/05. One hypothesis is that there has been a decline in the population across all age classes, whether due to an increase in mortality or other events.

4.98 Based on the results of the two hypotheses (Annex 5, paragraph 5.123) the catch limit for icefish in Subarea 48.3 in the 2005/06 fishing season could be 2 244 or 4 760 tonnes.

4.99 The Scientific Committee agreed that, given the inability of the commercial fishery and acoustic research survey to find concentrations of icefish in 2004/05, the yield suggested by hypothesis 1 (4 760 tonnes) would be inappropriate.

Management advice for *C. gunnari* (Subarea 48.3)

4.100 The Scientific Committee recommended that the catch limit for *C. gunnari* should be revised to 2 244 tonnes for the period from 15 November 2005 to 14 November 2006. Any catch taken between 1 October 2005 and the end of the 2004/05 fishing season (14 November 2005) should be counted against the catch limit for the 2005/06 fishing season.

4.101 All other components of Conservation Measure 42-01 should remain in force.

C. gunnari at Heard and McDonald Islands (Division 58.5.2)

4.102 The catch limit of *C. gunnari* in Division 58.5.2 for the 2004/05 season was 1 864 tonnes (Conservation Measure 42-02) for the period from 1 December 2004 to 30 November 2005. The catch reported for this division as of 1 October 2005 was 1 791 tonnes.

4.103 Catch-weighted length frequencies in the 2004/05 season were dominated by a single year class of 3+ fish. This cohort was observed to dominate the population in the survey undertaken in June 2005.

4.104 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the survey. All other parameters were the same as in previous years.

4.105 The Scientific Committee considered the following advice from WG-FSA:

(i) The projection of age 3+ fish from 2004/05 gives a projected yield of 647 tonnes in the 2005/06 season in the scenario of spreading the catch over two years. If all catch is taken in the first year and zero catch on this cohort in the second year, then the yield could be 1 210 tonnes in the coming season. The Working Group agreed that either of these approaches would satisfy the objectives of the Commission (Annex 5, Appendix M, paragraph 24).

(ii) In considering these different options, the Working Group had noted (Annex 5, Appendix M, paragraph 25):

(a) the cohort has been reproductive for one year and will have 75% escapement over the next two years, having the opportunity to reproduce again;

(b) although it seems unlikely because of the absence of any indication of a strong 1+ year class in the 2005 survey, should a survey in 2006 show a 2+ cohort entering the fishable population, then it may be difficult to have a fishery in the 2006/07 season that results in a negligible catch of the current cohort, which would be 4+ during that survey.

(iii) Other measures in the conservation measure be retained.

Management advice for *C. gunnari* (Division 58.5.2)

4.106 The Scientific Committee recommended that the catch limit in 2005/06 be 1 210 tonnes.

4.107 In making this recommendation, the Scientific Committee noted that:

(i) this catch would primarily be on age-4 fish, which would have been reproductively mature for at least one year;

(ii) the catch of this cohort in the following year (2006/07) should be zero in order to satisfy the decision rule that the biomass of the stock should be greater than, or equal to, 75% of that which would have been present after two years in the absence of fishing;

(iii) this strategy would provide for three years of reproduction by this cohort, although the strategy of having the catch concentrated in one year may slightly reduce the capacity for reproduction in the cohort's fifth year;

(iv) although it seems unlikely because of the absence of any indication of a strong 1+ year class in the 2005 survey, should a survey in 2006 show a 2+ cohort entering the fishable population, then it may be difficult to have a fishery in the 2006/07 season that results in a negligible catch of the current dominant cohort, which would be 4+ during that survey.

4.108 The Scientific Committee also requested that WG-FSA investigate the ages at which *C. gunnari* is likely to be most successful in reproduction. In doing so, WG-FSA is asked to consider how best to frame decision rules that satisfy the objectives of CCAMLR in terms of reproduction of the stock and the maintenance of predators, especially given the unusual demographic characteristics of this species. It requested that the development and evaluation of a management procedure for *C. gunnari* be considered a high priority.

4.109 The remaining provisions of Conservation Measure 42-02/B should be carried forward to the 2005/06 season.

Other finfish fisheries

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

4.110 CCAMLR closed commercial finfishing in the Antarctic Peninsula (Subarea 48.1) and the South Orkney Islands (Subarea 48.2) after the 1989/90 season. Both subareas should only be reopened to commercial fishing if scientific surveys had demonstrated that the condition of fish stocks had improved to the extent which would allow commercial harvesting.

4.111 The last surveys of the two areas occurred in 2003 (Subarea 48.1) and 1999 (Subarea 48.2). They showed no improvement in the condition of the stocks which would give rise to considerations of reopening the two areas for commercial finfishing. No new information has become available since then as no surveys were conducted in the 2004/05 season.

Management advice (Subareas 48.1 and 48.2)

4.112 The Scientific Committee recommended that Conservation Measures 32-02 and 32-03 on the prohibition of taking finfish in Subareas 48.1 and 48.2 should remain in force.

D. eleginoides at South Sandwich Islands (Subarea 48.4)

4.113 Prior to the current season, commercial fishing has not occurred at the South Sandwich Islands since exploratory longline fishing in 1993 by Bulgarian and Chilean vessels (Ashford et al., 1994). Following results from the 1993 cruise, CCAMLR set a catch limit of 28 tonnes of *Dissostichus* spp. for this subarea (Conservation Measure 41-03).

4.114 During the 2004/05 season, one UK-flagged vessel fished around the South Sandwich Islands and caught 27 tonnes of *D. eleginoides* (CCAMLR-XXIV/BG/13). During this time, fish were tagged in order to start a mark–recapture program to assess the toothfish population. Preliminary results from the survey indicated catch rates were similar to those experienced in Subarea 48.3 (Annex 5, paragraph 5.141).

4.115 The UK proposed to undertake a more extensive mark–recapture experiment in Subarea 48.4 during the period 2005/06 to 2007/08 in accordance with Conservation Measure 24-01 (WG-FSA-05/57). The objective of the experiment will be to assess toothfish population structure, size, movement and growth.

4.116 The Scientific Committee welcomed this proposal and noted that the proposed mark–recapture program will be a valuable tool for contributing to an assessment in the future. The proposed catch is for a fixed term and is only slightly greater than the total catch that might have been taken under the existing conservation measure had it been activated each year. The current catch limit is not based on an assessment. It was noted that some consideration will need to be given by the Commission to ensure that the experiment is not affected by other fishing activities and that the total catch in Subarea 48.4 does not exceed 100 tonnes at least in the 2005/06 fishing season.

4.117 The Scientific Committee recommended that an appropriate mechanism for this would be to restrict the fishery to participation only by vessels undertaking the tagging experiment.

Management advice for *D. eleginoides* (Subarea 48.4)

4.118 The Scientific Committee recommended that the mark–recapture program for *Dissostichus* spp. be established for the next three to five years in Subarea 48.4 with a 100 tonne catch limit per season, noting the comments in Annex 5, paragraph 5.143 and the need to ensure that the experiment is not affected by other fishing activities.

Electrona carlsbergi (Subarea 48.3)

4.119 No new information was made available to WG-FSA for *E. carlsbergi* in Subarea 48.3 on which to base an assessment.

Management advice for *E. carlsbergi* (Subarea 48.3)

4.120 The Scientific Committee noted that Conservation Measure 32-17 remains in force.

C. gunnari at Kerguelen Islands (Division 58.5.1)

4.121 No new information has been provided to the Scientific Committee on icefish in Division 58.5.1.

Management advice for *C. gunnari* (Division 58.5.1)

4.122 The Scientific Committee recommended that the fishery for *C. gunnari* within the French EEZ of Division 58.5.1 should remain closed in the 2005/06 season until information on stock status is obtained from a survey.

New and exploratory fisheries

New and exploratory fisheries in 2004/05

4.123 Last year the Commission agreed to seven exploratory longline fisheries for *Dissostichus* spp. in the 2004/05 season (Conservation Measures 41-04, 41-05, 41-06, 41-07, 41-09, 41-10 and 41-11). Activities in these fisheries are summarised in Annex 5, Table 5.1.

Catches of *Dissostichus* spp. in excess of 100 tonnes were reported in the exploratory fisheries in Divisions 58.4.1 (480 tonnes), 58.4.2 (127 tonnes), 58.4.3a (110 tonnes) and 58.4.3b (295 tonnes), and Subareas 88.1 (3 079 tonnes) and 88.2 (412 tonnes).

4.124 The exploratory fishery in Subarea 48.6 was undertaken by two Members with a total catch of 49 tonnes of *Dissostichus* spp. taken against a total catch limit of 900 tonnes (455 tonnes north of 60°S and 455 tonnes south of 60°S).

4.125 The exploratory fishery in Division 58.4.1 was undertaken by four Members with a total catch of 480 tonnes of *Dissostichus* spp. against a catch limit of 600 tonnes.

4.126 The exploratory fishery in Division 58.4.2 was undertaken by four Members with a total catch of 127 tonnes of *Dissostichus* spp. against a catch limit of 780 tonnes.

4.127 The exploratory fishery in Division 58.4.3a was undertaken for the first time. Three Members fished with a total catch of 110 tonnes of *Dissostichus* spp. against a catch limit of 250 tonnes.

4.128 The exploratory fishery in Division 58.4.3b was undertaken by three Members with a total catch of 295 tonnes of *Dissostichus* spp. against a catch limit of 300 tonnes. The fishery was closed on 14 February 2005. The closure was triggered by the catch of *Dissostichus* spp. (total catch was 98% of the catch limit).

4.129 The exploratory fishery in Subarea 88.1 was undertaken by six Members with a total catch of 3 079 tonnes of *Dissostichus* spp. taken against a catch limit of 3 250 tonnes. The fishery was closed on 27 March 2005 (see CCAMLR-XXIV/BG/13, Table 2). During the course of fishing, a number of SSRUs were closed, as detailed in Annex 5, paragraph 5.7.

4.130 The catch limit for *Dissostichus* spp. in SSRU C in Subarea 88.1 was exceeded by 92% (206 tonnes). This over-run illustrates the difficulty in forecasting closures when a number of vessels fish in an area where catch rates are high relative to the catch limits. The fishing events which resulted in the over-run in SSRU C are summarised in CCAMLR-XXIV/BG/13 and Annex 5, paragraph 5.9.

4.131 Catch limits were over-run on four other occasions in SSRUs in Subarea 88.1 (two catch limits for *Dissostichus* spp. and two catch limits for *Macrourus* spp.). Key factors in these over-runs included rapid changes in fishing effort and/or catches, and the late submission of catch and effort reports.

4.132 Despite these over-runs, the Scientific Committee noted that the total catch of *Dissostichus* spp. in Subarea 88.1 was only 95% of the overall catch limit. Given the five-day reporting period and the relatively small size of SSRU catch limits, the Scientific Committee agreed that both under-runs and over-runs of SSRU catch limits are inevitable. Provided these more or less balance over the season within subareas or divisions, these do not pose a conservation threat to the stock.

4.133 The exploratory fishery in Subarea 88.2 was undertaken by three Members with a total catch of 412 tonnes of *Dissostichus* spp. (110% of the catch limit of 375 tonnes). The fishery was closed on 5 February 2005.

4.134 Under Conservation Measure 41-01 all vessels operating in exploratory fisheries are required to carry out a research plan which includes completing a minimum number of research sets on entering an SSRU. Some vessels exceeded their required quota of research sets. However, there were a number of instances where vessels failed to complete any research sets. There were also cases where a vessel conducted some research sets but failed to complete the required quota even though more commercial sets were completed.

4.135 The aim of requiring research sets with substantial biological sampling in new and exploratory fisheries is to obtain an understanding of the distribution and abundance of target and by-catch species on as wide a geographical scale as possible at an early stage of the fisheries' development. For most exploratory fisheries, this requirement is still relevant and should remain. The Scientific Committee agreed, however, that for Subareas 88.1 and 88.2 the required geographical spread of fishing has now been achieved.

4.136 Accordingly, the Scientific Committee recommended that the requirement to carry out specific research sets as defined in Annex 41-01/B of Conservation Measure 41-01 within Subareas 88.1 and 88.2 be removed. In its place, it recommended that there be a requirement that all fish of each *Dissostichus* spp. in a haul (up to a maximum of 35 fish) be measured and randomly sampled for biological studies (cf. paragraphs 2(iv) to (vi) of Annex 41-01/A) from all lines hauled within Subareas 88.1 and 88.2.

4.137 The Scientific Committee also considered that the introduction of more structured research plans for exploratory fisheries may lead to a more effective and efficient collection of research data. It therefore recommended that development of such plans should be considered during the intersessional period for implementation next year.

4.138 An additional requirement of Conservation Measure 41-01 is that each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. is required to tag and release *Dissostichus* spp. at the rate of one toothfish per tonne of green-weight catch throughout the season. All vessels fishing reported tagging *Dissostichus* spp. in exploratory fisheries with a total of 4 858 *Dissostichus* spp. tagged in 2004/05 (Annex 5, Appendix T, Tables 1 and 2). However, some vessels did not fully meet the requirements of the conservation measure.

4.139 The Scientific Committee noted with concern that the research set and tagging requirements of Conservation Measure 41-01 were not being met by all vessels. The Scientific Committee reiterated the importance of both these requirements and drew this matter to the attention of the Commission.

4.140 Prof. Moreno observed that there is a need for Conservation Measure 41-01 to be as explicit as possible in its requirements, to avoid possible misinterpretation by vessels. As an example, he cited a Chilean vessel that had more than met the required tagging rate over the season, but had not met this in every area fished. He also noted that there can be entirely innocent reasons why the research set requirement is not met; for example the same Chilean vessel was in the process of completing the required number of research sets when the area in which it was fishing was closed.

4.141 To facilitate analyses of tagging data, the Scientific Committee recommended that vessels be asked to record a unique identifier on the C2 data forms for every set made and that observers ensure that this identifier is also recorded on their data forms.

Notifications for new and exploratory fisheries in the 2005/06 season

4.142 A summary of new and exploratory fisheries notifications for 2005/06 is given in Table 1 of SC-CAMLR-XXIV/BG/5. No notifications have been received from Members for exploratory fisheries in closed areas. No notifications have been made for new fisheries.

4.143 Twelve Members submitted paid notifications for exploratory fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1, 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b.

4.144 The Scientific Committee did not attempt to determine whether all the notifications for new and exploratory fisheries satisfied the requirements of Conservation Measure 21-02 paragraphs 4, 5 and 7.

4.145 Notifications for exploratory fisheries for *Dissostichus* spp. in 2005/06 are summarised, grouped by subarea or division, along with the numbers of vessels, in Table 2 of SC-CAMLR-XXIV/BG/5. Two Members submitted notifications after the deadline of 24 July 2005, however all payments were received by the deadline of 24 August 2005. As was the case last year, there were multiple notifications of exploratory fisheries for *Dissostichus* spp. for several subareas or divisions.

4.146 There has been a large number of notifications for fishing in Subareas 88.1 (9 notifications and 21 vessels), 88.2 (8 notifications and 17 vessels) and Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3b (4–6 Members and 6–11 vessels). Depending on the size of the precautionary catch limits, this implies that if all vessels operated simultaneously, the available catch per vessel could be lower than that required for economic viability, especially for those vessels operating in high latitudes where fishing imposes considerable operational difficulties.

4.147 It is likely that, once again, there will be additional administrative problems in determining closure dates for fishing in SSRUs when many vessels are fishing simultaneously in a subarea or division (CCAMLR-XXIV/BG/13).

4.148 In several notifications, individual vessels have been notified for more than one subarea or division. The Scientific Committee noted that this may increase operational flexibility and provide access in the case of areas being closed or constricted by factors such as heavy sea-ice. In such circumstances, it recommended that the notification should include an indicative fishing plan including projected timings for fishing in different areas.

4.149 Dr Constable advised that the Australian notifications (CCAMLR-XXIV/17 to 20), represented precisely such a case. The intent of the single vessel notified is mainly to fish in Division 58.4.3b. Other areas will be fished according to prevailing conditions and whether or not a catch is available when the vessel wishes to enter an area.

Progress towards assessments of new and exploratory fisheries

4.150 Substantial progress has again been made this year in assessing stocks of *Dissostichus* spp. in Subareas 88.1 and 88.2, with an assessment of yield having been completed for the first time for the Ross Sea and SSRU 882E.

4.151 For the other areas and divisions in which exploratory fisheries are conducted, the Scientific Committee reiterated the urgent need to develop a means for estimating abundance and providing assessments of stock status. In this context, it noted that with the continuing tagging programs in all areas, in the next year or two it may be possible to obtain mark–recapture estimates of abundance provided that sufficient tags are deployed each year.

Exploratory fishery for *Dissostichus* spp. in Subareas 88.1 and 88.2

4.152 The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is contained in Annex 5, Appendix F and discussed in Annex 5, paragraphs 5.41 to 5.64.

4.153 The CASAL model, using catch-at-age, CPUE and tag–recapture data and *D. mawsoni* biological parameters, was used to undertake an assessment and to calculate long-term annual yields that would satisfy the CCAMLR decision rules.

4.154 This assessment split Subareas 88.1 and 88.2 into two regions (i) the Ross Sea (Subarea 88.1 and SSRUs 882A and B), and (ii) SSRU 882E.

4.155 The long-term yield for the Ross Sea that satisfies the CCAMLR decision rules was estimated to be 2 964 tonnes. For SSRU 882E, the long-term yield that satisfies the CCAMLR decision rules was estimated to be 273 tonnes.

4.156 Prof. Beddington noted that, given the reported catches in Subareas 88.1 and 88.2 during the 2004/05 season (3 079 tonnes and 412 tonnes respectively), it was likely that the total of the catches taken in the combined areas assessed using CASAL exceeded the estimated long-term yields.

4.157 The Scientific Committee noted that SSRU 882E could be separated from the remaining SSRUs in Subarea 88.2 because it has an assessment of its own. No catches have been taken so far in SSRUs 882C, D, F and G and so, in the absence of information about these SSRUs, the Scientific Committee is unable to provide advice as to appropriate catch limits in these SSRUs.

4.158 For Subarea 88.1 and SSRUs 882A and B, the Scientific Committee agreed that advice would be needed for catch limit allocation amongst the SSRUs for the coming season.

4.159 In developing its advice, the Scientific Committee recalled:

(i) the SSRUs and associated catch limits used in Subarea 88.1 in the 2002/03 season provided larger catches per SSRU than the current system (Table 5);

(ii) the SSRUs now used (Table 5) were designed to be more consistent with the bathymetric features of the subarea, including the south–north variation from shelf areas to slope areas to northern seamount areas as well as the west–east variation between open and coastal waters;

(iii) the difficulties in administering catch limits in small SSRUs, noting the catch over-runs in some areas as well as the by-catch limits being reached in some SSRUs (Table 5);

(iv) a desire to spread effort across the subarea during the early phase of the fishery to understand the distribution of toothfish in this area but that ice variability caused the fishing effort to be concentrated in different areas in different years;

(v) variability in catch rates between SSRUs (Table 5);

(vi) differences in the amount of fishable area between SSRUs (Table 5).

4.160 The Scientific Committee noted the advice of WG-FSA on proportional allocation between SSRUs based on the combination of historical CPUE in each area and the fishable area (Annex 5, Appendix F, Table 22; Tables 5 and 6).

4.161 In further considering the issue of allocation, the Scientific Committee agreed that the allocation should be based on the proportion of the estimate of yield that can be taken in a given SSRU, such that a change in the overall catch limit for the Ross Sea can be easily translated into a catch limit in each SSRU. The proportional allocations are developed in Table 6, which shows the proportional allocation applied in the 2004/05 season and the model provided by WG-FSA this year. It also gives the proportions that would arise if the Commission chose to use the WG-FSA model of allocation but only have catches in SSRUs for which the catch limit would exceed 100 tonnes (Annex 5, Appendix F, Table 22; Table 6).

4.162 The Scientific Committee endorsed the recommendations of WG-FSA that:

(i) the Ross Sea assessment comprises Subarea 88.1 (primarily SSRUs B, C, G, H, I, J, K, L) plus SSRU 882A and B;

(ii) the assessment represents considerable progress in developing assessments in this fishery and was achieved because of the concentration of fishing in the slope areas over the course of the fishery, despite the interannual variability in ice conditions;

(iii) the area of the fishery remains very large by comparison to assessed fisheries in Subarea 48.3 and Division 58.5.2;

(iv) uncertainty in stock structure in the Ross Sea remains because most recorded movement is within SSRUs rather than between them, although the data obtained from the fishery suggests that young fish recruit to the southern part of the Ross Sea, move to the slope areas as they get older and then onto the northern areas, including the seamounts, to reproduce;

(v) more tag recoveries from tag–release areas are needed in order to improve assessments, noting that if the fishery is dispersed, then the uncertainties may remain unresolved for 10 to 15 years.

4.163 The Scientific Committee agreed that there is a need to concentrate fishing in areas of greatest activity in the short term in order to address these issues. These areas are primarily in the slope region of the Ross Sea, its location being characterised by the 1 000 m contour, comprising predominantly SSRUs 881H, I and K. It also agreed that an experiment for three years is needed to help resolve these issues, after which time it will be better understood how to gain the information necessary to establish catch limits in other areas of the Ross Sea.

4.164 The Scientific Committee agreed that this experiment should be concentrated in a north–south series of SSRUs – 881B, C, G, H, I, J, K, L – and that the estimate of yield from the assessment be distributed among these according to the recommendation of the WG-FSA. The remainder of the SSRUs in the Ross Sea (881A, D, E, F and 882A and B) would be closed for the duration of the experiment in order to ensure that fishing effort was retained in the area of the experiment. The proportions of catch in each SSRU for this experiment and the respective catch limits are shown in Table 6.

4.165 The Scientific Committee considered the implications of this allocation for managing catch limits and by-catch and noted that the arrangements could be improved while maintaining the experiment and the conservation of by-catch species by amalgamating SSRUs 881B, C, G into a northern SSRU and SSRUs 881H, I and K into a 'slope' SSRU. This proposal forms the foundation of advice to the Commission (Table 7).

4.166 The Scientific Committee noted that some slope areas may be in SSRU 881J and requested that WG-FSA review the boundaries to this SSRU so that these slope areas are appropriately included in the adjacent slope areas.

Management advice

General

4.167 Catch limits were over-run on five occasions in SSRUs in Subarea 88.1 (three catch limits for *Dissostichus* spp. and two catch limits for *Macrourus* spp.). Despite these over-runs, the total catch of *Dissostichus* spp. in Subarea 88.1 was only 95% of the overall catch limit. The Scientific Committee agreed that both under-runs and over-runs of SSRU catch limits are inevitable. Provided these more or less balance over the season within subareas or divisions, they do not pose a conservation threat to the stocks.

4.168 To facilitate analyses of tagging data, the Scientific Committee recommended that vessels be asked to record a unique identifier on the C2 data forms for every set made and that observers ensure that this identifier is also recorded on their data forms.

4.169 The Scientific Committee did not attempt to determine whether all the notifications for new and exploratory fisheries satisfied the requirements of Conservation Measure 21-02 paragraphs 4, 5 and 7.

4.170 There has been a large number of notifications for fishing in Subareas 88.1, 88.2 and 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3b. Depending on the size of the precautionary catch limits, this implies that if all vessels operated simultaneously, the available catch per vessel could be lower than that required for economic viability, especially for those vessels operating in high latitudes where fishing imposes considerable operational difficulties. There are also additional administrative problems in determining closure dates for fishing in SSRUs when many vessels are fishing simultaneously in a subarea or division.

4.171 The Scientific Committee recommended that, where individual vessels have been notified for more than one subarea or division, the notification should include an indicative fishing plan including projected timings for fishing in different areas.

4.172 The Scientific Committee reiterated the importance of completion of the research sets and tagging requirements of Conservation Measure 41-01. Not all vessels met these requirements during the 2004/05 season and the Scientific Committee drew this to the attention of the Commission.

Subareas 88.1 and 88.2

4.173 The Scientific Committee recommended that the requirement to carry out specific research sets as defined in Annex 41-01/B of Conservation Measure 41-01 within Subareas 88.1 and 88.2 be removed. In its place, it recommended that there be a requirement that all fish of each *Dissostichus* spp. in a haul (up to a maximum of 35 fish) be measured and randomly sampled for biological studies (cf. paragraphs 2(iv) to (vi) of Annex 41-01/A) from all lines hauled within Subareas 88.1 and 88.2.

4.174 The Scientific Committee recommended that the catch limit for SSRU 882E for 2005/06 should be 273 tonnes.

4.175 The Scientific Committee was unable to provide advice on suitable catch limits for SSRUs 882C, D, F and G.

4.176 The Scientific Committee recommended that:

(i) the catch of *Dissostichus* spp. be limited to 2 964 tonnes in the areas comprising Subarea 88.1 and SSRUs A and B in Subarea 88.2;

(ii) the SSRUs in Subarea 88.1 be retained except that SSRUs B, C and G be considered as a single area – 'northern SSRU' and that SSRUs H, I and K be considered a single area – 'slope SSRU';

(iii) the proportions of the catch limit allocated to each of these SSRUs be managed as an experiment for three years and that these be:

88.1 northern SSRU – 0.12
88.1 slope SSRU – 0.64
88.1 J – 0.18
88.1 L – 0.06
88.1 A, D, E, F – 0.0
88.2 A, B – 0.0.

(iv) the catch limits in each of the SSRUs be:

88.1 northern SSRU – 348 tonnes
88.1 slope SSRU – 1 893 tonnes
88.1 J – 551 tonnes
88.1 L – 172 tonnes
88.1 A, D, E, F – 0 tonnes
88.2 A, B – 0 tonnes.

4.177 Mr Pshenichnov objected to this recommendation and noted that no SSRU should have a zero catch limit on the basis of the following:

(i) it is important to obtain catch statistics from all areas in the SSRUs to assess the status of the stocks in these areas;

(ii) the variability in ice cover means that all SSRUs should be open for fishing;

(iii) the concentration of 64% of the catch limit into a small part of the slope area may result in impacts on that part of the population;

(iv) the need both to tag fish in all areas and to permit tag recoveries from all SSRUs.

4.178 The Scientific Committee thanked New Zealand for its efforts in completing an assessment of toothfish in Subareas 88.1 and 88.2. This represents the first instance for an exploratory fishery to have an assessment completed.

Other subareas and divisions

4.179 With the exception of Subareas 88.1 and 88.2, the Scientific Committee was unable to provide any new advice on catch limits for *Dissostichus* spp. taken in exploratory fisheries. No new advice is available on catch limits for any by-catch species in any of the exploratory fisheries.

4.180 The Scientific Committee reiterated the urgent need to develop a means for estimating abundance and providing assessments of stock status for exploratory fisheries, other than those in Subareas 88.1 and 88.2. With the continuing tagging programs in all areas, in the next year or two it may be possible to obtain mark–recapture estimates of abundance, provided that sufficient tags are deployed each year.

Crab resources

4.181 No target fishery for stone crabs was carried out in the last three seasons and no proposal for their harvest has been received by CCAMLR for the 2005/06 season.

Advice to the Commission

4.182 The Scientific Committee recommended that the existing Conservation Measures 52-01 and 52-02 on stone crabs should remain in force.

Squid resources

Martialia hyadesi (Subarea 48.3)

4.183 No target fishery for squid (*Martialia hyadesi*) was carried out in the last three seasons and no new request has been submitted to CCAMLR to continue exploratory fishing in the 2005/06 season.

Advice to the Commission

4.184 The Scientific Committee recommended that the existing Conservation Measure 61-01 on *M. hyadesi* should remain in force.

Fish and invertebrate by-catch

4.185 The subjects of interest which were brought to the attention of the Scientific Committee are as follows:

- assessment of the status of by-catch species and groups of species
- estimation of levels and rates of by-catch
- reporting of by-catch data
- evaluation of risk, in terms of both geographical area and demography of populations.

A work plan was developed to address each of these issues.

Assessment of the status of by-catch species and groups

4.186 No new assessment had been conducted which would enable the recommended catch limits to be revised in 2005. As a result, the Scientific Committee recommended that precautionary measures should be adopted so as to set an upper limit on by-catch, thus reducing the possibility of localised depletion.

4.187 The Scientific Committee also recommended that future work should include research aimed at generating population parameters for the estimation of standing stocks of rays and grenadiers.

Estimation of by-catch levels and rates

4.188 Estimates of total removals of by-catch in the longline and trawl fisheries are shown in Appendix N, Tables 2 and 3 respectively, of the WG-FSA report (Annex 5).

4.189 Because of an underestimation of by-catch resulting from the way in which by-catch is reported on the relevant forms, the Scientific Committee highlighted the need to take particular care to report such data accurately.

4.190 IUU fishing may also contribute to an underestimation of real removals.

Reporting of by-catch data

Observer information

4.191 Data on catch composition and biological data obtained simultaneously are summarised by the Secretariat in documents WG-FSA-05/7 (longline) and WG-FSA-05/8 (trawl). Data reporting for Subareas 88.1 and 88.2 is very poor (WG-FSA-05/24).

4.192 In order to address these problems, the Scientific Committee recommended that the catch composition form L5 to be completed by observers, be modified by adding fields for recording 'number of hooks observed for by-catch', and the total estimated number and weight of each species retained or discarded during longline hauling (i.e. observed numbers and weights, scaled in proportion to the number of hooks observed). These additional fields would assist in validation and cross-checking of by-catch records.

Reporting of data on rays cut off the line

4.193 The Scientific Committee noted that data on rays cut off the line by snood section before landing on board are not uniformly and accurately recorded.

4.194 The Scientific Committee recommended that all vessels engaged in the fishery record the number of rays cut off the line, by adding a new field to form C2, entitled 'number of rays released (including tagged specimens)'. These would not be counted against by-catch limits.

4.195 The Scientific Committee urged the observers to fill out form L11 correctly so as to include information on rays cut off the line. This form should be filled out at each longline haul, or an observation recorded, as a minimum requirement, at least once every 48 hours.

Identification of levels of risk in terms of geographical area and demography of populations

4.196 The Scientific Committee encouraged Members engaged in fisheries to collect information necessary to establish levels of risk, as used in the development of the level of risk for species such as the grenadier *M. whitsoni* and the ray *Amblyraja georgiana* in the exploratory fishery in the Ross Sea. Ways in which this could be linked to assessment and management should be explored in conjunction with ad hoc WG-IMAF (Annex 5, paragraphs 14.1 to 14.6).

Consideration of mitigation measures

Factors influencing by-catch rates

4.197 In order to develop mitigation and avoidance measures for by-catch species, it is necessary to determine factors which influence catch rates. An initial study on grenadiers in the Ross Sea (Subareas 88.1 and 88.2) showed the influence of fishing method, depth, geographical area, bait type etc. For rays, however, these factors cannot be so reliably determined because of poor reporting of specimens cut off the line.

4.198 The Scientific Committee recommended that work should be continued in the intersessional period to compare by-catch rates arising from different fishing gear to determine whether this information would be useful when recommending mitigation and avoidance measures for by-catch species.

4.199 The Scientific Committee requested Members and observers to submit to the Secretariat, where feasible, reports on fishing methods and strategies likely to reduce by-catch of non-target species.

4.200 The Scientific Committee recommended that a field specifying whether integrated weighting was used for longlines be added to the C2 data form.

Release of rays

4.201 The Scientific Committee recommended that vessels be advised that, where possible, they should release rays from the lines by cutting the snoods when the rays are still in the water, unless requested not to do so by the observer during his biological sampling period.

4.202 It has become current practice by fishing crews to cut snoods to release rays, however there was no new information available to WG-FSA this year from studies of the survival and vulnerability of species released in this way.

4.203 The Scientific Committee recommended a relaxation of the above requirement to cut all rays from lines whilst still in the water when observers are carrying out particular tasks aimed at collecting further information on rays during the sampling period. Examples of such tasks include:

(i) collection of biological data – for example measurement of length, weight, sex, maturity stage, stomach contents, samples of vertebrae and thorns for age determination;

(ii) landing rays in order to assess their condition, as if these animals had been released whilst still in the water. It would be necessary to observe hauling procedures to ensure that wounds were not sustained during hauling;

(iii) assessment of the probability of detecting tagged rays. It is likely to be difficult to detect tagged individuals when they are released in the water, particularly when the sea is rough.

4.204 The Scientific Committee recommended the adoption of a new 4-category scale (Annex 5, Appendix N, paragraph 87) to assess the condition of specimens when they are returned to the water. This data should be accurately recorded for at least one observation period every 48 hours.

INCIDENTAL MORTALITY

5.1 The Scientific Committee reviewed the report of ad hoc WG-IMAF (Annex 5, section 7 and Appendix O). It endorsed the report and its conclusions, and the plan of intersessional work (SC-CAMLR-XXIV/BG/28) subject to the comments set out below.

Incidental mortality of seabirds during regulated longline and pot fishing in the Convention Area in 2005

5.2 The Scientific Committee noted that:

(i) for Subarea 48.3, the total extrapolated seabird mortality was 13 birds at a rate of 0.0011 birds/thousand hooks, compared to the rates in 2004 and 2001 of 0.0015 birds/thousand hooks and the rate for 2003 of 0.0003 birds/thousand hooks (Annex 5, Appendix O, Table 3). Total extrapolated captures decreased between 2003/04 and 2004/05 (Annex 5, Appendix O, paragraph 12);

(ii) for Subarea 58.4, the total extrapolated seabird mortality was eight birds at a rate of <0.001 birds/thousand hooks, from one vessel operating in Division 58.4.1. No mortalities had been reported prior to 2004/05 (Annex 5, Appendix O, paragraph 13);

(iii) within the South African EEZ in Subareas 58.6 and 58.7, the total extrapolated mortality was 76 seabirds (from the one vessel that fished there) at a rate of 0.149 birds/thousand hooks, compared to 0.025 and 0.003 in 2003/04 and 2002/03 respectively (Annex 5, Appendix O, Table 3). In earlier years (1997 to 2001) extrapolated mortalities and rates ranged between 834–156 birds and 0.52–0.018 birds/thousand hooks respectively (Annex 5, Appendix O, paragraph 14);

(iv) in Subareas 48.4, 48.6, 88.1 and 88.2 and Division 58.5.2, no seabird mortalities were observed on longline vessels (Annex 5, Appendix O, paragraph 15, Table 3);

(v) no incidental mortalities were recorded on two cruises in Subareas 58.6 and 58.7 undertaking pot fishing for *D. eleginoides* (Annex 5, Appendix O, paragraph 16).

5.3 The Scientific Committee noted that the extrapolated total of 97 seabirds was a 65% increase from the extrapolated 58 mortalities for 2003/04. The vast majority of this mortality (78%) is attributed to one vessel fishing in Subareas 58.6 and 58.7 (Annex 5, Appendix O, paragraphs 6 to 9).

5.4 The Scientific Committee noted that the reports of seabirds being caught injured and uninjured indicates that seabirds are being caught on the haul and that this accounts for at least 68% of seabird captures in 2004/05 (Annex 5, Appendix O, paragraph 11 and Table 1). It welcomed progress towards actions to address this.

5.5 The Scientific Committee welcomed the submission by France of historical data from longline fishing in the French EEZ in Division 58.5.1 for 2000/01 (Annex 5, Appendix O, paragraph 17). The total seabird mortality reported by captains in 2000/01 was 1 917 birds and the corresponding catch rate was 0.092 birds/thousand hooks. France indicated that data for Subarea 58.6 will be submitted next year (Annex 5, Appendix O, paragraph 19).

5.6 The Scientific Committee noted that in 2004/05 the total reported seabird mortality from observers for Subarea 58.6 and Division 58.5.1 was 61 and 1 054 birds respectively (Annex 5, Appendix O, Table 8). The corresponding rates were 0.047 and 0.161 birds/thousand hooks. The total seabird mortality reported by captains in Subarea 58.6 and Division 58.5.1 was 137 and 1 901 birds respectively (Annex 5, Appendix O, Table 7). The corresponding rates were 0.028 and 0.071 birds/thousand hooks (Annex 5, Appendix O, paragraphs 22 and 23).

5.7 Comparing this year's to last year's data is complicated by different count methods. Data submitted to CCAMLR from 2000 to mid-year 2004 were collected by captains. Beginning April 2004, on-board observers collected seabird incidental mortality and mitigation-related information (Annex 5, Appendix O, paragraph 21). Comparing 2003/04 and 2004/05 for the period from April to August, observers' rates showed an increase of 87% (0.006 to 0.011 birds/thousand hooks) and 21% (0.058 to 0.070 birds/thousand hooks) respectively in Subarea 58.6 and Division 58.5.1 (Annex 5, Appendix O, paragraph 24). The Scientific Committee noted that in order to be consistent with CCAMLR procedures, the use of observer data only is recommended.

5.8 The seabird data recorded by observers were used to extrapolate total seabird mortality (Annex 5, Appendix O, Table 9). For Subarea 58.6, the observed incidental mortalities of 61 birds extrapolates to a mortality of 242 seabirds (0.049 birds/thousand hooks). For Division 58.5.1, the observed incidental mortalities of 1 054 birds extrapolates to a mortality of 4 387 seabirds (0.164 birds/thousand hooks) (Annex 5, Appendix O, paragraph 28, Table 11).

5.9 The Scientific Committee noted that 30% of seabirds captured were caught alive, indicating that they were taken on the haul. It was recognised that attention to mitigating captures on the haul would be required as part of efforts to achieve a continuing reduction in seabird mortality (Annex 5, Appendix O, paragraph 30).

5.10 The Scientific Committee noted the continued efforts to use and develop effective mitigation measures in the French EEZ fisheries. Following recommendations made by the Scientific Committee last year, new regulations entered into force in 2005 and include weighting regimes, multiple streamer lines, an area closure, and prohibition of hook discard and of the use of black hookline, and new measures will continue to be tested (Annex 5, Appendix O, paragraphs 36 and 37).

5.11 The Scientific Committee commended the initiatives taken by France for research and management relating to the incidental mortality of seabirds in its EEZs. It recommended that:

(i) observers continue to be deployed on 100% of vessels (Annex 5, Appendix O, paragraph 26);

(ii) consideration be given to increasing the proportion of hooks observed (e.g. to 40–50%) (Annex 5, Appendix O, paragraphs 32 and 33);

(iii) data collection protocols be improved including incorporating the CCAMLR distinctions and definitions relating to dead and live seabird by-catch (Annex 5, Appendix O, paragraphs 31 and 41);

(iv) appropriate analysis of the 2005 data be undertaken (Annex 5, Appendix O, paragraphs 38 to 40).

5.12 Prof. Beddington asked why there was a problem in increasing the proportion of hooks being observed in this fishery. Dr T. Micol (France) noted that an increase in the proportion of hooks observed would be logistically difficult to achieve given the present workload of observers. Mr Smith, as ad hoc WG-IMAF Co-Convener, noted that, based on the comments in CCAMLR-XXIV/BG/26 and the review of WG-FSA-05/50, it was recommended that France explore increasing the proportion of hooks observed to allow the levels of error associated with estimates of incidental mortality to be better determined, as current levels of coverage may be insufficient to allow this to occur in a statistically robust manner (Annex 5, Appendix O, paragraphs 32 and 33).

Information relating to the implementation of Conservation Measures 25-01, 25-02 and 25-03

5.13 The Scientific Committee noted that compliance with Conservation Measures 25-01, 25-02 and 25-03 is summarised as follows:

(i) with respect to Conservation Measure 25-01, nine of the 10 vessels which had packaging bands on board complied with the requirement to dispose of them using on-board incineration (Annex 5, Appendix O, paragraph 46; WG-FSA-05/9 Rev. 2, Table 1);

(ii) with respect to Conservation Measure 25-02:

(a) line weighting (Spanish system) – for the first time there was 100% compliance in all subareas and divisions (Annex 5, Appendix O, paragraph 47, Table 13);

(b) line weighting (autoline system) – all vessels fishing in Subareas 88.1, 88.2 and Division 58.4.2 south of 60°S in daylight met the requirements described in Conservation Measure 24-02. As in previous years, this line-weighting requirement has been fully achieved by all vessels (Annex 5, Appendix O, paragraph 48; WG-FSA-05/9 Rev. 2, Table 6; SC-CAMLR-XXIII, Annex 5, paragraph 7.57);

(c) night setting – in Subareas 58.6 and 58.7, 100% of sets occurred at night, an increase from 83% last year; in Subarea 48.3, 99% of sets occurred at night (98% in 2004) (Annex 5, Appendix O, Table 13). In Subareas 48.6, 88.1, 88.2 and Divisions 58.4.2 and 58.4.3b, all vessels demonstrated a consistent minimum line sink rate of 0.3 m/s and hence fished under Conservation Measure 24-02, which provides exemptions to night setting south of 60°S (Annex 5, Appendix O, paragraph 49; WG-FSA-05/9 Rev. 2, Table 6);

(d) offal discharge – a single vessel discharged offal during one set and one haul in Subarea 88.1 (offal discharge is prohibited in this subarea); in Subarea 48.3, a single vessel discharged offal during one set (Annex 5, Appendix O, paragraph 50, Table 1);

(e) discard of hooks – hooks were present in discards on six vessels; on three of these this was a rare event (WG-FSA-05/9 Rev. 2, Table 1). However, on one vessel it was a daily occurrence during the first half of the season; following a mid-season crew change, the discarding of hooks stopped (Annex 5, Appendix O, paragraph 51);

(f) streamer lines – the number of cruises complying with streamer line specifications increased from 64 to 74% this year (Annex 5, Appendix O, Table 12), although this is not as high as the 92% in 2003. In Subareas 48.6, 58.6, 58.7 and Divisions 58.4.2, 58.4.3b and 58.5.2, all vessels used streamer lines on all sets; in Subarea 48.3, only one of 1 847 sets was undertaken without using a streamer line; in Subareas 88.1 and 88.2, one vessel undertook a single set without using a streamer line (Annex 5, Appendix O, paragraphs 52 to 54 and 60, Tables 1 and 12);

(g) haul scaring devices – in Subarea 48.3, three vessels did not use haul scaring devices on all of the hauls; in Subareas 58.6 and 58.7, 100% of hauls used scaring devices; in Division 58.5.2 the only longline vessel fishing in that area was equipped with a moonpool, hence no devices were required (Annex 5, Appendix O, paragraphs 57 to 59, Table 12);

(iii) with respect to Conservation Measure 25-03, two of nine (22%) vessels did not comply with the prohibition of discharge of offal during the shooting or hauling of trawl gear (Annex 5, Appendix O, paragraph 62, Table 14). This level of compliance is higher than 2004, when four of eight (50%) vessels discharged offal.

5.14 In relation to Conservation Measure 25-02, the level of reported compliance increased for all elements and overall, 12 of 25 vessels (48%) fully complied with all measures at all times throughout the Convention Area, compared to 33% last year (Annex 5, Appendix O, Tables 1 and 12; WG-FSA-05/9 Rev. 2, Table 1). Some vessels failed to comply by small margins, and the Scientific Committee re-emphasised that vessels should be advised to exceed the standards to prevent compliance failure (Annex 5, Appendix O, paragraph 61).

5.15 The Scientific Committee noted some cases of potential non-compliance were corrected following a dialogue between the Secretariat and technical coordinators of national observer programs. The Scientific Committee encouraged such dialogue in that it may avoid the erroneous interpretation of ambiguous reporting leading to a misrepresentation of the level of compliance by individual vessels (Annex 5, Appendix O, paragraphs 45, 55 and 56).

Research pertaining to the revision of Conservation Measures 24-02 and 25-02 and related matters

5.16 The Scientific Committee, recollecting previous Commission recommendations (CCAMLR-XX, paragraph 6.26), endorsed a proposal to develop improved Spanish longline mitigation measures (WG-FSA-05/12). The stepwise research plan (Annex 5, Appendix O, paragraphs 68 to 70), with initial tests outside the Convention Area in fisheries where Convention Area seabirds range, was endorsed, including future tests in the Convention Area (Annex 5, Appendix O, paragraph 71).

5.17 With respect to future improvements to Conservation Measure 25-02, the Scientific Committee recommended:

(i) routine collection of longline sink rate data for a wide range of line-weighting scenarios including information on vessel setting speed and aerial extent of streamer line (Annex 5, Appendix O, paragraphs 72 to 76 and 93);

(ii) collection of data at least every seven days of streamer line characteristics, including streamer line aerial extent; the height of streamer line at the stern; the length of streamer lines; and the number, spacing and length of individual branched streamers. These data should be reported on a diagram-based form to be developed by the Secretariat. Where sink rate data collection is required according to Conservation Measure 24-02, paragraph B2(ii), streamer line data are to be collected in the course of sink rate data collection (Annex 5, Appendix O, paragraphs 77 to 79);

(iii) appropriate experiments on the design features of streamer lines with a view to being able to recommend refinements to the streamer line requirements (Annex 5, Appendix O, paragraph 80);

(iv) development of effective haul scaring devices for use throughout the Convention Area (Annex 5, Appendix O, paragraph 84);

(v) haul mitigation devices, such as the bird-excluder device, should be encouraged in all CCAMLR areas regardless of risk status to reduce the large proportion of bird captures during line hauling (Annex 5, Appendix O, paragraphs 85 and 86).

5.18 With respect to the Japanese proposal for the *Shinsei Maru* bottom-line system (WG-FSA-05/26), the Scientific Committee: (i) recognised the potential for the fishing method to minimise exposure of baited hooks to seabirds during setting operations and therefore supported the proposal; (ii) recommended that Conservation Measures 24-02 and 25-02 be applied to this novel fishing system (Annex 5, Appendix O, paragraph 81); and (iii) recommended that the fishery observer assigned to this vessel describe how the gear is deployed and retrieved with special attention to gear and seabird behaviour during the haul and set, as this would enable understanding the performance of this fishing gear and its appropriateness for continued use in the Convention Area (Annex 5, Appendix O, paragraphs 81 and 83).

5.19 In response to a Commission request (CCAMLR-XXIII, paragraph 10.24), the Scientific Committee reviewed available data on the maximum length of longlines used in the Convention Area with respect to Conservation Measure 24-02 and longline sink rate testing prior to entering the Convention Area (Annex 5, Appendix O, paragraph 87). The Scientific Committee recommended that the requirement for line sink rate testing prior to entering the Convention Area should be changed from the current requirement to test the maximum length of longline to that of testing a specific minimum length of 6 000 m for auto longline system vessels and 16 000 m for Spanish longline system vessels (Annex 5, Appendix O, paragraph 89). Specific text for the revision of Conservation Measure 24-02 is contained in Annex 5, Appendix O, paragraph 95.

5.20 With respect to future revisions of Conservation Measures 24-02 and 25-02 for the auto longline system, the Scientific Committee noted that mandatory line-weighting prescriptions for autoline vessels were no longer considered appropriate due to the rapid adoption of IWLs and the line sink rate testing regime (Annex 5, Appendix O, paragraph 91).

5.21 Although no additional information on the specification of IWLs had been provided, and a revision of Conservation Measure 25-02 at this time would be premature, the Scientific Committee agreed that IWLs should continue to be endorsed as a viable line weighting alternative (Annex 5, Appendix O, paragraphs 90 and 92) and that research be undertaken on IWLs with the intention of combining Conservation Measures 24-02 and 25-02 if possible (Annex 5, Appendix O, paragraph 93).

Incidental mortality of seabirds during unregulated longline fishing in the Convention Area

5.22 The Scientific Committee noted that the overall estimated total potential seabird by-catch in the unregulated fishery for the whole Convention Area in 2004/05 was 4 415 (95% confidence interval range of 3 605 to 12 400) seabirds (SC-CAMLR-XXIV/BG/27; Annex 5, Appendix O, paragraph 101, Table 18).

5.23 In comparison with estimates for previous years, calculated in identical fashion, the value for 2004/05 is similar to the value estimated for 2003/04 (SC-CAMLR-XXIII/BG/23). These are the lowest reported values since estimates started in 1996 (Annex 5, Appendix O, paragraph 102).

5.24 The Scientific Committee reiterated its conclusions of recent years that even these levels of IUU incidental mortality of seabirds were of substantial concern and likely unsustainable for some of the populations concerned (Annex 5, Appendix O, paragraph 105). The Commission was encouraged to continue to take action in respect of incidental mortality of seabirds caused by IUU fishing (Annex 5, Appendix O, paragraph 106).

Incidental mortalities of seabirds during longline fishing
outside the Convention Area

5.25 The Scientific Committee noted that new data on the incidental mortality of seabirds outside the Convention Area relevant to fisheries and/or seabirds within the Convention Area had been presented by Brazil (Annex 5, Appendix O, paragraph 107). The Scientific Committee welcomed the progress on the implementation of mitigation measures in Brazil (Annex 5, Appendix O, paragraph 109) and encouraged reporting of new information in 2006.

Research into the status and distribution of seabirds

5.26 The Scientific Committee noted new data contributions from Brazil, Australia and BirdLife International (Annex 5, Appendix O, paragraphs 112, 113 and 118) and endorsed the subsequent revisions of the spatial risk assessments for CCAMLR subareas on the distribution of albatrosses and petrels vulnerable to fisheries interactions (SC-CAMLR-XXIV/BG/26). The Scientific Committee requested that France submit a report on its Crozet and Kerguelen Islands petrel population study when available (Annex 5, Appendix O, paragraph 130).

5.27 The Scientific Committee requested holders of new information on Procellariiform distribution to submit these to the BirdLife International global database initiative for application to fisheries management initiatives (Annex 5, Appendix O, paragraph 119) and that BirdLife International provide an analysis of the summary data to the Secretariat on distribution of Southern Ocean seabirds from its tracking database at approximately three-year intervals, or when accumulation of data warrants (Annex 5, Appendix O, paragraph 123).

5.28 The Scientific Committee welcomed the ACAP observer; it noted the preliminary report from ACAP on albatross and petrel populations protected under ACAP, which includes all Procellariiform seabirds occurring in the Convention Area (Annex 5, Appendix O, paragraphs 131 to 140). The Scientific Committee endorsed the advice that such information is best compiled and reviewed by ACAP. The Scientific Committee recommended that, to avoid duplication, ACAP could be the single repository for these data and the Secretariat should request the submission of summary documents on albatross and petrel population status from ACAP annually, or as appropriate (Annex 5, Appendix O, paragraph 141).

International and national initiatives relating to incidental mortality
of seabirds in relation to longline fishing

5.29 The Scientific Committee noted reports on current international initiatives under the auspices of:

(i) ACAP – items of particular relevance to CCAMLR (Annex 5, Appendix O, paragraph 145);

(ii) FAO (NPOA-Seabirds) – noting the near completion of plans by Brazil and Chile (Annex 5, Appendix O, paragraphs 147 and 149);

(iii) RFMOs – responses received to CCAMLR Resolution 22/XXIII by CCSBT, IATTC and ICCAT; initial progress with IOTC, ICCAT and WCPFC (Annex 5, Appendix O, paragraphs 155 to 167);

(iv) NGOs – a new BirdLife International initiative was noted (Annex 5, Appendix O, paragraph 154) and a Southern Seabirds Solution fisher exchange between New Zealand and Chile (Annex 5, Appendix O, paragraphs 152 and 153);

(v) a workshop resulting in recommendations for best-practice data collection on protected species in longline fisheries at the Fourth International Fisheries Observer Conference was noted (Annex 5, Appendix O, paragraphs 150 and 151).

5.30 The Scientific Committee noted papers tabled at CCSBT's Fifth Meeting of the ERS WG and subsequently provided to the Secretariat. Data from the RTMP observer program of the Japanese southern bluefin tuna longline fishery estimates the annual incidental takes of seabirds for the 2001 and 2002 fishing seasons at 6 000 to 9 000 birds per year and suggests these levels have been stable since 1995. Species composition sampling indicates approximately 75% of the species taken were albatrosses and 20% petrels, most of which breed in the Convention Area (Annex 5, Appendix O, paragraphs 168 to 173).

5.31 Noting that the Japanese southern bluefin tuna fleet probably represents about two-thirds of the longline fishing effort in the overall CCSBT fishery, the total annual mortality of seabirds could approach, or even exceed, 13 500 seabirds, including about 10 000 albatrosses, the Scientific Committee expressed substantial concern and re-emphasised a need for effective mitigation, its evaluation, and a more extensive and detailed program of data collection by observers (Annex 5, Appendix O, paragraphs 175 and 176).

5.32 The Scientific Committee endorsed the request to Members of CCAMLR, especially those also members of the participating RFMOs, to support a thorough review of by-catch-related initiatives and requirements at the proposed joint meeting of the secretariats of the tuna RFMOs and their members (Annex 5, Appendix O, paragraphs 177 and 178).

Incidental mortality of seabirds in relation to new and exploratory fisheries

5.33 The Scientific Committee noted that:

(i) twenty-five of the 35 applications for exploratory longline fisheries for 2003/04 were undertaken (Annex 5, Appendix O, paragraph 184). No incidental mortality of seabirds was observed in fisheries in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.2, 58.4.3a and 58.4.3b. Two seabird mortalities and one bird released alive were observed in Division 58.4.1 (Annex 5, Appendix O, paragraph 185);

(ii) the assessment of potential risk of interactions between seabirds and longline fisheries for all statistical areas in the Convention Area was reviewed, revised and provided as advice to the Scientific Committee and Commission as SC-CAMLR-XXIV/BG/26. There were seven changes to levels of risk this year (Annex 5, Appendix O, paragraphs 183 and 186);

(iii) the 39 proposals by 12 Members for exploratory fisheries in seven subareas/ divisions of the Convention Area in 2005/06 were addressed in relation to the advice in SC-CAMLR-XXIV/BG/26, Figure 1 and Table 19. The results, summarised in Annex 5, Appendix O, paragraph 190, involve two categories: those that provided sufficient information and were assessed as conforming with advice relating to incidental mortality of seabirds (Annex 5, Appendix O, paragraph 190(i)); and those that contained insufficient information to determine whether they conformed with advice relating to incidental mortality of seabirds (paragraph 190(ii)). The potential inconsistencies in the 10 proposals in this category were resolved at the meeting; all are now in conformity with advice relating to incidental mortality of seabirds;

(iv) issues relating to:

(a) exemptions from setting longlines at night;

(b) exemptions in respect of closed seasons;

(c) maintaining maximum levels for the incidental mortality of seabirds as in the 41 series conservation measures, with reversion to the provisions of Conservation Measure 25-02 when these are reached;

(d) including reference to the definition of birds caught in all relevant conservation measures;

are addressed in SC-CAMLR-XXIV/BG/26 and Annex 5, Appendix O, paragraphs 194 and 195.

5.34 The Scientific Committee recommended the Commission request that Members take greater care in future submissions to ensure that the intent to comply with relevant seabird by-catch measures was clear (Annex 5, Appendix O, paragraph 192).

5.35 Prof. Moreno and Dr Marschoff noted that the current system of notification, and the requirement for a separate notification for each subarea or division, at times caused confusion. They agreed that a checklist would help with future notifications.

5.36 The Scientific Committee recommended that to assist in the review of notifications for new and exploratory fisheries in future years, a checklist be developed by the Secretariat for Members to complete when submitting notifications (Annex 5, Appendix O, paragraph 193).

Interactions involving marine mammals and longline fishery operations

5.37 The Scientific Committee noted that three southern elephant seal mortalities were reported in the toothfish fishery in Division 58.5.2 (Annex 5, Appendix O, paragraph 196). Two Antarctic fur seals entangled in a longline in the Subarea 48.3 toothfish fishery were both released alive (Annex 5, Appendix O, paragraph 197).

Interactions involving seabirds and marine mammals
and trawl finfish fishery operations

5.38 The Scientific Committee noted that:

(i) eleven seabirds were observed killed in the Subarea 48.3 icefish fishery and another 14 released alive and uninjured (Annex 5, Appendix O, Table 16), an order of magnitude decrease in the rate for this subarea compared to previous years (0.04 birds per tow in 2005 and 0.37 and 0.20 birds per tow in 2004 and 2003 respectively (Annex 5, Appendix O, paragraph 201, Table 17);

(ii) eight seabirds were observed killed in the Division 58.5.2 icefish/toothfish fishery, with the rate increasing from zero in 2004 and 0.005 birds per tow in 2003 to 0.01 birds per tow in 2005 (Annex 5, Appendix O, paragraph 202);

(iii) the reduction in seabird mortality in the icefish fishery in Subarea 48.3 could be due to a combination of reduced seabird abundance, associated with the reduction in icefish catches, and the continued adoption of mitigation measures, but insufficient data were available to investigate this further (Annex 5, Appendix O, paragraphs 204 to 206);

(iv) binding the net with sisal string is a potentially effective and easily implemented mitigation measure for the icefish trawl fleet (Annex 5, Appendix O, paragraphs 207 and 208);

(v) one Antarctic fur seal was caught and released alive in the toothfish trawl fishery in Division 58.5.2 (Annex 5, Appendix O, paragraph 216).

Interactions involving marine mammals and
seabirds and krill fishing operations in 2004/05

5.39 The Scientific Committee noted that:

(i) in Subareas 48.2 and 48.3 one incidental mortality of a Cape petrel was recorded and one Antarctic fulmar was caught on a warp splice and released uninjured. Information from the report of the krill fishery scientific observer from the in Subarea 48.3 included anecdotal records of seabird collisions with trawl warps during hauling (Annex 5, Appendix O, paragraph 209);

(ii) in Area 48, 95 Antarctic fur seals were observed caught during krill fishing operations (WG-FSA-05/8, Table 4), of which 74 were released alive, compared to 156 of which 12 were released alive in 2004 (Annex 5, Appendix O, paragraph 217);

(iii) the observer coverage was not sufficient to extrapolate the total Antarctic fur seal mortality in the krill fishery (Annex 5, Appendix O, paragraphs 223 and 224).

5.40 Dr D. Agnew (UK) sought clarification as to why extrapolation of total Antarctic fur seal mortality in the krill fishery could not be undertaken. Mr Smith, as ad hoc WG-IMAF Co-Convener, noted that although there had been significant observer coverage in Subarea 48.3 over the last two years, coverage levels were insufficient for the extrapolation in most areas of the fishery; a further problem was that the total effort in the fleet was not available on a tow-by-tow basis.

5.41 The Scientific Committee recollected its advice from last year that:

(i) until such time as marine mammal mitigation measures specific to this fishery could be incorporated into the relevant conservation measures, every vessel fishing for krill should employ a device for excluding seals or facilitating their escape from the trawl net (Annex 5, Appendix O, paragraphs 218 to 222(i)).

(ii) observers on krill vessels collecting reliable data on seal entrapment and on the effectiveness of devices to mitigate this (SC-CAMLR-XXIII, paragraph 5.37) should allow a very substantial resolution of the problem.

5.42 The Scientific Committee agreed that for scientific purposes the minimum requirement would be to have observations from each vessel in the fishery to assess the type and efficacy of the mitigation measures employed on a vessel-by-vessel basis. This would also provide an opportunity to collect information on the rate of trawl warp strikes by seabirds in this fishery (Annex 5, Appendix O, paragraphs 209, 222(ii), 224 and 225).

5.43 In considering the recommendation of the Working Group for 100% observer coverage on krill trawl vessels to obtain reliable data on incidental mortality and on the effectiveness associated with mitigation devices:

(i) Prof. Beddington noted that the conservation status of some of the species involved does not support the notion that 100% observer coverage is required, however, there were other reasons (e.g. quantifying fish by-catch and biological sampling of the target species) for 100% observer coverage in this fishery;

(ii) Dr Naganobu noted that Japan continued to have concerns over the cost of this recommendation, issues associated with the proprietary nature of the data, and considered that these data could be effectively collected by bilateral observer arrangements outside the CCAMLR Scheme of International Scientific Observation;

(iii) Dr Holt noted that there did not appear to be disagreement over the scientific need for 100% observer coverage of the krill fishery, bilateral observer coverage had not provided the relevant data to date and that now an inability to resolve political and practical implementation issues was delaying progress this matter.

5.44 Mr Smith, as ad hoc WG-IMAF Co-Convener, clarified that the recommendation for 100% observer coverage had been made on the basis that an assessment of incidental mortality of seabirds and marine mammals, and the efficacy of mitigation measures utilised in the krill fishery, is required. Without comprehensive observer data such an assessment could not be undertaken.

5.45 The Scientific Committee endorsed advice to develop warp strike data collection protocols during the intersessional period (Annex 5, Appendix O, paragraphs 211 to 214) and that at future meetings the ad hoc WG-IMAF assessments of incidental mortality of seabirds and marine mammals in the icefish, toothfish and krill trawl fisheries be undertaken collectively (Annex 5, Appendix O, paragraph 215).

Other business

5.46 The Scientific Committee reviewed Spain's proposal (SC-CAMLR-XXIV/8) for testing new streamer line designs (Annex 5, Appendix O, paragraphs 231 to 234) and made three general recommendations on the testing of seabird mitigation measures:

(i) that further testing of modifications to mitigation methods, which would require exemption from the provisions of current conservation measures, should require prior provision to CCAMLR of full details of the proposed research and experiments (Annex 5, Appendix O, paragraph 235);

(ii) that, to avoid confusion, the Commission confirm that the role of scientific observers does not include the ability to agree to fishing-related practices that are in contravention of CCAMLR conservation measures without relevant prior exemptions having been agreed by CCAMLR (Annex 5, Appendix O, paragraph 235(i));

(iii) that full proposals for any such testing must be notified to WG-FSA in advance of the fishing season in which the trials are proposed to be conducted (Annex 5, Appendix O, paragraph 235(ii));

and three specific recommendations on the proposal (Annex 5, Appendix O, paragraph 236):

(iv) it was not feasible or appropriate for ad hoc WG-IMAF to devise specific experimental protocols for applicants;

(v) ad hoc WG-IMAF could comment on the content and design of experiments proposed by applicants, provided these were available two weeks in advance of the start of its meeting so that there was sufficient time for appropriate expert consultation;

(vi) consequently it was not recommended that a test of the streamer line designs outlined in Annex 1 of SC-CAMLR-XXIV/8 proceed in the 2005/06 fishing season.

5.47 The Scientific Committee endorsed comments on the proposal should the applicants wish to resubmit it next year (Annex 5, Appendix O, paragraphs 237 and 238).

5.48 Mr López Abellán noted that Spain's proposal sought to encourage discussion of these issues, that fishers need an opportunity to innovate with new mitigation ideas and that it was not clear at present how to proceed with such research.

5.49 Ms Rivera, as ad hoc WG-IMAF Co-Convener, agreed that the proposal had highlighted the need for a clear process for experimenting with alternative designs of mitigation measures and recalled that such a process had existed in Conservation Measure 25-02 (2002). Recent proposals relating to line-weighting experiments (WG-FSA-05/12 for the Spanish longline system and WG-FSA-03/17 for IWL) may serve as a useful guide for future applications. These proposals called for testing in areas and at times of high risk to allow for definitive results. Ms Rivera reiterated the Scientific Committee's concern that halving the length of the streamer line, as suggested in SC-CAMLR-XXIV/8, was unlikely to ensure an optimal aerial coverage to prevent seabirds from accessing baited hooks.

5.50 The Scientific Committee agreed that clarification of the process for experimenting with alternative mitigation designs was important, and recommended that any future proposals for testing should conform with the advice contained in paragraphs 5.47 to 5.49 and within the constraints previously specified in Conservation Measure 25-02 (2002). The Scientific Committee noted that, subject to the Commission's confirmation of this advice, a revision of Conservation Measure 25-02 (2003) is not required at this time.

5.51 The Scientific Committee endorsed the advice that the UK proposal for a toothfish mark–recapture experiment in Subarea 48.4 (WG-FSA-05/57) conformed with the risk assessment in SC-CAMLR-XXIV/BG/26 in respect of avoidance of incidental mortality of seabirds (Annex 5, Appendix O, paragraphs 239 and 240).

Advice to the Commission

5.52 This section attempts to distinguish 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

5.53 The Commission was requested to note:

(i) the continuing low levels and rates of incidental mortality of seabirds in regulated longline fisheries in most parts of the Convention Area in 2005 (paragraphs 5.2 and 5.3);

(ii) that effort is required on mitigating incidental mortality of seabirds during the haul of longlines (paragraphs 5.4 and 5.9);

(iii) levels of incidental mortality of seabirds in the French EEZs similar to last year's and continued efforts to improve mitigation effectiveness (paragraphs 5.5 to 5.10);

(iv) assessment of implementation of relevant conservation measures, including improved performance for all elements (paragraphs 5.13 to 5.15);

(v) enhanced collection of streamer line and line sink rate data to enable improvements to Conservation Measures 25-02 to be proposed (paragraphs 5.17(i) and (ii));

(vi) that the adoption of IWLs and sink rate testing regimes is replacing the need for mandatory line-weighting prescriptions for autoline vessels (paragraph 5.20);

(vii) estimates of potential seabird by-catch associated with IUU longline fishing in the Convention Area in 2005 and that these are the lowest values so far estimated (paragraphs 5.22 and 5.23);

(viii) new data on mortality of seabirds from the Convention Area in adjacent regions provided by Brazil and the request for a report on new information in 2006 (paragraph 5.25);

(ix) a request to France for a report on its Crozet and Kerguelen Islands petrel study when available (paragraph 5.26);

(x) revisions of the spatial risk assessments for CCAMLR subareas on the distribution of albatrosses and petrels vulnerable to fisheries interactions (SC-CAMLR-XXIV/BG/26, paragraphs 5.26 and 5.33(ii));

(xi) a request that BirdLife International provide the Secretariat with an analysis of summary data from its Procellariiform tracking database at approximately three-year intervals, or as warranted (paragraph 5.27);

(xii) progress with national and international initiatives involving ACAP, FAO NPOA-Seabirds, RFMOs and initiatives developed by Southern Seabird Solutions and BirdLife International (paragraph 5.29);

(xiii) concern with reported levels of CCAMLR Convention Area seabirds in CCSBT fisheries (paragraphs 5.30 and 5.31);

(xiv) reduced levels of seabird and marine mammal incidental mortality in trawl fisheries in the Convention Area in 2005, notably of seabirds in the icefish fishery in Subarea 48.3 (paragraph 5.38) and of fur seals in krill fisheries in Area 48 (paragraph 5.39);

(xv) a potentially effective and easily implemented mitigation measure for reducing seabird mortalities in the icefish trawl fleet (paragraph 5.38(iv));

(xvi) observer coverage is not sufficient in the krill fishery to extrapolate the total Antarctic fur seal mortality (paragraph 5.39(iii));

(xvii) the development of a data collection protocol during the intersessional period for interactions of seabirds with trawl warps (paragraph 5.45);

(xviii) advice that a test of streamer line designs as proposed by Spain (SC-CAMLR-XXIV/8) not proceed in the 2005/06 fishing season (paragraph 5.46(vi)).

5.54 The Commission was requested to endorse:

(i) recommendations for improvements to data collection protocols, continued 100% observer coverage, consideration of the proportion of hooks observed, and an analysis of the 2005 data in the French EEZ (paragraph 5.11);

(ii) the improvement of dialogue between technical coordinators and the Secretariat to confirm compliance-related information relevant to the work of ad hoc WG-IMAF (paragraph 5.15);

(iii) the proposal to develop improved Spanish-system line weighting regimes (paragraph 5.16);

(iv) development of effective haul scaring devices (paragraphs 5.17(iv) and (v));

(v) the recommendation that Conservation Measures 24-02 and 25-02 apply to the proposed *Shinsei Maru* bottom-line system and for observer-collected information on seabird behaviour at the set and haul of the gear (paragraph 5.18);

(vi) the recommendation that IWLs continue to be endorsed as a viable line weighting alternative and that IWL research be undertaken with the intention of combining Conservation Measures 24-02 and 25-02 (paragraph 5.21);

(vii) that ACAP should be the single repository for data on albatross and petrel population status and trends and that summary documents be regularly submitted to the Secretariat (paragraph 5.28);

(viii) the recommendation that a checklist be developed by the Secretariat to assist Members in their applications for new and exploratory fisheries (paragraphs 5.34 and 5.36);

(ix) the recommendation for all vessels to use seal-excluder devices in krill trawl fisheries (paragraph 5.41(i));

(x) confirm that the role of observers does not include the ability to agree to fishing-related practices in contravention of CCAMLR conservation measures (paragraph 5.46(ii));

(xi) the recommendation that experimentation with alternative mitigation designs was important, and any future proposals for testing should conform with the advice contained in paragraphs 5.46 to 5.49 and the constraints previously specified in Conservation Measure 25-02 (2002) (paragraph 5.50);

(xii) advice that the UK proposal for a toothfish mark–recapture experiment in Subarea 48.4 conformed with the risk assessment of avoidance of incidental mortality of seabirds (paragraph 5.51).

Specific advice

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

(i) suggested revisions to Conservation Measure 24-02 (paragraph 5.19);

(ii) continued action in respect of seabird mortality caused by IUU fishing (paragraph 5.24);

(iii) a request to Members to support a review of by-catch-related initiatives and requirements at the proposed meeting of tuna RFMOs in early 2007 (paragraph 5.32), particularly given the reported high levels of seabird incidental mortality in the CCSBT fishery, noting that most of these are likely to be Convention Area seabirds (paragraphs 5.30 and 5.31);

(iv) advice in relation to proposals for new and exploratory longline fisheries in the Convention Area in 2005 (paragraph 5.33).

ADDITIONAL MONITORING AND MANAGEMENT ISSUES

Marine debris

6.1 The Secretariat prepared a paper on the current status of national surveys on monitoring of marine debris and its impact on marine mammals and seabirds in the Convention Area (SC-CAMLR-XXIV/BG/13).

6.2 The CCAMLR marine debris database contains data from 12 sites, predominantly within Area 48. Of these, four sites have data for at least three years that have been collected according to CCAMLR standard methods. Members, locations and durations are as follows:

(i) beached marine debris: Chile (Cape Shirreff, Livingston Island, South Shetland Islands 1993 to 1997), UK (Bird Island, South Georgia 1989 to present, and Signy Island, South Orkney Islands 1991 to present), Uruguay (King George Island, South Shetland Islands 2001 to present) and South Africa (Marion Island 2004);

(ii) debris associated with seabird colonies: UK (Bird Island 1993 to present);

(iii) marine mammal entanglement: UK (Bird Island 1991 to present and Signy Island 1997 to present);

(iv) hydrocarbon soiling: UK (Bird Island 1993 to present).

6.3 A summary of the trends presented in SC-CAMLR-XXIV/BG/13 indicated that:

(i) marine debris, principally packaging items and fishing gear, reached a peak in the period from 1994 to 1996 at Bird Island and Signy Island and has declined thereafter;

(ii) the level of marine debris found in seabird colonies at Bird Island increased between 1998 and 2003 since when there has been a substantial decline, particularly in the relative proportion of fishing gear, such as snoods and hooks;

(iii) Antarctic fur seal entanglement at Bird Island reached a peak in 1993 and has shown a general decline since that time, with the lowest levels recorded in 2004/05. Plastic packaging bands, synthetic string/longline fragments and fishing net are most frequent entangling materials;

(iv) the number of seabirds contaminated with hydrocarbons remains low.

6.4 The Scientific Committee recalled its request for papers relating to the methods used for analyses of marine debris data to be submitted for consideration at SC-CAMLR-XXIV (SC-CAMLR-XXIII, paragraph 6.6). As requested, the Secretariat contacted CEP in May 2005 for information relating to marine debris and monitoring methods that might be used or proposed for estimating trends in marine pollution (SC-CAMLR-XXIII, paragraph 6.5); there had been no response from CEP prior to CCAMLR-XXIV.

Reports of surveys of marine debris on beaches

6.5 Standardised surveys of marine debris were reported from Signy Island, South Orkney Islands, in 2004/05 (SC-CAMLR-XXIV/BG/18), and Bird Island, South Georgia, in 2003/04 (SC-CAMLR-XXIV/BG/15). There was an increase in the amount of debris at Signy Island (86%) and at Bird Island (97%) including 11 plastic packaging bands at the latter site, compared to four in the previous year.

6.6 Marine debris surveys conducted at Cape Shirreff, Livingston Island, between 2001 and 2005, reported in SC-CAMLR-XXIV/BG/4, found the highest number of items (1 023) in 2004/05 of which 95% were plastics, many of which showed clear evidence of partial incineration. Plastic packaging bands were present in each year of the study. A single survey at President Head, Snow Island, found 252 items of debris, 78% of which were plastic.

6.7 The Scientific Committee noted the overall reduction in the levels of marine debris, in particular plastic packaging bands, and suggested that this may indicate a change in the behaviour of fishers with respect to waste disposal processes.

6.8 As in previous years, Dr Naganobu reported that no fishing gear had been lost from Japanese krill trawlers and that all damaged nets had been disposed of in the incinerators installed on board all of those vessels.

Entanglement of marine mammals in marine debris

6.9 Standardised reporting of the entanglement of Antarctic fur seals in marine debris was reported from Signy Island, South Orkney Islands (SC-CAMLR-XXIV/BG/18), where two entangled animals were recorded and Bird Island, South Georgia (SC-CAMLR-XXIV/BG/16), where nine entangled seals were recorded between 1 April 2004 and 31 March 2005, the lowest number of entanglements recorded since 1991.

Marine debris associated with seabird colonies

6.10 Marine debris associated with seabirds at Bird Island, South Georgia, from 1 April 2004 to 31 March 2005 was reported in SC-CAMLR-XXIV/BG/14. There were 26 items of fishing gear (mostly longlining gear) found in seabird colonies, a substantial reduction from the previous year.

6.11 The Scientific Committee noted the reduction in the incidence of longline-based fishing gear found in association with wandering and black-browed albatross nests in 2004/05 and agreed that this is a positive indication of the effectiveness of the requirement to remove hooks from offal prior to discharge (Conservation Measure 25-02, paragraph 5). In respect of wandering albatrosses, the Scientific Committee noted that some of the fishing gear could be acquired by birds interacting with longline fisheries outside the Convention Area as well as in Subarea 48.3.

Seabirds and marine mammals soiled with hydrocarbons

6.12 Six cases of oil contamination of wandering albatrosses were recorded at Bird Island, South Georgia, between 1 April 2003 and 31 March 2004, including five birds during a two-week period in March 2005, were reported in SC-CAMLR-XXIV/BG/14.

Management Advice

6.13 The Scientific Committee noted the reduction in the levels of marine debris in some parts of the Convention Area and encouraged all Members to submit data on marine debris to the Secretariat.

MANAGEMENT UNDER UNCERTAINTY

7.1 Two different matters were dealt with under management under uncertainty:

(i) catch and effort data for toothfish exploitation in waters adjacent to the Convention Area;

(ii) IUU fishing and the close collaboration of WG-FSA and SCIC with respect to IUU fishing.

Toothfish catch outside the Convention Area

7.2 The Scientific Committee noted the data on catch of *Dissostichus* spp. outside the Convention Area (Annex 5, paragraphs 8.1 and 8.2). Catches of *Dissostichus* spp. were mostly taken in Areas 41 and 87. The catch was lower in 2004/05 than in 2003/04 (8 511 tonnes versus 10 966 tonnes).

7.3 Dr Barrera-Oro provided additional information on the catch of *D. eleginoides* in the Patagonian sector of the Argentine EEZ (Area 41). The Argentine Government introduced additional precautionary measures in this fishery from 2002 onwards to maintain the sustainability of the stocks. As the fishery operates both by bottom trawling and longlining, catches in waters less than 800 m became restricted in order to better protect juvenile fish. In addition, the use of circle hooks became mandatory, with an increase in the gap from 3.5 to 4 cm. All vessels carry scientific observers and inspectors. The catch limit was reduced from 6 000 tonnes in the period 2000–2002 to 4 800 tonnes in 2003 to 2 250 tonnes in the 2004 and 2005 seasons.

IUU fishing

7.4 There has been a decline in IUU catches over the last years. The Scientific Committee drew SCIC's attention to WG-FSA's considerations that the CDS previously assumed to capture the world trade in toothfish reasonably well, may now be less accurately capturing trade in IUU catch. The Scientific Committee re-emphasised WG-FSA's recommendations that its assessments require the best estimates of IUU fishing as model inputs (e.g. in CASAL) rather than 'conservative' or 'precautionary' estimates (Annex 5, paragraphs 8.5 to 8.7).

7.5 The Scientific Committee endorsed the recommendations of WG-FSA on close collaboration between WG-FSA and SCIC and agreed:

(i) that the Secretariat should review its annual estimation and extrapolation of IUU catches after the close of the season (Annex 5, paragraphs 8.1 and 8.2);

(ii) to ask SCIC to consider the further development of estimation methods for IUU catches;

(iii) to continue work to better understand the effectiveness of different levels of observation in detecting levels of IUU activity (Annex 5, paragraph 8.4);

(iv) to ask SCIC to consider undertaking a review of the historical series of IUU catches with respect to the assumptions made by WG-FSA in estimating these catches (Annex 5, paragraph 8.8).

7.6 The Scientific Committee supported WG-FSA's findings that compliance and enforcement experts are required to determine the information needed and reiterated WG-FSA's request from 2004 (SC-CAMLR-XXIII, Annex 5, paragraph 8.6) for SCIC to consider whether qualitative information could be provided for each of the CCAMLR areas, so that the level of monitoring needed for those areas can be classified along with an indication as to whether the level of monitoring changed significantly from the previous year (Annex 5, paragraph 8.10).

7.7 In order to take this forward, the Scientific Committee agreed, on the basis of a draft agenda circulated during its meeting, to a proposal by SCIC for an intersessional meeting of the Joint Assessment Group (JAG) for the 'Estimation of IUU in the Convention Area'. The Scientific Committee agreed that the meeting should take place following WG-FSA-SAM in July 2006.

7.8 On request by WG-FSA, the Scientific Committee asked the Commission which body is responsible for routinely estimating and reviewing the IUU catches in each statistical area and by what method this might best be achieved (Annex 5, paragraph 8.9).

SCIENTIFIC RESEARCH EXEMPTION

8.1 Scientific research surveys notified to the Secretariat under Conservation Measure 24-01 are regularly updated on the CCAMLR website. Future surveys identified were:

- bottom trawl survey in Subarea 48.1 by Germany in November/December 2006
- bottom trawl survey of Division 58.5.1 by France in 2006/07
- bottom trawl survey in Subarea 88.3 by the USA in March 2006
- bottom trawl survey of Division 58.5.2 by Australia in 2006
- bottom trawl survey of Subarea 48.3 by the UK in January/February 2006
- a research exemption was also requested by the UK to carry out a tagging experiment in Subarea 48.4 (Annex 5, paragraphs 5.140 to 5.146). This was considered under Agenda Item 4(ii).

8.2 The Scientific Committee recognised the value of the proposed tagging experiment in Subarea 48.4 and agreed it would need to be conducted over a number of years. It also recognised that for the research objectives to be effective, steps should be taken to ensure the proposed research efforts are not compromised.

8.3 Dr M. Azzali (Italy) advised that in December 2006 and January 2007, Italy will carry out an acoustic survey in the Ross Sea (Subarea 88.1) on *E. superba*, *E. crystallorophias*, *Pleuragramma antarcticum* and their predators.

COOPERATION WITH OTHER ORGANISATIONS

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

Cooperation with the Antarctic Treaty System

CEP

9.2 The Chair of the Scientific Committee, Dr Fanta, was an observer at the VIIIth meeting of CEP to the Antarctic Treaty, from 6 to 10 June 2005, in Stockholm, Sweden (CCAMLR-XXIV/BG/20). It was chaired by Dr A. Press (Australia). Dr Fanta reported to the Scientific Committee on the deliberations of CEP:

(i) The UK called attention to the work carried out by CCAMLR in lowering the level of IUU fishing, and to all efforts of CCAMLR to diminish the IUU fishery that should be supported by ATCM Members, as well as the importance of inviting non-parties to CCAMLR to join in and to participate in its meetings. Australia mentioned CCAMLR, and reported on the joint Chile–Australia informal intersessional meeting to discuss the future of CCAMLR.

(ii) The increased level of human activity in the Antarctic was recognised to present a challenge to the environment. The importance of the marine ecosystems was mentioned and the competence of CEP in respect to contamination and sea-ice melting and of CCAMLR in respect to marine debris was noted. The CCAMLR Observer noted that CCAMLR planned a Workshop on Marine Protected Areas.

(iii) It was also noted that there is a need for databases of environmental indicators and the possibility of obtaining information from other bodies such as SCAR, CCAMLR or COMNAP.

(iv) The CEP website will transfer to the ATS website in the four treaty languages, and include information on the status of protected area management plans, and initial/comprehensive environmental impact evaluations. This may be helpful when CCAMLR is considering protected areas that contain a significant marine area under the Treaty.

(v) Concern was expressed about the impact of the IPY activities on the Antarctic environment. Better indicators to describe the Antarctic environment should be found. The UK recommended an expansion of the agenda, incorporating IPY, climate change, bioprospecting and outreach.

(vi) The use of satellite images was mentioned as being useful for environmental monitoring, including the detection of cumulative impacts. This kind of monitoring would also be useful for the marine environment, mainly related to water temperature, ice extension and the presence of phytoplankton. This information could be used in CCAMLR's environmental models that deal with krill populations and distribution, for example.

(vii) SCAR presented an analysis of criteria that are used when advising CEP on which species should remain or be designated as Specially Protected Species under the Treaty, in consultation with Parties, CCAMLR and other expert bodies, and with the assistance of IUCN. CEP requested SCAR to assist in reviewing those species which were classed as 'Vulnerable', 'Endangered' or 'Critically Endangered', 'Data Deficient' or 'Near Threatened' which occur in the Antarctic Treaty area. CEP also needs to consider how to interact both with other parts of the Antarctic Treaty System (e.g. CCAMLR, CCAS) over any proposal for designation where the jurisdiction may be shared, and with other international conventions (e.g. ACAP) which may have global responsibilities for particular groups of organisms. Of the species that breed regularly in Antarctica, the macaroni penguin and southern giant petrel are globally considered Vulnerable, and the gentoo penguin is Near Threatened. Of the species that regularly visit Antarctica, the black-browed albatross is Endangered, the rockhopper penguin, wandering albatross and grey-headed albatross are Vulnerable, and the light-mantled albatross, northern giant petrel, mottled petrel and sooty shearwater are Near Threatened. Preliminary results suggest that some species may warrant categories of higher extinction risk at the regional than global level, e.g. chinstrap penguin, southern giant petrel, and Antarctic prion, while others may warrant categories of lower extinction risk at the regional than global level, e.g. gentoo penguin and mottled petrel. The southern giant petrel is at risk of extinction as a breeding species within the Antarctic.

(viii) SCAR also presented the suggestion for a delisting of an Antarctic Specially Protected Species, recommending that sub-Antarctic fur seal and Antarctic fur seal be removed from Appendix A of Annex II on the basis of the current population estimates and annual trend. Some Members felt that this needed more consideration.

(ix) The Committee adopted Guidelines for CEP Consideration of Proposals for New and Revised Designations of Antarctic Specially Protected Species under Annex II of the Protocol.

(x) The problem of introduction of new species to the Antarctic and the transfer of species between Antarctic sites was raised by Australia. France stated that the introduction of non-native species may be the main threat to biodiversity in Antarctica and COMNAP raised the question of the introduction of marine species in ballast water. It was suggested that CEP could address this issue as part of future work on biosecurity.

(xi) ASPA No. 149, Cape Shirreff and San Telmo Island, Livingston Island, South Shetland Islands, was revised and recommended to the ATCM for approval and ASPA No. 145, the marine part of the Deception Island ASMA, was recommended to the ATCM for approval.

(xii) Criteria to be developed for the indication of new areas for protection and nominations of areas were discussed and it was noted that CCAMLR could make available data obtained through its programs to collect marine debris data as well as other information within CEMP.

(xiii) Progress made by the intersessional Contact Group on the State of the Antarctic Environment Reporting System (SAER) was reported. The conclusion was that the system is still under development, and that more work has to be done.

(xiv) The next meeting of CEP will take place in Edinburgh, Scotland, UK, from 12 to 23 June 2006.

9.3 Dr Holt congratulated CEP on its considerable progress and noted that there were several areas where the expertise and interest of CEP and the CCAMLR Scientific Committee overlapped. As an example he noted that CEP had considered a proposal from SCAR to de-list Antarctic fur seals but noted that the fur seal rate of population increase at Cape Shirreff had levelled off in recent years. This and similar information should be provided to CEP.

9.4 The Scientific Committee requested that the CEP Guidelines for CEP Consideration of Proposals for New and Revised Designations of Antarctic Specially Protected Species under Annex II of the Protocol be provided to the Secretariat and made available to all Members. In respect of the revision of the SCAR paper to remove sub-Antarctic fur seals and Antarctic fur seals from Appendix A of Annex II of the Protocol, it was agreed that it was important for CEP to have input from CCAMLR.

9.5 Accordingly, the Chair of CEP was requested to forward, when available, the revised SCAR proposal to the CCAMLR Secretariat, together with an indication of the deadline for CCAMLR input. The Secretariat was requested to make the proposal available to all Members and to forward it to the Convener of WG-EMM. He was asked to:

(i) arrange for a review by appropriate CCAMLR experts, taking account of any comments from Members;

(ii) forward the results of the expert review for approval by WG-EMM or the Scientific Committee, either electronically or as a tabled paper, depending on the deadlines involved.

The final comments and recommendations of the Scientific Committee would then be forwarded by the Secretariat to the Chair of CEP.

9.6 Dr Press, Chair of CEP, replied that CEP acknowledged the valuable work and the competence of CCAMLR and said that there were a number of areas where CCAMLR advice will be useful for CEP. CEP has asked the Scientific Committee of CCAMLR to provide information on the proposal from SCAR to de-list fur seals.

9.7 Dr N. Gilbert noted that New Zealand had offered to hold a workshop on non-native species including marine species at the University of Canterbury, Christchurch, New Zealand, in early April 2006. He said he would make the information about the workshop available to the Secretariat should CCAMLR wish to be involved.

SCAR

9.8 Dr G. Hosie, SCAR Observer to CCAMLR, presented a report (CCAMLR-XXIV/BG/36) on SCAR:

(i) The scientific business of SCAR is conducted by its three Standing Scientific Groups in Geosciences, Life Sciences and Physical Sciences, which represent the scientific disciplines active in Antarctic research. Each of the Standing Scientific Groups is supported by a number of subgroups.

(ii) SCAR has recently developed a new strategic plan for 2004–2010 which describes SCAR's vision and mission statements and the objectives to achieve its mission. A copy of SCAR's strategic plan can be downloaded from www.scar.org/about/introduction/strategicplan/index.html.

(iii) The Standing Scientific Group on Life Sciences (SSG-LS) is found on www.scar.org/researchgroups/lifescience.

(iv) In July 2005, SCAR held the IXth SCAR International Biology Symposium in Curitiba, Brazil, organised by Dr Fanta. A record 350 people from 32 countries participated. It is intended to publish the keynote papers and a selection of related papers as a special issue of the international journal *Antarctic Science*.

(v) Three scientists from the CCAMLR community provided keynote lectures on various aspects of the Antarctic ecosystems. These lectures underlined the close relationship between CCAMLR and SCAR.

(vi) SCAR carries out several specific marine biological activities that are relevant in one way or another to CCAMLR, and that provide the potential for links to CCAMLR:

- The previous Evolutionary Biology of Antarctic Organisms (EVOLANTA) program has now been absorbed into the new SCAR EBA program (Evolution and Biodiversity in the Antarctic). EBA is a major program which seeks to describe the past, understand the present and predict the future (www.scar.org/researchgroups/lifescience).

(vii) SCAR is the leading sponsor of the Census of Antarctic Marine Life (CAML), which is a Southern Ocean contribution to EBA and to the global Census of Marine Life (CoML), supported largely by the US Sloan Foundation. CAML (www.caml.aq) has begun its work and will have a data collection phase during the IPY in 2007/08. It provides much potential interest for CCAMLR, and CCAMLR's involvement is encouraged. Specifically, there is an opportunity for CCAMLR to provide CAML with data and samples, especially for species identification, collected during CCAMLR activities, and similarly CAML has the potential of providing similar information on CCAMLR's target species, e.g. krill demographics and specimens, during CAML's circum-Antarctic survey.

(viii) As a contribution to EBA, SCAR is developing a Marine Biological Information Network (SCAR-MarBIN), which will provide CCAMLR with useful references on general ecosystem activity (see www.scarmarbin.be).

(ix) SCAR is keen to sponsor a Southern Ocean Continuous Plankton (CPR) recorder database as a service to the Antarctic community, including CCAMLR. The data can assist in addressing CEMP's second objective of distinguishing harvesting impact from natural variability or other sources of variation in the Antarctic marine ecosystem. Access to the data is available on request.

(x) The Ecology of the Antarctic Sea-Ice Zone (EASIZ) program was successfully terminated with a closing symposium in September 2004 in Croatia. The proceedings will be published in a special issue of *Deep-Sea Research*.

(xi) SCAR continues with the activities of its Expert Groups on Birds and on Seals, which have collected unique databases and are regularly called upon to provide CCAMLR with information. SCAR is prepared to provide information provided that SCAR receives clear specifications as to what is required.

(xii) The latest report from the last SCAR Expert Group on Seals meeting in Curitiba, Brazil, can be found at the EGS website (www.seals.scar.org/docs/scar.htm).

(xiii) SCAR has an acoustics working group that has already produced two papers for the ATCM on the links between scientific acoustic devices and marine mammals. A workshop will be organised in Cadiz, Spain, in January 2006 to assess the information published over the last two years.

(xiv) SCAR and CCAMLR share an interest in the topic of MPAs, an important current topic in marine conservation initiatives worldwide. As an international body committed to scientific conservation, SCAR suggested that it could provide advice or access to data to assist in the future development of MPAs, as SCAR has done previously with ASPAs at the ATCM. In 2006, SCAR will be providing ACAP with an information paper on the potential contribution of at-sea data to the selection of high-seas MPAs.

(xv) SCAR has a growing involvement in studying and forecasting the ocean–ice–atmosphere system of the Southern Ocean, on short, medium and long time scales. These studies include the behaviour of the ACC. Studies and numerical models of this system provide the potential for close links with CCAMLR.

(xvi) A new SCAR Scientific Research program, Antarctica and the Global Climate System (AGCS), will provide a study of the modern ocean–atmosphere–ice system, and develop and apply models of the way in which that system behaves. The AGCS Proposal can be downloaded from the SCAR website (www.scar.org/researchgroups/physicalscience).

(xvii) The ASPeCT (sea-ice) Expert Group has continued to develop its database of sea-ice parameters from *in situ* ship observations. Data from 81 voyages were added over the last two years. A comprehensive database should be available by the end of 2005. ASPeCT is now part of AGCS program.

(xviii) SCAR is involved in several of the leading research proposals for the IPY:

(a) EoI 83: CAML. This has subsequently been selected as a lead proposal;

(b) EoI 577: EBA. This was identified as the lead program for a cluster. The proposal has yet to be submitted for the second phase;

(c) EoI 9: SASSI (Synoptic Antarctic Shelf-Slope Interactions Study). This has subsequently been selected as a lead proposal;

(d) EoI 109: CASO (Climate in Antarctica and the Southern Ocean). This was identified as the lead program for a cluster. The proposal was submitted for the second phase before the 30 September deadline.

(xix) The next SCAR Meeting and 2nd SCAR Open Science Conference will be held in Hobart, Australia, from 9 to 19 July 2006. SCAR-XXIX is being jointly held with the COMNAP-XVII meeting. The 2nd SCAR Open Science Conference will be from 12 to 14 July 2006 and the theme of the conference is 'Antarctica in the Earth System'. Details are available at www.scarcomnap2006.org.

(xx) SCAR continues to play a central role in the development of scientific understanding in the Antarctic region. This role will be enhanced in future by SCAR's involvement at the heart of the planning process for the IPY.

(xxi) SCAR is keen to continue to play a major role as the scientific partner to other organisations with interests in the south polar region and the Southern Ocean, and in particular SCAR seeks to develop a strong mutual relationship with CCAMLR.

9.9 Dr H. Kawall (Brazil) noted that among the many participants to the SCAR symposium there were many graduate and undergraduate students that had received a lot of inspiration and knowledge regarding Antarctic biological science. The three keynote speakers from among the CCAMLR scientists were especially thanked for their participation.

Reports of observers from international organisations

ASOC

9.10 ASOC drew delegates' attention to the following papers: SC-CAMLR-XXIV/BG/21 for recommendations on management of the krill fishery; SC-CAMLR-XXIV/BG/20 on Antarctic marine ecosystem research in the Convention Area; CCAMLR-XXIV/BG/32 for ASOC's recommendations and priorities for this meeting.

9.11 ASOC emphasised the need for remote monitoring of the krill fishing fleet and urged the Scientific Committee to recommend 100% observer coverage on all krill fishing vessels. ASOC also called for the Scientific Committee to produce a detailed krill fishing plan. ASOC regards this to be critical as it expects an expansion in krill fishery. ASOC encouraged CCAMLR Members to endeavour to better coordinate between different krill and marine ecosystem research programs.

Reports of CCAMLR representatives at meetings of other international organisations

IWC

9.12 The IWC Observer, Dr Kock, reported on relevant elements from the meeting of the SC-IWC held in Ulsan, Republic of Korea, from 30 May to 10 June 2005 (SC-CAMLR-XXIV/BG/9).

(i) The sea-ice workshop that preceded the SC-IWC reviewed information on sea-ice environments both in the Antarctic and the Arctic. The workshop stressed that the Integrated Analysis of Circumpolar Ecosystem Dynamics (ICCED) initiatives in Southern Ocean and the IPY afford unprecedented opportunities for collaborative research in Southern Ocean. Dr Nicol, on behalf of CCAMLR, made a significant contribution to the workshop, which was much appreciated.

(ii) The abundance of minke whales in whaling area V was estimated, and new information was available on the number of humpback whale stocks in the Southern Ocean.

(iii) Japan proposed an expansion of its scientific whaling program. It intends to take 850 (±10%) minke whales, 50 humpback whales and 50 fin whales in various areas of the Southern Ocean.

International Fisheries Observer Conference

9.13 The conference was attended by two officers of the Secretariat (SC-CAMLR-XXIV/BG/10). The following topics were of direct interest to CCAMLR: video-based electronic monitoring, observer safety and training and data collection requirements.

9.14 CCAMLR was the only organisation with the attributes of an RFMO represented at the conference. The conference took note that the CCAMLR Scheme of International Scientific Observation has proven to be an indispensable source of a wide spectrum of fishery-related data required for CCAMLR conservation and fisheries management purposes, and agreed to expand the scope of the next conference to include the consideration of observer programs in high seas in areas of responsibility of RFMOs to convene a special workshop.

First meeting of the Parties to ACAP and First Advisory Committee Meeting

9.15 The report from the first ACAP meeting of Parties held in Hobart, Australia, between 10 and 12 November 2004 and the first Advisory Committee Meeting in Hobart, Australia, between 20 and 22 July 2005 was presented by Mr W. Papworth (ACAP Secretariat) (CCAMLR-XXIV/BG/9).

9.16 These two meetings offered unique opportunities for CCAMLR to showcase its successes in managing the problem of incidental mortality of seabirds in the Convention Area during fishing. It also provided the first interchange of information between the two bodies. Such exchanges are likely to expand in the future with ACAP being invited to attend CCAMLR-XXIV as an observer.

9.17 ACAP is likely to become the repository for petrel and albatross population status/trend information providing that such information remains freely available to CCAMLR Members.

ICES

9.18 Dr P. Trathan (UK) presented the report from the 2005 ICES Annual Science Conference in Aberdeen, UK, held from 20 to 25 September 2005 (SC-CAMLR-XXIV/BG/23).

9.19 ICES is the organisation that coordinates and promotes marine research in the North Atlantic. This includes adjacent seas such as the Baltic Sea and North Sea. ICES also gives advice to international organisations on fisheries management and pollution:

(i) The opening address on the Ecosystem Approach to Fisheries Management by Dr K. Sainsbury was followed by a full-day theme session entitled the 'Ecosystem Approach to Fisheries Management: Worked Examples'. The European Commissioner for Fisheries and Maritime Affairs addressed a plenary session of the meeting on the morning of day three and outlined the development of the EU's Common Fisheries Policy.

(ii) The other theme sessions included many papers of interest to the CCAMLR community, notably in the acoustics session, the marine mammal by-catch section and connecting physical–biological interactions to recruitment variability, ecosystem dynamics and the management of exploited stocks.

The 11th session of CWP

9.20 The Data Manager, Dr Ramm, reported on the session of CWP (SC-CAMLR-XXIV/BG/8), which was attended by representatives from CCAMLR, EUROSAT, FAO, IATTC, ICCAT, ICES, IWC, NAFO, OEDC and SEAFDEC.

9.21 CWP noted that CCAMLR had undertaken further developments in fishery statistics since the 20th Session of CWP in 2003. This work included:

(i) the adoption of a resolution seeking further collaboration with RFMOs to reduce the incidental mortality of seabirds arising from fishing;

(ii) the further development of the CDS;

(iii) the implementation of a C-VMS;

(iv) a revision of the Rules for Access and Use of CCAMLR Data.

9.22 The benefits of CCAMLR's involvement in CWP will include participation in the:

(i) promotion of CCAMLR's work amongst CWP members;

(ii) greater collaboration with RFMOs, including the development and implementation of standard protocols for the exchange of fishery statistics, including catches, landings and trade;

(iii) development of global initiatives for improving the quality of fishery statistics.

9.23 Prof. Croxall enquired what progress CWP was making with the development and implementation of mechanisms for the collection, analysis and dissemination of data on by-catch, especially incidental mortality of seabirds, noting particularly the importance attached to this topic by the Commission in Resolution 22/XXIII.

9.24 Dr Ramm reported that the mandate of many CWP Members was limited to matters related to target species, such as tunas, and did not extend to the collection of by-catch data. However, some CWP Members were making progress on this topic and a number of small-scale projects had been implemented to collect regional information on by-catch.

The 3rd IUCN World Conservation Congress

9.25 The report from the 3rd IUCN World Conservation Congress held in Bangkok, Thailand, from 17 to 25 November 2004, was available as CCAMLR-XXIV/BG/34. Three resolutions and one recommendation of particular relevance to CCAMLR were adopted. Issues of relevance to the Scientific Committee include:

(i) Resolution 3.036 on Antarctica and the Southern Ocean – a need to develop a comprehensive network of protected areas with special urgency being given to marine habitats and diversity and to further strengthen the precautionary management regime for krill fisheries;

(ii) Recommendation 3.099 and Resolution 3.066 on the protection of seamounts, deep-sea corals and other vulnerable deep-sea habitats from destructive fishing practices, including bottom trawling, on the high seas – a need to develop conservation and management measures to protect the deep-sea environment;

(iii) Resolution 3.064 on the conservation and sustainable management of high-seas biodiversity – a need to support marine scientific research on high-seas biological diversity, ecological processes and productivity and to ensure the sustainability of human activities.

Other meetings

9.26 Dr Naganobu drew the attention of the Scientific Committee to the 3rd International Conference on the Oceanography of the Ross Sea, Antarctica, recently held in Venice, Italy, from 10 to 14 October 2005. He underlined the importance of the Ross Sea area as one of the key regions in the Southern Ocean and noted that many of the topics at the conference were of relevance to the Scientific Committee's work. The conference highlighted the evidence for long-term changes, *inter alia,* in the characteristics of Antarctic bottom water in that region. Members hoped that the results of the conference would be available soon as a publication.

9.27 Dr Azzali reported that during the meeting 'Underwater Acoustic Measurement', held in Crete, Greece, from 1 to 10 July 2005, a target strength model for krill, alternative to the SDWBA model, was presented and discussed.

Future cooperation

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

- 6th Meeting of CCSBT-ERSWG, 20 to 23 February 2006, Kaohsiung, Taiwan – New Zealand;
- CWP intersessional meeting, February 2006, Madrid, Spain – Data Manager;
- Second meeting of the ACAP Advisory Committee (AC2), date and location to be confimed – Brazil;
- 58th Annual Meeting of the SC-IWC, 26 May to 6 June 2006, St Kitts and Nevis – Dr Kock;
- CEP-IX – Antarctic Treaty, 12 to 16 June 2006, Edinburgh, Scotland, UK – Chair, Scientific Committee;
- XXIXth meeting of SCAR, 8 to 20 July 2006, Hobart, Australia – Australia;
- XVIIIth meeting of COMNAP working groups and committees, 9 to 14 July 2006, Hobart, Australia – Australia;
- ICES Annual Science Conference, 19 to 23 September 2006, Maastricht, Netherlands – UK;
- SCOR 2006 General Meeting (dates yet to be determined), Concepción, Chile (to be confirmed) – Chile;

BUDGET FOR 2006 AND FORECAST BUDGET FOR 2007

Scientific Committee budget

10.1 The agreed budget of the Scientific Committee for 2006 and the forecast budget for 2007 are summarised in Table 8. These budgets include the following items:

(i) Budget for 2006:

(a) support for WG-FSA based on a revised estimate for the 2005 meeting. The report of WG-FSA-05 comprised an additional 119 pages which required an additional A$44 000 for translation and publication. Costing for 2006 and 2007 is based on reports of similar length and complexity as the report from WG-FSA-05;

(b) Data Manager's participation and two days of secretarial support for the 2006 meeting of WG-FSA-SAM which will be held immediately prior to the meeting of WG-EMM at the same, or nearby, location;

(c) participation costs (airfares, subsistence and freight) for four Secretariat staff at the 2006 meeting of WG-EMM;

(d) participation costs (airfares and subsistence) for invited experts at the 2006 meetings of WG-FSA-SAM (one expert) and SG-ASAM (up to three experts, no airfares required);

(e) editing, translation and publication of the report from the 2005 meeting of SG-ASAM. This report will be appended to the report of SC-CAMLR-XXIV;

(f) editing and publication of the report from the 2005 Workshop on Marine Protected Areas. This report was partially translated prior to SC-CAMLR-XXIV and will be appended to the report of SC-CAMLR-XXIV.

(ii) Forecast budget for 2007:

(g) estimated costs (airfares and subsistence) for two Secretariat staff at the Fifth International Fisheries Observer Conference (airfares and subsistence);

(h) estimated costs (airfare and subsistence) for the Data Manager's attendance at the planning meeting for the CCAMLR-IPY projects;

(i) estimated costs (airfares and subsistence) for invited experts at meetings (including WG-EMM).

10.2 The Scientific Committee noted that the forecast budget for 2008 is likely to include:

- participation of one expert at a three-day workshop on land-based predators (A$6 000 for airfare and subsistence);

- participation of Secretariat staff at the second MPA workshop, and editing, translation and publication of the report from that meeting.

10.3 The Scientific Committee recalled that its newly established Special Science Fund allows specified amounts to be carried forward for a maximum period of three years. The fund currently holds amounts for the independent external review of the GYM and part of the review of the *Scientific Observers Manual*. The Scientific Committee noted that the revision of the *Scientific Observers Manual* is no longer required (paragraph 2.29), and the Scientific Committee sought advise from WG-FSA regarding the review of the GYM.

10.4 The Scientific Committee discussed ways to reduce the size and cost of the report of WG-FSA. This discussion is reported in paragraphs 13.18 to 13.25.

Commission budget

10.5 The Scientific Committee endorsed the following expenditures under the Commission's budget for 2006:

- level funding for language support for *CCAMLR Science*;
- establishment of an internet newsgroup service;
- participation cost for the Chair of the Scientific Committee at the 2006 meeting of CEP;
- participation cost for the Data Manager at the 2006 meeting of CWP.

ADVICE TO SCIC AND SCAF

11.1 The Chair presented the Scientific Committee's advice to SCIC and SCAF during the meeting. The advice to SCAF is summarised in Section 10. The advice to SCIC is summarised below.

IUU fishing

11.2 Advice to SCIC on the topic of IUU fishing may be found in paragraphs 7.5, 7.6 and 7.8.

11.3 The Scientific Committee welcomed SCIC's initiative to re-form JAG with representatives from the Scientific Committee and SCIC. A meeting of JAG was proposed in association with the 2006 meeting of WG-FSA-SAM (paragraphs 7.7, 13.12 to 13.15; CCAMLR-XXIV, Annex 5, paragraphs 2.16 to 2.21).

11.4 The Scientific Committee advised SCIC that the best estimates of IUU activities are required for its work in assessing and determining sustainable yields for Convention Area fish stocks.

New and exploratory fisheries

11.5 The Scientific Committee advised SCIC that WG-FSA and WG-IMAF had agreed that participants at future meetings would not attempt to determine whether all the notifications for new and exploratory fisheries satisfied the requirements of the relevant Conservation Measure 21-02, paragraphs 4, 5 and 7. The Scientific Committee requested that this work be done by SCIC.

Scientific observers on krill vessels

11.6 The Scientific Committee advised SCIC that there are compelling scientific reasons for deploying CCAMLR scientific observers on krill fishing vessels. This matter had been debated extensively by the Scientific Committee (section 2) and Members generally agreed that observer coverage was required, *inter alia*, to provide essential data on:

(i) biology and distribution of krill (e.g. length frequencies; reproductive condition);

(ii) technological developments in the fishery (e.g. new fishing technique such as the continuous pumping method);

(iii) by-catch of fish (e.g. catches of larval *C. gunnari*);

(iv) incidental catches (e.g. interactions with seals and seabirds);

(v) mitigation measures (e.g. efficacy of seal-exclusion devices).

11.7 Another compelling reason for scientific observer coverage is illustrated in the assessment of toothfish in Subarea 48.3. Scientific observer data collected in that fishery since the mid-1990s have provided fundamental data on length frequencies and fishing effort, and those data were essential to the present understanding and assessment of that fishery. Further, most of the difficulties in assessing that stock arise from a paucity of detailed data during the developmental phase of that fishery during the late 1980s and early 1990s. These data are not available because scientific observers were not present on fishing vessels at a time when fundamental changes in fishing patterns had occurred. As a result, large changes in the CPUE time series in the toothfish fishery remain unexplained and are difficult to reconcile with the available data (Annex 5, Appendix G, paragraphs 70 to 74).

11.8 WG-FSA had recommended 100% observer coverage on krill trawl vessels to obtain reliable data on seal entrapment and on the effectiveness of associated mitigation devices (Annex 5, paragraphs 7.55 and 7.56).

SECRETARIAT SUPPORTED ACTIVITIES

Data Management

12.1 The Scientific Committee noted the Data Manager's report (SC-CAMLR-XXIV/BG/6) which outlined the work undertaken by the Data Management team in 2004/05, and measures taken to maintain the integrity of CCAMLR data.

Development of analytical routines and databases

12.2 A number of analytical routines and databases were revised and extended during the intersessional period.

(i) a new trial electronic version of the *CCAMLR Statistical Bulletin* (eSB) was developed as a Microsoft Access database (SC-CAMLR-XXIV/5). This development was discussed in paragraphs 4.16 to 4.18;

(ii) the routine for generating catch-weighted length frequencies was reviewed and further developed following intersessional consultation (Annex 5, paragraphs 3.3 and 3.4);

(iii) a procedure was developed for identifying hauls which matched the criteria of the research plan under Conservation Measure 41-01 (SC-CAMLR-XXIII, Annex 5, paragraph 5.20);

(iv) a method is being developed to treat 'missing catch values' for by-catch species using estimates derived from the mean weights of by-catch species by fishing gear, region and period (Annex 5, paragraph 3.5);

(v) further developments were undertaken in the tagging database, which is now being populated with data (Annex 5, paragraph 3.6) and the ageing database;

(vi) the new CEMP method for calculating the growth rate of fur seal pups (SC-CAMLR-XXII, Annex 4, paragraphs 4.103 and 4.104) was further developed. The mean annual growth deviate is now calculated for male and female pups, and separate time series of this index (C2b) were presented to WG-EMM (Annex 4, paragraph 4.1);

(vii) measures of fishery–predator overlap in krill fisheries in Area 48 were further developed. Overlap indices can now be estimated taking account of variations in predation rates between species, SSMUs, month and depth zone of foraging. This progress was presented to WG-EMM using a relative measure of overlap based on the Fishing-to-Predation Index (Annex 4, paragraph 4.1).

Data processing

12.3 All fishery and observer data from 2004/05 submitted prior to the 2005 meetings of WG-FSA and WG-IMAF had been processed in time for these meetings (Annex 5, paragraph 3.28). In addition, fishery data from the French EEZs in Division 58.5.1 and Subarea 58.6 in 2004/05 (to August 2005) were also submitted. Preliminary validation of the data for 2004/05 was undertaken prior to WG-FSA-05.

12.4 Validation and logic testing on CEMP data continued and is now complete for data submitted to 1 June 2005. CEMP indices were updated and presented to WG-EMM (Annex 4, paragraph 4.1).

CCAMLR fisheries

12.5 Notifications for new or exploratory fisheries, and krill fisheries, were collated by the Data Management team. Twelve Members submitted paid notifications for exploratory fisheries in 2005/06 (SC-CAMLR-XXIV/BG/5). Notifications for krill fisheries in 2005/06 were considered by WG-EMM (Annex 4, paragraph 3.7).

12.6 In 2004/05, the Data Management team monitored 179 catch limits for managed species in SSRUs, management areas, divisions, subareas and areas (CCAMLR-XXIV/BG/13). The majority of these limits were monitored at five-day intervals between December 2004 and August 2005. The CCAMLR model for forecasting fishery closures was used routinely, once the reported catch of a managed species exceeded 50% of its catch limit, and this resulted in the closure of 16 fishing areas.

12.7 Most of the closures were triggered when the catch of a target species (*Dissostichus* spp.) approached the agreed limit. However, on four occasions in the exploratory fishery in Subarea 88.1, closures were triggered by the catch of a by-catch species (*Macrourus* spp.) approaching the limit. Events which lead to the closure of fisheries and SSRUs, and in some cases over-runs of catch limits, are summarised in CCAMLR-XXIV/BG/13.

12.8 In 2004/05, the Secretariat's workload associated with monitoring fisheries increased markedly. This is illustrated by using the volume of catch and effort reports submitted to the Secretariat as a proxy for the workload associated with monitoring fisheries. The number of catch and effort reports submitted over the past five seasons was as follows:

- 2000/01 778 records
- 2001/02 489 records
- 2002/03 707 records
- 2003/04 625 records
- 2004/05 1 018 records.

12.9 The increase in workload in 2004/05 is largely a result of increased fishing effort in exploratory fisheries and the large number of parameters which need to be monitored in these fisheries.

12.10 The Data Management team has maintained the database which holds the information on Fishery Plans (Annex 5, paragraph 3.12) and key data for 2004/05 have been added to the time series. The inventory of Fishery Plans is listed in Table 9.

Publications

12.11 The Scientific Committee noted that the following documents had been published in 2005 in support of its work:

(i) Report of the Twenty-third Meeting of the Scientific Committee
(ii) *CCAMLR Science*, Volume 12 (published immediately prior to CCAMLR-XXIV)
(iii) *CCAMLR Scientific Abstracts 2004*, available on the CCAMLR website
(iv) *Statistical Bulletin*, Volume 17
(v) Revisions to the *Scientific Observers Manual*.

12.12 The Scientific Committee agreed that language support for *CCAMLR Science* would be required in 2006. The Commission had approved level funding for 2006 (see Section 10).

Guidelines for the submission of meeting documents

12.13 At the request of SC-CAMLR-XXIII, the Secretariat prepared a single reference document which provides guidelines for the submission of meeting documents to the Scientific Committee, WG-EMM and WG-FSA (including ad hoc WG-IMAF). In doing so, the Secretariat noted some working group-specific differences in relation to: submission deadline, exception to the deadline, and approach to accepting revised documents. These specific differences were considered by both WG-EMM and WG-FSA.

12.14 WG-EMM agreed that standardising the Working Groups' guidelines in relation to the submission of meeting documents would simplify and unite the guidelines which participants to both WG-EMM and WG-FSA are required to follow. Standardisation would also simplify the Secretariat's work in preparing information and documents for meetings. Consequently, WG-EMM agreed to a proposal to standardise the specific differences which related to the submission of documents to its meetings.

12.15 In revising its guidelines, WG-EMM also agreed to the following points (Annex 4, paragraphs 7.14 to 7.20):

(i) Papers would not be limited to 15 pages, but authors should note that long papers many not be given full attention if there is limited time.

(ii) In relation to the submission of published papers to the meeting, WG-EMM agreed that authors should continue to provide an electronic version of the published paper. It was also agreed that the author of the published paper was responsible for any copyright issue arising from the submission to the meeting.

(iii) Papers that were 'in press' at the time of the meeting should be considered as published documents with respect to copyright.

(iv) References to in-press and published papers should continue to be listed under ‘Other Documents’ in the ‘List of Documents’ which is appended to the report.

(v) There is a need for easily identifying published papers for which the authors have requested consideration by the Working Group. The Secretariat was asked to consider a simple method for identifying such papers, for the purpose of the meeting.

(vi) All meeting documents distributed by the Secretariat should be in locked pdf format to avoid any unauthorised use or incidental change to the text. However, in order to facilitate the work of the rapporteurs, it was agreed that the one-page synopses should be made available separately and in unlocked pdf during the meeting.

WG-FSA considered its submission guidelines, and agreed to amend its guidelines to include points (i) to (vi) above.

12.16 The Scientific Committee endorsed the changes to the guidelines for the submission of meeting documents to WG-EMM and WG-FSA, and requested that the Secretariat place the agreed guidelines on the Scientific Committee’s webpage. Members were urged to follow these guidelines when submitting documents at future meetings.

Access to meeting documents

12.17 The Scientific Committee considered WG-FSA’s proposal that documents submitted at previous meetings be made available electronically in a reference library at future meetings of WG-FSA and, generally, CCAMLR working groups (Annex 5, paragraph 14.34).

12.18 The Scientific Committee recalled that, under the Rules for Access and Use of CCAMLR Data, meeting documents shall not be cited or used for purposes other than the work of the CCAMLR Commission, Scientific Committee or their subsidiary bodies without the written permission of the originators and/or owners of the data therein. These documents are presented for consideration by CCAMLR and may contain unpublished data, analyses and/or conclusions subject to change.

12.19 The Scientific Committee endorsed this proposal and agreed that an electronic reference library of all relevant meeting documents should be made available generally to meeting participants under the Rules for Access and Use of CCAMLR Data (see also Item 15).

Trial electronic volume of the *Statistical Bulletin*

12.20 The Scientific Committee considered the trial electronic version of the *Statistical Bulletin* (eSB) which the Secretariat had developed at the request of WG-FSA (SC-CAMLR-XXI, Annex 5, paragraph 13.8). This development was reported in SC-CAMLR-XXIV/5.

12.21 The eSB, which supports all four official languages, would allow users to replicate the six sections which are published in the hard copy of the bulletin, namely:

Section A	Maps and standard abbreviations.
Section B	Catch and effort data based on STATLANT data which are reported by Members. Catch statistics are presented for all taxa of fish and invertebrates reported in the STATLANT data.
Section C	Catch histories for species which have a total reported catch in any one season of more than 2 000 tonnes. Catches are taken from the STATLANT data.
Section D	Fine-scale catches of target species, plotted by fine-scale rectangle (0.5° latitude by 1° longitude) and three-month period (quarter), in Area 48 based on aggregated fine-scale data.
Section E	Landing and trade data reported under the CDS for *Dissostichus* spp.
Section F	Seabed areas used in fishery assessments conducted by WG-FSA. These areas are mostly derived from the global and seafloor topography dataset of Sandwell and Smith.

12.22 In addition, the eSB would allow users to access the complete dataset of statistics underlying Sections B to E and to develop user-defined queries to summarise these data, generate tables and graphics, and extract selected data (as requested by WG-FSA).

12.23 Users of the eSB would have access to the following datasets:

(i) STATLANT data, as submitted by Members;

(ii) aggregated fine-scale data. These data are highly aggregated and do not allow users to obtain vessel-specific, location-specific or country-specific information. The aggregated fine-scale data available in the eSB are limited to the following fields:

- Species (code, name)
- Area (subarea, division)
- Coordinates of the fine-scale rectangle
- Season
- Month
- Quarter
- Catch (tonnes);

(iii) aggregated CDS data, as presented in tables in Section E of the hardcopy;

(iv) seabed areas, as presented in Section F of the hardcopy.

12.24 The Scientific Committee noted that aggregated fine-scale data for target species in Area 48 have been published in the bulletin in graphic form since 1990, and in digital format since 2002 (in the Excel version of the electronic volume). These data do not contain any effort information and could not be used to calculate catch rates.

12.25 The Scientific Committee noted the comments of WG-FSA on the publication of aggregated fine-scale data in the eSB (Annex 5, paragraphs 14.10 to 14.13):

(i) the concern by some Members that these data, although aggregated, may provide information which may be used by IUU fishing vessels and that it may also divulge proprietary information;

(ii) the trade-off between protecting confidential information and providing detailed information to users;

(iii) the three options for addressing these concerns:

  (a) accept that the aggregated fine-scale data were sufficiently aggregated to protect the interests of Members;

  (b) categorise the catch reported in the aggregated fine-scale data using a scale similar to that currently used to plot catches for Area 48;

  (c) make the data available to Members only, according to the Rules for Access and Use of CCAMLR Data;

(iv) the need for the Scientific Committee and the Commission to address this issue and decide on an appropriate approach concerning fine-scale data.

12.26 The Scientific Committee agreed that the policy governing the publication of aggregated fine-scale data should be uniformly applied to all fisheries in all areas.

12.27 The Scientific Committee requested that the Commission determine the policy for publication of aggregated fine-scale data, including whether it should be available in the *Statistical Bulletin*, taking into account the comments in paragraphs 12.21 to 12.24. This policy should be determined in relation to both the trial eSB and the annual hard copy publication.

Internet newsgroup

12.28 The Scientific Committee endorsed the Secretariat's proposal for establishing an Internet newsgroup in support of working groups' activities (SC-CAMLR-XXIV/9). The Scientific Committee agreed that the Internet newsgroup would be established in accordance with agreed terms of reference, and would not require any moderation by the Secretariat. Funding for the development of the newsgroup system would be provided by the Commission (paragraph 10.1).

SCIENTIFIC COMMITTEE ACTIVITIES

Reorganisation of the work of the Scientific Committee and its working groups

13.1 Dr Constable introduced SC-CAMLR-XXIV/BG/30, the latest version of proposals, earlier versions of which had been discussed in some detail at WG-EMM (Annex 4, paragraphs 7.21 to 7.28) and WG-FSA (Annex 5, paragraphs 4.15 to 4.27), to streamline the work of the Scientific Committee by reorganising aspects of the nature, operation and work programs of its subsidiary groups. In introducing his paper, Dr Constable noted:

(i) a number of factors are impinging on the work of the Scientific Committee, including:

  (a) an increasingly heavy workload for the working groups;

  (b) the increasing expectations and work needing to be undertaken by WG-FSA-SAM in its one-week meeting;

  (c) the need to attract new members to the working groups;

  (d) the need to accommodate the increasing number of global initiatives, especially to do with the conservation of high-seas biodiversity;

(ii) two themes of work are paramount in the work of the Scientific Committee, which had been discussed at the 2005 CCAMLR Symposium in Valdivia, Chile:

  (a) developing an ecosystem-based approach to managing the krill, toothfish and icefish fisheries, including reviewing the decision rules used for all fisheries to be confident that they are couched in terms of the latest theory on the ecosystem effects of fishing on target species such as top predators;

  (b) the development of methods and advice to satisfactorily address the conservation of marine biodiversity, such as the use of marine protected areas, which is an issue raised in the United Nations General Assembly;

(iii) the Scientific Committee and its working groups do not spend sufficient time discussing biological, ecological and conservation theory that might facilitate its work;

(iv) the work of WG-EMM and WG-FSA has converged in recent years and that the work in these groups might benefit from having the respective experts come together to discuss these common issues rather than working on them independently and in parallel;

(v) the current work program could potentially be subdivided so that some work could be undertaken less frequently, such as icefish assessments may be undertaken by request of Members following surveys, toothfish assessments might be reviewed every 2–3 years once the assessments are consolidated and krill assessments may be reviewed every 5 years;

(vi) it is important that the meeting structure and commitments be such that Members with limited budgets and resources remain able to contribute to the work of the Scientific Committee, which may mean that the work program is readjusted to accommodate the highest priority work rather than creating more meetings and workshops to address new issues;

(vii) the proposal in SC-CAMLR-XXIV/BG/30 took into account many issues raised at WG-EMM and WG-FSA and tried to accommodate the new initiatives, the need for integration of the expertise, the need to streamline the priorities of work and the need to facilitate the participation of all Members of the Scientific Committee in its work.

13.2 The Scientific Committee, particularly via an ad hoc subgroup, discussed the implications of this proposal, taking account of the earlier comments of working groups and additional ideas expressed by participants.

13.3 As a result of these discussions, the Scientific Committee agreed that it was an appropriate time to undertake a detailed appraisal of ways in which the work of the Scientific Committee might be streamlined in order for it to progress its work to help the Commission meet its objectives.

13.4 The Scientific Committee endorsed the need to consider a reorganisation of its work to improve the balance, conduct and integration of work between the major current elements of its work program, particularly:

(i) fundamental aspects of biology and ecology
(ii) the development of robust assessment methods
(iii) the development of appropriate models
(iv) the application of all these approaches in the development of a full range of advice on conservation and management procedures for systems and stocks.

It recognised that the approach outlined in SC-CAMLR-XXIV/BG/30 was one way to achieve this, and noted that much deliberation on this proposal had already taken place and that the tables in SC-CAMLR-XXIV/BG/30 provide a very valuable overview of the current and prospective work program of the Scientific Committee.

13.5 The Scientific Committee also recognised the need to address various other issues relating to a reorganisation of its work program and the working arrangements for the Scientific Committee and its subsidiary groups, *inter alia*:

(i) developing a program of workshops closely linked to the main work themes;

(ii) proposals for elements of intersessional work which could be conducted primarily through electronic communication;

(iii) review of the structure and function of existing subgroups;

(iv) review of the frequency with which topics need to be considered by subgroups;

(v) feasibility of involving additional experts and other resources to supplement the work of the working groups and the Scientific Committee.

13.6 To achieve all this, the Scientific Committee established a Steering Committee, comprising the conveners of its main existing subsidiary groups (WG-EMM, WG-FSA, ad hoc WG-IMAF and WG-FSA-SAM), requesting them to coopt a small number of additional members of the Scientific Committee with complementary expertise and representation. The Steering Committee would be convened by Dr Holt.

13.7 It requested the subgroup to prepare initial proposals for consideration at the 2006 meeting of WG-EMM, and to revise these as appropriate for discussion at the 2006 meetings of WG-FSA and the Scientific Committee. At each stage of the process, the proposals should be available for comment by all Members of the Scientific Committee (e.g. via a specific area of the Scientific Committee section of the CCAMLR website).

13.8 The Scientific Committee noted that, should consensus on the proposed reorganisation be readily achieved at its 2006 meeting, it would not be possible for the necessary changes to take place earlier than at the 2007 meetings of working groups. If the subgroup is required to undertake further work during 2007, then changes could not be implemented until 2008 at the earliest. Existing working group structures and arrangements would be expected to be maintained in the interim.

13.9 The Scientific Committee noted that any changes are likely to have budgetary and related implications. It recognised that whatever changes were recommended and adopted, these were unlikely to require less than five weeks per annum of formal working group meetings (at least initially). Consideration will need to be given as to how to maintain the involvement of Members with limited resources.

13.10 In developing its terms of reference, the Steering Committee recognised that any proposal for change must provide a plan that increases the efficiency of the work of the Scientific Committee, and the emphasis should be on effectiveness rather than speed of implementation. It is important to recall that under the current structures the Scientific Committee of CCAMLR has progressed a number of areas of science very successfully and that the process of change should be regarded as a process of evolution. As with the evolution of WG-Krill and WG-CEMP to WG-EMM, this may not require wholly new working groups with totally new agendas, but that the working group structures would be an appropriate refinement and reorganisation of the existing work programs and initiatives.

13.11 The Scientific Committee approved the following terms of reference for the Steering Committee on the Review of the Structure of the Working Groups of the Scientific Committee:

1. The work of the Steering Committee should be considered in three parts:

   (i) review of science priorities and impediments to achievement;

   (ii) provide options to facilitate the work of the Scientific Committee including an appropriate implementation schedule;

   (iii) provide a decision paper to the Scientific Committee.

2. The review process should include the examination of alternative options that might include the following:

   (i) how the current structure of the working groups might be developed and what mechanisms may be required for greater interaction between them;

   (ii) produce revised terms of reference for the existing working groups to better address the objectives of the Scientific Committee;

   (iii) collate the current priorities of the Scientific Committee and the existing working groups and then to design a structure capable of delivering these priorities.

3. Any changes that are to be implemented should not negatively impact the delivery of advice to the Scientific Committee. Therefore the Steering Committee should develop an implementation schedule such that the transition from the existing structures to any arrangements has a minimal impact on the delivery of scientific advice to the Scientific Committee. The implementation schedule for the different options will depend on the extent of the changes associated with the different options.

4. The Steering Committee should aim to present a decision paper to the Scientific Committee, following consultation with all of the working groups, at its meeting in 2006. If this is not possible then it should be presented no later than its meeting in 2007. This paper should outline the alternative restructuring options and their associated implementation schedules.

5. The Steering Committee should operate primarily by email, potentially facilitated by the Secretariat newsgroup facility, and is open to all Members of the Scientific Committee and its existing working groups.

Intersessional activities during 2005/06

13.12 The Scientific Committee accepted with great pleasure Namibia's invitation to host the 2006 meeting of WG-FSA-SAM (one week) and the meeting of WG-EMM (two weeks) from 10 to 28 July 2006. In addition, a meeting of the newly reformed JAG would be held in association with the meeting of WG-FSA-SAM. The exact dates and venues for these meetings would be announced as soon as possible.

13.13 The Scientific Committee reviewed and endorsed the intersessional work plans of WG-EMM, WG-FSA and ad hoc WG-IMAF.

13.14 The Scientific Committee agreed to the following meetings in the 2005/06 intersessional period:

(i) meeting of SG-ASAM in Hobart in March 2006, in association with the meeting of the ICES Working Group on Fisheries Acoustic Science and Technology (ICES-FAST) (Annex 5, paragraphs 13.9 to 13.11) (Convener – Dr R. O'Driscoll (New Zealand));

(ii) the second workshop on the age determination of *C. gunnari* is scheduled between April and June 2006 (Annex 5, paragraph 9.11) (Convener – to be announced).

(iii) meeting of WG-FSA-SAM in Namibia in the week immediately prior to WG-EMM-06 (approximate dates: 10 to 14 July 2006) (Convener – Dr Jones);

(iv) meeting of JAG in Namibia during the week following WG-FSA-SAM-06 (approximate dates: 17 to 21 July 2006) (Convener – to be announced);

(v) meeting of WG-EMM in Namibia from 17 to 28 July 2006 – the Second Workshop on Management Procedures will be held in week 1 of the meeting (Co-Conveners – Ms Akkers and Dr Reiss);

(vi) meeting of WG-FSA, including ad hoc WG-IMAF, in Hobart from 9 to 20 October 2006 (Convener – Dr Hanchet).

13.15 The dates and venue of the meetings of JAG, SG-ASAM and the age determination workshop will be determined in consultation with meeting organisers and information will be circulated to the Scientific Committee in early 2006.

13.16 The Scientific Committee agreed that the Secretariat should afford the highest priority to the following areas of its work in 2005/06:

- work in support of WG-FSA's assessments of toothfish, icefish and by-catch species;
- work in support of WG-EMM's subdivision of krill catch limits amongst SSMUs in Area 48.

13.17 The Scientific Committee extended a warm welcome to Dr Reid as the incoming Convener of WG-EMM.

Report of WG-FSA

13.18 The Scientific Committee thanked WG-FSA for reorganising the structure and format of its report in line with the guidance provided by the Scientific Committee in 2004 (SC-CAMLR-XXIII, paragraphs 13.12 and 13.13). The main part of the WG-FSA report provided a clear and balanced presentation of the work accomplished in 2005. However, the numerous appendices contributed to a large and complex report which was 119 pages longer, overall, than the report of WG-FSA-04. This had resulted in a budget over-run of some A$44 000 (paragraph 10.1).

13.19 The Scientific Committee recognised that the large size of the report was due partly to reporting of a new assessment method (CASAL) and the first assessment of an exploratory fishery (toothfish in Subareas 88.1 and 88.2), and to the reporting of divergent views regarding some assessments (e.g. toothfish in Subarea 48.3).

13.20 The Scientific Committee also recognised that WG-FSA had developed 'Fishery Reports' for eight fisheries and these were included in the appendices. Some of these fishery reports were not expected to change much over the coming years, and may not require translation on a regular basis.

13.21 The Scientific Committee was very concerned about the budget over-run and discussed ways to reduce the future costs of translating and publishing the report of WG-FSA. All Members agreed that the report was large. However Members' individual needs for information were varied and precluded consensus being reached over which sections of the report should be retained, and which may be removed.

13.22 Further, the Scientific Committee recalled that WG-FSA had tried to reduce the cost of translation in 2003 by placing some appendices in background documents. This approach resulted in information being available in English only and subject to the Rules for Access and Use of CCAMLR Data. While saving considerable costs, this approach was found to be generally unacceptable to Members (SC-CAMLR-XXII, paragraphs 10.3 to 10.5; SC-CAMLR-XXIII, paragraph 13.11).

13.23 The Scientific Committee also noted that the development of new assessment methods and new assessments of exploratory fisheries would require WG-FSA to continue to develop detailed documentation of its work over the next 2–3 years. However, once methods were established, and fishery assessments developed for exploratory fisheries, its was expected that the report of WG-FSA may be reduced in size and complexity.

13.24 The Scientific Committee sought the Commission's advice on the contents of the WG-FSA report: which sections of the report were essential to the Commissioners' work, and which sections were not required? Sections which were not required may be placed in the WG-FSA archive for reference at future working group meetings.

13.25 In order to reduce some of the costs associated with the large WG-FSA report in 2005, the Scientific Committee agreed that the translated Fishery Reports should only be published electronically on the CCAMLR website. It was agreed that these reports would be placed on the 'Publication' section of the website which was in the public domain. The remaining appendices would be translated and published in the report of SC-CAMLR.

Second meeting of the Subgroup on Acoustic Survey and Analysis Methods

13.26 Following recommendations from WG-FSA (Annex 5, paragraph 13.11), the Scientific Committee agreed to hold a second meeting of SG-ASAM.

13.27 The terms of reference for that meeting would be limited to issues with respect to surveys of *C. gunnari*, namely: (i) frequency-specific definition of *C. gunnari* target strength; and (ii) classification of volume backscattering strength attributed to *C. gunnari* versus other taxa.

13.28 The Scientific Committee also requested more general advice on the conduct of acoustic surveys, namely: (i) survey design; (ii) documentation of survey methods; (iii) presentation of results; and (iv) protocols for archiving data.

13.29 Members agreed to make available experts for consultation, particularly those associated with ICES-FAST.

13.30 The Scientific Committee endorsed a plan offered by Dr Hanchet whereby Dr O'Driscoll would convene the second meeting of SG-ASAM, that the meeting would be held for 1–3 days in conjunction with the meeting of ICES-FAST in Hobart, Australia, from 27 to 30 March 2006, and that financial support for the participation of up to three experts be provided. It was expected that financial support for invited experts would be limited to living expenses for experts already in Hobart for the meeting of ICES-FAST.

13.31 The Scientific Committee agreed to the following terms of reference for the participation of invited experts:

1. Attend second meeting of SG-ASAM to be held in conjunction with the meeting of ICES-FAST in Hobart, Australia, from 27 to 30 March 2006.

2. Provide consultation and advice on frequency-specific definition of the acoustic target strength of *C. gunnari*.

3. Provide consultation and advice on classification of volume backscattering strength attributed to *C. gunnari* versus other taxa.

4. Provide consultation and advice on the conduct of acoustic surveys, including: (i) survey design; (ii) documentation of survey methods; (iii) presentation of results; and (iv) protocols for archiving data.

13.32 The Scientific Committee noted that future meetings of SG-ASAM could address target strength and classification of volume backscattering from other taxa; namely *Pleuragramma* spp., myctophid spp. and *E. crystallophias*.

Activities of the CCAMLR-IPY Group during the intersessional period

13.33 In 2004 the Scientific Committee agreed that a synoptic survey in the South Atlantic region would be the most appropriate activity for CCAMLR in the IPY-2008 (SC-CAMLR-XXIII, paragraphs 15.4 to 15.7). The Scientific Committee had noted the suggestions of WG-EMM regarding possible CCAMLR-related activities for the IPY (SC-CAMLR-XXIII, Annex 4, paragraphs 7.1 to 7.4), but recognised that a single large-scale CCAMLR activity for the IPY was most likely to win support of the IPY Planning Group. It was agreed to conduct a synoptic acoustic and net sampling survey in the South Atlantic region which would focus on krill but would collect a range of ancillary physical and biological data including observations on marine zooplankton, marine mammals and birds.

13.34 The Commission noted that the Scientific Committee had established an intersessional steering group under the convenership of Dr Siegel to formulate CCAMLR's Expression of Intent (EoI) for activities in the IPY and submit this document to the IPY Joint Group by the deadline of 14 January 2005 (CCAMLR-XXIII, paragraph 19.8).

13.35 The steering group has developed and submitted this EoI to the Joint IPY Committee (SC-CAMLR-XXIV/BG/2 Rev. 1). Concurrently contact was established with the IWC

Scientific Committee Chair, the Chair of the SCAR Group of Experts on Birds and the steering group of the CoML, inviting these groups to actively participate in the CCAMLR-IPY-2008 activity.

13.36 The Joint IPY Committee evaluated the CCAMLR proposal and formal recognition of the CCAMLR initiative was received by IPY. The CCAMLR proposal was listed on the IPY home page as EoI 148. After comprehensive assessments and discussions in the CCAMLR steering group and with the IPY Joint Group, the CCAMLR Survey 2008 became the 'lead project' for the topic 'Natural Resources, Antarctic'.

13.37 The CCAMLR Steering Committee discussed future activities during the 2005 meeting of WG-EMM. For this purpose it was felt necessary to develop terms of reference for the group to conduct its future planning work. Given that the CCAMLR-IPY-2008 Survey had become the 'lead project' for the core topic 'Natural Resources, Antarctic', the subgroup discussed the wider context of the objectives of the CCAMLR-IPY-2008 Survey.

13.38 Accordingly, and with the support of WG-EMM, the umbrella proposal was drafted and circulated among members of the Steering Group as well as lead scientists of the related proposals that fell within the scope of the CCAMLR consortium. The final proposal was submitted to IPY as a consortium proposal on 7 September 2005 (SC-CAMLR-XXIV/BG/2 Rev. 1).

13.39 The Scientific Committee endorsed the CCAMLR proposal submitted as EoI 148 to conduct a large-scale multi-national multi-ship synoptic survey in 2008. The Scientific Committee also endorsed the extended proposal submitted by the CCAMLR Steering Group and related EoIs as the CCAMLR consortium 'umbrella proposal', which has a wider circum-Antarctic perspective than the core proposal submitted by CCAMLR. The draft 'Terms of Reference' for the CCAMLR Steering Group (see SC-CAMLR-XXIV/BG/2 Rev. 1 and Annex 4, Appendix E) were endorsed by the Scientific Committee.

13.40 The Scientific Committee requested that the Commission formally endorse the CCAMLR core project (EoI 148) and the umbrella project.

13.41 At this time, one Member has committed ship-time for the core project. Several other Members had indicated their willingness to participate in the large-scale survey.

13.42 The Scientific Committee noted the interest expressed by Peru to join the CCAMLR-IPY-2008 Survey. The Scientific Committee welcomed Peru to participate in this international multi-ship exercise as an Acceding State to the Commission. The Scientific Committee endorsed the recommendation to invite Peruvian scientists to the next meeting of WG-EMM and future planning meetings of the CCAMLR-IPY steering group.

13.43 The Scientific Committee encouraged all Members to actively participate in the CCAMLR core project. Firm commitments for ship-time and other activities should be provided to the next subgroup meeting which will be held in association with WG-EMM in July 2006. This information is essential so as the subgroup may begin to plan and coordinate the field activities in accordance with the terms of reference.

Joint CCAMLR-IWC workshop

13.44 The Scientific Committee noted the discussion by WG-EMM (Annex 4, paragraph 6.55) on the work being undertaken in a variety of forums to model the Antarctic marine ecosystem, particularly modelling of krill predators to provide advice on management issues in the region by the Scientific Committees of CCAMLR and the IWC. It also noted the request by WG-EMM for a proposal to be developed for consideration by the Scientific Committee for a joint CCAMLR-IWC workshop (Annex 4, paragraphs 6.33 to 6.37), which was provided in SC-CAMLR-XXIV/BG/31.

13.45 The Scientific Committee noted that:

(i) SC-CAMLR is the leading body to collect, collate and utilise knowledge of krill predators and their interactions with krill and other parts of the ecosystem for the purposes of providing advice on the management of the Antarctic marine ecosystem;

(ii) the Scientific Committee of the IWC (SC-IWC) is the leading body to collect, collate and utilise knowledge of the abundance of whales and utilises these estimates and other knowledge of the Antarctic marine ecosystem for the purposes of providing management advice;

(iii) Members of both Scientific Committees are now developing models of the Antarctic marine ecosystem which could form the basis for providing management advice;

(iv) it would be useful for both Scientific Committees to utilise knowledge of krill predators in a consistent way, such knowledge would be estimates of abundance, trends in populations and parameters for key ecological processes, in particular the physical environment and food-web dynamics.

13.46 The Scientific Committee agreed that a workshop would be useful 'to review the state and characteristics of information, including knowledge on abundance, trends in populations and parameters, required for ecosystem models being developed to provide management advice on krill predators in the Antarctic marine ecosystem.' Also, it would be desirable for this workshop to be jointly coordinated by the Scientific Committees of CCAMLR and the IWC.

13.47 The Scientific Committee agreed to establish a Steering Committee to develop a work program leading to a workshop in 2008. The terms of reference for the workshop were agreed to be:

1. Consider the types of information needed for models on the Antarctic marine ecosystem that could be developed for providing management advice.

2. Consider how the information could be used in modelling the Antarctic marine ecosystem, the quality of the information and key gaps needing to be resolved before such information might be used in the development of those models.

3. Consider metadata, rather than reviewing individual datasets and undertaking analyses to summarise the data, where the metadata would comprise information on the estimates of abundance, population trends and parameters, their data sources and methods used to estimate them.

13.48 The Scientific Committee requested the Steering Committee liaise, as needed, with data owners about how to report on the information to be used in the workshop that arises from their data.

13.49 The Scientific Committee agreed that experts in the development of Antarctic marine ecosystem models generally, such as in GLOBEC, ICED, should be involved in the workshop in order to help facilitate discussion on the types and quality of information needed in developing models for the provision of management advice.

13.50 In undertaking its work, the Steering Committee should consider, *inter alia*:

(i) the Report of the Workshop on Plausible Ecosystem Models for Testing Approaches to Krill Management (SC-CAMLR-XXII, Annex 4, Appendix D);

(ii) reviewing the state and characteristics of information, including knowledge on abundance, trends in populations and parameters, required for ecosystem models being developed to provide management advice on krill predators in the Antarctic marine ecosystem;

(iii) summarising the types of information, including knowledge on abundance, trends in populations and parameters, used to model the Antarctic marine ecosystem for providing management advice, where such information might include, *inter alia*:

(a) the key physical and biological elements of the models defined at appropriate spatial and temporal scales;

(b) production and life history characteristics of the key taxa;

(c) functions dealing with movement and space;

(d) trophic relationships, including predator–prey relationships and competition;

(e) initialising biomasses (current or historical);

(iv) reviewing the relative state of existing information (in terms of extent and quality), with emphasis on the guild of krill predators in the Antarctic food web, including fish, squid, penguins, flighted seabirds, seals and whales, including:

(a) abundance, trends and temporal and spatial structure of populations;

(b) parameters used in capturing relationships between the distribution and behaviour of predators with sea-ice, bathymetry and oceanography;

(v) reviewing the parameters needed to model top-down or bottom-up influences on krill biomass;

(vi) identifying key knowledge gaps;

(vii) the relative importance of the information required to appropriately explore the role of krill predators in the Antarctic marine ecosystem.

13.51 The Scientific Committee recommended that the SC-IWC be invited to join SC-CAMLR in organising this workshop and requested:

(i) the Secretariat correspond with the IWC Secretariat to inform them of this invitation;

(ii) the CCAMLR observer to the IWC, Dr Kock, work with the Steering Committee to correspond with the Chairs of the IWC and the SC-IWC to initiate communication between the two Scientific Committees, with the view to having this invitation considered at the next meeting of the SC-IWC.

13.52 The Scientific Committee requested that the Steering Committee develop a work plan and initiate subgroups to begin preparations of materials for the workshop in 2008 over the intersessional period and provide next year a consolidated proposal for the workshop, including details of a work plan over 2007–2008, a venue and budget. It was agreed that the new CCAMLR Headquarters would be an appropriate workshop venue pending consideration of timing, budget and the availability of the Secretariat.

13.53 The Scientific Committee agreed for the Steering Committee to initially comprise Drs A. Constable (Convener), M. Goebel, K. Kovacs, J. Pierre, P. Trathan and C. Southwell. The Scientific Committee requested that Members participate in the development of the work program and asked that the Steering Committee update, and obtain feedback from, Members during this work.

Invitation of observers to the next meeting

13.54 The Scientific Committee agreed that all observers invited to the 2005 meeting would be invited to participate in SC-CAMLR-XXV.

13.55 The Scientific Committee recognised the significant contributions which observers have made to its work (e.g. see SC-CAMLR-XXIV/7), and examined ways to enhance expert contributions at future meetings of working groups.

13.56 The Scientific Committee agreed that invitations to observers at the meetings of SC-CAMLR could be extended, according to the Rules of Procedure, to intersessional meetings of the working group, subject to the following conditions:

(i) all observers participate at meetings in accordance with the Scientific Committee's rules of procedures;

(ii) observers with expert contributions submit meeting documents in accordance with the guidelines for the submission of meeting documents at working groups (paragraphs 12.13 to 12.16);

(iii) the meeting convener and the Chair of the Scientific Committee would review each meeting document submitted by observers and determine the scientific merit of the contribution and its relevance to the objectives of the meeting;

(iv) subject to approval by the meeting convener and the Chair of the Scientific Committee, observers who provided a significant scientific contribution (by way of a meeting document) would be invited to participate in the intersessional meeting.

13.57 The Scientific Committee agreed it would be useful to harmonise the Rules of Procedure with the intention in paragraph 13.56 at its next meeting.

13.58 During the meeting the Scientific Committee was advised by the Commission of a small proposed change to the Rules of Procedure regarding participation of observers.

13.59 The change was proposed to clarify the notification requirement applicable to observers at meetings.

13.60 The Scientific Committee did not feel able to agree to a change in its Rules of Procedure until any changes made by the Commission were adopted. Accordingly, it recommended that this matter should be addressed at the next meeting of the Scientific Committee. In the intervening period, in the event that problems arise, it requested the Secretariat to take decisions on observer attendance guided by the Commission's rules.

Invitation of experts to the meetings of working groups

13.61 The Scientific Committee agreed to invite external experts to the 2006 meetings of WG-FSA-SAM and SG-ASAM (sections 10 and 13).

Next Meeting

13.62 The next meeting of the Scientific Committee will be held at the CCAMLR Headquarters in Hobart, Australia, from 23 to 27 October 2006.

ELECTION OF THE VICE-CHAIR OF THE SCIENTIFIC COMMITTEE

14.1 Dr Barrera-Oro's term as Vice-Chair ended with this meeting and the Scientific Committee sought nominations for a new Vice-Chair. Dr Barrera-Oro nominated Mr Pshenichnov and this nomination was seconded by Dr Shin. Mr Pshenichnov was unanimously elected to the position for a term of two regular meetings (2006 and 2007). A very warm welcome was extended to the incoming Vice-Chair.

14.2 The Scientific Committee thanked Dr Barrera-Oro for his significant contribution to the work of the Committee.

OTHER BUSINESS

Reports of Members' Activities

15.1 The Scientific Committee noted that the Commission had requested the Secretariat to prepare a document outlining options for improving the Reports of Members' Activities (CCAMLR-XXII, paragraph 3.7). Following consultation with Members in 2004, the Secretariat had tabled a proposal to improve the contents of these reports (CCAMLR-XXIII/7).

15.2 The Commission subsequently agreed that the Reports of Members' Activities should be retained (CCAMLR-XXIII, paragraph 3.8). To improve the content of this publication, the Secretariat was directed to liaise with the Scientific Committee to formulate a proposal addressing the Reports' contents as well as associated requirements for releasing some of their contents into the public domain. Both these issues had been addressed in the Secretariat paper (CCAMLR-XXIII/7, paragraphs 13 to 19).

15.3 In 2005, the Secretariat distributed a circular (SC CIRC 05/28) calling for comments from the Scientific Committee in order to execute the Commission's instruction outlined above. No responses were received and the Secretariat was unable to progress the matter any further. A progress report was submitted to the Scientific Committee (SC-CAMLR-XXIV/6).

15.4 The Scientific Committee considered the options presented in SC-CAMLR-XXIV/6. The Scientific Committee agreed that the Reports of Members' Activities are no longer used in its work.

15.5 The Scientific Committee advised the Commission that the Reports of Members' Activities are no longer required in its work, or that of its working groups.

Submission of meeting documents by international organisations

15.6 The Scientific Committee noted SC-CAMLR-XXIV/BG/19 Rev. 1 and recalled that it had, from time to time, approached international organisations for specific advice or data in support of its work. Consequently, meeting documents had been received and distributed by the Secretariat as papers submitted by international organisations, e.g. papers on the assessment of status and trends in populations of marine mammals and birds submitted by SCAR.

15.7 The Scientific Committee noted that the Secretariat had applied this approach when processing papers with specific advice requested by the Scientific Committee on behalf of ad hoc WG-IMAF and received from BirdLife International for the 2005 meeting of the Working Group.

15.8 The Scientific Committee recognised that requested papers from international organisations often provided information fundamental to the Scientific Committee's work and/or that of its working groups. The Scientific Committee agreed that the above approach was appropriate and that the Secretariat should continue to follow this practice.

Meeting documents in electronic format

15.9 The Scientific Committee noted that both WG-EMM and WG-FSA have established a routine procedure whereby meeting participants may connect their laptops to a server and download meeting documents in electronic format. Further, the document folder on the server is maintained by the Secretariat and contains all meeting documents, including revisions.

15.10 The Scientific Committee agreed that this procedure, if available at its meetings, would also allow delegates with laptops to access documents electronically. Users who chose to use this option may not require the hardcopy bundle of documents. This option may result in substantial savings in the amount of paper used during the meetings.

15.11 The Scientific Committee noted the Secretariat's proposal to establish a wireless network (CCAMLR-XXIV/BG/37), and agreed that such a facility would be of great benefit to meeting participants.

15.12 The Scientific Committee urged the Secretariat to implement a trial at SC-CAMLR-XXV whereby:

(i) delegates would be asked in advance of the meeting whether they wished to participate in the trial;

(ii) delegates participating in the trial would be issued at registration with a CD-ROM containing the meeting documents, and would be able to update their electronic document folder during the meeting using either a wireless network (if possible) or a limited number of network hubs (i.e. cable connection);

(iii) delegates participating in the trial would also retain the option to request a hardcopy bundle should they find the trial difficult to implement.

15.13 For the purpose of this trial, the Secretariat was encouraged to establish a small wireless network for limited use in the Convention Room.

ADOPTION OF THE REPORT

16.1 The report of the Twenty-fourth meeting of the Scientific Committee was adopted.

CLOSE OF THE MEETING

17.1 In closing the meeting, Dr Fanta thanked all the Secretariat staff for their dedicated support, the interpreters for facilitating the plenary discussions, the conveners of working groups, subgroups and other groups for developing the intersessional work of the Scientific Committee, and the rapporteurs and participants for their major contributions to the success of the meeting. Dr Fanta noted that all participants had enjoyed the new meeting venue and the facilities available to delegates.

17.2 Dr Fanta also thanked Dr Hewitt, the outgoing Convener of WG-EMM, and Prof. Croxall, both of whom are leaving CCAMLR, for their very significant contributions to the work of the Scientific Committee over many years. In addition, Dr Fanta had greatly appreciated their guidance during her first meeting in the Chair.

17.3 Dr Holt, on behalf on the Scientific Committee, thanked Dr Fanta for her excellent work in her new role. The Scientific Committee was very appreciative of her leadership and looked forward to the next meeting.

17.4 Dr Holt also expressed the Scientific Committee's great appreciation of Prof. Croxall's long association with Antarctic research and the great expertise which he had contributed to the Scientific Committee over many years.

17.5 Dr Holt also reiterated the Scientific Committee's great appreciation of Dr Hewitt's long association with the Scientific Committee and for his great contribution to Antarctic research. Earlier in the meeting, Dr Constable, on behalf on the Scientific Committee, had also thanked Dr Hewitt for his vision and drive in developing the agenda of WG-EMM, and furthering the Scientific Committee's work in ecosystem monitoring and management.

17.6 Ms G. Tanner (Communications Officer) presented Dr Kirkwood with a new award for best rapporteur at the meeting.

17.7 The meeting was closed.

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Table 1: Illustration of the types of protected areas (in the context of Article IX of the Convention) that could be used by CCAMLR for protection or conservation, noting the need to define areas in geographic coordinates and depth.

Objective	Type of Area
Representativeness	Specially Protected Areas Conservation Zones*
Protection of areas vulnerable to human activities	Specially Protected Areas Conservation Zones* Fisheries Closed Areas+
Science	Specially Protected Areas Conservation Zones* Fisheries Closed Areas+
Protection of ecosystem function	Specially Protected Areas Conservation Zones* Fisheries Closed Areas+

* In the application of the CCAMLR precautionary approach, interim measures may be required for candidate areas while being considered; in this case Conservation Zones could be established.

\+ Established according to the requirements of individual fisheries.

Table 2: Catch (tonnes) of target species for the 2003/04 season (December 2003 to November 2004). Official record of catch provided by Members in STATLANT data.

	Species	Country	Subarea or Division												Total
			48.1	48.2	48.3	48.6	58.4.2	58.4.3	58.5.1	58.5.2	58.6	58.7	88.1	88.2	
Toothfish	*Dissostichus eleginoides*	Argentina											1		1
		Australia					0	1		2 864					2 864
		Chile			1 542										1 542
		EC – France							5 171		537				5 708
		EC – Spain			660										660
		EC – UK			1 392										1 392
		Japan				7									7
		New Zealand											1	0	1
		Norway											0		0
		Korea, Republic of			325										325
		Russian Federation											0		0
		South Africa			232						71	133	0		435
		Ukraine											9		9
		USA											1		1
		Uruguay			346								0		347
	Dissostichus mawsoni	Argentina											162		162
		Australia					20	6							26
		EC – Spain											114		114
		EC – UK											16		16
		New Zealand											782	374	1 157
		Norway											98		98
		Korea, Republic of											105		105
		Russian Federation											261		261
		South Africa											110		110
		Ukraine											154		154
		USA											194		194
		Uruguay											187		187
	Total (toothfish)				4 497	7	20	7	5 171	2 864	607	133	2 197	375	15 877
Icefish	*Champsocephalus gunnari*	Australia								78					78
		Chile			972										972
		EC – UK			678										678
		Korea, Republic of			1 034										1 034
	Total (icefish)				2 683					78					2 762

Table 2 (continued)

	Species	Country	Subarea or Division												Total
			48.1	48.2	48.3	48.6	58.4.2	58.4.3	58.5.1	58.5.2	58.6	58.7	88.1	88.2	
Krill	*Euphausia superba*	EC – UK			16										16
		Japan	5 069	10 668	17 846										33 583
		Poland	1 148	4 795	3 024										8 967
		Korea, Republic of	1 608	9 506	13 408										24 522
		Russian Federation			775										775
		Ukraine		7 981	4 280										12 261
		USA	903	4 366	3 282										8 550
		Vanuatu	5 153	9 140	15 198										29 491
	Total (krill)		13 882	46 456	57 829										118 166

Table 3: Catch (tonnes) of target species for the 2004/05 season (December 2004 to November 2005). Catches reported to date (21 September 2005) in the catch and effort reporting system, unless indicated otherwise.

	Species	Country	Subarea or Division																Total
			48*	48.1	48.2	48.3	48.4	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	58.5.1	58.5.2	58.6	58.7	88.1	88.2	
Toothfish	*Dissostichus eleginoides*	Australia									1			2 783					2 784
		Chile				717													717
		EC – France**											3 186		385				3 571
		EC – Spain				372			0		90	1							463
		EC – UK				1 626	27												1 653
		Japan						47											47
		New Zealand							0	0							1	0	1
		Korea, Republic of								1	9								10
		Russian Federation															5		5
		South Africa				303									31	92			426
		Uruguay															0		0
	Dissostichus mawsoni	Argentina															253		253
		Australia									0			0					0
		Chile							146	25		39							210
		EC – Spain							145	8	10	242							405
		EC – UK															260		260
		New Zealand							21	38							1 499	268	1 826
		Norway															207	4	211
		Korea, Republic of						2	167	54		13							236
		Russian Federation															487	141	628
		Uruguay															367		367
	Total (toothfish)					3 018	27	49	480	127	110	295	3 186	2 783	416	92	3 079	412	14 074
Icefish	*Champsocephalus gunnari*	Australia												1 791					1 791
		Chile				1													1
		EC – UK				20													20
		Korea, Republic of				179													179
		USA																	0
	Total (icefish)					200								1 791					1 991

Table 3 (continued)

Species	Country	Subarea or Division																Total
		48*	48.1	48.2	48.3	48.4	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	58.5.1	58.5.2	58.6	58.7	88.1	88.2	
Euphausia superba	Japan	22 678																22 678
	Poland		436	3 140	759													4 335
	Korea, Republic of		142	21 713	5 065													26 920
	Ukraine		387	10 183	10 573													21 142
	USA			1 072														1 072
	Vanuatu			31 139	17 249													48 389
Total (krill)		22 678	965	67 247	33 646													124 535

* Unspecified within Area 48
** To 31 August 2005

Table 4: Catch (tonnes) of krill (*Euphausia superba*) in Area 48 between the 1999/2000 and 2004/05 seasons, by Member country. Catches reported in 2004/05 are from the monthly catch and effort reports, other catches from STALTANT data.

Species	Code	Country	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05*
Euphausia superba	KRI	Japan	80 602	67 377	51 079	59 682	33 583	22 678
		Poland	20 049	13 696	16 365	8 905	8 967	4 335
		Korea, Republic of	7 233	7 525	14 353	21 276	24 522	26 920
		Russian Federation	-	-	-	-	775	-
		Ukraine	-	14 023	32 015	17 715	12 260	21 142
		UK	-	-	-	-	16	-
		USA	70	1 561	12 174	10 150	8 550	1 072
		Uruguay	6 477	-	-	-	-	-
		Vanuatu	-	-	-	-	29 491	48 389
Total			114 430	104 182	125 987	117 728	118 166	124 535

* Preliminary figures as of September 2005

Table 5: History of allocation of catches in SSRUs in the Ross Sea, including: (a) details of the SSRU and catch limits in 2002/03; (b) the corresponding SSRUs (approximately), proportional allocation, catch limits and landed catches (including by-catch) for 2004/05; (c) the allocation of the 2005 estimate of yield amongst the 2002/03 SSRUs; (d) the data used by WG-FSA in 2005 to propose a proportional allocation of catch limits, the results of those calculations and the resulting catch allocation.

(a) 2002/2003 season		(b) 2004/05						2005/06 catch allocation				
			Dissostichus spp.			*Macrourus* spp.		(c) 2002/03 SSRUs	(d) 2004/05 SSRUs			
SSRU	Catch limit	SSRU	Proportion	Catch limit	Catch	Catch limit	Catch	Catch limit	Fishable area	Historical CPUE	Proportion of yield WG-FSA-05	Catch limit
881A	256	881A	0	0	0			137	4 908	0.09	0.01	31
		881B	0.02	80	70	13	1		4 318	0.2	0.02	59
		881C	0.07	223	428	36	3		4 444	0.55	0.06	165
881B	876	881D	0	0	0			471	49 048	NA	0	0
		881E	0.02	57	55	9	2		14 797	0.09	0.03	90
		881F	0	0	0		0		18 398	0.02	0.01	25
		881G	0.03	83	53	13	16		7 110	0.13	0.02	63
		881H	0.24	786	787	126	28		19 245	0.36	0.16	467
881C	876	881I	0.24	776	612	124	157	471	30 783	0.26	0.18	535
881D	876	881J	0.1	316	193	51	46	471	43 594	0.15	0.15	455
881E	876	881K	0.23	749	736	120	205	471	24 695	0.33	0.19	558
		881L	0.06	180	135	29	4		16 807	0.12	0.05	142
882A			0		137		<1	471	12 478	0.4	0.12	341
882B			0		0		0	471	8 726	0.06	0.01	33

Table 6: Proportional allocation of the catch limit amongst SSRUs based on: (a) the allocation in the 2004/05 season; (b) the advice of the WG-FSA according to the historical CPUE and fishable area in each SSRU; (c) the advice of WG-FSA restricted to SSRUs in which the catch would be greater than 100 tonnes; (d) the proposed experiment over three years to concentrate the fishery into the central north–south band of SSRUs in the Ross Sea. The catch limit resulting from the allocation for the experiment is also shown.

SSRU	(a)	(b)	(c)	(d)	Catch limit
881A	0	0.01	0	0	0
881B	0.02	0.02	0	0.02	72
881C	0.06	0.06	0.06	0.07	200
881D	0	0	0	0	0
881E	0.02	0.03	0	0	0
881F	0	0.01	0	0	0
881G	0.03	0.02	0	0.03	76
881H	0.24	0.16	0.18	0.19	566
881I	0.24	0.18	0.20	0.22	650
881J	0.10	0.15	0.17	0.19	551
881K	0.23	0.19	0.21	0.23	677
881L	0.06	0.05	0.06	0.06	172
882A		0.11	0.12	0	0
882B		0.01	0	0	0

Table 7: Recommended proportional allocation of the yield estimate amongst SSRUs, including the combining of SSRUs in the northern area and in the slope area, for the experiment in the Ross Sea over three years. The resulting catch limits for each SSRU are shown.

SSRU	2004/05 SSRUs combined	Proportional allocation of yield	Recommended catch limit
881A		0	0
881 north	881B, C, G	0.12	348
881D		0	0
881E		0	0
881F		0	0
881 slope	881H, I, K	0.64	1 893
881J		0.19	551
881L		0.06	172
882A		0	0
882B		0	0

Table 8: Scientific Committee budget for 2006 and forecast budget for 2007. The 'Notes' refer to the items described in paragraph 10.1.

2005 Budget	Item	2006 Budget	2007 Forecast	Notes
	WG-FSA			
	Meeting			
5 200	Computing facilities	5 400	5 500	
28 300	Preparation and Secretariat support	29 100	30 000	
99 100	Report completion and translation	80 200	80 400	a
132 600		114 700	115 900	
3 600	Secretariat support for meeting of WG-FSA-SAM Review of the GYM (see text)	3 700	3 800	b
	WG-EMM			
	Meeting			
24 100	Preparation and Secretariat support	24 800	25 500	
36 300	Report completion and translation	37 400	38 500	
60 400		62 200	64 000	
	Other expenses for Scientific Committee program			
51 200	WG-EMM meeting (airfares, subsistence, freight)	52 700	54 300	c
19 300	External experts invited to meetings	12 000	24 600	d, i
	SG-ASAM report (translation and publication)	7 500	7 500	e
	Report on the Workshop on MPAs (publication)	4 000		f
	International Fishery Observer Conference (airfares and subsistence)		12 500	g
	International Polar Year		8 000	h
1 200	**Contingency**	1 200	1 200	
A$ 268 300	Total	A$ 258 000	A$ 291 800	

Table 9: Inventory of Fishery Plans. 'X' seasons included in the plan; '-' data to be prepared. Fisheries are identified by their target species and area of operation (e.g. TOP483 refers to the toothfish fishery in Subarea 48.3).

Fishery	Season																			
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Toothfish																				
TOP483						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TOP5851					-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
TOP5852										X	X	X	X	X	X	X	X	X	X	X
TOP586												-	-	-	-	-	X	X	X	-
TOP587												-	-	X	X	X	X	X	X	-
TOT481													-	X	X	X	X	X	X	-
TOT482													-	X	X	X	X	X	X	-
TOT484								-	-	-	-	-	-	-	-	-	-	-	X	X
TOT485																			X	
TOT486												-	-	-	-	-	X	-	X	X
TOT5841														-	-	-	-	-	X	X
TOT5842															-	-	X	-	X	X
TOT5843a											-	-	-	-	-	-	X	-	X	X
TOT5843b											-	-	-	-	-	-	X	-	X	X
TOT5844												-	-	-	-	-	X	X	X	-
TOT881												X	X	X	X	X	X	X	X	X
TOT882												X	X		X	X	X	X	X	X
TOT883													-	-	-	-	-	-	X	-
Icefish																				
ANI483			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ANI5852										X	X	X	X	X	X	X	X	X	X	X
Other finfish																				
ANS5842															-	-	X	-	X	-
ELC483							-	-	-	-	-	-	-	-	-	-	-	-	X	-
GRV5843a																			X	-
GRV5843b																			X	-
MZZ481						-	-	-	-	-	-	-	-	X	X	X	X	X	X	-
MZZ482						-	-	-	-	-	-	-	-	X	X	X	X	X	X	-
NOG483					-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
NOK5842																			X	-
NOR481		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
NOR482		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
NOR483	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
NOS483					-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
NOS5844						-	-	-	-	-	-	-	X	X	X	X	X	X	X	-
NOT483				-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
PGE483					-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
SSI483					-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
TRL5842															-	-	X	-	X	-
WIC5842															-	-	X	-	X	-
Krill																				
KRI48							X	X	X	X	X	X	X	X	X	X	X	X	X	X
KRI5841												X	X	X	X	X	X	X	X	X
KRI5842								X	X	X	X	X	X	X	X	X	X	X	X	X
Crab																				
KCX483								-	-	-	-	-	-	-	-	-	-	-	X	X
Squid																				
SQS483												-	-	-	-	-	-	-	X	X

ANNEX 1

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LIST OF PARTICIPANTS

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LIST OF DOCUMENTS

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SC-CAMLR-XXIV/3	Report of the meeting of the Working Group on Ecosystem Monitoring and Management (Yokohama, Japan, 4 to 15 July 2005)
SC-CAMLR-XXIV/4	Report of the Working Group on Fish Stock Assessment (Hobart, Australia, 10 to 21 October 2005)
SC-CAMLR-XXIV/5	Development of the electronic volume of the *Statistical Bulletin* Secretariat
SC-CAMLR-XXIV/6	Reports of Members' Activities Secretariat
SC-CAMLR-XXIV/7	Report of the CCAMLR Workshop on Marine Protected Areas (Silver Spring, MD, USA, 29 August to 1 September 2005)
SC-CAMLR-XXIV/8	Proposal to test a new streamer line as a mitigation method to reduce incidental mortality of seabirds in longline fishing Delegation of Spain
SC-CAMLR-XXIV/9	Establishment of a newsgroup for the Subgroup on Development of Operating Models Secretariat

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SC-CAMLR-XXIV/BG/1	Catches in the Convention Area in the 2003/04 and 2004/05 seasons Secretariat
SC-CAMLR-XXIV/BG/2 Rev. 1	Convener's summary on intersessional activities of the Subgroup for the Implementation of the CCAMLR-2008-IPY-Survey V. Siegel (Convener, Steering Group 'CCAMLR-2008-IPY-Survey')

SC-CAMLR-XXIV/BG/3	Report of the First Meeting of the Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) (La Jolla, USA, 31 May to 2 June 2005)
SC-CAMLR-XXIV/BG/4	Recolección de desechos marinos en la temporada 2004/05 en Cabo Shirreff, Isla Livingston, Shetland del sur, Antártica Delegación de Chile
SC-CAMLR-XXIV/BG/5	Summary of notifications for new and exploratory fisheries in 2005/06 Secretariat
SC-CAMLR-XXIV/BG/6	Data Management: report on activities during 2004/05 Secretariat
SC-CAMLR-XXIV/BG/7	Summary of scientific observation programmes undertaken during the 2004/05 season Secretariat
SC-CAMLR-XXIV/BG/8	Report on the 21st session of the Coordinating Working Party on Fisheries Statistics (CWP) Secretariat
SC-CAMLR-XXIV/BG/9	Observer's Report from the 57th Meeting of the Scientific Committee of the International Whaling Commission (Ulsan, Republic of Korea, 30 May to 10 June 2005) CCAMLR Observer (K.-H. Kock, Germany)
SC-CAMLR-XXIV/BG/10	Report on the 4th International Fisheries Observer Conference (Sydney, Australia, 8 to 11 November 2005) CCAMLR Observer (Secretariat)
SC-CAMLR-XXIV/BG/11	Report of the Convener of WG-EMM-05 to SC-CAMLR-XXIV
SC-CAMLR-XXIV/BG/12	Synopses of papers submitted to WG-EMM-05 Secretariat
SC-CAMLR-XXIV/BG/13	Review of CCAMLR activities on monitoring marine debris in the Convention Area Secretariat
SC-CAMLR-XXIV/BG/14	Fishing equipment, marine debris and hydrocarbon soiling associated with seabirds at Bird Island, South Georgia, 2004/05 Delegation of the United Kingdom

SC-CAMLR-XXIV/BG/15	Beach debris survey – Main Bay, Bird Island, South Georgia, 2003/04 Delegation of the United Kingdom
SC-CAMLR-XXIV/BG/16	Entanglement of Antarctic fur seals (*Arctocephalus gazella*) in man-made debris at Bird Island, South Georgia, during the 2004 winter and 2004/05 breeding season Delegation of the United Kingdom
SC-CAMLR-XXIV/BG/17	Beach debris survey Signy Island, South Orkney Islands, 2004/05 Delegation of the United Kingdom
SC-CAMLR-XXIV/BG/18	Entanglement of Antarctic fur seals (*Arctocephalus gazella*) in man-made debris at Signy Island, South Orkney Islands, 2004/05 Delegation of the United Kingdom
SC-CAMLR-XXIV/BG/19 Rev. 1	Submission of papers by international organisations on direct request from the Scientific Committee and its working groups Secretariat
SC-CAMLR-XXIV/BG/20	Antarctic marine ecosystem research in the CCAMLR Area Submitted by ASOC
SC-CAMLR-XXIV/BG/21	Ecosystem management of the Antarctic krill fishery Submitted by ASOC
SC-CAMLR-XXIV/BG/22	Marine noise pollution – mitigation and the need for wider protection Submitted by ASOC
SC-CAMLR-XXIV/BG/23	Report from the 2005 ICES Annual Science Conference (Aberdeen, UK, 20 to 25 September 2005) CCAMLR Observer (M. Collins, UK)
SC-CAMLR-XXIV/BG/24	Calendar of meetings of relevance to the Scientific Committee in 2005/06 Secretariat
SC-CAMLR-XXIV/BG/25	Scientific justification for a marine protected area designation around the Balleny Islands to protect ecosystem structure and function in the Ross Sea region, Antarctica: progress report Delegation of New Zealand

SC-CAMLR-XXIV/BG/26	IMAF risk assessment of fisheries by statistical area Ad Hoc Working Group on Incidental Mortality Associated with Fishing (WG-IMAF)
SC-CAMLR-XXIV/BG/27	Incidental mortality of seabirds during unregulated longline fishing in the Convention Area Ad Hoc Working Group on Incidental Mortality Associated with Fishing (WG-IMAF)
SC-CAMLR-XXIV/BG/28	Intersessional work plan for Ad Hoc WG-IMAF for 2005/06 Ad Hoc Working Group on Incidental Mortality Associated with Fishing (WG-IMAF)
SC-CAMLR-XXIV/BG/29	Ad Hoc WG-IMAF Conveners' summary for the Scientific Committee 2005
SC-CAMLR-XXIV/BG/30	A proposal for streamlining the work of the Scientific Committee for the Conservation of Antarctic Marine Living Resources Delegation of Australia
SC-CAMLR-XXIV/BG/31	Proposal for a joint CCAMLR-IWC Workshop: data and parameter requirements for models exploring the roles of predators in the Antarctic marine ecosystem Delegation of Australia
SC-CAMLR-XXIV/BG/32	Brazilian voluntary report on the Implementation of the ACAP Action Plan Delegation of Brazil
SC-CAMLR-XXIV/BG/33	Brazilian International Scientific Observers Course for Fisheries in the Convention Area Delegation of Brazil
SC-CAMLR-XXIV/BG/34	Report of the Convener of WG-FSA to SC-CAMLR-XXIV, October 2005

Other documents

SC-CAMLR-XXIV/P1	Kock, K.-H., K. Reid, J. Croxall and S. Nicol. Fisheries in the Southern Ocean – an ecosystem approach. *Trans. Roy. Soc. Lond.* (in press)
WS-MPA-05/4	Marine protected areas in the context of CCAMLR: a management tool for the Southern Ocean IUCN information paper Submitted by IUCN

WG-EMM-05/6	Summary of notifications for krill fisheries in 2005/06 Secretariat
WG-EMM-05/32	On the use of scientific observers on board krill fishing vessels Delegation of Ukraine

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CCAMLR-XXIV/4	Review of the 2005 budget, draft 2006 budget and forecast budget for 2007 Executive Secretary
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CCAMLR-XXIV/7	Executive Secretary's report to SCAF 2005 Executive Secretary
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CCAMLR-XXIV/8 ADDENDUM	Watching brief on the Fishery Resource Monitoring System (FIRMS) and the partnership arrangement Secretariat
CCAMLR-XXIV/9	Notification of Spain's proposal to conduct exploratory fisheries for toothfish (*Dissostichus* spp.) in CCAMLR Subareas 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b in the 2005/06 season Delegation of Spain

CCAMLR-XXIV/10	Notification of exploratory fisheries for *Dissostichus* spp. in the 2005/06 season in CCAMLR Subarea 48.6 Delegation of Japan
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CCAMLR-XXIV/17	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.1 for *Dissostichus* spp. Delegation of Australia
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CCAMLR-XXIV/21	Notification by the United Kingdom of its intention to participate in the exploratory fishery for *Dissostichus* spp. in CCAMLR Subareas 88.1 and 88.2 during the 2005/06 season Delegation of the United Kingdom
CCAMLR-XXIV/22	Notification of exploratory fisheries for *Dissostichus* spp. in the 2005/06 season in Subareas 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b Delegation of the Republic of Korea
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CCAMLR-XXIV/26	Notification to conduct an exploratory longline fishery in Division 58.4.2 for *Dissostichus* spp. on board of the *Globalpesca I* and *II* in the 2005/06 season Delegation of Chile

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CCAMLR-XXIV/39	Implementation of Conservation Measures 10-06 and 10-07 draft lists of IUU vessels, 2005 Secretariat
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CCAMLR-XXIV/BG/4	Report of Conference on the Governance of High Seas Fisheries and the UN Fish Agreement: moving from words to action (1 to 5 May 2005, St John's, Canada) Executive Secretary

CCAMLR-XXIV/BG/5	Report of Interministerial Task Force Meeting on IUU Fishing (9 and 11 March 2005, Paris, France and Rome, Italy) Executive Secretary
CCAMLR-XXIV/BG/6	Report of attendance at the Twenty-sixth Meeting of the FAO Committee on Fisheries (COFI), the Fourth Meeting of Regional Fisheries Bodies (RFBs) and the FAO Ministerial Meeting on Fisheries (7 to 15 March 2005, Rome, Italy) Executive Secretary
CCAMLR-XXIV/BG/7	Report of the CCAMLR Observer to ATCM-XXVIII (Stockholm, Sweden, 6 to 17 June 2005) Executive Secretary
CCAMLR-XXIV/BG/8	Report on the Global Fisheries Enforcement Training Workshop (18 to 22 July 2005, Kuala Lumpur, Malaysia) Secretariat
CCAMLR-XXIV/BG/9	Report of CCAMLR Observer to the First ACAP Meeting of Parties and Advisory Committee Meeting (Hobart, Australia, 8 to 12 November 2004 and 20 to 22 July 2005) CCAMLR Observer (Secretariat)
CCAMLR-XXIV/BG/10	Summary of potential items for the Commission's attention from various Secretariat reports Executive Secretary
CCAMLR-XXIV/BG/11	Financial support for CCAMLR meeting attendance by non-Contracting Party Developing States Secretariat
CCAMLR-XXIV/BG/12	Summary of current conservation measures and resolutions in force 2004/05 Secretariat
CCAMLR-XXIV/BG/13	Implementation of fishery conservation measures in 2004/05 Secretariat
CCAMLR-XXIV/BG/14	Implementation of the System of Inspection and other CCAMLR enforcement provisions in 2004/05 Secretariat

CCAMLR-XXIV/BG/15	Implementation and operation of the Catch Documentation Scheme in 2004/05 Secretariat
CCAMLR-XXIV/BG/16	Report of the E-CDS trial Secretariat
CCAMLR-XXIV/BG/17	Implementation and operation of the Centralised Vessel Monitoring System (C-VMS) in 2004/05 Secretariat
CCAMLR-XXIV/BG/18	Development and maintenance of the CCAMLR Vessel Database Secretariat
CCAMLR-XXIV/BG/19	On the determination and establishment of marine protected area in the area of the Argentina Islands Archipelago Delegation of Ukraine
CCAMLR-XXIV/BG/20	Report on the VIII Meeting of the Committee for Environmental Protection (Stockholm, Sweden, 6 to 10 June 2005) Chair of the CCAMLR Scientific Committee
CCAMLR-XXIV/BG/21	Plan d'action pour l'évaluation du stock de légine dans les Terres australes et antarctiques françaises (une campagne de chalutage scientifique) Délégation française
CCAMLR-XXIV/BG/22	État des mesures mises en œuvre par les armements à la pêche français impliqués dans la pêcherie palangrière de légine des TAAF, pour maîtriser la mortalité accidentelle d'oiseaux Délégation française
CCAMLR-XXIV/BG/23	Étude relative aux pétrels Délégation française
CCAMLR-XXIV/BG/24	Note de commentaires sur les chiffres communiqués par la France concernant la mortalité aviaire accidentelle Délégation française
CCAMLR-XXIV/BG/25	Fonctions et attributions des contrôleurs de pêche Délégation française
CCAMLR-XXIV/BG/26	Expérimentations relatives à la lutte contre la mortalité aviaire Délégation française

CCAMLR-XXIV/BG/27	L'E-CDS moderne Délégation française
CCAMLR-XXIV/BG/28	Modification de la réglementation relative à la mortalité aviaire dans les Terres australes et antarctiques françaises Délégation française
CCAMLR-XXIV/BG/29	Projet de station de distribution de gasoil aux navires extérieurs à Kerguelen Délégation française
CCAMLR-XXIV/BG/30	CCAMLR Symposium Report Delegations of Australia and Chile
CCAMLR-XXIV/BG/31	Invitation from the Western and Central Pacific Fisheries Commission Secretariat
CCAMLR-XXIV/BG/32	ASOC Priorities for CCAMLR-XXIV Submitted by ASOC
CCAMLR-XXIV/BG/33	Agreement on the Conservation of Albatross and Petrels, summary of the First Session of the Meeting of Parties Delegation of Australia
CCAMLR-XXIV/BG/34	Report from the CCAMLR Observer to the 3rd IUCN World Conservation Congress (17 to 25 November 2004, Bangkok, Thailand) CCAMLR Observer (Australia)
CCAMLR-XXIV/BG/35 Rev. 1	Calendar of meetings of relevance to the Commission in 2005/06 Secretariat
CCAMLR-XXIV/BG/36	Report on the activities of the Scientific Committee on Antarctic Research (SCAR) 2004/05 SCAR Observer to CCAMLR G. Hosie (Australia)
CCAMLR-XXIV/BG/37	Installation of a wireless network at the CCAMLR Secretariat Headquarters Secretariat

CCAMLR-XXIV/BG/38	Assessment of IUU fishing activities in the French waters bordering Kerguelen and Crozet Islands for the season 2004/05: general information concerning CCAMLR Area 58 (1 June 2004 to 30 June 2005) Delegation of France (available in English and French)
CCAMLR-XXIV/BG/39	Rapport concernant les activités du Comité des pêcheries de l'Organisation de coopération et de développement économiques (OCDE) Délégation française
CCAMLR-XXIV/BG/40	FAO Observer's Report FAO Observer (R. Shotton)
CCAMLR-XXIV/BG/41	The 57th Annual Meeting of the International Whaling Commission (20 to 24 June 2005, Ulsan, Republic of Korea) CCAMLR Observer (Republic of Korea)
CCAMLR-XXIV/BG/42	Observer's Report on the WTO Committee on Trade and Environment (CTE) 2005 CCAMLR Observer (New Zealand)
CCAMLR-XXIV/BG/43 Rev. 1	Letter from CCSBT on Cooperation with CCAMLR in the management of blue fin tuna in the CCAMLR Area Secretariat
CCAMLR-XXIV/BG/44	Report of the World Conservation Union (IUCN) Twenty-fourth Meeting of the Commission for the Conservation of Antarctic Marine Living Resources 24 October to 4 November 2005 Submitted by IUCN
CCAMLR-XXIV/BG/45	IWC Observer's Report to CCAMLR Annual Meeting 2005 IWC Observer (B. Fernholm, Sweden)
CCAMLR-XXIV/BG/46	See document CCAMLR-XXIV/43
CCAMLR-XXIV/BG/47	Drafts of revised conservation measures prepared by SCIC at CCAMLR-XXIV
CCAMLR-XXIV/BG/48	Report of Scientific Committee Chair to the Commission
CCAMLR-XXIV/BG/49	Report from the CCAMLR Observer to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT12) CCAMLR Observer (Australia)

CCAMLR-XXIV/BG/50	Vessel information in support of exploratory fishery notifications Secretariat
CCAMLR-XXIV/BG/50 ADDENDUM	Vessel information in support of exploratory fishery notifications Secretariat

ANNEX 3

AGENDA FOR THE TWENTY-FOURTH MEETING OF THE SCIENTIFIC COMMITTEE

AGENDA FOR THE TWENTY-FOURTH MEETING OF THE SCIENTIFIC COMMITTEE

1. Opening of the meeting
   - (i) Adoption of the agenda
   - (ii) Report of the Chair
   - (iii) Preparation of advice to SCAF and SCIC

2. CCAMLR Scheme of International Scientific Observation
   - (i) Scientific observations conducted in the 2004/05 fishing season
   - (ii) Advice to the Commission

3. Ecosystem monitoring and management
   - (i) Advice from WG-EMM
   - (ii) Management of protected areas
   - (iii) Interactions between WG-FSA and WG-EMM
   - (iv) Advice to the Commission

4. Harvested species

   - (i) Krill resources
     - (a) Status and trends
     - (b) Advice from WG-EMM
     - (c) Advice to the Commission

   - (ii) Fish resources
     - (a) Status and trends
     - (b) Target species
     - (c) Advice from WG-FSA
     - (d) Advice to the Commission

   - (iii) New and exploratory fisheries
     - (a) New and exploratory fisheries in the 2004/05 season
     - (b) Notifications for new and exploratory fisheries in the 2005/06 season
     - (c) Revision of boundaries
     - (d) Advice to the Commission

   - (iv) Crab resources
     - (a) Status and trends
     - (b) Advice from WG-FSA
     - (c) Advice to the Commission

   - (v) Squid resources
     - (a) Status and trends
     - (b) Advice from WG-FSA
     - (c) Advice to the Commission

(vi) Fish and invertebrate by-catch
  (a) Status and trends
  (b) Advice from WG-FSA
  (c) Advice to the Commission

5. Incidental mortality
  (i) Incidental mortality of seabirds and marine mammals arising from fisheries
  (ii) Advice to the Commission

6. Additional monitoring and management issues
  (i) Marine debris
  (ii) Marine mammal and bird populations
  (iii) Advice to the Commission

7. Management under conditions of uncertainty about stock size and sustainable yield

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. Budget for 2006 and forecast budget for 2007

11. Advice to SCIC and SCAF

12. Secretariat supported activities
  (i) Data management
  (ii) Publications

13. Scientific Committee activities
  (i) Reorganisation of the work of the Scientific Committee and its working groups
  (ii) Intersessional activities during 2005/06
  (iii) Report of WG-FSA
  (iv) Second meeting of SG-ASAM
  (v) Joint CCAMLR-IWC workshop
  (vi) Invitation of observers to the next meeting
  (vii) Invitation of experts to the meetings of working groups
  (viii) Next meeting

14. Election of Vice-Chair of the Scientific Committee

15. Other business

16. Adoption of the Report of the Twenty-fourth Meeting of the Scientific Committee

17. Close of the meeting.

ANNEX 4

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT

(Yokohama, Japan, 4 to 15 July 2005)

CONTENTS

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT

(Yokohama, Japan, 4 to 15 July 2005)

INTRODUCTION

Opening of the meeting

1.1 The eleventh meeting of WG-EMM was held at the National Research Institute of Fisheries Science (NRIFS), Yokohama, Japan, from 4 to 15 July 2005. The meeting was convened by Dr R. Hewitt (USA).

1.2 Dr Hewitt thanked Dr M. Naganobu and Mr A. Hachimine (Japan) and the NRIFS for hosting the meeting, and welcomed the participants.

1.3 Dr Hewitt outlined the program of work for the meeting which comprised two main elements:

- the Workshop on Management Procedures to Evaluate Options for Subdividing the Krill Catch Limit among Small-scale Management Units (SSMUs) which was conducted from 4 to 8 July 2005 (Section 2);

- the core business of the Working Group which was considered during the second week of the meeting.

1.4 Some of the core business was further developed by the:

- Advisory Subgroup on Protected Areas
- Subgroup on Methods
- Subgroup of the Steering Group for the 'CCAMLR-IPY-2008 Survey'
- Predator Survey Correspondence Subgroup.

Adoption of the Agenda and organisation of the meeting

1.5 The Provisional Agenda was discussed and adopted with the following changes (Appendix A):

- Subitems 4.2 and 6.2 were merged and renamed '6.2 Ecosystem models, assessments and approaches to management';

- Subitem 4.3 was deleted from the agenda because no new information had been submitted to the meeting. However, the Working Group agreed that this subitem should remain on the agenda for next year's meeting.

1.6 The meeting participants are listed in Appendix B. The documents submitted to the meeting are listed in Appendix C.

1.7 The report was prepared by Drs A. Constable (Australia), M. Goebel (USA), C. Jones (USA), S. Kawaguchi (Australia), G. Kirkwood (UK), P. Penhale (USA), D. Ramm (Data Manager), K. Reid (UK), H.-C. Shin (Republic of Korea), C. Southwell (Australia), P. Trathan (UK), W. Trivelpiece (USA), J. Watkins (UK) and G. Watters (USA).

WORKSHOP ON MANAGEMENT PROCEDURES

2.1 Following the past four workshops at WG-EMM in support of the development of a revised management procedure for krill, WG-EMM (SC-CAMLR-XXIII, Annex 4, paragraph 6.13) and the Scientific Committee (SC-CAMLR-XXIII, paragraphs 3.86 to 3.90) agreed that the first workshop to evaluate management procedures for the krill fishery should examine the six candidate methods for subdividing the krill catch. The agreed candidate methods to be evaluated were based on:

(i) the spatial distribution of catches by the krill fishery;

(ii) the spatial distribution of predator demand;

(iii) the spatial distribution of krill biomass;

(iv) the spatial distribution of krill biomass minus predator demand;

(v) spatially explicit indices of krill availability that may be monitored or estimated on a regular basis;

(vi) pulse-fishing strategies in which catches are rotated within and between SSMUs.

2.2 The Working Group agreed that, in order to provide information upon which management advice could be developed within the objectives of CCAMLR, performance measures were required to evaluate which options were robust or sensitive both to the initialisation data and conditions and to the alternative structural assumptions.

2.3 The Working Group agreed that the performance measures for krill that were based on the current operational decisions used by CCAMLR in the management of the krill fishery would be appropriate. For krill predators, two categories of potential performance measures were considered by the Working Group; these were based on rates of decline and recovery that are scaled to generation times, and the frequency with which these populations were below a reference ‘depletion’ level or above a reference ‘recovery’ level. In the case of the krill fishery, performance measures based on absolute catch, catch as proportion of allocation, probability of ‘voluntary change’ (where krill density falls below specified threshold) and the deviation of fishing patterns from historical patterns of spatial distribution were considered appropriate (Appendix D, paragraphs 4.1 and 4.6).

2.4 Three papers describing models relevant to the evaluation of options for the subdivision of the precautionary catch limit for krill amongst SSMUs in Area 48 were presented.

2.5 WG-EMM-05/13 described a krill–predator–fishery model (KPFM) developed specifically to address options for subdivision of the precautionary catch limit in Area 48 amongst SSMUs. The model is designed to investigate the performance of the identified options and their sensitivity to numerical and structural uncertainty. The model is spatially resolved to the level of SSMUs and surrounding oceanic areas, and it includes the transport of krill between these areas. Krill and predator population dynamics (of up to four predators in each SSMU, typically generic seal, whale, penguin and fish) are implemented with coupled delay-difference models, which are formulated to accommodate various assumptions about the recruitment and predation processes. The fishery is represented as a simultaneous and equal competitor with predators for available krill. Monte Carlo simulations can be used to integrate the effects of numerical uncertainty, and structural uncertainty can be assessed by comparing and merging results from multiple such simulations. A range of possible performance measures was also presented that can be used to evaluate catch-allocation procedures and assess trade-offs between predator and fishery performance. The paper provided basic instructions on running the model in S-Plus and illustrated its use. Although the model necessarily simplifies a complex system, it provides a flexible framework for investigating the roles of transport, production, predation and harvesting in the operation of the krill–predator–fishery system.

2.6 WG-EMM-05/14 outlined a proposed spatial modelling framework that could be used to quantify the flux of krill past islands in the Antarctic Peninsula region, in an attempt to quantify what level and localisation of the fishing effort might impact the land-based predators negatively. The approach described represents work in progress as the focus thus far has been on first developing a model of the possible impact of pelagic fishing on seal and penguin colonies on the South African west coast. The latter ecosystem shares a number of common features with the Antarctic Peninsula ecosystem in that there is a substantial advective flux of either pelagic fish or krill, with both species serving as dominant prey items for colonies of land-based predators in the region concerned. Subject to the availability of data from both predator studies and krill surveys, the South African west coast model methodology could potentially be adapted to the Antarctic Peninsula region. This would permit the evaluation of a wide range of management options taking into account the needs of other species when setting precautionary krill catch limits at an appropriate spatial scale.

2.7 WG-EMM-05/33 described an ecosystem, productivity, ocean, climate (EPOC) model that has been developed in the R statistical language to help explore topical issues on Antarctic marine ecosystems, including impacts of climate change, consequences of over-exploitation, conservation requirements of recovery and interacting species, and the need to evaluate whether harvest strategies are ecologically sustainable. EPOC has been designed as an object-oriented framework, with the main modules on biota, environment, human activities and management. Each element within a module (e.g. a species in the biota module) is an object carrying all its own functions and data. EPOC is designed to be a fully flexible plug-and-play modelling framework. This is because of the need to easily explore the consequences of uncertainty in model structures but, more importantly, to enable ecosystem modelling to proceed despite widely varying knowledge on different parts of the ecosystem and avoiding the need to guess model parameters for which no information exists. The author noted that EPOC provides these opportunities as well as examining the sensitivity of outcomes to changes in model structures. It can also be used to develop alternative ways of modelling different taxa such that, within the same simulation, different species can be modelled at different spatial and temporal scales as well as with different biological and ecological complexity (Appendix D, paragraphs 5.4 and 5.5).

2.8 During the workshop there was agreement that, given the limited time available, it would concentrate its review on the KPFM. The Working Group noted that the KPFM, with its extensive documentation, graphic outputs and diagnostics, had successfully engaged participants from a wide range of backgrounds, including those with and without sophisticated modelling skills (Appendix D, paragraphs 5.7 and 8.2).

2.9 The Working Group recognised that there was a range of possible formats for the presentation of information for making decisions. Graphical presentation was thought to convey important properties of performance measures. Overall, the Working Group indicated that it preferred graphical presentation over tabular presentation, particularly with respect to what might be considered to be robust performance, where large amounts of data were to be summarised (Appendix D, paragraphs 4.7 and 4.8).

2.10 The Working Group agreed that considerable progress had been made this year sufficient for it to believe that a further year's work should allow the delivery of appropriate advice on the evaluation of options for the subdivision of the precautionary catch limit for krill in Area 48.

2.11 In order to achieve this, however, it was essential that appropriate benchmarks be established. It was agreed that it would be necessary to present to WG-EMM next year sets of results that demonstrated the sensitivity of results and performance measures to plausible ranges of model parameters and structural hypotheses and robustness to uncertainties. The Working Group agreed that at least three key aspects should be given further attention in the models and their implementation (Appendix D, paragraphs 5.8 to 5.10, 5.18 and 5.19):

(i) incorporation of shorter time steps and/or seasonality
(ii) incorporation of alternative movement hypotheses
(iii) incorporation of a threshold krill density below which a fishery will not operate.

STATUS AND TRENDS IN THE KRILL FISHERY

Fishing activity

3.1 The Secretariat advised that 10 vessels had been licensed to fish for krill in Area 48 in the 2004/05 season. At the time of preparing WG-EMM-05/5, nine vessels had harvested krill, and the total catch of krill reported so far this season was 62 049 tonnes. This total did not include the catch taken by Vanuatu in April, as the monthly report was overdue. Most of the catch was taken in Subarea 48.2 between January and May. So far, the Republic of Korea has reported the largest catch of krill (19 675 tonnes), followed by Vanuatu (17 087 tonnes), Japan (11 653 tonnes), Ukraine (8 929 tonnes), Poland (3 633 tonnes) and the USA (1 072 tonnes) (WG-EMM-05/5).

3.2 Dr Ramm advised that Vanuatu had submitted all overdue data during the week prior to the meeting. Based on this season's catch reported to April 2005, and the equivalent catch reported to April 2004, the preliminary estimate of total catch for the 2004/05 season was approximately 165 000 tonnes. The Working Group noted that this forecast indicated a 33% increase from last year's total catch.

3.3 In the 2003/04 fishing season, based on STATLANT data, the total catch of krill in Area 48 was 118 166 tonnes. Japan remained the largest taker of krill with a total catch of 33 583 tonnes. The Republic of Korea and Vanuatu also reported large catches, followed by Poland, Ukraine, USA, Russia and the UK (WG-EMM-05/5, Table 6).

3.4 Krill catches in Area 48 have been relatively steady since the 1999/2000 season (104 425–125 987 tonnes per annum) however, catches by Japan decreased markedly during this period, from 80 597 tonnes (1999/2000) to 33 583 tonnes (2003/04). Catches by Poland have also declined from 20 049 tonnes (1999/2000) to 8 967 tonnes (2003/04). In contrast, catches by the Republic of Korea increased from 2 849 tonnes (1997/98) to 24 522 tonnes (2003/04). Vanuatu entered the fishery in 2003/04 with a reported catch of 29 491 tonnes (WG-EMM-05/5).

3.5 Distribution of catch among SSMUs was analysed using fine-scale data by weighting the catch to the total catch reported in STATLANT data (WG-EMM-05/5, Table 8). Catches in excess of 30 000 tonnes of krill in a single season have been taken in nine SSMUs, and in the past six seasons (1998/99 to 2003/04), the maximum annual catch per SSMU was taken within three SSMUs.

3.6 The Working Group was in agreement that fine-scale data submission on a haul-by-haul basis is preferred to adequately describe krill catch from each SSMU.

3.7 A total of 10 vessels from six Members (Japan, Republic of Korea, Norway, Russia, Ukraine and the USA) notified their intention to fish for krill in Area 48 in 2005/06. The total expected catch was 247 500 tonnes. Notably, Norway expressed its intention to fish for the first time, and expected to catch 100 000 tonnes which is the highest expected catch among the notifying Members. This is followed by 50 000 tonnes by the USA, approximately 30 000 tonnes by Ukraine, approximately 25 000 tonnes each by Japan and the Republic of Korea and 15 000 tonnes by Russia. The type of product was wide ranging: raw, boiled, peeled, meal, oil, frozen and dried shell (WG-EMM-05/6). In addition, the Secretariat advised that Uruguay had notified its intent to fish for krill using a single vessel. This notification had been made during the week prior to the meeting and no further detail was available.

3.8 Dr V. Siegel (Germany) asked for clarification through the Secretariat as to whether Vanuatu would continue fishing in the 2005/06 fishing season. Dr Ramm advised that, in follow-up correspondence with Norway regarding its notification, Norway had indicated that the Vanuatu-flagged vessel *Atlantic Navigator* would cease fishing for krill in August 2005, and be replaced by the Norwegian-flagged vessel *Saga Sea* which would begin fishing in December under the Norwegian notification.

3.9 The Working Group noted the increasing number of recent new entrants into the fishery. It also noted that the expected catch from the 2004/05 season of 165 000 tonnes was less than last year's total intention of 226 000 tonnes.

3.10 Some members interpreted this as an indication of possible growing demand or development of a new market. However, other members noted that the expression of intent to fish is arbitrary. The fishing operators tend to indicate the maximum possible catch and not necessarily the realistic catch, therefore discussion of trends should be based on reported catches.

3.11 Dr Shin noted that the total expected catch is often determined by the overly optimistic projections by new entrants and has not been a reliable prediction. He also noted that there is not a great deal of evidence to indicate a rapid expansion of the krill fishery.

By-catch

Fish

3.12 The Secretariat advised that scientific observers have reported by-catch of fish and invertebrates from a total of 4 431 tows in the krill fishery in Area 48, indicating a by-catch of approximately 0.05% by weight. The by-catch in Area 48 is dominated by *Champsocephalus gunnari*, both by number (69%) and weight (39%) (WG-EMM-05/5).

3.13 Fish by-catch from Japanese-flagged krill trawlers at South Georgia was also reported (WG-EMM-05/19). Japan now has accumulated an extensive amount of fish by-catch data from Area 48. The Working Group thanked Japan for its ongoing contribution to knowledge of the krill fishery and encouraged further overall analysis of the entire by-catch data.

Fur seals

3.14 Based on data submitted to the Secretariat, 208 Antarctic fur seals and two individuals of an unknown species have been reported as killed accidentally in the krill fishery in Area 48, and all fatalities occurred in the 2003/04 season (WG-EMM-05/5). There were no records of incidental catches in the krill fishery between 1999/2000 and 2002/03 in the CCAMLR database. However, the Working Group noted that 53 seals were killed in 2002/03 (SC-CAMLR-XXIII, paragraph 5.34) but the data were not reported to the Secretariat in the specified format and hence were not included in WG-EMM 05/5.

3.15 In 2004, the Scientific Committee recommended that exclusion devices should be employed by all vessels engaged in the krill fishery so as to minimise the incidental catch of fur seals and that observers should be deployed on all vessels to assess the effectiveness of these devices (SC-CAMLR-XXIII, paragraph 5.37).

3.16 The Secretariat noted that 25 Antarctic fur seals had been killed accidentally in the krill fishery during 2004/05 thus far, however there was no information available as to whether exclusion devices were employed on these vessels or not, therefore it was unclear how this fur seal by-catch was influenced by the use of exclusion devices.

3.17 The Working Group recognised that there was a paper in preparation for *CCAMLR Science* reviewing mitigation measures. The paper had been prepared in response to a request from the Scientific Committee last year (SC-CAMLR-XXIII, paragraph 5.37). The Working Group requested that the paper be presented to ad hoc WG-IMAF at its meeting in 2005.

3.18 The Working Group emphasised the need for the evaluation of exclusion devices and agreed that WG-IMAF has the appropriate expertise to deal with this problem, and therefore agreed to ask WG-IMAF to further consider this issue at its next meeting.

Description of fishery

Historical pattern of fishing ground selection

3.19 WG-EMM-05/28 summarised succession of fishing ground usage in space and time since the early 1980s. Among the 15 SSMUs within Subareas 48.1, 48.2 and 48.3, including the pelagic SSMUs, only one-third of these were identified as the main contributors to the total catch (SGE, SOW, APEI, APDPE, APDPW).

3.20 A shift of operational timing towards later months within fishing seasons was observed in Subarea 48.1 (from December–February to March–May). However, operational timing stayed relatively constant in Subareas 48.2 (March–May) and 48.3 (June–August).

3.21 These patterns of seasonal SSMU selection were characterised using cluster analysis. Frequently used SSMUs did not always match the areas of high krill densities observed by scientific surveys. This may be because skippers tended to fish at preferred fishing grounds. However, in the long term, it was thought that the patterns may also change with time, possibly through gaining experience, analysis of available information, and in response to changing economic environments.

3.22 The Working Group noted that the information would be useful in developing the SSMU management procedure (Appendix D, paragraphs 3.28 to 3.35).

New technology

3.23 WG-EMM-05/12 provided details of the fishing methods employed by the *Atlantic Navigator*. The vessel used a conventional fishing system with pelagic net and a continuous fishing system using midwater trawl with air-bubbling suspension which continuously pumped krill from the codend to the vessel. Both methods were alternatively used, depending on the distribution, density and behaviour of krill concentrations, weather and sea state, skipper's decision and processing capacity of the factory. The continuous fishing system was best used to fish shallow aggregations of krill within reach of the pumping hose.

3.24 Dr Kawaguchi noted that the observer data (see paragraph 3.28) gave the Working Group an opportunity to understand the operation pattern of the fishery early in its development, as well as the difference in the krill catch composition between these two different fishing methods.

3.25 Selectivity and mortality of krill by the new method needs to be understood to estimate the impact on the krill population. Dialog between fishing operators and Working Group members was encouraged to obtain this information.

3.26 The Working Group examined whether or not the pumping method could be categorised as a 'new or exploratory fishery'. It was concluded that the fishery based on this method would not be considered new or exploratory if selectivity of krill, characterisation of the haul (how to describe the catch rate), and spatial information of where (SSMU) the catch was caught could adequately be described.

3.27 The Working Group agreed to seek advice from WG-FSA on the kind (type of format) of information and data needed to allow cross-fleet comparison between different fishing methods in order to understand the trends in the krill fishery.

3.28 The Working Group thanked the Uruguayan observers for submitting their useful observer report, and hoped that the entire observer dataset would be submitted to the Secretariat in the near future.

Scientific observation

CCAMLR international scientific observers

3.29 The Secretariat has received two notifications for scientific observers on krill fishing vessels in Area 48 in 2004/05:

(i) Ukraine: one national scientific observer on *Foros* (Ukraine)

(ii) Uruguay: one international scientific observer on *Atlantic Navigator* (Vanuatu), whose observer report was submitted to the current Working Group meeting.

3.30 Six scientific observer datasets from the krill fishery were submitted in the 2003/04 season. At present, the CCAMLR database holds scientific observer data from 20 trips/deployments in the krill fishery between 1999/2000 and 2003/04 in Subareas 48.1, 48.2 and 48.3.

3.31 Although the krill fishing season extends from summer to winter, deployment of CCAMLR scientific observers occurred mainly during summer and autumn (WG-EMM-05/28). The Working Group agreed that CCAMLR scientific observers should be evenly distributed throughout the fishing season to increase the observation coverage.

3.32 As there was no appreciable observer information from Subareas 48.1 and 48.2, the Working Group re-emphasised the need of wider international observer coverage in space and time to further improve the understanding of the operation of the fishery in the entire Area 48 (paragraph 3.45).

3.33 WG-EMM-05/31 summarised the result of a preliminary analysis of krill fishing behaviour based on the questionnaire provided in the *Scientific Observers Manual*. The analysis found that it was difficult to interpret the time-budget data without diagrams of vessel track and positions of krill aggregations. Possible inconsistency of search time definition employed among the skippers and nations was also pointed out.

3.34 WG-EMM-05/30 analysed the behaviour patterns of Japanese krill fishery vessels in Area 48 using questionnaires on the reasons why the vessels changed their fishing grounds.

3.35 The Working Group noted that the type of questionnaire issued routinely in the Japanese krill fishery provided very useful information to understand fishing behaviour, and it was agreed to incorporate these questions in the CCAMLR questionnaire form together with the diagrams of vessel track and positions of krill aggregations.

Regulatory issues

Data submission

Monthly reporting

3.36 The Secretariat advised that most Contracting Parties fishing for krill reported monthly catch and effort by subarea. However, some Parties reported monthly catch and effort by area only. As a result, it is not possible for the Secretariat to estimate catches by SSMU in the current season, nor accurately estimate catch by subarea (WG-EMM-05/5).

3.37 The Working Group agreed to the need for monthly catch and effort reports to be provided at SSMU resolution to support the current move towards the SSMU management regime. Therefore, it recommended that paragraph 2 of Conservation Measure 23-06 be modified to read:

> 'Catches shall be reported in accordance with the monthly catch and effort reporting system set out in Conservation Measure 23-03. When fishing in SSMUs in Area 48, each Contracting Party shall report monthly catch and effort data by SSMU. When fishing in other areas, each Contracting Party shall report monthly catch and effort data by subarea/division.'

3.38 While Dr Naganobu agreed in principle with the reporting of monthly catch and effort data by SSMU, he wished to reserve his position at this meeting because SSMUs are not contained in any of the current conservation measures and he wished to consult with the relevant groups.

Fine-scale catch and effort data reporting

3.39 Dr Ramm reported that all Contracting Parties fishing for krill in the 2003/04 season had submitted fine-scale data. Some of these data were submitted after the deadline of 1 April 2005 (Conservation Measure 23-06).

3.40 The current minimum requirement for fine-scale data is catch and effort aggregated by 10 x 10 n mile rectangle by 10-day period. However, the Commission has encouraged Members to submit fine-scale data on as detailed a level as possible. Recently, with the exception of two Members, all Contracting Parties now submit all their fine-scale data from the krill fishery on a haul-by-haul basis.

3.41 Because of the complex shape of SSMUs, the Working Group agreed that submission of fine-scale data on a haul-by-haul basis is likely to be required to adequately monitor the fishery and allow future management under SSMU subdivision.

3.42 Dr Naganobu stated that, although Japan agreed to the provision of haul-by-haul catch and effort data for scientific purposes on a voluntary basis, it is not agreeable to make it compulsory due to the commercial confidentiality of these data.

3.43 The Working Group requested that the Secretariat revise the data reporting format to accommodate the information arising from the new fishing method (pumping method) so that the properties of the fishing activities are adequately archived (paragraphs 3.23 to 3.27).

Scientific observation

3.44 WG-EMM-05/32 requested scientific observers (international or national) be compulsory for the Antarctic krill fishery.

3.45 The Working Group was in agreement that there is an urgent need for international observers to be deployed on all krill fishing vessels operating in the Convention Area to adequately understand the nature of the krill fishery, especially given the situation of recent change in fishing/processing technology, and needs to maximise seasonal and spatial coverage.

3.46 The majority of members agreed in principle that the deployment of scientific observers should be required on all krill fishing vessels. However, the Working Group could not reach a consensus agreement.

3.47 Dr Naganobu noted that, although Japan was willing to contribute to the international observer scheme on a voluntary basis, at this stage it was difficult to accept the scheme as compulsory due to reasons such as commercial confidentiality.

3.48 Dr R. Holt (USA) expressed his disappointment that Japan could not accept a compulsory observer scheme and hoped that in the near future this could be resolved.

Key points for consideration by the Scientific Committee

3.49 Starting in the 2003/04 fishing season, a new operation method (continuous pumping method) has been employed by one of the operators (paragraph 3.23).

3.50 The Working Group requested the Secretariat to revise the data reporting format to accommodate the information arising from the new fishing method (pumping method) (paragraph 3.43).

3.51 The Working Group agreed that ad hoc WG-IMAF has the appropriate expertise to deal with the problem of fur seal by-catch in the krill trawl fishery and therefore agreed to ask WG-IMAF to consider this issue at its next meeting (paragraph 3.18).

3.52 The Working Group agreed to seek advice from WG-FSA about the kind (type of format) of information and data needed to allow cross-fleet comparison between different fishing methods in order to understand the trends in the krill fishery (paragraph 3.27).

3.53 The Working Group agreed that the *Scientific Observers Manual* should include the type of questionnaire used by the Japanese krill fishery together with diagrams of the vessel track and positions of krill (paragraph 3.35).

3.54 The Working Group agreed that the monthly catch and effort report should be provided at SSMU resolution and recommended modification of paragraph 2 of Conservation Measure 23-06 to read (paragraph 3.37):

> 'Catches shall be reported in accordance with the monthly catch and effort reporting system set out in Conservation Measure 23-03. When fishing in SSMUs in Area 48, each Contracting Party shall report monthly catch and effort by SSMU. When fishing in other areas, each Contracting Party shall report monthly catch and effort data by subarea/division.'

Note Dr Naganobu's reservation in paragraph 3.38.

3.55 The majority of members agreed on the compulsory deployment of an international observer on all vessels operating in the krill fishery, but the Working Group could not reach consensus (paragraph 3.46).

STATUS AND TRENDS IN THE KRILL-CENTRIC ECOSYSTEM

Predators

4.1 WG-EMM-05/4 reported on progress on data validation and logic testing for all data submissions to the Secretariat of all CEMP indices up to 1 June 2005. This paper reported on predator indices following agreement last year to discontinue maintaining and reporting environmental indices. Fishery indices and measures of overlap with predators are reported in WG-EMM-05/5 (section 3.1). The Secretariat reported progress on the previously agreed recommendation of the Working Group to move from reporting CEMP indices as positive and negative anomalies to an ordination approach. It anticipates reporting in the new style within one to two years. WG-EMM-05/4 also reported results based on the new method for calculating fur seal pup growth as a mean annual growth deviate.

4.2 Dr Ramm reported that the Secretariat has developed data forms for the submission of Antarctic shag diet data collected in accordance with the newly established protocol (SC-CAMLR-XXIII, Annex 4, paragraphs 4.93 to 4.96). This work had been done in consultation with Drs E. Barrera-Oro and R. Casaux (Argentina) and the new data forms are available on the CCAMLR website. In addition, Dr Ramm reported that Dr Casaux had submitted an annual series (1991–2005) of Antarctic shag diet data from the Argentine monitoring program for archiving with the Secretariat. The Secretariat will develop an index based on this series for consideration by WG-EMM and WG-FSA in 2006.

Pinnipeds

4.3 WG-EMM-05/23 presented results from a survey designed to estimate the abundance of pack-ice seals off east Antarctica conducted in the early summer of 1999/2000 using an icebreaker and two helicopters. The survey collected data on crabeater, Ross and leopard seals in an area of 1.5 million km^2 of pack-ice between 60° and 150°E. The paper described the efforts to correct for the proportion of the population not hauled out using ARGOS satellite-linked dive recorders on 33 crabeater and 2 Ross seals. Using double observer line-transect methods and a number of geographic covariates including depth, slope, distance to the shelf break, distance to the ice-edge, ice cover and ice width, the authors estimated 700 000 to 1.4 million crabeater seals in the survey area. Ross and leopard seals were more difficult to estimate but estimates for these species are also provided.

4.4 Dr Southwell added that a point estimate for population abundance of crabeater seals in the surveyed region in the 1970s was within the confidence interval for this survey, and hence there was no evidence for a change in crabeater populations between the 1970s and 2000.

4.5 Reid and Forcada (2005) reported on the causes of pup mortality in Antarctic fur seals breeding at South Georgia and the role of intrinsic (density of seals at breeding beaches) and extrinsic processes (e.g. offshore prey availability and maternal foraging success). The mean survival rate from 1989 to 2003 was 77.6% (range 52.6–92.8%). Starvation was the most common cause of death (47%) and negatively correlated with overall pup survival but showed no relationship with the number of pups born. The second most common cause of death, traumatic injury (19%), increased significantly with number of pups produced. It was concluded that the rate of increase in the fur seal population at South Georgia appears to be controlled by food availability rather than the availability of breeding habitat.

4.6 Forcada et al. (in press) examined the role of environmental forcing and climate-induced changes in the marine ecosystem on Antarctic fur seal pup production at South Georgia from 1984 to 2003. Non-linear mixed effects models indicated that positive sea-surface temperature anomalies were correlated with reductions in pup production. Warm anomalies at South Georgia, which occur three years after ENSO events in the Pacific, lead to a reduction in pup production in the following year. The Working Group agreed that studies such as this are important in separating the influences of environmental forcing and the effects of fisheries on CEMP indicator species.

Seabirds

4.7 WG-EMM-05/9 provided an update in trends in penguin population dynamics, as well as interannual variation in penguin diet and foraging behaviour at Cape Shirreff, Livingston Island. The chinstrap population continued to decline and is at its lowest size since the start of the eight-year study. In addition, fledging success was low compared to earlier years. However, the gentoo penguin breeding population has remained relatively stable and the fledging success in 2004/05 was similar to the long-term mean. Fledging weights of both species decreased from last year, and were the lowest average weights seen over nine years. The diet of both chinstrap and gentoo penguins contained primarily adult female Antarctic krill in the 46–50 mm length range. This continued a four-year trend of increasing proportions of female krill and increasing size of krill in the diets of the penguins at this site.

4.8 In response to a query from the Working Group, Dr Trivelpiece noted that the proportion of female krill in the penguin diets increased with the number of years since a strong krill recruitment event had occurred. He suggested that female krill may move to inshore habitats that are more productive if they are not in condition to spawn; while males may remain offshore where most spawning occurs. He further noted that the concurrent net samples, collected largely offshore in the adjacent region, did not show the extreme sex ratio skewing reported in the penguin data.

4.9 Dr Goebel noted that diet data from fur seals at Cape Shirreff show interannual differences in krill sex ratios (WG-EMM-05/26). However, he noted that fur seal and penguin foraging areas do not overlap during the chick/pup-rearing period of January to February at Cape Shirreff; both chinstrap and gentoo penguins forage inshore on the shelf, while fur seals forage well offshore at the shelf break.

4.10 WG-EMM-05/21 examined the relationship between breeding success and foraging trip duration on fledging weights of Adélie penguins measured over 11 years at Béchervaise Island. Concordance between the latter two was apparent when considering guard stage foraging trip durations but this was not as strong for the crèche foraging trips later in the season. Fledgling weights which are measured at the end of the breeding season were more strongly correlated with later foraging trips than with earlier trips. In some seasons, there appeared to be constant levels of resources throughout the breeding season resulting in good breeding success with heavy fledglings or poor breeding success with below-average weight fledglings. In other seasons, there was a disparity between breeding success and fledgling weight. Concerns raised by Williams and Croxall (1990) that fledgling weight may increase with an associated truncation of the distribution in poor seasons for seabirds with prolonged chick-rearing periods were unfounded for the Béchervaise Island Adélie penguin population. The authors suggested it would be useful to determine the demographic consequences of variable fledgling weights in terms of subsequent chick survival for this population.

4.11 Lynnes et al. (2004) reported that the diet of Adélie and chinstrap penguins at Signy Island, South Orkney Islands, was almost exclusively krill (>99% by mass) between 1997 and 2001; however, there was considerable interannual variation in reproductive output. Detailed analysis of the population size structure of krill in the diet indicated a lack of recruitment of small krill into the population from 1996 to 2000. A simple model of krill growth and mortality indicated that the biomass represented by the last recruiting cohort would decline dramatically between 1999 and 2000. Thus, despite the lack of a change in the proportion of krill in the diet, the demographics of the krill population suggested that the abundance of krill may have fallen below the level required to support normal breeding success of penguins during the 2000 breeding season. The authors noted that the role of marine predators as indicator species may be greatly enhanced when those species can also indicate links between the population dynamics of krill and its availability to predators.

4.12 WG-EMM-05/37 reported an outbreak of avian cholera (*Pasteurella multocida*) in a single colony at Marion Island that killed about 2 000 macaroni penguins in November 2004. Other colonies of macaroni penguins and other species of seabirds were not affected. This was the first known occurrence of the disease at the island; however, in March 1993 an unknown disease killed several thousand macaroni penguins, again in a single colony, but other colonies or other species of seabirds were not affected.

4.13 The Working Group was reminded that field researchers encountering die-offs of seabirds in the field should refer to *CEMP Standard Methods*, Part IV, Section 6 ‘Protocols for collection of samples for pathological analysis in the event of disease being suspected among monitored species of birds’.

4.14 Dr Constable suggested that a collation of known disease outbreaks and the numbers of affected seabird populations might be valuable to the work of the Working Group.

4.15 WG-EMM-05/38 suggested that winter conditions may be an important factor determining breeding success. Rockhopper penguin breeding success was correlated with female arrival mass, while date of arrival was affected by winter conditions in macaroni penguins. Arrival mass and the timing of breeding may have substantial impacts on future recruitment to the breeding populations of these species.

4.16 Dr Southwell noted that the time series in WG-EMM-05/38 provided some insight into an important question that arose from the CEMP review, namely whether a single site is representative of a larger region.

Krill

4.17 WG-EMM-05/15 examined the distribution of female krill of different maturity stages to reveal the preferred bottom depths of spawning. Calculations based on data from scientific surveys and observers revealed no statistically significant trend for gravid females to move offshore to deeper waters. The authors cast doubts on the conventional view of krill spawning and proposed that the distribution of gravid females is determined by hydrodynamics and food supply.

4.18 Members noted that the data, presented only in relative proportions, made it difficult to deduce the actual quantity of krill in different stages and depth ranges. It was also thought that the distinction between onshore and offshore at 500 m depth was arbitrary. Dr V. Sushin (Russia) explained that the proportion of animals in different stages as well as the occurrence in trawl samples of animals in different stages was presented, and this analysis was from an extensive dataset. Members encouraged further quantitative analysis, particularly more detailed examination of spatial variability of occurrence of gravid females.

4.19 WG-EMM-05/29 used an LMM to analyse growth trends of Antarctic krill with sex, length, season and region using over 10 years of instantaneous growth rate (IGR) measurements. A model of inter-moult period (IMP) as a function of temperature was used to predict seasonal IMP. Growth rates and life span may differ between sexes. The period of rapid growth was in December in the Indian Ocean sector whereas in the Scotia Sea it appeared to be earlier. Seasonal specific growth rates estimated in this study were compared to previous studies, and suggested that wild krill show more rapid growth over a shorter period than previously thought.

4.20 WG-EMM-05/27 introduced an alternative approach to predict the trajectory of krill body length over time using a step-growth function combining models of IGR with a model of temperature-dependent IMP. A number of growth trajectories were generated starting from an age 1+ mean length for different scenarios of winter and spring growth. The models indicate that, allowing for shrinkage, age 6+ mean length for the Indian Ocean sector was close to 53 mm compared to 57 mm from studies for the Atlantic sector.

4.21 Some Members enquired if temperature is the only key factor to determine krill growth in the model and how food condition is taken into account. It was explained that varying temperature determines the IMP, which is required to convert IGR to specific growth rates, and that food conditions were indirectly considered at this stage by using growth rate measurements from each region representing different food conditions. Dr Sushin noted that the period of rapid growth of krill in the Scotia Sea area a few months earlier than December does not seem to agree well with field observations, and this may be because the model used a far smaller number of IGR measurements from the Scotia Sea area compared to the Indian Ocean sector. He was of the view that spatial and temporal variability in food condition play a significant role in krill growth and this deserves due consideration in model development. Dr Kawaguchi responded that there are publications which show that krill grow rapidly in the Scotia Sea before December (e.g. Reid, 2001; Siegel, 1986).

4.22 Members welcomed this exercise and expected it might enable simulation of krill growth across space and time, and would be of great utility in the formulation of management procedures. Members encouraged further development of the model, which may include the incorporation of other critical factors, particularly food supply for krill.

4.23 A study by Atkinson et al. (2004) combined all available scientific net sampling data from 1926 to 2003. The productive southwest Atlantic sector contains >50% of Southern Ocean krill stocks, but here their density has declined since the 1970s. Spatially, within their habitat, summer krill density correlates positively with chlorophyll concentrations. Temporally, within the southwest Atlantic, summer krill densities correlated positively with sea-ice extent the previous winter. This study concluded that, as krill densities decreased last century, salps appear to have increased in the southern part of their range. The authors noted that this might have management implications.

4.24 A study by Yoshitomi (2005) examined digestive enzyme activity throughout a fishing season in Area 48, and demonstrated how krill fishery samples could be used to describe seasonal trends in biological properties of krill.

Environmental influences

4.25 WG-EMM-05/16 described a multidisciplinary survey carried out in the Ross Sea and adjacent waters by the RV *Kaiyo Maru* during the summer of 2004/05. The survey was designed to collect simultaneous data on Antarctic krill, other zooplankton and krill predators in order to relate their mesoscale distribution and abundance to the physical and biological environment.

4.26 The paper presented some preliminary results from the full-depth synoptic oceanographic section along 175°E (60°–77°S). Antarctic Surface Water (<0°C) occupied the shelf area and extended in a narrow surface band northwards beyond the shelf edge where it reached a depth of approximately 150 m. The authors suggested that the distributions of both Antarctic krill (*Euphausia superba*) and crystal krill (*E. crystallorophias*) were related to water temperature, based on the average value between the surface and 200 m. The authors suggested that Antarctic krill occurred in the warmer waters north of the shelf slope while crystal krill occurred in the colder shelf waters.

4.27 Dr P. Wilson (New Zealand) reminded the meeting that the distribution of Antarctic and crystal krill is reflected in differences in the diet of Adélie penguins breeding in the Ross Sea. He recalled that over 1 million pairs bred in the western Ross Sea and that of these, approximately one-third bred south of Coulman Island (approximately 73°S 170°E) (principally those colonies on Ross Island) and approximately two-thirds bred north of Coulman Island (particularly at Cape Adare, Cape Hallett and at Possession Island). Dr Wilson reported that diet studies of penguins at these locations reflected the distribution of krill reported in WG-EMM-05/16. North of Coulman Island penguins primarily fed on Antarctic krill (together with some fish), while south of the island they fed on crystal krill (also with some fish).

4.28 Dr Trathan enquired whether long-term information was available on diet and whether it indicated any interannual variability. Dr Wilson indicated that the diet data from the Ross Sea colonies showed interannual variability that appeared to be related to pack-ice cover. Fish (mainly *Pleuragramma antarcticum*) were more important than crystal krill when pack-ice was reduced or absent in the foraging area of penguins (and crystal krill more important when pack-ice was more extensive). Dr Wilson further indicated that diet data from the northern colonies were much more limited and that interpretation was therefore more difficult. Dr Naganobu enquired whether any information was available on the status of Adélie penguin populations in the region. Dr Wilson responded that populations at Ross Island had increased in the past, but that these had now declined to their former levels and overall, the Ross Sea penguin population remained relatively stable.

4.29 WG-EMM-05/17 described an atmospheric index calculated from sea-level pressure differences across the Drake Passage, between Rio Gallegos (51°32'S 69°17'W), Argentina, and Base Esperanza (63°24'S 56°59'W) on the Antarctic Peninsula. The Working Group has considered the DPOI at previous meetings (SC-CAMLR-XXIII, Annex 4, paragraph 4.45), when it noted that DPOI reflected environmental variability that related to the krill-centric ecosystem (see also Naganobu et al., 1999). Dr Naganobu suggested that it would be interesting to carry out a reanalysis of krill recruitment in the context of DPOI now that both time series were longer and contained more data points.

4.30 WG-EMM-05/41 examined the characteristics of geostrophic flow across the Scotia Sea based on Russian oceanographic stations sampled since the 1960s in Area 48. The station data included in the analysis were used to estimate geostrophic flows referenced to 1 000 m. The analysis does not account for non-geostrophic components of water velocity.

4.31 The authors suggested that average water velocity was approximately 20 cm s^{-1}, but that there was considerable spatial variability, with geostrophic velocities at different locations varying by more than one order of magnitude (<5 cm s^{-1} to 60 cm s^{-1}). The authors also suggested that the reported water velocities were sufficient to cause the complete replacement of water in some SSMUs several times during one fishing season. The authors further suggested that such levels of transport could significantly affect the dynamics and distribution of krill biomass in the Scotia Sea, particularly if krill were passive particles carried in the geostrophic flow.

4.32 Dr C. Reiss (USA) noted that this was an interesting paper and a useful approach; however, he suggested that it was critical to better understand how the data had been referenced to 1 000 m as the methodology was not detailed and not referenced to either standard textbook methods or recent relevant papers such as Panteleev et al. (2002) or Yaremchuk and Maximenko (2002). Dr Reiss indicated that it was important to understand the basis of the method used so that the meeting could better appreciate how the reported flows related to errors consequent on water shear below 1 000 m and on the shelf.

4.33 Dr Reiss also suggested that it would be useful to examine the data seasonally. The current analysis temporally smooths the data and this may introduce bias, whereas a seasonally resolved analysis would help the Working Group better appreciate the importance of geostrophic flow.

Methods

4.34 WG-EMM-05/20 and 05/22 presented analyses of the data collected as part of the Australian contribution to CEMP carried out on Béchervaise Island, East Antarctica. The analyses in both papers suggested some revisions for sample sizes were required in Standard Methods A5 (penguin foraging trip duration) and A7 (penguin fledging mass).

4.35 WG-EMM-05/20 examined the potential for fledging mass to be biased by differential mortality, i.e. years with low breeding success when only a few large chicks reach fledging age. However, the authors indicated that in the analysis there was no indication that situation had occurred in this dataset. However, Dr Wilson commented that he had observed this situation in the penguin monitoring in the Ross Sea region.

4.36 WG-EMM-05/22 reviewed the power to detect changes in penguin foraging trip duration (Standard Method A5) and found that there was a much greater power to detect step changes compared to gradual changes. Furthermore, the analysis suggested that monitoring the foraging trip durations of more than 30 birds is unlikely to significantly improve the power to detect changes.

4.37 The Subgroup on Methods commended the Australian program and recognised that it is essential for any monitoring program to be under a continual process of review in order to accommodate specific operational and logistical constraints. The subgroup recognised that the power to detect changes will depend on the level of natural variability and that this is likely to vary with regions. Therefore, it was recognised that the papers were not suggesting that the CEMP standard methods be revised at this time, but the subgroup encouraged other Members to analyse monitoring data and to provide advice on optimising sample sizes.

4.38 WG-EMM-05/26 presented results of an analysis of the relationship between krill carapace length and width to determine the sex of krill from the South Shetland Islands in comparison to a previous study at South Georgia (Reid and Measures, 1998). The multi-year approach highlighted the effect of krill size and maturity on the ability to discriminate the sex of krill such that for krill with carapace lengths of ≥13 mm sex could be determined with >80% success. The subgroup agreed that this provided a very useful means of obtaining additional data on krill consumed by predators in samples where whole krill are not available (e.g. fur seal scats) and noted that it was important to use appropriate regionally derived allometric relationships to account for regional differences in growth rates.

Acoustic

Report of SG-ASAM

4.39 Dr Watkins presented a summary of the Report of the First Meeting of SG-ASAM (SC-CAMLR-XXIV/BG/3) which met in La Jolla, USA, from 31 May to 2 June 2005, to consider models of krill target strength (TS) and classification of volume backscattering strength (S_v).

Models of target strength

4.40 The TS model (Greene et al., 1991) presently used by CCAMLR for the estimation of biomass is a linear regression model derived from measurements of northern hemisphere zooplankton. Although the model was corroborated with empirical data (e.g. Foote et al., 1990) it was recognised at the outset that there were a number of problems with the model when applied to krill. In particular:

- it is only accurate for krill that are larger than the wavelength of the sound pulse (e.g. λ_{120kHz} = 12.5 mm);
- it does not account for changes in target morphology, physiology and orientation, all of which have been shown to significantly affect TS (Demer and Martin 1994, 1995);
- it was not actually derived from measurements of *E. superba* at 120 kHz;
- it predicts that TS of crustacean zooplankton is dependent on the animal's volume, when it is actually thought to be dependent on its area (Demer and Martin, 1994, 1995).

4.41 Since 1991 a physics-based TS model has been developed (distorted-wave Born approximation (DWBA): Morse and Ingard, 1968; Stanton et al., 1993, 1998; Chu et al., 1993a, 1993b; McGehee et al., 1998, 1999) that represents an improvement to the Greene et al. (1991) model because it considers not just size, but the other parameters (shape, material properties and orientation) that contribute to TS.

4.42 McGehee et al. (1998, 1999) empirically validated the DWBA model obtaining a good fit between empirical measurements and DWBA model predictions when the sound impinged on the animal from a dorsal, ventral or lateral aspect but a poor fit at other orientations.

4.43 Demer and Conti (2003a, 2004a) theoretically explained the poor fit between DWBA predictions and empirical measurements at orientations away from 90° using a modified DWBA model (the so-called 'stochastic DWBA', or SDWBA), which takes additional account of three stochastic parameters:

(i) scattering in a field with noise
(ii) the complexity of krill shape
(iii) the flexure of the body as it swims.

4.44 Demer and Conti (2002, 2003b, 2004b) went on to validate the theoretical SDWBA model with empirical measurements of krill total TS (TTS) using a new technique (De Rosny and Roux, 2001). The empirical measurements agreed closely with the SDWBA model predictions over the frequency range 60–202 kHz ('to better than about 1 dB'); the empirical measurements at lower frequencies (36–60 kHz) were slightly higher than theory and the discrepancies were attributed to noise.

4.45 In a final step, Demer and Conti (2004c, 2005) applied the SDWBA to data from the CCAMLR-2000 Survey (Watkins et al., 2004) to explore the consequences of their new TS model on the overall estimate of B_0. Depending on the orientation distribution used, the original B_0 estimate of 44.3 million tonnes (CV 11.4%) was increased to as much as 192.4 million tonnes (CV 11.7%).

4.46 SG-ASAM recognised that there are a variety of parameters that influence TS and that these were not all encompassed in the Greene et al. (1991) model. The subgroup agreed that theoretical models have the capacity to encompass all of the relevant parameters implicated in TS. Further the subgroup endorsed the change in philosophy from the use of an empirical-only TS model (i.e. Greene et al., 1991) towards the use of theoretically-based empirically-validated models.

4.47 The subgroup considered which type of theoretical TS model was most appropriate to use for krill. The subgroup agreed, based on the information available to them at the time, that the most appropriate theoretical model for krill TS was currently the SDWBA; however, the subgroup also agreed that the use of the SDWBA is subject to the caveats described below.

- The SDWBA utilises multiple parameters and the range of values associated with each parameter is not well characterised, the subgroup recognised that determining the distributions of these parameters should be accorded a high priority.

- The subgroup emphasised the importance of determining krill orientation distributions that are representative of those occurring under the ship during survey conditions.

- The orientation distribution used in the published application of the SDWBA (Demer and Conti, 2005) was derived from the CCAMLR-2000 Survey data, however another plausible orientation distribution was calculated at the workshop. Further work to assess the implication and appropriateness of these different distributions was required.

- The phase variability term of the SDWBA (φ) takes account of noise, complexity of shape and flexure of the body (Demer and Conti, 2003a). While these terms should ideally be individually characterised and used in the DWBA, this is not practical at present and the SWDBA offers a pragmatic solution.

4.48 In addition to recommending the use of the SDWBA to estimate krill TS, the subgroup also recommended that:

- a 'simplified SDWBA' with constrained parameters be used to generate a 'base-case' estimate of B_0 for CCAMLR acoustic surveys of krill;

- model parameters be considered as probabilistic as opposed to deterministic and that the uncertainty associated with the input parameters must be accounted for in estimates of TS and hence B_0.

4.49 SG-ASAM considered that, given the time available at its workshop, it would not be possible to use a full probability density function (PDF) for each parameter to estimate TS and its variability. Moreover, there is presently insufficient empirical data to adequately characterise the PDF of any parameter. As a compromise, the subgroup considered each parameter in terms of its mean value ±1 SD. The values used to parameterise the simplified SDWBA are provided in SC-CAMLR-XXIV/BG/3, Table 1.

4.50 The TS values for the constrained simplified SDWBA using the above parameter values are shown graphically in SC-CAMLR-XXIV/BG/3, Figure 4 (krill TS as a function of L at 38, 70, 120 and 200 kHz). There is a large range of uncertainty in TS (and hence B_0), and this range is both frequency and length dependent. For instance, at f = 120 kHz where (i) L = 25 mm, SDWBA-predicted krill TS ranges from –88 to –73 dB (range = 15 dB); and (ii)where L = 50 mm, SDWBA-predicted TS ranges from –77 to –71 dB (range = 6 dB). The subgroup recommended that this uncertainty should be incorporated into estimates of krill TS and hence B_0.

Classification of volume backscattering strength

4.51 SG-ASAM recognised that early classifications of hydroacoustic data by taxon typically relied on the subjective visual analysis of echograms combined with information from net catches if available. For the CCAMLR-2000 Survey analysis a formalised and objective classification method was used. This was based on the dual-frequency dB-difference technique (ΔS_v) described by Madureira et al. (1993a, 1993b) and further validated and refined by Watkins and Brierley (2002).

4.52 When employing this ΔS_v method for classifying krill, the subgroup recognised that there are two major types of misclassification that can occur: (i) non-krill targets are classified as krill ('acoustic by-catch'); and (ii) krill targets are not classified as krill ('acoustic bypass'). The effect of 'acoustic by-catch' will be to overestimate the biomass of krill, while the effect of 'acoustic bypass' will be to underestimate the biomass of krill.

4.53 SG-ASAM recognised that with the adoption of a physics-based model for TS, it would now be possible to derive theoretical backscattering spectra that can be used to improve ΔS_v classification of krill currently derived from empirical observations.

4.54 The subgroup agreed that, for the time being, the ΔS_v technique continues to represent the most objective and pragmatic technique for classifying Sv by taxon. The subgroup recommended that when using the ΔS_v technique, acoustic by-catch and bypass should be minimised by constraining the ΔS_v windows to the size range of krill measured in the survey area. To facilitate this step, the subgroup calculated the minimum and maximum ΔS_v values for different size ranges of krill using the constrained, simplified SDWBA model (SC-CAMLR-XXIV/BG/3, Table 3).

Working Group discussion of SC-CAMLR-XXIV/BG/3 and recommendations

4.55 The Working Group endorsed SG-ASAM's recommendation that krill TS should be estimated using the SDWBA model and appropriate values of parameters in the model for surveys and, as appropriate, different areas within a survey be applied.

4.56 Currently, the classification of hydroacoustic data by taxon is undertaken by using the ΔS_v technique described by Madureira et al. (1993a, 1993b). The Working Group recognised that with the adoption of a physics-based model for TS (SDWBA) it would now be possible to derive theoretical backscattering spectra that could be used to improve ΔS_v classification of krill. The Working Group therefore recommended that when using the ΔS_v technique, misclassification of taxa should be minimised by constraining the ΔS_v windows to the size range of krill measured in the survey area.

4.57 The Working Group recognised that use of the SDWBA to calculate levels of uncertainty associated with the estimate of TS was an important development that had not been available with previous TS estimates.

4.58 It was also noted that it is important to understand to what degree acoustic surveys are able to produce an unbiased estimate of krill biomass.

4.59 It was recognised that the present levels of uncertainty are large and this is likely to be reflected in recalculations of B_0 for surveys already undertaken. However, these levels of uncertainty may be reduced if parameters for the SDWBA model are estimated directly for individual surveys or areas. The Working Group therefore recommended that actual measurement of the relevant parameter values be undertaken in all future surveys to minimise the uncertainty associated with the estimation of TS. The Working Group also recommended that, where possible, parameters be estimated for past surveys and areas.

4.60 With regard to recalculation of B_0 estimates for previous large-scale surveys used to generate precautionary catch limits, the Working Group agreed that recalculation incorporating the appropriate level of uncertainty was a high priority and should be undertaken within the next two years.

Estimation of material properties of krill

4.61 WG-EMM-05/36 described studies to estimate the material properties (sound speed and density contrast) of krill sampled during cruises of the RV *Kaiyo Maru* in 2000 and 2004/05. Measurements of sound speed contrast were made using a similar method to that described by Foote et al. (1990). Density contrast was measured using a series of bottles, each containing water of a different density. A mean density contrast of 1.0295 and 1.0448 (for krill of mean length 43.5 and 41.7 mm) was derived for the years 2000 and 2005 respectively. Corresponding sound speed contrasts of 1.0442 and 1.0348 for krill of mean length 25.1 and 48.6 mm were derived for the two years.

4.62 The Working Group welcomed the presentation of this study, particularly given the new importance of such information for the parameterisation of the SDWBA krill TS model.

4.63 In this context it was noted that the range of values presented in WG-EMM-05/36 was comparable with the range of values utilised in SC-CAMLR-XXIV/BG/3, Table 1.

4.64 The Working Group noted the difficulties of estimating krill density at sea and suggested that a comparison of the different techniques used to date would be valuable.

Estimate of biomass using maximum entropy techniques

4.65 WG-EMM-05/42 presented results of an analysis of the CCAMLR-2000 Survey using an alternative method of estimating krill abundance and producing maps of krill distribution. The method used a probabilistic Bayesian Maximum Entropy (MaxEnt) technique to interpolate density values for the unsurveyed off-transect portions of the survey area. These density values were then summed to infer total biomass across the survey region and within individual SSMUs. The resulting total biomass inferred for the survey area was 208 million tonnes (SD = 10 million tonnes).

4.66 It was noted that there was insufficient expertise within the Working Group to be able to evaluate this paper in detail. However studies using this developing technique were being submitted to other organisations (ICES) dealing with abundance estimates of exploited fish stocks and so it was likely that the technique would be evaluated appropriately in due course.

4.67 The Working Group agreed that in its present state of development the technique should not be seen as an alternative to the Jolly and Hampton (1990) method of calculating B_0 estimates that were to be used for setting precautionary catch limits.

Future surveys

Survey of Division 58.4.2

4.68 WG-EMM-05/11 provided an update of plans for the Australian BROKE-West acoustic survey to estimate a new krill B_0 for use in setting a new precautionary catch limit for Division 58.4.2. Plans for this cruise had previously been presented to WG-EMM in 2004 for comment and approval. The overall cruise design and strategy was based on a design approved by WG-EMM in 1995.

4.69 The Working Group endorsed the proposed cruise plan with the following additional suggestions:

(i) to minimise the level of uncertainty associated with estimation of TS using the new SDWBA, the values of parameters used in the model should be measured during the cruise if possible;

(ii) the Working Group welcomed the proposed comparisons with ships (Germany and Japan) surveying in adjacent areas. It was recognised that the value of such comparisons would be maximised if coordinated and common protocols for equipment settings and calibrations could be agreed and used.

CCAMLR-IPY-2008 Survey

4.70 At its 2004 meeting the Scientific Committee agreed that a synoptic acoustic survey in the South Atlantic region would be the most appropriate activity for CCAMLR in the IPY 2008 (SC-CAMLR-XXIII, paragraphs 15.4 to 15.7). It was agreed that a synoptic acoustic/net sampling survey in the South Atlantic region should focus on krill but would collect a range of ancillary physical and biological data including observations on marine zooplankton, marine mammals and birds.

4.71 The Scientific Committee established an intersessional steering group under Dr Siegel to formulate CCAMLR's Expression of Intent (EoI) for activities in the IPY. The Steering Group developed a document and submitted this to the IPY Joint Committee by the deadline of 14 January 2005. Concurrently, contact was established with the IWC, the SCAR Group of Experts on Birds and the Census of Antarctic Marine Life (CAML) Group inviting them to actively participate in the CCAMLR-IPY-2008 Survey. In response, representatives of all three groups welcomed the CCAMLR initiative and indicated that they will circulate the CCAMLR proposal among their members for closer consideration.

4.72 By the end of March the CCAMLR initiative received formal recognition by the IPY Joint Committee and was listed as EoI 148. After comprehensive assessments and discussions, the CCAMLR Steering Group developed a revised clustering scheme for related IPY projects.

4.73 On 6 June 2005 the CCAMLR Steering Group received a response from the IPY Joint Committee that it agreed with the reclustering suggested by the CCAMLR Steering Group and that the CCAMLR-IPY-2008 Survey should become the 'lead project' for the topic 'Natural Resources, Antarctic'. Consequently, the CCAMLR Steering Group will have to prepare and submit an 'umbrella proposal' and coordinated research plan for all related EoIs by the deadline 30 September 2005 or 16 January 2006.

4.74 Leaders of all potentially related projects were contacted before the WG-EMM meeting and almost all expressed their interest in close cooperation with the planned CCAMLR activity.

4.75 A close link was established with CAML EoI 83, the lead project for 'Biodiversity', which also has a strong pelagic component. Dr Watkins participated as a member of the CCAMLR Steering Group at the CAML Workshop in Brussels, Belgium, from 26 to 28 May 2005.

4.76 Dr Watkins reported to the subgroup of the Steering Group that a representative from most projects interested in biodiversity issues attended, and that most had limited access to or expectation of shiptime. The CAML Group was therefore developing a plan under the leadership of Prof. M. Stoddard (Australia) that was flexible and could incorporate shiptime as it became available. Dr Watkins gave a presentation to CAML. He suggested that CCAMLR would be able to offer CAML its experience in developing and coordinating large multi-ship surveys with standard protocols. While CCAMLR would likely benefit from the CAML program through access to additional vessels and coverage in areas that were not sampled by the CCAMLR-IPY-2008 Survey. There was an extreme diversity of CAML plans from biological to oceanographic studies. There was considerable debate as to whether CAML should focus on unsampled areas or better understand the areas already sampled.

There was consensus that the Bellingshausen area was very undersampled, and that the basic science plan should address the lowest common denominator, that is the presence or absence of animals in areas.

4.77 The subgroup discussed the status of shiptime for those interested in participating in the CCAMLR-IPY-2008 Survey.

(i) Germany will provide the *Polarstern* for the IPY, but there are around 15 competing proposals for the shiptime. A German shiptime steering group meeting will take place within the next two months.

(ii) Ukraine stated that it will not be able to contribute a ship for the CCAMLR-IPY-2008 Survey, but commercial fishing vessels will provide additional data from the fishery during the IPY.

(iii) New Zealand has no plans to contribute a ship for a CCAMLR-type survey, but individuals will be participating in the general IPY program.

(iv) The UK BAS DISCOVERY-2010 Programme has allocated 45 days of shiptime but will be heavily constrained by program goals. It will undertake process studies and limited survey work in the Scotia Sea and to the east of the South Sandwich Islands. BAS will continue its surveys north of South Georgia during the period of the CCAMLR-IPY-2008 Survey.

(v) Russia wishes to participate and expects to have a ship, but it will not know of the status of its request until 2007.

(vi) Japan wishes to take part but at this stage final participation remains to be confirmed.

(vii) Brazil will be participating in the general IPY program, but will not have a ship available for a Scotia Sea survey.

(viii) Norway has intentions of participating in the IPY program. It expects to have a ship available for two to three months, and will focus its survey in Subarea 48.6. It will undertake both acoustical and net sampling.

(ix) The USA will participate fully in a CCAMLR-IPY-2008 Survey, and will contribute approximately one month of shiptime. The USA will also survey the South Shetland Islands as currently performed.

(x) The Republic of Korea is expecting to contribute some shiptime to IPY activities, but there will be competing proposals. A pelagic ecosystem survey may be funded which is likely to take place in the early summer around the South Shetland Islands.

(xi) There was also a report that Chile, through INACH, would charter a vessel for the IPY, and would be looking for appropriate acoustic, net and hydrographic equipment.

(xii) Dr E. Fanta (Chair, Scientific Committee) informed the group that Chile, Argentina, Peru, Brazil and Uruguay are discussing a collaboration and may conduct a joint CCAMLR survey using a Peruvian research vessel. Further information should be available by the time of the Scientific Committee meeting in 2005.

(xiii) South Africa presently has no plans to participate in the CCAMLR-IPY-2008 Survey, however it will be undertaking a biodiversity survey around Prince Edward Islands.

4.78 The subgroup reviewed the terms of reference of the CCAMLR-IPY-2008 Survey Steering Group (Appendix E) and asked that the Scientific Committee, at its next meeting in October 2005, discuss the membership of the steering group and endorse its terms of reference.

4.79 Given that the CCAMLR-IPY-2008 Survey has become the 'lead project' for the core topic 'Natural Resources, Antarctic', the subgroup discussed the wider context of the objectives of the CCAMLR-IPY-2008 Survey. It was agreed that a primary focus of the IPY was the facilitation of multidisciplinary circumpolar science. In particular it was recognised that successful IPY core programs would need to provide sufficient breadth and scope of goals so that constituent projects could be included in the proposal. The subgroup therefore proposed that in addition to the core focus on the South Atlantic, the scope of the proposal should be developed to increase the area of interest to be circumpolar. This would increase the direct benefit to CCAMLR by facilitating opportunities for surveys in other areas by CCAMLR Members who are unable to work in the South Atlantic.

4.80 The subgroup, with the approval of the Working Group, agreed that the Steering Group will continue to develop the proposal for submission to the IPY Joint Committee by the September deadline. This proposal would also be submitted to the Scientific Committee meeting in October 2005. Any revisions to the proposal as a result of comments from the Scientific Committee will then be submitted to the IPY Joint Committee in January.

Key points for consideration by the Scientific Committee

Predators

4.81 Based on an aerial survey carried out during 1999/2000, the abundance of pack-ice seals in an area (1.5 million km^2) off east Antarctica (between longitudes 60° and 150°E) was (95% confidence intervals): crabeater seals 0.7–1.4 million animals, Ross seals 37 000–124 000 and leopard seals 1 300–17 000. A point estimate for the population abundance of crabeater seals made in the 1970s for the same survey area was within the confidence interval for the 1999/2000 survey; as a consequence, there was no clear evidence for a population change (paragraphs 4.3 and 4.4).

4.82 The role of environmental forcing and climate-induced change on the population processes of Antarctic fur seals at South Georgia are becoming increasingly evident. Over the period from 1984 to 2003, positive sea-surface temperature anomalies explained extreme reductions in pup production; lagged correlations (by three years) with large-scale ENSO events in the Pacific explained much of the variability. Such relationships help explain environmental forcing and are important for interpreting potential impacts of fisheries on the ecosystem (paragraph 4.6).

4.83 The chinstrap penguin population breeding at Cape Shirreff, Livingston Island, continued to decline and is currently the smallest in the eight years of study. In addition, breeding success was poor compared with earlier years and fledging weights were the lowest recorded in the study (paragraph 4.7).

4.84 An outbreak of avian cholera occurred in November 2004 at Marion Island. It killed about 2 000 macaroni penguins at one colony but other colonies and other seabird species were not affected (paragraph 4.12).

Environmental influence

4.85 Preliminary results from a multi-disciplinary survey carried out in the Ross Sea during the summer of 2004/05 suggested a close relationship between water temperature and the distributions of both Antarctic and crystal krill; Antarctic krill occurred in the warmer waters north of the shelf slope while crystal krill occurred in the colder shelf waters (paragraphs 4.25 to 4.28).

Methods

4.86 It was recognised that there are a variety of parameters that influence krill TS and that these were not all encompassed in the empirical model currently used by CCAMLR (Greene et al., 1991). The Working Group therefore endorsed a change from the current model towards the use of a theoretically-derived empirically-validated model. Based on the information available, the Working Group agreed that the most appropriate theoretical model for krill TS was currently the SDWBA model. The Working Group therefore endorsed the subgroup recommendation that krill TS should be estimated using the SDWBA model and appropriate values of parameters in the model for surveys and, as appropriate, areas be applied as discussed in paragraphs 4.55 and 4.56.

4.87 Following the adoption of a physics-based model for TS (SDWBA), the Working Group recognised that the present levels of uncertainty are large and this is likely to be reflected in recalculations of B_0 for surveys already undertaken. However, these levels of uncertainty may be reduced if parameters for the SDWBA model are estimated directly for individual surveys or areas. The Working Group therefore recommended that actual measurement of the relevant parameter values be undertaken in all future surveys to minimise the uncertainty associated with the estimation of TS. The Working Group also recommended that, where possible, parameters be estimated for past surveys and areas (paragraph 4.59).

4.88 With regard to the recalculation of B_0 estimates for previous large-scale surveys used to generate precautionary catch limits, the Working Group agreed that recalculation incorporating the appropriate level of uncertainty was a high priority and should be undertaken within the next two years (paragraph 4.60).

4.89 The Working Group agreed that the Jolly and Hampton (1990) method of estimating B_0 should still be used when setting precautionary catch limits (paragraph 4.67).

Future surveys

4.90 The Working Group endorsed the plans for the Australian BROKE-West acoustic krill biomass survey of CCAMLR Division 58.4.2 in the 2006/07 season. The Working Group suggested using the new SDWBA TS as well as measuring the necessary data to parameterise the TS model. The Working Group welcomed the proposed comparisons with ships (Germany and Japan) surveying in adjacent areas. It was recognised that the value of such comparisons would be maximised if coordinated and common protocols for equipment settings and calibrations could be agreed and used (paragraphs 4.68 and 4.69).

4.91 The CCAMLR-IPY-2008 Survey initiative received formal recognition by the IPY Joint Committee and was listed as EoI 148; it has become the 'lead project' for the topic 'Natural Resources, Antarctic'. A close link has also been established with CAML EoI 83, the lead project for 'Biodiversity', which also has a strong pelagic component (paragraphs 4.72 to 4.75).

4.92 A number of Members will contribute shiptime to the IPY. At the moment, only the USA can commit to full participation in the CCAMLR-IPY-2008 Survey; other Members will need to win shiptime through their respective national IPY processes. Other vessels may also be available following joint international initiatives (paragraph 4.77).

4.93 The Working Group reviewed the terms of reference for the CCAMLR-IPY-2008 Survey Steering Group (Appendix E) and asked that the Scientific Committee discuss the membership of this steering group and endorse its terms of reference (paragraph 4.78).

4.94 The Working Group agreed that a primary focus of the IPY was facilitation of multidisciplinary circumpolar science. In particular, it was recognised that successful IPY core programs would need to provide sufficient breadth and scope of goals so that constituent projects could be included in the proposal. The Working Group therefore proposed that in addition to the core focus on the South Atlantic, the scope of the proposal should be developed to increase the area of interest to a circumpolar scale. This would increase the direct benefit to CCAMLR by facilitating opportunities for surveys in other areas by CCAMLR Members who are unable to work in the South Atlantic (paragraph 4.79).

4.95 The Working Group agreed that the CCAMLR-IPY-2008 Survey Steering Group should continue to develop the proposal for submission to the IPY Joint Committee by the September deadline. This proposal should also be submitted to the next Scientific Committee meeting. Any revisions to the proposal as a result of comments from the Scientific Committee should then be submitted to the IPY Joint Committee in January (paragraph 4.80).

STATUS OF MANAGEMENT ADVICE

Protected areas

5.1 Dr Penhale, Chair of the Subgroup on Protected Areas, reported that 14 Members and interested parties participated in the meeting of the subgroup.

5.2 Progress made during the intersessional period included the transmittal from CCAMLR to the ATCM advising of CCAMLR's approval of the management plans for ASPA Nos. 145 and 149. Advice for improvement of these plans also was transmitted to the ATCM and the originators of the plans. Informal comments on the proposed ASPA at Edmonson Point were provided by CCAMLR to the ATCM and originator of the plans, with formal comments to be provided following the 2005 meeting of the Commission.

5.3 The Chair of the subgroup reported that new material on MPAs was added to the subgroup section of the CCAMLR website, along with an updated list of the subgroup membership.

5.4 Dr Penhale provided information on the revised ATCM Decision regarding protected area management plans containing marine areas. Decision 9 (2005) entitled 'Marine Protected Areas and other areas of interest to CCAMLR' (ATCM-XXVIII Final Report) replaced Decision 4 (1998, ATCM-XXII Final Report). The revised decision eliminated the list of sites that should be considered by CCAMLR and deferred to the principle of reviewing sites in which there would be CCAMLR interest.

5.5 The Working Group agreed to transmit to the Scientific Committee approval recommendations for two ATCM management plans containing marine areas. These include the ASPA at Edmonson Point (WG-EMM-05/7) and a revised plan for the ASMA at Admiralty Bay (WG-EMM-05/8).

5.6 Dr Penhale introduced the topic of the CCAMLR MPA Workshop by providing an update on progress. A workshop Steering Committee consisting of nine members was created through Party nominations. A consensus was reached to hold the workshop from 29 August to 2 September 2005 in the Washington DC area. It was recognised that there was insufficient time for all interested Members to attend. However, due to the importance ascribed to the topic by the Commission, the decision was made to proceed. Eight Member countries had indicated an intention to send participants to the workshop.

5.7 The Chair of the subgroup, who is Convener of the workshop, reported that papers are expected to be submitted which will report on the progress that some countries have made in establishing MPAs in their EEZs. Additionally, papers that discuss potential MPAs within the CCAMLR Convention Area, as well as papers on the general topic of MPAs as related to CCAMLR, are expected. Participants were encouraged to submit papers two weeks prior to the workshop in order for the papers to be placed on the MPA section of the CCAMLR website. It was agreed that the deadline for papers would be 0900 h on the first day of the workshop.

5.8 Dr Penhale reported the subgroup's discussion on the topic of workshop participation by those not nominated by Members. The Chair referred to the recommendation arising from the 2004 Scientific Committee report (SC-CAMLR-XXIII, paragraph 3.51) that the workshop include invited experts to take advantage of the large body of MPA knowledge that could be used to promote the goals of CCAMLR. The Convener reported that the Steering Committee had supported the idea of inviting an expert who was affiliated with IUCN, one organisation specifically mentioned in the Scientific Committee report.

5.9 Some subgroup participants were strongly supportive of opening the workshop to observers, with the rationale that all stakeholders with interests in the Convention Area should be brought into the discussion. Others strongly felt that observers should not be participants, due to previous agreements regarding observer participation in CCAMLR working groups.

5.10 The Working Group continued this discussion, expressing varying opinions as to whether experts were limited to those affiliated with IUCN and whether observers could attend. Most members agreed with the Scientific Committee report, which allowed for experts to be invited and which made no provision for the attendance of observers.

5.11 The Convener noted that the full membership of the Steering Committee would need to be involved in an agreement on the invitation of any expert and that this process would require knowledge of the credential.

Harvesting units

5.12 Dr Naganobu reported on the discussions of the Correspondence Subgroup on Harvesting Units that has been considering the subdivision of the large FAO statistical areas into smaller areas that have greater ecological, oceanographic or biological homogeneity. Dr Naganobu reported that he and Dr Constable had begun discussions on this topic several years ago, and that Dr S. Nicol (Australia) had replaced Dr Constable last year. The correspondence subgroup spent time examining the large-scale distribution of krill to define ecologically based subdivisions. There was consensus within the correspondence subgroup members that they would wait until the Australian survey (acoustic and hydrographic data) is completed in Division 58.4.2, which will complement the 1996 survey of Division 58.4.1. The combined dataset will include information on one-third of the Antarctic coastline, and thus will facilitate the examination and delineation of smaller more ecologically based subdivisions of the large FAO subareas in eastern Antarctica.

5.13 The Working Group then considered the issue of bio-regionalisation as suggested by Dr Constable. Dr Constable provided a brief overview of the concept and its implementation in Australia to subdivide large management areas into local areas that may engender differential management strategies tailored to specific management objectives in adjacent areas of potentially larger management units.

5.14 There was some discussion among members of WG-EMM that this is, in some ways, the original concept in the evaluation and development of SSMUs for the allocation of fishing, but would revise structure of regions to achieve long-term conservation as per Article II of the Convention. This may require better integration of data across areas.

5.15 Dr Siegel posed two questions regarding the establishment of these bioregions. The first was whether development would require different bioregions for fish, krill etc., or would the areas be similar or the same. The second question was whether the Working Group would wish to establish these similar bioregions before it understands more about a system such as Subarea 48.6.

5.16 Dr Constable responded to these questions by clarifying that the bioregions should not be individually tailored to individual species components, and that the bioregion concept provides an integrated view of the ecosystem. He further clarified that implementation could be sequential, incorporating new information as this was developed. Dr Naganobu generally agreed but thought that such a decision to establish bioregions should include more discussion and he believed that the acquisition of more information about the Southern Ocean was important for this concept.

5.17 Dr Hewitt indicated that Dr I. Everson (UK) had previously used this type of integrated approach to look at oceanographic units in developing the foundation for establishing the FAO subdivision of the Convention Area. It was agreed that further data may not need to be collected in order to start the process such as for Subareas 48.6, 58.4, 88.1, 88.2 and 88.3, as initial work might expose gaps for future research.

Small-scale management units

5.18 The Working Group agreed that it was unable, at this time, to comment on the robustness of the candidate options for subdividing the catch limit for krill in Area 48 amongst SSMUs. Nevertheless, it has made substantial progress in developing the tools and parameter sets for providing advice on a subdivision of the Area 48 catch limit in the near future (Appendix D, paragraph 6.4).

5.19 The Working Group agreed that sufficient progress had been made with the KPFM development this year for it to believe that a further year's work should allow appropriate advice, based on runs with a revised version of the simulation model, to be provided by WG-EMM to the Scientific Committee and Commission next year. The Working Group agreed, however, that it would also be valuable if results were available from other models (Appendix D, paragraphs 5.18 to 5.20).

5.20 The Working Group recognised that there was a range of possible formats for the presentation of information for making decisions. Graphical presentation, particularly for the trade-offs between predator and fishery performance, was thought to convey important properties of performance measures, particularly with respect to what might be considered to be robust performance, especially where large amounts of data were to be summarised (Appendix D, paragraphs 4.7 and 4.8).

Analytical models (summary of WG-FSA-SAM)

5.21 The third meeting of WG-FSA-SAM was held immediately prior to WG-EMM-05, from 27 June to 1 July 2005, also at the NRIFS. WG-FSA-SAM was tasked to examine, develop and agree on the use of assessment methods to be implemented during WG-FSA-05.

5.22 WG-FSA-SAM held discussions primarily relevant to advancements in assessment methods for *Dissostichus* spp. Topics included methods for estimation of recruitment, abundance indices, alternative assessment approaches, and plausible operating models for use in evaluating assessment methods. The subgroup focused discussions principally on evaluation of alternative assessment approaches, including methods that use mark–recapture information, and integrated approaches for stock assessment.

5.23 With respect to mark–recapture methods, WG-FSA-SAM agreed that advancements were made in the understanding of potential bias in estimates of stock size of *D. eleginoides* in Subarea 48.3 arising from imperfect mixing and uneven distribution of fishing effort. The subgroup recognised that toothfish tagging efforts in Subareas 88.1 and 88.2 are now yielding a number of valuable results in terms of movement and growth, and that continued tagging studies will result in further knowledge of the Ross Sea *Dissostichus* stocks. The subgroup agreed that mark–recapture estimates of abundance would be useful not only by themselves, but also as inputs to integrated assessment methods.

5.24 The principal integrated assessment methods considered by WG-FSA-SAM were the ASPM and CASAL.

5.25 The ASPM was applied to *D. eleginoides* in Subarea 48.3 in two separate studies and in Subarea 58.7. Although the former two studies yielded contrasting conclusions, the subgroup agreed that the properties of the ASPM as an integrated modelling technique were being adequately explored in relation to Subareas 48.3 and 58.7.

5.26 Model structure, assumptions, and implementation for calculating precautionary yields of *Dissostichus* spp. using CASAL were considered by the subgroup. Using a point estimate, CASAL does not strictly reproduce precautionary yields by the method of the current GYM. However, using samples from the posterior distribution generated by Bayesian Monte Carlo Markov Chain (MCMC) runs of CASAL followed by future projections of each sample, a set of projections closer to the current GYM could potentially be generated.

5.27 A framework for implementing the precautionary approach in cases where a number of different datasets are integrated was considered, with application to the *D. eleginoides* assessment in Division 58.5.2 using CASAL and the GYM. The framework comprises four components, with the process managed by the use of a controller. This methodology represents an extension of the current practice, and better coordinates the integration of the different steps in the precautionary approach used by CCAMLR.

5.28 WG-FSA-SAM was encouraged by the advancements and continued exploration of the behaviour and suitability of CASAL for *Dissostichus* spp. assessments, and recommended further development of CASAL models for Subareas 48.3 and 88.1 and Division 58.5.2.

5.29 However, the subgroup recommended that the comparability of yield estimates resulting from the GYM and CASAL would need to be investigated. It agreed that the development of any assessment methods include: (i) examination of whether the method had been applied correctly, as well as whether model construction is robust; (ii) a need to undertake comparison of methods; and (iii) evaluation of robustness to operating model uncertainties.

5.30 WG-FSA-SAM provided advice on generating or refining parameter estimates for use at WG-FSA-05, including recommendations pertaining to natural mortality, recruitment, selectivity, age and growth, and movements.

5.31 An assessment timetable was discussed for the period leading up to WG-FSA-05. The subgroup recognised that the proposed integrated assessment methods to be explored for toothfish assessments are time consuming and will be extremely difficult to run during the course of WG-FSA. The subgroup therefore suggested that (i) the Convener of WG-FSA request members of the Stock Assessment Subgroup meet during the week prior to the beginning of WG-FSA-05 (beginning 6 October 2005); and (ii) proposed methodologies and input data for new methods be circulated as early as possible to the WG-FSA Stock Assessment Subgroup.

5.32 In cases where the proposed methodology is found unacceptable, the subgroup recommended that the methodology used in previous years be applied. In a worst-case scenario where new assessment are not agreed upon, WG-FSA-SAM recommended that the Commission may want to utilise management measures in force in 2004/05 during the 2005/06 season.

5.33 The subgroup provided specific advice for assessment methodologies to be employed during WG-FSA-05. It agreed that a CASAL assessment be attempted for *D. eleginoides* in Subarea 48.3 (South Georgia), with papers describing other assessments welcomed as well. WG-FSA-SAM had no new information from which to formulate assessment advice for *C. gunnari* in Subarea 48.3. Assessment advice for *D. eleginoides* in Division 58.5.2 included updates to input parameters (recruitment, growth, selectivity), CPUE and mark–recapture estimates of abundance. The subgroup endorsed the use of the GYM with these revised parameters. It also noted it would be possible to explore the use of CASAL in the toothfish assessment in this division, although it recognised that there may not be sufficient time to complete the work this year. With respect to Subareas 58.6/58.7 (Prince Edward and Marion Islands), WG-FSA-SAM recommended a revised and updated ASPM assessment, further development of operating models for testing candidate management procedures, and an examination of commercial pot fishing data to potentially evaluate the impact of predation by cetaceans in this fishery.

5.34 The subgroup agreed that further work was required to develop and implement a new assessment methodology, although the extent of this work would depend largely on consideration of integrated assessments and comparison of long-term projections made using integrated assessments and CASAL. WG-FSA-SAM therefore agreed to defer advice on future work until this work was partially undertaken during the time leading up to and during WG-FSA-05.

5.35 The Working Group thanked Dr Jones, convener of the subgroup, for his report. It noted that integrated methods and other assessment procedures now being developed by WG-FSA-SAM might be utilised in assessments of krill yield.

Existing conservation measures

5.36 WG-EMM-05/32 proposed that it should be mandatory for all vessels fishing for krill in the Convention Area to carry a scientific observer (national or international). Most members agreed that deployment of international scientific observers should be compulsory on krill vessels, but it was not possible to achieve consensus onthis recommendation (paragraphs 3.44 to 3.48).

5.37 In order to achieve monthly reporting of krill catch and effort at the resolution of SSMUs, the Working Group recommended modification of paragraph 2 of Conservation Measure 23-06 to read:

> 'Catches shall be reported in accordance with the monthly catch and effort reporting system set out in Conservation Measure 23-03. When fishing in SSMUs in Area 48, each Contracting Party shall report monthly catch and effort data by SSMU. When fishing in other areas, each Contracting Party shall report monthly catch and effort data by subarea/division.'

5.38 While Dr Naganobu agreed in principle with the reporting of monthly catch and effort data by SSMU, he wished to reserve his position at this meeting because SSMUs are not contained in any of the current conservation measures and he wished to consult with the relevant groups. See also paragraphs 3.36 and 3.38.

Key points for consideration by the Scientific Committee

5.39 The Working Group agreed to transmit to the Scientific Committee approval recommendations for two ATCM management plans containing marine areas. These include the ASPA at Edmonson Point (WG-EMM-05/7) and a revised plan for the ASMA at Admiralty Bay (WG-EMM-05/8) (paragraph 5.5).

5.40 Views relating to possible participation in the CCAMLR MPA Workshop by those not nominated by Members are contained in paragraphs 5.8 to 5.11.

5.41 The Working Group agreed that it was unable, at this time, to comment on the robustness of the candidate options for subdividing the catch limit for krill in Area 48 amongst SSMUs. Nevertheless, it has made substantial progress in developing the tools and parameter sets for providing advice on a subdivision of the Area 48 catch limit in the near future (paragraph 5.18).

5.42 The Working Group agreed that sufficient progress had been made with the KPFM development this year for it to believe that a further year's work should allow appropriate advice, based on runs with a revised version of the simulation model, to be provided to the Scientific Committee and Commission next year by WG-EMM. The Working group agreed, however, that it would also be valuable if results were also available from other models (paragraph 5.19).

5.43 The Working Group recognised that there was a range of possible formats for the presentation of information for making decisions. Graphical presentation, particularly for the trade-offs between predator and fishery performance, was thought to convey important properties of performance measures, particularly with respect to what might be considered to be robust performance, especially where large amounts of data were to be summarised (paragraph 5.20).

5.44 The Working Group noted that integrated methods and other assessment procedures now being developed by WG-FSA-SAM might be utilised in assessments of krill yield (paragraph 5.35).

5.45 Most members of the Working Group agreed that deployment of international scientific observers should be compulsory on all vessels fishing for krill in Convention Area waters, but it was not possible to achieve consensus on this recommendation (see paragraphs 3.44 to 3.48 and 5.36).

5.46 In order to achieve monthly reporting of krill catch and effort at the resolution of SSMUs, the Working Group recommended modification of paragraph 2 of Conservation Measure 23-06 to read:

> 'Catches shall be reported in accordance with the monthly catch and effort reporting system set out in Conservation Measure 23-03. When fishing in SSMUs in Area 48, each Contracting Party shall report monthly catch and effort data by SSMU. When fishing in other areas, each Contracting Party shall report monthly catch and effort data by subarea/division.'

5.47 Dr Naganobu agreed in principle with this requirement, but wished to reserve his position at this meeting (paragraph 5.38).

FUTURE WORK

Predator surveys

6.1 Four working papers relating to predator surveys were submitted (WG-EMM-05/23, 05/24, 05/25 and 05/39).

6.2 WG-EMM-05/23, which provided estimates of the abundance of crabeater, leopard and Ross seals in the pack-ice between 60° and 150°E in East Antarctica, is described in paragraph 4.3. The remaining three papers relate to surveys of land-based predators.

6.3 WG-EMM-05/25 described the preliminary development of a GIS tool to assist in developing sample survey designs for broad-scale surveys of colonial breeding species. Sample survey designs have the advantages of maximising the use of existing colony map information and minimising the counting effort required. When the GIS tool was applied to a regional population in the Mawson area using a simple stratified random design, only a few percent of the population needed to be counted to derive an estimate of abundance that was close to the true value with high probability. Although the tool needs more development, it could be refined to address more complex and efficient designs.

6.4 WG-EMM-05/39 provided a summary of information provided in the Antarctic Site Inventory (ASI). At the 2004 meeting of the Scientific Committee, the Chair of CEP informed the Scientific Committee on progress in the ASI project. The Scientific Committee then asked the Secretariat to discuss with CEP the nature of the data contained within the inventory, and to liaise with working groups as to whether the information in the inventory may be of use to them. The ASI contains three forms of information: (i) site information, such as key physical and topographical features and distribution of flora; (ii) variable site information and data on weather, environmental conditions, counts of nests and chicks in selected colonies of penguins and other seabirds; and (iii) maps and photo-documentation, including locations of colonies, assemblages of fauna, and oblique aerial photography from a helicopter. Data of particular interest to CCAMLR includes counts of several land-based predator species and maps of colonies at each of the locations. The inventory includes data from 639 visits to 93 sites on the Antarctic Peninsula over 11 years (1991–2003), with regular data available for 17 sites. The Working Group considered that there is much information in the inventory of great interest to CCAMLR, particularly with regard to estimating land-based predator abundance, and recommended that the usefulness of the data to CCAMLR should be conveyed to the Scientific Committee and CEP.

6.5 WG-EMM-05/24 summarised deliberations by the land-based predator survey correspondence group from the time of the group's inception in 2001 until the time of submission of papers to WG-EMM-05. The correspondence group was formed to assess the feasibility of undertaking future surveys of land-based predator abundance as a requirement for estimating predator demand. In addition, in 2004 the Scientific Committee asked the correspondence group to review the usefulness of status and trend information provided by the SCAR expert groups on birds and seals, after the utility of these data for CCAMLR was examined within WG-EMM and the Scientific Committee.

6.6 During the meeting further substantial discussions by the correspondence group took place. The outline below covers both the contents of WG-EMM-05/24 and the outcome of discussions.

6.7 At WG-EMM-05, much of the group's discussion focused on the practical issues of securing the logistics required for future surveys. In this regard the Working Group recognised that:

(i) surveys of land-based predators would be logistically very difficult due to the need to survey multiple species with varying techniques, and using multiple types of survey platforms;

(ii) logistics would need to be sought from various sources, and the chances of securing enough resources are uncertain;

(iii) the IPY is likely to tie up logistic resources until 2008/09, so unless predator surveys were proposed as part of the IPY it may not be possible to undertake any surveys for another four to five years. The Working Group felt it was unwise to rush the planning of surveys to be part of the IPY;

(iv) a major concern was that securing logistics would require a full commitment from one or more members of the Working Group over a substantial period with an unknown probability of success. This would require that such members re-prioritise their domestic commitments.

6.8 Taking all these factors into account, the correspondence group considered that the most useful and practical way forward was to: (i) examine existing data for potential biases and uncertainties; (ii) where possible develop estimates of abundance and its uncertainty from the existing data; and (iii) identify areas where data were inadequate or absent. The Working Group agreed with this approach.

6.9 The Working Group also agreed that a workshop should be held to develop procedures to estimate land-based predator abundance and associated uncertainty from existing data in SSMUs in Area 48. The timing of this workshop was discussed in paragraphs 6.39 and 6.49.

6.10 The Working Group discussed the suitability of the status and trend summary information provided by SCAR, and recognised that some essential attributes of count data (such as dates) were not included in the summary. As a result, some of the summary information cannot be used in its current form to determine the uncertainty in abundance estimates as required by CCAMLR. The Working Group also recognised that in the past CCAMLR had not provided any specific guidance to SCAR on the format in which data would be most useful for CCAMLR's work.

6.11 As CCAMLR has requested summary information from SCAR at approximately five-year intervals in the past, and the last summary was provided by SCAR in 2000, the Working Group was aware that SCAR may now be expecting another request for information. However, noting that no specific guidance had been supplied to SCAR on the most appropriate format in relation to CCAMLR's present specific needs, and recognising that a workshop proposed in the near future (paragraph 6.9) will consider, amongst other issues, the format required for existing data to meet CCAMLR's needs, the Working Group considered that it would not formally request further information from SCAR at this time.

6.12 The Working Group felt that the Scientific Committee should communicate to SCAR its intention to hold a workshop in the future, and extend an invitation for SCAR representatives to attend that workshop when it occurs.

Ecosystem models, assessments and approaches to management

Operating models to evaluate management procedures

6.13 The Working Group noted the work undertaken at the Workshop on Management Procedures to Evaluate Options for Subdividing the Krill Catch Limit among Small-scale Management Units. In particular, it noted the steps to evaluate options (management procedure/strategy) for managing a fishery (Appendix D, paragraphs 6.1 to 6.3), which require the development of operating models (plausible simulation models of the ecosystem and fishery). In general, a management procedure comprises a program to monitor indicators (acquisition of data from the target species, the fishery and/or the ecosystem), method/s to assess the indicators (stock and/or ecosystem assessments) and rules for deciding on the harvest strategy (decision rules) to be used over one or many years (e.g. spatially and/or temporally adjusted catch limits).

6.14 The Working Group agreed that its focus over the last five years has been to progress the development of a feedback management procedure for krill based on information from the fishery, krill population surveys and CEMP. In the past four years, workshops have focused on:

(i) 2001 – design of the work program
(ii) 2002 – delineation of SSMUs
(iii) 2003 – review of CEMP
(iv) 2004 – elaboration of plausible marine ecosystem models for the Antarctic.

6.15 This year, the workshop made substantial progress on evaluating spatially-structured harvest strategies that can appropriately account for predator requirements in SSMUs.

6.16 In considering future work in this area, the Working Group noted that the primary advances over the last year were in the development of operating models for evaluating management procedures. Three papers were presented to the workshop elaborating operating models being developed for use by the Working Group (WG-EMM-05/13, 05/14 and 05/33; Appendix D, paragraphs 5.1 to 5.5) (see paragraphs 2.5 to 2.7). A fourth paper was considered relevant to this work (WG-EMM-05/34; Appendix D, paragraph 5.6). Two other papers were available to the Working Group for general consideration of the development of operating models (WG-EMM-05/18; Atkinson et al., 2004).

6.17 The Working Group noted the suggestions from the workshop for models to be used for evaluating candidate methods for subdividing catch limits in Area 48. These suggestions regarded parameterisation of the models, as well as structural and functional issues relating to the operation of the ecosystem and the manner in which these could be presented in a plausible model. These included (Appendix D, paragraph 3.36):

(i) the benefits of a seasonally resolved model, compared to those of a model with a single annual time step;

(ii) the transport of krill from one region (or SSMU) to another (or other SSMU);

(iii) predators and fisheries may have different selection criteria for krill;

(iv) the availability of krill to the fishery and to predators was important, and that factors such as density and/or swarm characteristics would be important;

(v) the recognition that the movement of predators between SSMUs was potentially important;

(vi) the recognition that the dynamics of some pelagic predators may be independent of krill availability assessed at the scale of SSMUs;

(vii) the method for allocating catch and consumption, particularly when the combined demand was greater than the available abundance of krill;

(viii) the need to account for harvesting of fish that are krill predators in some SSMUs.

6.18 The Working Group endorsed the workshop view that at least three key aspects that should be given further attention in the models and their implementation are the incorporation of (Appendix D, paragraphs 5.10 to 5.13):

(i) shorter time steps and/or seasonality
(ii) alternative movement hypotheses
(iii) a threshold krill density below which a fishery will not operate.

6.19 The Working Group also noted the work identified by the workshop that could usefully be undertaken for the development of these models to evaluate candidate methods for subdividing the krill catch limit in Area 48 among SSMUs, including complementary development of the different modelling approaches (Appendix D, paragraphs 5.18 to 5.26).

6.20 WG-EMM-05/34 described a minimally realistic model of the dynamics of krill, four baleen whale (blue, fin, humpback and minke) and two seal (Antarctic fur and crabeater) species in two large sectors of the Antarctic. The model was developed to investigate whether predator–prey interactions alone can broadly explain observed population trends since the onset of seal harvests in 1780. It concluded that the answer to this question is yes, although not without some difficulties. The authors identified the paper to be a first step towards the development of models of predator–prey interactions at a circumpolar scale, which could with further development assist in providing scientific advice for management measures for the krill and other fisheries in the region which take account of the indirect effect of harvesting on dependent and related species.

6.21 Dr E. Plagányi (South Africa) noted that this model had used existing data to develop a model reconstruction of the Antarctic marine ecosystem. She had also noted in the workshop that the model in WG-EMM-05/34 is not currently suitable for the development of management advice in the context of subdividing catch limits amongst SSMUs but could be used to explore the effect of trends in abundances over larger spatial scales than those addressed for Area 48 (Appendix D, paragraph 5.24).

6.22 Dr Hewitt drew the attention of the Working Group to the estimates of krill biomass in this model for the Scotia Sea, which were similar to existing estimates from surveys in the region of 100–200 million tonnes.

6.23 Dr Constable indicated that it would be useful for the authors to explore alternative hypotheses that might explain the data rather than focusing on the single hypothesis of competitive interactions amongst species.

6.24 Dr Plagányi agreed, noting that it would be useful for modellers to explore more fully the role of environmental factors generally.

6.25 WG-EMM-05/18 reported on the development of a carbon-budget trophic model for the Ross Sea. The food web was characterised with 22 functional compartments. The authors noted that this work is preliminary. The next step in its development is to determine the range of ecosystem variables that are consistent with the current understanding of the constraints on ecosystem functioning. It is intended to further develop the model to help investigate potential trophic impacts of the Antarctic toothfish fishery in this region.

6.26 Dr M. Pinkerton (New Zealand) also highlighted that the development of this model was a useful exercise in collating the information into a form that could be useful to CCAMLR in the future.

6.27 The Working Group noted the utility of this work in establishing feasible parameter space for the Ross Sea.

6.28 Dr K. Shust (Russia) noted that it was important to recognise that the Ross Sea ecosystem may not be dependent on Antarctic krill.

6.29 Atkinson et al. (2004) examined potential long-term decline in krill stock and increase in salps within the Southern Ocean. They combined all available scientific net sampling data from 1926 to 2003 and examined correlations between the abundances of different biota to draw inferences on changes in the Southern Ocean. The authors suggested that krill densities may have decreased since the 1970s, whilst salps may have increased in the southern part of their range over the last century. They noted that such changes would potentially introduce increased levels of uncertainty for fisheries managers as they attempt to manage the fishery in the face of regional climate variability.

Subgroup on Development of Operating Models

6.30 The Working Group noted the work now being undertaken on modelling the Antarctic marine ecosystem. In terms of its own work, it considered that the development of operating models could be facilitated by a subgroup in preparing for future work on the evaluation of management procedures. To that end, the Working Group agreed that a Subgroup on Development of Operating Models be established according to the terms of reference in Appendix F.

6.31 The Working Group agreed that the primary function in the beginning would be to establish a newsgroup as part of the subgroup with the assistance of the Secretariat. Dr Constable undertook to facilitate the establishment of the newsgroup with the Secretariat and to help coordinate the work of the subgroup in providing support to the conveners of the workshop of WG-EMM next year. The Working Group noted that this may have budgetary implications and requested that the Secretariat provide advice to the Scientific Committee.

6.32 The Working Group agreed that members and experts desiring access to the newsgroup would require approval of their representative to the Scientific Committee in order to ensure they are aware of the terms of reference and the rules governing participation in the group.

Parameters in large-scale models of the Antarctic marine ecosystem

6.33 In reflecting on the modelling work described in paragraphs 6.16 to 6.29 and the considerable work undertaken by the working groups of the Scientific Committee on developing plausible models of the Antarctic marine ecosystem, WG-EMM noted that CCAMLR is a leading body in the development of such models, given the breadth of expertise brought to its work by biologists, oceanographers and modellers. Nevertheless, it also recognised that other bodies, including the IWC, are developing models of the Antarctic marine ecosystem for their purposes. In particular, large-scale models looking at circum-Antarctic trends and prognoses are drawing on ecosystem information being collated and synthesized by CCAMLR. These large-scale models are also important to CCAMLR in understanding trends and dynamics at these larger scales. The Working Group agreed that it would be desirable to ensure that parameters were consistent across these models.

6.34 The Working Group noted that there was a range of academic groups involved in developing large-scale circumpolar models of the Southern Ocean. In particular the Integrated Analysis of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean (ICCED), which is the Southern Ocean component of the IGBP's Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) program, has a similar set of aims to those large-scale models indicated above. At the recent meeting of the ICCED steering committee, membership of which includes scientists involved in both CCAMLR and IWC, it was recognised that interaction and integration of the modelling efforts of a range of experts would be required to develop circumpolar ecosystem models.

6.35 Dr Constable proposed that a way forward to provide consistency in the use of model parameters would be to hold a workshop involving the IWC and other ecosystem modelling groups, including modellers, biologists and physical scientists. In terms of the work of CCAMLR, such a workshop could focus on determining the key parameters and their characteristics required for large-scale ecosystem models developed to explore the role and response of krill predators in the Antarctic marine ecosystem. This would help facilitate work of both WG-EMM and WG-FSA in the development of operating models. Given that such a proposal would require time for coordinating with the IWC and other groups, it would be conceivable to hold the meeting in the first half of 2007. He offered to help coordinate a proposal with members of WG-EMM and WG-FSA, as well as the subgroup promoting the development of operating models, for consideration by the Scientific Committee at its meeting in October 2005.

6.36 The Working Group agreed that such a workshop would be useful, particularly if it included the diversity of groups involved with Antarctic marine ecosystem modelling. For example, it would be beneficial for workshop organisers to correspond with the IWC and ICCED among others in developing its plans. Some Members indicated there may be sensitivities with the inclusion of the IWC Scientific Committee in this work.

6.37 The Working Group agreed that a proposal to hold a workshop to discuss the parameterisation of large-scale ecosystem models should not be considered as part of the work of WG-EMM but should be undertaken as an activity of the Scientific Committee. It would be expected that the Scientific Committee would establish a steering committee should it agree to the proposal.

Long-term work plan

6.38 To initiate discussion on its long-term work plan, the Working Group recalled both its objective of developing a feedback approach to the management of the krill fishery and its review of progress made towards this objective (paragraph 6.14).

6.39 The Working Group agreed that useful progress had been made towards its objective but acknowledged that there are still a large number of items for future work. The Working Group identified the following items of importance that may need intensive work in the coming years:

(i) facilitate the continued evaluation of procedures to allocate the precautionary krill catch limit in Area 48 among SSMUs (paragraphs 2.10 and 5.19);

(ii) consider revising estimates of B_0 and γ in all areas taking account of recent developments in estimating parameters used in assessments, thereby revising estimates of precautionary yield (paragraph 4.60);

(iii) develop SSMU-specific estimates of predator abundance and demand in Area 48 (paragraph 6.9);

(iv) plan for and coordinate future surveys and field efforts related to krill (paragraphs 4.78 to 4.80 and Appendix E) noting that these efforts may ultimately require workshops to facilitate collaborative data analyses;

(v) continue the development of plausible ecosystem models (paragraphs 6.16 to 6.19).

6.40 It was agreed that the first three work items should have priority status and form the basis of ensuing workshops at the next three meetings of WG-EMM (i.e. 2006–2008).

6.41 It was agreed that, in 2006, WG-EMM should hold a workshop focused on continuing the evaluation of procedures to allocate the precautionary krill catch limit in Area 48 among SSMUs. The workshop could therefore be titled the 'Second Workshop on Management Procedures'.

6.42 The Working Group acknowledged that evaluating options for allocating the krill catch limit among SSMUs prior to revising area-specific estimates of krill biomass (density) and predator abundance (demand) would pose some challenges because the performance of the candidate options may be sensitive to these estimates. Nevertheless, it was noted that the operating models being developed to conduct such evaluations will be purposefully built to integrate over various sources of uncertainty (paragraphs 2.5 to 2.7).

6.43 Considering the points in paragraph 6.42, the Working Group noted that its decision to convene a Second Workshop on Management Procedures prior to work that will revise the data used to evaluate the candidate options for allocating the krill catch among SSMUs necessitates a flexible approach to providing advice to the Scientific Committee and Commission. The provision of advice, should it be possible, is consistent with CCAMLR's use of the best available scientific evidence. This does not preclude revisions in the future, as knowledge and methods improve.

6.44 The Working Group agreed that the Second Workshop on Management Procedures should build on the work completed this year, and, therefore, it should have the terms of reference identified in the following list.

(i) Review the development of operating models since the 2005 Workshop on Management Procedures.

(ii) Explore the performance of the operating models submitted to the workshop by determining whether they meet necessary benchmarks and conducting appropriate sensitivity analyses.

(iii) Evaluate the candidate options for allocating the precautionary krill catch limit among SSMUs in Area 48.

(iv) Summarise the results of those evaluations in the form of advice to WG-EMM.

6.45 If multiple operating models are submitted to the workshop, successful progress will require a coordinated effort to produce comparable outputs from each model. The Working Group therefore advised that Members constructing models for use at the workshop develop, at a minimum, the capacity to report on the performance measures identified in paragraph 2.3. The Working Group also advised that the workshop conveners should act to facilitate coordination among model-development teams. This facilitation could be done through the subgroup described in paragraphs 6.30 to 6.32 and Appendix F.

6.46 The Convener of WG-EMM asked Ms T. Akkers (South Africa) and Dr C. Reiss (USA) to co-convene the Second Workshop on Management Procedures, and the Working Group agreed with their joint nomination.

6.47 The Working Group agreed not to invite an outside expert(s) to the Second Workshop on Management Procedures, but Members were encouraged, as appropriate, both to independently consult with outside experts and to bring new delegates to the workshop. It was agreed that the latter approach had contributed to the success of the first workshop.

6.48 The Working Group also agreed that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007. Delaying such work would be problematic for two reasons. First, the report provided by SG-ASAM clearly indicates that biomass (density) estimates from the CCAMLR-2000 Survey need to be revised, and, since the work done this year indicated that the performance of candidate options for allocating the krill catch limit among SSMUs may be sensitive to initial estimates of krill density, such revisions may influence advice provided on management procedures for the krill fishery. Second, some Members have surveys planned for the near future and the results of this field work will need to be reviewed and considered by WG-EMM.

6.49 The Working Group agreed that it would be beneficial to have a strategic planning workshop.

Key points for consideration by the Scientific Committee

Advice from Agenda Item 6.1

6.50 The ASI contains much information of great interest to CCAMLR, particularly with regard to counts of land-based predators. WG-EMM recommended that the Scientific Committee indicate to CEP that the information in the ASI is potentially very useful to the work of CCAMLR (paragraph 6.4).

6.51 The Scientific Committee should communicate to SCAR its intention to hold a workshop in the near future to assess the utility of existing data for estimating land-based predator abundance and its uncertainty, and to extend an invitation for SCAR representatives to attend that workshop when it occurs (paragraph 6.12).

6.52 The Scientific Committee should also communicate to SCAR that it would not formally request further information from SCAR on status and trends in marine mammal and seabird populations at this time (paragraph 6.11).

Advice from Agenda Item 6.2

6.53 In considering future work in ecosystem models, assessments and approaches to management, the Working Group noted that the primary advances over the last year were in the development of operating models for evaluating management procedures (paragraphs 6.13 to 6.16). A future work program for further developing these models has been identified (paragraphs 6.17 to 6.19).

6.54 The Working Group agreed that a Subgroup on Development of Operating Models be established according to the terms of reference in Appendix F to facilitate the further work identified above. The Working Group agreed that the primary function in the beginning would be to establish a newsgroup as part of the subgroup with the assistance of the Secretariat. Dr Constable will be responsible for facilitating the establishment of the newsgroup with the Secretariat and to help coordinate the work of the subgroup in providing support to the conveners of the workshop of WG-EMM next year (paragraphs 6.30 and 6.31). The Working Group agreed that Members and experts desiring access to the newsgroup would require approval of their representative to the Scientific Committee in order to ensure they are aware of the terms of reference and the rules governing participation in the group (paragraph 6.32).

6.55 The Working Group agreed that it would be desirable to ensure that parameters used in large-scale models looking at circum-Antarctic trends and prognoses were consistent across these models. It agreed that CCAMLR was a leading organisation in the acquisition of data for deriving these parameters as well as in developing ecosystem models. The Working Group agreed that Dr Constable correspond with the working groups, including the Subgroup on Development of Operating Models, to develop a proposal for the Scientific Committee this year to consider holding a workshop to focus on determining the key parameters and their characteristics required for large-scale ecosystem models developed to explore the role and response of krill predators in the Antarctic Marine Ecosystem (paragraph 6.33 to 6.37). This would help facilitate work of both WG-EMM and WG-FSA in the development of operating models. Such a workshop should not be considered as part of the work of WG-EMM but should be undertaken as an activity of the Scientific Committee.

Advice from Agenda Item 6.3

6.56 The Working Group agreed that useful progress had been made towards its objective of developing a feedback approach to managing the krill fishery but acknowledged that there are still a large number of items for future work. The Working Group identified the following items of importance that may need intensive work in the coming years:

(i) facilitate the continued evaluation of procedures to allocate the precautionary krill catch limit in Area 48 among SSMUs (paragraphs 2.10, 5.19 and 6.39(i));

(ii) consider revising estimates of B_0 and γ in all areas taking account of recent developments in estimating parameters used in assessments, thereby revising estimates of precautionary yield (paragraphs 4.60 and 6.39(ii));

(iii) develop SSMU-specific estimates of predator abundance and demand in Area 48 (paragraphs 6.9 and 6.39(iii));

(iv) plan for and coordinate future surveys and field efforts related to krill (paragraphs 4.78 to 4.80 and Appendix E) noting that these efforts may ultimately require workshops to facilitate collaborative data analyses (paragraph 6.39(iv));

(v) continue the development of plausible ecosystem models (paragraphs 6.16 to 6.19 and 6.39(v)).

6.57 It was agreed that the first three work items should have priority status and form the basis of ensuing workshops at the next three meetings of the WG-EMM (i.e. 2006–2008) (paragraph 6.40).

6.58 The Working Group agreed that a Second Workshop on Management Procedures should be held in 2006 and that this workshop should build on the work completed this year. The Second Workshop on Management Procedures should have the terms of reference identified in paragraph 6.44.

6.59 The Convener of WG-EMM asked Ms Akkers and Dr Reiss to co-convene the Second Workshop on Management Procedures, and the Working Group agreed with their joint nomination (paragraph 6.46).

6.60 The Working Group agreed not to invite an outside expert(s) to the Second Workshop on Management Procedures, but Members were encouraged, as appropriate, both to independently consult with outside experts and to bring new delegates to the workshop. It was agreed that the latter approach had contributed to the success of the first Workshop on Management Procedures (paragraph 6.47).

6.61 It was agreed that provision of advice, should it be possible from work done at the Second Workshop on Management Procedures, is consistent with CCAMLR's use of the best available scientific evidence. This does not preclude revisions in the future, as knowledge and methods improve (paragraph 6.43).

6.62 The Working Group also agreed that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007 (paragraph 6.48).

6.63 The Working Group agreed that it would be beneficial to have a strategic planning workshop (paragraph 6.49).

OTHER BUSINESS

Ross Sea

7.1 Dr Wilson reported that, in the absence of Italian representatives at this year's meeting of WG-EMM, a small group of participants interested in research in the Ross Sea had held informal discussions in the margins of the meeting. The discussions focussed on:

- the valuable contribution to knowledge of the Ross Sea which had been made recently by Japan (WG-EMM-05/16);
- progress in the development of a carbon-budget trophic model for the Ross Sea (WG-EMM-05/18);
- the planning for future LTER research in McMurdo Sound;
- the consequence of the current release of the huge icebergs which had effectively blocked the breakout of McMurdo Sound sea-ice for the past five years.

7.2 Dr Naganobu advised that the 3rd International Conference on the Oceanography of the Ross Sea will be held in Venice, Italy, from 10 to 14 October 2005.

CEP

7.3 Dr Penhale reported that SCAR had submitted two working papers to CEP-VIII (Sweden, 2005) which were of relevance to CCAMLR. The first paper was entitled 'De-listing Antarctic Specially Protected Species' (ATCM-XXVIII WP 033) and proposed de-listing two species: *Arctocephalus gazella* (Antarctic fur seal) and *Arctocephalus tropicalis* (sub-Antarctic fur seal)'.

7.4 The second paper was entitled 'Proposal to list a species as a Specially Protected Species under Annex II' (ATCM-XXVIII WP 034) and presented a procedure and format for listing, using the example of the southern giant petrel (*Macronectes giganteus*)'.

7.5 Both papers generated considerable interest and discussion at CEP-VIII. The de-listing paper did not include relevant and readily available data and a discussion of the by-catch of fur seals in the krill fishery. It was noted by CEP that both papers did not correctly describe the relationship between the ATCM, CCAS and CCAMLR. An informal discussion group made progress on delineating an improved process for listing a Specially Protected Species. No formal recommendations arose with regard to either papers. The outcome of discussions is an expectation that SCAR will resubmit improved papers on both topics for CEP-IX.

7.6 WG-EMM expressed interest in these developments and looked forward to the outcome of the CEP deliberations in 2006.

Workshop on 'Practical Biological Indicators of Human Impacts in Antarctica'

7.7 Dr Reid attended an NSF/COMNAP/SCAR sponsored Workshop on 'Practical Biological Indicators of Human Impacts in Antarctica' which was held in Texas, USA, between 16 and 18 March 2005. The objectives of the meeting were to:

- bring together practitioners, experts, scientists, regulators and national operators to assess the state-of-the-art of biological indicators of human impact;
- advise national programs on how to implement meaningful biological monitoring in Antarctica that is economical, feasible, practical and meets legal and treaty obligations.

7.8 WG-EMM noted that one of the primary recommendations was the desirability of much greater collaboration between SCAR, COMNAP, CEP and CCAMLR, particularly with respect to the availability of existing data and information from monitoring programs.

ICCED

7.9 The ICCED program is part of the new joint initiative between the IGBP and SCOR. ICCED will bring together climatologists, oceanographers, biogeochemists, ecosystem and fisheries scientists to generate unique circumpolar datasets and models to address three globally important questions:

- How do climate processes affect the dynamics of circumpolar ocean ecosystems?
- How does ecosystem structure affect circumpolar ocean biogeochemical cycles?
- How should ecosystem structure and dynamics be included in the development of sustainable approaches to managing exploitation?

7.10 WG-EMM noted that ICCED hopes to establish strong ties with international programs and organisations with a Southern Ocean focus, including CCAMLR, SCAR, GLOBEC and IWC.

SCAR Biology Symposium

7.11 WG-EMM noted that SCAR will hold the Ninth International Antarctic Biology Symposium in Curitiba, Brazil, from 25 to 29 July 2005. Three invited keynote speakers from CCAMLR (Drs Kawaguchi, K.-H. Kock (Germany) and Reid) will promote the role and activities of CCAMLR.

Standardising the submission of meeting documents to working groups

7.12 At the request of the Scientific Committee, the Secretariat prepared a reference document which provided guidelines for the submission of meeting documents to the Scientific Committee, WG-EMM and WG-FSA, including ad hoc WG-IMAF (WG-EMM-05/10, Attachment). This reference document has highlighted the elements common to both working groups' guidelines, as well as some specific differences.

7.13 WG-EMM considered the Secretariat's proposal to standardise the working group-specific differences in relation to submission deadlines, exceptions to deadlines and approaches to accepting revised documents (WG-EMM-05/10, Table 1). WG-EMM agreed that standardising the working groups' guidelines would simplify the procedures which participants must follow, as well as the Secretariat's work in preparing information and documents for meetings.

7.14 WG-EMM agreed to revise its guidelines for the submission of meeting documents as follows:

(i) The deadline for the submission of papers would be moved to no later than 0900 h on the Monday exactly two weeks prior to the commencement of the meeting, based on Eastern Australia standard time ('Hobart' time), and the deadline would apply to meeting documents as well as to SC-CAMLR and CCAMLR documents submitted to WG-EMM.

(ii) Two types of papers may be exempted from the deadline: (i) Secretariat papers dealing with data, and (ii) Members' meeting papers, subject to prior notification and at the discretion of the convener and the Chair of the Scientific Committee. In relation to (i), the Working Group agreed that the exemption applied to papers dealing with data received close to the start of the meeting or reporting Secretariat tasks specifically identified by the convener and/or the working group. In relation to (ii), it was agreed that the exemption would apply only to those papers which would make a significant difference to the conduct of the meeting, or would impact on the decision of the Commission.

(iii) Factual corrections to papers would be accepted at any time. However, if corrections were made after the deadline, then the author(s) must clearly identify the changes (e.g. using track-change or bold in the document).

In addition, WG-EMM agreed that papers would not be limited to 15 pages, but authors should note that long papers may not be given full attention if there is limited time.

7.15 WG-EMM requested that the Secretariat modify the guidelines for the submission of documents to WG-EMM in accordance with the points above. These new guidelines would be circulated to participants prior to the 2006 meeting of WG-EMM.

7.16 In relation to the submission of published papers to the meeting, WG-EMM agreed that authors should continue to provide an electronic version of the published paper. It was also agreed that the author of the published paper was responsible for any copyright issue arising from the submission to the meeting.

7.17 WG-EMM agreed that papers that were 'in press' at the time of the meeting should be considered as published documents with respect to copyright.

7.18 The Working Group agreed that references to in-press and published papers should continue to be listed under 'Other Documents' in the 'List of Documents' which is appended to the report.

7.19 In further discussion, WG-EMM recognised the difficulty in referring to published and in-press papers during the meeting. In particular, the Working Group recognised the need for easily identifying published papers for which the authors have requested consideration by the Working Group. The Secretariat was asked to consider a simple method for identifying such papers for the purpose of the meeting.

7.20 WG-EMM agreed that all meeting documents distributed by the Secretariat should be in locked pdf to avoid any unauthorised use or incidental change to the text. However, in order to facilitate the work of the rapporteurs, it was agreed that the one-page synopses should be made available, separately and in unlocked pdf during the meeting.

Streamlining the work of the Scientific Committee

7.21 WG-EMM considered Dr Constable's proposal to streamline the work of the Scientific Committee by re-arranging the work of its working groups under three general topics (WG-EMM-05/35): (i) Biology, ecology and conservation; (ii) Development of assessment methods; and (iii) Assessments.

7.22 Dr Constable indicated that this proposal had its genesis in a paper he presented at the 25th Anniversary CCAMLR Symposium in Valdivia, Chile, in April 2005. The symposium was a Member-organised event and a report from the symposium co-chairs will be presented to the Commission for consideration in 2005.

7.23 The Working Group noted that WG-EMM-05/35 reported on work in progress, and the concepts and ideas had been further advanced during discussions in the margin of WG-EMM. Dr Constable advised that he would take account of these discussions and the views of WG-EMM expressed below, and would develop a revised proposal which would be submitted to WG-FSA and the Scientific Committee for their consideration later this year.

7.24 In its presently revised state, Dr Constable's proposal was to reform WG-EMM and WG-FSA-SAM into two working groups and an inter-connected workshop, each with its own convener. These groups would meet intersessionally over a three-week period:

(i) A working group on biology, ecology and conservation to discuss the broad issues and ideas about how the Antarctic marine ecosystem works and general conservation requirements, including the use of marine protected areas in the CCAMLR context.

(ii) A workshop to address topical issues of interest to one or preferably both of the working groups.

(iii) A working group to develop methods for (a) assessing fish, krill and by-catch populations, (b) status of predator and other populations and habitats, (c) ecosystem monitoring, and (d) estimation of yield as well as (e) methods for evaluating management systems.

7.25 Dr Constable's proposal also included retaining an assessment working group to apply approved and evaluated methods to assess (i) fish, krill and by-catch populations, (ii) status of predator and other populations and habitats, (iii) status of the ecosystem, and (iv) yield. The present work and structure of ad hoc WG-IMAF would be retained within this working group.

7.26 The following arguments were raised during discussion by WG-EMM:

(i) The proposal would provide more time for consideration of biological and ecological issues of importance to the foundation of operating models.

(ii) Any change from the present multidisciplinary working groups to dedicated focused groups might increase the time commitments and financial cost of Members which are represented at meetings by a single delegate, or small number of delegates.

(iii) The formation of dedicated, focused groups may isolate biologists and modellers, and reduce the present level of synergy of the Working Group.

(iv) The proposed inter-connected workshop could provide the forum for combined multidisciplinary work.

(v) The Workshop on Management Procedures last week demonstrated the value of multidisciplinary workshops to progressing the work of the Working Group.

(vi) WG-EMM, WG-FSA and ad hoc WG-IMAF, might be retained while WG-FSA-SAM could be formed into a methods working group advising on assessment methods of interest to both WG-EMM and WG-FSA, including integrated models and acoustic methods. Under such a structure, the methods working group would need to adequately address the annual assessment cycle for finfish and the multi-year assessment for krill. This would require a clear indication from the Scientific Committee of the work priorities.

7.27 Ms Akkers noted that the Commission faced similar challenges as the Scientific Committee in developing ways of addressing the very high workload.

7.28 WG-EMM thanked Dr Constable for his thought-provoking proposal, and invited other Members to collaborate in further developing ways to address the high workload of the working groups.

New Convener

7.29 In the light of discussions on the possible restructuring of the working groups, WG-EMM agreed to withhold further consideration of convenership, and refer this matter to the 2005 meeting of the Scientific Committee. Dr Hewitt reiterated the urgent need to find a new convener for the 2006 meeting.

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

8.1 The report of the eleventh meeting of WG-EMM was adopted.

8.2 In drawing the meeting to a close, Dr Hewitt thanked the participants for the fruitful discussions over the past two weeks. He thanked the rapporteurs, the co-conveners of the workshop and the Secretariat for their efforts in ensuring a successful meeting.

8.3 Dr Hewitt thanked Dr Naganobu and the NRIFS staff for hosting the meeting and for providing excellent facilities. Their generous hospitality was greatly appreciated by all.

8.4 This was Dr Hewitt's last meeting as Convener of WG-EMM. Although the work of WG-EMM had been, and remained, of great interest to him, Dr Hewitt advised the Working Group last year that he would need to step down as Convener due to his new job and a new set of work commitments.

8.5 Over his six-year term as Convener, Dr Hewitt led the Working Group through the development of management procedures for the krill fishery. This work required extensive long-term planning and the reformatting of the meetings so as to allow the necessary thematic workshops and multidisciplinary approach. Substantial new work was also required to develop the Working Group's understanding of krill and the marine ecosystem. Dr Hewitt's leadership greatly contributed to the overall success of the work. Further, the Working Group was now well placed to carry this work into the future.

8.6 Dr Constable, on behalf of the Working Group, thanked Dr Hewitt for his very significant contribution to the work of WG-EMM and the Scientific Committee, and in the development of management procedures for the krill fishery. The Working Group hoped that Dr Hewitt would be able to continue his participation in its work.

8.7 The meeting was closed.

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APPENDIX A

AGENDA

Working Group on Ecosystem Monitoring and Management
(Yokohama, Japan, 4 to 15 July 2005)

1. Introduction
   1.1 Opening of the meeting
   1.2 Adoption of the agenda and organisation of the meeting

2. Workshop on Management Procedures to evaluate options for subdividing the krill catch limit among SSMUs

3. Status and trends in the krill fishery
   3.1 Fishing activity
   3.2 Description of the fishery
   3.3 Scientific observation
   3.4 Regulatory issues
   3.5 Key points for consideration by the Scientific Committee

4. Status and trends in the krill-centric ecosystem
   4.1 Status of predators, krill resource and environmental influences
   4.2 Methods
   4.3 Future surveys
   4.4 Key points for consideration by the Scientific Committee

5. Status of management advice
   5.1 Protected areas
   5.2 Harvesting units
   5.3 Small-scale management units
   5.4 Analytical models
   5.5 Existing conservation measures
   5.6 Key points for consideration by the Scientific Committee

6. Future work
   6.1 Predator surveys
   6.2 Ecosystem models, assessments and approaches to management
   6.3 Long-term work plan
   6.4 Key points for consideration by the Scientific Committee

7. Other business

8. Adoption of report and close of meeting.

APPENDIX B

LIST OF PARTICIPANTS

Working Group on Ecosystem Monitoring and Management
(Yokohama, Japan, 4 to 15 July 2005)

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APPENDIX C

LIST OF DOCUMENTS

Working Group on Ecosystem Monitoring and Management
(Yokohama, Japan, 4 to 15 July 2005)

WG-EMM-05/1	Provisional Agenda and Provisional Annotated Agenda for the 2005 Meeting of the Working Group on Ecosystem Monitoring and Management (WG-EMM)
WG-EMM-05/2	List of participants
WG-EMM-05/3	List of documents
WG-EMM-05/4	CEMP Indices: 2005 update Secretariat
WG-EMM-05/5	Krill fishery report: 2005 update Secretariat
WG-EMM-05/6	Summary of notifications of krill fisheries in 2005/06 Secretariat
WG-EMM-05/7	Management Plan for Antarctic Specially Protected Area (ASPA) No. XYX, Edmonson Point, Wood Bay, Victoria Land, Ross Sea Delegation of Italy
WG-EMM-05/8	Review of the Admiralty Bay Antarctic Specially Managed Area Management Plan (ASMA No. 1) Delegations of Brazil and Poland
WG-EMM-05/9	Seabird research at Cape Shirreff, Livingston Island, Antarctica, 2004/05 A.K. Miller, E. Leung and W.Z. Trivelpiece (USA) (*AMLR 2004/2005 Field Season Report*, in press)
WG-EMM-05/10	Proposal to standardise the submission of meeting documents to working groups Secretariat
WG-EMM-05/11	The BROKE-West acoustic krill biomass survey of CCAMLR Division 58.4.2 S. Nicol, S. Kawaguchi, T. Jarvis and T. Pauly (Australia)

WG-EMM-05/12	Descriptive analysis of haul data from FV *Atlantic Navigator* in Elephant Islands (48.1), South Georgia Islands (48.3) and South Orkney Islands (48.3) krill fishery (summer 2004 to early winter 2005) O. Pin, H. Nión, E. Delfino and P. Meneses (Uruguay)
WG-EMM-05/13	A krill–predator–fishery model for evaluating candidate management procedures G.M. Watters, J.T. Hinke (USA), K. Reid and S. Hill (United Kingdom)
WG-EMM-05/13 Appendix 3	Summary of work done to augment and enhance that presented in WG-EMM-05/13 G.M. Watters, J.T. Hinke (USA), K. Reid and S. Hill (United Kingdom)
WG-EMM-05/14	Modelling the impact of krill fishing on seal and penguin colonies É.E. Plagányi and D.S. Butterworth (South Africa)
WG-EMM-05/15	Some additional data challenge the concept of the distribution of the gravid krill females related to bottom depths V.A. Sushin, F.F. Litvinov, A.S. Sundakov and G. Andrianov (Russia)
WG-EMM-05/16	Preliminary report of the Japanese RV *Kaiyo Maru* survey in the Ross Sea and adjacent waters, Antarctica, in 2004/05 M. Naganobu, K. Taki and T. Hayashi (Japan)
WG-EMM-05/17	Time series of Drake Passage Oscillation Index (DPOI) from 1952 to 2005, Antarctica M. Naganobu and K. Kutsuwada (Japan)
WG-EMM-05/18	Developing a carbon-budget trophic model of the Ross Sea, Antarctica: work in progress M. Pinkerton, S. Hanchet, J. Bradford-Grieve and P. Wilson (New Zealand)
WG-EMM-05/19	By-catch of fishes caught by the fishery vessel *Niitaka Maru* in the South Georgia area (August to September 2004) T. Iwami, T. Hayashi, K. Taki and M. Naganobu (Japan)
WG-EMM-05/20	Quantifying within- and between-season variability in Adélie penguin fledgling weights: statistical and practical implications for detecting change L. Emmerson, C. Southwell and J. Clarke (Australia) (*CCAMLR Science*, submitted)

WG-EMM-05/21	Do Adélie penguin fledgling weights provide an index of prey availability? L. Emmerson, C. Southwell and J. Clarke (Australia)
WG-EMM-05/22	Detection of systematic change in Adélie penguin foraging trip duration: consequences of high inter-annual variability and usefulness of ice cover as a covariate J. Clarke, C. Southwell and L.M. Emmerson (Australia) (*CCAMLR Science*, submitted)
WG-EMM-05/23	Estimating the abundance of pack-ice seals off east Antarctica C. Southwell (Australia), D. Borchers, C. Paxton (United Kingdom), B. de la Mare (Canada), P. Boveng (USA), A.S. Blix and E.S. Nordoy (Norway)
WG-EMM-05/24	Developments, considerations and recommendations by the land-based predator survey group: a summary and up-date C. Southwell (Australia), P. Trathan (United Kingdom), W. Trivelpiece, M. Goebel (USA) and P. Wilson (New Zealand)
WG-EMM-05/25	A GIS tool to assist in the planning and design of sample surveys of the abundance of colonial breeding species C. Southwell, R. Dreissen, S. Candy, G. McPherson and J. Clarke (Australia)
WG-EMM-05/26	Using carapace measurements to determine the sex of Antarctic krill (*Euphausia superba*) J.D. Lipsky, M.E. Goebel, C.S. Reiss and V. Loeb (USA)
WG-EMM-05/27	Modelling growth of Antarctic krill: a new approach to describing the growth trajectory S. Candy and S. Kawaguchi (Australia)
WG-EMM-05/28	Fishing ground selection in krill fishery: trends in its patterns across years, seasons, and nations S. Kawaguchi (Australia), K. Taki and M. Naganobu (Japan) (*CCAMLR Science*, submitted)
WG-EMM-05/29	Modelling growth of Antarctic krill: growth trends with sex, length, season, and region S. Kawaguchi, S. Candy, R. King (Australia), M. Naganobu (Japan) and S. Nicol (Australia)
WG-EMM-05/30	A conceptual model of Japanese krill fishery S. Kawaguchi, S. Nicol (Australia), K. Taki and M. Naganobu (Japan) (*CCAMLR Science*, submitted)

WG-EMM-05/31	CCAMLR observer manual questionnaires: summary results of preliminary analysis during its introductory period S. Kawaguchi and S. Nicol (Australia)
WG-EMM-05/32	On the use of scientific observers on board krill fishing vessels Delegation of Ukraine
WG-EMM-05/33	Implementing plausible ecosystem models for the Southern Ocean: an ecosystem, productivity, ocean, climate (EPOC) model A.J. Constable
WG-EMM-05/34	Modelling the predator–prey interactions of krill, baleen whales and seals in the Antarctic ecosystem M. Mori and D.S. Butterworth (South Africa) (*CCAMLR Science*, submitted)
WG-EMM-05/35	A proposal for streamlining the work of the Scientific Committee for the Conservation of Antarctic Marine Living Resources A.J. Constable (Australia)
WG-EMM-05/36	Preliminary report of sound-speed contrast and density of krill measured on board RV *Kaiyo Maru* Y. Takao, H. Yasuma , R. Matsukura and M. Naganobu (Japan)
WG-EMM-05/37	Mortality of macaroni penguins (*Eudyptes chrysolophus*) at Marion Island caused by avian cholera (*Pasteurella multocida*) in 2004/05 R.J.M. Crawford, B.M Dyer, M.S. De Villiers, G.J.G. Hofmeyr and D. Tshingana (South Africa)
WG-EMM-05/38	Breeding numbers and success of *Eudyptes* penguins at Marion Island, and the influence of arrival of adults R.J.M. Crawford, J. Cooper, B.M. Dyer and L.G. Underhill (South Africa) (*CCAMLR Science*, submitted)
WG-EMM-05/39	Information on the CEP'S Antarctic site inventory Secretariat
WG-EMM-05/40	Withdrawn
WG-EMM-05/41	Some characteristics of krill transport in the Scotia Sea based on the Russian survey data S.M. Kasatkina, V.N. Shnar and O.V. Berezhinsky (Russia) (*CCAMLR Science*, submitted)

WG-EMM-05/42	A quantified Bayesian maximum entropy estimate of Antarctic krill abundance across the Scotia Sea and in small-scale management units from the 2000 CCAMLR survey B.G. Heywood, S.F. Gull and A.S. Brierley (United Kingdom) (*CCAMLR Science*, submitted)
WG-EMM-05/43	Report of the Workshop on Management Procedures (Yokohama, Japan, 4 to 8 July 2005)

Other Documents

WG-FSA-05/4	Report of the WG-FSA Subgroup on Assessment Methods (Yokohama, Japan, 27 June to 1 July 2005)
SC-CAMLR-XXIV/BG/2	Convener's summary on intersessional activities of the Subgroup for the Implementation of the CCAMLR 2008 IPY Survey V. Siegel (Convener, Steering Group 'CCAMLR 2008 IPY Survey')
SC-CAMLR-XXIV/BG/3	Report of the First Meeting of the Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) (La Jolla, USA, 31 May to 2 June 2005)
	Long-term decline in krill stock and increase in salps within the Southern Ocean A. Atkinson (United Kingdom), V. Siegel (Germany), E. Pakhomov (Canada/South Africa), P. Rothery (United Kingdom) (*Nature*, 432: 100–103)
	The effects of global climate variability in pup production of Antarctic fur seals J. Forcada, P.N. Trathan, K. Reid and E.J. Murphy (United Kingdom) (*Ecology*, in press)
	Diet and reproductive success of Adélie and chinstrap penguins: linking response of predators to prey population dynamics A.S. Lynnes, K. Reid and J.P. Croxall (United Kingdom) (*Polar Biol.*, 27: 544–554 (2004))
	Seasonal variation of crude digestive protease activity in Antarctic krill *Euphausia superba* B. Yoshitomi (Japan) (*Fisheries Science*, 71: 12–19 (2005))
	Causes of offspring mortality in the Antarctic fur seal, *Arctocephalus gazella*: the interaction of density dependence and ecosystem variability K. Reid and J. Forcada (United Kingdom) (*Can. J. Zool.*, 83: 1–6 (2005))

APPENDIX D

REPORT OF THE WORKSHOP ON MANAGEMENT PROCEDURES
(Yokohama, Japan, 4 to 8 July 2005)

CONTENTS

REPORT OF THE WORKSHOP ON MANAGEMENT PROCEDURES
(Yokohama, Japan, 4 to 8 July 2005)

INTRODUCTION

1.1 The Workshop on Management Procedures to Evaluate Options for Subdividing the Krill Catch Limit among Small-scale Management Units was held at the National Research Institute of Fisheries Science (NRIFS), Yokohama, Japan. The workshop was conducted during the first week of WG-EMM-05 (4 to 8 July 2005) and was co-convened by Drs K. Reid (UK) and G. Watters (USA).

1.2 The Provisional Agenda was discussed and adopted without change (Attachment 1), and the meeting participants are listed in Attachment 2.

1.3 The report was prepared by Drs A. Constable (Australia), R. Hewitt (USA), R. Holt (USA), S. Kawaguchi (Australia), G. Kirkwood (UK), D. Ramm (Data Manager) and P. Trathan (UK).

REVIEW OF AIMS OF THE WORKSHOP

2.1 The workshop Co-conveners presented the background to the workshop and how it had evolved since the establishment of the precautionary catch limit for krill in 1991, noting:

(i) the known overlap in spatial distributions of krill catches and foraging areas of dependent species and the potential for fishing to impact on those species;

(ii) the limitation of fishing to 620 000 tonnes in Area 48 until a method for distributing the catch amongst subareas has been determined (Conservation Measure 51-01);

(iii) the request by the Commission to advise on a subdivision of the krill catch limit in Area 48 according to the SSMUs developed by WG-EMM and endorsed by the Commission in 2002 (CCAMLR-XXI, paragraph 4.6).

2.2 Following the past four workshops at WG-EMM in support of the development of a revised management procedure for krill, there was agreement by WG-EMM, which was endorsed by the Scientific Committee, that the first workshop to evaluate management procedures for the krill fishery should examine how well six candidate methods for subdividing the krill catch would meet the objectives of CCAMLR (SC-CAMLR-XXIII, Annex 4, paragraphs 6.12 to 6.24). The candidate methods to be evaluated included subdivisions based on:

(i) the spatial distribution of catches by the krill fishery;

(ii) the spatial distribution of predator demand;

(iii) the spatial distribution of krill biomass;

(iv) the spatial distribution of krill biomass minus predator demand;

(v) spatially explicit indices of krill availability that may be monitored or estimated on a regular basis;

(vi) pulse-fishing strategies in which catches are rotated within and between SSMUs.

2.3 The workshop agreed that its overall aim was to evaluate these six allocation options for subdividing the catch limit of Area 48 amongst the 15 SSMUs to meet the objectives of CCAMLR. In order to meet these aims the workshop agreed that there was a requirement to:

(i) identify models suitable to make appropriate evaluations;

(ii) discuss key topics relating to uncertainty and structural assumptions of such models;

(iii) discuss information required to facilitate the provision of management advice;

(iv) consider a mechanism to advance the outcomes of the workshop.

STRUCTURAL AND NUMERICAL ASSUMPTIONS OF THE OPERATION OF THE ECOSYSTEM AND FISHERIES IN AREA 48

3.1 At the previous meeting of the Working Group, three correspondence groups were established to consider krill, krill predators and the krill fishery (SC-CAMLR-XXIII, Annex 4, paragraphs 6.12 to 6.24). Dr Reid reminded the workshop that these correspondence groups had been tasked with the following issues in anticipation of the current workshop:

(i) to consider the range of datasets that would be necessary to initialise any models formulated to consider the candidate procedures;

(ii) to consider the range of alternative structural and functional assumptions that would be relevant to the dynamics of the predator–krill–fishery system and the formulation of any models constructed to consider the candidate procedures;

(iii) to identify important measures of performance. These measures would be used to determine whether the candidate procedures would be likely to produce results that were robust or sensitive both to the initialisation data and conditions, and to the alternative structural assumptions.

Review of reports from the Krill Correspondence Group

3.2 Dr Hewitt reported on communications among members of the Krill Correspondence Group. The correspondence group advised that three datasets describing the demography, distribution and abundance of krill in portions of the Scotia Sea would be appropriate for initialising models used to examine candidate procedures. These include:

(i) the surveys conducted by the British Antarctic Survey in the vicinity of South Georgia;

(ii) the series of surveys conducted in the vicinity of the South Shetland Islands by the US AMLR Program and Germany;

(iii) the CCAMLR-2000 Survey.

3.3 The correspondence group also advised that the most important assumptions regarding the dynamics of the predator–krill–fishery system were those that described the movement of krill within the Scotia Sea. The correspondence group noted that the possible range of assumptions could be characterised by two extremes:

(i) krill populations actively maintain their position in the vicinity of the major archipelagos (South Shetlands, South Orkneys, South Georgia) and there is no exchange between them (i.e. a situation with no krill flux);

(ii) all krill passively drift with the ACC, generally moving west to east through the Scotia Sea.

3.4 The correspondence group further advised that neither extreme was likely and that reality was somewhere in between. However, the correspondence group advised that by modelling these two extremes the range of possibilities would be covered.

3.5 The correspondence group also advised that it was likely that there were two sources of krill in the Scotia Sea: the Bellingshausen Sea via the ACC and the Weddell Sea via the Weddell Gyre.

3.6 Dr Hewitt noted evidence within the datasets described in paragraph 3.2 for large interannual variations in krill recruitment and that these variations may be autocorrelated in time. He further suggested that krill recruitment parameters be adjusted to reflect the degree of variability observed and that competing hypotheses of random versus autocorrelated variability be investigated.

3.7 Two papers were tabled at WG-EMM-05 that provided further information to be considered in the initialisation of models used to examine candidate procedures. These were:

(i) WG-EMM-05/41, which described geostrophic flow across three sections of the ACC as derived from hydrographic data collected on Russian surveys in the Scotia Sea;

(ii) WG-EMM-05/42, which described a reanalysis of acoustic data collected during the CCAMLR-2000 Survey.

These papers provided the basis for computing alternative parameters for initialising the movement matrix and initial krill densities respectively.

Review of reports from the Predator Correspondence Group

3.8 Dr Trathan reported on the intersessional work of the Predator Correspondence Group.

Relevant datasets

3.9 The Predator Correspondence Group recommended that the workshop utilise available CEMP data to provide information on predator population size, diet and breeding success. Further, that the matrices of available data that were developed for the CEMP Review Workshop (SC-CAMLR-XXII, Annex 4, Appendix 3) should be used to identify the most useful combinations of data.

Alternative assumptions

3.10 The Predator Correspondence Group advised that the following assumptions were likely to have differing implications for krill management, and that these should therefore be considered during the workshop:

(i) The presence or absence of krill flux (paragraph 3.3) will affect the breeding performance of land-based predators.

(ii) Land-based predators do/do not have traditional foraging grounds, and may/may not use alternative locations under differing environmental conditions.

(iii) Different predator species do/do not target krill swarms that have different aggregation characteristics, as revealed by their foraging behaviour.

(iv) Krill predator responses (foraging behaviour, output performance etc.) do/do not differ as a result of prey density or prey switching.

(v) Predators do/do not spend their winter periods outside the main summer breeding areas.

Indicators

3.11 The correspondence group advised that field-based indicators of reproductive performance should have a defined set of characteristics; this recommendation was based on ideas developed at the CEMP Review Workshop (SC-CAMLR-XXII, Annex 4, Appendix 3). Thus:

(i) indicators should relate to the krill-based food web
(ii) they should be sensitive to change and be based on practical field methods
(iii) indicators should have sufficient statistical power to detect change
(iv) both step changes and trend changes in the food web should be detectable.

3.12 The correspondence group advised that, as the workshop would be exploratory, the range of data, assumptions and indicators suggested (paragraphs 3.9 to 3.11), would enable a range of scenarios to be tested and that these would help the workshop in its task.

Review of reports from the Krill Fishery Correspondence Group

3.13 Dr Kawaguchi provided a report from the Krill Fishery Correspondence Group.

Data to be used to initialise the candidate procedures

3.14 Among the six candidate management procedures to subdivide the precautionary catch limit in Area 48, the correspondence group thought options (i) and (vi) were the options to be commented on by the correspondence group.

The spatial distribution of catches (option i)

3.15 The correspondence group advised that historical catches are to be used to initialise management option (i), taking into account:

(i) resolution of the data (spatially and temporally)
(ii) seasons
(iii) definition of fishing seasons.

3.16 The spatial resolution of the data should preferably be haul-by-haul or as fine-scale as possible to account for the curved boundaries of the SSMUs.

3.17 Krill, predators and krill fishery all have seasonality in their properties and the correspondence group suggested that in many cases a separation of the timing of importance between the predators and the fishery occurs. Subdividing a fishing season into quarterly periods was thought to be necessary to adequately reflect seasonal factors in interactions between those components.

3.18 It was also suggested that there were shifts in the main fishing grounds due to changes in the nations engaged in the krill fishery. The largest change in the catch occurred with the changing economic circumstances of the former Soviet Union in the early 1990s.

3.19 From the 1992/93 fishing season onwards, the total annual catch has gradually increased and became stable around 100 000 tonnes with the highest proportion of catch taken by Japan.

3.20 Examples of how the historical catch could be used to subdivide the catch among the SSMUs are, although not exclusively, limited to:

(i) use all historical catch data without subdividing into four seasons;

(ii) use all historical catch data with subdivision into four seasons;

(iii) use historical catch data only from the 1992/93 season onwards without subdividing into four seasons;

(iv) use historical catch data only from the 1992/93 season onwards with subdivision into four seasons;

(v) use of all historical catch data with subdivision into four seasons but weighted by the similarity of the historical fleet to the current fleet.

Pulse-fishing between SSMUs (option vi)

3.21 It was suggested that historical catches could be used to initialise this option such that historical maximum annual catch (520 000 tonnes), the current trigger level (620 000 tonnes) and the recent annual catch level (120 000 tonnes) could be rotated among SSMUs within each of the subareas. This could be further divided into seasons.

Alternative structural and functional assumptions

3.22 The correspondence group listed the following possible structural and functional assumptions.

(i) Fishery–predator interactions

(a) the types of krill aggregations which fisheries are targeting are the same (different) from the ones that predators target (size and density of the patch, distance from shore etc.);

(b) the fishery does (does not) avoid the active foraging areas of predators.

(ii) Fishery–krill interactions

(a) the fishery avoids (does not avoid) low quality krill (green krill);

(b) the fishery prefers (has no preference for) gravid females;

(c) the fishery follows (does not follow) drifting patches;

(d) the fishery prefers (has no preference for) certain types of krill aggregation (e.g. swarms or layers);

(e) the fishery only operates above critical densities; below these densities, vessels move onto nearby SSMUs.

3.23 Interactions between the fishery and krill depend on the decisions on where to fish made by the fishing operators. Therefore, information on fishing strategies and their economic implications are extremely important to understand these processes.

Performance measures

3.24 The following were suggested as candidate performance measures:

(i) catch per towing volume
(ii) catch per towing time
(iii) catch per day
(iv) catch per haul
(v) catch per searching time
(vi) daily factory operation time.

3.25 Each of the performance measures may have different levels of sensitivity to the different processes and fishing strategies involved. Since the sensitivity of performance measures is likely to be dictated by the resolution of data and also how they are modelled, it was recognised that exchanging information between each of the correspondence groups is necessary to give further advice.

Implications of future technical advancement and market demand

3.26 Implications of future technical advances and market demand were considered in relation to size composition of the catch, swarm type targeted, quality of krill being caught, predator by-catch, daily catch and overall catch. Pumping was suggested to be a likely method in the future, where krill are pumped from the codend continuously without hauling the net (WG-EMM-05/12).

3.27 It was recognised that different krill products require a different grade (quality) of krill catch and that using the different conversion factors for these products can dramatically change the estimation of total krill catch. Changes in the market demand may also affect the required quality of krill and product types, which has implications for the fishing and processing methodology.

Analysis of historical catch

3.28 WG-EMM-05/5 reported the annual time series of krill catches from SSMUs in Area 48, which was derived from fine-scale data and scaled to the total catches reported in the STATLANT data (Table 1). Annual catches in excess of 30 000 tonnes of krill have been taken in nine SSMUs.

3.29 The document further presented time series of catch and effort and overlap measure between predators and fishery by SSMU. It was indicated that the relative fishing-to-predation index (FPI) shows the largest value in SOW. Within each SSMU the relative FPI peaked typically in the 10-year period between 1986/87 and 1995/96, however, in APBSW and APW it peaked more recently (2000/01 and 1998/99 respectively).

3.30 WG-EMM-05/28 summarised changes of fishing ground in space and time since the early 1980s. Patterns of fishing ground selection were characterised using STATLANT and CCAMLR fine-scale data. Catch by every quarterly period by each SSMU was analysed. It further noted how SSMUs of relative importance vary dramatically inter- and intra-annually.

3.31 Among the 15 SSMUs within Subareas 48.1, 48.2 and 48.3, including the pelagic SSMUs, only one-third were identified as the main contributors to the total catch (SGE, SOW, APEI, APDPE, APDPW), and these SSMUs generally seem to match with the area of high krill density, but at the same time, other areas identified to show high density, including pelagic areas, were not used as fishing grounds. Dr V. Sushin (Russia) noted that although there are cases when scientific surveys recorded high krill abundances in the pelagic SSMUs, there is published evidence that such aggregations are unstable and therefore it is hard to make a profit by operating on these (Sushin, 1998; Sushin and Myskov, 1992).

3.32 A shift of operational timing towards later months within fishing seasons was observed in Subarea 48.1 (December–February to March–May). However, operational timing stayed relatively constant in Subareas 48.2 (March–May) and 48.3 (June–August).

3.33 In WG-EMM-05/28 patterns of seasonal SSMU selection were characterised into three patterns using cluster analysis. Frequently used SSMUs did not always match the areas of high krill densities observed by scientific surveys. However, the reasons for this are not clear.

3.34 Japan voluntarily submitted its entire haul-by-haul catch and effort data from Area 48 for the purpose of conducting analyses in preparation for this workshop. The workshop welcomed this contribution.

3.35 The workshop recognised that the better resolution of the information provided gives better foundation of the way historical fishery data may be used to subdivide catch limits under candidate management options (i) and (vi).

General discussion on ecosystem structure and function

3.36 After reviewing reports from the three correspondence groups and the relevant papers (WG-EMM-05/13, 05/14, 05/33 and 05/34), the workshop had a more general discussion about the structural and functional issues relating to the operation of the ecosystem and the manner in which these could be represented in a plausible model. These included:

(i) The benefits of a seasonally resolved model, compared to those of a model with a single annual time step.

(a) The workshop noted that it would need to explore seasonality, as ecosystem properties would probably change for different seasons. This was likely to be necessary irrespective of season length. The workshop further noted that physical and biological processes would need to be represented at the same temporal scale.

(b) The workshop recognised that the parameterisation of a model with intra-annual time steps could potentially present a number of challenges, but would be valuable. For example, it may be important to ensure that annual rates are not simply scaled rates estimated from a single season (e.g. from summer) as this could introduce bias.

(c) The potential for spatial and/or temporal separation between harvesting and centrally placed predators foraging during the breeding season. This may be best represented in a seasonal model with intra-annual time steps.

(ii) The transport or flux of krill from one region (or SSMU) to another (or other SSMU). The workshop recognised that transport could be represented by a transition matrix of probabilities derived from an oceanographic model seeded with passive particles (WG-EMM-05/13; Murphy et al., 2004). The workshop noted that:

(a) a probability transition matrix could be derived from flow fields derived from different circulation models of the Scotia Sea, from geostrophic calculations (WG-EMM-05/41), from satellite altimetry, or from oceanographic surface drifters;

(b) different probability transition matrices could be built for years of extreme environmental differences;

(c) the choice of time step was critical to the flux process, particularly where transport rates were very high;

(d) flux was not instantaneous and that mortality could be important during movement;

(e) passive movement may be modified by behaviour.

(iii) The fact that predators and fisheries may have different selection criteria for krill.

(iv) The fact that the availability of krill to the fishery and to predators was important, and that factors such as density and/or swarm characteristics would be important.

(v) The recognition that the movement of predators between SSMUs was potentially important.

(vi) The recognition that the dynamics of some pelagic predators may be independent of krill availability assessed at the scale of SSMUs.

(vii) The method for allocating catch and consumption, particularly when the combined demand was greater than the available abundance of krill. The workshop recognised that a mechanism for altering the relative allocations between the fishery and predators could be included in a model.

(viii) The need to account for harvesting of fish that are krill predators in some SSMUs.

CANDIDATE PERFORMANCE MEASURES

Performance measures for krill

4.1 The Krill Correspondence Group advised that the performance measures currently used by CCAMLR in the management of the krill fishery would be appropriate. These are based on:

(i) the probability that the spawning stock declines below 20% of the median level of the unexploited spawning stock;

(ii) the median spawning biomass of the krill population divided by the median spawning biomass of the unexploited population.

Performance measures for krill predators

4.2 Two categories of potential performance measures for krill predators were presented. These were (i) assessment of the conservation status of local populations based on rates of decline and recovery that are scaled to generation times, and (ii) the frequency of time steps in which these populations were below a reference 'depletion' level or above a reference 'recovery' level.

4.3 It was noted that performance measures should be defined in a manner consistent with the ecological theory represented by a particular model. This may include criteria defined in the simulation environment that represent a healthy ecosystem function as well as critical threshold levels that ensure the stable recruitment of predator species. A large number of performance measures could be developed from the output of a suitable model of the krill–predator–fishery system. The workshop also considered that any such performance measures should reflect both local-scale (SSMU) and global-scale (Area 48) population changes.

Performance measures for the krill fishery

4.4 The following performance measures for the krill fishery were introduced by Dr S. Hill (UK):

- absolute catch
- catch as proportion of allocation
- probability of 'voluntary change' (where krill density falls below a specified threshold).

4.5 The workshop noted that catch rate may also be an appropriate performance measure.

4.6 Deviation of fishing patterns from historical patterns of spatial distribution may also be a useful performance measure for the krill fishery. However, use of deviation from the current fishing patterns as a performance measure may be problematic since fishing patterns may change as annual catch and the number of countries fishing increases.

Presentation of performance measures

4.7 Presentation of performance measure was discussed. Graphical presentation was thought to convey important properties of the measures, and what might be considered to be robust performance (paragraphs 6.1 to 6.3). On the other hand, tables with true/false (i.e. binary) information are difficult to interpret. Overall, the workshop preferred graphical presentation over tabular presentation.

4.8 It was also realised that precise description of presentations is essential to convey the meaning of the graphs correctly. For example, describing fishery performance as absolute catch will often lead to different interpretations than describing fishery performance as the ratio of realised catch to allocated catch.

MODELS FOR PROVIDING ADVICE

Review of models presented to the workshop

5.1 Three papers describing models relevant to the evaluation of options for subdividing the precautionary krill catch limit amongst SSMUs in Area 48 were available to the workshop. These were WG-EMM-05/13, 05/14 and 05/33. Also considered relevant to these discussions was WG-EMM-05/34.

5.2 WG-EMM-05/13 described a krill–predator–fishery model (KPFM) developed specifically to address options for subdividing the precautionary catch limit amongst SSMUs in Area 48. The model is designed to investigate the performance of the identified options and their sensitivity to numerical and structural uncertainty. The model is spatially resolved to the level of SSMUs and surrounding oceanic areas, and it includes the transport of krill between these areas. Krill and predator population dynamics are implemented with coupled delay-difference models, which are formulated to accommodate various assumptions about the recruitment and predation processes. The fishery is represented as a simultaneous and equal competitor with predators for available krill. Monte Carlo simulations can be used to integrate the effects of numerical uncertainty, and structural uncertainty can be assessed by comparing and merging results from multiple such simulations. A range of possible performance measures was also presented that can be used to evaluate catch-allocation procedures and assess trade-offs between predator and fishery performance. The paper provided basic instructions on running the model in S-Plus and illustrated its use. Although the model necessarily simplifies a complex system, it provides a flexible framework for investigating the roles of transport, production, predation and harvesting in the operation of the krill–predator–fishery system.

5.3 WG-EMM-05/14 outlined a proposed spatial modelling framework that could be used to quantify the flux of krill past islands in the Antarctic Peninsula region, in an attempt to quantify what level and localisation of the fishing effort might impact the predators negatively. The approach described represents work in progress as the focus thus far has been on first developing a model of the possible impact of pelagic fishing on seal and penguin colonies on the South African west coast. The latter ecosystem shares a number of common features with the Antarctic Peninsula ecosystem in that there is a substantial advective flux of either pelagic fish or krill, with both species serving as dominant prey items for colonies of land-based predators in the region concerned. Subject to the availability of data from both predator studies and krill surveys, the South African west coast model methodology could potentially be adapted to the Antarctic Peninsula region. This would permit the evaluation of a wide range of management options taking into account the needs of other species when setting precautionary krill catch limits at an appropriate spatial scale.

5.4 WG-EMM-05/33 described an ecosystem, productivity, ocean, climate (EPOC) model that has been developed in the R statistical language to help explore topical issues on Antarctic marine ecosystems, including impacts of climate change, consequences of overexploitation, conservation requirements of recovery and interacting species, and the need to evaluate whether harvest strategies are ecologically sustainable. As such, it can be used to facilitate the development of plausible ecosystem models for evaluating management procedures for krill following the recommendations of the workshop held by WG-EMM in 2004. The EPOC model has been designed as an object-oriented framework currently built around the following modules: (i) biota, (ii) environment, (iii) human activities, (iv) management, (v) outputs, and (vi) presentation, statistics and visualisation. Each element within a module is an object carrying all its own functions and data. The EPOC model is designed to be a fully flexible plug-and-play modelling framework. This is because of the need to easily explore the consequences of uncertainty in model structures but, more importantly, to enable ecosystem modelling to proceed despite widely varying knowledge on different parts of the ecosystem and avoiding the need to guess model parameters for which no information exists. The EPOC model provides these opportunities as well as examining the sensitivity of outcomes to changes in model structures, not only in the magnitude of parameters but in the spatial, temporal and functional structure of the system. The paper presented a case study for Antarctic krill as an example.

5.5 In presenting his model, Dr Constable also provided an example of alternative ways of modelling different taxa rather than solely as age-structured or biomass models. This example illustrated that, within the same simulation, different species can be modelled at different spatial and temporal scales as well as with different biological and ecological complexity.

5.6 WG-EMM-05/34 described a model of the dynamics of krill, including four baleen whale (blue, fin, humpback and minke) and two seal (Antarctic fur and crabeater) species in two large sectors of the Antarctic. The model was developed to investigate whether predator–prey interactions alone can broadly explain observed population trends since the onset of seal harvests in 1780. It concluded that the answer to this question is yes, although not without some difficulties.

5.7 The workshop agreed that given the limited time available, it would concentrate its review on the KPFM described in WG-EMM-05/13.

Discussion of model selection/suitability

5.8 The process adopted by the workshop for reviewing the KPFM involved a number of steps. These included:

(i) detailed examination of the dynamics of the modelled krill and predator populations in a single SSMU under a range of different key biological parameter values, a fixed fishing pattern, and with and without movement. The emphasis here was on confirming that trends predictable from the input parameters chosen could be reproduced by the model;

(ii) as for (i), but with two coupled SSMUs;

(iii) a review of structural assumptions made in the model, with particular emphasis on identifying any factors that were not currently accounted for in the model, but which should be;

(iv) a review of appropriate parameter values for each of the main processes (biological dynamics of krill and predators, fishery characteristics and movement patterns between SSMUs);

(v) examination of runs of the full model (with 15 SSMUs) using updated parameter values.

5.9 A summary report of the model performance with only one or two SSMUs is included in Attachment 3. The workshop agreed that the model had performed very satisfactorily on these trials, with outcomes corresponding to predictions in each trial experiment.

5.10 The review of structural assumptions of the model is discussed under Agenda Item 3 (paragraph 3.36). The workshop agreed that at least three key aspects should be given further attention in the models and their implementation:

(i) incorporation of shorter time steps and/or seasonality
(ii) incorporation of alternative movement hypotheses
(iii) incorporation of a threshold krill density below which a fishery will not operate.

5.11 In respect of seasonality, it was agreed that this was important both to model more accurately the seasonality of the dynamics and feeding behaviour of predators and to take account of variable timing within a year of the fisheries and peak predator foraging in different SSMUs (see also paragraphs 3.10 and 3.17).

5.12 At present, movement matrices estimated for the model allow either for no movement between SSMUs, or movements estimated from runs of the Ocean Circulation Climate Advanced Modelling (OCCAM) project (see Murphy et al., 2004). It was agreed that incorporation of a seasonal time step might allow a more realistic portrayal of movements between SSMUs than is currently possible with an annual time step.

5.13 Different movement patterns and rates may be implied by the results presented in WG-EMM-05/41, but it was not possible during the meeting to develop alternative movement matrices to reflect these (see paragraph 3.36(ii)). The workshop agreed that these should be developed during the coming year. However, it was noted that when different water movement rates are applied, the seasonal changes in krill abundance have to be considered along with the water exchange rates to avoid an overestimate of the overall annual krill flux.

5.14 Subject to incorporation of these structural changes, which could be carried out in the coming year, the workshop agreed that the KPFM was in principle suitable for use to investigate the different options for catch limit subdivision, however it noted that a final decision would have to await demonstration of suitable performance of the model when applied to all 15 SSMUs and revised parameter sets. This is discussed in the next section.

5.15 The workshop congratulated the authors of WG-EMM-05/13 for the large amount of work they had carried out, and especially for the excellent progress that had been made on model development and parameterisation in such a short time. In particular, several participants noted that, despite many attempts elsewhere in the world, there are very few examples of ecosystem models that are being, or are capable of being, used to develop explicit management advice on catch limits or the subdivision of catches in an ecosystem context. The progress that has been achieved so far with the KPFM is therefore very encouraging.

Choice of parameters for the KPFM

5.16 Small groups of workshop participants with expertise in each of the main species groups were asked to review the parameters used to generate the KPFM results presented in WG-EMM-05/13 for the full set of SSMUs. Unfortunately, only limited time was available for this after completion of the initial model structural review. Consequently, while some revisions were made to parameter values, each group reported that it had had insufficient time to consider these in sufficient depth and to take account of all relevant data.

5.17 It was therefore not entirely unexpected that when these revised parameter sets were used in test runs of the full model, it became clear that additional work would be needed to further refine the parameter values and to ensure consistency between them. In the absence of time to allow this, the workshop agreed that it would not be appropriate to attempt to conduct simulation trials with a view to providing advice on the different catch allocation options or subdivision of catch limits amongst SSMUs at this meeting.

Future work necessary to provide advice on SSMU catch limit subdivision

5.18 The workshop agreed that sufficient progress had been made with the KPFM development this year for it to believe that a further year’s work should allow appropriate advice based on runs with a revised version of the simulation model to be provided by WG-EMM to the Scientific Committee and Commission next year.

5.19 In order to achieve this, however, it is essential that appropriate benchmarks be established. It was agreed that it would be necessary to present to WG-EMM next year sets of results that demonstrated the sensitivity of results and performance measures to plausible ranges of model parameters and structural hypotheses and robustness to uncertainties.

5.20 For the KPFM, the work required is relatively easily specified. The workshop agreed, however, that it would also be valuable if results were also available from other models (see also paragraph 5.26).

5.21 In relation to the model in WG-EMM-05/14, Dr É. Plagányi (South Africa) commented that she was now more confident that data were available to allow her to attempt to apply the approach. Preliminary work on this would be carried out in the next few months. If this confirmed the potential applicability of the model, she hoped to be able to present a paper describing its application to Area 48 at the next meeting of WG-EMM.

5.22 In relation to the EPOC model (WG-EMM-05/33), Dr Constable indicated that he had already started work on developing a model that would be complementary to the KPFM, and that he intended to continue this work in the coming months. He noted that one of the potential advantages of the EPOC framework was that it was possible to incorporate different assumptions regarding the dynamics of the main component species. By doing so and comparing results with those of the KPFM, this may allow identification of which are the key parameters in the system and allow partial validation of the results of the two models. He noted, however, that an important difference at present between the EPOC model and the KPFM was that the former is much slower to run.

5.23 The workshop noted that it would be desirable for WG-EMM to provide opportunities for the Working Group to become familiar with these models when they are presented, as was done for the KPFM.

5.24 Dr Plagányi noted that the model in WG-EMM-05/34 is not currently suitable for the development of management advice in this context, but could be used to explore the effect of trends in abundances over larger spatial scales than those addressed in the KPFM.

5.25 The workshop agreed that, in order to be in a position to provide advice next year, it is essential that the benchmarks identified in paragraph 5.19 be achieved. The workshop further agreed that scientists undertaking development of the KPFM or other models during the intersessional period coordinate as necessary through the steering group set up by WG-EMM last year (SC-CAMLR-XXIII, Annex 4, paragraph 5.62). Given the experience of the workshop, however, it is essential that this group include the full range of necessary expertise. It therefore recommended that WG-EMM bear this in mind when reviewing the group at its meeting this year (see also paragraph 7.6).

5.26 The workshop noted that procedures will need to be determined for how to assess and use the results of multiple models in this work, given that three models may be available to assist with this task. It recommended that WG-EMM ask the steering committee to provide advice on this to the Working Group next year.

PERFORMANCE OF INDIVIDUAL OPTIONS

6.1 The workshop noted that the evaluation of the candidate options for subdividing catch limits required an examination of their robustness in meeting the objectives of CCAMLR. This is achieved in a number of steps:

- erecting a sufficiently plausible description of the ecosystem, the fishery and the candidate option in a simulation model, termed the ‘operating model’;

- using the operating model to simulate the system, keeping track of the important states of each species, the fishery as well as other parameters;
- determining the performance of the system according to important ecosystem and fishery 'performance measures';
- doing this many times to account for natural variability and uncertainty, thereby providing probabilities of different levels of the chosen performance measures.

6.2 A candidate strategy would be considered 'robust' to underlying uncertainties if the objectives of CCAMLR can be met, irrespective of model structure, uncertainty in parameter estimates or natural variability. Robustness is estimated by the probability of 'good' performance shown by the performance measures. As such, the measures of performance need to relate to the objectives of CCAMLR; each performance measure articulates, in a quantitative way, aspects of the objectives.

6.3 Of course, each candidate option will not perform the same way across all performance measures. The important part of this evaluation work is to illustrate the trade-offs between performance measures as well as to present the potential consequences of different options to krill, dependent species and the fishery. The workshop agreed that advice may not be able to be provided as to the relative importance of different measures. It agreed that methods for presenting the trade-offs need to continue to be explored but that a graphical presentation, such as in Figure 1, would be a good foundation for such presentations.

6.4 The workshop agreed that it was unable, at this time, to comment on the robustness of the candidate options for subdividing the catch limit for krill in Area 48 amongst SSMUs. Nevertheless, it has made substantial progress in developing the tools and parameter sets for providing advice on a subdivision of the Area 48 catch limit in the near future. The workshop agreed that advice to the Scientific Committee should be possible next year.

ADVICE TO WG-EMM

7.1 Following the past four workshops at WG-EMM in support of the development of a revised management procedure for krill, there was agreement by WG-EMM in 2004 (SC-CAMLR-XXIII, Annex 4, paragraph 6.13), which was endorsed by the Scientific Committee (SC-CAMLR-XXIII, paragraphs 3.86 to 3.90), that the first workshop to evaluate management procedures for the krill fishery should examine how well six candidate methods for subdividing the krill catch would meet the objectives of CCAMLR (paragraph 2.2).

7.2 The workshop agreed that the performance measures for krill based on the current operational decisions used by CCAMLR in the management of the krill fishery would be appropriate (paragraph 4.1). Two categories of potential performance measures for krill predators were suggested (paragraphs 4.2 and 4.3). In addition, performance measures for the krill fishery were provided (paragraph 4.4).

7.3 Three papers describing models relevant to the evaluation of options for the subdivision of the precautionary krill catch limit in Area 48 amongst SSMUs were presented (paragraphs 5.1 to 5.7). The workshop agreed that, given the limited time available, it would concentrate its review on the KPFM described in WG-EMM-05/13.

7.4 The workshop agreed that sufficient progress had been made with the KPFM development this year for it to believe that a further year's work should allow appropriate advice based on runs with a revised version of the simulation model to be provided by WG-EMM to the Scientific Committee and Commission next year (paragraph 5.18). The workshop agreed, however, that it would be valuable if results were also available from other models (paragraphs 5.20 to 5.26).

7.5 The workshop noted that the evaluation of the candidate options for subdividing catch limits required an examination of their robustness in meeting the objectives of CCAMLR. This could be achieved by the work and approaches outlined in paragraphs 6.1 to 6.3.

7.6 The workshop discussed possible ways of continuing its work intersessionally, and recommended that a means to facilitate this be considered by WG-EMM.

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

8.1 The report of the workshop was adopted.

8.2 The workshop agreed that the KPFM, with its extensive documentation, graphic outputs and diagnostics, had successfully engaged participants from a wide range of backgrounds, including those with and without sophisticated modelling skills. This level of participation encouraged exploration of the effects of various parameter combinations and structural assumptions, as well as facilitated consensus agreement on future work.

8.3 The Co-conveners of the workshop, Drs Reid and Watters, thanked the participants for their work and cooperation during the workshop. They also thanked Drs Hewitt, Kawaguchi and Trathan, the coordinators of the correspondence groups, for their contributions in preparation for, and during, the workshop, and the Secretariat for its contribution and support.

8.4 Dr Constable, on behalf of the participants, thanked the Co-conveners for their leadership in developing an approach to the evaluation of the management procedures for the krill fishery. The workshop also thanked the Co-conveners, and Dr Hill and Mr J. Hinke (USA), the co-authors of the KPFM, for their great effort in developing and testing that model.

8.5 The Co-conveners thanked Dr Naganobu and his organising team for their support and hospitality.

8.6 The workshop closed on 8 July 2005.

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Sushin, V.A. and A.S. Myskov. 1992. Location and intensity of the Soviet krill fishery in the Elephant Island area (South Shetland Islands), 1988/89. In: *Selected Scientific Papers, 1992 (SC-CAMLR-SSP/9)*. CCAMLR, Hobart, Australia: 305–335.

Table 1: Annual catch (tonnes) of krill from the fishery in Area 48, by season and SSMU. Antarctic Peninsula (AP) SSMUs: Pelagic Area (APPA); Bransfield Strait East (APBSE); Bransfield Strait West (APBSW); Drake Passage East (APDPE); Drake Passage West (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). Other: Area 48, unspecified or outside SSMUs. Source: fine-scale data weighted to catches reported in the STATLANT data (see WG-EMM-05/5 for detail).

Season	SSMU group weighting factor			Total catch (tonnes)	SSMU															Other
	AP	SG	SO		APBSE	APBSW	APDPE	APDPW	APE	APEI	APPA	APW	SGE	SGPA	SGW	SONE	SOPA	SOSE	SOW	
1980/81	18.9		*	154474	887	27	22047	8522	134	16199	45630	271					*60540			217
1981/82	13.2		187.2	326788		1	7277	15186		5062	40407	260				1081	238628		18887	
1982/83	1.2	*	13.5	65115				4			2290			*2004		631	51731		7710	745
1983/84	1.0	*	1.0	40534	5	0	9725	3619	17	4196	12411	258		*73		1145	59	1	9025	
1984/85	1.2	*	6.2	212011	6		3108	477		6370	2961	11		*60724		8517	10975		118863	
1985/86	1.2	*	12.2	378739	32		8317	2705		21051	7367	1574		*110596		4656	5336		217104	1
1986/87	1.0	3.6	1.0	400835		1	9022	187		53785	7274		312134			196	1102		17128	5
1987/88	1.1	1.0	1.0	388953		0	34171	10363		24967	9387	30	105990	105636	24	4323	4627	19284	70047	104
1988/89	1.0	1.0	1.0	352271		18	37689	17193		42132	8490	33	157204	1412		14	72755		15332	
1989/90	1.0	1.0	1.0	376099	106		13847	691		24002	6097	8	89557	11349	6907	12657	81808		129067	
1990/91	1.0	1.2	1.0	331318	1035	6	16580	15508		29719	6818		88023	8339	5307	12774	5249		141961	
1991/92	1.0	0.9	1.4	257663	32	5	21668	40754		6355	6735	15	49115	331	14801	3665	48708		65429	50
1992/93	1.0	1.1	1.0	60783		43	928	29870		2373	54		3478	124	11139	4111	1253		7306	104
1993/94	1.0	1.0	1.0	84645		107	1066	26237		17659	11	5	19908	381	11	80	4	1303	17872	
1994/95	1.0	1.2	1.0	134420		179	2922	11674		15030	8359		46624	473	325	1273	27	24	47509	
1995/96	1.0	1.0	1.3	91150		507	5772	36695	25	12613	6351		23872	14	2566	4	51		2679	
1996/97	1.0	1.0	*	75653	13	87	17489	20389		9143	1722		26605		106		*99			
1997/98	1.0	1.0	1.0	90024	102	679	18853	24205		5808	4047	2879	23301	54	3422	290	602		5781	
1998/99	1.0	*	1.0	101957	914	24	10732	11364		8970	2982	3910		*985		3379	984	12324	45389	
1999/00	0.9	1.3	1.0	114425	3728	4950	21073	30090		10673	1362	101	14992	8335	2230	1130	3145	1493	11123	
2000/01	0.9	1.5	1.0	104182	609	3255	16444	21902		4133	5	430	37186	534	14703	1354	2	2511	1114	
2001/02	1.0	1.1	1.3	125987	94	285	1449	4672		4114	32		30856	3079	9346	3354	70	1161	67474	
2002/03	1.1	1.0	0.9	117728	18	256	2029	31905		1040	67	62	52003	791	14131	54	509	44	14821	
2003/04	2.3	1.2	1.7	118166	4282	862	439	3534		3414	836	514	26158	309	31362	348	261	17	45830	

* Weighting cannot be determined (STATLANT data reported for SSMU group, fine-scale data for related SSMU insufficient), catch is for the SSMU group.

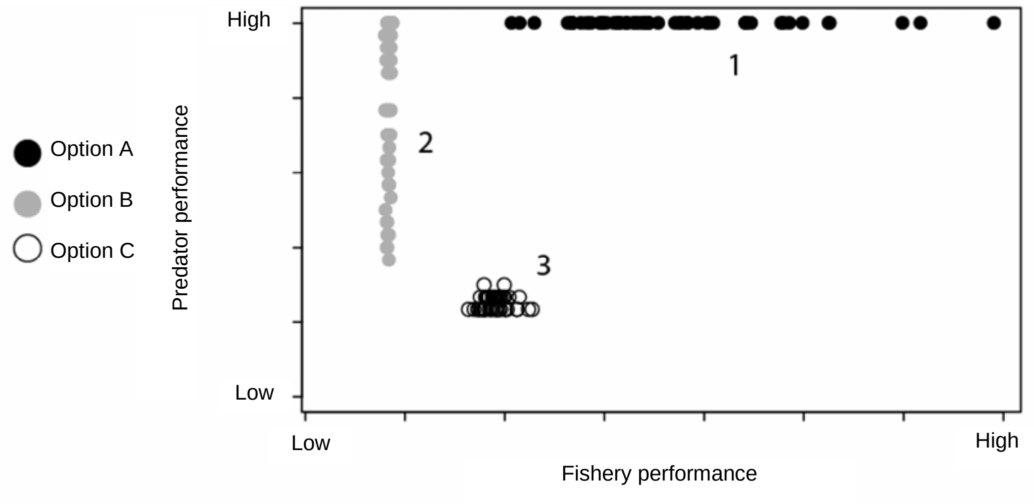

Figure 1: An example illustration of the trade-offs associated with three candidate management procedures (identified as Options A–C). A hypothetical measure of fishery performance is used to define the x-axis of the plot, and a hypothetical measure of predator performance is used on the y-axis. Three groups of points are illustrated in the plot, and each group is associated with one of the candidate procedures. The points in group 1 illustrate the outcomes of simulations in which Option A is used as the fishery management procedure. This procedure results in variable fishery performance and high predator performance. The points in group 2 illustrate the outcomes of simulations using Option B; this procedure results in poor fishery performance and variable predator performance. The points in group 3 illustrate simulated outcomes from Option C. This management procedure results in low fishery performance and low predator performance. The examples presented here are simply illustrative.

AGENDA

Workshop on Management Procedures
(Yokohama, Japan, 4 to 8 July 2005)

1. Introduction
   1.1 Opening of the workshop
   1.2 Adoption of the agenda and organisation of the workshop

2. Review of aims of the Workshop on Management Procedures to evaluate options for subdividing the krill catch limit among SSMUs

3. Structural and numerical assumptions of the operation of the ecosystem and fisheries in Area 48
   3.1 Review of the reports from the Correspondence Group on Krill
   3.2 Review of the reports from the Correspondence Group on Predators
   3.3 Review of the reports from the Correspondence Group on the Krill Fishery

4 . Candidate performance measures
   4.1 Performance measures for krill
   4.2 Performance measures for krill predators
   4.3 Performance measures for the krill fishery

5. Models for providing management advice
   5.1 Review of model(s) presented to the workshop
   5.2 Discussion of model selection/suitability
   5.3 Choice of parameters for model(s) selected in subitem 5.2

6. Performance of individual options

7. Advice to WG-EMM.

ATTACHMENT 2

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(Yokohama, Japan, 4 to 8 July 2005)

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ATTACHMENT 3

SOME EXPLORATIONS WITH KPFM – MOVING FROM PREDICTING OUTCOMES TO EXPLAINING OUTCOMES

SOME EXPLORATIONS WITH KPFM – MOVING FROM PREDICTING OUTCOMES TO EXPLAINING OUTCOMES

The Workshop on Management Procedures used a set of simplified examples to review the Krill–Predator–Fishery Model (KPFM) (paragraphs 5.7 and 5.8). Those examples are provided in this attachment. Tables 1 and 2 provide the parameter values and initial information used to generate the examples. This attachment is presented as a series of Microsoft Powerpoint slides that are taken from an original presentation made at the workshop.

Table 1: State variables and parameters for krill and other initial conditions used in Examples 1 to 13. Parameter and variable names are identified as they are implemented in the S-Plus version of the KPFM; definitions of these parameters and variables are provided in WG-EMM-05/13. In the movement matrices (v.matrix), the letter 'S' is used to indicate an SSMU, and the letters 'BT' are used to indicate boundary areas.

Parameter or variable name in S-Plus	Values used in Examples 1–9	Values used in Examples 10–13
M0	Examples 1–9: 0	Examples 10–13, SSMUs 1–2: 0
Ralpha	Examples 1–3, 7–9: $2.5 \cdot 10^{11}$ Examples 4–6: $2.7 \cdot 10^{11}$	Examples 10–13, SSMUs 1–2: $2.5 \cdot 10^{11}$
Rbeta	Examples 1–9: $1.0 \cdot 10^{8}$	Examples 10–13, SSMUs 1–2: $1.0 \cdot 10^{8}$
krill.Rage	Examples 1–9: 2	Examples 10–13, SSMUs 1–2: 2
Rphi	Examples 1–9: 0	Examples 10–13, SSMUs 1–2: 0
wbar	Examples 1–9: 1	Examples 10–13, SSMUs 1–2: 1
historical.catch	Examples 1–9: $2.28 \cdot 10^{11}$	Examples 10–13: SSMU 1: $4.56 \cdot 10^{11}$ SSMU 2: $2.28 \cdot 10^{11}$
areas	Examples 1–9: $1.58 \cdot 10^{10}$	Examples 10–13, SSMUs 1–2: $1.58 \cdot 10^{10}$
v.matrix	Examples 1–7: $\begin{array}{c\|ccc} \text{from} \backslash \text{to} & S1 & BT1 & BT2 \\ \hline S1 & 0 & 0 & 0 \\ BT1 & 0 & 0 & 0 \\ BT2 & 0 & 0 & 0 \end{array}$ Example 8: $\begin{array}{c\|ccc} \text{from} \backslash \text{to} & S1 & BT1 & BT2 \\ \hline S1 & 0 & 0 & 0.1 \\ BT1 & 0.5 & 0 & 0 \\ BT2 & 0 & 0 & 0 \end{array}$ Example 9: $\begin{array}{c\|ccc} \text{from} \backslash \text{to} & S1 & BT1 & BT2 \\ \hline S1 & 0 & 0 & 1 \\ BT1 & 0.1 & 0 & 0 \\ BT2 & 0 & 0 & 0 \end{array}$	Examples 10, 12–13: $\begin{array}{c\|cccc} \text{from} \backslash \text{to} & S1 & S2 & BT1 & BT2 \\ \hline S1 & 0 & 0 & 0 & 0 \\ S2 & 0 & 0 & 0 & 0 \\ BT1 & 0 & 0 & 0 & 0 \\ BT2 & 0 & 0 & 0 & 0 \end{array}$ Example 11: $\begin{array}{c\|cccc} \text{from} \backslash \text{to} & S1 & S2 & BT1 & BT2 \\ \hline S1 & 0 & 0.1 & 0 & 0 \\ S2 & 0 & 0 & 0 & 0 \\ BT1 & 0 & 0 & 0 & 0 \\ BT2 & 0 & 0 & 0 & 0 \end{array}$
sd.krill.Rdev	Examples 1–9: not used (random.Rkrill = F)	Examples 10–13: not used (random.Rkrill = F)
env.index	Examples 1–9: not used (env.index = NULL)	Examples 10–13: not used (env.index = NULL)
init.density	Examples 1–9: 37.7	Examples 10–13, SSMUs 1–2: 37.7
available.fraction	Examples 1–6, 8–9: 0.95 Example 7: 0.2	Examples 10–12, SSMUs 1–2: 0.95 Example 13: SSMU 1: 0.8 SSMU 2: 0.2
actual.gamma	Examples 1–9: 0.17	Examples 10–13: 0.17
nyears	Examples 1–9: 50	Examples 10–13: 50
start.fishing	Examples 1–9: 11	Examples 10–13: 11
stop.fishing	Examples 1–9: 31	Examples 10–13: 31
fishing.option	Examples 1, 3–4, 7–9: NULL Examples 2, 5–6: 1	Examples 10–11: NULL Examples 12–13: 1

Table 2: State variables and parameters for predators used in Examples 1 to 13. Parameter and variable names are provided as they are implemented in the S-Plus version of the KPFM; definitions of these parameters and variables are provided in WG-EMM-05/13.

Parameter or variable name in S-Plus	Values used in Examples 1–9	Values used in Examples 10–13
M	Examples 1–9, Penguins: 0.16	SSMUs 1–2, Penguins: 0.16
	Examples 3–6, Seals: 0.08	
Rage	Examples 1–9, Penguins: 7	SSMUs 1–2, Penguins: 3
	Examples 3–6, Seals: 3	
Ralpha	Examples 1–9, Penguins: 0.5	SSMUs 1–2, Penguins: 0.5
	Examples 3–6, Seals: 0.5	
RRpeak	Examples 1–5, 7–9, Penguins: $8.2 \cdot 10^5$	SSMUs 1–2, Penguins: $8.2 \cdot 10^5$
	Example 6, Penguins: $6.56 \cdot 10^5$	
	Examples 3–5, Seals: $1.153 \cdot 10^4$	
	Example 6, Seals: $6.9 \cdot 10^3$	
RSpeak	Examples 1–5, 7–9, Penguins: $2 \cdot 10^6$	SSMUs 1–2, Penguins: $2 \cdot 10^6$
	Example 6, Penguins: $2.5 \cdot 10^6$	
	Examples 3–5, Seals: $7.3 \cdot 10^4$	
	Example 6, Seals: $1 \cdot 10^5$	
QQmax	Examples 1–9, Penguins: $4.3 \cdot 10^5$	SSMUs 1–2, Penguins: $4.3 \cdot 10^5$
	Examples 3–6, Seals: $1.7 \cdot 10^6$	
Rphi	Examples 1–5, 7–9, Penguins: 2	SSMUs 1–2, Penguins: 2
	Example 6, Penguins: 1	
	Examples 3–5, Seals: 2	
	Example 6, Seals: 0.1	
Qk5	Examples 1–9, Penguins: 20	SSMUs 1–2, Penguins: 20
	Examples 3–6, Seals: 20	
Qq	Examples 1–9, Penguins: 0	SSMUs 1–2, Penguins: 0
	Examples 3–6, Seals: 0	
init.demand	Examples 1–9, Penguins: $2.505 \cdot 10^{11}$	SSMUs 1–2, Penguins: $2.505 \cdot 10^{11}$
	Examples 3–6, Seals: $1.98 \cdot 10^{10}$	

Slide 1: Description of the initial conditions for Examples 1 to 9, where krill–predator–fishery interactions were simulated in a single SSMU.

Basic Setup for 1 SSMU

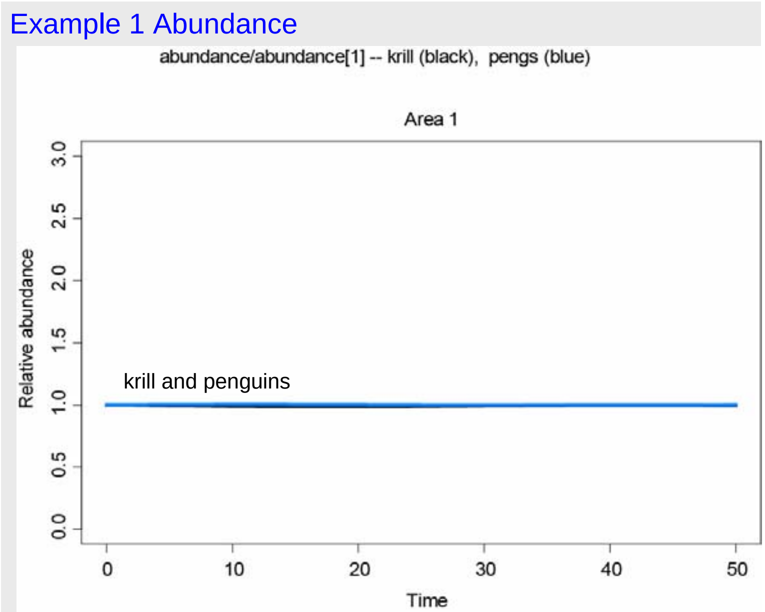
- 50-yr simulations
- If **FISHING** then start = 11 and stop = 31
- No random variation in krill recruitment
- Hyperdepletion in relationship between relative consumption and relative breeders
- Penguins recruit at age 7 and seals recruit at age 3
- If **MOVEMENT** then immigration from and emigration to single bathtub
- If **LOW available.fraction** then change 0.95 to 0.2

Slide 2: The sequence of examples used to review the KPFM when interactions inside a single SSMU are simulated (Examples 1 to 9). The column marked ‘setup’ describes each example. The column marked ‘conditions’ describes the initial relationship between krill recruitment (R), demand by predators (D1 for penguins and D2 for seals), and the catch allocated to the fishery (AC). The conditions also describe whether, when the setup includes movement of krill between a boundary area (BT) and the SSMU, imports (I) are greater or less than exports (E). The column marked ‘expectations’ provides a short description of the dynamics that would be expected in each example.

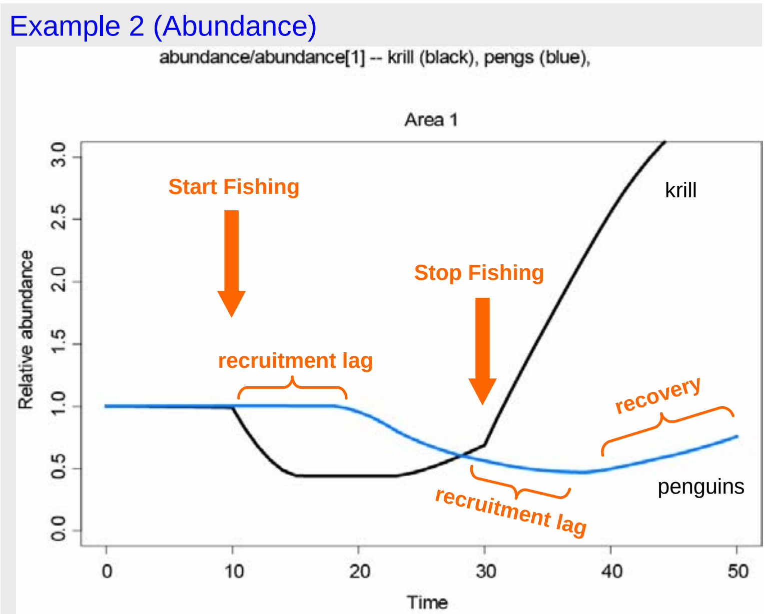
Sequence with Single Area

#	Setup	Conditions	Expectations
1	Penguin	R = D1	Flat lines
2	1 + Fishing	R < D1+AC	Decreases then Increases
3	1 + Seal	R < D1+D2	Decreases
4	3 + More Krill R	R = D1+D2	Flat lines
5	4 + Fishing	R < D1+D2+AC	Decreases & Lagged Increases
6	5 + Proportional Penguins + Hyperstable Seals	R < D1+D2+AC	Increases from 5 with Seals increasing more
7	1 + low available.fraction	R = D1	Penguins decrease then increase and krill increase
8	1 + Movement from BT	R = D1, I > E	Increases
9	1 + Movement from BT	R = D1, I < E	Decreases

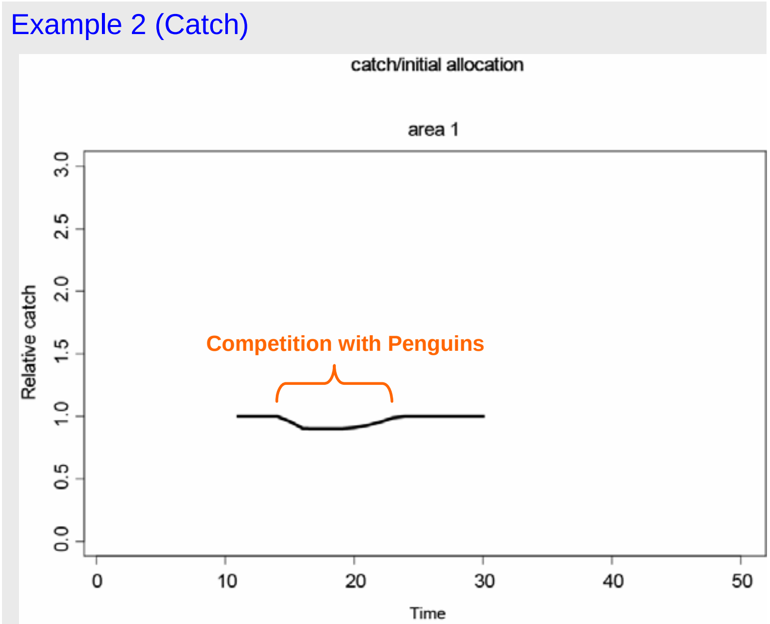
Slide 3: Simulation with a single SSMU and one predator (penguins). Recruitment of krill satisfies predator demand.



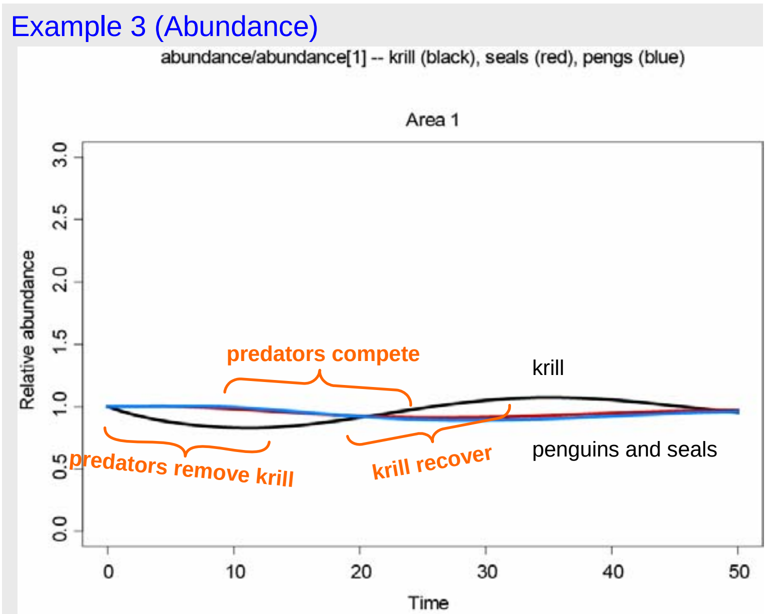
Slide 4: Simulation with a single SSMU, one predator (penguins), and krill fishing. Krill recruitment does not satisfy the sum of demand by predators and catch allocated to the fishery.



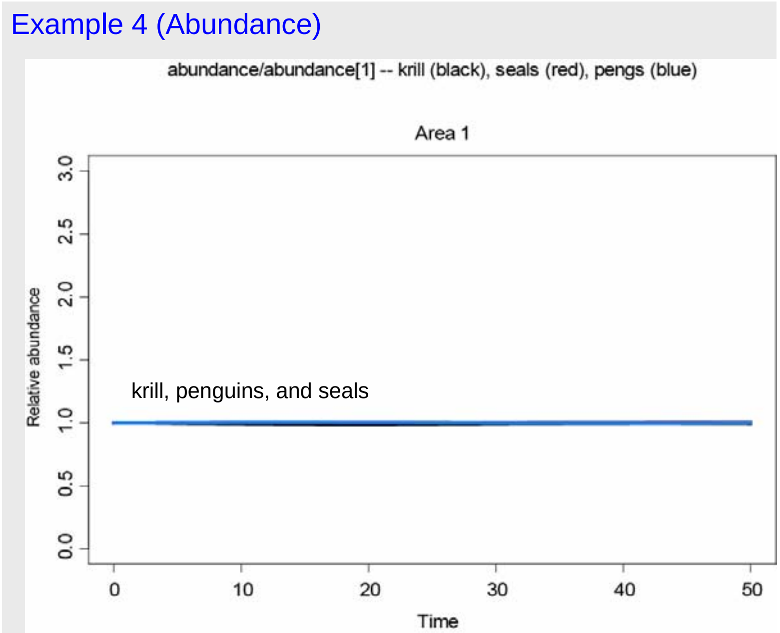
Slide 5: Simulation with a single SSMU, one predator (penguins), and krill fishing. Krill recruitment does not satisfy the sum of demand by predators and catch allocated to the fishery.



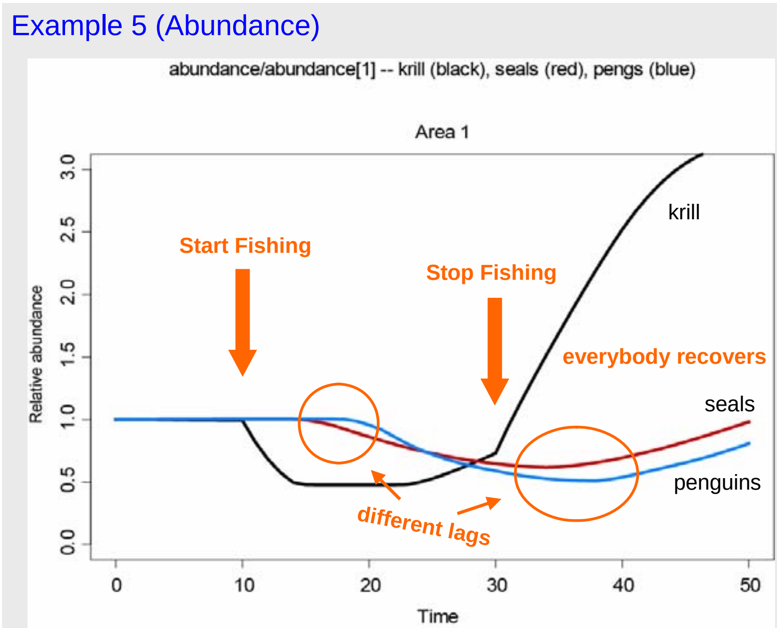
Slide 6: Simulation with a single SSMU and two predators (penguins and seals). Krill recruitment does not satisfy the sum of the demands by both predators.



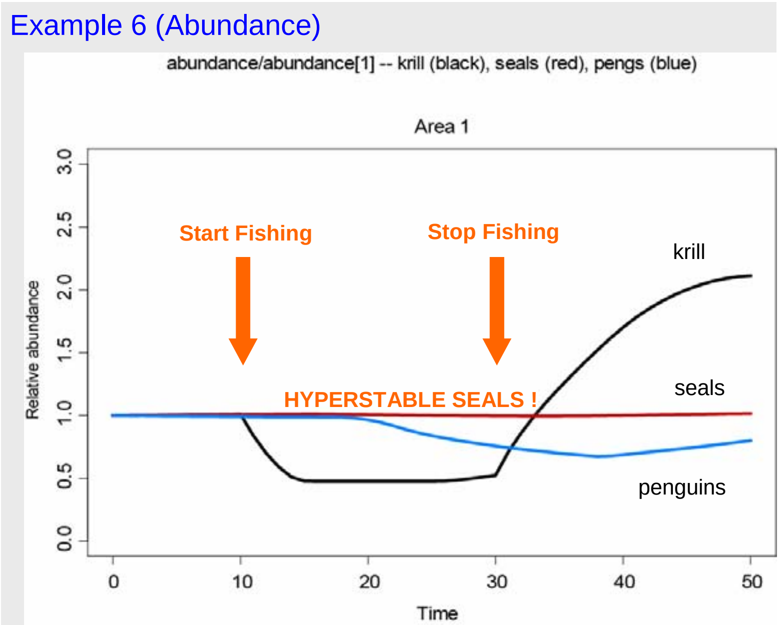
Slide 7: Simulation with a single SSMU and two predators (penguins and seals). Krill recruitment satisfies the sum of the demands by both predators.



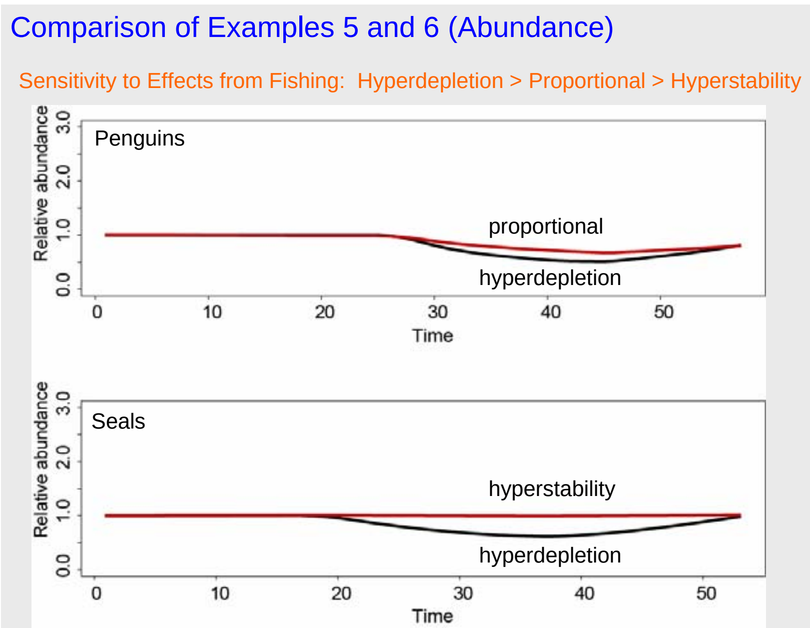
Slide 8: Simulation with a single SSMU, two predators (penguins and seals), and krill fishing. Krill recruitment does not satisfy the sum of demands by predators and catch allocated to the fishery.



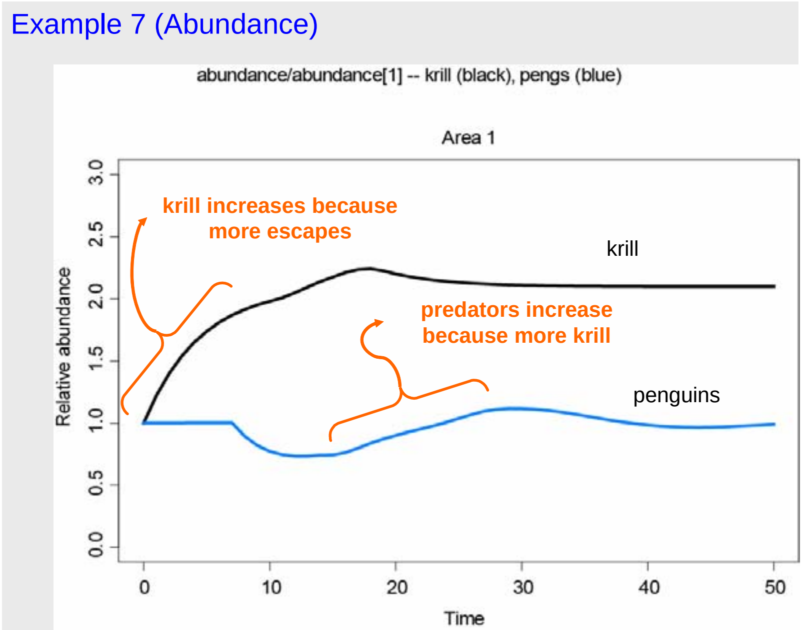
Slide 9: Simulation with a single SSMU, two predators (penguins and seals), and krill fishing. Krill recruitment does not satisfy the sum of demands by predators and catch allocated to the fishery, but decreases in krill consumption have reduced effects on predator breeding.



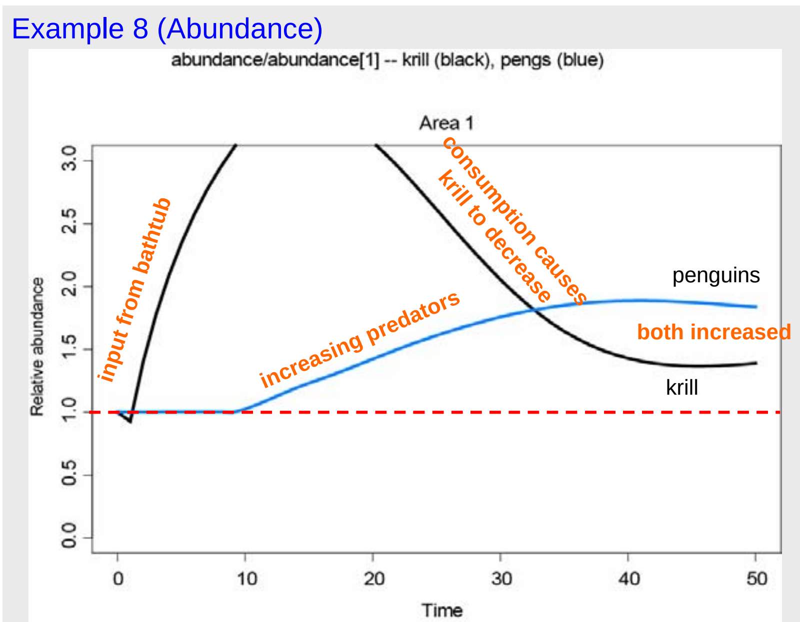
Slide 10: Comparison of simulations presented in Slides 8 and 9.



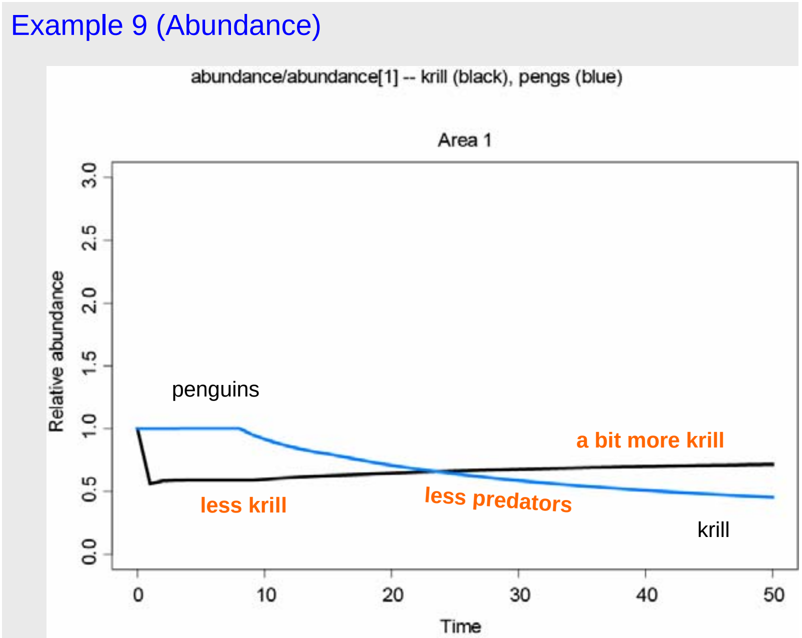
Slide 11: Simulation with a single SSMU and one predator (penguins). Recruitment of krill is sufficient to satisfy predator demand, but less krill are available for consumption.



Slide 12: Simulation with a single SSMU and one predator (penguins). Initially, local recruitment of krill is sufficient to satisfy predator demand, then krill are moved through the SSMU using boundary areas. Movement into the SSMU is greater than movement out of the SSMU.



Slide 13: Simulation with a single SSMU and one predator (penguins). Local recruitment of krill is sufficient to satisfy predator demand, but krill are moved through the SSMU using boundary areas. Movement into the SSMU is less than movement out of the SSMU.



Slide 14: Description of the initial conditions for examples in which krill–predator–fishery interactions were simulated in two SSMUs.

Basic Setup for 2 SSMUs

- 50-yr simulations
- If **FISHING** then start = 11 and stop = 31
- If **FISHING** then AC1 = 2 x AC2
- No random variation in krill recruitment
- Hyperdepletion in relationship between relative consumption and relative breeders
- If **MOVEMENT** then krill move from SSMU 1 to SSMU 2
- If **2 available.fractions** then SSMU 1 = 0.8 and SSMU 2 = 0.2

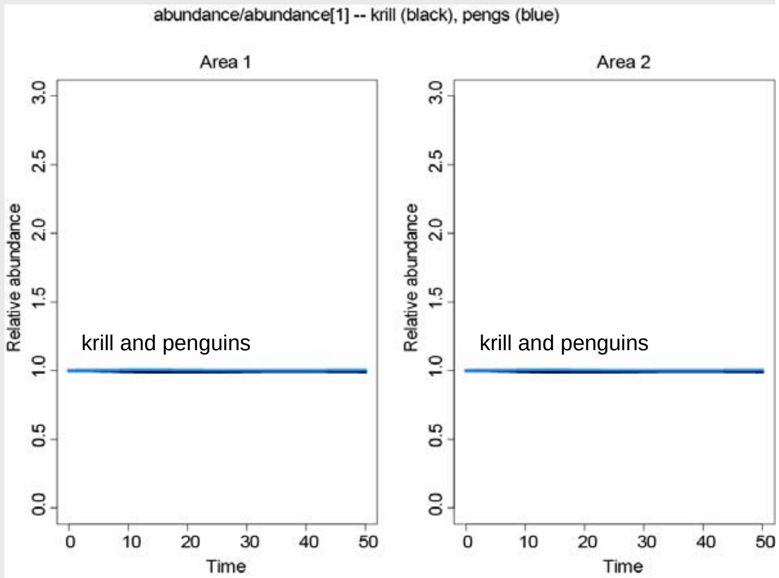
Slide 15: The sequence of examples used to review the KPFM when interactions within two SSMUs are simulated. The column marked ‘setup’ describes each example. The column marked ‘conditions’ describes the initial relationship between krill recruitment (R1 for recruitment in SSMU 1 and R2 for recruitment in SSMU 2), demand by predators (D1 for penguins in SSMU 1 and D2 for penguins in SSMU 2), and the catch allocated to the fishery (AC1 and AC2 for the catch respectively allocated to SSMUs 1 and 2). The column marked ‘expectations’ provides a short description of the dynamics that would be expected in each example.

Sequence with Two Areas

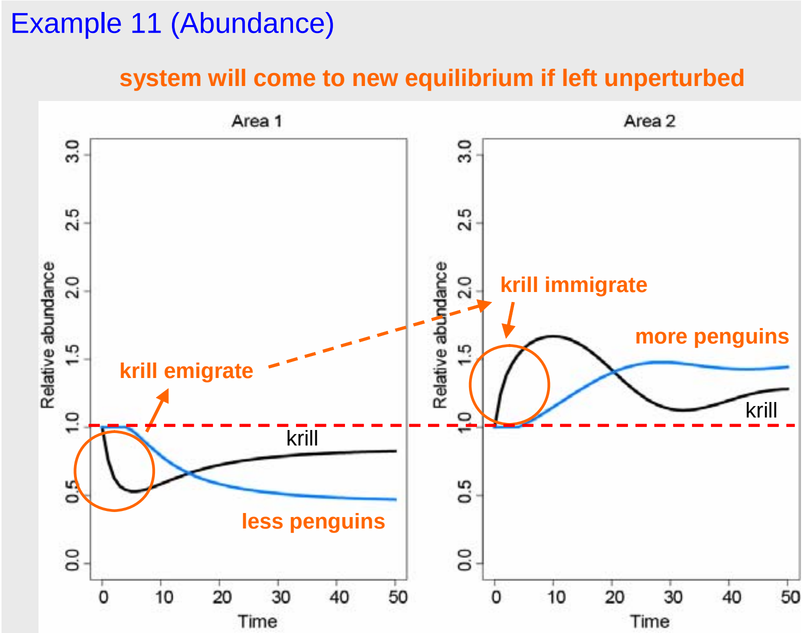
#	Setup	Conditions	Expectations
10	Two Penguins	R1 = D1, R2=D2	Flat lines
11	10 + Movement	R1 = D1, R2=D2	P1 Decreases, P2 Increases
12	10 + Fishing	R1 < D1+AC1, R2 < D2+AC2	Unequal Decreases & Increases
13	12 + Two available.fractions	R1 < D1+AC1, R2 < D2+AC2	?

Slide 16: Simulation with two SSMUs and one predator (penguins) in each SSMU. Local recruitment of krill satisfies predator demand in each SSMU.

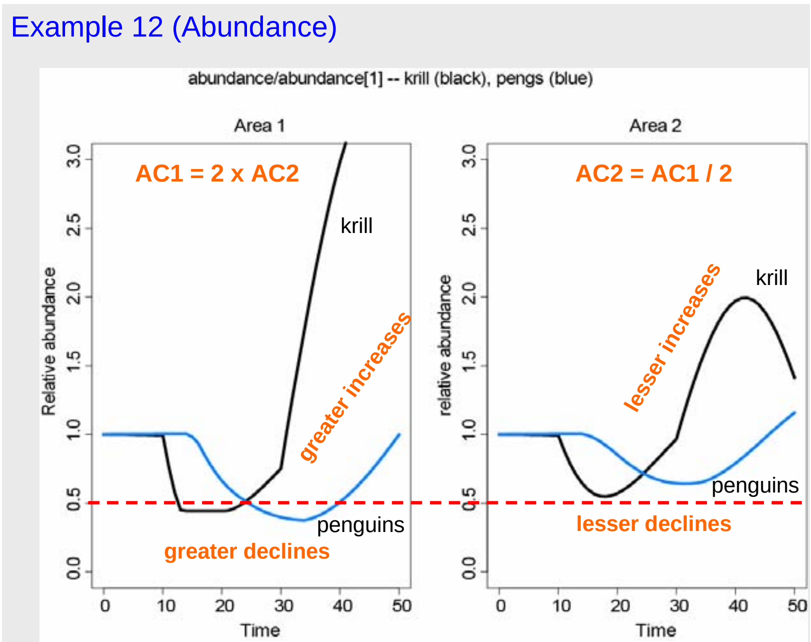
Example 10 (Abundance)



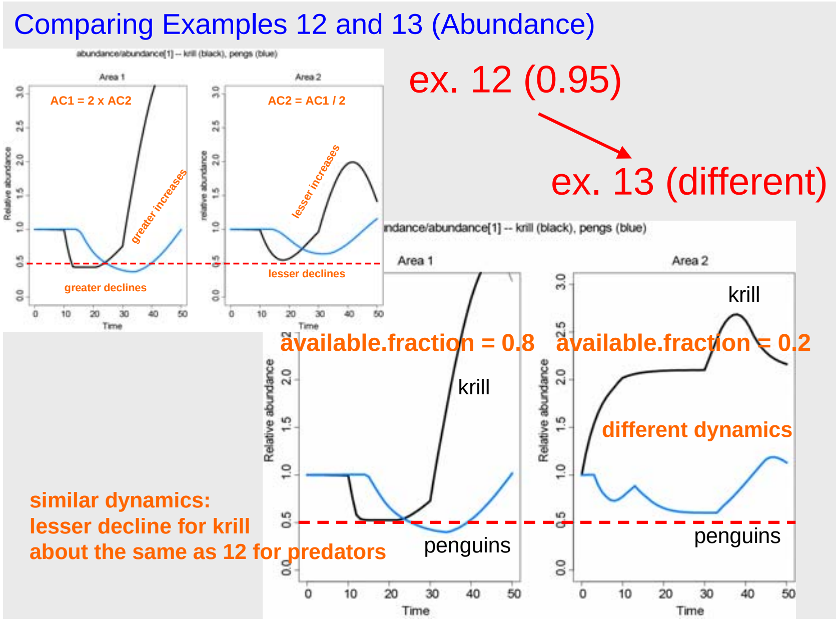
Slide 17: Simulation with two SSMUs and one predator (penguins) in each SSMU. Local recruitment of krill is sufficient to satisfy predator demand in each SSMU, but there is net movement of krill from SSMU 1 into SSMU 2.



Slide 18: Simulation with two SSMUs, one predator (penguins) in each SSMU, and krill fishing in both SSMUs. Local recruitment of krill is not sufficient to satisfy the combined predator demand and allocated catch in each SSMU.



Slide 19: Comparison of the simulation presented in Slide 18 to a simulation in which krill are less available to predation and fishing. All other conditions are the same in each simulation.



APPENDIX E

TERMS OF REFERENCE FOR THE CCAMLR-IPY-2008 SURVEY STEERING GROUP

TERMS OF REFERENCE FOR THE CCAMLR-IPY-2008 SURVEY STEERING GROUP

1. The Steering Group should develop a plan for a joint multi-ship synoptic survey for the assessment of krill biomass to be conducted in the Atlantic Sector of the Convention Area in summer 2008.

   Specific tasks during the planning phase:

   (i) plan a CCAMLR 2008 Synoptic Survey planning meeting;

   (ii) propose survey design;

   (iii) develop primary protocols to cover acoustic, net and CTD sampling;

   (iv) develop secondary protocols to cover the collection of other multinational datasets;

   (v) develop principles for data archiving;

   (vi) coordinate cruise plans and preparations.

2. The Steering Group should act in a proactive way to promote and coordinate the analyses and publication of results relating to the survey.

3. Specifically the Steering Group should:

   (i) Science tasks:

   (a) define analyses to be undertaken collaboratively
   (b) define analyses to be conducted unilaterally.

   (ii) Analysis:

   (a) ensure that all analyses are coordinated and agreed by the Steering Group prior to commencing work;

   (b) define, coordinate and promote analysis workshop(s);

   (c) coordinate analyses of data not undertaken at workshops;

   (d) act as a two-way information conduit such that Steering Group members are made aware of individual analyses being conducted in each member's country, and that individual scientists are made aware of this information.

   (iii) Publication:

   (a) oversee production of joint publications in a peer-reviewed international journal;

(b) establish an Editorial Board for this issue;

(c) produce a proposed publication list for this issue;

(d) act as arbitrators/mediators for conflicts in all publication authorships;

(e) ensure that all manuscripts are brought to the attention of the Steering Group prior to submission;

(f) maintain a register of all publications relating to the survey.

The tasks of the survey coordinator are:

- to serve as at-sea coordinator
- to ensure the data are supplied to CCAMLR and to participants
- to organise a post-survey data analysis workshop
- to coordinate report generation.

During the planning phase, the Steering Group will liaise with IWC, SCAR, CAML and other ‘EoIs’ for collaborative work during the 2008 survey.

APPENDIX F

**TERMS OF REFERENCE FOR THE
SUBGROUP ON DEVELOPMENT OF OPERATING MODELS**

TERMS OF REFERENCE FOR THE SUBGROUP ON DEVELOPMENT OF OPERATING MODELS

The Subgroup on Development of Operating Models is established to provide a group to facilitate the discussion, review and promotion of the development of operating models for use in evaluating management procedures. Such work will include the assessment, estimation or interpretation of model input parameters. It is intended to provide a forum for freely engaging in discussion, reviewing and developing these approaches while recognising the CCAMLR rules governing the use of data, information and conclusions obtained in this way.

1. The subgroup should promote and, where appropriate, coordinate the development of suitable models for evaluating management procedures and the review of appropriate candidate models, including to:

   (i) promote the development of suitable frameworks to include the management and/or implementation of:

      (a) data, parameters, database availability

      (b) required code, platforms, components and protocols

      (c) validation process of the models.

   (ii) promote coordination and collaboration and, where needed, assist in:

      (a) developing timetables and workshops for model development, analyses, estimation of input parameters, model verification and validation;

      (b) coordinating analyses of data not undertaken at workshops;

      (c) identifying and coordinating outputs and products;

   (iii) act as a two-way information conduit such that subgroup members are made aware of individual analyses being conducted by Members, and that individual scientists are made aware of this information;

   (iv) correspond with the conveners of WG-EMM and WG-FSA and conveners of workshops using operating models on their requirements in this work.

2. The subgroup should operate according to (i) the Rules for Access and Use of CCAMLR Data, and (ii) CCAMLR rules governing access to and use of information, unpublished data, analyses and/or conclusions such that they will not be cited or used for purposes other than the work of the CCAMLR Commission, Scientific Committee or their subsidiary bodies without the permission of the originators and/or owners of the data or information.

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 10 to 21 October 2005)

CONTENTS

[1] Appendices F to M have been published only in electronic format. Please refer to www.ccamlr.org/pu/E/e_pubs/fr/drt.htm for these reports.

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REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT
(Hobart, Australia, 10 to 21 October 2005)

OPENING OF THE MEETING

1.1 The meeting of WG-FSA was held in Hobart, Australia, from 10 to 21 October 2005. It was opened by the Convener, Dr S. Hanchet (New Zealand), and participants were welcomed to the new Secretariat Headquarters and meeting venue.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

Organisation of the meeting

2.1 The agenda of the meeting was discussed and adopted with the addition of subitem 14.3 to consider a proposal to reorganise the work of the Scientific Committee.

2.2 The Agenda is included as Appendix A, the List of Participants as Appendix B and the List of Documents presented to the meeting as Appendix C.

2.3 The report was prepared by the participants.

Report restructure

2.4 WG-FSA noted that its report from the 2004 meeting was extremely long and resulted in considerable problems in translating and copying the report in time for the start of last year's meeting of the Scientific Committee. Subsequently, the Scientific Committee had discussed options for alleviating this problem (SC-CAMLR-XXIII, paragraphs 13.8 to 13.13). It concluded that management advice and information essential to the work of the Scientific Committee should be retained in the main body of the report, but that the remaining text, which provided background information and advice for future work of WG-FSA, should be placed in appendices. These appendices would be translated during the intersessional period and published with the report of WG-FSA.

2.5 The Scientific Committee offered the following guidance (SC-CAMLR-XXIII, paragraph 13.12):

- rapporteurs at WG-FSA should be encouraged to remove background documentation from the main body of the report;
- in cases where consensus is not reached, the report of WG-FSA should include a balanced presentation of the various views;
- the main body of the report should include the detail necessary to understand the development of each element of management advice.

2.6 WG-FSA considered various approaches to following the guidelines of the Scientific Committee. The Working Group agreed that each subgroup would prepare a stand-alone subgroup report by the end of the first week of the meeting. These subgroup reports would form appendices to the report of WG-FSA[2]. Each subgroup report would be reviewed in plenary. The report of WG-FSA would reflect the plenary discussions and, where appropriate, the text of the report would contain background paragraphs, distilled from the relevant subgroup report, the key points discussed in plenary, and WG-FSA's advice to the Scientific Committee.

2.7 WG-FSA agreed that the approach outlined above would be extended to the Fishery Reports[3] and the report of ad hoc WG-IMAF. It was also agreed that WG-FSA's report would contain the detail necessary to understand the development of each element of management advice. Guidance on the level of detail required, and consequently the extent of translation required prior to the meeting of the Scientific Committee, would be provided by participants.

REVIEW OF AVAILABLE INFORMATION

Data requirements specified in 2004

Development of the CCAMLR database

3.1 The Data Manager, Dr D. Ramm, provided an update on recent developments in managing CCAMLR's data. During the intersessional period, the Secretariat had revised a number of databases and procedures used in support of the work of WG-FSA.

3.2 A new trial electronic version of CCAMLR's *Statistical Bulletin* (eSB) was developed as a Microsoft Access database (SC-CAMLR-XXIV/5). The work was undertaken by Mr S. Morgan (Database Administrator and Programmer). The eSB allows users to replicate the six sections which are published in the hard copy of the bulletin. In addition, the eSB allows users to access the complete dataset of statistics underlying the bulletin and to develop user-defined queries to summarise these data, generate tables and graphics, and extract selected data. The Working Group evaluated this development under Item 14.2.

3.3 The routine for generating catch-weighted length frequencies was reviewed and further developed following intersessional consultation (WG-FSA-05/6 Rev. 1). The Secretariat has simplified the operation of the routine by incorporating all of the procedures in a single Microsoft Access database. The routine (described in WG-FSA-99/15) was also expanded to include all types of length measurements reported in the CCAMLR database (previously only lengths reported to the nearest 1 cm below were included in the routine). Updated catch-weighted length frequencies are provided in the Fishery Reports (see Appendices F to M).

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[2] Throughout this report, cross references to paragraphs, tables and figures in the appendices are prefixed by the letter of the appendix, e.g. paragraph N6 is paragraph 6 in Appendix N, Table M12 refers to Table 12 in Appendix M. Also, please note that Appendices D and E do not exist as they were subsumed into the main body of the report.

[3] The Scientific Committee later agreed that the Fishery Reports be published in a separate electronic volume (SC-CAMLR-XXIV, paragraph 4.13) (see www.ccamlr.org/pu/E/e_pubs/fr/drt.htm).

3.4 The Secretariat developed a procedure for identifying hauls which matched the criteria of the research plan under Conservation Measure 41-01 (SC-CAMLR-XXIII, Annex 5, paragraph 5.20). The procedure selects hauls from the fine-scale effort data which meet the following criteria (WG-FSA-05/6): longline hauls with 3 500–10 000 hooks and soak times of not less than 6 hours; or trawl hauls with at least 30 minutes of effective fishing time. Selected hauls are then drawn at random and assigned as 'research' hauls if they are separated by not less than 5 n miles from any other 'research' haul, with the distance measured from the midpoint of each haul. The first 'research' haul in a sequence may be specified or chosen at random.

3.5 Quantifying the catch rates and biomass of by-catch species on CCAMLR's fishing grounds is an essential component of the assessment advice prepared by WG-FSA. However, such analyses are problematic because the CCAMLR by-catch datasets are incomplete and have a high occurrence of 'missing catch values'. The Secretariat is developing a method to treat 'missing catch values' for by-catch species using estimates derived from the mean weights of by-catch species by fishing gear, region and period (WG-FSA-SAM-05/4). In 2005, WG-FSA-SAM encouraged the Secretariat to develop the method, noting that further work would be required to address inconsistencies in the data (e.g. weight reported and numbers only partially reported), and uncertainties associated with using mean weights (WG-FSA-05/4, paragraphs 7.4 and 7.5).

3.6 Further developments were also undertaken in the tagging database, which is now populated with data (see WG-FSA-05/7 Rev. 1, Table 7) and the ageing database. These developments were considered by the Subgroup on Tagging (Appendix T) and the CCAMLR Otolith Network (paragraphs 9.5 to 9.7).

3.7 WG-FSA noted that the majority of the routine queries used to extract data analysed during the meeting are held in a database operated by the Secretariat. The Working Group requested the Secretariat to develop a manual, which can be updated each year, that specifies its procedures and equations, where appropriate, for the extraction and mathematical manipulation of data, and to make this reference information available at the start of future meetings.

3.8 The Data Manager reminded WG-FSA that all data provided by the Secretariat during the meeting are subject to the Rules for Access and Use of CCAMLR Data.

Data processing

3.9 The Working Group noted that all the available CCAMLR fishery and observer data from the 2004/05 season had been submitted by the time of the meeting; many of these data had been submitted 4–6 weeks prior to the meeting. In addition, fishery data from the French EEZs in Division 58.5.1 and Subarea 58.6 in 2004/05 (to August 2005) had also been submitted. Fine-scale data from the fishery in the South African EEZ around Prince Edward and Marion Islands in 2004/05 were unavailable.

3.10 The Working Group noted that some fisheries in 2004/05 were still operating (e.g. fishery for icefish in Subarea 48.3) and that the data arising from these activities would be considered at the 2006 meeting.

3.11 The fishery and observer data from 2004/05 had been received and processed by Mrs L. Millar (Data Administration Officer) and Mr E. Appleyard (Scientific Observer Data Analyst) in time for the meeting. Preliminary validation of these data had also been undertaken. The Working Group thanked Mrs Millar and Mr Appleyard for preparing these data in time for the meeting.

Fishery Plans

3.12 The Secretariat has maintained the database which holds the information on Fishery Plans (WG-FSA-SAM-04/4) and had updated data from 2004/05 to the time series.

Fisheries information

Catch, effort, length and age data reported to CCAMLR

3.13 Under the conservation measures in force in 2004/05, fishing took place in 13 fisheries targeting icefish (*Champsocephalus gunnari*), toothfish (*Dissostichus eleginoides* and/or *D. mawsoni*) and krill (*Euphausia superba*):

- fishery for *C. gunnari* in Subarea 48.3
- fishery for *C. gunnari* in Division 58.5.2
- fishery for *D. eleginoides* in Subarea 48.3
- fishery for *D. eleginoides* in Subarea 48.4
- fishery for *D. eleginoides* in Division 58.5.2
- exploratory fishery for *Dissostichus* spp. in Subarea 48.6
- exploratory fishery for *Dissostichus* spp. in Division 58.4.1
- exploratory fishery for *Dissostichus* spp. in Division 58.4.2
- exploratory fishery for *Dissostichus* spp. in Division 58.4.3a
- exploratory fishery for *Dissostichus* spp. in Division 58.4.3b
- exploratory fishery for *Dissostichus* spp. in Subarea 88.1
- exploratory fishery for *Dissostichus* spp. in Subarea 88.2
- fishery for *E. superba* in Area 48.

3.14 In addition, four other managed longline fisheries targeting toothfish were conducted in the Convention Area in 2004/05:

- 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 Subarea 58.6
- fishery for *D. eleginoides* in the South African EEZ in Subarea 58.7.

3.15 Catches of target species by region and gear reported from fisheries conducted in the CCAMLR Convention Area in the 2004/05 fishing season are summarised in Table 3.1.

3.16 The Working Group noted the Secretariat's work in monitoring fisheries and some of the difficulties encountered in 2004/05 (CCAMLR-XXIV/BG/13). The Secretariat had proposed various improvements which may be considered by the Commission.

3.17 At the request of the Convener of WG-FSA (August 2005), the Secretariat had mapped the general area of operation of each of the main CCAMLR fisheries (WG-FSA-05/6 Rev. 1). The Working Group found these maps to be helpful in understanding the distribution of fishing effort. However, it was decided not to include the haul locations in the fishery reports due to data confidentially.

3.18 The Secretariat updated the catch-weighted length frequencies for *C. gunnari* taken in fisheries in Subarea 48.3 and Division 58.5.2, *D. eleginoides* taken in fisheries in Subareas 48.3 and 58.7 and Division 58.5.2, and *D. mawsoni* taken in fisheries in Subareas 88.1 and 88.2 (WG-FSA-05/6 Rev. 1).

3.19 The Working Group recalled that the length-frequency plots for the fisheries in Division 58.5.2 included research data (SC-CAMLR-XXIII, Annex 5, Figures 5.17 and 5.22), and noted that the Secretariat had been working with Dr A. Constable and Mr T. Lamb (Australian Antarctic Division) to address this problem. Further work was required to separate the research data from the commercial fishery data and it was hoped that this would be completed during the forthcoming intersessional period. In the meantime, the Working Group agreed to use the catch-weighted length frequencies for *D. eleginoides* in Division 58.5.2 which had been provided by Dr Constable.

3.20 The Working Group also noted that the length–weight parameters used to generate the catch-weighted length frequencies were estimated from observer data (WG-FSA-05/6 Rev. 1, Table 2) and are not the same as those used in the assessments. WG-FSA agreed that the Subgroup on Biology and Ecology should review these coefficients and develop a set of agreed values for use in the length-frequency procedure (see also Items 3.4 and 9).

3.21 The Secretariat updated the catch histories for target species and managed by-catch species in the Convention Area (WG-FSA-05/6 Rev. 1). Catch histories for *Dissostichus* spp. included estimates of IUU catches (see below).

3.22 The Working Group noted WG-FSA-05/54 which described the autoline fishing method and the terminology for the fishing operation and gear. This paper was further discussed under Item 7. The Working Group thanked the authors for preparing this reference document and encouraged participants to develop a similar description for the Spanish longline fishing method.

3.23 The Working Group noted WG-FSA-05/26 which described a proposal to use vertical droplines in the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 in 2005/06. This paper was further discussed under Item 7.

Estimates of catch and effort from IUU fishing

3.24 WG-FSA reviewed estimates of IUU catches in the Convention Area prepared by the Secretariat and based on information submitted by 1 October 2005 (Table 3.2 and SCIC-05/10 Rev. 1). The deterministic method presently used by the Secretariat to estimate IUU fishing effort was the same method as used in previous years. This method used information on the number of vessels sighted/apprehended and reports of port inspections. Ancillary information on fishing trips and catch rates is derived from CCAMLR data on licensed vessels. The estimates of IUU catch were discussed under Item 8.

Catch and effort data for toothfish fisheries in waters adjacent to the Convention Area

3.25 Catches of *Dissostichus* spp. in CCAMLR waters which were reported to the Secretariat in STATLANT data and the catch and effort reporting system, and catches outside the Convention Area reported in the CDS for the 2003/04 and 2004/05 seasons are summarised in Table 3.3.

3.26 WG-FSA noted that the catch of *Dissostichus* spp. outside the Convention Area in 2003/04 and 2004/05 was taken mostly in Areas 41 and 87. The total CDS-reported catch so far in 2004/05 from areas to the north of the Convention Area (8 511 tonnes) was lower than that reported over the comparable period in 2003/04 (10 966 tonnes to October 2004; SC-CAMLR-XXIII, Annex 5, Table 3.3).

3.27 Dr E. Balguerías (Spain) submitted catch data from Spanish-flagged vessels fishing for toothfish and finfish in the Atlantic and Indian Oceans outside the Convention Area. Spanish-flagged vessels had reported the following catches of *D. eleginoides*:

2004 calendar year:
Atlantic Ocean outside the SEAFO Convention Area – 242.6 tonnes
Indian Ocean – 0.9 tonnes

2005 calendar year:
Atlantic Ocean outside of the SEAFO Convention Area – 17.6 tonnes
Indian Ocean – no catch.

The Working Group thanked Dr Balguerías for submitting this information.

Scientific observer information

3.28 Scientific observers participated in a total of 47 cruises on board longliners (31 cruises), trawlers (14 cruises) and pot vessels (2 cruises) targeting toothfish or icefish in the Convention Area in 2004/05 (WG-FSA-05/7 Rev. 1, 05/8 and 05/10). In addition, six cruises were reported from trawlers in the krill fishery in Area 48. Scientific observations were discussed under Item 7 and 11.

Research information

Research surveys

3.29 Australia conducted a random stratified trawl survey in Division 58.5.2 in the vicinity of Heard Island between 31 May and 27 June 2005 continuing the time series started in 1990. The survey followed the revised design adopted in 2004 (Candy, 2004). All known areas of distribution of juvenile toothfish and icefish were surveyed on the Heard Island Plateau and Shell Bank. The icefish stations were completed during daytime only. In addition, all deeper water areas between 500 and 1 000 m surrounding the plateau were included in the toothfish portion of the survey. A total of 158 and 57 valid hauls were completed for toothfish and icefish respectively. Preliminary assessments of toothfish and icefish using data from the survey are provided in WG-FSA-05/30 and 05/39 respectively.

3.30 New Zealand conducted a longline survey in Subarea 88.3. The sampling strategy was based on a two-phase approach targeting two areas of interest:

- Area 1: about the De Gerlache seamounts between 95°W and 85°W
- Area 2: on the main Antarctic shelf between 105°W and 95°W.

A New Zealand-flagged vessel carried out research activities between 11 and 20 February 2005. Due to unfavourable sea-ice conditions, research stations were limited to eight hauls in Area 1; six of these met the definition of a successful research line as defined in Annex 41-01/B. In Area 2, two successful stations were sampled before moving sea-ice curtailed activities. Preliminary results from these hauls are provided in WG-FSA-05/53.

3.31 The UK undertook a research survey in Subarea 48.3 during January 2005. The objectives of the survey were to:

(i) refine methods for estimating icefish biomass using acoustics;

(ii) examine temporal changes in the vertical distribution of icefish;

(iii) assess precision of baited-camera-system estimates of crab density;

(iv) ‘ground-truth’ the baited-camera-system estimates of crab density using comparisons with bottom trawls;

(v) provide more information on the distribution of the benthos on the South Georgia shelf;

(vi) monitor commercial fishing activities in the area.

3.32 Catches of icefish in both demersal and pelagic trawls were very small. Following the loss of the baited-camera system, the survey concentrated on using bottom trawls to investigate the ecology of the ichthyofauna and the distribution of benthos. Preliminary results from the survey are provided in WG-FSA-05/79.

Future surveys

Germany

3.33 Germany will conduct a bottom trawl survey in the Elephant Island–South Shetland Islands–Joinville/D’Urville Islands region (Subarea 48.1) with the RV *Polarstern* in November–December 2006. A commercially sized 140' bottom trawl with a mouth opening of 18–19 m and 3.5–4 m will be used. Survey depth (50–500 m) and survey design will be the same as during the *Polarstern* cruise in 2002 and the US AMLR cruises since 1998. Trawling time will be 30 min on the bottom. It is envisaged that 65–70 hauls will be conducted in the Elephant Island–South Shetland Islands area while 12–15 hauls will be performed off Joinville/D'Urville Islands. Results of the survey will be submitted to CCAMLR in time for discussion at the 2007 WG-FSA meeting.

France

3.34 France expects to conduct a 45-day research survey on fish stocks in the Kerguelen EEZ (Division 58.5.1) during 2006/07. The targeted species will be *D. eleginoides*, *C. gunnari*, *Notothenia rossii* and *Lepidonotothen squamifrons*. Randomly stratified stations will be occupied in the shelf area of the northern part of the Kerguelen Plateau using a chartered commercial trawler. Determination of biomass will be completed. In addition, a tagging program for toothfish will be initiated in the French EEZ in Subarea 58.6.

USA

3.35 The USA will conduct a 30-day bottom trawl survey in Subarea 88.3 and possibly in Subarea 48.1 (if weather or sea-ice prohibits sampling in Subarea 88.3) during the period of February and March 2006. The ship will occupy randomly stratified stations and will target all finfish stocks, including pre-recruit *D. mawsoni*.

Australia

3.36 In the 2006 season Australia will again conduct its standard surveys for toothfish and icefish around the Heard and McDonald Islands. Survey design will be the same as used this year. Results will be presented at the 2006 WG-FSA meeting.

Tagging studies
(see also Appendix T)

3.37 The Working Group welcomed reports of a number of studies investigating essential characteristics of tagging programs, such as tagging survivorship rates, tag shedding rates, possible reductions in growth rate immediately following tagging, tagging-related growth retardation, growth and movement. These estimates have been taken forward into assessments where appropriate. WG-FSA-05/19 reported results of the first large-scale experiment on toothfish immediate post-tagging mortality, coordinated by the UK in Subarea 48.3. Dr D. Agnew (UK) reported that smaller fish and those in better condition had higher post-tagging survivorship. The experiment confirmed that toothfish are relatively robust; most observers should be able to achieve a tagging survivorship of 95% or better, and a conservative estimate of survivorship across the fleet would be 90%.

3.38 Conservation Measure 41-01/C required that all exploratory fisheries tag toothfish at a rate of 1 toothfish per tonne green weight of catch throughout the season, up to a maximum of

500 fish per vessel. Tables T1 and T2 show that most Members achieved this target level in most fisheries, and the combined tagging rate of all Members achieved the target tagging level in all fisheries except in Divisions 58.4.1 and 58.4.3b and Subarea 88.2.

3.39 The Working Group noted that that mark–recapture data were being used in the assessments of toothfish in Subareas 48.3 and 88.1, and that there was a tagging program in Division 58.5.2; that tagging data were being gathered in all exploratory fisheries; that the UK proposed to initiate a mark–recapture program in Subarea 48.4 with the objective of achieving a tag-based stock assessment within three to five years (paragraphs 5.141 to 5.143; WG-FSA-05/57); and that France intended to initiate a tagging program at Crozet Island (Subarea 58.6).

3.40 Given the advances in knowledge of critical tagging parameters and the use of mark–recapture data in assessments, there is a real possibility that tagging data could lead to assessments of most exploratory fisheries within a few years of their initiation, but only if the following tag conditions are met:

(i) Tags need to be released at a reasonable rate. Many Members are currently achieving rates of greater than 1 tag/tonne and this should be encouraged.

(ii) Tagging programs should be considered as multi-year programs. There needs to be a long-term (three to five years) commitment to repeated tagging and fishing in exploratory fisheries.

(iii) Considering the slow mixing rates for toothfish, releases should be widely distributed across all fishing areas and depths, and recapture fishing effort should be similarly distributed.

3.41 There has been concern that large toothfish are difficult to tag and have a lower survivorship than small fish. In terms of assessments, which require a known and preferably high survivorship of tagged fish, only the relatively smaller fish within the main body of the dome-shaped selectivities contribute significantly to the estimate of vulnerable biomass. These fish naturally have high survivorship. Thus for most purposes fish only need to be tagged in proportion to their occurrence in the catch, but only so long as they are in good condition.

3.42 The Working Group noted that skate tagging programs were under way in Subarea 88.1 and Division 58.5.2 (section 6), and encouraged the development of additional programs. It recognised that there may be a conflict between the requirement to cut off and release all skates at the water surface and the demands of successful skate tagging programs. Alternative approaches may be needed to resolve this conflict, for instance:

(i) tagging a number of skates on deck after assessing their condition (paragraphs N87 and N88), rather than in the water, so that there is a subset of released animals for which condition and likely survivorship is known accurately;

(ii) double tagging as many skates as possible;

(iii) ensuring accurate reporting of all skates cut-off the line (paragraphs 6.11 to 6.15), and close examination of these skates for tags (paragraph N82);

(iv) recovering all skates caught on some lines, rather than cutting them off at the water surface, to estimate the success of in-water observation of tagged fish. This may require an exception from the requirement to cut off all skates, and from the by-catch limits within appropriate conservation measures.

Biological information

3.43 Twelve papers provided new biological information of potential use in assessments.

3.44 The biological parameters used in the *D. eleginoides* assessment in Subarea 48.3 were reviewed in WG-FSA-05/18. The age–length data (WG-FSA-04/86) were reanalysed using the fishing selectivities, and following the method detailed in WG-FSA-SAM-05/13, to derive alternative von Bertalanffy growth parameters. A range of results was obtained, which depended on the model structure, and could, potentially, be used in sensitivity trials of the assessment. Examination of tagging data indicated that there is a post-tagging shock period of 180 days, when no growth occurs. The data also indicate an overestimate of 10 mm in the measurement of live toothfish. The probability of tag loss is estimated as 0.06 per year. Immediate post-tagging mortality, derived from multi-observer experiments, was found to be between 5 and 11% and a value of 10% was proposed for assessments. The fishery length-frequency data were adjusted to account for the different measurement units used at different stages of the fishery. Length–weight parameters were updated, based on the latest fishery data. It was proposed that the assessment use existing estimates of L_{m50}, but the paper noted that these were confounded by the mixture of males and females and it was proposed that separate growth and L_{m50} parameters be derived for males and females for future assessments. An examination of the current biological parameters and Beverton and Holt invariants suggested that the natural mortality range of 0.13 to 0.2 was too high (2–3 times K). The CPUE series were updated using the latest fishery data and the standard GLM and GLMM methods. The results showed a slight downward trend, but analysing Shag Rocks and South Georgia separately showed a decline in CPUE at Shag Rocks and a slight increase at South Georgia.

3.45 In WG-FSA-05/20 otoliths from juvenile *Macrourus whitsoni*, caught during the BioRoss cruise in Subarea 88.1, were aged to generate more accurate von Bertalanffy parameters. Studying otoliths from small *M. whitsoni* has given more confidence in the interpretation of the zone structure displayed in each year's growth. Von Bertalanffy parameters were derived for male and female fish, but did not differ much from the parameters previously used to estimate γ.

3.46 WG-FSA-05/23 summarised the state of knowledge on age determination in *C. gunnari* and assessed the validity of ageing. A workshop on age determination of this species is planned for the intersessional period, to be held in Kaliningrad, Russia.

3.47 WG-FSA-05/29 provided an overview of the eight years of the toothfish fishery in Subarea 88.1 and four years in Subarea 88.2. In 2004/05 the *D. mawsoni* catch was the highest to date, with the fishery benefiting from a relatively ice-free season. The size distribution of the catch strongly depended on depth; size increased steadily from 1998/99 to 2003/04 but decreased slightly in the last two years.

3.48 Differences between *D. mawsoni* caught near the seamounts in the north of Subarea 88.1 and those caught on the Ross Sea shelf to the south were described in WG-FSA-05/52. *D. mawsoni* from the northern part of the Ross Sea had a unimodal length distribution of a consistent size over all seasons, were in poorer condition, with more advanced reproductive development and with a consistently higher ratio of males to females. The results are consistent with a spawning migration from the southern areas to the north. The different length–weight coefficients between northern and southern areas have implications for stock assessment.

3.49 Examination of strontium chloride marked otoliths from tagged and recaptured *D. eleginoides* at Heard Island has confirmed the annual deposition of increments for fish aged between 5 and 18 years (WG-FSA-05/60). Daily growth rings were also counted in a small sample of *D. eleginoides* otoliths from Heard Island and confirmed that the first translucent increment succeeding the opaque centre region corresponds approximately with the end of the first year's growth (WG-FSA-05/61).

3.50 WG-FSA-05/63 reported on the utility of histological and microscopic analysis of ovary samples from *D. mawsoni* caught in the Ross Sea to improve estimates of size-at-maturity. Two methods were applied. The first used classic histological techniques to classify the state of oocyte development in histological sections to determine the proportion of fish maturing to spawn, and thus the mean size-at-maturity. The calculated L_{m50} of 113.0 cm was very close to the value of 115.2 cm estimated in 2000/01. GSI data collected from across the fleet, however, still raised doubt about the true L_{m50}. The second method examined ovaries to histologically identify fish that spawned the previous season, but this method requires ground truthing with fish that are know to have spawned.

3.51 In WG-FSA-05/64 Rev. 1 von Bertalanffy and segmented linear models, with and without fishing selectivity, were used to estimate growth parameters of *D. eleginoides* from Heard Island. A two-segment linear model, separated at age 6, gave the best fit to the data and for lengths above 557 mm was similar to growth increments obtained from mark–recapture data. For the 5- to 25-year age range, predicted lengths from the von Bertalanffy curve and the segmented linear model were almost identical.

3.52 In WG-FSA-05/65 length dependent selectivity of *D. eleginoides* in the Heard Island trawl fishery was estimated by comparison of trawl to longline length-frequency data. Using GLMMs fitted to length-frequency data, the upper arm of the trawl gear selectivity function was estimated as a linear decline in selectivity beginning from 1 at 800 mm to 0 at 1 731 mm length. Adjusting for gear type, the GLMM predicts the availability of large fish increases with increasing fishing depth.

3.53 WG-FSA-05/70 provided estimates of growth of 15 mm per year for the skate *Bathyraja eatonii* from tagging work at Heard Island. Updated length–weight parameters are provided for *B. eatonii*, *B. irrasa* and *B. murrayi*.

PREPARATION FOR ASSESSMENT AND ASSESSMENT TIMETABLE

Report of the Subgroup on Assessment Methods

4.1 The third meeting of WG-FSA-SAM was held immediately prior to WG-EMM-05, from 27 June to 1 July 2005, at the National Research Institute of Fisheries Science, Yokohama, Japan. WG-FSA-SAM was tasked to examine, develop and provide advice on the use of assessment methods to be implemented during WG-FSA-05. The meeting was convened by Dr C. Jones (USA). The full report of WG-FSA-SAM is provided in WG-FSA-05/4.

4.2 The Working Group noted that WG-FSA-SAM held discussions primarily relevant to advancements in assessment methods for *Dissostichus* spp. Topics included methods for estimation of recruitment, abundance indices, alternative assessment approaches and plausible operating models for use in evaluating assessment methods. The subgroup focused discussions principally on evaluation of alternative assessment approaches, including methods that use mark–recapture information, and integrated approaches for stock assessment.

4.3 With respect to mark–recapture methods (WG-FSA-05/4, paragraphs 2.15 to 2.22), the Working Group agreed that some advancements were made in understanding potential bias in estimates of stock size of *D. eleginoides* in Subarea 48.3 arising from imperfect mixing and uneven distribution of fishing effort. With respect to Subareas 88.1 and 88.2, the Working Group recognised that toothfish tagging efforts are now yielding a number of valuable results in terms of movement and growth, and that continued tagging studies will result in further knowledge of the Ross Sea *Dissostichus* stocks. The Working Group encouraged further work in understanding the robustness of mark–recapture data because they are useful not only by themselves, but also as inputs to integrated assessment methods.

4.4 The Working Group noted that the principal integrated assessment methods considered by WG-FSA-SAM were the age-structured production model (ASPM), and the C++ algorithmic stock assessment laboratory (CASAL) (WG-FSA-05/4, paragraphs 2.26 to 2.40).

4.5 The ASPM was applied to *D. eleginoides* in Subarea 48.3 and in Subareas 58.6 and 58.7. The Working Group agreed that the properties of the ASPM as an integrated modelling technique were being adequately explored in relation to these subareas (WG-FSA-05/4, paragraph 2.30).

4.6 The Working Group noted that model structure, assumptions and implementation for calculating precautionary yields of *Dissostichus* spp. using CASAL had been examined by WG-FSA-SAM. Using a point estimate, CASAL does not strictly reproduce precautionary yields by the method of the current GYM. However, using samples from the posterior distribution generated by Bayesian Monte Carlo Markov Chain (MCMC) runs of CASAL followed by future projections of each sample, a set of projections closer to the current GYM could be generated (WG-FSA-05/4, paragraph 2.35).

4.7 The Working Group was encouraged by the advancements and continued exploration of the behaviour and suitability of CASAL for *Dissostichus* spp. assessments, and recommended further development of CASAL models for Subareas 48.3 and 88.1 and Division 58.5.2.

4.8 The Working Group agreed that the comparability of yield estimates resulting from the GYM and CASAL would need to be investigated prior to implementation. The Working Group agreed that the development of any assessment methods include: (i) examination of whether the method had been applied correctly, as well as whether model construction is robust; (ii) a need to undertake comparison of methods; and (iii) evaluation of robustness to operating model uncertainties.

4.9 The Working Group reviewed advice from WG-FSA-SAM on refinement of parameter estimates for use during the course of the assessments (WG-FSA-05/4, paragraphs 4.1 to 4.20), including recommendations pertaining to natural mortality, recruitment, selectivity, age and growth, and movement.

4.10 The Working Group was encouraged by the progress made in the evaluation of assessment methods using operating models (WG-FSA-05/4, paragraphs 2.46 to 2.52) and strongly urged further evaluation in the intersessional period.

4.11 WG-FSA-SAM recommended integrated assessments be developed for toothfish in Subareas 48.3, 58.6, 58.7, 88.1 and 88.2 and Division 58.5.2 where possible and provided specific details for each area (WG-FSA-05/4, paragraphs 6.1 to 6.13).

Summary of the report from the invited expert to the 2005 WG-FSA-SAM meeting

4.12 Dr M. Maunder from IATTC attended the WG-FSA-SAM meeting as an invited outside assessment modelling expert. His report was submitted to WG-FSA, and appears as WG-FSA-05/5. The terms of reference for his participation included:

(i) review usage and efficacy of the generalised yield model for estimating long-term precautionary yield of toothfish in the CCAMLR Convention Area;

(ii) provide input on refining methods of estimating recruitment for toothfish stocks;

(iii) examine potential for uniform approach of CPUE standardisation;

(iv) review and evaluate use of alternative approaches for the assessment of toothfish in CCAMLR waters, including:

(a) CASAL
(b) mark–recapture approaches
(c) other models or quantitative methodologies.

4.13 Dr Maunder gave favourable remarks to the approach of WG-FSA-SAM. WG-FSA-05/5 addressed all the terms of reference with the exception of refining methods of estimating recruitment for toothfish. The Working Group noted that for this item, no new information was available from which to advance this work during the course of the WG-FSA-SAM meeting. The Working Group agreed that an alternative process may be needed to ensure all identified topics of importance are addressed.

4.14 The Working Group noted five major points from the discussion and conclusion of WG-FSA-05/5:

(i) A consensus toward application of an integrated assessment for implementing the precautionary approach was achieved. The use of a Bayesian framework appears to be appropriate, as it would be consistent with GYM. The CASAL framework appears to fulfil the requirements necessary to carry out this type of analysis.

(ii) The negative side of this approach is that models are computationally intensive, the assessment is difficult to interpret and evaluate, and this limits the number of sensitivities that can be performed. Thus, it would be useful to analyse the components of the data independently to evaluate their properties prior to integrating them into the model.

(iii) Integrated analysis requires weighting of different datasets. Weighting assumptions can produce different results when different datasets provide conflicting information. There are several methods of determining effective sample size and weighting, though further research is needed to determine effectiveness of various methods.

(iv) Full Bayesian integration can take extensive periods of time, and can reduce the amount of analysis that can be performed, though many diagnostics and sensitivities can be applied through estimating model parameters by finding the joint mode of the posterior distribution.

(v) Management strategies, including the assessments, need to be evaluated for their robustness to uncertainties and errors.

4.15 The Working Group agreed that Dr Maunder's invitation and participation in the meeting was worthwhile and valuable toward the work of WG-FSA, and recommended that a letter of appreciation from WG-FSA thanking him for his time and participation would be appropriate.

4.16 WG-FSA-SAM noted that WG-FSA struggles to complete assessments within the course of its meeting and in the past had discovered errors near the end or even after the meeting had concluded. The integrated assessment methods now being proposed to be used for toothfish assessments are time-consuming and will be extremely difficult to run during the meeting. The subgroup also recalled the request of the Scientific Committee and Commission to provide consensus stock assessment advice as soon as possible for Subareas 48.3 and 88.1 (SC-CAMLR-XXIII, paragraphs 4.62, 4.63, 4.167 and 4.168; CCAMLR-XXIII, paragraphs 4.32 and 9.7).

4.17 To allow for more time for model and input parameter evaluations during the 2005 WG-FSA meeting, WG-FSA-SAM suggested: (i) the Convener of WG-FSA request members of the assessment subgroup to meet in Hobart during the week prior to the beginning of WG-FSA (beginning 6 October 2005) to investigate and evaluate proposed assessment models including proposed data inputs; and (ii) manuscripts submitted by the WG-FSA deadline (two weeks prior to the start of WG-FSA) would serve as the main source for review.

Status of assessment methods

Current assessment methods

Recruitment-based long-term yield assessment

4.18 A preliminary GYM assessment for the Heard Island (Division 58.5.2) toothfish fishery was provided in WG-FSA-05/30. The preliminary assessment of yield was calculated using the standard GYM and long-term projection methodology. Additional sensitivity analysis of the assessment was examined for: (i) further consideration of the survey series and the sensitivity to exclusion of observations of older cohorts in recent surveys, (ii) implementation of revised growth parameters, including the use of a length-at-age vector, (iii) consideration of a vulnerability function for the future projections based on full selection of adult fish, and (iv) consequences of reducing the range of natural mortality from 0.13–0.2 to 0.13–0.165, consistent with slower growth rates of fish.

Short-term projections

4.19 A preliminary assessment for the estimation of precautionary yield of icefish in the vicinity of Heard Island for the 2005/06 CCAMLR season was presented in WG-FSA-05/39. This paper provided a preliminary assessment of yield using standard short-term projection assessment methods previously employed for icefish. The paper proposed a one-year projection be used in the implementation of the CCAMLR assessment method because the fish are likely to disappear after they become four years old during the coming season.

New assessment methods

4.20 As recommended by WG-FSA-SAM, the assessment subgroup met to discuss and review integrated assessments over a three-day period from 6 to 8 October 2005 at the CCAMLR Headquarters, convened by Dr Jones.

4.21 During the course of the pre-meeting, attendees developed an integrated assessment checklist to assist both the individuals putting together the components and running the integrated assessment, as well as others who conduct the assessment review. This checklist included elements associated with:

- model structure
- observations and data inputs
- biological and fishery parameters
- internal consistency
- parameters to be estimated
- model diagnostics
- sensitivity trials
- management strategy procedures.

4.22 The presentations focused on the use of integrated assessment methods in four toothfish fisheries:

- Ross Sea (Subareas 88.1 and 88.2)
- South Georgia (Subarea 48.3)
- Heard Island and McDonald Islands (Division 58.5.2)
- Prince Edward Islands (Subareas 58.6 and 58.7).

4.23 Presentations provided detail to the participants beyond what was included in the WG-FSA papers, including an exploration of model inputs, diagnostics and sensitivities and decision-making processes for the preliminary assessments that were tabled. Presentations were made largely within the context of the developed assessment checklist.

CASAL

4.24 For the Subarea 88.1/88.2 toothfish fisheries, the Working Group examined the preliminary CASAL toothfish assessment provided in WG-FSA-05/31 and 05/33. The base-case scenario included separate shelf, slope and northern fisheries of Subarea 88.1 as recommended by WG-FSA-SAM (WG-FSA-05/4, paragraph 6.7). The Working Group considered likelihood profiles, model fits to CPUE indices, catch-at-age proportions, and mark–recapture fits for this base case for both Maximum Posterior Distribution (MPD) and MCMC runs. The analysis examined 10 sensitivity trials, including scenarios assuming absence of tagging data, modifications in assumptions regarding growth and tagging, equal selectivity shifts across fisheries, low natural mortality, revised maturity ogives, number of fisheries and fixing selectivities at MPD values.

4.25 The Working Group considered evaluation of yield estimates against the decision rules for the base case. Issues identified by the Working Group included methods for handling recruitment variability, and the consequences of selectivities and recruitment variability for the model, the projections, and the CCAMLR decision rules. The Working Group requested additional model runs examining sensitivity to recruitment variability, looking at the three areas separately, evaluating CCAMLR decision rules for SSRU 882E, and a retrospective analysis for the Ross Sea.

4.26 For the South Georgia (Subarea 48.3) toothfish fishery, diagnostics and model fits from the preliminary CASAL assessment (WG-FSA-05/16) were presented for consideration by the Working Group. The population model was a single-area three-season model. Two model runs were examined for the South Georgia fishery: a two-fleet model and a one-fleet model. The rationale for the two-fleet assessment was based on a change detected in the length-frequency data from 1992–1997 and 1998–2004. Here, separate selectivities were estimated for each of the fleets. The CPUE time-series was split into two, as the CPUEs are relative indices of the vulnerable biomass for two fleets with differing selectivities. The one-fleet assessment consisted of a model with a single selectivity ogive estimated, and CPUE data considered as one continuous relative vulnerable biomass index.

4.27 The Working Group examined fits to CPUE indices, length frequencies and selectivities for both models. The Working Group noted differences in all estimated model parameters between the two models, and agreed the two-fleet assessment demonstrated a superior model fit. Sensitivities were examined by the Working Group for steepness, natural mortality, data removal (CPUE, recruitment survey, tagging data), as well as standard and tagging-only retrospective analysis.

4.28 Preliminary development work on the use of CASAL was also carried out in Division 58.5.2 (WG-FSA-05/69). The paper focused on a comparison of the characteristics of the GYM and CASAL approaches as applied to the toothfish fishery. The Working Group examined the differences in recruitment estimates, where the traditional method of maximum likelihood estimates provided using CMIX are replaced with a likelihood fit in CASAL. The Working Group agreed that similar trends in recruitment were estimated by CASAL and CMIX.

4.29 A direct comparison of CASAL and GYM projections for determining yield under the same conditions was attempted at WG-FSA. When the projections were examined, they yielded different results, in that number of trials in which depletion occurred was substantially higher for the GYM runs.

4.30 The difference between CASAL and GYM in these comparisons is the manner in which the spawning biomass was estimated. In GYM, all functions are modelled in continuous time, such that instantaneous rates of fishing mortality, natural mortality and growth enable spawning biomass to be estimated at any time in an unbiased way. In CASAL, a year is divided into a number of time steps in which various actions might occur. Natural mortality is modelled as a continuous rate function. A catch in the time step is modelled by subtracting the catch from the population in the middle of the time step. In this comparison, when the spawning biomass was estimated in a time step, the value was linearly interpolated between the magnitudes of the population at the beginning and end of the time step. The point within the time step when this is done is determined by the user. As a result, the spawning biomass was biased upwards compared to the continuous rate processes of the GYM unless it is estimated at the beginning or end of the time step.

4.31 Later in the meeting, it was identified that this problem could be resolved.

4.32 Under very similar assumptions WG-FSA agreed that projections from both models gave very similar results. The Working Group requested developers of CASAL consider whether an option could be included that could estimate the spawning biomass in a manner consistent with the GYM.

4.33 The Working Group noted that MCMC techniques allow a more full exploration of the posterior parameter space, provides more information as to the assessment uncertainty, and provides a potential method for calculating the long-term yield based on the CCAMLR decision rules.

ASPM

4.34 A presentation on the assessment of the Prince Edward Island (Subareas 58.6 and 58.7) toothfish fishery using the ASPM was given by Prof. D. Butterworth (South Africa). The preliminary assessment is presented in WG-FSA-05/58. The Working Group examined diagnostics and model fits from the Subarea 58.6/58.7 ASPM assessment which was generalised and allowed a second fleet to accommodate a pot fishery that was initiated in

November 2004. The Working Group noted that pots demonstrate a greater selectivity for larger toothfish. The Working Group further noted information that indicated frequent instances of depredation occurring in the longline fishery by cetaceans, where anecdotal evidence has suggested up to two out of three fish are taken off longlines by killer and sperm whales.

4.35 An application of the ASPM for the South Georgia (Subareas 48.3) toothfish fishery was presented to the Working Group and described in WG-FSA-05/73. The model demonstrated acceptable fits to standardised CPUE series, annual catches and observed catch-length proportions. The model included a function to estimate vulnerability patterns, with results similar to those presented in WG-FSA-SAM-05/5.

Assessment timetable

4.36 Assessment issues addressed during the course of WG-FSA were identified by the Scientific Committee during the previous year's CCAMLR meeting, the WG-FSA-SAM meeting, papers available to WG-FSA, and the assessment subgroup pre-meeting.

4.37 The following points were noted concerning the assessments this year:

(i) it was agreed that advice on precautionary yields would be based on assessments undertaken according to the decision rules adopted by the Commission;

(ii) WG-FSA-SAM had met intersessionally in order for it to review and develop assessment methods prior to implementation by WG-FSA, thereby saving time at the Working Group meeting;

(iii) the assessment subgroup had met for three days from 6 to 8 October 2005 to review and discuss the integrated assessments;

(iv) evaluation of these methods includes:

(a) the validation of the implementing software, scripts or worksheets
(b) examination of the methods to see that the assumptions are met
(c) sensitivity trials to examine the robustness of consequent advice with respect to CCAMLR objectives.

4.38 All assessment work was undertaken with submitted preliminary assessments reviewed independently in consultation with the authors. The outcomes of the assessments were reported in the Fishery Reports.

4.39 Fishery Reports that have been revised or developed as a result of analyses and deliberations during the course of WG-FSA are:

(i) Subarea 48.3: toothfish and icefish
(ii) Division 58.5.1: toothfish
(iii) Division 58.5.2: toothfish and icefish
(iv) Subareas 58.6 and 58.7: toothfish (South African EEZ)
(v) Subarea 58.6: toothfish (French EEZ)
(vi) Subareas 88.1 and 88.2: toothfish.

ASSESSMENTS AND MANAGEMENT ADVICE

New and exploratory fisheries in 2004/05 and notifications for 2005/06

New and exploratory fisheries in 2004/05

5.1 Last year the Commission agreed to seven exploratory longline fisheries for *Dissostichus* spp. in the 2004/05 season (Conservation Measures 41-04, 41-05, 41-06, 41-07, 41-09, 41-10 and 41-11). Activities in these fisheries are summarised in Table 5.1. There were no new fisheries notified for 2004/05. Catches of *Dissostichus* spp. in excess of 100 tonnes were reported in the exploratory fisheries in Divisions 58.4.1 (480 tonnes), 58.4.2 (127 tonnes), 58.4.3a (110 tonnes) and 58.4.3b (295 tonnes), and Subareas 88.1 (3 079 tonnes) and 88.2 (412 tonnes).

5.2 The exploratory fishery in Subarea 48.6 was undertaken by two Members with a total catch of 49 tonnes of *Dissostichus* spp. taken against a total catch limit of 900 tonnes (455 tonnes north of 60°S and 455 tonnes south of 60°S).

5.3 The exploratory fishery in Division 58.4.1 was undertaken by four Members with a total catch of 480 tonnes of *Dissostichus* spp. against a catch limit of 600 tonnes.

5.4 The exploratory fishery in Division 58.4.2 was undertaken by four Members with a total catch of 127 tonnes of *Dissostichus* spp. against a catch limit of 780 tonnes.

5.5 The exploratory fishery in Division 58.4.3a was undertaken for the first time. Three Members fished with a total catch of 110 tonnes of *Dissostichus* spp. against a catch limit of 250 tonnes. Some fishing took place outside the prescribed season, but this was in accordance with the conservation measures in force.

5.6 The exploratory fishery in Division 58.4.3b was undertaken by three Members with a total catch of 295 tonnes of *Dissostichus* spp. against a catch limit of 300 tonnes. Fishing took place outside the prescribed season, but this was in accordance with the conservation measures in force, and the fishery was closed on 14 February 2005. The closure was triggered by the catch of *Dissostichus* spp. (total catch was 98% of the catch limit).

5.7 The exploratory fishery in Subarea 88.1 was undertaken by six Members with a total catch of 3 079 tonnes of *Dissostichus* spp. taken against a catch limit of 3 250 tonnes. The fishery was closed on 27 March 2005 (see CCAMLR-XXIV/BG/13, Table 2). During the course of fishing, the following SSRUs were closed:

- SSRU B closed 31 December, triggered by the catch of *Dissostichus* spp. (total catch 70 tonnes; 87% of the catch limit);

- SSRU C closed 20 December, triggered by the catch of *Dissostichus* spp. (total catch 429 tonnes; 192% of the catch limit);

- SSRU E closed 20 March, triggered by the catch of *Dissostichus* spp. (total catch 59 tonnes; 104% of the catch limit);

- SSRU G closed 27 March, triggered by the catch of *Macrourus* spp. (total catch 16 tonnes; 78% of the catch limit);

- SSRU H closed 13 January, triggered by the catch of *Dissostichus* spp. (total catch 773 tonnes; 98% of the catch limit);

- SSRU I closed 27 January, triggered by the catch of *Macrourus* spp. (total catch 160 tonnes; 129% of the catch limit);

- SSRU J closed 2 March, triggered by the catch of *Macrourus* spp. (total catch 46 tonnes; 92% of the catch limit);

- SSRU K closed 7 February, triggered by the catch of *Macrourus* spp. (total catch 201 tonnes; 168% of the catch limit);

- SSRU L closed 12 March, triggered by the catch of *Dissostichus* spp. (total catch 169 tonnes; 94% of the catch limit).

5.8 The Working Group noted that the catch limit for *Dissostichus* spp. was exceeded by 92% (206 tonnes) in SSRU C in Subarea 88.1. This over-run illustrates the difficulty in forecasting closures when a number of vessels fish in an area where catch rates are high relative to the catch limits. The fishing events which resulted in the over-run in SSRU C are summarised in CCAMLR-XXIV/BG/13.

5.9 Another contributing factor to the over-run in SSRU C arose because that SSRU straddles the International Date Line. At the time of the closure in SSRU C, the Secretariat had inadvertently omitted to specify the closure date and time in relation to GMT. The closure was intended to be 20 December 2400 h local time GMT +12; some vessels had fished to the west of longitude 180 and interpreted the closure as 2400 h GMT –12. The Working Group noted that the Secretariat now includes the GMT time zone in all closure notices.

5.10 Catch limits were over-run on four other occasions in SSRUs in Subarea 88.1 (two catch limits for *Dissostichus* spp. and two catch limits for *Macrourus* spp.). Key factors in these over-runs included rapid changes in fishing effort and/or catches, and the late submission of catch and effort reports.

5.11 Despite these overruns, the Working Group noted that the total catch of *Dissostichus* spp. in Subarea 88.1 was only 95% of the overall catch limit. Given the 5-day reporting period and the relatively small size of SSRU catch limits, the Working Group agreed that both under-runs and over-runs of SSRU catch limits are inevitable. Provided these more or less balance over the season within subareas or divisions, and provided there is no trend for a preponderance of over-runs over time, these do not pose a conservation threat to the stocks.

5.12 The exploratory fishery in Subarea 88.2 was undertaken by three Members with a total catch of 412 tonnes of *Dissostichus* spp. (110% of the catch limit of 375 tonnes). The fishery was closed on 5 February.

5.13 Unstandardised CPUE data for *Dissostichus* spp. taken in exploratory longline fisheries in 1997–2005 are summarised in Table 5.3.

5.14 Under Conservation Measure 41-01 all vessels operating in exploratory fisheries are required to carry out a research plan which includes completing a minimum number of research sets on entering an SSRU. The Working Group analysed the performance of each vessel using an extract of the fine-scale C2 data and the output from a new routine developed by the Secretariat (paragraph 3.4; see also WG-FSA-05/6 and SC-CAMLR-XXIII, Annex 5, paragraph 5.23).

5.15 The Working Group welcomed the results from some vessels which exceeded their required quota of research sets. However there were a number of instances where vessels failed to complete any research sets. There were also cases where a vessel conducted some research sets but failed to complete the required quota even though more commercial sets were completed.

5.16 The Working Group noted that the aim of requiring research sets with substantial biological sampling in new and exploratory fisheries was to obtain an understanding of the distribution and abundance of target and by-catch species on as wide a geographical scale as possible at an early stage of the fisheries' development. For most exploratory fisheries, this requirement is still relevant and should remain. The Working Group agreed, however, that for Subareas 88.1 and 88.2 the required geographical spread of fishing has already been achieved. Under these circumstances, the Working Group agreed that a more effective scheme for collecting biological samples from fisheries in those subareas would be to obtain random samples from catches on all sets carried out.

5.17 The Working Group recommended that to further this objective, the requirement to carry out specific research sets as defined in Annex 41-01/B of Conservation Measure 41-01 within Subareas 88.1 and 88.2 be removed.

5.18 The Working Group further recommended that there be a requirement that all fish of each *Dissostichus* spp. in a haul (up to 35 fish) be measured and randomly sampled for biological studies (cf. paragraphs 2(iv) to 2(vi) of Annex 41-01/A) from all lines hauled within Subareas 88.1 and 88.2, as proposed and justified in WG-FSA-05/49.

5.19 The Working Group also considered that the introduction of more structured research plans for exploratory fisheries may lead to a more effective and efficient collection of research data. It therefore recommended that development of such plans should be considered during the intersessional period for implementation next year.

5.20 An additional requirement specified in Conservation Measure 41-01 is that each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. is required to tag and release *Dissostichus* spp. at the rate of one toothfish per tonne of green-weight catch throughout the season. All vessels fishing reported tagging *Dissostichus* spp. in exploratory fisheries with a total of 4 858 *Dissostichus* spp. tagged in 2004/05. However, some vessels did not fulfil the requirements of Conservation Measure 41-01. The Working Group noted its concern that the tagging requirements, as specified in Conservation Measure 41-01, were not being met by all vessels. It reiterated the importance for Members to conduct tagging and to submit data in accordance with Conservation Measure 41-01 (see also Appendix T).

5.21 Analysis of tag–recapture data requires an ability to link accurately the observer data and C2 catch data. For the historical data held by the Secretariat, this is not always possible because of a lack of a unique identifier for each longline set used consistently in both observer and catch datasets. The Working Group recommended that vessels be asked to record a unique identifier on the C2 data forms for every set made and that observers ensure that this identifier is also recorded on their data forms.

New and exploratory fisheries in 2005/06

5.22 Notifications for exploratory fisheries in 2005/06 are summarised in Table 5.2. Twelve 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. Two Members submitted notifications after the deadline of 24 July 2005, however all payments were received by the deadline of 24 August 2005. There were no notifications for new fisheries, and no notifications were received for fisheries in closed areas.

5.23 The Working Group agreed that it would not attempt to determine whether all the notifications for new and exploratory fisheries satisfied the requirements of the relevant Conservation Measures 21-02 (paragraph 4), 21-02 (paragraph 5) and 21-02 (paragraph 7); this, it believed, should be done by SCIC.

5.24 There were a large number of notifications for fishing in Subareas 88.1 (9 notifications and 21 vessels) and 88.2 (8 notifications and 17 vessels), and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b (4–6 Members and 6–11 vessels). The Working Group recalled its advice from last year (SC-CAMLR-XXIII, Annex 5, paragraph 5.42). Depending on the size of the precautionary catch limits, this implies that if all vessels operated simultaneously, the available catch per vessel could be lower than that required for economic viability, especially for those vessels operating in high latitudes where fishing imposes considerable operational difficulties.

5.25 The Working Group noted that individual vessels may have notified for more than one subarea or division to increase operational flexibility and to provide access in the case of areas closed or constricted by factors such as heavy sea-ice.

5.26 In this context, the Working Group recommended that in cases where a vessel is notified for a number of subareas or divisions, the notification should include an indicative fishing plan including projected timings for fishing in different areas.

5.27 The Working Group noted that it is likely that, once again, there will be additional administrative problems in determining closure dates for fishing in SSRUs when many vessels are fishing simultaneously in a subarea or division (CCAMLR-XXIV/BG/13).

5.28 Given the importance of tag–recapture data to assessments, the Working Group recommended that Members be urged to continue to emphasise to their vessels the need to look out for recaptured tagged fish and to submit tag–recapture data to the Secretariat in a timely manner.

5.29 Issues related to the allocation of catch limits amongst SSRUs in Subareas 88.1 and 88.2 are discussed in Appendix F.

Progress towards assessments of new and exploratory fisheries

5.30 The Working Group agreed that substantial progress had again been made this year in assessing stocks of *Dissostichus* spp. in Subareas 88.1 and 88.2 (see Appendix F) to develop management advice.

5.31 For the other areas and divisions in which exploratory fisheries are conducted, the Working Group was unable to develop management advice based on assessments of yield and is therefore unable to provide any new advice on catch limits for these fisheries.

5.32 Given the large number of notifications for the 2005/06 fishing year, the Working Group reiterated the urgent need to develop a means for estimating abundance and providing assessments of stock status in exploratory fisheries other than Subareas 88.1 and 88.2.

Management advice for new and exploratory fisheries

5.33 Except for Subareas 88.1 and 88.2, the Working Group reiterated the necessity for Members fishing in exploratory fisheries to ensure that the required research sets are completed (Conservation Measure 41-01) and submitted to the Secretariat in a timely manner and accurate format. In addition, *Dissostichus* spp. should be tagged and data submitted in accordance with Conservation Measure 41-01.

5.34 The Working Group reiterated the importance for Members to conduct tagging and to submit data as part of the Research and Data Collection Plan (Conservation Measure 41-01). Members should also be urged to emphasise to their vessels the need to look out for tagged fish and submit tag–recapture data to the Secretariat in a timely manner.

5.35 In order to facilitate analysis of tag–recapture data, the Working Group recommended that vessels be asked to record a unique identifier on their C2 forms for every set made and that observers ensure that this identifier is also recorded on their data forms.

5.36 The Working Group did not attempt to determine whether all the notifications for new and exploratory fisheries satisfied the requirements of Conservation Measures 21-02 (paragraph 4), 21-02 (paragraph 5) and 21-02 (paragraph 7).

5.37 There has been a large number of notifications for Subareas 88.1 (9 notifications and 21 vessels) and 88.2 (8 notifications and 17 vessels), and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b (4–6 Members and 6–11 vessels). The Working Group recalled its advice from last year (SC-CAMLR-XXIII, Annex 5, paragraphs 5.96 and 5.97). Depending on the size of the precautionary catch limits, this implies that if all vessels operated simultaneously, the available catch per vessel could be lower than that required for economic viability, especially for those vessels operating in high latitudes where fishing imposes considerable operational difficulties.

5.38 The Working Group recommended that in cases where a vessel is notified for exploratory fisheries in a number of subareas or divisions, the notification should include an indicative fishing plan including projected timings for fishing in different areas.

5.39 With the exception of Subareas 88.1 and 88.2, the Working Group was unable to provide any new advice on catch limits for *Dissostichus* spp. or any by-catch species in any of the exploratory fisheries.

5.40 For the other areas and divisions in which exploratory fisheries are conducted, the Working Group reiterated the urgent need to develop a means for estimating abundance and providing assessments of stock status for all exploratory fisheries. In this context, it noted that with the continuing tagging programs in a number of areas, in the next year or two it may be possible to obtain mark–recapture estimates of abundance provided that sufficient tags are deployed each year.

Dissostichus spp. Subareas 88.1 and 88.2

5.41 The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is in Appendix F[4].

5.42 The catch limit of *Dissostichus* spp. in Subarea 88.1 for the 2004/05 season was 3 250 tonnes (Conservation Measure 41-09) for the period from 1 December 2004 to 30 November 2005. The catch reported for this subarea was 3 079 tonnes in 2004/05. The estimated IUU catch for the 2004/05 season was 144 tonnes.

5.43 The catch limit of *Dissostichus* spp. in Subarea 88.2 for the 2004/05 season was 375 tonnes (Conservation Measure 41-09) for the period from 1 December 2004 to 30 November 2005. The catch reported for this subarea was 412 tonnes in 2004/05. There was estimated to be no IUU catch for the 2004/05 season.

5.44 The catch-weighted length frequency showed that the catch of *D. mawsoni* ranged from 50 to 180 cm. There was an increased level of fishing on the hills and ridges of the Pacific-Antarctic Ridge in the north of the Ross Sea during the 2001/02 and 2002/03 seasons. This resulted in a greater proportion of larger fish in the catch. This trend has diminished over the last two years as a result of changed SSRU boundaries and reallocation of allowed catch.

5.45 A standardised CPUE analysis of *D. mawsoni* in Subarea 88.1 showed no significant trend from 1998/99 to 2002/03, a decline in 2003/04, and a sharp increase in 2004/05 (WG-FSA-05/32). The decline in 2003/04 was thought to be related to a combination of extreme ice conditions and effects from a large number of vessels operating in a confined area. These factors were not present in 2004/05.

5.46 In 2004/05, a total of 3 562 *Dissostichus* spp. were tagged in Subareas 88.1 and 88.2 (Table T2). Since 2000/01, a total of 5 346 toothfish have been tagged in Subareas 88.1 and 88.2 by New Zealand vessels (WG-FSA-05/34). Tag–release and recapture data from New Zealand vessels were used as inputs for the modelling. Data for other vessels were unavailable for the assessment.

5.47 The CASAL model, using catch-at-age, CPUE and tag–recapture data, and the *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.

5.48 The CASAL assessment split Subareas 88.1 and 88.2 into two areas: (i) the Ross Sea (Subarea 88.1 and SSRUs 882A–B), and (ii) SSRU 882E.

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[4] Appendix F is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

Management advice

5.49 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 2 964 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 2 964 tonnes is therefore recommended.

5.50 For SSRU 882E, assuming a future fishing selectivity equal to the maturity ogive, the constant catch for which there was a 10% chance of spawning biomass dropping to less than 20% of the initial biomass was 273 tonnes. At this yield, the median escapement of 50% of the pre-exploitation spawning biomass level at the end of the 35-year projection period was 61%. A yield of 273 tonnes is therefore recommended.

5.51 The Working Group recommended that tagging be continued as part of the Research and Data Collection Plan (Conservation Measure 41-01).

5.52 The Working Group noted that the aim of requiring research sets with substantial biological sampling in new and exploratory fisheries was to obtain an understanding of the distribution and abundance of target and by-catch species on as wide a geographical scale as possible at an early stage of the fisheries' development. However, the Working Group noted that, for Subareas 88.1 and 88.2, the required geographical spread of fishing has already been achieved. Hence, the Working Group agreed that a more effective scheme for collecting biological samples from fisheries in those subareas would be to obtain random samples from catches on all sets carried out.

5.53 The Working Group recommended that to further this objective, the requirement to carry out specific research sets as defined in Annex 41-01/B within Subareas 88.1 and 88.2 be removed.

5.54 The Working Group further recommended that there be a requirement that all fish of each *Dissostichus* spp. in a haul (up to 35 fish) be measured and randomly sampled for biological studies (cf. paragraphs 2(iv) to 2(vi) of Annex 41-01/A) from all lines hauled within Subareas 88.1 and 88.2, as proposed and justified in WG-FSA-05/49.

5.55 The Working Group also considered that the introduction of more structured research plans for exploratory fisheries may lead to a more effective and efficient collection of research data. It therefore recommended that development of such plans should be considered during the intersessional period.

5.56 WG-FSA-05/72 discussed a number of issues relating to the allocation of catch limits amongst SSRUs in Subarea 88.1. These included the small current size of SSRUs, which has led to difficulties with the conduct and management of the fisheries in them due to the sometimes very short fishing seasons, problem with representativeness of data collected in different SSRUs in different times of the year, the effect of poor ice years on southern SSRUs, and the methodology used to determine the allocations. The paper concluded that there is a need to amend the current allocation methods, particularly with a view to having fewer, larger SSRUs and avoiding SSRUs with zero catch limits.

5.57 In relation to the existing methodology for allocation, it was noted that last year (see SC-CAMLR-XXIII, Annex 5, paragraph 5.6), the analysis to estimate fish density in each SSRU was based on the total catch of *Dissostichus* spp. divided by total effort by all vessels in each SSRU over the history of the fishery, rather than on CPUE in Subarea 48.3 as suggested in WG-FSA-05/72.

5.58 The Working Group agreed 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 that is not yet available. Such a revision should take account not only of the principal target species, but also by-catch species and ecosystem considerations. Also, if expansion of the size of existing SSRUs were to be considered, then ensuring the appropriate spreading of effort within SSRUs and by-catch management may need to be reconsidered. Some members recommended that these issues be considered intersessionally.

5.59 Other members noted that the SSRU definitions discussed in WG-FSA-03/29 that split Subarea 88.1 into five areas (i.e. four SSRUs formed by the boundaries at latitudes 65°S, 70°S and 76°S, with the central area between 70°S and 76°S split by a boundary at 180°E) might be more appropriate. In their view this proposal could resolve the issues noted in paragraph 5.58.

5.60 However, the Working Group recognised that SSRU 882E could be separated from the remaining SSRUs because it has an assessment of its own, and that advice needed to be provided for catch limit allocation amongst the other SSRUs for the coming season. Furthermore, the assessments conducted this year (for the Ross Sea and SSRU 882E) will require a different method of allocation than last year.

5.61 If a similar method to that used in 2003/04 and 2004/05 for allocating catch limits to SSRUs was applied for 2005/06, then the possible allocations of catch limits for Subarea 88.1 and SSRUs 882A–B are given in Table F22.

5.62 If the SSRU definitions considered in paragraph 5.61 were used, then the catch limits could be separated between five SSRUs in Subarea 88.1.

5.63 In relation to catch limit allocations, the following issues need to be considered:

- management of the possibly large numbers of vessels that may be fishing simultaneously in an SSRU;
- consideration of compliance issues resulting from the potential for over-runs and under-runs of catch limits for SSRUs;
- the fact that poor sea-ice conditions frequently restricted the ability to fish in the more southerly SSRUs. A discount factor to allow for this may possibly be considered;
- the utility of distribution of catch and research information for assessments should not be diminished as a result of SSRU allocations, e.g. consistency in the location of fishing will provide more reliable CPUE and tag–recapture estimates;

- the desire to retain zero catch limits so that effects of fishing on *Dissostichus* spp. populations can be distinguished from environmental effects;

- allocation of catch limits for by-catch species by SSRU.

5.64 Dr K. Shust (Russia) indicated that zero catch limits within an SSRU would not provide information on toothfish distribution and abundance in that SSRU.

Dissostichus eleginoides South Georgia (Subarea 48.3)

5.65 The Fishery Report for *D. eleginoides* in Subarea 48.3 is contained in Appendix G[5].

5.66 In 2004, Subarea 48.3 was subdivided into areas, one containing the South Georgia–Shag Rocks (SGSR) stock and other areas, to the north and west, that do not include the SGSR stock. Within the SGSR area, three management areas (A, B and C) were defined (Conservation Measure 41-02/A). Catch limits for the areas to the north and west were set at zero for 2004/05.

5.67 The catch limits in the 2004/05 season for areas A, B and C were 0 (excepting 10 tonnes for research fishing), 915 and 2 135 tonnes respectively, with an overall catch for SGSR of 3 050 tonnes. The total declared catch was 3 018 tonnes. An additional 23 tonnes were taken by a single IUU vessel (the *Elqui*) reported by the UK prior to the fishery. The total removals were therefore 3 041 tonnes. Catches in areas A, B and C were 9, 910 and 2 122 tonnes respectively. The proportion of catches in areas A and B declined from 35% in 2003/04 to 30% in 2004/05.

5.68 The standardised GLM and GLMM CPUE analyses were updated. Standardised CPUE dropped only very slightly between 2004 and 2005. Separate GLMM analyses of CPUE data for Shag Rocks and South Georgia confirmed a relatively constant CPUE at South Georgia in recent years compared with the initial increase and then decrease at Shag Rocks.

5.69 During 2004/05, a further 3 944 tagged *Dissostichus* spp. have been released in SGSR, bringing the total number of tagged fish released to around 8 000. In 2005, 93 recaptures of tagged fish were reported. Estimates of vulnerable biomass for 2005 using the modified Petersen estimator were between 53 000 and 54 000 tonnes, with 95% confidence intervals of approximately 44 000–63 000 tonnes, depending on the selectivity curve used in the analysis.

5.70 Two separate assessments were considered by the Working Group, each using a different modelling strategy. The first was an integrated assessment, implemented in CASAL, that used data on catches, standardised catch rates, catches-at-length, recruitment indices-at-age and tag–recapture data. The base case involved two fleets with separate estimated selectivity curves and two catchability estimates across the time series of catch rates. The second assessment used an augmented ASPM, implemented in an Excel workbook, which used data on catches, standardised catch rates, and catches-at-length. The ASPM base case involved a single fleet with two periods of different selectivity (estimated outside the model) and a single catchability estimate across the catch rate time series plus estimation of the steepness of the recruitment relationship.

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[5] Appendix G is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

5.71 Although the underlying basic age-structured population dynamics models assumed in CASAL and ASPM were similar, there were considerable differences in assumptions and implementation of the two methods (see table below). An initial test was carried out to check that the two approaches would produce sufficiently similar estimates when applied to the same datasets and when the assumptions made were as similar as possible without requiring substantial modifications to the methods. The results of this test were satisfactory and the Working Group agreed that subsequent differences in assessment results between the two methods could reasonably be attributed to differences in assumptions and input data, rather than fundamental differences in the assessment methods.

CASAL	ASPM
Data • Length-frequency data • GLMM CPUE (1987–1989,1991–2004) • GLMM CPUE variance • Total catches • Mark–recapture data • Recruitment survey data	Data • Length-frequency data • GLMM CPUE (1987–1989, 1991–1992, 1996–2005) • Total catches
Base-case assumptions • CPUE is an index of vulnerable biomass. • The discontinuity in the CPUE series was caused by a major shift in the fishing fleet and fishing strategy without any change in average recruitment or major reduction in biomass. • Two fleets are used, one prior to and one after 1998, each with a different selectivity and catchability. • Selectivity curves are fitted by the model. • Recruitment variability is estimated parametrically. • Growth had an L_∞ of 194.6; natural mortality was 0.165.	Base-case assumptions • CPUE is an index of vulnerable biomass. • The decline in the CPUE series was caused by a drop in vulnerable biomass which was a result of changes in recruitment and fishing. • One fleet is used with the same catchability across years, but with different selectivities according to different periods of the fishery. • Selectivity curves are calculated outside the model. • Interannual recruitment variability is estimated. • Growth had an L_∞ of 194.6; natural mortality was 0.165.
Sensitivities • Sensitivity runs included tests of a single-fleet model, low L_∞ and low natural mortality.	Sensitivities • Sensitivity runs included tests of the full CPUE series, low L_∞, low natural mortality and different weights on different indices.

5.72 For the CASAL assessments, four separate assessment runs were identified by the Working Group:

(i) a base case, assuming two fleets, and using the growth curve (with L_∞ = 194.6) and natural mortality rate (0.165) assumed in the 2004 assessment of this stock;

(ii) as for (i), but with a growth curve with a lower L_∞ (152.8) (‘Low L_∞’);

(iii) as for (i), but with M = 0.13 (‘Low M’);

(iv) as for (i), but assuming a single fleet, rather than two fleets.

5.73 For the ASPM, assessments considered included:

(i) a base case, fitting to total catches, a reduced CPUE series, using externally fixed selectivity functions and the same growth curve and natural mortality as used in the 2004 assessment of this stock;

(ii) as for (i) but using the Low L_∞ growth curve;

(iii) as for (i) but using the lower M;

(iv) other sensitivity trials, including alternative selectivities, CPUE series and data weightings.

5.74 A full description of the models, their assumptions, their diagnostics, their fits to the data, and their results is given in Appendix G.

Management advice

5.75 The Working Group recalled that it had been unable to agree on an assessment of toothfish in Subarea 48.3 at its 2004 meeting, and that the Scientific Committee had asked the Working Group to undertake work to address uncertainties in the assessment of this stock (SC-CAMLR-XXIII, paragraphs 4.62 and 4.63). The Working Group recognised that due to a large amount of work being carried out in the intersessional period, during the meeting of WG-FSA-SAM and during the course of the WG-FSA meeting, considerable progress had been made in addressing these issues.

5.76 The Working Group noted the various results, which are given in Tables G12, G13 and G16 and paragraph G92, along with the consideration of parameter inputs and conclusions in Appendix G, should be considered as the basis of advice on catch limits for 2005/06. For example, in respect of the CASAL results, the MCMC projections of yield (Table G13) are as follows:

(i)	base case	5 629 tonnes
(ii)	low L_∞	3 407 tonnes
(iii)	low M	5 876 tonnes
(iv)	one fleet	5 428 tonnes.

In respect of the ASPM run, the GY projections of yield are as follows (paragraph G92):

(v)	base case	696 tonnes.

5.77 Because of the complexity of the modelling assumptions, hypotheses and model results, the Working Group was unable to provide advice on which of the base cases, or the sensitivity runs, was the best estimate of current stock status of toothfish and an appropriate yield. Accordingly, it could not recommend an appropriate catch limit in the 2005/06 season.

5.78 Taking account of its consideration of by-catch and other fisheries issues, the Working Group recommended the continuation of all other aspects of management under Conservation Measure 41-02 for the 2005/06 fishing season (Table G20).

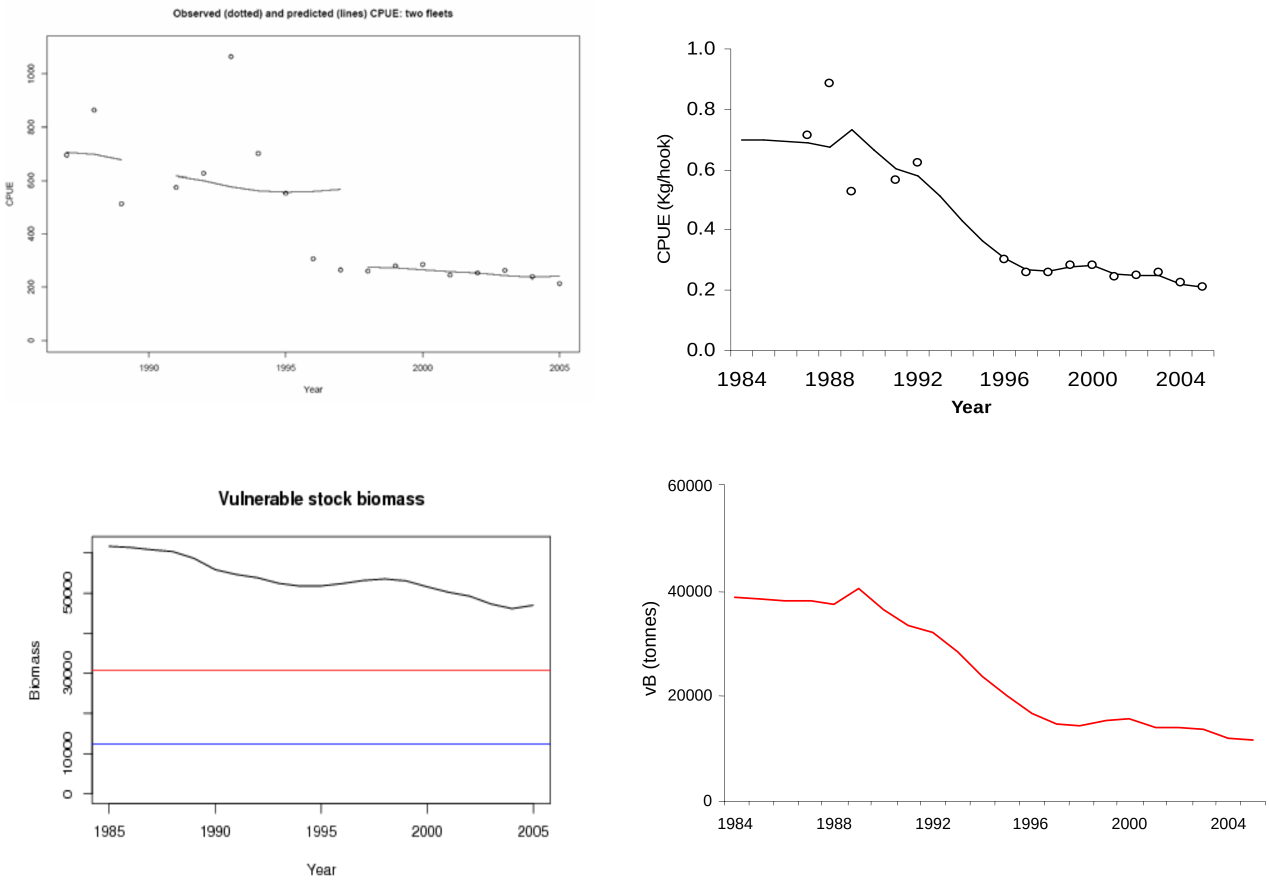
5.79 Drs E. Marschoff and O. Wöhler (Argentina) made the following comments:

(i) In the CASAL implementation, recruitment is derived from a fixed *h* value, without interannual variability. Under this condition, it is difficult to fit the model to the entire CPUE series. The definition of two fleets fishing from 1984 to 1997 and from 1998 to 2005 absorbs the observed decline in CPUE which is considered as a change in catchability (around 50% from 1997 to 1998). Finally, the selectivity function is estimated through the model, which ensures good fit to the catch proportions at length. Those restrictions combined determine that the vulnerable biomass estimated by the model cannot follow the entire CPUE standardised trend. In terms of the estimation, the consequence of this is an overestimation of spawning stock, vulnerable biomass and long-term estimation of yield.

(ii) The ASPM assumes variable recruitment estimated from a fitted *h* parameter and a vector of recruitment variability. The absence of constraints in the stock recruitment relationship allows the vulnerable biomass to be fitted to the entire CPUE series. Thus, the estimated vulnerable biomass follows the decline in the CPUE series. The assumptions of two fixed selectivities-at-age, entered as input data, results in biased fits to the proportions of length in the catches in the last years. This results in an underestimation of the current spawning stock biomass and a consequent underestimation of long-term yield.

CASAL approach

ASPM approach



5.80 Drs G. Kirkwood, Agnew and R. Hillary (UK) pointed out several difficulties with the methodological approach, underlying hypotheses and fits of the ASPM that in their view invalidated that assessment of toothfish in Subarea 48.3:

(i) The ASPM assumption that there is a single CPUE series takes no account of the major changes in fleet structure and behaviour that occurred in the middle of the CPUE series, and which have been detailed in Appendix G. This is an unlikely assumption given the major changes that have occurred. By contrast, the assumption of different fleets and catchabilities in the base-case CASAL model directly accounts for the known changes in the fishery.

(ii) To examine the possibility that catchability and selectivity had not changed over the course of the fishery, a CASAL sensitivity run was performed which did assume a single fleet. This produced very similar results to the CASAL base case.

(iii) The CASAL model fits to all the data available: length frequencies, CPUE, mark–recapture and recruitment indices. The fits to all the data except the early CPUE are good, including to the later CPUE series. By contrast, the ASPM effectively ignores all data except CPUE, by giving very high weighting to these data and hypothesises a strong declining recruitment to create the apparent drop in CPUE between 1995 and 1997. The fits to length-frequency data are poor, and the model does not make use of the tagging data.

(iv) The authors of the ASPM did not express any doubt in the validity of the mark–recapture data, or the Petersen estimates of biomass arising from the use of these data. The lack of use of tagging data in the ASPM arose solely from an inability to incorporate the data within the model. Our experience in fitting both CPUE data and tagging data in CASAL would suggest that, once the tagging data are incorporated into the ASPM, the fit to CPUE will deteriorate.

(v) The ASPM estimate of current vulnerable biomass of 11 600 tonnes is clearly an underestimate, for several reasons.

(vi) The estimated length frequencies in the ASPM show a very poor fit to the data, particularly in the early and recent years. By contrast, good fits were achieved by all CASAL model runs. The ASPM fit gets progressively worse from 1997 to 2005. This is because the model is estimating a very strong decline in biomass, a removal of large animals from the population and high recruitment. The model predicts that the fishery should not be able to catch large fish, in direct contradiction of the actual catches made by the fishery.

(vii) We note that the authors acknowledge that the model underestimates current biomass and that in discussion many members of the Working Group agreed with this conclusion.

(viii) Since 1997 the fishery has experienced average annual removals of 4 700 tonnes, with only a minor effect on CPUE. It is most unlikely that such catches taken from a vulnerable biomass of about 13 000 tonnes would not have caused significant changes in CPUE.

(ix) The selectivity used in the ASPM base case generates a similar mark–recapture estimate of current vulnerable biomass as the CASAL base-case selectivity does (Table G6). In the case of CASAL, estimates of the confidence limits of current vulnerable biomass overlap with the confidence limits estimated from tagging data alone (Table G6). In the case of ASPM, the estimates of current vulnerable biomass are substantially lower (11 600 tonnes) than the tagging estimates (53 400 tonnes), without overlapping confidence limits. The ASPM estimate of current biomass is clearly not supported by the tagging data.

(x) CASAL estimates selectivities from the data. ASPM fixes the selectivities according to calculations made outside the model. Moreover, the fixed lower limit on selectivity at older ages used in the ASPM is completely arbitrary, and is not estimated by any data.

(xi) The GLMM estimates very high observation error for the CPUE series in the early 1990s (Figure G5) and low error after 1996. The ASPM ignores this very significant change in variance, which leads to a very poor fit to the early 1990s CPUE and improbably perfect fits to the late 1990s CPUE. The fits to the early 1990s CPUE are no better than the fits of the CASAL model, which does take the differences in observation error into account.

(xii) One of the most important parameters in the ASPM is annual recruitment, although there are no observational data to inform the estimation of these parameters. The only purpose of allowing interannual recruitment variations is to allow the model to fit very closely to the CPUE trend. Low recruitments are estimated in the period preceding the drop in CPUE (1990–1995), which depletes the stock as required to fit the decline in observed CPUE. Higher recruitment values are necessary in the late 1990s to create a stable CPUE. These trends are in direct opposition to the indications of the relative levels of recruitment in the survey data (Table G4).

(xiii) The ASPM's estimate of very low recruitment in the early 1990s, which is necessary to fit the sharp decline in CPUE, creates a depression of recruitment at high biomass. The resulting inverse relationship between stock and recruitment is not plausible, as was pointed out by several members of the Working Group.

(xiv) In conclusion, the ASPM assumptions are not supported by the known history of the fishery, the assessment does not attempt to utilise all the data that are available, and does not fit some of the data well (the early CPUE series and the length data). By contrast, the CASAL model is consistent with the known history of the fishery, it makes use of all the available data and obtains a good fit to each dataset (with the sole exception of early CPUE data, which have high CVs, and for which it obtains a fit as good as that obtained by ASPM). The base case and range of sensitivities run using CASAL are informative. It is plausible that natural mortality could be lower for toothfish, but less plausible that the single-fleet model accurately reflects the history of this fishery. It is unlikely that the L_∞ is as low as that used in the Low L_∞ trial.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

5.81 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Appendix H[6].

5.82 The catch reported for this division as of 1 September 2005 was 3 186 tonnes. Only longlining occurs in the fishery. The estimated IUU catch for the 2004/05 season was zero inside the French EEZ. Some IUU may have occurred outside the EEZ as reported in SCIC-05/10 Rev. 1.

5.83 GLM analyses show a general decreasing trend in the standardised CPUE with two steps (i.e. 1999–2000 and 2002–2005). Mean weight declined from 1999 to 2003, but has been stable since then. No stock assessment has been carried out.

5.84 By-catch removals are important for this toothfish fishery (longline) and the majority of the catch is processed but no stock assessment is available for evaluation of the impact on affected populations.

Management advice

5.85 The Working Group encouraged the estimation of biological parameters for toothfish at the Kerguelen Islands. The Working Group also noted that a preliminary stock assessment could be carried out if CPUE, catch-weighted length frequencies and biological parameters were available.

5.86 As for other toothfish fisheries in the Convention Area, the Working Group recommended that tag–recapture experiments be conducted. It also noted that a recruitment survey in the Kerguelen area would be planned for 2006 and that this would be very beneficial for an assessment of toothfish stocks on the Kerguelen Plateau.

5.87 The Working Group recommended that, where possible, all rajids should be cut from the line while still in the water, except on the request of the observer. Areas with high by-catch rates should be avoided.

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6 Appendix H is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

5.88 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.

Dissostichus eleginoides Heard Island (Division 58.5.2)

5.89 The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Appendix I[7].

5.90 The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E for the 2004/05 season was 2 787 tonnes (Conservation Measure 41-08) for the period from 1 December 2004 to 30 November 2005. The catch reported for this division as of 1 October 2005 was 2 783 tonnes. Of this, 2 170 tonnes (78%) was taken by trawl and the remainder by longline. The estimated IUU catch for the 2004/05 season, 0–265 tonnes, was the lowest since IUU fishing began in 1995/96.

5.91 The length-at-age vector was revised from 2004 using a two-segment linear model to take account of validated length-at-age readings and mark–recapture data. A von Bertalanffy growth curve was not used because of its failure to estimate the size of young and old fish reliably. The new vector better estimates the size of young fish. Young fish (less than 6 years old) are fast-growing. Fish older than 6 years are slower growing than previously estimated. The growth of fish older than 20 years requires more data in the future that will be obtained from the longline fishery. As a result of this new information, it seems unlikely that natural mortality is as high as 0.20 year^{-1}.

5.92 The estimate of mean recruitment was less than at the 2004 meeting, and the CV greater, as a result of the inclusion of the results of a trawl survey carried out in 2005. A review of the recruitment series needs to be undertaken to take account of uncertainties in the estimates of cohort strength using CMIX (positive and negative biases may arise under some circumstances).

5.93 The CPUE series and estimates of abundance from the mark–recapture program were not updated at the meeting.

5.94 Future catches from this fishery will have greater proportions of catch taken by longlines and pots. These gears will be taking larger fish because of their selectivity and that they will be operating in deeper water than the trawl fishery. Consequently, the overall vulnerability of the stock in future years is likely to include a greater proportion of larger fish than is currently the case in the trawl fishery. A vulnerability pattern that combines trawl, longline and pots was calculated for use in the assessments.

5.95 The GYM, using the updated time series of recruitment estimates and the updated length-at-age vector was used to estimate the long-term annual yield that would satisfy the CCAMLR decision rules.

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[7] Appendix I is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

5.96 Three main model runs were carried out based on the parameters considered for the assessment and including the 2005 survey of juvenile fish and the revised length-at-age vector from the two-segmented linear model:

(i) $M = 0.13–0.20$ year^{-1}, trawl vulnerability in future projections;

(ii) $M = 0.13–0.20$ year^{-1}, combined gear (trawl, longline, pot) vulnerability in future projections;

(iii) $M = 0.13–0.165$ year^{-1}, trawl vulnerability in future projections.

Each of these was undertaken with IUU catch in the 2004/05 season at 0 tonnes and 265 tonnes.

Management advice

5.97 The Working Group recommended the Scientific Committee consider the following in providing advice to the Commission on Conservation Measure 41-08:

(i) the validated length-at-age vector in these assessments has removed the uncertainty surrounding length-at-age in younger fish, the revised vulnerability is likely to be closer to the actual future vulnerability of toothfish to fishing because of the increase in the proportion of the catch to be taken by longlines and pots (increasing to two-thirds of the catch limit) compared to trawls (one-third), and a natural mortality rate of 0.2 is likely to be too high for *D. eleginoides* in this division (paragraph I34);

(ii) the outcomes of the three scenarios should be used as the basis for setting catch limits in the 2005/06 season. The following estimates of long-term annual yield are for the IUU catch of 265 tonnes (paragraph I35):

(a)	$M = 0.13–0.20$ year^{-1}, trawl vulnerability in future projections;	2 303 tonnes
(b)	$M = 0.13–0.20$ year^{-1}, combined gear (trawl, longline, pot) vulnerability in future projections;	2 439 tonnes
(c)	$M = 0.13–0.165$ year^{-1}, trawl vulnerability in future projections.	2 440 tonnes

If SCIC decides that the IUU catch is lower than 265 tonnes, then the recommended limits could be revised upwards according to Table I12;

(iii) the vulnerability for combined trawl, longline and pot gears was not combined with a range of lower natural mortality rates into a single assessment (paragraph I36). Such a combination would be expected to give a higher estimate of yield than those presented here;

(iv) other conservative aspects of this assessment include (paragraph I37):

  (a) age-7 fish have been included as being absent from the population in the 2004 and 2005 recruitment surveys. It is unlikely that they have disappeared from the population because they are being caught in the longline fishery (Figure I2);

  (b) longline catches (including IUU catches, except for 1995/96) are incorporated in the assessments with a vulnerability equivalent to the trawl fishery, which will result in an impact on the assessment of IUU fishing greater than would be expected in reality due to the catching of larger fish by illegal fishers;

  (c) the cohort at age-8 fish in the 1999 survey is likely to have been exploited by fishing in previous years and is therefore likely to be an underestimate;

(v) these scenarios do not account for the uncertainty surrounding the estimation of cohort strength using CMIX, although the effects of this uncertainty are unlikely to result in a uniform positive or negative bias in estimates of cohort abundance across all surveys (paragraph I38).

5.98 Dr P. Gasyukov (Russia) gave an alternative interpretation of the dynamics of the spawning stock biomass (SSB) presented in Figure I10. In his view, this figure shows a high degree of uncertainty in the state of the stock of *D. eleginoides* in Division 58.5.2. The nature of the model is such that it is not possible to determine the real biomass estimate in any year but only the potential range of abundance of the spawning biomass. For example, the 95% confidence interval of the SSB in the 2005 season has the range of 19 885–93 507 tonnes. This might mean that the real biomass value can be 19 885 tonnes, the lower bound of that confidence interval. As a result, Dr Gasyukov made the following points:

(i) Management advice should be given for 1–2 years from the current year, as in the case of *C. gunnari*; advice for the 2005/06 and 2006/07 seasons should be based on the SSB estimates in the 2004/05 season and should take into account its uncertainty. Using the approach for *C. gunnari*, the projection should be calculated on the basis of the one-sided lower 95% confidence interval of the spawning biomass derived from the GYM projections.

(ii) He believes that this approach would be more likely to achieve target levels and avoidance of depletion for the stock when the confidence intervals suggest a low abundance of fish.

(iii) It would be useful to include short-term assessments as well as long-term assessments in order to take account of the status of the stock in the most recent years.

5.99 Dr Constable welcomed suggestions on alternative methods for taking account of uncertainty. However, in this case, the existing projection framework takes uncertainty into account with the application of the current decision rules; the implications of low biomass for a given year in a trial are accounted for in the estimated probability of depletion (paragraph I33). In that case, a low biomass in any year of the projection in the past, present or future will contribute to assessing the probability of depletion. A short-term assessment will require different decision rules and appropriate assessment methods. It will be important to evaluate the consequences of changes in the decision rules as well as evaluating methods for assessing yield in *D. eleginoides* in order to be confident that the advice derived from those assessments is robust to uncertainties.

5.100 Other elements of the conservation measure are recommended to follow the advice in paragraphs I43 to I51.

5.101 The Working Group recommended the following future work as described in section 12:

(i) further development of an integrated assessment of *D. eleginoides* in CASAL, including an evaluation of the assessment methods and overall management strategy for this division (paragraph I41);

(ii) the means by which recruitment cohort strength is estimated from toothfish survey data should be reviewed in the intersessional period, including investigating the possible effects of using the new two-segment growth model (paragraph I42);

(iii) given the lack of defined modes in the length-density data, it would be useful to use age–length keys, if possible, as an alternative method for estimating densities of cohorts (paragraph I42);

(iv) studies on optimal sampling schemes for establishing age–length keys should be encouraged (paragraph I42).

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

5.102 The Fishery Report for *D. eleginoides* in Subarea 58.7 is contained in Appendix J[8].

5.103 The catch limit of *D. eleginoides* in Subarea 58.7 for the 2004/05 season was 450 tonnes (Conservation Measure 41-08) for the period from 1 December 2004 to 30 November 2005. The catch reported for this subarea as of 5 October 2005 was 141 tonnes. Of this, 103.5 tonnes (73.4%) was taken by pots and the remainder by longline. The IUU catch for the 2004/05 season was estimated to be 156 tonnes.

5.104 The estimated total removals in 2004/05 was 297 tonnes, although cetacean predation of longline catches is reported to be significant implying that total removals are greater than just the estimated fishery catches. It was noted that the pot fishery was reported to not be subject to cetacean predation.

[8] Appendix J is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

5.105 There was no catch-weighted length frequency information available for the 2004/05 season, although it was suggested that the pot fishery was selecting for larger fish than the longline fishery. The CPUE series was updated for the meeting.

5.106 An augmented ASPM that used catches, standardised CPUE, and catch-at-length data was used to estimate a long-term annual yield. The results from the model were sensitive to the relative weightings given to CPUE and catch-at-length data, because these two sources of data suggest different degrees of resource depletion. In addition, the model was sensitive to changes in the assumed natural mortality value and to whether or not cetacean predation was included in the calculations.

Management advice

5.107 The Working Group considered that the results of the ASPM remained very sensitive to the weightings used for different data sources. The Working Group also noted that the advice on the appropriate levels of future catch provided in the paper were not based on the CCAMLR decision rules. Therefore the Working Group was unable to provide management advice to the Scientific Committee for the fishery in the South African EEZ at the Prince Edward Islands.

5.108 The Working Group noted that the pot fishery is reported not to be subject to cetacean predation. As industry observations suggested that cetacean predation might be very high, the Working Group suggested that South Africa give consideration to this in formulating management measures for this fishery.

5.109 The Scientific Committee should note the recommendations by ad hoc WG-IMAF with respect to mitigation of seabird mortalities (SC-CAMLR-XXIII, Annex 5, paragraphs 5.289 and 5.290).

5.110 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 32-11, 32-12 and 32-10, remains in force.

Dissostichus eleginoides Crozet Islands inside French EEZ (Subarea 58.6)

5.111 The Fishery Report for *D. eleginoides* in Subarea 58.6 (French EEZ) is contained in Appendix K[9].

5.112 The catch reported for this subarea as of 1 September 2005 was 385 tonnes. Only longlining occurs in the fishery. The estimated IUU catch for the 2004/05 season was zero inside the French EEZ. Some IUU fishing may have occurred outside the EEZ as reported in SCIC-05/10 Rev. 1.

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[9] Appendix K is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

5.113 Depredation on toothfish catches by killer whales (*Orcinus orca*) is becoming a major problem for this longline fishery.

5.114 GLM analyses show a general decreasing trend in the standardised CPUE to 2002/03 with no further decrease indicated between then and the present. Mean weight declined from 1999 to 2003, but has been stable since then. No stock assessment has been carried out.

5.115 By-catch removals are important for this toothfish fishery (longline) and the majority of the catch is processed but no stock assessment is available for evaluation of the impact on affected populations.

Management advice

5.116 The Working Group encouraged the estimation of biological parameters for toothfish at Crozet. The Working Group also noted that a preliminary stock assessment could be carried out if CPUE, catch-weighed length frequencies and biological parameters were available.

5.117 As for other toothfish fisheries in the Convention Area, the Working Group recommended that tag–recapture experiments be conducted. The Working Group was pleased to hear that tag–recapture experiments will be conducted by France in the 2005/06 season as a first step to assessing the stock.

5.118 Estimated total removals have declined steadily over the last eight seasons and are at substantially lower levels than those taken before then. Standardised CPUE has fallen substantially from 1999/2000 to 2002/03 but has stabilised since then. In the absence of a stock assessment, the Working Group agreed that it was unable to recommend appropriate levels of catch for this fishery.

5.119 The Working Group recommended that, where possible, all rajids should be cut from the line while still in the water, except on the request of the observer. Areas with high by-catch rates should be avoided.

5.120 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 32-13 remain in force.

Champsocephalus gunnari South Georgia (Subarea 48.3)

5.121 In the 2004/05 fishing season the catch limit set for icefish in Subarea 48.3 was 3 574 tonnes. The fishery caught 200 tonnes in December 2004 and early January 2005. The fishery will close on 14 November 2005.

5.122 There was no new bottom trawl survey for this species in Subarea 48.3 in 2005. The Working Group therefore used the results of the January 2004 biomass survey as the basis of its assessment (Fishery Report, Appendix L[10]). Additional insight into the situation of the stock was gained through consideration of the results of an acoustic research survey that covered part of Subarea 48.3 in 2005; information from the fishery in 2004/05; and a recalculation of the mixture analysis of 2004 survey data undertaken by Dr Gasyukov (WG-FSA-05/78).

5.123 Neither the acoustic research survey nor the fishery found large concentrations of fish, and possible reasons for this are discussed in the Fishery Report (Annex L). The Working Group conducted assessments based on the following hypotheses:

(i) Through some change in behaviour or distribution, possibly related to spawning, concentrations of icefish were not available to the fishery or the acoustic research survey, but icefish were dispersed over Subarea 48.3. Periodic dispersion and re-appearance of icefish has been noted before, for instance in 1989/99–1999/2000, and spawning behaviour and factors affecting distribution are not well understood for this species. The 2005/06 yield appropriate to this hypothesis was 4 760 tonnes.

(ii) The difference in commercial length frequencies between 2003/04 and 2004/05 might indicate that most age 4+ fish were no longer present in the population at South Georgia, whether due to a mortality or other event. This event did not apply to age-3 fish (which were age-2 in the January 2004 survey). The 2005/06 yield appropriate to this hypothesis was 2 244 tonnes.

5.124 The Working Group noted that there are additional hypotheses consistent with the observation from the fishery and research survey in 2004/05. One hypothesis is that there has been a decline in the population across all age classes, whether due to an increase in mortality or other events.

Management advice

5.125 The Working Group did not have sufficient scientific information to determine which hypothesis on changes in the distribution and/or abundance of icefish was the most plausible (paragraphs 5.123 and 5.124).

5.126 Based on the results of the two hypotheses in paragraph 5.123, the Working Group recommended that the catch limit for icefish in Subarea 48.3 in the 2005/06 fishing season could be 2 244 or 4 760 tonnes.

5.127 Any catch taken between 1 October 2005 and the end of the 2004/05 fishing season (14 November 2005) should be counted against the catch limit for the 2005/06 fishing season.

5.128 All other components of Conservation Measure 42-01 should remain.

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[10] Appendix L is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

5.129 Dr Gasyukov noted that his alternate analysis of age-class densities indicated a higher proportion of age-2 fish in the January 2004 survey than had been estimated by CMIX. As a consequence of this analysis Dr Gasyukov considered that the upper yield limit would be more appropriate.

5.130 Some members noted that, given the inability of the commercial fishery and the acoustic research survey to find concentrations of icefish in 2004/05, the yield suggested by hypothesis 1 (4 760 tonnes) would be inappropriate.

Champsocephalus gunnari Heard Island (Division 58.5.2)

5.131 The Fishery Report for *C. gunnari* in Division 58.5.2 is contained in Appendix M[11].

5.132 The catch limit of *C. gunnari* in Division 58.5.2 for the 2004/05 season was 1 864 tonnes (Conservation Measure 42-02) for the period from 1 December 2004 to 30 November 2005. The catch reported for this division as of 1 October 2005 was 1 791 tonnes.

5.133 Catch-weighted length frequencies in the 2004/05 season were dominated by a single year class of 3+ fish. This cohort was observed to dominate the population in the survey undertaken in June 2005.

5.134 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the survey. All other parameters were the same as in previous years.

Management advice

5.135 The Working Group recommended the Scientific Committee consider the following in providing advice to the Commission on Conservation Measure 42-02:

(i) the projection of age 3+ fish from 2004/05 gives a projected yield of 647 tonnes in the 2005/06 season in the scenario of spreading the catch over two years. If all catch is taken in the first year and zero catch on this cohort in the second year, then the yield could be 1 210 tonnes in the coming season. The Working Group agreed that either of these approaches would satisfy the objectives of the Commission (paragraph M24);

(ii) in considering these different options, the Working Group noted (paragraph M25):

   (a) the cohort has been reproductive for one year and will have 75% escapement over the next two years, having the opportunity to reproduce again;

[11] Appendix M is only available electronically at www.ccamlr.org/pu/E/e_pubs/fr/drt.htm.

(b) although it seems unlikely because of the absence of any indication of a strong 1+ year class in the 2005 survey, should a survey in 2006 show a 2+ cohort entering the fishable population then it may be difficult to have a fishery in the 2006/07 season that results in a negligible catch of the current cohort, which would be 4+ during that survey;

(c) that the strategy to date has been to spread risk over two years in order to provide greater opportunities for spawning by a cohort and, as such, it is not apparent what the consequence of changing that strategy might be in this case, given that it will be an older cohort, the natural mortality rate is variable between years and tends to increase substantially after age 4;

(iii) other measures in the conservation measure be retained.

5.136 The Working Group recommended that further work on developing a management procedure for *C. gunnari* is a high priority (paragraph M26).

Assessment and management advice for other areas and species in the Atlantic Ocean

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

5.137 CCAMLR closed commercial finfishing in the Antarctic Peninsula (Subarea 48.1) and the South Orkney Islands (Subarea 48.2) after the 1989/90 season. Both subareas should only be reopened to commercial fishing if scientific surveys had demonstrated that the condition of fish stocks had improved to the extent which would allow commercial harvesting.

5.138 The last surveys of the two areas occurred in 2003 (Subarea 48.1) and 1999 (Subarea 48.2). They showed no improvement in the condition of the stocks which would give rise to considerations of reopening the two areas for commercial finfishing. No new information has become available since then as no surveys were conducted in the 2004/05 season.

Management advice

5.139 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.

South Sandwich Islands (Subarea 48.4)

5.140 Prior to the current season, commercial fishing has not occurred at the South Sandwich Islands since exploratory longline fishing in 1993 by Bulgarian and Chilean vessels (Ashford et al., 1994). Following results from the 1993 cruise, CCAMLR set a catch limit of 28 tonnes of *Dissostichus* spp. for this subarea (Conservation Measure 41-03).

5.141 During the 2004/05 season, one UK-flagged vessel fished around the South Sandwich Islands and caught 27 tonnes of *D. eleginoides* (CCAMLR-XXIV/BG/13). During this time, fish were tagged in order to start a mark–recapture program to assess the toothfish population. Preliminary results from the survey were presented in WG-FSA-05/57 and indicated catch rates were similar to those experienced in Subarea 48.3.

5.142 The UK proposed to undertake a more extensive mark–recapture experiment in Subarea 48.4 during the 2005/06 and 2006/07 seasons in accordance with Conservation Measure 24-01. The objectives of the experiment will be to assess toothfish population structure, size, movement and growth. The research will be undertaken during April in each year by up to two vessels. The proposal is to tag 500+ fish while taking 100 tonnes of catch each year. The target species will be *D. eleginoides* but any *D. mawsoni* caught will also be tagged or retained for analysis as appropriate.

5.143 The Working Group welcomed this proposal and noted that:

(i) the current catch limit is not based on an assessment;

(ii) the proposed mark–recapture program will be a valuable tool for contributing to an assessment in the future;

(iii) the proposed operation to facilitate the program will be restricted to the northern part of the island chain in Subarea 48.4, which is separated from the southern part of the chain by a channel approximately 2 000 m deep;

(iv) the number of fish in good condition for tagging is limited by the rough operational conditions of the area but more than 500 tagged fish will be released if possible;

(v) the proposed catch is for a fixed term and is only slightly greater than the total catch that might have been taken under the existing conservation measure had it been activated each year.

5.144 Based on results from the 2004/05 season, the Working Group agreed that the proposed experiment would provide useful data needed to undertake an assessment of toothfish in Subarea 48.4. It also agreed that the experiment needed to be conducted over a number of years (3–5 years) and that subject to operational access conditions (such as ice), all fishing in the subarea should follow the proposed experimental design and be restricted to the northern fishing grounds. It noted that some consideration will need to be given by the Commission to ensure that the experiment is not affected by other fishing activities and that the total catch in Subarea 48.4 does not exceed 100 tonnes at least in the 2005/06 fishing season.

5.145 The Working Group also noted that the research catches should count towards the catch limit set for this subarea. In addition, it was recommended that tagging efforts should ensure a distribution of effort so that the northern part of the subarea is effectively covered. However, it is recognised that ice coverage may prohibit fishing in some parts of the area. It was suggested that in later years some fishing might take place in the southern fishing grounds to investigate catch rates and possible movement of fish from north to south.

Management advice

5.146 The Working Group recommended that the mark–recapture program for *Dissostichus* spp. be established for the next three to five years in Subarea 48.4 with a 100 tonne limit to catches of those species, noting the comments in paragraph 5.143 and the need to ensure that the experiment is not affected by other fishing activities.

Electrona carlsbergi (Subarea 48.3)

5.147 The state of the stock was last assessed in 1994. A precautionary catch limit was set at as a result of the assessment. Since the average life span of this species is about five years, the 1994 assessment is no longer applicable, so the fishery was closed in 2003 (Conservation Measure 32-17).

Management advice

5.148 Due to the lack of new information on the current status of the stock, the Working Group recommended that the fishery remain closed. The Working Group agreed that no further consideration of this species was required until new survey data were available.

Stone crabs (*Paralomis* spp.) (Subarea 48.3)

5.149 Stone crabs were not exploited in the 2004/05 season. No proposal for the harvest of crabs has been received by CCAMLR for the 2005/06 season.

Management advice

5.150 Stone crabs are subject to Conservation Measures 52-01 and 52-02 regulating the fishery and experimental harvest of crabs. The Working Group recommended that these conservation measures should remain in force.

Squid (*Martialia hyadesi*) (Subarea 48.3)

5.151 The exploratory fishery on *M. hyadesi* was subject to Conservation Measure 61-01. No new information on the species was available. No new request has been submitted to CCAMLR to continue exploratory fishing on this species in 2005/06.

Management advice

5.152 The Working Group recommended that the existing Conservation Measure 61-01 should remain in force.

FISH AND INVERTEBRATE BY-CATCH SUMMARY FOR WG-FSA (see also Appendix N)

6.1 Issues of potential mutual interest and importance to WG-FSA and ad hoc WG-IMAF identified by the Working Group in 2004 (SC-CAMLR-XXIII, Annex 5, paragraph 6.38) included:

(i) assessment of the status of by-catch species and groups
(ii) estimation of by-catch levels and rates
(iii) by-catch reporting
(iv) assessment of risk, both in terms of geographical areas and population demography
(v) mitigation measures.

A work plan was agreed which addressed these issues as described below.

Assessment of the status of by-catch species or groups

6.2 There were no new assessments of by-catch species or recommendations for revised catch limits in 2005.

6.3 In the absence of assessments for by-catch species, the Working Group recommended that precautionary measures, which place upper limits on by-catch and reduce the potential for localised depletion, be adopted.

6.4 The Working Group recommended that future work include research towards generating population parameters and estimates of standing stock for macrourids and rajids.

Estimation of by-catch levels and rates

6.5 Estimates of total removals derived from fine-scale reports of by-catch by area for the 2004/05 fishing season are presented for longline and trawl fisheries in Tables N2 and N3 respectively.

6.6 The Working Group strongly reiterated the need for accurate reporting of by-catch in all data formats.

6.7 The Working Group noted that IUU fishing is also likely to result in mortality of by-catch species. Therefore the estimates of total removals presented here should be treated as minimum estimates.

By-catch reporting

Information from scientific observers

6.8 Observer by-catch data was extracted by the Secretariat by fishery for the 2004/05 fishing season and summarised in WG-FSA-05/7 (longline fisheries) and 05/8 (trawl fisheries). These documents include tables of the species composition of the observed catch and biological data collected.

6.9 WG-FSA-05/24 reported that it was very difficult to estimate total levels of by-catch for Subareas 88.1 and 88.2 from observer data. The most common recurring problem was incomplete recording.

6.10 The Working Group recommended a modification of the L5 catch composition form for observers. Additional fields should be added that record 'number of hooks observed for fish by-catch', and the total estimated number and weight of each species retained and discarded for the set (i.e. observed number and weight scaled by proportion of hooks observed). These additional fields would help to validate and cross-check the by-catch data being recorded.

Reporting of cut-offs of rajids

6.11 The Working Group noted that information on cut-offs of rajids is still not uniformly and accurately recorded and therefore it is still not possible to calculate estimates of cut-offs for all fisheries.

6.12 The Working Group further noted that some Members have collected data on rajid cut-offs using their own national databases which indicate that releases comprise a significant proportion of the total catch (WG-FSA-05/24 and 05/68).

6.13 The Working Group recommended that all vessels be required to report the number of rajids cut from longlines through the addition to the fine-scale C2 form, of a new field: 'Number of rajids released (including tagged animals)'.

6.14 The Working Group reiterated that rajids cut from, or tagged and released from, longlines and reported as part of the fine-scale data should not be counted against by-catch limits.

6.15 The Working Group strongly recommended that observers fill out the L11 forms correctly, including information on rajid cut-offs. The Working Group noted that whilst it was desirable for this form to be completed for each set, the minimum requirement would be the completion of this form for at least one observation period every 48 hours.

Assessment of risk, both in terms of geographical areas and population demography

Identification of levels of risk

6.16 WG-FSA-05/21 presented risk categorisation tables for *M. whitsoni* and *Amblyraja georgiana*, which are the major by-catch species in the exploratory fishery for toothfish in the Ross Sea (Subareas 88.1 and 88.2) (Tables N5 and N6).

6.17 The Working Group encouraged Members to collate information to allow risk categorisation for major by-catch species in the Convention Area.

6.18 The Working Group urged Members to consider how such risk assessments should be linked to assessment and management considerations in the future. It noted that this concept should be further explored in conjunction with ad hoc WG-IMAF (paragraphs 14.1 to 14.6).

Consideration of mitigation measures

Factors affecting by-catch rates

6.19 Understanding factors that affect by-catch rates may yield information that could be used to develop mitigation and avoidance measures for by-catch.

6.20 The major factors influencing macrourid by-catch in Subareas 88.1 and 88.2 were vessel, area and depth (Figure N1). Catch rates of *M. whitsoni* were highest along the shelf edge (SSRUs 881E, 881I, 881K and 882E) in depths from 600 to 1 000 m, and there was an order of magnitude difference in macrourid catch rates between different vessels. Examination of vessel characteristics (Figure N2) showed that catch rates of macrourids were lower with the Spanish line system than with the autoline system. This effect was confounded by the bait type, as Spanish line vessels tended to use the South American pilchard as bait, whereas autoline vessels used varying species of squid and/or mackerel. However, the difference in macrourid catch rates between the few Spanish line vessels that used squid and mackerel for bait and the majority that used pilchards was much less than the overall difference between Spanish line and autoline vessels. Russian and Korean vessels had extremely low catch rates compared to other vessels fishing in the same location.

6.21 It was not possible to reliably determine factors influencing catch rates of rajids in Subareas 88.1 and 88.2 from either fine-scale or observer data because a high proportion of rajids are cut free and released at the surface and these are not accurately recorded or reported in either dataset (paragraphs N42 to N53). However, there was no obvious difference in by-catch rates of rajids between autoline and Spanish line vessels.

6.22 The Working Group recommended that further work should be carried out in the intersessional period to compare by-catch levels arising from different gear configurations and to determine whether this information could be used to develop mitigation and avoidance measures for by-catch.

6.23 The Working Group requested that Members and observers, where feasible, provide a report to the Secretariat on methods or strategies of fishing that minimise non-target fish by-catch.

6.24 The Working Group recommended that a field specifying whether integrated weighting was used for longlines be added to the C2 data form.

Release of rajids

6.25 The Working Group recommended that vessels be advised that, where possible, all rajids should be cut from the lines whilst still in the water, except on the request of the observer during the observer's biological sampling period.

6.26 Data from Member countries indicate that large numbers of rajids are cut off longlines (paragraphs N47 and N48). The effectiveness of releasing rajids as a mitigation measure will depend very strongly on the survivorship of released animals. In the absence of information on survivorship of cut-off rajids, the effectiveness of this type of mitigation measure is unknown.

6.27 No new information on the survivorship or vulnerability of rajids was available at WG-FSA-05. The Working Group noted that estimates of survivorship of rajids cut from longlines is limited and encouraged Members to undertake further survivorship experiments in the future.

6.28 The Working Group recommended that a relaxation of the requirement to cut all rajids from longlines be applied in the case where observers carried out specific tasks to gather more information on rajids during their biological sampling period. Examples of tasks include:

(i) biological data collection – i.e. measurements of length, weight, sex, maturity, stomach contents and vertebral columns/thorns for age analysis;

(ii) landing rajids in order to assess condition, as if these animals had been released whilst still in the water. It would be necessary to observe the hauling and landing procedure to ensure that injuries were not sustained through hauling;

(iii) assessing the probability of detecting tagged rajids. It may be difficult to detect tagged animals that are released whilst in the water, particularly in rough sea states.

6.29 The Working Group recommended the adoption of a new 4-category scale (paragraph N87) for assessing rajid release condition by observers. These data should be accurately recorded for at least one observation period every 48 hours.

INCIDENTAL MORTALITY OF MAMMALS AND SEABIRDS
ASSOCIATED WITH FISHING
(see also Appendix O)

Advice to the Scientific Committee

General
(see also paragraphs O1 to O5)

7.1 The plan of intersessional work for 2005/06 (SC-CAMLR-XXIV/BG/28) summarises requests to Members and others for information of relevance to the work of the Working Group (paragraphs O1 to O4). Members are particularly invited to review the membership of the Working Group, to suggest additional members and to facilitate attendance of their representatives at meetings (paragraph O5).

Incidental mortality of seabirds during regulated longline
and pot fishing in the Convention Area in 2005
(see also paragraphs O6 to O16)

7.2 The total number of observed mortalities was 56, and consisted of 6 (11%) yellow-nosed albatrosses, 1 (2%) wandering albatross, 43 (76%) white-chinned petrels and 6 (11%) southern giant petrels. The total extrapolated mortality for 2004/05 was 97 birds split between Subareas 48.3 (13 birds), 58.6 and 58.7 (76 birds) and Division 58.4.1 (8 birds) (Table 2). This was a 65% increase from the extrapolated 58 mortalities for 2003/04. The vast majority of the extrapolated mortality (78%) is attributed to one vessel fishing in Subareas 58.6 and 58.7 (paragraphs O6 to O9).

(i) For Subarea 48.3, the total extrapolated seabird mortality was 13 birds compared with 27, 8, 27 and 30 birds in the last four years (Table O3). The overall catch rate was 0.0011 birds/thousand hooks, compared to the rates of 2004 and 2001 (0.0015 birds/thousand hooks) and the rate for 2003 (0.0003 birds/thousand hooks). The four birds observed killed were southern giant petrels (Table O4). Total extrapolated captures decreased between 2003/04 and 2004/05 (paragraph O12).

(ii) For Subarea 58.4, the total extrapolated seabird mortality was eight birds, with a catch rate of <0.001 birds/thousand hooks, from one vessel operating in Division 58.4.1 (Table O3). In 2003/04 longline fishing was undertaken for the first time in Subarea 58.4. No mortalities had been reported prior to 2004/05 (paragraph O13).

(iii) Within the South African EEZ in Subareas 58.6 and 58.7, the total extrapolated mortality was 76 seabirds from the one vessel that fished there. The catch rate for this area was 0.149 birds/thousand hooks, compared to 0.025 and 0.003 in 2003/04 and 2002/03 respectively (Table O3). In previous years (1997 to 2001) extrapolated mortalities and rates ranged between 834–156 birds and 0.52–0.018 birds/thousand hooks respectively (paragraph O14).

(iv) In Subareas 48.4, 48.6, 88.1 and 88.2 and Division 58.5.2, no seabird mortalities were observed on longline vessels. Incidental mortality of seabirds in Subareas 88.1 and 88.2 has been very low over the past eight years, with only one bird observed killed in 2003/04 (Table O3, paragraph O15).

7.3 The Working Group noted that the reports of seabirds being caught injured and uninjured indicates that seabirds are being caught on the haul; this accounts for at least 68% of seabird captures in 2004/05 (Table O1). This indicates that an increased focus on haul mitigation measures is required (paragraphs O10 and O11).

7.4 No incidental mortalities were recorded on two cruises in Subareas 58.6 and 58.7 undertaking pot fishing for *D. eleginoides* (paragraph O16).

French EEZs in Subarea 58.6 and Division 58.5.1
(see also paragraphs O17 to O43)

7.5 Data requested for 2000/01 were received for Division 58.5.1 (paragraph O17). The total seabird mortality reported by captains in 2000/01 was 1 917 birds (Table O5). The corresponding catch rate (reported birds/total hooks set) was 0.092 birds/thousand hooks, of which approximately 94% were white-chinned petrels. Data for Subarea 58.6 will be submitted next year (paragraphs O19 and O20).

7.6 In 2004/05 the total reported seabird mortality from observers for Subarea 58.6 and Division 58.5.1 was 61 and 1 054 birds respectively (Table O8). The corresponding incidental mortality rates were 0.047 and 0.161 birds/thousand hooks. The total seabird mortality reported by captains in Subarea 58.6 and Division 58.5.1 was 137 and 1 901 birds respectively (Table O7). The corresponding incidental mortality rates were 0.028 and 0.071 birds/thousand hooks (paragraphs O22 and O23).

7.7 Comparing this year's to last year's data is complicated by different count methods. Data submitted to CCAMLR from 2000 to mid-2004 were collected by captains. Beginning April 2004, on-board observers collected seabird incidental mortality and mitigation-related information (paragraph O21). Data were therefore compared where available in the same format for the same period. Comparing 2003/04 and 2004/05 for the period from April to August, observers' incidental mortality rates showed an increase of 87% (0.006 to 0.011 birds/thousand hooks) and 21% (0.058 to 0.070 birds/thousand hooks) respectively in Subarea 58.6 and Division 58.5.1 (paragraph O24). Differences between captain and observer-reported data are addressed in CCAMLR-XXIV/BG/24 (paragraph O25).

7.8 The Working Group noted that in order to be consistent with CCAMLR procedures, the use of observer data only is recommended. From 2005/06 all French data on incidental mortality of seabirds will be collected only by observers, thereby allowing direct comparison with other CCAMLR areas (paragraph O26).

7.9 The seabird data recorded by observers were used to extrapolate total seabird mortality (Table O9). The mean proportions of hooks observed in Subarea 58.6 and Division 58.5.1 were 25.5 and 24.5% respectively. For Subarea 58.6, the observed incidental mortalities of 61 birds extrapolates to a mortality of 242 seabirds (0.049 birds/thousand hooks). For Division 58.5.1, the observed incidental mortalities of 1 054 birds extrapolates to a mortality of 4 387 seabirds (0.164 birds/thousand hooks) (paragraphs O28 and O29, Table O11).

7.10 The Working Group noted that 30% of seabirds captured were caught alive, indicating that they were taken on the haul. It was recognised that attention to mitigating captures on the haul would be required as part of efforts to achieve a continuing reduction in seabird mortality (paragraph O30).

7.11 The Working Group noted that the CCAMLR totals included the dead and mortally injured birds in the 'total caught dead' numbers, whereas the French data included only 'dead' and 'alive' categories, the latter including both mortally injured and live birds. The Working Group recommended the use of the CCAMLR methodology by French observers to allow for better estimates of overall mortality and to facilitate comparison with other fisheries in the Convention Area (paragraph O31).

7.12 The Working Group noted the continued efforts to use and develop effective mitigation measures in the French EEZ fisheries. Following recommendations made by the Scientific Committee last year, new regulations entered into force in 2005 and include weighting regimes, multiple streamer lines, an area closure, and prohibition of hook discard and use of black hookline. New measures will continue to be tested (e.g. hook design, reconstituted colour bait, line shooter, laser technology) (paragraphs O36 and O37).

7.13 The Working Group commended the initiatives taken by France for research and management relating to the incidental mortality of seabirds in its EEZs. It recommended that:

(i) observers continue to be deployed on 100% of vessels (paragraph O26);

(ii) consideration be given to increasing the proportion of hooks observed (e.g. to 40–50%) (paragraphs O32 and O33);

(iii) data collection protocols be improved including incorporating the CCAMLR distinctions and definitions relating to dead and live seabird by-catch (paragraph O42);

(iv) appropriate analysis of the 2005 data be undertaken (paragraphs O38 and O39).

Information relating to the implementation of
Conservation Measures 25-01, 25-02 and 25-03
(see also paragraphs O44 to O62)

7.14 This year the level of reported compliance has increased for all elements. With respect to Conservation Measure 25-02, this is summarised as follows:

(i) Line weighting (Spanish system) – for the first time there was 100% compliance with the required line-weighting regime in all subareas and divisions (paragraph O46, Table O13).

(ii) Line weighting (autoline system) – all vessels fishing in Subareas 88.1, 88.2 and Division 58.4.2 south of 60°S in daylight met the requirement to achieve a consistent minimum line sink rate as described in Conservation Measure 24-02. As in previous years, this line-weighting requirement has been fully achieved by all vessels (paragraph O48, WG-FSA-05/9 Rev. 2, Table 6; SC-CAMLR-XXIII, Annex 5, paragraph 7.57).

(iii) Night setting – in Subareas 58.6 and 58.7, 100% of sets occurred at night, an increase from the 83% night-setting rate last year; in Subarea 48.3, 99% of sets occurred at night (98% in 2004) (Table O13). In Subareas 48.6, 88.1, 88.2 and Division 58.4.2 and 58.4.3b, all vessels demonstrated a consistent minimum line sink rate of 0.3 m/s and hence fished under Conservation Measure 24-02, which provides exemptions to night setting south of 60°S (paragraph O49, WG-FSA-05/9 Rev. 2, Table 6).

(iv) Offal discharge – a single vessel discharged offal during one set and one haul in Subarea 88.1 (offal discharge is prohibited in this subarea); in Subarea 48.3, a single vessel discharged offal during one set (offal discharge during setting is prohibited under Conservation Measure 25-02) (paragraph O50, Table O1).

(v) Discard of hooks – hooks were present in discards on six vessels; on three of these this was a rare event (WG-FSA-05/9 Rev. 2, Table 1). However, on one vessel it was a daily occurrence during the first half of the season; following a mid-season crew change the discarding of hooks stopped (paragraph O51).

(vi) Streamer lines – the number of cruises complying with streamer line specifications increased from 64 to 74% this year (Table O12), although this is not as high as the 92% in 2003. In Subareas 48.6, 58.6, 58.7 and Divisions 58.4.2 and 58.4.3b, all vessels used streamer lines on all sets; in Subarea 48.3, only 1 of 1847 sets was undertaken without using a streamer line; in Subareas 88.1 and 88.2, one vessel undertook a single set without using a streamer line (Table O1) (paragraphs O52 to O54 and O60, Table O12).

(vii) Haul scaring devices – in Subarea 48.3, three vessels did not use haul scaring devices on all of the hauls; in Subareas 58.6 and 58.7, 100% of hauls used scaring devices; in Division 58.5.2 the only longline vessel fishing in that area was equipped with a moonpool hence no devices were required (paragraphs O57 to O59, Table O12).

7.15 With respect to Conservation Measure 25-01, 9 of the 10 vessels which had packaging bands on board complied with the requirement to dispose of them using on-board incineration. One vessel was observed disposing plastic packaging bands overboard and therefore did not comply with Conservation Measure 25-01 (paragraph O46; WG-FSA-05/9 Rev. 2, Table 1).

7.16 With respect to Conservation Measure 25-03, 2 of 9 (22%) vessels did not comply with the prohibition of discharge of offal during the shooting or hauling of trawl gear (paragraph O62, Table O14). This level of compliance is higher than 2004, when 4 of 8 (50%) vessels discharged offal.

7.17 In relation to overall compliance with Conservation Measure 25-02, 12 of 25 vessels (48%) fully complied with all measures at all times throughout the Convention Area, compared to 33% last year (Tables O1 and O12). Some vessels failed to comply by small margins, and the Working Group re-emphasised that vessels should be advised to exceed the standards to prevent compliance failure (paragraph O61).

7.18 During the meeting, the Working Group undertook an evaluation of the data prepared by the Secretariat on the implementation of Conservation Measures 25-01, 25-02 and 25-03. During this process some examples of potential non-compliance were identified by the Working Group and in some cases corrected following a dialogue between the Secretariat and technical coordinators of observer programs. The Working Group noted that such dialogue may avoid the erroneous interpretation of ambiguous reporting leading to a misrepresentation of the level of compliance by individual vessels (paragraphs O45, O55 and O56).

Research pertaining to the revision of Conservation Measures 24-02 and 25-02 and related matters (see also paragraphs O63 to O95)

7.19 The Working Group, recollecting previous Scientific Committee and Commission recommendations and endorsements (paragraphs O65 and O67), strongly supported the proposal to develop improved Spanish longline mitigation measures (paragraphs O68 to O70). The research is intended to test the effectiveness of Spanish longline weighting regimes in reducing incidental mortality of seabirds including in high-risk areas at high-risk times of year, and test methods to reduce the substantial amounts of fishing gear lost (paragraphs O66 and O70). The stepwise research plan (paragraphs O68 to O70), with initial tests outside the Convention Area in fisheries where Convention Area seabirds range, was endorsed, including implications for future tests in the Convention Area (paragraph O71).

7.20 With respect to future improvements to Conservation Measure 25-02, the Working Group recommended:

(i) routine collection of longline sink rate data for a wide range of line-weighting scenarios including related vessel setting speed and aerial extent of streamer line information to allow the determination of potential access by seabirds to baited hooks behind longline vessels (paragraphs O72 to O76 and O93);

(ii) collection of data, at least every seven days, of streamer line features including streamer line aerial extent; the height of streamer lines at the stern; the length of streamer lines; and the number, spacing and length of individual branched streamers. These data should be collected on a diagram-based form to be developed by the Secretariat. Where sink rate data collection is required according to Conservation Measure 24-02, paragraph B2(ii), the Working Group recommended that streamer line data be collected in the course of sink rate data collection (paragraphs O77 to O79);

(iii) appropriate experiments on the design features of streamer lines with a view to being able to recommend refinements to the streamer line requirements (paragraph O80);

(iv) development of effective haul scaring devices for use throughout the Convention Area (paragraph O84);

(v) haul mitigation devices, such as the BED, should be encouraged in all CCAMLR areas regardless of risk status to reduce the large proportion of bird captures during line hauling (paragraph O86).

7.21 With respect to the Japanese proposal for the *Shinsei Maru* bottom-line system, the Working Group recognised the potential for the fishing method to minimise exposure of baited hooks to seabirds during setting operations and therefore expressed support for the proposal. The Working Group strongly recommended that Conservation Measures 25-02 and 24-02 be applied to this fishing system novel to the Convention Area (paragraph O82). In addition, some details were lacking that might have allowed a complete evaluation of the potential threats to seabirds in the Convention Area. The Working Group recommended that the fishery observer assigned to this vessel describe how the gear is deployed and retrieved with special attention to gear and seabird behaviour during the haul and set as this would enable understanding the performance of this fishing gear and its appropriateness for continued use in the Convention Area (paragraphs O81 and O83).

7.22 In response to a Commission request (CCAMLR-XXIII, paragraph 10.24), the Working Group reviewed available data on the maximum length of longlines used in the Convention Area with respect to Conservation Measure 24-02 and longline sink rate testing prior to entering the CCAMLR Convention Area (paragraph O87).

7.23 The Working Group recommended that the requirement for line sink rate testing prior to entering the Convention Area should be changed from the current requirement to test the maximum length of longlines to that of testing the average length, being 6 000 m for auto longline system vessels and 16 000 m for Spanish longline system vessels (paragraph O89).

7.24 Accordingly, the Working Group recommended that Conservation Measure 24-02 be revised as follows (paragraphs O94 and O95):

Replace paragraph A1(i) with:

(i) set a minimum of two longlines with a minimum of four TDRs on the middle one-third of each longline, where:

(a) for vessels using the auto longline system, each longline shall be at least 6 000 m in length;

(b) for vessels using the Spanish longline system, each longline shall be at least 16 000 m in length.

Replace paragraph B1(i) with:

(i) set a minimum of two longlines with a minimum of four bottle tests (see paragraphs B5 to B9) on the middle one-third of each longline, where:

(a) for vessels using the auto longline system, each longline shall be at least 6 000 m in length;

(b) for vessels using the Spanish longline system, each longline shall be at least 16 000 m in length.

Replace paragraph C1(i) with:

(i) set a minimum of two longlines with either a minimum of four TDRs, or a minimum of four bottle tests (see paragraphs B5 to B9) on the middle one-third of each longline, where:

(a) for vessels using the auto longline system each longline shall be at least 6 000 m in length;

(b) for vessels using the Spanish longline system each longline shall be at least 16 000 m in length.

7.25 In reviewing its advice from 2004 (SC-CAMLR-XXIII, Annex 5, paragraphs 7.91 to 7.93), the Working Group noted that the proposed changes to Conservation Measure 25-02 with respect to mandatory line-weighting prescriptions for autoline vessels were no longer considered appropriate. The rapid adoption of IWLs and the line sink rate testing regime had largely superseded the need for an external line-weighting regime for autoline vessels (paragraph O91).

7.26 Although no additional information on the specification of IWLs had been provided, and a revision of Conservation Measure 25-02 at this time would be premature, the Working Group agreed that IWLs should continue to be endorsed as a viable line weighting alternative (paragraphs O90 and O92).

7.27 The Working Group recommended that research be undertaken on IWLs to allow revision of Conservation Measure 25-02 with the intention of combining Conservation Measures 24-02 and 25-02 if possible (paragraph O93).

Incidental mortality of seabirds during unregulated longline fishing in the Convention Area (see also paragraphs O96 to O106)

7.28 The overall estimated total for the whole Convention Area in 2004/05 indicates a potential seabird by-catch in the unregulated fishery of 4 415 (95% confidence interval range of 3 605 to 12 400) seabirds (SC-CAMLR-XXIV/BG/27). The values for this and previous years are summarised in respect of different parts of the Convention Area in Table 18 (paragraph O101).

7.29 In comparison with estimates for previous years, calculated in identical fashion, the value for 2004/05 is similar to the value estimated for 2003/04 (SC-CAMLR-XXIII/BG/23). These are the lowest reported values since estimates started in 1996. This presumably reflects a commensurate reduction in toothfish removals and/or changes in the areas from where IUU fishing occurs (paragraph O102).

7.30 Nevertheless, the Working Group reiterated its conclusions of recent years that even these levels of IUU incidental mortality of seabirds were of substantial concern and likely unsustainable for some of the populations concerned (paragraph O105). The Commission was encouraged to continue to take action in respect of incidental mortality of seabirds caused by IUU fishing (paragraph O106).

Incidental mortalities of seabirds during longline fishing outside the Convention Area (see also paragraphs O107 to O111)

7.31 As requested in 2004 (paragraph O108), Brazil provided new data on mortality of seabirds outside the Convention Area relevant to fisheries and/or seabirds within the Convention Area. Cruises on Brazilian domestic vessels were observed with an average catch rate of 0.09 birds/thousand hooks between 2000 and 2005, and species from the Convention Area were among those captured (paragraph O107). These data indicate a high risk of capture of birds from the Convention Area in Brazilian fisheries, especially during winter (paragraph O108).

7.32 The Working Group noted the progress on the implementation of mitigation measures in Brazil (paragraph O109) and encouraged reporting of new information in 2006.

7.33 Data from the Falklands/Malvinas toothfish longline fishery were also reported (paragraph O110); however, there were no direct implications for Convention Area breeding species (paragraph O111).

Research into the status and distribution of seabirds (see also paragraphs O112 to O143)

7.34 Data were reported on winter foraging areas off the Brazilian coast of species that breed in the Convention Area (paragraph O112). Data from a recent satellite-tracking study of albatross populations on Heard Island (light-mantled sooty and black-browed albatrosses) indicates an overlap of foraging areas with new and exploratory fisheries in Divisions 58.4.1, 58.4.2 and 58.4.3 (paragraph O114). The satellite-tracking study provided important information for the understanding and management of incidental mortality of black-browed albatrosses in fisheries adjacent to Heard Island (paragraph O115). Several population studies and analyses are under way for the petrel populations on Crozet and Kerguelen Islands and results are anticipated in early 2007 (paragraph O130).

7.35 A requested analysis by BirdLife International of albatross and petrel distribution relevant to the Convention Area indicated that the subareas with the highest proportion of albatross and petrel distribution were Subareas 48.3 and 58.6, but the breeding ranges extend across the majority of the Convention Area. Data acquisition priorities were identified (paragraph O123) and the spatial risk assessments for CCAMLR subareas were revised based on this new and relevant information on the distribution of albatrosses and petrels vulnerable to interactions with fisheries (SC-CAMLR-XXIV/BG/26) (paragraphs O120 and O121).

7.36 The Working Group requested holders of new information on Procellariiform distribution to submit these to the BirdLife International global database initiative for application to fisheries management initiatives (paragraph O119) and that BirdLife International provide summary data to the Secretariat on the distribution of Southern Ocean seabirds from its tracking database at approximately three-year intervals, or when accumulation of data warrants (paragraph O123).

7.37 The Working Group welcomed the ACAP observer and received and reviewed ACAP's preliminary report on albatross and petrel populations protected under ACAP, which includes all the Procellariiform seabirds occurring in the Convention Area (paragraphs O131 to O140). The Working Group agreed that such information is best compiled and reviewed by ACAP and, to avoid duplication, suggested that ACAP be the single repository for these data. ACAP would be requested to submit summary documents of albatross and petrel population status to the Secretariat annually, or as appropriate (paragraph O141).

International and national initiatives relating to incidental mortality of seabirds in relation to longline fishing
(see also paragraphs O166 to O179)

7.38 Information was reported on current international initiatives under the auspices of:

(i) ACAP – items of particular relevance to CCAMLR (paragraph O145);

(ii) FAO (NPOA-Seabirds) – noting the near completion of plans by Brazil and Chile (paragraphs O147 and O149);

(iii) RFMOs – responses received to CCAMLR Resolution 22/XXIII by CCSBT, IATTC and ICCAT; initial progress with IOTC, ICCAT and WCPFC (paragraphs O155 to O167);

(iv) NGOs – a new BirdLife International initiative was noted (paragraph O154) and a Southern Seabirds Solution fisher exchange between New Zealand and Chile (paragraphs O152 and O153);

(v) a workshop resulting in recommendations for best-practice data collection on protected species in longline fisheries at the Fourth International Fisheries Observer Conference was noted (paragraphs O150 and O151).

7.39 The Working Group reviewed requested papers tabled at CCSBT's Fifth Meeting of the ERS WG, taking particular note of CCSBT members' reports on mitigation and estimates of seabird incidental mortality. Data from the RTMP observer program of the Japanese southern bluefin tuna longline fishery estimated the annual incidental takes of seabirds for the 2001 and 2002 fishing years at 6 000 to 9 000 birds per year and suggested these levels have been stable since 1995. Species composition sampling indicated approximately 75% of the species taken were albatrosses and 20% petrels, most of which breed in the Convention Area (paragraphs O166 to O173).

7.40 Noting that the Japanese southern bluefin tuna fleet probably represents about two-thirds of the longline fishing effort in the overall CCSBT fishery, the total annual mortality of seabirds could approach, or even exceed, 13 500 seabirds, including about 10 000 albatrosses, the Working Group expressed substantial concern and re-emphasised a need for effective mitigation, its evaluation, and a more extensive and detailed program of data collection by observers (paragraphs O175 and O176).

7.41 At the 26th Session of COFI, Japan proposed a joint meeting of the secretariats of the tuna RFMOs and their members. The Working Group expressed strong support of the proposal and requested Members of CCAMLR, especially those also members of the participating RFMOs, to support a thorough review of by-catch-related initiatives and requirements at this meeting (paragraphs O177 and O178).

Incidental mortality of seabirds in relation
to new and exploratory fisheries
(see also paragraphs O180 to O195)

7.42 Of the 35 applications for exploratory longline fisheries for 2003/04, 25 were undertaken (paragraph O184). No incidental mortality of seabirds was observed in fisheries in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.2, 58.4.3a and 58.4.3b. Two seabird mortalities and one bird released alive were observed in Division 58.4.1 (paragraph O185).

7.43 The assessment of potential risk of interactions between seabirds and longline fisheries for all statistical areas in the Convention Area was reviewed, revised and provided as advice to the Scientific Committee and Commission (SC-CAMLR-XXIV/BG/26). There were seven changes to levels of risk this year (paragraphs O183 and O186).

7.44 The 39 proposals by 12 Members for exploratory fisheries in seven subareas/divisions of the Convention Area in 2005/06 were addressed in relation to the advice in SC-CAMLR-XXIV/BG/26, Figure 1 and Table 19. The results, summarised in Table 20, involve two categories: those that provide sufficient information and are assessed as conforming with advice relating to incidental mortality of seabirds (paragraph O190(i)), and those that contain insufficient information to determine whether they conform with advice relating to incidental mortality of seabirds (paragraph O190(ii)). Applications by Argentina (CCAMLR-XXIV/12), Chile (CCAMLR-XXIV/27, 28), Norway (CCAMLR-XXIV/11), Republic of Korea (CCAMLR-XXIV/22), Russia (CCAMLR-XXIV/31) and Uruguay (CCAMLR-XXIV/23, 24, 29, 30) fall into the latter category. The Working Group noted that as for last year (SC-CAMLR-XXIII, Annex 5, paragraph 7.273) these inconsistencies should be able to be resolved during the Scientific Committee meeting (paragraph O193).

7.45 The Working Group requested that Members take greater care in future submissions to ensure the intent to comply with relevant seabird by-catch measures was clear (paragraph O192) and recommended that to assist in the review of notifications for new and exploratory fisheries in future years a checklist be developed by the Secretariat for Members to complete when submitting notifications (paragraph O193).

7.46 Issues relating to:

(i) exemptions from setting longlines at night;

(ii) exemptions in respect of closed seasons;

(iii) maintaining maximum levels for the incidental mortality of seabirds as in the 41-series conservation measures, with reversion to the provisions of Conservation Measure 25-02 when these are reached;

(iv) including reference to the definition of birds caught in all relevant conservation measures;

are addressed in paragraphs O194 and O195.

Other incidental mortality
(see also paragraphs O196 to O230)

Interactions involving marine mammals
and longline fishery operations

7.47 Three southern elephant seal mortalities were reported in the toothfish fishery in Division 58.5.2 (paragraph O196). Two Antarctic fur seals entangled in a longline in the Subarea 48.3 toothfish fishery were both released alive (paragraph O197).

Interactions involving seabirds and marine mammals
and trawl finfish fishery operations

7.48 In 2005, 11 seabirds were observed killed in the Subarea 48.3 icefish fishery and another 14 released alive and uninjured (Table O16), an order of magnitude decrease in the mortality rate for this subarea compared to previous years (0.04 birds per tow in 2005 and 0.37 and 0.20 birds per tow in 2004 and 2003 respectively (Table O17)) (paragraph O201). Eight seabirds were observed killed in the Division 58.5.2 icefish/toothfish fishery, with the mortality rate increasing from zero in 2004 and 0.005 birds per tow in 2003 to 0.01 birds per tow in 2005 (paragraph O202). An additional five seabirds, including two black-browed albatrosses, were reported killed (paragraph O203).

7.49 The reduction in seabird mortality in the icefish fishery in Subarea 48.3 could be due to a combination of reduced seabird abundance, associated with the reduction in icefish catches, and the continued adoption of mitigation measures, but insufficient data were available to investigate this further (paragraphs O204 to O206).

7.50 The Working Group noted that binding the net with sisal string is a potentially highly effective and easily implemented mitigation measure for the icefish trawl fleet (paragraphs O207 and O208).

7.51 One Antarctic fur seal was caught and released alive in the toothfish trawl fishery in Division 58.5.2 (paragraph O216).

Interactions involving marine mammals and seabirds and krill fishing operations

7.52 In 2005 in Subareas 48.2 and 48.3 one incidental mortality of a Cape petrel was recorded and one Antarctic fulmar was caught on a warp splice and released uninjured. Information from the report of a scientific observer from the krill fishery in Subarea 48.3 included anecdotal records of seabird collisions with trawl warps during hauling (paragraph O209).

7.53 In 2004/05, 95 Antarctic fur seals were observed caught during krill fishing operations in Area 48 (WG-FSA-05/8, Table 4), of which 74 were released alive, compared to 156 of which 12 were released alive in 2004 (paragraph O217). The observer coverage was not sufficient to extrapolate a total Antarctic fur seal mortality in the krill fishery (paragraphs O223 and O224).

7.54 The Working Group recollected the Scientific Committee advice from last year that until such time as marine mammal mitigation measures specific to this fishery could be incorporated into the relevant conservation measures, every vessel fishing for krill should employ a device for excluding seals or facilitating their escape from the trawl net (paragraphs O218 to O222(i)).

7.55 The Working Group reiterated the recommendations made by the Scientific Committee last year, that observers on krill vessels collecting reliable data on seal entrapment and on the effectiveness of devices to mitigate this (SC-CAMLR-XXIII, paragraph 5.37) should allow a very substantial resolution of the problem. A minimum requirement would be to have observations from each vessel in the fishery in order to assess the type and efficacy of the mitigation measures employed on a vessel-by-vessel basis. This would also provide an opportunity to provide information on the rate of trawl warp strikes by birds in this fishery (paragraphs O209, O222(ii), O224 and O225).

7.56 The Working Group recommended 100% observer coverage on krill trawl vessels to obtain reliable data on seal entrapment and on the effectiveness of associated mitigation devices (paragraph O226).

General

7.57 The Working Group intends to develop detailed warp strike data collection protocols during the intersessional period to allow a more comprehensive assessment of the incidental mortality of seabirds in trawl fisheries to be undertaken in future (paragraphs O211 to O214).

7.58 The Working Group recommended that at future meetings assessments of incidental mortality of seabirds and marine mammals in the icefish, toothfish and krill trawl fisheries be undertaken collectively as a part of a generic review of the trawl methodology for mitigation purposes (paragraph O215).

Other business
(see also paragraphs O231 to O240)

7.59 The Working Group reviewed SC-CAMLR-XXIV/8, a proposal for testing new streamer line designs (paragraphs O231 to O234) and made three general recommendations on the testing of seabird mitigation measures:

(i) that further testing of modifications to mitigation methods which would require exemption from the provisions of current conservation measures should require prior provision to CCAMLR of full details of the proposed research and experiments (paragraph O235);

(ii) to avoid confusion, that the Scientific Committee confirm that the role of scientific observers does not include the ability to agree to fishing-related practices that are in contravention of CCAMLR conservation measures without relevant prior exemptions having been agreed by CCAMLR (paragraph O235(i));

(iii) that the Scientific Committee confirm that full proposals for any such testing must be notified to WG-FSA in advance of the fishing season in which the trials are proposed to be conducted (paragraph O235(ii));

and three specific recommendations on the proposal (paragraph O236):

(i) it was not feasible or appropriate for the Working Group to devise specific experimental protocols for applicants;

(ii) the Working Group was prepared to comment on the content and design of experiments proposed by applicants provided these were available two weeks in advance of the start of its meeting so that there was sufficient time for appropriate expert consultation;

(iii) consequently it was not recommended that a test of the streamer line designs outlined in Annex 1 of SC-CAMLR-XXIV/8 should proceed in the 2005/06 fishing season.

7.60 The Working Group provided additional comments on the proposal should the applicant wish to resubmit it next year (paragraphs O237 and O238).

7.61 With respect to the UK proposal for a toothfish mark–recapture experiment in Subarea 48.4, the Working Group noted that, despite the change in risk assessment for incidental mortality of seabirds in this subarea for 2005 (paragraph O186), the proposal conformed with the advice of the Working Group in respect of avoidance of incidental mortality of seabirds (paragraphs O239 and O240).

EVALUATION OF THREATS ARISING FROM IUU ACTIVITIES (see also Appendix P)

Current estimate of IUU catches

8.1 The Working Group examined the calculations of IUU made by the Secretariat in SCIC-05/10 Rev. 1 (Table 3.2). As in previous years, information supplied to the Secretariat by Members on the number of IUU vessels active in an area (subarea/division), was combined with estimates of the duration of a fishing trip likely to be undertaken by an IUU vessel in that area, the number of fishing trips represented by the sighting, and the likely IUU catch rate in that area.

IUU catch = [number of observations of activity] x [trip duration (days)] x [number of trips per year] x [catch rate (tonnes/day)].

8.2 Currently the Secretariat makes an assessment of IUU activity up to the beginning of October, and provides both these estimates (column 11 of Table 1 of SCIC-05/10 Rev. 1) and extrapolations to the end of the fishing season (column 12). The table needs to be updated at the end of each fishing season, when the final sightings information is available, so that all figures for a fishing season are based on estimation rather than extrapolation. The Working Group requested the Secretariat do this intersessionally for the current and all previous fishing seasons so that the best estimates of IUU catch can be used in assessments.

8.3 The estimates made by the Secretariat for the 2004/05 fishing season will be reviewed by SCIC after the conclusion of the WG-FSA meeting. In case SCIC was to decide that the figures or the method used are in some way inappropriate, WG-FSA agreed that it should use two alternative IUU scenarios, to provide the Scientific Committee and Commission with appropriate alternative assessments of toothfish catch limits. Bearing in mind the discussion in paragraph 8.2, these two scenarios would assume:

(i) that the estimates given in Table 1 are correct up to the point of 1 October 2005, i.e. to the point of extrapolation, and therefore that the figures in column 11 should be used for IUU estimated catch in the 2004/05 fishing season;

(ii) that the estimates given in column 11 of Table 1 are uncertain, and therefore that IUU catch could be assumed to be zero in the 2004/05 fishing season.

8.4 The Working Group recommended that SCIC give consideration to the viability and priority of further developing estimation methods as well as undertaking additional work with simulated and historical data to better understand the effectiveness of different levels of observation in detecting levels of IUU activity, particularly for situations where evasion of detection might be a real possibility.

Trends in IUU catch

8.5 There has been a decline in IUU catches over the last three years, although estimates for 2005 are at similar levels to 2004. Table 3.2 shows that the pressure from surveillance operations in traditional fishing areas within the Convention Area has forced IUU fishing on to high-seas areas within the Convention Area. The consequence of this is that methods of assessing IUU catch, previously developed and applied primarily to non-high-seas areas of the Convention Area, now need to be applied if possible to high-seas areas. The Working Group requested that the Scientific Committee and SCIC consider how these estimates are best made, which body or which combination of bodies of CCAMLR is required to best make an accurate assessment of IUU catch, and how data required for the assessment may be acquired.

8.6 There is now very little catch being reported in the CDS from Areas 47, 51 and 57, and in 2005 the CDS catch declared from these areas was lower than the estimated IUU catch (Tables 3.2 and 3.3). If significant IUU catches were mis-reported as having come from Areas 47, 51 and 57 in the past, this would no longer appear to be the case. WG-FSA requested that SCIC consider the possibility that the CDS, previously assumed to be capturing the world trade in toothfish reasonably well, may now be less accurately capturing trade in IUU catch.

8.7 WG-FSA emphasised that its assessments required the best estimates of IUU fishing rather than 'conservative' or 'precautionary' estimates, because the use of these latter estimates may not necessarily result in precautionary estimates of sustainable yield, depending on the assessment method being used. For instance, in the newer CASAL assessments, where the current exploitable biomass is directly estimated from tagging data, the addition of 'precautionarily' high levels of historical IUU fishing might artificially increase the apparent productivity of the stock, whereas in the forward-projection of GYM the reverse would be true.

8.8 The Working Group noted that the historical series of IUU catches might need to be reviewed by SCIC because of the sensitivity of historical estimates to assumptions about catch rates, trip duration and observations of IUU activity. As an example, the Working Group examined the sensitivity of the results to assumed catch rates of IUU vessels (Appendix P), particularly in the 1998/99 to 2000/01 fishing seasons, which would have consequences for historical estimates of IUU catches. The Working Group requested that SCIC review these issues and determine whether a review of the IUU catch series is needed. The Working Group emphasised that the best estimates of IUU are required for its work in assessing and determining sustainable yields for Convention Area fish stocks.

8.9 The Working Group requested that the Scientific Committee ask the Commission which body is responsible for estimating and reviewing the IUU catch in each statistical area and by what method this might be achieved. For example, it will be important to determine the values for input parameters to these calculations, such as:

(i) how to use the sightings information (some of which cannot be adequately verified) currently submitted to the Secretariat by Members without requiring explicit information on surveillance operations to be made available;

(ii) what fishing time might be represented by an observation (i.e. the number of vessels fishing, the duration that they might be fishing in the area, the potential fishing time). One option might be to provide a weighting for each type of observation, such as whether a vessel is observed near to, or far away from, fishing grounds;

(iii) how surveillance activity might be used to estimate IUU fishing activity from observations;

(iv) how these values might be influenced by different kinds of sightings;

(v) what other factors may need to be taken into account to make this approach viable.

8.10 WG-FSA noted that compliance and enforcement experts are needed to determine this information and reiterated its request last year (SC-CAMLR-XXIII, Annex 5, paragraph 8.6) for SCIC to consider whether qualitative information could be provided for each of the regions suitable so that they can be classified as either unmonitored, slightly monitored or heavily monitored with an indication as to whether the level of monitoring has increased or decreased significantly from the previous year.

BIOLOGY, ECOLOGY AND DEMOGRAPHY OF TARGET AND BY-CATCH SPECIES (see also Appendix Q)

New biological information

9.1 In addition to information which was pertinent to the assessment of stocks and dealt with in Fishery Reports and paragraphs 3.43 to 3.53, a large number of papers contained substantial biological information on target and non-target species which was not directly relevant to the assessments. This information, however, helped considerably in further improving our biological understanding of these species. These papers address the following subject areas:

(i) distribution of *C. gunnari* in relation to oceanography and temperature in Subarea 48.3 (WG-FSA-05/76, 05/77);

(ii) reproductive biology of *D. mawsoni* (WG-FSA-05/28, 05/52, 05/63);

(iii) diet of *D. eleginoides* at South Georgia and Shag Rocks (WG-FSA-05/P6);

(iv) age estimation and maturity of the grenadier *M. whitsoni* in Subarea 88.1 (WG-FSA-05/20);

(v) the biology of *D. eleginoides* at Kerguelen (WG-FSA-05/27);

(vi) biology of skate species caught in the toothfish fishery in Division 58.5.2 (WG-FSA-05/70);

(vii) the biology of toothfish and by-catch species in the exploratory fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2 (WG-FSA-05/62);

(viii) validation of ageing in *D. eleginoides* (WG-FSA-05/60, 05/61);

(ix) development of a database of bones from Antarctic fish for identification of fish prey (WG-FSA-05/35).

Matters arising from biology and ecology papers

9.2 The Working Group welcomed the papers from Russia examining the influence of temperature and oceanography on the distribution of *C. gunnari* in Subarea 48.3 (WG-FSA-05/76 and 05/77). The papers indicated that during winter distribution is confined to water temperatures of 1.6–1.7°C, in water deeper than 250 m. During the summer the distribution expands to cover temperatures of 0–1.9°C, with feeding aggregations associated with frontal zones where food is concentrated. Temperatures in excess of 2°C are avoided as they cause physiological processes to slow.

9.3 WG-FSA-05/52 highlighted differences between the size distribution, sex ratio and reproductive condition of *D. mawsoni* in the north and south of Subarea 88.1 with larger fish, a higher proportion of females and higher GSI values in fish in the northern area. The data suggest a possible spawning movement from the southern area to the north.

Species profiles

9.4 The Working Group noted that the icefish species profiles have not been updated since 2003 and that updating the profiles is a major task. The Working Group considered that the species profiles be maintained for *C. gunnari*, *D. eleginoides* and *D. mawsoni*, concentrating on biology and ecology. The species profiles will be coordinated by Dr Hanchet (*D. mawsoni*), Dr M. Collins (UK) (*D. eleginoides*) and Drs K.-H. Kock (Germany) and M. Belchier (UK) (*C. gunnari*). The Working Group noted that it would also be useful to develop profiles for key by-catch species such as skates and macrourids.

CCAMLR Otolith Network (CON)

9.5 In 2004, WG-FSA requested that members of CON provide all age–length data to the Secretariat to assist with the development of a central CCAMLR age-reading database (SC-CAMLR-XXIII, Annex 5, paragraphs 3.59 and 3.60).

9.6 All CON facilities currently involved in toothfish ageing have indicated a willingness to submit their data to such a database. It was agreed that the development of a new age-reading database linked to the existing CCAMLR observer and research survey databases would be the best way to proceed. The vast majority of fish aged to date appear on these databases. However, it was noted that there are age-reading data available for specimens (usually juveniles) that have been obtained from surveys and shore-based sampling programs for which associated biological and related information is not currently available on the CCAMLR databases.

9.7 The Working Group and the Secretariat discussed possible structures for the new database. It was agreed that, in addition to the biological and capture information held for each fish on the current CCAMLR databases, several new fields would be required. These include fields to identify individual laboratories, readers, ring count number, birth date used, quality or readability of otolith preparation and assigned age. The database should also be able to accept multiple readings for individual otoliths thus enabling readings from reference otolith sets to be submitted. It was also recognised that the sampling strategy used to select individuals for ageing needs to be clearly identified in the database and linked, where possible to the relevant sampling documentation.

9.8 The Secretariat produced an outline of the new database structure (Table Q1 and Figure Q1) to be assessed by CON ageing facilities and encouraged CON members to submit their age data to the Secretariat as soon as possible.

9.9 Data access and ownership issues were discussed and the Working Group noted that data ownership resides with Members rather than with the ageing facilities. The Working Group recalled a discussion at WG-EMM about rules for data access (SC-CAMLR-XXI, Annex 4, paragraphs 6.44 and 6.45) and considered that the Rules for Use and Access of CCAMLR Data should provide a framework for access and use of data held in the otolith database.

Ageing workshop of mackerel icefish in 2006

9.10 Age estimates of mackerel icefish differ considerably between laboratories involved in ageing Antarctic fish. These differences could not be reconciled even after an 'Age Determination Workshop' was held in Moscow, Russia, in 1986 and subsequently an exchange of otoliths between laboratories was established (Kock, 1989). The 'Workshop on Approaches to the Management of Icefish' held in Hobart, Australia, in October 2001 recommended further growth studies of this species at South Georgia and Shag Rocks (SC-CAMLR-XX, Annex 5, Appendix D). Following the 'Age Determination Workshop on *Dissostichus eleginoides*' in 2001 (SC-CAMLR-XXI, Annex 5, Appendix H) and considering new ageing techniques which have been developed since the CCAMLR workshop was held in 1986 (Campaña, 2001) and which might be applied to *C. gunnari*, WG-FSA recommended that a second workshop on the ageing of *C. gunnari* be held in the first half of 2006.

9.11 In preparation for the workshop, a paper has been compiled summarising existing knowledge on the ageing of the species (WG-FSA-05/23). Following the meeting of WG-FSA, and after further discussion with the Vice-Director of AtlantNIRO (V. Sushin) on the organisation of the workshop, the Convener will write a letter to the Russian Fisheries Agency in order to seek permission to hold such a workshop in AtlantNIRO in Kaliningrad (Russia) between early April and the end of June 2006.

CONSIDERATIONS OF ECOSYSTEM MANAGEMENT
(see also Appendix R)

Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM)

10.1 In 2004, the Working Group supported the proposal by WG-EMM to establish a standing Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) to advise the Scientific Committee on protocols to be used in acoustic surveys and analyses (SC-CAMLR-XXIII, Annex 5, paragraph 10.8). The Working Group also proposed to extend the terms of reference for SG-ASAM (SC-CAMLR-XXIII, Annex 5, paragraph 13.7).

10.2 Although both WG-EMM and WG-FSA recognised that the acoustic protocol for assessing *C. gunnari* in Subarea 48.3 is an immediate issue to be addressed by SG-ASAM (SC-CAMLR-XXIII, Annex 4, paragraph 4.94; Annex 5, paragraph 13.8), the Scientific Committee agreed that the terms of reference for the first meeting of SG-ASAM would be restricted to issues with respect to krill surveys, namely: (i) alternative models of krill target strength, and (ii) delineation of volume backscattering attributed to krill versus other taxa (SC-CAMLR-XXIII, paragraph 13.5).

10.3 SG-ASAM met in La Jolla, USA, from 31 May to 2 June 2005 (SC-CAMLR-XXIV/BG/3).

10.4 The issue of delineation of volume backscattering strength from krill and other taxa has wider implications for WG-FSA. For example, an acoustic survey for *C. gunnari* needs to discriminate this species from other acoustic scatterers, including krill. The Working Group noted with interest that the conclusion of SG-ASAM was that the 'dB difference' (ΔS_v) technique continues to represent the most objective and pragmatic technique for classifying volume backscattering by taxon (SC-CAMLR-XXIV/BG/3).

10.5 The Working Group recalled the tasks identified for SG-ASAM in its report of last year (SC-CAMLR-XXIII, Annex 4, paragraph 4.94; Annex 5, paragraph 13.8) and that these remained a high priority for the Working Group.

Ecological interactions

10.6 The Working Group considered the ecological interactions arising with respect to fisheries and considered papers that addressed fish by-catch in the krill fishery (WG-EMM-05/19), the fish diet of Antarctic shags (Casaux and Barrera-Oro, 2005), benthos by-catch from the trawl survey (WG-FSA-05/79), and cetacean–fisheries interactions (Kock et al., 2005) (Appendix R).

10.7 The Working Group suggested that a system to quantify the interactions between marine mammals and the longline fishery in a systematic fashion be developed in the intersessional period. This should include direct observations of fish being removed from the line and indirect observations of depredated fish, lost hooks and broken gear, as well as systematic reporting of the presence of killer whales and sperm whales.

Dependent species and ecosystem considerations

10.8 The Working Group considered the broader ecosystem approach to fisheries and in particular consideration of the effects of fisheries on non-target species, through both direct effects, such as incidental mortality, and through trophodynamic changes brought about by fishing. With respect to the ecosystem approach, the Working Group considered that the management of fisheries as two complementary components would be useful:

- firstly, the setting of catch limits for the target species in a fishery
- secondly, the implementation and conduct of that fishery.

10.9 The Working Group agreed that CCAMLR had made progress on both of these components, including implementing the precautionary approach for assessing catch limits. However, beyond adopting escapement levels that endeavour to take account of dependent species, there are currently no adopted tools or assessment procedures used by the Scientific Committee to advise on catch limits according to the requirements of predators on small or large scales. Nor are there adopted tools and assessment procedures for assessing the impacts of existing harvest strategies on dependent species.

10.10 The Working Group highlighted the need to use field observations in an adaptive feedback management procedure in order to proactively monitor the consequences of different management advice and change management strategies before problems arise. This is compared to reactive management, where management measures are implemented in response to unwanted impacts of the fishery.

10.11 In order to help develop such adaptive feedback management procedures, simulation models that characterise important properties of the food webs and ecosystem can be used to help evaluate the robustness of the management strategy to uncertainties arising from natural variability, model structure, the data acquisition program, the assessment methods and the implementation of management measures. In order to provide the data required to develop a simulation environment within which management procedures can be evaluated, the Working Group encouraged the broader consideration of the biology of the exploited species as well as key dependent and related species. Such considerations should include key trophodynamic interactions and life-history parameters in order to aid the development of appropriate ecosystem models.

10.12 In recognising the importance of this work to the development of the ecosystem approach, the Working Group noted that the Steering Committee on Antarctic Plausible Ecosystem Modelling Efforts (APEME) (SC-CAMLR-XXIII, Annex 4, paragraph 5.62) was established by the Scientific Committee to assist with this work. WG-EMM reviewed the nature of this group at its 2005 meeting and has suggested to the Scientific Committee a revised name, Subgroup on Development of Operating Models, along with a revision to the terms of reference for the group (Annex 4, paragraphs 6.30 to 6.32, 6.53 and 6.54). These changes are suggested to better capture the intended function of the group. The Working Group also noted the proposal from WG-EMM to have a workshop coordinated by the Scientific Committee on parameters for use in large-scale models of Antarctic food webs. A proposal for such a workshop, that is intended to benefit the work of both WG-EMM and WG-FSA, will be considered by the Scientific Committee this year (Annex 4, paragraphs 6.33 to 6.47 and 6.55). The Working Group encouraged Members to participate in the work of the subgroup and this workshop and for the Conveners of WG-EMM and WG-FSA to work with the subgroup to provide opportunities for the development of models for use by both working groups.

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION (see also Appendix S)

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 in 2004/05. A total of 47 observation cruises was undertaken (31 trips on longliners, 14 trips on trawlers and 2 trips on vessels fishing with pots). In addition, six observation cruises were carried out on board krill fishing vessels in accordance with the scheme.

11.2 Details of the Working Group discussions on issues related to the Scheme of International Scientific Observation are contained in Appendix S. Specific areas and relevant paragraphs were as follows:

(i) general matters (paragraphs S1 to S9);

(ii) observer conference (paragraphs S10 to S14);

(iii) data collected during the 2004/05 season (paragraph S15);

(iv) conversion factors (paragraphs S16 to S19);

(v) by-catch (paragraph S21);

(vi) tagging programs (paragraph S22);

(vii) *Shinsei Maru* bottom-line system (paragraph S23);

(viii) incidental mortality in fisheries – current and additional requirements (paragraphs S24 to S29);

(ix) scientific observation on krill vessels (paragraphs S30 and S31);

(x) electronic monitoring (paragraphs S32 to S34);

(xi) review of the *Scientific Observers Manual* (paragraphs S35 to S42).

Advice to the Scientific Committee

11.3 Advice provided to the Scientific Committee by the Working Group on the areas outlined above was as follows:

(i) Additional operational requirements of the scheme including, in particular, additions and modifications to the *Scientific Observers Manual* logbook data recording and reporting sheets, and instructions to scientific observers and technical coordinators, should be made in respect of:

(a) only current versions of the cruise reports and logbook forms be used for reporting to CCAMLR, and electronically wherever possible (paragraph S3);

(b) collection of observer data in such a way as to distinguish between haul and set captures (paragraph O10);

(c) the collection of data by observers on longline vessels of vessel setting speed, longline sink rate and streamer line aerial extent remain priority tasks for observers (paragraph O76);

(d) where sink rate data collection is required according to Conservation Measure 24-02, the streamer line data should be collected at the same time as sink rate data where possible (paragraph O79);

(e) improvement in the recording of net cleaning procedures in trawl fisheries (paragraph O205);

(f) accurate reporting of trawl fishery operations including number of tows in voyage, number of tows observed, number of incidental mortalities observed by species per tow and number of incidental mortalities reported from non-observed tows (paragraph S28);

(g) the continued use of the definition of the status of birds 'caught' (SC-CAMLR-XXII, Annex 5, paragraphs 6.214 to 6.217);

(h) an amendment to the krill logbook questionnaire to include a number of additional questions with diagrams of the vessel track and position of krill aggregations (paragraph S34; Annex 4, paragraph 3.36);

(i) accurate reporting of fish by-catch in all data formats (paragraph N36);

(j) modification of the L5 catch composition form for observers to include 'number of hooks observed for fish by-catch' and the total estimated number and weight of each species retained and discarded for a set (paragraph 6.10);

(k) correct completion of L11 forms including information on rajid cut-offs. The minimum requirement would be the completion of this form for at least one observation period every 48 hours (paragraph 6.15);

(l) providing a report to the Secretariat on methods or strategies of fishing that minimise non-target fish by-catch (paragraph 6.23);

(m) advising vessels that all rajids should be cut from the lines whilst still in the water, except on the request of the observer during the observer's biological sampling period (paragraph 6.25);

(n) adoption of a new 4-category scale for assessing rajid release condition by observers. These data should be accurately recorded for at least one observation period every 48 hours (paragraph 6.29);

(o) measurements of fish that are to be tagged and released should not be considered to be part of the observer's random length-frequency sample (i.e. if a fish is to be released as a tagged fish, then this fish should be excluded from the random sample of the catch taken by the observer) (paragraph T12);

(p) measurements of tagged fish that are recaptured should be added to the commercial catch length frequency (where they would normally be a part of the random selection of the observed catch) and landed catch weights (paragraph T12).

(ii) Funding for the participation of CCAMLR observers at the next International Fisheries Observer Conference should be considered (paragraph S13).

(iii) Observer coverage should be required on all vessels participating in Convention Area krill fisheries (paragraph S31).

(iv) Instructions and logbooks from the *Scientific Observers Manual* should be compiled as separate electronic documents. The manual itself would then consist of a comprehensive range of observation guidelines and reference materials which would not necessarily require annual updates (paragraph S42). Furthermore, logbooks should be recorded and submitted in electronic format and the manual should be distributed electronically.

FUTURE ASSESSMENTS

12.1 The Working Group considered future assessment work in light of the discussion and outcomes of this year's meeting. It was agreed that there is a need to continue the development of integrated assessment approaches for toothfish fisheries in the Convention Area.

12.2 In order to improve the efficiency of the work of WG-FSA, the Working Group considered matters of importance to progress the assessment process, data requirements, inputs to these and for each assessed fishery, what was required to be done before an assessment method would be used by WG-FSA to help provide advice on harvest strategies, including catch limits, to the Scientific Committee.

Subarea 48.3 – toothfish

12.3 The Working Group noted a number of other issues that require further examination, including:

(i) Continue development of an integrated assessment for toothfish, including:

(a) different sexes
(b) fleet structure
(c) age–length key
(d) evaluation of recruitment functions, e.g. stock-recruitment relationship, recruitment variability σ_R.

(ii) ASPM

(a) methods for including tagging data in ASPM.

(iii) Assessment inputs

(a) review of biological parameters
(b) movement.

(iv) Standardisation of CPUE.

Division 58.5.1 – toothfish

12.4 The Working Group encouraged the estimation of biological parameters for toothfish at Kerguelen. The Working Group also noted that a preliminary stock assessment could be carried out if CPUE, catch-weighted length frequencies and biological parameters were available.

12.5 As for other toothfish fisheries in the Convention Area, the Working Group recommended that tag–recapture experiments be conducted. It also noted that the carrying out of a recruitment survey in the Kerguelen area would be planned for 2006 and would be very beneficial for a fuller assessment of toothfish stocks on the Kerguelen Plateau.

12.6 The Working Group noted a number of other issues that require further examination, including:

(i) standardisation of CPUE
(ii) estimating biological parameters.

Division 58.5.2 – toothfish

12.7 The Working Group noted the progress in developing an integrated assessment of *D. eleginoides* in CASAL and in evaluating the assessment methods and overall management strategy for this division (WG-FSA-05/69). It agreed that this work should be regarded as a high priority because:

(i) it will enable separating longline fishing from trawl fishing in the historical series as well as using other data such as length composition of catches and the mark–recapture data;

(ii) both short-term and long-term assessments, such as CASAL and GYM, should be evaluated.

12.8 The Working Group also recommended that:

(i) the means by which recruitment cohort strength is estimated from toothfish survey data should be reviewed in the intersessional period, including investigating the possible effects of using the new two-segment growth model;

(ii) given the lack of defined modes in the length-density data, it would be useful to use age–length keys, if possible, as an alternative method for estimating densities of cohorts;

(iii) studies on optimal sampling schemes for establishing age–length keys should be encouraged.

12.9 The Working Group further noted a number of other issues that require further examination, including:

(i) Complete development of an integrated assessment for toothfish

(a) incorporation of survey data, mark–recapture data, catch data
(b) evaluation of recruitment functions, e.g. stock-recruitment relationship, recruitment variability σ_R.

(ii) Assessment inputs

(a) review of recruitment series
(b) development of the use of age–length keys if possible
(c) methods for combining selectivities of different gear types
(d) reviewing biological parameters
(e) movement.

(iii) Standardisation of CPUE.

Subarea 58.6 (Crozet) – toothfish

12.10 The Working Group encouraged the estimation of biological parameters for toothfish at Crozet. The Working Group also noted that a preliminary stock assessment could be carried out if CPUE, catch-weighted length frequencies and biological parameters were available.

12.11 As for other toothfish fisheries in the Convention Area, the Working Group recommended that tag–recapture experiments be conducted.

12.12 The Working Group noted a number of other issues that require further examination, including:

(i) assessment inputs, including estimating biological parameters
(ii) standardisation of CPUE.

Subarea 58.7 (Prince Edward and Marion Islands) – toothfish

12.13 While making some suggestions for further investigations related to the assessment, the Working Group noted that the limited (and conflicting) data available for such analyses meant that considerable uncertainty would remain associated with the results for some time. For this reason, the Working Group encouraged further development of the feedback control management procedure approach of which an initial account is given in WG-FSA-SAM-05/15, particularly as this might also prove informative for other toothfish fisheries.

12.14 The Working Group encouraged South Africa to consider:

(i) requesting the scientific observers on board its vessels to report on the extent of cetacean activity and to collect data on toothfish remains on longline hooks evidencing cetacean predation;

(ii) in the absence of research surveys to consider a 'commercial survey' conducted as a component of commercial operations whereby certain locations are fished in a systematic manner each year to provide an index that is comparable over time.

12.15 The Working Group noted a number of other issues that require further examination, including:

(i) ASPM model advancement;
(ii) evaluation of recruitment functions, e.g. stock-recruitment relationship, recruitment variability σ_R;
(iii) assessment inputs;
(iv) estimating biological parameters;
(v) methods for combining selectivities of different gear types;
(vi) standardisation of CPUE.

Subareas 88.1 and 88.2 – toothfish

12.16 The Working Group welcomed the development of stock models in the Ross Sea and SSRU 882E, and thanked New Zealand for the work that had gone into the development of the integrated modelling approach for the assessment of toothfish in Subareas 88.1 and 88.2.

12.17 The Working Group recommended that future work include investigation and inclusion of the tag and recapture data from all nations operating in Subareas 88.1 and 88.2. The Working Group further recommended that future research consider the movement and stock structure of toothfish, and perhaps investigate such issues using simulation and/or multiple area models.

12.18 The Working Group noted a number of other issues that require further examination:

(i) Continued development of integrated assessments for toothfish, including:

    (a) evaluation of recruitment functions, e.g. stock-recruitment relationship, recruitment variability σ_R.

(ii) Assessment inputs

    (a) review of biological parameters.

(iii) Standardisation of CPUE.

(iv) Development of fisheries research data collection plan for assessments.

12.19 The Working Group also identified issues common to all CCAMLR fisheries, including research needs in the following areas:

(i) By-catch:
tagging of skates
survivorship of rajids released from longlines
age estimation for rajids
standing stock estimates for rajids and *Macrourus* spp.
risk assessments
improved by-catch reporting (cut-offs of rajids).

(ii) Tagging:
Continued evaluation of bias, parameter inputs such as growth challenged, initial mortality, tag loss, tag detection etc.

(iii) Reporting:
Trawl survey report pro forma.

General research toward advancing assessments

12.20 The Working Group agreed that evaluation of management strategies, alternative decision rules and assessment methods for toothfish should be addressed.

12.21 Other topics which the Working Group agreed on include:

(i) the use of alternative approaches to undertake assessments of yield using the outputs of an integrated assessment, e.g. alternative approaches of using MPD combined with multivariate normal approximations of uncertainty compared with using MCMC outputs for toothfish;

(ii) the necessity to have the most up-to-date fisheries data for assessments in the year of assessment;

(iii) determining whether advice could be given on catch limits with data only being complete up to the previous year;

(iv) evaluation of management strategies, alternative decision rules, assessment methods for icefish;

(v) design of age–length key sampling program for toothfish;

(vi) evaluation of the *Scientific Observers Manual* and role of observers from the perspective of data requirements for assessments;

(vii) documenting inputs for assessments, including a review of the essential content of Fishery Reports;

(viii) timetable of assessments:

(a) the timing of agreement on parameter inputs and methodologies for providing advice;

(b) agreement on method at WG-FSA-SAM but incorporate latest available data at WG-FSA;

(c) role of the Secretariat in preparing for assessments, 'newsgroup' for preparing for assessments between WG-FSA-SAM and WG-FSA, secure web location for depositing initial input files for review.

12.22 The Working Group also recommended the following future work:

(i) further development of an integrated assessment of *D. eleginoides* in CASAL, including an evaluation of the assessment methods and overall management strategy for this division (paragraph I41);

(ii) the means by which recruitment cohort strength is estimated from toothfish survey data should be reviewed in the intersessional period, including investigating the possible effects of using the new two-segment growth model (paragraph I42);

(iii) given the lack of defined modes in the length-density data, it would be useful to use age–length keys, if possible, as an alternative method for estimating densities of cohorts (paragraph I42);

(iv) studies on optimal sampling schemes for establishing age–length keys should be encouraged (paragraph I42).

Intersessional work for 2006

12.23 The Working Group agreed on the need for WG-FSA-SAM to meet in July 2006. The Working Group agreed that there is a sufficient amount of work to occupy more than one week.

12.24 Three main areas of work needed (agenda will depend on the time available):

(i) review stock assessment methods for the 2006 WG-FSA meeting (~3 days) – (as in WG-FSA-05 pre-meeting);

(a) review data inputs
(b) determine an agreed methodology/structure
(c) initial MPD trials to review sensitivities etc. in order to determine work plan for preparing for WG-FSA meeting;

(ii) continue development and evaluation work (~3 days);

(iii) estimation of parameters (~2 days).

12.25 The Working Group agreed that the invited expert who participated in the 2005 WG-FSA-SAM meeting was very valuable to the work of the group, and requested that an external expert be invited to the 2006 WG-FSA-SAM meeting.

12.26 The Working Group developed terms of reference for the participation of the invited expert during the 2006 WG-FSA-SAM meeting. They are as follows:

(i) review and evaluate use of alternative approaches for the assessment of toothfish in CCAMLR waters, including:

(a) CASAL
(b) mark–recapture approaches
(c) other models or quantitative methodologies;

(ii) provide input to approaches for evaluating management strategies.

12.27 The Working Group noted that the Scientific Committee will need to consider a budget for the invited expert.

FUTURE WORK

Intersessional Work

13.1 Future work identified by the Working Group is summarised in Table 13.1 and SC-CAMLR-XXIV/BG/28, together with the persons or subgroups identified to take the work forward and references to sections of this report where the tasks are described. The Working Group noted that these summaries list the tasks identified at the meeting or associated with established meeting procedures, and do not include ongoing tasks undertaken by the Secretariat, such as data processing and validation, publications and routine preparations for meetings.

13.2 The Working Group reviewed the activities of subgroups that had worked during 2004/05. These subgroups, with the support of the Secretariat, had produced valuable work and information that had contributed to the assessments and review of information available at the meeting. WG-FSA agreed that these groups should continue their work during the forthcoming intersessional period. Where possible, each subgroup would focus on a small number of key issues. The subgroups would also provide a conduit for information on a wide range of related research. In addition, other tasks were specifically assigned to the Secretariat and/or Members.

13.3 The Working Group reminded participants that membership to the subgroups was open.

13.4 The Working Group agreed to the following intersessional work plan for the subgroups (coordinators are listed in brackets):

- WG-FSA-SAM (Dr Jones) will review and further develop assessment methods and preliminary assessments (see below).

- Subgroup on By-catch (Dr Collins) will review and further develop the assessment of the status of by-catch species and groups, estimation of by-catch levels and rates, assessment of risk both in terms of geographical areas and population demography, estimation of by-catch limits, and mitigation measures.

- Subgroup on Tagging (Mr A. Dunn (New Zealand) and Dr Agnew) will review and further develop the treatment of tagging data, the structure of the tagging database and the tagging protocol.

- Subgroup on the Observer Program (Drs Balguerías and Belchier) will review and further develop the observer protocols, the *Scientific Observers Manual* and priorities for scientific observers in various fisheries.

- Subgroup on Biology and Ecology (Drs Collins and Kock) will review the literature, identify gaps in knowledge and update and coordinate development of species profiles.

- Subgroup on Ecosystem Interactions (Drs Kock and K. Reid (UK)) will review the literature and develop a work plan for the subgroup.

- CCAMLR Otolith Network (Dr Belchier) will review and further develop ageing techniques and age estimation, the structure of the CCAMLR ageing database and the protocols for submitting data to CCAMLR, and coordinate the submission of data.

- Subgroup on IUU Fishing (Dr Agnew and Secretariat) will review and further develop approaches for improved estimation of IUU fishing and total removals and develop the time series of catches estimated from IUU fishing.

- Subgroup on New and Exploratory Fisheries (Dr R. Holt (USA)) will further develop the methods used to monitoring and assessing new and exploratory fisheries and review the Research and Data Collection Plans.

- Subgroup on Fisheries Acoustics (Drs R. O'Driscoll (New Zealand) and S. Kasatkina (Russia)) will further develop the application of acoustic methods for estimating finfish biomass (see below, and paragraphs 10.21 and 10.22).

13.5 Each subgroup was requested to develop a work plan for the intersessional period, in consultation with the appropriate colleagues, members of WG-EMM where appropriate, the Convener of WG-FSA and the Chair of the Scientific Committee.

13.6 The responsibilities for coordinating the intersessional activities of ad hoc WG-IMAF are set out in SC-CAMLR-XXIV/BG/28.

Meeting of WG-FSA-SAM

13.7 The Working Group agreed to hold a meeting of WG-FSA-SAM in 2006, in association with the meeting of WG-EMM. The work plan for WG-FSA-SAM and the meeting arrangements are discussed in paragraphs 12.21 to 12.25.

Age Determination Workshop on *Champsocephalus gunnari*

13.8 The Working Group agreed that an Age Determination Workshop on *C. gunnari* will be held in 2006 (see paragraphs 9.10 and 9.11).

Meeting of SG-ASAM

13.9 The Working Group recommended that the Scientific Committee should again consider the following terms of reference for SG-ASAM, which were proposed by WG-FSA in 2004 (SC-CAMLR-XXIII, Annex 5, paragraph 13.7):

(i) to develop, review and update as necessary, protocols on:

(a) the design of acoustic surveys to estimate biomass of nominated species;

(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 surveys, and *in situ* target strength measurements;

(ii) to evaluate results of acoustic surveys carried out in the CCAMLR Convention Area during the previous year;

(iii) to estimate target strength and its statistical characteristics for key species in the CCAMLR Convention Area;

(iv) to use data from acoustic surveys to investigate ecological interactions and produce information for ecosystem monitoring and management.

13.10 The Working Group noted that the ICES Working Group on Fisheries Acoustic Science and Technology (ICES-FAST) is meeting in Hobart, Australia, from 27 to 30 March 2006 (with associated subgroups meeting on 25 and 26 March and 31 March to 2 April 2006). The Working Group recommended that the Scientific Committee investigate the possibility of holding the second meeting of SG-ASAM in conjunction with the ICES-FAST meeting. Representatives of several Members will already be attending ICES-FAST.

13.11 The Working Group reiterated that an immediate issue for WG-FSA to be addressed by SG-ASAM is the acoustic protocol for assessing *C. gunnari* in Subarea 48.3, including:

(i) discrimination of *C. gunnari* from other acoustic scatterers
(ii) further improvements in target strength estimates for *C. gunnari*
(iii) age-specific patterns in daily vertical distribution of *C. gunnari*
(iv) combination of trawl and acoustic indices for stock assessment.

Fishery Reports

13.12 The Working Group agreed that the newly established Fishery Reports provide concise reference documents for use by participants are well as other readers of the report of WG-FSA. For completeness, the Working Group agreed that the management advice developed during plenary discussion should be reported in the main section of the report of WG-FSA as well as in the relevant Fishery Reports. This has resulted in some duplication of text.

13.13 For other parts of the report, the Working Group strived to avoid duplication. As a result, the management advice developed by subgroups, and later agreed in plenary discussions, is reported only in the main section of the report of WG-FSA.

13.14 The Working Group sought feedback and advice from the Scientific Committee and Commission on the approach adopted in 2005, and on ways to further improve its reports.

OTHER BUSINESS

Matters of importance to WG-FSA and ad hoc WG-IMAF regarding by-catch

14.1 As agreed last year (SC-CAMLR-XXIII, Annex 5, paragraph 6.38), WG-FSA and ad hoc WG-IMAF came together to discuss the development of risk assessments for fish by-catch, based on the model developed by WG-IMAF for seabirds.

14.2 The Working Group recalled the progress achieved last year when an example of risk categorisation for sleeper sharks (*Somniosus* spp.) in Division 58.5.2 was developed based on information presented in WG-FSA-03/69 (SC-CAMLR-XXIII, Annex 5, paragraphs 6.53 to 6.58 and Table 6.5).

14.3 WG-FSA-05/21 presented new summaries for *M. whitsoni* and *A. georgiana* in the Ross Sea based on published and unpublished literature and data from the exploratory fishery up to and including 2004/05. *Amblyraja georgiana* was placed in risk category 3. The risk to *A. georgiana* was considered to be mitigated by CCAMLR's recommendation to cut and release all skates from longlines whilst still in the water. *Macrourus whitsoni* was placed in risk category 2–3. These categories are described in paragraph N55.

14.4 WG-FSA and WG-IMAF considered ways to develop such risk assessments and how these assessments may be used in the future. It was recognised that at present the risk assessments undertaken by the WG-FSA subgroup and by WG-IMAF are rather different in terms of criteria and scope. Thus WG-FSA criteria related mainly to life-history characteristics (especially demography) and to distribution (especially in terms of overlap with existing fisheries and with exploited target species) whereas WG-IMAF criteria principally related to overlap with fisheries and to global conservation status (incorporating demography and population trends) as defined by IUCN criteria. It was agreed that, as feasible, harmonisation of risk assessment principles and procedures would be desirable. In addition, risk categories should be linked to assessment and management considerations. For example, a by-catch species in risk category 3 may require the development of a long-term assessment of its biomass and vulnerability to fishing.

14.5 WG-FSA and WG-IMAF agreed that this concept should be further explored and then applied, initially, to major by-catch groups.

CCAMLR Statistical Bulletin

14.6 The Working Group considered the eSB which the Secretariat had developed at the request of WG-FSA (SC-CAMLR-XXI, Annex 5, paragraph 13.8). This development was reported in SC-CAMLR-XXIV/5 (see also paragraph 3.2).

14.7 The eSB, which supports all four official languages, allows users to replicate the six sections which are published in the hardcopy of the bulletin, namely:

Section A Maps and standard abbreviations.

Section B Catch and effort data based on STATLANT data which are reported by Members. Catch statistics are presented for all taxa of fish and invertebrates reported in the STATLANT data.

Section C Catch histories for species which have a total reported catch in any one season of more than 2 000 tonnes. Catches are taken from the STATLANT data.

Section D Fine-scale catches of target species, plotted by fine-scale rectangle (0.5° latitude by 1° longitude) and three-month period (quarter), in Area 48 based on aggregated fine-scale data.

Section E Landing and trade data reported under the CDS for *Dissostichus* spp.

Section F Seabed areas used in fishery assessments conducted by WG-FSA. These areas are mostly derived from the global and seafloor topography dataset of Sandwell and Smith.

14.8 In addition, the eSB allows users to access the complete dataset of statistics underlying Sections B to E and to develop user-defined queries to summarise these data, generate tables and graphics, and extract selected data (as requested by WG-FSA).

14.9 Users of the eSB may access and extract the following datasets:

(i) STATLANT data, as submitted by Members.

(ii) Aggregated fine-scale data. These data are highly aggregated and do not allow users to obtain vessel-specific, location-specific or country-specific information. The aggregated fine-scale data available in the eSB are limited to the following fields:

- species (code, name)
- area (subarea, division)
- coordinates of the fine-scale rectangle
- season
- month
- quarter
- catch (tonne).

(iii) Aggregated CDS data, as presented in tables in Section E of the hardcopy.

(iv) Seabed areas, as presented in Section F of the hardcopy.

14.10 The Working Group noted that aggregated fine-scale data for target species in Area 48 have been published in the bulletin in graphic form since 1990, and in digital format since 2002 (in the Excel version of the electronic volume). These data did not contain any effort information and could not be used to calculate catch rates.

14.11 Some participants expressed concern that the aggregated fine-scale data available in the eSB, although aggregated, may provide information which may be used by IUU fishing vessels. Some participants were concerned that the aggregated fine-scale data may divulge proprietary information.

14.12 The Working Group considered three options for addressing these concerns:

(i) accept that the aggregated fine-scale data were sufficiently aggregated to protect the interests of Members;

(ii) categorise the catch reported in the aggregated fine-scale data using a scale similar to that used in the plots in the hardcopy (e.g. 0–5, 5–25, 25–125, 125–625, 625–3 000 and >3 000 tonnes); or

(iii) make the eSB available to Members only.

14.13 The Working Group agreed that choosing one of these options would involve a trade-off between protecting confidential information and proving detailed information to users. The Working Group requested the Scientific Committee and Commission address this issue and decide on an appropriate approach concerning fine-scale data.

14.14 The Working Group thanked the Secretariat for developing the eSB and providing an advanced version of the database for evaluation.

Proposal to reorganise the work of the Scientific Committee

14.15 Dr Constable presented a proposal to reorganise the work of the Scientific Committee and its working groups. This proposal was initially presented to WG-EMM (WG-EMM-05/35; Annex 4, paragraphs 7.21 to 7.28) and a revised version would be presented to SC-CAMLR-XXIV.

14.16 The proposal is to rearrange the intersessional timetable of the Scientific Committee and its working groups to better accommodate the generic structure of the work of the Scientific Committee and to remove unnecessary overlap currently existing across the two working groups – WG-FSA and WG-EMM. The generic structure contains elements of:

- biology and ecology
- fisheries information
- quantitative modelling and assessment methods
- assessment of harvest controls
- implementation of the precautionary approach
- conservation requirements
- scientific observer program
- advice to the Commission.

14.17 This new structure would be designed to provide a greater focus to specific intersessional meetings that deal with general issues in a single forum rather than having to be discussed across many meetings that are currently designed around specific species, thereby allowing participants to focus their work and participation in areas of need, expertise and interest. Improved focus would also allow conveners and meeting organisers to draw more readily on experts to contribute in key areas of CCAMLR's work.

14.18 The Working Group noted that the present workload during its meetings and during the intersessional periods was very high. This was because all aspects of the work of the Scientific Committee were endeavoured to be covered every year. As a result, work was progressing in areas of immediate need (e.g. WG-FSA-SAM) at the expense of having greater longer-term strategic activity. Increasing the workload of participants was not considered feasible. Yet, it has become clear that biology and ecology is not given much attention at meetings. Similarly, there is an increasing need to consider conservation issues with no time available to do so without extra meetings in the existing calendar.

14.19 Dr Constable proposed that the focus of the Scientific Committee's work could be improved by rearranging the manner in which the Committee manages the current five weeks of intersessional work (currently – 2 weeks of WG-EMM, 1 week of WG-FSA-SAM and 2 weeks of WG-FSA including ad hoc WG-IMAF). It is proposed that a three-week meeting block be held in the middle of the intersessional period comprising:

- a meeting on biology, ecology and conservation (including protected areas) in week 1;

- a workshop on management procedures allowing interaction between biologists, statisticians and modellers in week 2;

- a meeting on assessment, analytical and modelling methods in week 3.

14.20 Meeting participants could then choose whether to attend for 1, 2 or 3 weeks according to their expertise and interests. This arrangement would not preclude participants in the meeting in the first week from continuing deliberations into the second week. Similarly, the meeting on methods in the third week could begin earlier if need be to facilitate satisfactory conclusions in the main meeting.

14.21 In addition, it may be possible to reduce some of the current workload on providing advice to the Scientific Committee by reducing the frequency of revisions and updates of information and assessments. For example, assessment and management advice may be provided to the Scientific Committee:

- every two years for assessed toothfish fisheries
- every five years for krill fisheries
- on request for icefish fisheries (i.e. following a survey)
- every two years for by-catch species
- every five years for the ecosystem
- every year for an update on the conduct, status and future of CCAMLR fisheries, including new and exploratory fisheries.

As a result of altering the frequency of activities, the meeting of WG-FSA and WG-IMAF might be able to achieve satisfactory outcomes in one week rather than two, provided that adequate time was available by participants and the Secretariat for preparation of meeting reports. If special preparations are required, then a pre-meeting preparatory session could be arranged for appropriate experts.

14.22 Dr Constable also proposed that the Scientific Committee may wish to consider an enhanced role for the Secretariat in preparing preliminary assessments for the working groups.

14.23 These arrangements would leave one week on the intersessional calendar for the Scientific Committee to have a workshop on strategic issues as needed.

14.24 In terms of structure, Dr Constable proposed that three working groups could be designed to accommodate the intersessional activities:

- Working Group on Biology, Ecology and Conservation
- Working Group on Statistical, Assessment and Modelling Methods
- Working Group on Assessments.

The Scientific Committee would be responsible for appointing conveners and coordinating the workshops.

14.25 The Working Group thanked Dr Constable for looking ahead and developing a proposal to improve the allocation of the Scientific Committee's and its participants' work and time commitments. However, it was difficult to see how such a re-focus may be achieved given the very high work load of WG-FSA.

14.26 The Working Group recommended that the Scientific Committee establish an ad hoc group during SC-CAMLR-XXIV to further consider Dr Constable's proposal and investigate the feasibility, acceptability and logistics of reorganising its work.

14.27 The Working Group agreed that the integrated toothfish assessments are in a state of development. These assessments will require annual review in the short term. Consequently, it will be several years before such assessments could be reviewed at less frequent intervals.

Submission of meeting documents

14.28 At the request of the Scientific Committee, the Secretariat prepared a single reference document which provides guidelines for the submission of meeting documents to the Scientific Committee, WG-EMM and WG-FSA (including ad hoc WG-IMAF).

14.29 In doing so, the Secretariat noted some working group-specific differences in relation to: submission deadline; exception to the deadline; and approach to accepting revised documents.

14.30 WG-EMM agreed that standardising the working groups' guidelines in relation to the submission of meeting documents would simplify and unite the guidelines which participants to both WG-EMM and WG-FSA are required to follow. Standardisation would also simplify the Secretariat's work in preparing information and documents for meetings. Consequently, WG-EMM agreed to a proposal to standardise the specific differences which relate to the submission of documents to its meetings (WG-EMM-05/10).

14.31 In revising its guidelines, WG-EMM also agreed to the following points (Annex 4, paragraphs 7.14 to 7.20):

(i) papers would not be limited to 15 pages, but authors should note that long papers many not be given full attention if there is limited time;

(ii) in relation to the submission of published papers to the meeting, WG-EMM agreed that authors should continue to provide an electronic version of the published paper. It was also agreed that the author of the published paper was responsible for any copyright issue arising from the submission to the meeting;

(iii) papers that were 'in press' at the time of the meeting should be considered as published documents with respect to copyright;

(iv) references to in-press and published papers should continue to be listed under 'Other Documents' in the 'List of Documents' which is appended to the report;

(v) there is a need for easily identifying published papers for which the authors have requested consideration by the Working Group. The Secretariat was asked to consider a simple method for identifying such papers, for the purpose of the meeting;

(vi) all meeting documents distributed by the Secretariat should be in locked pdf format to avoid any unauthorised use or incidental change to the text. However, in order to facilitate the work of the rapporteurs, it was agreed that the one-page synopses should be made available separately and in unlocked pdf during the meeting.

14.32 WG-FSA noted that the Secretariat had illustrated points (ii) to (v) by extending the document numbering system used at WG-FSA-05 to include a category for published papers (e.g. WG-FSA-05/P1). This category uses a modified one-page synopsis which provides details of the authors and summary findings as related to nominated agenda items; published papers submitted to the meetings are to be listed under 'Other Documents'.

14.33 The Working Group considered this matter and agreed to amend its submission guidelines to include points (i) to (vi) above.

Access to meeting documents

14.34 Dr Constable proposed that documents submitted at previous meetings be made available electronically in a reference library at future meetings of WG-FSA and, generally, CCAMLR working groups.

14.35 The Working Group recalled that, under the Rules for Access and Use of CCAMLR Data, meeting documents shall not be cited or used for purposes other than the work of the CCAMLR Commission, Scientific Committee or their subsidiary bodies without the written permission of the originators and/or owners of the data therein. These documents are presented for consideration by CCAMLR and may contain unpublished data, analyses and/or conclusions subject to change.

14.36 The Working Group noted that WG-FSA participants had access, through the Secretariat's library, to the bound hardcopy volumes of all meeting documents submitted to the Scientific Committee and its working groups.

14.37 The Working Group considered Dr Constable's proposal and agreed to refer this matter to the Scientific Committee. The Scientific Committee's advice was sought as to whether or not an electronic reference library of meeting documents could be made available generally to meeting participants under the Rules for Access and Use of CCAMLR Data.

Other

14.38 Dr Marschoff stated that, regarding incorrect references to the territorial status of the Malvinas Islands made in WG-FSA-05/56 (paragraphs O110 and O111), Argentina reserves its position as to its sovereignty rights on the Malvinas Islands and surrounding waters. The Malvinas Islands, South Georgia and the South Sandwich Islands and the surroundings waters are an integral part of the Argentine national territory.

ADOPTION OF THE REPORT

15.1 The report of the meeting and associated background documents SC-CAMLR-XXIV/BG/26, BG/27 and BG/28 were adopted.

CLOSE OF MEETING

15.2 In closing the meeting, the Convener thanked all participants, rapporteurs and subgroup coordinators for furthering the work of WG-FSA, and the Secretariat for their contribution and support. Substantial progress had been achieved during the meeting, including the first assessment of an exploratory fishery (toothfish in Subareas 88.1 and 88.2).

15.3 Drs Constable and Kirkwood, on behalf of WG-FSA, thanked Dr Hanchet for his work in the intersessional period and during the meeting; his convenership had ensured the success of the meeting.

15.4 The meeting was closed.

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Table 3.1: Total reported catches (tonnes) of target species in fisheries in the Convention Area in the 2004/05 season. Source: catch and effort reports submitted by 21 September 2005 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-04	14-Nov-05	42-01 (2004)	200	3 574	6
	58.5.2	Trawl	01-Dec-04	30-Nov-05[1]	42-02 (2004)	1 791	1 864	96
Dissostichus eleginoides	48.3	Longline and pot	01-May-05	29-Aug-05[2]	41-02 (2004)	3 018	3 034[3]	99
	48.4	Longline	01-May-05	1-Aug-05[b]	41-03 (1999)	27	28	96
	58.5.1	Longline in French EEZ[4]	ns	ns	ns	3 186	ns	-
	58.5.2	Longline and trawl	01-May-05	30-Nov-05[1]	41-08 (2004)	2 783	2 787	100
	58.6	Longline in French EEZ[4]	ns	ns	ns	385	ns	-
	58.6	Longline in South African EEZ	ns	ns	ns	31	ns	-
	58.7	Longline in South African EEZ	ns	ns	ns	92	ns	-
Dissostichus spp.	48.6	Exploratory longline	01-Dec-04	30-Nov-05	41-04 (2004)	49	910	5
	58.4.1	Exploratory longline	01-Dec-04	30-Nov-05	41-11 (2004)	480	600	80
	58.4.2	Exploratory longline	01-Dec-04	30-Nov-05	41-05 (2004)	127	780	16
	58.4.3a	Exploratory longline	01-May-05	31-Aug-05	41-06 (2004)	110	250	44
	58.4.3b	Exploratory longline	01-May-05	14-Feb-05[2,5]	41-07 (2004)	295	300	98
	88.1	Exploratory longline	01-Dec-04	27-Mar-05[2]	41-09 (2004)	3 079	3 250	95
	88.2	Exploratory longline	01-Dec-04	5-Feb-05[2]	41-10 (2004)	412	375	110
Euphausia superba	48	Trawl	01-Dec-04	30-Nov-05	51-01 (2002)	124 535	4 000 000	3
	58.4.1	Trawl	01-Dec-04	30-Nov-05	51-02 (2002)	0	440 000	0
	58.4.2	Trawl	01-Dec-04	30-Nov-05	51-03 (2002)	0	450 000	0
Lithodidae	48.3	Pot	01-Dec-04	30-Nov-05	52-01 (2004)	0	1 600	0
Martialia hyadesi	48.3	Exploratory jig	01-Dec-04	30-Nov-05	61-01 (2004)	0	2 500	0

1 Closure under review.
2 Fishery closed on advice from the Secretariat.
3 Catch limit of 3 050 tonnes was reduced by 16 tonnes to take account of the IUU catch from the vessel *Elqui*.
4 Data reported by France for fishing to August 2005.
5 Fishing allowed under exemption to prescribed season.
ns Not specified by CCAMLR.

Table 3.2: Estimated effort, catch rates and total catches from IUU fishing for *Dissostichus* spp. in the Convention Area in the 2004/05 season. Detailed calculations are in SCIC-05/10 Rev. 2 (see also SC-CAMLR-XXIII, Annex 5, Table 3.3).

Subarea/ Division	Estimated start of IUU fishing	No. of vessels sighted	No. of IUU fishing vessels otherwise reported	Total no. vessels reported	Additional no. vessels extrapolated to 30 Nov 2005	Estimated no. of IUU fishing vessels	Estimated no. of days per fishing trip	No. trips per year	Estimated effort (days fished), no extrapolation	Estimated effort in days fishing 2005	Mean catch rate (tonnes/ day)	Estimated IUU catch to 30 Sep 2005, no extrapo- lation	Estimated IUU catch (9) x (10) extrapolated to 30 Nov 2005
(column)		1	2	3	4	5	6	7	8	9	10	11	12
48.3	1991	1		1	0.2	1.2	15	1.0	15	15	1.6	23	23
58.4.2	2002		2	2	0.4	2.4	41	1.5	123	148	0.7	86	103
58.4.3a	2003	2		2	0.4	2.4	41	1.5	123	148	0.8	98	118
58.4.3b	2003	6	4	10	2.0	12.0	41	1.5	615	738	1.5	923	1107
58.4.4a	1996	2		2	0.4	2.4	40	2.5	200	240	1.1	220	264
58.5.1	1996		1	1	0.2	1.2	30	1.9	57	68	4.7	268	321
58.5.2	1997		1	1	0.2	1.2	30	2.0	59	71	4.5	265	318
58.6	1996	1		1	0.2	1.2	40	1.0	40	48	0.3	12	14
58.7	1996	2		2	0.4	2.4	40	1.5	120	144	0.5	60	72
88.1	2002	1		1	0.2	1.2	40	1.0	40	48	3.6	144	173
Subtotal												2100	2515
Including undocumented landings of toothfish which cannot be attributed to a sighting or an area												508	508
Total												2608	3023

Notes on the columns
1. From reports of vessel sightings submitted by Members.
2. From information reported via other sightings, port inspections or fishing vessels/traders.
4. Calculated pro rata for 1 October to 30 November 2005.
6. Estimates of the duration of fishing trips for IUU vessels have been agreed and used by WG-FSA for a number of years.
10. Mean catch rates taken from the five-day catch and effort database, where available. CDS data used otherwise.

Undocumented landings = 730 tonnes not included in total. Vessels were *Golden Sun*, *Lucky Star*, *Keta*/*Julius*/*Sherpa Uno*, *Lugalpesca*/*Hoking*/*Sargo* and *Ross*. *Sargo* and *Ross* were included in sightings which accounts for an estimated 222 tonnes (although *Ross* actually had 160 tonnes but may have accepted transhipped catch). Therefore, 508 tonnes were added to the overall total.

Details of sighted vessels

Column 1	48.3	*Elqui* (15/3/05)
Column 2	58.4.2	*Sargo*, *Keta*?
Column 1	58.4.3a	*Hammer* (22/2/05 and 28/4/05)
Column 1	58.4.3b	*Condor* (25/2/05), *Koko* (22/4/05), *Jian Yuan* (26/2/05), *Kang Yuan* (24/1/05 and 24/2/05), *Ross* (23/2/05 and 17/3/05)
Column 2	58.4.3b	4 x unidentified (31/1/05, 9/1/05, 10/1/05, 9/3/05)
Column 1	58.4.4a	*Condor* (2/8/05), *Red Lion* (1/8/05 – sighted in Division 58.4.4b, but advised that it intended to fish in Division 58.4.4a)
Column 2	58.5.1	*Condor* (29/12/04)
Column 2	58.5.2	*Condor* (30/12/04)
Column 1	58.6	*Sea Storm* (29/7/05)
Column 1	58.7	*Aldabra* (10/8/05), 1 x unidentified (9/2/05 – gear and marker buoys found)
Column 1	88.1	*Taruman* (15/6/05 – 145 tonnes offloaded)

Table 3.3: Reported catch (tonnes) of *Dissostichus* spp. and estimated catch from IUU fishing in the Convention Area, and catch reported in the CDS in areas outside the Convention Area in the 2003/04 and 2004/05 seasons.

2003/04 season

Inside	Subarea/Division	Reported catch	IUU catch	Total CCAMLR	*Catch limit*
	48.3	4 497	0	4 497	*4 420*
	48.4	0		0	*28*
	48.6	7		7	*910*
	58.4.2	20	197	217	*500*
	58.4.3 (a and b)	7	246	253	*550*
	58.4.4	0	0	0	*0**
	58.5.1	5 171	643	5 814	*0**
	58.5.2	2 864	637	3 501	*2 873*
	58.6	607	456	1 063	*0**
	58.7	133	58	191	*0**
	88.1	2 197	240	2 437	*3 250*
	88.2	375	0	375	*375*
	Area unknown	0	145	145	-
	Total inside	15 877	2 622	18 500	
Outside	**Area**	**CDS catch EEZ**	**CDS catch high seas**	**Total Outside CCAMLR**	
	41	3 811	4 600	8 411	-
	47	0	798	798	-
	51	25	364	389	-
	57	0	18	18	-
	81	362	0	362	-
	87	5 565	263	5 828	-
	Total outside	9 763	6 043	15 806	-
Global Total				34 306	

2004/05 season (to October 2005)

Inside	Subarea/Division	Reported catch	IUU catch	Total CCAMLR	*Catch limit*
	48.3	3 018	23	3 041	*3 050*
	48.4	27		27	*28*
	48.6	49		49	*910*
	58.4.1	480		480	*600*
	58.4.2	127	103	230	*780*
	58.4.3 (a and b)	405	1 225	1 630	*550*
	58.4.4	0	264	264	*0**
	58.5.1	3 186	321	3 507	*0**
	58.5.2	2 783	318	3 101	*2 787*
	58.6	416	14	430	*0**
	58.7	91	72	163	*0**
	88.1	3 079	173	3 252	*3 250*
	88.2	412	0	412	*375*
	Area unknown	0	508	508	-
	Total inside	14 074	3 023	17 094	

(continued)

Table 3.3 (continued)

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR	
	41	2 741	1 724	4 465	-
	47	0	78	78	-
	51	8	33	41	-
	57	0	0	0	-
	81	54	0	54	-
	87	3 870	3	3 873	-
	Total outside	6 673	1 838	8 511	-
Global total				25 605	

* Outside EEZs

Reported catch: 2003/04 from STATLANT data
2004/05 catch and effort reports to 21 September 2005, except data for France reported to August 2005

IUU catch: From SCIC-05/10 Rev. 2

CDS estimate: Data submitted to the Catch Documentation Scheme by 4 October 2005. The allocation between EEZ and high seas is based on the Secretariat's knowledge of vessel activity such as licence information, vessel size and trip duration.

Catch limits agreed by the Commission.

Table 5.1: Summary table for exploratory fisheries in 2004/05. Source: WG-FSA-05/6 Rev. 1.

Exploratory fisheries in Area 48 (Atlantic Ocean sector)

Subarea/Division	Member	Number of vessels		Reported catch (tonnes) of *Dissostichus* spp.
		Notified	Fished	
48.6 north of 60°S	Japan	1	1	
	Republic of Korea	2	0	
	New Zealand*	4	0	
Total		7	1	47
48.6 south of 60°S	Republic of Korea	2	1	
	New Zealand*	4	0	
Total		6	1	2

Exploratory fisheries in Area 58 (Indian Ocean sector)

Subarea/Division	Member	Number of vessels		Reported catch (tonnes) of *Dissostichus* spp.
		Notified	Fished	
58.4.1	Chile+	3	1	
	Republic of Korea	2	2	
	New Zealand	4	1	
	Spain	2	2	
	Ukraine*	1	0	
Total		12	6	480
58.4.2	Chile+	2	1	
	Republic of Korea	2	1	
	New Zealand	4	1	
	Spain	2	1	
	Ukraine*	1	0	
Total		11	4	127
58.4.3a	Australia	1	1	
	Republic of Korea	2	1	
	Spain	2	2	
Total		5	4	110
58.4.3b	Australia	1	0	
	Chile+	2	1	
	Japan*	1	0	
	Republic of Korea	2	1	
	Spain	2	2	
Total		8	4	295

Exploratory fisheries in Area 88 (Southwest Pacific sector)

Subarea/Division	Member	Number of vessels		Reported catch (tonnes) of *Dissostichus* spp.
		Notified	Fished	
88.1	Argentina	2	1	
	Australia*	1	0	
	New Zealand	5	3	
	Norway	1	1	
	Russia	2	2	
	South Africa	2	0	
	Spain	2	0	
	Ukraine*	1	0	
	UK	1	1	
	Uruguay	4	2	
Total		21	10	3079
88.2	Argentina	2	0	
	New Zealand	5	1	
	Norway	1	1	
	Russia	2	2	
Total		10	4	412

* Withdrawn from fishery
[+] Vessel withdrawn from fishery

Table 5.2: Number of vessels (a) notified by Members in exploratory longline fisheries for *Dissostichus* spp. in the 2005/06 season, and (b) corresponding number of vessels and catch limits agreed in conservation measures in force in the 2004/05 season. Source: SC-CAMLR-XXIV/BG/5.

Member notifications	Number of vessels notified per subarea/division						
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
(a) Exploratory longline fisheries for *Dissostichus* spp. in the 2005/06 season							
Argentina						2	2
Australia		1	1	1	1		
Chile[1]		2	2	2	2		
Japan	1						
Republic of Korea		2	1	1	2	2	1
New Zealand	1	3	2			5	5
Norway						1	1
Russia						2	2
South Africa[2]						1	
Spain		2	2	2	2	3	3
UK						2	2
Uruguay		1			1	3	1
Number of Members	2	6	5	4	5	9	8
Number of vessels	2	11	8	6	8	21	17
(b) Conservation measures in force in the 2004/05 season							
Number of Members	3	5	5	3	5	10	4
Number of vessels	3*	9	8	3*	5*	21	10
Target species catch limit (tonnes)	910	600	780	250	300	3250	375

[1] Notifications received 23 August 2005
[2] Notification received 4 August 2005
* Maximum number of vessels allowed to fish at any one time

Table 5.3: Unstandardised CPUE (kg/hook) of *Dissostichus* spp. in exploratory longline fisheries between the 1996/97 (1997) and 2004/05 (2005) fishing seasons. Source: fine-scale data from commercial and fishery-based research hauls.

Subarea/ Division	SSRU	Season								
		1997	1998	1999	2000	2001	2002	2003	2004	2005
48.6	486A								0.04	0.07
	486E									0.08
58.4.2	5842A									0.07
	5842C							0.10		0.07
	5842D							0.19	0.06	
	5842E							0.21	0.11	0.14
58.4.3a	5843A									0.05
58.4.3b	5843B								0.09	0.16
88.1	881A	0.01				0.02		0.15		
	881B	0.05	0.03			0.16	0.25	0.27	0.11	0.55
	881C					0.44	0.87	0.58	0.31	0.53
	881E		0.07	0.06		0.03		0.05	0.08	0.28
	881F		0.00					0.03		
	881G		0.06	0.02		0.13	0.12	0.16	0.12	0.15
	881H		0.17	0.26	0.38	0.41	0.72	0.45	0.21	0.73
	881I		0.37	0.23	0.28	0.28	0.43	0.20	0.16	0.44
	881J			0.09	0.18	0.04			0.04	0.22
	881K		0.32	0.15	0.39		0.45		0.01	0.32
	881L					0.12			0.10	0.13
88.2	882A						0.82		0.11	0.44
	882B								0.06	
	882E							0.35	0.42	0.70

Table 13.1: List of tasks identified by WG-FSA for the 2005/06 intersessional period. Tasks identified by ad hoc WG-IMAF are listed in SC-CAMLR-XXIV/BG/28. The paragraph numbers (Ref.) refer to this report. E – established practice. Priority: high priority (1); general request (2).

	Task	Ref.	Priority	Action required	
				Members/Subgroups	Secretariat
	Organisation of the meeting				
1.	Submit papers to WG-FSA-06 in accordance with the guidelines.	14.33	1	Members to implement	Coordinate and implement
2.	Circulate list of documents with agenda items at start of meeting.	E	1	Convener to implement	Assist
	Review of available information				
3.	Continue tagging rajids.	E	1	Members to implement	
4.	Provide accurate and consistent data on by-catch.	E	1	Members to implement	Assist
5.	Submit data in a timely manner and using current CCAMLR formats.	E	1	Members to implement	Assist
6.	Process fishery, observer and survey data submitted to CCAMLR.	E	1		Implement
7.	Further develop routine validation procedures for database extractions.	E	1		Implement
8.	Update time series of data in the Fishery Reports.	E	1		Implement
9.	Update estimates of reported catches, catches from IUU fishing and total removals by season and area within the Convention Area.	E	1	Members to provide information on IUU fishing by 1 October	Implement
10.	Update estimates of catches reported in CDS data by season and area outside the Convention Area.	E	1		Implement
11.	Update information on scientific observations.	E	1		Implement
12.	Update Fishery Plans.	E	1		Implement
13.	Develop a manual on database extractions used by WG-FSA.	3.7	1		Implement
14.	Notify research surveys.	E	1	Members to implement	
	Assessments and management advice				
15.	Review and provide additional information for Fishery Reports.	E	2	Members to implement	Update

	Task	Ref.	Priority	Action required	
				Members/Subgroups	Secretariat
	Fish and invertebrate by-catch				
16.	Compare by-catch levels arising from different longline configurations.	6.22	2	Members to implement	Assist
17.	Report to the Secretariat on methods or strategies of fishing that minimise by-catch catches.	6.23	1	Members to implement	Assist
18.	Cut all rajids from fishing lines whilst still in the water, except on the request of the observer during biological sampling periods.	6.25, 6.28	1		
19.	Undertake further experiments to estimate the survivorship of rajids cut from longlines.	6.27	1		
20.	Develop a framework for risk assessments.	14.4–14.5	1	Members to develop	Assist
	Evaluation of threats arising from IUU activities				
21.	Further develop estimation methods.	8.4–8.9	1	SCIC to consider, Members to implement	Coordinate and implement
	Biology, ecology and demography of target and by-catch species				
22.	Update the species profile for *D. eleginoides*.	9.4	1		Assist
23.	Update the species profile for *D. mawsoni*.	9.4	1		Assist
24.	Update the species profile for *C. gunnari*.	9.4	1		Assist
25.	Develop a central CCAMLR age-reading database.	9.5–9.9	1	CON to coordinate	Implement
26.	Convene a workshop on the age determination of icefish.	9.10–9.11	1		Assist
	Consideration of ecosystem management				
27.	Progress the work program of the Steering Committee on Antarctic Plausible Ecosystem Modelling Efforts.	10.12	1	Members to implement	Assist

	Task	Ref.	Priority	Action required	
				Members/Subgroups	Secretariat
	New and Exploratory Fisheries				
28.	Develop a more structured research plan for 2006/07.	5.19	1	Members to develop proposals	
29.	Tag toothfish under the research plan and submit the data to the Secretariat.	5.33	1	Members to implement	Assist
30.	Look out for tagged fish and submit data from recaptured fish.	5.34	1	Members to implement	Assist
31.	Vessels to record a unique haul identifier on the C2 data form, observers to ensure that the identifier is recorded on their data form.	5.35	1	Members to implement	Assist
32.	Ensure that the required number of research sets is completed and submitted to the Secretariat.	5.33	1	Members to implement	Assist
	Scheme of International Scientific Observation				
33.	Use only current versions of CCAMLR data forms.	11.3	1	Members to implement	Assist
34.	Report experience with sub-sampling methods.	11.3	1	Members to implement	Assist
35.	Collect data according to the revised procedure.	11.3	1	Members to implement	Assist
36.	Update the *Scientific Observers Manual* and data forms.	11.3	1		Implement
37.	Accurately report by-catch in all data forms.	11.3	1	Members to implement	Assist
38.	Accurately report rajid cut-offs.		1	Members to implement	Assist
39.	Update the *Scientific Observers Manual* to include a new 4-category scale for assessing the condition of rajids released from longlines.	11.3, 6.29	1		Implement
40.	Implement a new 4-category scale for assessing the condition of rajids released from longlines.	11.3, 6.29	1	Members to implement	Assist
41.	Compile observer instructions and logbooks as separate documents.	11.3	1		Implement

	Task	Ref.	Priority	Action required	
				Members/Subgroups	Secretariat
	Future Assessments				
42.	Convene a meeting of WG-FSA-SAM.	12.23–12.26	1	Members to implement	Assist
43.	Further develop assessments for toothfish in Subarea 48.3.	12.3	1	Members to implement	Assist
44.	Further develop assessments for toothfish in Division 58.5.1.	12.4–12.6	2	Members to implement	Assist
45.	Further develop assessments for toothfish in Division 58.5.2.	12.7–12.9, 5.101	1	Members to implement	Assist
46.	Further develop assessments for toothfish at Crozet Islands.	12.10–12.12	2	Members to implement	Assist
47.	Further develop assessments for toothfish at Prince Edward and Marion Islands.	12.13–12.15	2	Members to implement	Assist
48.	Further develop assessments for toothfish in Subareas 88.1 and 88.2.	12.16–12.19	1	Members to implement	Assist
49.	Conduct general research towards advancing assessments.	12.20	2	Members to implement	Assist
50.	Convene a meeting of SG-ASAM.	13.9–13.11	1	SC-CAMLR-XXIV to consider, Members to implement	Assist
51.	Liaise with data owners and extend the catch-weighted length frequencies for toothfish in Subarea 48.3 prior to 1992/93.	App. G: 6	1	Members to assist	Implement

APPENDIX A

AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2005)

1. Opening of the meeting

2. Organisation of the meeting and adoption of the agenda

    2.1 Organisation of meeting
    2.2 Report restructure

3. Review of available information

    3.1 Data requirements specified in 2004
        3.1.1 Development of the CCAMLR database
        3.1.2 Data processing
        3.1.3 Fishery plans
        3.1.4 Other

    3.2 Fisheries information
        3.2.1 Catch, effort, length and age 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 Research information
        3.3.1 Research surveys
        3.3.2 Tagging studies
        3.3.3 Stock structure and management areas
        3.3.4 Other

    3.4 Biological parameters for use in stock assessment

4. Preparation for assessments and assessment timetable

    4.1 Report from the Subgroup on Assessment Methods

    4.2 Status of assessment methods
        4.2.1 Current assessment methods
            Recruitment-based long-term yield assessment
            Short-term projections
        4.2.2 New assessment methods
            ASPM, CASAL
            Other methods

    4.3 Assessment timetable

5. Assessments and management advice

5.1 New and exploratory fisheries in 2004/05 and notifications for 2005/06
 5.1.1 New and exploratory fisheries in 2004/05
 5.1.2 New and exploratory fisheries notified for 2005/06
 5.1.3 Progress towards assessments of new and exploratory fisheries
  5.1.3.1 Update Fishery Report for Subarea 88.1

5.2 Update or develop Fishery Reports for the following assessed fisheries
 5.2.1 *Dissostichus eleginoides* South Georgia (Subarea 48.3)
 5.2.2 *Dissostichus eleginoides* Kerguelen Islands (Division 58.5.1)
 5.2.3 *Dissostichus eleginoides* Heard Island (Division 58.5.2)
 5.2.4 *Dissostichus eleginoides* Prince Edward and Marion Islands (Subarea 58.7) and Crozet Islands (Subarea 58.6)
 5.2.5 *Champsocephalus gunnari* South Georgia (Subarea 48.3)
 5.2.6 *Champsocephalus gunnari* Heard Island (Division 58.5.2)

5.3 Assessment and management advice for other fisheries
 5.3.1 Antarctic Peninsula (Subarea 48.1) and South Orkney Islands (Subarea 48.2)
 5.3.2 South Sandwich Islands (Subarea 48.4)
 5.3.3 *Electrona carlsbergi* South Georgia (Subarea 48.3)
 5.3.4 Crabs (*Paralomis spinosissima* and *P. formosa*) (Subarea 48.3)
 5.3.5 *Martialia hyadesi* (Subarea 48.3)

6. Fish and invertebrate by-catch

6.1 Estimation of by-catch levels and rates
6.2 Progress on methods for monitoring abundance and/or stock status
6.3 Assessment of risk
6.4 Consideration of mitigation measures

7. Incidental mortality of mammals and seabirds associated with fishing (ad hoc WG-IMAF Report)

8. Evaluation of the threats arising from IUU activities (Fish + IMAF)

8.1 Development of approaches for estimating total removals of toothfish
8.2 Review of historical trends in IUU activity
8.3 Advice to the Scientific Committee

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

9.1 Review information available to the meeting
9.2 Update species profiles
9.3 Identify gaps in the knowledge

10. Considerations of ecosystem management

    10.1 Interactions with WG-EMM
    10.2 Ecological interactions (e.g. multi-species, benthos etc.)

11. Scheme of International Scientific Observation

    11.1 Summary of information extracted from observer reports and/or provided by technical coordinators

    11.2 Implementation of observer program
        11.2.1 *Scientific Observers Manual*
        11.2.2 Sampling strategies
        11.2.3 Priorities

    11.3 Advice to the Scientific Committee

12. Future assessments

13. Future work

    13.1 Data requirements
    13.2 Organisation of intersessional activities in subgroups
    13.3 Plans for WG-FSA-06

14. Other business

    14.1 Matters of importance to WG-FSA and WG-IMAF regarding by-catch
    14.2 *CCAMLR Statistical Bulletin*
    14.3 Proposal to reorganise the work of the Scientific Committee

15. Adoption of the report

16. Close of the meeting.

APPENDIX B

LIST OF PARTICIPANTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2005)

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APPENDIX C

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2005)

WG-FSA-05/1	Provisional Agenda and Provisional Annotated Agenda for the 2005 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-05/2	List of participants
WG-FSA-05/3	List of documents
WG-FSA-05/4	Report of the WG-FSA Subgroup on Assessment Methods (Yokohama, Japan, 27 June to 1 July 2005)
WG-FSA-05/5	Report from invited expert to WG-FSA-SAM-05
WG-FSA-05/6 Rev. 1	CCAMLR fisheries: 2005 update Secretariat
WG-FSA-05/7 Rev. 1	A summary of observations on board longline vessels operating within the CCAMLR Convention Area Secretariat
WG-FSA-05/8	Summary of observations aboard trawlers operating in the Convention Area during the 2004/05 season Secretariat
WG-FSA-05/9 Rev. 2	A summary of scientific observations related to Conservation Measures 25-01 (1996), 25-02 (2003) and 25-03 (2003) Secretariat
WG-FSA-05/10	Summary of an observation aboard a pot vessel operating in the Convention Area during the 2004/05 season Secretariat
WG-FSA-05/11	Interactions between cetaceans and fisheries in Southern Ocean K.-H. Kock (Germany), M. Purves (South Africa) and G. Duhamel (France)
WG-FSA-05/12	Program of research to improve the seabird by-catch mitigation effectiveness of the Spanish system of longline fishing G. Robertson (Australia) and C. Moreno (Chile)

WG-FSA-05/13	Notification of research-in-progress in an Australian tuna fishery of relevance to the conservation of Convention Area seabirds G. Robertson, B. Wienecke, K. Lawton and B. Baker (Australia)
WG-FSA-05/14	Satellite tracking of black-browed and light-mantled sooty albatrosses from Heard Island and potential interactions with fisheries K. Lawton, R. Kirkwood and G. Robertson (Australia)
WG-FSA-05/15	Proposal to standardise the submission of meeting documents to working groups Secretariat
WG-FSA-05/16	An assessment of toothfish in Subarea 48.3 using CASAL R.M. Hillary, G.P. Kirkwood and D.J. Agnew (United Kingdom) (*CCAMLR Science*, submitted)
WG-FSA-05/17	Results of the mark–recapture experiment in Subarea 48.3, 2005 D.J. Agnew and A. Payne (United Kingdom) (*CCAMLR Science*, submitted)
WG-FSA-05/18	Parameters for the assessment of toothfish in Subarea 48.3 D.J. Agnew, G.P. Kirkwood, A. Payne, J. Pearce and J. Clarke (United Kingdom)
WG-FSA-05/19	A study of Patagonian toothfish (*Dissostichus eleginoides*) post-tagging survivorship in Subarea 48.3 D. J. Agnew, J. Moir Clark, P.A. McCarthy, M. Unwin, M. Ward, L. Jones (United Kingdom), G. Breedt, S. Du Plessis, J. Van Heerdon (South Africa) and G. Moreno (Spain) (*CCAMLR Science*, submitted)
WG-FSA-05/20	Age estimation and maturity of the ridge-scaled macrourid (*Macrourus whitsoni*) from the Ross Sea P.M. Marriott, M.J. Manning and P.L. Horn (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-05/21	Risk categorisation for *Macrourus whitsoni* and *Amblyraja georgiana* in the Ross Sea R.L. O'Driscoll (New Zealand)
WG-FSA-05/22	Approaches to monitoring and assessing the abundance of rattails (*Macrourus* spp.) and skates in the Ross Sea R.L. O'Driscoll, S.M. Hanchet and B.A. Wood (New Zealand)
WG-FSA-05/23	Towards a validation of ageing in mackerel icefish (*Champsocephalus gunnari*) – can we estimate age more accurately? K.-H. Kock (Germany) and Zh. A. Frolkina (Russia)

WG-FSA-05/24	A review of rattail (*Macrourus* spp.) and skate by-catch and analysis of standardised CPUE, for the exploratory fishery in the Ross Sea (CCAMLR Subareas 88.1 and 88.2) from 1997/98 to 2004/05 S.L. Ballara and R.L. O'Driscoll (New Zealand)
WG-FSA-05/25	Agreement on the Conservation of Albatrosses and Petrels – Report of the First Meeting of the Advisory Committee Interim Secretariat – Agreement on the Conservation of Albatrosses and Petrels
WG-FSA-05/26	Proposal for adopting new longline system in the exploratory fisheries for *Dissostichus* spp. in 2005/06 Delegation of Japan
WG-FSA-05/27	La pêche à la légine australe (*Dissostichus eleginoides*) à Kerguelen (secteur Indien de l'océan Austral) C. Lord, G. Duhamel et P. Pruvost (France) (*CCAMLR Science*, submitted)
WG-FSA-05/28	New data on Antarctic toothfish and some others by-catch fishes fecundity with gonads histological pictures from Ross Sea region and data on Patagonian toothfish from the Argentina Sea V.G. Prutko and L.A. Lisovenko (Russia)
WG-FSA-05/29	A characterisation of the toothfish fishery in Subareas 88.1 and 88.2 from 1997/98 to 2004/05 S.M. Hanchet, M.L. Stevenson, N.L. Phillips and A. Dunn (New Zealand)
WG-FSA-05/30	Preliminary assessment of long-term yield of Patagonian toothfish (*Dissostichus eleginoides*) for the Heard Island region (CCAMLR Division 58.5.2) based on a random stratified trawl survey in June 2005 A.J. Constable, T. Lamb and R. Williams (Australia)
WG-FSA-05/31	A single-area stock assessment model of Antarctic toothfish (*Dissostichus mawsoni*) in SSRU 88.2E for the 2004/05 season A. Dunn, D.J. Gilbert and S.M. Hanchet (New Zealand)
WG-FSA-05/32	Standardised CPUE analysis of Antarctic toothfish (*Dissostichus mawsoni*) fishery in the Ross Sea for the years 1997/98 to 2004/05 A. Dunn and N.L. Phillips (New Zealand)
WG-FSA-05/33	A single-area stock assessment model of Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea for the 2004/05 season A. Dunn, D.J. Gilbert and S.M. Hanchet (New Zealand)

WG-FSA-05/34	An updated descriptive analysis of the Antarctic toothfish (*Dissostichus mawsoni*) tagging scheme in the Ross Sea for the years 1997/98 to 2004/05 A. Dunn, S.M. Hanchet and K. Maxwell (New Zealand)
WG-FSA-05/35	Project of a software catalog of skeletal elements from Antarctic fish species, including some identification facilities J. von Busekist, M. Vacchi and G. Albertelli (Italy)
WG-FSA-05/36	Seabird avoidance measures for small Alaskan longline vessels E.F. Melvin and M. Wainstein (USA)
WG-FSA-05/37	Pilot test of techniques to mitigate seabird interactions with catcher processor vessels in the Bering Sea pollock trawl fishery: final report E.F. Melvin, K.S. Dietrich and T. Thomas (USA)
WG-FSA-05/38	Chilean National Plan of Action: second step completed C.A. Moreno (Chile) and J. Arata (USA)
WG-FSA-05/39	Preliminary assessment of mackerel icefish (*Champsocephalus gunnari*) for the Heard Island Plateau region (Division 58.5.2) based on a survey in June 2005 A.J. Constable, T. Lamb and R. Williams (Australia)
WG-FSA-05/40	Warp strike observations E. Abraham (New Zealand)
WG-FSA-05/41	Seabird warp-strike research design A. Kennedy (New Zealand)
WG-FSA-05/42	Review of research into seabird–fishery interactions R. Alderman (New Zealand)
WG-FSA-05/43	Recommendations for the toothfish tagging protocol in Subareas 88.1 and 88.2 N.W. Bagley and A. Dunn (New Zealand)
WG-FSA-05/44	United States research under way on seabirds vulnerable to fisheries interactions Delegation of the USA (Compiled by K. Rivera)
WG-FSA-05/45	Development of best practices for the collection of longline data to facilitate research and analysis to reduce by-catch: report of a workshop held at the International Fisheries Observer Conference, 8 November 2004, Sydney, Australia – Draft Executive Summary K.S. Dietrich, K.S. Rivera, V. Cornish and T. Conant (USA)

WG-FSA-05/46	NPOA-Seabirds Science Advisory Group Final recommendations on fields of research for the NPOA Medium Term Research Plan 2006/07–2010/11 S. Waugh (Convener) (New Zealand)
WG-FSA-05/47	Fisher training exchanges in seabird mitigation S. Waugh (New Zealand)
WG-FSA-05/48	The use of sea lion exclusion devices in the New Zealand Auckland Islands shelf trawl squid fishery R. Mattlin (New Zealand)
WG-FSA-05/49	Ross Sea fishery research and data collection plan J. Fenaughty (New Zealand)
WG-FSA-05/50	Observer coverage required for the prediction of incidental capture of seabirds in New Zealand commercial fisheries M.H. Smith and S.J. Baird (New Zealand)
WG-FSA-05/51	Review of the population status and national research conducted by New Zealand on Southern Ocean seabirds vulnerable to fisheries interactions E.C. Garland and S.M. Waugh (New Zealand)
WG-FSA-05/52	Geographical differences in the condition, reproductive development, sex ratio, and length distribution of Antarctic toothfish (*Dissostichus mawsoni*) from the Ross Sea, Antarctica (CCAMLR Statistical Subarea 88.1) J.M. Fenaughty (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-05/53	Results of the scientific research survey in CCAMLR Subarea 88.3 in the 2004/05 season G. Patchell (New Zealand)
WG-FSA-05/54	Longlining operations on New Zealand autoline vessels fishing for toothfish in CCAMLR waters J. Fennaughty and J. Bennet (New Zealand)
WG-FSA-05/55	Australian albatross and petrel research programs B. Baker and R. Gales (Australia)
WG-FSA-05/56	Seabird mortality associated with Patagonian toothfish longliners in Falkland Island waters during 2002/03 and 2003/04 H. Otley and T. Reid (United Kingdom)
WG-FSA-05/57	Proposal for a mark–recapture experiment to estimate toothfish population size in Subarea 48.4 Delegation of the United Kingdom

WG-FSA-05/58	A two-fleet ASPM assessment of the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity A. Brandão and D.S. Butterworth (South Africa)
WG-FSA-05/59	Mitigation trials and recommendations to reduce seabird mortality in the pelagic icefish (*Champsocephalus gunnari*) fishery (Subarea 48.3) J.O. Roe (United Kingdom)
WG-FSA-05/60	Age validation of Patagonian toothfish (*Dissostichus eleginoides*) from Heard and Macquarie Islands K. Krusic-Golub and R. Williams (Australia)
WG-FSA-05/61	First increment validation of Patagonian toothfish (*Dissostichus eleginoides*) from Heard Island K. Krusic-Golub, C. Green and R. Williams (Australia)
WG-FSA-05/62	Results from the New Zealand exploratory fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2 in the 2004/05 season G.J. Patchell (New Zealand)
WG-FSA-05/63	Size at maturity and histological procedures explored to determine spawning activity of female *Dissostichus mawsoni* from samples collected from the Ross Sea in January 2004, December 2004 and January 2005 M.E. Livingston and P. Grimes (New Zealand)
WG-FSA-05/64 Rev. 1	Growth models for *D. eleginoides* for the Heard Island plateau region (Division 58.5.2) calibrated from otolith-based length-at-age data and validated using mark-recapture data S.G. Candy, T. Lamb, A.J. Constable and R. Williams (Australia) (*Can. J. Fish. Aquat. Sci*., submitted)
WG-FSA-05/65	Estimating fishing gear selectivity for Patagonian toothfish (*Dissostichus eleginoides*) caught by trawlers on the Heard Island plateau region (Division 58.5.2) using trawl and longline length-frequency data and forward-calculated continuation ratios S.G. Candy (Australia)
WG-FSA-05/66	A method for inferring movement rates of fish from mark–recapture data C. Wilcox (Australia)
WG-FSA-05/67	Seabird abundance and by-catch on Brazilian longline fishing fleet T.S. Neves, L. Bugoni, D.S. Monteiro, L. Nascimento and F. Peppes (Brazil)

WG-FSA-05/68	By-catch in the Australian fisheries in Division 58.5.2 E.M. van Wijk (Australia)
WG-FSA-05/69	Evaluating methods to assess yield of Patagonian toothfish (*Dissostichus eleginoides*) in CCAMLR Division 58.5.2 A.J. Constable, I. Ball, B. Raymond, S. Candy, R. Williams (Australia) and A. Dunn (New Zealand)
WG-FSA-05/70	Biological and fishery information for skates in Division 58.5.2 E.M. van Wijk and R. Williams (Australia)
WG-FSA-05/71	Two species of toothfish in two basic longline fisheries regions – Patagonian toothfish in Subarea 48.3 (South Atlantic) and Antarctic toothfish in Subareas 88.1 and 88.2 (South Pacific) K.V. Shust, E.N. Kuznetsova, A.N. Kozlov, N.V. Kokorin and A.F. Petrov (Russia)
WG-FSA-05/72	On necessity of reconsideration of geographic boundaries, TAC estimates and duration of research fishing of Antarctic toothfish in SSRUs of Subarea 88.1 in the Ross Sea K.V. Shust, N.V. Kokorin and A.F. Petrov (Russia)
WG-FSA-05/73	Reviewing the age structured production model (ASPM) as an alternative method to estimate the Patagonian toothfish biomass at CCAMLR Subarea 48.3 O.C. Wöhler, P.A. Martinez and A. Aubone (Argentina)
WG-FSA-05/74	Video monitoring trial *Avro Chieftain* 2005 an interim report B. Stanley (Australia)
WG-FSA-05/75	Analysis of albatross and petrel distribution within the CCAMLR Convention Area: results from the global procellariiform tracking database BirdLife International (*CCAMLR Science*, submitted)
WG-FSA-05/76	Oceanological factors affecting formation of mackerel icefish aggregations in the South Georgia area during different seasons of the year Zh.A. Frolkina (Russia)
WG-FSA-05/77	Reasons of differences between distribution and density of mackerel icefish (*Champsocephalus gunnari*) aggregations in the South Georgia area during summer and autumn periods in different years from the bottom trawl survey data Zh.A. Frolkina (Russia)

WG-FSA-05/78	Alternative method of the age composition assessment on the basis of surveys length data using mixture distributions P. Gasyukov (Russia) (*CCAMLR Science*, submitted)
WG-FSA-05/79	Experimental acoustic survey of icefish resources in Subarea 48.3, 2005 M. Belchier, M. Collins (United Kingdom), R. O'Driscoll (New Zealand), S. Clarke and W. Reid (United Kingdom)
WG-FSA-05/80	Setting a minimum line length for line sink rate testing: a review of existing data and some preliminary proposals for CCAMLR consideration in revising Conservation Measure 24-02 (2004) N. Smith (New Zealand)

Other Documents

WG-FSA-05/P1	Hooper, J., J.M. Clark, C. Charman and D. Agnew. 2005. Seal mitigation measures on trawl vessels fishing for krill in CCAMLR Subarea 48.3. *CCAMLR Science*, 12: 195–205.
WG-FSA-05/P2	ACAP Interim Secretariat. 2005. Towards a review of the population status and trends of albatrosses and petrels listed within the agreement. *ACAP Global Review Status and Trends July 2005*: 17 pp.
WG-FSA-05/P3	Bull, B., R.I.C.C. Francis, A. Dunn, A. McKenzie, D.J. Gilbert and M.H. Smith. 2005. CASAL (C++ algorithmic stock assessment laboratory): CASAL User Manual v2.07-2005/08/21. *NIWA Technical Report*, 127: 272 pp.
WG-FSA-05/P4	Waugh, S., D. Filippi, A. Fukuda, M. Suzuki, H. Higuchi, A. Setiawan and L. Davis. 2005. Foraging of royal albatrosses, *Diomedea epomophora*, from the Otago Peninsula and its relationship to fisheries. *Can. J. Fish. Aquat. Sci*, 62: 1410–1421.
WG-FSA-05/P5	Casaux, R. and E. Barrera-Oro. Shags in Antarctica: their feeding behaviour and ecological role in the marine food web. *Ant. Sci.*, accepted.
WG-FSA-05/P6	Barrera-Oro, E.R., R.J. Casaux and E.R. Marschoff. 2005. Dietary composition of juvenile *Dissostichus eleginoides* (Pisces, Nototheniidae) around Shag Rocks and South Georgia, Antarctica. *Polar Biol*., 28: 637–641.
WG-FSA-05/P7	Ball, I. 2005. An alternative method for estimating the level of illegal fishing using simulated scaling methods on detected effort. *CCAMLR Science*, 12: 143–161.

WG-FSA-05/P8	Bull, L.S. In press. A review of methodologies aimed at avoiding and/or mitigating incidental catch of protected seabirds. DoC Research, *Development and Improvement Series*.
WG-FSA-05/P9	Small, C.J. 2005. *Regional Fisheries Management Organisations: their duties and performance in reducing bycatch of albatrosses and other species*. BirdLife International, Cambridge, UK. (Executive summary and full paper)
WG-FSA-05/P10	BirdLife International. 2004. *Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1–5 September, 2003, Gordon's Bay, South Africa*. BirdLife International, Cambridge, UK. (Executive summary and full paper)
WG-EMM-05/18	Developing a carbon-budget trophic model of the Ross Sea, Antarctica: work in progress M. Pinkerton, S. Hanchet, J. Bradford-Grieve and P. Wilson (New Zealand)
CCAMLR-XXIV/9	Notification of Spain's proposal to conduct exploratory fisheries for toothfish (*Dissostichus* spp.) in CCAMLR Subareas 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b in the 2005/06 season Delegation of Spain
CCAMLR-XXIV/10	Notification of exploratory fisheries for *Dissostichus* spp. in the 2005/06 season in CCAMLR Subarea 48.6 Delegation of Japan
CCAMLR-XXIV/11	Notification of exploratory fisheries for *Dissostichus* spp. in the 2005/06 season in CCAMLR Subareas 88.1 and 88.2 Delegation of Norway
CCAMLR-XXIV/12	Notification of Argentina's intention to conduct exploratory fisheries for *Dissostichus* spp. in CCAMLR Subareas 88.1 and 88.2 Delegation of Argentina
CCAMLR-XXIV/13	New Zealand notification to undertake exploratory fishing for *Dissostichus* spp. in CCAMLR Subarea 48.6 in the 2005/06 season Delegation of New Zealand
CCAMLR-XXIV/14	New Zealand notification to undertake exploratory fishing for *Dissostichus* spp. in CCAMLR Divisions 58.4.1 and 58.4.2 in the 2005/06 season Delegation of New Zealand

CCAMLR-XXIV/15	New Zealand notification to undertake exploratory fishing for *Dissostichus* spp. in CCAMLR Subareas 88.1 and 88.2 in the 2005/06 season Delegation of New Zealand
CCAMLR-XXIV/16	Notification of exploratory fisheries for *Dissostichus* spp. in the 2005/06 season in CCAMLR Subarea 88.1 Delegation of South Africa
CCAMLR-XXIV/17	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.1 for *Dissostichus* spp. Delegation of Australia
CCAMLR-XXIV/18	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.2 for *Dissostichus* spp. Delegation of Australia
CCAMLR-XXIV/19	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.3a for *Dissostichus* spp. Delegation of Australia
CCAMLR-XXIV/20	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.3b for *Dissostichus* spp. Delegation of Australia
CCAMLR-XXIV/21	Notification by the United Kingdom of its intention to participate in the exploratory fishery for *Dissostichus* spp. in CCAMLR Subareas 88.1 and 88.2 during the 2005/06 season Delegation of the United Kingdom
CCAMLR-XXIV/22	Notification of exploratory fisheries for *Dissostichus* spp. in the 2005/06 season in Subareas 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b Delegation of the Republic of Korea
CCAMLR-XXIV/23	Notification of an exploratory fishery in Division 58.4.3b Delegation of Uruguay
CCAMLR-XXIV/24	Notification of an exploratory fishery in Subarea 88.2 Delegation of Uruguay
CCAMLR-XXIV/25	Notification to conduct an exploratory longline fishery in Division 58.4.1 for *Dissostichus* spp. on board of the *Globalpesca I* and *II* in the 2005/06 season Delegation of Chile

CCAMLR-XXIV/26	Notification to conduct an exploratory longline fishery in Division 58.4.2 for *Dissostichus* spp. on board of the *Globalpesca I* and *II* in the 2005/06 season Delegation of Chile
CCAMLR-XXIV/27	Notification to conduct an exploratory longline fishery in Division 58.4.3a for *Dissostichus* spp. on board of the *Globalpesca I* and *II* in the 2005/06 season Delegation of Chile
CCAMLR-XXIV/28	Notification to conduct an exploratory longline fishery in Division 58.4.3b for *Dissostichus* spp. on board of the *Globalpesca I* and *II* in the 2005/06 season Delegation of Chile
CCAMLR-XXIV/29	Notification of an exploratory fishery in Statistical Division 58.4.1 Delegation of Uruguay
CCAMLR-XXIV/30	Notification of an exploratory fishery in Subarea 88.1 Delegation of Uruguay
CCAMLR-XXIV/31	Notification by Russia of its intention to continue an exploratory fishery for Dissostichus spp. in CCAMLR Subareas 88.1 and 88.2 for the 2005/06 season Delegation of Russia
CCAMLR-XXIV/BG/12	Summary of current conservation measures and resolutions in force 2004/05 Secretariat
CCAMLR-XXIV/BG/13	Implementation of fishery conservation measures in 2004/05 Secretariat
CCAMLR-XXIV/BG/21	Plan d'action pour l'évaluation du stock de légine dans les Terres australes et antarctiques françaises (une campagne de chalutage scientifique) Délégation française
CCAMLR-XXIV/BG/22	État des mesures mises en œuvre par les armements à la pêche français impliqués dans la pêcherie palangrière de légine des TAAF, pour maîtriser la mortalité accidentelle d'oiseaux Délégation française
CCAMLR-XXIV/BG/23	Étude relative aux pétrels Délégation française

CCAMLR-XXIV/BG/24	Note de commentaires sur les chiffres communiqués par la France concernant la mortalité aviaire accidentelle Délégation française
CCAMLR-XXIV/BG/26	Expérimentations relatives à la lutte contre la mortalité aviaire Délégation française
CCAMLR-XXIV/BG/28	Modification de la réglementation relative à la mortalité aviaire dans les Terres australes et antarctiques françaises Délégation française
CCAMLR-XXIV/BG/33	Agreement on the Conservation of Albatross and Petrels, summary of the First Session of the Meeting of Parties Delegation of Australia
SC-CAMLR-XXIV/5	Development of the electronic volume of the *Statistical Bulletin* Secretariat
SC-CAMLR-XXIV/8	Proposal to test a new streamer line as a mitigation method to reduce incidental mortality of seabirds in longline fishing Delegation of Spain
SC-CAMLR-XXIV/BG/1	Catches in the Convention Area in the 2003/04 and 2004/05 seasons Secretariat
SC-CAMLR-XXIV/BG/3	Report of the First Meeting of the Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) (La Jolla, USA, 31 May to 2 June 2005)
SC-CAMLR-XXIV/BG/5	Summary of notifications for new and exploratory fisheries in 2005/06 Secretariat
SC-CAMLR-XXIV/BG/10	Report on the 4th International Fisheries Observer Conference CCAMLR Observer (Secretariat)
SCIC-05/10	Estimation of IUU catches of toothfish inside the Convention Area during the 2004/05 season Secretariat
WG-FSA-SAM-05/1	Agenda
WG-FSA-SAM-05/2	List of participants
WG-FSA-SAM-05/3	List of documents
WG-FSA-SAM-05/4	Estimating by-catch from CCAMLR data Secretariat

WG-FSA-SAM-05/5 Rev. 1	Exploring the ASPM as an alternative method to estimate the Patagonian toothfish biomass at CCAMLR Subarea 48.3 O.C. Wöhler, P.A. Martínez and A. Aubone (Argentina)
WG-FSA-SAM-05/6 Rev. 1	Investigation of bias in the mark–recapture estimate of toothfish population size at South Georgia D.J. Agnew, G.P. Kirkwood, J. Pearce and J. Clark (United Kingdom) (*CCAMLR Science*, submitted)
WG-FSA-SAM-05/7	Implementation of the modified Petersen mark–recapture method in S-Plus A. Payne, D.J. Agnew and R. Hillary (United Kingdom)
WG-FSA-SAM-05/8	Stratification of catch-at-length data using tree based regression: an example using Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea N.L. Phillips, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-SAM-05/9	Simulation experiments and CCAMLR yield estimates using CASAL A. Dunn (New Zealand)
WG-FSA-SAM-05/10	Descriptive analysis of the Antarctic toothfish (*Dissostichus mawsoni*) tagging scheme in the Ross Sea for the years 1997/98 to 2003/04 A. Dunn, S.M. Hanchet and K. Maxwell (New Zealand)
WG-FSA-SAM-05/11	Computer program for the calculation and validation of Verhoeff check digits A. Dunn (New Zealand)
WG-FSA-SAM-05/12	Further development and progress towards evaluation of an Antarctic toothfish (*Dissostichus mawsoni*) stock model for the Ross Sea A. Dunn, D.J. Gilbert and S.M. Hanchet (New Zealand)
WG-FSA-SAM-05/13	Fitting a von Bertalanffy growth model to length-at-age data accounting for length-dependent fishing selectivity and length-stratified sub-sampling of length frequency samples S.G. Candy (Australia)
WG-FSA-SAM-05/14	Testing the performance of a recompiled version of TrawlCI to calculate confidence intervals of abundance in surveys of Patagonian toothfish (*Dissostichus eleginoides*) and mackerel icefish (*Champsocephalus gunnari*) T.D. Lamb, W.K. de la Mare and A.J. Constable (Australia)

WG-FSA-SAM-05/15	Initial development of operating models for testing management procedures for the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity A. Brandão and D.S. Butterworth (South Africa)
WG-FSA-SAM-05/16	Developing integrated assessments for *Dissostichus eleginoides* based on the CCAMLR precautionary approach I. Ball and A.J. Constable (Australia)
WG-FSA-SAM-05/17	Examination of the characteristics of the fishery for *Dissostichus eleginoides* in the CCAMLR Statistical Subarea 48.3 and its implications on estimating trends in catch per unit effort A.J. Constable, S.G. Candy and B. Raymond (Australia)
WG-FSA-SAM-05/18	Age-structured production model for toothfish at South Georgia A. Payne, G.P. Kirkwood, R. Hillary and D.J. Agnew (United Kingdom)
WG-FSA-SAM-05/19	Selectivity-induced bias in growth parameter estimates G.P. Kirkwood (United Kingdom)

Appendices D–E do not exist –
they were subsumed into the main body of the report.

Appendices F–M (Fishery Reports) are only available electronically at:
www.ccamlr.org/pu/E/e_pubs/fr/drt.htm

APPENDIX N

SUBGROUP ON FISH AND INVERTEBRATE BY-CATCH

CONTENTS

SUBGROUP ON FISH AND INVERTEBRATE BY-CATCH

The long-term status of by-catch taxa has been identified as an issue for urgent attention by the Scientific Committee (SC-CAMLR-XXI, Annex 5, paragraphs 5.151 to 5.153). The key issues that need to be addressed are:

- assessments of the status of by-catch taxa (particularly rajids and macrourids)
- assessments of the expected impact of fisheries on by-catch species
- consideration of mitigation measures.

2. Issues of potential mutual interest and importance to WG-FSA and ad hoc WG-IMAF identified by the Working Group in 2004 (SC-CAMLR-XXIII, Annex 5, paragraph 6.38) included:

(i) assessment of the status of by-catch species and groups;

(ii) estimation of by-catch levels and rates;

(iii) by-catch reporting;

(iv) assessment of risk, both in terms of geographical areas and population demography;

(v) mitigation measures.

A work plan was agreed which addressed these issues as described below.

ASSESSMENT OF THE STATUS OF BY-CATCH SPECIES OR GROUPS

3. There were no new assessments of by-catch species or recommendations for revised catch limits in 2005.

4. The priority by-catch taxa for which assessments of status are required are macrourids and rajids (SC-CAMLR-XXI, Annex 5, paragraphs 5.151 to 5.154).

Rajidae

Bathyraja spp. in Division 58.5.2

5. WG-FSA-05/70 presented new biological information for rajids in Division 58.5.2, including growth from tagging data, length–weight relationships, length-at-maturity, composition of the catch by fishery and depth, and estimates of abundance from research trawl surveys. Estimates of growth from trawl-tagged recaptured *Bathyraja eatonii* were 15 mm per year in length, and 0.15 kg per year in mass, indicating that this species is very slow growing. Length–weight relationships relating total length (TL) to mass are updated for three species: *B. irrasa, B. eatonii* and *B. murrayi*. *Bathyraja irrasa* is the only species that

appears to show sexual dimorphism with females attaining a larger mass per length and larger maximum sizes than males. The length at sexual maturity (L_{50}) was estimated for *B. irrasa* at 865 mm (TL) and the length at first spawning (L_{m50}) at 1 210 mm (TL).

6. The combined abundance of all three rajid species in the survey area ranged from 2 076 to 10 507 tonnes, with an average of 4 717 tonnes (Table 1). *Bathyraja eatonii* is the most abundant rajid in the survey area with total abundance estimates ranging from 536 to 3 549 tonnes. The next most abundant rajid was *B. irrasa* with estimates ranging from 377 to 2 760 tonnes. *Bathyraja murrayi* was the least common rajid with abundance estimates between 59 and 1 165 tonnes. Coefficients of variation for the abundance estimates varied from 0.28 to 0.55 for *B. eatonii*, 0.36 to 0.59 for *B. irrasa*, and 0.21 to 0.39 for *B. murrayi*.

7. The composition of the rajid by-catch was described by fishery and depth zone. The catch in the longline fishery operating at depths between 800 and 1 600 m comprised almost exclusively *B. irrasa* (97%). These are large fish with total lengths ranging from 740 to 1 320 mm. The trawl fishery for *Dissostichus eleginoides*, operating at depths of 400 to 1 300 m, catches predominantly *B. eatonii* (61%), *B. murrayi* (26%) and *B. irrasa* (12.5%). This fishery catches predominantly large *B. eatonii* with total lengths between 600 and 1 200 mm and mostly larger *B. irrasa* ranging in length from 900 to 1 360 mm (TL) with a small contribution of smaller *B. irrasa*. The fishery for *Champsocephalus gunnari* operating on the plateau at depths of 160 to 330 m catches predominantly *B. eatonii* (76%), *B. murrayi* (21%) and a very small amount of *B. irrasa* (2.5%). *Bathyraja eatonii* are mostly small fish ranging in size from 340 to 600 mm TL. Similarly, the *B. irrasa* catch consists mostly of small fish with lengths between 160 and 580 mm (TL). The size range of *B. murrayi* is similar between the two trawl fisheries.

Macrourus spp.

M. whitsoni in Subarea 88.1

8. Updated biological parameters for *M. whitsoni* in Subarea 88.1 were presented in WG-FSA-05/20. Intensive analysis of otoliths from juvenile *M. whitsoni* collected on the BioRoss research cruise in 2004 greatly increased confidence in the interpretation of the zone structure displayed in the early growth rings. The findings of WG-FSA-05/20 supported the interpretation protocols used in previous work on this species (Marriott et al., 2003). Revised von Bertalanffy parameters including the new juvenile data were L_∞ = 76.12 cm TL, K = 0.065 and t_0 = –0.159 for males and L_∞ = 92.03 cm TL, K = 0.055 and t_0 = 0.159 for females. Revised estimates of the mean total length-at-maturity and mean age-at-maturity were 38.8 cm and 10.6 years for males, and 46.4 cm and 13.6 years for females.

9. There was no significant difference between revised von Bertalanffy growth curves from WG-FSA-05/20 and the previous results from Marriott et al. (2003). The subgroup therefore decided that it was not necessary to update the estimate of γ for *M. whitsoni* in Subarea 88.1 (SC-CAMLR-XXII, paragraph 4.132), which was based on these previous biological parameters (SC-CAMLR-XXII, Annex 5, Table 5.20).

10. WG-FSA-05/24 updated the standardised CPUE for *M. whitsoni* in Subareas 88.1 and 88.2 based on an analysis of fine-scale data from all vessels in the exploratory fishery from

1997/98 to 2004/05. Standardised CPUE increased to a peak in 2002 and 2003, dropped in 2004, before increasing again in 2005 (Figure 1a). This pattern was consistent for a range of response variables as well as for subsets of the data based on core vessels only. The updated CPUE series was similar to the results of the previous standardised CPUE analysis (WG-FSA-02/40).

11. CPUE is unlikely to provide a reliable method of monitoring rattail abundance in the Ross Sea because of changes in fishing area due to variability in ice and changes with fisher behaviour with increasing experience (WG-FSA-05/22). The subgroup noted that even if the CPUE series monitored abundance, it would need to show a reasonable level of contrast to provide reliable estimates of biomass and yield in a stock assessment. This is not the case currently, as CPUE is increasing or stable.

APPROACHES TOWARDS ASSESSMENT OF BY-CATCH SPECIES IN SUBAREA 88.1

12. WG-FSA-05/22 presented results from a desktop study to consider approaches to monitoring and assessing macrourids and rajids in Subarea 88.1. Seven approaches were evaluated: standardised CPUE analysis, quantitative research longline surveys, experimental manipulation of fishing effort, catch-curve analysis, tagging programs, bottom trawl surveys and acoustic surveys.

13. WG-FSA-05/22 recommended that a random bottom trawl survey would be the best approach towards obtaining abundance estimates for macrourids and rajids in Subarea 88.1. The major advantage of this approach is that preliminary stock assessments could be carried out for both species groups after only one successful trawl survey. Simulations indicated that only 35–40 trawls would be required in the depth range 600–1 500 m to obtain a precise estimate of by-catch abundance in the area of highest densities (SSRUs 881E, G, H, I, J and K). A trawl survey could also be used in conjunction with other methods of monitoring abundance, e.g. rajids caught during the trawl survey could be tagged, macrourids could be aged for catch-curve analysis. The main limitations of this approach are the variable ice cover in the Ross Sea, which may restrict access to some areas, the rough bottom topography, and concerns about the environmental impact of bottom trawling on benthic communities. Tag–recapture experiments for rajids and experimental manipulation of fishing effort are alternative methods which show some promise for monitoring abundance.

14. The subgroup noted that 35–40 trawls seemed a low number for the proposed survey area of nearly 100 000 km^2. It urged further work on survey design before a trawl survey was carried out in Subarea 88.1.

15. The subgroup also noted that gear type is an important factor in rajid catchability in bottom trawls and that catchability is likely to be less than 1.

16. The subgroup further noted that an earlier study (WG-FSA-SAM-04/7) concluded that a trawl survey for juvenile *D. mawsoni* in Subarea 88.1 would be very difficult because of extensive and variable ice cover. A trawl survey for by-catch species is more feasible for three reasons. First, the spatial and depth distribution of macrourids and rajids is quite well understood from the exploratory longline fishery, whereas the location of juvenile toothfish in

the Ross Sea is largely unknown. This means that the trawl survey area and depth boundaries for a survey of macrourids and rajids are relatively well defined. Consequently the number of trawls required is much lower than the 200–300 stations that may be needed for a juvenile toothfish survey (WG-FSA-SAM-04/7). Second, ice appears to be less of a problem over by-catch depths of 600–1 500 m than in the shallower areas (0–600 m) where juvenile toothfish are likely to occur. Between 25 and 84% of the area from 600–1 500 m was fishable in 2002–2004 (WG-FSA-05/22), while only 11–69% of the area shallower than 600 m had less than 3/10 ice cover in the same years (WG-FSA-SAM-04/7). Third, a trawl survey of macrourids and rajids would be a 'one-off' to obtain estimates of adult standing stock, with estimates of precautionary yield based on a γ assessment. A trawl survey of juvenile toothfish would provide estimates of cohort strength, and would need to be repeated at regular intervals to provide a robust estimate of mean recruitment (SC-CAMLR-XXII, Annex 5, paragraph 5.55).

17. The subgroup thanked New Zealand for the work that had gone into the examination of alternative approaches for assessing abundance of macrourids and rajids during the intersessional period. It encouraged New Zealand to carry out a trawl survey for macrourids and rajids in Subarea 88.1.

ESTIMATION OF BY-CATCH LEVELS AND RATES

18. In 2003, WG-FSA compared by-catch information from STATLANT data (reported by Flag State at the end of the season), fine-scale data (haul-by-haul), and catch and effort data (reported by vessel in 5-day, 10-day or monthly periods) and concluded that fine-scale data is the most comprehensive of the three datasets for estimating levels of total removals of by-catch (SC-CAMLR-XXII, Annex 5, paragraph 5.283).

19. Estimates of total removals derived from fine-scale reports of by-catch by area for the 2004/05 fishing season are presented for longline and trawl fisheries in Tables 2 and 3 respectively.

20. The subgroup noted that there were no fine-scale data available on by-catch in the South African EEZ in Subareas 58.6 and 58.7 and urged South Africa to make these data available to the Secretariat.

21. Macrourid by-catch (as a percentage of *Dissostichus* spp. catch) in longline fisheries during 2004/05 ranged from 1.7 to 24.9%, with the highest reported by-catch rates in Subareas 58.6 and 88.1 and Divisions 58.4.2 and 58.5.1.

22. Reported rajid by-catch (as a percentage of *Dissostichus* spp. catch) in longline fisheries during 2004/05 was less than 3% in all areas except in Divisions 58.4.3a and 58.5.1 and Subarea 58.6. The subgroup emphasised that the estimates for rajids are conservative and do not include those cut or lost from longlines (paragraphs 42 to 53). In Division 58.5.1 and Subarea 58.6, almost all rajids are retained and processed and this accounts for the higher reported by-catch of rajids in these areas.

23. The other major by-catch species caught in longline fisheries during 2004/05 was *Antimora rostrata*. The by-catch rate of *A. rostrata* was 14.3% of the catch of *Dissostichus* spp. in Subarea 58.6.

24. By-catch rates of macrourids and rajids were much lower in trawl fisheries than in longline fisheries, jointly contributing less than 0.5% of the target catch in all areas in 2004/05. The major by-catch species in trawl fisheries were *Channichthys rhinoceratus* in fisheries for *D. eleginoides* and *C. gunnari* in Division 58.5.2 and *Pseudochaenichthys georgianus* in the fishery for *C. gunnari* in Subarea 48.3.

25. Present and historical information about levels of by-catch from fine-scale data for some managed fisheries were also presented in WG-FSA-05/6 and are included in individual Fishery Reports.

26. Further information on levels of by-catch is available from observer data and this is discussed in paragraphs 37 to 41.

27. Table 2 of CCAMLR-XXIV/BG/13 provided summaries of total removals of managed species, including macrourids and rajids, by area for CCAMLR fisheries in 2004/05 from catch and effort reports submitted by 21 September 2005. The subgroup noted that these estimates were generally similar to estimates from fine-scale data in Tables 2 and 3.

28. WG-FSA-05/68 presented by-catch information for the Australian fisheries in Division 58.5.2 for the 2003/04 and 2004/05 seasons. By-catch in the trawl fisheries was low, generally less than 1% of the total catch (target plus by-catch). Higher percentage by-catch rates occurred in trawling grounds where the fishing effort and therefore target catch was low. By-catch in the longline fisheries was higher, ranging from 6 to 13% of the total catch when only landed by-catch was considered and ranging between 11 and 26% when rajids and macrourids cut and lost from longlines were included. The main by-catch species were rajids and macrourids in the *D. eleginoides* fishery and rajids and *C. rhinoceratus* in the *C. gunnari* fishery. The total landed catch of rajids in the longline fishery in Division 58.5.2 was 13 tonnes in 2003/04 and 3 tonnes in 2004/05. The total landed catch of macrourids in the longline fishery in Division 58.5.2 was 42 tonnes in 2003/04 and 35 tonnes in 2004/05.

29. Data on by-catch in the exploratory fishery in Subareas 88.1 and 88.2 were described and analysed in WG-FSA-05/24 and 05/29. The main by-catch species is *M. whitsoni*, which comprised 4–16% (mean 10%) of the annual catch since 1997/98. By-catch of *M. whitsoni* varies considerably between SSRUs, with highest by-catch rates along the shelf edge (SSRUs 881E, I, K and 882E) and lower by-catch in the northern and southern SSRUs. Length-frequencies for *M. whitsoni* were similar in the last four seasons, with most fish between 13 and 30 cm snout–vent length. The next most important by-catch group is rajids (mainly *A. georgiana*), which made up 1–9% of the annual catch since 1997/98. The lower recorded by-catch percentage of rajids in recent years is due to the release of rajids at the surface, which were not included in estimates of total removals (paragraphs 42 to 53).

30. The subgroup noted with concern that catch limits for macrourids were exceeded in SSRUs 881I and K during 2004/05. Closures of SSRUs 881G and J were also triggered by the by-catch limits for macrourids (CCAMLR-XXIV/BG/13).

31. WG-FSA-05/53 presented results from a New Zealand research longline survey in Subarea 88.3. Only 10 research hauls were completed. Major by-catch species were *M. whitsoni* (1 341 kg), *M. holotrachys* (218 kg) and *A. rostrata* (183 kg). The catch of macrourids was 94% of the target *Dissostichus* spp. catch (1 667 kg). No rajids were caught.

32. Data on by-catch composition from two New Zealand vessels in the exploratory fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2 in 2004/05 are presented in WG-FSA-05/62.

Methods for estimating by-catch

33. WG-FSA-SAM-05/4 proposed a method to improve estimates of by-catch by interpolating missing catch values using estimates derived from the mean weights of by-catch species by fishing gear, region and period (WG-FSA report, paragraph 3.5). This method would improve the consistency of the CCAMLR datasets.

34. The subgroup encouraged the Secretariat to develop and adopt this method. It also recommended that the Secretariat conduct some validation work during the intersessional period.

35. The subgroup further noted the Secretariat has developed standard methods to summarise by-catch removals by area and species prior to WG-FSA, and that the extraction and documentation of by-catch data has improved considerably in 2005. The subgroup thanked the Secretariat for these improvements, which considerably reduced its workload.

BY-CATCH REPORTING

36. In order to adequately assess by-catch levels and rates, it is necessary to have accurate reporting of information on the total removals of by-catch taxa at a fishery level.

Information from scientific observers

37. Observer by-catch data was extracted by the Secretariat by fishery for the 2004/05 fishing season and summarised in WG-FSA-05/7 Rev. 1 (longline fisheries) and 05/8 (trawl fisheries). These documents included tables of the species composition of the observed catch and biological data collected.

38. WG-FSA-05/24 compared total reported catches of macrourids and rajids from fine-scale and observer data in Subareas 88.1 and 88.2. Total observed catches for both groups were of a similar magnitude to fine-scale catches, but there were large differences in some years. For the macrourids, observer catches were 11.4% greater than the fine-scale catch in 2004 and 19.8% less than the fine-scale catch in 2005. A zero catch of macrourids was reported in 18% of all sets in the fine-scale data, but only 5% of sets in the observer data. For rajids, observer catches were 44% higher than the fine-scale catches in 2000 and 56% higher in 2004. Observed and fine-scale catches of rajids were similar in 2005.

39. WG-FSA-05/24 reported that it was very difficult to estimate total levels of by-catch for Subareas 88.1 and 88.2 from observer data. The most common recurring problem was incomplete fields. Although almost all longline sets reported in the observer database were observed, the proportion of the hooks observed for fish by-catch could often not be determined. The field 'Estimated percentage of haul observed for by-catch' was blank for 14–29% of sets in 2003 to 2005. In some cases this may indicate that the entire haul was observed (i.e. 100%), but this could not be assumed. In addition, some observers recorded observed catch weights (i.e. catch weights in that portion of the haul that was observed), while others scaled catch weights up to the total haul. In these cases, although the 'Estimated percentage of haul observed for by-catch' was recorded correctly, the estimated catch of the by-catch species was incorrect (already scaled up to 100%). Because of the missing values and inconsistencies in recording, estimates of total removals could not be reliably scaled up to fishery level. In addition, the recording of retained and discarded fish was inconsistent between vessels and trips in the observer data.

40. On the L5 catch composition form, observers currently record the estimated percentage of the haul observed for by-catch, and the number and weight of each species retained and discarded. To improve the consistency of data reporting for by-catch, the subgroup recommended that additional fields should be added that record 'number of hooks observed for fish by-catch', and the total estimated number and weight of each species retained and discarded for the set (i.e. observed number and weight scaled by proportion of hooks observed). These additional fields would help to validate and cross-check the by-catch data being recorded.

41. Incomplete recording may be due to uncertainty by observers about by-catch data recording protocols. The subgroup recommended that observers be thoroughly briefed by technical coordinators, and guidelines for recording by-catch data be followed as closely as possible. In addition, the subgroup reiterated the importance of using the most up-to-date forms.

Reporting of cut-offs of rajids

42. It is not possible to reliably estimate by-catch of rajids in all longline fisheries. This is particularly the case with rajids cut free and released at the surface. These released rajids are usually not recorded on the fine-scale forms and are often not recorded by observers.

43. The revised observers' logbooks and forms distributed by the Secretariat to technical coordinators in February 2003 included fields that specify discard methods (landed then discarded, retained, cut off, shaken or gaffed off, lost at surface or dropped off).

44. Available observer data on the number and fate of rajids recorded on these new (L11) forms in 2004/05 is given in Table 4.

45. The subgroup noted with concern that this represented a very limited number of observations. For example, in Subareas 88.1 and 88.2 only 10.6% of the observed catch of rajids was recorded on the L11 form (WG-FSA-05/24). Also, observers have often failed to record the proportion of the line observed for rajids, and so numbers cannot be scaled up to estimate catch.

46. The subgroup further noted that some Members have collected data on rajid cut-offs using their own national databases which indicate that releases comprise a significant proportion of the total catch.

47. WG-FSA-05/68 presented estimates of cut-off rajids for the longline fisheries in Division 58.5.2. Estimates of rajids cut from longlines were reported by both observers and the vessel. These estimates were generally similar. Including rajids cut from longlines resulted in an estimated rajid catch of 80 tonnes in 2003/04 and 54 tonnes in 2004/05, (observer estimates) or 65 tonnes in 2003/04 and 63 tonnes in 2004/05 (vessel estimates). Regardless of the method of estimation, rajids cut from longlines comprised between 80 and 95% of the total rajid catch.

48. In 2004/05, the New Zealand Ministry of Fisheries collected additional data on the number of rajids released from New Zealand vessels in the exploratory fishery for *Dissostichus* spp. in Subareas 88.1 and 88.2, by adding the field 'Number of rajids released but not tagged' in the C2 data form given to these vessels. Data presented by WG-FSA-05/24 indicated that a total of 4 405 rajids (equivalent to 34.2 tonnes) were released by four New Zealand vessels in 2004/05. This was 13 times greater than the landed rajid catch reported by the same four vessels in 2004/05 of 2.6 tonnes and illustrates the magnitude of the released catch.

49. The subgroup welcomed this information, and encouraged other Members to submit any available information on by-catch cut-offs to WG-FSA.

50. The subgroup made the following two recommendations to improve the reporting of the number of rajids cut from longlines.

51. The subgroup recommended that all vessels be required to report the number of rajids cut from longlines through the addition to the fine-scale C2 form, of a new field 'Number of rajids released (including tagged animals)'. This vessel data would provide a useful check given the current inconsistent reporting of cut-offs through observer forms.

52. The subgroup reiterated that rajids cut from, or tagged and released from longlines and reported as part of the fine-scale data, should not be counted against by-catch limits.

53. The subgroup further recommended that observers fill out the L11 forms correctly, including information on rajid cut-offs. The subgroup noted that whilst it was desirable for this form to be completed for each set, due to high observer workloads it may be preferable to reduce the frequency of observation to obtain a smaller but higher-quality dataset on rajid cut-offs. This could be achieved by recommending that observers complete the L11 form specifically for rajids for at least one observation period every 48 hours. Information required would include the number of rajids released from longlines, including tagged animals and the proportion of the set observed, if not the entire set.

ASSESSMENT OF RISK, BOTH IN TERMS OF GEOGRAPHICAL AREAS AND POPULATION DEMOGRAPHY

Identification of levels of risk

54. In 2004, WG-FSA considered the possibility of producing risk assessments for fish and invertebrate by-catch species in a similar way to the assessment of seabirds (SC-CAMLR-XXIII, Annex 5, paragraph 6.53). The Working Group prepared a risk assessment table for the sleeper shark (*Somniosus antarcticus*) in Division 58.5.2 based on WG-FSA-03/69 as an example of the type of information that might be included in a risk categorisation for other by-catch species (SC-CAMLR-XXIII, Annex 5, Table 6.5).

55. Risk status categories were based on Castro et al. (1999):

Category 1: Exploited species that cannot be placed on any of the subsequent categories, because of lack of data.

Category 2: Species pursued in directed fisheries, and/or regularly found in by-catch, whose catches have not decreased historically, probably due to their higher reproductive potential.

Category 3: Species that are exploited by directed fisheries or by-catch, and have a limited reproductive potential, and/or other life history characteristics that make them especially vulnerable to overfishing, and/or that are being fished in their nursery areas.

Category 4: Species in this category show substantial historical declines in catches and/or have become locally extinct.

Category 5: Species that have become rare throughout the ranges where they were formerly abundant, based on historical records, catch statistics, or experts' reports.

56. The subgroup encouraged Members to collate information during the intersessional period to allow risk categorisation for other major by-catch species in the CAMLR Convention Area (SC-CAMLR-XXIII, Annex 5, paragraph 6.57).

57. WG-FSA-05/21 presented risk categorisation tables for *M. whitsoni* and *A. georgiana*, which are the major by-catch species in the exploratory fishery for toothfish in the Ross Sea (Subareas 88.1 and 88.2). These tables are included as Tables 5 and 6.

58. *Amblyraja georgiana* were categorised as risk category 3. The risk to *A. georgiana* is potentially mitigated due to the requirement to cut rajids from longlines whilst still in the water and release them. *Macrourus whitsoni* were categorised as between risk category 2 and 3. Although life-history characteristics may make this species vulnerable to overfishing, catch rates in the toothfish fishery have not declined, juveniles are not selected by the fishery, and comparison of longline and trawl catch rates with other Antarctic areas suggest that the population in the Ross Sea may be relatively large.

59. The subgroup thanked New Zealand for this contribution and encouraged Members to collate information during the intersessional period to allow risk categorisation for other

major by-catch species in the CAMLR Convention Area. It also recommended that alternatives to, and refinements of, this categorisation be considered during the intersessional period.

60. The subgroup noted that tables of the type shown in Tables 5 and 6 provide indicators of potential risk, not real and proven risk. It further noted that the comprehensiveness of the information provided would not equate with the level of risk, pointing out lack of information does not mean lack of risk.

61. The subgroup urged Members to consider how such risk assessments should be linked to assessment and management considerations in the future. It noted that this concept should be further explored in conjunction with WG-IMAF (WG-FSA report, paragraphs 14.1 to 14.5).

CONSIDERATION OF MITIGATION MEASURES

Factors affecting by-catch rates

62. Understanding factors that affect by-catch rates may yield information that could be used to develop mitigation and avoidance measures for by-catch.

63. In 2004, WG-FSA analysed by-catch by vessel in Subarea 88.1 during the 2003/04 season. This preliminary analysis suggested that the Spanish longline system may have lower by-catch rates of *Macrourus* spp. than the autoline system (SC-CAMLR-XXIII, Annex 5, paragraph 6.63). However, before this conclusion could be reached, the Working Group felt it was important to examine the spatial vessel/gear-type patterns and by-catch rates in greater detail, and recommended that this work be conducted in the intersessional period (SC-CAMLR-XXIII, Annex 5, paragraph 6.64).

64. WG-FSA-05/24 used a standardised CPUE analysis to determine factors affecting by-catch rates of macrourids and rajids in the exploratory fishery for toothfish in Subareas 88.1 and 88.2. The analysis was based on fine-scale haul-by-haul data and observer data from all vessels in the fishery from 1997/98 to 2004/05.

65. The major factors influencing macrourid by-catch in Subareas 88.1 and 88.2 were vessel, area and depth (Figure 1). Catch rates of *M. whitsoni* were highest along the shelf edge (SSRUs 881E, I, K and 882E) in depths from 600 to 1 000 m, and there was an order of magnitude difference in macrourid catch rates between different vessels. Examination of vessel characteristics (Figure 2) showed that catch rates of macrourids were lower with the Spanish longline system than with the autoline system. This effect was confounded by the bait type, as Spanish longline vessels tended to use the South American pilchard as bait, whereas autoline vessels used varying species of squid and/or mackerel. However, the difference in macrourid catch rates between the few Spanish longline vessels that used squid and mackerel for bait and the majority that used pilchards was much less than the overall difference between Spanish longline and autoline vessels. Russian and Korean vessels had extremely low catch rates compared to other vessels fishing in the same location.

66. It was not possible to reliably determine factors influencing catch rates of rajids in Subareas 88.1 and 88.2 from either fine-scale or observer data because a high proportion of

rajids are cut free and released at the surface and these are not accurately recorded or reported in either dataset (paragraphs 42 to 53). However, there was no obvious difference in by-catch rates of rajids between autoline and Spanish longline vessels.

67. Higher macrourid by-catch was also observed for autoline vessels fishing for *D. eleginoides* in the South Atlantic outside the Convention Area (V. Leptikhovsky, Falkland Islands Fisheries Department, pers. comm.). From 1995 to 2000, observer records showed that macrourids made up 21.7% of the catch taken by autoline vessels, but only 10.5% of the catch taken by Spanish longline vessels. Rajids made up 5.4% of the catch of autoline vessels and 6.9% of the catch of Spanish longline vessels from 1995 to 2000.

68. The subgroup welcomed these contributions and considered explanations which may account for the differences in by-catch rates between vessels.

69. One potential biological explanation for the observed difference in by-catch rates of macrourids between the two line configurations is that hooks on an autoline will tend to be closer to the bottom. This is particularly true for autolines with integrated weighted lines (IWLs). Several of the vessels with high macrourid catch rates in Subareas 88.1 and 88.2 are known to use IWLs. WG-FSA-05/24 attempted to examine the influence of IWLs on macrourid catch rates, but there were insufficient data about when vessels began using IWLs.

70. The subgroup suggested that, if hooks are closer to the bottom, higher catch rates of rajids on autolines than on Spanish longlines could be expected. This did not seem to be the case in Subareas 88.1 and 88.2 (WG-FSA-05/24).

71. The subgroup noted that the use of integrated line weighting was not currently recorded as part of the fine-scale data for longlines and recommended that this option be added to the C2 data form.

72. Size and type of bait may also affect catch rates of by-catch species. Dr D. Agnew (UK) informed the subgroup that preliminary results from the longline fishery in Subarea 48.3 suggested that fishing area, vessel, depth and bait were all significant factors in influencing rajid catch rates.

73. Some vessels had much lower rates of by-catch than other vessels fishing in the same area in Subarea 88.1 (WG-FSA-05/24). The subgroup urged Members to describe aspects of their gear or fishing behaviour which may have led to this very low by-catch.

74. The subgroup suggested that an experimental approach might also be used to investigate potential methods of reducing by-catch. It recalled that, in 2004, Russia proposed conducting an experimental set-up of combined bottom-vertical longlines for the exploratory fisheries for *D. mawsoni* in Subareas 88.1 and 88.2 in order to determine whether *D. mawsoni* occur in the meso- and bathypelagic areas (SC-CAMLR-XXIII/BG/19). This experiment was not carried out in 2004/05, but the subgroup encouraged work of this kind, noting that it would also improve understanding about the behaviour and vulnerability of by-catch species.

75. It might be possible to reduce by-catch of macrourids in Subareas 88.1 and 88.2 by avoiding fishing in the depth ranges and areas where by-catch rates are highest. However, the

subgroup noted that there is a considerable overlap with the spatial and depth distribution of *Dissostichus* spp. and area and/or depth restrictions would also impact the ability of the fleet to catch *Dissostichus*.

Release of rajids

76. In 2002, WG-FSA noted that information was required on (SC-CAMLR-XXI, Annex 5, paragraph 5.196):

- the vulnerability of rajids to capture
- methods for adequately assessing survivorship of animals released
- methods for handling rajids that maximise survivorship
- methods for adequately documenting the biological characteristics, including size, of rajids hooked but not landed.

77. Data from Members indicated that large numbers of rajids are cut off longlines (paragraphs 47 and 48). The effectiveness of releasing rajids as a mitigation measure will depend very strongly on the survivorship of released animals. In the absence of information on survivorship of cut-off rajids the effectiveness of this type of mitigation measure is unknown.

78. No new information on the survivorship or vulnerability of rajids was available at WG-FSA-05. The subgroup noted that estimates of survivorship of rajids cut from longlines are limited and encouraged Members to undertake further survivorship experiments in the future.

79. Dr Agnew informed the subgroup that the UK was continuing with its program of research on rajids at South Georgia following on from that previously reported in Endicott and Agnew (2004). This program includes assessment of discard survivorship, species distribution, abundance, growth and maturity. Initial results had confirmed the general pattern of decreasing survivorship with increasing depth reported in Endicott and Agnew (2004). Research is continuing, and when completed will be reported to WG-FSA.

80. Research is also required on methods for handling rajids that maximise survivorship (SC-CAMLR-XXI, Annex 5, paragraph 5.196). Mr J. Fenaughty (New Zealand) described a method for releasing rajids from New Zealand longliners that attempts to maximise survivorship. A small cutting knife attached to the end of a long tagging pole cuts the snood to release the rajid at water level. Damage to mouthparts is reduced as rajids are not hauled upwards. The subgroup encouraged Members to document methods for releasing rajids that maximise survivorship.

81. WG-FSA-05/70 described a sampling program conducted by one longline vessel in Division 58.5.2 where observers were asked to sample 10 sequential rajids per longline set for biological analysis, with over 1 000 rajids sampled for length, weight, sex, maturity and age. The subgroup noted that this type of sampling strategy could be undertaken in conjunction with assessments of rajid condition and other biological data collection.

82. The subgroup recommended that a relaxation of the requirement to cut all rajids from longlines be applied in the case where observers carried out specific tasks to gather more information on rajids during their biological sampling period. Examples of tasks include:

(i) biological data collection – i.e. measurements of length, weight, sex, maturity, stomach contents and vertebral columns/thorns for age analysis;

(ii) landing rajids in order to assess condition, as if these animals had been released whilst still in the water. It would be necessary to observe the hauling and landing procedure to ensure that injuries were not sustained through hauling;

(iii) assessing the probability of detecting tagged rajids. It may be difficult to detect tagged animals that are released whilst in the water, particularly in rough sea states.

83. These tasks could be carried out independently of one another, although the subgroup recommended that, if rajids are to be sacrificed for biological data collection, that the observers assess the condition of the animal prior to sampling (paragraph 87). An indicative number of rajids could be 10 sequential animals per longline set, with samples to be taken randomly throughout the line, however in cases where few rajids were caught this figure may need to be revised.

84. The current observer form requires the observers to assess the release condition of rajids cut from longlines in one of the following three categories:

(i) dead
(ii) injured and unlikely to survive
(iii) alive and likely to survive.

85. The subgroup noted very little useable data had been returned on rajid condition. It suggested that the quality of the information might be improved by providing more detailed descriptions about the type of injuries in each category.

86. The subgroup further noted that it is extremely difficult to assess the condition of rajids whilst still in the water. It recommended that observers discontinue assessing the condition of rajids released from longlines whilst in the water and instead assess the condition of rajids brought on board during an experimental sampling period (paragraph 83) as if they were going to be released. Careful observation by observers during hauling would be required to ensure that injuries to rajids were not sustained during hauling or landing operations. If a rajid was observed to be damaged during hauling or landing then the condition of this rajid should not be included in the dataset.

87. The subgroup recommended that the following four categories and descriptions (adapted from Endicott and Agnew, 2004), be adopted in the observer protocol for assessing condition of rajids once brought on board the vessel:

1. Rajid is dead. No movement of spiracles (gill openings). No response when touched.

2. Rajid is alive. Life-threatening injuries. Examples of injuries are crushed or missing jaws/mouthparts, prolapsed intestines, severely ripped muscles in the oesophagus and mouthparts.

3. Rajid is alive. Injuries serious enough to possibly reduce survival post release. Examples of injuries include large areas of ripped soft tissue in the oesophagus and mouthparts, and small areas of ripped muscle.

4. Rajid is alive and in good condition or may have some small injury that is not deemed to be life threatening. Examples include small areas of observed ripped tissue and muscles of the pectoral fins; hook puncture wounds in the soft tissue of the mouthparts.

88. The subgroup noted that observers may have trouble distinguishing between categories 2 and 3 and recommended that further work be undertaken during the intersessional period to improve the description of these categories or provide alternative assessments of condition. Suggestions included: providing to observers example photographs of different types of injuries or providing a checklist or table of different injuries that allows for various combinations of injury types.

89. The subgroup recognised that the observers already have an extensive workload at sea and suggested that information on release condition is not necessary for all observed rajids. Rather, the subgroup recommended that data on release condition are accurately recorded for at least one observation period every 48 hours (paragraph 53).

90. In addition to an assessment of rajid condition, observers should be encouraged to collect data for biological measurements on length, weight, sex, maturity and vertebral column samples for age analysis from retained rajids.

MANAGEMENT ADVICE

91. Management advice is provided in section 6 of the main text of WG-FSA's report.

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Table 1: Estimates of total abundance in tonnes (CV in parentheses) of rajids by species by year from trawl surveys in Division 58.5.2 (from WG-FSA-05/70).

Survey year	*B. irrasa*		*B. eatonii*		*B. murrayi*		*Bathyraja* spp.	Total
2005	1 039	(0.357)	3 549	(0.309)	59	(0.261)	-	4 647
2004	376	(0.442)	536	(0.547)	1 165	(0.266)	-	2 076
2002	888	(0.586)	2 652	(0.362)	713	(0.214)	-	4 253
2001	2 760	(0.473)	2 091	(0.282)	359	(0.387)	79	5 289
1999	1 148	(0.409)	1 923	(0.433)	154	(0.338)	-	3 225
1993*								2 370
1992*								10 507
1990*								5 372
Average	1 242		2 150		490		-	4 717

* Analyses of early surveys were not separated by species.

Table 2: By-catch estimates from longline fisheries for the 2004/05 season. The table provides information for macrourids, rajids and other species (including other managed species), and is derived from fine-scale (haul-by-haul) data. Catches are given in tonnes and as a percentage of the catch of *Dissostichus* spp. TOP – *Dissostichus eleginoides*, TOT – *Dissostichus* spp. Rajids cut from longlines and released are not included in these estimates. Data for some areas are incomplete because fisheries were ongoing at the time of the meeting.

Area	Target species	*Dissostichus* catch (tonnes)	Macrourids		Rajids		Other	
			Catch (tonnes)	%	Catch (tonnes)	%	Catch (tonnes)	%
48.3	TOP	3029.5	120.7	4.0	8.4	0.3	19.7	0.7
48.4	TOP	26.9	3.4	12.8	0.0	0.0	0.4	1.4
48.6	TOT	49.4	5.8	11.8	0.0	0.1	0.1	0.2
58.4.1	TOT	479.7	16.9	3.5	0.1	0.0	1.4	0.3
58.4.2	TOT	111.3	17.8	16.0	2.3	2.1	2.3	2.0
58.4.3a	TOT	105.3	1.8	1.7	16.7	15.9	2.1	2.0
58.4.3b	TOT	297.5	6.6	2.2	5.6	1.9	0.5	0.2
58.5.1	TOP	3185.5	485.4	15.2	724.3	22.7	11.1	0.3
58.5.2	TOP	665.2	71.7	10.8	8.4	1.3	2.9	0.4
58.6*	TOP	385.0	95.8	24.9	70.2	18.2	55.0	14.3
88.1	TOT	3064.9	461.9	15.1	68.9	2.2	24.4	0.8
88.2	TOT	418.7	20.6	4.9	0.0	0.0	3.5	0.8

* Only includes French EEZ in Subarea 58.6.

Table 3: By-catch estimates from trawl fisheries for the 2004/05 season. The table provides information for macrourids, rajids and other species (including other managed species), and is derived from fine-scale (haul-by-haul) data. Catches are given in tonnes and as a percentage of the catch of the target species. ANI – *Champsocephalus gunnari*, KRI – *Euphausia superba*, TOP – *Dissostichus eleginoides*. Data for some areas are incomplete because fisheries were ongoing at the time of the meeting.

Area	Target species	Target catch (tonnes)	Macrourids		Rajids		Other	
			Catch (tonnes)	%	Catch (tonnes)	%	Catch (tonnes)	%
48.2	KRI	41 183.4	0.0	0.0	0.0	0.0	0.6	0.0
48.3	KRI	23 199.2	0.0	0.0	0.0	0.0	0.0	0.0
48.3	ANI	200.9	0.0	0.0	0.2	0.1	28.5	14.2
58.5.2	ANI	1 790.8	0.0	0.0	5.1	0.3	36.1*	2.0
58.5.2	TOP	2 144.5	2.2	0.1	3.4	0.2	10.0	0.5

* Excludes by-catch of *D. eleginoides* of 93.9 tonnes.

Table 4: Number and fate of rajids reported by observers on the L11 observer form for 2004/05. Data for some areas are incomplete because fisheries were ongoing at the time of the meeting.

Fate	Area					
	58.4.1	58.4.3a	58.4.3b	58.5.2	88.1	88.2
Cut off line (snood cut)	39	116	26	6927	741	4
Shaken or gaffed off line	0	148	0	-	0	0
Retained	0	0	0	643	208	1
Landed then discarded	0	82	23	-	0	0
Lost at surface or dropped off	0	0	0	-	33	0
Tagged and released	0	0	0	1149	86	0
Unknown	0	2	0	-	16	0
Total	39	348	49	8719	1084	5

Table 5: Risk categorisation for *Macrourus whitsoni* in Subareas 88.1 and 88.2 (from WG-FSA-05/21).

Life history characteristics	
Geographical distribution	*M. whitsoni* is found throughout the Southern Ocean and on the continental slopes of Antarctica (Gon and Heemstra, 1990). In the Ross Sea, *M. whitsoni* appears to be concentrated along the continental slope. Catch rates in the toothfish longline fishery are highest in SSRUs 881E, G, H, I and K and 882E but lower in the northern and southern SSRUs (WG-FSA-04/20).
Depth distribution	Depth range from about 400 m to over 3 000 m, but most often found in depths of 600–1 500 m (Gon and Heemstra, 1990). Over 95% of rattails caught in the longline fishery in the Ross Sea are taken from depths of 600–1 500 m (WG-FSA-05/22).
Age/growth	Appears to be a slow-growing and long-lived species, living to at least 55 years (Marriott et al., 2003). Females appear to attain a larger size at age than males. Von Bertalanffy parameters are L_∞ 76.12, K 0.065 and t_0 –0.159 for males and L_∞ 92.03, K 0.055 and t_0 0.159 for females (WG-FSA-05/20), where L_∞ is expressed as TL length in cm. Estimates of M based on the oldest 1% of aged individuals were 0.08 for males and 0.09 for females (Marriott et al., 2003). However, because the longline fishery is unlikely to provide an unbiased estimate of population numbers at age, these estimates are very uncertain. Marriott et al. (2003) recommend a range of M from 0.05 to 0.12.
Reproduction	Observers have recorded fish with ripe gonads throughout the period of the fishery in December–March. Some spent females have also been recorded during this period (Marriott et al., 2003; WG-FSA-04/89). Estimates of TL at 50% maturity are 38.8 cm for males and 46.4 cm for females, corresponding to mean age-at-maturity of 10.6 years for males and 13.6 years for females (WG-FSA-05/20).
Diet	Feeds on pelagic crustaceans (especially euphausiids), small fish and polychaetes (Gon and Heemstra, 1990).
Vulnerability to fishing	
Overlap between distribution and fishing	Occurs mostly within the depth range and area of the longline fishery in the Ross Sea.
Co-occurrence with exploited species	Overlap in geographical and depth distribution with *Dissostichus* spp. *Macrourus whitsoni* is the most important prey species of *D. mawsoni* caught in the Ross Sea (Fenaughty et al., 2003).

(continued)

Table 5 (continued)

Trawl or longline catchability	Few small fish (less than 40 cm TL and about 9 years old) are taken in the longline fishery, probably because of selectivity related to hook size. Smaller specimens were caught in research trawls, especially around the Balleny Islands (WG-FSA-05/20). TL of 50% selectivity estimated as 44–47 cm (SC-CAMLR-XXII, 2003).
Catch	Total catch in the Ross Sea has increased from 9 tonnes in 1997/98 to 482 tonnes in 2004/05 (WG-FSA-05/22). Contributes 4–16% of the total longline catch by weight.
Population status	Population status is unknown. No assessments have been carried out of the impact of the target toothfish fishery on *M. whitsoni*. The estimate of the precautionary pre-exploitation harvest level (γ) based on biological data was 0.01439 (SC-CAMLR-XXII, 2003). This indicates that this species has relatively low productivity and thus may be vulnerable to overexploitation. There is no evidence for a decline in standardised CPUE over the course of the fishery (WG-FSA-05/24). Unstandardised longline catch rates of *M. whitsoni* by autoline vessels *Janas* and *San Aotea II* in the Ross Sea (*Janas* = 0.053 kg/baited hook, *San Aotea II* = 0.036 kg/baited hook) were twice as high as by-catch rates of *Macrourus* spp. by the same vessels in other CCAMLR areas (*Janas* in Division 58.5.2 = 0.024 kg/baited hook, *San Aotea II* in Subarea 48.3 = 0.017 kg/baited hook). Mean trawl catch rates of *M. whitsoni* deeper than 600 m in SSRUs 881H and E during the BioRoss survey in 2004 were 4 235 kg/km^2 (n = 6) and 103 kg/km^2 (n = 4) respectively. The mean catch rate in SSRU 881H was an order of magnitude greater than the estimate of the mean density of *Macrourus* spp. (176 kg/km^2) from a research trawl survey of BANZARE Bank (van Wijk et al., 2000). WG-FSA decided that trawl catch rates from the BioRoss survey did not provide good estimates of B_0 for *M. whitsoni* in SSRUs 881H and E because the small number of stations did not provide a representative sample of the overall area in the depth range 600–1 800 m in each SSRU (SC-CAMLR-XXIII, 2004).

(continued)

Table 5 (continued)

Conservation measures and mitigation	A total catch limit of 520 tonnes in Subarea 88.1 and 60 tonnes in Subarea 88.2 in 2004/05. Catch limits in each SSRU are based on the following rule from Conservation Measure 33-03 (2004): *Macrourus* spp. 16% of the catch limit of *Dissostichus* spp. or 20 tonnes whichever is greater. The 16% ratio of the catch limit of *Macrourus* spp. to the catch limit of *Dissostichus* spp. is based on the ratio of the by-catch limit for *Macrourus* spp. to the catch limit for *Dissostichus* spp. in Division 58.5.2 in 2002/03 (CCAMLR-XXI, 2002). There is also a 'move-on' rule, which requires a vessel to move to another location at least 5 n miles distant if the by-catch in any one haul is greater than 1 tonne. The vessel is not allowed to return to any point within 5 n miles of the location where the by-catch exceeded 1 tonne for a period of at least five days (Conservation Measure 33-03 (2004)).
Category	2–3 Although life history characteristics may make this species vulnerable to overfishing, catch rates in the toothfish fishery have not declined, juveniles are not selected by the fishery, and comparison of longline and trawl catch rates with other Antarctic areas suggest that the population in the Ross Sea may be relatively large.

Table 6: Risk categorisation for *Amblyraja georgiana* in Subareas 88.1 and 88.2 (from WG-FSA-05/21).

Life history characteristics	
Geographical distribution	*Amblyraja georgiana* is abundant on the shelf and upper slope around South Georgia (Gon and Heemstra, 1990; WG-FSA-03/59). In the Ross Sea, *A. georgiana* is one of the two main skate species (with *Bathyraja eatonii*) caught in the toothfish fishery. Catch rates of skates are highest along the shelf edge in SSRUs 881E–J, and lower in the northern and southern SSRUs in Subarea 88.1, and in Subarea 88.2 (WG-FSA-05/22). Recovery of tagged skates suggests that there is only limited movement in the Ross Sea (WG-FSA-02/42). Fourteen recaptures of *A. georgiana* were reported by WG-FSA-02/42. Most (12) were in-season recaptures, with a period at liberty of 10–120 days, moving between 9 and 74 km. The longest period at liberty was 733 days, during which the individual only moved about 7 km. Preliminary DNA results indicate that *A. georgiana* in the Ross Sea is one species, but the genetic relationship with *A. georgiana* and another recently described species (*Amblyraja* sp. anon) in the Atlantic is unknown (WG-FSA-04/27). Initial comparisons revealed some morphological differences between specimens of *A. georgiana* from the Ross Sea and South Georgia (WG-FSA-01/45).
Depth distribution	Over 95% of skates caught in the longline fishery in the Ross Sea are taken from depths of 600–1 300 m, with highest catch rates from 800–1 100 m (WG-FSA-05/22). Only three specimens of *A. georgiana* were caught during the BioRoss trawl survey in 2004, and none were caught shallower than 500 m. Around South Georgia, *A. georgiana* is frequently caught as shallow as 150 m (WG-FSA-03/59).
Age/growth	Longevity of *A. georgiana* is estimated as at least 14 years based on caudal thorn bands (WG-FSA-04/29). However this should be regarded as a conservative estimate because of the possibility that thorn growth ceases in large individuals. There are no obvious differences in growth between the sexes. Von Bertalanffy growth parameters were estimated as L_∞ 70.8, K 0.308 and t_0 1.10 for both sexes combined (WG-FSA-04/29), where L_∞ is expressed as pelvic length in cm. This growth rate is moderately fast compared with other skates. WG-FSA noted that these estimates of age and growth were unreliable due to the uncertain and unvalidated age estimates (SC-CAMLR-XXIII, 2004). The relatively fast growth rates reported for *A. georgiana* also contrasted with the much slower growth by tagged *B. eatonii* in Division 58.5.2 (WG-FSA-04/68).

(continued)

Table 6 (continued)

Reproduction	*Amblyraja georgiana* is oviparous. The timing of spawning in the Ross Sea is unknown. Egg cases and newly hatched juveniles have been caught during trawl surveys around South Georgia in January (e.g. WG-FSA-03/59). The total length at 50% maturity for male *A. georgiana* from the Ross Sea is about 92 cm (64 cm pelvic length), and females appear to mature at a slightly greater total length of 95–100 cm (66–69 cm pelvic length) (WG-FSA-03/42).
Diet	Diet is unknown.
Vulnerability to fishing	
Overlap between distribution and fishing	Occurs mostly within the depth range and area of the longline fishery in the Ross Sea.
Co-occurrence with exploited species	Overlap in geographical and depth distribution with *Dissostichus* spp.
Trawl or longline catchability	Most skates caught in the longline fishery in the Ross Sea are between 40 and 120 cm total length, with a median of 92 cm.
Catch	Reported catch of skates in the Ross Sea has ranged from 5 tonnes in 1997/98 to 66 tonnes in 2004/05, of which *A. georgiana* is the major component (WG-FSA-05/22). The reported catch of skates is underestimated since 2000 due to a tagging program and a by-catch mitigation program. In both programs, skates are returned to the water and are not usually reported in catch and effort (C2) data. Skates made up 9–10% of the total catch by weight in the Ross Sea in 1997/98 and 1998/99.
Population status	Population status is unknown. No assessments have been carried out of the impact of the target toothfish fishery on *A. georgiana*. There is insufficient information to estimate the precautionary pre-exploitation harvest level (γ) because of uncertain and unvalidated age estimates. CPUE cannot be used to monitor abundance because of inadequate reporting of skates that are cut-off longlines and released (WG-FSA-05/24). Insufficient skates have been tagged and recaptured to estimate abundance. There is also considerable uncertainty about survival following release, tag retention, tag detection and catch reporting (WG-FSA-05/22).

(continued)

Table 6 (continued)

Conservation measures and mitigation	A total catch limit of 163 tonnes in Subarea 88.1 and 50 tonnes in Subarea 88.2 in 2004/05. Catch limits in each SSRU are based on the following rule from Conservation Measure 33-03 (2004): • skates and rays 5% of the catch limit of *Dissostichus* spp. or 50 tonnes whichever is greater. There is also a 'move-on' rule which requires a vessel to move to another location at least 5 n miles distant if the by-catch in any one haul is greater than 1 tonne. The vessel is not allowed to return to any point within 5 n miles of the location where the by-catch exceeded 1 tonne for a period of at least five days (Conservation Measure 33-03 (2004)). Vessels are advised that, where possible, they should cut all skates from their lines whilst still in the water, except on the request of the observer during the observer's biological sampling period. Tagging in the Ross Sea (WG-FSA-02/42) and in other Antarctic areas (e.g. Division 58.5.2, WG-FSA-04/68) has shown that some skates survive the capture and release event, but survivorship may be depth related (Endicott and Agnew, 2004)
Category	3 *Amblyraja georgiana* likely have a limited reproductive potential and other life history characteristics, such as limited movement, that may make them vulnerable to overfishing. The risk to *A. georgiana* is mitigated due to a CCAMLR program to cut all skates from longlines whilst still in the water and release them.

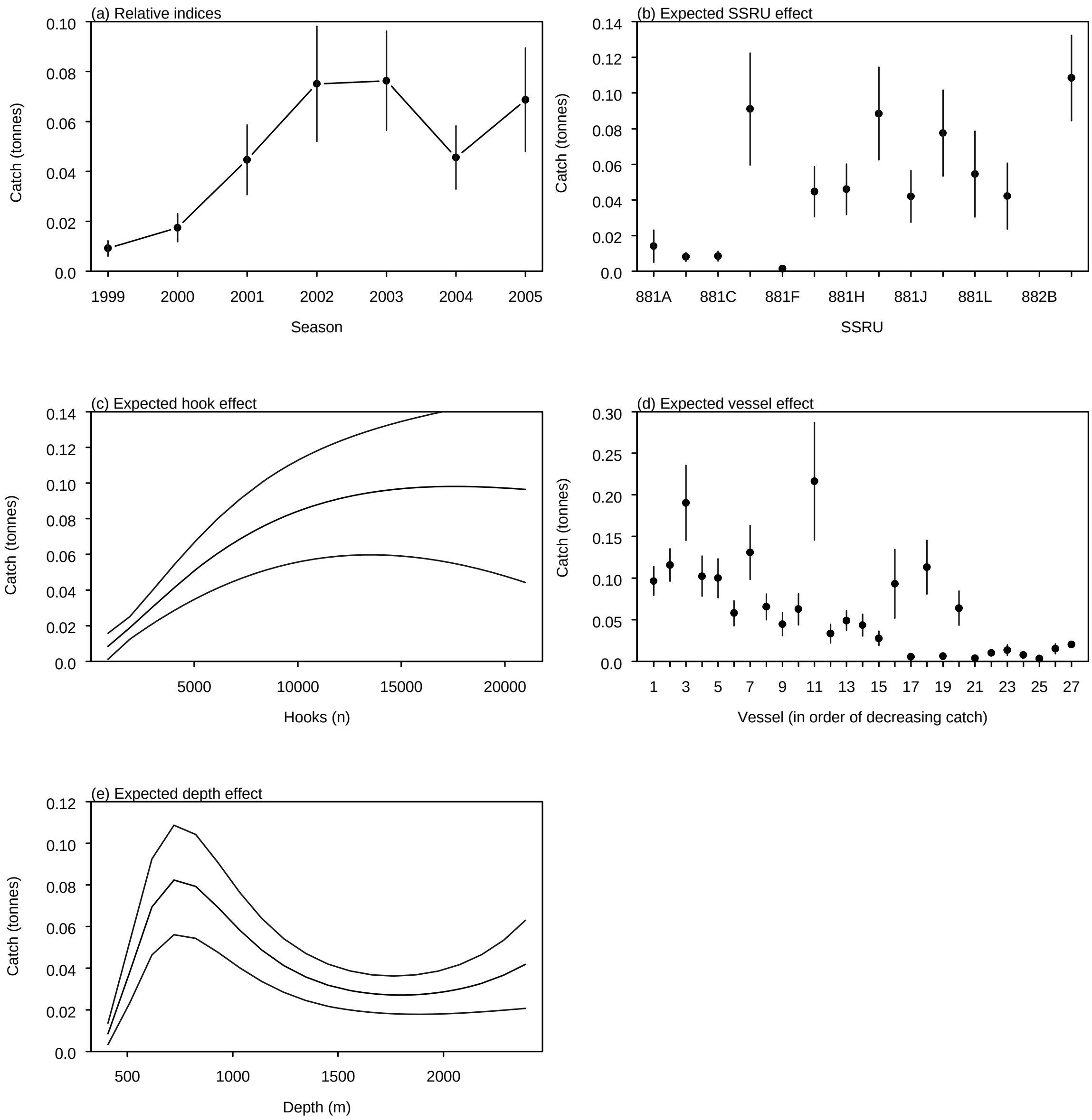

Figure 1: Expected catch of rattails (tonnes) for median values of fixed parameters from all vessels involved in the exploratory fishery for toothfish in Subareas 88.1 and 88.2 from 1998/99 to 2004/05 showing effects of: (a) year, (b) area, (c) number of hooks, (d) vessel and (e) depth. Outer lines indicate approximate 95% confidence intervals (from WG-FSA-05/24).

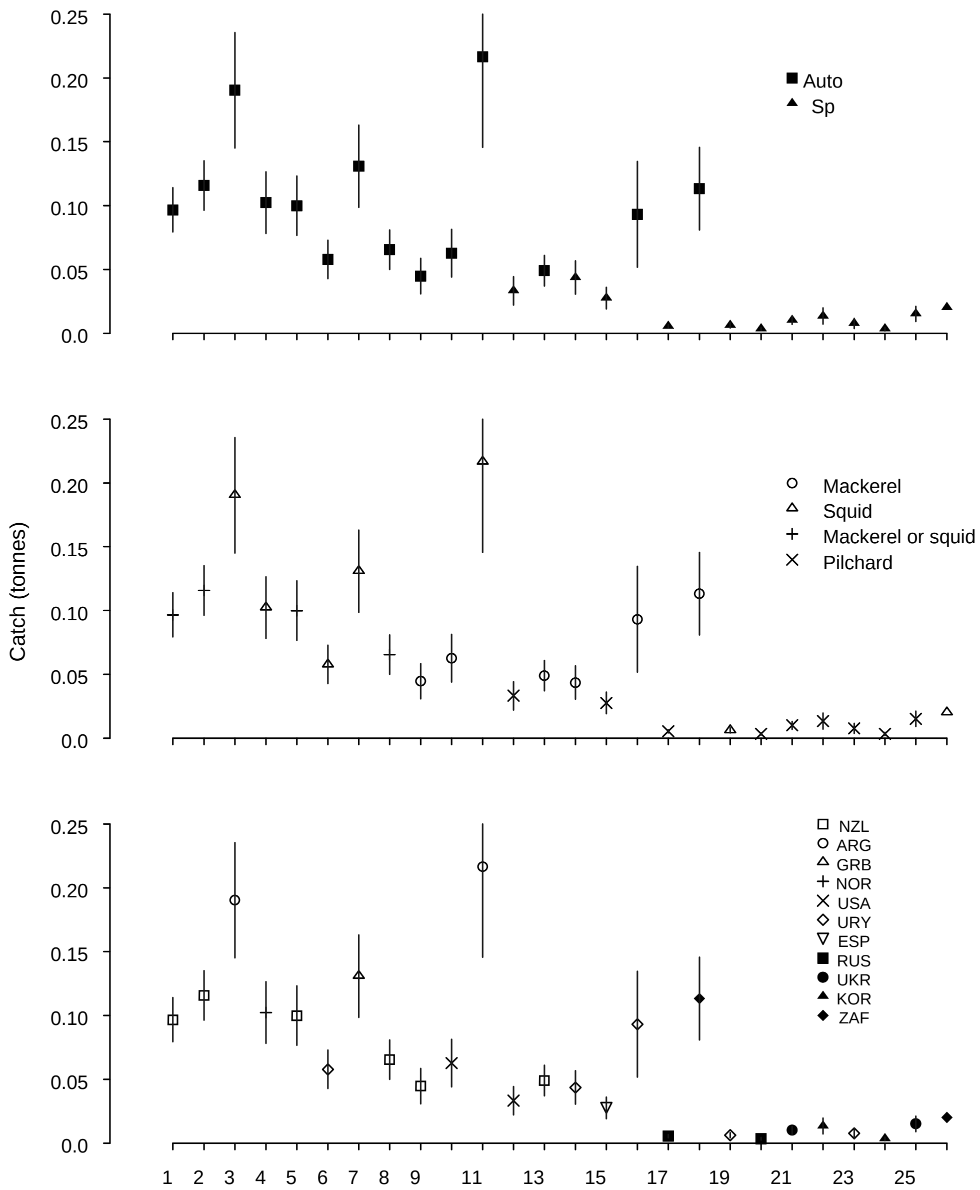

Figure 2: Expected catch (tonnes) of rattails for median vessel effects (in order of decreasing rattail catch) using the lognormal model for all vessels involved in the exploratory fishery for toothfish in Subareas 88.1 and 88.2 from 1998/99 to 2004/05. Plots are labelled with longline type (autoline or Spanish line), bait species and vessel nationality. Lines indicate approximate 95% confidence intervals (from WG-FSA-05/24). NZL – New Zealand, ARG – Argentina, GRB – United Kingdom, NOR – Norway, USA – United States of America, URY – Uruguay, ESP – Spain, RUS – Russia, UKR – Ukraine, KOR – Republic of Korea, ZAF – South Africa.

APPENDIX O

INCIDENTAL MORTALITY OF MAMMALS AND SEABIRDS ASSOCIATED WITH FISHING (AD HOC WG-IMAF REPORT)

CONTENTS

INCIDENTAL MORTALITY OF MAMMALS AND SEABIRDS ASSOCIATED WITH FISHING (AD HOC WG-IMAF REPORT)

Intersessional work of ad hoc WG-IMAF

The Secretariat reported on the intersessional activities of ad hoc WG-IMAF according to the agreed plan of intersessional activities for 2004/05 (SC-CAMLR-XXIII, Annex 5, Appendix D). The report contained records of all activities planned and results of their completion and is available on the IMAF page of the CCAMLR website.

2. The Working Group thanked the Science Officer for his work on the coordination of IMAF activities and the technical coordinators for their extensive support. It also thanked the Scientific Observer Data Analyst for his work on the processing and analysis of data submitted to the Secretariat by international and national observers during the course of the 2004/05 fishing season.

3. The Working Group concluded that most tasks planned for 2004/05 had been successfully implemented. 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 for 2005/06, compiled by the co-conveners and the Science Officer, be appended to its report (SC-CAMLR-XXIV/BG/28).

4. The Working Group noted that no intersessional work took place on issues identified last year on the development of the *Scientific Observers Manual* (SC-CAMLR-XXIII, Annex 5, Appendix D, task 6.6), however, the work proposed by WG-IMAF was subject to plans for a major review of the *Scientific Observers Manual* which had not yet been finalised by the Scientific Committee and its working groups. If required, this task could be carried forward to the next intersessional period.

5. The Working Group especially welcomed to the meeting Drs R. Mattlin (New Zealand) and J. Pierre (New Zealand) and Mr W. Papworth (ACAP) who were attending the meeting for the first time. The Working Group continued to appreciate Mr M. McNeill's (New Zealand) expert advice on operational aspects of fishing and encouraged analogous input from other Members, including in relation to trawl fisheries. Members were asked to review their representation on WG-IMAF intersessionally, to suggest additional members and to facilitate the attendance of their representatives at the meetings.

Incidental mortality of seabirds during regulated longline and pot fishing in the Convention Area

6. Data were available from all 31 longline cruises conducted within the Convention Area during the 2004/05 season (WG-FSA-05/7 Rev. 1).

7. The Working Group noted that the proportions of hooks observed were similar to those observed for last year for Subareas 48.3 (31% (range 20-62) compared with 28% (range 18–50)) and 88.1 and 88.2 (51% (range 23–100) compared with 61% (range 30–99)). For all other areas the observation rates and ranges increased from last year: Subarea 48.6, 31% (one

vessel) compared with 23%; Subarea 58.4, 56% (range 28–94) compared with 39% (one vessel); Division 58.5.2, 36% (range 31–41) compared with 34% (range 33–34); Subareas 58.6 and 58.7, 65% (one vessel) compared with 32% (range 27–37).

8. As usual, the total observed seabird catch rate was calculated using the total number of hooks observed and the total seabird mortality observed (Table 1). The estimated total catch of seabirds by vessel was calculated using each vessel's observed catch rate multiplied by the total number of hooks set.

9. The total number of observed mortalities was 56, and consisted of 6 (11%) yellow-nosed albatrosses, 1 (2%) wandering albatross, 43 (76%) white-chinned petrels and 6 (11%) southern giant petrels. The total extrapolated mortality for 2004/05 was 97 birds split between Subareas 48.3 (13 birds), 58.6 and 58.7 (76 birds), and Division 58.4.1 (8 birds) (Table 2). This was a 65% increase from the extrapolated 58 mortalities for 2003/04. The vast majority of the extrapolated mortality (78%) is attributed to one vessel, *Koryo Maru 11*, fishing in Subareas 58.6 and 58.7.

Mortality during the haul

10. The Working Group noted that extrapolations of incidental mortality combining data from seabirds caught on either the haul or the set are appropriate for quantifying total removals; however, data need to be split between haul and set to allow analysis of mitigation effectiveness.

11. The Working Group noted that the incidence of birds being caught injured and uninjured (i.e. birds that are caught on the haul), accounted for 68% of seabird captures in 2004/05 (Table 1). The proportion of seabirds caught on the haul suggests that an increased focus on haul mitigation measures is required.

Subarea 48.3

12. The total extrapolated seabird mortality was 13 birds compared with 27, 8, 27 and 30 birds in the last four years (Table 3). The overall catch rate was 0.0011 birds/thousand hooks compared to the rates of 2004 and 2001 (0.0015 birds/thousand hooks) and the rate for 2003 (0.0003 birds/thousand hooks). The four birds observed killed were southern giant petrels (Table 4). Total extrapolated captures decreased between 2003/04 and 2004/05. Changes in extrapolated capture totals presented to the Working Group in 2005 differed from those presented in 2004 for the 2003/04 year because the 2004 totals were produced using vessel capture rates with three decimal places, compared to using four decimals places in 2003 and 2005.

Subarea 58.4

13. The total extrapolated seabird mortality was eight birds, with a catch rate of <0.001 birds/thousand hooks from one vessel operating in Division 58.4.1 (Table 3). In 2003/04 longline fishing was undertaken for the first time in Subarea 58.4. No mortalities had been reported prior to 2004/05.

South African EEZ in Subareas 58.6 and 58.7

14. The total extrapolated seabird mortality for these subareas was 76 seabirds from the one vessel that fished there. The catch rate for this area was 0.149 birds/thousand hooks, compared to 0.025 and 0.003 in 2003/04 and 2002/03 respectively (Table 3). In earlier years (1997 to 2001) extrapolated mortalities and rates ranged between 834–156 birds and 0.52–0.018 birds/thousand hooks respectively.

Subareas 48.4, 48.6, 88.1 and 88.2 and Division 58.5.2

15. No seabird mortalities on longline vessels were observed in these areas. Incidental mortality of seabirds in Subareas 88.1 and 88.2 has been very low over the past eight years, with only one bird observed killed in 2003/04 (Table 3).

Incidental mortality of seabirds during regulated pot fishing in the Convention Area

16. No incidental mortalities were recorded during fishing for *Dissostichus eleginoides* on two cruises in Subareas 58.6 and 58.7.

Evaluation of levels of incidental mortality

French EEZs in Subarea 58.6 and Division 58.5.1

17. The requested French data for 2000/01 (SC-CAMLR-XXIII, paragraph 5.7) and 2004/05 have been submitted to the Secretariat in tabulated form analogous to the summaries prepared by the Secretariat for the rest of the Convention Area (WG-FSA-05/7 Rev. 1). Dr T. Micol (France) presented the French data on seabird incidental mortality and supporting papers (CCAMLR-XXIV/BG/22, BG/23, BG/24, BG/26 and BG/28).

18. CCAMLR-XXIV/BG/24 presented 2004/05 data involving observations of seabird mortality reported by captains (Tables 7 and 10), and national observers (Tables 8, 9 and 11).

2000/01 fishing season

19. The total reported (by captains) seabird mortality in 2000/01 for Division 58.5.1 was 1 917 birds (Table 5). The corresponding catch rate (reported birds/total hooks set) was 0.092 birds/thousand hooks. Data for Subarea 58.6 were not presented as they have not yet been analysed; these data will be submitted next year.

20. The reported seabird by-catch in Division 58.5.1 comprised 94% white-chinned petrels and 5% grey petrels. The remaining 1% comprised giant petrels, grey-headed albatrosses and black-browed albatrosses (Table 6).

2004/05 fishing season

21. Observers recorded seabird mortality on a proportion of the hooks set in the 2004/05 season. This recording was done in the same way as in the last six months of 2003/04 and differs in only minor detail from CCAMLR observer specifications.

22. The total reported seabird mortality from observers for Subarea 58.6 and Division 58.5.1 was 61 and 1 054 birds respectively (Table 8). The corresponding incidental mortality rates were 0.047 and 0.161 birds/thousand hooks.

23. The total seabird mortality reported by captains in Subarea 58.6 and Division 58.5.1 was 137 and 1 901 birds respectively (Table 7). The corresponding incidental mortality rates were 0.028 and 0.071 birds/thousand hooks.

24. Comparing the full year to last year's data is not possible directly as count methods are different. Data were compared when available in the same format for the same period. March was excluded as a period where 2003/04 data were a mix of both reporting methods. Comparing 2003/04 and 2004/05 for the period from September to February, captains' incidental mortality rates showed a decrease of 35% (0.071 to 0.047 birds/thousand hooks) and 57% (0.126 to 0.055 birds/thousand hooks) respectively in Subarea 58.6 and Division 58.5.1. Comparing 2003/04 and 2004/05 for the period from April to August, observers' incidental mortality rates showed an increase of 87% (0.006 to 0.011 birds/thousand hooks) and 21% (0.058 to 0.070 birds/thousand hooks) respectively in Subarea 58.6 and Division 58.5.1.

25. The discrepancy between the results presented in Tables 7 and 8 was addressed in CCAMLR-XXIV/BG/24. This paper suggested that French fishers should be commended for their degree of application of methods to manage seabird mortality. It also noted the relatively important difference this year between the data from observation of all longlines by captains and data from observation of 25% of lines by observers. The paper suggested that care is required in interpreting the extrapolated results and that the attention of captains may be less focussed on the observation of seabird mortality than that of observers.

26. The Working Group noted that in order to be consistent with CCAMLR procedures, the use of observer data only is recommended. Dr Micol indicated that from 2005/06 all French data on incidental mortality of seabirds will be collected only in a format that allows direct comparison with other CCAMLR areas and other fisheries outside the Convention Area (e.g. WG-FSA-04/72).

27. CCAMLR-XXIV/BG/24 suggested that the reduction to zero of IUU vessels in the French EEZs may have increased the abundance of birds around the small number of remaining authorised vessels, possibly increasing interactions, and thereby counteracting the improvements in mitigation measures.

28. The data on birds recorded by observers can be converted to estimates of total seabird mortality using reported data on the proportion of hooks observed (Table 9). The mean proportions of hooks observed in Subarea 58.6 and Division 58.5.1 were 25.5% (n = 20; range 19.3–38.0%) and 24.5% (n = 26; range 14.3–31.0%). For the 20 cruises in Subarea 58.6, the observed incidental mortality of 61 birds converts to an estimated mortality of 242 birds (0.049 birds/thousand hooks). For the 26 cruises in Division 58.5.1, the observed incidental mortality of 1 054 birds converts to an estimate of 4 387 birds killed (0.164 birds/thousand hooks).

29. The reported seabird by-catch in Subarea 58.6 comprised 89% white-chinned petrels and 11% grey petrels; in Division 58.5.1 it comprised 94% white-chinned petrels and 6% grey petrels (Table 10). Dr Micol pointed out that no albatrosses were caught during the past two years, probably due to use of mitigation measures such as night setting and use of several streamer lines.

30. The Working Group noted that an important proportion of birds (30%) was caught alive, indicating that they were caught on the haul. It was recognised that, in future, attention to mitigating captures on the haul would be required as part of efforts to achieve a continuing reduction in seabird mortality. The Working Group is in the process of developing improved recommendations for haul mitigation.

31. The Working Group noted that the CCAMLR totals included the dead and mortally injured birds in the 'total caught dead' numbers, whereas the French data included only 'dead' and 'alive' categories, the latter including both mortally injured and live birds. From raw data, 3 of 334 live birds were reported injured, and the remainder were released unharmed. The Working Group recommended the use of the CCAMLR methodology by French observers to allow for better estimates of overall mortality and to facilitate comparison with other fisheries in the Convention Area.

32. The Working Group had traditionally considered that in analogous CCAMLR areas, 25% of hooks observed was acceptable for the purposes of monitoring seabird incidental mortality rates and estimating total captures. However, for new and exploratory fisheries in high-risk areas, 40–50% hooks observed is suggested (SC-CAMLR-XXIII, Annex 5, Table 7.17) and this may be more appropriate in the circumstances of this fishery of high incidental mortality rates. Dr Micol indicated that increasing these rates may not be compatible with other observer tasks.

33. The Working Group noted that higher levels of coverage of hauls within a trip may also be needed to provide robust estimates of capture rates and their variances. The Working Group suggested that methods similar to those developed in WG-FSA-05/50 might be useful in this context.

34. The Working Group noted that there was considerable variation between vessels in the levels of reported seabird incidental mortality (Table 9). In Subarea 58.6, 120 birds (49% of the total) were reported from *Ship 3* (53 birds) and *Ship 6* (67 birds). In Division 58.5.1, 2 517 birds (57% of the total) were taken by *Ship 6* (1 403 birds) and *Ship 7* (1 114 birds).

35. Only one French vessel (*Ship 11*) was using integrated weighted lines (IWLs) for all sets, with an estimated 210 birds caught. This is a lower number than the other vessels in the same fishery but a higher rate (0.065 birds/thousand hooks) than catch rates of vessels using IWLs observed in other fisheries (0.01 birds/thousand hooks; WG-FSA-04/72).

36. CCAMLR-XXIV/BG/28 pointed out that new regulations entered into force in the French EEZ on 1 September 2005; and followed recommendations from the Scientific Committee (SC-CAMLR-XXIII, paragraph 5.7):

(i) weighting regimes as specified in Conservation Measure 25-02 are now applicable to autoliners, with fishers obliged to comply fully by 1 January 2006;

(ii) at least two streamer lines meeting the CCAMLR specification are compulsory. Some vessels use up to seven streamer lines;

(iii) in 2004/05 all vessels had observers on board who observed 25% of hooks set. This level of observer effort will be continued in 2005/06;

(iv) closure of Division 58.5.1, classified as a high-risk area, is maintained in February during the main seabird breeding season.

In addition, the discard of hooks is now forbidden, as is the use of black lines which were shown to catch more birds than white lines in the analysis of 2001–2003 data by Delord et al. (2005). Dr Micol indicated that as a result of the new regulations set out in CCAMLR-XXIV/BG/28, all vessels would use integrated line-weighting gear from 1 January 2006. The Working Group commended this initiative.

37. CCAMLR-XXIV/BG/22 discussed measures used by fishers to mitigate incidental mortality in the French EEZs. Among new measures, a new hook design will be tested as well as reconstituted coloured baits. Only the autoline vessel using Mustad gear has a lineshooter. As this equipment appears to decrease incidental mortality, other vessels will adopt it as soon as such gear is commercially available. New laser technology is also currently under trial as a potential deterrent to birds.

38. The Working Group noted that better understanding of the continuing high rates of seabird incidental mortality in the French EEZs would require a thorough analysis of recent data, similar to that carried out by Delord et al. (2005). This should assist in allowing further improvements to be made in reducing mortalities in the French EEZ fisheries.

39. The Working Group recommended that analysis of the 2005 data should include:

(i) consideration, as feasible, of the effects of time of year, area, moon phase, hour, sink rates, setting speed, bird abundance, streamer-line configuration, fishing gear configuration, hook type, line colour, line-weighting regime, offal discharge, sea state or wind, observer and vessel;

(ii) special attention to circumstances associated with sets or hauls where a large number of birds are caught.

40. It was requested that France report the results of this analysis to the next meeting of the Working Group.

41. Future analyses should also take account of the life status (alive, dead, injured) and mode of capture (e.g. hooked, foul-hooked, entangled) of the birds. Use of the CCAMLR definitions to determine the life status of the birds would allow consistent comparison with other Convention Areas of catch rates and circumstances.

42. In addition, the acquisition of data on all variables listed above should be considered in the development of improved data collection protocols for seabird incidental mortality in those areas.

43. The Working Group commended the initiatives taken by France for research and management relating to the incidental mortality of seabirds in its EEZs. It recommended that in future:

(i) observers continue to be deployed on 100% of vessels;

(ii) consideration be given to increasing the proportion of hooks observed (e.g. to 40–50%);

(iii) data collection protocols be improved, including incorporating the CCAMLR distinctions and definitions relating to dead and live seabird by-catch;

(iv) undertaking appropriate analysis of the 2005 data.

Information relating to the implementation of Conservation Measures 25-01, 25-02 and 25-03

44. Information from observer reports relating to the implementation of Conservation Measures 25-01, 25-02 and 25-03 in 2004/05 were provided by the Secretariat in WG-FSA-05/7 Rev. 1, 05/8, 05/9 Rev. 2 and are summarised in Tables 1, 12 and 14 with a comparison with similar data from previous years provided in Table 13.

45. During the meeting, the Working Group undertook an evaluation of the data prepared by the Secretariat on the implementation of Conservation Measures 25-01, 25-02 and 25-03. During this process some examples of potential non-compliance were identified by the Working Group and in some cases corrected following a dialogue between the Secretariat and national coordinators of observer programs. The Working Group agreed that such dialogue may avoid the erroneous interpretation of ambiguous reporting leading to a misrepresentation of the level of compliance by individual vessels.

Conservation Measure 25-01 (1996) 'Regulation of the use and disposal of plastic packaging bands on fishing vessels'

46. Conservation Measure 25-01 requires that the use of plastic packaging bands is restricted to those vessels with on-board incineration facilities and that all bands be cut and disposed of using this facility. Information from observer reports indicated that whilst plastic packaging bands were disposed of appropriately on 10 vessels, on one vessel, the *Punta Ballenas*, some plastic packaging bands were disposed of overboard (WG-FSA-05/9 Rev. 2, Table 1).

Conservation Measure 25-02 (2003) 'Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area'

Line weighting – Spanish system

47. For the first time there was 100% compliance with the required line-weighting regime in all subareas and divisions (Table 13).

Line weighting – autoline system

48. All vessels fishing in Subareas 88.1, 88.2 and Division 58.4.2 south of 60°S in daylight met the requirement to achieve a consistent minimum line sink rate as described in Conservation Measure 24-02. As in previous years this line-weighting requirement has been fully achieved by all vessels (WG-FSA-05/9 Rev. 2, Table 6; SC-CAMLR-XXIII, Annex 5, paragraph 7.57).

Night setting

49. In Subareas 58.6 and 58.7, 100% of sets occurred at night, an increase from the 83% night-setting rate last year. In Subarea 48.3, 99% of sets occurred at night (98% in 2004) (Table 13); the *Protegat* undertook six of its 258 sets during the day. In Subareas 48.6, 88.1, 88.2 and Divisions 58.4.2 and 58.4.3b, all vessels demonstrated a consistent minimum line sink rate of 0.3 m/s and hence fished under Conservation Measure 24-02, which provides exemptions to night setting south of 60°S (WG-FSA-05/9 Rev. 2, Table 6).

Offal discharge

50. A single vessel, the *Antarctic III*, was observed discharging offal during one set and one haul in Subarea 88.1; offal discharge is prohibited in this subarea. In Subarea 48.3, the *Jacqueline* was observed discharging offal during one set; offal discharge during setting is prohibited under Conservation Measure 25-02 (Table 1).

Discard of hooks

51. Observers reported hooks being present in discards on six vessels; on three of these this was reported as a rare event. However, the observer report for the *Argos Georgia* indicated that this was a daily occurrence during the first half of the season; following a mid-season crew change the discarding of hooks stopped (WG-FSA-05/9 Rev. 2, Table 1).

Streamer lines

52. Compliance with streamer line design has increased from 64% (28 of 44 cruises) to 74% (23 of 31 cruises) this year, although this is not as high as the 92% (34 of 37 cruises) in 2003 (Table 12).

53. The cruises where streamer lines did not comply failed on streamer line lengths (7 cruises), attachment height (1 cruise), total length (1 cruise) and branched streamer spacing (1 cruise). One vessel failed on three different streamer line specifications (*Viking Bay*) and one vessel did not comply on two specifications (*Punta Ballena*).

54. Vessels fishing in Subareas 48.6, 58.6, 58.7 and Divisions 58.4.2 and 58.4.3b, used streamer lines on all sets. In Subarea 48.3, of 1 847 sets only one was undertaken without using a streamer line (*Protegat*). In Subareas 88.1 and 88.2, the *Antarctic III* undertook a single set without using a streamer line. On some occasions the *Protegat* used non-compliant streamers in Subarea 48.3 (Table 12).

55. Mr McNeill suggested that some instances of non-compliance with respect to streamer line length may result from the use of additional streamers on the seaward part of the line where the distance between the water and the line is less than 1 m, i.e. shorter than the minimum length specified in Conservation Measure 25-02.

56. The Working Group agreed that where the seaward part of the line had additional short streamers attached, in the absence of which the streamer lines would otherwise be fully compliant, measuring and reporting them as the minimum streamer length would provide a misleading indication of non-compliance.

Haul-scaring devices

57. Conservation Measure 25-02 (paragraph 8) requires that a device designed to discourage birds from accessing baits during the haul of longlines (haul-scaring devices) shall be employed in those areas defined by CCAMLR as average-to-high or high (level of risk 4 or 5) in terms of risk of seabird by-catch. These areas are currently Subareas 48.3, 58.6 and 58.7 and Divisions 58.5.1 and 58.5.2.

58. In Subarea 48.3, three vessels (*Jacqueline* (99 %), *Argos Georgia* (91%) and *Viking Bay* (53%)) did not use haul-scaring devices on all the hauls. In Subareas 58.6 and 58.7, 100% of hauls used scaring devices and in Division 58.5.2 the only longline vessel fishing in that area was equipped with a moonpool; hence no devices were required (Table 12).

59. The *Argos Georgia* and the *Viking Bay* were, coincidentally the only two vessels that killed birds in Subarea 48.3 and the detailed status of these birds (Table 12) indicated that they were killed during hauling.

General

60. In its report last year the Commission noted its concern regarding the reduced compliance with several elements of Conservation Measure 25-02 (CCAMLR-XXIII, paragraph 5.6); this year the level of compliance had increased for all elements, in particular in Subarea 48.3 with line weighting increasing to 100% from 87% last year and with overall streamer requirements increasing to 75% from 69% last year (Table 13).

61. The Working Group noted that if compliance with Conservation Measure 25-02 is interpreted strictly (i.e. 100% in all elements of the conservation measure), 12 of 25 vessels (48%) fully complied with all measures at all times throughout the Convention Area. This compares to 33% last year (Tables 1 and 12; WG-FSA-05/9 Rev. 2, Table 1). The fully compliant vessels were the *Argos Helena, Arnela, Avro Chieftain* (Australia), *Frøyanes, Galaecia, Globalpesca II, Janas, No. 707 Bonanza, Polarpesca I, San Aotea II, Shinsei Maru 3* and *Yantar*. As was noted last year, some vessels failed to comply by small margins, and the Working Group recommended that vessels should be advised to exceed the standards to prevent compliance failure (SC-CAMLR-XXIII, Annex 5, paragraph 7.253).

Conservation Measure 25-03 (2003) 'Minimisation of the incidental mortality of seabirds and marine mammals in the course of trawl fishing in the Convention Area'

62. The discharge of offal during the shooting or hauling of trawl gear is prohibited under Conservation Measure 25-03; however, two vessels fishing in Subarea 48.3 discharged offal at these times, the *Robin M Lee* (22% shots) and *InSung Ho* (13% shots and 4% hauls) (Table 14). For both of these vessels the incidence of offal discharge was higher than last year (SC-CAMLR-XXIII, Annex 5, paragraph 7.62).

Research into and experience with mitigation measures

63. WG-FSA-05/13 reported work in progress in an Australian tuna fishery of general relevance to seabird conservation in global tuna fisheries, including fisheries where Convention Area seabirds range. The report described the results of experiments testing the effects of line-weighting regimes and bait types on the sink rate of tuna branchlines. The research plan includes assessment of the effectiveness of bird-scaring streamer lines (in addition to efforts to expedite gear sink rates) as deterrent to *Puffinus* shearwaters, the importance of which was highlighted by the Working Group in 2004 (SC-CAMLR-XXIII, Annex 5, paragraph 7.88). Empirical evidence of the effectiveness of streamer lines as a deterrent to *Puffinus* shearwaters and other deep-diving species, such as white-chinned

petrels, is lacking. The Working Group welcomed progress in developing seabird by-catch mitigation for pelagic longline gear and recognised its importance in efforts to reduce seabird mortality in tuna fisheries operating in the migration ranges of Convention Area seabirds.

64. WG-FSA-05/P8 provided a review of mitigation of seabird–fisheries interactions in New Zealand's EEZ as well as international and high-seas fisheries with methodological similarities to those in New Zealand. The mitigation method, results of any trials or perceptions of efficacy, costs, benefits and recommendations for future research and management are included. Recommendations for mitigation in pelagic and demersal longline fisheries included: combinations of mitigation are likely to work best; offal (and fish waste) retention, paired streamer lines, line weighting and night setting were the most consistently effective methods at reducing seabird incidental mortality. Future research recommendations include refining existing methods that seem promising such as underwater setting, side setting, and novel methods still in the preliminary stages of testing (e.g. fish oil). The review also emphasised the importance of conducting mitigation research using properly designed controlled experiments.

Proposed research plan for Spanish system line weighting

65. In 2000, the Scientific Committee endorsed further work to develop line-weighting regimes to ensure sink rates that will preclude seabirds accessing bait. Such work could enhance the likelihood of permitting exemption from several of the mitigating measures currently in use in the Convention Area, noting in particular that the ultimate aim in managing seabird by-catch in the Convention Area will be to allow fishing at any time of day without seasonal closure of fishing grounds (SC-CAMLR-XIX, paragraphs 4.40 and 4.41; SC-CAMLR-XIX, Annex 5, paragraph 7.147).

66. WG-FSA-05/12 presented a research plan to improve the seabird by-catch mitigation effectiveness of the Spanish system of longline fishing. The plan also aims to explore methods to reduce the substantial amounts of fishing gear lost (and ghost fishing) by Spanish system vessels in the Convention Area. A similar proposal was submitted in 2001 (WG-FSA-01/29) which recognised that fishing in some high-risk areas of the Convention Area occurs only in winter, a low-risk time of year, and that effectiveness must be determined in high-risk areas at times of high risk to seabirds (e.g. summer).

67. In 2001, the Scientific Committee recommended that Members should accord this proposal high priority, noting its importance as a means to improving Conservation Measure 29/XIX (now Conservation Measure 25-02), and that the research would also contribute to advice on appropriate mitigation measures for use by vessels employing the Spanish system of longlining in other parts of the world, including in areas where birds from the Convention Area are currently being killed in large numbers (SC-CAMLR-XX, paragraph 4.63). The Commission endorsed the Scientific Committee's recommendation (CCAMLR-XX, paragraph 6.26), but opportunities and resources to conduct the proposed experiment have been lacking until now.

68. WG-FSA-05/12 proposed to conduct an experiment on a chartered vessel in Chile to determine the effects of setting speed, line-weight spacing and weight of line weights on the sink rate of Spanish system longlines. A new weight spacing (30 m) will be tested in an effort

to reduce the degree of lofting of the hookline from that which occurs with 40 m spacings as required by Conservation Measure 25-02. Lofting occurs when Spanish system gear is deployed and the hookline between weights lofts in the propeller turbulence, thereby allowing seabirds access to baited hooks and increasing the likelihood that they will be caught. A new line-weighting spacing/line weight/setting speed combination will then be tested, along with streamer lines, as a deterrent to black-browed albatrosses in the *D. eleginoides* fishery in southern Chile.

69. If the new regime eliminates albatross mortality, it will then be important to test the gear against white-chinned petrels, the most commonly killed seabird in Convention Area fisheries. Reducing white-chinned petrel by-catch is considered the best current indicator for efforts to improve seabird by-catch mitigation effectiveness for Convention Area seabirds.

70. It will be important to test the new line-weighting configuration against white-chinned petrels at a high-risk location in the Convention Area. The exact nature and timing of the tests will become clear following provision of a report from the vessel charter experiment and trial against black-browed albatrosses. Trials against white-chinned petrels in the Convention Area could conceivably take place in a conservative, step-wise manner involving (i) day-setting trials during winter, (ii) night-setting trials in the seabird breeding season, and (iii) day-setting trials in the seabird breeding season. Progress with this series of trials would be contingent on being able to achieve conservative predetermined seabird mortality targets before progressing to the next stage of the trials.

71. The Working Group strongly endorsed the research proposed in WG-FSA-05/12 to reduce seabird mortality in Spanish system fisheries operating in areas where Convention Area seabirds range. It noted that if these trials are successful in Chile, the conduct of subsequent trials in the Convention Area in a high-risk area for incidental mortality of seabirds and at a high-risk time of year would be appropriate.

Factors influencing line sink rate

72. WG-FSA-05/36 determined the ‘2-m access window’, or the distance astern that longline hooks sink to a depth of 2 m, on eight small vessels (>7.9 to 16.8 m) for two demersal gear types (fixed gear and snap-on gear) used in Alaska. Seabirds in Alaska are most vulnerable to hooking while longlines are within 2 m of the surface. The capability of these vessels to deploy streamer lines and buoys according to performance standard guidelines was also determined. Vessel speed was found to be a primary determinant of both the distance astern that longline hooks were accessible to surface-foraging seabirds, and the performance standards of streamer lines. Using gear with similar sink rates, the 2-m access window ranged from 28 to 38 m for vessels setting gear at slower speeds (2 to 3.5 knots) to a mean of 90 m for vessels setting gear at faster speeds (up to 7.4 knots). Given the reduced size of the access window for vessels setting snap-on gear at slow speeds, the reduced aerial extent requirement for this gear type was shown to be justified in terms of risk to seabirds and practical to use, especially with a lighter streamer line.

73. The Working Group noted that these data suggest that ‘the 2-m access window’, which incorporates vessel speed and hookline sink rate into a single measure, provides an improved measure of risk to seabirds rather than sink rate alone, and that vessel speed is an important component of seabird risk to longline gear.

74. The Working Group then analysed vessel speed data for 4 715 longline gear deployments in 2004/05 for both Spanish and IWLs and estimated the 2-m access window for both gear types operating in the Convention Area (Figure 2). Assuming a sink rate to a depth to 2 m of 0.13 m/s for Spanish gear and a sink rate of 0.20 m/s to 2 m for IWLs, IWLs produced access windows that ranged from a low of 20.6 m at the minimum setting speed of 4 knots and a high of 41 m at the maximum setting speed of 8 knots and 32 m at the autoline average setting speed of 6.2 knots. In contrast, Spanish gear produced 2-m access windows ranging from a low of 32 m at the slowest setting speed of 4 knots and a high of 79 m at the maximum setting speed of 10 knots and 60 m at the average setting speed of 7.6 knots.

75. It is clear from this analysis that the 2-m access window, where birds are most vulnerable to hooklines, can vary at least two-fold depending on vessel speed for both gear types and that Spanish longline gear presents more risk to seabirds than IWLs.

76. Noting that vessel speed data are routinely collected for all longline sets and that sink rate data are available for a wide range of line-weighting scenarios, the Working Group recommended that the ‘2-m access window’ analysis be used in concert with sink rate data to evaluate the merits of line-weighting scenarios and prescriptions for the aerial extent of streamer lines in future refinements of conservation measures. Accordingly, the collection of data by observers on vessel setting speed, longline sink rate and streamer line aerial extent remain priority tasks for observers.

Streamer line aerial extent

77. Following a Commission endorsement (CCAMLR-XXIII, paragraph 5.12(iii)) of requests for key data to allow for the eventual improvement of Conservation Measure 25-02, data on the aerial extent of streamer lines were collected uniformly for the first time in 2004/05. These data were collected once for each cruise by fishery observers. The aerial extent of the streamer line, which is the part of the line supporting the streamers, is the effective seabird deterrent component of the streamer line, and therefore, of great interest to the Working Group.

78. The Working Group noted that data on the aerial extent of streamer lines reported in Table 15 were highly variable across the fleet, ranging from a low of 7 m to a maximum of 150 m and further noted that most vessels (16 of 31) achieved an aerial extent of $\geq$50 m. Given the wide range of distances reported, in some cases for the same vessel fishing in different areas, the Working Group recommended that aerial extent data and other compliance features of streamer lines be collected more frequently according to a specific protocol in order to yield a reliable representation of how effectively streamer lines are deployed and a more realistic evaluation of streamer line compliance in CCAMLR longline fisheries.

79. The Working Group proposed that data on streamer line aerial extent and other streamer line features including the height of streamer lines at the stern, the length of streamer

lines, the number, spacing and length of individual branched streamers, be collected once every seven days. Further, it was suggested that these data be collected on a diagram-based data collection form to be developed by CCAMLR. Where sink rate data collection is required according to Conservation Measure 24-02, paragraph B2(ii), the Working Group recommended that streamer line data be collected in the course of sink rate data collection.

Individual branched streamers of streamer lines

80. The Working Group also discussed the most appropriate material for individual streamers noting that if the material used for streamers is too lightweight streamers may be rendered ineffective in moderate to high winds. In the Working Group's assessment of compliance to streamer line requirements in Conservation Measure 25-02, it was recognised that empirical information on the seabird deterrent effectiveness of various types of streamer line configurations against selected seabird species (e.g. black-browed albatross, white-chinned petrel) is lacking. It is therefore not currently possible to recommend adoption of streamer line configurations other than that recommended in Conservation Measure 25-02. The Working Group recognised the importance of the provision of such information and encouraged Members to conduct appropriate experiments on the design features of streamer lines with a view to being able to recommend refinements to the streamer line requirements in the conservation measure.

Shinsei Maru bottom-line system

81. The Working Group noted that the *Shinsei Maru* bottom-line system proposed in WG-FSA-05/26 appears similar to trot-line fishing gear used in other fisheries, but that details were lacking (mass of weights used, stern or side setting, setting speed, rate of loss of weights) to fully evaluate potential threats to seabirds in the Convention Area. The Working Group recommended that the scientific observer assigned to this vessel report how the gear is deployed and retrieved with special attention to gear and seabird behaviour during the haul and set. Ultimately a description of the gear similar to that in WG-FSA-05/54 would be beneficial to understanding the strengths and weaknesses of this fishing gear and its appropriateness for use in the Convention Area.

82. Moreno et al. (in press) characterised seabird interactions with similar gear in the Chilean artisanal fishery for toothfish. While heavily weighted individual vertical longlines sank quickly during line setting with minimal interactions with seabirds, hooklines were often exposed to seabird interactions during hauling, resulting in a substantial number of seabird fatalities. Given the substantial catch of seabirds during the haul in Convention Area longline fisheries (paragraph 10), the potential for increased interactions with the proposed gear during the haul is considerable.

83. The Working Group recognised the potential for the fishing method proposed in WG-FSA-05/26 to minimise exposure of baited hooks to seabirds during setting operations and therefore expressed support for the proposal; however, the Working Group strongly recommended that Conservation Measures 24-02 and 25-02 be applied to this fishing system novel to the Convention Area.

Seabird mitigation during the haul

84. Most seabirds were caught during the haul of longline operations, as indicated by their 'injured' or 'uninjured' status (Table 1). Thus, the Working Group suggested that development of effective haul scaring devices with prescribed standards are appropriate throughout the Convention Area and once developed could result in refinements to Conservation Measure 25-02. Currently Conservation Measure 25-02 (2003), paragraph 8, requires that a device designed to discourage birds from accessing baits during the haul of longlines be used in higher-risk areas for seabird by-catch (Subareas 48.3, 58.6 and 58.7 and Divisions 58.5.1 and 58.5.2), however, a specific haul mitigation device is not prescribed.

85. A Bird Excluder Device (BED) was used very successfully on the FV *Janas* while fishing in Division 58.5.2 to reduce seabird interactions with the hookline during hauling (Figure 3) in 2003 and 2004. No birds were captured during the haul while using this device. The concept of the BED is to prevent birds from swimming and flying towards the area where hooks emerge from the surface of the water. It consists of two arms hinged above the hauling area. Three-metre fluorescent streamers attached to the arms and suspended between the ends of each arm reach down to the water surface, effectively excluding birds from the hauling area. A line with purse seine floats on the surface of the water (also attached to the ends of the arms) forms a boundary fence surrounding the hauling area, preventing birds from swimming towards the danger zone. This setup cordons off the line-hauling area while eliminating the potential for fouling the BED with the hookline as it is hauled. The hinged arms allow for easy retrieval and deployment.

86. The Working Group recommended that haul mitigation devices such as the BED used on the *Janas* should be encouraged in all CCAMLR areas regardless of risk status to reduce the large proportion of bird captures during line hauling.

Longline sink rate testing prior to entering the CCAMLR Convention Area

87. In response to a Commission request (CCAMLR-XXIII, paragraph 10.24), the Working Group reviewed available data on the maximum length of longlines used in the Convention Area with respect to Conservation Measure 24-02 and longline sink rate testing prior to entering the CCAMLR Convention Area.

88. The data on the maximum length of the longline used showed a clear distinction between the Spanish longline system and the auto longline system (WG-FSA-05/80). Given the wide variation in maximum lengths exhibited in the data, it was considered more appropriate to use the mean longline length for fleet-wide application of line sink rate testing.

89. Noting the differences between the two longline fishing systems, the expert opinion of those involved in the development of line-weighting regimes and the review in WG-FSA-05/80, the Working Group recommended that the requirement for testing line sink rate prior to entering the Convention Area should be changed from the current requirement of the maximum length to be used in the Convention Area for all vessels to a minimum of 6 000 m for auto longline system vessels and 16 000 m for Spanish longline system vessels.

Revision of Conservation Measures 24-02 (2004) and 25-02 (2003)

90. The Working Group agreed that IWLs should continue to be endorsed as a viable alternative and that the revisions to the provisions of Conservation Measure 24-02 made in 2004 were successfully implemented in 2005.

91. In reviewing its advice from 2004 (SC-CAMLR-XXIII, Annex 5, paragraphs 7.91 to 7.93), the Working Group noted that proposed changes to Conservation Measure 25-02 with respect to mandatory line-weighting prescriptions for autoline vessels were no longer considered appropriate. The rapid adoption of IWLs and the line sink rate testing regime had largely superseded the need for an external line-weighting regime for autoline vessels.

92. The Working Group considered proposing changes to Conservation Measure 25-02 to accommodate IWL provisions for autoline vessels, but recognised that no additional information on the specification of IWLs had been provided and suggested that a revision of Conservation Measure 25-02 in 2005 would be premature.

93. The Working Group recommended that research be undertaken in 2005/06 on IWLs to allow a more informed revision of Conservation Measure 25-02 in 2006, with the intention of combining Conservation Measures 24-02 and 25-02, if possible. It noted that research to relate the current values of line sink rate to values that include both vessel speed, streamer line aerial extent and sink rate is planned. This would allow more flexible prescriptions to be developed for the conservation measure (paragraph 73).

94. The Working Group recommended that Conservation Measure 24-02 be revised, via introduction of a specification of the length of longline to be tested prior to entering the CCAMLR Convention Area (paragraph 89).

95. The Working Group recommended that Conservation Measure 24-02 be revised as follows:

Replace paragraph A1(i) with:

(i) set a minimum of two longlines with a minimum of four TDRs on the middle one-third of each longline, where:

(a) for vessels using the auto longline system, each longline shall be at least 6 000 m in length;

(b) for vessels using the Spanish longline system, each longline shall be at least 16 000 m in length.

Replace paragraph B1(i) with:

(i) set a minimum of two longlines with a minimum of four bottle tests (see paragraphs B5 to B9) on the middle one-third of each longline, where:

(a) for vessels using the auto longline system, each longline shall be at least 6 000 m in length;

(b) for vessels using the Spanish longline system, each longline shall be at least 16 000 m in length.

Replace paragraph C1(i) with:

(i) set a minimum of two longlines with either a minimum of four TDRs, or a minimum of four bottle tests (see paragraphs B5 to B9) on the middle one-third of each longline, where:

(a) for vessels using the auto longline system each longline shall be at least 6 000 m in length;

(b) for vessels using the Spanish longline system each longline shall be at least 16 000 m in length.

Incidental mortality of seabirds during unregulated longline fishing in the Convention Area

96. As no information is available on rates of incidental mortality of seabirds from the unregulated fishery, estimates of the incidental mortality of seabirds during IUU fishing within the Convention Area present a number of difficulties, requiring various assumptions to be made.

97. In previous years, the Working Group has prepared estimates 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. Justification for using the worst catch rate from the regulated fishery is that unregulated vessels accept no obligation to use any of the mitigation measures prescribed in CCAMLR conservation measures. Therefore catch rates, on average, are likely to be considerably higher than in the regulated fishery.

98. As no information is available on rates of incidental mortality of seabirds from the unregulated fishery, estimates have been made by bootstrapping the observed catch rates from fishing operations in 1996/97. The fleet in 1996/97 implemented relatively few mitigation measures and has been considered to provide the best estimate the Working Group has of likely catch rates in the unregulated fishery. 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-XXIV/BG/27 and in SC-CAMLR-XXII, Annex 5, paragraphs 6.112 to 6.117.

99. The Working Group agreed that the following values should be applied to the toothfish removals data to estimate seabird by-catch in IUU *Dissostichus* spp. fisheries in the Convention Area in 2005 (SCIC-05/10 Rev. 2), and also agreed that these values should be used to generate similar estimates for previous years. The resulting median and 95% confidence intervals for seabird incidental mortality rates (birds/thousand hooks) for the unregulated fishery are shown below. It should be noted that where incidental mortality rates

are not available for a regulated fishery within a statistical area, the rate for an adjacent area of similar level of risk (SC-CAMLR-XXIV/BG/27) has been used. Thus, because a regulated fishery has never existed in Division 58.4.3, the rate applied is that for Division 58.4.4.

Subarea/Division	Season	Lower 95%	Median	Upper 95%
48.3	Summer	0.39	0.741	11.641
	Winter	0	0	0.99
58.6, 58.7, 58.5.1, 58.5.2	Summer	0.45	0.55	1.45
	Winter	0.01	0.01	0.07
58.4.2, 58.4.3, 58.4.4	Summer	0.27	0.33	0.87
	Winter	0.006	0.006	0.042
88.1	Summer	0.27	0.33	0.87
	Winter	Not applicable, access not possible in winter		

100. The estimates of potential unregulated seabird by-catch in the Convention Area in 2004/05 and comparison with estimates for previous years are provided in detail in SC-CAMLR-XXIV/BG/27.

101. The overall estimated total for the whole Convention Area in 2004/05 indicates a potential seabird by-catch in the unregulated fishery of 4 415 (95% confidence interval range of 3 605 to 12 400) seabirds. The values for this and previous years are summarised in respect of different parts of the Convention Area in Table 18.

102. In comparison with estimates for previous years, calculated in identical fashion, the value for 2004/05 is similar to the value estimated for 2003/04 (SC-CAMLR-XXIII/BG/23). These are the lowest reported values since estimates started in 1996. This presumably reflects a commensurate reduction in toothfish removals or changes in the areas from where IUU fishing occurs.

103. Based on the data since 1996 (SC-CAMLR-XXIV/BG/27), an estimated total of 180 623 (95% confidence interval range of 147 013 to 529 722) seabirds have been killed by these vessels. Of these:

(i) 40 469 (95% confidence interval range of 32 728 to 128 460) were albatrosses, including individuals of four species listed as globally threatened using the IUCN threat classification criteria (BirdLife International, 2004);

(ii) 7 155 (95% confidence interval range of 5 844 to 20 054) were giant petrels, including one globally threatened species;

(iii) 113 270 (95% confidence interval range of 92 343 to 325 210) were white-chinned petrels, a globally threatened species.

104. As in previous years, it was emphasised that these values are very rough estimates (with potentially large errors). The present estimates should only be taken as indicative of the potential levels of seabird mortality occurring in the Convention Area due to unregulated fishing and should be treated with caution.

105. Nevertheless, even taking this into account, the Working Group endorsed its conclusions of recent years that:

(i) the levels of loss of seabirds from the populations of these species and species groups are still broadly consistent with such data as exist on the population trends of these taxa, including deterioration in conservation status as measured through the IUCN criteria;

(ii) although considerably reduced from previous years, such levels of mortality probably still continue to be unsustainable for some of the populations of albatrosses and giant and white-chinned petrels breeding in the Convention Area.

106. Many albatross and petrel species are facing potential extinction as a result of longline fishing. The Working Group again requested the Commission to continue to take action to prevent further incidental mortality of seabirds by unregulated vessels in the forthcoming fishing season.

Incidental mortalities of seabirds during longline fishing
outside the Convention Area

107. Ms T. Neves (Brazil) presented information from a study conducted from 2000 to 2005 of captures of seabirds in Brazilian waters (WG-FSA-05/67). Fishing trips were observed with an average catch rate of 0.09 birds/thousand hooks during the period. In 2002, the catch rate was 0.2 birds/thousand hooks with 105 300 hooks observed, in 2003, 0.18 birds/thousand hooks with 56 700 hooks observed and in 2004, 0.03 birds/thousand hooks with 90 858 hooks observed. Species from the Convention Area were among those captured and among species returned by fishers from trips where observers were not present. Observations were from Brazilian domestic vessels only. It was noted that fishing captains were likely to adopt different practices when observers were present. Therefore, results represent minimum catch rates. Pelagic fishing effort by both Brazilian and foreign vessels in winter is concentrated south of 20°S and relatively close to the coast, where the propensity for bird capture is highest. Effort by foreign fishing vessels is higher than that of domestic vessels, particularly during the winter when birds are most likely to be caught.

108. The Working Group thanked Ms Neves for the presentation of the new information from Brazil as requested last year (SC-CAMLR-XXIII, Annex 5, paragraph 7.129), which shows that there is a high risk of capture of birds from the Convention Area, especially during winter.

109. Ms Neves noted that mitigation had been developed in cooperation with industry, including raising awareness of the issue through an education program, developing streamer lines, and developing blue-dyed bait. Both measures were voluntarily adopted during at least three years by part of the Brazilian domestic fleet. She indicated that concurrent to finalising the Brazilian NPOA-Seabirds, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) is also creating regulations and incentives for Brazilian fishers to mitigate incidental seabird mortality. It is hoped that this approach will ensure that voluntary measures adopted by the fleet thus far are encouraged and spread to the rest of the

fleet. In addition, the Special Secretariat of Aquaculture and Fisheries of the Presidency of the Republic (SEAP) is introducing sea turtle and seabird mitigation measures into the criteria for granting fishing licences to new foreign vessels. Some of these measures are obligatory for the National Funding Programme for the National Fishing Fleet (Profrota Pesqueira).

110. Prof. J. Croxall (UK) presented WG-FSA-05/56, a summary of seabird mortalities from the last two years for toothfish longlining from the Falkland/Malvinas Islands. Observer coverage was 59% of sets. All mortalities were black-browed albatrosses with estimated mortalities of 45 and 80 birds in 2002/03 and 2003/04 respectively. Rates of capture were 0.011 and 0.0005 birds/thousand hooks respectively. Target maximum rates of seabird by-catch for the fishery in the Falklands/Malvinas NPOA-Seabirds were 0.01 birds/thousand hooks by 2004/05 and 0.002 birds/thousand hooks by 2006/07. The rates measured meet these targets.

111. The Working Group noted there was no direct implication of the findings for the Convention Area breeding species, as all of the individuals reported in this study were likely to come from breeding sites outside. The fishery has moved to standardised steel weights, which improve the efficiency of line-weighting procedures, and are less likely to result in loss of fishing gear. The Working Group further noted that in the one case where a streamer line had temporarily not been used, high bird by-catch had resulted, indicating the need to continue to use streamer lines.

Research into the status and distribution of seabirds

112. Ms Neves presented information on seabird abundance off the Brazilian coast obtained through the Projeto Albatroz observer program between 2000 and 2005 (WG-FSA-05/67). Many of the species recorded in this study were species of importance to CCAMLR, including wandering albatrosses, white-chinned petrels, Cape petrels, southern fulmars, giant petrels and Wilson's storm petrels. Overall, the southern region of Brazil is an important foraging area, particularly during the autumn and winter months when seabird abundance is higher than during the breeding season. The results showed that the southern Brazilian area is important for the conservation of birds from four main breeding areas, including CCAMLR areas, Falkland/Malvinas Islands, Tristan da Cunha and New Zealand.

113. WG-FSA-05/14 presented results of a recent tracking study of albatrosses on Heard Island. In the summer of 2003/04, five light-mantled sooty albatrosses and 10 black-browed albatrosses breeding on Heard Island were tracked. The black-browed albatrosses foraged over shelf slope waters within 150 km of Heard Island and concentrated their foraging effort over the Gunnari Ridge which lies to the east of Heard Island. There is considerable spatial overlap with trawl and longline fisheries operations within the EEZ. The light-mantled sooty albatrosses foraged over 1 000 km to the south in productive waters between the southern boundary of the Antarctic Circumpolar Current and the northern edge of the pack-ice. This was the first time either albatross population from Heard Island had been tracked.

114. Specifically, the light-mantled sooty albatrosses from Heard Island foraged along the Antarctic shelf break/pack-ice edge, including in areas where new and exploratory fisheries operate in Divisions 58.4.1, 58.4.2 and 58.4.3. This new information has been incorporated into the risk assessments for these areas.

115. Considering the recent mortality of seven adult black-browed albatrosses in the icefish trawl fishery operating adjacent to Heard Island in Division 58.5.2 (WG-FSA-05/8) and the small size of this population (c. 600 pairs), it was noted that this satellite-tracking information provided important information for the understanding and management of incidental mortality in fisheries adjacent to Heard Island.

116. Dr S. Waugh (New Zealand) presented new research on the foraging ecology of albatrosses in relation to fishing activity. GPS loggers were used to track royal albatrosses foraging within the New Zealand EEZ and linked with real-time fishing locations from trawl fisheries. Linking individual's behaviour with fishing locations indicates a degree of attraction between birds and vessels actively fishing, and thus a wider range of target-species fisheries were potentially involved in interactions with royal albatrosses than had been previously indicated based on recoveries of dead birds from fisheries. In particular, royal albatrosses associated with deep-water vessels to a high degree than expected. A management response to this information has been an improved targeting of observer coverage to examine bird interactions.

117. The Working Group noted the important technological advances of the application of GPS technology to seabird foraging studies. Unlike information derived from satellite or geolocation information, there has been no global synthesis of Procellariiform distribution using GPS-derived spatial information. Importantly, GPS spatial assessments enable consideration of interactions between birds and fishing operations at much finer scales than previously possible. The Working Group envisaged the need for a workshop in the future to harmonise and consolidate practices and analyses in the rapidly increasing application of GPS technology to seabirds and the application of such studies to fisheries management.

118. As requested by the Working Group last year, BirdLife International submitted 'Tracking Ocean Wanderers: the Global Distribution of Albatrosses and Petrels', a report describing its global Procellariiform tracking initiative (WG-FSA-05/P10). The initiative was introduced last year (SC-CAMLR-XXIII, Annex 5, paragraph 7.144) and the full report is now available (www.birdlife.org). The Working Group congratulated BirdLife International and the data contributors for providing a comprehensive global assessment for the remote-tracking distributions of albatrosses and petrels.

119. Dr B. Sullivan (UK) reiterated a request for holders of new information on Procellariiform distribution to submit these to the database to ensure that it remains as relevant and up-to-date as possible for application to fisheries management initiatives.

120. As requested by the Working Group last year (SC-CAMLR-XXXIII, Annex 5, paragraph 7.145) BirdLife International provided an analysis of albatross and petrel distribution relevant to the CCAMLR Convention Area (WG-FSA-05/75). The results of this analysis highlight the importance of the Convention Area, particularly for breeding distributions of populations of wandering, grey-headed, light-mantled, black-browed and sooty albatrosses, and populations of both northern and southern giant petrels and white-chinned petrels. The distribution data also emphasise the importance for breeding albatrosses and petrels of regions north of Convention Area boundaries.

121. The CCAMLR subareas with the highest proportion of albatross and petrel distribution were Subareas 48.3 and 58.6, but the breeding ranges extend across the majority of the

Convention Area. The spatial risk assessments for CCAMLR subareas were revised based on this new and relevant information on the distribution of albatrosses and petrels vulnerable to interactions with fisheries (SC-CAMLR-XXIV/BG/26).

122. This new tracking information on Procellariiform seabirds enabled the Working Group to undertake a provisional gap analysis of albatross and petrel distribution data with respect to their occurrence in the Convention Area.

123. In this regard, and taking particular account of the size and location of populations and the likelihood of obtaining distributional data relevant to improving existing risk assessments, the Working Group suggested the following priorities for data acquisition:

(i) Breeding birds:

Priority A:

Grey-headed albatross	Crozet Islands, Kerguelen Islands
Indian yellow-nosed albatross	Crozet Islands, Prince Edward Islands
Light-mantled albatross	Auckland Islands, Campbell Island, Crozet Islands, Kerguelen Islands
Northern giant petrel	Chatham Islands, Crozet Islands, Kerguelen Islands, Macquarie Island
Southern giant petrel	Antarctic Peninsula, South Orkney Islands, Heard and MacDonald Islands
White-chinned petrel	Antipodes Island, Auckland Islands, Kerguelen Islands

Priority B:

Black-browed albatross	Crozet Islands
Campbell albatross	Campbell Island
Sooty albatross	Prince Edward Islands
Northern giant petrel	Campbell Island
Southern giant petrel	Falkland/Malvinas Islands, Macquarie Island, Prince Edward Islands, South Sandwich Islands

(ii) Non-breeding birds:

With the exception of data for grey-headed and black-browed albatrosses from South Georgia, acquisition of data from the at-sea distribution of non-breeding adults and juvenile birds from all major populations of each species breeding in the Convention Area is a very high priority.

The Working Group recommended that BirdLife International be requested to provide summary data on distribution of Southern Ocean seabirds from its tracking database at approximately three-year intervals, or when accumulation of data warrants.

124. WG-FSA-05/42 presented a review of research on seabird–fishery interactions commissioned by the New Zealand Ministry of Fisheries. The review considered recent research (from 1990 onwards) in five main topic areas (estimation of incidental mortality, methods for estimating population size and trends, the utility of genetic research, management efficacy and foraging information).

125. The aim of the review was to assist the New Zealand NPOA-Seabirds Science Advisory Group (SAG). SAG's objective was to advise the government on the research appropriate to meet the objectives of the NPOA. The group reviewed six research areas (population estimation and modelling, estimation of incidental mortality, molecular ecology, mitigation, foraging ecology, monitoring management efficacy) and considered two reviews by Ms R. Alderman (WG-FSA-05/42) and Dr L. Bull (WG-FSA-05/P8). The main findings, methodological recommendations and gaps were identified and set out for each research domain. Priorities were specified for seabird–fishery research. These latter items are subject to ongoing development and were used in the development of a five-year research plan undertaken by the Ministry of Fisheries and the Department of Conservation.

126. The Working Group noted that New Zealand's activities on research and conservation of albatrosses and petrels are of high significance to CCAMLR as this Member has the greatest diversity of breeding Procellariform species. The Working Group congratulated New Zealand's initiative, especially the ongoing and full engagement of the Ministry of Fisheries in seabird conservation issues.

127. Information summarising national research on seabirds (albatrosses and *Macronectes* and *Procellaria* petrels) was presented by Australia (WG-FSA-05/55), USA (WG-FSA-05/44) and New Zealand (WG-FSA-05/51). Reference to some research on petrels by France was included in CCAMLR-XXIV/BG/23. The UK submitted an electronic summary of national research to the Working Group. It was encouraged also to submit the data in hard-copy format in future.

128. Of countries known to be conducting relevant research, no reports were received from Argentina, France or South Africa. These countries were encouraged to provide input about their work that has relevance to the Convention Area.

129. It was noted that the UK data submission included reference to a multinational project undertaking molecular analyses of taxonomic relationships of *Macronectes* and *Procellaria* petrels; this study being coordinated by Dr P. Ryan (South Africa).

130. Dr Micol presented information on petrel populations on Crozet and Kerguelen Islands (CCAMLR-XXIV/BG/23). In order to assess the impact of the incidental mortality in the French EEZ, particularly on white-chinned and grey petrels, a study funded by fishing companies and France has been initiated by CNRS of Chizé. The two-year study, which started in 2004, aims to determine population trends, examine the impact of current and historical levels of fisheries-related seabird mortalities, and compare the relative impact of incidental mortality and fluctuations due to environmental variables. The work includes a complete census of white-chinned petrels on Possession Island (Crozet) with comparisons to 1983 population estimates. As no previous population estimates are available for Kerguelen, population sizes will be assessed over the two-year period. Analyses will also consider long-term demographic data, as well as new information on diet, satellite monitoring and fisheries interactions. Results are expected in early 2007.

131. ACAP agreed at the First Meeting of Parties (MOP1) in November 2004 that ACAP's Advisory Committee would review the population status, trends and demography of albatrosses (21 species) and petrels (7 species) listed in Annex 1 of the Agreement. Thus, an ACAP working group, chaired by Dr R. Gales (Australia), was formed to collect and collate information on breeding numbers and critical population and demographic parameters for each species. It was anticipated that this synthesis would enable gaps in information to be identified and facilitate the prioritisation of actions to collect information to fill these gaps.

132. Information provided by four Parties (Australia, New Zealand, South Africa and the UK) to ACAP consisted of population-specific data for 19 albatross and seven petrel species. The ACAP working group's preliminary review was provided to the first ACAP Advisory Committee meeting in July 2005. Information from Argentina was subsequently made available at the ACAP meeting but has not yet been incorporated in the review.

133. The review provided to WG-IMAF (WG-FSA-05/P2) includes information on breeding populations for ACAP species within Australian jurisdiction (Tasmania, Heard and Macquarie Islands). Demographic studies are under way for four of the albatross species and there are ongoing long-term population monitoring studies for albatrosses and petrels breeding on Macquarie Island and in Tasmania. Current trends for the ACAP species breeding on Macquarie Island indicate that these populations are either increasing or stable in numbers. Fewer data are available for the species breeding on Heard Island; in particular there is a lack of reliable information on population trends for the species breeding at this site.

134. Extensive information was provided by New Zealand for species breeding within its jurisdiction. Population estimates are available for most breeding sites, although for some species (e.g. light-mantled albatross), the reliability of these estimates is low. Very little information is available for a number of species including Pacific, white-capped and Salvin's albatrosses and Westland petrel. Information for these species is essentially restricted to limited point estimates of population size with no robust information on population trends. Population trend information is available for 18 of the 40 populations in the New Zealand region. Of these, 16 (89%) are reported as being either stable or increasing. The two populations that are reported to be in decline are Salvin's albatrosses at the Bounty Islands and grey-headed albatrosses breeding on Campbell Island.

135. South Africa submitted comprehensive information for the nine ACAP species breeding at both Marion and Prince Edward Islands. Considerably greater knowledge exists for the eight species breeding at Marion Island. The population trends of seven species at this

site are known with at least moderate reliability and, of these, four are stable and three (sooty albatross, southern giant petrel and white-chinned petrel) are decreasing. Information is most limited for grey and white-chinned petrels. Much less information was presented for species breeding at Prince Edward Island, with information essentially restricted to population estimates conducted in 2001/02.

136. The UK submitted data for Tristan da Cunha and Gough, the Falkland/Malvinas Islands and South Georgia. The most comprehensive dataset was available for South Georgia, derived largely from long-term demographic studies from Bird Island, but also with recent archipelago-wide surveys of wandering, black-browed and grey-headed albatrosses confirming long-term declines. There are reliable estimates of productivity, adults and juvenile survival from Bird Island for these three species and this will be available in the future for both giant petrels. Population trend information for six ACAP species breeding at South Georgia showed that most (five) are in decline, with only southern giant petrels being stable in numbers. There is very little information on demography, current population size and status of the light-mantled albatross and white-chinned petrel, except that the latter is in long-term decline.

137. Similarly, little is known about long-term demographic processes or status of the three Falkland/Malvinas Islands ACAP species except that the black-browed albatross has recently undergone a rapid decline, and a survey in 2004 of the southern giant petrel recorded many more birds than anticipated. At Tristan da Cunha/Gough the limited data on population size suggests that the Tristan, Atlantic yellow-nosed and sooty albatrosses are in decline, and the southern giant petrel and spectacled petrel are apparently increasing. With the exception of two (of three) albatross species breeding on Gough, there is very little data on vital rates.

138. Information from all sites is consistent in showing that considerably more information is available for albatross and giant petrel species, with very little information being available for *Procellaria* species.

139. Comparing the available regional data on population trends suggests that populations in the Australian and New Zealand region are generally more secure than populations elsewhere. For other ACAP populations the situation is more serious. The most extensive suite of data for ACAP species is from South Georgia, and at this site five of the six species for which data are available are in decline. This regional comparison highlights the serious predicament of populations breeding in the CCAMLR Convention Area compared with the generally less precarious situation of populations elsewhere.

140. The Working Group thanked ACAP and the chair of the Status and Trends Working Group for providing the information. The preliminary review indicates excellent progress toward a global revision of population status and underscores the considerable interest and relevance of the ACAP work to CCAMLR. It was noted that, with the exception of Argentina, all breeding species of most concern to CCAMLR are represented by signatories to ACAP. Thus, the Working Group recognised it was not necessary to update SC-CAMLR-XXIV/BG/22 ‘Summary of population data, conservation status and foraging range of seabird species at risk from longline fisheries in the Convention Area’.

141. The Working Group agreed that such information is best compiled and reviewed by ACAP and to avoid duplication, it was agreed that ACAP be the single repository for these data. ACAP would be requested to submit summary documents of albatross and petrel population status to WG-IMAF annually, or as appropriate.

142. The Working Group considered the potential for similar cooperation between WG-IMAF and ACAP in the area of taxonomic revision and molecular research. It was agreed that, at this stage, WG-IMAF would maintain the request to Members for information on relevant national seabird genetic research.

143. In relation to international initiatives coordinated by Prof. H. Caswell and Dr C. Hunter (USA) to develop new population models for albatrosses (see SC-CAMLR-XXIII, Annex 5, paragraph 7.153), Prof. Croxall reported that a second meeting of the working group had been held in March 2005 in the USA. The main developments at this meeting were: (i) fitting and evaluation of models using nine datasets for six albatross species; (ii) refining questions of interest into three broad groupings, viz: (a) life-history issues, primarily involving interactions between breeding frequency, productivity and survival; (b) management issues, especially consequences of 'catastrophe' years, estimation of potential biological removals, power to detect change and possible provision of best-practice advice; and (c) other issues involving effects such as density-dependence, environment, dispersal etc. The group's report will be tabled at the next ACAP meeting. The next meeting of the group will take place in France in May 2006.

International and national initiatives relating to incidental mortality of seabirds in relation to longline fishing

ACAP

144. WG-FSA-05/25 reported on the first meeting of the Advisory Committee of ACAP held in Hobart, Australia, from 20 to 22 July 2005 with four Parties (Australia, New Zealand, South Africa and UK), two Signatory States (Argentina and France) and three Range States (Norway, Ukraine and USA) in attendance. All are Members of CCAMLR, which was also represented as an invited observer (together with SCAR, BirdLife International and IASOS). The meeting was informed of recent ratifications by France and Peru and of progress towards ratification by Argentina, Chile and Norway. A full report of the meeting is available at www.acap.aq/index.php/acap/advisory_committee/first_advisory_committee_meeting.

145. Items of particular relevance to CCAMLR included:

(i) the review of data relevant to the assessment of status and trends of albatross populations by the ACAP Status and Trends Working Group (see paragraphs 131 to 141);

(ii) the establishment of a Taxonomy Working Group to review the status of existing and potential ACAP-listed taxa;

(iii) the establishment of a Working Group on Breeding Sites, to develop an inventory and assess the conservation status of all breeding sites of ACAP species;

(iv) commendation of the work CCAMLR has undertaken to address mitigation of seabird by-catch and recognition of the need for substantial progress in areas of application of other organisations with responsibility for the management of fisheries in which incidental mortality of ACAP species occurs;

(v) the desire to maintain a close working relationship with CCAMLR.

FAO IPOA-Seabirds

146. At the 26th (2005) meeting of FAO COFI 11 members reported on aspects of IPOA-Seabirds implementation. Reports ranged from implementation under way (Japan (which submitted a revised NPOA-Seabirds), New Zealand and the USA), NPOAs near completion (Brazil, Chile, Namibia and South Africa), IPOA-Seabird relevant activity (Australia, Canada, Peru and Uruguay) and two assessments (Mexico, El Salvador) which had concluded that an NPOA-Seabirds was unnecessary.

147. WG-FSA-05/38 reported on further substantial progress in the development of the Chilean NPOA with the completion of the second (of three) steps, involving development and testing of mitigation measures for each longline fishery (Patagonian toothfish, austral hake and swordfish) operating in the Chilean EEZ. For Patagonian toothfish the mitigation specifications include using streamer lines on all sets, weights of 8.5 kg every 40 m on the motherline and a setting speed of 6.5 knots. Further tests on the line-weighting specification and of paired streamer lines are also planned. The hake (and ling) fishery will only set at night and trials of streamer lines and line weighting are planned. The swordfish fishery will set at night, use a streamer line (≥100 m) and use 60 g weights at the swivel (sink rates of ≥0.23 m/s). Further tests of streamer lines and of interactions between line weighting and setting speed are proposed.

148. The main aim of the Chilean NPOA is to reduce, by 90% over three years, the rate and level of incidental mortality of seabirds observed in 2002. Analysis of data from 2004/05 suggests a 72% reduction but indicates that by-catch rates for black-browed albatross, of 0.113 birds/thousand hooks observed in 2004/05, suggest that further improvements in design and use of mitigation measures are needed to reduce this level to the nominal target of 0.05 birds/thousand hooks.

149. Ms Neves noted that the Brazilian NPOA-Seabirds (see SC-CAMLR-XXIII, Annex 5, paragraph 7.161) is about to be published; this version will incorporate some revision to statistics that have changed during the period in press.

Other international organisations and initiatives,
including non-governmental organisations

150. Ms K. Rivera (USA) introduced WG-FSA-05/45 reporting on a workshop held in November 2004 at the Fourth International Fisheries Observer Conference, to facilitate research and analysis of factors influencing by-catch of marine mammals, sea turtles and seabirds in longline fisheries, including by recommending the best practice in respect of data collection.

151. The Working Group noted that CCAMLR already requires the provision of the data recommended by the workshop. Nevertheless the recommendations would represent very valuable advice to RFMOs generally and the authors were encouraged to facilitate submission of the documentation and recommendations to all relevant RFMOs, especially those with areas of application adjacent to the Convention Area.

152. Dr Waugh presented WG-FSA-05/47 which reported on an initiative to provide training exchanges in seabird mitigation. The aim was to provide a placement for a fisher from a Latin-American country on board a vessel, with a proven record of seabird-friendly fishing techniques, in the New Zealand demersal longline ling fishery. The report of the selected fishing captain, Luis Uribe from Chile, indicated the benefit of the experience and contained important recommendations for informing other fishers of how to implement cost-effective techniques for reducing seabird by-catch.

153. The Working Group commended the New Zealand and USA sponsors of this initiative which had provided valuable insight into how to transmit conservation messages across language and cultural barriers. The Working Group would be interested to learn of any longer-term benefits within Chilean and Latin-American fishing constituencies.

154. Dr Sullivan informed the Working Group of a BirdLife International workshop held in Hobart, Australia, in October 2005 to develop an implementation plan for an international initiative (Operation Ocean Task Force) to work at sea and in onshore workshops to undertake mitigation research and collect baseline by-catch data, where required, and to assist fishers in the correct use of a range of mitigation measures available to reduce seabird mortality in longline and trawl fisheries. Many of the fisheries to be targeted in southern Africa and South America have incidental mortality of seabirds that breed in the Convention Area.

RFMOs, tuna commissions and international governmental organisations

155. The Working Group noted the review and analysis by BirdLife International (WG-FSA-05/P9), conducted during 2004 and launched at the FAO COFI meeting in March 2005, of the duties and performance of 14 RFMOs in reducing by-catch of albatross and other species. The evaluation criteria were based on the principles established in the Code of Conduct for Responsible Fisheries and the United Nations Fish Stock Agreement. Of the five RFMOs most important in terms of overlap with albatross distribution (in order of priority CCSBT, WCPFC, IOTC, ICCAT and CCAMLR), CCAMLR scored the most highly in almost every category (participation and transparency; target fish data and assessment; target fish management and status; combatting IUU fishing; commitment to reducing by-catch; by-catch data collection and by-catch mitigation).

156. The Working Group appreciated the value and importance of this independent external review and the testimony it provided to the effective, extensive and pioneering work of CCAMLR. The low performance levels of other RFMOs, especially the three tuna commissions, reinforced the concerns expressed by CCAMLR in recent years.

157. The Working Group recollected that for several years the Commission had strongly supported collaboration with those RFMOs with responsibilities for areas adjacent to the Convention Area where seabirds from the Convention Area, are, or may be, killed, in order to promote the adoption by these RFMOs of appropriate mitigation measures for the fisheries actually or potentially involved (e.g. CCAMLR-XXII, paragraph 5.17). The Working Group recollected its earlier advice, endorsed by the Commission, that the greatest threats confronting the conservation at sea of albatrosses and petrels breeding in the Convention Area are the levels of mortality likely to be associated with IUU longline fishing inside the Convention Area, and with longline fishing for species other than *Dissostichus* in areas adjacent to the Convention Area (CCAMLR-XX, paragraph 6.33; CCAMLR-XXIII, paragraph 5.22).

158. Last year, as a result of continuing failure to establish constructive dialogue with the main RFMOs responsible for regulating longline fishing (and associated by-catch of non-target species including seabirds) in areas adjacent to the Convention Area (CCAMLR-XXIII, paragraphs 5.26 to 5.29), the Commission adopted Resolution 22/XXIII:

(i) requesting the relevant RFMOs to implement and develop mechanisms for collecting, reporting and disseminating data on seabird incidental mortality;

(ii) urging CCAMLR Members also members of relevant RFMOs[1] (and especially new and developing ones) to ensure that the topic of seabird incidental mortality is placed on the agendas of the pertinent RFMO meetings, that areas of unknown or potential by-catch and the most effective mitigation measures to be used in these areas and circumstances are identified and that appropriate observer programs are in place to provide sufficient data for evaluation purposes.

159. To date (and since 18 November 2004) responses to the CCAMLR resolution and the accompanying letter from the Chair of the Commission have been received from CCSBT, IATTC and ICCAT.

160. However, it was noted that appreciable initial progress had been made intersessionally in terms of communication on by-catch (including seabird) issues with RFMOs (see paragraph 179).

161. Thus IOTC had now established a by-catch subgroup, the inaugural meeting of which had been attended by BirdLife International, presenting a paper on known and potential seabird–fishery interactions. IOTC had welcomed this input and further presentations, including advice on mitigation measures, were scheduled for the next meeting.

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[1] CCSBT: Australia, Japan, Republic of Korea and New Zealand.
WCPFC: Australia, European Community, France, Japan, Republic of Korea and New Zealand; USA as a Signatory; UK as a Participating non-member.
IOTC: Australia, European Community, France, India, Japan, Republic of Korea and the UK; South Africa as a Cooperating non-member.
ICCAT: Brazil, European Community, France, Japan, Republic of Korea, Namibia, Norway, Russia, South Africa, UK and the USA.
IATTC: France, Japan, Spain and the USA; European Community and the Republic of Korea as Cooperating non-members.

162. Similarly, for the recent meeting (October 2005) of ICCAT's by-catch subcommittee, BirdLife International tabled a paper on overlap of albatrosses and petrels with ICCAT longline fishing effort. About 10% (30–40 million hooks) of ICCAT's annual longline fishing effort overlaps albatross habitat, being greatest in the second and third quarters of the year and mainly involving Taiwanese and Japanese vessels.

163. In respect of ICCAT's resolution (of 2002), requesting members to provide its by-catch subcommittee with data to assess the impact of incidental catches of seabirds, proposals had been made to hold a workshop on this topic.

164. The response from ICCAT to the CCAMLR letter and Resolution 22/XXIII included a summary of fishing effort data south of 40°S in 2000–2002 which indicated that the main fleets involved are those of Taiwan (for albacore) and Taiwan and Spain (for swordfish).

165. In respect of WCPFC, Mr N. Smith (New Zealand) reported progress by this newly formed Commission on matters relating to the incidental mortality of seabirds. The WCPFC held its inaugural Commission meeting in December 2004. At that meeting the Commission directed its scientific experts to prepare estimates of the mortality of non-target species with an initial focus on seabirds, sea turtles and sharks.

166. In response, at its first Scientific Committee meeting in August 2005, the WCPFC established an Ecosystem and By-catch Specialist Working Group (EB-SWG). At its first meeting during August 2005 the EB-SWG considered two papers of interest to WG-IMAF:

(i) a paper, compiled by the Secretariat of the Pacific Community Oceanic Fisheries Programme, containing estimates of the incidental mortality of seabirds in the WCPFC Convention Area based on observer data;

(ii) a paper, compiled by Birdlife International, describing the distribution of albatrosses and petrels in the Western and Central Pacific and potential overlap with WCPFC longline fisheries.

167. The key recommendations resulting from the review of these papers by the EB-SWG and WCPFC Scientific Committee were that:

(i) current levels of observer data were inadequate to produce reliable estimates of incidental mortality of seabirds in the WCPFC Convention Area. Accordingly it would be necessary to implement higher levels of observer coverage, especially in longline fisheries in the more temperate waters of the WCPFC Convention Area, to allow reliable estimates of seabird incidental mortality to be made in future;

(ii) an ecological risk analysis should be conducted in order to prioritise species of sea turtles, sharks and seabirds and non-target fish species for future research.

The WCPFC Commission will consider these recommendations at its next meeting in December 2005.

168. In respect of CCSBT, the Working Group noted that the report and tabled papers from the Fifth Meeting of the ERS WG (February 2004 in New Zealand) had been approved by the CCSBT Commission and made available to CCAMLR.

169. The Working Group thanked CCSBT for this and noted that the papers contained valuable data on the timing, area and extent of fishing effort and estimates (from reports by national observers) of seabird by-catch and on the nature of mitigation methods currently in use.

170. The annual report from the Republic of Korea indicated that no data on seabird by-catch were reported and that there were no mandatory mitigation measures in use, though some vessels voluntarily used streamer lines. Some educational materials with respect to mitigation of by-catch of seabirds and sea turtles were in development.

171. The report from Chinese Taipei indicated that there is currently no reporting of seabird by-catch data, but that use of streamer lines is mandatory on all vessels fishing for southern bluefin tuna south of 30°S. The report also noted the workshop convened jointly with BirdLife International on seabird by-catch and mitigation which was reported to CCAMLR last year (SC-CAMLR-XXIII, Annex 5, paragraph 7.176).

172. The reports from Japan were particularly commended for the provision of data on effort and by-catch and on extensive research to investigate the utility of various mitigation measures, especially dyed bait. The Japanese reports indicated that:

(i) use of streamer lines (which may vary in design and detail of use) is mandatory on all vessels fishing for southern bluefin tuna south of 30°S;

(ii) all vessels use thawed bait and bait-casting machines;

(iii) virtually all vessels experience incidental mortality of seabirds;

(iv) enforcement of compliance with mitigation measures involved enforcement vessels observing 637 fishing operations on 31 vessels in 2002;

(v) observer coverage in 2001 and 2002 was 5.7–6.8% of cruises, 3.6–3.7% of sets and 2.9–3.2% of hauls.

173. The analysis of the level and rate of seabird by-catch indicates that in 2001 and 2002 respectively the estimated total seabird by-catch levels and rates were 6 516 (95% CI 3 376–10 378) birds (with an average rate of 0.139 birds/thousand hooks) and 6 869 (95% CI 3 811–10 213) birds (with an average rate of 0.181 birds/thousand hooks). The report suggested that the levels of by-catch have been broadly stable since 1995 at 6 000–9 000 birds per year with the estimated value of c. 14 000 birds in 2000 probably due to sampling error. Catch rates have varied by season and area and ranged from 0.026 to 0.312 birds/thousand hooks. The main areas fished in 2001 and 2002 were south of 40°S off South Africa (mainly in quarters 2 and 3), south of 40°S east of Australia (mainly in quarter 2) and from 25°S to 45°S west and southwest of Australia (mainly quarters 3 and 4). Seabird by-catch composition, based on a sample of 467 birds from 2001 and 2002 combined, comprised 74.1% albatrosses (amongst those identified to species (n = 281), 45.2% grey-headed albatross, 20.6% black-browed albatross, 10.0% shy albatross, 4.3% wandering albatross), 7.8% giant petrel and 13.7% smaller petrels (at least 50% of which were *Procellaria* species).

174. The Working Group expressed concern at the levels and rates of seabird (especially albatross) by-catch in the CCSBT fisheries. Given the low level of observer coverage, and that reports derived from birds brought on board vessels underestimate (sometimes substantially so) the number of birds actually killed, it is perfectly conceivable that if up to at least 9 000 seabirds are killed annually, this could represent 6 670 albatrosses (including c. 3 000 grey-headed albatrosses and 1 370 black-browed albatrosses), 690 giant petrels and at least 600 *Procellaria* petrels. Most of these birds are likely to be from populations breeding in the Convention Area.

175. Noting that the Japanese southern bluefin tuna fleet probably represents about two-thirds of the longline fishing effort in the overall CCSBT fishery, the total annual mortality of seabirds could approach, or even exceed, 13 500 seabirds including about 10 000 albatrosses.

176. The Working Group, while acknowledging the very approximate nature of these estimates and the substantial extrapolations involved, viewed these numbers with substantial concern. It re-emphasised the need for effective mitigation of seabird by-catch, not simply confined to the mandatory use of streamer lines but involving some combination of improved line weighting, night setting and offal management. Evaluation of the effectiveness of the improved mitigation, together with acquiring better estimates of seabird by-catch levels and rates, would require a more extensive and detailed program of data collection by observers.

177. In this context, the Working Group noted that the 26th Session of COFI (March 2005) had expressed strong support for a proposal by Japan that, with FAO technical cooperation, Japan and possibly other sponsors convene a joint meeting of the secretariats of the tuna RFMOs and their members. It had been agreed that the meeting should be held in January or February 2007 in Japan.

178. The Working Group noted that the provisional agenda for the meeting includes reviewing incidental catch-related measures and could be a valuable opportunity to explore implementation of consistent best-practice provisions for collection, analysis and dissemination of by-catch data, together with improved implementation of mitigation measures appropriate to the areas, times and target species involved. Members of CCAMLR, especially those also members of the participating RFMOs, were requested to support a thorough review of by-catch-related initiatives and requirements at this meeting. The Working Group also noted that it would be a valuable opportunity to promote knowledge of CCAMLR's work and concerns in this field.

179. Overall, the Working Group recognised that there had been a considerably enhanced level of interaction with tuna commissions during the last year and thanked all involved, especially Members of CCAMLR and non-governmental organisations for their role and assistance in achieving some progress in furthering the goals of CCAMLR. The importance of moving rapidly to interactive involvement in the collection of appropriate data and the application of appropriate mitigation throughout all relevant fleets was re-emphasised.

Incidental mortality of seabirds in relation to new and exploratory fisheries

Assessment of risk in CCAMLR subareas and divisions

180. As in previous years, the Working Group assessed the numerous proposals for new and exploratory fisheries and the potential for these fisheries to lead to substantial increases in seabird incidental mortality.

181. In order to address these concerns, the Working Group reviewed its assessments for relevant subareas and divisions of the Convention Area in relation to:

(i) timing of fishing seasons
(ii) need to restrict fishing to night time
(iii) magnitude of general potential risk of by-catch of albatrosses and petrels.

182. Comprehensive assessments of the potential risk of interaction between seabirds and longline fisheries for all statistical areas in the Convention Area are carried out each year and have been combined into a background document for use by the Scientific Committee and Commission (SC-CAMLR-XXIV/BG/26).

183. This year new data derived from an analysis of the distribution of albatrosses and petrels in the CCAMLR Convention Area (areas, subareas, divisions and subdivisions), based on data from BirdLife International's Global Procellariiform Tracking Database (WG-FSA-05/75) provided substantial information on the foraging ranges of seabirds that breed within the Convention Area. Additional information on the distribution of black-browed and light-mantled albatrosses from Heard Island was also provided (WG-FSA-05/14). This information was used to update the assessment of potential risk of interactions between seabirds and longline fisheries for Subareas 48.2, 48.4, 88.1 and 88.3 and Division 58.4.2. The revised assessments incorporating new information made available at the meeting (with changes/additions underlined) have been issued as SC-CAMLR-XXIV/BG/26.

New and exploratory longline fisheries operational in 2004/05

184. Of the 35 proposals last year for new and exploratory longline fisheries in seven subareas and divisions, only 25 were actually undertaken: by Japan and the Republic of Korea in Subarea 48.6; Chile, Republic of Korea, New Zealand and Spain in Division 58.4.1; Chile, Republic of Korea, New Zealand and Spain in Division 58.4.2; by Australia, Republic of Korea and Spain in Division 58.4.3a; by Chile, Republic of Korea and Spain in Division 58.4.3b; by Argentina, New Zealand, Norway, Russia, UK and Uruguay in Subarea 88.1; and by New Zealand, Norway and Russia in Subarea 88.2.

185. No seabird by-catch was reported to have been observed in fisheries in Subareas 48.6, 88.1 and 88.2, and Divisions 58.4.2, 58.4.3a and 58.4.3b. Two seabird mortalities and another bird released alive were observed caught on one vessel during day sets in Division 58.4.1. All birds were southern giant petrels. Clearly, the strict adherence in Subareas 48.6, 88.1 and 88.2, and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b to the specific requirements set out in Conservation Measures 24-02 and 25-02 with respect to line-weighting regimes, combined with fishing in areas of average-to-low and average risk, has proven successful in achieving zero or extremely low incidental by-catch of seabirds.

New and exploratory longline fisheries proposed for 2005/06

186. Following the annual review of the actual levels of risk adopted last year in SC-CAMLR-XXIII/BG/21, the Working Group suggested the following changes:

Subarea/Division	Current level of risk	Proposed level of risk
48.2	Average (3)	Average to high (4)
48.4	Low (1)	Average (3)
58.4.2	Average (3)	Average to low (2)
88.1 Overall risk No change	Average (3)	Average (3)
88.1 Northern sector No change	Average (3)	Average (3)
88.1 Southern sector	Average to low (2)	Low (1)
88.3	Low (1)	Average to low (2)

187. The assessment of the risk to seabirds posed by new and exploratory longline fisheries in the Convention Area is incorporated into the revised assessment SC-CAMLR-XXIV/BG/26 (an update of SC-CAMLR-XXIII/BG/21) and summarised in Figure 1 and Table 19, and also includes an assessment of recommended levels of observer coverage.

188. Thirty-nine applications for exploratory longline fisheries, submitted by 12 countries, were received by CCAMLR in 2005. No applications for new longline fisheries were received. The areas for which these proposals were received were:

Subarea 48.6	Japan, New Zealand
Division 58.4.1	Australia, Republic of Korea, New Zealand, Spain, Russia, Uruguay
Division 58.4.2	Australia, Chile, Republic of Korea, New Zealand, Spain
Division 58.4.3a	Australia, Chile, Republic of Korea, Spain
Division 58.4.3b	Australia, Chile, Republic of Korea, Spain, Uruguay
Subarea 88.1	Argentina, Republic of Korea, New Zealand, Norway, Russia, South Africa, Spain, UK, Uruguay
Subarea 88.2	Argentina, Republic of Korea, New Zealand, Norway, Russia, Spain, UK, Uruguay.

189. All the areas listed above were assessed in relation to the risk of seabird incidental mortality according to the approach and criteria set out in SC-CAMLR-XXIV/BG/26. A summary of risk level, risk assessment, the Working Group's recommendations relating to mitigation measures, including fishing season and any inconsistencies between these and the proposals for new and exploratory longline fisheries in 2005, is set out in Table 20.

190. Applications fell into two categories:

(i) Those that provided sufficient information to indicate that the proposals fully comply with relevant seabird by-catch minimisation conservation measures (Conservation Measures 24-02 and 25-02, and the relevant measures in the 41-series) and do not conflict with the IMAF assessment. Applications submitted by Australia (CCAMLR-XXIV/17, 18, 19, 20), Chile (CCAMLR-XXIV/25, 26), Japan (CCAMLR-XXIV/10), New Zealand (CCAMLR-XXIV/13, 14, 15), South Africa (CCAMLR-XXIV/16), Spain (CCAMLR-XXIV/9) and the UK (CCAMLR-XXIV/21) were assessed as being fully compliant.

(ii) Those that contain insufficient information to be certain that the proposals fully comply with relevant seabird by-catch minimisation conservation measures, but which express sufficient sentiment to indicate that this is the intention. Applications by Argentina (CCAMLR-XXIV/12), Chile (CCAMLR-XXIV/27, 28), Republic of Korea (CCAMLR-XXIV/22), Norway (CCAMLR-XXIV/11), Russia (CCAMLR-XXIV/31) and Uruguay (CCAMLR-XXIV/23, 24, 29, 30) fall into this category.

191. Applications in the second category usually state intent to comply with relevant conservation measures but then indicate elsewhere that their fishing plans do not comply. Typical examples include:

(i) fishing seasons simply stated as ‘2005/06’, and not acknowledging that seasonal restrictions apply to some of the divisions and subareas;

(ii) stating an intent to fish outside fishing seasons without seeking a derogation by meeting the line sink rate requirements prescribed in Conservation Measure 24-02;

(iii) stating an intent to fish during the day without seeking a derogation from paragraph 4 of Conservation Measure 25-02 through implementation of the provisions of Conservation Measure 24-02.

192. In cases where Members were intending to fish using multiple vessels operated by more than one company, there were inconsistencies in the level of information provided within subareas or divisions, and hence the level of compliance with relevant seabird by-catch minimisation conservation measures, provided in the applications. Members were requested to take greater care in future submissions to ensure the intent to comply with relevant seabird by-catch measures was clear.

193. Members who have submitted applications falling into the second category should be requested to confirm with the Secretariat that their proposals fully comply with relevant seabird by-catch minimisation conservation measures and do not conflict with the IMAF assessment for the subareas and divisions in which they wish to fish. To assist in this for this year and submissions in future years, a checklist was developed by the Working Group. Members are requested to advise that their applications:

(i) comply with the requirements of Conservation Measure 25-02 in order to minimise seabird by-catch;

(ii) comply fully with measures specified in Conservation Measure 24-02 if an exemption is sought from setting longlines at night, or fish outside specified fishing seasons (if applicable);

(iii) comply fully with measures specified in Conservation Measures 41-04, 41-05, 41-06, 41-07, 41-09, 41-10 and 41-11 (as applicable to the relevant subarea or division) if specified seabird by-catch levels are reached when fishing during daytime setting and/or fishing outside normal fishing seasons.

194. Setting of longlines within the Convention Area during daylight hours or outside normal fishing seasons using currently approved fishing gear still represents a risk for seabirds, even in areas of low to average risk. In all instances where the provisions of Conservation Measure 24-02 are applied, there remains the need for continued review of performance with respect to incidental mortality of seabirds during fishing operations. The Working Group recommended that any vessel operating under the provisions of this conservation measure, and which catches a total of three (3) seabirds, as defined in SC-CAMLR-XXII, Annex 5, paragraphs 6.214 to 6.217, shall revert to night setting in accordance with Conservation Measure 25-02. Similar provisions were specified in previous years.

195. With respect to the prescription of a seabird by-catch level, the Working Group noted the successful implementation of the definition of the status of birds ‘caught’ (SC-CAMLR-XXII, Annex 5, paragraph 6.214 to 6.217). The Working Group recommended the continued use of the definition and requested feedback from scientific observers on the ability to apply this definition whilst at sea.

Other incidental mortality

Interactions involving marine mammals with longline fishing operations

196. WG-FSA-05/7 Rev. 1 indicated that three southern elephant seal mortalities were observed on the *Avro Chieftain*. While fishing in Division 58.5.2, one was caught by a hook in the mouth and another fell off the line prior to reaching the surface and was of unknown life status. The third was entangled in a longline in Division 58.4.3a.

197. WG-FSA 05/9 Rev. 2 reported that two Antarctic fur seals became entangled in a longline on the vessel *Viking Bay* in Subarea 48.3; both were released alive.

198. WG-FSA-05/11 reviewed interactions between cetaceans and longline fishing operations. The most frequent types of interactions were of sperm whales and killer whales taking fish from lines; there were only two occurrences of incidental mortality of cetaceans reported: one dolphin and one small whale; both unidentified.

199. The interactions between toothed whales and longline vessels appear to present a very limited risk of incidental mortality of cetaceans, perhaps because sperm and killer whales are capable of breaking longlines.

200. However, the Working Group noted that the loss of fish and gear as a result of interactions with cetaceans may have two implications:

(i) the risk to cetaceans from entanglement in broken sections of longlines;

(ii) the number of hooks that enter the water may increase to compensate for reduced catches and therefore increase the risk to non-target species.

Interactions involving seabirds with trawl fishing operations

Finfish

201. In 2005, 11 bird mortalities (9 black-browed albatrosses, 1 white-chinned petrel and 1 southern giant petrel) were reported in the Subarea 48.3 icefish fishery from four vessels; in addition, 14 birds were released alive, uninjured (Table 16). This compares to 87 bird mortalities (and 132 released alive) in 2004 and 36 bird mortalities (and 15 released alive) in 2003. The rate of mortalities for this subarea in 2005 was 0.04, compared to the 0.37 and 0.20 birds per tow recorded in 2004 and 2003 respectively (Table 17).

202. In 2005, eight bird mortalities were observed in the icefish/toothfish fishery in Division 58.5.2 from two vessels (5 black-browed albatrosses and 3 white-chinned petrels (Table 16)). The capture rate in this division was 0.01, compared to zero in 2004 and 0.005 birds per tow in 2003.

203. Mr B. Baker (Australia) reported that a further five bird mortalities had occurred in the icefish/toothfish trawl fishery in Division 58.5.2 (2 black-browed albatrosses and 3 white-chinned petrels). These were reported to the observer by the vessel crew and hence have not been included in the capture totals. The Working Group noted that the substantial increase in black-browed albatross mortalities in this division was a concern, given the proximity of the small population of this species at Heard Island, and its vulnerability to population decrease through fisheries mortalities (WG-FSA-05/14).

204. The Working Group noted that the reduction in seabird mortality in the icefish fishery in Subarea 48.3 could be due to a combination of a reduced seabird abundance, associated with the reduction in icefish catches, and the continued adoption of mitigation measures. Information from the description of mitigation measures from the reports of scientific observers indicated that in addition to streamer lines, the *Insung Ho* and the *Betanzos* also used a Brady Baffler and the *Dongsan Ho* also used a water cannon.

205. The Working Group also noted that there was a reduced level of reporting by observers on the effort of crews to thoroughly clean the net before shooting operations; changes should be made to the Cruise Report Forms to improve this situation.

206. There were two new trawl mitigation measures trialled in the 2005 season that showed potential to reduce seabird entanglements. A system of net binding (paragraph 207) was used on the *Sil* and *Robin M Lee* to reduce entanglements and mortality that occur during shooting operations, and the *Argos Vigo* used a free floating panel attached over the top of the net to cover mesh sizes ranging from 135 to 400 mm. There were insufficient data to determine the effectiveness of these methods but it was noted that both methods had potential to further reduce seabird mortality in the fishery.

207. WG-FSA-05/59 reported on the trials of the effectiveness of net binding, streamer lines and net modifications to reduce seabird interactions with trawl nets in the *Champsocephalus gunnari* fishery in Subarea 48.3:

(i) The use of 3–ply sisal string with a breaking strength of 110 kg to bind the net prior to setting prevented the net from spreading and lofting at the surface and increased the net sink rate; the string broke when the trawl doors were paid away.

(ii) Streamer lines failed to protect the net during the haul as tension could not be maintained in the lines to keep them aloft as the vessel slowed, stopped or went in reverse during hauling.

(iii) Reducing mesh size from 200 to 140 mm in an effort to reduce seabird interactions with the net and adding chains to each side of the body of the net to sink the net more quickly caused damage to the net.

208. The Working Group noted that binding the net with sisal string is potentially highly effective, easily accomplished and should be easily implemented as a mitigation measure by the icefish trawl fleet.

Krill

209. In krill fisheries in 2005 in Subareas 48.2 and 48.3 only one incidental mortality of a Cape petrel was recorded; one Antarctic fulmar was caught on a warp splice and released uninjured. The rate of capture was 0.003 birds per tow in Subarea 48.2. Information from the report of a scientific observer from the krill fishery in Subarea 48.3 included anecdotal records of collisions with trawl warps during hauling; collisions generally appeared to be light.

General

210. The Working Group noted that currently there appeared to be a relatively limited level of offal discharge in the trawl fisheries in the Convention Area; however, observer reports indicated that more information is required to assess the extent and timing of offal discharge and the potential interactions with seabirds.

211. The Working Group recalled (WG-FSA-04/79) that observations of trawl warp strike rates require dedicated observer effort with an appropriate level of coverage, given the high level of within- and between-tow variance, to accurately estimate seabird interactions and mortality. In order to better understand the interactions between seabirds and vessels in relation to discharge when the trawl warps are in the water, i.e. in addition to the times of setting and hauling, the following forms should be included in the observer cruise report:

(i) deck discards – including all discarded fish and associated waste discarded from the deck during all trawling operations;

(ii) factory discharge – all materials discarded from the factory during all trawling operations.

212. During the intersessional period the Working Group will develop data collection protocols for the investigation of interactions between seabirds and trawl warps for consideration by WG-IMAF in 2006.

213. Pilot trials to test a range of mitigation measures to reduce seabird strikes on warp cables and net sonde cables in the Bering Sea pollock trawl fishery identified several promising methods. A boom with straps hanging to the water placed in the offal stream forward of the warps was considered to have potential at reducing warp cable strikes. Paired streamer lines were also identified as potentially reducing strikes with warp cables (as reported in WG-FSA-04/79 outside the Convention Area in the South Atlantic). Streamer lines were also effective at reducing contacts with the net sonde cable, as was a snatch block system that lowered the exit point of the netsonde cable to the trawl deck level. Trials are planned to further test these methods.

214. Detailed data collection protocols designed to monitor seabird interactions with both the warps and net developed for the New Zealand southern squid trawl fishery (WG-FSA-05/41) were tested using data collected in the summer of 2004/05 (WG-FSA-05/40). It was noted that of the 106 dead or injured birds recorded during the trials, approximately half occurred on the warp cable and half were due to net entanglements. Data modelling identified the presence and rate of offal discharge as the primary factor related to warp cable strikes.

215. The Working Group recommended that at future meetings, assessments of incidental mortality of seabirds and marine mammals in the icefish, toothfish and krill trawl fisheries be undertaken collectively as part of a generic review of the trawl methodology for mitigation purposes. This approach, assessing the gear rather than the target fishery, has been useful in the development of mitigation methods in longline fisheries. Fishery-specific and species-specific attributes would be considered when appropriate.

Interactions involving marine mammals and trawl fishing operations

Toothfish

216. There was a single Antarctic fur seal caught and released alive in the toothfish trawl fishery in Division 58.5.2.

Krill

217. In 2004/05, 95 Antarctic fur seals were observed caught during krill fishing operations in Area 48, of which 74 were released alive (WG-FSA-05/8, Table 4) compared to 156 of which 12 were released alive last year (SC-CAMLR-XXIII, Annex 5, paragraph 7.229). The observer coverage was not sufficient to extrapolate a total mortality in the fishery.

218. The Working Group recalled that in considering this subject last year it was unable to recommend a particular source of mitigation (SC-CAMLR-XXIII, Annex 5, paragraph 7.243) and welcomed the paper by Hooper et al. (2005) in which various seal-exclusion devices, with information regarding their success, were described.

219. Information from observer reports with details of the mitigation methods used in 2004/05 were available from three vessels:

(i) the *Insung Ho* used a net bag at the opening of the net that was designed to prevent entry into the net (as described in Hooper et al., 2005). This vessel caught 69 seals of which 64 were released alive;

(ii) the *Top Ocean* used a seal excluder device that consisted of a mesh panel sewed diagonally inside the posterior intermediate sections of the trawl nets intended to conduct pinnipeds upward toward one of three approximately 75 cm diameter oval holes cut into the top of the net. However, the manner in which seals were entangled, in both the excluder panel and side meshes of the intermediate net (usually with their heads forced through the mesh or their snouts and flippers entangled), suggested that the holes at the top of the net may not have been apparent to the seals. There were 24 Antarctic fur seal captures reported from this vessel, of which 16 were dead;

(iii) the *Niitaka Maru* implemented the MARUHA system (SC-CAMLR-XXIII, Annex 5, paragraph 7.239), although the report of the observer indicated that the opening in the roof of the net was smaller than described last year. There were two fur seals caught and released alive on this vessel.

220. The observer report from the *Foros* indicated that it did not implement any specific mitigation measures and no Antarctic fur seal mortality was reported. However, the observer pointed out that it was not possible to observe the codend emptying process and therefore the recording of seal mortality is likely to have been compromised.

221. The Working Group discussed the information on the mitigation devices used in the fishery this year, and acknowledged that, as last year, there was insufficient information available with which to evaluate the relative design and efficacy of different seal mitigation systems.

222. The Working Group recalled that, given the increasing evidence of seal entrapment in krill fisheries and the apparent efficacy of some of the seal exclusion methods tested last year, the Scientific Committee last year recommended that:

(i) every vessel fishing for krill should employ a device for excluding seals or facilitating their escape from the trawl net;

(ii) observers should be required on krill trawl vessels to collect reliable data on seal entrapment and on the effectiveness of devices used to mitigate this (SC-CAMLR-XXIII, paragraph 5.37).

223. In 2004/05 observer reports were received from four of the nine vessels fishing for krill in Area 48. Observer data from the *Top Ocean* (USA) covered 100% of its fishing period predominantly in Subarea 48.2. The reports from UK observers on the other three vessels were from the period of time that those vessels were fishing in Subarea 48.3 and covered a smaller proportion of their overall time fishing in Area 48 (*Insung Ho* 23%, *Niitaka Maru* 17% and *Foros* 16%).

224. Based on the experience of WG-IMAF in addressing the design and implementation of mitigation measures for the reduction of incidental mortality of seabirds in longline fisheries, concern was expressed that the current level of observer coverage is likely to be insufficient to allow resolution of seal entanglement problems. In addition, the Working Group felt that, given this low level of observer coverage, it is not feasible to estimate the total Antarctic fur seal mortality in the krill fishery.

225. The Working Group reiterated the recommendations made by the Scientific Committee last year, in particular for observers on krill vessels to collect reliable data on seal entrapment and on the effectiveness of devices to mitigate this (SC-CAMLR-XXIII, paragraph 5.37), which should allow a very substantial resolution of the problem. A minimum requirement would be to have observations from each vessel in the fishery in order to assess the type and efficacy of the mitigation measures employed on a vessel-by-vessel basis. This would also enable provision of information on the rate of seabird trawl warp strikes by birds in this fishery (see paragraph 209).

226. The Working Group recommended 100% observer coverage on krill trawl vessels to obtain reliable data on seal entrapment and on the effectiveness of associated mitigation devices.

227. In circumstances where a short-term solution to the current problem is not available, the Working Group considered potential criteria relevant to developing solutions in the future based on experience with sea lion mitigation in New Zealand (WG-FSA-05/48). The Working Group noted that attempts to develop seal mitigation devices for use in trawl fisheries should consider the following points or issues:

(i) any mitigation device should be tested, preferably in a flume tank, to ensure that it does not adversely affect the dynamics of the net during deployment, tow and retrieval, i.e. that the system is implementable;

(ii) the device must be easy to use and must comply with all applicable health and safety standards in order to achieve operator buy-in;

(iii) the excluder device must not have a significant adverse effect on the quantity and quality of the target species;

(iv) the device must be shown to successfully expel the non-target species;

(v) animals that are directed out of the net through the device must be shown to survive, i.e. the device must have a negligible effect on survivability.

228. Without successfully addressing the first three points, it is unlikely that the fishing industry will fully implement the exclusion device. Without addressing the last two points, there is no way to demonstrate post-release survivability, i.e. the efficacy of the device to release non-target species safely and efficiently.

229. In the present circumstances however, the Working Group recognised that the effectiveness of existing measures could be adequately assessed if sufficient data and reports from observers were available. Devices currently in use in the krill fishery already appear to

be implementable, safe and without discernable effect on the target species. More data are needed on exclusion/expulsion of non-target species, together with information on potential survivorship of ejected animals.

230. While welcoming consideration of principles derived from experience with sea lions in New Zealand, the Working Group:

(i) observed that the species involved is classified as globally threatened, unlike Antarctic fur seals;

(ii) noted that within an overall goal of eliminating non-target by-catch, the management actions involved should be consistent with the level of risk to populations and species concerned. It recollected the discussion on the topic last year (SC-CAMLR-XXIII, paragraphs 5.25 to 5.33).

Other business

Proposal for testing new streamer line designs

231. The Working Group reviewed SC-CAMLR-XXIV/8. In doing so it recognised that comments were necessary in respect of:

(i) procedures involving the role and responsibilities of observers;

(ii) procedures for proposals to test mitigation measures which would require exemption from some element of existing conservation measures;

(iii) the details of the proposal itself.

232. The Working Group expressed concern that this proposal had arisen from circumstances wherein the observer had given a fishing master ‘permission to trial [a] vessel streamer line’ which did not meet the specification of the conservation measure, despite the fact that streamer lines complying with the CCAMLR specification were on board.

233. The Working Group recollected the long history of development of streamer line design and application and the very extensive review in 2003 that had led to the latest revision of the specifications for streamer line design and use.

234. In regard to proposals to test new mitigation methods (or modifications thereof) it recollected that up to 2002 the relevant conservation measure (e.g. 25-02 (2002)) contained a clause specifying that ‘other variations in the design of streamer lines may be tested on vessels carrying two observers’ and that ‘testing should be carried out independently of actual commercial fishing’.

235. When the conservation measure was comprehensively revised in 2003 this clause was no longer included and this may have led to some confusion. The Working Group recommended that further testing of modifications to mitigation methods which would require exemption from the provisions of current conservation measures should require prior

provision to CCAMLR of full details of the proposed research and experiments, as had been done in relation to line-weighting experiments. The Working Group therefore recommended that, to avoid any further confusion, the Scientific Committee confirm that:

(i) the role of scientific observers does not include the ability to agree to fishing-related practices that are in contravention of CCAMLR conservation measures without relevant prior exemptions having been agreed by CCAMLR;

(ii) full proposals for any such testing shall be notified to WG-FSA in advance of the fishing season in which the trials are proposed to be conducted.

236. In respect of the specific proposal in SC-CAMLR-XXIV/8, the Working Group noted that:

(i) it was not feasible or appropriate for the Working Group to devise specific experimental protocols for applicants;

(ii) it was prepared to comment on the content and design of experiments proposed by applicants provided these were available two weeks in advance of the start of the meeting so that there was sufficient time for appropriate expert consultation;

(iii) consequently it was not recommended that a test of the streamer line designs outlined in Annex 1 of SC-CAMLR-XXIV/8 should proceed in the 2005/06 fishing season.

237. The Working Group further noted, in respect of the proposed streamer line designs, that:

(i) the existing conservation measure would allow the use of the colours, number and spacing of streamers being proposed for testing;

(ii) the absence of swivels would certainly lead to the operational problems described. In areas and times of higher risk of seabird by-catch than at the time of year when the design had been used, mitigation performance would likely be substantially reduced;

(iii) an important objective of Conservation Measure 25-02 is to ensure optimal aerial coverage, and a line only half the length of that currently recommended would likely be seriously defective in this regard;

(iv) proper testing of the proposed streamer line designs would need to include circumstances of much higher risk of seabird by-catch than that applying in Subarea 48.3 during the currently approved fishing season in winter months.

238. Accordingly, the applicants were advised to consider carefully whether it was worthwhile seeking to conduct in future appropriate trials of streamer lines of the designs proposed.

Toothfish fishing proposal for Subarea 48.4

239. WG-FSA-05/57 proposed a mark–recapture experiment to estimate toothfish population size in Subarea 48.4 which would involve longline fishing in April.

240. The risk assessment in respect of seabird by-catch for this subarea was revised in 2005 from level 1 to level 3 (SC-CAMLR-XXIV/BG/26 and paragraph 186). The new risk-assessment level would require longline fishing to be prohibited during the breeding season of southern giant petrel (October to March), except when fishing is undertaken under Conservation Measure 24-02. This advice would not appear to conflict with the timing of fishing proposed in the application.

Management Advice

241. Management advice is provided in section 7 of the main text of WG-FSA's report.

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Table 1: Observed incidental mortality of seabirds in the longline fisheries for *Dissostichus* spp. in Subareas 48.3, 48.6, 58.6, 58.7, 88.1, 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b and 58.5.2 during the 2004/05 season, including related mitigation information. Sp – Spanish method; Auto – autoliner; N – night-time setting; D – daytime setting (including nautical dawn and dusk); O – opposite side to hauling; S – same side as hauling; * – information obtained from cruise report.

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 %		Offal discharge during	
			N	D	Total	%N	Obs.	Set	% observed	Dead		Injured		Uninjured					N	D	Set	Haul
										N	D	N	D	N	D	N	D	Total			(%)	(%)
Subarea 48.3																						
Argos Georgia	1/5–28/8/05	Sp	280	0	280	100	451.2	1452.4	31	0	0	1	0	12	0	0.002	0	0.002	100		(0)	O (10)
Isla Santa Clara	10/5–4/8/05	Sp	185	0	185	100	278.2	1145.4	24	0	0	0	0	0	0	0	0	0	100		(0)	O (100)
Jacqueline	2/5–24/8/05	Sp	204	0	204	100	292.2	1406.2	20	0	0	0	0	1	0	0	0	0	100		(1)	O (99)
Koryo Maru No. 11	2/5–16/8/05	Sp	186	0	186	100	399.9	1638.0	24	0	0	0	0	0	0	0	0	0	100		(0)	O (97)
Polarpesca I	13/5–21/8/05	Sp	221	0	221	100	255.1	1262.4	20	0	0	0	0	0	0	0	0	0	100		(0)	O (99)
Protegat	1/5–21/8/05	A	252	6	258	98	937.4	1510.9	62	0	0	3	0	0	0	0	0	0	99.6	100	(0)	O (90)
Viking Bay	1/5–21/8/05	Sp	222	0	222	100	387.5	1224.9	31	0	0	0	0	3	0	0.007	0	0.007	100		(0)	O (83)
Argos Helena	1/5–29/8/05	A	297	0	297	100	451.2	2228.4	28	0	0	0	0	0	0	0	0	0	100		(0)*	S (0)*
Total						99	11868.5	11868.5	31							0.0011	0	0.0011				
Subarea 48.6																						
Shinsei Maru No. 3	23/1–18/3/05	Sp	33	85	118	28	224.3	709.2	31	0	0	0	0	1	1	0	0	0	100	100	(0)*	O (0)*
Total						28	224.3	709.2	31							0	0	0				
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b																						
Arnela	3/12–16/3/05	Sp	11	161	172	6	605.9	1614.9	37	0	0	0	2	0	1	0	0.005	0.005	100	100	(0)	O (65)
Globalpesca II	19/12–2/3/05	Sp	0	90	90	0	647.1	1090.2	59	0	0	0	0	0	0	0	0	0		100	(0)	O (0)
Galaecia	16/12–10/3/05	Sp	5	113	118	4	413.1	1445.9	28	0	0	0	0	0	0	0	0	0	100	100	(0)	O (23)
No. 829 Yeon Seong	20/12–21/2/05	Sp	19	89	108	17	911.7	1191.1	76	0	0	0	0	0	0	0	0	0	100	100	(0)	S (0)
Janas	5/3–29/3/05	Ao	6	40	46	13	127.6	235.6	54	0	0	0	0	0	0	0	0	0	100	100	(0)	(0)
Avro Chieftain	4/9–7/9/05	Ao	10	0	10	100	25.3	67.0	37	0	0	0	0	0	0	0	0	0	100		(0)	O (0)
Galaecia	15/4–6/7/05	Sp	41	72	113	36	979.2	1673.5	58	0	0	0	0	0	0	0	0	0	100	100	(0)	O (100)
No. 707 Bonanza	26/12–10/3/05	Sp	5	105	110	4	986.0	1043.7	94	0	0	0	0	0	0	0	0	0	100	100	(0)	O (0)
Total						26	4695.9	8361.9	56							0	<0.001	<0.001				
Division 58.5.2																						
Avro Chieftain	25/7–1/9/05	A	57	54	111	50	236.0	756.3	31	0	0	0	0	0	0	0	0	0	100	100	(0)	O (0)
Avro Chieftain	10/5–1/7/05	A	-	-	150		350.9	851.5	41	0	0	0	0	0	0	0	0	0	100*	100*	(0)	O (0)
Total							586.9	1607.8	36							0	0	0				
Subareas 58.6, 58.7																						
Koryo Maru No. 11	24/2–1/4/05	Sp	72	0	72	100	336.0	510.0	65	25	0	25	0	2	0	0.149	0	0.149	100		(0)	O (99)
Total						100	336.0	510.0	65							0.149	0	0.149				
Subareas 88.1, 88.2																						
Antartic III	5/12–5/2/05	A	0	168	168	0	415.0	671.2	61	0	0	0	0	0	0	0	0	0		99	(1)	S (1)
Argos Helena	4/12–4/3/05	A	2	160	162	1	202.3	869.1	23	0	0	0	0	0	0	0	0	0	100	100	(0)	(0)
Janas	1/12–6/2/05	A	0	172	172	0	335.6	782.8	42	0	0	0	0	0	0	0	0	0		100	(0)	(0)
Paloma V	27/12–1/3/05	Sp	0	132	132	0	461.5	1184.6	38	0	0	0	0	0	0	0	0	0		98	(0)	(0)
Punta Ballena	14/1–13/3/05	A	0	124	124	0	585.1	747.6	78	0	0	0	0	0	0	0	0	0		100	(0)	(0)
San Aotea II	4/12–14/2/05	A	0	196	196	0	313.2	743.2	42	0	0	0	0	0	0	0	0	0		100	(0)	(0)
Frøyanes	29/12–1/3/05	A	0	191	191	0	251.7	804.1	31	0	0	0	0	0	0	0	0	0		100	(0)	(0)
Volna	18/12–18/3/05	Sp	0	132	132	0	1181.2	1181.2	100	0	0	0	0	0	0	0	0	0		100	(0)	(0)
Yantar	18/12–18/3/05	Sp	-	-	168		474.1	1142.1	41	0	0	0	0	0	0	0	0	0		100*	(0)	(0)
Avro Chieftain	31/12–6/2/05	A	0	83	83	0	143.3	365.1	39	0	0	0	0	0	0	0	0	0		100	(0)	(0)
San Aspiring	25/12–23/2/05	A	2	114	116	1	313.6	647.5	48	0	0	0	0	0	0	0	0	0		100	(0)	(0)
Total							4676.5	9138.4	51							0	0	0				

1 Birds 'caught' as defined by the Commission in 2004 (CCAMLR-XXIII, paragraphs 10.30 and 10.31).

Table 2: Extrapolated incidental mortality of seabirds, for those vessels on which incidental mortalities of seabirds were observed, in Subareas 48.3, 58.6 and 58.7 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b during the 2004/05 season.

Vessel	Hooks observed (thousands)	Hooks set (thousands)	Percentage of hooks observed	% Night sets	Extrapolated number of incidental seabird mortalities		
					Night	Day	Total
Subarea 48.3							
Argos Georgia	451.2	1 452.4	31	100	4	0	4
Viking Bay	387.5	1 224.9	31	100	9	0	9
Subtotal					13	0	13
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b							
Arnela	605.9	1 614.9	37	6	0	8	8
Subtotal					0	8	8
Subareas 58.6, 58.7							
Koryo Maru No. 11	336.0	510.0	65	100	76	0	76
Subtotal					76	0	76
Total					89	8	97

Table 3: 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 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b and 58.5.2 from 1997 to 2005 (- indicates no fishing occurred).

Subarea	Year								
	1997	1998	1999	2000	2001	2002	2003	2004	2005
Subarea 48.3									
Extrapolated mortality	5 755	640	210*	21	30	27	8	27	13
Observed mortality rate	0.23	0.032	0.013*	0.002	0.002	0.0015	0.0003	0.0015	0.0011
Subarea 48.4									
Extrapolated mortality	-	-	-	-	-	-	-	-	0
Observed mortality rate	-	-	-	-	-	-	-	-	0
Subarea 48.6									
Extrapolated mortality	-	-	-	-	-	-	-	0	0
Observed mortality rate	-	-	-	-	-	-	-	0	0
Subareas 58.6, 58.7									
Extrapolated mortality	834	528	156	516	199	0	7	39	76
Observed mortality rate	0.52	0.194	0.034	0.046	0.018	0	0.003	0.025	0.149
Subareas 88.1, 88.2									
Extrapolated mortality	-	0	0	0	0	0	0	1	0
Observed mortality rate	-	0	0	0	0	0	0	0.0001	0
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b									
Extrapolated mortality	-	-	-	-	-	-	-	0	8
Observed mortality rate	-	-	-	-	-	-	-	0	<0.001
Division 58.5.2									
Extrapolated mortality	-	-	-	-	-	-	0	0	0
Observed mortality rate	-	-	-	-	-	-	0	0	0

* Excluding *Argos Helena* line-weighting experiment cruise.

Table 4: Species composition of seabird mortalities (injured and dead)[1] in longline fisheries in Subareas 48.3, 58.6 and 58.7 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, during the 2004/05 season. N – night-time setting; D – daytime setting (including nautical dawn and dusk); DCR – yellow-nosed albatross; DIX – wandering albatross; MAI – southern giant petrel; PRO – white-chinned petrel; () – % composition.

Vessel	Dates of fishing	No. seabird mortalities by group						Species composition (%)			
		Albatrosses		Petrels		Total		DCR	DIX	MAI	PRO
		N	D	N	D	N	D				
Subarea 48.3											
Argos Georgia	1/5–28/8/05	0	0	1	0	1	0			1 (100)	
Viking Bay	1/5–21/8/05	0	0	3	0	3	0			3 (100)	
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b											
Arnela	3/12/04–16/3/05	0	0	0	2	0	2			2 (100)	
Subareas 58.6 and 58.7											
Koryo Maru No. 11	24/2–1/4/05	7	0	43	0	50	0	6 (12)	1 (2)		43 (86)
Total (%)		3	0	8	2	11	2	6 (11)	1 (2)	6 (11)	43 (76)

1 Birds 'caught' as defined by the Commission in 2004 (CCAMLR-XXIII, paragraphs 10.30 and 10.31).

Table 5: Observed incidental mortality, reported by captains, of seabirds in the longline fisheries for *Dissostichus* spp. in Division 58.5.1 during the 2000/01 season (September to August). Sp – Spanish method; Auto – autoliner; N – night-time setting; D – daytime setting (including dawn and dusk); NC – not collected.

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			Hooks baited (%)	No. of birds caught [1]						Reported seabird mortality (birds/1 000 hooks)			Streamer line in use %		Offal discharge during haul (%)
			N	D	Total	%N	Reported	Set	% Observed		Dead		Alive		Total							
											N	D	N	D	N	D	N	D	Total	N	D	
Ship 3	4/10–18/11/00	Auto	83	0	83	100	3 568.9	3 568.9	100	NC	0	0	NC	0	0	0	0.000	0	0.000	NC	0	(0)
Ship 3	26/1–10/2/01	Auto	32	0	32	100	1 241.1	1 241.1	100	NC	294		NC	0	294	0	0.237	0	0.237	NC	0	(0)
Ship 8	21/10–2/12/00	Auto	174	0	174	100	2 234.2	2 234.2	100	NC	0	0	NC	0	0	0	0.000	0	0.000	NC	0	(0)
Ship 8	12/2–18/3/01	Auto	122	0	122	100	1 546.6	1 546.6	100	NC	363	0	NC	0	363	0	0.235	0	0.235	NC	0	(0)
Ship 8	17/4–14/5/01	Auto	61	0	61	100	1 908.4	1 908.4	100	NC	191	0	NC	0	191	0	0.100	0	0.100	NC	0	(0)
Ship 8	15/6–29/6/01	Auto	27	0	27	100	925.2	925.2	100	NC	3	0	NC	0	3	0	0.003	0	0.003	NC	0	(0)
Ship 9	8/10–20/11/00	Sp	34	0	34	100	2 862.6	2 862.6	100	100	458	0	NC	0	458	0	0.160	0	0.160	NC	0	(0)
Ship 9	14/12/00–28/1/01	Sp	42	0	42	100	1 477.5	1 477.5	100	100	47	0	NC	0	47	0	0.032	0	0.032	NC	0	(0)
Ship 9	23/4–2/5/01	Sp	10	0	10	100	381.2	381.2	100	100	0	0	NC	0	0	0	0.000	0	0.000	NC	0	(0)
Ship 9	24/5–28/6/01	Sp	33	0	33	100	2 243.4	2 243.4	100	100	54	0	NC	0	54	0	0.024	0	0.024	NC	0	(0)
Ship 10	14/2–12/4/01	Sp	54	0	54	100	2 346.1	2 346.1	100	100	507	0	NC	0	507	0	0.216	0	0.216	NC	0	(0)
Total						100	20 735.2	20 735.2	100		1 917						0.092	0	0.092			

1 Birds ‘caught’ as defined by the Commission in 2004 (CCAMLR-XXIII, paragraphs 10.30 and 10.31).

Table 6: Species composition, as reported by captains, of incidental mortality of seabirds in longline fisheries in Division 58.5.1 during the 2000/01 season (September to August). N – night-time setting; D – daytime setting (including dawn and dusk); PRO – white-chinned petrel; MAH – northern giant petrel; PCI – grey petrel; DIC – grey-headed albatross; DIM – black-browed albatross; () – % composition.

Vessel	Dates of fishing	No. birds killed by group								Species composition (%)				
		Petrels		Albatrosses		Penguins		Total						
		N	D	N	D	N	D	N	D	PRO	MAH	PCI	DIC	DIM
Ship 3	4/10–18/11/00	0	0	0	0	0	0	0	0					
Ship 3	26/1–10/2/01	292	0	2	0	0	0	294	0	292 (99.3)			2 (0.7)	
Ship 8	21/10–2/12/00	0	0	0	0	0	0	0	0					
Ship 8	12/2–18/3/01	363	0	0	0	0	0	363	0	363 (100)				
Ship 8	17/4–14/5/01	191	0	0	0	0	0	191	0	145 (74.9)	2 (1.0)	44 (23.0)		
Ship 8	15/6–29/6/01	3	0	0	0	0	0	3	0			3 (100)		
Ship 9	8/10–20/11/00	458	0	0	0	0	0	458	0	458 (100)				
Ship 9	14/12/00–28/1/01	44	0	3	0	0	0	47	0	44 (93.6)				3 (6.4)
Ship 9	23/4–2/5/01	0	0	0	0	0	0	0	0					
Ship 9	24/5–28/6/01	54	0	0	0	0	0	54	0		2 (3.7)	52 (96.3)		
Ship 10	14/2–12/4/01	507	0	0	0	0	0	507	0	507 (100)				
Total (%)		1912	0	5	0	0	0	1917	0	1809 (94.4)	4 (0.2)	99 (5.2)	2 (0.1)	3 (0.2)

Table 7: Incidental mortality, reported by captains, of seabirds in the longline fisheries for *Dissostichus* spp. in Subarea 58.6 and Division 58.5.1 during the 2004/05 season (September to August). Sp – Spanish method; Auto – autoliner; N – night-time setting; D – daytime setting (including nautical dawn and dusk); NC – not collected.

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			Hooks baited (%)	No. of birds caught						Reported seabird mortality (birds/1 000 hooks)			Streamer line in use %		Offal discharge during haul (%)
			N	D	Total	%N	Reported	Set	% Observed		Dead		Alive		Total							
											N	D	N	D	N	D	N	D	Total	N	D	
Subarea 58.6																						
Ship 1	9/9–13/9/04	Auto	10	0	10	100	90.9	90.9	100.0	85.0	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 1	4/2–9/2/05	Auto	12	0	12	100	104.8	104.8	100.0	NC	8	0	1	0	9	0	0.0763	0	0.0763	100	0	0
Ship 1	15/2–23/2/05	Auto	19	0	19	100	197.4	197.4	100.0	NC	1	0	4	0	5	0	0.0051	0	0.0051	100	0	0
Ship 1	19/5–25/6/05	Auto	71	0	71	100	674.1	674.1	100.0	89.9	3	0	1	0	4	0	0.0045	0	0.0045	100	0	0
Ship 2	5/11–11/11/04	Auto	14	0	14	100	104.9	104.9	100.0	85.0	0	0	31	0	31	0	0.0000	0	0.0000	100	0	0
Ship 2	4/2–10/2/05	Auto	20	0	20	100	126.5	126.5	100.0	95.0	9	0	1	0	10	0	0.0711	0	0.0711	100	0	0
Ship 2	10/5–18/5/05	Auto	23	0	23	100	201.3	201.3	100.0	96.0	0	0	3	0	3	0	0.0000	0	0.0000	100	0	0
Ship 2	23/7–11/8/05	Auto	48	0	48	100	335.9	335.9	100.0	90.4	0	0	7	0	7	0	0.0000	0	0.0000	100	0	0
Ship 3	20/1–22/2/05	Auto	65	0	65	100	672.0	672.0	100.0	95.0	50	0	6	0	56	0	0.0744	0	0.0744	100	0	0
Ship 4	1/9–3/9/04	Sp	4	0	4	100	31.2	31.2	100.0	100.0	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 5	3/9–8/9/04	Auto	13	0	13	100	101.7	101.7	100.0	95.0	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 5	6/2–9/2/05	Auto	7	0	7	100	77.9	77.9	100.0	NC	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 5	15/2–25/2/05	Auto	32	0	32	100	183.5	183.5	100.0	NC	14	0	0	0	14	0	0.0763	0	0.0763	100	0	0
Ship 5	31/5–21/6/05	Auto	43	0	43	100	427.5	427.5	100.0	94.0	2	0	3	0	5	0	0.0047	0	0.0047	100	0	0
Ship 6	20/11–29/11/04	Auto	35	0	35	100	175.5	175.5	100.0	85.6	18	0	0	0	18	0	0.1026	0	0.1026	100	0	0
Ship 6	2/2–23/2/05	Auto	45	0	45	100	363.5	363.5	100.0	92.4	15	0	17	0	32	0	0.0413	0	0.0413	100	0	0
Ship 7	4/2–25/2/05	Auto	54	0	54	100	381.2	381.2	100.0	NC	12	0	15	0	27	0	0.0315	0	0.0315	100	0	0
Ship 7	17/6–29/6/05	Auto	30	0	30	100	232.3	232.3	100.0	95.0	0	0	1	0	1	0	0.0000	0	0.0000	100	0	0
Ship 11	16/2–25/2/05	Auto	26	0	26	100	136.8	136.8	100.0	96.1	1	0	0	0	1	0	0.0073	0	0.0073	100	0	0
Ship 11	20/6–12/7/05	Auto	61	0	61	100	304.0	304.0	100.0	96.2	4	0	2	0	6	0	0.0132	0	0.0132	100	0	0
Total						100	4 922.7	4 922.7	100.0		137		92		229							

(continued)

Table 7 (continued)

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			Hooks baited (%)	No. of birds caught						Reported seabird mortality (birds/1 000 hooks)			Streamer line in use %		Offal discharge during haul (%)
			N	D	Total	%N	Reported	Set	% Observed		Dead		Alive		Total		N	D	Total	N	D	
											N	D	N	D	N	D						
Division 58.5.1																						
Ship 1	17/9–16/11/04	Auto	166	0	166	100	1369.3	1369.3	100.0	85.0	47	0	12	0	59	0	0.0343	0	0.0343	100	0	0
Ship 1	22/12/04–31/01/05	Auto	100	0	100	100	903.2	903.2	100.0	NC	18	0	22	0	40	0	0.0199	0	0.0199	100	0	0
Ship 1	1/3–13/3/05	Auto	33	0	33	100	348.5	348.5	100.0	NC	61	0	10	0	71	0	0.1750	0	0.1750	100	0	0
Ship 1	18/4–14/5/05	Auto	72	0	72	100	645.9	645.9	100.0	88.5	27	0	1	0	28	0	0.0418	0	0.0418	100	0	0
Ship 2	8/9–2/11/04	Auto	153	0	153	100	1185.6	1185.6	100.0	85.0	16	0	74	0	90	0	0.0135	0	0.0135	100	0	0
Ship 2	30/11/04–31/1/05	Auto	161	0	161	100	1198.1	1198.1	100.0	95.8	32	0	61	0	93	0	0.0267	0	0.0267	100	0	0
Ship 2	1/3–6/5/05	Auto	175	0	175	100	1498.8	1498.8	100.0	96.4	108	0	23	0	131	0	0.0721	0	0.0721	100	0	0
Ship 2	5/6–19/7/05	Auto	126	0	126	100	1000.8	1000.8	100.0	91.8	25	0	15	0	40	0	0.0250	0	0.0250	100	0	0
Ship 3	25/9–12/12/04	Auto	158	0	158	100	2070.6	2070.6	100.0	90.3	98	0	15	0	113	0	0.0473	0	0.0473	100	0	0
Ship 3	1/3–13/4/05	Auto	83	0	83	100	1122.5	1122.5	100.0	95.0	64	0	1	0	65	0	0.0570	0	0.0570	100	0	0
Ship 3	19/5–27/6/05	Auto	79	0	79	100	1082.6	1082.6	100.0	NC	39	0	17	0	56	0	0.0360	0	0.0360	100	0	0
Ship 5	11/9–8/11/04	Auto	146	0	146	100	1217.0	1217.0	100.0	95.0	131	0	11	0	142	0	0.1076	0	0.1076	100	0	0
Ship 5	15/12/04–30/1/05	Auto	142	0	142	100	1057.3	1057.3	100.0	NC	44	0	23	0	67	0	0.0416	0	0.0416	100	0	0
Ship 5	1/3–6/3/05	Auto	22	0	22	100	140.1	140.1	100.0	NC	54	0	6	0	60	0	0.3854	0	0.3854	100	0	0
Ship 5	14/4–29/5/05	Auto	107	0	107	100	1071.9	1071.9	100.0	92.7	65	0	34	0	99	0	0.0606	0	0.0606	100	0	0
Ship 6	4/9–16/11/04	Auto	199	0	199	100	1666.8	1666.8	100.0	88.4	165	0	15	0	180	0	0.0990	0	0.0990	100	0	0
Ship 6	11/1–29/1/05	Auto	46	0	46	100	429.3	429.3	100.0	88.2	78	0	7	0	85	0	0.1817	0	0.1817	100	0	0
Ship 6	1/3–30/3/05	Auto	78	0	78	100	694.5	694.5	100.0	90.9	190	0	15	0	205	0	0.2736	0	0.2736	100	0	0
Ship 6	8/5–5/7/05	Auto	159	0	159	100	1315.5	1315.5	100.0	93.2	57	0	12	0	69	0	0.0433	0	0.0433	100	0	6
Ship 7	13/9–6/12/04	Auto	189	0	189	100	1975.4	1975.4	100.0	91.7	19	0	NC	0	NC	0	0.0096	0	0.0096	100	0	0
Ship 7	12/1–31/1/05	Auto	50	0	50	100	450.9	450.9	100.0	NC	127	0	4	0	131	0	0.2817	0	0.2817	100	0	0
Ship 7	1/3–5/4/05	Auto	98	0	98	100	840.0	840.0	100.0	NC	276	0	24	0	300	0	0.3286	0	0.3286	100	0	0
Ship 7	11/5–13/6/05	Auto	88	0	88	100	755.5	755.5	100.0	95.0	8	0	16	0	24	0	0.0106	0	0.0106	100	0	0
Ship 11	29/10/04–13/1/05	Auto	202	0	202	100	1377.0	1377.0	100.0	NC	39	0	0	0	39	0	0.0283	0	0.0283	100	0	0
Ship 11	1/3–15/5/05	Auto	174	0	174	100	1286.1	1286.1	100.0	95.7	107	0	2	0	109	0	0.0832	0	0.0832	100	0	0
Ship 11	10/6–14/6/05	Auto	12	0	12	100	86.0	86.0	100.0	97.7	6	0	1	0	7	0	0.0698	0	0.0698	100	0	0
Total						100	26 789.1	26 789.1	100.0		1 901		421		2 303							

Table 8: Observed incidental mortality of seabirds in the longline fisheries for *Dissostichus* spp. in Subarea 58.6 and Division 58.5.1 during the 2004/05 season (September to August). Sp – Spanish method; Auto – autoliner; N – night-time setting; D – daytime setting (including nautical dawn and dusk); NC – not collected.

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			Hooks baited (%)	No. of birds caught						Reported seabird mortality (birds/1 000 hooks)			Streamer line in use %		Offal discharge during haul (%)
			N	D	Total	%N	Reported	Set	% Observed		Dead		Alive		Total		N	D	Total	N	D	
											N	D	N	D	N	D						
Subarea 58.6																						
Ship 4	1/9–3/9/04	Sp	4	0	4	100	8.0	31.2	25.6	100.0	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 5	3/9–8/9/04	Auto	13	0	13	100	26.7	101.7	26.2	95.0	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 2	5/11–11/11/04	Auto	14	0	14	100	20.3	104.9	19.3	85.0	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 1	9/9–13/9/04	Auto	10	0	10	100	22.6	90.9	24.8	85.0	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 6	20/11–29/11/04	Auto	35	0	35	100	44.0	175.5	25.1	85.6	6	0	0	0	6	0	0.1364	0	0.1364	100	0	0
Ship 2	4/2–10/2/05	Auto	20	0	20	100	26.9	126.5	21.2	95.0	3	0	1	0	4	0	0.1117	0	0.1117	100	0	0
Ship 5	6/2–9/2/05	Auto	7	0	7	100	20.0	77.9	25.7	NC	0	0	0	0	0	0	0.0000	0	0.0000	100	0	0
Ship 5	15/2–25/2/05	Auto	32	0	32	100	49.0	183.5	26.7	NC	9	0	0	0	9	0	0.1837	0	0.1837	100	0	0
Ship 1	4/2–9/2/05	Auto	12	0	12	100	27.1	104.8	25.8	NC	5	0	1	0	6	0	0.1848	0	0.1848	100	0	0
Ship 1	15/2–23/2/05	Auto	19	0	19	100	48.2	197.4	24.4	NC	0	0	3	0	3	0	0.0000	0	0.0000	100	0	0
Ship 6	2/2–23/2/05	Auto	45	0	45	100	85.2	363.5	23.4	92.4	10	0	17	0	27	0	0.1173	0	0.1173	100	0	0
Ship 7	4/2–25/2/05	Auto	54	0	54	100	100.3	381.2	26.3	NC	7	0	12	0	19	0	0.0698	0	0.0698	100	0	0
Ship 3	20/1–22/2/05	Auto	65	0	65	100	166.1	672.0	24.7	95.0	13	0	2	0	15	0	0.0782	0	0.0782	100	0	0
Ship 11	16/2–25/2/05	Auto	26	0	26	100	45.5	136.8	33.3	96.1	1	0	0	0	1	0	0.0220	0	0.0220	100	0	0
Ship 2	10/5–18/5/05	Auto	23	0	23	100	46.8	201.3	23.2	96.0	0	0	1	0	1	0	0.0000	0	0.0000	100	0	0
Ship 1	19/5–25/6/05	Auto	71	0	71	100	256.3	674.1	38.0	89.9	2	0	1	0	3	0	0.0078	0	0.0078	100	0	0
Ship 5	31/5–21/6/05	Auto	43	0	43	100	96.5	427.5	22.6	94.0	2	0	1	0	3	0	0.0207	0	0.0207	100	0	0
Ship 7	17/6–29/6/05	Auto	30	0	30	100	55.5	232.3	23.9	95.0	0	0	1	0	1	0	0.0000	0	0.0000	100	0	0
Ship 11	20/6–12/7/05	Auto	61	0	61	100	76.3	304.0	25.1	96.2	3	0	2	0	5	0	0.0393	0	0.0393	100	0	0
Ship 2	23/7–11/8/05	Auto	48	0	48	100	84.2	335.9	25.1	90.4	0	0	7	0	7	0	0.0000	0	0.0000	100	0	0
Total						100	1305.3	4922.7	25.5		61						0.0467		0.0467			

(continued)

Table 8 (continued)

Vessel	Dates of fishing	Method	Sets deployed				No. of hooks (thousands)			Hooks baited (%)	No. of birds caught						Reported seabird mortality (birds/1 000 hooks)			Streamer line in use %		Offal discharge during haul (%)
			N	D	Total	%N	Reported	Set	% Observed		Dead		Alive		Total							
											N	D	N	D	N	D	N	D	Total	N	D	
Division 58.5.1																						
Ship 5	11/9–8/11/04	Auto	146	0	146	100	356.5	1217.0	29.3	95.0	66	0	11	0	77	0	0.1851	0	0.1851	100	0	0
Ship 2	8/9–2/11/04	Auto	153	0	153	100	367.3	1185.6	31.0	85.0	6	0	31	0	37	0	0.0163	0	0.0163	100	0	0
Ship 1	17/9–16/11/04	Auto	166	0	166	100	337.0	1369.3	24.6	85.0	24	0	6	0	30	0	0.0712	0	0.0712	100	0	0
Ship 6	4/9–16/11/04	Auto	199	0	199	100	444.7	1666.8	26.7	88.4	104	0	10	0	114	0	0.2339	0	0.2339	100	0	0
Ship 7	13/9–6/12/04	Auto	189	0	189	100	491.3	1975.4	24.9	91.7	14	0	8	0	22	0	0.0285	0	0.0285	100	0	0
Ship 3	25/9–12/12/04	Auto	158	0	158	100	450.5	2070.6	21.8	90.3	61	0	5	0	66	0	0.1354	0	0.1354	100	0	0
Ship 11	29/10/04–13/1/05	Auto	202	0	202	100	326.8	1377.0	23.7	NC	11	0	6	0	17	0	0.0337	0	0.0337	100	0	0
Ship 2	30/11/04–31/1/05	Auto	161	0	161	100	274.1	1198.1	22.9	95.8	9	0	23	0	32	0	0.0328	0	0.0328	100	0	0
Ship 5	15/12/04–30/1/05	Auto	142	0	142	100	283.5	1057.3	26.8	NC	20	0	23	0	43	0	0.0705	0	0.0705	100	0	0
Ship 5	1/3–6/3/05	Auto	22	0	22	100	36.6	140.1	26.1	NC	27	0	5	0	32	0	0.7377	0	0.7377	100	0	0
Ship 1	22/12/04–31/1/05	Auto	100	0	100	100	210.8	903.2	23.3	NC	11	0	20	0	31	0	0.0522	0	0.0522	100	0	0
Ship 1	1/3–13/3/05	Auto	33	0	33	100	85.8	348.5	24.6	NC	19	0	10	0	29	0	0.2214	0	0.2214	100	0	0
Ship 6	11/1–29/1/05	Auto	46	0	46	100	84.9	429.3	19.8	88.2	41	0	7	0	48	0	0.4831	0	0.4831	100	0	0
Ship 6	1/3–30/3/05	Auto	78	0	78	100	156.3	694.5	22.5	90.9	170	0	15	0	185	0	1.0877	0	1.0877	100	0	0
Ship 7	12/1–31/1/05	Auto	50	0	50	100	115.0	450.9	25.5	NC	98	0	3	0	101	0	0.8522	0	0.8522	100	0	0
Ship 7	1/3–5/4/05	Auto	98	0	98	100	215.7	840.0	25.7	NC	171	0	24	0	195	0	0.7928	0	0.7928	100	0	0
Ship 3	1/3–13/4/05	Auto	83	0	83	100	160.8	1122.5	14.3	95.0	30	0	1	0	31	0	0.1866	0	0.1866	100	0	0
Ship 11	1/3–15/5/05	Auto	174	0	174	100	310.2	1286.1	24.1	95.7	35	0	2	0	37	0	0.1128	0	0.1128	100	0	0
Ship 2	1/3–6/5/05	Auto	175	0	175	100	330.5	1498.8	22.1	96.4	32	0	7	0	39	0	0.0968	0	0.0968	100	0	0
Ship 1	18/4–14/5/05	Auto	72	0	72	100	195.7	645.9	30.3	88.5	12	0	1	0	13	0	0.0613	0	0.0613	100	0	0
Ship 5	14/4–29/5/05	Auto	107	0	107	100	261.9	1071.9	24.4	92.7	38	0	15	0	53	0	0.1451	0	0.1451	100	0	0
Ship 7	11/5–13/6/05	Auto	88	0	88	100	189.3	755.5	25.1	95.0	2	0	15	0	17	0	0.0106	0	0.0106	100	0	0
Ship 3	19/5–27/6/05	Auto	79	0	79	100	273.8	1082.6	25.3	NC	31	0	17	0	48	0	0.1132	0	0.1132	100	0	0
Ship 6	8/5–5/7/05	Auto	159	0	159	100	315.4	1315.5	24.0	93.2	12	0	4	0	16	0	0.0381	0	0.0381	100	0	6
Ship 11	10/6–14/6/05	Auto	12	0	12	100	22.3	86.0	25.9	97.7	1	0	1	0	2	0	0.0449	0	0.0449	100	0	0
Ship 2	5/6–19/7/05	Auto	126	0	126	100	236.2	1000.8	23.6	91.8	9	0	15	0	24	0	0.0381	0	0.0381	100	0	0
Total						100	6 532.8	26 789.1	24.5		1 054						0.1613		0.1613			

Table 9: Extrapolated incidental mortality of seabirds for those vessels on which seabird mortalities were observed in Subarea 58.6 and Division 58.5.1 during the 2004/05 season (September to August).

Vessel	Hooks observed (thousands)	Hooks set (thousands)	Percentage of hooks observed	% Night sets	Estimated number of birds caught dead		
					Night	Day	Total
Subarea 58.6							
Ship 1	22.6	90.9	24.8	100	0	0	0
Ship 1	27.1	104.8	25.8	100	19	0	19
Ship 1	48.2	197.4	24.4	100	0	0	0
Ship 1	256.3	674.1	38.0	100	5	0	5
Ship 2	20.3	104.9	19.3	100	0	0	0
Ship 2	26.9	126.5	21.2	100	14	0	14
Ship 2	46.8	201.3	23.2	100	0	0	0
Ship 2	84.2	335.9	25.1	100	0	0	0
Ship 3	166.1	672.0	24.7	100	53	0	53
Ship 4	8.0	31.2	25.6	100	0	0	0
Ship 5	26.7	101.7	26.2	100	0	0	0
Ship 5	20.0	77.9	25.7	100	0	0	0
Ship 5	49.0	183.5	26.7	100	34	0	34
Ship 5	96.5	427.5	22.6	100	9	0	9
Ship 6	44.0	175.5	25.1	100	24	0	24
Ship 6	85.2	363.5	23.4	100	43	0	43
Ship 7	100.3	381.2	26.3	100	27	0	27
Ship 7	55.5	232.3	23.9	100	0	0	0
Ship 11	45.5	136.8	33.3	100	3	0	3
Ship 11	76.3	304.0	25.1	100	12	0	12
					242	0	242
Division 58.5.1							
Ship 1	337.0	1369.3	24.6	100	98	0	98
Ship 1	210.8	903.2	23.3	100	47	0	47
Ship 1	85.8	348.5	24.6	100	77	0	77
Ship 1	195.7	645.9	30.3	100	40	0	40
Ship 2	367.3	1185.6	31.0	100	19	0	19
Ship 2	274.1	1198.1	22.9	100	39	0	39
Ship 2	330.5	1498.8	22.1	100	145	0	145
Ship 2	236.2	1000.8	23.6	100	38	0	38
Ship 3	450.5	2070.6	21.8	100	280	0	280
Ship 3	160.8	1122.5	14.3	100	209	0	209
Ship 3	273.8	1082.6	25.3	100	123	0	123
Ship 5	356.5	1217.0	29.3	100	225	0	225
Ship 5	283.5	1057.3	26.8	100	75	0	75
Ship 5	36.6	140.1	26.1	100	103	0	103
Ship 5	261.9	1071.9	24.4	100	156	0	156
Ship 6	444.7	1666.8	26.7	100	390	0	390
Ship 6	84.9	429.3	19.8	100	207	0	207
Ship 6	156.3	694.5	22.5	100	755	0	755
Ship 6	315.4	1315.5	24.0	100	50	0	50
Ship 7	491.3	1975.4	24.9	100	56	0	56
Ship 7	115.0	450.9	25.5	100	384	0	384
Ship 7	215.7	840.0	25.7	100	666	0	666
Ship 7	189.3	755.5	25.1	100	8	0	8
Ship 11	326.8	1377.0	23.7	100	46	0	46
Ship 11	310.2	1286.1	24.1	100	145	0	145
Ship 11	22.3	86.0	25.9	100	4	0	4
					4387	0	4387

Table 10: Species composition of birds killed in longline fisheries in Subarea 58.6 and Division 58.5.1 during the 2004/2005 season (September to August) as reported by captains. N – night-time setting; D – daytime setting (including nautical dawn and dusk); PRO – white-chinned petrel; PCI – grey petrel; () – % composition.

Vessel	Dates of fishing	No. birds killed by group						Species composition (%)	
		Albatross		Petrels		Total		PRO	PCI
		N	D	N	D	N	D		
Subarea 58.6									
Ship 1	9/9–13/9/04	0	0	0	0	0	0		
Ship 1	4/2–9/2/05	0	0	0	0	0	0		
Ship 1	15/2–23/2/05	0	0	0	0	0	0		
Ship 1	19/5–25/6/05	0	0	0	0	0	0		
Ship 2	5/11–11/11/04	0	0	0	0	0	0		
Ship 2	4/2–10/2/05	0	0	14	0	14	0	14 (100)	
Ship 2	10/5–18/5/05	0	0	8	0	8	0	8 (100)	
Ship 2	23/7–11/8/05	0	0	1	0	1	0	1 (100)	
Ship 3	20/1–22/2/05	0	0	15	0	15	0	15 (100)	
Ship 4	1/9–3/9/04	0	0	12	0	12	0	12 (100)	
Ship 5	3/9–8/9/04	0	0	50	0	50	0	50 (100)	
Ship 5	6/2–9/2/05	0	0	1	0	1	0	1 (100)	
Ship 5	15/2–25/2/05	0	0	0	0	0	0		
Ship 5	31/5–21/6/05	0	0	3	0	3	0		3 (100)
Ship 6	20/11–29/11/04	0	0	2	0	2	0		2 (100)
Ship 6	2/2–23/2/05	0	0	0	0	0	0		
Ship 7	4/2–25/2/05	0	0	4	0	4	0		4 (100)
Ship 7	17/6–29/6/05	0	0	0	0	0	0		
Ship 11	16/2–25/2/05	0	0	18	0	18	0	18 (100)	
Ship 11	20/6–12/7/05	0	0	9	0	9	0	9 (100)	
Division 58.5.1									
Ship 1	17/9–16/11/04	0	0	131	0	131	0	126 (96.2)	5 (3.8)
Ship 1	22/12/04–31/1/05	0	0	16	0	16	0	12 (75.0)	4 (25.0)
Ship 1	1/3–13/3/05	0	0	47	0	47	0	45 (95.7)	2 (4.3)
Ship 1	18/4–14/5/05	0	0	165	0	165	0	164 (99.4)	1 (0.6)
Ship 2	8/9–2/11/04	0	0	32	0	32	0	32 (100)	
Ship 2	30/11/04–31/1/05	0	0	44	0	44	0	44 (100)	
Ship 2	1/3–6/5/05	0	0	54	0	54	0	52 (96.3)	2 (3.7)
Ship 2	5/6–19/7/05	0	0	18	0	18	0	18 (100)	
Ship 3	25/9–12/12/04	0	0	61	0	61	0	61 (100)	
Ship 3	1/3–13/4/05	0	0	78	0	78	0	78 (100)	
Ship 3	19/5–27/6/05	0	0	190	0	190	0	187 (98.4)	3 (1.6)
Ship 5	11/9–8/11/04	0	0	127	0	127	0	127 (100)	
Ship 5	15/12/04–30/1/05	0	0	276	0	276	0	270 (97.8)	6 (2.2)
Ship 5	1/3–6/3/05	0	0	64	0	64	0	61 (95.3)	3 (4.7)
Ship 5	14/4–29/5/05	0	0	107	0	107	0	104 (97.2)	3 (2.8)
Ship 6	4/9–16/11/04	0	0	108	0	108	0	99 (91.7)	9 (8.3)
Ship 6	11/1–29/1/05	0	0	27	0	27	0	16 (59.3)	11 (40.7)
Ship 6	1/3–30/3/05	0	0	65	0	65	0	43 (66.2)	22 (33.8)
Ship 6	8/5–5/7/05	0	0	8	0	8	0	8 (100)	
Ship 7	13/9–6/12/04	0	0	39	0	39	0	39 (100)	
Ship 7	12/1–31/1/05	0	0	57	0	57	0	1 (1.8)	56 (98.2)
Ship 7	1/3–5/4/05	0	0	6	0	6	0		6 (100)
Ship 7	11/5–13/6/05	0	0	25	0	25	0		25 (100)
Ship 11	29/10/04–13/1/05	0	0	19	0	19	0	18 (94.7)	1 (5.3)
Ship 11	1/3–15/5/05	0	0	98	0	98	0	98 (100)	
Ship 11	10/6–14/6/05	0	0	39	0	39	0	39 (100)	
Total (%)		0	0	2038	0	2038	0	1870 (91.8)	168 (8.2)

Table 11: Species composition of birds observed killed in longline fisheries in Subarea 58.6 and Division 58.5.1 during the 2004/05 season (September to August). N – night-time setting; D – daytime setting (including nautical dawn and dusk); PRO – white-chinned petrel; PCI – grey petrel; () – % composition.

Vessel	Dates of fishing	No. birds killed by group						Species composition (%)	
		Albatross		Petrels		Total		PRO	PCI
		N	D	N	D	N	D		
Subarea 58.6									
Ship 1	9/9–13/9/04	0	0	0	0	0	0		
Ship 1	4/2–9/2/05	0	0	5	0	5	0	5 (100)	
Ship 1	15/2–23/2/05	0	0	0	0	0	0		
Ship 1	19/5–25/6/05	0	0	2	0	2	0		2 (100)
Ship 2	5/11–11/11/04	0	0	0	0	0	0		
Ship 2	4/2–10/2/05	0	0	3	0	3	0	3 (100)	
Ship 2	10/5–18/5/05	0	0	0	0	0	0		
Ship 2	23/7–11/8/05	0	0	0	0	0	0		
Ship 3	20/1–22/2/05	0	0	13	0	13	0	13 (100)	
Ship 4	1/9–3/9/04	0	0	0	0	0	0		
Ship 5	3/9–8/9/04	0	0	0	0	0	0		
Ship 5	6/2–9/2/05	0	0	0	0	0	0		
Ship 5	15/2–25/2/05	0	0	9	0	9	0	9 (100)	
Ship 5	31/5–21/6/05	0	0	2	0	2	0		2 (100)
Ship 6	20/11–29/11/04	0	0	6	0	6	0	6 (100)	
Ship 6	2/2–23/2/05	0	0	10	0	10	0	10 (100)	
Ship 7	4/2–25/2/05	0	0	7	0	7	0	7 (100)	
Ship 7	17/6–29/6/05	0	0	0	0	0	0		
Ship 11	16/2–25/2/05	0	0	1	0	1	0	1 (100)	
Ship 11	20/6–12/7/05	0	0	3	0	3	0		3 (100)
Division 58.5.1									
Ship 1	17/9–16/11/04	0	0	24	0	24	0	22 (91.7)	2 (8.3)
Ship 1	22/12/04–31/1/05	0	0	11	0	11	0	11 (100)	
Ship 1	1/3–13/3/05	0	0	19	0	19	0	19 (100)	
Ship 1	18/4–14/5/05	0	0	12	0	12	0	7 (58.3)	5 (41.7)
Ship 2	8/9–2/11/04	0	0	6	0	6	0	4 (66.7)	2 (33.3)
Ship 2	30/11/04–31/1/05	0	0	9	0	9	0	9 (100)	
Ship 2	1/3–6/5/05	0	0	32	0	32	0	29 (90.6)	3 (9.4)
Ship 2	5/6–19/7/05	0	0	9	0	9	0		9 (100)
Ship 3	25/9–12/12/04	0	0	61	0	61	0	61 (100)	
Ship 3	1/3–13/4/05	0	0	30	0	30	0	29 (96.7)	1 (3.3)
Ship 3	19/5–27/6/05	0	0	31	0	31	0	31 (100)	
Ship 5	11/9–8/11/04	0	0	66	0	66	0	62 (93.9)	4 (6.1)
Ship 5	15/12/04–30/1/05	0	0	20	0	20	0	20 (100)	
Ship 5	1/3–6/3/05	0	0	27	0	27	0	26 (96.3)	1 (3.7)
Ship 5	14/4–29/5/05	0	0	38	0	38	0	23 (60.5)	15 (39.5)
Ship 6	4/9–16/11/04	0	0	104	0	104	0	103 (99.0)	1 (1.0)
Ship 6	11/1–29/1/05	0	0	41	0	41	0	41 (100)	
Ship 6	1/3–30/3/05	0	0	170	0	170	0	167 (98.2)	3 (1.8)
Ship 6	8/5–5/7/05	0	0	12	0	12	0		12 (100)
Ship 7	13/9–6/12/04	0	0	14	0	14	0	13 (92.9)	1 (7.1)
Ship 7	12/1–31/1/05	0	0	98	0	98	0	98 (100)	
Ship 7	1/3–5/4/05	0	0	171	0	171	0	169 (98.8)	2 (1.2)
Ship 7	11/5–13/6/05	0	0	2	0	2	0	2 (100)	
Ship 11	29/10/04–13/1/05	0	0	11	0	11	0	11 (100)	
Ship 11	1/3–15/5/05	0	0	35	0	35	0	33 (94.3)	2 (5.7)
Ship 11	10/6–14/6/05	0	0	1	0	1	0		1 (100)
Total (%)		0	0	1115	0	1115	0	1044 (93.6)	71 (6.4)

Table 12: Compliance, as reported by observers, of streamer lines with the minimum specifications set out in Conservation Measure 25-02 (2003) during the 2004/05 season. Y – yes; N – no; - – no information; A – autoliner; Sp – Spanish; MP – moon pool; * – conservation measure not applicable in this area.

Vessel name (Nationality)	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 scaring 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 Georgia	1/5–28/8/05	Sp	Y	Y (7)	Y (152)	6	Y (5)	Y (1–6.7)	100		91
Isla Santa Clara	10/5–4/8/05	Sp	Y	Y (7)	Y (151)	8	Y (5)	Y (1–7)	98		100
Jacqueline	2/5–24/8/05	Sp	Y	Y (8)	Y (150)	9	Y (5)	Y (1–7)	100		99
Koryo Maru 11	2/5–16/8/05	Sp	Y	Y (8)	Y (150)	10	Y (5)	Y (1–8)	100		100
Polarpesca I	13/5–21/8/05	Sp	Y	Y (7.5)	Y (162)	7	Y (5)	Y (2–7)	100		100
Protegat	1/5–21/8/05	A	N	Y (7.5)	Y (150)	12	Y (5)	N (0.5–7)	99	100	100
Viking Bay	1/5–21/8/05	Sp	N	N (6.5)	N (83)	50	Y (2)	N (0.8)	100		53
Argos Helena	1/5–29/8/05	A	Y	Y (7.4)	Y (150)	13	Y (5)	Y (1–8)	100		MP
Subarea 48.6											
Shinsei Maru 3	23/1–18/3/05	Sp	Y	Y (7.1)	Y (155)	6	Y (5)	Y (5–7)	100	100	100*
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b											
Arnela	3/12/04–16/3/05	Sp	Y	Y (7.5)	Y (152)	13	Y (5)	Y (1–7)	100	100	48*
Globalpesca II	19/12/04–2/3/05	Sp	Y	Y (7)	Y (150)	12	Y (5)	Y (1–6.5)	100		0*
Galaecia	16/12/04–10/3/05	Sp	Y	Y (7.1)	Y (150)	6	Y (2)	Y (1–6.5)	100	100	0*
829 Yeon Seong	20/12/04–21/2/05	Sp	N	Y (7)	Y (150)	10	Y (5)	N (1–4)	100	100	100*
Janas	5/3–29/3/05	A	Y	Y (7)	Y (165)	19	Y (1.5)	Y (1–7)	100	100	0*
Avro Chieftain	4/9–7/9/05	A	Y	Y (7)	Y (150)	10	Y (4.5)	Y (1–7)	100		MP*
Galaecia	15/4–6/7/05	Sp	Y	Y (7)	Y (162)	9	Y (5)	Y (1–6.5)	100	100	0*
No. 707 Bonanza	26/12/04–10/3/05	Sp	Y	Y (7)	Y (150)	25	Y (5)	Y (1–6.5)	100	100	100*
Division 58.5.2											
Avro Chieftain	25/7–1/9/05	A	Y	Y (7)	Y (150)	10	Y (4.5)	Y (1–7)	100	100	MP
Avro Chieftain	10/5–1/7/05	A	Y	Y (7)	Y (150)	10	Y (4.5)	Y (1–7)	100	100	MP
Subareas 58.6, 58.7											
Koryo Maru 11	24/2–1/4/05	Sp	N	Y (8)	Y (150)	7	N (6.5)	Y (3–7.5)	100		100
Subareas 88.1, 88.2											
Antarctic III	5/12/04–5/2/05	A	Y	Y (8)	Y (150)	5	Y (5)	Y (7)		99	0*
Argos Helena	4/12/04–4/3/05	A	Y	Y (7)	Y (150)	7	Y (5)	Y (1–9)	100	100	MP*
Janas	1/12/04–6/2/05	A	Y	Y (7)	Y (165)	26	Y (1.5)	Y (1–7)		100	0*
Paloma V	27/12/04–1/3/05	Sp	Y	Y (8)	Y (150)	11	Y (5)	-		98	0*
Punta Ballena	14/1–13/3/05	A	N	Y (7)	Y (150)	5	N (6)	N (2–6)		100	0*

(continued)

Table 12 (continued)

Vessel name (Nationality)	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 scaring 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											
San Aotea II	4/12/04–14/2/05	A	Y	Y (7)	Y (165)	14	Y (5)	Y (1–7)		100	1*
Frøyanes	29/12/04–1/3/05	A	Y	Y (7)	Y (150)	16	Y (5)	Y (1–8)		100	0*
Volna	18/12/04–18/3/05	Sp	N	Y (7)	Y (150)	5	Y (5)	N (2–5)		100	0*
Yantar	18/12/04–18/3/05	Sp	Y	Y (7)	Y (150)	8	Y (5)	Y (1–6.5)	-		0*
Avro Chieftain	31/12/04–6/2/05	A	N	Y (7.6)	Y (242)	17	Y (2)	N (2–6.3)		100	MP*
San Aspiring	25/12/04–23/2/05	A	N	Y (7.5)	Y (169)	17	Y (5)	N (0.5–7.5)	100	100	0*

Table 13: Summary of scientific observations relating to compliance with Conservation Measure 25-02 (2003), based on data from scientific observers from the 1996/97 to the 2004/05 season. Values in parentheses are % of observer records that were complete. na – not applicable.

Subarea/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		No. of streamers		Distance apart		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)	[7]		100	(100)	0.001	0
2004/05	100	(100)	9.5	45	99	100	(100)	75	(100)	88	(100)	88	(100)	[7]		100	(100)	0.001	0
Subarea 48.6																			
2003/04	100	(100)	7.0	20	41[6]	No Discharge		0	(100)	100	(100)	100	(100)	[7]		0	(100)	0	0
2004/05	100	(100)	6.5	19.5	29[6]	No Discharge		100	(100)	100	(100)	100	(100)	[7]		0	(100)	0	0
Divisions 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)	[7]		100	(100)	0	0
2004/05	33[9]	(100)	7.9	40	26[5]	No Discharge		88	(100)	100	(100)	100	(100)	[7]		88	(100)	0	<0.001
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	No Discharge		100	(100)	100	(100)	100	(100)	[7]		100	(100)	0	0
2004/05	Auto only		na	na	50[8]	No Discharge		100	(100)	100	(100)	100	(100)	[7]		100	(100)	0	0
Subareas 58.6, 58.7																			
1996/97	0	(60)	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)	[7]		100	(100)	0.03	0.01
2004/05	100	(100)	6.5	20	100	100	(100)	0	(100)	100	(100)	100	(100)	[7]		0	(100)	0.0149	0

(continued)

Table 13 (continued)

Subarea/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	No. of streamers	Distance apart	Night	Day
Subareas 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)	[7]	100 (100)	0	<0.01
2004/05	33[9] (100)	9.0	45	1[4]	1% by 1 vessel	64 (100)	100 (100)	100 (100)	[7]	64 (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 210/XIX, 216/XX and 41-09 (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 Measure 41-05 (2002, 2003, 2004) permits daytime setting in Division 58.4.2 if the vessel can demonstrate a sink rate of 0.3 m/s.
6 Conservation Measure 41-04 (2003, 2004) permits daytime setting in Subarea 48.6 if the vessel can demonstrate a sink rate of 0.3 m/s.
7 Conservation Measure 25-02 (2003) was updated and the requirement for a minimum of five streamers per line was removed.
8 Conservation Measure 41-08 (2004) permits daylight setting with the use of an integrated weighted line of at least 50 g/m.
9 Conservation Measure 24-02 (2004) exempts vessels from line weighting requirements if they comply with sink rates or have an integrated weighted line of 50 g/m.

Table 14: Offal discharge observed during net shooting and hauling operations in the Convention Area during the 2004/05 season.

Vessel name	Area	Cruise dates	Offal discharged during (%)	
			Net shooting	Net hauling
No. 207 Insung	48.3	7/12–30/12/04	9 (13)	3 (4)
Robin M Lee	48.3	17/12/04–23/1/05	6 (22)	

Table 15: Aerial extent of streamer lines reported by observers during the 2004/05 season. * – information from observer cruise reports.

Vessel name	Dates of fishing	Fishing method	Aerial extent of streamer line
Subarea 48.3			
Argos Georgia	1/5–28/8/05	Spanish	30*
Isla Santa Clara	10/5–4/8/05	Spanish	40
Jacqueline	2/5–24/8/05	Spanish	37
Koryo Maru 11	2/5–16/8/05	Spanish	20
Polarpesca I	13/5–21/8/05	Spanish	30*
Protegat	1/5–21/8/05	Auto	70
Viking Bay	1/5–21/8/05	Spanish	25
Argos Helena	1/5–29/8/05	Auto	45
Subarea 48.6			
Shinsei Maru 3	23/1–18/3/05	Spanish	30
Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b			
Arnela	3/12/04–16/3/05	Spanish	70
Globalpesca II	19/12/04–2/3/05	Spanish	75
Galaecia	16/12/04–10/3/05	Spanish	10
No. 829 Yeon Seong	20/12/04–21/2/05	Spanish	-
Janas	5/3–29/3/05	Auto	65
Avro Chieftain	4/9–7/9/05	Auto	80
Galaecia	15/4–6/7/05	Spanish	7
No. 707 Bonanza	26/12/04–10/3/05	Spanish	150
Division 58.5.2			
Avro Chieftain	25/7–1/9/05	Auto	80
Avro Chieftain	10/5–1/7/05	Auto	80
Subareas 58.6, 58.7			
Koryo Maru 11	24/2–1/4/05	Spanish	50
Subareas 88.1, 88.2			
Antarctic III	5/12/04–5/2/05	Auto	-
Argos Helena	4/12/04–4/3/05	Auto	45
Janas	1/12/04–6/2/05	Auto	65
Paloma V	27/12/04–1/3/05	Spanish	-
Punta Ballena	14/1–13/3/05	Auto	50
San Aotea II	4/12/04–14/2/05	Auto	70
Frøyanes	29/12/04–1/3/05	Auto	60
Volna	18/12/04–18/3/05	Spanish	125
Yantar	18/12/04–18/3/05	Spanish	90
Avro Chieftain	31/12/04–6/2/05	Auto	45
San Aspiring	25/12/04–23/2/05	Auto	60

Table 16: Seabird mortality totals and rates (BPT: birds/trawl) and species composition of incidental mortality, recorded by observers in the CAMLR Convention Area trawl fisheries for the 2004/05 season. KRI – *Euphausia superba*; ANI – *Champsocephalus gunnari*; TOP – *Dissostichus eleginoides*; DIC – grey-headed albatross; DIM – black-browed albatross; PRO – white-chinned petrel; MAH – northern giant petrel; PWD – Antarctic prion; DAC – Cape petrel; MAI – southern giant petrel.

Season	Area	Vessel	Cruise dates	Trawls observed	BPT	Dead							Total dead	Alive (combined)
						DIC	DIM	PRO	MAH	PWD	DAC	MAI		
2005	48.2	*Top Ocean* (KRI)	5/5–31/5/05	156	0.01						1		1	0
		Atlantic Navigator (KRI)	28/1–11/5/05	157	0.00								0	0
		Total		313	0.003								1	0
	48.3	*Betanzos* (ANI)	20/12/04–26/1/05	37	0.03		1						1	2
		Dongsan Ho (ANI)	20/12/04–7/1/05	33	0.15		4	1					5	0
		InSungHo (ANI)	4/12/04–7/1/05	45	0.07		3						3	6
		No. 207 Insung (ANI)	7/12–30/12/04	34	0.03		1						1	6
		Argos Vigo (ANI)	17/12–31/12/04	40	0.00								0	0
		Robin M Lee (ANI)	17/12/04–23/1/05	26	0.00								0	0
		Sil (ANI)	27/11/04–22/1/05	38	0.03				1				1	0
		Total		253	0.04								11	14
	48.3	*Niitaka Maru* (KRI)	19/6–22/7/05	257	0.00								0	0
		InSungHo (KRI)	10/7–19/8/05	97	0.00								0	1
		Foros (KRI)	20/6–9/7/05	75	0.00								0	0
		Niitaka Maru (KRI)	16/8–19/8/05	25	0.00								0	0
		Total		454	0.00									
	58.5.2	*Austral Leader* (ANI/TOP)	16/1–12/2/05	224	0.00								0	0
		Austral Leader (ANI/TOP)	24/3–12/4/05	67	0.03		2						2	0
		Southern Champion (ANI/TOP)	22/1–6/2/05	163	0.00								0	0
		Southern Champion (ANI/TOP)	2/3–31/3/05	262	0.02		3	3					6	0
		Southern Champion (ANI/TOP)	22/4–25/5/05	103	0.00								0	0
		Southern Champion (ANI/TOP)	30/5–6/7/05	303	0.00								0	0
		Total		1122	0.01								8	0

Table 17: Seabird mortality totals and rates (BPT: birds/trawl) and species composition of incidental mortality, recorded by observers in the CAMLR Convention Area trawl fisheries over the last five seasons. DIC – grey-headed albatross; DIM – black-browed albatross; PRO – white-chinned petrel; MAH – northern giant petrel; PWD – Antarctic prion; DAC – cape petrel; MAI – southern giant petrel.

Season	Area	Target species	Trips observed	Trawls observed	BPT	Dead							Total dead	Alive (combined)
						DIC	DIM	PRO	MAH	PWD	DAC	MAI		
2001	48.1	*E. superba*	2	427	0								0	0
	48.3	*C. gunnari*	6	350	0.26	5	46	41					92	40
	58.5.2	*D. eleginoides* and *C. gunnari*	7	1387	0.00								0	0
2002	48.3	*E. superba*	5	755	0.00								0	0
	48.3	*C. gunnari*	5	431	0.16		18	49		1			68	52
	58.5.2	*D. eleginoides* and *C. gunnari*	6	1111	0.00								0	1
2003	48.3	*E. superba*	6	1073									0	0
	48.3	*C. gunnari*	3	182	0.20	1	7	28					36	15
	58.5.2	*D. eleginoides* and *C. gunnari*	8	1309	0.005		2	2			2		6	11
2004	48	*E. superba*	1	521	0.00								0	0
	48.3	*E. superba*	6	566	0.00								0	0
	48.3	*C. gunnari*	6	238	0.37	1	26	59				1	87	132
	58.5.2	*D. eleginoides* and *C. gunnari*	5	1215	0.00								0	13
2005	48.2	*E. superba*	2	313	0.003						1		1	0
	48.3	*C. gunnari*	7	253	0.04		9	1	1				11	14
	48.3	*E. superba*	5	454	0.00									
	58.5.2	*D. eleginoides* and *C. gunnari*	6	1122	0.01		5	3					8	0

Table 18: Extrapolated potential incidental mortality of seabirds in the IUU *Dissostichus* spp. fishery in the Convention Area from 1996 to 2005. Lower and upper refer to 95% confidence limit.

Subarea/ Division	Year	Extrapolated potential incidental mortality of seabirds		
		Lower	Median	Upper
48.3	2005	24	45	736
	1996–2004	1 811	3 441	56 031
58.4.2	2005	171	209	557
	1996–2004	537	655	1 748
58.4.3	2005	1 225	1 495	3 992
	1996–2004	522	636	1 699
58.4.4	2005	1 020	1 244	3 321
	1996–2004	2 866	3 497	9 338
58.5.1	2005	444	542	1 446
	1996–2004	46 988	57 332	153 081
58.5.2	2005	204	248	663
	1996–2004	31 857	38 870	103 787
58.6	2005	39	48	128
	1996–2004	44 888	54 769	146 238
58.7	2005	382	466	1 243
	1996–2004	12 475	15 221	40 640
88.1	2005	97	119	314
	1996–2004	392	479	1 264
Totals	2005	3 605	4 415	12 400
	1996–2004	142 335	174 899	513 826
Total		145 941	179 314	526 226

Table 19: Summary of IMAF assessment of risk to seabirds posed by new and exploratory longline fisheries in the Convention Area (see also Figure 1).

Risk level	Mitigation requirements	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[2]. • No offal dumping.	20% of hooks hauled 50% of hooks set
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 75% of hooks set
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] 95% of hooks set
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] 95% of hooks set
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 hooks set

[1] Conservation Measure 25-02 with the possibility of exemption to paragraph 4 as provided by Conservation Measure 24-02.
[2] This is likely to require the presence of two observers.

Table 20: Summary of IMAF risk assessment in relation to proposed new and exploratory longline fisheries in 2005/06 (five-point risk scale as defined in SC-CAMLR-XXIII/BG/21).

Area	Risk scale	Mitigation requirements	Proposal assessment
48.6 north of ca. 55°S	2 – average to low	• Strict compliance with standard seabird by-catch conservation measure. • 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 at any time.	Proposal from Japan (WG-FSA-05/26 and CCAMLR-XXIV/10) conflicts with the IMAF assessment. Proposal from New Zealand (CCAMLR-XXIV/13) does not conflict with the IMAF assessment.
48.6 south of ca. 55°S	1 – low	• Strict compliance with standard seabird by-catch conservation measure. • No need for restriction of longline fishing season. • Daytime setting permitted subject to line sink rate requirement. • No offal dumping at any time.	Proposal from Japan (WG-FSA-05/26 and CCAMLR-XXIV/10) conflicts with the IMAF assessment. Proposal from New Zealand (CCAMLR-XXIV/13) does not conflict with the IMAF assessment.
58.4.1	2 – average to low	• Strict compliance with standard seabird by-catch conservation measure. • 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 at any time.	Proposals from Australia (CCAMLR-XXIV/17), Chile (CCAMLR-XXIV/25), Spain (CCAMLR-XXIV/9) and New Zealand (CCAMLR-XXIV/14) do not conflict with the IMAF assessment. Proposals from the Republic of Korea (CCAMLR-XXIV/22) and Uruguay (CCAMLR-XXIV/29) do not contain sufficient information to be certain they do not conflict with the IMAF assessment.
58.4.2	2 – average to low	• Strict compliance with standard seabird by-catch conservation measure. • 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 at any time.	Proposals from Australia (CCAMLR-XXIV/18), Chile (CCAMLR-XXIV/26), Republic of Korea (CCAMLR-XXIV/22), Spain (CCAMLR-XXIV/9) and New Zealand (CCAMLR-XXIV/14) do not conflict with the IMAF assessment. Proposal from the Republic of Korea (CCAMLR-XXIV/22) does not contain sufficient information to be certain it does not conflict with the IMAF assessment.

(continued)

Table 20 (continued)

Area	Risk scale	Mitigation requirements	Proposal assessment
58.4.3a	3 – average	• Strict compliance with standard seabird by-catch conservation measure. • Restrict longline fishing to May through August (outside the September through April albatross, giant petrel and white-chinned petrel breeding season) unless line sink rate requirements met at all times. • Daytime setting permitted subject to strict line sink rate requirements and seabird by-catch limits. • No offal dumping at any time.	Proposals from Australia (CCAMLR-XXIV/19) and Spain (CCAMLR-XXIV/9) do not conflict with the IMAF assessment. Proposals from Chile (CCAMLR-XXIV/27) and the Republic of Korea (CCAMLR-XXIV/22) do not contain sufficient information to be certain they do not conflict with the IMAF assessment.
58.4.3b	3 – average	• Strict compliance with standard seabird by-catch conservation measure. • Restrict longline fishing to May through August (outside the September through April albatross, giant petrel and white-chinned petrel breeding season) unless line sink rate requirements met at all times. • Daytime setting permitted subject to strict line sink rate requirements and seabird by-catch limits. • No offal dumping at any time.	Proposals from Australia (CCAMLR-XXIV/20) and Spain (CCAMLR-XXIV/9) do not conflict with the IMAF assessment. Proposals from Chile (CCAMLR-XXIV/28), Republic of Korea (CCAMLR-XXIV/22) and Uruguay (CCAMLR-XXIV/23) do not contain sufficient information to be certain they do not conflict with the IMAF assessment.
88.1 north of 65°S	3 – average	• Strict compliance with standard seabird by-catch conservation measure. • No need for restriction of longline fishing season, but line sink rate requirements to be met at all times. • Daytime setting permitted subject to strict line sink rate requirements and seabird by-catch limits. • No offal dumping at any time.	Proposals from New Zealand (CCAMLR-XXIV/15), South Africa (CCAMLR-XXIV/16), Spain (CCAMLR-XXIV/9) and the UK (CCAMLR-XXIV/21) do not conflict with the IMAF assessment. Proposals from Argentina (CCAMLR-XXIV/12), Republic of Korea (CCAMLR-XXIV/22), Norway (CCAMLR-XXIV/11), Russia (CCAMLR-XXIV/31) and Uruguay (CCAMLR-XXIV/30) do not contain sufficient information to be certain they do not conflict with the IMAF assessment.

(continued)

Table 20 (continued)

Area	Risk scale	Mitigation requirements	Proposal assessment
88.1 south of 65°S	1 –low	• Strict compliance with standard seabird by-catch conservation measure. • 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 at any time.	Proposals from New Zealand (CCAMLR-XXIV/15), South Africa (CCAMLR-XXIV/16), Spain (CCAMLR-XXIV/9) and the UK (CCAMLR-XXIV/21) do not conflict with the IMAF assessment. Proposals from Argentina (CCAMLR-XXIV/12), Republic of Korea (CCAMLR-XXIV/22), Norway (CCAMLR-XXIV/11), Russia (CCAMLR-XXIV/31) and Uruguay (CCAMLR-XXIV/30) do not contain sufficient information to be certain they do not conflict with the IMAF assessment.
88.2	1 – low	• Strict compliance with standard seabird by-catch conservation measure. • 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 at any time.	Proposals from New Zealand (CCAMLR-XXIV/15), Spain (CCAMLR-XXIV/9) and UK (CCAMLR-XXIV/21) do not conflict with the IMAF assessment. Proposals from Argentina (CCAMLR-XXIV/12), Republic of Korea (CCAMLR-XXIV/22), Norway (CCAMLR-XXIV/11), Russia (CCAMLR-XXIV/31) and Uruguay (CCAMLR-XXIV/30) do not contain sufficient information to be certain they do not conflict with the IMAF assessment.

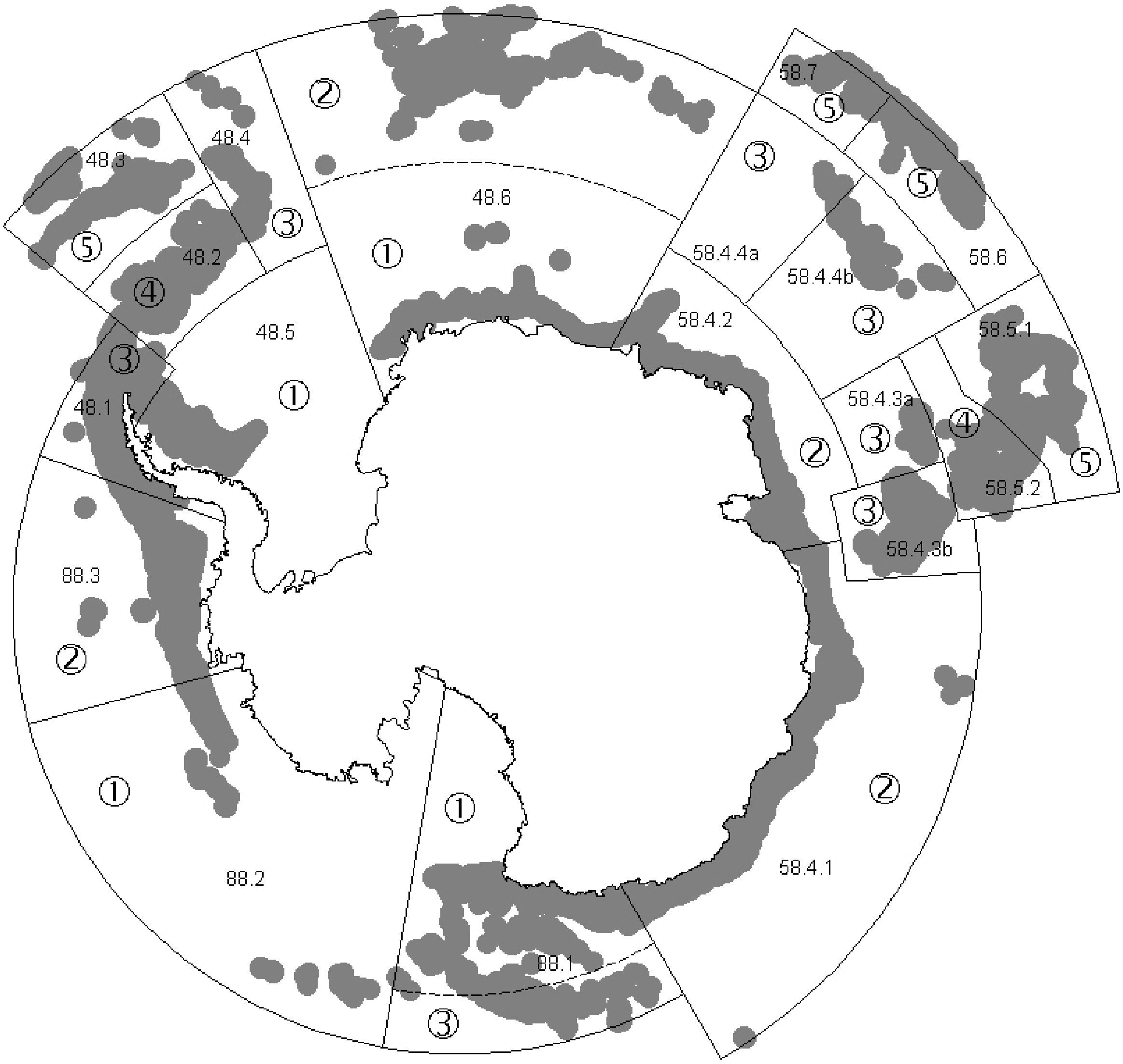

Figure 1: Assessment of the potential risk of interaction between seabirds, especially albatrosses, and longline fisheries within the Convention Area. 1: low, 2: average to low, 3: average, 4: average to high, 5: high. Shaded patches represent seabed areas between 500 and 1 800 m.

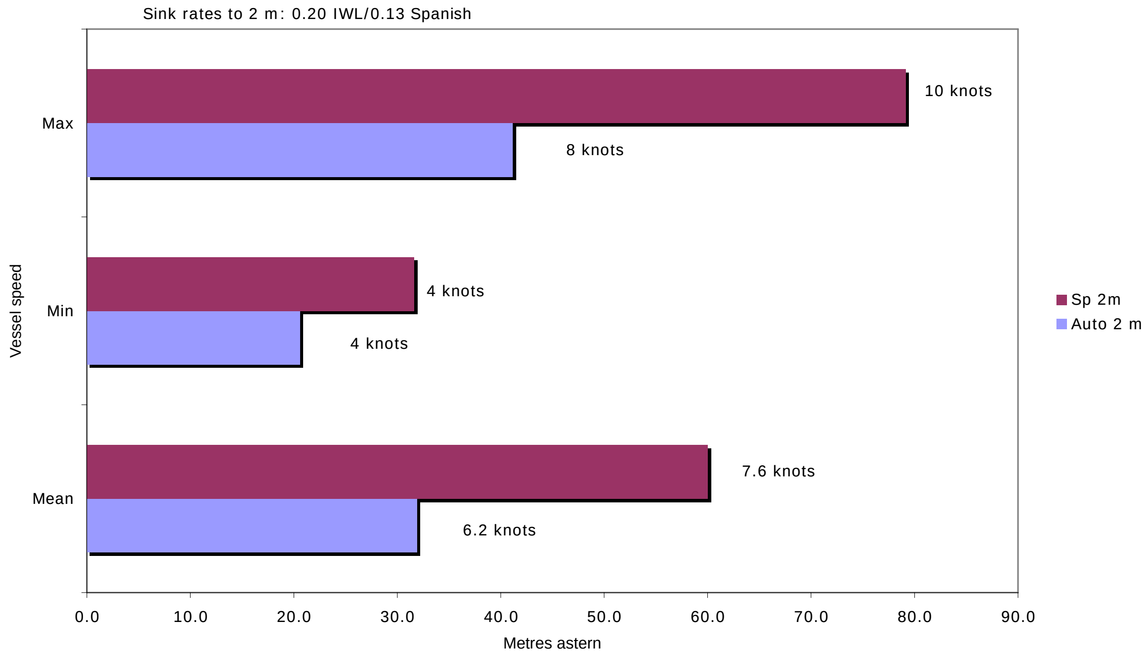

Figure 2: Two-metre access window for IW autoline and Spanish longline gear for maximum, minimum and average vessel speeds for each gear type in the 2004/05 CCAMLR fisheries. Seabirds are most vulnerable to capture when hooklines are within 2 m of the surface.

Figure 3: Bird Excluder Device used on the FV *Janas*.

SUBGROUP ON IUU FISHING

CONTENTS

SUBGROUP ON IUU FISHING

IUU ESTIMATES FOR THE CURRENT SEASON

The subgroup examined the calculations of IUU made by the Secretariat in SCIC-05/10. As in previous years, information supplied to the Secretariat by Members on the number of IUU vessels active in an area (subarea/division), was combined with estimates of the duration of a fishing trip likely to be undertaken by an IUU vessel in that area, the number of fishing trips represented by the sighting, and the likely IUU catch rate in that area.

IUU catch = [number of observations of activity] x [trip duration (days)] x [number of trips per year] x [catch rate (tonnes/day)].

2. For the 2005 fishing season, IUU activity was derived exclusively from sightings (visual, radar, satellite or VMS) although other intelligence and information from found fishing gear may also be used; trip length was based on the average trip length for non-IUU vessels; and catch rates were matched with non-IUU vessel catch rates.

3. Currently the Secretariat makes an assessment of IUU activity up to the beginning of October, and provides both these estimates (column 11 of Table 1 of SCIC-05/10) and extrapolations to the end of the fishing season (column 12). The table needs to be updated at the end of each fishing season, when the final sightings information is available, so that all figures for a fishing season are based on estimation rather than extrapolation. The Working Group recommended that the Secretariat do this intersessionally for the current and all previous fishing seasons so that the best estimates of IUU catch can be used in assessments.

4. The estimates made by the Secretariat for the 2004/05 fishing season will be reviewed by SCIC after the conclusion of the WG-FSA meeting. In case SCIC was to decide that the figures or the method used are in some way inappropriate, WG-FSA agreed that it should use two alternative IUU scenarios, to provide the Scientific Committee and Commission with appropriate alternative assessments of toothfish catch limits. Bearing in mind the discussion in paragraph 3, these two scenarios would assume:

(i) that the estimates given in Table 1 of SCIC-05/10 are correct up to the point of 1 October 2005, i.e. to the point of extrapolation, and therefore that the figures in column 11 should be used for IUU-estimated catch in the 2004/05 fishing season;

(ii) that the estimates given in column 11 of Table 1 are uncertain, and therefore that IUU catch could be assumed to be zero in the 2004/05 fishing season.

5. WG-FSA emphasised that its assessments require the best estimates of IUU fishing rather than 'conservative' or 'precautionary' estimates, because the use of these latter estimates may not necessarily result in precautionary estimates of sustainable yield, depending on the assessment method being used. For instance, in the newer CASAL assessments, where the current exploitable biomass is directly estimated from tagging data, the addition of 'precautionarily' high levels of historical IUU fishing might artificially increase the apparent productivity of the stock, whereas in the forward-projection of GYM the reverse would be true.

6. The Working Group recognised that there was some possibility that the FV *Taruman*, currently assumed to have been fishing exclusively in Subarea 88.1, had in fact been fishing elsewhere. It suggested that the Australian authorities might usefully undertake genetic analysis of the catch, to determine the species, and if possible the stock from which the fish were taken.

REVIEW OF HISTORICAL IUU ACTIVITY

7. Accurate historical, as well as current, estimates of IUU catches are required by WG-FSA both to assess the current status of fish stocks and their historical productivity. The subgroup noted that the historical series of IUU catches might need to be reviewed by SCIC because of the sensitivity of historical estimates to assumptions about catch rates, trip duration and observations of IUU activity (see above). It also noted that estimates may be derived each year from national sources, which may not equate directly with the assumed calculations used by the Secretariat, and that these two estimates should, if possible, be reconciled.

8. As an example, Table 1 shows the catch rates that have been used for this calculation since 1996/97. The catch rates used for Area 58 are lower for the assessments of the 1998/99–2000/01 split-years than the catch rates either earlier or later, such as in Divisions 58.5.1 and 58.5.2. Thus, there was a decline in IUU catches estimated for that period, although the overall estimates of assumed effort were constant (Figure 1). The subgroup noted that the result may, or may not, be an accurate reflection of IUU catches for those years.

9. The Working Group recalled that at the time that the calculations were originally made, a variety of sources had been used to estimate catch rates, including in 1999 an expert group of compliance and fisheries officers (SC-CAMLR-XVIII, Annex 5; WG-FSA-99/51). One way to investigate the sensitivity of the calculations to catch rates would be to examine catch rates from licensed vessels, reported later on in the CDS but unavailable at the time that the calculations were originally performed (Table 1). Figure 2 shows the effect of these alternative catch rates, which would lead to a different interpretation of the historical IUU catch series.

10. Some Members indicated that the decline in IUU catch in Area 58 may be a product of the assumed parameter values used in the calculations. Other Members noted that throughout the historical series compliance and enforcement activities have varied, and that these or other factors may have resulted in changes in IUU activities.

11. It has long been suspected that catches reported in the CDS from Areas 47, 51 and 57 were in fact largely misreported IUU catches taken from the Convention Area. Areas of fishable ground are very small in these areas and licensed vessels report very low catch rates (≤1 tonne/day) compared to the catch rates reported by suspected misreporting IUU vessels (SC-CAMLR-XXIII, Annex 5, paragraph 8.12). Notwithstanding that several Members have reported licensed catches from these areas (including Spain and the Republic of Korea), the majority of catches are likely to be misreported. The Working Group noted last year that these misreported catches may be accounted for in the estimates of IUU catches from within the Convention Area (SC-CAMLR-XXIII, Annex 5, paragraph 8.13) because they match the

estimated IUU catches reasonably well (Table 1). However, there are very limited data that can be used to reliably estimate the proportion of those catches which were misreported that could be reassigned to other statistical areas within the Convention Area.

12. The Working Group requested that SCIC review these issues and determine whether a review of the IUU catch series is needed. The Working Group emphasised that the best estimates of IUU are required for its work in assessing and determining sustainable yields for Convention Area fish stocks.

CONSIDERATION OF IUU ESTIMATION METHODOLOGY

13. WG-FSA recognised that sightings information could be treated as indicative or actual estimates of IUU activity. If they were treated as actual estimates of IUU, each sighting would be accompanied by an estimate of the actual IUU catch that could have been taken by that vessel, using a mixture of verifiable factual data (e.g. hold capacity) and assumptions about various other aspects (e.g. where and for how long it fished, whether it returned to port with a full hold etc). No other information would be required. If they were treated as indicative, each would be a sampled 'observation' of the general IUU activity. Indications of the level of effective monitoring, and the behaviour of IUU vessels, would be used to generate an estimated IUU catch, again using a mixture of verifiable factual data and also assumed inputs. This is the approach explicitly taken by the Agnew and Kirkwood (2005) and Ball (2005) simulation models.

14. The current method attempts to treat the sightings as indicative, but this is hampered, amongst other aspects, by the lack of information on the proportion of fishable time or area which could be considered to be under effective monitoring for IUU activity. WG-FSA requested this information from SCIC last year (SC-CAMLR-XXIII, Annex 5, paragraphs 8.5 and 8.6). For instance, the percentage of the year in which surveillance observations were made – the number of days a patrol vessel, overflight or satellite surveillance operated compared to the effective fishing season.

15. The subgroup requested that the Scientific Committee ask the Commission which body is responsible for estimating and reviewing the IUU catch in each statistical area and by what method this might be achieved. For example, it will be important to determine the values for input parameters to these calculations such as:

(i) how to use the sightings information currently submitted to the Secretariat, some of which cannot be adequately verified, that would not require explicit information on surveillance operations to be made available;

(ii) what fishing time might be represented by an observation (i.e. the number of vessels fishing, the duration that they might be fishing in the area, the potential fishing time). One option might be to provide a weighting for each type of observation, such as whether a vessel is observed near to, or far away from, fishing grounds;

(iii) how surveillance activity might be used to estimate IUU fishing activity from observations;

(iv) how these values might be influenced by different kinds of sightings;

(v) what other factors may need to be taken into account to make this approach viable.

16. The subgroup noted that compliance and enforcement experts are needed to determine this information and reiterated WG-FSA's request from last year (SC-CAMLR-XXIII, Annex 5, paragraph 8.6) for SCIC to consider whether qualitative information could be provided for each of the regions suitable so that they can be classified as either unmonitored, slightly monitored or heavily monitored with an indication as to whether the level of monitoring has increased or decreased significantly from the previous year.

17. Results presented in Ball (2005) from the application of the IUU estimation model described in WG-FSA-04/63 were considered. This work suggested that there was a level of observation below which the uncertainty surrounding estimation of IUU activity was extremely high and above which it was much more stable. The point at which this happens was highly dependent on the input parameters to the model and the study was only preliminary. Therefore, at the moment the subgroup cannot advise on an appropriate level of surveillance in the Convention Area.

MANAGEMENT ADVICE

18. Management advice is provided in section 8 of the main text of WG-FSA's report.

REFERENCES

Agnew, D.J. and G.P. Kirkwood. 2005. A statistical method for estimating the level of IUU fishing: application to CCAMLR Subarea 48.3. *CCAMLR Science*, 12: 119–141.

Ball, I. 2005. An alternative method for estimating the level of illegal fishing using simulated scaling methods on detected effort. *CCAMLR Science*, 12: 143–161.

Table 1: Possible implications of recalculating estimated IUU catch in Area 58. Panel 1 is IUU catch rates (tonnes/day) used in IUU estimation calculations in past working groups. The boxed figures are inferred from the estimated IUU catches alone which were made independently of any calculation based on catch rates. The grey boxes indicate years for which there is an apparent dip in assumed CPUE. Panel 2 contains suggested new CPUE data, based either on the previous values (simple text), on CDS data (bold) or interpolated (italics). Panel 3 presents the current IUU estimates by season compared to the CDS data from Areas 47, 51 and 57. Note that only partial CDS data are available for 1999/2000 and 2004/05, so the figures here have been pro-rata increased to a whole year.

	Estimates reported by split-year					*Estimates reported by season*			
IUU assumed catch rates (tonnes/day)	**96/97**	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**
58.7	7.7	2.5	1.4	1.1	1.5	1.3	1	0.8	0.5
58.6	8.5	3.5	1.9	1.8	1.1	1.2	0.6	1.9	0.3
58.5.1	8.5	5	2	3	3	2.6	5.5	4.7	4.7
58.5.2	8.8	5	2	2	3.3	9.3	4.5	4.5	4.5
58.4.2						1.2	0.8	0.8	0.7
58.4.3								0.8	1.15
58.4.4	5	5	1.5	1.5	2.2	2.2	1.1	1.1	1.1
58	5		1.5						
	Estimates reported by split-year					*Estimates reported by season*			
Alternative CPUE	**96/97**	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**
58.7	7.7	2.5	*2*	**1.5**	**0.94**	**1**	**1.3**	**1.4**	0.5
58.6	8.5	3.5	*3.1*	**2.7**	**2**	**1.7**	**1.05**	**0.4**	0.3
58.5.1	8.5	5	*5.95*	**6.9**	**5.5**	2.6	**3.95**	**3.3**	**4.7**
58.5.2	8.8	5			3.3	9.3	4.5	4.5	**4.5**
58.4.2						**1.4**	**1.4**	0.8	0.7
58.4.3								0.8	1.15
58.4.4	5	5	*3.1*	**1.2**	**0.9**	2.2	1.1	1.1	1.1
58			*3.1*						
CCAMLR season	**96/97**	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**
48	0	146	667	1 015	196	3	0	0	0
58	32 673	14 960	5 201	6 629	8 606	11 762	10 070	2 237	1 932
88	0	0	0	0	0	92	0	240	144
CDS (Areas 47, 51, 57)				9 586	15 409	15 080	8 352	1205	142

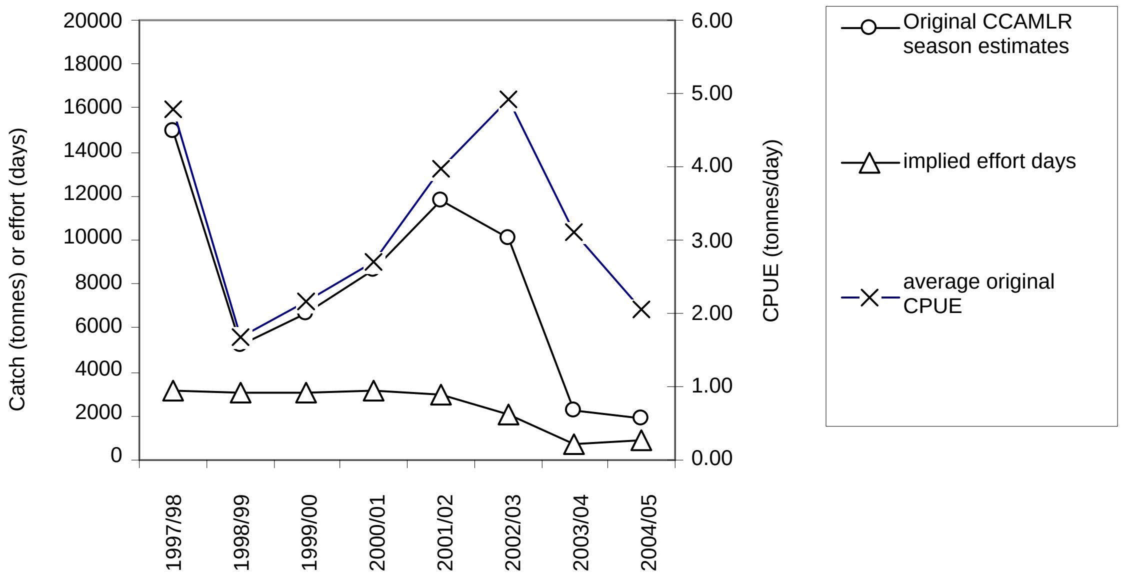

Figure 1: Comparison of current CCAMLR estimates of IUU catch with the implied effort (days IUU fishing) and average IUU CPUE (tonnes/day), both calculated from the IUU estimation tables (e.g. SC-CAMLR-XXIII, Annex 5, Table 3.2).

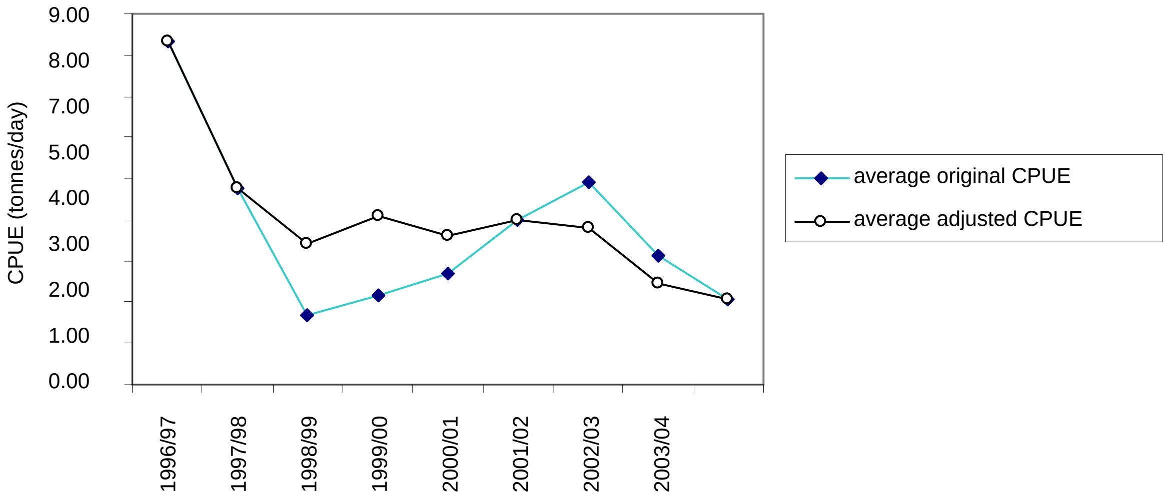

Figure 2: Comparison of original and adjusted average CPUE in Area 58.

APPENDIX Q

SUBGROUP ON BIOLOGY, ECOLOGY AND DEMOGRAPHY OF TARGET AND BY-CATCH SPECIES

SUBGROUP ON BIOLOGY, ECOLOGY AND DEMOGRAPHY OF TARGET AND BY-CATCH SPECIES

SUMMARIES OF PAPERS

WG-FSA-05/27: **The Patagonian toothfish fishery (*Dissostichus eleginoides*) in the Kerguelen Islands (Indian Ocean sector of the Southern Ocean).** Analyses of *D. eleginoides* length-frequency data (LFD) from the longline fishery at Kerguelen confirm an increase in mean length with depth, with the majority of adults present below 500 m. LFDs differ between the sexes, with females having a larger range than males. Size of sexual maturity has been estimated and differs between males and females (63 and 85 cm respectively). The maturity stages followed all year round show differences between the eastern and western parts of the shelf. The eastern shelf appears to be a recruitment area and the western part is where spawning concentrations occur in winter (June).

WG-FSA-05/28: **New data on Antarctic toothfish and some other by-catch fishes fecundity with gonads histological pictures from Ross Sea region and data on Patagonian toothfish from the Argentina Sea**. The paper presents data on reproduction and oogenesis of Antarctic toothfish and a number of by-catch species in January to March 2005. Absolute fecundity in *Dissostichus mawsoni* ranged from 500 000 to 1.7 million eggs (15–41 eggs g^{-1}). *Macrourus whitsoni* had an egg size at spawning of 3.5 mm. *Chionobathyscus dewitti* were in pre-spawning condition in January to March. A female close to spawning had a GSI of 23.9. Some females with resting gonads were observed in the pre-spawning period, which were unlikely to spawn in the current season. Absolute fecundity ranged from 3 200 to 6 100 eggs (5–12 eggs g^{-1}) in 38–49 cm fish. Females of *Cryodraco antarcticus* were in pre-spawning condition with oocytes of 3–3.5 mm size. Egg size at spawning was 4.5 mm. Absolute fecundity varied from 10 000 to 13 000 eggs (58–64 cm fish). *Chionodraco hamatus* were found in pre-spawning condition with oocyte diameters of 4 mm. Fish in spawning condition had egg sizes of 4.5–4.8 mm, with absolute fecundity of 4 200–6 400 (4–6 eggs g^{-1}) in 42–50 cm fish. Ovaries of *Muraenolepis microps* in pre-spawning condition contained eggs of 1 mm diameter, with absolute fecundity 92 000 to 230 000 oocytes (150–200 eggs g^{-1}) in 40–50 cm fish. In *Lepidonotothen kempi* (squamifrons) oocyte diameter was 1 mm and GSI was 11.5. Absolute fecundity was 86 000 eggs in a female of 34 cm (190 eggs g^{-1}).

WG-FSA-05/35: **Project of a software catalogue of skeletal elements from Antarctic fish species, including some identification facilities**. Skeletal elements from fish species of the Antarctic waters were extracted by bioenzyme to provide a computer-supported identification system, including a database of bone pictures. In the database most of the skeletal elements of the cranial and axial skeleton (apart from a few bones of the neurocranium) are represented by pictures, with otoliths and vertebrae also included. Cooperation with other institutions is needed to extend the existing work.

WG-FSA-05/52: **Geographical differences in the condition, reproductive development, sex ratio and length distribution of Antarctic toothfish (*Dissostichus mawsoni*) from the Ross Sea, Antarctica (CCAMLR Subarea 88.1)**. Morphological and reproductive data collected on Antarctic toothfish (*Dissostichus mawsoni*) during the 2000/01 to 2004/05 fishing seasons indicate differences between toothfish found on the Ross Shelf proper and those from the more isolated seamounts and features to the north. Average sampling depth north of 70°S was 1 226–1 621 m, while it was 937–1 389 m south of 70°S. Median length of females was 150–153 cm and thus 10 cm larger than length in males (140–143 cm). Females dominated the catches south of 70°S: 59.2–62.3% while females were less dominant north of 70°S: 27.3–49.5%. The reason for this remains unclear. There has been consistently lower mean weight for length in the northern area than in the south over all seasons (2000/01–2004/05). Overall, Fulton's index of condition K was higher for females than for males. K was generally higher south of 70°S than further north. The gonadosomatic index (GSI) increased from January to March for fish in the north, but remained low in fish in the southern area. A running ripe female caught out of season in December had a GSI of 30. Mature fish apparently increased in condition for spawning in the south and then moved north to spawn.

WG-FSA-05/62: **Results from the New Zealand exploratory fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2 in the 2004/05 season**. Exploratory fishing for *Dissostichus* spp. was undertaken in Divisions 58.4.1 (February) and 58.4.2 (March). *D. mawsoni* caught in Division 58.4.1 were mainly adult, with a similar size distribution to that found in Subarea 88.1. In Division 58.4.2 there was a bimodal distribution, with a significant part of the catch being 70–90 cm pre-recruit fish. The larger fish in both areas were dominated by females. In Division 58.4.1 in late February most fish of both sexes were maturing to spawn, but none were fully mature. The gonadosomatic indices (GSI) for females ranged from 0.35 to 7.5%. In Division 58.4.2 (SSRU E), the majority of the fish (64%) were still immature while the other 36% were evenly spread between resting and developing. The GSI for female *D. mawsoni* ranged from 0.04 to 11.61%. In contrast, the fish caught in SSRU A were mostly found to be maturing. One running ripe female and nine ripe males were taken in SSRU A during the voyage. This is the first evidence we are aware of that identifies potential spawning grounds in this division. The GSI for females ranged from 0.25% to a maximum of 16.2%. The heaviest ovary weighed 7.3 kg. Most of the fish found in this division, especially in SSRU A, were in poor condition (skinny/'axe handle' fish) similar to those found in SSRU 881C in some years.

WG-FSA-05/63: **Size-at-maturity and histological procedures explored to determine spawning activity of female *Dissostichus mawsoni* from samples collected from the Ross Sea in January 2004, December 2004 and January 2005**. Gonad samples from female Antarctic toothfish (*Dissostichus mawsoni*), collected during the 2003/04 and 2004/05 commercial fishing seasons in the Ross Sea were examined macroscopically and histologically to improve estimates of size-of-maturity. Two methods were applied. The first used classic histological techniques to classify ovary stages by the most advanced state of oocyte development visible in histological sections of the 2003/04 samples to determine the proportion of fish maturing to spawn, and thus the mean size at maturity. The calculated L_{m50} of 113.0 cm was very close to the value of 115.2 cm estimated in 2000/01. GSI data collected from across the fleet, however, still raise doubt about the true L_{m50}. The second method examined ovaries to identify histologically fish that spawned the previous season, but requires further ground truthing.

WG-FSA-05/71: **Two species of toothfish in two basic longline fisheries regions – Patagonian toothfish in Subarea 48.3 (South Atlantic) and Antarctic toothfish in Subareas 88.1 and 88.2 (South Pacific)**. Analysis of the depth distribution of catches showed that smaller fish prevailed closer to the shelf and to the Balleny Islands while larger individuals were found in deepwater areas of the Ross Sea. These observations confirmed earlier observations by Hanchet et al. (2003, 2004). Antarctic toothfish appear to grow faster than Patagonian toothfish. At the same age, Antarctic toothfish were 120–150 cm long while Patagonian toothfish were 105–120 cm long. Analysis of stomach content of Antarctic toothfish showed that macrourids (18.8% frequency of occurrence), cephalopods (12.0%) and icefish (8.9%) formed the predominant part of the diet. The composition of the diet varied considerably from the diet of fish collected near McMurdo Sound in the late 1970s/early 1980s (Eastman, 1985) when primarily notothenioids (*Pleuragramma antarcticum* and others) and mysids were found in the diet.

WG-FSA-05/76: **Oceanological factors affecting formation of mackerel icefish aggregations in the South Georgia area during different seasons of the year**. At South Georgia icefish occupy a limited temperature range and are intolerant of temperatures greater than 2°C. During winter the fish are not feeding and occupy a limited temperature range of 1.6–1.7°C at depths greater than 250 m. In spring/summer icefish occupy a wider range of depth and temperature (0.0–1.9°C in the South Georgia area and to 2.0°C near Shag Rocks). Autumn includes the feeding and pre-spawning periods, with fish migrating to the spawning grounds, which occur in the near-bottom layer. The impulse of the spawning migration beginning is when the near-bottom water warming in the spawning ground increases to 1.6°C.

WG-FSA-05/77: **Reasons of differences between distribution and density of mackerel icefish (*Champsocephalus gunnari*) aggregations in the South Georgia area during summer and autumn periods in different years from the bottom trawl survey data**. During the feeding period, icefish aggregations are confined to frontal zones between opposite flows (coastal circumfluent current and ACC) or formed inside quasi-stationary circulations, where the largest aggregations of food organisms are concentrated at the beginning of the spring period. Such a confinement of fish aggregations to dynamically active zones arises from a concentration of food organisms in these areas rather than as a result of favourable oceanographic conditions for the fish. The presence of a cold intermediate layer may have a negative effect on the formation of aggregations as it impedes descending food to the horizons inhabited by icefish and inhibits migration of fish to the upper 100 m layer. Very high water temperature (above 1.8–2.0°C) for this area in the places of food organism aggregation is another obstacle to vertical migrations by foraging fish. All physiological processes of icefish begin to recede at such a temperature, and at a higher temperature the fish evidently falls into a condition close to anabiosis. In such locations the fish are distributed deeper than this temperature layer, most often near the ground. As a rule, transition of icefish to pre-spawning condition is conditioned by visceral fat content (over 2 points).

WG-FSA-05/P6: **Dietary composition of juvenile *Dissostichus eleginoides* (Pisces, Nototheniidae) around Shag Rocks and South Georgia, Antarctica**. The diet of Patagonian toothfish (predominantly 30–70 cm TL) was investigated from animals trawled in the South Georgia area in March–April 1996. Using frequency of occurrence (F%) and coefficient Q (%), fish was by far the main food on the shelves of Shag Rocks and South Georgia, accounting for about 70% of prey. Krill appeared as secondary food, although its importance was overestimated by the frequency of occurrence method. *Lepidonotothen kempi*, *Champsocephalus gunnari* and *Chaenocephalus aceratus* constituted the main fish prey and their variability between Shag Rocks and South Georgia depended on their local abundance.

Table 1: New CCAMLR ageing database structure.

Table name	Field	Type	Description
FISH_AGE	Database	'R' or 'O'	Used to determine whether the link is to Observer or Research Data
	DataOwner	Text	Identity of the data owner
	CruiseID	Number	Linked to Observer or Research CruiseID
	SetID	Number	Linked to Observer or Research CruiseID
	FishID	Number	Unique identifier for the fish
	SpeciesCode	3-alpha code	Linked to Species Codes tables
	Length	Number	Length (in cm) of the fish
	Weight	Number	Weight (in g) of the fish
	Sex	M/F/U	Gender of the fish
	Maturity	1-alpha	Maturity Stage of the fish – linked to Maturity Codes table
	CaptureDate	Date	Date of capture
	BirthDate	Date	Estimated birth date
FISH_AGE_READING	ReadingID	Number	Unique identifier for the reading
	FishID	Number	Linked to FISH_AGE FishID
	ReaderID	Number	Linked to AGE_READER table. Details of the reader
	Reading	Number	Otolith reading
AGE_READER	ReaderID	Number	Unique identifier for the reader
	ReaderName	Text	Name of the reader
	ReaderCode	Number	Quality of the reader – linked to ReaderCode table
READER_CODE	Code	Number	Number for identifier
	Meaning	Text	Meaning of the code

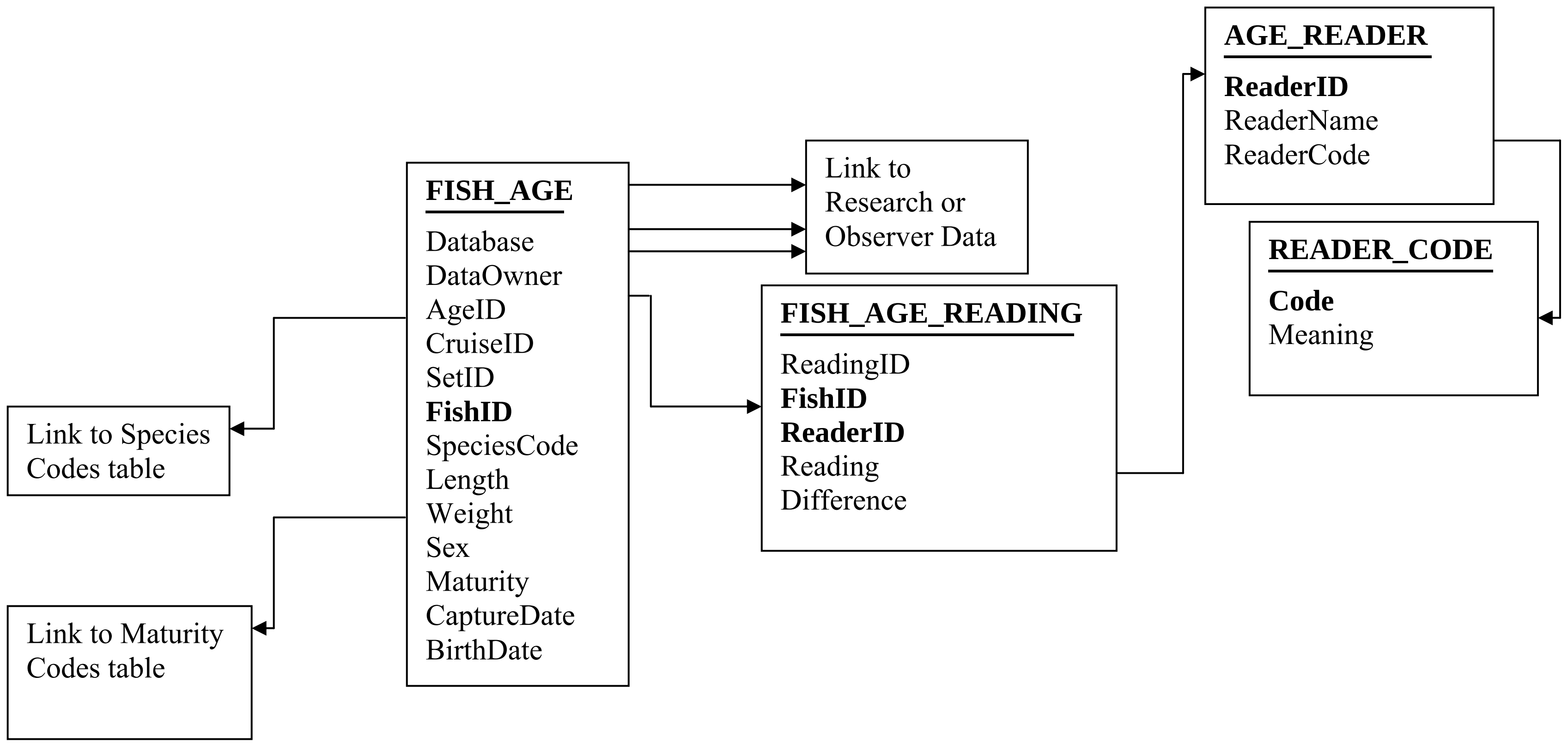

Figure 1: Outline of CCAMLR ageing database.

APPENDIX R

SUBGROUP ON ECOSYSTEM MANAGEMENT

CONTENTS

SUBGROUP ON ECOSYSTEM MANAGEMENT

CONSIDERATIONS OF ECOSYSTEM MANAGEMENT

In order to satisfy requirements of CCAMLR Articles II.3(b) and (c), an ecosystem approach to management is needed.

2. This subgroup report summarises information relevant to interactions with WG-EMM and ecological interaction.

Interactions with WG-EMM

3. There was little interaction between WG-EMM and WG-FSA in 2005. WG-EMM provided some information on the by-catch of fish in the krill fishery in Area 48. Based on the analysis of 4 431 tows, the by-catch of fish was 0.05% by weight. *Champsocephalus gunnari* was the dominant by-catch species with 69% by number and 39% by weight. No account has been made of differences between the fish by-catch in the various CCAMLR subareas.

4. The fish by-catch from Japanese-flagged krill trawlers at South Georgia was described in WG-EMM-05/19. During 100 hauls, conducted from 6 August to 8 September 2004, 12 species of six families were caught. Lanternfish (Myctophidae) were the most abundant occurring in 61% of the hauls. The most abundant notothenioid species in the catches was *Lepidonotothen larseni* with three different age classes present. There was some indication for less fish being found in large krill hauls (CPUE > 20 tonnes/hour) and fish being more abundant in smaller krill hauls (CPUE < 5 tonnes/hour). However, the authors cautioned that a negative correlation between krill CPUE and the by-catch of fish had not been statistically evaluated.

5. A Ukrainian krill trawler fished in Subarea 48.1 from 3 to 17 May 2005 conducting 69 sets. Five fish species of two families were caught. The largest catch (5 kg) consisted of *Pleuragramma antarcticum*. Two size groups were present at 7–8.2 and 14.7–19.2 cm. Channichthyid species were caught occasionally. Two Ukrainian trawlers fished for krill in Subarea 48.3 from 23 May to 18 August 2005. During the 534 sets observed, eight species of four families were caught. The two most abundant species were *L. larseni* (present in 4% of the hauls) and *C. gunnari* (present in 10% of the hauls). The length of *L. larseni* in krill catches was 4.6–6.0 cm. The length of *C. gunnari* in krill catches was 7.6–11.9 cm. In one catch it was 19–25.2 cm when the entire catch of the species in the haul was 42 kg (extract from National Scientific Observer Logbooks provided by L. Pshenichnov, Ukraine).

6. The subgroup thanked Ukraine for this information and encouraged it to submit this analysis to WG-EMM next year as it provided useful information on the broader ecological impacts of the krill fishery.

Ecological interactions

Fish as predator and prey

7. Like other sub-Antarctic shags, the Antarctic shag (*Phalacrocorax bransfieldensis*) and the South Georgia shag (*P. georgianus*) are bottom feeders (Casaux and Barrera-Oro, 2005). In inshore shallow waters, shags are the main predators of demersal fish and play an important role as regulators of their main fish prey. Their prey consisted predominantly of demersal fish. In the southern Scotia Arc and the western Antarctic Peninsula the nototheniid *Notothenia coriiceps* constituted their main prey. The decline in the number of breeding pairs in some areas has been partly attributed by the authors to the effects of the commercial fishery on the shags' preferred prey.

8. In discussion, the subgroup questioned that the decline in the number of breeding shags is accountable to the fishery-induced decline of certain fish species in the area for two reasons:

(i) The main species in the fishery were *C. gunnari* and, to a lesser extent, *N. rossii*, *Gobionotothen gibberifrons* and two other icefish species. These species have been fished heavily and their biomass was largely depleted in the late 1970s/early 1980s. Their decline does not match the decline in the number of breeding shags which occurred from the mid-1990s onwards.

(ii) The fishery in the southern Scotia Arc (Subareas 48.1 and 48.2) was closed after the 1989/90 fishing season and stocks should have started to slowly recover.

9. *Dissostichus eleginoides* is an important predator of other fish species. The dietary composition of juvenile *D. eleginoides* was investigated around South Georgia in March/April 1996 (Barrera-Oro et al., 2005). *Lepidonotothen squamifrons*, *C. gunnari* and *Chaenocephalus aceratus* formed the main part of the fish diet. Their variability between Shag Rocks and South Georgia mirrored differences in the local abundance of fish species. No difference in the diet between male and female toothfish was observed.

Cetacean–fisheries interactions

10. Based on a review of fishery–cetacean interactions (WG-FSA-05/11) the subgroup noted that the two cetacean species primarily involved in interactions with longline fisheries were orcas (*Orcinus orca*) and male sperm whales (*Physeter macrocephalus*). Both species took substantial numbers of fish from the line primarily during daylight hours. Catch rates of longliners declined to less than 50% when orcas occurred close to longline vessels while the loss to sperm whales was much less obvious. They were seen diving close to the line down to 400 m where they apparently took fish. Their impact on catch rates was much less notable. Sperm whales became frequently entangled in the line and part of the line was lost in a number of cases. Other cetaceans were rarely seen in the vicinity of longline vessels. They became entangled in the line only occasionally and one whale (presumably a minke whale) died in 2003 (Kock et al., 2005).

11. The subgroup recognised that killer whales, unlike sperm whales, do not have the diving capability to feed on toothfish at the depth at which the fish are caught by the fishery,

therefore, these fish are only available to killer whales because of the action of the fishery. These fish are currently not included as ecological removals from the fish population. The predation by killer whales is likely to be a learned behaviour, hence, it may increase with time and consideration for how it is included in removals should be given in the future.

12. Depredation of fish from longlines in the Prince Edward Islands has escalated in recent years and had reached saturation by 2002 (WG-FSA-05/58). Cetaceans consume two out of every three toothfish caught. Since 2004 one of the vessels involved in the fishery used pots to catch toothfish. There are no indications of toothfish lost to cetaceans in the pot fishery since pots were introduced.

13. The subgroup also noted high instances of depredation by killer whales in the Crozet longline toothfish fishery (WG-FSA report, paragraph 5.113).

14. The subgroup suggested that a system to quantify the interactions between marine mammals and the longline fishery in a systematic fashion be developed in the intersessional period. This should include direct observations of fish being removed from the line and indirect observations of depredated fish, lost hooks and broken gear, as well as systematic reporting of the presence of killer whales and sperm whales.

Benthos

15. Bottom trawling was banned in the early 1990s at South Georgia to protect benthic communities (see SC-CAMLR-XXIII, Annex 5, paragraphs 5.26 to 5.39). The benthos by-catch from the 2004 bottom trawl survey around South Georgia was recorded in WG-FSA-05/79. The by-catch, which accounted for nearly one-third of the total catch, was split into the major taxa and recorded (WG-FSA-05/79). Benthos by-catch ranged from 3.97 to 614 kg/tow. Average catch size did not differ significantly between depth zones (0–150, 151–250 and 251–500 m) or areas (Shag Rocks, South Georgia). Catches were often diverse with as many as 17 classes of invertebrates represented in individual hauls. Catches were dominated by echinoderms and poriferans, with large numbers of cnidarians and tunicates.

16. The subgroup thanked the UK for providing more detailed information on the benthos by-catch in bottom trawls, although this came from research trawls. It will enhance the information available on the effects of bottom trawling on benthic communities should bottom trawling be reintroduced.

Management advice

17. Management advice is provided in section 10 of the main text of WG-FSA's report.

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APPENDIX S

SUBGROUP ON THE SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

CONTENTS

SUBGROUP ON THE SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

GENERAL MATTERS

Current observation requirements as detailed in conservation measures have not changed from those presented in last year's report (SC-CAMLR-XXIII, Annex 5, Table 11.1).

2. Following the recommendations of WG-FSA at its 2004 meeting, updated versions of the observer logbook forms and cruise report format were placed on the CCAMLR website and distributed to all Members and technical coordinators on 16 February 2005 (COMM CIRC 05/15). All the observer logbooks were submitted using the electronic versions, however the use of outdated logbooks remains a problem when requested data fields are not completed (e.g. by-catch data). It has been recognised that for some new and exploratory fisheries, where the season commences before the official distribution of the updated observer logbook forms, there may be a 12-month delay in obtaining the updated forms. Where possible, the Secretariat issues draft versions of the updated logbook forms, in English, to the relevant technical coordinators prior to the commencement of these fisheries.

3. The subgroup reiterated the advice of the Scientific Committee (SC-CAMLR-XXIII, paragraph 2.7) that all technical coordinators ensure that only the current versions of cruise reports and logbook forms be used by observers in order that all requested data fields are completed.

4. Information collected by scientific observers was summarised in WG-FSA-05/7 Rev. 1, 05/8, 05/9 Rev. 2 and 05/10.

5. A total of 31 longline cruises were conducted during the 2004/05 season, with scientific observers (international and national) on board all vessels. Eight cruises were undertaken in Subarea 48.3 by eight vessels (with one vessel undertaking several sets in Subarea 48.4), one cruise was undertaken by one vessel in Subarea 48.6, eight cruises were undertaken by seven vessels in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, two cruises were conducted by one vessel in Division 58.5.2, one cruise was conducted by one vessel in Subareas 58.6 and 58.7 and 11 cruises were undertaken in Subareas 88.1 and 88.2 by 11 vessels.

6. During the 2004/05 fishing season, nine vessels conducted 14 trawl operations targeting finfish. In accordance with the conservation measures in force, there was 100% observer coverage on all finfish trawl vessels. In total, seven national scientific and seven internationally designated scientific observers participated in these operations.

7. By the commencement of the WG-FSA meeting, six scientific observation programs were reported from five of the nine krill vessels operating in the fishery. These observation programs were undertaken by one national and five internationally appointed scientific observers. The estimated overall observer coverage, based on the number of days when an observer was present, for the krill fishery in 2004/05 was 19% (paragraph O223).

8. Two pot fishing cruises were conducted during the 2004/05 season, both targeting *Dissostichus eleginoides*. These cruises were undertaken in Area 51 (South African EEZ) and Subareas 58.6 and 58.7 by the South African-flagged vessel *South Princess*, with national scientific observers on board.

9. The quality of submitted observer logbook data was high. The subgroup commended all the observers that worked in the CAMLR Convention Area in 2004/05 for their hard work.

OBSERVER CONFERENCE

10. In accordance with the decision of the Scientific Committee (SC-CAMLR-XXIII, paragraph 2.18), two officers from the Secretariat (Dr E. Sabourenkov – Science and Compliance Officer and Mr E. Appleyard – Scientific Observer Data Analyst) attended the Fourth International Fisheries Observer Conference which was hosted in Sydney, Australia. Details of the conference were provided in SC-CAMLR-XXIV/BG/10.

11. CCAMLR was the only Regional Fisheries Management Organisation (RFMO) represented at the conference. The conference considered a number of topics of direct relevance to CCAMLR observer programs. CCAMLR representatives participated in two pre-meeting workshops and presented a talk on scientific observation in CCAMLR fisheries.

12. The Conference:

(i) noted that the CCAMLR Scheme of International Scientific Observation has proven to be an indispensable source of a wide spectrum of fishery-related data required for CCAMLR conservation and fisheries management purposes;

(ii) agreed to expand the scope of the next conference to include consideration of observer programs on high seas in areas of responsibility of RFMOs and to convene a special workshop to consider the matter.

13. The subgroup recommended that the Scientific Committee consider funding the participation of CCAMLR observers at the next International Fisheries Observer Conference.

14. The next International Fisheries Observer Conference is planned to be convened in May 2007 in Canada.

DATA COLLECTED DURING THE 2004/05 SEASON

15. Data collected by scientific observers during the 2004/05 season were used in stock assessments, by-catch estimation and analyses of seabird and marine mammal mortality arising from fishing operations.

CONVERSION FACTORS

16. The main processing method for *D. eleginoides* and *D. mawsoni* reported by observers in longline fisheries (WG-FSA-05/7 Rev. 1) was headed, gutted and tailed (HGT), with some being processed as headed and gutted (HAG) product (WG-FSA-05/7 Rev. 1, Table 5). The average observed HGT conversion factor for *D. eleginoides* in Subarea 48.3 was 1.75 (±0.19), in Subarea 48.6 was 1.64 (±0.15) and 1.63 (±0.13) in Subareas 58.6 and 58.7. The average HAG conversion factor for *D. eleginoides* in Division 58.5.2 was 1.68 (±0.07) and 1.50 (±0.29) in Subareas 88.1 and 88.2. The average observed HGT conversion factor for *D. mawsoni* in Subareas 88.1 and 88.2 was 1.82 (±0.17), and the average HAG conversion factor was 1.64 (±0.111).

17. Observers also provided information on processing and conversion factors from the trawl fishery in Division 58.5.2 (WG-FSA-05/8). The main processing method for *D. eleginoides* was HGT, with calculated conversion factors ranging from 1.72 to 1.78. All vessels in this fishery used a standard conversion factor of 1.74 for *D. eleginoides* processed as HGT. All *Champsocephalus gunnari* caught in this division were processed as a whole fish product.

18. The processing method for *D. eleginoides* in the pot fishery was HGT, with observer-calculated conversion factors of 1.62 in Area 51 (South African EEZ) and 1.66 in Subareas 58.6 and 58.7. No vessel-derived conversion factor was recorded (WG-FSA-05/10).

19. Dr D. Agnew (UK) reported that, using data presented in WG-FSA-05/7 Rev. 1, the catch-weighted average conversion factor measured by observers in Subarea 48.3 (1.775) was very close to the conversion factor used by the vessels (1.77).

20. For the krill fishery in Area 48, the main processing methods were whole, boiled, peeled and mealed. The conversion factor used by the vessels for peeled product was 10.0 and mealed product ranged from 6.5 to 10.0. Observers reported that due to the operation of the mealing and boiling factories it was not possible for them to calculate conversion factors (WG-FSA-05/8).

BY-CATCH

21. Discussions of the subgroup related to by-catch and observer data are contained in paragraphs N37 to N53 and advice to the Scientific Committee is summarised in the WG-FSA report, paragraph 11.3.

TAGGING PROGRAMS

22. Discussions of the subgroup related to tagging and observer data are presented in paragraphs T12 and T15.

SHINSEI MARU BOTTOM-LINE SYSTEM

23. The subgroup requested that the fishery observer assigned to this vessel provide a report describing how the gear is deployed and retrieved with special attention to gear and seabird behaviour during the haul and set (paragraph O81).

INCIDENTAL MORTALITY IN FISHERIES – CURRENT AND ADDITIONAL REQUIREMENTS

24. The subgroup noted that to support extrapolations of incidental mortality of seabirds caught in trawl and longline fisheries, observer data need to be collected in such a way as to distinguish between haul and set captures (paragraph O10).

25. The subgroup noted that to support future analysis of the '2-m access window' the collection of data by observers on longline vessels of vessel setting speed, longline sink rate and streamer line aerial extent remain priority tasks for observers (paragraph O76).

26. The subgroup proposed that for longline vessels, data on streamer line aerial extent and other streamer line features, including the height of streamer line at the stern, the length of streamer lines, the number, spacing and length of individual branched streamers, be collected once every seven days on a diagram-based data collection form to be developed by the Secretariat. Where sink rate data collection is required according to Conservation Measure 24-02, the streamer line data should be collected at the same time as sink rate data where possible (paragraph O79).

27. With respect to trawl fisheries, the Working Group noted a reduced level of reporting by observers on the effort of crews to thoroughly clean the net before shooting operations, and recommended that changes should be made to the observer data collection forms to improve this situation (paragraph O205).

28. With respect to all trawl fisheries (icefish, toothfish and krill) the subgroup reiterated that the following data are required to be accurately reported for all observed cruises to allow extrapolation of incidental mortality per trip and for each relevant management area:

(i) number of tows during voyage;

(ii) number of tows observed specifically for incidental mortality (marine mammals and/or seabirds) during voyage;

(iii) number of incidental mortalities observed by species per tow;

(iv) number of incidental mortalities reported from non-observed tows;

(v) whether offal was discharged at any time during the tow.

29. The subgroup recalled that last year the Scientific Committee endorsed the decision of WG-FSA that, in future, proposals for adding data collection tasks should be submitted in a standard format including a description of the data collection objectives, data collection protocols and data usage (SC-CAMLR-XXIII, Annex 5, paragraph 11.39).

30. The subgroup recommended the continued use of the definition of the status of birds ‘caught’ (SC-CAMLR-XXII, Annex 5, paragraphs 6.214 to 6.217) and requested feedback from scientific observers on the ability to apply this definition whilst at sea (paragraph O195).

SCIENTIFIC OBSERVATION ON KRILL VESSELS

31. The subgroup recommended that observer coverage be required on all vessels participating in Convention Area krill fisheries to allow incidental mortality levels of seabirds and marine mammals and the effectiveness of mitigation measures to be determined, and asked the Scientific Committee to consider how this might be achieved (paragraphs O222 to O226).

32. Since the 2004 fishing season, a questionnaire on krill fishing strategies has been incorporated in the Krill Trawl Fishing Observer Logbook. At its recent meeting, WG-EMM recommended that the questionnaire be amended to include a number of additional questions together with diagrams of the vessel track and position of krill aggregations (Annex 4, paragraphs 3.35 and 3.53).

ELECTRONIC MONITORING

33. Trials conducted by the Australian Fisheries Management Authority to test an Archipelago Marine Research video monitoring system on board the *Avro Chieftain* (WG-FSA-05/74) to monitor setting and hauling had some interesting preliminary results.

34. After initial lighting problems, the video system and the events that trigger activation worked well at capturing the hauling process in a moonpool environment. However, due to the frequency of night setting during the trial period, a limited field of view and frame capture rate, the system had a reduced success at capturing baiting efficiency, streamer line performance and bird behaviour during setting operations.

35. Further trials and technical adaptations are required to refine the method for setting operations. These issues were further complicated by vessel pitching during rough sea conditions. Adaptations being considered to reduce the time and cost of analysis include a fast scanning technique and a randomisation process to enable sub-sampling.

REVIEW OF THE *SCIENTIFIC OBSERVERS MANUAL*

36. The subgroup noted that there had been little progress with the proposed major review of the *Scientific Observers Manual* (SC-CAMLR-XXIII, paragraph 2.8).

37. The subgroup considered that before any review of the *Scientific Observers Manual* is undertaken the following three areas should be considered:

(i) a review of research priorities for different fisheries, target species and by-catch species and the type of data to be collected to allow research priorities to be met;

(ii) a review of whether existing data collection and recording protocols meet the identified data collection requirements. This phase should also include development of clear guidance on prioritisation of observer tasks where requested data collection exceeds time available to the observer at sea;

(iii) a consideration of the most appropriate structure, format and contents of the manual.

38. The subgroup agreed that items (i) and (ii) above should be reviewed annually by WG-FSA incorporating the recommendations and advice of WG-FSA-SAM and ad hoc WG-IMAF with respect to the Scheme of International Scientific Observation. The Scientific Committee will need to take these recommendations into account along with requests for priority data collection from WG-EMM (and SCIC) in deciding the final list of priorities for the observer scheme.

39. The subgroup felt that changes recommended annually by the Scientific Committee and its working groups (item (iii) above) should be implemented as appropriate by the Secretariat following the annual review process.

40. Consequently, the subgroup agreed that a major review of the *Scientific Observers Manual* was currently unnecessary as the mechanisms for its continual update and review are already in place and work effectively.

41. The subgroup identified the following procedures for reviewing the observer logbook forms, instructions, sampling procedures and observer work priorities:

(i) scientific observers should provide comments on the use of the logbooks and instructions to technical coordinators;

(ii) technical coordinators should collate and forward all relevant comments and suggested changes to the Secretariat in one concise document by 1 September on an annual basis;

(iii) the Secretariat will present a summary of all recommended changes to WG-FSA for consideration;

(iv) WG-FSA will consider the proposed changes, evaluate them in view of existing research proprieties and data collection protocols, and prepare recommendations to the Scientific Committee as required;

(v) recommendations from working groups (WG-EMM and WG-FSA) relating to observer research priorities and data collection requirements will be submitted as part of their advice to the Scientific Committee;

(vi) once the Scientific Committee has approved the changes considering also requests from WG-EMM (and as appropriate SCIC) together with the research priorities, the Secretariat will update the logbook forms and distribute them to all Members as soon as possible.

42. The Secretariat proposed that the manual's current format could be substantially improved if paper-based observer logbooks and instructions were removed and be replaced

with electronic logbooks which could easily be amended as required. The manual itself would then consist of a comprehensive range of observation guidelines and reference materials which would not necessarily require annual updates.

43. The subgroup strongly supported this proposal.

MANAGEMENT ADVICE

44. Management advice is provided in section 11 of the main text of WG-FSA's report.

APPENDIX T

SUBGROUP ON TAGGING

CONTENTS

SUBGROUP ON TAGGING

TAGGING STUDIES

Toothfish

The subgroup noted that tagging programs in Subareas 48.3, 88.1 and 88.2 and Division 58.5.2 have been continuing in the current season. These data have been included in integrated assessments of toothfish for Subareas 48.3 (WG-FSA-05/16), 88.1 (WG-FSA-05/33) and 88.2 (WG-FSA-05/31), and in the development of integrated assessments in Division 58.5.2 (WG-FSA-05/69).

2. WG-FSA-05/17 and 05/18 presented some results from the tagging program in Subarea 48.3. Tagging data were used by the authors to examine the possibility of there being reduced growth rates of fish immediately following the shock of tagging, to calculate tag-shedding rates and to estimate the selectivity of longlines and to derive estimates of current vulnerable biomass. The results were used in the CASAL assessment of toothfish in Subarea 48.3 (WG-FSA-05/16; WG-FSA report, paragraphs 5.65 to 5.80, and Appendix G). The subgroup agreed that these methods were promising, but more years of tagging data would be required to improve the accuracy of the estimates, especially for the estimation of selectivity.

3. The subgroup welcomed the first large-scale experiment on the immediate post-tagging mortality of toothfish, coordinated by the UK in Subarea 48.3 (WG-FSA-05/19). Dr D. Agnew (UK) reported that smaller fish and those in better condition had higher post-tagging survivorship. The experiment confirmed that toothfish are relatively robust; most observers should be able to achieve a toothfish tagging survivorship of 95% or better, and a conservative estimate of survivorship across the fleet would be 90%.

4. Dr A. Constable (Australia) informed the subgroup that Australia would be undertaking studies of post-tagging mortality utilising pots. Dr Agnew recalled that a similar method had been used to assess the survivorship of crabs at South Georgia (Purves et al., 2003).

5. WG-FSA-05/35 reported the results of New Zealand mark and recaptures in the Ross Sea. The results confirmed the results obtained elsewhere, that movement rates are low (80% of fish moved less than 50 km/year), that tag-shedding rates are 0.06 tags/year and that tagging appears to have some immediate effect on the growth of toothfish. These results are similar to those obtained in Subarea 48.3 (WG-FSA-05/18).

Tagging in exploratory fisheries

6. Conservation Measure 41-01/C required that all exploratory fisheries tag toothfish at a rate of 1 toothfish per tonne green weight of catch throughout the season, up to a maximum of 500 fish per vessel.

7. Table 1 shows that most Members achieved this target level in most fisheries. Table 2 shows that the tagging rate of all Members combined achieved an average tagging level of 1 fish/tonne in all exploratory fisheries except for Divisions 58.4.1 and 58.4.3b and Subarea 88.2.

8. The subgroup noted that mark–recapture data were being used in the assessments of toothfish in Subareas 48.3, 88.1 and 88.2, and that the UK proposed to initiate a mark–recapture program in Subarea 48.4 with the objective of achieving a tag-based stock assessment within three to five years (WG-FSA report, paragraphs 5.141 to 5.143; WG-FSA-05/57). The knowledge of critical rates, such as tag shedding and post-tagging mortality, has also improved. There is therefore a real possibility that tagging data could lead to assessments of all exploratory fisheries within a few years of their initiation, but only if the following tag conditions are met:

- Tags need to be released at a reasonable rate. Many Members are currently achieving rates of greater than 1 tag/tonne and this should be encouraged.

- Tagging programs should be considered as multi-year programs. There needs to be a long-term (three to five year) commitment to repeated tagging and fishing in exploratory fisheries.

- Considering the slow mixing rates for toothfish, releases should be widely distributed across all fishing areas and depths, and recapture fishing effort should be similarly distributed.

9. There has been concern that large fish are difficult to tag and have a lower survivorship than small fish. In terms of assessments, which require a known and preferably high survivorship of tagged fish, only the relatively smaller fish within the main body of the dome-shaped selectivities contribute significantly to the estimate of vulnerable biomass. These fish naturally have high survivorship. The subgroup recommended that, for most purposes, fish should be tagged in proportion to their occurrence in the catch, but only so long as they are in good condition.

10. The subgroup recognised that there may be some confusion between the Flag State, which has responsibility for undertaking the tagging program in Conservation Measure 41-01/C and reporting the data, and the observer in whose database the tagging data will be held. It recommended that observers should deposit a copy of their data with the Flag State immediately after they leave the vessel, so that if the Secretariat does not receive the observer's data and report within the required deadline they may additionally contact the Flag State.

11. With so many Members now issuing tags to their observers and vessels, there is a risk that number sequences will be duplicated. The subgroup recommended that when ordering tags in future, Members specify the number sequences to include their three-letter code as a part of the tag number sequence.

12. Minor revisions to the tagging protocol were made by the subgroup. In addition it was agreed that:

(i) C2 records of numbers of fish released should include tagged fish in addition to cut-off skates (WG-FSA report, section 6);

(ii) measurements of fish that are to be tagged and released should not be considered to be part of the observer's random length-frequency sample (i.e. if a fish is to be released as a tagged fish, then this fish should be excluded from the random sample of the catch taken by the observer);

(iii) measurements of tagged fish that are recaptured should be added to the commercial catch length frequency (where they would normally be a part of the random selection of the observed catch) and landed catch weights.

Skates

13. WG-FSA-05/70 presented results of the Australian skate tagging program in Division 58.5.2. This program is opportunistic, including releases from trawlers and longliners. In the trawl fishery, 1 057 tags have been deployed since 2001 and 2 026 in the longline fishery since 2003. There have only been 21 recaptures to date, 19 of trawl-tagged *Bathyraja eatonii*, one of trawl tagged *B. murrayi* and two of longline-tagged *B. irrasa*. The average distance between release and recapture was only 6.7 km. Growth in total length of recaptured tagged *B. eatonii* was 15 mm per year.

14. New Zealand has been tagging skates in Subarea 88.1 for [3] years. Animals are tagged in the water prior to cut-off. This method appears to be successful and a number of animals have been recovered. Dr Agnew informed the subgroup that the UK intended to undertake an intensive skate tagging program in Subarea 48.3, starting in 2006, to investigate skate movement, growth and population size.

15. The subgroup recognised that there may be a conflict between the requirement to cut off and release all skates at the water surface and the demands of successful tagging programs (paragraph N82). Alternative approaches may be needed to resolve this conflict, for instance:

(i) tagging a number of skates on deck after assessing their condition, rather than in the water, so that there is a subset of released animals for which condition and likely survivorship is known accurately (paragraphs N87 to N90);

(ii) double tagging as many skates as possible;

(iii) ensuring accurate reporting of all skates cut-off the line (paragraphs N42 to N53), and close examination of these skates for tags;

(iv) recovering all skates caught on some lines, rather than cutting them off at the water surface, to estimate the success of in-water observation of tagged fish (paragraph N82). This may require an exception from the requirement to cut off all skates from longlines.

Using tag data to estimate movement

16. WG-FSA-05/66 described a model able to infer movement of tagged fish by building an underlying model of movement, and then considering spatially variable sampling of marked fish moving according to this model. This may have some advantages over simple calculations of distance moved when there is uneven sampling at different locations.

17. The subgroup noted that a model of toothfish movement in Subarea 48.3, used to investigate potential bias in the Petersen mark–recapture estimate of toothfish population size, had been presented to WG-FSA-SAM (WG-FSA-SAM-05/6), and that it had encouraged the further development of models of toothfish movement (WG-FSA-05/4, paragraph 2.16).

MANAGEMENT ADVICE

18. Management advice is provided in section 3 of the main text of WG-FSA's report.

REFERENCE

Purves, M.G., D.J. Agnew, G. Moreno, T. Daw, C. Yau and G. Pilling. 2003. Distribution, demography and discard mortality of crabs caught as by-catch in an experimental pot fishery for toothfish in the South Atlantic. *Fish. Bull.*, 101: 874–888.

Table 1: Tagging rates by Member and area in exploratory fisheries in the 2004/05 fishing season. NZL – New Zealand; JPN – Japan; KOR – Republic of Korea; CHL – Chile; ESP – Spain; AUS – Australia; ARG – Argentina; GBR – United Kingdom; NOR – Norway; RUS – Russia; URY – Uruguay.

Fishery	Area	Member	Catch (tonnes)	Tags (*n*)	Rate (*n*/tonne)
Closed	88.3	NZL	2	8	4.78
Exploratory	48.6	JPN	47	57	1.21
Exploratory	48.6	KOR	2	5	2.21
Exploratory	58.4.1	CHL	146	94	0.65
Exploratory	58.4.1	ESP	145	159	1.09
Exploratory	58.4.1	KOR	167	184	1.10
Exploratory	58.4.1	NZL	22	25	1.15
Exploratory	58.4.2	CHL	25	145	5.79
Exploratory	58.4.2	ESP	8	11	1.34
Exploratory	58.4.2	KOR	55	141	2.57
Exploratory	58.4.2	NZL	38	45	1.17
Exploratory	58.4.3a	AUS	1	4	2.75
Exploratory	58.4.3a	ESP	100	163	1.64
Exploratory	58.4.3a	KOR	9	32	3.72
Exploratory	58.4.3b	CHL	39	13	0.33
Exploratory	58.4.3b	ESP	243	217	0.89
Exploratory	58.4.3b	KOR	13	1	0.08
Exploratory	88.1	ARG	253	291	1.15
Exploratory	88.1	GBR	260	381	1.46
Exploratory	88.1	NOR	207	317	1.53
Exploratory	88.1	NZL	1500	1536	1.02
Exploratory	88.1	RUS	492	285	0.58
Exploratory	88.1	URY	367	411	1.12
Exploratory	88.2	NOR	4	0	0.00
Exploratory	88.2	NZL	268	269	1.01
Exploratory	88.2	RUS	141	72	0.51

Table 2: Tagging rates for all Members combined in exploratory fisheries in the 2004/05 fishing season.

Fishery	Area	Catch (tonnes)	Tags (*n*)	Rate (*n*/tonne)
Closed	88.3	2	8	4.78
Exploratory	48.6	49	62	1.26
Exploratory	58.4.1	480	462	0.96
Exploratory	58.4.2	127	342	2.70
Exploratory	58.4.3a	110	199	1.82
Exploratory	58.4.3b	295	231	0.78
Exploratory	88.1	3079	3221	1.05
Exploratory	88.2	412	341	0.83

ANNEX 6

REPORT OF THE FIRST MEETING OF THE SUBGROUP ON ACOUSTIC SURVEY AND ANALYSIS METHODS (SG-ASAM)

(La Jolla, USA, 31 May to 2 June 2005)

CONTENTS

REPORT OF THE FIRST MEETING OF THE SUBGROUP ON ACOUSTIC SURVEY AND ANALYSIS METHODS (SG-ASAM)

(La Jolla, USA, 31 May to 2 June 2005)

BACKGROUND TO THE SUBGROUP

Introduction

The Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) met at the Southwest Fisheries Science Center in La Jolla, USA, from 31 May to 2 June 2005, following recommendations from WG-EMM (SC-CAMLR-XXIII, Annex 4, paragraphs 4.89 to 4.93), WG-FSA (SC-CAMLR-XXIII, Annex 5, paragraph 10.8) and SC-CAMLR (SC-CAMLR-XXIII, paragraph 13.5).

2. The terms of reference for this meeting were restricted to two issues relating to hydroacoustic surveys of *Euphausia superba* (Antarctic krill, hereafter 'krill'), namely:

(i) models of krill target strength (TS)
(ii) classification of volume backscattering strength (S_v).

3. The meeting was convened by Dr R. Hewitt (USA) and attended by Drs S. Conti (USA), D. Demer (USA), T. Jarvis (Australia), S. Kasatkina (Russia), R. Korneliussen (Norway), Mr Y. Takao (Japan) and Dr J. Watkins (UK).

4. The subgroup acknowledged the peer-reviewed publications and CCAMLR working papers by Drs Demer and Conti that formed the foundation for this meeting; this body of work was summarised by Dr Demer in a presentation at the start of the meeting.

History of the krill TS model currently endorsed by CCAMLR

5. Estimates of the pre-exploitation biomass (B_0) of krill in a given area have been derived from hydroacoustic surveys since FIBEX in 1981 (Trathan et al., 1992).

6. CCAMLR uses the estimate of B_0 to set a precautionary catch limit for the krill fishery by means of a yield model, with the current GYM (Constable and de la Mare, 1996) representing a development of the KYM first described in 1991 (Butterworth et al., 1991, 1994).

7. Target strength (TS, measured in dB re 1 m^2) is the factor used to scale hydroacoustic data (mean volume backscattering strength, S_v, measured in dB re 1 m^2) to biomass (areal biomass density, ρ, measured in g m^{-2}). Of the various contributing factors, estimates of B_0 from hydroacoustic data are thought to be most sensitive to the TS model used (Demer, 2004).

8. The krill TS model currently endorsed by CCAMLR is that of Greene et al. (1991), which is an empirically-derived linear regression model relating TS to log-length ($\log_{10}L$). The regression is based on empirical measurements of TS at 420 kHz made on 43 individuals

of ‘representative zooplanktonic and micronektonic taxa’ (not including *E. superba*) in a 30 m^3 enclosure (Wiebe et al., 1990). The ratio of acoustic wavenumbers ($10\log_{10}k_f / k_{420\text{kHz}}$, where $k = 2\pi f/c$) is used to transform the model to a different frequency (f) at a given sound speed (c).

9. Despite being corroborated with empirical data (Foote et al., 1990; Hewitt and Demer, 1991a, 1991b; Pauly and Penrose, 1997, 1998), and endorsed as an improvement over the previous BIOMASS TS model (SC-CAMLR-X, paragraph 3.34, and Annex 5, paragraph 4.30(i)), it has also been recognised from the outset that there are four main problems with the Greene et al. (1991) model when applied to krill:

(i) As Greene et al. (1991) themselves note, it is not applicable to the Rayleigh scattering regime, meaning that it will only be accurate for krill that are larger than the wavelength of the sound pulse (e.g. $\lambda 1_{20\text{kHz}} = 12.5$ mm).

(ii) It does not account for changes in target morphology, physiology and orientation, all of which have been shown to significantly affect TS (Demer and Martin, 1994, 1995).

(iii) It was not actually derived from measurements of *E. superba* at 120 kHz, but rather from ‘representative zooplanktonic and micronektonic taxa’ at 420 kHz (Wiebe et al., 1990); the most similar species measured was *E. pacifica*.

(iv) It predicts that the TS of crustacean zooplankton is dependent on the animal’s volume, when it is actually thought to be dependent on its area (Demer and Martin, 1994, 1995).

10. When SC-CAMLR endorsed the original Greene et al. (1991) model, it also endorsed the recommendations of WG-Krill for future work (SC-CAMLR-X, paragraph 3.35, and Annex 5, paragraph 4.30(ii)), namely:

(i) *in situ* single animal TS measurements with dual- or split-beam echosounders;

(ii) *in situ* and experimental TS measurements of aggregations over a range of frequencies, animal lengths and physiological condition;

(iii) measurements of the morphology, orientation and physical condition of krill whenever possible;

(iv) theoretical modelling to predict the *in situ* distributions of individual TS, parameterised with available empirical data.

Development of a physics-based krill target strength model: the DWBA and the SDWBA

11. With reference to paragraph 10(iv), a physics-based TS model has been developed (DWBA: Morse and Ingard, 1968; Stanton et al., 1993, 1998; Chu et al., 1993a, 1993b;

McGehee et al., 1998, 1999) that represents an improvement to the Greene et al. (1991) model because it considers not just size, but all of the parameters that contribute to TS (Figure 1), namely:

(i) size, measured as the total length (L mm = anterior edge of eye to tip of telson, Morris et al., 1988);

(ii) shape, described as a series of n linked cylinders of radius r mm and length l mm;

(iii) material properties, described in terms of the density contrast (g) and sound-speed contrast (h) between the animal tissue and the surrounding seawater;

(iv) incidence angle of the acoustic wave relative to the longitudinal axis of the krill, referred to hereafter as orientation (θ, measured in degrees) and implemented as a Gaussian (normal) distribution of orientations ($\theta = \mathrm{N}[\bar{\theta} = x°$, s.d. $= y°]$).

12. McGehee et al. (1998, 1999) empirically validated the DWBA model by making TS measurements of 14 live, loosely constrained individual krill at 120 kHz in a chilled tank. They obtained data over a range of orientations, finding a good fit[1] between empirical measurements and DWBA-model predictions when the sound impinged on the animal from a dorsal, ventral or lateral aspect (referred to by the authors as an incidence angle of 90°), but a poor fit at orientations away from 90° when predicted scattering was much less than that measured.

13. The poor fit between DWBA predictions and empirical measurements at orientations away from 90° were explained theoretically by Demer and Conti (2002a, 2003a, 2004a) using a modified DWBA model (the so-called ‘stochastic DWBA’, or SDWBA), which takes additional account of three stochastic parameters: (i) scattering in a field with noise, (ii) the complexity of krill shape, and (iii) the flexure of the body as it swims.

14. Demer and Conti (2002b, 2003b, 2004b) went on to validate the theoretical SDWBA model with empirical measurements of krill total TS (TTS). These measurements were obtained using a new technique (De Rosny and Roux, 2001) that permits good measurement accuracy and precision (Demer et al., 2003) and which is independent of both orientation and equipment calibration. TTS values were obtained over a broad range of frequencies (36–202 kHz) and a broad range of L (17–58 mm), and the SDWBA was solved for a krill ‘shape’ that was representative of the experimental animals. The empirical measurements agreed closely with the SDWBA-model predictions over the frequency range 60–202 kHz (‘to better than about 1 dB’); the empirical measurements at lower frequencies (36–60 kHz) were slightly higher than theory and the discrepancies were attributed to noise.

15. In a final step, Demer and Conti (2004c, 2005) applied the SDWBA to data from the CCAMLR-2000 Survey (Watkins et al., 2004) to explore the consequences of their new TS model to the overall estimate of B_0. Depending on the orientation distribution used, the original B_0 estimate of 44.3 million tonnes (CV 11.4%) was increased to as much as 192.4 million tonnes (CV 11.7%).

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[1] Note: The authors reported that the accuracy of the empirical orientation measurements was ±15°, which may help to explain the spread of the empirical points around the 90° peaks.

History of the S_v classification technique currently endorsed by CCAMLR

16. For hydroacoustic studies in general, early efforts to classify hydroacoustic data by taxon have typically relied on the subjective visual analysis of echograms combined with information from net catches if available (e.g. Yudanov, 1971; Forbes and Nakken, 1972; Jefferts et al., 1987; Rose and Legget, 1988; Richards et al., 1991). In the same way, the first official CCAMLR hydroacoustic survey to estimate krill B_0 (BROKE: Pauly et al., 2000) used 'interpretation aided by the catch data from target trawls' to filter the data used.

17. The subject of S_v classification was considered further for the second CCAMLR krill survey (CCAMLR-2000 Survey: Hewitt et al., 2004). At the post-survey 'B_0 Workshop' to analyse the data 'it was accepted that [the visual analysis technique] was very much dependent on operator skill and experience and was subject to considerable individual variation. The workshop agreed that a processing algorithm would offer a better approach by providing a formalised and objective method' (SC-CAMLR-XIX, Annex 4, Appendix G, paragraph 3.22). The technique agreed on is based on the dual-frequency dB-difference technique ($\Delta S_{v120-38kHz}$) described by Madureira et al. (1993a, 1993b) and further validated and refined by Watkins and Brierley (2002). This is an empirical technique, having been derived from field observations.

18. While additional developments of relevance to CCAMLR surveys have been made, such as the use of three-frequency algorithms to help further reduce the possibility of misclassification (e.g. Azzali et al., 2000; Hewitt et al., 2003), the CCAMLR-2000 Survey ΔS_v classification protocol remains as the currently endorsed technique by CCAMLR.

INFORMATION CONSOLIDATED BY THE SUBGROUP

TS models for krill

19. The subgroup recognised that there are a variety of parameters that influence TS (Figure 1), and that these were not all encompassed in the Greene et al. (1991) model.

20. Based on both paragraph 19 and an agreement that theoretical models have the capacity to encompass all of the relevant parameters implicated in TS, the subgroup endorsed the change in philosophy from the use of an empirical-only TS model (i.e. Greene et al., 1991) towards the use of theoretically-based, empirically-validated models.

21. The subgroup considered which type of theoretical TS model was most appropriate to use for krill:

(i) The Kirchoff-ray mode (KRM) model is used to quantify fish and zooplankton backscatter as a function of frequency, size (length) and orientation (e.g. Clay, 1992; Clay and Horne, 1994; Horne and Clay, 1998). However, this model is considered to be appropriate for targets with a strong density discontinuity; it is therefore appropriate for fish with swimbladders, but not for fluid-filled type organisms such as krill. Furthermore, it is not valid in the Rayleigh regime, nor at high orientation angles.

(ii) The subgroup recognised that the most comprehensive guidance to date on which type of theoretical model to use is contained in a review paper by Stanton and Chu (2000). This review recommended the use of the DWBA for krill, but predates the development of the SDWBA.

(iii) The subgroup agreed, based on the information available to them at the time, that the most appropriate theoretical model for krill TS was currently the SDWBA; however, the subgroup also agreed that the use of the SDWBA is subject to the caveats described below (paragraph 22).

22. Caveats on the use of the SDWBA:

(i) The SDWBA utilises multiple parameters (Figure 1). Since the range of values associated with each parameter is not well characterised, the subgroup recognised that determining the distributions of these parameters should be accorded a high priority.

(ii) The subgroup emphasised the importance of determining krill orientation distributions that are representative of those occurring under the ship during survey conditions.

(iii) The orientation distribution (θ = N[$\bar{\theta}$ = 15°, s.d. = 5°]) used in the published application of the SDWBA (Demer and Conti, 2005) was derived from the CCAMLR-2000 Survey data and has a potential for refinement. Another solution (θ = N[$\bar{\theta}$ = 11°, s.d. = 4°]) provides what may be an improved least squares fit to the CCAMLR-2000 Survey data (Demer and Conti, pers. comm.) but may imply that small krill at low densities have been underestimated (Figure 3). Alternatively, the implication may be an artefact of the analysis. This point needs to be investigated further.

(iv) The phase variability term of the SDWBA (φ) takes account of noise, complexity of shape and flexure of the body (Demer and Conti, 2003a). While these terms should ideally be individually characterised and used in the DWBA, this is not practical at present and the SWDBA offers a pragmatic solution.

S_v classification algorithms for krill

23. When employing the ΔS_v method for classifying krill, the subgroup recognised that there are two major types of misclassification that can occur: (i) non-krill targets classified as krill (hereafter 'acoustic by-catch'), and (ii) krill targets not classified as krill (hereafter 'acoustic bypass'). The effect of 'acoustic by-catch' will be to overestimate the biomass of krill, while the effect of 'acoustic bypass' will be to underestimate the biomass of krill. These two phenomena are not necessarily mutually exclusive.

24. The subgroup recognised that a variety of information and processing protocols can be used when attempting to classify S_v (Figure 2). These can be used either in isolation or, preferably, in conjunction with each other (see Horne, 2000 for a review). The subgroup also

recognised that combined approaches have the potential to reduce both acoustic by-catch and bypass. Further work on developing these techniques to make them suitable for adoption as standard CCAMLR techniques was encouraged.

25. The subgroup recognised that, for CCAMLR applications, classification has typically been implemented using SonarData Echoview software. However, it was also recognised that there are a variety of other software packages in which classification of volume backscatter has been implemented. Two such packages that were described by Dr Korneliussen at the meeting are given below:

(i) Korneliussen and Ona (2002, 2003, 2004a, 2004b) have described S_v classification techniques used in the Bergen Echo Integrator (BEI) software. Acoustic backscatter of marine organisms is divided into one, or a combination of, three fundamental scattering classes: (i) 'fluid-like', (ii) 'resonant', and (iii) 'hard'. Each of these scattering classes is described by the relative frequency response, $r(f) = s_v(f)/s_v(38\text{ kHz})$. $r(f)$ measured over all available acoustic frequencies is the main acoustic feature used by the BEI when the acoustic component of the separator algorithms is established; other features such as depth, time and position are also used if the acoustic category is identical to a single species. Smoothed, noise-corrected and geometry-adjusted multi-frequency data-points are used as input to the categorisation system to discriminate between the acoustic categories. In Stage-1 of the BEI categorisation system, strong model-based or empirical requirements must be fulfilled by a multi-frequency data-point in order to put the corresponding volume-segment (pixel) into one of the specific acoustic target categories. The acoustic requirements on the data-point become weaker for each of the categorisation stages, but the requirement of belonging to the same category as the nearest neighbours (found in previous stage) are strengthened.

(ii) Lebourges-Dhaussy (1996), Lebourges-Dhaussy and Ballé-Béganton (2004) and Lebourges-Dhaussy et al. (2004) have described a multi-frequency, multiple model method implemented in Matlab and MOVIES software that is capable of classifying S_v by species and size. This method is based on the algorithm described by Holliday and Pieper (1995) for the classification of small zooplankton using high frequencies. The use of lower frequencies allows for classification of larger organisms. The data used are the S_v values at each available frequency. The method is based on the NNLS inversion algorithm, applied to a system of equations with as many equations as there are measured frequencies. A set of backscattering models is used to describe copepods, euphausiids and gas-filled organisms. In order to classify the organisms figuring in a sample, the algorithm looks for the optimal population (type, sizes and abundances) that minimises the residual error between the S_v measured and S_v calculated using the corresponding backscattering model. The algorithm yields a lower level of success when the number of frequencies decreases. The range of the size vector initialising the algorithm with respect to the sizes actually present in the population has been found to be an important parameter.

26. The subgroup recognised that with the adoption of a physics-based model for TS it would also be possible to derive theoretical backscattering spectra that can be used to improve classification of krill currently derived from empirical observations.

RECOMMENDATIONS OF THE SUBGROUP

Implementing the SDWBA for general use

27. The subgroup recommended that the SDWBA be used to estimate krill TS (see paragraphs 20 and 21(iii)).

28. The subgroup recommended the use of a 'simplified SDWBA' with constrained parameters to generate a 'base case' estimate of B_0 for CCAMLR acoustic surveys for krill.

29. The subgroup recommended also making the full SDWBA available, and encouraged researchers to work towards both improving the model and characterisation of the parameters, and assessing the implications for estimates of B_0. Drs Demer and Conti agreed to work with the Secretariat to make the source code available to all Members.

Characterising the parameters and running the simplified SDWBA

30. The subgroup recommended that the model parameters (Figure 1) be considered as probabilistic as opposed to deterministic. That is to say, one should characterise them as a probability density function (PDF) rather than as a single value (e.g. the mean).

31. The subgroup recognised that the use of a probabilistic model implies that there is uncertainty associated with the input parameters, and that this uncertainty must be accounted for in estimates of TS and hence B_0.

32. The subgroup considered how to implement a probabilistic approach into the model:

(i) It was agreed that the most comprehensive method would be to use the full PDF for each parameter to estimate TS and its variability; this could be performed by applying either a bootstrapping analysis or a Monte Carlo simulation.

(ii) However, it was also recognised that not only is this comprehensive approach computationally extensive, but that also there is insufficient empirical information at present with which to characterise the PDF of any of the parameters with any degree of confidence.

(iii) As a compromise, it was therefore agreed to consider each parameter in terms of its mean value ±1 standard deviation.

33. The final values chosen to parameterise the simplified SDWBA are given in Table 1. The details of the implementation of the simplified SDWBA using these parameters are given in the appendix. The reasons for choosing these values are considered in turn as follows:

(i) Orientation (θ): The subgroup deemed this to be the most objective information available at present (see paragraph 22(iii) and Figure 3).

(ii) Density contrast (g) and sound-speed contrast (h): These values were both taken from Foote (1990) because they were already implemented in the SDWBA computer code (Demer and Conti, 2003a, after McGehee et al., 1998), and because time precluded consideration of other measurements (e.g. Chu and Wiebe, 2005; Takao, pers. comm.).

(iii) Shape ('fatness coefficient'): The subgroup agreed that the starved krill described by McGehee et al. (1998) would represent a fair approximation of a minimum 'fatness' value. The maximum value was empirically obtained from a photograph of a gravid female during the meeting (Demer, pers. comm.). As a value that lay between the chosen minimum and maximum, the subgroup agreed that the '40% fatter' shape described by Demer and Conti (2005) would represent a fair approximation of a median value.

(iv) Speed of sound in water (c): The weighted harmonic mean calculated by Demer (2004) for the CCAMLR-2000 Survey covered the full range of environments that krill are likely to encounter in Southern Ocean; the subgroup therefore agreed that this was an appropriate value to use.

34. The outputs of the subgroup's agreed run of the constrained, simplified SDWBA are shown graphically in Figure 4 (krill TS as a function of L at 38, 70, 120 and 200 kHz), Figure 5 (krill TS as a function of θ at 38, 70, 120 and 200 kHz) and Figure 6 (krill ΔS_v as a function of L for three dual-frequency scenarios).

35. Figure 4 implies that there is a large range of uncertainty in TS (and hence B_0), and that this range is both frequency and length dependent. This can be illustrated at f = 120 kHz for two different values of L: (i) where L = 25 mm, SDWBA-predicted krill TS ranges from –88 to –73 dB (range = 15 dB); (ii) where L = 50 mm, SDWBA-predicted TS ranges from –77 to –71 dB (range = 6 dB). The subgroup recommended that this uncertainty should be incorporated into estimates of krill TS and hence B_0.

S_v classification algorithms

36. The subgroup agreed that, for the time being, the ΔS_v technique continues to represent the most objective and pragmatic technique for classifying S_v by taxon.

37. The subgroup agreed that when using the ΔS_v technique, acoustic by-catch and bypass should be minimised by constraining the ΔS_v windows to the size range of krill measured in the survey area. To facilitate this step, the subgroup calculated the minimum and maximum ΔS_v values for different size ranges of krill using the constrained, simplified SDWBA model (Table 3).

Recommendations for further research relating to TS models and S_v classification

38. The subgroup emphasised the importance of understanding the orientation distribution, sound speed contrast, density contrast and animal shape for krill under the surveying vessel. The subgroup encouraged further work on these topics as a high priority.

39. The subgroup recognised that the use of 70 kHz transducers should improve krill detection, classification, and estimation of B_0 (Furusawa et al., 1994; Korneliussen, pers. comm.; Demer, pers. comm.), and recommended their use during krill surveys whenever possible.

SUMMARY

40. With respect to the issues considered during this meeting (paragraph 2), the subgroup recommended for CCAMLR hydroacoustic surveys to estimate krill B_0 that:

(i) the simplified SDWBA model (appendix equation 10; Table 2) with constrained parameters (Table 1) be used to define krill TS as a function of L at a given f (Figure 4);

(ii) the minimum and maximum TS values shown in Figure 4 should be used as a first estimate of the error associated with krill TS;

(iii) the classification of S_v to filter out non-krill targets should be undertaken using the ΔS_v technique, with the ΔS_v windows constrained for the appropriate size range of krill as specified in Table 3.

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Table 1: The range of parameter values used in the constrained, simplified SDWBA model to estimate error in the prediction of krill TS, where frequency (f_0) = 120 kHz, number of cylinders (n_0) = 14, krill length (L_0) = 38.35 mm and phase variability (φ_0) = $\sqrt{2}/2$.

	–1 s.d. (scenario 1)	Mean (scenario 2)	+1 s.d. (scenario 3)
Radius of cylinders (r_0 multiplier: see text)	1.0	1.4	1.7
Density contrast (g: after Foote, 1990)	1.0290	1.0357	1.0424
Sound speed contrast (h: after Foote, 1990)	1.0255	1.0279	1.0303
Orientation ($\overline{\theta}$, s.d.: Demer and Conti, pers. comm.)	N(7, 4)	N(11, 4)	N(15, 4)
Sound velocity in water (c m s^{-1}: after Demer, 2004)	1451	1456	1461

Table 2: Coefficients and reference length (L_0) for the simplified SDWBA model of krill TS (appendix equation 10), averaged over the krill orientation distribution (θ = N[$\overline{\theta}$ = 11°, s.d. = 4°]). Exponential notation ($\times 10^x$) is denoted by ''e±x''. The simplified model has an rms error of 0.75 dB over this range of kL.

A	6.64558746e+000
B	1.27909076e-001
C	4.46318146e-001
D	-1.19209591e-011
E	7.42324712e-009
F	-1.73916236e-006
G	1.86327198e-004
H	-8.67465215e-003
I	1.32140873e-001
J	-8.09830343e+001
L_0	38.35e-003 m

Table 3: The recommended ranges (min–max) of ΔS_v values (in dB) to use to classify different size distributions of krill on hydroacoustic echograms. The values shown on the upper, middle and lower lines of each cell represent the ΔS_v ranges for 120–38 kHz, 200–120 kHz and 200–38 kHz respectively. These values are based on constrained, simplified SDWBA calculations made for an orientation distribution of (θ = N[$\overline{\theta}$ = 11°, s.d. = 4°]).

Minimum krill length (mm)	Maximum krill length (mm) 30	40	50	60
10	11.1–17.7 0.4–6.8 11.5–24.5	7.7–17.7 -0.3–6.8 7.4–24.5	4.6–17.7 -0.5–6.8 4.1–24.5	2.5–17.7 -0.5–6.8 2–24.5
20	11.1–14.7 0.4–2.1 11.5–16.8	7.7–14.7 -0.3–2.1 7.4–16.8	4.6–14.7 -0.5–2.1 4.1–16.8	2.5–14.7 -0.5–2.1 2–16.8
30	- - -	7.7–11.1 -0.3–0.4 7.4–11.5	4.6–11.1 -0.5–0.4 4.1–11.5	2.5–11.1 -0.5–0.4 2–11.5
40	- - -	- - -	4.6–7.7 -0.5– -0.3 4.1–7.4	2.5–7.7 -0.5– -0.3 2–7.4

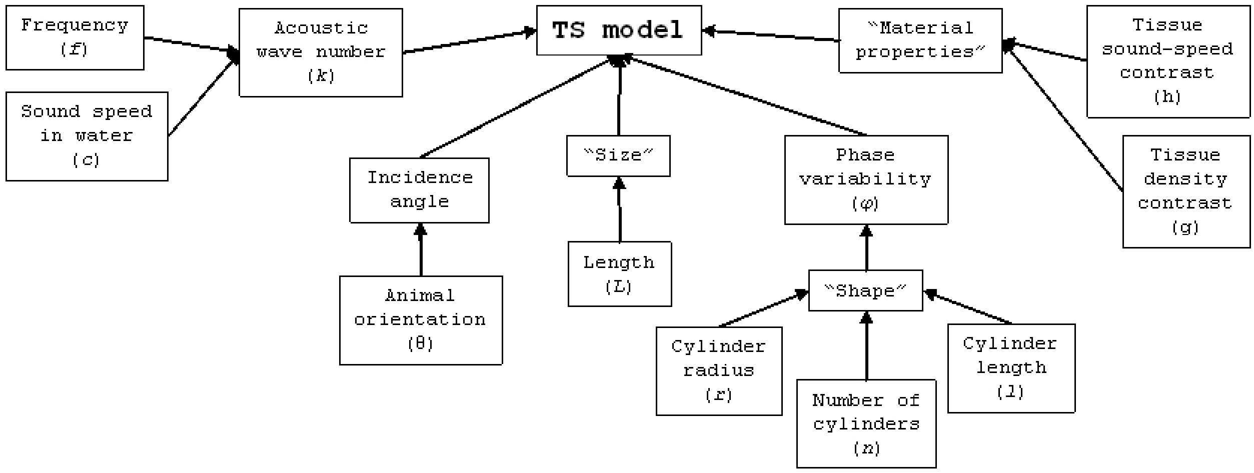

Figure 1: The relationships of the parameters that contribute to the target strength of Antarctic krill. Note, this is a simplified approximation and does not account for co-dependencies.

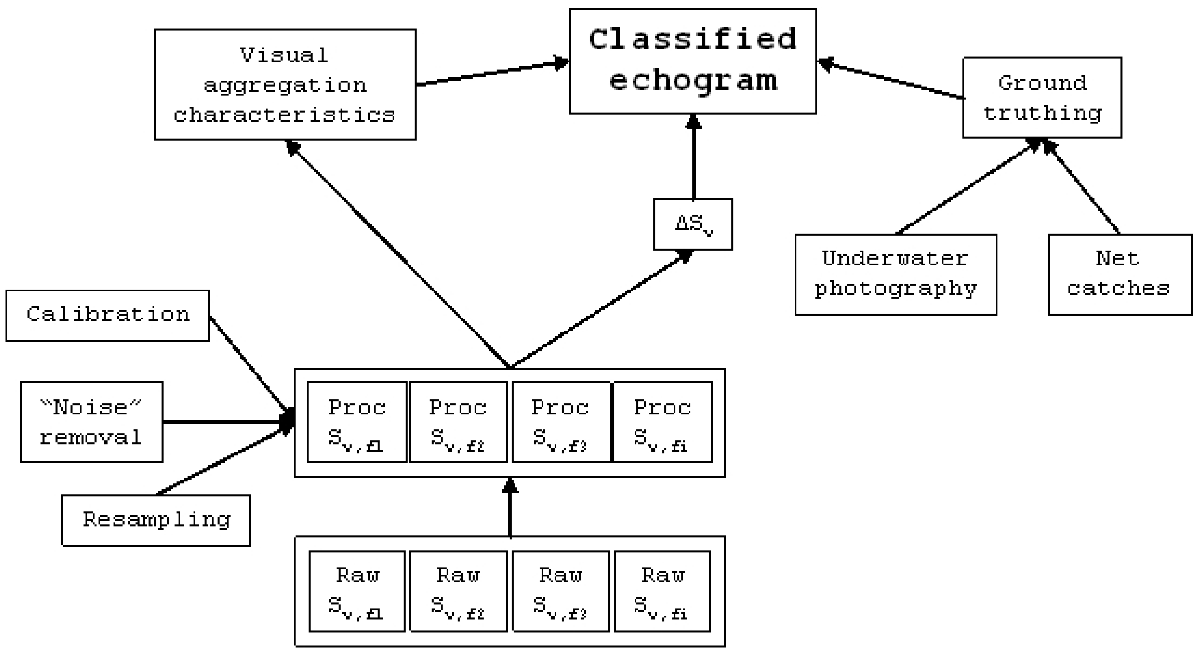

Figure 2: The relationships of the generalised information and procedure categories that are currently available for classifying S_v data by taxon. Proc – processed S_v data.

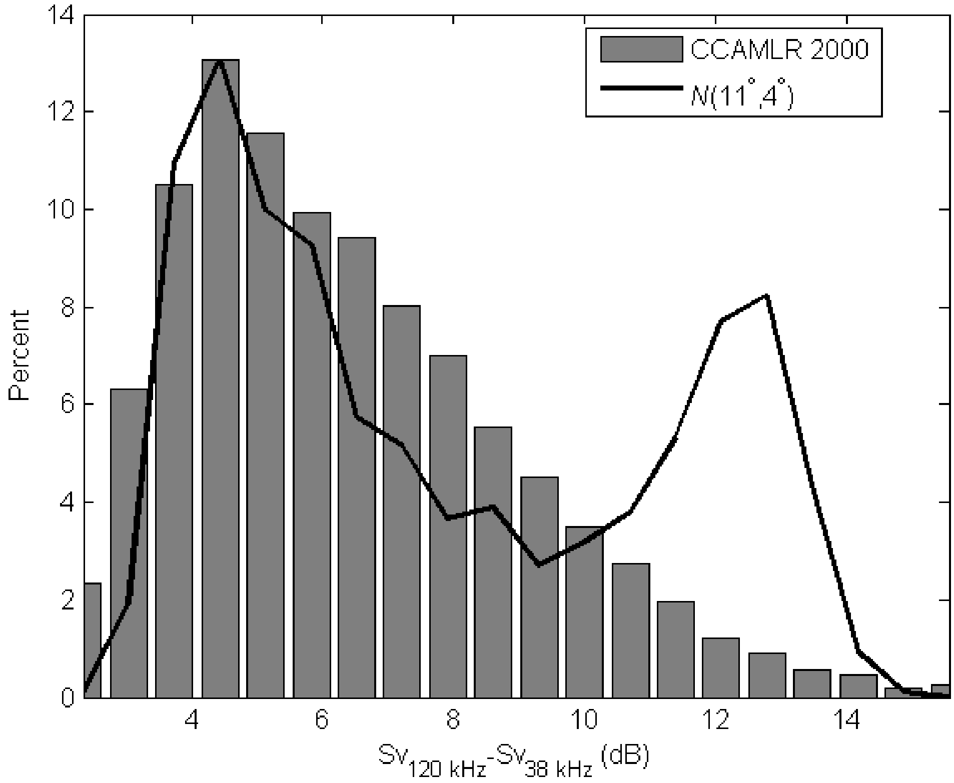

Figure 3: The differences in volume-backscattering strengths (ΔS_v) attributed to krill at 120 and 38 kHz measured from RV *Yuzhmorgeologiya* during the CCAMLR-2000 Survey (grey bars), compared to predictions from the SDWBA model solved with the CCAMLR-2000 krill length-frequency distribution and the (θ = N[$\bar{\theta}$ = 11°, s.d. = 4°]) krill-orientation distribution (black line).

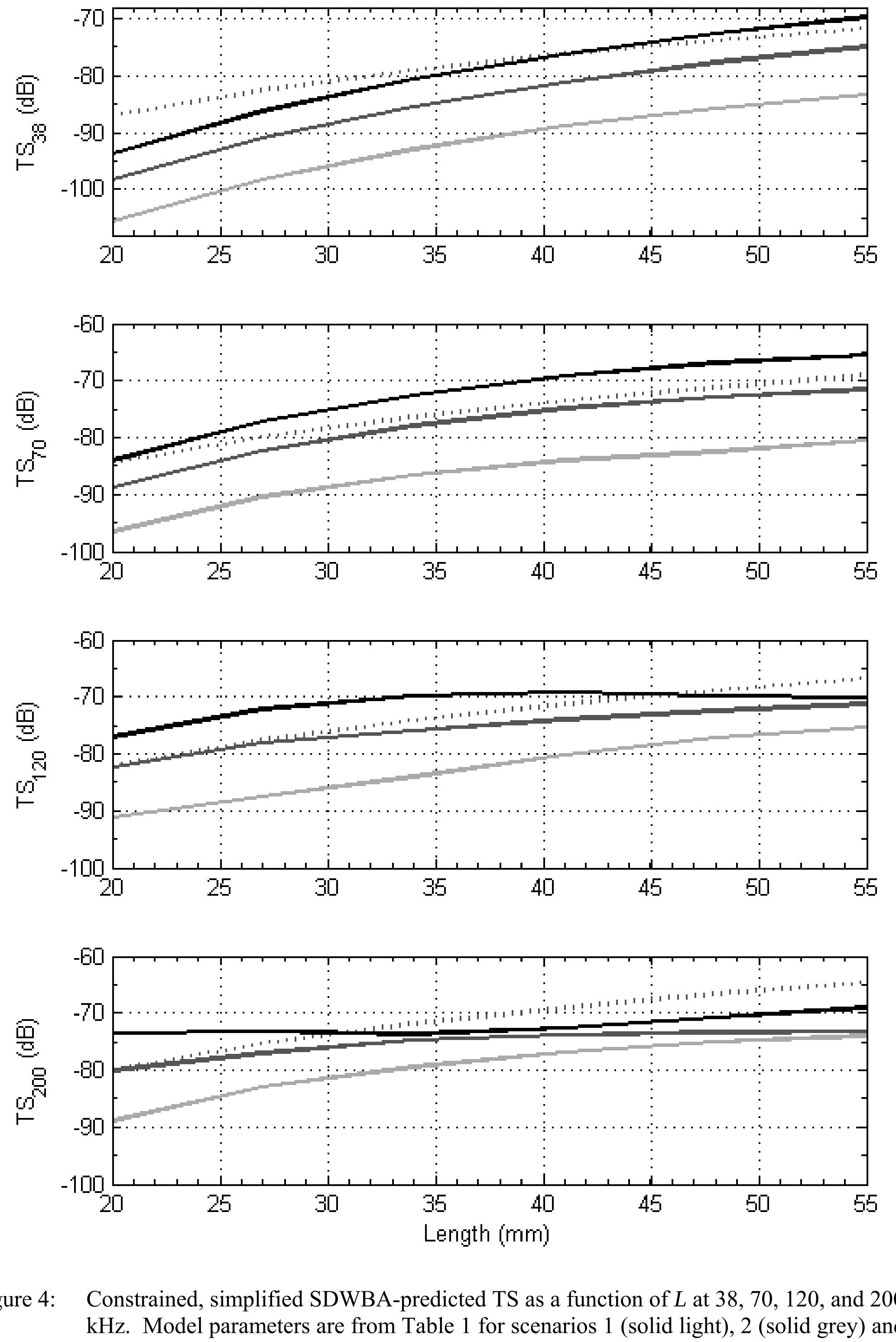

Figure 4: Constrained, simplified SDWBA-predicted TS as a function of *L* at 38, 70, 120, and 200 kHz. Model parameters are from Table 1 for scenarios 1 (solid light), 2 (solid grey) and 3 (solid dark). The dashed line corresponds to the predictions for Greene et al. (1991).

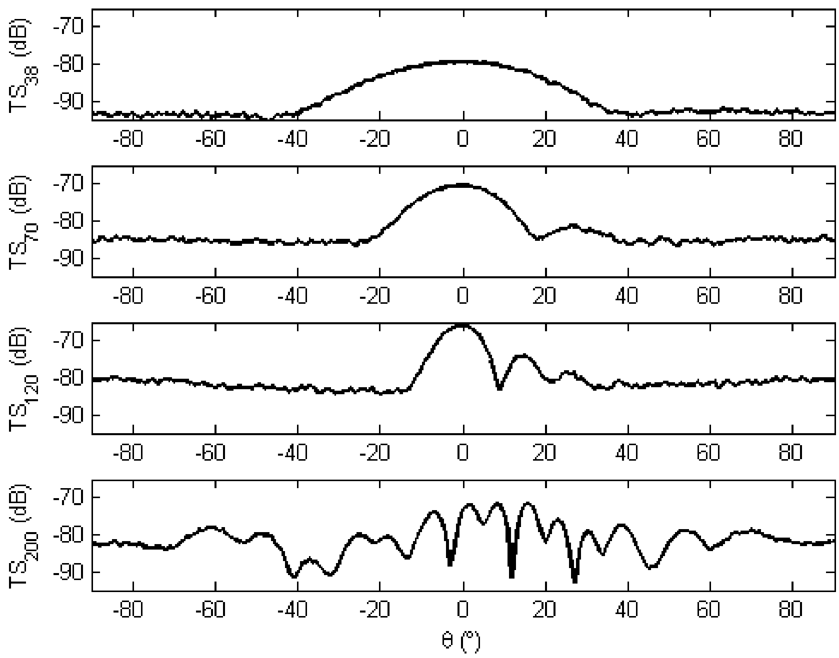

Figure 5: Constrained, simplified SDWBA-predicted TS as a function of orientation angle at 38, 70, 120 and 200 kHz. Model parameters are from Table 1 scenario 2.

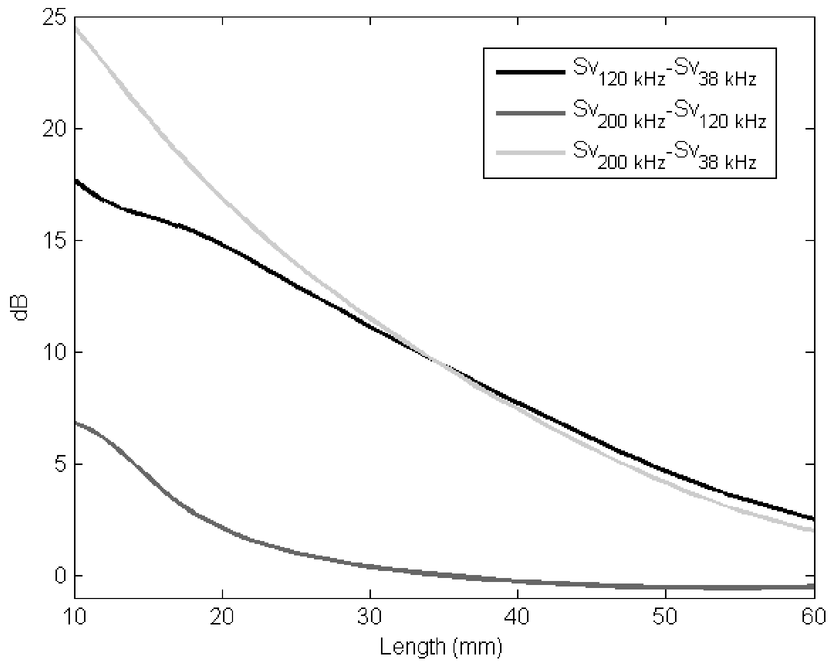

Figure 6: Differences in constrained, simplified SDWBA-predicted S_v at 200, 120, and 38 kHz as a function of *L*. These relationships may be used for minimising acoustic by-catch and bypass (see Table 3).

APPENDIX

THE STOCHASTIC DISTORTED-WAVE BORN APPROXIMATION (SDWBA) MODEL

Krill is approximated by N discretised-bent cylinders of various radii a_j. In that case, the backscattering form function for the cylinder j and incident angle θ is:

$$f_{bs\,j}\left(\theta\right)=\frac{k_1}{4}\int\left[\gamma_\kappa-\gamma_\rho\right]\exp\left(-2i\vec{k}_i\vec{r}_0\right)\frac{a_jJ_1\left(2k_2a_j\cos\beta_{tilt}\right)}{\cos\beta_{tilt}}dr_0 \tag{1}$$

where $\gamma_\kappa=\left(\rho_1c_1^2/\rho_2c_2^2\right)-1$, $\gamma_\rho=\left(\rho_2-\rho_1\right)/\rho_2$, the subscript 1 denotes the ambient seawater, and 2 the krill. J_1 is the Bessel function of first kind of order 1, $\vec{r}_0$ the position vector, $\vec{k}_i=k_1\begin{bmatrix}\sin\theta\\0\\\cos\theta\end{bmatrix}$ the incidence wave vector, and β_{tilt} the angle between the cylinder and the central axis of the body. The form function for the SDWBA is obtained by summing the components from each cylinders with a different random phase φ_j:

$$f_{bs}\left(\theta\right)=\sum_{j=1}^{N}f_{bs\,j}\left(\theta\right)\exp\left(i\varphi_j\right) \tag{2}$$

The phase variability φ_j is obtained from a Gaussian distribution centered on 0, with standard deviation sd_φ, for each cylinder j along the body. Finally, the backscattering cross section $\sigma_{bs}\left(\theta\right)$ is obtained from the average of multiple realisations of the ensembles of phase φ_j:

$$\sigma_{bs}\left(\theta\right)=\left\langle\left|f_{bs}\left(\theta\right)\right|^2\right\rangle_\varphi, \tag{3}$$

and

$$TS\left(\theta\right)=10\log_{10}\left(\sigma_{bs}\left(\theta\right)\right). \tag{4}$$

The generic krill shape was defined by McGehee et al. (1998, standard length L_0 = 38.35 mm). The width of the generic shape was increased by 40% in Demer and Conti (2003a), because freshly caught animals were found to be fatter than the starved animals measured by McGehee et al. (1998). At $f_0=120$ kHz, and using $N_0=14$ cylinders, $sd_{\varphi 0}$ was estimated to be $\sqrt{2}/2$ radians from comparison of the SDWBA predictions to the experimental measurements. Because the factors *N*, sd_φ, *f* and *L* are co-dependent in their effects on the SDWBA results, $sd_\varphi(f)f$ was held constant,

$$sd_\varphi(f)f = sd_{\varphi 0} f_0 \,. \tag{5}$$

Similarly, as *f* and *L* were modified, *N* was also adjusted so that the spatial resolution of the body of the krill remained constant relative to the wavelength. Therefore, the ratio between the wavelength λ and the length of each individual cylinder was held constant:

$$\frac{L}{N\lambda} = \frac{L_0}{N_0 \lambda_0} \tag{6}$$

or

$$\frac{Lf}{N} = \frac{L_0 f_0}{N_0} \,. \tag{7}$$

From Equations (5) and (7):

$$N(f,L) = N_0 \frac{fL}{f_0 L_0} \tag{8}$$

and

$$sd_\varphi(f,L) = sd_{\varphi 0} \frac{N_0 L}{N(f,L) L_0} \,. \tag{9}$$

Thus, sd_φ and *N* were adjusted to the desired *L* and *f*. TS was estimated versus *L* at *f* = 38, 70, 120 and 200 kHz (Figure 4) by solving the SDWBA with a generic fat krill shape, and adjusting *N* and sd_φ according to Equations (8) and (9). The parameters are summarised in Table 1.

The SDWBA *TS* predictions are concisely expressed as a function of the product of the acoustic wave number $k=(2\pi/\lambda)$ and *L*. Averaging this function over a normal distribution (θ = N[$\bar{\theta} = x°$, s.d. = $y°$]) of krill orientations, Demer and Conti (2005) presented a simplified or polynomial representation of the *TS*(*kL*) function:

$$\begin{aligned} TS(kL) = {} & A\left[\frac{\log_{10}(BkL)}{BkL}\right]^C + D(kL)^6 + E(kL)^5 + F(kL)^4 \\ & + G(kL)^3 + H(kL)^2 + I(kL) + J + 20\log_{10}\left(\frac{L}{L_0}\right) \quad . \end{aligned} \tag{10}$$

New parameters for this model were generated using the parameters in Table 2, and kL ranging from 0 to 200, for (θ = N[$\bar{\theta}$ = 11°, s.d. = 4°]) (Table 1). The average rms error over this range of kL is 0.75 dB.

The (θ = N[$\bar{\theta}$ = 11°, s.d. = 4°]) distribution of orientation was estimated using the CCAMLR 2000 data. The S_v differences between 120 and 38 kHz measured during the survey was compared to the predicted values using the model and the distribution of length measured during the survey (Figure 3). Using a least mean square optimisation with mean and standard deviation of the orientation between 0° to 25° and 1° to 30° respectively, the best fit was obtained for (θ = N[$\bar{\theta}$ = 11°, s.d. = 4°]).

ANNEX 7

REPORT OF THE CCAMLR WORKSHOP ON MARINE PROTECTED AREAS

(Silver Spring, MD, USA, 29 August to 1 September 2005)

CONTENTS

REPORT OF THE CCAMLR WORKSHOP ON MARINE PROTECTED AREAS
(Silver Spring, MD, USA, 29 August to 1 September 2005)

INTRODUCTION

At CCAMLR-XXIII held in 2004, the Commission addressed the topic on Marine Protected Areas (MPAs[1]) and urged the Scientific Committee to proceed with this work as a matter of priority. It also reaffirmed the need to develop advice on MPAs commensurate with Articles II and IX of the Convention (CCAMLR-XXIII, paragraph 4.13).

2. The Scientific Committee endorsed in principle the concept of a CCAMLR workshop on MPAs, developed its draft terms of reference and requested that the Chair of the WG-EMM Subgroup on Protected Areas, Dr P. Penhale (USA), act as Convener for the workshop (SC-CAMLR-XXIII, paragraphs 3.52 and 3.53). Intersessional tasks included the creation of a steering committee to develop the agenda and the suggested papers, as well as to identify the appropriate venue and timing of the workshop. The Scientific Committee also recommended that the workshop include invited experts, to take advantage of the large body of MPA knowledge that could be used to promote the goals of CCAMLR (SC-CAMLR-XXIII, paragraph 3.51).

3. The Steering Committee worked during the intersessional period. Based on the view of the Steering Committee, the Convener suggested that the workshop be held in 2005 before CCAMLR-XXIV. The proposal was circulated both to Members of the Commission and the Scientific Committee and received no objections. The workshop was held from 29 August to 1 September 2005 (NOAA National Marine Fisheries Service, Silver Spring, MD, USA).

OPENING OF THE WORKSHOP

4. Dr S. Murawski, Chief Science Adviser to the NOAA National Marine Fisheries Service, welcomed participants of the workshop. He highlighted the unique opportunity and challenges for CCAMLR to further its objective by applying MPAs not only as a tool for conservation and management of resources but also for monitoring general response of the Antarctic ecosystem to environmental and human-induced changes. In particular, the use of MPAs by CCAMLR would be most important in the light of the CCAMLR approach to ecosystem management.

ADOPTION OF AGENDA AND WORKSHOP ORGANISATION

5. The workshop Convener, Dr Penhale, advised participants on the workshop organisation. The draft agenda of the workshop was considered and adopted (see Appendix I). The agenda addressed all items listed in the workshop terms of reference agreed

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[1] In the general context provided by IUCN: 'any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment'.

by the Scientific Committee (SC-CAMLR-XXIII, paragraph 3.52). The lists of workshop participants and papers considered are appended (see Appendix II and Appendix III respectively). Ms L. Kimball (IUCN) participated in the workshop as an invited expert. The workshop report was prepared by Dr A. Constable (Australia), Dr N. Gilbert and Miss J. McCabe (New Zealand), Prof. J. Croxall and Ms S. Grant (UK), Dr R. Holt and Ms P. Toschik (USA) and Dr E. Sabourenkov (Secretariat).

WORKSHOP OBJECTIVES

6. The following terms of reference for the workshop were agreed by the Scientific Committee (SC-CAMLR-XXIII, paragraph 3.52):

(i) to review current principles and practices related to the establishment of MPAs;

(ii) to discuss how the use of MPAs could be used to contribute to furthering the objectives of CCAMLR;

(iii) to consider proposals that are currently under development or in a conceptual phase that relate to MPAs in the Convention Area;

(iv) to discuss the types of scientific information that may be required for the development of MPAs to further the objectives of CCAMLR, including the identification of biophysical regions across the Convention Area.

7. The Convener reiterated that the workshop was organised to develop advice to the Scientific Committee on the application of MPAs commensurate with Articles II and IX of the Convention.

REVIEW OF CURRENT PRINCIPLES AND PRACTICES RELATED TO THE ESTABLISHMENT OF MPAS

General principles and guidelines

8. The workshop considered several papers that had been presented (WS-MPA-05/4, 05/6, 05/14 and COFI/2005/8). The workshop noted in particular that IUCN’s paper on MPAs in the CCAMLR context (WS-MPA-05/4), which was introduced by Ms Kimball, provided helpful guidance and background information on many of the issues under consideration, including definitions of MPAs, and the international context for MPA designation.

9. Ms Grant presented WS-MPA-05/13 which reported on the SCAR Biology Symposium MPA workshop (July 2005, Curitiba, Brazil). This workshop highlighted, in particular, the potential for SCAR to contribute toward the collation of scientific data for the development of MPAs. The importance of monitoring programs in contributing towards an improved understanding of the potential benefits of MPAs was also noted.

10. Against the background of IUCN's paper, the workshop discussed the meaning of the term 'marine protected area' and agreed that it encompassed a range of mechanisms that could be used to help meet the objectives of Article II of CCAMLR. These included provisions available under CCAMLR and the Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol).

11. Dr R. Brock (USA) introduced 'Issues to Consider Before Jumping on the MPA Bandwagon' (WS-MPA-05/14) which provided practical advice on the process for MPA creation. This highlighted the importance of clearly articulating objectives for MPA designation, and of early consultation with a broad range of stakeholders. The paper also suggested that a successful MPA should be of sufficient size to achieve its goals, and its design should incorporate mechanisms to ensure effective monitoring and enforcement. The paper also noted that in order to ensure flexibility and to incorporate all stakeholders' views, the drawing of MPA boundaries might well be the final stage in the process.

12. Dr Constable introduced 'Guidelines for Establishing the Australian National Representative System of Marine Protected Areas (NRSMPA)' (WS-MPA-05/6). He noted that the notion of regional marine planning was a direct result of Australia's Oceans Policy and indicated that the NRSMPA had three key elements, referred to as the CAR system:

- Comprehensiveness – the need to include the full range of ecosystems across each bioregion;

- Adequacy – appropriately sized MPAs to ensure protection of ecological viability and integrity of populations, species and communities;

- Representativeness – sufficient MPAs to reflect the biotic diversity of marine ecosystems.

13. Dr Constable highlighted the importance of the precautionary approach built into the principles for developing the NRSMPA, and noted that the absence of scientific certainty was not considered sufficient reason to avoid designating MPAs. He also drew attention to the criteria contained in the NRSMPA for the identification and selection of MPAs (see WS-MPA-05/6, pp. 10 and 11).

14. The workshop agreed that the NRSMPA, and in particular the CAR principles, provided a candidate approach to the designation of MPAs that may have application in terms of principles and criteria, to CCAMLR's consideration of MPAs in the Southern Ocean.

15. The workshop considered two papers that provided worked examples of processes that had been followed to establish MPAs in the Southern Ocean. WS-MPA-05/7, submitted by Australia, provided information on the establishment of an MPA around Heard Island and McDonald Islands (HIMI), and WS-MPA-05/15, submitted by South Africa, provided information on the Prince Edward Islands MPA. The workshop agreed that these provided useful case studies on the establishment of MPAs within the CCAMLR Convention Area, albeit within existing EEZs.

16. Within the CCAMLR context, the workshop recognised the need to develop a strategic approach to MPA design and implementation throughout the Convention Area, notably in relation to a system of protected areas developed later in the report (paragraphs 66 to 70).

17. The workshop also recognised that there was a strong need for collaboration at technical and policy levels to further develop the MPA concept in the Convention Area. Relevant bodies in such a dialogue would include key elements of the Treaty System (CEP and the ATCM) as well as SCAR, SCOR, Observers to CCAMLR, intergovernmental and non-governmental organisations. It was also noted that, in many cases, CCAMLR Parties were also Parties to other international arrangements within which the issue of high-seas MPAs was being considered and that opportunities therefore existed to exchange information and expertise with such external agencies and organisations.

Economics of MPAs

18. Prof. Croxall introduced this topic and referred to a paper by the Royal Society for the Protection of Birds (WS-MPA-05/08) on the economics of MPAs. Participants were also directed to a paper on the worldwide cost of MPAs (Balmford et al., 2004 – see Appendix III). The workshop agreed that the Scientific Committee should be aware of the background material available on economic aspects of MPAs.

19. The workshop noted that costs associated with MPAs lay firstly with their selection and designation and secondly with their management and enforcement. It was agreed that, potentially, considerable additional costs could be associated with the acquisition of scientific data for the designation of MPAs as well as with the implementation of monitoring programs associated with MPAs. However, it was also recognised that current CCAMLR initiatives already involved compliance and enforcement and so additional costs might not be substantial.

20. The workshop noted also that it might be possible to harness funding through initiatives such as the World Bank and the Global Environmental Facility to assist with the research necessary to underpin MPA selection and designation.

Current instruments and agreements

21. Dr Gilbert presented WS-MPA-05/12 on legal considerations surrounding the designation of MPAs in Antarctica. Mr E. McIvor (Australia) presented WS-MPA-05/9 on the process for the establishment of MPAs by CCAMLR and the Antarctic Treaty Parties. This paper also included a proposal to establish a geographical reference line (e.g. 1 n mile from the coast or the 100 m isobath) to assist in determining whether ASPA or ASMA proposals under Annex V to the Protocol needed to be submitted to CCAMLR.

22. However, the workshop suggested that establishing a harmonised regime for the protection of the Antarctic marine environment across the ATS should be the primary aim but recognised that there would need to be a division between ATCM and CCAMLR on the management of different human activities in the region.

23. The workshop noted the applicability of current ATS instruments to the designation of MPAs in the Southern Ocean and the relationship between those provisions under Annex V to the Protocol and those under Article IX of CCAMLR. The workshop recalled that ATCM Decision 9 (2005) set out the criteria under which protected area proposals under the Protocol

that included a marine component needed to be submitted to CCAMLR for approval. However, it was recognised that the conditions under which these criteria were triggered needed further consideration and coordination.

24. Ms Grant introduced a paper which was previously submitted to WG-EMM and the Scientific Committee (SC-CAMLR-XXIII/BG/30) and later revised for publication. It discussed the applicability of international conservation agreements to the establishment of MPAs in Antarctica. Certain commitments and decisions from agreements such as the Convention on Biological Diversity (CBD) and the World Summit on Sustainable Development (WSSD) have relevance to MPA development under CCAMLR, particularly with regard to the commitments of most CCAMLR Members under these instruments. Specific decisions relate to the development of guidelines and criteria for MPAs, and improved processes for their implementation. Other species-specific agreements such as ACAP may also have relevance in providing mechanisms to strengthen protection for particular species.

25. Participants noted that additional background could be found in the IUCN's publication on international oceans governance and the 2005 information paper prepared by the IUCN on the international legal regime on the high seas and seabed beyond the limits of national jurisdiction (Kimball, 2001 – see Appendix III).

Research papers/summary papers/abstracts

26. The workshop also noted a number of other papers provided as background to its discussion (see Appendix III, List of Documents).

THE USE OF MPAS TO FURTHERING THE OBJECTIVES OF CCAMLR

Principles involved in the identification of potential MPAs in the Convention Area

27. The objectives of CCAMLR, for which the use of MPAs (in the broadest sense) could be appropriate, derive principally from Articles II and IX of the Convention.

28. Article II establishes the basic objective of CCAMLR as the conservation of Antarctic marine living resources (where conservation includes rational use) and sets out the principles by which harvesting and associated activities shall be carried out.

29. Article IX further specifies the ways to give effect to the objective and principles of Article II. This Article relates particularly to the development and use of conservation measures, specifically including the opening and closing of areas, regions or sub-regions for purposes of scientific study or conservation, including special areas for protection and scientific study.

30. Under this provision, CCAMLR has used closed areas to support its precautionary approach to managing finfish fisheries. These have been established for specific purposes not related to MPAs.

31. Article IX also enjoins CCAMLR: (i) to take such other measures as necessary to fulfil the objective of the Convention, including those concerning the effects of harvesting and associated activities on components of the marine ecosystem other than harvested populations (e.g. dependent and associated species); (ii) to take full account of any relevant measures in regulations established or recommended by ATCMs pursuant to Article IX of the Antarctic Treaty.

32. In general, and particularly in the CCAMLR context, there is widespread evidence of the known or potential benefits of MPAs for, *inter alia*, the: (i) conservation (including restoration) of biodiversity; (ii) minimisation of detrimental effects of harvesting on non-target species; and (iii) protection (including restoration) of age classes, life-history stages, stocks and populations of species targeted by harvesting.

33. In addition, the workshop recognised that, in common with other international organisations with responsibility for the conservation and management of marine living resources on the high seas, CCAMLR had particular responsibility (not least as an organisation with the attributes of a regional fisheries management organisation but with a wider conservation mandate) for participating in the current international discussions on the use of MPAs to further such objectives.

34. Furthermore the workshop noted: (i) the existing commitments (e.g. in respect of WSSD, CBD, World Parks Congress etc.) of many, if not most, Members of CCAMLR to the establishment of representative networks of MPAs; (ii) the agreement of FAO to assist its members to achieve the WSSD target with respect to representative networks of MPAs and to develop technical guidelines for defining, implementing and testing of MPAS; (iii) the obligations of all Members of CCAMLR in respect of the Madrid Protocol.

35. Annex V (Article 3.2) of the Madrid Protocol contains the requirement to establish a system of ASPAs to include, *inter alia*:

(i) areas kept inviolate from human interference so that future comparisons may be possible with localities that have been affected by human activities;

(ii) representative examples of major terrestrial, including glacial and aquatic, ecosystems and marine ecosystems;

(iii) areas with important or unusual assemblages of species, including major colonies of breeding native birds or mammals;

(iv) the type locality or only known habitat of any species;

(v) areas of particular interest to ongoing or planned scientific research.

36. Overall, therefore, the workshop concluded that MPAs had considerable potential for furthering CCAMLR's objective in applications ranging from protection of ecosystem processes, habitats and biodiversity, to protection of species (including population and life history stages).

37. However, it was recognised that, given the diversity of potential benefits deriving from MPAs and the variety of different types of MPA (including the many different management practices that they could include), considerable clarity would be needed in specifying the precise objectives of using MPAs in the Convention Area.

38. In the specific context of fishery-related MPAs, the advice in the FAO COFI paper (COFI/2005/8), particularly in paragraphs 5 to 7, should be carefully considered, together with assessments deriving from MPA reviews by other relevant bodies.

39. Given the nature and scale of many processes and systems in the Southern Ocean, the emphasis of any attempt to create networks protecting ecosystem processes, representative areas, species or populations, is likely to require approaches that are flexible and medium to large scale, and that involve specific management measures relevant to the requirements of populations with substantial seasonal movements or changes in abundance. It will be particularly challenging to develop systems and networks to address the requirements of wide-ranging, long-lived taxa with complex life cycles and breeding systems.

40. However, there may be a need for CCAMLR to consider the adequacy of arrangements for the appropriate protection of certain spatially-restricted habitats with unique and/or highly diverse biological assemblages, such as seamounts (SC-CAMLR-XXIII, paragraph 3.31).

41. In this context it was noted that WS-MPA-05/4 contained a reference to a decision by NEAFC to close to fishing with all types of bottom fishing gears certain seamounts within its area of application. Details of the selection and designation procedure used by NEAFC, and by other relevant organisations, may be of relevance to CCAMLR.

42. Dr Constable noted that consideration of measures to mitigate impacts on benthic assemblages needed to include all bottom fishing practices, including trawling and longlining.

Examples of protected areas in the Convention Area

43. The workshop considered various general and specific examples of protected areas currently in force in the Convention Area.

44. Ms Grant introduced a paper which was previously submitted to WG-EMM and the Scientific Committee (SC-CAMLR-XXIII/BG/28) and later revised for publication. It listed current and proposed MPAs within the CCAMLR Convention Area. This paper demonstrates that almost all existing ASPAs and ASMAs are small, coastal areas that do not contribute to the objectives of CCAMLR, and have little relevance to CCAMLR-related activities. Furthermore, these existing areas make little contribution to the development of a representative system of MPAs under the requirements of the Madrid Protocol.

45. However, terrestrial or nearshore sites of scientific interest to CCAMLR (i.e. CEMP sites) highlight the importance of joint consideration by both CCAMLR and CEP.

46. The workshop also noted that the IWC has extended the designation of its Southern Ocean Sanctuary to 2014.

47. The workshop agreed that, overall, when viewed in relation to the IUCN categories of protected areas, the Convention Area as a whole would qualify as Category IV (Habitat/Species Management Area: protected area managed mainly for conservation through management intervention). This is defined as an area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

48. Dr Constable presented WS-MPA-05/7, outlining the process undertaken by the Australian Government to identify and declare the HIMI Marine Reserve an IUCN Category I protected area, under the Australian Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

49. In preparing a report on the conservation values of the HIMI EEZ, the Australian Antarctic Division had reviewed available, though in some cases limited, physical and biological data to define 13 biophysical units within the EEZ (report summary appended to the paper). The report identified that the HIMI region contains conservation values of global importance, and values which are unique within the Australian EEZ, including benthic habitat, the foraging range of land-based marine predators and nursery grounds for commercial fish species.

50. With consideration given to known and potential threats to the conservation values, the Australian NRSMPA principles (comprehensive, adequate and representative) and criteria for identification of MPAs (outlined in WS-MPA-05/6) were used to identify a possible reserve configuration that would:

- provide for protection of the marine and terrestrial conservation values;
- contribute to integrated and ecologically sustainable management of the HIMI region;
- provide scientific reference areas;
- add to the NRSMPA.

51. Consultation on the Reserve proposal with government, conservation groups and fishing industry stakeholders indicated the need for further investigation of particular areas where there was insufficient data to make a definite case for protection or fishing access. This resulted in the declaration of a conservation zone under the EPBC Act and the establishment of a three-year program, overseen by stakeholders, to provide protection of those areas while studies are undertaken to further assess the conservation values and fisheries resource potential of the area. On completion of the assessment, a decision will be made by the Minister for the Environment and Heritage over whether to add the conservation zone areas to the Reserve.

52. The conservation report also identified a number of questions for further investigation, including to consider the effects of current and future activities in the area, to determine the need to refine the Reserve configuration to better facilitate protection of the values.

53. The process to establish the Reserve was referred to the workshop as a model for CCAMLR consideration, because:

(i) the Reserve is in the CCAMLR Convention Area (Division 58.5.2), and was declared as part of a representative system of MPAs (the NRSMPA) within a substantial marine jurisdiction (Australian);

(ii) the Reserve and adjacent comprehensively managed (IUCN Category 'IV+' protected area equivalent) commercial fishery effectively collectively comprise a multiple-use MPA;

(iii) the declaration process involved comprehensive and transparent consultation throughout with relevant stakeholders, government agencies, conservation and industry non-governmental organisations;

(iv) Reserve compliance is supported by comprehensive regional, national and international arrangements for compliance and enforcement.

54. Mr McIvor referred the workshop to the HIMI website www.heardisland.aq for further information regarding the Reserve and its management plan and the HIMI Conservation Zone.

55. The workshop commended the specific procedures and frameworks for planning biodiversity conservation outlined in the Guidelines for Establishing the Australian National Representative System of MPAs, which had underpinned the establishment of the HIMI Marine Reserve. It recognised that the principles involved, notably those relating to CAR, together with the use of precautionary approaches and wide consultation with appropriate interest groups, combined with flexible decision-making and review procedures, and the capacity to designate areas for interim protection, were fundamental to the development of protected area networks in regional seas. Such principles were recognised as being fundamental to similar undertakings in high-seas areas.

56. The specific example of the process leading to the declaration of the HIMI Marine Reserve was also recognised to be a model of the practical implementation of the relevant procedures. The workshop noted that this approach should have widespread applicability to any part of the Convention Area wherein the application of MPAs (in the widest sense) was deemed appropriate.

57. It was noted that, in relation to IUCN protected area categories, the marine reserve within HIMI is an IUCN Category I. The remainder of the area would be equivalent to at least Category IV with conservation zones incorporating additional provisions.

58. Dr D. Nel (South Africa) indicated that South Africa had made considerable use of the framework provided by the HIMI example in developing its approaches to the designation of MPAs around the Prince Edward Islands. He enquired whether the CAR approach was able to incorporate consideration of maintenance of ecological processes, as well as contribute to the long-term sustainability of the fishery in the area.

59. Dr Constable indicated that the Australian NRSMPA explicitly incorporates maintenance of ecosystem processes as part of its primary goal. The sustainability of fishing is covered across a number of legal jurisdictions. It is intended that the NRSMPA contribute to a formal management framework for a broad spectrum of human activities, one of which is fisheries.

60. The workshop noted that the approaches developed by Australia offered advantages that may be useful to the development of approaches to establishing a network of MPAs within the Convention Area. These include: (i) flexibility, including the development of interim measures and provisions, recognising the benefit of improved scientific data on which

to develop more permanent designations and provisions; (ii) wide and continuing consultation with all interest groups, in particular to ensure appropriate balance between the sustainable use of marine living resources and minimising the effects of known or potential environmentally damaging activities; and (iii) matching levels of constraint on access to, and operation within, MPAs to the perceived importance of the conservation and/or biodiversity values of the area and to the level of scientific data available.

61. The workshop agreed that conservation outcomes appropriate for achieving the objectives in CCAMLR Article II would include the maintenance of biological diversity[2] as well as the maintenance of ecosystem processes.

62. It was agreed that attention may need to be given to the need for, *inter alia,* protection of:

(i) representative areas[3];

(ii) scientific areas to assist with distinguishing between the effects of harvesting and other activities from natural ecosystem changes as well as providing opportunities for understanding the Antarctic marine ecosystem without interference;

(iii) areas potentially vulnerable to impacts by human activities, to mitigate those impacts and/or ensure the sustainability of the rational use of marine living resources.

63. It was noted that some areas in the Southern Ocean may have predictable features that are critical to the function of local ecosystems. The workshop agreed that such areas would be appropriate to be included in a system of protected areas. Some participants felt that this should be considered as an objective in its own right, as follows:

> The protection or maintenance of important ecosystem processes, in locations where those processes are amenable to spatial protection.

64. The workshop also considered the need for the Commission to achieve satisfactory fishery outcomes in terms of sustainable rational use. The process for establishing a system of protected areas will need to have regard for this objective of the Commission.

65. In the context of the discussion below an area would need to be defined according to geographic coordinates as well as depth. This is because some areas may not need to encompass the entire water column in order to achieve their objectives.

66. The conservation outcomes listed in paragraphs 62 and 63 are consistent with the criteria identified in the Madrid Protocol, Annex V, Article 3 that might be used to establish ASPAs, and with CCAMLR Article II. Protection of these areas would need to be indefinite or for a sufficiently long term to satisfy their objectives, such as for scientific reference areas. These areas would be equivalent to IUCN Category I areas. Recalling the discussion on the

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2 'Biological diversity' means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity).

3 A system of representative areas would aim to provide a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine systems, to maintain ecological processes and systems, and to protect the Antarctic marine biological diversity at all levels.

HIMI Marine Reserve and the Australian NRSMPA (paragraphs 48 to 60), the workshop agreed that there was a need for the use of protected areas to satisfy the general CAR requirements.

67. For the purposes of this workshop, such areas are termed ‘Specially Protected Areas’. This term and those used below for other types of areas have meanings in other forums that are not the same meanings as those used here. The workshop recommended that the Scientific Committee or Commission consider the terms to be used for the different forms of closed areas (as in CCAMLR Article IX) identified here. It also noted that the Commission will need to correspond with the ATCM over how to harmonise the implementation of CCAMLR closed areas as discussed here.

68. In addition to Specially Protected Areas, some areas may be identified as candidates for special protection but need more information before a conclusion on protection can be reached. In this case, the workshop agreed that interim protection would be needed to implement CCAMLR’s precautionary approach. During this period, fisheries exploration and scientific activity would be limited to that needed to obtain data required to finalise consideration of its need for protection. Such interim protection would not be indefinite but should be sufficient to ensure protection of future options while the process is completed. Here, these areas are termed ‘Conservation Zones’. Such interim protection could be short or long term, according to the agreed period required to decide on protection.

69. Closed areas, specifically for achieving outcomes for fisheries, would be considered separately to this process by the respective working groups of the Scientific Committee. These areas are termed ‘Fisheries Closed Areas’.

70. The general objectives for which protected areas may be established and the types of protection that could be given in accordance with CCAMLR Article IX are illustrated in Table 1. These types of areas could be applied anywhere within the Convention Area.

PROPOSALS THAT ARE CURRENTLY UNDER DEVELOPMENT OR IN A CONCEPTUAL PHASE THAT RELATE TO MPAS IN THE CONVENTION AREA

71. Several papers were submitted to the workshop addressing MPAs in the Convention Area currently under development or in a conceptual phase.

Area around Prince Edward Islands

72. Dr Nel introduced WG-MPA-05/15, submitted by South Africa, which provided an update on the status of outlining the development process and status of an MPA around the Prince Edward Islands.

73. The development of the Prince Edwards Islands MPA benefited from the example of the HIMI Marine Reserve, and Dr Nel commended Australia for its excellent work.

74. The Prince Edward Islands area suffered huge impacts from IUU fishing in late 1990s due to the lack of offshore enforcement capacity. This led to a movement to extend the special nature reserve from the low-water mark to include a no-fishing marine area, which currently extends out to 12 n miles. An MPA including and extending beyond 12 n miles will be established to combat IUU fishing and allow ecosystem recovery; increased compliance and patrols will help enforce the MPA.

75. South Africa is implementing a three-phase conservation plan. The initial phase was the creation of a geographic information system with relevant data layers. This was followed by a stakeholder consultation workshop in June 2005, where important biological and physical processes and habitats were identified. Currently South Africa is conducting analyses of the data and is creating a final conservation plan. South Africa noted it is taking a phased approach for the MPA declaration, additional information regarding the MPA will be announced during the next year.

76. Objectives for this MPA include reduction of IUU fishing, allowing Patagonian toothfish to recover from overexploitation, reducing threats to albatrosses and petrels, reducing and avoiding impacts to the benthic habitat from destructive fishing practices, and setting aside reference habitat to inform future management. These objectives support CCAMLR principles by conserving representative habitats, ecosystem integrity, reducing impacts of IUU fishing, providing a fisheries replenishment zone, and providing a source of scientific benchmarks.

77. Participants agreed that this proposal clearly stated the objectives for the MPA and these objectives were consistent with CCAMLR principles.

78. Consistent with the modern concept of zoning in MPAs, complete protection from all extractive impacts will be identified for some areas in the Prince Edwards Islands, while others will be zoned with various levels of protection.

79. Participants agreed that to be successful in establishing MPAs, support from organisations in adjacent areas is essential. Support from CCAMLR in the case of EEZ-based MPAs would be useful. MPAs will also need the support of other agencies internationally, e.g. those that impact seabirds and foraging grounds outside the CAMLR Convention Area.

80. The ecosystem processes being conserved in the Prince Edward Islands MPA extend outside the South African EEZ to the high seas and the EEZs of other CCAMLR Members. South Africa noted it would welcome complementary efforts to extend the protected area.

81. The workshop commended the South African approach in designing the Prince Edward Islands MPA.

82. South Africa will conduct further biodiversity surveys in the area during 2006/07.

Area around Anvers Island, Antarctic Peninsula

83. Ms Toschik introduced WS-MPA-05/10, submitted by the USA, which summarised a conceptual phase proposal for an ASMA in the Anvers Island area, which may include a large

marine component. This paper led to discussion on the specific area around Anvers Island, the generic process of MPA development, and creation of a checklist to aid in interpretation of ATCM Decision 9 (2005).

84. The workshop noted that it would be useful for CCAMLR Members with data relevant to the Anvers Island marine area to share these data with the originators of the proposal in order for them to decide whether to submit the MPA proposal to CCAMLR or not.

85. However, it was noted that, in respect of krill, a very small portion of the krill population range in the South Atlantic would likely be included within an Anvers Island ASMA. Even when considered at the SSMU level, only a small portion of the area utilised by krill would be encompassed. Consequently, establishment of an ASMA in the Anvers Island area would be unlikely to impact krill fishing at all and therefore would not be of interest to CCAMLR.

86. Ms Toschik noted the desire of the USA to prevent duplication of effort and streamline the plan for both ATCM and CCAMLR requirements, if submission to both organisations is necessary.

87. Several participants wondered if an Anvers Island ASMA would be of interest to CCAMLR based on ATCM Decision 9 (2005). However, the size of the ASMA has not yet been defined.

88. The workshop noted that an Anvers Island ASMA may be of relevance to CCAMLR in terms of future CEMP sites, based on the long-term research in the area. However, the establishment of an ASMA now would not preclude the establishment of an overlapping CEMP site in the future. It was noted that data from this region have been submitted to the CEMP database in the past, although it was never designated a CEMP site.

89. Participants generally agreed that an ASMA around Anvers Island would be more appropriate than solely a CEMP site designation, because it will include terrestrial and marine components, and it is necessary to balance science, tourism, and fishing interests in the area.

Interpretation of ATCM Decision 9 (2005)

90. The workshop agreed on the need to further elaborate on ATCM Decision 9 (2005) with clear guidelines for determining if a protected area will be of interest to CCAMLR. This would help prevent the referral to CCAMLR of proposals for areas which would not have a discernable impact on CCAMLR interests.

91. Unlike proposals in the past, the proposal for Anvers Island has an area overlapping with the range of krill, in order to encompass penguin foraging areas. As a result there may have been a perceived impact on the fishing range of the krill fishery. The workshop agreed that if the range of krill within a CCAMLR statistical unit taken up in protected areas was only small, then it was unlikely to impact on the rational use of krill in that statistical area. It therefore agreed that it would be useful if general guidelines could be developed to indicate what percentage of the range of krill could be covered by protected areas within a statistical unit before CCAMLR would need to determine if a proposed protected area might impact on rational use. This same approach could also be used for other target species.

92. The workshop agreed that experiences with recent and current proposals could be used to develop a whole set of guidelines. CCAMLR Members could be asked to indicate whether or not those proposals should have been submitted to CCAMLR, and this information could then be used to help develop the guidelines. This would allow CCAMLR to continue the review of proposals for protected areas, but would generate clearer guidance for the review of future proposals, and consequently reduce the workload of CCAMLR.

Balleny Islands area

93. Dr B. Sharp (New Zealand) introduced WS-MPA-05/11, submitted by New Zealand, which presented scientific justification for an MPA around the Balleny Islands. Dr Sharp clarified that this paper was not a proposal, but rather a scientific justification for an MPA around the Balleny Islands.

94. The paper provided scientific justification for an MPA to protect ecosystem structure and function as well as representative habitats. It noted the presence of regionally important top predator populations foraging in the vicinity of the islands, and the existence of tightly coupled trophic relationships in the larger regional ecosystem. The paper further noted that the area has high krill production, and provides regionally important habitat for both juvenile krill and juvenile toothfish. The establishment of an MPA in the area was therefore seen as a means of protecting key predator foraging resources (especially during breeding season), and safeguarding the integrity of ecosystem processes in an area that contributes to the function and value of the regional fisheries and wider ecosystem.

95. Dr K. Shust (Russia) noted that the Balleny Islands do not have broad continental shelves, and they have a steep slope that is not good for bottom trawling or longlining. A longline prohibition is already in place for 10 n miles around the islands, and the area does not currently have a strong fishery. He noted that this ecosystem is not directly linked with the Ross Sea. He also noted that the islands and surrounding waters are covered with ice, making the area difficult to access not only for tourists, but also for scientists. For these reasons, he did not foresee negative impacts on this ecosystem.

96. Dr Shust also asked for further justification for the suggested 50 n mile boundary.

97. Dr Sharp clarified that the 50 n mile boundary was a general approximation, based on foraging ranges of high trophic level marine predators, not a definitive decision. This distance may shift as the scientific information available is further considered.

98. Dr M. Naganobu (Japan) was strongly concerned about the concept introduced in the New Zealand paper. He requested that the workshop consider the following three points:

(i) There is not much survey data around Balleny Islands compared to the South Shetland Islands and South Georgia. Japan has interests and has conducted research in the area around the Balleny Islands and the Ross Sea. He suggested that New Zealand should continue to survey around the Balleny Islands, similar to research programs such as US AMLR long-term surveys, and UK long-term surveys in the South Shetland Islands and South Georgia, where very detailed data have been collected.

(ii) The value of fishing grounds and other human-use values around the Balleny Islands should be considered in the context of developing an MPA in the area. Reports regarding krill density and fish stocks could be referenced. The area around the Balleny Islands has potential value as a fishing resource for humans. This resource should be considered under the concept of rational use in CCAMLR Article II.

(iii) An MPA around the Balleny Islands would differ from past ASPA projects in that is not closely associated with centres of intense scientific research.

99. It was noted that the Balleny Islands MPA concept is the first time CCAMLR has considered a substantial initiative for a relatively large area within the Convention Area but outside an EEZ.

100. The workshop also recognised that there may be merit in considering interim protection for the values New Zealand seeks to protect, and to provide time for further assessment, as demonstrated with zoning in the HIMI Marine Reserve.

101. Participants agreed that what constitutes sufficient data needs to be specified, and measures that can be taken in the interim while data collection is ongoing should be identified. It was also noted that those calling for additional data collection and research should clearly identify the objectives and criteria for such work.

102. Prof. C. Moreno (Chile) noted that when an ecosystem/community is perturbed, it is never restored to exactly the same condition as it was in the past. To conserve this area is a mechanism to retain the actual essence of ecosystem processes. An MPA in the Balleny Islands area could help the fishery in the area to be sustainable in the long term, and to maintain elements of the ecosystem that are under threat from increasing human activities. It was noted that the scientific justification provided by New Zealand contained most of the elements that science offers for people to take a position on this problem.

103. Some participants noted that protection of the Balleny Islands would protect the recruitment zone for toothfish and krill, which has not happened in any other Antarctic fishery.

104. Many participants congratulated New Zealand on its excellent paper. Dr Gilbert noted his appreciation for the feedback provided and, following a suggestion, agreed to form an informal contact group to meet at the upcoming CCAMLR meetings with interested parties to discuss the options for further developing an MPA in the vicinity of the Balleny Islands.

105. Dr Naganobu expressed concern about the proposed informal consultations because a definite proposal by New Zealand has not yet been made.

106. However, the workshop noted that it is important to engage interested parties and generate as much feedback as possible at this early stage of MPA consideration, and it was noted that no additional formal meetings were planned, although an informal contact group will be formed.

SCIENTIFIC INFORMATION REQUIRED FOR THE DEVELOPMENT OF MPAS AND IDENTIFICATION OF BIOPHYSICAL REGIONS ACROSS THE CONVENTION AREA

107. The workshop considered the scientific work needed for considering a system of protected areas to assist CCAMLR in achieving its broader conservation objectives. The key tasks in this process (not necessarily to be undertaken sequentially) would be:

- a broad-scale bioregionalisation[4] of the Southern Ocean;
- a fine-scale subdivision of biogeographic provinces, which may include hierarchies of spatial characteristics and features within regions[5], giving particular attention to areas identified in the bioregionalisation;
- identification of areas that might be used to achieve the conservation objectives identified in paragraph 62;
- determination of areas requiring interim protection.

108. The workshop agreed that these tasks should be attempted with a 'desktop study'[6] in the first instance. It was noted that a number of organisations and individuals are already proceeding with analyses that might facilitate the large-scale bioregionalisation as well as small-scale delineation of provinces, such as for Heard Island and McDonald Islands, Prince Edward Islands and the Ross Sea. It also agreed that the designation of protected areas need not wait for an entire system to be specified.

109. Table 2 lists the types of data that might be used in a process to determine key bioregions and provinces in a bioregionalisation of the Southern Ocean. The table is drawn from Table 1 of WS-MPA-05/15 on the work being undertaken for determining a large MPA around South Africa's sub-Antarctic Prince Edward Islands. It also draws on the material and approach used in developing the conservation report on the Heard Island region indicated in WS-MPA-05/7. As described in WS-MPA-05/15, these data can be used to delineate

4 Bioregionalisation is a process to classify marine areas from a range of data on environmental attributes. The process results in a set of bioregions, each reflecting a unifying set of major environmental influences which shape the occurrence of biota and their interaction with the physical environment. Reference: adapted from 'Interim biogeographic regionalisation for Australia (IBRA)' 1997 (www.deh.gov.au/parks/nrs/ibra).
A recent marine bioregionalisation process is described in 'Australia's South-east Marine Region: A User's Guide to Identifying Candidate Areas for a Regional Representative System of Marine Protected Areas' by Commonwealth of Australia 2003
(www.deh.gov.au/coasts/mpa/southeast/publications/identifying/index.html).
An example of bioregionalisation outcomes can be seen in Butler, A., P. Harris, V. Lyne, A. Heap, V. Passlow and R. Smith. 2001. An interim, draft bioregionalisation for the continental slope and deeper waters of the South-east Marine Region of Australia. Report to the National Oceans Office, CSIRO Marine Research and Geoscience Australia
(www.oceans.gov.au/pdf/SE%20Bioregionalisation%20Final%20Report.pdf).

5 See Butler et al. (2001) for a description of the hierarchy of classifications within biogeographic provinces.

6 A 'desktop study' is the collation and synthesis of existing data and information, including expert knowledge, o undertake analyses and draw conclusions on a topic of interest. It does not include the acquisition of new field data or the undertaking of extensive statistical and modelling development.

important patterns, areas in which important processes occur and areas where pressures may be arising now and/or in the future. The workshop noted that some data may contribute to understanding one or more of the patterns, processes and/or pressures.

110. Dr Gilbert showed how these types of data can be used to create a bioregionalisation by describing the Environmental Domains Analysis of the Antarctic Continent presented to CEP by New Zealand in 2005. The workshop agreed that such an approach would be useful for combining the data into a single analysis but recognised that expert input would be essential.

111. Dr Sharp cautioned that care needs to be taken in the use of particular terrestrial classification algorithms if applied to a bioregionalisation of dynamic marine environments.[7]

112. The workshop agreed that a variety of statistical techniques could be used to integrate the data and that experts in this area would need to correspond to determine an appropriate method for underpinning a bioregionalisation of the Southern Ocean.

113. A difficulty identified by the workshop is that the biological data will not have a universal coverage like data on geomorphology, ocean, climate and ice. It was considered unlikely to restrict the larger-scale bioregionalisation. However, it will be likely that some regions will be able to be subdivided into provinces before others because of differences in availability of small-scale data. Nevertheless, an important task will be to determine areas that may need to be given interim protection so that existing activities do not compromise the long-term conservation of biodiversity while the process elaborated below is undertaken.

114. The workshop agreed that the process identified above will require a Steering Committee, including members of the Scientific Committee and CEP. It would be useful if the work in paragraph 107 could be progressed for a workshop. The aim of the workshop would be to advise on a bioregionalisation of the Southern Ocean, including, where possible, advice on smaller-scale delineation of provinces and potential areas for protection to further the conservation objective of CCAMLR. To that end, the workshop requested the Scientific Committee consider whether this work should be progressed within the work program of WG-EMM or whether it should be an independent process.

115. An important role of the Steering Committee will be to involve appropriate experts from outside the Scientific Committee and CEP that could have data or expertise useful for the bioregionalisation.

116. In developing this work program and recognising the relative expertise of the Scientific Committee and CEP, the workshop suggested that CEP be invited to undertake the initial work necessary to develop a bioregionalisation of the coastal provinces, as an extension of its terrestrial bioregionalisation work, while the Scientific Committee undertakes the initial work needed to delineate the oceanic provinces. Such work would involve examination of both the benthic and pelagic systems in the respective areas.

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[7] A similar algorithm to that used for the Antarctic Environmental Domains Analysis was applied in the New Zealand EEZ. The resulting classification does not always capture the important biological contrasts due to the difficulties involved in the integration of different types of data (e.g. biological versus physical, pattern versus process, large-scale versus small-scale) in an automated process.

117. As a result of these discussions, the workshop identified the following steps in the process leading to a workshop in 2008, noting that some of this work could occur in parallel rather than sequentially:

(i) collate existing data on coastal provinces, including benthic and pelagic features;

(ii) collate existing data on oceanic provinces, including benthic and pelagic features;

(iii) determine the statistical analyses required to facilitate a bioregionalisation, including the use of empirical, model and expert data;

(iv) develop a broad-scale bioregionalisation based on existing datasets and other datasets possibly available prior to the workshop;

(v) delineate fine-scale provinces within regions, where possible;

(vi) establish a procedure for identifying areas for protection to further the conservation objectives of CCAMLR.

118. The workshop recommended that the Steering Committee be given the following terms of reference:

1. To facilitate collaboration between the CCAMLR Scientific Committee and CEP in this work.

2. To facilitate the involvement of appropriate experts in this work.

3. To coordinate and facilitate:

   (i) collating existing data on coastal provinces, including benthic and pelagic features and processes;

   (ii) collating existing data on oceanic provinces, including benthic and pelagic features and processes;

   (iii) determining the analyses required to facilitate a bioregionalisation, including the use of empirical, model and expert data;

   (iv) developing a broad-scale bioregionalisation based on existing datasets and other datasets possibly available prior to the workshop;

   (v) delineating fine-scale provinces within regions, where possible;

   (vi) establishing a procedure for identifying areas for protection to further the conservation objectives of CCAMLR.

4. To organise a workshop to establish a bioregionalisation for the CCAMLR Convention Area and to consolidate advice on a system of protected areas.

119. In discussing these scientific requirements, the workshop noted the potential synergies in the future between this work and work undertaken in WG-FSA and WG-EMM on the spatial components of fisheries and ecosystem function (e.g. areas of high productivity, foraging areas, movement and dispersal patterns).

ADVICE TO THE SCIENTIFIC COMMITTEE

120. In accordance with instructions from the Commission (CCAMLR-XXIII, paragraph 4.13) and the Scientific Committee (SC-CAMLR-XXIII, paragraphs 3.51 to 3.53), the CCAMLR Workshop on Marine Protected Areas met at NOAA National Marine Fisheries Service in Silver Spring, MD, USA, from 29 August to 1 September 2005. Terms of reference are provided in paragraph 6.

121. The workshop agreed that advice on the application of MPAs as related to Articles II and IX of the Convention would be provided to Members at the 2005 meeting of the Scientific Committee.

Term of reference (i) to review current principles and practices related to the establishment of MPAs

122. The workshop agreed that the NRSMPA, which included three elements referred to as the comprehensive, adequate and representative (CAR) system, provided one candidate approach to the designation of MPAs that may have applications in terms of principles and criteria, to CCAMLR's consideration of MPAs in the Southern Ocean (paragraphs 12 to 14).

123. The workshop noted that South Africa's Prince Edward Islands MPA process also provided a useful case study on the establishment of MPAs within the CCAMLR Convention Area (paragraph 15).

124. Within the CCAMLR context, the workshop recognised the need to develop a strategic approach to MPA design and implementation throughout the Southern Ocean notably in relation to a system of protected areas described below (paragraphs 16 and 66 to 70). It also recognised that there was a strong need for collaboration at technical and policy levels to further develop the MPA concept in the Southern Ocean. Relevant bodies in such a dialogue would include key elements of the Treaty System (CEP and the ATCM) as well as SCAR, SCOR, Observers to CCAMLR, intergovernmental and non-governmental organisations (paragraph 17).

125. The workshop suggested that establishing a harmonised regime for the protection of the Antarctic marine environment across the ATS should be the primary aim but recognised that there would need to be a division between ATCM and CCAMLR on the management of different human activities in the region (paragraph 22).

Workshop Term of Reference (ii) to discuss how the use of MPAs could be used to contribute to furthering the objectives of CCAMLR

126. Given the noted benefits of MPAs and the existing commitments of many, if not most, Members of CCAMLR to the establishment of representative networks of MPAs (e.g. in respect of the WSSD, the CBD, World Parks Congress etc.), the workshop concluded that MPAs had considerable potential for furthering CCAMLR's objective in applications ranging from protection of ecosystem processes, habitats and biodiversity, to protection of species (including population and life history stages) (paragraphs 32 to 36).

127. The workshop agreed that, overall, when viewed in relation to the IUCN categories of protected areas, the Convention Area as a whole would qualify as Category IV (Habitat/Species Management Area: protected area managed mainly for conservation through management intervention). This is defined as an area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species (paragraph 47).

128. The workshop commended the specific procedures and frameworks for planning biodiversity conservation outlined in the Guidelines for Establishing the Australian National Representative System of MPAs (NRSMPA), which had underpinned the establishment of the HIMI Marine Reserve. It recognised that the principles involved, notably those relating to CAR, together with the use of precautionary approaches and wide consultation with appropriate interest groups, combined with flexible decision-making and review procedures, and the capacity to designate areas for interim protection, were fundamental to the development of protected area networks in regional seas. They would be equally essential to similar undertakings in high-seas areas (paragraphs 48 to 60).

129. The workshop agreed that conservation outcomes appropriate for achieving the objectives in CCAMLR Article II would include the maintenance of biological diversity as well as the maintenance of ecosystem processes (see paragraphs 61 to 64 for detail).

130. It was agreed (paragraph 62) that attention may need to be given to the need for, *inter alia,* protection of:

- representative areas;
- scientific areas to assist with distinguishing between the effects of harvesting and other activities from natural ecosystem changes as well as providing opportunities for understanding the Antarctic marine ecosystem without interference;
- areas potentially vulnerable to impacts by human activities, to mitigate those impacts and/or ensure the sustainability of the rational use of marine living resources.

131. It was noted that some areas in the Southern Ocean may have predictable features that are critical to the function of local ecosystems. The workshop agreed that such areas would be appropriate to be included in a system of protected areas. Some participants felt that this should be considered as an objective in its own right, as follows (paragraph 63):

> The protection or maintenance of important ecosystem processes, in locations where those processes are amenable to spatial protection.

132. The workshop also considered the need for the Commission to achieve satisfactory fishery outcomes in terms of sustainable rational use. The process for establishing a system of protected areas will need to have regard for this objective of the Commission (paragraph 64).

133. The workshop recommended that the Scientific Committee work toward developing a system of protected areas described in paragraphs 61 to 70. The general objectives for which protected areas may be established and the types of protection that could be given in accordance with Article IX are illustrated in Table 1. These types of areas could be applied anywhere within the Convention Area.

134. The workshop advised that some areas may be identified as candidates for special protection but that it needs more information before a conclusion on protection can be reached. In this case, it agreed that interim protection would be needed (paragraph 68).

135. The workshop recognised that the term 'Specially Protected Areas' and other similar terms as provided in Table 1 and discussed in paragraphs 66 to 70 have meanings in other forums that are not the same meanings as those used in this report. The workshop recommended that the Scientific Committee or Commission consider the terms to be used for the different forms of closed areas identified and consult with the ATCM over how to harmonise the implementation of CCAMLR closed areas.

Term of reference (iii) to consider proposals that are currently under development or in a conceptual phase that relate to MPAs in the Convention Area

136. The workshop recommended that CCAMLR consider clarifying implementation of ATCM Decision 9 (2005), with clear guidelines for determining if a marine protected area will be of interest to CCAMLR. Identifying guidelines in terms of a percent of area occupied by a known harvestable resource and encompassed in a protected area that would be of interest to CCAMLR would be useful. These guidelines could be incorporated into a whole set of guidelines described below (paragraphs 90 and 91).

137. The workshop agreed that experiences with recent and current proposals could be used to develop a whole set of guidelines. CCAMLR Members could be asked to indicate whether or not those proposals should have been submitted to CCAMLR, and this information could then be used to help develop the guidelines. This would allow CCAMLR to continue the review of proposals for protected areas, but would generate clearer guidance for the review of future proposals, and consequently reduce the workload of CCAMLR (paragraph 92).

Term of Reference (iv) to discuss the types of scientific information that may be required for the development of MPAs to further the objectives of CCAMLR, including the identification of biophysical regions across the Convention Area

138. The workshop identified key tasks needed in considering a system of protected areas to assist CCAMLR in achieving its broader conservation objectives. These are (not necessarily to be undertaken sequentially) (paragraph 107):

- a broad-scale bioregionalisation of the Southern Ocean;
- a fine-scale subdivision of biogeographic provinces, which may include hierarchies of spatial characteristics and features within regions, giving particular attention to areas identified in the bioregionalisation;
- identification of areas that might be used to achieve the conservation objectives identified in paragraphs 61 to 70 (see paragraph 133);
- determination of areas requiring interim protection.

139. The workshop agreed that these tasks should be attempted with a desktop study in the first instance. Finally, Table 2 lists the types of data that might be used in a process to determine key bioregions and provinces in a bioregionalisation of the Southern Ocean (paragraphs 107 to 109).

140. The workshop noted that an important task will be to determine areas that may need to be given interim protection so that existing activities do not compromise the long-term conservation of biodiversity while the process elaborated below is undertaken (paragraph 113).

141. The workshop agreed that the process identified above will require a Steering Committee, including members of the Scientific Committee and CEP. It would be useful if the work in paragraph 107 could be progressed for a workshop. The aim of the workshop would be to advise on a bioregionalisation of the Southern Ocean, including, where possible, advice on smaller-scale delineation of provinces and potential areas for protection to further the conservation objective of CCAMLR. To that end, the workshop requested the Scientific Committee consider whether this work should be progressed within the work program of WG-EMM or whether it should be an independent process (paragraph 114).

142. An important role of the Steering Committee will be to involve appropriate experts from outside the Scientific Committee and CEP that could have data or expertise useful for the bioregionalisation (paragraph 115).

143. In developing this work program and recognising the relative expertise of the Scientific Committee and CEP, the workshop suggested that CEP be invited to undertake the initial work necessary to develop a bioregionalisation of the coastal provinces, as an extension of its terrestrial bioregionalisation work, while the Scientific Committee undertake the initial work needed to delineate the oceanic provinces. Such work would involve examination of both the benthic and pelagic systems in the respective areas (paragraph 116).

144. The workshop recommended (paragraph 118) that the Steering Committee be given the following terms of reference:

1. To facilitate collaboration between the CCAMLR Scientific Committee and CEP in this work.

2. To facilitate the involvement of appropriate experts in this work.

3. To coordinate and facilitate:

   (i) collating existing data on coastal provinces, including benthic and pelagic features and processes;

   (ii) collating existing data on oceanic provinces, including benthic and pelagic features and processes;

   (iii) determining the analyses required to facilitate a bioregionalisation, including the use of empirical, model and expert data;

   (iv) developing a broad-scale bioregionalisation based on existing datasets and other datasets possibly available prior to the workshop;

   (v) delineating fine-scale provinces within regions, where possible;

   (vi) establishing a procedure for identifying areas for protection to further the conservation objectives of CCAMLR.

4. To organise a workshop to establish a bioregionalisation for the CCAMLR Convention Area and to consolidate advice on a system of protected areas.

CLOSE OF THE WORKSHOP

145. The report of the workshop was adopted.

146. Dr Penhale congratulated all participants on the successful conclusion of the workshop and thanked them for their contribution. She especially thanked the rapporteurs for producing the workshop report.

147. The participants joined Prof. Croxall in thanking the US National Science Foundation, the NOAA National Marine Fisheries Service and Dr Penhale and her team, particularly Ms R. Tuttle, Mr R. Williams and Ms Toschik, for organisation and hosting the meeting, and providing outstanding support.

148. The meeting was closed.

Table 1: Illustration of the types of closed areas that could be used by CCAMLR for protection or conservation, noting the need to define areas in geographic coordinates and depth.

Objective	Type of area
Representativeness	Specially Protected Areas Conservation Zones*
Protection of areas vulnerable to human activities	Specially Protected Areas Conservation Zones* Fisheries Closed Areas
Science	Specially Protected Areas Conservation Zones* Fisheries Closed Areas
Protection of ecosystem function	Specially Protected Areas Conservation Zones* Fisheries Closed Areas

* In the application of the CCAMLR precautionary approach, interim measures may be required for candidate areas while being considered; in this case Conservation Zones could be established.

Table 2: List of types of data that might be used in a process to determine key bioregions and provinces in a bioregionalisation of the Southern Ocean. These data can be used to delineate important patterns, areas in which important processes occur and areas where pressures may be arising now and/or in the future.

Category	Specific types of data
Geology and geomorphology	Bathymetry Geological zones – coastal formations, islands, seamounts, plateaus, banks, ridges, canyons Substratum
Ocean	Sea-surface heights Temperature and salinity Biogeochemistry Fronts and gyres Currents (surface, midwater, deep) Upwelling areas
Climate	Wind shear and direction Pressure systems Temperature
Ice	Ice shelves Sea-ice coverage and progression
Biota (distribution, abundance, movement)	Sessile and sedentary benthos including habitat forming features Surface chlorophyll Secondary producers Demersal species (e.g. nototheniids) Small mesopelagic species (krill, myctophids) Large mesopelagic species – finfish (e.g. icefish), squid Marine mammals Birds
Outcomes of dynamic models	Outputs from existing ocean models
Existing and/or potential pressures	Existing fishing patterns Target and by-catch statistics Pollution Climate change Ocean noise Shipping activity Introduced species Tourism and/or national operations potentially impacting on marine species or ecosystems

APPENDIX I

AGENDA

CCAMLR Workshop on Marine Protected Areas
(Silver Spring, MD, USA, 29 August to 1 September 2005)

Introduction

Opening of the workshop
Welcome to participants
Overview of facilities, computer support, rapporteurs etc.

Adoption of the agenda and organisation of the workshop

Workshop objectives

Terms of reference for the workshop

(i) to review current principles and practices related to the establishment of MPAs

general principles and guidelines
current instruments/agreements
economics
examples in the Convention Area
research papers/summary papers/abstracts

(ii) to discuss how the use of MPAs could be used to contribute to furthering the objectives of CCAMLR

Articles II and IX of the Convention
principles involved in the identification of potential MPAs in the Convention Area
examples in the Convention Area

(iii) to consider proposals that are currently under development or in a conceptual phase that relate to MPAs in the Convention Area

area around Prince Edward Islands
southwest Anvers Island and vicinity
the Balleny Islands and vicinity

(iv) to discuss the types of scientific information that may be required for the development of MPAs to further the objectives of CCAMLR, including the identification of biophysical regions across the Convention Area

follow-up from discussions in term of reference (iii)
identification of representative marine habitats

Recommendations for future work

Conclusion of the workshop.

APPENDIX II

LIST OF PARTICIPANTS

CCAMLR Workshop on Marine Protected Areas
(Silver Spring, MD, USA, 29 August to 1 September 2005)

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APPENDIX III

LIST OF DOCUMENTS

CCAMLR Workshop on Marine Protected Areas
(Silver Spring, MD, USA, 29 August to 1 September 2005)

WS-MPA-05/1	MPA Workshop Terms of Reference
WS-MPA-05/2	List of participants
WS-MPA-05/3	List of documents
WS-MPA-05/4	Marine protected areas in the context of CCAMLR: a management tool for the Southern Ocean IUCN information paper Submitted by IUCN
WS-MPA-05/5	A compilation of abstracts relating to marine protected areas and fisheries management IUCN information paper Submitted by IUCN
WS-MPA-05/6	Guidelines for establishing the [Australian] National Representative System of Marine Protected Areas Submitted by Australia
WS-MPA-05/7	The Heard and McDonald Islands Marine Reserve Delegation of Australia
WS-MPA-05/8	RSPB – The economics of marine protected areas
WS-MPA-05/9	Improving the process for the establishment of marine protected areas by CCAMLR and Antarctic Treaty Parties Delegation of Australia
WS-MPA-05/10	Progress on an Antarctic Specially Managed Area: Southwest Anvers Island and vicinity Delegation of the USA
WS-MPA-05/11	Scientific justification for a marine protected area designation around the Balleny Islands to protect ecosystem structure and function in the Ross Sea region, Antarctica: progress report Delegation of New Zealand
WS-MPA-05/12	Legal considerations surrounding the establishment of marine protected areas in Antarctica Delegation of New Zealand

WS-MPA-05/13	SCAR Biology Symposium (Curitiba, Brazil, 25 to 29 July 2005) Workshop on Marine Protected Areas (27 July) S. Grant (United Kingdom)
WS-MPA-05/14	Issues to consider before jumping on the marine protected area (MPA) bandwagon R.J. Brock and J.A. Uravitch (USA)
WS-MPA-05/15	Progress towards the declaration of a large marine protected area around South Africa's sub-Antarctic Prince Edward Islands D. Nel, A. Lombard, T. Akkers, J. Cooper and B. Reyers (South Africa)

Other CCAMLR documents

CCAMLR-XXIII/BG/22	Towards the creation of a marine protected area around South Africa's sub-Antarctic Prince Edward Islands Delegation of South Africa
SC-CAMLR-XXIII/BG/28 (Revised August 2005)	Summary tables of current and proposed Antarctic marine protected areas Delegation of the United Kingdom
SC-CAMLR-XXIII/BG/29	The biology, ecology and vulnerability of seamount communities Delegation of the United Kingdom
SC-CAMLR-XXIII/BG/30 (Revised: in press)	The applicability of international conservation instruments to the establishment of marine protected areas in Antarctica Delegation of the United Kingdom

Other papers

COFI/2005/8	Marine protected areas (MPAs) and fisheries
Balmford et al., 2004	Balmford, A., P. Gravestock, N. Hockley, C.J. McClean and C.M. Roberts. 2004. The worldwide cost of marine protected areas. *PNAS*, 101 (26): 9694–9697.
Blyth et al., 2004	Blyth, R.E., M.J. Kaiser, G. Edwards-Jones and P.J.B. Hart. 2004. Implications of a zoned fishery management system for marine benthic communities. *J. Appl. Ecol.*, 41: 951–961.
Clarke and Harris, 2003	Clarke, A. and C.M. Harris. 2003. Polar marine ecosystem: major threats and future change. *Environmental Conservation*, 30(1): 1–25.

Gianni, 2004	Gianni, M. 2004. *High Seas Trawl Fisheries and their Impacts on the Biodiversity of Vulnerable Deep-sea Ecosystems: Options for International Action*. IUCN, Gland, Switzerland: 88 pp.
Kimball, 2001	Kimball, L.A. 2001. *International Ocean Governance: Using International Law and Organizations to Manage Marine Resources Sustainability*. IUCN, Gland, Switzerland and Cambridge, UK: 124 pp.
Tuck and Possingham, 2000	Tuck, G.N. and H.P. Possingham. 2000. Marine Protected Areas for spatially structured exploited stocks. *Mar. Ecol. Prog. Ser.*, 192: 89–101.
IUCN, 2005	IUCN. 2005. The international legal regime of the high seas and the seabed beyond the limits of national jurisdiction and options for cooperation for the establishment of Marine Protected Areas (MPAs) in marine areas beyond the limits of national jurisdiction. Information Document UNEP/CBD/WG-PA/1/INF/2 prepared for the Convention on Biological Diversity's meeting of the ad hoc open-ended working group on protected areas, 13–17 June 2005, Montecatini, Italy: www.biodiv.org/doc/meeting.aspx?mtg=PAWG-01&tab=1.

SPECIFIC TASKS IDENTIFIED BY THE SCIENTIFIC COMMITTEE FOR THE 2005/06 INTERSESSIONAL PERIOD

SPECIFIC TASKS IDENTIFIED BY THE SCIENTIFIC COMMITTEE FOR THE 2005/06 INTERSESSIONAL PERIOD

No.	Task	Reference to paragraphs in SC-CAMLR-XXIV	Deadline	Action required	
				Secretariat	Members
1.	**Scheme of International Scientific Observation**				
1.1	Deploy scientific observers on krill fishing vessels to collect scientific information required under the CCAMLR scheme.	2.32	Ongoing	Assist	Implement as appropriate
1.2	Ensure that only the current versions of cruise reports and logbook forms be used, and that observers are aware of all existing and new data requirements.	2.5	Ongoing	Assist	Implement through technical coordinators
1.3	Update the *Scientific Observers Manual*, logbooks and instructions to scientific observers and technical coordinators.	2.30	Feb 2006	Implement	Distribute
1.4	Prepare for participation in the 2007 International Fisheries Observer Conference.	2.6	2007	Implement	
2.	**Ecosystem monitoring and management**				
2.1	Undertake tasks identified by WG-EMM.	Annex 4, Section 6	Jun 2006	Implement	Implement
2.2	Write to SCAR to advise of the workshop on land-based predator surveys and to extend an invitation for SCAR to attend.	3.32	Dec 2005	Assist	Chair SC-CAMLR
2.3	Advise CEP that the Antarctic Site Inventory contained information of interest to CCAMLR, particularly with respect to land-based predators.	3.35	CEP meeting	Assist	Chair SC-CAMLR
2.4	Establish the Subgroup on the Development of Operating Models (SG-DOM).	3.37, 3.80	Ongoing	Assist	Dr Constable (Australia), Convener WG-FSA, Convener WG-EMM
2.5	Establish a newsgroup in support of SG-DOM.	3.37	Dec 2005	Implement	Dr Constable (Australia)
2.6	Convene the second Workshop on Management Procedures.	3.43	Jul 2006	Assist	Ms Akkers (South Africa) and Dr Reiss (USA)
2.7	Convene a workshop to review and revise the precautionary catch limits for krill in Area 48.	3.43	2007	Assist	Consider
2.8	Establish an MPA workshop Steering Committee, including members of the Scientific Committee and CEP.	3.65, 3.66, 3.72	Jul 2006	Assist	Dr Penhale (USA) and Chair SC-CAMLR
2.9	Invite CEP to participate in the work of the MPA Workshop Steering Committee and nominate appropriate members.	3.72	Jul 2006	Assist	Chair SC-CAMLR

No.	Task	Reference to paragraphs in SC-CAMLR-XXIV	Deadline	Action required	
				Secretariat	Members
2.10	Develop a strategic approach to MPA design and implementation throughout the Southern Ocean.	3.51–3.65	Ongoing	Assist	MPA Steering Committee
2.11	Develop a system to quantify the interactions between marine mammals and the longline fishery.	3.77	Oct 2006	Assist	Implement
3.	**Harvested species**				
3.1	Undertake tasks identified by WG-FSA.	Annex 5, Table 13.1	Sep 2006	Implement	Implement
3.2	Submit notification of intention to fish for krill in 2006/07.	4.5	Jun 2006	Assist	Implement
3.3	Update the Fishery Report for krill.	4.7	Jun 2006	Implement	
3.4	Revise the format for reporting haul-by-haul data to accommodate the new pumping technique used in the krill fishery.	4.8	Dec 2005	Implement	Assist
3.5	Submit data on the selectivity of the new pumping technique used for catching krill, a characterisation of the haul (or catch rate) and information on the location of krill catches.	4.8	Ongoing	Assist	Implement
3.6	Provide a report for WG-EMM in 2006 on the operation of the new pumping technique used for catching krill and on its ecological impacts.	4.9	Jun 2006	Assist	Norway to implement
3.7	Deploy scientific observer(s) designated in accordance with the CCAMLR scheme on board krill fishing vessels using the new continuous pumping technique.	4.10	Dec 2005	Assist	Norway and other Members
3.8	Develop a manual that specifies the Secretariat's procedures and equations, where appropriate, for the extraction and mathematical manipulation of data used in assessments.	4.17	Sep 2006	Implement	
3.9	Establish/maintain tagging programs for target species and by-catch species.	4.27, 4.29, 4.67	Ongoing	Assist	Implement
3.10	Continue work on population parameters of assessed species.	4.30, 4.67	Ongoing	Assist	Implement
3.11	Convene a workshop on the ageing of *C. gunnari*.	4.33	Jun 2006	Assist	Dr Sushin (Russia), Convener WG-FSA
3.12	Further develop the validation of the implementing assessment software, scripts or worksheets, examination of the methods to see that the assumptions are met, and sensitivity trials to examine the robustness of consequent advice with respect to CCAMLR objectives.	4.38	Jun 2006	Assist	Implement

No.	Task	Reference to paragraphs in SC-CAMLR-XXIV	Deadline	Action required	
				Secretariat	Members
3.13	Continue to develop, where possible, integrated assessments for toothfish fisheries in Subareas 48.3, 58.6, 58.7, 88.1 and 88.2 and Division 58.5.2.	4.40	Jun 2006	Assist	Implement
3.14	Consider the use of CCAMLR decision rules in estimating yields for the fishery in the South African EEZ.	4.83	Jun 2006	Assist	South Africa
3.15	Undertake high-priority work to develop and evaluate a management procedure for *C. gunnari*.	4.108	Ongoing	Assist	Implement
4.	**New and exploratory fisheries**				
4.1	Maintain tagging programs in all toothfish fisheries.	4.27, 4.29	Ongoing	Assist	Implement
4.2	Submit information on difficulties in applying the tagging requirements in Conservation Measure 41-01.	4.28	Sep 2006	Assist	Implement
4.3	Develop more structured research plans for exploratory fisheries that may lead to a more effective and efficient collection of research data.	4.137	Sep 2006	Assist	Implement
4.4	Ensure that vessels comply with the research set and tagging requirements of Conservation Measure 41-01.	4.139	Ongoing	Assist	Implement
4.5	Ensure that vessels record a unique identifier on the C2 data forms for every set made and that observers record this identifier on their data forms.	4.141	Ongoing	Assist	Implement
4.6	Include an indicative fishing plan when submitting notifications with individual vessels notified for more than one subarea or division.	4.148	Jul 2006	Assist	Implement
4.7	Continue to develop, where possible, integrated assessments for exploratory toothfish fisheries.	4.40	Jun 2006	Assist	Implement
5.	**Fish and invertebrate by-catch**				
5.1	Undertake research aimed at generating population parameters for the estimation of standing stocks of rays and grenadiers.	4.187	Ongoing	Assist	Implement
5.2	Report detailed data on by-catch.	4.189, 4.191–4.195	Ongoing	Assist	Implement
5.3	Modify data reporting forms.	4.192, 4.194, 4.200	Dec 2005	Implement	
5.4	Collect information necessary to establish levels of risk for by-catch species.	4.196	Ongoing	Assist	Implement
5.5	Compare by-catch rates arising from different fishing gear to determine whether this information would be useful when recommending mitigation and avoidance measures for by-catch species.	4.198, 4.199	Sep 2006	Assist	Implement

No.	Task	Reference to paragraphs in SC-CAMLR-XXIV	Deadline	Action required	
				Secretariat	Members
5.6	Advise vessels that, where possible, they should release rays from the lines by cutting the snoods when the rays are still in the water, unless requested not to do so by the observer during his biological sampling period.	4.201–4.204	Ongoing	Assist	Implement
6.	**Incidental mortality**				
	Undertake tasks identified by WG-IMAF.	SC-CAMLR-XXIV/BG/28	Sep 2006	Implement	Implement
6.1	Continue to take action in respect of incidental mortality of seabirds caused by IUU fishing.	5.55	Ongoing	Assist	Implement
6.2	Support a review of by-catch related initiatives and requirements at the proposed meeting of tuna RFMOs.	5.55	2007	Assist	Implement
6.3	Ensure that future notifications clearly indicate the intent to comply with all relevant seabird by-catch measures.	5.55	Jul 2006	Assist	Implement
7.	**Additional monitoring and management issues**				
7.1	Submit papers relating to the methods used for analyses of marine debris data.	6.4	Ongoing	Assist	Implement
7.2	Submit data on marine debris in CCAMLR format.	6.13	Ongoing	Assist	Implement
8.	**Management under uncertainty**				
8.1	Submit catch and effort data for toothfish exploitation in waters adjacent to the Convention Area.	7.1	Ongoing	Assist	Implement
8.2	Further develop methods for estimating IUU catches and continue work to better understand the effectiveness of different levels of observation in detecting levels of IUU activity.	7.5	Ongoing	Implement	Implement
9.	**Secretariat supported activities**				
9.1	Update guidelines for the submission of meeting documents to the Scientific Committee and its working groups and place on website.	12.16	Dec 2005	Implement	
9.2	Follow the guidelines when submitting documents.	12.16	Ongoing	Assist	Implement
9.3	Prepare an electronic reference library of all relevant meeting documents and make available to meeting participants.	12.19	Ongoing	Implement	
9.4	Develop a draft policy for publication of aggregated fine-scale data.	12.27	Sep 2006	Implement	

No.	Task	Reference to paragraphs in SC-CAMLR-XXIV	Deadline	Action required	
				Secretariat	Members
9.5	Implement the computing system to support Internet newsgroups.	12.28	Dec 2005	Implement	
10.	**Other tasks**				
10.1	Establish a Steering Committee on the Review of the Structure of the Working Groups of the Scientific Committee.	13.6, 13.11	early 2006	Assist	Dr Holt (USA)
10.2	Consider a reorganisation of the work of the Scientific Committee to improve the balance, conduct and integration of work between the major current elements of its work program.	13.4–13.11	2006	Assist	Steering Committee
10.3	Translate the Fishery Reports and publish electronically on the CCAMLR website.	13.25	May–June 2006	Implement	
10.4	Convene the second meeting of SG-ASAM.	13.26–13.32	Mar 2006	Assist	Dr O'Driscoll (New Zealand)
10.5	Further develop CCAMLR's core project and umbrella project for the IPY.	13.39–13.43	Ongoing	Implement	Steering Group
10.6	Invite Peruvian scientists to the next meeting of WG-EMM and future planning meetings of the CCAMLR-IPY steering group.	13.42	early 2006	Assist	Dr Siegel (Germany)
10.7	Actively participate in the CCAMLR-IPY core project and provide, where possible, firm commitments for ship-time and other activities.	13.43	July 2006	Assist	Implement
10.8	Establish a Steering Committee to develop a work program leading to a joint SC-CAMLR and IWC workshop.	13.47	early 2006	Assist	Dr Constable (Australia)
10.9	Undertake the work program leading to a joint SC-CAMLR and IWC workshop.	13.48–13.53	Ongoing	Assist	Steering Committee
10.10	Extend the Scientific Committee Rules of Procedure in relation to observers at meetings, and harmonise rules with those of the Commission.	13.56–13.60	Sep 2006	Implement	Implement
10.11	Reports of Members' Activities are no longer required in the work of the Scientific Committee or that of its working groups.	15.5	Ongoing	Note	Note
10.12	Implement a trial distribution of documents in electronic format at the meeting of the Scientific Committee.	15.12	Sep 2006	Implement	Assist

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN SC-CAMLR REPORTS

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN SC-CAMLR REPORTS

AAD	Australian Antarctic Division
ACAP	Agreement on the Conservation of Albatrosses and Petrels
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
ALK	Age–length key
AMD	Antarctic Master Directory
AMLR	Antarctic Marine Living Resources
APBSW	Bransfield Strait West (SSMU)
APDPE	Drake Passage East (SSMU)
APDPW	Drake Passage West (SSMU)
APEC	Asia-Pacific Economic Cooperation
APEI	Elephant Island (SSMU)
APEME Steering Committee	Steering Committee on Antarctic Plausible Ecosystem Modelling Efforts
APIS	Antarctic Pack-Ice Seals Program (SCAR-GSS)
APW	Antarctic Peninsula West (SSMU)
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
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
CAC	Comprehensive Assessment of Compliance
cADL	calculated Aerobic Dive Limit
CAF	Central Ageing Facility
CAML	Census of Antarctic Marine Life
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
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	Commission on the South Pacific
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)
CTD	Conductivity Temperature Depth Probe
CV	Coefficient of Variation
C-VMS	Centralised Vessel Monitoring System
CWP	Coordinating Working Party on Fishery Statistics (FAO)
DCD	*Dissostichus* Catch Document

DVM	Diel vertical migration
DPM	Dynamic Production Model
DPOI	Drake Passage Oscillation Index
DWBA	Distorted wave Born approximation model
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
EIV	Ecologically Important Value
ENSO	El Niño Southern Oscillation
EoI	Expression of Intent (for activities in the IPY)
EPOC	Ecosystem, productivity, ocean, climate
EPOS	European *Polarstern* Study
EPROM	Erasable Programmable Read-Only Memory
eSB	Electronic version of CCAMLR's *Statistical Bulletin*
FAO	Food and Agriculture Organization of the United Nations
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)
FPI	Fishing-to-Predation Index

FRAM	Fine Resolution Antarctic Model
FV	Fishing Vessel
GAM	Generalised Additive Model
GATT	General Agreement on Tariffs and Trade
GEBCO	General Bathymetric Chart of the Oceans
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 (US Global Change Research Program)
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
GRT	Gross Registered Tonnage
GTS	Greene et al., (1990) linear TS versus length relationship
GYM	Generalised Yield Model
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
ICCED	Integrated Analysis of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean
ICES	International Council for the Exploration of the Sea
ICES FAST Working Group	ICES Fisheries Acoustics Science and Technology Working Group
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 Arising from 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
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
KYM	Krill Yield Model
LADCP	Lowered Acoustic Doppler Current Profiler (lowered through the water column)
LMM	Linear Mixed Model
LMR	Living Marine Resources Module (GOOS)
LTER	Long-term Ecological Research (USA)
MARPOL Convention	International Convention for the Prevention of Pollution from Ships
MBAL	Minimum Biologically Acceptable Limits
MCMC	Monte Carlo Markov Chain

MCS	Monitoring Control and Surveillance
MEA	Multilateral Environmental Agreement
MFTS	Multiple-Frequency Method for in situ TS Measurements
MIA	Marginal Increment Analysis
MIZ	Marginal Ice Zone
MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Marine Protected Area
MPD	Maximum of the posterior density
MRAG	Marine Resources Assessment Group (UK)
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	Northeast Atlantic Fisheries Commission
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)
OCCAM Project	Ocean Circulation Climate Advanced Modelling Project
OECD	Organisation for Economic Cooperation and Development
PBR	Permitted Biological Removal
PCA	Principal Component Analysis
PCR	Per Capita Recruitment
pdf	Portable Document Format
PDF	Probability Density Function
PFZ	Polar Frontal Zone
PTT	Platform Terminal Transmitter
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
SAF	Sub-Antarctic Front
SACCF	Southern Antarctic Circumpolar Current Front
SAER	State of the Antarctic Environment Report
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-EASIZ	Ecology of the Antarctic Sea-Ice Zone (SCAR Program)
SCAR-GOSEAC	SCAR Group of Specialists on Environmental Affairs and Conservation
SCAR-GSS	SCAR Group of Specialists on Seals
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 CCAMLR
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
SIBEX	Second International BIOMASS Experiment
SIC	Scientist-in-Charge
SIOFA	Southern Indian Ocean Fisheries Agreement
SIR Algorithm	Sampling/Importance Resampling Algorithm
SO GLOBEC	Southern Ocean GLOBEC

SOI	Southern Oscillation Index
SO JGOFS	Southern Ocean JGOFS
SOW	South Orkney West (SSMU)
SOWER	Southern Ocean Whale Ecology Research Cruises
SPA	Specially Protected Area
SPC	Secretariat of the Pacific Community
SSB	Spawning Stock Biomass
SSG-LS	The Standing Scientific Group on Life Sciences (SCAR)
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
TDR	Time Depth Recorder
TEWG	Transitional Environmental Working Group
TIRIS	Texas Instruments Radio Identification System
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
US AMLR	United States Antarctic Marine Living Resources Program
US LTER	United States Long-term Ecological Research
UV	Ultra-Violet
UW	Unweighted
VMS	Vessel Monitoring System
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-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)

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
WTO	World Trade Organization
WWD	West Wind Drift
WWW	World Wide Web
XBT	Expendable Bathythermograph
XML	Extensible Mark-up Language
Y2K	Year 2000