SC-CAMLR-XXI

SCIENTIFIC COMMITTEE FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

REPORT OF THE TWENTY-FIRST MEETING OF THE SCIENTIFIC COMMITTEE

HOBART, AUSTRALIA
21–25 OCTOBER 2002

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Abstract

This document presents the adopted report of the Twenty-first Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, from 21 to 25 October 2002. 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

Page

**REPORT OF THE TWENTY-FIRST MEETING
OF THE SCIENTIFIC COMMITTEE**
(Hobart, Australia, 21 to 25 October 2002)

OPENING OF THE MEETING

1.1 The Scientific Committee for the Conservation of Antarctic Marine Living Resources met under the Chairmanship of Dr R. Holt (USA) from 21 to 25 October 2002 at the Wrest Point Hotel, Hobart, Australia.

1.2 In opening the meeting, Dr Holt expressed the Scientific Committee's deepest sympathies to the victims of the bomb attack in Bali.

1.3 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, Poland, Russian Federation, South Africa, Spain, Sweden, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America and Uruguay.

1.4 The Chair welcomed to the meeting observers from the People's Republic of China, Mauritius, Mozambique and Seychelles, along with observers from ASOC, CEP, FAO, IOC, IUCN, IWC and SCAR, and encouraged them to participate in the meeting as appropriate.

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

1.6 The following rapporteurs were appointed to prepare the report of the Scientific Committee:

- Mr B. Watkins (South Africa) – CCAMLR Scheme of International Scientific Observation;
- Drs R. Hewitt and P. Penhale (USA) – Ecosystem Monitoring and Management;
- Dr K. Reid (UK) – Krill Resources and Additional Monitoring and Management Issues;
- Mr C. Jones (USA) and Dr S. Hanchet (New Zealand) – Fish Resources;
- Dr G. Kirkwood (UK) – New and Exploratory Fisheries;
- Dr M. Collins (UK) – Crab Resources;
- Prof. P. Rodhouse (UK) – Squid Resources;
- Prof. J. Croxall (UK) and Mr R. Williams (Australia) – Incidental Mortality;
- Dr K.-H. Kock (Germany) – Management under Conditions of Uncertainty about Stock Size and Sustainable Yield;
- Dr S. Kawaguchi (Japan) and Mr L. López Abellán (Spain) – Cooperation with Other Organisations;
- Dr D. Ramm (Secretariat) – all other matters.

Adoption of Agenda

1.7 The Provisional Agenda had been circulated prior to the meeting (SC-CAMLR-XXI/1). The Scientific Committee agreed to include a subitem on 'Data Access' under 'Other Business'. With this change, the Agenda was adopted (Annex 3).

Report of the Chair

Intersessional Meetings

1.8 The following meetings were held during the 2001/02 intersessional period:

(i) The eighth meeting of WG-EMM was held from 5 to 16 August 2002 in Big Sky, Montana, USA. It was convened by Dr Hewitt and was attended by 39 participants, representing 11 Members.

The Interim Steering Committee for the Review of CEMP met in Big Sky on 3 August 2002 immediately prior to the WG-EMM meeting. It was convened by Prof. Croxall.

The Workshop on the Small-scale Management Units, such as Predator Units (SSMU Workshop), was held from 7 to 15 August 2002 in conjunction with the WG-EMM meeting. It was convened by Dr W. Trivelpiece (USA).

(ii) The meeting of WG-FSA was held from 7 to 17 October 2002 in Hobart prior to the Scientific Committee meeting. It was convened by Dr I. Everson (UK).

(iii) Ad Hoc WG-IMAF conducted its meeting as part of WG-FSA. It was convened by Prof. Croxall.

1.9 On behalf of the Scientific Committee, the Chair thanked the conveners for their significant contributions to the intersessional meetings. The report of WG-EMM is attached as Annex 4 and that of WG-FSA as Annex 5.

Fisheries

1.10 CCAMLR Member countries actively participated in eight fisheries under conservation measures in force in the 2001/02 season (1 December 2001 to 30 November 2002):

- longline fishery for toothfish (*Dissostichus eleginoides*) in Subarea 48.3;
- trawl fishery for toothfish (*D. eleginoides*) in Division 58.5.2;
- exploratory longline fishery for toothfish (*Dissostichus* spp.) in Subarea 88.1 (north and south of 65°S);
- exploratory longline fishery for toothfish (*Dissostichus* spp.) in Subarea 88.2;
- pot fishery for crabs in Subarea 48.3;
- trawl fishery for icefish (*Champsocephalus gunnari*) in Subarea 48.3;

- trawl fishery for icefish (*C. gunnari*) in Division 58.5.2; and
- trawl fishery for krill (*Euphausia superba*) in Area 48.

1.11 Thirteen Member countries fished in these fisheries: Australia, Chile, Japan, Republic of Korea, New Zealand, Poland, Russia, South Africa, Spain, Ukraine, UK, Uruguay and the USA.

1.12 In addition, five other fisheries were undertaken in EEZs within the Convention Area:

- trawl fishery for *D. eleginoides* in Division 58.5.1 (French EEZ);
- longline fishery for *D. eleginoides* in Division 58.5.1 (French EEZ);
- longline fishery for *D. eleginoides* in Subarea 58.6 (French EEZ);
- longline fishery for *D. eleginoides* in Subarea 58.6 (South African EEZ); and
- longline fishery for *D. eleginoides* in Subarea 58.7 (South African EEZ).

CCAMLR Scheme of International Scientific Observation

1.13 International scientific observers, nominated in accordance with the scheme, were on board all vessels fishing for toothfish, icefish and crab. International scientific observers were also deployed on some vessels fishing for krill. Observers, both national and international, were deployed on 40 fishing trips within the Convention Area during the 2001/02 season. In addition, three observers were deployed on vessels fishing in waters adjacent to the Convention Area.

CCAMLR SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

Scientific Observations Conducted in the 2001/02 Fishing Season

2.1 In the 2001/02 season 24 longline cruises were conducted within the Convention Area with international and national scientific observers on board all vessels. Ten trawler cruises for finfish were conducted with international and national observers on board all vessels. Five international observers were present on four vessels fishing for krill in Subarea 48.3. One international observer was present on board a 'pot' vessel in Subarea 48.3 (SC-CAMLR-XXI/BG/14). In addition, observer reports were submitted from South African vessels fishing in FAO Statistical Areas 47 and 51.

2.2 Two logbooks and two cruise reports from the longline fishery had not been received by the Secretariat at the time of the meeting.

2.3 In March 2002 updated versions of the observer logbook forms and a cruise report format were placed on the CCAMLR website and distributed to all Members and technical coordinators (COMM CIRC 02/15). Although all logbooks had been submitted in the standard CCAMLR format, only three had been submitted in the new 2002 format (Annex 5, paragraphs 3.27 and 3.28). The Scientific Committee requested that all future submissions should be made according to the most recent data format.

2.4 Dr E. Goubanov (Ukraine) stated that in accordance with the CCAMLR Scheme of International Scientific Observation an international observer from Ukraine on board a US voyage in Area 48 submitted data from a krill fishery. An international observer from Ukraine on board a Russian vessel also submitted data from a toothfish voyage in Subarea 48.3 to the Secretariat. In addition, three national observers submitted C1 data from the krill fishery in Area 48.

2.5 In addition to information reported last year (SC-CAMLR-XX, paragraph 3.3), two observer reports had been received for the 2000/01 krill fishing season: one from a national observer on board a Japanese krill trawler and one from an international observer on board a US krill trawler. Japan also indicated that it would deploy one national observer during the 2002/03 season. For the entire history of the fishery the Secretariat had received only three observer reports from krill fishing cruises (Annex 4, paragraphs 2.59, 2.63 and 5.47; SC-CAMLR-XXI/BG/16). Since the meeting of WG-EMM-02, four additional observer reports had been received; all were from UK observers on krill fishing vessels operating near South Georgia in Subarea 48.3.

2.6 No comments had been received on the revised questionnaire on fishing strategies in the krill fishery, and the Scientific Committee agreed that in its current form the questionnaire was now suitable for general use. Completed questionnaires had been received from two Polish-flagged vessels and the Scientific Committee requested that the Secretariat synthesise the information contained in these and any subsequent submission for consideration at future meetings of WG-EMM (Annex 4, paragraphs 2.52 to 2.55; SC-CAMLR-XXI/BG/16).

2.7 Biological data had been collected by scientific observers in accordance with research priorities identified by the Scientific Committee in previous years. Background information and statistical analyses on conversion factors are presented in SC-CAMLR-XXI/BG/27.

2.8 An analysis of data provided by observers on conversion factors for *Dissostichus* spp. showed that fish length had the most influence on conversion factors (SC-CAMLR-XXI/BG/27, Figure 3.1). In the longline fishery the conversion factor increases with length. In the trawl fishery, however, there is a decline in the conversion factor in relation to size and this may have a significant effect on estimating green weights (SC-CAMLR-XXI/BG/27). The Scientific Committee was advised that a subgroup would coordinate work on this topic intersessionally (Annex 5, paragraph 3.37).

2.9 In relation to revision of the *Scientific Observers Manual* logbook data recording and reporting forms, and instructions to scientific observers, the Scientific Committee endorsed the proposals in relation to the krill fishery from WG-EMM (Annex 4, paragraphs 2.60 to 2.62) in respect of:

(i) revision and inclusion of data forms in the manual;

(ii) assigning priorities to some tasks (Annex 4, paragraph 2.62(i));

(iii) revision of the colour chart used to determine physiological condition;

(iv) development of new methodologies for sampling fish by-catch and determining product-to-catch conversion factors (Annex 4, paragraphs 2.62(iv) and (vi)); and

(v) inclusion of the questionnaire on krill fishing strategies (Annex 4, paragraph 2.62(vi); SC-CAMLR-XXI/BG/16).

2.10 The Scientific Committee also noted that provision should be made for observers, working on krill fishing vessels, to seek assistance from the crew of the vessel on which they are working.

2.11 For fisheries other than krill, the Scientific Committee recommended that changes be made to the *Scientific Observers Manual* logbook data recording and reporting forms, and instructions to scientific observers, as appropriate, in respect of:

(i) better recording of levels of deck lighting; and

(ii) better reporting (including video recording) of entanglement of seabirds, including reporting on their entanglements on the five-day catch and effort reporting forms for trawl fisheries for icefish.

2.12 The Scientific Committee also recommended changes to the manual to make provision for (Annex 5, paragraphs 10.2 to 10.6 and 10.19; SC-CAMLR-XXI/BG/31):

(i) recording both pre-sorting and post-sorting data from the crab fishery;

(ii) sexing of all crabs measured;

(iii) male chelae measurements;

(iv) better collection and reporting of data on rates of hook discard in fish heads in appropriate longline fisheries;

(v) potential changes in respect of any redefinition of the status of birds 'caught' and any new definition of what a dead seabird is;

(vi) providing technical coordinators with the algorithm used to determine nautical twilight so that they can develop area-specific day-by-day, degree-by-degree tables; the large size of such files makes their inclusion in the observer logbook impractical; and

(vii) collection of indicative data on the area over which streamer lines behind vessels are effective in order to help simplify Conservation Measure 29/XIX (Annex 5, paragraph 10.19).

2.13 The Scientific Committee agreed that the *Species Identification Sheets* should be updated and coordinated intersessionally by Dr Collins (Annex 5, paragraph 10.9).

2.14 The Scientific Committee noted that in respect of by-catch, such as seabirds, skates and rays, there is a need to develop a definition of what constitutes a 'catch' and also to consider how the categories 'dead' and 'alive' might be defined (Annex 5, paragraphs 10.6 and 10.22). The Scientific Committee requested advice from the Commission on such definitions.

2.15 The Scientific Committee recommended all changes to the format of the *Scientific Observers Manual* should be coordinated through the technical coordinators.

2.16 The Scientific Committee noted that there is a need to consider levels of observations appropriate for accurate determination of the number of birds caught, specifically in relation to fisheries for which closure (or reversion to night-time setting) is, in part, dependent on the number of birds killed (Annex 5, paragraph 6.177). The Scientific Committee, indicating one approach which might be considered (Annex 5, paragraph 6.178), recommended that the Commission provide guidance on this issue.

2.17 Intersessionally a subgroup on sampling catches from longlines had developed recommendations on: (i) sampling and subsampling units based on time and gear, (ii) the allocation of observer effort within longline haul and between hauls, and (iii) allocation of observer effort directed toward fishery target species versus ecological interactions.

2.18 The present objective in established longline fisheries is to sample 60 fish/day and the subgroup had suggested instead of sampling the first 60 fish in a biological sampling period, that all fish on a fixed number of hooks be sampled for biological data. This would be a gear-based sampling system. The Scientific Committee agreed that this would be a difficult task to ask of the scientific observers. An alternative suggestion was that a gear-based method be undertaken only every fifth day of a cruise. The observer should monitor the average number of hooks required to obtain 60 fish in the previous four days, and then only monitor this number of hooks. Every fish would be sampled from this time, whether the sample was greater or less than 60 fish. The Scientific Committee recommended this procedure be carried out where possible in 2002/03 and requested further information on sampling methods from areas other than Subarea 48.3 be made available to the next meeting of WG-FSA (Annex 5, paragraphs 10.11 to 10.14).

2.19 In Annex 5, paragraph 10.15, it was noted that the subgroup had no information on which to base sampling for age of *Dissostichus* spp. and that it seemed reasonable to sample approximately every 30th fish for otoliths during each haul. The first fish to be sampled would be randomly selected from 1–30 approximating to two otoliths/day collected during a 60-day voyage. The Scientific Committee noted that sampling two otoliths/day may not account for segregation in the stock and that for this situation the design of otolith collection would need to be more stringent and that the collection of additional samples is needed in case future work is required.

2.20 The Scientific Committee agreed that the protocols on sampling fish developed for the established longline fishery in Subarea 48.3 be applied to that fishery in the coming season. For other longline fisheries, the Scientific Committee recommended that:

(i) the principles of obtaining unbiased estimates of the characteristics of catches and the biology of species be applied in the coming season; and

(ii) the procedures used in such application of those principles be submitted to WG-FSA for review next year.

2.21 The Scientific Committee also reminded observers that the standard measurement of length for macrourids is pre-anal length (Annex 5, paragraph 10.17).

2.22 The Scientific Committee noted the complexity of keeping track of proposals for modifications to the *Scientific Observers Manual* logbook data recording and reporting forms and instructions to scientific observers. It requested WG-EMM and WG-FSA next year to include in their reports summarised tabulations of the changes being requested with clear indications of which part of the documentation needed revision and who would be responsible for providing any necessary information to the Secretariat.

Advice to the Commission

2.23 The *Scientific Observers Manual* logbook data recording and reporting forms and instructions to scientific observers should be revised to give effect to the recommendations in paragraphs 2.9 to 2.12 and 2.21.

2.24 It was recommended that the *Species Identification Sheets* should be updated in time for the 2002/03 season (paragraph 2.13).

2.25 In respect of by-catch such as seabirds, skates and rays there is a need to develop a definition of what constitutes a 'catch' and also to consider how the categories 'dead' and 'alive' might be defined (paragraph 2.14; Annex 5, paragraphs 10.6 and 10.22).

2.26 There is a need to consider levels of observations appropriate for accurate determination of the number of birds caught, especially in relation to fisheries for which closure (or reversion to night-time setting) is, in part, dependent on the number of birds killed (paragraph 2.16; Annex 5, paragraphs 10.6 and 10.23).

ECOSYSTEM MONITORING AND MANAGEMENT

General Comments

3.1 Dr Hewitt reported that the 2002 meeting of WG-EMM-02 was held from 5 to 16 August in Big Sky, Montana, USA. Intersessional activities had been conducted by correspondence groups on the subdivision of CCAMLR statistical areas into ecological units, on modelling approaches and on the feasibility of conducting krill predator surveys. Just prior to the meeting the steering committee for next year's review of CEMP conducted a one-day planning session. During the meeting the Subgroup on Designation of CEMP Sites, the Subgroup on CEMP Methods and the Subgroup on Predator Surveys met. A major part of the meeting was concerned with a workshop to delineate small-scale management units (SSMUs) for the krill fishery.

3.2 Conveners of these subgroups were:

- Harvesting Units – Dr A. Constable (Australia), to be replaced in the future by Dr S. Nicol (Australia) and Dr M. Naganobu (Japan);
- Modelling Approaches – Dr Constable;

- CEMP Review – Prof. Croxall, to be co-convened in the future with Dr C. Southwell (Australia);

- Designation of CEMP Sites – Dr Penhale;

- Methods – Dr Reid;

- Predator Surveys – Dr Southwell; and

- SSMU Workshop – Dr Trivelpiece.

3.3 These activities were summarised in three documents for consideration by the Scientific Committee:

(i) report of WG-EMM-02 (Annex 4) containing a listing of 'Key Points for Consideration by Scientific Committee' at the end of each major agenda item, as well as the report of the SSMU Workshop (Annex 4, Appendix D) and the report of the Steering Committee for the CEMP Review (Annex 4, Appendix E);

(ii) synopses of working papers (SC-CAMLR-XXI/BG/15) considered at the meeting, each containing an abstract and a summary of the findings and/or conclusions as they related to a particular agenda item; and

(iii) report of the Convener of WG-EMM-02 to SC-CAMLR-XXI (SC-CAMLR-XXI/BG/16) containing appropriate references to paragraphs in the report of WG-EMM-02.

The last two documents were requested by the Scientific Committee as aides to its discussions (SC-CAMLR-XX, paragraphs 18.3 and 18.4).

3.4 The Scientific Committee took special note of four items in the report of WG-EMM-02:

(i) the delineation of SSMUs for the krill fishery in Area 48. These divisions can be used in the short term to subdivide the precautionary catch limit for krill (SC-CAMLR-XIX, paragraph 5.15), and in the long term in the development of a feedback management scheme for krill (SC-CAMLR-X, paragraph 3.56);

(ii) the elaboration of work plans in preparation for the review of CEMP to be conducted during the 2003 meeting of WG-EMM. This will be the second step (after the establishment of SSMUs) in the long-range work plan to establish a feedback management scheme for krill (SC-CAMLR-XX, paragraphs 6.20 and 6.21). As part of this process the ecosystem monitoring requirements of alternative management procedures will be reviewed;

(iii) the extreme difficulty of predicting trends in the krill fishery given the absence of reliable information; and

(iv) reaffirmation of the need for detailed data on catch and effort for the krill fishery, but an inability to agree on when to introduce such a requirement.

Status and Trends in the Krill-centric Ecosystem

3.5 The Scientific Committee noted that WG-EMM reviewed the status and trends apparent in the CEMP indices provided by the Secretariat and concluded that 2001/02 was an average year in comparison to the time series of data available, and that there were no apparent differences between subareas within Area 48. Based on the Secretariat's review and preliminary analysis of selected CEMP data, the Scientific Committee concurred with the Working Group recommendations that:

(i) data submitters use the most current data forms;

(ii) additional information be provided in the comment fields to assist in data validation;

(iii) guidelines be developed for automated data collection;

(iv) the Secretariat should assess the utility of various indices of fishery–predator overlap while discontinuing the use of the Agnew–Phegan index; and

(v) the Secretariat undertake a major redesign of the CEMP database after the CEMP Review Workshop in 2003 (Annex 4, paragraphs 3.1 to 3.15, 3.40, 3.41 and 3.124 to 3.127).

3.6 The Scientific Committee noted that several papers describing various aspects of the foraging ecology of land-based krill predators were reviewed by WG-EMM preparatory to the SSMU Workshop. Discussion was organised around four broad areas of interest: satellite-tracking studies of predator foraging, estimates of prey consumption, issues of spatial scale, and overlap between predators and krill fisheries (Annex 4, paragraphs 3.16 to 3.41).

3.7 The Scientific Committee welcomed the contribution of a life table for Adélie penguins based on 12 years of demographic studies and encouraged the development of CEMP standard methods for the collection and analyses of demographic data (Annex 4, paragraphs 3.46 to 3.48).

3.8 The Scientific Committee noted that the annual increase of fur seal pup production in the South Shetland Islands has slowed from 13.5% per year between 1987 and 1994, to 8.5% per year between 1994 and 1996, to 0.9% per year between 1996 and 2002. The Scientific Committee also noted that the recovery of fur seals in the South Shetland Islands is different in several aspects to that reported for South Georgia and warrants further investigation (Annex 4, paragraphs 3.49 and 3.50).

3.9 The Scientific Committee noted that the Working Group reviewed evidence that age-1 krill are transported by currents into different regions of the Scotia Sea, but that regional differences in growth and mortality might determine the relative abundances of older age classes. Several participants noted the potential importance of regional variations in demographic parameters, retention of krill in the vicinity of island groups, and genetic variability to understanding krill population dynamics in the southwest Atlantic and hence the estimated yield from the CCAMLR-2000 Survey (Annex 4, paragraphs 3.54 to 3.59, 3.64, 3.129 and 5.33).

3.10 The Scientific Committee considered evidence presented by WG-EMM that krill recruitment was correlated across the southwest Atlantic sector of the Southern Ocean, from the Bellingshausen Sea to South Georgia, but uncorrelated with the Indian Ocean. Similar to the southwest Atlantic, interannual variability in krill recruitment in the Ross Sea appears to be high, while it appears to be less so in the Indian Ocean (Annex 4, paragraphs 3.60 to 3.69, 3.129 and 5.34).

3.11 The Scientific Committee considered a review of the Ross Sea marine ecosystem and agreed that the region had experienced relatively little commercial exploitation, had a long history of scientific exploration, and constituted a unique natural location to study the effects of climate change on ecosystem processes (Annex 4, paragraphs 3.88 and 3.89). The Scientific Committee noted the review of an Italian design for a survey of krill in the Ross Sea in 2003/04, which had been compromised because of a reduction in available ship time. The Scientific Committee advised adoption of the CCAMLR-2000 Survey protocols, so that the surveys may be comparable, and encouraged Italy and New Zealand to pool their research vessel resources in order to do so (Annex 4, paragraphs 3.116 to 3.123).

3.12 The Scientific Committee endorsed the recommended revision of CEMP Standard Method C2, Procedure B (Antarctic fur seal pup growth), which clarified issues of sampling and interpretation of this index (Annex 4, paragraphs 3.103, 3.104 and 3.130).

3.13 The Scientific Committee noted several developments in the processing and interpretation of acoustic data, including methods for the identification of krill, determination of target strength and analysis of distribution and abundance. The Scientific Committee also noted that these developments could result in reanalysis of historical krill surveys, including the CCAMLR-2000 Survey (Annex 4, paragraphs 3.105 to 3.110 and 3.128).

Generalised Yield Model (GYM)

3.14 The Scientific Committee noted that work is continuing with the development and validation of the GYM and proposed that sensitivity analyses be conducted to determine the effects of regional differences in the growth and mortality of krill on estimates of yield. A new user interface has been developed for the GYM, which is currently available on CD-ROM from the Secretariat. In addition, the main modules of the GYM are being recoded by a programmer in the UK, which will enable further validation of the model. The Secretariat is currently developing a reference database on all analysis software used by CCAMLR (Annex 4, paragraphs 5.32 to 5.41 and 5.56).

Harvesting Units

3.15 The Scientific Committee noted that work is continuing on the subdivision of large CCAMLR statistical areas into ecologically based harvesting units. Harvesting units may be further defined as those areas over which CCAMLR conservation objectives will need to be achieved (Annex 4, paragraphs 5.17 to 5.20 and 5.53).

Small-Scale Management Units

3.16 The Scientific Committee noted the results of the SSMU Workshop. The aim of the workshop was to define these units in order to facilitate the subdivision of the precautionary yield in Area 48 as requested by the Scientific Committee and the Commission. The units were delineated after collating and comparing information on krill distribution, krill predator foraging areas and krill fishing grounds. The full report of the workshop is attached to the report of WG-EMM-02 (Annex 4, Appendix D).

3.17 The Scientific Committee endorsed the SSMUs outlined below, and recommended that the units be used by the Commission as a basis on which to subdivide the precautionary catch limit for krill in Area 48. The Scientific Committee also noted that these units may be useful in developing management procedures for krill fisheries that can adequately account for localised effects on krill predators. The SSMUs and their nested hierarchy, as described in the report (Annex 4, paragraphs 5.21 and 5.22), are:

- (i) Subarea 48.1
    - (a) 48.1 Pelagic Area
    - (b) 48.1 Land-based Predator Area
        - (i) Western Antarctic Peninsula
        - (ii) Drake Passage
            1. West
            2. East
        - (iii) Bransfield Strait
            1. West
            2. East
        - (iv) Elephant Island

- (ii) Subarea 48.2
    - (a) 48.2 Pelagic Area
    - (b) 48.2 Land-based Predator Area
        - (i) West South Orkney
        - (ii) East South Orkney
            1. North
            2. South

- (iii) Subarea 48.3
    - (a) 48.3 Pelagic Area
    - (b) 48.3 Land-based Predator Area
        - (i) West South Georgia
        - (ii) East South Georgia

SSMUs are illustrated in Figures 1 to 3.

3.18 The Scientific Committee noted that:

(i) this assessment is the first of its kind in CCAMLR;

(ii) this assessment used a variety of datasets that enabled the detailed analyses presented here, such that deficiencies in one dataset could be compensated by strengths in others;

(iii) fine-scale fisheries data were very important to the success of this assessment;

(iv) a number of uncertainties remain regarding the relationships between predators, krill and the fishery and further information on krill, krill movement, predator demand and predator foraging grounds may provide opportunities to refine these boundaries in the future;

(v) the next step is to develop an understanding of the linkages and dynamics between these areas in order to facilitate the subdivision of the precautionary catch limit for krill in Area 48, taking account of the oceanography and the environmental variability of the region;

(vi) this assessment has demonstrated the utility of satellite-tagging programs for an understanding of the relationships between predators, krill and the fishery, and, as a result, the workshop highly recommended further studies of this kind; and

(vii) the manner in which these proposed SSMUs are used may have implications for monitoring that would need to be considered by the Commission (Annex 4, paragraph 5.26).

3.19 The Scientific Committee further recommended that:

(i) the subdivisions described in the maps be considered the best available advice on SSMUs in the region (Annex 4, Appendix D, paragraph 5.31);

(ii) refinements to the boundaries may be required over time to fully meet the requirements of the Commission and that such proposals be considered as they arise;

(iii) submission of haul-by-haul krill fishery data is necessary for future assessments of activities in these units, and that concerns regarding data confidentiality should be addressed while maintaining the spirit and intent of the Rules for Access and Use of CCAMLR Data; and

(iv) consideration be given to using the proposed SSMUs as an alternative structure to the Integrated Study Areas for organising future work on the relationships between krill, krill predators and the fishery (Annex 4, paragraphs 5.27 to 5.31).

3.20 Prof. Croxall noted that the critical next step in the use of the SSMUs to subdivide the precautionary catch limit of krill in Area 48 appeared to rely on proposals from Working Group participants (Annex 4, paragraph 5.29). He suggested that it might be advisable to establish a subgroup with the task of clarifying the necessary procedures. Dr Hewitt replied that discussions on this topic were planned for future Working Group meetings with an expected recommendation for the Scientific Committee in 2004, that he expected these discussions to arise from consideration of working papers tabled at the meetings, that it was certainly possible to task a subgroup but that such a subgroup would still be dependent on contributions from individuals, and renewed his plea to Members to send experts to the meetings of WG-EMM so that progress can be ensured.

3.21 Dr Constable drew the attention of the Scientific Committee to the work plan of WG-EMM and that consideration of a subdivision of the precautionary catch limit would occur in 2004, in parallel with consideration of ecosystem models at a workshop of WG-EMM in that year.

3.22 Dr Kawaguchi noted the importance of high-resolution fishery data to the development and use of SSMUs for managing the krill fishery in Area 48. He noted that Japan was prepared to provide data for this work, but also noted that the rights of data owners must be acknowledged. He suggested the following conditions for use of haul-by-haul data:

(i) use of haul-by-haul data be limited to work in regard to SSMUs;
(ii) all copies of data must be returned to the owner; and
(iii) data analyses to be conducted in the presence of the data owner.

Dr Holt noted that access to fishery data was part of a broader topic of access to CCAMLR data and referred this issue to a subgroup for discussion (paragraph 15.1).

Future Work of WG-EMM

3.23 The Scientific Committee reviewed the report of the Interim Steering Committee for the CEMP Review (Annex 4, Appendix E) and endorsed the intersessional work plan. A Workshop on the Review of CEMP will be held during the 2003 meeting of WG-EMM with the following terms of reference:

(i) Are the nature and use of the existing CEMP data still appropriate for addressing the original objectives?

(ii) Do these objectives remain appropriate and/or sufficient?

(iii) Are additional data available which should be incorporated in CEMP or be used in conjunction with CEMP data?

(iv) Can useful management advice be derived from CEMP or be used in conjunction with CEMP data?

The Interim Steering Committee considered the terms of reference, the appropriate data and analyses required to address them, and the need to invite experts on the linkage of statistical and ecological models.

3.24 The Scientific Committee noted that the species profile and time-series data on *C. gunnari*, developed as part of the work of WG-FSA, may be useful in expanding the scope of the CEMP review. Of greatest value in this context would be long-term time series of data on standing stock and indices such as condition index, gonadosomatic index and diet.

3.25 The Scientific Committee noted the budgetary implications of the intersessional work plan in preparation for the Workshop on the CEMP Review. These include costs associated with invited experts and those associated with additional work required of the CCAMLR Data Manager (Annex 4, paragraphs 6.10, 6.12 and 6.13).

3.26 The Scientific Committee noted that substantial progress was made by the subgroup established last year to investigate the possibility of a synoptic survey of krill predator surveys. The subgroup laid out a long-range work plan that included reviews of existing methods and data, evaluation of new and emerging technologies, assessment of survey designs, and detailed logistic planning. It was agreed that the best strategy would be a series of staged regional surveys to be conducted over several years. Considering the substantial amount of preliminary work required, it is reasonable to expect actual survey work to begin in 2008/09 (Annex 4, paragraphs 6.17 to 6.26).

3.27 The Scientific Committee noted a number of ecosystem modelling activities currently under way in various parts of the world that may be useful to CCAMLR when considering appropriate models to underpin a feedback management scheme for krill. The Working Group agreed to maintain the correspondence group on modelling approaches to develop an agenda and prepare for a workshop on modelling to be held in conjunction with WG-EMM-04 (Annex 4, paragraphs 6.27 to 6.31).

3.28 The Scientific Committee reviewed progress by WG-EMM toward its long-term goal of developing a feedback management scheme for the krill fishery, by which management measures are adjusted in response to ecosystem monitoring. The Scientific Committee also noted progress toward the shorter-term request of the Commission to subdivide the precautionary catch limit of krill in Area 48 (Annex 4, paragraphs 6.33 and 6.34).

3.29 The Scientific Committee endorsed the long-range work plan of WG-EMM in the form of Table 1, which outlines the major issues and a timetable for addressing them. Activities include discussion of working papers, planning sessions for workshops, formal workshops with specified products, and the generation of recommendations to the Scientific Committee (Annex 4, paragraphs 6.35 to 6.39). This table is an update of the timeline in SC-CAMLR-XX, paragraph 6.20.

3.30 Dr Hewitt noted progress on the four issues outlined in the table. He also noted that an essential element in the development of a revised krill management procedure was the definition of reporting requirements from the fishery, but that the Working Group had been unable to make progress on this topic (see also Annex 4, paragraph 2.74).

Management of Protected Areas

3.31 The Scientific Committee considered the management advice of WG-EMM with regard to deliberations of the Subgroup on Designation and Protection of CEMP Sites (SC-CAMLR-XXI, Annex 4, paragraphs 5.1 to 5.16).

3.32 The Scientific Committee recommended that the Commission (Annex 4, paragraph 5.52):

(i) approve the four management plans (WG-EMM-02/56, 02/57, 02/58 and 02/59) for protected sites containing marine areas that sought protection as Antarctic Specially Protected Areas (ASPAs) under the Antarctic Treaty (Annex 4, paragraphs 5.2 to 5.10);

(ii) transmit recommendations for improvements to the originators of the four plans (Annex 4, paragraphs 5.8 to 5.10);

(iii) endorse the following future tasks for the subgroup:

(a) review guidance for the production of maps of protected areas (Annex 4, paragraphs 5.11 and 5.12);

(b) review a paper to be produced by the Secretariat that summarises CCAMLR decisions related to the evaluation of Antarctic Treaty management plans containing marine areas that are submitted to CCAMLR for approval (Annex 4, paragraph 5.15);

(c) produce a paper summarising its current terms of reference (Annex 4, paragraph 5.15); and

(d) endorse revision of the subgroup name 'Advisory Subgroup on Protected Areas' (Annex 4, paragraph 5.16).

3.33 Dr Constable informed the Scientific Committee that Australia had recently proclaimed the Heard Island and McDonald Islands (HIMI) Marine Reserve and Conservation Zone (SC-CAMLR-XXI/BG/18). He indicated that Australia applies CCAMLR conservation measures in the region and that this proclamation would give additional capacity to conserve and monitor Antarctic marine living resources in its EEZ beyond the provisions of CCAMLR conservation measures.

3.34 Dr Constable referred to the advice of WG-FSA, which noted that the stock assessments in the region would not be adversely affected by the proclamation (Annex 5, paragraph 5.90).

3.35 Some questions regarding the applicability of this marine reserve designation to overall CCAMLR procedures followed. The Chair of the Scientific Committee noted that the reserve is located within the Australian EEZ and thus is subject to Australian law.

3.36 Several Members and observers congratulated Australia on its approach to marine conservation as evidenced by the establishment of the HIMI reserve.

HARVESTED SPECIES

Krill Resources

Krill Fishing

4.1 Reported catches of krill from catch and effort data are shown in Table 2. A total of 118 705 tonnes was caught during the 2001/02 season (up to 18 October 2002). The catch was taken by Japan, Republic of Korea, Poland, Ukraine and the USA. All of the catch came from Area 48; however, the catch cannot be reported by subareas as a result of differences in the format of the catch data submitted.

4.2 The overall total represents an increase from the 93 572 tonnes caught in the previous year, although this increase is not as great as the forecast indicated by the fishing plans presented to the Scientific Committee last year (SC-CAMLR-XX, paragraph 2.7). The same five nations participated in the fishery in both years.

4.3 Dr Goubanov informed the Scientific Committee that in the period from July 2001 to June 2002, three Ukrainian krill fishing vessels caught a total of 21 240 tonnes of krill in Subarea 48.2 and 14 280 tonnes in Subarea 48.3.

4.4 At the meeting of WG-EMM-02 fishing plans were reported from Japan, which indicated that there would be three vessels fishing for krill in the 2002/03 season with an estimated catch of 60 000 to 65 000 tonnes, and the USA, which indicated that there may be a single vessel fishing for krill in Area 48.

4.5 Dr Goubanov indicated that in the forthcoming season the Ukrainian fishery would be carried out by three to four vessels in Area 48 and that the projected catch would be between 40 000 and 50 000 tonnes. On board every vessel (or at least on board one vessel of the group of vessels operating in the same sector) there will be a national scientific observer.

4.6 The Scientific Committee recognised that it was unable to provide detailed data on the krill catch during the current year and requested guidance from the Commission on how the catch for the current year should be reported in future and how it may wish to receive information on trends in this fishery.

Advice from WG-EMM

4.7 The Scientific Committee noted that the information provided from the fishing nations on their future plans is generally less accurate than is necessary to indicate future trends in the krill fishery (Annex 4, paragraphs 2.1 to 2.12, 2.44 and 2.75).

4.8 The Scientific Committee agreed that interpretation of CPUE data from the krill fishery would not be possible without additional information on factors such as vessel type and product type, and that data submission on these parameters should be sought. Further, the voluntary submission of CPUE and associated data makes the krill fishery unique amongst CCAMLR fisheries which otherwise require mandatory submission of detailed catch and effort data (Annex 4, paragraphs 2.13 to 2.20 and 2.69).

4.9 The Scientific Committee welcomed the considerable information that was submitted on the developmental phase of a US-flagged krill fishing operation and reiterated its requirement for continued submission of detailed information from krill fishing fleets at all phases of their development (SC-CAMLR-XX, paragraph 2.4).

4.10 The Scientific Committee further welcomed the market analysis reported by the US krill fishing operation as well as technological information from patent databases in an effort to understand the potential development of the fishery. Apparent trends include the increased use of krill for aquaculture and pharmaceutical products over human consumption; developments in harvesting methods that may enable production of new products derived from krill; and the expansion of interest from traditional fishing nations to companies from other countries in the development of new products derived from krill (Annex 4, paragraphs 2.43 to 2.50).

4.11 The Scientific Committee recognised the importance of identifying the market factors critical to the krill fishery and to evaluate how these might be monitored to assess the development potential of the fishery. Several factors were identified in this regard; these included:

(i) the advisability of subscribing to a commercial source for market prices and other information;

(ii) obtaining information on factors that might affect the development of the krill fishery, such as the possible movement of under-utilised large fishing trawlers in the northern hemisphere to the krill fishery in the Southern Ocean;

(iii) development of competence necessary to access and interpret economic, marketing and technological information; and

(iv) monitoring the demand for aquaculture feeds and development of krill fisheries elsewhere in the world (Annex 4, paragraphs 2.45, 2.71 and 2.73).

Forecasting Closure of the Fishery

4.12 In response to a request by the Commission (CCAMLR-XX, paragraph 4.16) regarding mechanisms to forecast closure of the krill fishery, the Scientific Committee noted that a shorter reporting interval than that currently in place would be required to avoid a potential 30% overshoot.

4.13 Drs Kawaguchi and K. Shust (Russia) stressed that since the current level of catch is still well below the precautionary catch limit, it should not be an urgent task to change the reporting system. Dr Kawaguchi suggested that, as the predicted catch forecast approaches the precautionary catch limit for krill, then the reporting periods should be changed accordingly.

4.14 The Scientific Committee questioned whether it was appropriate that the frequency of data reporting in the krill fishery should be related to the forecast level of catch given the lack of data on which to make accurate predictions (see paragraph 4.7). It also noted that this requirement should be included in the fishery plan as part of the regulatory framework.

4.15 In addition, the Scientific Committee noted that the subdivision of the precautionary catch limit of krill in Area 48 into SSMUs (paragraph 3.17) will require a greater degree of fine-scale reporting than currently required.

Data Reporting

4.16 The Scientific Committee noted that the consistency and timeliness of data reporting was deteriorating. The low level of data submission and the timing of those submissions meant that important relevant aspects of the work of the Scientific Committee were not able to proceed (Annex 4, paragraph 2.64 to 2.68 and 2.74).

4.17 The Scientific Committee reaffirmed the need for detailed data on catch and effort from krill fisheries, and for the timely submission of such data using a consistent format. The SSMU Workshop (Annex 4, Appendix D) had demonstrated the utility of such data especially in relation to the development of key potential mechanisms for the precautionary management of the krill fishery and for the delineation of SSMUs.

4.18 The Scientific Committee recognised the important contribution made by Japanese data to the SSMU Workshop (Annex 4, paragraph 2.21) which highlights the need to have such data available to the work of WG-EMM.

4.19 The Scientific Committee noted that monthly catch data (with no specified format) and STATLANT data were the only types of mandatory data required from krill fisheries, which made these fisheries inconsistent with all others managed by CCAMLR. The Scientific Committee also recognised the importance of data collected by scientific observers. It was agreed that these data complemented the detailed catch and effort data being sought from the krill fisheries. However, the irregular collection of observer data limited the scope of analyses based on such data (Annex 4, paragraphs 5.43 and 5.47).

4.20 The debate over the submission of detailed data for the krill fishery is longstanding, having been initiated at SC-CAMLR-VII in 1988. In recognition of this, the Scientific Committee indicated the importance of identifying the reasons for the difficulty in resolving the issue, in particular to examine the extent to which it was either not possible to collect the data or whether there were issues relating to the validation and submission of data.

4.21 The information presented by the US-flagged krill fishing operation provided an indication that it is possible to make such data available to the work of WG-EMM. Consequently, advice is sought from the Commission on how to implement the Scientific Committee's requirement for submission of detailed catch and effort data to the Secretariat (Annex 4, paragraphs 2.74, 5.50, 5.51, 5.57 and 5.60).

4.22 The Scientific Committee agreed that there were compelling reasons for requiring detailed data for krill fisheries. In recognising the need for, and utility of, detailed data for the krill fishery, the Scientific Committee requested that a subgroup convened by Dr Kawaguchi develop formalised data reporting requirements that address the formats and frequencies for those data required for the work of the Scientific Committee that it is reasonable to collect from the krill fishery.

4.23 The Scientific Committee noted the current inconsistencies in data reporting between different Members operating in the krill fishery and also noted the need for detailed data reporting when the precautionary catch limit for krill in Area 48 is subdivided into SSMUs.

4.24 The Scientific Committee recommended that the current reporting requirement of monthly catch data by FAO statistical area be maintained.

4.25 In addition, the Scientific Committee recommended that catch and effort data aggregated over 10 x 10 n mile squares by 10-day periods be reported for the entire fishing season no later than 1 April of the following year.

4.26 The Scientific Committee further recommended that these reporting requirements be considered as interim requirements.

4.27 When the precautionary catch limit for krill in Area 48 is subdivided among SSMUs, the Scientific Committee recommended that reporting of haul-by-haul data by 10-day periods be required.

Fish Resources

Status and Trends

Fishing Activity in the 2001/02 Season

4.28 Nine fisheries, including two exploratory fisheries, were carried out for finfish under conservation measures in force during the fishing season of 2001/02. These included fisheries for *D. eleginoides* and *C. gunnari* in Subarea 48.3 and Division 58.5.2, and exploratory fisheries for *Dissostichus* spp. in Subareas 88.1 and 88.2. Other fisheries for *D. eleginoides* occurred in the EEZs of South Africa (Subareas 58.6 and 58.7) and France (Subarea 58.6 and Division 58.5.1) by trawl and longlines.

4.29 The Scientific Committee noted that catches of target species had been described in Annex 5, Table 3.1; these had been updated to 18 October 2002 and reported in SC-CAMLR-XXI/BG/1. The Scientific Committee agreed that only catches within the Convention Area available at the start of the Scientific Committee meeting will be considered, and that future Scientific Committee meetings will use this approach.

4.30 Catches of all target species within the Convention Area by Member country are shown in Table 2 for the 2001/02 fishing season, and Table 3 for the 2000/01 fishing season.

Reported Catches of *Dissostichus* spp.

4.31 Reported catches of *Dissostichus* spp. are shown in Tables 2 and 3. Inside the CCAMLR Convention Area a total of 12 817 tonnes was reported during the 2001/02 season compared with 13 725 tonnes in the previous season. Catches outside the Convention Area were 25 054 tonnes during the 2001/02 season compared with 33 918 tonnes in the previous season. This information is detailed in Annex 5, Table 5.30. Most of this catch was reportedly taken from Areas 51, 57 and 87.

Estimates of Catch and Effort from IUU Fishing

4.32 To mitigate confusion arising from multiple data formats on total removals due to IUU fishing, all information has been standardised to fishing season.

4.33 For subareas and divisions other than Subarea 48.3, WG-FSA used the approach adopted in recent years to estimate the magnitude of IUU fishing effort and catches of *Dissostichus* spp. during the 2001/02 fishing season. In Subarea 48.3, the IUU catch of fish for the past three seasons was estimated using a simulation model that uses estimates of the encounter frequency of a fisheries protection vessel.

4.34 The estimated unreported catch for all subareas and divisions in the Convention Area was 10 898 tonnes (Annex 5, Table 3.2). This compares to an estimated IUU catch of 8 802 tonnes in the 2000/01 season. The estimated unreported catch within the Convention Area was some 46% of the total catch in 2001/02 compared with 39% in 2000/01. When the 25 054 tonnes of toothfish reported via the CDS as caught outside the Convention Area are added, the total global removal of toothfish in the 2001/02 season is estimated at 48 769 tonnes, compared to 56 445 tonnes during the 2000/01 season.

4.35 The Scientific Committee reviewed the historical trends in IUU activity and evaluation of the threats arising from IUU fishing presented in Annex 5, paragraphs 5.202 to 5.223. It expressed concern that continued IUU pressure would increase the potential for catastrophic and precipitous declines in stock biomass, and result in dramatic changes in estimates of sustainable yield as demonstrated in Figure 4.

4.36 The Scientific Committee noted the advice of WG-FSA outlined in Annex 5, paragraphs 5.224 to 5.227. The Working Group was principally concerned about the continued high levels of catch reported from Area 51. Drs Shust and Goubanov pointed out that Russia and Ukraine have biological and seabed information from the Indian Ocean sector (Area 51) that could assist the Scientific Committee in better determining the likelihood of such large catches from Area 51. Dr Shust informed the Scientific Committee that an analysis of sea floor bathymetry and seabed area calculations from 500 to 2 000 m in this area have been undertaken by Russia and will be reported to WG-FSA in 2003.

4.37 A preliminary analysis was undertaken by WG-FSA to address the feasibility of such large catches from Area 51 (Annex 5, paragraphs 5.210 to 5.212). The Working Group concluded it was extremely unlikely that such large catches could be taken from the limited available seabed area. There was strong agreement from the Scientific Committee that catches reported from Area 51 were IUU removals from the Convention Area. This has severe consequences both for the assessment of sustainable yields in areas adjacent to the Convention Area, and for the viability of toothfish populations into the future.

4.38 Dr K. Sullivan (New Zealand) observed that this was the first time IUU fishing had been estimated for Subarea 88.1 (Annex 5, Table 3.2). He noted that there was no direct evidence (vessel sightings) to confirm that IUU fishing had occurred, but accepted that it was precautionary to include this catch. Mr Watkins pointed out a windy buoy had been observed, but no fishing gear.

4.39 The Scientific Committee was asked by WG-FSA (Annex 5, paragraph 5.225) to provide comment on whether the assessments currently conducted by the Working Group are adequate with respect to IUU fishing, and if not what additional calculations might be required.

4.40 The Scientific Committee discussed the potential of including estimates of projected IUU catches in assessments of fish species in the Convention Area. Mr Jones pointed out that including projected IUU catches in the assessment could substantially reduce the yield that would be available for the legal fisheries. Further, there would be considerable uncertainty in future estimates of IUU catches. Dr Constable and Prof. J. Beddington (UK) agreed with the points of Mr Jones. They also noted that estimating IUU catch is outside the expertise of WG-FSA, and would be a topic best addressed by a technical subgroup that includes members from SCOI, WG-FSA and the Scientific Committee.

4.41 The Scientific Committee agreed that the current process for updating the stock assessments each year with the latest estimates of IUU fishing was the best practice at present.

Fish Biology/Demography/Ecology

4.42 The Scientific Committee welcomed a number of important contributions on the biology, demography and ecology of finfish resources which had been presented to WG-FSA. The Scientific Committee endorsed the use of separate background documents on the biology and demography of target species in the form of species profiles, and agreed that these profiles should be updated annually for use by WG-FSA and the Scientific Committee. The species profile for *Dissostichus* spp. is located in SC-CAMLR-XXI/BG/30, and for *C. gunnari* in SC-CAMLR-XXI/BG/29. The Scientific Committee thanked Dr Everson for his hard work during the intersessional period in preparing these documents.

4.43 It was noted that the method used to estimate cohort strength from length densities is dependent on the growth rates of the fish. This had contributed significantly to the uncertainties associated with the assessments of *C. gunnari* in Subarea 48.3 (paragraph 4.76) and Division 58.5.2 (paragraph 4.89). It was noted that during the intersessional period further work is planned on estimating the age of icefish from otoliths. It is hoped that this will lead to a workshop meeting in 2004 at which age determination methods can be agreed.

Developments in Assessment Methods

4.44 The Scientific Committee endorsed the use of a background document to describe the development and use of assessment methods employed by WG-FSA. This background document (SC-CAMLR-XXI/BG/28) will be updated each year as new approaches are explored and adopted by WG-FSA.

4.45 The Scientific Committee welcomed the progress toward making assessment software used during WG-FSA available to more participants through seminars and tutorials conducted during WG-FSA. The Scientific Committee thanked Dr Constable for his work to broaden the use of the assessment software, including tutorials to WG-FSA.

Research Surveys

4.46 Four trawl surveys and one acoustic survey of demersal fish species were carried out during the 2001/02 fishing season (Annex 5, paragraphs 3.38 to 3.43).

4.47 In particular, the Scientific Committee noted the development of promising acoustic techniques developed by Russia to survey *C. gunnari* in Subarea 48.3. The Scientific Committee encouraged the further development of the acoustic technique for assessing fish stocks, and recommended the establishment of an intersessional subgroup on fisheries acoustics. The objectives of the subgroup would be to evaluate the application of acoustics methods in estimating biomass of exploited fish in the CCAMLR Convention Area. In particular, the subgroup would be asked to re-examine the acoustic data from acoustic surveys to provide robust estimates of biomass, confidence intervals and age composition.

4.48 Dr E. Barrera-Oro (Argentina) drew the attention of the Scientific Committee to the trammel net research sampling conducted by Argentina throughout a total period of 20 years on King George and Nelson Islands in the South Shetland Islands and on the west coast of the Antarctic Peninsula. These studies demonstrated that after the commercial fishery numbers of juvenile *N. rossii* in Subarea 48.1 remain at low levels (Barrera-Oro et al., 2000; Casaux et al., 2000). He noted that these results were consistent with the conclusions from the research survey of Subarea 48.1 carried out by Germany and the US AMLR Program, that stocks of *N. rossii* appear to have not recovered (Annex 5, paragraphs 3.41, 5.131 and 5.132).

Assessment and Management Advice

Assessed Fisheries

D. eleginoides at South Georgia (Subarea 48.3)

4.49 The catch limit for the fishery for *D. eleginoides* in Subarea 48.3 in the 2001/02 season was 5 820 tonnes (Conservation Measure 221/XX). The total catch of *D. eleginoides* from this fishery, as reported by 18 October 2002 in the catch and effort reporting system, was 5 618 tonnes, most of which had been taken by longline.

4.50 The assessment of long-term annual yield for *D. eleginoides* for Subarea 48.3 was updated using the GYM. Several changes were incorporated during the WG-FSA-02 assessment, including a change in the GYM software to take account of the different timing of recruitment (Annex 5, paragraph 4.5), a new catch series (Annex 5, Table 5.9), the addition of the 2002 UK survey estimates of toothfish recruitment, new estimates of recent IUU catch, new estimates of fishing vulnerability at age and an updated CPUE series. The resulting precautionary estimate of long-term annual yield was 7 810 tonnes.

4.51 Dr Shust expressed several concerns about the assessment, and reiterated the concerns of Dr P. Gasiukov (Russia), made during WG-FSA, which are summarised in Annex 5, paragraph 5.81. He expressed concerns over the high degree of uncertainty in estimates of recruitment, natural mortality rate and selectivity at age. He also noted that alternative assessments using the dynamic production model and age-structured production models had produced much lower estimates of standing stock and yields to those of the GYM. Furthermore, that in some years substantial numbers of immature fish were taken in the fishery.

4.52 Dr Kock underscored the concerns expressed during WG-FSA as summarised in Annex 5, paragraphs 5.69 and 5.70. The primary concern was the substantial increase in yield in the current assessment based on the results of a single trawl survey. He pointed out that small increases in catchability between surveys could have a large effect on estimates of yield from the GYM. Dr E. Marschoff (Argentina) agreed that small variations in research survey design can have significant impacts on estimates of recruitments resulting in large variations in catch limits from year to year. He recommended, as a precautionary approach, to maintain catch limits at the current level. Dr Sullivan noted that there has been a 50% decline in the standardised CPUE (Annex 5, Figure 5.3).

4.53 Prof. Beddington noted that the GYM is already a very conservative approach to estimating long-term yield. He remarked that some of the assumptions of the more classical quantitative approaches employed by Dr Gasiukov, such as initial equilibrium conditions, were known to be violated during the analysis. Regarding the standardised CPUE trajectory, Prof. Beddington indicated that the decline was primarily due to a high level of IUU catch. He further pointed out that since the late 1990s, when the GYM procedure had been used as a basis for setting catch limits, there has been a slight increase in the CPUE trend.

4.54 Dr Constable noted that the GYM assessment approach is accepted as a precautionary approach that takes account of many of these uncertainties and is the same approach that has been used in recent years. He reiterated that WG-FSA encouraged the evaluation of alternative assessment techniques for use by WG-FSA, and that they will be discussed at the meeting of the Subgroup on Assessment Methods during the intersessional period. He also remarked that classical assessment methods had been used by WG-FSA prior to 1995, but at the Workshop on Methods for the Assessment of *D. eleginoides* this new method was developed for *D. eleginoides* because of the problems known to be evident in those classical methods.

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

4.55 The Scientific Committee recommended that the catch limit for *D. eleginoides* for the 2002/03 fishing season be set at 7810 tonnes. It also noted the points raised by several Members in paragraphs 4.49 to 4.54.

4.56 The remaining provisions of Conservation Measure 221/XX should be carried forward for the 2002/03 season.

4.57 Any catch of *D. eleginoides* taken in other fisheries (such as the pot fishery) in Subarea 48.3 should be counted against this catch limit.

D. eleginoides at South Sandwich Islands (Subarea 48.4)

4.58 No new information was made available to WG-FSA for *D. eleginoides* in Subarea 48.4 (South Sandwich Islands) on which to base an update of the assessment.

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

4.59 The Scientific Committee recommended that Conservation Measure 180/XVIII be carried forward for 2002/03. As with last year, the Scientific Committee recommended that the situation in this subarea be reviewed with a view to considering the period of validity of the existing assessment. However, the Scientific Committee noted the advice of WG-FSA that, given the high workload at its meetings, the Working Group was unlikely to be able to review this measure in the near future.

D. eleginoides at Kerguelen (Division 58.5.1)

4.60 The Scientific Committee was not able to consider any updated assessments or give advice on *D. eleginoides* population status or exploitation in Division 58.5.1 (Kerguelen) because recent haul-by-haul data had not been provided. The Scientific Committee endorsed the recommendation of WG-FSA that these data, as well as any other information that would help determine the current stock status, should be made available for assessment purposes.

4.61 Prof. G. Duhamel (France) informed the Scientific Committee that the fishery inside the French EEZ is in the process of changing from a trawl fishery to a longline fishery. He further noted that there had been a substantial decline in trawl CPUE that could not be attributed to legal catches. He offered to provide haul-by-haul data for Division 58.5.1 and Subarea 58.6 to the CCAMLR Secretariat in the near future.

4.62 The Scientific Committee thanked Prof. Duhamel for providing information on the current status of the fishery in Division 58.5.1, and looked forward to the submission of the haul-by-haul data. It agreed that the presence of a French scientist and comprehensive information from the fishery at WG-FSA is essential for undertaking an assessment of the status of *Dissostichus* spp. stocks in Division 58.5.1 and adjacent areas such as the Crozet Island region (Subarea 58.6).

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

4.63 The catch limit of *D. eleginoides* in Division 58.5.2 for the 2001/02 season was 2 815 tonnes (Conservation Measure 222/XX) for the period from 1 December 2001 to the end of the Commission meeting in 2002. The catch reported for this division at the time of the Scientific Committee meeting was 1 812 tonnes. It is expected that the catch limit will be reached before the end of the current fishing season.

4.64 The GYM assessment was updated using the new series of total removals and new estimates of recruitment from a 2002 trawl survey. The estimate of precautionary long-term annual yield was 2 879 tonnes.

4.65 Prof. Beddington noted that Australia's notification of a longline fishery in Division 58.5.2 would require WG-FSA to consider the different gear selectivities in future assessments. Dr Constable referred to the work undertaken by WG-FSA in 1999, which considered the implications of catch limits for different gear types in the same management area (SC-CAMLR-XVIII, Annex 5, paragraph 4.75). Dr Kirkwood noted that the use of trawl selectivity in the GYM was the more precautionary approach (Annex 5, paragraph 5.16).

4.66 The Scientific Committee endorsed the view of WG-FSA that the assessments of yield for *D. eleginoides* arising from the survey and other work on the Heard Island Plateau were solely applicable to *D. eleginoides* on the plateau. Thus, it was agreed that the advice from these assessments pertains to the area in Division 58.5.2 west of 79°20'E (Annex 5, paragraph 5.91).

Management Advice for *D. eleginoides* (Division 58.5.2)

4.67 The Scientific Committee recommended that the catch limit for Division 58.5.2 in the 2002/03 season be revised to 2 879 tonnes, representing the long-term annual yield estimate from the GYM. This catch limit is recommended to pertain only to the assessment area which is to the west of 79°20'E.

4.68 The Scientific Committee noted that the introduction of longline fishing to Division 58.5.2 (CCAMLR-XXI/10) could involve a change in the assessment in future years. However, the Scientific Committee recommended the general application of the catch limit above to trawl and longline operations, as this is a suitable precautionary approach at this stage (Annex 5, paragraph 5.16).

4.69 The remaining provisions of Conservation Measure 222/XX should be carried forward for the 2002/03 season.

D. eleginoides in Subarea 58.7

Prince Edward Islands EEZ

4.70 The Scientific Committee welcomed the assessment of *D. eleginoides* in the South African EEZ around the Prince Edward Islands described in Annex 5, paragraphs 5.126 to 5.128. The Scientific Committee noted that this assessment indicated that *D. eleginoides* stocks in the EEZ since 1996 have been subject to high levels of illegal catch leading to a sharp decline in the longline CPUE. It also showed that spawning stock biomass has been depleted to only a few percent of the pre-exploitation level. The Scientific Committee further noted that ultimately projections suggest that the annual allowable catch in the Prince Edward Islands EEZ could be up to 400 tonnes. However, such a catch level would depend on target levels of recovery that may be adopted by the Commission. It was noted that the changes in length composition might lead to conclusions different to those reliant on the CPUE data alone, and that further analysis would be reported to WG-FSA in 2003.

4.71 The Scientific Committee expressed concern about the continuation of this fishery given the extremely low estimated level of current spawning biomass relative to pre-exploitation levels. Mr Watkins stated that the area had been subject to significant IUU fishing in the past, and that the presence of a fishing vessel would act as a deterrent to IUU fishing activity.

Outside Prince Edward Islands EEZ

4.72 The Scientific Committee recommended that the prohibition of directed fishing for *D. eleginoides* in Subarea 58.7 (Conservation Measure 160/XVII) should continue.

C. gunnari at South Georgia (Subarea 48.3)

4.73 The catch limit for the fishery for *C. gunnari* in Subarea 48.3 in the 2001/02 season was 5 557 tonnes (Conservation Measure 219/XX). The total catch of *C. gunnari* from this fishery, as reported by 18 October 2002 in the catch and effort reporting system, was 2 656 tonnes.

4.74 The assessment followed the short-term projection method to update catch limits for the 2002/03 season (Annex 5, paragraphs 5.102 to 5.109). The assessment was updated using information derived from trawl surveys conducted by Russia and the UK in 2002. WG-FSA re-estimated the potential bias of the gears and agreed to a correction factor of 1.241 to be applied to the UK survey results. A difference of this magnitude was consistent with the differences between the trawl headline heights of the UK and Russian trawls.

4.75 Length densities from the UK and Russian surveys were analysed using the CMIX program to estimate numbers of fish at age. Concern was expressed by the Scientific Committee at the difficulty experienced in identifying 4-year-old fish in either the Russian or UK data. It agreed that the methods used to separate the cohorts for the purposes of assessment be reviewed by WG-FSA at its next meeting (paragraph 4.43).

4.76 The Scientific Committee agreed that the problems may be addressed by the age determination from otolith samples. It reiterated the importance of obtaining reliable age determinations in *C. gunnari* to assist with these assessments, and strongly encouraged the continuation of age and growth studies of *C. gunnari* during the intersessional period.

4.77 In view of the low estimate of biomass, Dr Marschoff considered it appropriate to afford to this stock the same degree of protection given to other stocks of the species by closing the fishery. He queried whether the food value of the catch is commensurate with the conservation issues at stake.

4.78 Prof. Beddington noted that this latter question is not within the remit of the Scientific Committee.

4.79 In response to Dr Marschoff's first point, Dr Shust noted that the icefish biomass in Subarea 48.3 from the Russian and UK surveys in 2002 is lower compared to the one from the acoustic survey. In general, the biomass was in excess of 40 000 tonnes and it cannot be considered low compared to recent years.

4.80 The results of the assessment indicated a projected yield of 2 181 tonnes in year 1 and 1 361 tonnes in year 2.

4.81 Dr V. Sushin (Russia) expressed concern that the bottom trawl surveys underestimated the biomass of *C. gunnari*. He suggested that recent changes in environmental conditions may have resulted in a change of the vertical distribution of *C. gunnari* stocks. More importantly, he noted that the acoustic method provides a more realistic estimate of standing stock throughout the water column than within the depth range sampled by bottom trawls. Arising from this, the standing stock estimate used to calculate the catch limit was significantly lower than the true biomass. Accordingly, he was very disappointed that the results of Russian acoustic surveys had not been used in the assessments, even though these results had been analysed and agreed on at a workshop in Cambridge, UK, in September 2002. He suggested that the results of the abovementioned acoustic survey be used by WG-FSA in 2003 for the assessment of total allowable catch for icefish.

4.82 The Scientific Committee agreed that a substantial proportion of the biomass is in the water column and was not available to the bottom trawl. However, it noted that WG-FSA recognised that additional uncertainties, such as target strength, mark identification and species composition introduce uncertainty, and potential bias, into the acoustic biomass estimate (see Annex 5, paragraphs 5.96 to 5.101). Time constraints and the lack of acoustic expertise meant it was not possible to resolve these issues at the WG-FSA meeting. Consequently, it was also not possible to derive new estimates of biomass and confidence intervals that would allow the use of these data in assessments.

4.83 The Scientific Committee strongly endorsed further development of the use of acoustic surveys for estimating the abundance of this species as it seems likely to be an important method for future assessments. It further recommended an intersessional workshop to directly address issues surrounding the use of acoustic methods to estimate the biomass of *C. gunnari* for use in the assessment of precautionary yield.

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

4.84 The Scientific Committee recommended that the precautionary catch limit for icefish in 2002/03 should be set at 2 181 tonnes.

4.85 The Scientific Committee had no information from which to consider or revise its advice of 2001 in respect of the current seasonal limitation in Conservation Measure 219/XX. It therefore recommended that these aspects of the conservation measure should be unchanged.

4.86 The Scientific Committee recommended the continuation of other aspects of Conservation Measure 219/XX, except for aspects subject to consideration of recommendations in paragraphs 5.42 to 5.50, including that it may be appropriate to reconsider whether bottom trawl gear might be permitted under appropriate conditions (Annex 5, paragraphs 5.113, 6.202 and 6.233(iii)).

C. gunnari at Kerguelen Islands (Division 58.5.1)

4.87 The Scientific Committee noted that icefish surveys in Division 58.5.1 have been conducted between 1996/97 and 2001/02 (WG-FSA-02/65), and that these surveys indicate that the biomass of *C. gunnari* is currently at low levels. The Scientific Committee also noted that the fishery for *C. gunnari* within the French EEZ of Division 58.5.1 would remain closed in the 2002/03 season (see also Annex 5, paragraph 5.84).

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

4.88 The Scientific Committee noted the details of the 2001/02 fishing season for *C. gunnari* in Division 58.5.2 (Annex 5, paragraphs 5.115 and 5.116). The catch limit for the 2001/02 season was 885 tonnes. The reported catch up to 18 October 2002 was 850 tonnes.

4.89 The assessment followed the short-term projection method to update catch limits for the 2002/03 season also used for this species last year (see Annex 5, paragraphs 5.118 to 5.120). Given the difficulties in separating ages 3 and 4 fish (paragraph 4.75), WG-FSA agreed as a precautionary approach to assume the cohort was comprised of 4-year-olds.

4.90 The catch limit satisfying the agreed criteria is 5 130 tonnes over two years. This is made up of 2 980 tonnes in the first year and 2 150 tonnes in the second year.

4.91 A cohort of 1-year-old fish was observed which may become legal size towards the end of the 2003/04 fishing season. The Scientific Committee agreed that WG-FSA should consider next year how unassessed cohorts might be able to be protected from being exploited prior to being assessed.

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

4.92 The Working Group agreed that the total catch limit should be revised to 2 980 tonnes for the period from 1 December 2002 to 30 November 2003.

4.93 The remaining provisions of Conservation Measure 220/XX should be carried forward to the 2002/03 season.

Other Finfish Fisheries

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

4.94 The Scientific Committee noted that WG-FSA considered other finfish fisheries in Subareas 48.1 (Antarctic Peninsula) and 48.2 (South Orkney Islands). Based on the results of a bottom trawl survey conducted by Germany in 2002 in Subarea 48.1, there appears to be little scope to reopen the fisheries in the two subareas in the near future given the comparatively low biomass of the abundant fish species.

Management Advice (Subareas 48.1 and 48.2)

4.95 The Scientific Committee endorsed the advice of WG-FSA that Conservation Measures 72/XVII and 73/XVII should remain in force.

Electrona carlsbergi (Subarea 48.3)

4.96 No new information was made available to WG-FSA on which an update of the previous assessment could be based. The Scientific Committee agreed that WG-FSA revise the assessment for *E. carlsbergi* at its 2003 meeting.

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

4.97 The Scientific Committee agreed that provisions of Conservation Measure 223/XX should be retained and carried forward to the 2002/03 season.

Fishery Closure Mechanism

4.98 The Scientific Committee reviewed the method for predicting fishery closure dates (Annex 5, paragraph 5.123 to 5.125). It recommended that the Secretariat continue to estimate future catches to predict closure dates, but that in applying the method it should incorporate information available to it on future vessel movements into its estimation of future effort on a trial basis. This will increase the accuracy of the prediction of closure dates, which in turn should reduce the level of under- or overshoot of the catch limit.

4.99 The Scientific Committee also noted that when there were a large number of vessels fishing in an area with a small catch limit, the timing of the fishery closure would be administratively difficult to manage (paragraph 4.105).

New and Exploratory Fisheries

New and Exploratory Fisheries in 2001/02

4.100 Thirteen conservation measures relating to exploratory fisheries were in force during 2001/02, but fishing only occurred in respect of three of these. In most of the active exploratory fisheries, the numbers of days fished and the catches reported were small. The notable exception was the exploratory fishery for *Dissostichus* spp. in Subarea 88.1 conducted under Conservation Measure 235/XX. During 2001/02 vessels from New Zealand took 1 275 tonnes of *Dissostichus* spp. south of 65°S.

New and Exploratory Fisheries Notified for 2002/03

4.101 Eight notifications of new or exploratory fisheries were made for 2002/03, and Australia also notified the commencement of a longline fishery for *D. eleginoides* in Division 58.5.2. All notifications had been received by the Secretariat by the due date, except for the Russian notification, for which only a statement of intent to submit had been received. The formal Russian notification was received on 6 September 2002.

4.102 The Scientific Committee noted that the longline fishery for *D. eleginoides* in Division 58.5.2 notified by Australia was not formally a new or exploratory fishery, but rather the introduction of a new fishing gear to an established fishery. The Scientific Committee welcomed the approach taken by Australia in providing advance notification of the proposed fishery and of the management provisions planned for that fishery.

4.103 There were multiple notifications of exploratory fisheries for *Dissostichus* spp. for several subareas or divisions (Annex 5, Table 5.2). While this is of potential concern, the Scientific Committee also noted that the experience of previous years suggested many of these may not be activated. The Scientific Committee noted in particular that notifications (sometimes multiple) have been made every year since 1997 for Subarea 48.6, but none have yet been activated.

4.104 The Scientific Committee also noted that there are still inconsistencies in the way in which notifications specified intended catch levels. As was the case again last year, some notifications attempted to specify realistic levels of intended catches, while others simply specified an intended catch that was equal to the current precautionary catch limit. While this inconsistency continues, the task of assessing the likely effects of multiple new or exploratory fisheries in an area is made much more difficult.

4.105 There have been a large number of notifications for Subareas 48.6, 88.1 and 88.2 and Division 58.4.4. 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 in high latitudes where fishing imposes considerable operational difficulties. In Subarea 88.2 the catch limit set at CCAMLR-XXI could potentially be taken in a short time or be overshot if all notified vessels participate. In Division 58.4.4, if all five notified vessels participate and achieve typical daily catch rates, it may be administratively impossible for the Secretariat to close the fishery before the catch limit set at CCAMLR-XXI has been taken.

4.106 In relation to Division 58.4.4, Dr Constable also noted that this area is believed to have been subject to high levels of IUU fishing. He considered that more information is needed about the state of *D. eleginoides* stocks in this area before any further fishing is allowed. Mr Watkins agreed and suggested that the Commission consider designation of a marine protected area in the region if Division 58.4.4 were closed to fishing. The Scientific Committee endorsed these views.

4.107 The Scientific Committee noted that there are additional administrative problems in managing conservation measure provisions for fishing in fine-scale rectangles and SSRUs when many vessels are fishing simultaneously in a subarea or division, particularly in terms of identifying when a vessel is considered to be resident in an area. Mr Watkins also noted that, while minimum soak times are set for fishing in fine-scale rectangles, no corresponding maxima are set. This needs clarification, since longer soak times are associated with larger by-catches.

4.108 The assessment of *D. eleginoides* in the Prince Edward Islands EEZ (paragraphs 4.70 and 4.71) suggested that the stock in that area had been greatly reduced from its unexploited level primarily by IUU fishing. This raises major concerns about the status of *D. eleginoides* stocks throughout Subareas 58.6 and 58.7. The catch limit for exploratory fisheries in Subarea 58.7 outside EEZs is currently zero. The Scientific Committee agreed that exploratory fisheries notified for Subarea 58.6 in 2002/03 should not proceed until appropriate information on stock status, such as from a stock survey, became available. Mr Watkins advised that South Africa would submit some new information on stocks in this area for consideration at next year's meeting.

4.109 With regard to provision of advice on precautionary catch limits for stocks likely to be subject to new or exploratory fisheries in 2002/03, the Working Group agreed that this would only be possible this year for Subareas 88.1 and 88.2. For all the other subareas and divisions for which notifications have been made, the Working Group is unable to provide any new advice on precautionary catch limits.

Precautionary Catch Limits

Subareas 88.1 and 88.2

4.110 Using new data resulting from the exploratory fishery in Subarea 88.1, estimates of precautionary yields for this subarea have been calculated by SSRU. These estimates are given in Annex 5, Table 5.3. The estimated yield for Subarea 88.1 has more than doubled since last year to 13 882 tonnes. This increase was due to the large increase in CPUE in Subarea 88.1 in 2001/02, as well as the increased recruitment estimates for Subarea 48.3.

4.111 Using new data resulting from the exploratory fishery in Subarea 88.2, an estimate of precautionary yield of 602 tonnes for this subarea has been calculated (Annex 5, Table 5.4). The Scientific Committee noted that this yield estimate applies only to SSRU A.

4.112 The Scientific Committee agreed that the revised estimates of yield for Subareas 88.1 and 88.2 should be treated with considerable caution and that a discount factor should again be applied to the results of these assessments. In this respect, it noted that discount factors of 0.3 and 0.5 had been used for *D. mawsoni* in Subarea 88.1 in the last two years. Recent catches, catch limits and estimated yields for each SSRU are given in Annex 5, Table 5.4. Mr Jones suggested that, in light of the uncertainties associated with this estimate of precautionary yield, another possible alternative would be to leave the catch limits at the same level at which they were set last year.

4.113 The Scientific Committee recognised that the approach employed by WG-FSA to estimate precautionary yield in Subareas 88.1 and 88.2 may have reached a point where the limitations had outweighed the efficacy.

4.114 The Scientific Committee noted the views of WG-FSA that the CPUE series used in the current assessments of Subareas 88.1 and 88.2 should not be updated further. This emphasises the importance of the research component of the exploratory fisheries in these subareas. The Scientific Committee therefore encouraged further research on recruitment, and on the most effective means of deploying effort. In particular, the Scientific Committee strongly encouraged continuation of mark–recapture experiments by New Zealand and all other Members who fish in these subareas in 2002/03.

Incidental Mortality

4.115 Consideration of new and exploratory fisheries from the perspective of seabird incidental mortality was undertaken by ad hoc WG-IMAF (Annex 5, paragraphs 6.162 to 6.178 and Table 6.9; SC-CAMLR-XXI/BG/21) and is reported in paragraphs 5.38 to 5.40.

Crab Resources

4.116 In the 2001/02 season a single Japanese vessel undertook commercial pot fishing for crabs in Subarea 48.3. The fishery targeted two species, *Paralomis spinosissima* and *P. formosa*, in accordance with Conservation Measure 225/XX. The vessel conducted fishery-based research in accordance with Conservation Measure 226/XX and Annex 226/A (see Annex 5, paragraphs 5.139 to 5.142). The total catches were 56 and 57 tonnes of *P. spinosissima* and *P. formosa* respectively.

4.117 The Scientific Committee noted that there was insufficient information available to conduct a rigorous stock assessment on either species, but recognised the value of the experimental harvest.

4.118 The Scientific Committee agreed that there was insufficient new biological information on size at maturity to warrant a revision of Conservation Measure 225/XX pertaining to the minimum retention size of crabs. The Scientific Committee endorsed the request of WG-FSA that all existing data on male cheliped height and length be submitted to CCAMLR, and a more comprehensive analysis of male size at maturity be conducted.

Advice to the Commission

4.119 The Scientific Committee recommended that Conservation Measure 226/XX remain in force.

4.120 Following a proposal from the Japanese Delegation, the Scientific Committee recommended a revision of paragraph 6 of Conservation Measure 225/XX (SC-CAMLR-XXI/BG/19 Rev. 3). This will allow observers to sample crabs after sorting, providing the observer is given unrestricted access to the catch for proper random sampling. It was emphasised that the observer should continue to sample the whole catch prior to sorting as well as sampling after sorting.

Squid Resources

4.121 The Convener of WG-FSA reported that no notification had been submitted for the *Martialia hyadesi* fishery for the 2002/03 season. He also reported that the Working Group agreed that Conservation Measure 238/XX should be retained and carried forward for the 2002/03 season.

INCIDENTAL MORTALITY

5.1 The Scientific Committee reviewed the report of ad hoc WG-IMAF. It endorsed the report and its conclusions and the plan of intersessional work (Annex 5, Appendix D), subject to the comments set out below, and drew these to the attention of the Commission.

Incidental Mortality of Seabirds during Regulated Longline Fishing in the Convention Area in 2002

5.2 The Scientific Committee noted that:

(i) for Subarea 48.3 only six birds were reported killed; the total estimated seabird by-catch in 2002 was only 27 birds at a rate of 0.0015 birds/thousand hooks, very similar to the values of the last two years (Annex 5, paragraph 6.9 and Table 6.3);

(ii) no observed seabird by-catch was reported from within the South African EEZ in Subareas 58.6 and 58.7, a substantial reduction from the estimated 199 birds last year (Annex 5, paragraph 6.10). The causes of this marked improvement are unknown, although fishing effort was greatly reduced (Annex 5, paragraphs 6.11 and 6.12); and

(iii) no incidental mortality of seabirds was observed in Subarea 88.1 for the fourth successive year, nor in Subarea 88.2, due to strict compliance with conservation measures (Annex 5, paragraph 6.13).

5.3 The Scientific Committee noted that, based on reported data, levels of seabird by-catch in the Convention Area had been the lowest ever recorded. It thanked all those involved in conducting and managing fishing operations for their efforts in achieving this excellent result.

5.4 It expressed concern at the absence of data from the French EEZs in Subarea 58.6 and Division 58.5.1 in 2002, especially given the very high rates of by-catch of white-chinned petrels reported from these areas for the 2000 and 2001 seasons (Annex 5, paragraphs 6.14 and 6.15).

5.5 Prof. Duhamel indicated that French scientists continued to address this issue in the manner described last year (SC-CAMLR-XX, paragraph 4.34), but the problem of by-catch of white-chinned petrels persisted. He indicated that the data for 2002 would be submitted in time for the meeting of WG-IMAF next year and that an appropriate expert from France would attend the meeting.

5.6 On behalf of WG-IMAF, Prof. Croxall welcomed this response. He noted that the strict application of Conservation Measure 29/XIX now appeared to have reduced seabird by-catch to very low levels in the South Africa EEZ in Subarea 58.6, which also involved fishing during the times of year of highest risk of seabird by-catch. If France could provide information on the precise details of the seabird mitigation measures in use on their vessels, then it should be possible for appropriate experts within the WG-IMAF group to collaborate in identifying ways in which seabird by-catch could be reduced to levels comparable with those in other parts of the Convention Area. It was hoped that this interaction might take place during the intersessional period so that the outcome could be discussed at next year's meeting.

Compliance with Conservation Measure 29/XIX

5.7 The Scientific Committee noted that, overall, compliance with this conservation measure this year, compared to last year, was substantially improved in all subareas and divisions and was again complete in Subarea 88.1. In Subarea 48.3, one vessel fully complied with all elements of this measure at all times and eight other vessels were at least 95% compliant with all elements of this conservation measure (Annex 5, paragraph 6.28).

5.8 It noted that this overall improvement involved better compliance with streamer line design (though some vessels still did not use them on all sets) (Annex 5, paragraphs 6.18 and 6.212(ii)); that only 1% of line setting had occurred during daytime (Annex 5, paragraph 6.21), and that there had been major improvements in line weighting, whereby compliance in Subareas 48.3 and 58.6/58.7 respectively had improved from zero in 2000 to 21% and 18% in 2001 and to 63% and 66% in 2002 (Annex 5, paragraph 6.24).

5.9 The Scientific Committee recognised that, for the first time, most vessels longline fishing in the Convention Area had managed to comply (at least at the 95% level) with Conservation Measure 29/XIX. Furthermore, full compliance could easily have been achieved with small improvements to operational practice.

Research into and Experience with Mitigating Measures

5.10 The Scientific Committee noted:

(i) significant progress with the development of integrated weights for autoline vessels in achieving the sink rates required under Conservation Measure 216/XX; and that tests under operational conditions are due in November 2002 (Annex 5, paragraphs 6.50 and 6.51);

(ii) mixed results from the tests of the underwater setting chute (Annex 5, paragraphs 6.60 to 6.64);

(iii) important advice concerning offal retention and discharge (Annex 5, paragraph 6.65); and

(iv) that based on successful experiences outside the Convention Area, paired streamer lines and boom-and-bridle design streamer lines should be used in the Convention Area (Annex 5, paragraphs 6.71 to 6.75).

5.11 It recognised that the research to develop integrated weights for longlines, involving collaboration between Australia, New Zealand and a major manufacturer of longline fishing gear from Norway, had potentially worldwide implications for improving the efficiency of mitigation measures based on achieving rapid initial sinking of longlines.

5.12 The information that in 82 days of longline fishing by one vessel in Subarea 48.3 an estimated total of 15 828 fish heads was discarded with fish hooks still in them (Annex 5, paragraph 6.67) was viewed with great concern. The Scientific Committee recommended that a requirement to remove fish hooks from discarded material should be added to Conservation Measure 29/XIX when it is next revised (Annex 5, paragraph 6.69); it commended the initiative on Chilean vessels of a bounty scheme for retrieving hooks (Annex 5, paragraph 6.70) and encouraged the emulation of this as widely as possible.

5.13 Noting the importance of experimental research to determine the most appropriate mitigation measures for use on vessels employing the Spanish longlining method (Annex 5, paragraph 6.76), the Scientific Committee was disappointed that the detailed proposal to address this (WG-FSA-02/30) had been unsuccessful in acquiring sufficient funding. It recollected the Commission’s strong support for this experiment (CCAMLR-XX, paragraph 6.26) and urged Members to assist in facilitating the financing and undertaking of this study.

5.14 The Scientific Committee endorsed the need to ensure that when new longline fishing vessels are built, their design should take account of features which would ensure or facilitate reduced levels of incidental mortality of seabirds. It drew the Commission’s attention to detailed advice in this regard (Annex 5, paragraph 6.84) and endorsed the request to France to provide relevant information on the design of its five newly commissioned vessels (Annex 5, paragraph 6.85).

Revision of Conservation Measure 216/XX

5.15 The Scientific Committee recommended a minor revision to the bottle test element of this measure as set out in Annex 5, paragraph 6.81.

Revision of Conservation Measure 29/XIX

5.16 The Scientific Committee noted the advice that full proposals for revision of several elements of this measure (those relating to streamer lines, line weighting for autoliners and hooks in offal) are likely to be developed next year (Annex 5, paragraph 6.82); some specific indications of likely proposals, together with recommendations for data collection that would assist the revision of this conservation measure, are set out in Annex 5, paragraph 6.83.

Assessment of Incidental Mortality of Seabirds during IUU Longline Fishing in the Convention Area

5.17 The Scientific Committee noted that:

(i) the estimates of potential IUU seabird by-catch by area for 2002 (Annex 5, paragraph 6.219(i); SC-CAMLR-XXI/BG/23) were:

Subarea 48.3:	10–20 to 50–70 seabirds;
Subareas 58.6 and 58.7:	5 900–8 000 to 10 800–14 400 seabirds;
Divisions 58.5.1 and 58.5.2:	24 300–32 600 to 43 900–59 100 seabirds;
Division 58.4.4:	8 100–10 900 to 14 700–19 700 seabirds; and
Subarea 88.1:	100–200 seabirds;

(ii) the overall estimated total for the whole Convention Area in 2002 (Annex 5, paragraph 6.96) of potential seabird by-catch in the IUU fishery was 39 000–52 000 (lower level) to 70 000–93 000 birds (higher level). This is broadly consistent with values from previous years (see Annex 5, Figure 6.2; SC-CAMLR-XXI/BG/23); and

(iii) since 1996 the overall total estimated potential seabird by-catch is 278 000–700 000 seabirds, comprising 74 000–144 000 albatrosses, 13 000–24 000 giant petrels and 203 000–378 000 white-chinned petrels (Annex 5, paragraph 6.99).

5.18 It noted that although the figure in the Working Group report (Annex 5, Figure 6.2) gave a clear illustration of the potential by-catch levels in each of the last seven years, it would be improved by also showing the estimates of cumulative potential seabird by-catch across the same period. It requested that these data be added to the figure and the result incorporated into the Scientific Committee's report (Figure 5). The Scientific Committee also requested WG-IMAF to consider how such cumulative data might be presented in the future.

5.19 The Scientific Committee drew the attention of the Commission to these data, endorsing the statement of the Working Group that such levels of mortality remain entirely unsustainable for populations of albatrosses, giant petrels and white-chinned petrels breeding in the Convention Area (Annex 5, paragraph 6.100), many of which are declining at rates where extinction is possible (SC-CAMLR-XX, paragraph 4.53). It requested the Commission to take even more stringent measures to combat IUU fishing in the Convention Area (Annex 5, paragraph 6.101).

5.20 The Scientific Committee emphasised the importance of assessing the effect of the removal by IUU fishing of these large numbers of seabirds on the populations of albatrosses, giant petrels and white-chinned petrels breeding in the Convention Area. The Scientific Committee recommended that WG-IMAF examine this issue at its next meeting.

5.21 Because the seabird mortality through potential IUU by-catch will affect juvenile as well as adult birds, the consequences, in terms of measurable changes in breeding populations, will continue to be evident for at least another decade (because of the long-delayed sexual maturity of these species), even if IUU fishing ceased next year. The potential effect of this is that IUU fishing is creating potential changes in seabird populations which are currently unlikely to be redressed, without prompt, effective and comprehensive action within the time span prescribed under Article II of the Convention.

5.22 It was also noted that it was possible that future reductions in estimated by-catch rates of seabirds might simply be attributable to the reduced size of the populations of seabirds at risk, rather than to genuine improvements in fishing practice.

Incidental Mortality of Seabirds during Longline Fishing outside the Convention Area

5.23 The Scientific Committee noted that:

(i) reports were received from Argentina, Chile, Falkland/Malvinas Islands, South Africa and Uruguay on rates of seabird by-catch observed in longline fisheries operating in areas adjacent to the Convention Area (Annex 5, paragraphs 6.103 to 6.107) and that these rates were generally at least an order of magnitude greater than those prevailing in regulated longline fisheries in the Convention Area; and

(ii) a review of the spatio–temporal trends of longline fishing effort in the Southern Ocean concluded that a combination of the consistently high effort (250 million hooks per annum) in the regulated fisheries and the substantial increase in IUU fishing, threatens the long-term viability of many Southern Ocean seabird species (Annex 5, paragraph 6.108).

5.24 The Scientific Committee noted that few, if any, Members had responded to SC CIRC 02/07 (COMM CIRC 02/22) requesting summary data relating to longline fishing in areas adjacent to the Convention Area, on:

(i) longline fishing effort (at least at the scale of FAO area) in each type of longline fishery;

(ii) rates of incidental mortality of seabirds associated with each longline fishery and details of the species involved;

(iii) mitigating measures in use in each fishery and the extent to which any of these are voluntary or mandatory; and

(iv) the nature of observer programs, including observer coverage, associated with each fishery.

5.25 Although Japan had not responded to this request, its example, in introducing the mandatory use of streamer lines on its vessels targeting southern bluefin tuna (SC-CAMLR-XX, paragraph 4.66) was commended. Members were urged to follow this example in this and other longline fisheries where Convention Area seabirds are killed and to implement other mitigating measures (such as those in Conservation Measure 29/XIX) in such fisheries.

5.26 The Scientific Committee endorsed the recommendation of the Working Group that responses should continue to be sought on seabird by-catch levels, mitigation measures in use (and whether voluntary or mandatory) and observer programs from all Members and other countries conducting or permitting longline fishing in areas where seabirds from the CCAMLR Convention Area are killed (Annex 5, paragraph 6.109).

Research into the Status and Distribution of Seabirds at Risk

5.27 The Scientific Committee endorsed the recommendation that Members continue to submit data on:

(i) size and trends of populations of albatross species and of *Macronectes* and *Procellaria* petrels vulnerable to interactions with longline fisheries;

(ii) the foraging ranges of populations of these species adequate to assess overlap with areas used by longline fisheries;

(iii) genetic research relevant to determining the origin of birds killed in longline fisheries; and

(iv) information on the extent and location of their seabird by-catch collections to facilitate the development of collaborative research to investigate the origins of birds killed (Annex 5, paragraphs 6.125 and 6.126);

in order that SC-CAMLR-XXI/BG/22 may be updated and a comprehensive review of these topics undertaken by the Working Group at next year's meeting (Annex 5, paragraphs 6.110 and 6.112 to 6.115).

5.28 It noted that information submitted this year indicated that:

(i) potential increases in the population of black-browed albatrosses at Heard Island had occurred over the last 50 years (Annex 5, paragraph 6.116);

(ii) survival rates of adult wandering albatrosses breeding at Marion Island were negatively correlated with the Japanese longline fishing effort in relevant parts of the Southern Ocean (Annex 5, paragraph 6.117);

(iii) albatrosses breeding in Chile forage in the Convention Area at certain times of year (Annex 5, paragraphs 6.118 to 6.121); and

(iv) studies of population size, trends and foraging ranges are still inadequate for many seabird species in the Convention Area threatened by longline fishing mortality, especially white-chinned petrels (Annex 5, paragraph 6.122).

International and National Initiatives relating to Incidental Mortality of Seabirds in relation to Longline Fishing

5.29 The Scientific Committee noted:

(i) that the USA was hosting a second IFF meeting, to address issues of seabird (and turtle) by-catch in fisheries, in November 2002, following the successful inaugural meeting in New Zealand in 2000. It encouraged Members to support this meeting by facilitating attendance of fishers and fishery managers; and

(ii) the expectation that the Agreement on the Conservation of Albatrosses and Petrels (ACAP) might enter into force in 2003 (SC-CAMLR-XXI/BG/20); it encouraged all relevant Members who have not done so to sign and/or ratify the agreement as soon as possible.

5.30 The Scientific Committee noted that last year the Commission agreed 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). In relation to the latter element, CCAMLR made a particular effort to contact intersessionally all relevant RFMOs (Annex 5, paragraphs 6.140 to 6.141) in order to acquire information on the steps they were taking in respect of seabird by-catch mitigation that would, *inter alia*, reduce the mortality of Convention Area seabirds.

5.31 The Scientific Committee noted that responses received to date had been limited and rather unsatisfactory (Annex 5, paragraphs 6.142 to 6.151 and 6.225). It recognised that the primary obligation of RFMOs managing fisheries in areas adjacent to the Convention Area was to ensure the sustainable use of the relevant fish stocks; however it expressed concern that for some of these bodies the issue of by-catch in general (and of seabird by-catch in particular) received no consideration at their formal meetings, nor did mechanisms exist for some of these bodies to acquire relevant data on the topic. This was viewed as potentially inconsistent with the proper responsibilities of such RFMOs, and unlikely to be appropriate in relation to obligations set out under the newly ratified UNFSA.

5.32 ASOC expressed surprise at the difficulties that the Scientific Committee had experienced obtaining data from these RFMOs, given that many CCAMLR Members were also members of these bodies. It noted that, in addition to the legitimate interest of CCAMLR, Antarctic Treaty States also had obligations under the Protocol on Environmental Protection to the Antarctic Treaty in relation to 'dependent and associated ecosystems' – which seem reasonably to include at least parts of the areas of application of these RFMOs. ASOC hoped that the Scientific Committee would report to the Commission on these difficulties, and seek its action at a political level to improve the prospects of acquiring the information sought from the relevant RFMOs.

5.33 The Scientific Committee encouraged CCAMLR members of and observers to relevant RFMOs to continue reporting on activities relating to seabird by-catch and to press for inclusion of this topic on RFMO agendas (Annex 5, paragraph 6.154).

5.34 It noted that some indication of a potential positive response to the intersessional provision of documentation to observers had been received from ICCAT (Annex 5, paragraphs 6.143 and 6.144), which had received resolutions to address incidental mortality of seabirds from Brazil, China, European Community, Japan and the Republic of Korea. It encouraged all Members of CCAMLR who are represented at ICCAT to strengthen and support these proposals.

5.35 The Scientific Committee also noted the very slow progress in the development of NPOAs under FAO's IPOA-Seabirds and even slower progress in implementation (Annex 5, paragraph 6.244(iii)).

5.36 It again requested Members, especially Argentina, Brazil, Chile, European Community (whose plan is apparently still only at the preliminary draft proposal stage), France (in respect of overseas territories) and Uruguay to submit reports on their progress towards developing and implementing NPOAs with particular reference to actions that would mitigate by-catch of seabirds from the Convention Area (Annex 5, paragraphs 6.135 to 6.138).

5.37 It welcomed the news that Japan was considering a general review of the seabird by-catch problem in advance of the COFI meeting in 2003 (see Annex 5, paragraph 6.137(iv)).

Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries

5.38 The Scientific Committee noted that:

(i) Of the 24 exploratory longline fisheries approved for 2001/02, only two, in Subareas 88.1 and 88.2, were operational in 2001/02; no seabird by-catch was reported in either of these fisheries (Annex 5, paragraphs 6.166 and 6.167).

(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 in SC-CAMLR-XXI/BG/21. There were no changes to this advice in relation to levels of risk of seabird by-catch for any part of the Convention Area. However, the potential for exemptions for daylight setting in areas of lower risk to seabirds has been incorporated into the advice (Annex 5, paragraphs 6.171 to 6.174).

(iii) The 21 proposals by five Members for new and exploratory longline fisheries in eight subareas/divisions of the Convention Area in 2002/03 were addressed in respect of issues relating to seabird incidental mortality, taking account of the advice in SC-CAMLR-XXI/BG/21 and Annex 5, Table 6.9.

5.39 The Scientific Committee noted that the only potential problems apparently needing to be resolved (Annex 5, paragraphs 6.170 and 6.176 to 6.178 and Table 6.9) were:

(i) to check that Russia intends to comply with Conservation Measures 235/XX and 236/XX in Subareas 88.1 and 88.2;

(ii) the need to define the nature and status of birds caught in relation to the limits on seabird by-catch (Annex 5, paragraph 6.176); and

(iii) the potential need to specify appropriate levels of observation to detect accurately low levels of bird by-catch (Annex 5, paragraphs 6.177 and 6.178).

5.40 Russia indicated its intention to comply fully with Conservation Measures 235/XX and 236/XX in Subareas 88.1 and 88.2. This response, and the other two recommendations in paragraph 5.39, were drawn to the attention of the Commission.

Other Incidental Mortality

5.41 The Scientific Committee noted that in the Convention Area in 2002:

(i) there were no reports of marine mammal mortality in the longline fishery;

(ii) one southern elephant seal was reported killed by a trawl vessel in Division 58.5.2 (Annex 5, paragraphs 6.179 and 6.184);

(iii) one penguin was found dead in the net of a krill trawler in Subarea 48.2 (Annex 5, paragraph 6.182); and

(iv) no instances of incidental mortality of marine mammals or seabirds had been recorded in the pot fishery for crabs in Subarea 48.3 (Annex 5, paragraph 6.183).

5.42 In respect of trawl fishing for icefish in Subarea 48.3 in 2002, the Scientific Committee noted that:

(i) 125 seabirds were entangled, at least 73 fatally, three times the estimated total seabird by-catch mortality for all regulated longline fishing in Subarea 48.3 in 2002 (Annex 5, paragraphs 6.185 to 6.190);

(ii) all vessels engaged in the fishery caught seabirds; detailed observations indicate that seabirds were caught when they became entangled in the large mesh at the mouth of the midwater trawls (Annex 5, paragraphs 6.198 and 6.200); and

(iii) despite vessel-specific differences in levels of seabird by-catch the main problem appears to be gear-related and associated with the use of midwater trawls during the period from December to March in Subarea 48.3 (Annex 5, paragraphs 6.199, 6.201 and 6.204).

5.43 It recollected that last year, in order to restrict seabird by-catch in this fishery to low levels, pending the collection of data to propose appropriate mitigation measures, the Commission decided that an interim precautionary seabird by-catch limit of 20 birds per vessel trawl fishing for icefish in Subarea 48.3 would be appropriate (CCAMLR-XX, paragraphs 6.38 and 6.39).

5.44 It noted that seabird by-catch levels in 2002 were similar to those last year (132 entangled, 92 fatally). In 2002 two vessels appeared to have reached the by-catch limit and a third vessel closely approached it (Annex 5, paragraph 6.189).

5.45 It endorsed the recommendations of the Working Group that:

(i) further data be collected to try to define appropriate mitigating measures for the icefish trawl fisheries in Subarea 48.3, continuing the work recommended by the Commission last year (CCAMLR-XX, paragraph 6.37);

(ii) unless the levels of seabird by-catch in the icefish fishery can be more effectively mitigated, consideration should be given to restricting the fishing season, at least during the main chick-rearing period of black-browed albatrosses and white-chinned petrels (January–March) (Annex 5, paragraph 6.206); and

(iii) there is a need to define precisely what is meant by the number of birds caught and to take account of this in any review of the seabird by-catch limit (Annex 5, paragraph 6.207).

5.46 The Scientific Committee noted the recommendation (relating to Annex 5, paragraph 6.215(iii)) that it may be appropriate to reconsider the need to continue to prohibit the use of bottom trawl gear in Subarea 48.3 (Annex 5, paragraph 6.202).

5.47 It was recollected that this conservation measure was originally enacted to provide protection for populations of finfish species, notably by-catch species, which had been reduced to low levels. Nowadays, issues relating to by-catch of non-target species are customarily addressed in conservation measures by some combination of catch limits and 'move-on' rules.

5.48 However, it was noted that by-catch species, with the exception of rays, skates and macrourids in certain areas, have not been assessed for 10 years, a subject to which WG-FSA may need to give timely attention.

5.49 The use of bottom trawl gear also raises concerns of damage to benthos, although appropriate configuration of fishing gear may reduce this (Annex 5, paragraphs 5.191 to 5.194).

5.50 The Scientific Committee agreed that, taking the above issues into account, it would be appropriate to review relevant conservation measures and to develop advice on the use of bottom trawl gear, taking into account issues relating to the by-catch of seabirds and non-target fish species, and potential damage to benthos.

Advice to the Commission

5.51 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 or advice, as well as topics which may contain the potential for action now or in the near future).

General Advice

5.52 The Commission is requested to note:

(i) levels and rates of seabird by-catch in regulated longline fisheries in the Convention Area in 2002 (paragraphs 5.2 and 5.3);

(ii) levels of compliance with Conservation Measure 29/XIX in 2002 (paragraphs 5.7 to 5.9);

(iii) progress with research on mitigation measures relevant to Conservation Measure 29/XIX (paragraph 5.10);

(iv) estimates of potential seabird by-catch associated with IUU longline fishing in the Convention Area in 2002 (paragraphs 5.17, 5.21 and Figure 5); and

(v) levels of seabird by-catch in fisheries other than longline fisheries in the Convention Area in 2002 (paragraphs 5.41 and 5.42).

5.53 The Commission is requested to endorse:

(i) reaffirmation of support for – and encouragement of Members' contributions towards – a key experiment concerning mitigation measures for the Spanish system of longline fishery (paragraph 5.13);

(ii) renewed attempts to acquire data from Members involved in longline fishery operations in areas adjacent to the Convention Area (paragraphs 5.24 to 5.26) and requests to Members to develop provisions for the mandatory use of mitigation measures in such fisheries, following the example of Japan (paragraph 5.25);

(iii) the need for continued submission by Members of data on seabird population sizes, foraging ranges and provenance of by-catch (paragraph 5.27);

(iv) support for forthcoming international initiatives, especially IFF2 and ACAP (paragraph 5.29); and

(v) renewed attempts to obtain progress reports on the development and implementation of FAO NPOAs from Members with responsibilities for areas adjacent to the Convention Area or conducting fisheries in these areas (paragraph 5.35 to 5.37).

Specific Advice

5.54 The Commission is requested to provide advice, and consider taking action, as appropriate, in respect of:

(i) suggested revisions to Conservation Measure 216/XX (paragraph 5.15);

(ii) outline of potential revisions to Conservation Measure 29/XIX (paragraphs 5.12 and 5.16; Annex 5, paragraph 6.83);

(iii) guidance, in respect of consideration of mitigation measures for seabird by-catch, for the construction of new longline vessels (paragraph 5.14; Annex 5, paragraph 6.84);

(iv) taking even more stringent measures to combat IUU fishing in the Convention Area in order to protect populations of seabirds at serious risk (paragraph 5.19);

(v) further steps to request RFMOs, with competences in areas adjacent to the Convention Area, to take action in respect of mitigation of seabird by-catch (paragraphs 5.30 to 5.35);

(vi) advice in relation to proposals for new and exploratory longline fisheries in the Convention Area in 2002 (paragraphs 5.38 to 5.40);

(vii) advice concerning the conduct of trawl fisheries for icefish in Subarea 48.3 (paragraph 5.45); and

(viii) advice concerning conservation measures relating to the use of bottom trawl gear (paragraphs 5.46 to 5.49).

Other By-catch Species

5.55 At last year's meeting, the Scientific Committee identified a number of key issues relating to by-catch species that needed urgent attention (SC-CAMLR-XX, paragraph 5.101). These included:

- assessment of the status of by-catch species or groups, particularly macrourids and skates and rays;

- assessment of the impact of fisheries on by-catch species; and

- consideration of mitigation measures.

5.56 Annex 5, paragraphs 5.154 to 5.163 deal with attempts to estimate a potential yield for a number of important by-catch species and areas. Sufficient biological data were available to make a preliminary estimate of ? (an estimate of the proportion of the pre-exploitation biomass that would be available for harvesting) for *Macrourus whitsoni* in Subarea 88.1 and for *M. carinatus* in Division 58.5.2.

5.57 For the former, the estimate of ? was 0.022, which would result in a median escapement of 0.74 and a probability of depletion of 0.10; and for the latter ? was estimated at 0.032, representing a median escapement of 0.51 and a probability of depletion of 0.10.

5.58 To estimate a precautionary yield requires an estimate of pre-exploitation biomass (B_0) as well as a value of ?. There is no estimate of B_0 for *M. whitsoni* in Subarea 88.1, and so it was not possible to estimate a precautionary yield. For *M. carinatus* in Division 58.5.2, however, B_0 could be estimated by pro-rating the density of *M. carinatus* on the neighbouring BANZARE Bank to the area within a suitable depth range in Division 58.5.2. Using this estimate of B_0 and applying the value of ? calculated above, gave an estimate of long-term annual yield of 465 tonnes. The Scientific Committee noted, however, that the value of natural mortality (M) may be too low and suggested that sensitivity tests of the assessment to variations of M and other parameters be conducted intersessionally for *M. carinatus* in Division 58.5.2 and *M. whitsoni* in Subarea 88.1.

5.59 Dr Constable noted that WG-FSA had been unable to undertake any assessments on skates and rays because of a lack of new data on biological parameters. He noted that at last year's meeting (SC-CAMLR-XX, paragraph 5.112) it was agreed that an interim measure to regulate by-catch of skates and rays for the forthcoming year would be 5% of the catch limit of the target species. The Scientific Committee noted that it was unable to provide new advice. It was also recalled that the application of by-catch limits is to provide adequate protection for by-catch species, with the understanding that the fishery takes steps to reduce by-catch rates. These limits with their attendant uncertainties should not be used as an indication of long-term sustainable yield. For Division 58.5.2 it was recalled that at the 1997 meeting the long-term yield for skates and rays was estimated at 120 tonnes (SC-CAMLR-XVI, paragraphs 5.119 to 5.121).

Estimated Total Removals

5.60 Estimates of total removals of by-catch species are discussed in Annex 5, paragraphs 5.170 to 5.179. The modified observers logbook and forms as recommended in SC-CAMLR-XX, paragraph 5.97, were not uniformly used in the 2001/02 season. The Scientific Committee reiterated its recommendation that all observers consistently use the current logbook and forms, and that by-catch is reported by fishing season instead of split-year.

5.61 Data on total removals of macrourids and skates and rays were available for the trawl fisheries in Division 58.5.2 and the longline fisheries in Subareas 58.6, 58.7 and 88.1 and Division 58.5.1. In Division 58.5.2 a total of 95 tonnes of by-catch was caught in the *D. eleginoides* fishery and 46 tonnes in the *C. gunnari* fishery between the 1996/97 and 2001/02 split-years, representing 1% and 2% respectively of the total catch weight in these fisheries. In the 2001/02 split-year, 5 tonnes of macrourids and 2 tonnes of skates and rays were caught in both fisheries.

5.62 In Subareas 88.1 and 88.2 the percentage of macrourids and skates and rays has ranged from 1 to 27% and 1 to 15% respectively between years and SSRUs. In the 2001/02 season *M. whitsoni* and skates and rays accounted for 12 and 2% respectively of the total catch.

5.63 Annex 5, Table 5.25 summarises the by-catch of macrourids and skates and rays by subarea or division for the 2001/02 season. Macrourids constitute about 10% of total catch in most areas, and skates and rays less than 10%. The higher figure in Subarea 58.7 is due to the low catch of target species. Total removals could not be estimated for Subarea 48.3 because reliable observer data on by-catch were not available for the whole fleet.

5.64 The Scientific Committee noted that the seabed area in Division 58.5.1 is roughly comparable to that in Division 58.5.2, and that the estimate of total removals of macrourids in Division 58.5.1 approaches the estimate of yield calculated for *M. carinatus* for Division 58.5.2. It further noted that the by-catch levels in Division 58.5.2 which are low in the current trawl fishery may increase if longlining proceeds in this division during the next fishing season.

Comparison of By-catch Datasets

5.65 The Scientific Committee noted that the reporting by observers of skates and rays either discarded from the vessel or cut off the longline before coming on board is inconsistent, and reiterated that complete information on by-catch of skates and rays should be reported, as provided for in the format of the current observer logbook and forms. Also, the STATLANT data appear to substantially underestimate by-catch in most fisheries and the quality of by-catch information from fine-scale catch and effort datasets (Form C2) is variable. These factors lead to sometimes large inconsistencies between data from observer reports, Form C2 and STATLANT.

Operation of Precautionary Measures

5.66 Conservation measures include two types of provisions to limit the level of by-catch: limits on the total removal of by-catch species by area, and ‘move-on’ provisions whereby a vessel must leave an area for a defined period if a specified amount of by-catch is exceeded in a single haul. The number of times the ‘move-on’ rule was triggered in Subarea 88.1 and Division 58.5.2 was evaluated.

5.67 In Subarea 88.1 during the 2001/02 season, total by-catch limits per fine-scale rectangle were not exceeded, and the ‘move-on’ rule was triggered by macrourids in up to

20% of longline sets, and by skates and rays in up to 4% of sets. Alternative trigger rates were examined, but the current trigger level of one tonne per haul was agreed to be still appropriate. In Division 58.5.2 the 'move-on' rule was only triggered on two occasions over the last four fishing seasons, in line with the low reported levels of by-catch, and does not hinder fishing operations unduly.

Measures to Reduce By-catch

5.68 The Scientific Committee agreed that the potential impact of fishing operations on benthic habitats is important for future consideration, and encouraged the quantitative reporting of benthic invertebrate by-catch in all fisheries in order to improve available information.

5.69 In this respect the Scientific Committee appreciated reports that benthos by-catch can be substantially reduced in trawl fisheries, for example, by using rubber discs instead of steel bobbins on the ground gear.

5.70 The Scientific Committee also noted that tagging experiments in Subarea 88.1 suggest that skates survive return to the water after capture and their mouth parts can heal from hook damage. The Scientific Committee would welcome further reports from tagging of skates and rays and on the survivorship of skates and rays following capture and release in the fisheries (Annex 5, paragraph 5.193).

5.71 It was also suggested that setting longline hooks a few metres above the seabed could reduce by-catch of skates and rays in some cases. Prof. C. Moreno (Chile), however, suggested that such a proposal could compromise the line-weighting regime necessary to minimise incidental mortality of seabirds, and careful thought would be necessary before such a measure was put into effect.

Management Advice

5.72 Estimates of γ for *M. whitsoni* and *M. carinatus* suggest that these species have relatively low productivity and may be vulnerable to overexploitation.

5.73 In order to undertake assessments for by-catch species, more information is required, especially for macrourids and skates and rays, on:

- estimates of standing stock;
- taxonomic descriptions of important species;
- length–mass relationships;
- age and growth parameters;
- reproductive information; and
- tagging studies on as many species as possible, where appropriate.

5.74 The estimate of precautionary yield for *M. carinatus* in Division 58.5.2 (465 tonnes) should be taken as the precautionary by-catch limit.

5.75 The precautionary by-catch limit of 120 tonnes should be adopted for skates and rays in Division 58.5.2.

5.76 In the SSRUs for other statistical areas, the by-catch of skates and rays should be set at 5% of the catch limit for *Dissostichus* spp. in that area, or 50 tonnes, whichever is the greater. Biological data should be submitted as soon as possible in order to evaluate more scientifically based by-catch limits at next year's WG-FSA meeting.

5.77 It is important to report the level of by-catch, including discarded skates, as accurately as possible in all forms of data submission.

5.78 Whenever possible during longlining operations, live skates and rays should be cut from the line while still in the water, and vessels should be encouraged to develop methods to minimise by-catch of these species.

ADDITIONAL MONITORING AND MANAGEMENT ISSUES

Proposal for Extension of CEMP Sites

6.1 No proposals for extensions of CEMP sites had been submitted to the meeting of WG-EMM-02.

Marine Debris

6.2 Last year the Scientific Committee and Commission adopted new standard reporting formats for marine debris (SC-CAMLR-XX, paragraph 4.101; CCAMLR-XX, paragraph 6.4).

6.3 The Scientific Committee also recommended that data provided by Members on:

(i) surveys of marine debris on beaches;
(ii) entanglement of mammals in marine debris; and
(iii) marine debris associated with seabird colonies;

for sites where at least five years of validated standard data exist (SC-CAMLR-XX, paragraph 4.101(v)(a–c)) would be incorporated into the CCAMLR database; other validated data would be archived in electronic formats (SC-CAMLR-XX, paragraph 4.102).

6.4 The Secretariat was also requested to prepare an annual report on status and trends relating to all the main aspects of marine debris related observations provided to the Scientific Committee (SC-CAMLR-XX, paragraph 4.99(iv)).

6.5 The Secretariat tabled a report summarising the data relating to marine debris submitted by Members to the CCAMLR database using the standard formats (SC-CAMLR-XXI/BG/13).

6.6 In 2002 data on surveys of marine debris were submitted by Norway, Uruguay and the UK. The UK also submitted data on entanglement of marine mammals (SC-CAMLR-XXI/BG/13, Table 1).

6.7 The Scientific Committee recollected that the request to the Secretariat referred to a report on the status and trends relating to all of the main aspects of marine debris related observations (SC-CAMLR-XX, paragraph 4.99(iv)). It noted that SC-CAMLR-XXI/BG/13 represented an inventory of the data rather than a report of status and trends shown in the data.

6.8 The Scientific Committee requested the Secretariat to produce a report of status and trends relating to all the main aspects of marine debris related observations following procedures and principles analogous to those used in the preparation of reports of the status and trends arising from the data submitted to CEMP.

6.9 In addition, the Scientific Committee encouraged Members to update the CCAMLR database with historical data collected using standard methods. It recommended that the Secretariat enter into the CCAMLR database historical data, collected using standard methods, that have already been reported to the Scientific Committee, and consult with relevant Members to ensure appropriate data validation.

Surveys of Marine Debris on Beaches

6.10 Standardised surveys of marine debris on three beaches in the vicinity of Artigas Base, King George Island (Subarea 48.1), were reported by Uruguay in SC-CAMLR-XXI/BG/35. All the items recovered were considered to be derived from all operations conducted in the Convention Area.

6.11 Prof. D. Torres (Chile) reported that debris had been collected at 36 beaches at Cape Shirreff, Livingston Island (Subarea 48.1), but that these data had not been submitted to the Secretariat. Prof. Torres indicated that the items collected were principally associated with fishing activities and included a large number of packaging bands, ropes and net.

6.12 Dr E. Fanta (Brazil) indicated that, since 1992, Brazil had reported on marine debris at Admiralty Bay, King George Island. In 2001/02 the new CCAMLR standard reporting form was officially adopted by the Brazilian Antarctic Program and data will be submitted regularly to the Secretariat in the forthcoming intersessional period.

6.13 During the 11th year of standardised beach surveys of man-made debris at Bird Island, South Georgia, a total of 290 items was collected during the period 1 October 2000 to 30 September 2001 (SC-CAMLR-XXI/BG/3). This represents a 33% decrease on the total of 408 items recorded in 1999/2000 and the lowest level during summer (147 items) since 1995. This was the first year in which the number of items collected in summer and winter was almost equal. Nylon line/braid and debris associated with fisheries remained the major component of all marine debris collected.

6.14 During 2001/02 the 12th annual beach debris survey was carried out at Signy Island, South Orkney Islands (SC-CAMLR-XXI/BG/5). A total of 39 items was collected, the largest number of items since 1999/2000. Plastic waste was predominant and there was an increase in the number of plastic packaging bands (eight) from the single record in the previous season, an abrupt change to what has otherwise been a declining trend since 1993/94.

6.15 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 that are installed on all of those vessels.

6.16 The Scientific Committee noted that packaging bands continue to be reported in debris surveys in Area 48 but that they may derive from IUU vessels or fisheries in adjacent areas rather than indicating use in the regulated fisheries in the Convention Area.

Entanglement of Marine Mammals in Marine Debris

6.17 The number of entanglements of Antarctic fur seals (*Arctocephalus gazella*) at Bird Island, South Georgia (Subarea 48.3), during the winter of 2001 and summer 2001/02 showed an increase from recent years, the number of entanglements during winter (20) were the same as in the previous year, however, the number of entanglements during summer (48) increased by 118% (SC-CAMLR-XXI/BG/4). Plastic packaging bands and synthetic string (nylon braid) accounted for the majority of all entanglements in both winter and summer. Loops of nylon string/braid, as used in longline fishing, is now the most frequently recorded entangling material, whilst numbers of entanglements involving plastic packaging bands are comparable with those before CCAMLR established measures to prohibit their use.

6.18 During the sixth annual survey of entanglement of marine mammals at Signy Island, South Orkney Islands (Subarea 48.2), there was a single sighting of an entangled Antarctic fur seal (SC-CAMLR-XXI/BG/6). This follows a year in which no entanglements were recorded at this site.

6.19 Prof. Torres indicated that there had been a total of five incidents of entanglements of Antarctic fur seals at Cape Shirreff, Livingston Island (Subarea 48.1), during December 2001 and January 2002.

Marine Debris associated with Seabird Colonies

6.20 A single record of a dead Adélie penguin (*Pygoscelis adeliae*) found entangled in fishing net was reported from King George Island (Subarea 48.1) (SC-CAMLR-XXI/BG/35).

6.21 In the ninth year of standardised reporting of marine debris associated with seabird colonies at Bird Island, South Georgia (Subarea 48.3), fewer hooks and other longline fishery discards were recorded in association with wandering albatrosses compared to last year, but the number of items (63) remains well above the average recorded over the period 1994 to 2002 (SC-CAMLR-XXI/BG/7).

Seabirds and Marine Mammals Soiled with Hydrocarbons

6.22 In October 2001 a black-browed albatross returning to a breeding colony at Bird Island, South Georgia (Subarea 48.3), had small patches of heavy black oil on its underparts (SC-CAMLR-XXI/BG/7).

Submission of Data on Marine Debris

6.23 The Scientific Committee again requested Members to submit data on standard forms in a timely fashion as this would allow the Secretariat to produce a report that would greatly simplify consideration of this topic by the Scientific Committee.

Marine Mammal and Bird Populations

6.24 At its sixth meeting the Scientific Committee decided to review the status of trends in marine mammal and bird populations every three to five years. The Scientific Committee noted that the last review took place in 2000. Information relevant to such a review included a survey of Antarctic fur seal pup production in the South Shetland Islands (paragraph 3.8; Annex 4, paragraphs 3.49 and 3.50) and data provided in material submitted to ad hoc WG-IMAF (Annex 5, paragraphs 6.110 to 6.126; SC-CAMLR-XXI/BG/22).

Management Areas

6.25 Dr Constable introduced Australia's proposal to separate William's Ridge as a separate management area from the Heard Island Plateau area in Division 58.5.2 (SC-CAMLR-XXI/7). The proposal was based on the separation of this ridge from the plateau by waters deeper than 2 000 m, which are deeper than the depth range used by WG-FSA to delimit the biological management areas of toothfish stocks. The Scientific Committee recommended that William's Ridge should be considered a separate management unit from the Heard Island Plateau area at 79°20'E.

MANAGEMENT UNDER UNCERTAINTY

7.1 The Scientific Committee noted the steps which had been taken from last year (SC-CAMLR-XX, paragraph 7.1) to further develop the unified framework for providing management advice on all fisheries in the Convention Area. As part of the regulatory framework, fishery plans have been compiled and submitted to the Scientific Committee in SC-CAMLR-XXI/BG/32.

7.2 The Scientific Committee thanked the Convener of WG-FSA, Dr Everson, for his considerable intersessional effort in producing the first draft of species profiles of the most important commercial species, *D. eleginoides*, *D. mawsoni* and *C. gunnari*. These drafts covered all important aspects of the biology and fisheries of the two species which are relevant to fish stock assessment purposes. Based on comments provided by various participants during the meeting, the species profiles will be updated in the intersessional period. Revised versions will be submitted to WG-FSA at its next meeting in 2003.

7.3 Ukraine stressed the need to conduct further surveys in those areas of which little is known on the state of the stocks which have either been fished previously, such as *Lepidonotothen squamifrons* on Ob and Lena Banks (Division 58.4.4), and/or where IUU activities on longlining of *D. eleginoides* are currently likely to take place. Furthermore, Ukraine emphasised the need to extend surveys to by-catch species, such as *Gobionotothen gibberifrons* and *Pseudochaenichthys georgianu*s, which may suddenly become target species of the fishery, as has occurred in 1977/78 around South Georgia when the abundance of the target species of the fishery, *C. gunnari*, was much lower than expected.

7.4 Australia supported this notion and stressed the need for surveys in yet unsurveyed areas, such as Subareas 88.1 and 88.2, where longlining for *Dissostichus* spp. is currently being conducted and catches are likely to increase in the near future. By-catch species which have not been assessed in areas for a long time, such as South Georgia, need to be included in data collection plans and assessments in the future. This would enable WG-FSA to better advise on the likely consequences of allowing the use of bottom trawl gear in areas, such as South Georgia, in order to reduce the by-catch of seabirds.

7.5 Other Members of the Scientific Committee emphasised that any consideration of the use of bottom trawls needs careful evaluation by the Scientific Committee. Not only do by-catch species need to be taken into account but also the impact of bottom trawling on benthic communities requires further consideration and studies. In this context, it was noted that changes to the ground tackle and the decrease in the size of the otter boards reduced the amount of benthos being caught from 9.6 to 1.6 tonnes without affecting the amount and composition of the fish being taken (Annex 5, paragraph 5.191).

7.6 Australia underlined that other aspects which require further consideration are the future development of the fishery plans. These are so far single-species plans. However, CCAMLR is different from other regional fisheries bodies in that Article II of the Convention specifies an ecosystem approach to fish stock assessment and management. This refers in particular to krill as the important prey species in the krill-dominated ecosystems and to *C. gunnari*, which is both an important prey species to CEMP species, such as Antarctic fur seals at South Georgia, Kerguelen and Heard and McDonald Islands, as well as an important predator of krill in the Atlantic Ocean sector.

7.7 The Scientific Committee agreed that the fishery plans should include summary statements of decision rules and requirements for ecosystem assessment.

7.8 Australia underlined that long time series of surveys, as are available in some areas, such as South Georgia, the South Shetland Islands and Heard and McDonald Islands, do help to better understand the dynamics of the species over space and time. This information is a prerequisite for successful fish stock assessment.

7.9 WG-EMM drew the attention of the Scientific Committee to the difficulties it has in predicting reliable trends in the krill fishery in the absence of reliable information pertaining to their future plans. The fact that scientists from only a few krill fishing nations attend WG-EMM and the voluntary nature of the submission of relevant data, is hindering its ability to provide in-depth information on developments in the krill fishery. Often, information is only anecdotal. In this regard, formal annual notification of a Member's intentions to participate in the krill fishery, such as that adopted for new and exploratory fisheries in the Convention Area, might facilitate identification of future trends in the krill fishery. A good example of how the necessary information can be submitted to CCAMLR is provided by the US fishing company which started krill fishing in the 2000 season.

SCIENTIFIC RESEARCH EXEMPTION

8.1 Last year, the Scientific Committee sought advice from the Commission on the minimum level of expected catch which required notification under Conservation Measure 64/XIX (SC-CAMLR-XX, paragraph 8.2). Some Members felt that, in general, surveys which only used small scientific sampling equipment (e.g. RMT) need not be required to notify under this measure. In turn, the Commission referred the matter of a minimum catch level back to the Scientific Committee (CCAMLR-XX, paragraph 4.31).

8.2 The intention of Conservation Measure 64/XIX is to:

- allow catches taken for research purposes to be considered as part of any catch limits in force for each species taken; and

- provide the opportunity for other Members to review and comment on substantial research plans (i.e. catches greater than 50 tonnes of finfish or 10 tonnes of *Dissostichus* spp.).

8.3 Under Conservation Measure 64/XIX, Members undertaking research are required to:

- report the catch of all species in the STATLANT data; and
- report the catch of all species using the appropriate catch and effort reporting system (Conservation Measures 40/X, 51/XIX or 61/XII) whenever that catch within a specified reporting period exceeds 5 tonnes.

8.4 In addition, Members are required to notify their intention to conduct a survey and two levels of notification are defined in the conservation measure:

(i) where the expected catch is less than 50 tonnes of finfish, including no more than 10 tonnes of *Dissostichus* spp., Members are required to:

- notify their survey to the Secretariat (who will notify all Members immediately) using the format provided in Annex 64/A; and

- include this notification in their Member's Activities Report.

(ii) where the expected catch is more than 50 tonnes of finfish or more than 10 tonnes of *Dissostichus* spp., Members are required to:

- notify the Commission and provide a research plan to the Secretariat for distribution to Members at least six months in advance of the planned starting date for the research. Based on the submitted research plan and any advice provided by the appropriate working group, the Scientific Committee will provide advice to the Commission where the review process will be concluded. Until the review process is complete the planned fishing for research purposes shall not proceed;

- report research plans in accordance with the standardised guidelines and formats adopted by the Scientific Committee, given in Annex 64/A;

- provide a summary of the results of any research subject to these provisions to the Secretariat within 180 days of the completion of the research fishing. A full report shall be provided within 12 months; and

- report catch and effort data resulting from the research fishing to the Secretariat according to the haul-by-haul reporting format for research vessels.

8.5 The Scientific Committee agreed that all surveys where finfish were expected to be caught are required to be notified under Conservation Measure 64/XIX. The Committee also recalled that the original version of this measure (64/XII) was more general, requiring Members to notify when surveys were expected to:

- take less than 50 tonnes of catch for any purpose; and
- take more than 50 tonnes of finfish.

8.6 In 2000 the Commission adopted a revision to this measure (64/XIX) which:

- limited notifications to those surveys where finfish were expected to be taken; and
- introduced specific notification requirements with respect to *Dissostichus* spp.

8.7 The Scientific Committee asked the Commission to clarify whether:

- the intent of the revision was to limit Conservation Measure 64/XIX to finfish; or
- the revision in 2000 had inadvertently resulted in the exclusion of species such as krill, squid and crab.

8.8 The Scientific Committee also asked the Commission whether it might be appropriate to alter the language of the measure to better provide for a flexible list of taxa-specific limits to research catches under this measure.

8.9 The Scientific Committee agreed to postpone further discussion of this measure until this matter was clarified.

COOPERATION WITH OTHER ORGANISATIONS

9.1 The Scientific Committee was chaired during this section by Dr Kawaguchi, Vice-Chair of the Scientific Committee. Reports under Agenda Items 9(i) and 9(iii) were reported in brief to the meeting by the rapporteur of this section.

Cooperation with the Antarctic Treaty System

CEP

9.2 The report of the Chair of the Scientific Committee, CCAMLR-XXI/BG/8, outlined his participation in CEP-V under the Madrid Protocol (Warsaw, Poland, 10 to 16 September 2002). The most important issues of relevance to CCAMLR were:

(i) SCAR presented to CEP two reports regarding marine acoustic technology and Antarctic environment. SCAR concluded that there is no evidence of negative impacts on the Antarctic marine organisms from the appropriate use of acoustic technology equipment. However, Germany had reservations concerning SCAR's reports. CEP asked SCAR to bring forward a final report on the environmental impacts of acoustic technology at CEP-VI.

(ii) Argentina and SCAR provided papers pertaining to the issue of specially protected species in Antarctica. CEP agreed with the two papers' conclusion that the IUCN Red List criteria should be used as the basis for the assessment of the status of species in Antarctica. SCAR offered to undertake, in conjunction with the IUCN, an assessment of the status of well-documented species using the IUCN criteria, beginning with birds and seals. CEP recognised the need for a dialogue with CCAMLR on how the category of specially protected species might be applied to marine species under the purview of CCAMLR.

(iii) CEP received a paper from the UK concerning biological prospecting in Antarctica. CEP recognised that the subject is complex and included legal and political issues. It agreed that these complexities and rapid developments in this field were strong reasons for the Antarctic community to be pre-emptive on the issue and that biological prospecting needed to be discussed during the next CEP meeting.

(iv) Four revised management plans for SPAs which contained marine components were reviewed by CEP. CEP recognised that these must be approved by CCAMLR prior to being accepted by the ATCM. In addition, Italy introduced a paper proposing a new ASPA in Terra Nova Bay, Ross Sea, which also must be approved by CCAMLR.

(v) Dr A. Press (Australia), CEP's Observer to the CCAMLR Scientific Committee, presented a report highlighting the main aspects of the last meeting of CCAMLR's Scientific Committee. Dr Press was appointed CEP Observer to this year's Scientific Committee.

(vi) Dr Press was elected as the new Chair of CEP.

Reports of Observers from International Organisations

ASOC

9.3 The ASOC representative drew attention to CCAMLR-XXI/BG/27 and BG/28 and gave the following recommendations to CCAMLR:

(i) ASOC commended WG-EMM on dividing Area 48 into SSMUs and urged WG-EMM to move forward and develop a plan to manage the fishery based on these units.

(ii) Following on from this, ASOC encouraged the harmonisation of the krill fishery with the finfish fisheries regarding standardised reporting requirements, independent observers, and mandatory VMS, especially considering the uncertainties surrounding the growth of the fishery in the near future.

(iii) In the true precautionary nature of the Convention, ASOC believed that the Scientific Committee has a tremendous opportunity to adopt a precautionary management plan that protects krill and its predators while there are relatively few vessels active in the fishery. To this end, ASOC encouraged the Scientific Committee to acquire fine-scale data from throughout the fishery in order to develop rapidly a precautionary management plan.

(iv) ASOC commended the progress of most regulated fisheries in reducing seabird by-catch. It shares this Committee's grave concern about the unsustainable bird by-catch in the IUU fishery and urged the Scientific Committee to use the strongest language possible to communicate its concern to the Commission and urge the Commission to take decisive action against IUU fishing.

(v) ASOC urged Parties to use all available means to stop the alarming level of bird by-catch in the regulated fishery in Division 58.5.1, including a limited fishing season. With an estimated IUU catch that is at least twice the legal catch figure which does not include toothfish nominally caught outside the Convention Area – ASOC questioned the argument that the year-round presence of legal boats deters IUU boats.

(vi) Finally, ASOC directed delegates' attention to an informal document titled 'The Alphabet Boats', which describes the increasing sophistication and organisation of the IUU fleet.

IUCN

9.4 IUCN's report (CCAMLR-XXI/BG/34) summarised pertinent resolutions and recommendations from the 2000 World Conservation Congress and highlighted IUCN activities, including the upcoming World Parks Congress in September 2003 where the contribution of marine protected areas to sustainable development will be featured.

9.5 The IUCN Observer noted that the commitment of Governments at the World Summit on Sustainable Development (Johannesburg, South Africa, 2002) to protection of biodiversity in areas beyond national jurisdiction also called for the development of representative systems of marine protected areas (MPAs). The IUCN Observer encouraged CCAMLR Members to consider several actions to progress the development of such a system for the Southern Ocean, through, *inter alia*:

(i) developing, in conjunction with CEP, guiding principles to assist with the selection and designation of a network of Antarctic MPAs and extending the systematic environmental geographic framework to the offshore marine environment, pursuant to Article 3(1) of Annex V to the Antarctic Environmental Protocol;

(ii) adding an additional criterion for CCAMLR's review of MPAs that reflects how the proposed protected area will contribute to the achievement of the principles of conservation, ecosystem-based management and precautionary decision making pursuant to Article IX.1(f) and IX.2(g) of the Convention; and

(iii) considering as a priority for a system of MPAs the establishment of protected areas co-extensive with at least the foraging areas of seals, penguins and other seabirds when they have dependent offspring.

9.6 In regard to pirate fishing and seabird mortality from longlining in the Southern Ocean and adjacent waters, IUCN encouraged Members to consider whether CITES may bring some added value to the existing CCAMLR measures for toothfish through its more comprehensive membership and global coverage of international trade.

9.7 The Scientific Committee noted the information and suggestions on MPAs in paragraph 9.5 and referred these to the WG-EMM Subgroup on Protected Areas for consideration.

FAO

9.8 The FAO Observer informed the meeting about the conference 'Deep Sea 2003' to be held in New Zealand in December next year, which will address issues of 'management and governance' of deep-sea fisheries. Specific sessions will address topics that include the environment, fisheries habitat, population biology, resource management, harvesting strategies, technology, compliance, management policies and instruments, future governance and identification of an ongoing program of activities.

9.9 He informed the Scientific Committee that the organisers – the Ministry of Fisheries in New Zealand, the Ministry of Agriculture, Fisheries and Forestry in Australia and FAO – particularly wish to invite organisations and government departments that share similar objectives to join as co-sponsors and assist in setting the conference's goals and contribute to its design. This could be done, for example, through the funding of speakers.

9.10 The organisers were of the view that the topic of the conference was central to CCAMLR's program and that the Commission would have much to contribute. He also believed that the conference should enable strategic and conceptual issues to be addressed for which there was rarely time to do so at Commission meetings. Existing co-sponsors include IUCN, Subsecretaría de Pesca in Chile and the Ministerio del Mar in Peru.

Reports of SC-CAMLR Representatives at Meetings of Other International Organisations

CWP

9.11 The Data Manager reported on the 2001/02 intersessional meeting of the CWP held in Rome, Italy, on 21 and 22 March 2002 (SC-CAMLR-XXI/BG/11). Key topics discussed at that meeting and of interest to the Scientific Committee included:

(i) development of CWP's advocacy role;

(ii) participation by CWP members in a new Fisheries Global Information System (FIGIS). A proposed partnership between CCAMLR and FIGIS-FIRMS (Fishery Resources Monitoring System) is described in SC-CAMLR-XXI/6;

(iii) definition of CWP's position on the proposed International Plan of Action on the Status and Trends Reporting in Fisheries;

(iv) consideration of catch and trade certification schemes; and

(v) development of the agenda for the 20th session of CWP (CWP-20).

9.12 CCAMLR's involvement in the work of CWP, and participation by the Data Manager in the meetings of CWP, allows CCAMLR to interact directly with other intergovernmental and regional agencies involved with the collection and dissemination of fisheries statistics. Such interactions are important in order to promote and establish common definitions and formats for the global exchange of fisheries information such as catch data, species codes and vessel registry data.

9.13 Referring to SC-CAMLR-XXI/BG/11, Prof. Croxall noted that CWP, in seeking to improve the quality, nature and relevance of fisheries statistics, is giving increased emphasis to reporting on elasmobranchs, including as by-catch. On behalf of ad hoc WG-IMAF, he requested that the Secretariat raise with CWP the issue of improving and standardising the reporting of by-catch of non-fish species (e.g. seabirds, turtles), drawing attention to CCAMLR's work in this area. This was agreed.

CMS

9.14 The progress toward an agreement on the conservation of albatrosses and petrels is presented in SC-CAMLR-XXI/BG/20 (see also paragraph 5.29(ii)).

ICES

9.15 The report from the 2002 meeting of the International Council for the Exploration of the Sea in Copenhagen, Denmark, is given in SC-CAMLR-XXI/BG/25. At the Annual

Science Conference this organisation celebrated the Centenary of its existence by signing the Copenhagen Declaration, a statement of renewed commitment to support marine science through ICES.

9.16 The conclusions of relevance to CCAMLR, contained in the ICES Strategic Plan and the ICES Integrated Action Plan, were:

(i) understand the physical, chemical and biological functioning of marine ecosystems;

(ii) understand and quantify human impacts on marine ecosystems, including living marine resources;

(iii) advice on the sustainable use of living marine resources and protection of the marine environment;

(iv) enhance collaboration with organisations, scientific programs and stakeholders (including the fishing industry) that are relevant to the ICES goals;

(v) broaden the diversity of the scientists who participate in ICES activities;

(vi) keep abreast of the needs and expectations of ICES member countries; and

(vii) make the scientific products of ICES more accessible to the public.

IWC

9.17 The IWC Observer, Dr Kock, reported on the meeting of SC-IWC held in Shimonoseki, Japan, from 27 April to 9 May 2002 (SC-CAMLR-XXI/BG/2).

9.18 A total of 440 minke whales was caught within the CCAMLR Convention Area under the remit of the IWC in 2001.

9.19 Cooperation with other international organisations and programs was discussed, such as SO-GLOBEC activities in 2001/02, the CCAMLR–IWC relationship, ongoing activities of the three organisations in the foreseeable future and whale research conducted by the IWC, such as SOWER 2002 in the Southern Ocean.

9.20 The Southern Ocean Sanctuary which was established in 1994 will be reviewed by the SC-IWC in 2003.

9.21 The collaboration between CCAMLR and the IWC regarding cooperative analysis of krill data and whale observations collected in the course of the CCAMLR-2000 Survey has resulted in a paper describing these analyses being submitted for inclusion in a special issue of *Deep-Sea Research*. The next step in this collaboration will be the inclusion of a whale-sighting survey as part of a survey to South Georgia and the Scotia Sea in January and February 2003 which will be conducted by the British Antarctic Survey. Subsequent data analysis will be carried out in close collaboration between CCAMLR and IWC researchers. A presentation of the analyses is envisaged for 2004.

GLOBEC

9.22 Dr Nicol reported on the Second GLOBEC Science Meeting held in Qingdao, China, from 15 to 18 October 2002 (SC-CAMLR-XXI/BG/36).

9.23 Of key interest to CCAMLR were the results from the SO-GLOBEC Regional Program. Preliminary results of studies carried out off the Western Antarctic Peninsula during autumn and winter 2001 and 2002 were presented, and papers at the meeting addressed:

(i) long-term change in Antarctic populations, including krill;

(ii) suggestions of an increase in the range of salps in the Southern Ocean at the expense of krill;

(iii) results from Chinese research on circumpolar estimates of condition in Antarctic krill and on acoustic estimates of krill biomass in the Prydz Bay region;

(iv) winter studies on Antarctic krill which investigated its relationship to sea-ice, larval growth rates and general condition;

(v) relationships between krill predators and krill distributions in winter; and

(vi) spatial and temporal variability in Antarctic marine ecosystem processes at the macro-, meso- and micro-scale.

9.24 Also of interest to CCAMLR were the developments being made in the modelling of larval transport and recruitment in several fish species as part of the Small Pelagics and Climate Change Program (SPACC) which are analogous with many of the processes occurring in Antarctic krill. SPACC was interested in holding a workshop in 2003 on the economics of small pelagic fisheries which would be of direct interest to CCAMLR because of the potential interaction between the fisheries for small pelagic fish, the krill fishery and the global fish meal market.

SCAR

9.25 The SCAR/CCAMLR Observer and Liaison Officer, Dr Fanta, reported on SCAR activities in 2001/02 and on the XXVII SCAR Meeting held in Shanghai, China, from 13 to 26 July 2002 (CCAMLR-XXI/BG/33).

9.26 At the meetings of the SCAR Working Group on Biology and the new Standing Scientific Group of Life Sciences, items of potential interest to CCAMLR include:

(i) the next SCAR Biology Symposium will be held in Brazil in 2005;

(ii) a compilation of best practice for the prevention of diseases in the Antarctic wildlife will be prepared by Australia;

(iii) the EASIZ Program will continue for two more years;

(iv) the Sub-committee on Evolutionary Biology of Antarctic Organisms will hold a workshop on Evolutionary Adaptation in Antarctic Organisms in Pontignano, Italy, from 1 to 7 December 2002, the results being published in a special volume of *Antarctic Science* in 2003;

(v) SCAR proposes to develop a new program entitled 'Evolution and biodiversity in Antarctica: the response of life to change', which will include some research topics previously covered by EASIZ and EVOLANTA;

(vi) the SCAR Group of Specialists on Seals and the Sub-committee on Bird Biology both met prior to XXVII SCAR. They discussed a number of items of relevance to CCAMLR, *inter alia*, status and trends in seal populations, dietary studies of seabirds, the conservation status of Antarctic birds and potential adverse effects of penguin banding. Reports from these meetings will be made available to CCAMLR;

(vii) SCAR was asked to contribute, in respect of Area 66 (Antarctica and the Southern Ocean), to the Global International Waters Assessment (GIWA), an initiative of UNEP. A workshop in 2003 in Curitiba, Brazil, convened by Drs Fanta, C. Howard-Williams (New Zealand) and D. Walton (UK), will establish a working plan for the GIWA project for Antarctica;

(viii) a new structure for SCAR was adopted. The SCAR Standing Scientific Group on Life Sciences, will include: Action Groups (GIWA; Best Practices for Conservation), Expert Groups (Birds; Seals; Human Biology and Medicine), Scientific Program Planning Groups (Evolution and Biodiversity in Antarctica: the response of life to change; Biological Monitoring) and Scientific Program Groups (EASIZ, APIS, EVOLANTA, RiSCC); and

(ix) SCAR was awarded the 'Prince of Asturias Prize for International Cooperation 2002', and will use it to establish a 'SCAR Fellowship Program' to fund relevant research of young scientists.

9.27 Matters arising from the meeting of GOSEAC in April 2002 in College Station, Texas, USA, included:

(i) GOSEAC will be replaced by a new SCAR group providing scientific and environmental advice to the ATCM and CEP.

(ii) Annex II of The Protocol on Conservation of Antarctic Fauna and Flora and the list of Specially Protected Species will be discussed and reviewed in connection with IUCN and CCAMLR (see paragraph 9.2(ii)).

(iii) SCAR should outline for the ATCM the importance of the adoption of the principles of the Convention on Biological Diversity to ensure that the Antarctic biological resources are treated on an equal basis to those of the rest of the world (see paragraph 9.2.(iii)).

9.28 In relation to the GIWA initiative (paragraph 9.26(vii)), the Scientific Committee requested SCAR to inform it of the results of the proposed planning workshop; it encouraged

Dr Fanta, and any other attendees familiar with the work of CCAMLR, to table at the workshop appropriate materials relating to the work of CCAMLR and to identify any areas where further input from CCAMLR might be necessary or appropriate.

FIGIS-FIRMS

9.29 The Scientific Committee considered SC-CAMLR-XXI/6, a proposal of partnership between CCAMLR and FIGIS-FIRMS. The document was also considered by WG-FSA (Annex 5, paragraphs 13.2 to 13.5), who reported that they were unable to identify any obvious benefit to WG-FSA from the proposed partnership.

9.30 The Scientific Committee noted that the information system proposed in this FAO initiative might, when further developed, provide benefits for CCAMLR. However, it was felt unnecessary to undertake any formal partnership at this stage. Through its continuing interaction with CWP, the Secretariat was asked to keep the Scientific Committee and its working groups informed of relevant developments.

Future Cooperation

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

(i) International Fisheries Observer Conference (sponsored by NOAA Fisheries and the Canadian Department of Fisheries and Oceans), 18 to 21 November 2002, New Orleans, Louisiana, USA – no nomination;

(ii) 20th Session of the CWP on Fishery Statistics (including discussions on FIGIS), 21 to 24 January 2003, Victoria, Seychelles – Data Manager;

(iii) Modelling Antarctic Ecosystems (a UBC Fisheries Centre Workshop), 14 to 17 April 2003, Vancouver, Canada – no nomination;

(iv) 55th Annual Meeting of the SC-IWC, 26 May to 6 June 2003, Berlin, Germany – Dr Kock;

(v) CEP-VI – Antarctic Treaty, 9 to 20 June 2003, Madrid, Spain – Chair of the Scientific Committee;

(vi) ICES Annual Science Conference, 23 to 27 September 2003, Tallinn, Estonia – Belgium;

(vii) SCAR meetings of relevance, (to be advised) – Dr Fanta; and

(viii) Eighth Conference of the Parties to CMS, (no information) – no nomination.

9.32 The Scientific Committee noted that the University of British Columbia Fisheries Centre had made a first announcement (and call for papers) for a workshop on 'Modelling

Antarctic Ecosystems' to be held at the University of British Columbia, Canada, from 14 to 17 April 2003. The edited workshop proceedings would be published as a Fisheries Centre Research Report. Further information is available from events@fisheries.ubc.ca.

9.33 The Scientific Committee endorsed the proposal by WG-EMM and WG-FSA for the involvement of the conveners of these groups in the planning of a session on the Southern Ocean at the Fourth World Fisheries Congress, to be held from 2 to 6 May 2004, in Vancouver, Canada (Annex 4, paragraphs 7.1 to 7.4; Annex 5, paragraph 8.7). The Scientific Committee noted that this would be an important opportunity to present CCAMLR science and resource management in a global context. It was noted that abstracts needed to be submitted by April 2003 to be considered for oral presentation. Further information may be obtained from Drs Everson and Hewitt.

Future Procedure

9.34 Recognising the complexity of this agenda item and the difficulties posed to participants and rapporteurs by late delivery of reports from observers, the Scientific Committee agreed to consider only those reports which had been submitted to the Secretariat by 0900 h on the opening day of its meeting. This requirement should be clearly drawn to the attention of all relevant observers.

BUDGET FOR 2003 AND FORECAST BUDGET FOR 2004

10.1 The budget of the Scientific Committee for 2003, and the forecast budget for 2004, as agreed by the Scientific Committee, is summarised in Table 4. The following points were agreed:

- the cost of completing and translating the report of WG-FSA-02 has been reduced as a result of the change in the reporting procedure of the Working Group; and

- the 2003 budget included partial funding for the participation of two invited experts at WG-EMM-03.

10.2 The Scientific Committee noted that the forecast budget for 2003 (SC-CAMLR-XX, Table 5) had included A$5 000 for the report of a possible workshop of the CCAMLR Otolith Network (CON). This workshop has now been postponed to 2004.

10.3 The Scientific Committee endorsed the following expenditures under the Commission's budget for 2003:

- participation by the Chair in the 2003 meeting of CEP; and
- participation of the Data Manager in the 2003 meeting of CWP.

10.4 The Scientific Committee recalled that an amount of A$10 000 had been set aside in the Commission's budget for 2002 to assist with the cost of publishing findings from the

CCAMLR-2000 Survey in a special issue of *Deep-Sea Research*. Publication of this issue was delayed to 2003, and the Scientific Committee noted that the budget item has been carried forward to the Commission's budget for 2003.

ADVICE TO SCOI AND SCAF

11.1 The Chair presented the Scientific Committee advice to SCOI and SCAF during the meeting. The advice to SCAF is in Section 10.

Report to SCOI of Scientific Committee Chair

11.2 Information on scientific observations conducted in the 2001/02 season and implementation of the Scheme of International Scientific Observation are set out in section 2 of this report.

IUU Fishing

11.3 The Scientific Committee endorsed the report and conclusions of WG-FSA with regard to its assessment of the threats from IUU fishing, including threats to the rational use of toothfish (Annex 5, paragraphs 5.202 to 5.227) as well as the threats to seabirds (Annex 5, paragraphs 6.86 to 6.126). In summary, the Scientific Committee agreed to the following points:

(i) The reports of catches from outside the Convention Area in Areas 51 and 57 provided in *Dissostichus* Catch Documents (DCDs) were unlikely to have come from those areas. Instead, these catches were most likely to have come from within the Convention Area in the Indian Ocean. The estimates of toothfish removals arising from these DCDs are, taken alone, still likely to be underestimates of total catch from IUU fishing in the Convention Area.

(ii) The estimates of IUU fishing within the Convention Area for the Indian Ocean are most likely to be underestimates of this activity.

(iii) The current levels of IUU fishing reported from Areas 51 and 57 would have seriously depleted whatever stocks might have been present in those areas, if they were present at all.

(iv) Continued IUU catches at the current levels will cause further significant declines in the legal fisheries in the Indian Ocean over the next five years, noting that IUU fishing has depleted stocks in Division 58.4.4 and in Subareas 58.6 and 58.7, and that the catch rates in Division 58.5.1 have been substantially reduced suggesting that the stock in this area is also reaching low levels.

(v) When combined with the broad estimates of population abundance of seabirds in the Southern Ocean, the rate of mortality of seabirds from IUU fishing over the last seven years indicates that, even by conservative estimates, seabird populations are likely to become substantially reduced over the next five years if IUU fishing continues at the current rate. It was noted that a number of these seabird populations are already considered to be either vulnerable or endangered.

11.4 The Scientific Committee also requested SCOI to indicate whether it has information to verify that the observer report from Uruguay (WG-FSA-02/67) is likely to contain data from the locations indicated in the report. This request has arisen because known information for the region suggests that most of the area is deeper than 1 000 m and is unlikely to have great quantities of young toothfish that were the primary component of the catches described in the report (Annex 5, paragraphs 3.23 and 3.24). Comparative data have been available to the Scientific Committee through surveys and other analyses presented by WG-FSA (e.g. SC-CAMLR-XX, Annex 5, Figures 16 and 20).

11.5 In view of the difficulties in estimating total removals, the Scientific Committee recommended the establishment of a technical group that would have as its primary role the compilation, validation and review of reports and information from all available sources to estimate total removals of Antarctic marine living resources and the locations from which these are taken. The Scientific Committee recommended that this group serve the needs of SCOI as well as the Scientific Committee. This group would need to meet just prior to the meetings of WG-FSA and SCOI.

11.6 The Scientific Committee is reviewing the Rules of Access and Use of CCAMLR Data to ensure that appropriate confidentiality requirements are met while maintaining appropriate access to data required for assessments and other purposes in CCAMLR. It has been recommended that the management of all data within CCAMLR be subject to a common set of rules and guidelines. To that end, the Scientific Committee invited members of SCOI to be involved in the revision of the data access rules.

Fishing Seasons

11.7 In relation to potential imminent achievement of full compliance with Conservation Measure 29/XIX and the continuing very low level of seabird by-catch, the Scientific Committee recalled its recent advice to the Commission (SC-CAMLR-XIX, paragraph 4.42; see also SC-CAMLR-XX, Annex 5, paragraph 7.91) that any relaxation of closed seasons should proceed in a step-wise fashion (e.g. similar to the process by which the closed season was extended) and the results of this be carefully monitored and reported.

11.8 Noting the timeliness of considering this issue from the perspective of the rapid recent improvement in compliance, the Scientific Committee endorsed the advice developed in relation to potential extensions to the fishing season (Annex 5, paragraphs 6.37 and 6.38), noting the associated discussion (Annex 5, paragraphs 6.39 to 6.46).

11.9 The three proposed options for season extension are:

(i) An extension of the season for two weeks in September once there was full compliance with Conservation Measure 29/XIX, and subject to a limit of three birds per vessel, assuming fishing effort was maintained at current levels.

Vessels would be required to carry two observers, so that the limit could be monitored accurately, and either two streamer lines or a single streamer line with a boom-and-bridle system would be required.

(ii) An extension of the season for the last two weeks in April once there was full compliance with Conservation Measure 29/XIX, and subject to a limit of three birds per vessel, assuming fishing effort was maintained at current levels. Vessels would be required to carry two observers, so that the limit could be monitored accurately, and either two streamer lines or a single streamer line with a boom-and-bridle system would be required.

(iii) In the forthcoming season to allow only vessels in Subarea 48.3 that were adjudged to have complied fully with Conservation Measure 29/XIX in 2001/02 to fish during the last two weeks of April to enable a preliminary assessment of seabird by-catch during this period. As part of the access arrangement during this period, the vessel would be required to collect data to allow a more reliable assessment of the risk to seabirds during this period. This would include collection of data on the sink rate of longlines, and observations of seabird behaviour around the vessel. A limit of three birds would be applied to the vessel; two observers would be required so that the limit could be monitored accurately; two streamer lines or a single streamer line with a boom-and-bridle system would be required.

Of the two options outlined in paragraphs 11.8(i) and 11.8(ii), the option in paragraph 11.8(i) is preferable, in terms of leading to an extension to the fishing season at a time of lower potential risk to seabirds.

Compliance with Conservation Measure 29/XIX

11.10 The Scientific Committee reiterated its advice of last year (SC-CAMLR-XX, paragraph 4.41) that vessels which do not comply with all elements of Conservation Measure 29/XIX should be prohibited from fishing in the CCAMLR Convention Area (Annex 5, paragraphs 6.25 and 6.29). It was noted that the request to the Commission to define its understanding of full compliance (paragraph 11.11) was an important consideration here.

11.11 The Scientific Committee referred this advice to SCOI and the Commission to assist their deliberations and with a view to receiving advice on, *inter alia*, what the Commission might wish to define as full compliance, whether this would relate to individual vessels, particular fisheries and/or subareas, or other criteria and how the Commission might wish to proceed when appropriate compliance had been achieved.

SECRETARIAT SUPPORTED ACTIVITIES

Data Management

12.1 Dr Ramm reported on the main activities of the Data Centre during the 2001/02 intersessional period (SC-CAMLR-XXI/BG/10). The Data Centre had continued to support the work of the Commission, Scientific Committee and working groups. Major activities and analyses were reported in meeting papers and publications produced by the Data Centre during 2001/02.

12.2 The Scientific Committee noted the Data Centre's activities during the 2001/02 intersessional period, including:

- the further development of the research survey database, including a new database schema and new data upload routines; and
- the development of an electronic version of the *Statistical Bulletin* now available on the CCAMLR website.

12.3 The Scientific Committee also noted that the work on the CDS database had been undertaken by the Database Developer over a period of 4 to 5 months and had taken precedence over other database developments.

12.4 It was also noted that the research survey database had operated satisfactorily during the meeting of WG-FSA, and that the Working Group had outlined further work during the intersessional period (Annex 5, paragraphs 3.2 to 3.8).

12.5 The Scientific Committee endorsed this advice and tasked the Secretariat to complete the acoustic components of the survey database so that data from the CCAMLR-2000 Survey could be archived along with other acoustic survey data such as the BIOMASS dataset. The Secretariat was also asked to consult with Members planning acoustic surveys for icefish to ensure that the CCAMLR survey database was also able to capture these types of acoustic data.

12.6 The Scientific Committee endorsed WG-FSA's request for the Secretariat to further develop the electronic version of the *Statistical Bulletin* so that the public-domain STATLANT database could be queried online (Annex 5, paragraph 13.8).

12.7 The Scientific Committee shared WG-FSA's concern that inconsistencies had arisen in the STATLANT data (Annex 5, paragraph 13.9). It is apparent that some STATLANT data do not reflect Members' official records of catches or may not contain information on all species caught in the Convention Area. The Scientific Committee urged Members to review their submissions of STATLANT data and ensure that these data provide the complete and correct official record of catch and effort.

12.8 One of the Data Centre's key functions was the monitoring of fisheries conducted under conservation measures in force using data from the in-season catch and effort reporting system (Conservation Measures 40/X, 51/XIX and 61/XII). Along with this task, approximately 390 fishery reports had been sent to Contracting Parties fishing in the 2001/02 season.

12.9 The requirement for Members to notify the Secretariat of the movements of their vessels into, and out of, subareas and divisions had greatly assisted the Secretariat in tracking overdue catch and effort reports. However, the Scientific Committee noted that such notifications had not always been reported by Members in 2001/02. The Scientific Committee reminded Members to comply with this requirement (Conservation Measure 148/XX, paragraph 4).

12.10 Dr Goubanov advised that Ukraine had a number of datasets from fishery surveys conducted in Subarea 48.3, as well as haul-by-haul catch and effort data (in paper format) from trawl and longline fishing targeting *D. eleginoides* between 1970 and 1995. The Scientific Committee encouraged Ukraine to process these data and submit available data to the CCAMLR database.

12.11 The Scientific Committee identified the following tasks as priority items for the work of the Data Centre:

WG-EMM

- review of CEMP (Annex 4, paragraphs 6.46 to 6.48):
  - CEMP data validation;
  - basic analysis of CEMP data;
  - matrices of CEMP data availability;
  - enhanced database support for the CEMP review; and
- statistical analysis of CEMP data.

WG-FSA (Annex 5, Table 12.1)

- research database:
  - completion;
  - methods for submission of data;
  - validation and correction of data;
- data extractions for assessments (following subgroup on assessment methods meeting);
- update documentation and procedures for data extraction and analyses;
- by-catch data to be submitted to the CCAMLR database;
- electronic access to STATLANT data;
- software database and archive;
- methods for estimating total removals; and
- update of *Statistical Bulletin* to be aligned with seasons.

12.12 Data-related tasks on behalf of WG-IMAF are specified in Annex 5, Appendix D.

Publications

12.13 In addition to annual reports of CCAMLR, the Scientific Committee noted that the following documents were also published in 2002:

(i) *CCAMLR Scientific Abstracts* covering abstracts of papers presented in 2001;
(ii) *CCAMLR Science*, Volume 9 (distributed at the meeting);
(iii) *Statistical Bulletin*, Volume 14;
(iv) Revisions to *Inspectors Manual*; and
(v) Revisions to *Scientific Observers Manual*.

12.14 The Scientific Committee recognised the usefulness of the database of CCAMLR working documents which had been developed in response to requests from the working groups (WG-EMM-02/8; Annex 4, paragraph 6.43; Annex 5, paragraph 11.2), and encouraged the Secretariat to continue this work and make available such a database via the secure pages of the CCAMLR website.

12.15 The Scientific Committee noted that the fishery-related work of both WG-EMM and WG-FSA had been recast in the context of the CCAMLR season (1 December to 30 November of the following year). Consequently, the Scientific Committee agreed that the *Statistical Bulletin* should now be published on the basis of a season rather than a split-year. The Scientific Committee recognised that this shift in reporting period would result in a change in the timing of the annual submission of monthly STATLANT data (at present 31 August) and the publication of the Bulletin (April). The Scientific Committee tasked the Secretariat with rescheduling the submission deadline of STATLANT data and publication of the Bulletin, and advising Members intersessionally.

12.16 The Scientific Committee recalled last year's deliberation on providing assistance with the preparation, in English, of manuscripts submitted to *CCAMLR Science* by authors whose native language was not English (SC-CAMLR-XX, paragraph 14.2). This matter had been referred to the Editorial Board, and a solution was presented to, and agreed by, the Scientific Committee.

12.17 The Scientific Committee agreed that the following steps should be taken to overcome problems with papers for which English is not the author's primary language, and which may need additional language editing assistance (SC-CAMLR-XX, Annex 5, paragraph 11.9):

(i) request authors first to write papers in their own language and then subject them to thorough scientific editing within their own scientific community;

(ii) papers should then be translated into the best quality English within the means of the authors;

(iii) both copies of the paper, in the original language and the translation, should be submitted to the Secretariat;

(iv) extra funding should be allocated to the Secretariat to deal with language editing which often includes retranslation into English of some sections of the original language; and

(v) reviewers of papers should also be requested to assist in further editing and English improvement.

12.18 The Scientific Committee emphasised that manuscripts should be submitted to *CCAMLR Science* only after completion of the requirements in paragraphs 12.17(i) and (ii). Further, at the time manuscripts are first considered by the Editorial Board, feedback may be provided to authors regarding the need for language editing. It was agreed that scientific review of all papers could be undertaken prior to scientific editing.

12.19 The Scientific Committee recognised that the Secretariat lacks sufficient resources to provide additional translation and scientific editing.

12.20 The Secretariat estimated it would cost approximately A$200 per page to provide the cost of translation, including scientific editing, and that assuming the average paper is approximately 15 pages, it would cost A$3 000 per paper. The Secretariat might expect four such papers per year for a total cost of A$12 000. This support would extend to all languages of Members.

12.21 The Scientific Committee requested the Commission to approve these additional services and include sufficient funds commencing with its 2004 budget.

SCIENTIFIC COMMITTEE ACTIVITIES

Long-term Work Plans

13.1 The Scientific Committee reviewed and endorsed the work plan of WG-EMM and WG-FSA.

Long-term Work Plan of WG-EMM

13.2 The Scientific Committee noted that the Working Group had reviewed progress towards its long-term goal of developing a feedback approach to manage the krill fishery, by which management measures are adjusted in response to ecosystem monitoring. The schedule of meetings and workshops leading to this had been summarised in SC-CAMLR-XX, Annex 4, paragraph 6.3.

13.3 The Working Group is making progress toward the shorter-term requests of the Scientific Committee and Commission (SC-CAMLR-XIX, paragraphs 5.14 and 5.15; CCAMLR-XIX, paragraph 10.11) to subdivide the precautionary catch limit of krill in Area 48.

13.4 The long-term plan of the Working Group has been revised to reflect progress during 2002 and needs for future work (Table 1).

13.5 The Scientific Committee noted that the results of the WG-EMM workshops would provide advice for use in the development of the long-term plan. It was recognised that such advice may be improved when better scientific information becomes available.

13.6 The Scientific Committee noted that the CEMP Review Workshop planned in 2003 would be held during the first week of WG-EMM-03, and that plenary sessions discussing core business would be held in the second week. This format would allow participants and invited experts to attend selected parts of the meeting if they so wished. WG-EMM had recognised that this format may not be suitable for all future workshops because some workshops may require input from plenary sessions.

13.7 The Scientific Committee welcomed and accepted the invitation from the British Antarctic Survey to host the 2003 meeting in Cambridge, UK, from 18 to 29 August 2003. WG-EMM recognised that the timing of the 2003 meeting was constrained by the availability of a suitable meeting venue.

13.8 Participants were reminded that proposals for future meetings of WG-EMM should be scheduled, when possible, earlier in the year (e.g. July). This would allow sufficient time for the full translation of the report prior to the meeting of the Scientific Committee.

Reorganisation and Work Plan of WG-FSA

13.9 The Scientific Committee noted that a new work format had been developed by WG-FSA in consultation with Members during the intersessional period (SC CIRCs 02/01 and 02/18 and COMM CIRC 02/56). Key elements of this new approach were:

- a reorganisation of the meeting format, so that information essential to the assessments is considered during days 1 and 2 of the meeting in order to allow assessments to be run and completed during the first week;

- a reorganisation of the meeting report, so that background information and advice on future work of WG-FSA is removed from the report and will not be translated. They will be disseminated as background papers to the Scientific Committee which will reduce the size of the report of the Working Group and improve readability and access to information and advice necessary to the Scientific Committee;

- the development of species profiles for *C. gunnari* and *D. eleginoides* – these reference documents contain species parameters which will be reviewed and updated by WG-FSA as new information becomes available; and

- development of an assessment manual to be reviewed and updated each year.

13.10 The Scientific Committee noted that the activities of subgroups of WG-FSA had worked during the intersessional period. 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 had agreed that the activities of several of these groups should be extended during the 2002/03 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.

13.11 The Scientific Committee noted that membership to the subgroups was open.

13.12 The subgroups for the intersessional period are:

(i) a subgroup to review observer reports and information, coordinated by Dr E. Balguerías (Spain) and Mr N. Smith (New Zealand);

(ii) a subgroup to continue developing assessment methods, coordinated by Dr Constable. This subgroup will interact and coordinate activities in the middle of the year (as detailed in Annex 5, Item 9). An invitation from Imperial College, London, UK, to host this group was made and accepted;

(iii) a subgroup to review, and where necessary assess, the biology and demography of species considered by the Working Group (Convener to appoint coordinator);

(iv) a subgroup on by-catch coordinated by Ms E. van Wijk (Australia);

(v) a subgroup to identify in conjunction with the SCAR EVOLANTA Program up-to-date information on stock identity for species within the Convention Area, coordinated by Dr Fanta;

(vi) a subgroup on conversion factors, coordinated by Mr Smith;

(vii) a subgroup on fisheries acoustics, coordinated by Drs Collins and Gasiukov;

(viii) a subgroup on estimation of IUU, coordinated by Dr Ramm; and

(ix) a subgroup on otolith exchange (CON), coordinated by Dr M. Belchier (UK).

13.13 Each subgroup was requested to develop a work plan for the intersessional period, in consultation with appropriate colleagues and with the Convener of WG-FSA and the Chair of the Scientific Committee.

13.14 The intersessional work plan for ad hoc WG-IMAF (Annex 5, Appendix D) sets out its plan for undertaking routine tasks which are carried out each year, and also activities for which longer-term strategic plans have been established. Examples of the latter relate to:

(i) assessment of seabird foraging ranges to determine risks of interactions with longline fisheries;

(ii) review of population status and trends of seabird species affected by longline fishery by-catch;

(iii) acquisition of data from longline fisheries in areas adjacent to the Convention Area in order to assess risks to Convention Area seabirds; and

(iv) improvements to existing, and development of, new mitigation measures to minimise by-catch of seabirds in fisheries in the Convention Area and adjacent regions.

Intersessional Activities in 2002/03

13.15 The following activities of the Scientific Committee are planned in 2002/03:

- meeting of WG-EMM (18 to 29 August 2003, Cambridge, UK);
- meeting of WG-FSA (13 to 23 October 2003, Hobart, Australia); and
- meeting of the WG-FSA Subgroup on Assessment Methods (12 to 15 August 2003, London, UK).

13.16 A fishery acoustic workshop was also scheduled at the time of WG-EMM-03.

13.17 The Scientific Committee noted that the past intersessional activities of the Secretariat and working groups had been reviewed during the meetings of WG-EMM and WG-FSA. The future work of WG-EMM is detailed in Annex 4 (paragraphs 6.33 to 6.40, Tables 3 and 4 and Appendix E, Attachment 4), and that of WG-FSA in Annex 5 (paragraphs 12.1 to 12.8,

Table 12.1 and Appendix D). In addition, major activities scheduled by the Scientific Committee in the 2002/03 intersessional period are listed in Annex 7. The Chair of the Scientific Committee, together with the conveners of the working groups, agreed to provide the Secretariat with a list of activities in 2002/03 which should be considered as high priority.

13.18 The Scientific Committee recalled that Dr Everson had agreed to convene WG-FSA-02 on the understanding that Dr Hanchet would be able to assist with this task, as well as accept a term as Convener of the Working Group commencing in 2003 (SC-CAMLR-XX, Annex 5, paragraph 13.4). The Scientific Committee noted that the reorganisation of the work of WG-FSA, which had been initiated by Dr Everson, was well in progress. However, this reorganisation would require another meeting in order to complete. With Dr Hanchet's agreement, the Scientific Committee accepted Dr Everson's offer to retain the convenership of WG-FSA for another year so that the reorganisation of the work of WG-FSA could be completed under his guidance. It was noted that Dr Everson's offer was subject to funding. If Dr Everson was unable to participate in WG-FSA-03, then Dr Hanchet would take up his role as convener in 2003.

Revision of the Scientific Committee Agenda

13.19 The Scientific Committee agreed that the reorganisation of its meeting agenda was a success, and thanked the Chair for finalising this new structure during the intersessional period. Two modifications were proposed for next year's meeting:

- a revision of the way in which by-catch is considered in the agenda; and

- reports under Item 9 (Cooperation with Other Organisations) should be submitted by 0900 h on the first day of the meeting so that these reports can be read and considered in advance of the Scientific Committee's deliberations. Further, the Committee agreed that, in future, any such report submitted after 0900 h on the first day of the meeting would not be considered formally during the meeting. Observers would be advised of this change of procedure in the letter of invitation to SC-CAMLR-XXII.

13.20 The Scientific Committee encouraged working groups to review their meeting agendas with the aim of further enhancing the flow of information and advice from the working groups to the Committee.

Invitation of Observers to the Next Meeting

13.21 The Scientific Committee agreed that all observers invited to the 2002 meeting would be invited to participate in SC-CAMLR-XXII.

13.22 The Scientific Committee also considered the application from ASOC to participate in the meeting of WG-FSA in 2002 and WG-EMM and WG-FSA in 2003 (SC-CAMLR-XXI/5). The Scientific Committee advised ASOC that its application to participate in the meeting of WG-FSA in 2002 (dated August 2002) was inappropriate because the Scientific Committee had discussed and rejected this application in 2001 (SC-CAMLR-XX, paragraph 18.10).

13.23 The Scientific Committee considered ASOC's application to participate in the meeting of WG-EMM and WG-FSA in 2003. As was the case last year (SC-CAMLR-XX, paragraphs 18.7 to 18.9), the Scientific Committee was unable to reach consensus on this matter, and the application was rejected.

13.24 A number of Members reminded the Scientific Committee that, last year, most Members supported this application in the interests of transparency of the work conducted by CCAMLR (SC-CAMLR-XX, paragraph 18.7). This view was reiterated by a number of Members at this meeting.

13.25 A number of Members questioned ASOC's scientific capacity and possible contribution to the work of the working groups because ASOC is primarily concerned with developing policies dealing with fisheries and conservation, and also because no details on their scientific expertise were provided in the application.

13.26 Most Members encouraged ASOC to contribute scientific papers to future meetings of the Scientific Committee. To assist with this task, they agreed that a pre-publication copy of the report of the meeting of WG-EMM-03 would be forwarded to ASOC on the understanding that ASOC abides by the Rules of Access and Use of CCAMLR Data.

13.27 However, some Members objected to such a proposal, because ASOC did not conduct its own research. Other Members supported that objection at the time of adopting the report.

Next Meeting

13.28 The next meeting of the Scientific Committee will be held in Hobart from 27 to 31 October 2003.

ELECTION OF CHAIR OF THE SCIENTIFIC COMMITTEE

14.1 Vice-Chairs, Mr López Abellán and Dr Kawaguchi, advised the Scientific Committee that the Scientific Committee representatives had met during SC-CAMLR-XXI and unanimously re-elected Dr Holt to the Chair of the Scientific Committee for a second term. Dr Holt thanked the Scientific Committee for their vote of confidence.

OTHER BUSINESS

Ad Hoc Subgroup on Data Access

15.1 The Scientific Committee established an ad hoc Subgroup on Data Access convened by Dr Hewitt to consider the Rules for Access and Use of CCAMLR Data following comments from WG-EMM (Annex 4, paragraphs 6.44, 6.45 and 6.57) and WG-FSA (Annex 5, paragraph 3.9). The subgroup met to consider those issues which included some discussions with members of SCOI. The Scientific Committee endorsed the subgroup's report (Annex 6), and recommended the Commission consider the points in paragraph 7 and that the Commission adopt the recommendations in paragraphs 8 to 10 of the annex.

ADOPTION OF THE REPORT

16.1 The report of the Twenty-first Meeting of the Scientific Committee was adopted.

CLOSE OF THE MEETING

17.1 In closing the meeting, Dr Holt thanked all Members of the Scientific Committee and the rapporteurs for their hard work at the meeting. He also thanked Dr Hewitt (Convener of WG-EMM), Dr Everson (Convener of WG-FSA) and Prof. Croxall (Convener of ad hoc WG-IMAF), for the tremendous amount of work they undertook for their meetings and in preparation for the Scientific Committee.

17.2 Dr Holt also thanked all the Secretariat staff for their relentless work during the meeting and over the past intersessional period, and the interpreters and sound technicians for their efforts.

17.3 Prof. Beddington, on behalf of the Scientific Committee, thanked Dr Holt for another excellent meeting. The Scientific Committee had greatly appreciated Dr Holt's leadership and the way in which he had facilitated discussions and cooperation amongst Members.

REFERENCES

Barrera-Oro, E.R., E.R. Marschoff and R.J. Casaux. 2000. Trends in relative abundance of fjord *Notothenia rossii, Gobionotothen gibberifrons* and *Notothenia coriiceps* at Potter Cove, South Shetland Islands, after commercial fishing in the area. *CCAMLR Science*, 7: 43–52.

Casaux, R., E. Barrera-Oro, A. Baroni and A. Ramón. 2000. Preliminary information on inshore demersal fish from the Danco Coast, Antarctic Peninsula, in the 1999/2000 summer season. Document *WG-FSA-00/63*. CCAMLR, Hobart, Australia: 17 pp.

Table 1: Long-range work plan of WG-EMM.

Issue	2002	2003	2004	2005
Subdivide Precautionary Catch Limit	Discussion	Discussion	Recommendation	
Revised Krill Management Procedure				
Delineation of small-scale management units in Area 48	Workshop			
CEMP review	Planning session	Workshop		
Selection of appropriate predator–prey–fishery–environment models	Discussion	Planning session	Workshop	
Evaluation of management procedures including objectives, decision rules, performance measures	Discussion	Discussion	Planning session	Workshop
Reporting requirements from fishery	Discussion	Awaiting guidance from the Scientific Committee		
Monitoring requirements from CEMP	Discussion	Discussion	Discussion	Discussion
Assessment of Predator Demand				
Large-scale surveys of land-based predators	Discussion	Discussion	Discussion	Discussion
Subdivision of Large FAO Statistical Areas				
Establishment of harvesting units	Discussion	Discussion		

Table 2: Catch (tonnes) of target species in the Convention Area for the 2001/02 fishing season (1 December 2001 to 30 November 2002). Information based on catches reported to date (18 October 2002) in the catch and effort reporting system.

	Species	Member Country	Subarea or Division										Total
			48*	48.1	48.2	48.3	58.5.1	58.5.2	58.6	58.7	88.1	88.2	
Toothfish	*Dissostichus eleginoides*	Australia						1 812					1 812
		Chile				1 413							1 413
		EC – France					2 930		989				3 919
		EC – Spain				832							832
		EC – UK				1 725							1 725
		Japan				1							1
		Korea, Republic of				300							300
		New Zealand									12		12
		Russian Federation				319							319
		South Africa				336			57	37			430
		Uruguay				692							692
	Dissostichus mawsoni	New Zealand									1 321	41	1 362
	Total (toothfish)					5 618	2 930	1 812	1 046	37	1 333	41	12 817
Icefish	*Champsocephalus gunnari*	Australia						850					850
		EC – UK				391							391
		Korea, Republic of				602							602
		Poland				296							296
		Russian Federation				1 367							1 367
	Total (icefish)					2 656		850					3 506
Krill	*Euphausia superba*	Japan**	13 140	9 207	23 733	1 263							47 343
		Korea, Republic of			8 033	6 321							14 354
		Poland			10 646	5 719							16 365
		Ukraine			19 241	9 280							28 521
		USA		396	11 726								12 122
	Total (krill)		13 140	9 603	73 379	22 583							11 8705
Crab	*Paralomis formosa*	Japan				57							57
	Paralomis spinosissima	Japan				56							56
	Total (crab)					113							113

* Unspecified within Area 48

** Monthly catches of krill reported by Japan in 2001/02 for the whole of Area 48 and available STATLANT data from Japan for the period December 2001 to June 2002

Table 3: Catch (tonnes) of target species in the Convention Area for the 2000/01 season (1 December 2000 to 30 November 2001). Information based on the official record of catch provided by Members in STATLANT data.

	Species	Member Country	Subarea or Division										Total
			48.1	48.2	48.3	58.4.2	58.4.4	58.5.1	58.5.2	58.6	58.7	88.1	
Toothfish	*Dissostichus eleginoides*	Australia							2 987				2 987
		Chile			534								534
		EC – France						4 747		1 091			5 838
		EC – Spain			643								643
		EC – UK			924								924
		Republic of Korea			787								787
		New Zealand										30	30
		Russian Federation			224								224
		South Africa			359					36	235	4	634
		Ukraine			62		8						70
		Uruguay			428								428
	Dissostichus mawsoni	New Zealand										582	582
		South Africa										21	21
		Uruguay										23	23
	Total (toothfish)				3 961		8	4 747	2 987	1 127	235	660	13 725
Icefish	*Chaenodraco wilsoni*	Australia				11							11
	Champsocephalus gunnari	Australia							1 150				1 150
		Chile			813								813
		EC – France			386								386
		EC – UK			208								208
		Russian Federation			2								2
	Total (icefish)				1 409	11			1 150				2 570
Krill	*Euphausia superba*	Japan	39 553	4 930	22 894								67 377
		Republic of Korea			7 525								7 525
		Poland	2 302		11 394								13 696
		Ukraine	3 362	51									3 413
		USA	1 561										1 561
	Total (krill)		46 778	4 981	41 813								93 572
Crab	*Paralomis formosa*	EC – UK			11								11
	Paralomis spinosissima	EC – UK			4								4
	Total (crab)				15								15
Squid	*Martialia hyadesi*	Republic of Korea			2								2
	Total (squid)				2								2

Table 4: Scientific Committee budget for 2003 and forecast for 2004.

2002 Budget			**2003 Budget**		2004 Forecast	
		WG-FSA				
		Meeting				
4 700		Computing facilities	**4 900**		5 000	
24 200		Preparation and Secretariat support	**25 200**		26 000	
34 500		Report completion and translation	**29 200**		30 100	
	63 400			**59 300**		61 000
		WG-EMM				
		Meeting				
21 800		Preparation and Secretariat support	**22 700**		23 400	
32 900		Report completion and translation	**34 200**		35 200	
	54 700			**56 900**		58 600
		Travel for Scientific Committee Program				
	42 700	WG-EMM meeting (freight, flights and subsistence)		**48 300**		49 700
	0	External Expert		**6 000**		0
	0	**CCAMLR Otolith Network**		**0**		5 000
	1 200	**Contingency**		**1 200**		1 200
	A$162 000	Total		**A$171 700**		A$175 600

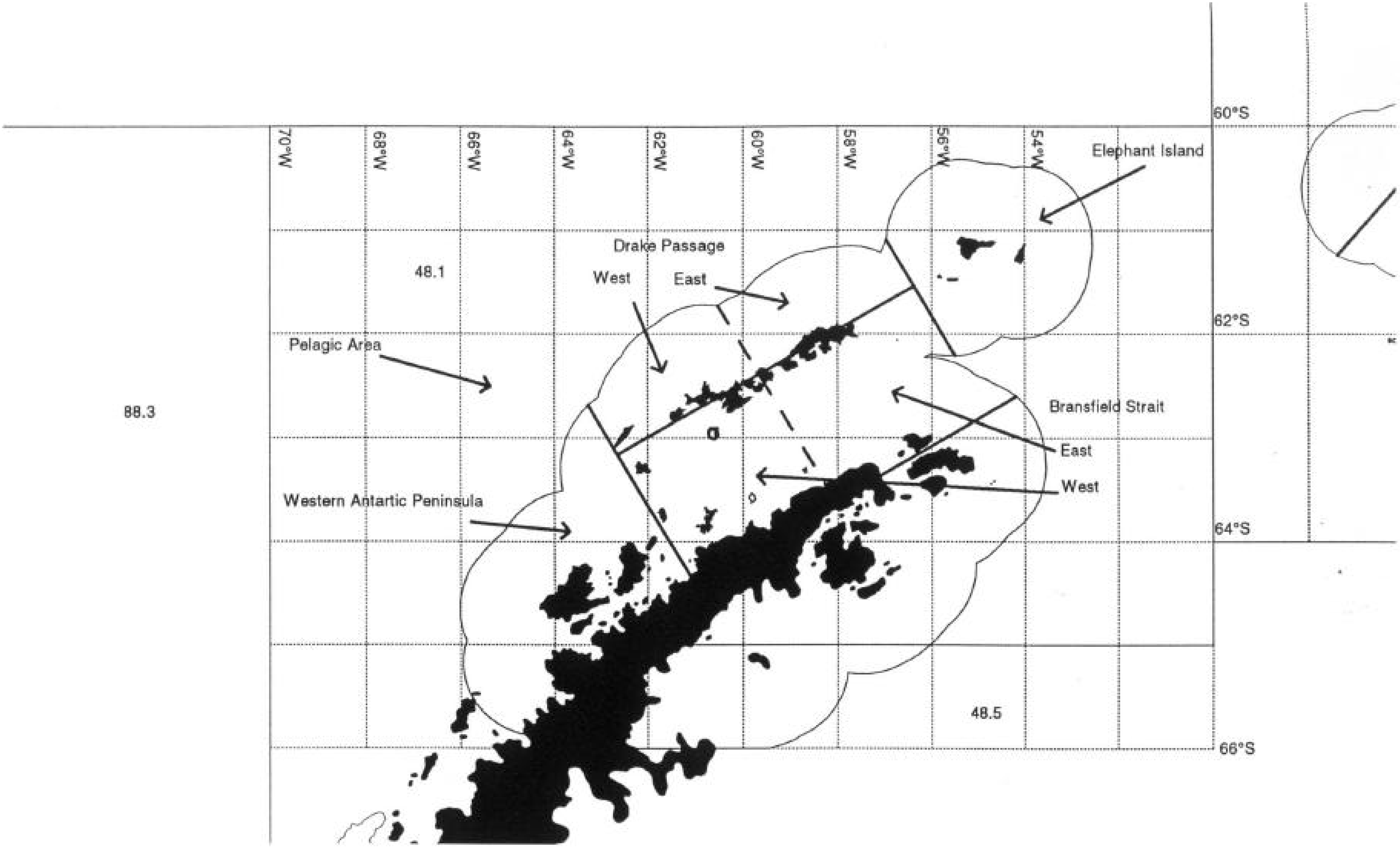


Figure 1: Proposed small-scale management units (SSMUs) for Subarea 48.1. The subarea is divided between a pelagic area and the land-based predator area, with the latter area divided into four main units: Drake Passage, Elephant Island, Bransfield Strait and the Western Antarctic Peninsula. The Drake Passage and Bransfield Strait units are proposed to be divided into east and west components to delineate different foraging grounds of land-based predators. Coordinates of these SSMUs are available from the Secretariat.

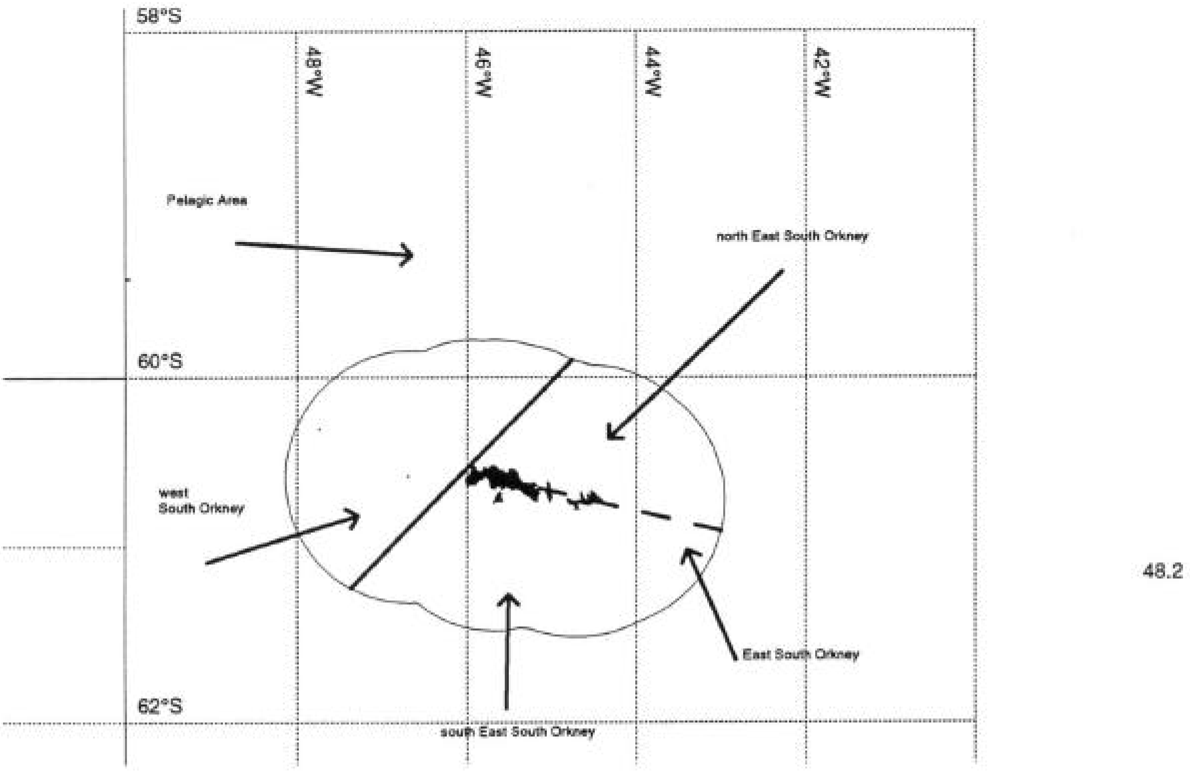


Figure 2: Proposed small-scale management units (SSMUs) for Subarea 48.2. The subarea is divided between a pelagic area and the land-based predator area, with the latter area divided into two main units: West South Orkney and East South Orkney. The division between north and south East South Orkney areas is proposed in the interim, pending further information on foraging of penguins from the Laurie and Powell Islands. Coordinates of these SSMUs are available from the Secretariat.

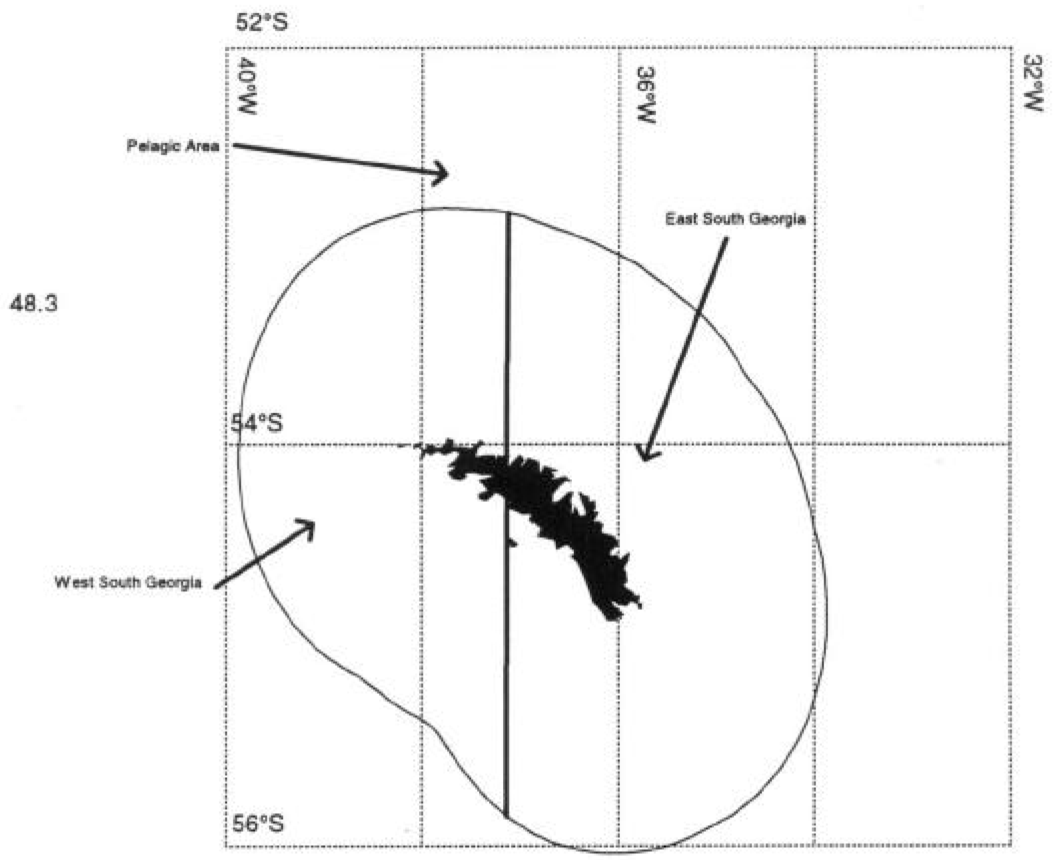


Figure 3: Proposed small-scale management units (SSMUs) for Subarea 48.3. The subarea is divided between a pelagic area and the land-based predator area, with the latter area divided into two main units: East South Georgia and West South Georgia. Coordinates of these SSMUs are available from the Secretariat.

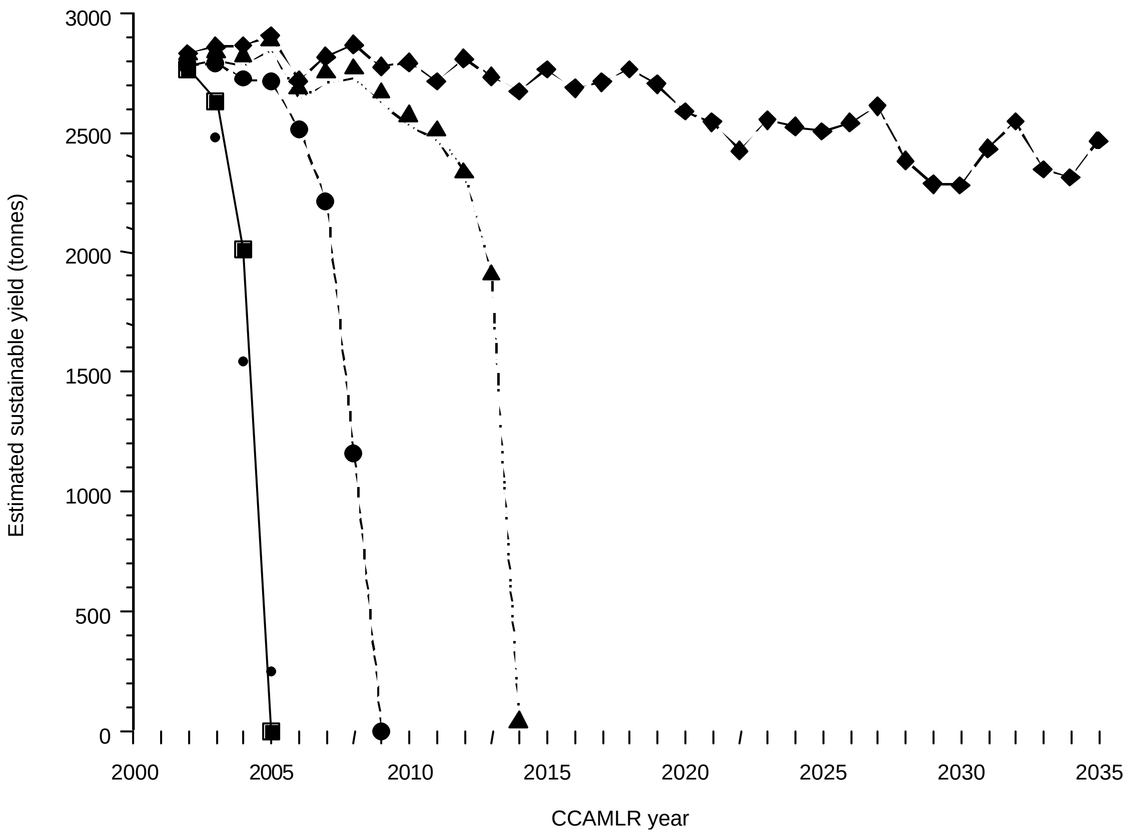
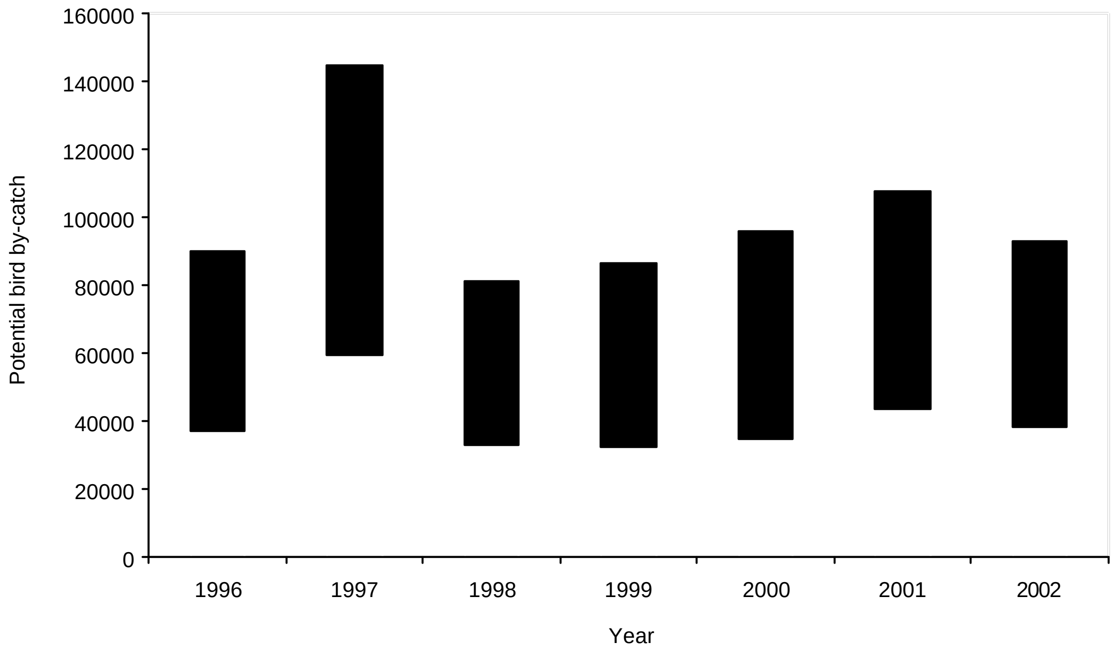


Figure 4: Projections of the estimated sustainable yield catch for *Dissostichus eleginoides*, using the CCAMLR assessment process under the following scenarios of IUU fishing in which the annual IUU catch is: (?) approximately 0.33x the estimated sustainable yield for 2001), (?) approximately 1x the estimated sustainable yield for 2001, (?) approximately 2x the estimated sustainable yield for 2001, and ( ) approximately 4x the estimated sustainable yield for 2001.

(a)



(b)

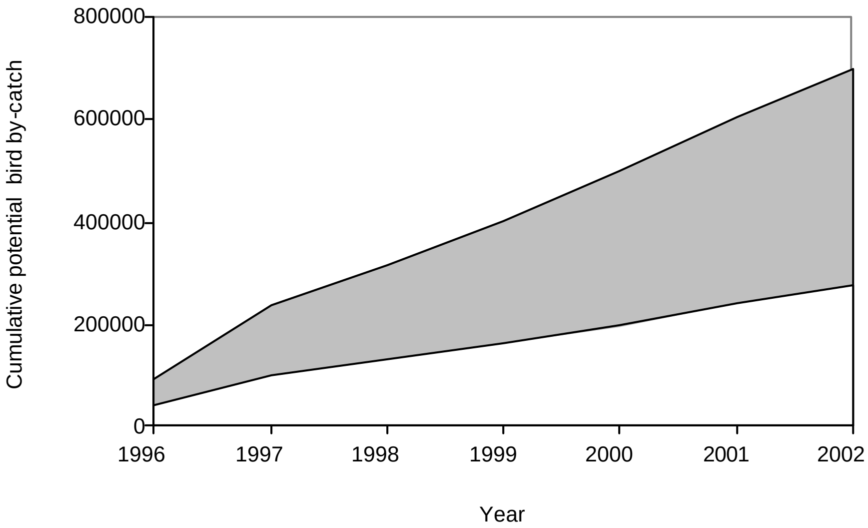


Figure 5: Estimated potential by-catch of seabirds in IUU longline fisheries in the Convention Area from 1996 to 2002: (a) annual range from the lower limit of the lower estimate to the upper limit of the upper estimate (see SC-CAMLR-XXI/BG/21); (b) cumulative numbers (shaded area) based on the lower limit of the lower estimate to the upper limit of the upper estimate (see SC-CAMLR-XXI/BG/21).

ANNEX 1

LIST OF PARTICIPANTS

LIST OF PARTICIPANTS

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ANNEX 2

LIST OF DOCUMENTS

LIST OF DOCUMENTS

SC-CAMLR-XXI/1	Provisional Agenda for the Twenty-first Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
SC-CAMLR-XXI/2	Provisional Annotated Agenda for the Twenty-first Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
SC-CAMLR-XXI/3	Report of the Working Group on Ecosystem Monitoring and Management (Montana, USA, 5 to 16 August 2002)
SC-CAMLR-XXI/4	Report of the Working Group on Fish Stock Assessment (Hobart, Australia, 7 to 17 October 2002)
SC-CAMLR-XXI/5	Application by ASOC for observer status at meetings of subsidiary bodies of the Scientific Committee Secretariat
SC-CAMLR-XXI/6	Proposed partnership between CCAMLR and FIGIS-FIRMS Secretariat
SC-CAMLR-XXI/7	A proposal to modify the boundaries of Statistical Division 58.5.2 to define William's Ridge Delegation of Australia

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SC-CAMLR-XXI/BG/1	Catches in the Convention Area in the 2000/01 and 2001/02 seasons Secretariat
SC-CAMLR-XXI/BG/2	Observer's report from the 54th Meeting of the Scientific Committee of the International Whaling Commission (Shimonoseki, Japan, 27 April to 9 May 2002) CCAMLR Observer (K.-H. Kock, Germany)
SC-CAMLR-XXI/BG/3	Beach debris survey – Main Bay, Bird Island, South Georgia 2000/01 Delegation of the United Kingdom

SC-CAMLR-XXI/BG/4	Entanglement of Antarctic fur seal *Arctocephalus gazella* in man-made debris at Bird Island, South Georgia during the 2001 winter and the 2002 breeding season Delegation of the United Kingdom
SC-CAMLR-XXI/BG/5	Beach debris survey – Signy Island, South Orkney Islands 2002 Delegation of the United Kingdom
SC-CAMLR-XXI/BG/6	Entanglement of Antarctic fur seal *Arctocephalus gazella* in man-made debris at Signy Island, South Orkney Islands 2001/02 Delegation of the United Kingdom
SC-CAMLR-XXI/BG/7	Fishing gear, marine debris and oil associated with seabirds at Bird Island, South Georgia, 2001/02 Delegation of the United Kingdom
SC-CAMLR-XXI/BG/8	United Kingdom report on data relating to the assessment and avoidance of incidental mortality in the Convention Area 2001/02 Delegation of the United Kingdom
SC-CAMLR-XXI/BG/9	Summary of notifications of new and exploratory fisheries in 2002/03 Secretariat
SC-CAMLR-XXI/BG/10	Data Management: report on activities during 2001/02 Secretariat
SC-CAMLR-XXI/BG/11	Intersessional meeting of Coordinating Working Party on Fisheries Statistics (CWP) Secretariat
SC-CAMLR-XXI/BG/12	VACANT
SC-CAMLR-XXI/BG/13	Marine debris and its impact on marine living resources (status of data submitted) Secretariat
SC-CAMLR-XXI/BG/14	Summary of scientific observation programs conducted during the 2001/02 season Secretariat
SC-CAMLR-XXI/BG/15	Synopses of working papers submitted to WG-EMM-02 Secretariat
SC-CAMLR-XXI/BG/16	Report of the Convener of WG-EMM-02 to SC-CAMLR-XXI

SC-CAMLR-XXI/BG/17	Calendar of meetings of relevance to the Scientific Committee in 2002/03 Secretariat
SC-CAMLR-XXI/BG/18	Conservation of marine areas in the Australian EEZ around the territory of Heard Island and McDonald Islands: notice of intent by Australia to declare a HIMI Marine Reserve and conservation zone Delegation of Australia
SC-CAMLR-XXI/BG/19 Rev. 3	Information on the crab fishery in Subarea 48.3 in 2001/02 and notification for 2002/03 Delegation of Japan
SC-CAMLR-XXI/BG/20	Progress toward an agreement on the conservation of albatrosses and petrels Delegation of Australia
SC-CAMLR-XXI/BG/21	IMAF assessment of new and exploratory fisheries by statistical areas (ad hoc WG-IMAF)
SC-CAMLR-XXI/BG/22	IMAF summary of research on seabird populations and distributions
SC-CAMLR-XXI/BG/23	IMAF by-catch of seabirds in IUU fisheries in the Convention Area
SC-CAMLR-XXI/BG/24	Initiatives by BirdLife International's Seabird Conservation Programme Delegation of South Africa
SC-CAMLR-XXI/BG/25	Report from the 2002 ICES meeting in Copenhagen CCAMLR Observer (Belgium)
SC-CAMLR-XXI/BG/26	Minutes of the Editorial Board meetings held in 2002 during WG-EMM and WG-FSA Secretariat
SC-CAMLR-XXI/BG/27	Background information supporting the Report of the Meeting of WG-FSA, 7 to 17 October 2002 (SC-CAMLR-XXI/4) Working Group on Fish Stock Assessment
SC-CAMLR-XXI/BG/28	WG-FSA Standard Assessment Methods Working Group on Fish Stock Assessment
SC-CAMLR-XXI/BG/29	Fish species profiles – mackerel icefish Convener of WG-FSA

SC-CAMLR-XXI/BG/30	Fish species profiles – toothfish Convener of WG-FSA
SC-CAMLR-XXI/BG/31	Working Group on Fish Stock Assessment Convener's Report to the Scientific Committee 2002
SC-CAMLR-XXI/BG/32	Draft fishery plans Secretariat
SC-CAMLR-XXI/BG/33	Scientific Committee Report to SCOI Chair of the Scientific Committee
SC-CAMLR-XXI/BG/34	Ad hoc WG-IMAF Convener's summary for the Scientific Committee
SC-CAMLR-XXI/BG/35	Relevamiento de desechos marinos en la Costa de la Base Científica Antártica Artigas (BCAA) en la Isla Rey Jorge/ 25 de Mayo – temporada 2001/02 Delegación de Uruguay
SC-CAMLR-XXI/BG/36	Report of Observer to the Second GLOBEC Science Meeting (Qingdao, China, 15 to 18 October 2002) CCAMLR Observer (S. Nicol, Australia)

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CCAMLR-XXI/1	Provisional Agenda for the Twenty-first Meeting of the Commission for the Conservation of Antarctic Marine Living Resources
CCAMLR-XXI/2	Provisional Annotated Agenda for the Twenty-first Meeting of the Commission for the Conservation of Antarctic Marine Living Resources
CCAMLR-XXI/3	Examination of the audited financial statements for 2001 Executive Secretary
CCAMLR-XXI/4	Review of the 2002 budget, draft 2003 budget and forecast budget for 2004 Executive Secretary
CCAMLR-XXI/5	Notification of Spain's intention to initiate an exploratory fishery in Subarea 88.1 for *Dissostichus* spp. in the 2002/03 season Delegation of Spain

CCAMLR-XXI/6	Notification of exploratory fisheries for *Dissostichus* spp. in the 2002/03 season Delegation of South Africa
CCAMLR-XXI/7	Notification by New Zealand of its intention to continue an exploratory fishery for *Dissostichus* spp. in CCAMLR Subareas 88.1 and 88.2 for the 2002/03 season Delegation of New Zealand
CCAMLR-XXI/8	Notification by New Zealand of its intention to continue an exploratory fishery for *Dissostichus* spp. in CCAMLR Subarea 48.6 for the 2002/03 season Delegation of New Zealand
CCAMLR-XXI/9	Notification of exploratory fisheries for *Dissostichus* spp. in the 2002/03 season Delegation of Japan
CCAMLR-XXI/10	Notification of Australia's intention to conduct a longline fishery in Division 58.5.2 for *Dissostichus eleginoides* Delegation of Australia
CCAMLR-XXI/11	Notification of Australia's intention to conduct an exploratory longline fishery in Divisions 58.4.3a and 58.4.3b for *Dissostichus* spp. Delegation of Australia
CCAMLR-XXI/12	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.2 for *Dissostichus* spp. Delegation of Australia
CCAMLR-XXI/11 CCAMLR-XXI/12 Addendum	To be read in conjunction with Australia's notifications for exploratory fisheries in the 2002/03 season Delegation of Australia
CCAMLR-XXI/13	CCAMLR Secretariat Strategic Plan: Summary Report to SCAF Executive Secretary
CCAMLR-XXI/14 Rev. 1	Documentation relating to CITES COP-12 Proposal 39 – inclusion in Appendix II of *Dissostichus eleginoides* and *D. mawsoni* Executive Secretary
CCAMLR-XXI/15	CCAMLR conservation measures: review of the numbering system Secretariat

CCAMLR-XXI/16 Rev. 1	Notification by Russia of its intention to initiate an exploratory fishery for *Dissostichus* spp. in CCAMLR Subareas 88.1 and 88.2 for the 2002/03 season Delegation of Russia
CCAMLR-XXI/17	Executive Secretary's Report to SCAF 2002 Executive Secretary
CCAMLR-XXI/18 Rev. 1	Proposal for an electronic web-based Catch Documentation Scheme for *Dissostichus* spp. Delegation of the USA
CCAMLR-XXI/19	Review of SCOI working arrangements Delegation of the European Community
CCAMLR-XXI/20	Cooperation with the Committee on Trade and Environment of the World Trade Organization (WTO) Secretariat
CCAMLR-XXI/21	A proposal to establish a CCAMLR centralised Vessel Monitoring System (VMS) Delegation of Australia
CCAMLR-XXI/22	International conference on the governance and management of deep-sea fisheries Secretariat
CCAMLR-XXI/23	Modification of the operation of Article 73(2) of the United Nations Convention on the Law of the Sea to assist in preventing IUU fishing that undermines CCAMLR conservation and management measures Delegation of Australia
CCAMLR-XXI/24	Achieving sustainable fisheries for *Dissostichus* spp.: managing the harvesting of stocks outside of the CCAMLR area Delegation of Australia
CCAMLR-XXI/25	Report of the Standing Committee on Administration and Finance (SCAF)
CCAMLR-XXI/26	Report of the Standing Committee on Observation and Inspection (SCOI)

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CCAMLR-XXI/BG/1 Rev. 2	List of documents
CCAMLR-XXI/BG/2	List of participants
CCAMLR-XXI/BG/3	Report on the Committee on Fisheries Sub-Committee on Fish Trade Eighth Session (Bremen, Germany, 12 to 16 February 2002) CCAMLR Observer (Germany)
CCAMLR-XXI/BG/4	Rapport de la dix-septième réunion annuelle de l'ICCAT (Murcia, Espagne, novembre 2001) Observateur de la CCAMLR (Communauté européenne)
CCAMLR-XXI/BG/5	Implementation of Conservation Measures in 2001/02 Secretariat
CCAMLR-XXI/BG/6	Summary of current conservation measures and resolutions in force 2001/02 Secretariat
CCAMLR-XXI/BG/7	Administración Chilena de la pesquería de bacalao de profundidad (*Dissostichus eleginoides*) Delegación de Chile (Executive Summary available in English)
CCAMLR-XXI/BG/8	Report on attendance at the Fifth Meeting of the Committee for Environmental Protection Under the Madrid Protocol Chair of the Scientific Committee
CCAMLR-XXI/BG/9	Calendar of meetings of relevance to the Commission in 2002/03 Secretariat
CCAMLR-XXI/BG/10	Report on the Expert Consultation of Regional Fisheries Management Bodies on the Harmonisation of Catch Certification (La Jolla, USA, 9 to 11 January 2002) Secretariat
CCAMLR-XXI/BG/11	Minutes of an informal meeting on the development of an electronic web-based CDS (Pascagoula, Mississippi, USA, 20 to 23 August 2002) Secretariat
CCAMLR-XXI/BG/12	Report on CDS catch verification procedure Delegation of Uruguay

CCAMLR-XXI/BG/13	The role of CCAMLR Delegation of Australia
CCAMLR-XXI/BG/14	International Conference against Illegal, Unreported and Unregulated Fishing (Santiago de Compostela, Spain, 25 and 26 November 2002) Delegation of Spain
CCAMLR-XXI/BG/15	Report of the CCAMLR Observer to ATCM-XXV (Warsaw, Poland, 9 to 20 September 2002) Executive Secretary
CCAMLR-XXI/BG/15 Corrigendum	Report of the CCAMLR Observer to ATCM-XXV (Warsaw, Poland, 9 to 20 September 2002) Executive Secretary
CCAMLR-XXI/BG/16	Information in relation to new and exploratory fisheries This document should be read in conjunction with CCAMLR-XXI/16 Rev. 1 Secretariat
CCAMLR-XXI/BG/17 Rev. 1	Évaluation de la pêche illicite dans les eaux françaises adjacentes aux îles Kerguelen et Crozet pour la saison 2001/02 (1er juillet 2001 – 30 juin 2002) Informations générales sur la zone CCAMLR 58 et la zone FAO 51 Délégation française
CCAMLR-XXI/BG/18	Estimated IUU fishing for toothfish in that portion of Australia's EEZ within Division 58.5.2 – 1 July 2001 to 30 June 2002 Delegation of Australia
CCAMLR-XXI/BG/19	CCAMLR centralised vessel monitoring system (VMS) implementation plan Delegation of Australia
CCAMLR-XXI/BG/20	The application of Port State jurisdiction The Antarctic and Southern Ocean Coalition
CCAMLR-XXI/BG/21	Observer report to CCAMLR on meetings of the Committee on Trade and Environment Special Session CCAMLR Observer (New Zealand)
CCAMLR-XXI/BG/22	Report on CDS catch verification procedure Delegation of Russia

CCAMLR-XXI/BG/23	Report to CCAMLR on the verification of catches reported from the high seas outside the Convention Area Republic of Seychelles
CCAMLR-XXI/BG/24	Rationale for the establishment of an electronic web-based Catch Documentation Scheme for *Dissostichus* spp. Secretariat
CCAMLR-XXI/BG/25	Implementation of the System of Inspection and other CCAMLR enforcement provisions in 2001/02 Secretariat
CCAMLR-XXI/BG/26	Implementation and operation of the Catch Documentation Scheme in 2001/02 Secretariat
CCAMLR-XXI/BG/27	Report of the Antarctic and Southern Ocean Coalition (ASOC) to the XXI Meeting of the Convention on the Conservation of Antarctic Marine Living Resources The Antarctic and Southern Ocean Coalition
CCAMLR-XXI/BG/28	Priority issues – The Antarctic and Southern Ocean Coalition (ASOC) for the XXI Meeting of the Convention on the Conservation of Antarctic Marine Living Resources The Antarctic and Southern Ocean Coalition
CCAMLR-XXI/BG/29	Position statement on listing toothfish under Appendix II of the Commission on International Trade in Endangered Species (CITES) The Antarctic and Southern Ocean Coalition
CCAMLR-XXI/BG/30	A CCAMLR response to use of flags of convenience by IUU vessels in the Convention Area The Antarctic and Southern Ocean Coalition
CCAMLR-XXI/BG/31	CDS-related information from Canada
CCAMLR-XXI/BG/32	Report to CCAMLR of the 69th Meeting of the Inter-American Tropical Tuna Commission (26 to 28 June, Manzanillo, Mexico) CCAMLR Observer (USA)
CCAMLR-XXI/BG/33	Report on SCAR activities 2001/02 and Report of the CCAMLR Observer to SCAR-XXVII (Shanghai, People's Republic of China, 13 to 26 July 2002) SCAR Observer at CCAMLR, CCAMLR Observer at SCAR GOSEAC liaison with the Scientific Committee of CCAMLR E. Fanta (Brazil)

CCAMLR-XXI/BG/34	Report of the World Conservation Union (IUCN) Twenty-first Meeting of the Commission for the Conservation of Antarctic Marine Living Resources Submitted by the IUCN
CCAMLR-XXI/BG/35	Report of CCAMLR Observer to WSSD CCAMLR Observer (South Africa)
CCAMLR-XXI/BG/36	FAO Observer's Report FAO Observer (R. Shotton)
CCAMLR-XXI/BG/37	Report of the Scientific Committee Chair to the Commission
CCAMLR-XXI/BG/38 Rev. 1	Fishery activities and trade of Patagonian toothfish in South America: a regional perspective Submitted by the IUCN
CCAMLR-XXI/BG/39	Marine fish and the Twelfth Meeting of the Conference of the Parties to CITES, Santiago, Chile 2002 Submitted by the IUCN
CCAMLR-XXI/BG/40	Information from the Delegation of the European Community
CCAMLR-XXI/BG/41	Biological prospecting in Antarctica Delegation of the United Kingdom
CCAMLR-XXI/BG/42	IWC Observer's Report to CCAMLR Annual Meeting 2002 IWC Observer (B. Fernholm, Sweden)
CCAMLR-XXI/BG/43	Report of the Fourth Meeting of the CCSBT Ecologically Related Species Working Group CCAMLR Observer (B. Baker, Australia)
CCAMLR-XXI/BG/44	The objective of the Convention Delegation of Chile
CCAMLR-XXI/BG/45	CITES/CCAMLR – frequently asked questions The Antarctic and Southern Ocean Coalition (available in English and Spanish)
CCAMLR-XXI/BG/46	54th Annual Meeting of the International Whaling Commission CCAMLR Observer (Japan)
CCAMLR-XXI/BG/47	CCAMLR intersessional tribunal Delegation of Australia

CCAMLR-XXI/BG/48	Application of CITES to fisheries management – a cause for concern Delegation of Norway
CCAMLR-XXI/BG/49	Preparations for fishing activity and trade of *Dissostichus eleginoides* by Brazil Delegation of Brazil

ANNEX 3

AGENDA FOR THE TWENTY-FIRST MEETING OF THE SCIENTIFIC COMMITTEE

AGENDA FOR THE TWENTY-FIRST 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 SCOI

2. CCAMLR Scheme of International Scientific Observation
   (i) Scientific Observations Conducted in the 2001/02 Fishing Season
   (ii) Advice to the Commission

3. Ecosystem Monitoring and Management
   (i) Advice from WG-EMM
   (ii) Management of Protected Areas
   (iii) 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) Advice from WG-FSA
      (c) Advice to the Commission

   (iii) New and Exploratory Fisheries
      (a) New Fisheries in the 2001/02 Season
      (b) Exploratory Fisheries in the 2001/02 Season
      (c) Notifications for New and Exploratory Fisheries in the 2002/03 Season
      (d) Revision of Boundaries
      (e) 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

5. Incidental Mortality
    (i) Incidental Mortality Arising from Longline Fisheries
    (ii) Incidental Mortality Arising from Trawl Fisheries
    (iii) By-catch Associated with Other Fisheries (Krill, Crab etc.)
    (iv) Advice to the Commission

6. Additional Monitoring and Management Issues
    (i) Proposals for Extension of CEMP Sites
    (ii) Marine Debris
    (iii) Marine Mammal and Bird Populations
    (iv) 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 2003 and Forecast Budget for 2004

11. Advice to SCOI and SCAF

12. Secretariat Supported Activities
    (i) Data Management
    (ii) Publications

13. Scientific Committee Activities
    (i) Intersessional Activities during 2002/03
    (ii) Revision of the Scientific Committee Agenda
    (iii) Invitation of Observers to the Next Meeting
    (iv) Next Meeting

14. Election of Chair of the Scientific Committee

15. Other Business
    (i) Data Access

16. Adoption of the Report of the Twenty-first Meeting of the Scientific Committee

17. Close of the Meeting.

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT

(Big Sky, Montana, USA, 5 to 16 August 2002)

CONTENTS

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT
(Big Sky, Montana, USA, 5 to 16 August 2002)

INTRODUCTION

Opening of the Meeting

1.1 The eighth meeting of WG-EMM was held at Big Sky, Montana, USA, from 5 to 16 August 2002. The meeting was convened by Dr R. Hewitt (USA).

1.2 Dr Hewitt welcomed participants and outlined the program for the meeting. This was the second meeting with a hybrid agenda consisting of plenary and subgroup sessions to discuss core topics, and a workshop (Workshop on Small-scale Management Units, such as Predator Units, hereafter called the SSMU Workshop).

1.3 This year's electronic submission of meeting papers had worked successfully and 60 meeting documents were submitted by the deadline of 19 July 2002 (two weeks prior to the start of the meeting). WG-EMM thanked the Secretariat, particularly Mrs R. Marazas (Website and Information Services Officer), for promptly processing all the papers. The complete set of meeting documents was available through the CCAMLR website from 21 July 2002. WG-EMM also congratulated the Secretariat for revising the CCAMLR website. The new format allowed rapid and easy access to meeting information and documents.

1.4 WG-EMM considered five papers which had been submitted after the deadline. It was agreed that two papers analysing fishery data of direct relevance to the workshop (WG-EMM-02/62 and 02/63) would be accepted. WG-EMM agreed that the acceptance of these two papers after the deadline would not set a precedent. The remaining three papers were not accepted.

1.5 WG-EMM reaffirmed that only papers accompanied by a completed one-page synopsis and submitted electronically by the deadline would be considered at future meetings (see also paragraph 6.32). The deadline is the Friday closest to two weeks prior to the meeting based on Eastern Australia standard time ('Hobart' time). It was agreed that the exact date of the deadline for the next meeting of WG-EMM would be contingent on the date agreed by the Scientific Committee for the commencement of the Working Group's meeting. Papers submitted after the deadline would not be considered.

1.6 WG-EMM welcomed the informal presentation of a poster brought by Dr B. Bergström (Sweden). The poster was displayed in the coffee break area. WG-EMM encouraged participants to use this medium if they wished to provide further information on activities which were of relevance to the work of WG-EMM.

Adoption of the Agenda and Organisation of the Meeting

1.7 The Provisional Agenda was discussed and it was agreed to include 'Review of procedures for the electronic submission of meeting documents' under Item 6. With this addition, the agenda was adopted (Appendix A).

1.8 The List of Participants is included in this report as Appendix B and the List of Documents submitted to the meeting as Appendix C.

1.9 The report was prepared by Dr A. Constable (Australia), Prof. J. Croxall (UK), Dr D. Demer (USA), Mr M. Goebel (USA) and Drs S. Nicol (Australia), P. Penhale (USA), D. Ramm (Data Manager), K. Reid (UK), E. Sabourenkov (Science Officer), V. Siegel (Germany), C. Southwell (Australia), P. Trathan (UK) and G. Watters (USA).

STATUS AND TRENDS IN THE KRILL FISHERY

Fishing Activity

2000/01 Season

2.1 The preliminary estimate of total reported catch from the krill fishery during the 2000/01 fishing season was 103 335 tonnes (Table 1). All krill fishing occurred in Area 48. Krill was taken by nine trawlers flagged to five Member countries: Japan (3 vessels), Republic of Korea (1 vessel), Poland (3 vessels), Ukraine (1 vessel) and the USA (1 vessel) (WG-EMM-02/6).

2.2 All Members fishing for krill submitted monthly catch and effort reports; however, some Members have only reported accumulated catch and effort for Area 48 as a whole. Available fine-scale data (67% of reported catches) indicate that most krill fishing during the 2000/01 season occurred in Subareas 48.1 (68% of reported catches) and 48.3 (24%).

2001/02 Season and Future Plans

2.3 Monthly catch and effort reports submitted so far for the 2001/02 fishing season indicate that krill fishing has only occurred in Area 48, with 77 085 tonnes of krill taken between January and June 2002 (Table 2). Fine-scale haul-by-haul data have been submitted by the USA (WG-EMM-02/6).

2.4 In 2001/02, nine trawlers fished for krill, and these were flagged to five Members: Japan (2 vessels), Republic of Korea (1 vessel), Poland (2 vessels), Ukraine (3 vessels) and the USA (1 vessel). These are the same countries and the same number of vessels that fished in the 2000/01 season.

2.5 The estimated catch for 2001/02, projected from the current catch level and previous catch history, is approximately 115 000 tonnes. This would represent an increase on the 2000/01 catch and be similar to the 1999/2000 level. This increase is largely due to higher catches by Ukraine and the USA.

2.6 It was noted that Ukraine had indicated at SC-CAMLR-XX that it intended to catch 50 000 tonnes of krill in 2001/02. Dr Sabourenkov indicated that he had visited Ukraine recently and that their fishery plans were for three vessels to continue fishing at the level of approximately 25 000 tonnes per year. During 2001/02, 8 500 tonnes of the catch of krill was peeled and the rest was frozen for human consumption or was converted to fish meal.

2.7 The Working Group welcomed the participation of scientists from two of the current krill fishing nations (USA and Japan), but noted with regret the lack of participation of scientists, and the lack of information from the three other current krill fishing nations: Republic of Korea, Poland and Ukraine.

2.8 Mr C. Jones (USA) indicated that the US krill vessel will continue to fish around South Georgia in July and August 2002 and the USA intends to fish next season with one vessel as was indicated in WG-EMM-02/18.

2.9 Japan indicated that there would be three vessels fishing for krill in 2002/03 (up from two in 2001/02) with an estimated catch of 60 000 tonnes.

2.10 Information relayed to the Secretariat indicated that Poland may not fish for krill in the 2002/03 season. Poland had previously sent two vessels fishing for krill.

2.11 Russia indicated that they had no plans to re-enter the krill fishery at this stage.

2.12 Neither Australia nor the UK had received any firm proposals for krill fishing in the future; they would notify WG-EMM as soon as any such proposals had been put forward. No other information was available on future plans for krill fishing from any other Members or non-Members.

CPUE

2.13 Data for Subareas 48.1, 48.2 and 48.3 were presented on vessel types, the mean monthly CPUE and fishing patterns from three main regional fishery associations in the Soviet fleet from 1977 to 1992 (WG-EMM-02/27).

2.14 CPUE appears dependent on vessel type; there were 16 different types of fishing vessels in the Soviet fleet. Some vessels were able to fish without restrictions due to their technical characteristics, and their CPUE depended mainly on krill availability. Other vessels were restricted by their ability to process the catch. Thus certain types of vessels provided a better indication of krill availability because some types of vessels were more common in the fishery than others, and some vessels had technical characteristics which allowed fishing under all conditions. Standardised CPUEs were also shown to change from subarea to subarea, from season to season and interannually.

2.15 Haul-by-haul data from USSR vessels operating in Subarea 48.3 from April to September 1984–1990 indicated the existence of two basic fishing grounds, one east of South Georgia and one to the west. There was also a smaller fishing ground around Shag Rocks (WG-EMM-02/63 Rev. 1). The eastern ground was more persistent, lasting from April to August, whereas the western one usually lasted from August to September.

2.16 Aggregated catch, CPUE by tows, towing time and fishing days were calculated from the Japanese fishery in Area 48 for 10 x 10 n mile squares (WG-EMM-02/28 Rev. 1). The distribution pattern of the aggregated catch generally resembled the distribution pattern of CPUE by fishing days, but not CPUE by haul and towing time.

2.17 Catch per haul is principally governed by the efficiency of the ship factory and the freezer capacity. Catch per towing time reflects the within-patch density, since krill trawlers adjust the tow length to the patch itself.

2.18 Catch per fishing day may be the better index for expressing the status of krill in the fishing grounds. Trawlers repeat searching until they come across krill in fishable aggregations. If fishable aggregations are scarce, the duration of searching time within a day increases, and consequently CPUE by fishing day decreases (paragraph 6.9).

2.19 The Working Group noted that the various measures of CPUE provided information on a number of different factors. For example, Dr P. Gasiukov (Russia) noted that CPUE per hour produces some information on krill density whereas a measure such as mean monthly CPUE per fishing day reflects the capability of the fishing vessels (WG-EMM-02/27). Additionally, information from the US fishing vessel *Top Ocean* indicated that CPUE is highly dependent on the type of product targeted by the fishery. Thus the interpretation of CPUE data requires considerable ancillary information.

2.20 The number of studies on CPUE submitted in recent years and the provision of more information on the strategies of the krill fleets make it desirable for the Working Group to review the utility of CPUE in the near future.

Description of the Fishery

2.21 A method for delineating krill fishing grounds in Area 48 based on commercial catch data for the region was proposed in WG-EMM-02/40 Rev. 1. Available information on krill distribution, abundance and movement in the region was also summarised. This could be used to improve understanding of the linkages between the fishing grounds and distribution of the krill population.

2.22 A 'fishing ground' is defined as being a predictable location where the fishery obtains relatively reliable catches from one year to the next for a number of years. Of interest is not only the total catch obtained from a location over the years, but how important that location is to the fishery each year. This is judged by that location providing a reasonable catch in a given year and that the catch remains sufficiently high on average over a number of years – the 'normalised catch'.

2.23 Some simple criteria for designating fishing grounds were presented (WG-EMM-02/40 Rev. 1). The type of analytical tools needed to convert catch data to a longitude–latitude grid of normalised catches and for determining boundaries on the grid according to the criteria was also presented. This process was developed using the commercial krill catch data from the CCAMLR database. The Working Group recognised that these analyses would form part of the SSMU Workshop.

2.24 The fishing patterns described in WG-EMM-02/40 Rev. 1 were similar to those presented in papers at past meetings. The distribution of catches across Area 48 shows distinct spatial and temporal shifts in fishing patterns since the beginning of the fishery. Total catches from each fine-scale rectangle in Area 48 (368 areas in all) were pooled for each three-month period in a split-year. The pattern of catches across all fine-scale rectangles was then statistically compared for every season between the 1980/81 and 1998/99 split-years (see also SC-CAMLR-XIX, Annex 4, Appendix D).

2.25 Autumn and winter fishing patterns were distinct from other seasons. Winter catches were concentrated around South Georgia. For autumn, the higher catches of the 1980s are evident as well as the fishing pattern being similar throughout the 1990s. The fishing patterns in spring and summer were similar in the 1980s but became segregated in the 1990s. The spring pattern has been much more variable than the tighter pattern in summer.

2.26 The summer fishery since 1991 has been more stable than the earlier years, and from 1996 there is a well established pattern compared to earlier years. The King George and Livingston Island area is the most important fishing ground in the current fishery, which has been consistently fished since 1988. The South Orkney and South Georgia regions have declined in importance since 1991, although they have been important in some years since then. Elephant Island remains relatively unimportant in the fishery. A differentiation between the eastern and western parts of the South Orkney and South Georgia areas is also evident.

2.27 There was further indication of changes from the established patterns of fishing over the past few seasons. Krill fishing had been carried out in Bransfield Strait (WG-EMM-02/18). Additionally, there had been a southward movement of the fishing fleet in recent years with winter fishing in Subarea 48.1 (WG-EMM-02/40 Rev. 1). It was uncertain whether these movements were for operational or ecological reasons.

2.28 Logbook data from Japanese krill trawlers were used to characterise their fishing strategies, especially focusing on their movement in time and space (WG-EMM-02/28 Rev. 1). A conceptual diagram of krill fishing operations was presented based on information provided from the krill fishing companies on individual krill patches, and local areas where these individual krill patches are aggregated.

2.29 Trawlers repeatedly fished a single patch or several patches nearby. When the trawlers decide to leave this local patch aggregation, they search nearby, and if they come across another fishable patch aggregation in terms of size and quality they start fishing on it. If not, the searching may be extended until the vessel finds fishable local aggregations.

2.30 Using this conceptual model, the fishing patterns of Japanese krill trawlers in recent times was examined. The distances between the starting position of a haul and the following haul was calculated using haul-by-haul data from five recent fishing seasons. A series of threshold distances were defined (10 n miles, 30 n miles and 60 n miles) and each of the consecutive operations were grouped within these thresholds and termed an ‘operation unit’.

2.31 Mean fishing position, fishing days, total catch and CPUE were calculated for each of these operation units. The 10 n mile threshold operation units were scattered throughout the historic range of the fishery. However, there were obvious differences in the distribution range between fishing seasons (e.g. widely distributed in 1997/98 and 1998/99, but more restricted in other seasons in Subarea 48.1). The formation of offshore and inshore operation units in the area north of the South Shetland Islands was also evident.

2.32 As the threshold changed to 30 and 60 n miles, the number of operation units decreased. The ranges of these units frequently overlapped spatially, but still remained discrete.

2.33 For the 30 n mile threshold operation units, most operations were completed within 2 to 4 days, but could last more than 8 days. Usually, less than 200 tonnes of krill were caught per operation unit, but occasionally 1 000 to 4 000 tonnes were removed.

2.34 For the 60 n mile threshold operation units, most operations were completed within 5 to 10 days, but occasionally operations lasted for more than 20 days. Usually less than 500 tonnes of krill were caught per operation unit, but occasionally up to 7 000 tonnes were removed. Most of the operation units with prolonged duration were located around South Georgia and the South Orkney Islands where the size of the fishing grounds is limited.

2.35 The impact of the Soviet commercial krill fishing fleet from 1987 to 1991 was estimated (WG-EMM-02/62). Soviet vessels operated in only 8 to 9% of the area of Subareas 48.2 and 48.3. The authors reported that catch of krill was only 9.4 to 15.6% of the estimated abundance of krill in the fishing grounds. Fishing mortality was estimated at less than 1% which included mortality of the catch and mortality due to damage to krill escaping from the nets.

2.36 The relationship between fishing removal at the highest level and predator demand was examined and, because the fishery consumed only 2% of the estimated predator demand, it was concluded in WG-EMM-02/62 that there was no competition between predators and the krill fishery.

2.37 The Working Group indicated that such analyses of fishery–predator competition were complex and were unlikely to be adequately assessed by such simple calculations. Further discussions of this issue are presented in paragraphs 3.35 to 3.41.

2.38 Considerable information on the developing US krill fishing venture was made available to the Working Group (WG-EMM-02/18). A US-flagged trawler started fishing operations for krill in Area 48 in July 2000. This fishery has continued and expanded each year since the initial fishing trials.

2.39 Initial fishing trials in 2000 were conducted in Bransfield Strait and north of South Georgia. In 2001, all fishing was conducted off the South Shetland Islands and in Bransfield Strait where the US vessel worked closely with other fishing fleets. In 2002, fishing operations were carried out off the Antarctic Peninsula, west of Elephant Island and northwest of the South Orkney Islands.

2.40 From July 2000 to April 2002, the US vessel made a total of 571 hauls and caught 9 461 tonnes of krill. Increasing catch rates with time are likely to be related to the increasing experience of the captain, rather than to changes in krill abundance. The decision-making processes involved during fishing operations were based on several factors, including krill abundance, weather, ice conditions, condition of krill in relation to the target product, and ad hoc information from nearby fishing fleets.

2.41 There was evidence for interactions between the type of krill, the fishing strategy and the end product. Once processing of krill began, the priority was to keep the factory running. Vessels fishing for a straight round bait market target large white or pink krill, and thus can have a different fishing pattern than vessels processing tail meat. Vessels fishing mainly for meal can use greener krill; whereas vessels producing tail meat must consider shell state and colour, and avoid green krill. Near Elephant Island in 2001 the krill shell was extremely hard and striped, which created considerable difficulties for the de-shelling equipment. The US venture is currently harvesting krill for meal and tail meat, but there are plans to expand into production of pharmaceutical-grade krill oil and soluble krill protein concentrate.

2.42 The Working Group welcomed the submission of WG-EMM-02/18 which provided information on the developmental phase of a krill fishing operation and encouraged further submissions on the continued evolution of this fishing venture. The Working Group reiterated its requirement for continued submission of detailed information from krill fishing fleets at all phases of their development.

Economics, Technology and Markets

2.43 Information from the US krill fishery indicated that in order for the krill fishery to develop, substantial investment in new vessels, gear and marketing was required (WG-EMM-02/18). At present the price of krill products and market development appears to be stagnant. Whether there will be an expansion to include additional vessels and fishing effort by the US fishery depends largely on the development of the market for its krill products.

2.44 An analysis of the predictions made by Members of their future level of krill fishing activities from Scientific Committee reports indicated that these predictions are generally less accurate than are necessary to indicate future trends in the krill fishery (WG-EMM-02/25).

2.45 A search of the Internet and follow-up enquiries by the Secretariat failed to locate relevant recent information regarding the market prices of krill (WG-EMM-02/6), but such information is available from a number of commercial sources, for example from Fish Information and Services (www.fis.com/fis) (WG-EMM-02/25). Access to such information is available by subscription only (US$500 per year). Regular access to such economic information will be necessary to provide reliable predictions of future harvesting trends.

2.46 Should the Commission consider it useful to have economic and marketing information, then the Working Group suggested that the Secretariat could be funded to identify possible sources of such market information and provide regular updates on market trends (paragraph 2.45).

2.47 Technological information that may provide early warnings of developments that could drive a future expansion in krill fishing is available from international patent databases. An examination of such patent databases revealed 376 recorded patents on products and processes involving krill (WG-EMM-02/25). It is apparent that there is considerable commercial and industrial interest in products derived from krill and that this interest is continuing.

2.48 These patents reveal some trends in the development of processes and products for krill:

- Development of technology and products for human consumption has recently been overtaken by the development of aquaculture feed products and of specialised products for pharmaceutical and medical purposes.

- There have been recent developments in harvesting methods which may make their way into the fishery and these may provide new opportunities for the production of novel products such as hydrolysates.

- The traditional fishing nations (Japan, Russia and Poland) are being joined by companies from industrialised western countries (Canada, UK and the USA) in patenting processes and products for krill with a wide spectrum of applications.

2.49 Aquaculture and human consumption are likely to require krill in large quantities, but medical and pharmaceutical requirements are for smaller quantities of high-quality krill products.

2.50 The Working Group noted that the krill fishery may be affected by the global oversupply of large fishing trawlers caused by declines in some Northern Hemisphere fisheries. The Working Group suggested that the Secretariat be tasked to contact ICES to obtain information about the number of vessels that might potentially enter the krill fishery.

Regulatory Issues

Fishery Plan

2.51 The Secretariat has further developed fishery plans, including the plan for the krill fishery, in accordance with the recommendation of SC-CAMLR-XX. Information for the plans is now held in a MS Access database. This database also includes other fishery-related information necessary for generating fishery summaries such as those developed by WG-FSA (WG-EMM-02/6). Information from the database is input to the Fishery Plan which is held in MS Excel. A copy of the fishery plan for the krill fishery in Area 48 was provided in WG-EMM-02/6.

Questionnaire on Fishing Strategies

2.52 The questionnaire on fishing strategies in the krill fishery was revised to address concerns raised by some Members that the information requested should be more quantitative in nature, and to integrate the questionnaire with the information on vessel activities which scientific observers are requested to collect (WG-EMM-02/6).

2.53 The revised questionnaire was distributed in March 2002 to representatives of the Scientific Committee, WG-EMM and Member countries involved in krill fisheries. Comments and feedback were invited, along with at-sea evaluation on board commercial krill vessels. No feedback had been received prior to the meeting, but Japanese scientists reported at the meeting that the questionnaire was now suitable for general use.

2.54 Completed questionnaires had been received from two Polish-flagged vessels. These questionnaires covered 50 days of activities in Subareas 48.1 and 48.2 and Division 41.3.2 (outside the CCAMLR Convention Area) in April, May and June 2002. One of these vessels had also completed five questionnaires covering fishing in Subarea 48.1 from March to June 2001.

2.55 The Working Group agreed that the Secretariat should collate and synthesise information from the krill fishery questionnaire for presentation at future meetings.

Forecasting Closure of the Fishery

2.56 Forecast closure dates are routinely generated and reported by the Secretariat as soon as the total reported catch in a fishery exceeds 50% of the catch limit. This is emailed regularly to Contracting Parties. CCAMLR uses an agreed regression method for forecasting closure dates. The projected closure date is the actual date when the catch is estimated to reach the catch limit, assuming the fishing continues at the current rate up to, and including, the closure date (WG-EMM-02/6).

2.57 The Working Group agreed that it will be necessary to change the current monthly reporting system used in the krill fishery to avoid a potential 30% over-run. This would require accurate information on krill catches being reported at shorter time intervals (see also paragraphs 2.64 to 2.67).

2.58 Drs S. Kawaguchi (Japan) and K. Shust (Russia), however, stressed that since the current level of catch is still well below the precautionary catch limit, it should not be an urgent task to change the reporting system.

International Scheme of Scientific Observation

2.59 Two datasets collected by scientific observers were submitted for the 2000/01 season: by the US-flagged vessel *Top Ocean*, and by a national scientific observer on board the Japanese-flagged vessel *Niitaka Maru*. At present the CCAMLR database holds data collected from only three krill-fishing cruises by designated CCAMLR scientific observers in 2000/01 (WG-EMM-02/6).

2.60 Suggested modifications to the *Scientific Observers Manual* were presented (WG-EMM-02/29). The current manual consists of nine forms; some of which were developed independently so there may be redundancies. Four of the forms, in particular, may require modification:

- Form K4 – Krill Biological Data Collection:
  It was pointed out that determining the maturity stage of krill may not be possible by non-specialists and the colour charts were unclear and needed revision. The sampling frequency from the catch should be increased to two hauls per day and the collection of length data should be accorded the highest priority.

- Form K5 – Finfish By-catch:
  As krill trawlers perform more than 10 hauls per day the current requirement to sample every haul might be modified, with the sampling frequency being advised by WG-FSA taking into account the experience of scientific observers who have worked in the krill fishery.

- Form K6 – Conversion Factor:
  Completion of this form has been difficult because, in most cases, the factories are off limit. A suggested approach was to use the catch estimates based on the fullness of the codends or the scales in the fishpond, and not to use a conversion factor to re-estimate the total catch.

- Form K7 – Krill Time Budget Data:
  As CCAMLR is introducing the Krill Fishing Strategy Questionnaire, Form K7 could be deleted.

2.61 The Working Group agreed with these recommendations and suggested that sampling for fish by-catch should be assessed by WG-FSA. A subgroup comprising Dr I. Everson (UK), Mr Jones and Drs Kawaguchi, Ramm and Sabourenkov discussed the recommended changes to the *Scientific Observers Manual*.

2.62 The subgroup noted that the krill observation logbook forms currently exist only in electronic format (i.e. Excel), and that further work is required by the Secretariat before these forms can be published in the *Scientific Observers Manual*. The subgroup made the following recommendations which were considered by WG-EMM and subsequently approved:

(i) The list of krill observation priorities as contained in the manual should be amended in order to accord the highest priority to the collection of krill length data. Collection of data on krill maturity stages was considered to be of lower priority.

(ii) The revised krill colour chart to be prepared by Dr Kawaguchi will be submitted for consideration at the 2003 meeting of WG-EMM for subsequent inclusion in the manual.

(iii) Instructions in the manual should include provision for scientific observers to seek assistance from the vessel's crew, as may be required from time to time, for their work, such as sampling by-catch or collecting data on krill product conversion factors.

(iv) A simplified sampling methodology should be developed for fish that are easily identifiable in catch samples, e.g. with a length of approximately 7 cm and more. A minimum of three hauls per day should be sampled for by-catch of fish species in accordance with instructions contained in the manual. WG-FSA should be requested to assist in the development of the methodology for sampling larvae and other small-sized fish (i.e. <7 cm).

(v) It was noted that collection of krill product conversion factors on board krill fishing vessels continues to be problematic for scientific observers because the current method requires the observer to track identifiable batches of krill through the processing line. This is not a feasible option on board most factory ships. Development of an alternative method should be given high priority for WG-EMM's intersessional work. If information on krill conversion factors continues to be difficult to obtain by observers, then Members should be requested to assist in the collection of such information directly from krill product manufacturers or provide direct measurement of green weight prior to processing.

(vi) The introductory note to the questionnaire on krill fishing strategies should incorporate a footnote indicating that the collection of data on krill product conversion factors will require development of an appropriate sampling method. Development of such a method should be given a high priority for WG-EMM's intersessional work.

2.63 The Working Group was informed that Japan would be deploying a scientific observer during winter in the coming season, specifically to examine the issue of fish by-catch. Additionally, the historical data on fish by-catch collected by Japanese scientific observers on krill fishing vessels were currently being consolidated and analysed.

Data Reporting

2.64 Fishery data reported to the Secretariat over the last two fishing seasons were presented in WG-EMM-02/6. The data that are mandatory (monthly catch, STATLANT data) are all submitted to the Secretariat, though not necessarily as promptly as would be ideal. Data that are voluntary (such as fine-scale catch and effort data and observer data) are not submitted by all Members and when they are submitted, are not presented in a uniform manner (see also paragraphs 5.43 and 5.44).

2.65 The frequency and format of data submission range from close adherence with the established procedure described in Conservation Measures 40/X (Monthly Catch and Effort Reporting System) and 122/XIX (Monthly Fine-scale Catch and Effort Data Reporting System for Trawl, Longline and Pot Fisheries) to annual submission (e.g. data for a 'split-year' submitted in October each year).

2.66 Unfortunately, the combination of the revised fishing season, the voluntary nature of most data submissions for the krill fisheries and other factors has resulted in a paucity of fishery data available to WG-EMM-02 for the most recent, completed, fishing season (2000/01: December 2000 to November 2001).

2.67 The Working Group noted that the fine-scale dataset for the 2000/01 season is incomplete. Japan usually submits aggregated data (10 x 10 n mile rectangles by 10-day periods) pertaining to a split-year (the 'old' fishing season: July to June of the following year) in October each year. As a result, the latest data submission (October 2001) provided fine-scale data for the 12-month period to June 2001. The Republic of Korea had provided fine-scale data to August 2001. In the past, Poland has submitted fine-scale data but there has been a suspension of data submission. Fine-scale data submission from Ukraine appears incomplete for June, July and August 2001.

2.68 The Working Group pointed out that although the catch of krill is small relative to the catch limits, the fishery is the largest in the Convention Area (in terms of catch weight), and that management of this fishery requires timely submission of the appropriate data (see also paragraphs 5.43 and 5.44).

Key Points for Consideration by the Scientific Committee

2.69 The Working Group drew to the Scientific Committee's attention that interpretation of CPUE data would not be possible without additional information on factors such as vessel type and product type, and that data submission on these ancillary parameters should be sought. Further, the voluntary submission of CPUE and associated data makes the krill fishery unique amongst CCAMLR fisheries which generally require mandatory submission of detailed data (paragraphs 2.13 to 2.20).

2.70 Formal annual notification of Members' intentions to participate in the krill fishery, such as that adopted for new and exploratory fisheries in the Convention Area, might facilitate identification of trends in the krill fishery. Although experience has shown that notifications are not always acted on, information on the numbers of annual notification would be useful in tracking interest in the krill fishery (paragraph 2.44).

2.71 The Working Group agreed that it does not have the expertise to fully interpret economic, marketing and technological information that is of great utility in interpreting developmental trends in the krill fishery. As regular submission and interpretation of this information is of vital interest to the Working Group, the Scientific Committee was requested to consider what mechanisms might be appropriate to access and analyse such information (paragraph 2.47).

2.72 Because it is evident that the development of krill-based aquaculture feeds will be a major factor in the future development of the krill fishery, the Working Group suggested that the Secretariat be asked to contact FAO for any information they might have on the demand for aquaculture feeds or on the development of other krill fisheries (paragraph 2.49).

2.73 The Scientific Committee was requested to enquire of the Commission what mechanisms it might want to employ to access information on factors that might affect the development of the krill fishery such as global excess fleet capacity (paragraph 2.50).

2.74 The Working Group noted that the consistency and timeliness of data reporting was deteriorating. The low level of data submission and the timing of those submissions were causing difficulties for the work of the Working Group. The Scientific Committee was requested to examine the issue of data submission from the krill fishery, including the requirements for consistency, the degree to which such submission should be voluntary and the timing of data submission (paragraphs 2.64 to 2.68).

2.75 The Working Group drew to the Scientific Committee's attention the extreme difficulty of predicting trends in the krill fishery in the absence of reliable information from fishing nations on their future plans. The voluntary nature of the submission of such information has resulted in a paucity of data available to the Working Group and this is hindering its ability to provide the Scientific Committee with information on developments of the krill fishery (paragraphs 2.64 to 2.68).

STATUS AND TRENDS IN THE KRILL-CENTRIC ECOSYSTEM

Status of Predators, Krill Resource and Environmental Influences

CEMP Indices

3.1 Updated information on the status and trends of the CEMP indices was reported in WG-EMM-02/5. A number of improvements to the indices were made by the Secretariat over the last year that included modifications to Indices A6a breeding success, A8a weight of stomach contents, A8b and A8c composition of diet. Schroeder's Index (SC-CAMLR-XV, Annex 4, Appendix H) was added to the CEMP measures of overlap between the krill fishery and krill predators. The calculation of the index is based on the same dataset as that used for the other measures of overlap.

3.2 Overall, and in respect to individual indices, 2001/02 was an average year in comparison to the time series of data available. In Area 48 there were no particular differences between the subareas for 2001/02.

3.3 Since WG-EMM-01 the Secretariat had undertaken a review and preliminary analysis of some specific CEMP data. The results of these were presented in WG-EMM-02/7. Considerable progress was made towards correcting irregularities and inconsistencies in the CEMP database. Specifically, problems with reporting of breeding success (chicks fledged per egg laid), zeros for null data, calculated weights for A8 chick diet, the lack of reporting of sampling dates for some indices, and inconsistencies in colony codes for certain CEMP sites were reported and where possible corrected. Comment sections of CEMP data forms were also found to be highly under-utilised.

3.4 The Working Group made the following recommendations:

- Researchers should be encouraged to use the most current data forms available, which are found on the CCAMLR website.

- Members should be encouraged to use comment sections of data forms and to send extra information that they believe may be useful in data validation, or for any other purposes. Such information, when given, should be clearly flagged to avoid misinterpretation during data entry.

- Sampling dates must be provided with every submission.

- Steps should be taken to ensure that colony codes are uniform from one season to the next, or that they allow for the merging or disappearance of colonies.

- Lastly, because automated data may, in the future, be used more frequently, guidelines in the standard methods should be drafted for their submission.

3.5 WG-EMM-02/7 also provided a preliminary analysis of Adélie penguin breeding population size which showed a significant decline at Anvers Island; other sites around the continent were either stable or had increased over their time series.

3.6 In discussion it was pointed out by Dr W. Fraser (USA), the Anvers Island data holder, that the results and conclusions presented in WG-EMM-02/7 were contradictory to his own more comprehensive analyses. He reported that, although a decline in population has occurred, breeding success has increased.

3.7 The Working Group noted that any analyses conducted by the Secretariat should be preceded by notification of data holders, which would have helped considerably in this case.

3.8 It was also noted that this analysis, and its deficiencies, in comparison with more comprehensive analyses, underscored the importance of design and scale in analyses of CEMP indices. These matters will be reviewed in 2003 in the CEMP Review Workshop.

3.9 With regard to WG-EMM-02/5, it was pointed out that the method for detection of anomalies was outdated and should be reviewed.

3.10 Dr Ramm pointed out that because of its increasing size, the CEMP database was in need of redesigning. It was agreed that small changes should be made to the database to increase ease and flexibility of access prior to the CEMP review. However, the Working Group agreed that major database restructuring should not be undertaken until after the CEMP Review Workshop.

3.11 WG-EMM-02/19 provided an update of CSIs used by Boyd (2001) for krill predators at Bird Island, South Georgia. It incorporated one additional species over earlier work and concluded that 2002 was a year of relatively good performance for krill predators at Bird Island, South Georgia.

3.12 Dr Constable noted the importance of updating WG-EMM with current assessments of predator performance. However, he noted that CSIs have not been properly evaluated and referred to discussions of WG-EMM-2000 (SC-CAMLR-XIX, Annex 4, paragraphs 3.50 to 3.52) on the importance of an evaluation before such analyses are adopted as a standard method of assessment. He cautioned against the routine reporting of CSIs becoming commonplace until such evaluations are satisfactorily concluded.

3.13 WG-EMM-02/46 reported on the results of an analysis of temporal variability in CEMP parameters for a population of Adélie penguins. It explored the interrelationships between CEMP parameters, particularly with measures of breeding success and found that: (i) events during the hatching period are crucial to chick survival, (ii) that the sex of foraging birds and the timing of foraging trips were important in determining whether foraging trip duration was negatively correlated with breeding success, and (iii) lower weights of females at first departure after egg laying appear to be the first indication that a season may have low breeding success.

3.14 This paper represents a significant step forward in identifying which parameters or indices hold the most power for identifying periods of poor predator performance.

3.15 The Working Group noted the utility of the approach used in WG-EMM-02/46 and encouraged other data holders with similar data to follow its approach and to see if similar relationships were revealed at other sites.

Predators

3.16 Dr Trathan identified those working papers that related to the foraging behaviour of krill-dependent predators, highlighting four main areas that were of interest to the Working Group as well as to the SSMU Workshop. These areas of interest were:

(i) satellite-tracking studies of predators;
(ii) estimates of prey consumption by predators;
(iii) issues of spatial scale; and
(iv) concerns about the overlap between predators and krill fisheries.

Satellite-tracking Studies

3.17 Dr Trathan reported that, although most satellite-tracking studies were usually restricted to data from a few individuals breeding at a few accessible colonies, such data were extremely important as they provided a detailed view of predator foraging range and behaviour not otherwise available. WG-EMM-02/15, 02/21, 02/22, 02/47, 02/53 and 02/55 all described studies of satellite tracking.

3.18 These papers highlight four important issues relevant to predator foraging: (i) that a detailed understanding of species-specific foraging ecology is necessary, particularly where individuals may adopt different foraging strategies; (ii) that during their winter (non-breeding season) dispersal, predators can travel considerable distances from their breeding colony; (iii) that foraging locations may be strongly influenced by physical features of the environment; and (iv) that interactions between species can potentially have important impacts on their foraging behaviour and their foraging range.

Individual Species Foraging Behaviour

3.19 WG-EMM-02/21 provided some general background about the foraging areas and foraging ranges of macaroni penguins breeding at Bird Island, South Georgia. The study highlighted a number of key issues relating to the foraging ecology of the species:

(i) macaroni penguins travel further from their colony during certain periods of the breeding season, for example, during incubation foraging occurs up to 572 km from the colony, whereas during chick rearing foraging is constrained to within 62 km;

(ii) differences in travel speed may occur, with birds travelling faster during their long incubation foraging trip;

(iii) birds generally showed directional foraging with most trips following similar bearings; and

(iv) the study revealed that differences between sexes may be important.

This paper highlighted the complexity of macaroni penguin foraging behaviour, suggesting that a detailed understanding for individual species is important.

Winter Dispersal

3.20 The importance of winter behaviour was highlighted by WG-EMM-02/47 and 02/55; these papers look at the winter foraging dispersal of chinstrap and Adélie penguins.

3.21 WG-EMM-02/55 examined the post-breeding dispersal of chinstrap and Adélie penguins from two colonies in the South Shetland Islands. Four of the five tracked chinstrap penguins remained close to their breeding colony staying mainly over the shelf in ice-free areas to the north of the South Shetland Islands. However, the other tracked bird travelled east towards the South Sandwich Islands. Adélie penguins also showed contrasting winter dispersal patterns. In one year the tracked birds remained close to their colony whilst the following season tracked birds travelled south into the Weddell Sea. These differing winter dispersal patterns indicate that penguins from individual colonies may have very different winter strategies and different winter feeding grounds.

3.22 WG-EMM-02/47 examined the dispersal of post-moult adult and fledging Adélie penguins from Béchervaise Island and Magnetic Island. In this study all tracked birds travelled westward either along the edge of the fast-ice or in pack-ice. Fledging birds initially travelled north before moving westwards. The authors suggested that this may represent exploratory behaviour prior to the time when these inexperienced birds learn where food concentrations exist. The authors also noted that adults were recorded in areas of known krill concentration. The study indicated that both post-moult adults and fledging birds follow a similar strategy, moving considerable distances from the breeding colony during winter.

Interactions between Foraging Behaviour and the Physical Environment

3.23 WG-EMM-02/21 and 02/47 indicated that physical features of the environment may be important in understanding where predators forage. For example, during incubation macaroni penguins from Bird Island travelled considerable distances to forage over the Maurice Ewing Bank within the Polar Frontal Zone. Similarly, Adélie penguins from Béchervaise Island travelled westward in the westward flowing coastal current before moving north of the southern boundary of the Antarctic Circumpolar Current into the eastward flowing Antarctic Circumpolar Current. Thus, WG-EMM-02/47 suggested that these Adélie penguins potentially track the ice and utilise oceanic gyres to increase their foraging efficiency. WG-EMM-02/53 also indicated that physical features may be important in determining the foraging behaviour and foraging ranges of Antarctic fur seals. For example, over a four-year period fur seals tracked from Cape Shirreff, Livingston Island, foraged over the mouth of a canyon at the edge of the continental shelf, about 40 km northwest of Cape Shirreff.

3.24 Physical features in the environment, such as submarine banks, oceanic gyres and shelf-break fronts have long been known to be areas where there are potentially higher levels of primary and secondary productivity. They may also be areas where prey are potentially aggregated.

Interactions between Species

3.25 WG-EMM-02/15 and 02/22 highlighted potential interactions between species. WG-EMM-02/15 reported a satellite-tracking study of Adélie and chinstrap penguins breeding at Signy Island, South Orkney Islands. In 2000, a year of apparent low prey availability, there was a statistically significant segregation of foraging areas between the two species; however in 2001, a year of apparent normal resource availability there was no such segregation. In 2000, the breeding success of Adélie penguins was 51% lower than the long-term mean compared to 15% lower for chinstrap penguins. Both species achieved above-average breeding success in 2001. The changes in foraging distribution and breeding success suggest that in years of apparent low resource availability, chinstrap penguins may be able to competitively exclude Adélie penguins from potential inshore foraging areas. This has considerable implications for the relative population performance of species, particularly under reduced levels of krill availability.

3.26 Dr V. Sushin (Russia) noted that Adélie penguins foraging from Signy Island were feeding to the south of the island; he wondered why they were not targeting the areas of high krill abundance known to occur to the west and northwest of Coronation Island. Dr Trathan replied that one possible reason could be that penguins from colonies on Coronation Island were using those areas.

3.27 Dr Naganobu also suggested that canyons at the edge of the shelf may influence foraging distribution, particularly if Warm Deep Water entering the canyon systems caused them to have elevated levels of primary and secondary production.

3.28 Dr W. Trivelpiece (USA) suggested that competitive exclusion of Adélie penguins by chinstrap penguins was not the only explanation for the results described in WG-EMM-02/15. He suggested that an alternative hypothesis was that foraging differences could be due to local changes in krill abundance; he added that this was plausible given the temporal differences in the tracking of Adélie penguins and chinstrap penguins. Dr Trivelpiece added, that differences in chick size and their level of independence could also have enabled Adélie penguin adults to travel further offshore. Dr Trathan responded that although these suggestions were possible, the tracking of both species had been carried out during a similar stage of breeding thereby controlling for phenological differences as much as was possible.

3.29 WG-EMM-02/22 examined potential competitive interactions between macaroni penguins and Antarctic fur seals breeding at Bird Island, South Georgia. The study highlighted changes in population size and some changes in diet over the past decade. It suggested that the competitive advantage of Antarctic fur seals may be enhanced as their populations continue to increase, particularly in years of low krill availability.

Prey Consumption

3.30 WG-EMM-02/23 presented an algorithm for synthesising information about physiology, metabolism, growth, diet, life history and activity budgets for Antarctic fur seals and macaroni penguins, two key land-based krill-dependent predators breeding at South Georgia. The outputs from the algorithm are estimates of the total population energy requirement and food consumption. A sensitivity analysis indicated that the estimates of prey consumption were most sensitive to uncertainty in some demographic variables. The analysis indicated that, assuming a diet mainly composed of krill, annual food consumption by Antarctic fur seals and macaroni penguins was 3.84 (CV = 0.11) and 8.08 (CV = 0.23) million tonnes respectively.

3.31 Dr Sushin noted that the combined total consumption figures for Antarctic fur seals and macaroni penguins at South Georgia were marginally different in this published version of Prof. I. Boyd's (UK) paper when compared to those in the earlier version tabled previously at WG-EMM. He wondered whether this was due to a difference in the data or in the method used. Prof. Croxall replied that this version used the same data and method but included a better energetic parameterisation.

Issues relating to Spatial Scale

3.32 WG-EMM-02/14 highlighted an important issue, that appropriate scales must be used when trying to assess levels of spatial correlation between foraging predators, their prey, and any potential overlap with krill fisheries. This study revealed characteristic scales apparent in the distribution of foraging predators using at-sea predator observations collected during the CCAMLR-2000 Survey. The study also had the objective of determining the spatial scales at which overlap between predators, krill and the krill fishery should be measured. The study indicated that in the Scotia Sea predator foraging demand for Antarctic krill was concentrated within a distance of 150 km from land, whilst that of the krill fishery was principally within 100 km of land. The study identified that the extent of potential overlap should be assessed at scales of 70 to 100 km to accommodate the scales of operation of the processes involved.

3.33 The study highlighted that at-sea predator observations are a valuable source of information, complementary to that from detailed satellite-tracking studies.

3.34 Dr Kawaguchi suggested that it was also important to consider other pelagic predators such as whales. Dr Hewitt agreed and reminded WG-EMM that Dr S. Reilly (IWC) had prepared a study considering the distribution of whale observations recorded during the CCAMLR-2000 Survey. This manuscript would be available to WG-EMM at a future date.

Overlap between Predators and Krill Fisheries

3.35 WG-EMM-02/53 indicated that from 1999 to 2001, 70% of the total krill harvest taken by the commercial fishery was caught within 100 km of Cape Shirreff and therefore within the foraging range of Antarctic fur seals.

3.36 WG-EMM-02/06 examined the location of reported catches of krill in Subarea 48.1 with respect to the location of known colonies of predators in the South Shetland Islands region. The annual mean distance of catches from these colonies in all seasons except 1980/81, 1981/82 and 1982/83 has been less than 50 km, and less than or equal to 25 km over the past five seasons. The smallest mean distance was 12 km in 1992/93, followed by 16 km in 1993/94 and 17 km in 2000/01. In addition, over 80% of the annual catches in Subarea 48.1 have been taken within 50 km of colonies in 12 out of the 22 seasons reported, including 99% in the 1993/94 and 2000/01 seasons, 98% in 1992/93, 93% in 1997/98 and 92% in 1999/2000.

3.37 In contrast, the authors of WG-EMM-02/62 and 02/63 Rev. 1 asserted that spatial and temporal overlap between the krill fishery at South Georgia and dependent species does not occur. Further, that functional overlap is probably not present as fishing vessels exploit krill at high densities (>100 g m^{-2}), whereas predators typically take krill at much lower densities (24 g m^{-2}) (Boyd, 2001). Similarly, in the South Orkney Islands where there may be an overlap between the krill fishery and the ecological niche of dependent species, the authors suggested the overlap is spatial rather than functional.

3.38 Prof. Croxall noted that WG-EMM-02/62 and 02/63 Rev. 1 considered the winter krill fishery at South Georgia and that this fishery operated at a time when few satellite-tracking or other data were available to describe the foraging distribution of predators. In addition, available data indicated that predators target areas of high-density krill. The value of 24 g m^{-2} quoted from Boyd (2001) in WG-EMM-02/62 and 02/63 Rev. 1 related to potentially average threshold values for maintaining fitness, derived from acoustic surveys rather than the densities of krill targeted by predators.

3.39 Dr Constable highlighted that the four indices of predator–fishery overlap reported in WG-EMM-02/06 showed some divergence. Dr Ramm emphasised that the indices included two types of metric; one set that was sensitive to the absolute amount of krill, and one set that was sensitive to the proportion of krill.

3.40 Dr Constable suggested that the Working Group should consider the value of the different predator–fishery overlap indices and make a recommendation as to which provided the measurements most relevant to the work of the group. Dr Everson agreed, and reminded the Working Group that his paper (Everson, 2002) summarised the merits of the various overlap indices. Further, that his paper described an additional index – the 'Fishing to Predation Index' – which provided information of the sort valuable to the Working Group. The Working Group agreed that the utility of the Agnew–Phegan (Agnew and Phegan, 1995) index was limited and that the Secretariat should discontinue to calculate it for management purposes.

3.41 The Working Group recommended that the Data Manager consider the most appropriate methods for presenting the different predator–fishery overlap indices and consider how best to present information on the relationships between these indices.

Predator Biology

3.42 WG-EMM-02/42 reported on an unusual mortality event of Adélie penguins near Mawson.

3.43 Because of the timing and magnitude of the event and the possibility of infectious disease as the cause, *CEMP Standard Methods*, Section 6, for collection of samples for pathological analysis, was implemented. Analysis of samples and post-mortem examinations of specimens revealed that most animals had fractures, internal injuries and peritonitis associated with physical trauma. The most likely cause was a severe storm that resulted in rapid transport of ice towards shore crushing many transiting penguins.

3.44 This event and the response of researchers in implementing the CEMP protocol proved the utility of CEMP standard methods for dealing with such events.

3.45 The Working Group noted the importance of reporting on the pathology of the birds. Dr K. Kerry (Australia) commented that it was the intention of the researchers involved to publish the results in a veterinarian journal.

3.46 WG-EMM-02/48 compiled 12 years of demographic studies for an Adélie penguin population and calculated age-specific mortality rates, fecundity and recruitment. A life table was constructed that provides predicted rates of population growth and breeding success. Large sample sizes and a long time sequence of data were found to be necessary to prevent year-to-year variation from obscuring long-term trends in reproductive success, juvenile survival and adult mortality. The authors suggest that sensitivity analyses be carried out in order to determine the numbers of adults and chicks that need to be marked each year in order to detect significant changes in annual adult mortality and juvenile survival as well as to detect correlations with other CEMP parameters.

3.47 The Working Group welcomed this valuable contribution to its work and noted the importance of demography data and long time series for understanding predator responses to environmental changes and to potential influences of fisheries.

3.48 Formulations of CEMP standard methods for collection and analyses of demography data should be encouraged and the advice of researchers with similar data should be sought. Dr Kerry agreed to coordinate such an approach in respect of the Adélie penguin.

3.49 WG-EMM-02/51 reported on the results of a 2002 survey of all known Antarctic fur seal breeding colonies in the South Shetland Islands by the US AMLR Program. Total pup production for the South Shetland Islands was 10 057 (±142). Comparisons to previous censuses reveal an average annual increase from 1987 to 1994 of 13.5%. Between 1994 and 1996 the rate of increase declined to 8.5% and from 1996 to the current census the averaged annual rate was only 0.9%. Changes in pup production at individual colonies were not consistent with some colonies increasing and other colonies decreasing.

3.50 The Working Group noted that the recovery of fur seals in the South Shetland Islands has not followed a similar trajectory to the rate and duration of population recovery reported for South Georgia. The reasons for the levelling off of fur seal population growth in the South Shetland Islands warrant further investigation.

Krill Biology

3.51 WG-EMM-02/13 reported for the first time on a disease found in krill off South Georgia during winter and spring. The initial stage of the disease is characterised by brown pigmentation, which becomes black later on. In its final stage the spots are perforations of the chitin shell of the animals. The infection increased from winter to spring and the later stages were not shed with the shell during moulting. It is still unclear whether the disease was caused by parasites, bacteria or viruses.

3.52 The Working Group noted that similar infections are known for crustaceans from waters of the Northern Hemisphere (e.g. Crangon or Pandalus). These diseases are obviously caused by bacteria. In the published literature it was often suggested that the outbreak of such a disease was possibly caused by mechanical damage of shrimps after escaping through the meshes of the fishing gear. From this, one might expect two additional problems: a potentially higher fishing mortality rate and a lower quality of krill products.

3.53 Dr M. Naganobu (Japan) indicated that a similar phenomenon was observed in the past in the Indian Ocean and that the infected krill were in a poor state of health.

3.54 WG-EMM-02/16 examined the level of concordance between the length-frequency distribution of krill from the South Shetland Islands and South Georgia using a stepwise model to account for the potential effects of higher growth and mortality at South Georgia. While the raw data showed little overlap, the output from the model indicated that the same pattern of recruitment of 1+ krill occurred simultaneously in both regions.

3.55 The authors suggest that it is only the 1+ krill that are advected into different regions of the Scotia Sea and that the resultant size structure is determined by regional differences in growth and mortality. The results suggest that where such differences in key demographic parameters exist, the implication of this for management advice should be considered.

3.56 Dr Constable noted that further development of models including spatial and temporal variation of demographic parameters would be helpful in understanding the dynamics of the krill population in the southwest Atlantic. It will be particularly interesting to examine the consequences to krill biomass around the different island groups, of changes in parameters such as growth and mortality, particularly if they are highly correlated. An important factor to include in these analyses is how retention and flux of krill in these areas might influence the estimation of these parameters.

3.57 Dr Trathan informed the Working Group that various modelling studies are currently being undertaken to consider the relative contributions of flux and retention in maintaining krill populations at South Georgia.

3.58 Dr Nicol pointed out that WG-EMM-02/16 used fur seal data from the western end of South Georgia and indicated that the krill population structure from this site may not be representative of the whole region.

3.59 Dr Bergström noted that genetic studies have the potential to address questions related to the movement of krill in the Scotia Sea. He indicated that initial analyses had not revealed any differences in the genetic structure of the krill population in the Scotia Sea based on data from the CCAMLR-2000 Survey, however, further analyses were in progress.

Net Sampling Surveys

3.60 WG-EMM-02/20 estimated the recruitment indices derived from German and the US LTER net sampling surveys in the northern Bellingshausen Sea since 1985. Recruitment indices varied considerably between years. Correlation analyses for R1 from various regional surveys show a significant correlation between the Bellingshausen Sea and Elephant Island as well as with South Georgia. No concordance is evident between the Atlantic and Indian Ocean survey sites. The 2002 R1 recruitment index was one of the highest values observed since the strong 1994/95 year class and an increase in stock biomass is predicted over the next year. For R2, only Elephant Island and the Bellingshausen Sea were correlated, while recruitment values from South Georgia were not.

3.61 The authors observed one phenomenon which may be crucial for the calculation of the R1 index. In the Bellingshausen Sea samples, a bimodal length-density distribution pattern occurred for the juvenile age 1+ component, especially in those years with high recruitment rates. This bimodality was observed before in the Elephant Island area, when samples from the Weddell Sea ice-edge in summer were included in the analysis. In this case the different origin of krill with different growth rates may be obviously responsible for the bimodal length-frequency composition. For the Bellingshausen Sea, the paper also discussed an alternative view to the spatial origin hypothesis. This would include the possibility of a second spawning event in the previous summer producing a subset of younger and smaller recruits.

3.62 Although the correlations were significant between R1 indices from various regions, the R1 value of 2001 from Elephant Island seemed to be too high compared to the Bellingshausen Sea results of the same year. Possibly the change in the extension of the survey grid to the south in 2001 to cover the eastern exit of the Bransfield Strait caused an inclusion of parts of the Weddell stock and overestimated the one-year-old recruits for the Elephant Island survey. A final conclusion could not be made, because the R2 values from Elephant Island were not available for 2002.

3.63 Dr Siegel suggested to continue with sampling the extended Elephant Island survey south to the Antarctic Peninsula shelf. This would give an opportunity to identify the potential boundaries of the juvenile stock affected by Antarctic Peninsula and Weddell Sea waters.

3.64 Dr Constable indicated that variability in demographic parameters highlighted by WG-EMM-02/16 and 02/20 might influence the estimated krill yield from the CCAMLR-2000 Survey. However, it was not clear that a reanalysis of the krill biomass was warranted at this stage.

3.65 The Working Group welcomed the participation of LTER scientists and the availability of data for the Working Group's deliberations. LTER scientists were encouraged to present more krill demographic data from this important long-term time series in future.

3.66 WG-EMM-02/32 reported on an Italian krill net sampling survey in the Ross Sea in January–February 2000. A distinct geographical separation can be seen between the distributions of Antarctic krill (*Euphausia superba*) and ice krill (*E. crystallorophias*), with

Antarctic krill confined to the continental slope and oceanic waters north of 74°S, and ice krill in neritic areas south of 74°S. The geometric mean biomass of Antarctic krill was 9.3 g 1 000 m^{-3}.

3.67 The paper also studied the age composition using the Macdonald and Pitcher mixture component analysis. Antarctic krill age group 1+ was missing from the Ross Sea data and age group 2+ only represented 6% of the krill stock in the area. The situation was totally different for ice krill, for which a full set of age groups was present in the net samples.

3.68 The Working Group noted that in the present study fishing depth was not standardised. It varied between stations, but was mostly shallower than 100 m, i.e. fishing was carried out in the more densely populated depth stratum for krill. The estimated krill density was less than 1 g m^{-2}. Even for the higher density depth stratum this is at least one order of magnitude lower than in the Elephant Island area for years with low biomass records. Obviously krill biomass in the Ross Sea is considerably lower than in other areas.

3.69 The Working Group also noted that the age composition described in WG-EMM-02/32 shows that krill recruitment can be extremely low in some years. The interannual variability in recruitment appears to be very high in the Ross Sea, a phenomenon also recorded from the Atlantic sector, but apparently less evident in the Indian Ocean.

Acoustic Surveys and Methods

3.70 WG-EMM-02/38 described the distribution and abundance of Antarctic krill and ice krill in the Ross Sea for acoustic surveys. The estimated krill biomass (estimated from 120 kHz) in the northern Ross Sea was 4 million tonnes in November 1994, 2 million tonnes in December 1997 and 1 million tonnes in January–February 2000. A three-frequency method was used to delineate between Antarctic krill and ice krill and to determine the average length of the targets.

3.71 Mean swarm size was 10 tonnes for Antarctic krill and 2.3 tonnes for ice krill. Total biomass of Antarctic krill was one order of magnitude higher than for ice krill.

3.72 Several members questioned the reliability of the three-frequency method to delineate between two very similar euphausiid species. A detailed discussion was deferred to Agenda Item 3.4 (paragraph 3.108).

3.73 Dr M. Azzali (Italy) answered that the empirical experience had shown in the past that the two species show distinct differences in frequency-specific volume backscattering strength and that the species separation was confirmed by the net sampling program.

3.74 WG-EMM-02/30 gave results on an acoustic survey in the Elephant Island area in summer 2001. The data-processing methods were carried out according to protocols developed during the CCAMLR-2000 Survey. The estimated average krill biomass density in the survey area was 15.3 g m^{-2} resulting in a total biomass of 1.67 million tonnes. Half of the biomass was found in the central shelf and shelf break areas, while highest densities were recorded in the southern part of the survey area, where juvenile krill dominated the stock.

The results were very similar to those obtained from US AMLR surveys in January (15.6 g m^{-2}) and February (12.8 g m^{-2}). It was noted that this biomass estimate is in the lower range of values estimated for this survey area time series.

3.75 WG-EMM-02/39 described results from four repeated acoustic surveys carried out by the British Antarctic Survey around South Georgia from November 2001 to May 2002. Krill densities showed a seasonal pattern, with a low of 5 g m^{-2} (November) at the start of the season, high during summer (46 and 72 g m^{-2}). Timing coincides with the onset of the predator breeding season, the period of peak predator demand and the period when offspring reach independence and is therefore of great importance for the functional relationship between reproductive performance of predators and abundance of krill.

3.76 The two summer estimates were the highest recorded for the survey area over the past seven years. The observed pattern of change in abundance is entirely consistent with a closed system with high seasonal growth and constant mortality, as well as with an open system with a pulsed seasonal immigration of krill into the area as a flow-through system. Future research activities are planned to collect additional information to further explore these alternative, but not mutually exclusive scenarios. The Working Group noted that the results presented in WG-EMM-02/39 were not consistent with a continuous high level input of krill into the South Georgia system required to satisfy estimated predator demand (WG-EMM-02/23).

3.77 WG-EMM-02/36 described results of acoustic surveys carried out at South Georgia using the Maximum Entropy (MaxEnt) method to reconstruct krill distribution and estimates of mean density. This method may be useful for the reconstruction of sparse and noisy acoustic line-transect survey data. Results show interannual differences in mean krill density ranging from 12 to 36 g m^{-2} in the western box and 11 to 160 g m^{-2} in the eastern box. Mean biomass estimates were similar to those obtained from the Jolly and Hampton approach, but the estimated variances differed considerably between the approaches.

3.78 The MaxEnt method also provided some persistent pattern of krill distribution, so-called 'hot-spots'. The evidence of consistent appearance of krill at these 'hot spots' may have importance for the understanding of krill distribution in general (i.e. non-random distribution and clustering of aggregations), and consequently for the survey design, and finally for the understanding of foraging behaviour of krill predators.

3.79 The Working Group welcomed the presentation of new methods to improve the accuracy of krill biomass estimates. However, the Working Group felt unable at this stage to recommend this method for future survey data analyses before the advantages of this method have been identified relative to the currently applied standard method (for further detailed discussion see paragraphs 3.106 and 3.107).

3.80 WG-EMM-02/50 highlighted that the accuracy and precision of acoustical surveys of krill abundance depend primarily on the uncertainties in identifying acoustical backscatter from Antarctic krill and estimating the mean backscattering cross-sectional area (σ_{bs}) or target strength (TS) of krill.

3.81 The Working Group noted that WG-EMM-02/36, 02/49 and 02/50 described methods for potentially reducing measurement uncertainties associated with reconstructing krill distribution and mean density from sparse data, species delineation, and TS estimation respectively. The implications for a re-analysis of the CCAMLR-2000 Survey data are unknown (for further detailed discussion on the methods, see paragraphs 3.109 and 3.110).

3.82 The Working Group also noted that the methods introduced in WG-EMM-02/49 and 02/50 will not only improve the accuracy and precision of the acoustic biomass estimates, but will also affect the mean. The implications for past surveys such as the CCAMLR-2000 Survey are yet unknown.

3.83 Dr Demer indicated that he is preparing a paper that quantifies the effects of using the stochastic distorted wave Born approximation (SDWBA) scattering model for species delineation and TS estimation on the CCAMLR-2000 Survey estimate of B_0 and associated CV.

Environmental Interactions

3.84 Dr Trathan identified that a number of papers provided details about Members ongoing work regarding the environment in areas of interest to CCAMLR. These include WG-EMM-02/17, 02/44, 02/54 and 02/60.

3.85 WG-EMM-02/17 described monitoring studies of sea-surface temperature at South Georgia from which the authors suggest temperatures have been anomalously cool in the early 2000s. WG-EMM-02/44 described how the Drake Passage Oscillation Index, first described by Naganobu et al. (1999), has now been extended backwards in time to 1952. This series is based on atmospheric pressure differences between Rio Gallegos and Esperanza. A 12-month running mean indicates considerable variability in the signal. WG-EMM-02/54 provided information on an atlas of sea-ice jointly produced by the University of Tasmania and the Australian Antarctic Division. The atlas compiles AVHRR satellite imagery initially to provide information on sea-ice in the vicinity of the CEMP sites at Béchervaise Island, near Mawson Station, at Edmonson Point, in the vicinity of the Terra Nova Bay Station, and at Ross Island. The atlas is scheduled for release in August 2002.

3.86 Dr Kerry reported that the atlas of sea-ice would be available to interested parties as a set of CD-ROMs.

3.87 WG-EMM-02/43 considered the distribution of Antarctic krill found during the Japanese RV *Kaiyo Maru* survey in January 1988 and that found during the CCAMLR-2000 Survey. The paper reports differences in sea-ice extent, oceanographic structure and krill distribution during 1988 and 2000. The authors suggested that Antarctic Surface Water, consisting of Winter Water and Summer Surface Water, was more extensive in 1988 extending northwards and covering a large area of the Scotia Sea. In contrast, Antarctic Surface Water was reduced and only occurred to the south during 2000. The authors used an environmental index of ocean temperature integrated over the top 200 m (EI $\overline{Q}_{200}$) of the water column as an index of upper ocean structure; they suggested that krill density is higher in association with colder values of the index.

3.88 WG-EMM-02/60 described how the ecosystem of the Ross Sea is composed of two related biotic systems – the Ross Sea shelf ecosystem and the Ross Sea slope ecosystem. To date, these two systems have largely escaped from the effects of human harvesting, although the Ross Sea slope ecosystem has, like all other large marine ecosystems, experienced harvesting of large baleen whales. The paper described the physical and trophic interactions in the Ross Sea, emphasising the importance of key prey species. The author suggested that the Ross Sea is an exceptional system and, given the history of scientific exploration in the region, forms a unique ecosystem laboratory for studying the biological consequences of climate change.

3.89 The Working Group agreed with the conclusion of WG-EMM-02/60 that the Ross Sea provided a unique natural location where commercial harvesting has been minimal.

Further Approaches to Ecosystem Assessment and Management

3.90 Dr Trathan indicated that only one paper was available to the Working Group that described further approaches to ecosystem assessment and management.

3.91 This paper, WG-EMM-02/26, provided information about the management of southern African fish stocks and moves towards establishing target populations for seabirds in South Africa, especially those of conservation value. It suggested that monitoring parameters that enable functional relationships to be developed between seabirds and their prey and the development of coupled predator–prey models should be considered. The paper also described anomalous breeding patterns of seabirds at Marion Island during 1997, and highlighted how large-scale global climate anomalies may episodically influence breeding success.

3.92 Dr Constable commended the paper and encouraged the authors of such studies to present their results to the proposed WG-EMM Workshop on Management Procedures that is scheduled to take place in 2005.

Other Prey Species

3.93 The Working Group considered five documents (WG-EMM-02/4, 02/9, 02/10, 02/11 and WG-FSA-02/6) describing diet studies that focused on predator–prey linkages involving prey species other than krill. These papers illustrate that there are many sources of variation in predator diets. The importance of krill, relative to other prey species, in the diets of predators varies from year to year and is also a function of season and location. The species composition of alternative prey also varies temporally and spatially.

3.94 WG-EMM-02/4 described how foraging patterns and breeding output of Antarctic shags varied between three colonies from the Antarctic Peninsula. Birds from one colony (at Py Point) made longer foraging trips and produced fewer chicks than birds from the other two colonies. This difference was attributed to differences in the species composition of the prey consumed by the birds at Py Point.

3.95 In relation to the submission of data on diet, foraging ecology and breeding biology of the blue-eyed shag, the Working Group recollected that this species is not a CEMP indicator species. However, the evaluation of its potential as a species to assist in monitoring young life-history stages of some harvested fish species had been encouraged.

3.96 Scientists engaged in this work were encouraged to prepare a synthesis of work to date so that the utility of this approach can be evaluated by WG-EMM and WG-FSA.

3.97 Consideration of the utility of the blue-eyed shag as an indicator species within CEMP would be subject to the approaches set out in WG-EMM-02/21 and paragraph 6.3.

3.98 WG-EMM-02/9, 02/10 and 02/11 described variation in the diets of sub-adult male fur seals. Interannual variation in the relative importance of krill and fish to the diets of sub-adult males was documented in WG-EMM-02/9 and spatial variation in the species composition of fish prey was documented in WG-EMM-02/10. Temporal variation in the consumption of penguins by male fur seals was documented in WG-EMM-02/11.

3.99 Variations in the consumption of benthic and pelagic fish by various predators in the Antarctic food web were reviewed in WG-FSA-02/6. In neritic zones, benthic fish that feed on demersal organisms are more important in predator diets, and, in offshore regions, pelagic fish that feed on krill are more important.

3.100 The Working Group noted a request made at last year's Workshop on Approaches to the Management of Icefish (SC-CAMLR-XX, Annex 5, Appendix D, paragraph 8.7) that consideration be given to the importance of *Champsocephalus gunnari* as a prey species. Information on the importance of *C. gunnari* to predators might be used to estimate a desired escapement. Along these lines, the Working Group noted that the 'species profile' currently being prepared for WG-FSA as background information for stock assessments of *C. gunnari* would also be useful for building models that describe the role of this fish in the ecosystem. Ultimately, a model that describes the role of *C. gunnari* in the ecosystem will need to examine the effects of fishing for both krill and the fish itself, and this will require collaborative work between WG-EMM and WG-FSA.

3.101 In regard to *C. gunnari*, the Working Group also noted that time-series data are available for icefish (e.g. survey estimates of biomass), and these data might be useful in expanding the scope of CEMP to consider predator–prey interactions based on species other than krill and for furthering the work of the CEMP review (Appendix E).

Methods

3.102 The WG-EMM Subgroup on Methods considered nine papers of which one (WG-EMM-02/52) addressed a revision of an existing CEMP standard method, two (WG-EMM-02/46 and 02/48) addressed issues relating to the interpretation of CEMP indices and four (WG-EMM-02/35, 02/37, 02/49 and 02/50) were concerned with acoustical determination of krill distribution and abundance. An additional paper (WG-EMM-02/34) that addressed the analysis of aerial surveys of penguin populations was also considered.

Modifications to Current Methods

3.103 WG-EMM-02/52 proposed changes to CEMP Standard Method C2 (Antarctic fur seal pup growth) in response to discussion in the subgroup at WG-EMM-01 (SC-CAMLR-XX, Annex 4, paragraph 3.92). The proposed revision would require that the median pupping date for the colony becomes 'Mandatory Data' and should be reported on the CEMP data form. The Working Group endorsed these changes and approved the following revised text to Procedure B:

> Determine the median pupping date (the date by which 50% of pups are born) for the colony. Weigh a random sample of about 100 pups, including a minimum of 40 of either sex, at 30-day intervals starting 30 days after the median pupping date. Ideally the last sample should be collected just prior to weaning, i.e. at about 100 to 110 days after birth. Determine the mean mass for each sex.

3.104 It was emphasised that selection of pups for weighing should be as unbiased as possible and that pups should not be selected on the basis of size and that there should be no collections targeted at a single sex. Members were encouraged to provide the median date of pupping for years in which they have previously submitted data using Standard Method C2, Procedure B.

Developments

3.105 In paragraph 3.93 of the report of WG-EMM-01 (SC-CAMLR-XX, Annex 4) it was agreed that the sampling protocols for the CCAMLR-2000 Survey should be considered as the CEMP standard method for collection of acoustic data. Similarly, the CCAMLR-2000 data-processing methods could be considered the CEMP standard method for analysis of acoustic data. While standardisation is an important objective when comparing data from different surveys, the Simrad EK500 echosounder equipment has been superseded, and potential improvements to the CCAMLR-2000 methods are presented in multiple papers. In WG-EMM-02/35, 02/37, 02/49 and 02/50 new methods are presented for: (i) estimating krill distribution and abundance from sparse acoustic backscatter data (WG-EMM-02/35), (ii) multi-frequency identification of species (WG-EMM-02/37 and 02/50), and (iii) modelling krill target strength (WG-EMM-02/49). Consequently, the authors of these papers were asked to explicitly identify the merits of these methods relative to the CCAMLR-2000 methods and identify the implications for reanalysis of existing survey data.

3.106 Maximum entropy methods have been used to reconstruct quantitative images from incomplete and noisy physical data. In WG-EMM-02/35, a method for inferring stock density and mapping distribution from acoustic line-transect data is presented. The method takes account of spatial correlation in the observed data and seeks to reconstruct a distribution of density across the whole survey area that is both consistent with the observed data and for which the entropy is maximised.

3.107 The Working Group recognised that this was another example of the many methods for interpreting sparsely sampled data. It is recommended that the maximum entropy and CCAMLR-2000 analytical methods along with other methods be evaluated and compared to each other using a simulated highly skewed krill distribution as the benchmark. The implications of the results should also be addressed regarding management issues. Such evaluation should also assess the maximum transect spacing for providing unbiased assessments.

3.108 WG-EMM-02/37 described a multi-frequency method that provides acoustical classification of two euphausiid species (*E. superba* and *E. crystallorophias*). The approach is a Bayesian approach to effectively inverting a fluid sphere model using volume backscattering measurements at three frequencies (38, 120 and 200 kHz) to estimate equivalent spherical radii of sound scatterers (one, the other, or neither of the two euphausiid species). The empirical scattering spectra are shown to be significantly different for these two very similar euphausiid species. According to the authors, the fundamental reason(s) for the differences are unknown. In many ways, the method described and employed in WG-EMM-02/37 is similar to the method proposed in WG-EMM-94/12 for delineating *E. superba* from *Salpa thompsoni* (i.e. multiple-frequency backscatter measurements and a statistical inversion of scattering models). These studies show that methods incorporating statistical fits of multiple-frequency backscatter data to physics-based scattering models have the potential to improve the accuracy and precision of acoustical identification of species. However, their effectiveness depends greatly on the uncertainties in the scattering models used. The Working Group agreed that this three-frequency method be compared to the CCAMLR-2000 two-frequency identification method. The implications of adopting the three-frequency technique for reanalysis of historical data and for analyses of future survey data should be addressed.

3.109 Model estimates of krill TS are either based empirically or on the physics of sound scattering. For Antarctic krill, Greene et al. (1991) proposed a linear model of TS versus total length (L), which is based on measurements of a variety of crustacean zooplankton (Wiebe et al., 1990), and corroborated at frequency f = 120 kHz for krill of two mean L (Foote et al., 1990; and Hewitt and Demer, 1991). The implications of using the Greene et al. model were explored (Everson et al., 1990), and the model was provisionally adopted as an international standard for estimating krill biomass (SC-CAMLR-X). Alternatively, McGehee et al. (1998) proposed a physics-based model to predict the TS of Antarctic krill versus incidence angle (θ). Based on the distorted wave Born approximation (DWBA), the model depends upon the coherent summation of scattering from elements of a discretised bent cylinder. It was empirically validated at 120 kHz near broadside incidence ($\theta \approx 90°$), but large discrepancies were observed at other angles away from the main lobe. In WG-EMM-02/50, it is shown that phase variability in the scatter from elements of a discretised bent cylinder (krill model) causes a dramatic flattening in the side-lobe regions of TS(θ), while negligibly affecting the main scattering lobe. These results are consistent with the krill TS measurements in McGehee et al. (1998). Thus, by accounting for phase-variability in the solution of the DWBA model, a more accurate and thus practical tool (SDWBA model) has been developed for predicting krill TS. A comparison between the SDWBA and Greene et al. TS models should be made and the implications of adopting a new physics-based model should be outlined.

3.110 In WG-EMM-02/49, total scattering cross-sections (σ_t) of Antarctic krill were acoustically measured over a broad-bandwidth (36 to 202 kHz) using a new technique (De Rosny and Roux, 2001). Measurement accuracy was determined to be 0.4 dB using standard metal spheres for references (Demer et al., in press), and the precision was estimated from the variability in krill TTS measurements. Opposed to the free-field requirement of conventional TS measurement techniques, the new method allows measurements of total target strength (TTS = 10log(σ_t/4π) to be extracted from time series of reverberation in a highly echoic tank. Also intriguing is that absolute measurements of sound scatter can be made without the usual system calibration, and the animals' orientations and positions within the acoustical beam are inconsequential. TTS of Antarctic krill measured with this technique provided broad-bandwidth corroboration of the SDWBA model described in WG-EMM-02/50. This study improves upon methods for acoustical identification and target strength estimation for Antarctic krill, thus reducing the uncertainty in biomass estimation using multi-frequency echosounder data and echo integration methods.

3.111 Two papers (WG-EMM-02/46 and 02/48) identified the importance of collateral information in the interpretation of CEMP indices from Adélie penguins at Béchervaise Island. WG-EMM-02/46 assessed the relationship between CEMP parameters and the mass of individual Adélie penguins collected using an automated weighing system (APMS). The analysis indicated that the mass of female penguins on post-laying departure from the colony was positively correlated with subsequent measures of reproductive performance, whereas there was little correlation between other measures of adult mass and reproductive output.

3.112 In WG-EMM-02/48, the importance of demographic parameters in the interpretation of population size parameters were exemplified by the different roles of adult survival and juvenile recruitment in changes in population size of Adélie penguins. In recognising the importance of collateral data in interpreting CEMP indices, the Working Group identified the need to develop appropriate protocols for the collection, analysis and interpretation of such additional parameters in order to make appropriate inter-site comparisons.

3.113 WG-EMM-02/34 outlined an automated analytical approach to determining the population size of macaroni penguins from aerial surveys. The methods utilise digitised, high definition, colour photography and image analysis software to discriminate and count penguins. The Working Group encouraged further development of these methods, particularly focussing on development of appropriate analysis software. It was suggested that multiple regression techniques may improve discrimination between penguins and the background. Also, the relationship between observer counts and photo-image analysis may not be a simple linear relationship. There may be little differences between the two methods at low densities; however, biases may be evident at greater densities. This could be tested in part by examining the relationship between observer error and density.

3.114 The Working Group recognised that the membership of the Subgroup on Methods may not necessarily include the required expertise to consider and evaluate fully all of the methods submitted. The development of new standard methods should be viewed as a multi-stage process involving the following stages:

(i) a new method is described to the Working Group in a tabled paper;

(ii) the method is considered by the Working Group in terms of its potential advances over existing methods;

(iii) the new method is submitted for appropriate peer review and subsequently evaluated with regard to its suitability for use by CCAMLR;

(iv) the Working Group decides whether to incorporate the new method into its program; and

(v) a full description of the method is lodged with the Secretariat.

3.115 The Working Group recognised that the role of the Subgroup on Methods should be to facilitate, rather than carry out, this process.

Future Surveys

3.116 A design for an acoustical survey of the Ross Sea and adjacent area of the Pacific Ocean in the early austral summer 2003/04 was presented in WG-EMM-02/31 for discussion and approval by WG-EMM. In addition to planned acoustical measurements of the distributions and abundances of Antarctic krill and ice krill, concurrent observations will be made of their top predators. Moreover, samples for studies of krill demography, energetics, physiology and genetics will be gathered using net tows, and the associated water masses will be characterised using CTD and XBT sampling.

3.117 While indicating that the CCAMLR-2000 Survey methods will be followed, there are many notable differences. The Italian survey plan is to use zigzag transects with ad hoc sampling densities, rather than planned randomly-spaced parallel-line transects. The planned analyses of these data are based on rectangles of constant area, rather than assumed-independent transect lines. Species delineation is to be effected using a three-frequency algorithm described in WG-EMM-02/37 rather than the two-frequency algorithm used in the CCAMLR-2000 Survey. Krill samples will be collected using a Hamburg Plankton Net rather than a RMT-8 net. While each of these planned methods has merit, they are inconsistent with the methods described in the CCAMLR website and used in the CCAMLR-2000 Survey data collection and analysis. Because of the many differences in the survey and analysis methods, it is anticipated that the results from the proposed multi-disciplinary survey may be difficult to compare to the CCAMLR-2000 Survey results.

3.118 WG-EMM commended the initiative of the Italians to conduct the survey.

3.119 It was noted that the problems encountered in surveying the Ross Sea area are somewhat different to those in other areas (i.e. species and species mixture, water masses and ice conditions). The historical data on water masses and krill distributions should be considered in the survey design.

3.120 While randomly-spaced parallel-line transects are highly recommended, it is recognised that dead-heads are eliminated by using zigzag transects and sampling time is thus reduced. However, one drawback of zigzag transects is that the sampling density is not uniform. In this case, the current sampling plan has different survey densities on-shore versus off-shore and for the expected distributional areas of *E. superba* and *E. crystallorophias*.

3.121 While zigzag transects may be processed as two sets of parallel-line transects, the conditions of random spacing and independence are not met. The authors agreed to use randomly-spaced parallel-line transects if five or more days of ship time can be acquired. However the survey will be conducted in early summer when ice conditions are likely to strongly influence the vessel track.

3.122 To make the survey results comparable to other surveys, WG-EMM strongly advised that the authors adopt the CCAMLR-2000 Survey sampling protocols and process the data two ways – using the CCAMLR-2000 Survey methods and the newer techniques discussed in the plan.

3.123 It was recommended that New Zealand be asked whether they could collaborate on the survey of the Ross Sea to extend the survey coverage.

Key Points for Consideration by the Scientific Committee

3.124 Arising from an analysis of submissions to the CEMP database, Members were encouraged to use the current data submission forms and to provide additional information in comment fields where this will assist data validation (paragraph 3.4).

3.125 The CEMP database requires modification to increase ease of access to data prior to the CEMP Review Workshop. However, a full redesign of the database should not be undertaken until the workshop (paragraph 3.10).

3.126 Based on CEMP data submitted to the CCAMLR database and from standard annual krill surveys for krill in Subarea 48.3, 2001/02 has been a good year for krill in comparison to the available time series of data (paragraphs 3.2 and 3.11).

3.127 In considering indices of predator–fisheries overlap, the Working Group noted that there was divergence in the four indices currently used and that an assessment of their utility to the work of WG-EMM should be evaluated. It was suggested that the Agnew–Phegan index was of limited utility and that the Secretariat should discontinue to calculate it (paragraph 3.40).

3.128 Developments of methods for the identification of krill, the determination of target strength and the analysis of distribution and abundance using acoustic survey data have the potential to provide reanalysis of historical krill survey data, including the CCAMLR-2000 Survey (paragraphs 3.105 to 3.110).

3.129 Analysis of time series of krill demography over a range of sites in the Scotia Sea and Bellingshausen Sea indicated large-scale concordance in krill recruitment. These analyses highlight the importance of considering the impact of regional differences in rates of krill growth and mortality when determining parameter values to be used to develop precautionary catch limits for krill using the GYM (paragraphs 3.54 to 3.56 and 3.62 to 3.64).

3.130 The Working Group endorsed a revision to CEMP Standard Method C2 (Antarctic fur seal pup growth), Procedure B, which clarified issues of sampling and interpretation of this index (paragraph 3.103).

3.131 The Working Group also clarified procedures and protocols for considering and evaluating new methods to derive indices of relevance to its work (paragraph 3.114).

WORKSHOP TO DEFINE PREDATOR UNITS

4.1 Last year the Scientific Committee endorsed the proposal by WG-EMM to hold a Workshop on Small-scale Management Units, such as Predator Units (SSMU Workshop), during its meeting this year (SC-CAMLR-XX, paragraphs 6.11 and 6.12 and 6.15 to 6.19, and Annex 4, paragraphs 4.1 to 4.11 and 5.9 to 5.13). The aim of the workshop was to define these units in order to facilitate the subdivision of the precautionary yield in Area 48 but that the manner in which the overall catch limit would be subdivided would be determined at a future meeting (SC-CAMLR-XX, paragraph 6.18).

4.2 The workshop was convened by Dr Trivelpiece from 7 to 15 August 2002. The report of the workshop is attached as Appendix D.

4.3 The Working Group welcomed the report of the workshop and thanked Dr Trivelpiece and the steering committee for facilitating such a successful meeting and for the workshop participants for such a thorough assessment of the subdivision of Subareas 48.1, 48.2 and 48.3 for use as small-scale management units.

4.4 The Working Group extended its special thanks to Dr Constable for his persistent vision, perseverance and hard work throughout all stages of the workshop.

4.5 The Working Group accepted the report, noting that it was the best scientific assessment available on the subdivision of Area 48.

4.6 The Working Group agreed that future preparations for workshops should include the development of format styles for the preparation of the report. These would include guidelines for satisfactory production of figures, maps and tables. It was envisaged that such styles would help ensure that the initial preparation of figures, tables and text would not need to be revised for report production.

STATUS OF MANAGEMENT ADVICE

Designation of Protected Areas

5.1 The WG-EMM Subgroup on Designation and Protection of CEMP Sites considered items that had been referred to it. These tasks included: (i) review of four marine protected areas that sought designation as Antarctic Specially Protected Areas (ASPAs) under the Antarctic Treaty, and (ii) review of revised CEMP site maps. The Subgroup also considered the organisation of its work by addressing: (i) a consolidation of the terms of reference for the subgroup, as there has been an increase in tasking since the subgroup was formed in 1992, and (ii) the possibility of renaming the subgroup to better reflect its current tasks.

5.2 The subgroup reviewed four management plans for protected sites containing marine areas that sought protection as ASPAs under the Antarctic Treaty. Three of the sites had already been afforded protection as SSSIs under the Antarctic Treaty. These were SSSI No. 36 (Eastern Dallman Bay, WG-EMM-02/57), SSSI No. 35 (Western Bransfield Strait, WG-EMM-02/58), and SSSI No. 1 (Cape Royds, WG-EMM-02/59). One of the sites (Terra Nova Bay, WG-EMM-02/56) was a revised plan for a proposed new protected area under the Antarctic Treaty.

5.3 Subgroup members first reviewed the three plans for the SSSIs that were currently afforded protection by the Antarctic Treaty. The management plans for these sites originated in the USA and had been revised to meet the new format as ASPAs adopted when Annex V of the Protocol on Environmental Protection to the Antarctic Treaty came into force. Additionally, new data available since the management plans had been written were used to slightly adjust boundaries.

5.4 The following main evaluation criteria identified by the Commission (CCAMLR-XIX, paragraphs 11.20 and 11.21) were used to review the three revised SSSIs plans:

(i) whether a site proposed for designation as a marine protected area affects actual or potential harvesting of marine resources in relation to Article II of the Convention; and

(ii) whether the draft management plan for the proposed site might prevent or restrict CCAMLR-related activities.

5.5 The Cape Royds plan (WG-EMM-02/59), which included a 500 m wide marine coastal strip to protect the seaward access and near-shore feeding ground of Adélie penguins was recommended for CCAMLR approval by the subgroup.

5.6 Plans for Eastern Dallman Bay (WG-EMM-02/57) and Western Bransfield Strait (WG-EMM-02/58) were reviewed. It was noted that these plans afforded protection to marine areas within Subarea 48.1 and have been in force for about a decade. Both management plans limited access to the area for scientific study of the marine environment, for essential management purposes consistent with plan objectives, and/or transit through the area.

5.7 Members commented that these two sites were located within the area of the Palmer Long-Term Ecological Research Program (PAL-LTER), which is a study providing useful long-term data of interest to CCAMLR. It was noted that both sites included potential areas for fisheries that are suitable for bottom trawling. It was also noted that no conflict with CCAMLR objectives had been raised since adoption by the Antarctic Treaty Consultative Meeting (ATCM) in 1991 and protection was unlikely to result in conflict in the future. Thus, the subgroup recommended CCAMLR approval for both plans.

5.8 The subgroup reviewed the plan which originated in Italy for Terra Nova Bay (WG-EMM-02/56). As this is a new proposal being reviewed by the ATCM and CCAMLR, additional review criteria identified in SC-CAMLR-XIX, paragraph 11.21 were applied. This plan includes a narrow strip of coastal waters immediately south of Terra Nova Bay Station. The subgroup recommended CCAMLR approval of the plan. The subgroup also recommended that the originators of the plan add the location of the nearby Adélie penguin population to the map.

5.9 The subgroup also made the following comments regarding consistency to the originators of the four plans:

(i) The subgroup observed that the plans for Eastern Dallman Bay, Western Bransfield Strait, and Terra Nova Bay did not contain a time frame for assessing whether the areas continue to serve the purposes for which they were designated. The subgroup recommended that a period for assessment, such as the five years noted in the Cape Royds plan, be included in all plans seeking Antarctic Treaty protection. The subgroup recommended that this would be best done by adding an additional point regarding the time frame for assessment of whether the site continues to serve the purposes for which it was designated, rather than including it with field visits to determine whether management and maintenance measures are adequate.

(ii) The subgroup also recommended the inclusion of a list of references in each plan that would allow interested parties to obtain more detailed information on the sites and to check the accuracy of the plan.

(iii) Finally, the subgroup recommended that originators of revised management plans currently afforded protection under the Antarctic Treaty include a brief summary of the main changes from the current plan in force when submitted to the ATCM for approval.

5.10 WG-EMM concurred with the subgroup's recommendation for CCAMLR approval for all four management plans noted, and with the recommendations for improvements directed to the originators of each plan.

5.11 The Scientific Committee (SC-CAMLR-XVIII, paragraph 4.40(v)) noted that a number of older maps of CEMP sites had deficiencies. Since 2000, the Secretariat has sent annual requests to Members to produce and submit good quality revised maps of CEMP sites for inclusion in the CEMP database. Revised maps had been submitted by a number of countries and reviewed by the subgroup. All submitted maps are now available on the CCAMLR website. As of 2002, maps are still missing for a number of sites. Members responsible for CEMP research at these sites are Brazil, Italy and the USA. The subgroup encouraged these Members to submit maps as soon as practical.

5.12 The subgroup noted that the brief guidelines for maps found in Conservation Measure 18/XIX (Annex 18/A) lacked detail. A copy of the Guidance Notes for Producing Maps for Inclusion in Management Plans from the Antarctic Treaty (CEP-I Final Report, Appendix 3) was distributed as an information item. It was suggested that advice on modern map production guidelines for protected areas should be considered intersessionally, in order to provide better guidance on producing maps of CEMP sites. WG-EMM endorsed the subgroup's intersessional plan to consider improvements to CCAMLR's guidance to producers of maps for CEMP sites.

5.13 The subgroup considered its current terms of reference as follows:

(i) To review the details of proposals relating to designation and protection of CEMP monitoring sites and review of CEMP management plans (SC-CAMLR-XI, Annex 7, paragraph 4.5).

(ii) To develop a methodology for assessment of proposals for marine protected areas forwarded in accordance with Article 6(2) of Annex V of the Protocol on Environmental Protection to the Antarctic Treaty (SC-CAMLR-XVIII, paragraph 8.98; CCAMLR-XVIII, paragraph 4.9).

(iii) To provide advice on marine protected areas that seek designation as an Antarctic Specially Protected Area (ASPA) or an Antarctic Specially Managed Area (ASMA) under the Antarctic Treaty (CCAMLR-XIII, paragraphs 11.16 to 11.18).

(iv) To provide advice on the implementation of closed areas that may be proposed in accordance with the provisions of Article IX.2(g) of the Convention, specifically with regard to 'the designation of the opening and closing of areas, regions or subregions for purposes of scientific study or conservation, including special areas for protection and scientific study' (CCAMLR-XIX, paragraph 11.21).

5.14 It was noted that proposals for closed areas made by WG-FSA would not ordinarily be passed on to WG-EMM or the subgroup for advice.

5.15 The subgroup chair noted the usefulness of an informal document produced by the Secretariat that summarised CCAMLR decisions related to the evaluation of Antarctic Treaty management plans containing marine areas submitted to CCAMLR for approval. WG-EMM recommended that the Secretariat submit this document formally to WG-EMM in 2003 for further review by the subgroup. Additionally, it was recommended that at the 2003 meeting the subgroup summarise its current terms of reference, with reference to past CCAMLR decisions, in a manner that properly places the tasks in context.

5.16 The Working Group recommended that the name of the subgroup be changed to 'Advisory Subgroup on Protected Areas'.

Harvesting Units

5.17 The Working Group was to consider a report from an intersessional group, co-convened by Drs Naganobu and Constable, which had been asked to develop the approach for designating appropriate scales for harvesting units in the CCAMLR Convention Area (SC-CAMLR-XX, paragraphs 5.6 to 5.11).

5.18 Dr Constable reported on behalf of the group, noting that Dr Naganobu had collated a large number of references and information to help with this task. Dr Constable also indicated that he had insufficient time in the past year to help complete this work.

5.19 The Working Group thanked Dr Naganobu for progressing this issue and looked forward to progress being made on this task in the coming year.

5.20 Dr Constable indicated to the Working Group that he, unfortunately, would be unlikely to be able to attend to this work in the near future. Dr Nicol agreed to assume Dr Constable's responsibilities on this intersessional group.

Small-scale Management Units

5.21 The Working Group agreed with the recommendations of the SSMU Workshop, that the proposed divisions of the region provided in the report be used by the Commission as a basis on which to subdivide the precautionary catch limit for krill in Area 48 as well as helping further the work of the Commission and the Scientific Committee in developing management procedures for krill fisheries that can accommodate localised effects on predators.

5.22 The Working Group agreed with the subdivision of Area 48 into the following units recommended in the workshop report, noting the nested hierarchy of areas described in the report:

- (i) Subarea 48.1
  - (a) 48.1 Pelagic Area
  - (b) 48.1 Land-based Predator Area
    - (i) Western Antarctic Peninsula
    - (ii) Drake Passage
      1. West
      2. East
    - (iii) Bransfield Strait
      1. West
      2. East
    - (iv) Elephant Island

- (ii) Subarea 48.2
  - (a) 48.2 Pelagic Area
  - (b) 48.2 Land-based Predator Area
    - (i) West South Orkney
    - (ii) East South Orkney
      1. North
      2. South

- (iii) Subarea 48.3
  - (a) 48.3 Pelagic Area
  - (b) 48.3 Land-based Predator Area
    - (i) West South Georgia
    - (ii) East South Georgia

- (iv) Subarea 48.4.

5.23 The Working Group noted that there was insufficient time at the workshop to consider a finer division of Subarea 48.4, but that this could be achieved at a later meeting using the principles established by the workshop.

5.24 The Working Group requested that the Secretariat, in consultation with the Convener of the Working Group and the Chair of the Scientific Committee, develop maps of these units in GIS form.

5.25 The Working Group noted the uncertainty surrounding the extrapolation of known foraging characteristics of land-based predators to colonies for which no foraging information was known (Appendix D, paragraphs 5.17, 5.19 and 5.28). It was noted that the proposals took account of the known information and assisted by, though not dependent on, the extrapolated results.

5.26 The Working Group noted (Appendix D, paragraph 5.34) that:

(i) this assessment is the first of its kind in CCAMLR;

(ii) this assessment used a variety of datasets that enabled the detailed analyses presented here, such that deficiencies in one dataset could be compensated by strengths in others;

(iii) fine-scale fisheries data were very important to the success of this assessment;

(iv) a number of uncertainties remain regarding the relationships between predators, krill and the fishery and further information on krill, krill movement, predator demand and predator foraging grounds may provide opportunities to refine these boundaries in the future;

(v) the next step is to develop an understanding of the linkages and dynamics between these areas in order to facilitate the subdivision of the precautionary catch limit for krill in Area 48, taking account of the oceanography and the environmental variability of the region;

(vi) this assessment has demonstrated the utility of satellite tagging programs for an understanding of the relationships between predators, krill and the fishery, and, as a result, the workshop highly recommended further studies of this kind; and

(vii) the manner in which these proposed small-scale management units are used may have implications for monitoring that would need to be considered by the Commission.

5.27 The Working Group agreed that the term 'small-scale management unit' provides a reference to the recommended subdivision described in paragraph 5.21, but that work remains to determine how these units would be used to achieve those purposes.

5.28 With respect to the tasks in paragraph 5.21, the Working Group noted that refinements to the boundaries may be required over time to fully meet the requirements of the Commission in its implementation of those tasks. The Working Group agreed to consider such proposals for refinements as they arise in the work on these tasks.

5.29 The Working Group invited Members and interested specialists to provide submissions to help the Working Group address these tasks into the future.

5.30 The Working Group agreed that the submission of haul-by-haul krill fishery data is necessary for future assessments of activities in these units. It requested that the Scientific Committee consider how the confidentiality requirements for the Japanese krill fishery could be met while maintaining the spirit and intent of the Rules for Access and Use of CCAMLR Data.

5.31 The Working Group agreed that the steering committee for the review of CEMP to be undertaken next year be asked to include in their review consideration of the utility of CEMP Integrated Study Regions and whether the proposed small-scale management units might provide a suitable alternative structure for future work on the relationships between krill, predators and the fishery.

Generalised Yield Model

5.32 New information was presented which may contribute to the development of input parameters used in the GYM.

5.33 The influence of regional differences in growth and mortality on population size structure was examined using data on the length-frequency distribution of krill in the Scotia Sea using samples from the South Shetland Islands and South Georgia collected annually from 1991 to 2000 (WG-EMM-02/16). The study found a higher mortality rate at South Georgia than at the South Shetland Islands, and this was consistent with published values and with other euphausiids species. Findings also indicated that first year krill are advected into different regions of the Scotia Sea where the resultant population size structure is determined by regional differences in growth and mortality.

5.34 In another study (WG-EMM-02/20), the proportional recruitment indices for one- (R1) and two-year-old (R2) krill were found to differ substantially between years in the upstream area of Elephant Island. Recruitment indices showed a significant correlation for 1-year-old krill between scientific surveys from the northern Bellingshausen Sea, the Elephant Island area and South Georgia. The correlation was weaker for R2 recruitment indices. No correlation was detectable between the krill recruitment of Atlantic and Indian Ocean survey sites.

5.35 WG-EMM-02/36 presented a MaxEnt reconstruction of krill distribution and estimates of mean krill density within two survey boxes to the northeast and northwest of South Georgia. The reconstruction yielded mean krill densities for which the confidence limits were often narrower than for estimates based upon more conventional techniques (e.g. Jolly and Hampton, 1990).

5.36 The Working Group considered these developments and proposed that sensitivity analyses be conducted to examine regional differences in growth and mortality and their impact on estimates of yield calculated using the GYM. It was possible that variations in these parameters may not have a significant effect on the output.

5.37 Dr G. Kirkwood (UK) advised that his group in London was re-coding the main modules of the GYM based on available literature and documentation. This re-coding would allow independent validation of the GYM and the results of this work would be reported at next year's meeting.

5.38 Dr Constable advised that a new front-end module had been added to the GYM. This updated version of the GYM, together with supporting documentation, is available on CD-ROM from either Dr Constable or the Secretariat.

5.39 Dr Gasiukov reported that a recent critique on the use of the delta distribution for the analysis of trawl survey data had found that the estimator of the mean was not robust to seemingly small departures from the assumed delta distribution (Syrjala, 2000). This finding may apply to CCAMLR's mixture analysis program (CMIX). The Working Group noted that sensitivity analyses had been conducted during the development of CMIX (de la Mare, 1994) and that the output from the CMIX program did provide some measure of the degree to which the model assumptions were violated.

5.40 The Working Group noted that the Subgroup on Assessment Methods of WG-FSA was reviewing the analytical tools developed and used by WG-FSA. This review will include further evaluation of the GYM and CMIX. It also noted that there was considerable overlap in the development of quantitative methods for use by the Working Group and encouraged Members to remain aware of the work of that subgroup.

5.41 The Working Group also noted that the Secretariat was developing a database on CCAMLR software. This database would allow working groups to track each version of software developed and used by CCAMLR. The database would also include links to background documents and papers, user guides, validation analyses and references to working group meetings where the software had been used. A copy of the database, in its present state of development, was available at the meeting.

Existing Conservation Measures

5.42 The Working Group noted that Conservation Measure 217/XX established a uniform season (1 December to 30 November of the following year) for all fisheries in the Convention Area. Accordingly, the fishing season for krill in Division 58.4.2 had been revised in Conservation Measure 45/XX. The fishing seasons for krill in Area 48 and Division 58.4.1 were revised in 2000 (Conservation Measures 32/XIX and 106/XIX) along the same lines.

Data Reporting

5.43 The Working Group noted once again that monthly catch data (with no specified format) and STATLANT data were the only types of mandatory data required from krill fisheries (see also paragraph 2.64). It was also noted that the krill fishery in Area 48 was the largest fishery in the Convention Area and that its development had been a prime reason for establishing CCAMLR. Inconsistencies between conservation measures for krill fisheries and other fisheries were discussed.

5.44 The Working Group reaffirmed the need for detailed data on catch and effort (e.g. data submitted by fine-scale rectangle or haul-by-haul), and for the timely submission of such data using a consistent format (see also Section 2). However, consensus could not be reached on the timing for the introduction of such a requirement. This debate is longstanding, being first initiated at SC-CAMLR-VII (SC-CAMLR-VII, paragraph 2.45) in 1988 and remains unresolved (SC-CAMLR-XX, paragraphs 5.13 to 5.18 and Annex 4, paragraph 4.4; SC-CAMLR-XVIII, Annex 4, paragraphs 2.4 and 12.2(vii); SC-CAMLR-XVII, Annex 4, paragraphs 2.4 and 12.2(ii); SC-CAMLR-XVI, Annex 4, paragraphs 2.10 and 10.2; SC-CAMLR-XV, paragraph 10.8(vii); SC-CAMLR-XIV, Annex 4, paragraph 3.29;

SC-CAMLR-XIII, Annex 5, Table 3; SC-CAMLR-XII, Annex 4, paragraph 3.24 and Table 6; SC-CAMLR-X, Annex 5, paragraphs 7.18(i) and (ii) and Table 8; SC-CAMLR-IX, paragraphs 2.63 and 2.68 and Annex 4, paragraphs 113 and 115; SC-CAMLR-VIII, paragraphs 2.39, 2.40 and 2.42 and Annex 5, Table 4).

5.45 The SSMU Workshop had clearly indicated the value of detailed data on catch and effort. While some of these data had been provided by workshop participants, data representing approximately 30% of catches taken in 2000/01 had not been available for analysis. In addition, valuable time at the workshop could have been saved had data been submitted in a consistent format to the Secretariat prior to the meeting.

5.46 In addition, WG-EMM had discussed the need for detailed CPUE data which would reflect changes in abundance and could be used for input, for example, to the forthcoming workshop on the CEMP review, other planned workshops or revised assessment using the GYM.

5.47 WG-EMM also recognised the importance of data collected by scientific observers. It was agreed that these data complemented the detailed catch and effort data sought from Flag States. However, the irregular voluntary collection of observer data limited the scope of analyses based on such data.

5.48 Dr Shust questioned the need for detailed data, given that recent annual krill catches are stable and lower than those reported during the early years of the fishery. He also expressed concern that the collection and submission of detailed catch and effort data would place a significant burden on the crew of fishing vessels and may be sufficient to prevent new vessels entering the fishery.

5.49 In response, Mr Jones indicated that such data requirements were not considered to be demanding on the crew of a US-flagged fishing vessel. This vessel has recently joined the fishery and provided detailed haul-by-haul data.

5.50 The Working Group agreed that there were now compelling reasons for requiring detailed catch and effort data to be submitted regularly in standard format by all Members involved in krill fishing.

5.51 The Working Group advised the Scientific Committee that it cannot see a resolution of this matter in the short term. Consequently, the need for detailed catch and effort data in krill fisheries was referred to the Scientific Committee for further advice, including that of the Commission.

Key Points for Consideration by the Scientific Committee

5.52 WG-EMM recommended to the Scientific Committee:

(i) approval of the four management plans for protected sites containing marine areas that sought protection as ASPAs under the Antarctic Treaty (WG-EMM-02/56, 02/57, 02/58 and 02/59) (paragraph 5.10);

(ii) transmission of recommendations for improvements to the originators of the four plans (paragraphs 5.8 to 5.10);

(iii) endorsement of future tasks for the subgroup: (a) review of guidance for the production of maps of protected areas, (b) review of a paper by the Secretariat that summarises CCAMLR decisions related to the evaluation of Antarctic Treaty management plans containing marine areas that were submitted to CCAMLR for approval, and (c) production of a paper summarising its current terms of reference (paragraphs 5.12 and 5.15); and

(iv) endorsement of revision of the subgroup name 'Advisory Subgroup on Protected Areas' (paragraph 5.16).

5.53 A correspondence group will continue to examine the feasibility of subdividing some CCAMLR statistical areas into manageable harvesting units (i.e. as areas in which the CCAMLR objectives will need to be achieved) (paragraphs 5.17 to 5.20).

5.54 The Working Group recommended that the Scientific Committee accept the proposed divisions of the region in paragraph 5.22 and that these divisions be used by the Commission as a basis on which to subdivide the precautionary catch limit for krill in Area 48 as well as helping further the work of the Commission and the Scientific Committee in developing management procedures for krill fisheries that can adequately manage for localised effects on predators (paragraph 5.21).

5.55 The Working Group also drew the attention of the Scientific Committee to paragraphs 5.23 and 5.26 to 5.31.

5.56 The Working Group advised that work is continuing with the development and validation of the GYM. A new front-end module had been added to the GYM (available on CD-ROM). In addition, the main modules of the GYM are being re-coded by an independent programmer and this work will enable further validation. A reference database on CCAMLR software is being developed by the Secretariat (paragraphs 5.37 and 5.38).

5.57 The Working Group reaffirmed the need for detailed data on catch and effort from krill fisheries, and for the timely submission of such data using a consistent format. However, consensus could not be reached on the timing for the introduction of such a requirement. This debate is longstanding and was first initiated at SC-CAMLR-VII (paragraph 5.44).

5.58 The SSMU Workshop had clearly indicated the value of detailed data on catch and effort. While some of these data had been provided by workshop participants, data representing approximately 30% of catches taken in 2000/01 had not been available for analysis. In addition, valuable time at the workshop could have been saved had data been submitted in a consistent format to the Secretariat (paragraph 5.45).

5.59 Detailed data will be required to complete WG-EMM's work plan, including work at next year's workshop on the CEMP review and other planned workshops (paragraph 5.46).

5.60 WG-EMM cannot see how this matter can be resolved at working group level. Consequently, advice is sought from the Scientific Committee and the Commission on how to implement the submission of detailed catch and effort data to the Secretariat (paragraph 5.51).

FUTURE WORK

Review of CEMP

6.1 Prof. Croxall presented the report of the Interim Steering Committee for the CEMP Review (Appendix E).

6.2 The Working Group accepted and endorsed this report, together with its associated intersessional work plan. It thanked the Convener and members of the Interim Steering Committee for their work both intersessionally and at the meeting. The Working Group then commented on certain aspects of the report.

6.3 In respect of recommendations concerning the potential expansion of CEMP to include monitoring of predator–prey interactions for species other than krill, the Working Group specifically endorsed Appendix E, paragraphs 17 and 18. It noted that, if appropriate outline proposals were received, the nature and scope of potentially appropriate monitoring programs should be a topic for review and consideration by WG-EMM in its program of future work.

6.4 In relation to Appendix E, paragraph 21, Dr Kawaguchi expressed a concern of Japanese scientists that any management procedures developed in association with these approaches should not unnecessarily constrain or restrict current fishing operations.

6.5 In respect of the section on management advice, and especially Appendix E, paragraphs 22 to 24, Drs Sushin and Shust indicated that this aspect of the CEMP Review Workshop in 2003 is based on the assumption of potential competitive interactions between the krill fishery and the krill-dependent predators for krill resources. They stressed that this hypothesis is not proved yet and that its validity needs further examination by WG-EMM.

6.6 In relation to Appendix E, paragraph 30, Dr Fraser noted the importance of taking account of site-specific methodological and data differences, particularly in respect of Adélie penguins at Anvers Island (paragraphs 3.5 and 3.6) and recommended that analysis of CEMP data should be undertaken in close consultation with data holders.

6.7 The Working Group and Interim Steering Committee agreed with this and noted that all holders of data in the CEMP database would need to be informed of the potential analyses of their data as part of the CEMP review. This announcement should be accompanied by an invitation to participate in the appropriate aspects of the work associated with the CEMP review. It was agreed that this task should be added to the intersessional work plan of the CEMP review group.

6.8 With reference to further work on CSIs and on identification of anomalies (Appendix E, paragraphs 32 and 33), Dr Constable recommended that further work on the former should address issues raised in SC-CAMLR-XIX, Annex 4, paragraph 3.51. In respect of the latter, any work should build on the approach developed by the Subgroup on Statistics (SC-CAMLR-XVI, Annex 4, Appendix D). It was agreed that the Report of the Interim Steering Committee for the CEMP Review (Appendix E) would incorporate appropriate cross references.

6.9 Concerning the potential of CPUE indices, Dr Kawaguchi noted that WG-EMM-02/28 Rev. 1 showed fine-scale catch data in relation to catch per tow, catch per towing time and catch per day. He suggested that fine-scale catch data showed good correlation with catch per day and therefore, krill fine-scale catch data at this scale should be sufficient for the CEMP review. The Working Group agreed.

6.10 The Working Group endorsed the principle of inviting to the workshop international experts with experience of linking ecological and statistical models (Appendix E, paragraph 58). It provided the Interim Steering Committee with suggestions and endorsed the procedure set out in Appendix E, paragraph 59. Any budgetary implications should be discussed with the Secretariat at the earliest opportunity and well before the budget for the Scientific Committee is compiled.

6.11 In reviewing the intersessional work plan, Dr Constable suggested that the review generally, and tasks 1 to 3 in particular, might benefit from a summary of the spatial and temporal scales at which CEMP indices integrate and of the degree to which CEMP indices/parameters vary with consumption of krill. It was agreed to include this in the work plan.

6.12 The Working Group noted that there were important resource implications associated with the intersessional work plan. It noted that the work plan accorded explicit high priority to certain tasks, many of which required work by the CCAMLR Data Manager and his staff. This would require workloads substantially in excess of that needed to deliver the existing level of management of CEMP data in order to report to the Working Group. Some of this work would need to start very soon.

6.13 The CEMP Review Steering Committee should work with the Data Manager and Secretariat to define the extra resources needed for the CEMP review in order that these could be included in the review by the Scientific Committee of its resources and budget requirements for 2003. The need to provide the 2003 meeting of WG-EMM with the annual review and analysis of CEMP data (e.g. WG-EMM-02/5) should be considered by the CEMP Review Steering Committee.

6.14 The Working Group agreed that the Interim Steering Committee should continue its work as the formal steering committee for the CEMP review.

6.15 Dr D. Miller indicated that, in his new role as Executive Secretary, it would no longer be appropriate for him to continue as a member. He was thanked for his input to date.

6.16 Prof. Croxall indicated that, for practical and logistic reasons, he wished to share the responsibility of the convenership of the CEMP Review Steering Committee. The Interim Steering Committee had recommended Dr Southwell as a Co-convener. This was agreed by the Working Group.

Predator Surveys

6.17 During correspondence prior to WG-EMM-02, the Subgroup on Land-Based Predator Surveys recognised the complexity of regional surveys of land-based predators, given that they would cover large areas and multiple species. It was recognised from the outset that a coordinated strategy and design would be essential for planning and implementing such surveys.

6.18 As a first step in dealing with the likely complexity of regional surveys, Dr Southwell developed and circulated to the subgroup a general framework for decision-making as a tool for survey design planning (WG-EMM-02/45).

6.19 The subgroup discussed the contents of WG-EMM-02/45 and considered a general way forward for assessing the feasibility of regional surveys of land-based predators.

6.20 The subgroup recognised that the large amount of data on land-based predator abundance from previous local, and in some cases, regional-scale surveys would be invaluable in planning future regional surveys. In particular, these data offer the potential for use as 'pilot' data for evaluating candidate survey designs. It would be important to liaise with data holders to assess the possibility of using these data for evaluation purposes.

6.21 There was agreement that maximising the use of new and emerging technologies would be essential to the success of any broad-scale surveys. To this end, the subgroup will work intersessionally to investigate the suitability of various technologies for survey work, including satellite imagery and aerosondes as survey platforms, and report to WG-EMM-03 through a working paper.

6.22 It was noted that a technological development (use of image analysis to automatically count penguins from aerial photographs) outlined in a paper considered in the Report of the Subgroup on Methods (WG-EMM-02/34, paragraph 11) is of great potential value to broad-scale land-based predator surveys.

6.23 The issue of a synoptic circumpolar survey was discussed in relation to an alternate strategy of staged regional surveys carried out over a number of years. There was agreement that staging surveys would be more feasible in requiring a more achievable logistic requirement in each year, and would allow prioritising regions by importance or by usefulness in developing techniques.

6.24 The subgroup recognised that collaboration and coordination with other interested parties, for example the SCAR expert groups on bird biology and seals, would enhance the feasibility of the regional surveys, by utilising appropriate specialist expertise. Collaboration with regard to the large logistical requirements of regional surveys would also be important.

6.25 A broad work plan and timetable was discussed. It was agreed that assessing the overall feasibility would require numerous tasks, including review of existing methods and data, review of new and emerging technologies, assessment of candidate survey designs and methods by field experimentation and simulation, and determining required and available logistical support. Under this work plan, preliminary work would require approximately five to six years and actual survey work was unlikely to be possible before 2008/09.

6.26 It was considered that the subgroup should produce a prospectus and a more detailed background document on land-based predator surveys for consideration at WG-EMM-03. The prospectus and background document would identify the objective and rationale of such surveys, provide an assessment of the design, methodological and logistical issues to be addressed, identify potential stakeholders and collaborators, and outline a preliminary work plan.

Model Development

6.27 At its meeting last year, the Working Group tasked Dr Constable with convening an intersessional correspondence group to consider the development of models on predator–krill–environment interactions and fishery–krill–environment interactions (SC-CAMLR-XX, Annex 4, paragraph 5.8). In this respect, the correspondence group was to consider:

(i) the status of existing models, including data requirements;
(ii) variety of modelling approaches being undertaken; and
(iii) modelling approaches which may be useful in management.

6.28 Dr Constable reported that the intersessional group had not been convened, but that he had attended a workshop just prior to the WG-EMM meeting held by the Scientific Committee of the International Whaling Commission (SC-IWC) on Approaches to Modelling Food Webs, held at the Southwest Fisheries Science Center, La Jolla, California, USA. A report of that meeting should be available next year through the IWC.

6.29 A discussion amongst interested members of the Working Group was held during the course of the meeting and identified a number of modelling activities currently under way:

(i) SC-IWC work on evaluating food web models;

(ii) Antarctic ecosystem and food-web modelling being undertaken at:

  (a) Australian Antarctic Division (Drs Constable and I. Ball);

  (b) British Antarctic Survey (Drs E. Murphy, Reid and Trathan);

  (c) Old Dominion University (Dr E. Hofmann);

  (d) US AMLR Program, Southwest Fisheries Science Center (Mr Jones);

  (e) University of California, Santa Cruz (Drs Alonzo, M. Mangel and Watters); and

  (f) University of California, Santa Barbara (Palmer Long-Term Ecological Research Program – Dr R. Ross);

(iii) ICES Working Group on Ecosystem Modelling;

(iv) Mote International Symposium in Fisheries Ecology on 'Confronting Tradeoffs in the Ecosystem Approach to Fisheries Management' held in conjunction with Florida State University at the Mote Marine Laboratory, Sarasota, Florida, 5 to 7 November 2002; and

(v) Fisheries Centre, University of British Columbia, Canada – developments in Ecopath with Ecosim.

6.30 The Working Group agreed to maintain the correspondence group to help prepare and develop an agenda for the workshop to be held in conjunction with WG-EMM in 2004.

6.31 Dr Constable indicated that he would need some assistance to help coordinate this work. The Working Group requested that members consider this request and notify Dr Constable in the near future (in time for SC-CAMLR-XXI) if they are able to help with this coordination.

Review of Procedures for the Electronic Submission of Meeting Documents

6.32 The Working Group reaffirmed its policy for the electronic submission of meeting documents. Documents must be submitted to the Secretariat by email and by the deadline (see paragraph 1.5). The Working Group agreed that any revision necessary to documents after the deadline and arising from legitimate mistakes would need to be clearly indicated so that readers may easily identify changes.

Long-term Work Plan

Planning for Future Meetings

6.33 The Working Group reviewed progress towards its long-term goal of developing a feedback approach to manage the krill fishery, by which management measures are adjusted in response to ecosystem monitoring. The schedule of meetings and workshops leading to this had been summarised in SC-CAMLR-XX, Annex 4, paragraph 6.3.

6.34 The Working Group also noted progress toward the shorter term requests of the Scientific Committee and Commission (SC-CAMLR-XIX, paragraphs 5.14 and 5.15; CCAMLR-XIX, paragraph 10.11) to subdivide the precautionary catch limit of krill in Area 48.

6.35 The long-term plan of the Working Group was revised to reflect progress during 2002 and needs for future work (Table 3).

6.36 The Working Group agreed that the results of the workshops would provide advice for use in the development of the long-term plan. It was recognised that such advice may be improved when better scientific information becomes available.

6.37 The Working Group agreed that the workshop planned in 2003 would be held during the first week of WG-EMM-03, and that plenary sessions discussing core business would be held in the second week. This format would allow participants and invited experts to attend selected parts of the meeting if they so wished. WG-EMM recognised that this format may not be suitable for all future workshops because some workshops may require input from plenary sessions.

6.38 The Working Group welcomed the invitation from the British Antarctic Survey to host the 2003 meeting in Cambridge, UK, from 18 to 29 August 2003. WG-EMM recognised that the timing of the 2003 meeting was constrained by the availability of a suitable meeting venue.

6.39 Participants were reminded that proposals for future meetings of WG-EMM should be scheduled, when possible, earlier in the year (e.g. July). This would allow sufficient time for the full translation of the report prior to the meeting of the Scientific Committee.

Intersessional Work

6.40 Intersessional work identified by the Working Group is listed in Table 4. Work identified by the Steering Committee for the CEMP Review is listed in Appendix E, Attachment 4.

Historic Record of Work Undertaken by WG-EMM

6.41 The Working Group also reviewed the history of development and completion of tasks which it had put forward since 1995 (WG-EMM-02/12). It was agreed that this paper, produced annually, provided a valuable aide-mémoire of developments undertaken by WG-EMM. However, the Working Group also recognised that it had established a five-year plan starting in 2001. Accordingly, it was agreed that WG-EMM-02/12 provided a suitable archive of tasks undertaken from 1995 to 2001. A similar record was required in the future, however that record should begin with the five-year plan.

6.42 WG-EMM welcomed the Secretariat's development of a database of CCAMLR meeting documents (WG-EMM-02/8). This database was a useful way of making all WG-EMM documents available to participants. Two further developments were proposed: adding a link between meeting documents which had been subsequently published and the published reference, and writing routines for exporting data to commonly used bibliographic software packages (e.g. EndNote).

6.43 It was agreed that this database should be made available to WG-EMM participants through a secure section of the CCAMLR website. In addition, WG-EMM agreed that copies of the database could be made available in DVD format, with password protection, to participants on request. Password protection was necessary in order to protect these documents under the Rules for Access and Use of CCAMLR Data.

Rules for Access and Use of CCAMLR Data

6.44 WG-EMM briefly discussed the Rules for Access and Use of CCAMLR Data (CCAMLR-XI, paragraph 4.35). The underlying principle was that data should be freely available for work within CCAMLR. Under these rules, the Secretariat may release data held in CCAMLR databases as follows:

- if data are requested for use within CCAMLR (e.g. analysis in support of WG-EMM and preparation of meeting documents), then data are released to the data requester and the data originator is advised that the data have been released and their proposed use; and

- if data are requested for use outside CCAMLR (e.g. work for publication), then permission to release the data is first sought from the data originator and then, only if permission is granted, the data are released.

6.45 During the course of the meeting, a number of issues regarding the rules had been raised and WG-EMM agreed that these should be referred to the Scientific Committee for consideration. The main issues were:

- How can the principle of maintaining access to data for CCAMLR work be retained while providing appropriate consideration for data owners to ensure their interests are also retained?
- Is there a need for consultation with data originators at the time of release and/or during subsequent analyses of certain types of data (e.g. CEMP data) for use within CCAMLR?
- How might the rules be revised in relation to the distribution of meeting documents (e.g. wider circulation of the database of CCAMLR meeting documents)?

Key Points for Consideration by the Scientific Committee

6.46 The Steering Committee for the CEMP Review was tasked with reviewing the terms of reference and preparing detailed plans for the workshop on 'Utility of CEMP' scheduled during the 2003 meeting of WG-EMM. The Working Group endorsed and accepted the work of the Steering Committee, and the work plan for the intersessional period leading to the workshop (Appendix E) (paragraph 6.2).

6.47 The Working Group endorsed the principle of inviting to the workshop international experts with experience in linking ecological and statistical models. Prof. Croxall and Dr Southwell, co-conveners of the Steering Committee, agreed to contact such experts in order to determine their availability and any budgetary implications for the Scientific Committee (paragraph 6.10).

6.48 Important resource implications were also associated with the intersessional work. Certain tasks have explicit high priority, many of which required work by the Data Manager and his staff. This would require workloads substantially in excess of that needed to deliver the existing level of management of CEMP data. The Steering Committee would work with the Data Manager to quantify the required resources and budgetary implications for the Scientific Committee (paragraphs 6.12 and 6.13).

6.49 A broad work plan and timetable was discussed, with preliminary work requiring some five to six years for completion. The actual survey work was likely to begin from approximately 2008/09 onwards (paragraph 6.25).

6.50 The Working Group agreed that staged, regional surveys would appear preferable over a single synoptic circumpolar survey. Staged surveys would allow an achievable logistic requirement in each year, and would allow prioritising of regions by importance or by usefulness in developing techniques (paragraph 6.23).

6.51 The Subgroup on Land-Based Predator Surveys would prepare a prospectus and a detailed background document for consideration at the 2003 meeting of WG-EMM (paragraph 6.26).

6.52 The Working Group advised that the correspondence group would help prepare and develop an agenda for the workshop to be held in conjunction with WG-EMM in 2004 (paragraph 6.30).

6.53 WG-EMM had reviewed progress towards its long-term goal of developing a feedback approach to manage the krill fishery (paragraph 6.33) and the revised work plan is summarised in Table 3. Work identified by the Working Group for the 2002/03 intersessional period is listed in Table 4 and tasks identified by the Steering Committee for the CEMP Review are listed in Appendix E (paragraph 6.40).

6.54 The next workshop (Utility of CEMP) will be held in 2003 during the first week of WG-EMM-03 and plenary sessions discussing core business will be held in the second week (paragraph 6.37).

6.55 The Working Group welcomed the invitation from the UK to host the 2003 meeting in Cambridge, UK, from 18 to 29 August 2003 (paragraph 6.38).

6.56 The budget implications on the Secretariat's work to develop a database of CCAMLR meeting documents work will need to be considered at SC-CAMLR-XXI (paragraphs 6.42 and 6.43).

6.57 During the course of the meeting, a number of issues regarding the rules of data access were raised, and these were referred to the Scientific Committee for consideration (paragraph 6.45).

OTHER BUSINESS

World Fisheries Congress

7.1 The Working Group noted the proposal (WG-EMM-02/24) that the original invitation to Prof. Boyd to lead a session on 'Reconciling Fisheries with Conservation in the Antarctic' at the next World Fisheries Congress (WFC) (Vancouver, Canada, 2 to 6 May 2004) might be extended to enable greater potential participation by CCAMLR scientists.

7.2 The Working Group agreed with this proposition and recommended that the Conveners of WG-EMM and WG-FSA should join Prof. Boyd as co-leaders of this session. They would all share the responsibility of coordinating the preparation of the 30-minute presentation.

7.3 It also recommended that CCAMLR should publicise the existence of this session at the WFC as an important opportunity to present CCAMLR science and management in a global context.

7.4 The Working Group encouraged scientists engaged in research and management in relation to CCAMLR to submit abstracts of oral/or poster presentations to the WFC so that a good representation of the best of CCAMLR science would be available for selection.

UBC Workshop on Modelling Antarctic Ecosystems

7.5 The Working Group noted that the University of British Columbia Fisheries Centre had made a first announcement (and call for papers) for a workshop on 'Modelling Antarctic Ecosystems' to be held at the University of British Columbia, Canada, 14 to 17 April 2003. The edited workshop proceedings would be published as a Fisheries Centre Research Report. Further information is available from events@fisheries.ubc.ca.

International Whaling Commission

7.6 The Working Group noted that the SC-IWC had met in Japan from 27 April to 9 May 2002. Dr K.-H. Kock (Germany) was the CCAMLR Observer at that meeting and his report is presented in SC-CAMLR-XXI/BG/2.

7.7 Dr Kock reported that the SC-IWC was considering holding a workshop in collaboration with CCAMLR in 2003 to analyse data collected during the CCAMLR-2000 Survey. The workshop would investigate links between krill distribution and abundance, environmental factors and whale distribution and abundance. The SC-IWC had also discussed future collaboration with CCAMLR.

7.8 WG-EMM looked forward to advice from SC-CAMLR on these initiatives.

SO-GLOBEC

7.9 The Working Group noted that the SO-GLOBEC Program was in its second field season following a series of successful cruises in the Antarctic autumn and winter of 2001. A special issue of *Deep-Sea Research* was being produced containing the results of this first season's cruises. Currently the US SO-GLOBEC Program was operating in the Marguerite Bay area using two ships to complete a time series of studies from February to September.

7.10 Preliminary results from the SO-GLOBEC studies, and other work of relevance to SO-GLOBEC, will be presented at the GLOBEC 2nd Open Science Meeting in Qingdao, China, from 15 to 18 October 2002. Sessions relevant to WG-EMM will include: variability in Antarctic marine populations physical and biological causes, development and application of indices/variables for the description/prediction of ecosystem dynamics, novel mechanisms for linking climate and fisheries and interactions between small-, meso- and large-scale physical and ecosystem processes.

Genetics Correspondence Group

7.11 Dr Bergström advised that the correspondence group had been active during the intersessional period, and that some related work had been reported in the informal poster presented at the meeting (paragraph 1.6). One of the group members, Ms A. Hjelmgren had established an email mailing list and anyone interested in discussing krill genetics was urged to contact her (anna.hjelmgren@rossini.zool.gu.se).

7.12 Dr Bergström reminded WG-EMM that genetic material was available for studies. This material had been collected both during the CCAMLR-2000 Survey and during the 2001 survey aboard the *Polarstern.* Samples collected during the latter expedition come from the Elephant Island area and an area close to the Neumayer Station in the eastern Weddell Sea.

7.13 The Working Group briefly considered sampling and methodological protocols for studies on krill genetics. A recent study (Jarman and Nicol, 2002) had identified problems with existing sampling protocols. WG-EMM tasked the group with identifying and/or developing suitable sampling and methodological protocols for conducting studies on krill stock discrimination.

7.14 In addition, the Working Group noted that a subgroup of WG-FSA had been tasked with identifying, in conjunction with the SCAR EVOLANTA Program, up-to-date information on stock identity for species within the Convention Area. That subgroup was coordinated by Dr E. Fanta (Brazil) and a link should be established between the work of the correspondence group and WG-EMM.

International Workshop on Krill

7.15 Dr Kawaguchi informed WG-EMM that Japan will be hosting an 'International Workshop on Understanding Living Krill for Improved Management and Stock Assessment'. This workshop will be held at the Port of Nagoya Public Aquarium, Japan, from 1 to 4 October 2002.

Survey Design and Analysis

7.16 The Working Group noted the proposal to hold a course on survey design and analysis at the Kristineberg Marine Research Station, Fiskebäckskil, Sweden, in September 2003 immediately following WG-EMM-03. The course will be organised by Dr Bergström and Ms M. Thomasson, with expert contributions from Drs Everson, Hewitt, Demer and Siegel. Dr Bergström was hoping to secure full funding for the course. Alternatively, a course fee would need to be charged to recoup some of the costs.

Ross Sea Research

7.17 The Working Group noted that an informal one-day meeting on research in the Ross Sea would be held immediately prior to its 2003 meeting. The informal meeting would consider relevant documents submitted to WG-EMM-03 as well as other material brought by participants. A verbal report would be presented at WG-EMM-03. The Working Group encouraged all scientists involved with research in the Ross Sea to contact Drs Azzali and S. Corsolini (Italy) or P. Wilson (New Zealand) to discuss participation and contributions to the informal meeting.

Japanese Survey

7.18 Dr Naganobu invited participants to collaborate in a planned survey to be conducted by the RV *Kaiyo Maru*. The dates and areas of the survey are not yet determined.

Observers at WG-EMM-03

7.19 The Working Group considered participation by observers from other international organisations at its 2003 meeting. It was agreed that no observers would be required at that meeting.

Submission of Synopses to SC-CAMLR

7.20 The Working Group considered a proposal from the Scientific Committee that the synopses of its meeting documents be circulated at the meeting of SC-CAMLR (SC-CAMLR-XX, paragraph 18.4). WG-EMM agreed to do this in the form of a background document.

CCAMLR Science Editorial Board

7.21 The Editorial Board of *CCAMLR Science* met during WG-EMM-02, and a brief report of that meeting would be submitted as a background paper to SC-CAMLR-XXI.

SC-CAMLR Agenda

7.22 The Working Group provided advice on proposed modifications to the agenda of SC-CAMLR-XXI which had been circulated during the meeting by the Chair of the Scientific Committee.

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

8.1 The report of the eighth meeting of WG-EMM was adopted.

8.2 In closing the meeting, Dr Hewitt thanked all participants for their contributions to the meeting and the workshop. The meeting had successfully developed the work of WG-EMM in line with its five-year work plan.

8.3 Dr Hewitt also thanked the local organisers of the meeting, Drs Sue and Wayne Trivelpiece for providing an excellent venue and support. This had greatly contributed to the success of the meeting.

8.4 Dr Hewitt thanked the Secretariat for their work in support of WG-EMM, both at the meeting and during the intersessional period.

8.5 Dr Everson, on behalf of the Working Group, thanked Dr Hewitt for his continued leadership and contribution to WG-EMM.

8.6 The meeting was closed.

REFERENCES

Agnew, D.J. and G. Phegan. 1995. A fine-scale model of the overlap between penguin foraging demands and the krill fishery in the South Shetland Islands and Antarctic Peninsula. *CCAMLR Science*, 2: 99–110.

Boyd, I.L. 2001. Integrated environment–prey–predator interactions off South Georgia: implications for management of fisheries. *Aquatic Conservation: Marine Freshwater Ecosystems*.

de la Mare, W.K. 1994. Estimating krill recruitment and its variability. *CCAMLR Science*, 1: 55–69.

Demer, D.A. Submitted. An estimate of error for the CCAMLR 2000 estimate of krill biomass. *Deep-Sea Res.* (CCAMLR-2000 Special Issue).

Demer, D.A., S.G. Conti, J. De Rosny and P. Roux. In press. Absolute measurements of total target strength from reverberation in a cavity. *J. Acoust. Soc. Am.*

De Rosny, J. and P. Roux. 2001. Multiple scattering in a reflecting cavity: application to fish counting in a tank. *J. Acoust. Soc. Am.,* 109: 2587–2597.

Everson, I. 2002. Consideration of major issues in ecosystem monitoring and management *CCAMLR Scienc*e, 9: 213–232.

Everson, I., J.L. Watkins, D.G. Bone and K.G. Foote. 1990. Implications of a new acoustic target strength for abundance estimates of Antarctic krill. *Nature*, 345: 338–340.

Foote, K.G., I. Everson, J.L. Watkins and D.G. Bone. 1990. Target strengths of Antarctic krill (*Euphausia superba*) at 38 and 120 kHz. *J. Acoust. Soc. Am.,* 87 (1): 16–24.

Greene, C.H., T.K. Stanton, P.H. Wiebe and S. McClatchie. 1991. Acoustic estimates of Antarctic krill. *Nature*, 349: 110 pp.

Hewitt, R.P. and D.A. Demer. 1991. Krill abundance. *Nature*, 353: p. 310.

Jarman, S.N. and S. Nicol. 2002. Sources of variance in studies of krill population genetics. *CCAMLR Science*, 9: 107–116.

Jolly, G.M. and I. Hampton. 1990. A stratified random transect design for acoustic surveys of fish stocks. *Can. J. Fish Aquat. Sci.*, 47: 1282–1291.

McGehee, D.E., R.L. O'Driscoll and L.V. Martin Traykovski. 1998. Effects of orientation on acoustic scattering from Antarctic krill at 120 kHz. *Deep-Sea Res.,* II, 45: 1273–1294.

Naganobu, M, K. Kutsuwada, Y. Sasai, S. Taguchi and V. Siegel. 1999. Relationships between Antarctic krill *(Euphausia superba*) variability and westerly fluctuations and ozone depletion in the Antarctic Peninsula area. *J. Geophys. Res.*, 104, C9: 20,651–20,665.

Syrjala, S.E. 2000. Critique on the use of the delta distribution for the analysis of trawl survey data. *ICES J. Mar Sci*., 57: 831–842.

SC-CAMLR. 2000. Report of the B_0 Workshop. In: *Report of the Nineteenth Meeting of the Scientific Committee (SC-CAMLR-XIX)*, Annex 4, Appendix G. CCAMLR, Hobart, Australia: 209–273.

Wiebe, P.H., C.H. Greene, T.K. Stanton and J. Burczynski. 1990. Sound scattering by live zooplankton and micronekton: empirical studies with a dual-beam acoustical system. *J. Acoust. Soc. Am.,* 88 (5): 2346–2360.

Table 1: Catch (tonnes) of krill from the Convention Area in the 2000/01 fishing season (December 2000 to November 2001) reported in monthly catch and effort reports. The percentage of the monthly catch reported in fine-scale data is shown in brackets.

Calendar		Catch of Krill Reported from Area 48					
Year	Month	Total	Japan	Rep. of Korea	Poland	Ukraine	USA
2000	December	2 305 (100)	1 707 (100)	598 (100)			
2001	January	3 394 (101)	3 161 (101)	232 (100)			
	February	6 422 (98)	6 388 (99)		34 (0)		
	March	7 509 (77)	5 908 (98)		1 601 (0)		
	April	12 730 (81)	9 029 (112)	264 (100)	3 437 (0)		
	May	17 907 (83)	12 865 (100)	1 202 (99)	2 970 (0)	870 (100)	
	June	17 161 (85)	9 929 (100)	1 013 (103)	2 166 (0)	2 492 (79)	1 561 (100)
	July	14 152 (24)	7 782 (0)	1 041 (104)	2 302 (0)	3 027 (78)	
	August	12 166 (31)	6 452 (0)	1 430 (104)	1 186 (0)	3 097 (75)	
	September	7 177 (33)	3 360 (0)	1 321 (0)		2 496 (95)	
	October	2 414 (80)		423 (0)		1 991 (97)	
	November	0					
Season total		103 335 (67)	66 580 (75)	7 525 (79)	13 696 (0)	13 973 (85)	1 561 (100)

Table 2: Catch (tonnes) of krill from the Convention Area in the 2001/02 fishing season (December 2001 to November 2002) reported in monthly catch and effort reports submitted by 16 July 2002. The percentage of the monthly catch reported in fine-scale data is shown in brackets.

Calendar		Catch of Krill Reported from Area 48					
Year	Month	Total	Japan	Rep. of Korea	Poland	Ukraine	USA
2001	December	0					
2002	January	1 940 (21)	143 (0)			1 400 (0)	397 (101)
	February	11 832 (25)	6 009 (0)			3 000 (0)	2 823 (106)
	March	16 157 (13)	6 602 (0)	2 268 (0)		3 383 (0)	2 013 (100)
	April	22 230 (12)	8 153 (0)	2 212 (0)	1 891 (0)	6 502 (0)	2 563 (104)
	May	17 115 (0)	7 979 (0)	1 958 (0)	2 801 (0)	3 611 (0)	
	June	7 812 (7)	5 653 (0)	1 595 (0)	3 566 (0)		564 (100)
	July	na					
	August	na					
	September	na					
	October	na					
	November	na					
Season total		77 085 (11)	34 539 (0)	8 033 (0)	8 258 (0)	17 896 (0)	8 359 (103)

Table 3: Revised plan of work scheduled between 2002 and 2005.

Issue	2002	2003	2004	2005
Subdivide Precautionary Catch Limit	Discussion	Discussion	Recommendation	
Revised Krill Management Procedure				
Delineation of small-scale management units in Area 48	Workshop			
CEMP review	Planning session	Workshop		
Selection of appropriate predator–prey–fishery–environment models	Discussion	Planning session	Workshop	
Evaluation of management procedures including objectives, decision rules, performance measures	Discussion	Discussion	Planning session	Workshop
Reporting requirements from fishery	Discussion	Awaiting guidance from the Scientific Committee		
Monitoring requirements from CEMP	Discussion	Discussion	Discussion	Discussion
Assessment of Predator Demand				
Large-scale surveys of land-based predators	Discussion	Discussion	Discussion	Discussion
Subdivision of Large FAO Statistical Areas				
Establishment of harvesting units	Discussion	Discussion		

Table 4: List of tasks identified by WG-EMM for the 2002/03 intersessional period. The paragraph numbers (Ref.) refer to this report unless stated otherwise. √ – general request, √√ – high priority

	Task	Ref.	Priority	Action Required	
				Members	Secretariat
	Status and trends in krill fisheries				
1.	Continue submission of krill fishery descriptions at all phases of their development.	2.42	√	Members	Remind
2.	Contact ICES and obtain information about the number of vessels from north Atlantic fisheries that might potentially enter the krill fishery.	2.50	√		Implement
3.	Collate and synthesise information from the krill fishery questionnaire.	2.55	√	Continue data submission	Implement
4.	Contact the FAO for information that they might have on the demand for krill for aquaculture feeds or on the development of other krill fisheries.	2.72	√		Implement
5.	Remind Members that the management of krill fisheries requires timely submission of appropriate data.	2.68–2.70, 2.74, 2.75	√√	Members	Remind
	Scientific Observers Manual				
6.	Revise krill observation logbook forms.	2.60–2.62	√	Members	Remind
7.	Request WG-FSA to assist in the development of the methodology for sampling larvae and other small-sized fish (i.e. <7 cm) taken as by-catch in krill fishing.	2.62(iv)	√	WG-FSA	Remind
8.	Develop an alternative method for collecting data on board fishing vessels on krill product conversion rates.	2.62(v)	√	Members	Remind
9.	Revise krill colour chart for its subsequent inclusion in the manual.	2.62(ii)	√	Dr Kawaguchi	Remind
	Status of the krill-centric ecosystem				
10.	Notify data holders of any forthcoming CEMP data analysis to be conducted by the Secretariat.	3.7	√√		Implement
11.	Encourage Members to use the current CEMP data submission forms and to provide additional information in comment fields where this will assist data validation.	3.4, 3.124	√		Implement
12.	Reorganise the CEMP database in order to increase ease and flexibility of accessing data.	3.10, 3.125	√√		Implement
13.	Discontinue calculation of the Agnew–Phegan index of predator–fishery overlap.	3.40, 3.127	√		Implement

	Task	Ref.	Priority	Action Required	
				Members	Secretariat
14.	Consider the best methods for presenting the different predator–fishery overlap indices and the way each index relates to the others available.	3.41	√		Implement
15.	Coordinate formulation of CEMP standard methods for collection and analysis of predator demography data, seek advice of researchers with similar data.	3.48	√	Dr Kerry (in respect of Adélie penguins)	
16.	Present more krill demographic data from the US Long-Term Ecological Research Program.	3.65	√	USA	Remind
17.	Revise as agreed Procedure B of Standard Method C2.	3.103, 3.130	√√		Implement
18.	Provide median dates of fur seal pupping for years in which Members have previously submitted data using Standard Method C2, Procedure B.	3.104	√	Members	Remind
19.	Request authors of papers WG-EMM-02/35, 02/37, 02/49 and 02/50 to explicitly identify the merits of new methods proposed relative to methods used during the CCAMLR-2000 Survey, and identify the implications for reanalysis of existing survey data.	3.105	√	Authors identified	Remind
20.	Implement a multi-stage process for developing new CEMP standard methods.	3.114	√	Members	Coordinate
	Status of management advice				
21.	Review of guidelines for the production of maps of protected areas.	5.52(iii)	√	Advisory Subgroup on Protected Areas	Coordinate
22.	Submit outstanding maps of CEMP sites; place maps on the website.	5.11	√	Members	Remind/implement
23.	Revise and submit a document summarising CCAMLR decisions related to the evaluation of ATCM management plans containing marine areas.	5.15, 5.52(iii)	√	Advisory Subgroup on Protected Areas	Implement
24.	Revise current terms of reference of the Subgroup on CEMP Sites in a manner that properly places new tasks in context of decisions taken by CCAMLR.	5.15, 5.52(iii)	√	Advisory Subgroup on Protected Areas	Implement
25.	Conduct sensitivity analysis to examine regional differences in krill growth and mortality and their impacts on estimates of yield calculated using the GYM.	5.36	√	Members	
26.	Identify and/or develop suitable sampling and methodological protocols for conducting studies on krill stock discrimination.	7.13	√	Genetics Correspondence Group (Convener, Dr Bergström)	Remind
27.	Develop GIS maps of small-scale units identified by the SSMU Workshop for Area 48.	5.22, 5.24	√√	WG-EMM Convener, Dr Hewitt; SC Chairman, Dr Holt	Implement as required

	Task	Ref.	Priority	Action Required	
				Members	Secretariat
	Future work of WG-EMM				
28.	Conduct WG-EMM business in accordance with the revised plan of work.	6.35, 6.53	√√	WG-EMM Convener, Members	Remind, coordinate and implement, where appropriate
29.	Preparation for the Workshop on the CEMP Review as required in accordance with the adopted plan of intersessional work.	6.2, 6.37	√√	Implement (Steering Committee and identified scientists)	Implement specific tasks identified
30.	Request Steering Committee for the Review of CEMP to include in the workshop review of consideration of the utility of CEMP Integrated Study Regions and whether the proposed small-scale management units might provide a stable structure for future work on the relationships between krill, predators and the fishery.	5.31	√√	Steering Committee	Remind
31.	Continue the work on the development of models on predator–krill–environment interactions and fishery–krill–environment interactions in order to help prepare and develop an agenda for the workshop on modelling to be held in conjunction with WG-EMM-04.	6.30, 6.31	√	Correspondence Group (Convener, Dr Constable)	Remind, assist as required
32.	Continue the work on designating scales for harvesting units.	5.19, 5.20	√	Correspondence Group (Convener, Dr Naganobu, Dr Nicol)	Remind
33.	Investigate the suitability of various technologies for predator survey work, including satellite imagery and aerosondes as survey platforms.	6.21	√	Subgroup on Land-Based Predator Surveys	
34.	Produce a prospectus and a more detailed background document on land-based predator surveys for consideration at WG-EMM-03.	6.26	√	Subgroup on Land-Based Predator Surveys	
35.	Establish a link between the work of the WG-FSA subgroup tasked with identifying up-to-date information on stock identification in the Convention Area and the SCAR EVOLANTA subgroup coordinated by Dr Fanta.	7.14	√	Genetics Correspondence Group (Convener, Dr Bergström)	Remind
36.	Invite Members to provide submissions to help refine boundaries of small-scale management units identified by the SSMU Workshop.	5.29	√	Members	Remind
	Working Group documents				
37.	Reaffirm that only papers accompanied by a complete one-page synopsis and submitted electronically by the deadline identified by the Scientific Committee would be considered at future meetings.	1.5, 6.32	√√	Members	Remind

	Task	Ref.	Priority	Action Required	
				Members	Secretariat
38.	Make available to WG-EMM participants the database of CCAMLR meeting documents in accordance with agreed procedures.	6.42, 6.43, 6.56	√		Implement
39.	Develop format styles for the preparation of workshop reports, including guidelines for production of figures, maps and tables.	4.6	√	Members	Implement in consultation with Members
	Research and development		√		
40.	Review the utility of CPUE in krill fisheries in the near future.	2.20	√	Members	Remind
41.	Publicise a session ‘Reconciling Fisheries with Conservation in the Antarctic’ to be held during the World Fisheries Congress (Canada, 2–6 May 2004).	7.3	√	Members	Implement

APPENDIX A

AGENDA

Working Group on Ecosystem Monitoring and Management
(Big Sky, Montana, USA, 5 to 16 August 2002)

1. Introduction
   1.1 Opening of the meeting
   1.2 Adoption of the agenda and organisation of the meeting

2. Status and trends in the krill fishery
   2.1 Fishing activity
   2.2 Description of the fishery
   2.3 Regulatory issues
   2.4 Key points for consideration by the Scientific Committee

3. Status and trends in the krill-centric ecosystem
   3.1 Status of predators, krill resource and environmental influences
   3.2 Further approaches to ecosystem assessment and management
   3.3 Other prey species
   3.4 Methods
   3.5 Future surveys
   3.6 Key points for consideration by the Scientific Committee

4. Workshop to define predator units

5. Status of management advice
   5.1 Designation of protected areas
   5.2 Harvesting units
   5.3 Small-scale management units
   5.4 Generalised yield model
   5.5 Existing conservation measures
   5.6 Key points for consideration by the Scientific Committee

6. Future work
   6.1 CEMP review
   6.2 Predator surveys
   6.3 Model development
   6.4 Review of procedures for the electronic submission of meeting documents
   6.5 Long-term work plan
   6.6 Key points for consideration by the Scientific Committee

7. Other business

8. Adoption of the report and close of the meeting.

APPENDIX B

LIST OF PARTICIPANTS

Working Group on Ecosystem Monitoring and Management
(Big Sky, Montana, USA, 5 to 16 August 2002)

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APPENDIX C

LIST OF DOCUMENTS

Working Group on Ecosystem Monitoring and Management
(Big Sky, Montana, USA, 5 to 16 August 2002)

WG-EMM-02/1	Provisional Agenda and Provisional Annotated Agenda for the 2002 Meeting of the Working Group on Ecosystem Monitoring and Management (WG-EMM)
WG-EMM-02/2	List of participants
WG-EMM-02/3	List of documents
WG-EMM-02/4	Do fish prey size affect the foraging patterns and breeding output of the Antarctic shag *Phalacrocorax bransfieldensis*? R. Casaux and A. Baroni (Argentina)
WG-EMM-02/5	CEMP indices 2002: analysis of anomalies and trends CCAMLR Secretariat
WG-EMM-02/6	Krill fishery information CCAMLR Secretariat
WG-EMM-02/7	A review and preliminary analysis of CEMP data CCAMLR Secretariat
WG-EMM-02/8	Database of CCAMLR working documents CCAMLR Secretariat
WG-EMM-02/9	The diet of the Antarctic fur seal *Arctocephalus gazella* at the Danco Coast, Antarctic Peninsula R. Casaux, A. Baroni and A. Ramón (Argentina)
WG-EMM-02/10	Geographical variation in the diet of the Antarctic fur seal *Arctocephalus gazella* R. Casaux, A. Baroni, F. Arrighetti, A. Ramón and A. Carlini (Argentina)
WG-EMM-02/11	The diet of the Antarctic fur seal *Arctocephalus gazella* at Harmony Point, South Shetland Islands: evidence of opportunistic foraging on penguins? R. Casaux, L. Bellizia and A. Baroni (Argentina)

WG-EMM-02/12	History of development and completion of tasks put forward by WG-EMM (1995–2001) Secretariat
WG-EMM-02/13	Incident of Antarctic krill (*Euphausia superba*) mass infection near the coasts of South Georgia Island (Subarea 48.3) M.S. Savich (Ukraine)
WG-EMM-02/14	Spatial distribution of predator/prey interactions in the Scotia Sea: implications for measuring predator/fisheries overlap K. Reid, M. Sims, R.W. White and K.W. Gillon (United Kingdom) (*Deep-Sea Research* (CCAMLR-2000 Special Issue), submitted)
WG-EMM-02/15	Conflict or co-existence? Foraging distribution and competition for prey between Adélie and chinstrap penguins A.S. Lynnes, K. Reid, J.P. Croxall and P.N. Trathan (United Kingdom) (*Marine Biology*, in press)
WG-EMM-02/16	Krill population dynamics in the Scotia Sea: variability in growth and mortality within a single population K. Reid, E.J. Murphy (United Kingdom), V. Loeb and R.P. Hewitt (USA) (*Journal of Marine Systems*, 36: 1–10)
WG-EMM-02/17	Current temperature conditions off South Georgia during recent years (satellite data on Subarea 48.3) G.P. Vanyushin (Russia)
WG-EMM-02/18	The US commercial krill fishery in Area 48: development, fishing patterns, and decision making C.D. Jones and M. Hull (USA) (*CCAMLR Science*, submitted)
WG-EMM-02/19	Combined standardised indices of predator performance at Bird Island, South Georgia, 1973–2002 K. Reid (United Kingdom)
WG-EMM-02/20	Are krill recruitment indices from meso-scale survey representative for larger areas? V. Siegel (Germany), R.M. Ross and L.B. Quetin (USA)
WG-EMM-02/21	Seasonal and interannual variation in foraging range and habitat of macaroni penguins *Eudyptes chrysolophus* at South Georgia K.E. Barlow and J.P. Croxall (United Kingdom) (*Marine Ecology Progress Series*, 232: 291–304)

WG-EMM-02/22	Are penguins and seals in competition for Antarctic krill at South Georgia? K.E. Barlow, I.L. Boyd, J.P. Croxall, K. Reid, U.J. Staniland and A.S. Brierley (United Kingdom) (*Marine Biology*, 140: 205–213)
WG-EMM-02/23	Estimating food consumption of marine predators: Antarctic fur seals and macaroni penguins I.L. Boyd (United Kingdom) (*Journal of Applied Ecology*, 39: 103–119)
WG-EMM-02/24	World Fisheries Congress J.P. Croxall (United Kingdom)
WG-EMM-02/25	Detecting trends in the krill fishery S. Nicol and J. Foster (Australia)
WG-EMM-02/26	Conserving seabirds competing with fisheries for food – observations from southern Africa and Marion Island R.J.M. Crawford, C.M. Duncombe Rae and D.C. Nel (South Africa)
WG-EMM-02/27	Soviet krill fishery in the Atlantic sector of Antarctic in 1977–1992: Part II – CPUE changes and fleet displacement F.F. Litvinov, P.S. Gasiukov, A.Z. Sundakov and O.A. Berezhinskiy (Russia)
WG-EMM-02/28 Rev. 1	Fishing patterns of Japanese krill trawlers S. Kawaguchi, T. Kameda and Y. Takeuchi (Japan)
WG-EMM-02/29	The krill fishery observer manual – points to be revised S. Kawaguchi (Japan)
WG-EMM-02/30	Results of an acoustic investigation of Antarctic krill, *Euphausia superba*, biomass-density in the Elephant Island area in January/February 2001 M.A. Thomasson (Sweden), J.H. Emery (USA), J. Rademan (South Africa), R.P. Hewitt (USA) and B.I. Bergström (Sweden)
WG-EMM-02/31	Design of the Italian acoustic survey in the Ross Sea for the Austral summer 2003/04 M. Azzali, A. Sala and S. Manoukian (Italy)

WG-EMM-02/32	Krill of the Ross Sea: distribution, abundance and demography of *Euphausia superba* and *Euphausia crystallorophias* during the Italian Antarctic expedition (January–February 2000) A. Sala, M. Azzali and A. Russo (Italy) (*Scientia Marina,* 66 (2): 123–133)
WG-EMM-02/33	Spatial and temporal variability in foraging patterns of krill predators at Signy Island and South Georgia P.N. Trathan, J.L. Tanton, A.S. Lynnes, M.J. Jessopp, H. Peat, K. Reid and J.P. Croxall (United Kingdom)
WG-EMM-02/34	Estimating penguin populations using image analysis of colour aerial photography P.N. Trathan (United Kingdom)
WG-EMM-02/35	Maximum entropy reconstruction of stock distribution and inference of stock density from line-transect acoustic survey data A.S. Brierley, S.F. Gull and M.H. Wafy (United Kingdom) (*ICES Journal of Marine Science*, submitted)
WG-EMM-02/36	MaxEnt reconstructions of krill distribution and estimates of krill density from acoustic surveys at South Georgia 1996–2000 M.H. Wafy, A.S. Brierley, S.F. Gull and J.L. Watkins (United Kingdom) (*CCAMLR Science*, submitted)
WG-EMM-02/37	The three-frequency method for classifying the species and assessing the size of two euphausiids (*Euphausia superba* and *Euphausia crystallorophias*) M. Azzali, G. Lanciani and I. Leonori (Italy) (*CCAMLR Science*, submitted)
WG-EMM-02/38	Relationships between distribution of two euphausiid species and oceanographic characteristics in the Ross Sea (January–February 2000) A. Russo, M. Azzali, E. Biffi, G. Lanciani and E. Paschine (Italy) (*Antarctic Science*, submitted)
WG-EMM-02/39	Seasonal variation in acoustic estimates of krill density at South Georgia during 2001/2002 C. Goss, S.A. Grant, N. Cunningham, J.L. Watkins, P.N. Trathan, E. Murphy and K. Reid (United Kingdom)

WG-EMM-02/40 Rev. 1	Defining fishing grounds in the Scotia Sea I.R. Ball and A.J. Constable (Australia), S. Kawaguchi (Japan) and D. Ramm (CCAMLR Secretariat) (*CCAMLR Science*, submitted)
WG-EMM-02/41	Defining predator foraging ranges, illustrated using Adélie penguin foraging tracks from Mawson coast I.R. Ball, A.J. Constable, J. Clarke and L. Emmerson (Australia) (*CCAMLR Science*, submitted)
WG-EMM-02/42	Deaths of Adélie penguins at Mawson November–December 2001 investigated K. Kerry and L. Irvine (Australia)
WG-EMM-02/43	Comparison between the CCAMLR-2000 and KY 1988 surveys on environmental variability of krill in the Scotia Sea, Antarctica M. Naganobu (Japan), M. Brandon (United Kingdom), K. Ito, K. Segawa (Japan) and V. Siegel (Germany) (*Deep-Sea Research* (CCAMLR-2000 Special Issue), submitted)
WG-EMM-02/44	Short note: time series of Drake Passage Oscillation Index (DPOI) from 1952 to 1988 M. Naganobu and K. Kutsuwada (Japan)
WG-EMM-02/45	Assessing the feasibility of regional surveys of land-based predator abundance in the Southern Ocean: a framework for decision making and planning C. Southwell (Australia)
WG-EMM-02/46	An assessment of temporal variability and interrelationships between CEMP parameters collected on Adélie penguins at Béchervaise Island L.M. Emmerson, J. Clarke, K. Kerry and C. Southwell (Australia) (*CCAMLR Science*, submitted)
WG-EMM-02/47	Post-fledging and winter migration of Adélie penguins (*Pygoscelis adeliae*) in the Mawson region of east Antarctica J. Clarke and K. Kerry (Australia), C. Fowler (USA), R. Lawless, S. Eberhard and R. Murphy (Australia) (*Marine Ecology Progress Series*, submitted)
WG-EMM-02/48	Demographic characteristics of the Adélie penguin population of Béchervaise Island after 12 years of study J. Clarke, K. Kerry, A. Townsend and L. Emmerson (Australia) (*CCAMLR Science*, submitted)

WG-EMM-02/49	Broadbandwidth total target strength measurements of Antarctic krill (*Euphausia superba*) from reverberation in a cavity D.A. Demer and S. G. Conti (USA) (*ICES Journal of Marine Science*, submitted)
WG-EMM-02/50	Reconciling theoretical versus empirical target strengths of krill; effects of phase variability on the distorted wave Born approximation D.A. Demer and S.G. Conti (USA) (*ICES Journal of Marine Science*, submitted)
WG-EMM-02/51	Antarctic fur seals in the South Shetland Islands: pup production and population trends M.E. Goebel (USA), V.I. Vallejos (Chile), W.Z. Trivelpiece, R.S. Holt (USA) and J. Acevedo (Chile)
WG-EMM-02/52	A proposal for modifications to Standard Method C2: fur seal pup growth M.E. Goebel (USA)
WG-EMM-02/53	Foraging range and at-sea locations of female Antarctic fur seals, Cape Shirreff, Livingston Island, from 1999–2002 M.E. Goebel, S.N. Sexton and D.P. Costa (USA)
WG-EMM-02/54	Atlas of coastal sea ice in eastern Antarctica K. Michael, K. Hill, K. Kerry and H. Brolsma (Australia)
WG-EMM-02/55	The winter distribution of Adélie and chinstrap penguins from two breeding colonies in the South Shetland Islands of Antarctica S.G. Trivelpiece and W.Z. Trivelpiece (USA)
WG-EMM-02/56	Proposal for a new Antarctic Specially Protected Area, Terra Nova Bay, Ross Sea Proposed by Italy
WG-EMM-02/57	Management plan for Site of Special Scientific Interest No. 36 – Eastern Dallmann Bay Submitted by the USA
WG-EMM-02/58	Management plan for Site of Special Scientific Interest No. 35 – Western Bransfield Strait Submitted by the USA
WG-EMM-02/59	Management plan for Site of Special Scientific Interest (SSSI) No. 1 Submitted by the Secretariat

WG-EMM-02/60	The Ross Sea, Antarctica, where all ecosystem processes still remain for study D. Ainley (USA)
WG-EMM-02/61 Rev. 1	Meeting of the Interim Steering Committee for the CEMP Review (Big Sky, Montana, USA, 3 August 2002)
WG-EMM-02/62	Fishing intensity of Russian fleet krill fishery in Subarea 48.2 and 48.3 S.M. Kasatkina and V.F. Ivanova (Russia) (*CCAMLR Science*, submitted)
WG-EMM-02/63 Rev. 1	Distribution of the Soviet fishing fleet and catches (CPUE) in Subdivision 48.3 during 1986–1990 V.A. Sushin, P.C. Gasiukov, A.V. Zimin and S.M. Kasatkina (Russia)

Other Documents:

SC-CAMLR-XXI/BG/2	Observer's Report from the 54th Meeting of the Scientific Committee of the International Whaling Commission (Shimonoseki, Japan, 27 April to 9 May 2002) CCAMLR Observer (K.-H. Kock, Germany)
WG-FSA-02/6	The role of fish in the Antarctic marine food web: differences between inshore and offshore waters in the southern Scotia Arc and west Antarctic Peninsula E. Barrera-Oro (Argentina)
	Draft fish species profiles I. Everson (United Kingdom)
	Abstracts of WG-EMM-01 presentation papers to be published in *CCAMLR Science*, Vol. 9 (2002)

REPORT OF THE WORKSHOP ON SMALL-SCALE MANAGEMENT UNITS, SUCH AS PREDATOR UNITS

(Big Sky, Montana, USA, 7 to 15 August 2002)

CONTENTS

REPORT OF THE WORKSHOP ON SMALL-SCALE MANAGEMENT UNITS, SUCH AS PREDATOR UNITS

(Big Sky, Montana, USA, 7 to 15 August 2002)

INTRODUCTION

1.1 Last year, the Scientific Committee endorsed the proposal by WG-EMM to hold a Workshop on Small-scale Management Units, such as Predator Units, during its meeting this year (SC-CAMLR-XX, paragraphs 6.11, 6.12 and 6.15 to 6.19; SC-CAMLR-XX, Annex 4, paragraphs 4.1 to 4.11 and 5.9 to 5.13). The aim of the workshop was to define these units in order to facilitate the subdivision of the precautionary yield in Area 48, but that the manner in which the overall catch limit would be subdivided would be determined at a future meeting (SC-CAMLR-XX, paragraph 6.18).

1.2 The delineation of small-scale management units would be achieved primarily by collating and comparing information on: (i) local predator foraging ranges and population distributions (especially of land-based predators); (ii) krill abundance, dispersion and movement; and (iii) fishing fleet behaviour and patterns of fishing (SC-CAMLR-XX, paragraph 6.16).

1.3 The workshop was convened by Dr W. Trivelpiece (USA), from 7 to 15 August 2002.

1.4 A Steering Committee convened by Dr Trivelpiece, comprised Drs A. Constable (Australia), R. Hewitt (USA), S. Kawaguchi (Japan), V. Sushin (Russia), P. Trathan (UK) and D. Ramm (Secretariat). This committee helped prepare for the workshop, including the preparation of the draft agenda, coordination and standardisation of data and the development of direction for the analyses.

1.5 It was noted that a meeting was held between Drs Kawaguchi, Constable, Ramm and I. Ball (Australia) at the CCAMLR Secretariat from 3 to 7 June 2002 to help develop analyses appropriate for fisheries data as requested by the Scientific Committee (SC-CAMLR-XX, paragraph 6.17). The results of this work were submitted to the meeting in WG-EMM-02/28 and 02/40.

1.6 The Agenda is given as Attachment 1 to guide the discussion and work of the workshop.

1.7 The work was divided into the major sections of the agenda and coordinated by Drs Trivelpiece (predator distribution and abundance), Trathan (predator foraging areas), Hewitt (krill distribution and abundance) and Kawaguchi (krill fishery). Dr Constable prepared the report with the assistance of these coordinators and Dr Ball, Ms J. Emery (USA), Dr P. Gasiukov (Russia), Mr M. Goebel (USA), Mr C. Jones (USA) and Drs K. Reid (UK) and G. Watters (USA).

PRINCIPLES FOR THE DEVELOPMENT OF
SMALL-SCALE MANAGEMENT UNITS

1.8 Last year, WG-EMM endorsed the use of the principles for developing small-scale management units described in WG-EMM-01/52 as a guide for its work this year in developing these units (SC-CAMLR-XX, Annex 4, paragraph 4.10). Dr Constable provided an overview of these principles and other elements of this paper. He described how the paper proposed the integration of data from the local krill populations, foraging areas of related predators, fishing ground information and potential influences of the environment (SC-CAMLR-XX, Annex 4, paragraph 5.10). He noted that these units could not only be used to subdivide the catch in Area 48 but would help: (i) to reduce the potential for undesirable local effects on predators by spreading catch and effort; and (ii) to ensure undesirable effects do not arise by providing the opportunity for a spatially-structured monitoring program (SC-CAMLR-XX, Annex 4, paragraph 4.4). With regard to the second point, these units could be used to provide strategic advice on the potential effects of fishing as intended through CEMP (SC-CAMLR-XX, Annex 4, paragraph 4.5). He noted that these units do not have to be ecosystem units but are simply units to help management (SC-CAMLR-XX, Annex 4, paragraph 4.8).

1.9 In his presentation, Dr Constable also summarised the results of discussions by the Steering Committee as well as methods proposed to be used in the development of small-scale management units. These points and the subsequent discussion are summarised in the following paragraphs.

1.10 The Workshop thanked Dr Constable for his detailed presentation of the principles, methods for characterising the spatial subdivision of krill, the krill fishery and predator foraging areas, and issues to be considered in the further development of small-scale management units. The presentation was archived with the CCAMLR Secretariat.

1.11 Papers specifically relevant to the workshop included:

(i) fisheries – WG-EMM-02/06, 02/18, 02/28, 02/40 and 02/63 Rev. 1; and
(ii) predators – WG-EMM-02/05, 02/14, 02/33, 02/41, 02/51, 02/53 and 02/55.

1.12 Data provided to the workshop are described under each section of the analyses below.

1.13 The workshop agreed that the primary part of its work was to determine:

(i) krill aggregations, which are predictable locations where krill are found at relatively high densities from one year to the next over a number of years;

(ii) predator foraging areas, which are predictable locations where a predator obtains food from one year to the next over a number of years; and

(iii) fishing grounds, which are predictable locations where the fishery obtains relatively reliable catches from one year to the next over a number of years.

1.14 The workshop agreed to use the method in WG-EMM-02/40 to determine these predictable locations. Such locations are identified by their relative within-year importance averaged over a number of years rather than being determined as an average density, consumption or catch over time. Thus, the method is designed to account for interannual variation in the importance of locations, where a location is a fine-scale area, say 10 x 10 n miles. The key features of the method are:

(i) bin the data at an appropriate spatial scale, e.g. 10 x 10 n mile areas;

(ii) normalise data within each year to provide a measure of the relative importance of different locations in each year;

(iii) smooth the data within each year using a bivariate normal kernel smoothing algorithm to take account of uncertainty in the location of the observations as well as uncertainty in the values in the spaces between observations;

(iv) average these values over the time series to give an average importance of those locations; and

(v) identify grounds or areas of importance by determining a threshold such that the area covers, say 95%, of the accumulated importance of the region.

1.15 For predators, the workshop agreed to circumscribe the foraging areas, in the first instance, using an average maximum foraging distance as described in WG-EMM-02/33. Within those ranges, the workshop agreed to subdivide them further by delineating the foraging grounds using the method described above combined with the approach in WG-EMM-02/41, which was based on methods previously described (Barlow and Croxall, 2001; Trathan et al., 1998; Wood et al., 2001; Worton, 1989). The additional step that preceded the above method was to convert tracking data to foraging densities at an appropriate scale, say 0.1° latitude x 0.2° longitude.

1.16 Areas of greatest importance to land-based predators would be identified by:

(i) estimating a characteristic foraging pattern (distance by foraging density) for each species using the methods above;

(ii) determining the location and distribution of colonies of each species of the most abundant land-based predators (i.e. centres of abundance/biomass);

(iii) use the relevant characteristic foraging pattern of each species to circumscribe a potential foraging 'footprint' associated with each population centre for the respective species;

(iv) weight the foraging area for each population centre by the biomass of predators in that centre; and

(v) sum all the weighted values from (iv) for each grid square in the area.

1.17 The partitioning of the foraging areas into predator units would be undertaken based on these overall estimates of biomass-weighted foraging density as well as by considering variation in the foraging locations of individual species. The latter consideration is important to ensure that individual species requirements will be met within the overall subdivision, particularly those of much lower abundance. Prof. J. Croxall (UK) indicated that there were no rare or endangered species that needed to be given special status in this analysis.

1.18 The workshop agreed that a nested approach to the subdivision of the region was necessary in order to account for the features described above as well as accounting for the potentially different summer (breeding) and winter (non-breeding) foraging activities by predators. It was considered that a subdivision based on summer breeding activities would result in a number of smaller areas. Winter foraging distributions would likely be comprised of several of these smaller predator units.

1.19 Dr Constable noted that issues surrounding the movement of krill from one small-scale management unit to another would need to be considered when the manner in which these units would be used by the Commission was to be discussed. He also noted that the small-scale management units would mostly be determined by species that have specific foraging areas rather than species that have widely distributed foraging activities.

1.20 Dr W. Fraser (USA) noted that oceanographic and bathymetric features may be primary determinants of foraging locations by predators. The workshop noted that these and other environmental influences may be important but these would be considered following the initial work on krill, predators and the fishery.

1.21 The workshop agreed that there were some natural locations for delineating small-scale management units, such as between the island groups. Other areas that may be easily separated could be between Bransfield Strait and Drake Passage.

1.22 The workshop agreed to begin its work by reviewing the spatial patterns in the available data for krill, predators and the fishery on a smaller scale than subareas, including consideration of how to account for seasonal and interannual variation in the behaviour of predators and the fishery. In part, the methods for analysing the data would account for this but the workshop noted that some consideration may be given to these issues in the final synthesis.

1.23 Although there is potential for future changes in krill, predator foraging and the fishery, as well as having more data in the future on existing patterns, the workshop noted the view of the Scientific Committee that the information available to the workshop is the best information available for delineating small-scale management units (SC-CAMLR-XX, Annex 4, paragraph 5.13).

1.24 Dr G. Kirkwood (UK) noted that consideration will need to be given to separating the areas foraged by land-based predators, which primarily include the shelf areas, from the areas foraged by sea-based predators. Also, Dr I. Everson (UK) noted that the fishery was mostly concentrated in the foraging range of land-based predators. He noted that the CCAMLR-2000 Survey could be used to identify whether fishable concentrations of krill are likely to occur in the offshore areas.

1.25 The workshop welcomed the participation of members from the USA Palmer LTER Program who could provide an overview of the region to the southwest of the primary fishing areas in the South Shetland Islands. It was noted that this area could provide a location for monitoring the behaviour of the Antarctic marine ecosystem in the absence of fishing. The workshop encouraged further participation of this group in future meetings of WG-EMM.

1.26 The workshop agreed that the use of diet data was outside the scope or time available for delineating small-scale management units, although such information would be useful in determining how to subdivide catch limits in the future, if necessary.

1.27 Presentations were provided to the workshop outlining the data available for analyses and the patterns currently observed:

(i) predators at South Georgia and South Orkney Islands – Dr Trathan;
(ii) fur seals at Livingston Island – Mr Goebel;
(iii) penguins at South Shetland Islands – Dr Trivelpiece;
(iv) demersal fish species around South Shetland and South Orkney Islands – Mr Jones;
(v) krill distribution and abundance – Dr Hewitt;
(vi) Japanese krill fishery – Dr Kawaguchi; and
(vii) Soviet krill fishery – Dr Sushin.

1.28 Dr Ball had developed software ('Tracks and Fields') to support the methods described above for predators, fisheries and krill. He gave a brief presentation on how the software worked as well as a brief tutorial on how to use it as part of the method for determining areas of importance, which also required the use of standard spreadsheet and statistical packages. The workshop thanked Dr Ball for his presentation and for providing this software, which was used by all participants for analysing their datasets. The software with its manual was archived with the CCAMLR Secretariat.

1.29 Dr J. Watkins (UK) presented results from a simulation study undertaken by Drs E. Murphy and S. Thorpe (UK) on the potential movement of krill through the Scotia Sea based on the distribution of krill determined from the CCAMLR-2000 Survey and the use of the oceanographic model from the Ocean Circulation and Climate Advanced Modelling project. The advantage of this model over other models previously used is its use of known wind vectors to drive the model. It was noted that krill from the Scotia Sea were likely to be split to the southeast of South Georgia so that not all would pass directly by South Georgia, but that some would be advected directly past the South Sandwich Islands. The model also indicated the potential for retention of krill in the island areas, particularly around the Antarctic Peninsula and the South Orkney Islands. Dr Watkins noted the potentially important role of the ice-edge extent in driving the distribution of krill. The workshop thanked Dr Watkins for his presentation and encouraged further work using this model.

KRILL FISHERY

2.1 The patterns of the krill fishery were analysed according to the method outlined in paragraph 1.14. This analysis considered the relative importance of 10 x 10 n mile areas to the fishery when subdivided in the following ways:

(i) historical fishing period (five-year periods); and
(ii) country.

2.2 These analyses were then integrated to provide advice on the nature of fishing grounds in the region.

2.3 The data used in these analyses were catch data taken from the CCAMLR database reported for 10-day periods from 1986 to 2000. Data were extracted from the database for 10 x 10 n mile areas. Records for which only fine-scale data were available (30 x 30 n mile areas) had the catches evenly divided into nine areas in order to match the appropriate scale.

2.4 Data were also available for the USSR krill fishery around South Georgia between 1986 and 1990, as presented in WG-EMM-02/63 Rev. 1. These data were analysed in a similar way but were based on haul by haul data and summarised by 3 x 1.5 n mile areas.

Historical Fishing Period

Average Annual Importance of Fishing Locations

2.5 The average normalised catches for two periods, 1986–1990 and 1996–2000, are shown in Figures 1 and 2 respectively. These show how the major fishing areas included South Georgia, South Orkney Islands and Elephant Island. In recent years, the fishery has concentrated more on the South Shetland Islands and South Georgia with less emphasis on the South Orkney Islands and Elephant Island.

Seasonal Importance of Fishing Locations

2.6 The average importance of different locations within each season is shown in Figure 3. The figure shows the progression of the fishery during the year from October through to September (quarter 2 – October to December, quarter 3 – January to March, quarter 4 – April to June, quarter 1 – July to September). This shows the general trend of the fishery concentrating in Subareas 48.1 and 48.2 at the beginning of the fishing year, moving further south in summer and then moving north in winter. South Georgia is not important from October to March.

2.7 In terms of differences between the 1986–1990 and 1996–2000 periods, the South Orkney and South Shetland Islands have increased in importance during July to September in recent years. The South Orkney Islands have become much less important for the two quarters between October and March. King George and Livingston Islands have become more important for the three quarters between October and June.

USSR Krill Fishery around South Georgia from 1986 to 1990

2.8 The analysis of the USSR krill fisheries in Subarea 48.3 has been based on haul-by-haul data for 1986 to 1990. It covers the main fishing season for this area, which was from April to September (quarters 4 and 1 according to CCAMLR split-years). This period comprises 10 quarters in all – 5 years x 2 quarters per year. The results are shown in Figure 4.

2.9 The workshop agreed that there are three clearly identifiable areas to the north of South Georgia:

(i) a main eastern fishing ground, which is well pronounced during all fishing seasons and present in nine out of 10 quarters in this fishing period;

(ii) a small eastern fishing ground, which can be observed only in the April–June quarter and was observed in only two of those quarters in the fishing period; and

(iii) a western fishing ground, which exists only during the July–September quarter but was present in all years.

Country

2.10 The fishing patterns of five main countries were examined for each of the two periods (Figure 5). Japan, Republic of Korea and Poland were fishing in both periods, while the USSR fleet fished in the 1986–1990 period and the Ukrainian fleet fished in the 1996–2000 period.

2.11 Japan changed its predominant fishing locations from primarily Elephant Island followed by the South Orkney and South Shetland Islands in the earlier period to the South Shetland Islands and South Georgia in the later period, with the South Shetland Islands being of primary importance to the fishery in recent years.

2.12 The Republic of Korea has expanded from the Elephant Island region to include all the island groups.

2.13 The USSR and Ukrainian fleets have concentrated on the South Orkney Islands and South Georgia.

2.14 Poland has moved its fishery from being primarily around South Georgia to being primarily around the South Shetland Islands and Elephant Island.

Fishing Grounds

2.15 The workshop agreed that the following fishing grounds could be identified from these analyses:

(i) eastern South Georgia – east of 37.5°E;
(ii) western South Georgia – west of 37.5°E;
(iii) northwest of South Orkney Islands;
(iv) Elephant Island; and
(v) Drake Passage – north of King George and Livingston Islands.

2.16 The workshop agreed that the fishery was currently concentrated in the vicinity of the shelf break in these areas.

2.17 The workshop noted that the importance of Bransfield Strait is very small at present and that the fishery does not extend to the west of Livingston Island because of hazardous bathymetry and difficult conditions.

2.18 Drs Gasiukov and Sushin indicated that the fishing grounds at South Georgia may come from different sources of krill and are influenced by the oceanography of the region (WG-EMM-02/63 Rev. 1), such that:

(i) catches in the eastern fishing ground comprise krill associated with the eastern route of krill drift to South Georgia; and

(ii) catches in the western ground comprise krill associated with the western route of krill drift to South Georgia.

2.19 Drs Trathan and Everson indicated that these grounds may not be differentiated in such a way but may be connected through the seasonal transport of krill across the northern area of South Georgia.

2.20 The workshop noted that oceanography is likely to influence the availability of krill in these grounds and that further consideration would be needed to understand the connections between these areas and the potential for interannual fluctuation in krill availability. However, it was agreed that the analyses presented to the workshop are sufficient for circumscribing fishing grounds and to facilitate the delineation of small-scale management units. Those other issues will need to be considered when identifying how those units will be used in the future.

KRILL

3.1 Analyses of krill distributions were undertaken for the CCAMLR-2000 Survey as well as for eight small-scale surveys undertaken by the US AMLR Program around the Antarctic Peninsula (1998–2002).

CCAMLR-2000 Survey

3.2 Sample-weighted krill densities for the CCAMLR-2000 Survey were obtained using the smoothing algorithm in 'Tracks and Fields' (Figure 6). These results show aggregations of krill to the northwest and southeast of South Georgia, aggregations near Maurice Ewing Bank, high density of krill around the South Orkney Islands and aggregations of krill around the South Shetland Islands, particularly Livingston Island and in Bransfield Strait, and Elephant Island. Also, there were large aggregations in areas away from the island shelf areas to the east of the South Orkney Islands.

Predictable Krill Locations in Subarea 48.1

3.3 Areas where predictable concentrations of krill were found from 1998 to 2002 were estimated using the eight small-scale acoustic surveys undertaken by the US AMLR Program.

3.4 Data were analysed using the methods described in paragraph 1.14. The raw data were Nautical Area Scattering Coefficients (NASCs) for each 1 n mile interval, which was used as a measure of krill density for those intervals (MacLennan and Fernandez, 2000). The method was modified to obtain relative densities (importance) of krill for each 1 n mile grid square for each survey. The normalised, smoothed densities arising from 'Tracks and Fields' were accumulated densities at each point according to the contributions of other points dictated by the smoothing algorithm. Thus, the relative density at each point needed to be restored to a relative density per unit effort. This was achieved by dividing the relative density at that point by the relative effort for that point. The relative effort was obtained by using 'Tracks and Fields', but using the sampling effort at each point (=1) in place of the values for krill density and smoothing as for density. The resulting density values were then normalised to restore the relative densities for comparison across years.

3.5 The parameters used in 'Tracks and Fields' are given in each figure.

3.6 The results for the eight acoustic surveys in Subarea 48.1 are shown in Figure 7. The average relative densities of krill in January and in February–March are shown in Figure 8.

3.7 For January, these results indicate that the average location of aggregations occurs to the northwest of Elephant Island with lesser aggregations to the northeast and south of Elephant Island, to the north of Livingston Island, and to the northwest and immediately to the south of King George Island. Some smaller aggregations are present further to the west and east of the South Shetland Islands.

3.8 For February–March, these results indicate that the average location of aggregations occurs predominantly to the north of Livingston Island with lesser aggregations to the north of King George Island and even smaller aggregations further east, including around Elephant Island. There is also an aggregation in Bransfield Strait around the shelf break off the Antarctic Peninsula to the southeast of King George Island.

3.9 Overall, the aggregations in this area are concentrated over the shelf and at the shelf break.

3.10 The workshop agreed that Subarea 48.1 could be separated into the following areas based on the persistent locations of high densities of krill:

(i) Elephant Island;
(ii) Bransfield Strait to the south of Livingston and King George Islands;
(iii) Drake Passage to the north of Livingston and King George Islands; and
(iv) west of Livingston Island.

3.11 The workshop noted that there were higher aggregations of krill to the north of Livingston Island compared to the north of King George Island but it was difficult to separate the two.

KRILL PREDATORS

Patterns of Distribution and Abundance

4.1 The distribution and indices of abundance of predators were used to help determine centres of foraging activity in the South Atlantic. This was to be achieved by combining the information on predator distribution and abundance with the known information on foraging ranges from the main areas currently being regularly monitored.

4.2 The workshop agreed to concentrate on the distribution and abundance of four main groups of krill predators: land-based predators, including Antarctic fur seals, macaroni, gentoo, chinstrap and Adélie penguins and black-browed albatrosses, and krill-eating fish species.

Land-based Predator Breeding Colonies

4.3 For the land-based predators, data on the distribution and abundance of breeding colonies were compiled from the following sources: Woehler (1993), Trathan et al. (1996) and WG-EMM-02/51.

4.4 For the purposes of the workshop the colony information for each species was pooled into centres of biomass. The pooling of colonies was based on an assessment of whether the colonies were likely to have overlapping foraging ranges. Colonies were considered to have a functional overlap where the distance between colonies was less than the critical foraging distance (CFD) where

$$\text{CFD} = \text{maximum foraging distance}/\sqrt{2}.$$

4.5 Colonies were initially grouped together with those colonies with which they directly overlapped. These groups were aggregated where individual colonies occurred in more than one group, this procedure was carried out until no single colony occurred in more than one colony group (see Figure 9). The numbers of predators in the colonies included in each group were summed and the colony group was centred on the colony with the largest breeding population size.

4.6 Distributions of colonies and the resulting centres of biomass in Subareas 48.1, 48.2 and 48.3 are shown in Figures 10 to 19 and listed in Attachment 2.

Fish

4.7 The spatial distribution and abundance of krill-eating finfish biomass on shelf regions in Area 48 was assessed using data obtained from recent research trawl surveys conducted by the US AMLR Program in the South Shetland Islands (1998, 2001), and the South Orkney Islands (2000), and from Russian and UK surveys around South Georgia (2000). These surveys were undertaken using bottom trawls made in depths ranging from 50 to 500 m, which encompasses the majority of the biomass of demersal finfish species.

4.8 Surveys conducted in the vicinity of the South Shetland Islands and Elephant Island included diet analysis for 20 of the most abundant species (Figure 20). Of these, 14 species were found to feed on krill (>25% average stomach contents). These species were pooled in the subsequent analysis of the spatial distribution and abundance of krill-feeding fish. Information for krill predators around South Georgia was restricted to *Champsocephalus gunnari*, which is the most abundant and primary krill-eating finfish species.

4.9 All research survey hauls were standardised to kg/n mile, and treated in an identical manner to that of other krill predators examined during the workshop. The abundance information was smoothed using 'Tracks and Fields' with kernel options set at a 0.1 smoothing level, a maximum distance of 3, and densities gridded to 0.1° latitude and 0.1° longitude resolution. Data were normalised and truncated at 95%.

4.10 The resulting spatial distributions are plotted in Figure 21.

4.11 Around the South Shetland Islands and Elephant Island (Figure 21a), the highest densities of krill-eating finfish biomass were west of Elephant Island and north of King George Island. This pattern is likely to be relatively consistent across years, as these areas also served as primary fishing grounds when the commercial fishery operated in this subarea.

4.12 Around the South Orkney Islands (Figure 21b), there were three modes in the spatial distribution and abundance of krill-eating finfish. The highest densities were on the western shelf of the islands, with another important area to the north, and a region of lesser importance on the eastern shelf.

4.13 Around South Georgia (Figure 21c), the surveys indicated that the highest densities of *C. gunnari* were on the western shelf of South Georgia, near Shag Rocks, and other smaller areas of lesser importance. However, other surveys, from which the data were not available at the workshop, indicate that there may be areas of importance in the southeast shelf region of South Georgia as well (SC-CAMLR-XX, Annex 5, Appendix D, paragraph 5.24). Thus, it is likely that most shelf areas within the 500 m isobath of South Georgia are important krill feeding areas for *C. gunnari*, as well as other krill-eating finfish.

Spatial Patterns of Foraging

Subarea 48.1

4.14 Satellite-tracking data for penguins were made available to the workshop from studies in Subarea 48.1 undertaken through the US AMLR and NSF programs. These data were obtained using satellite tags (PTTs) deployed on Adélie, chinstrap and gentoo penguins, which were breeding at two colonies at the South Shetland Islands (Subarea 48.1), Cape Shirreff on the Drake Passage side of Livingston Island, and Copa in Admiralty Bay on the Bransfield Strait side of King George Island. The studies were undertaken from 1996 to 2002 (see Table 1 for details).

4.15 All PTTs were epoxied to the lower back feathers of the penguins to minimise the effects of drag and location data were obtained from the ARGOS satellite-tracking system.

4.16 ARGOS provides a Location Quality (LQ) code for each location fix, based on the number of uplinks received and the results of four plausibility checks ('NOPC', ARGOS 2000). LQs range from 0 to 3 with an ARGOS predicted accuracy of <150 m to 1 km+. Two other LQ codes, 'A' and 'B' are assigned lower assurance (due to fewer uplinks and/or lower NOPC).

4.17 All PTTs used on birds during the breeding season were set for continuous transmissions at 50 s intervals. PTTs deployed on chinstrap penguins from March to July 2000 and on Adélie penguins from February to April 2001 and February to March 2002 were set to transmit for 12 h on and 72 h off in order to save battery power during the winter period. Satellite data were sorted by site, individual, date and time. Only location data of classes 0 to 3 were used in these analyses.

4.18 The workshop noted that the number of replicates were small in many of the tracking periods. For that reason most conclusions by the workshop were drawn from the composite foraging area for each species, where all samples for a species were pooled together.

Chinstrap Penguins

4.19 The results are illustrated in Figure 22, which shows chinstrap penguins foraging over the shelf areas near the colonies being monitored at both Cape Shirreff and Copa. This pattern was consistent between breeding and winter seasons from 2000 to 2002.

4.20 In winter, two chinstrap penguins tagged at the Cape Shirreff colony were tracked from February to May 2000. Birds left the colony and travelled southwest, keeping well inshore until they reached the vicinity of Snow Island (area of concentration, Figure 22b). Here, they spent two to three weeks just off the western coast of Snow Island before moving well offshore. The birds remained in this offshore region for another two weeks, moving slowly to the northeast throughout the period. In mid-April, they returned to the inshore shelf area off Livingston Island and were proceeding to the northeast, on the shelf, when their signals were lost near Nelson Island from late April to early May.

4.21 From February to May 2000, three penguins were tracked from the Copa colony in Admiralty Bay, from where they proceeded to the northwestern end of King George Island where they spent the remainder of the March to May period foraging on the shelf in this vicinity (Figure 22c).

4.22 During the incubation period in November 2000, birds were at sea for 5- to 10-day intervals and their foraging distributions extended well beyond the shelf break (Figure 22d).

4.23 Foraging distributions of chinstrap penguins during the chick-rearing stage of the reproductive cycle were largely confined to the shelf, within approximately 10 km of the colony at Cape Shirreff, although some penguins were observed to make frequent trips out to the shelf break, approximately 30 km from the colony (Figures 22e and 22f).

Adélie Penguins

4.24 The results are illustrated in Figure 23, which shows the foraging areas for Adélie penguins from Copa colony in Admiralty Bay on King George Island. These penguins concentrate their foraging in Bransfield Strait (Figure 23a), particularly over the shelf and shelf break to the south off the western shore of the Antarctic Peninsula. Foraging trips are typically 10 to 14 days in length following clutch completion (Figure 23b). There were two distinct patterns followed by approximately half the birds tagged. One group moved to the southwest, the other proceeded to the northeast, entering the upper Weddell Sea in the 1996 season (not shown here).

4.25 Early winter distributions of Adélie penguins tagged at the Copa colony in 2001 and 2002 (Figures 23c and 23d) showed marked differences in behaviour of the three animals tagged each season. The behaviour in 2001 was similar to the incubation foraging behaviour described above while in 2002 the foraging tracks went deep into the Weddell Sea on the east side of the Antarctic Peninsula.

4.26 The workshop agreed to use the incubation foraging pattern for the purposes of its work.

Gentoo Penguins

4.27 The foraging distribution of gentoo penguins during the chick-rearing period in 2002 is shown in Figure 24. Gentoo penguins forage very close to the colony, where 90% of their locations were within the 100 m bathymetric contour line off Cape Shirreff.

Antarctic Fur Seals

4.28 Studies of foraging range and at-sea locations of Antarctic fur seals in the South Shetland Islands were conducted by the US AMLR Program at Cape Shirreff, an ice-free peninsula (ca. 2.5 km^2) on the north side of Livingston Island, South Shetland Islands (62°29’S, 60°47’W). Cape Shirreff has the largest breeding colony of Antarctic fur seals in the South Shetland Islands (SSI) and together with San Telmo Islands (<1 km northwest of Cape Shirreff) has an annual pup production of 8 500+ (85% of the total SSI pup production) (WG-EMM-02/51). The continental shelf (to 500 m) extends to approximately 30 km north at Cape Shirreff.

4.29 All individuals in the Cape Shirreff study were females from 23 to 76 days post-partum. Length, girth, and mass were recorded, and an ARGOS-linked PTT (Kiwisat 100, Sirtrack Ltd.), time-depth recorder (Wildlife Computers Mark 7) and a VHF radio transmitter were attached mid-back. Females were recaptured with their pups after one to three trips to remove all instruments; the mother and pup were released together after recording mass, length and girth.

4.30 Each PTT had a unique ID code and a transmission repetition rate of 34 s while the seal was at the surface. PTTs were equipped with a wet/dry conductivity switch.

Transmissions were continuous until the instrument logged 120 min 'dry', putting the PTT in a 'sleep' mode (saving battery life). The instruments were programmed to re-transmit after a two-minute 'wet' interval was detected.

4.31 For the data received from ARGOS, previous studies have determined that 'A' and 'B' assigned locations are frequently acceptable locations (Vincent et al., 2002; Boyd et al., 1998) and that often 'A' locations, in spite of their lower ARGOS rating, were considerably better than LQ-0 locations and of similar accuracy to LQ-1 locations (Vincent et al., 2002). Thus, for the Cape Shirreff study, all locations (LQ 1–3, A, B) were initially included regardless of their LQ rating. Starting with all ARGOS downloaded data (LQ 0–3, A, B), location fixes were filtered to eliminate positions that required an animal to travel at speeds greater than 4 m/s. Consecutive locations flagged for having travelling rates of >4 m/s were alternately deleted to determine which locations had the greatest error.

4.32 The sites of capture and release were recorded with a GPS unit accurate to 15 m. The accuracy of the onshore ARGOS location fixes was obtained by comparing positions with the more accurate GPS fixes.

4.33 Departure and arrival times were recorded using VHF transmitters and a continuously operating logging station. Trip durations were calculated using VHF data. Maximum distance travelled, considered a female's maximum range, was calculated from the most distant ARGOS location received. The total distance travelled was recorded as the sum of the distances between locations.

4.34 The analyses comprised data obtained during January and February in each year from 1999 to 2002 (Table 2). Trip duration, foraging range and total distance travelled are shown in Table 3.

4.35 Data were analysed using 'Tracks and Fields' and the results are shown in Figures 25 to 27. Parameters used to smooth the data are shown in each figure.

4.36 Although the mean foraging range and trip duration varied from year to year, at-sea locations for fur seals in all years were centred over an area of the continental shelf and slope region approximately 40 km northwest of Cape Shirreff (Figure 26).

4.37 The distribution of foraging locations in February were more broadly distributed over the continental shelf slope region, were bimodal and were on average further west of Cape Shirreff (Figure 27).

Subarea 48.2

4.38 Foraging areas were determined for Adélie penguins and chinstrap penguins at Signy Island (Table 4). Methods of PTT attachment and deployment are described in WG-EMM-02/15. Tracks were obtained for both species during the summer chick-rearing period.

4.39 'Tracks and Fields' was used to smooth the foraging tracks for these two species. The method followed that used for Subarea 48.3. The input to the program was ARGOS satellite-tracking data that had previously been screened to remove all low-quality positions; only positions of quality class 3, 2, 1 and 0 were used. Summaries of the ARGOS data are given in Tables 5 and 6. The parameters used in 'Tracks and Fields' were:

Trip duration maps	Yes
Smoothing parameter	0.1
Maximum distance	100
Latitude step size	0.1
Longitude step size	0.2
Truncation value	0.0005
Density isopleth	0.05
Minimum speed	0.0

4.40 The average annual footprints for chinstrap and Adélie penguins are shown in Figures 28 and 29 respectively.

Subarea 48.3

4.41 Foraging areas were determined for macaroni penguins, black-browed albatrosses and Antarctic fur seals at Bird Island (Table 4). Antarctic fur seals were also monitored at Husvik in 1998. Methods of PTT attachment and deployment are described in WG-EMM-02/21 and 02/22 and references therein.

4.42 The data analysis method used and parameter inputs to 'Tracks and Fields' were the same as that used for Subarea 48.2 with additions as described below. The ARGOS data available for analysis are described in Tables 7 to 9. Only summer data are used in this analysis.

4.43 An additional level of screening was carried out for black-browed albatrosses. This was to remove the effects of long-time intervals between positions that could distort the smoothing of foraging time allocation; these occasionally occurred where intervening low quality positions had been screened. Data were also screened to remove positions east of 0°E and north of 50°S.

4.44 All data were analysed according to breeding chronology. Thus, for Antarctic fur seals each of the breeding seasons were analysed separately. Similarly, for black-browed albatrosses, incubation was analysed separately from brood guard and chick rearing. For macaroni penguins, the breeding season was divided into incubation, brood guard, chick rearing and premoult. All foraging trips were analysed according to actual colony chronology, as this can vary slightly in some years.

4.45 In the 'Tracks and Fields' analysis a consistent set of parameters were chosen. This was selected after experimentation with the software to ensure results adequately reflected the input data. As smoothing is a non-parametric process, the assessment to compare different sets of parameters was made subjectively. A spatial analysis of the residuals from the smoothing was carried out by eye to ensure that smoothing was not extended too far beyond the input data.

4.46 The output of the 'Tracks and Fields' analysis was used to prepare average spatial foraging distributions for the various species for their various breeding periods during the summer breeding season. For this, the output data 'Isopleth Threshold' was used. Annual estimates of smoothed spatial foraging distribution for a given period were averaged and normalised using scripts written in S-Plus (Mathsoft Inc.) (archived with the secretariat). These average breeding chronology footprints were subsequently merged to provide an average footprint for the complete breeding season. The different chronological periods were weighted using the relative time duration that each period contributed to the total duration of the breeding season.

4.47 The average annual footprint for black-browed albatrosses, macaroni penguins, and Antarctic fur seals are shown in Figures 30 to 32 respectively.

Designation of Foraging Areas

4.48 The foraging areas for predators of krill were to be derived from aggregating the foraging locations of all colonies across all species.

4.49 The method proposed to achieve this involved extrapolating the characteristics of known foraging areas for each species described above to the centres of biomass for which no foraging data are available (paragraphs 4.3 to 4.6).

4.50 The foraging ranges were then pooled by weighting each grid square in the foraging range by the estimates of the colony or biomass centre along with the estimated foraging intensity for that square. These values are then summed across all biomass centres and species to give the distribution of foraging intensities expected across the region.

4.51 The workshop agreed to keep separate the foraging areas of the monitored colonies from the extrapolated foraging areas but would consider both when formulating its views on the different foraging areas in each subarea.

Extrapolated Foraging Areas

4.52 The general method for extrapolating to colonies without foraging information included the following steps for each species in each subarea:

(i) estimating the 'maximum foraging distance';

(ii) estimating the 'characteristic foraging density' by distance from the centre of foraging;

(iii) determining the centre of foraging for the colonies without foraging data; and

(iv) estimating a foraging area for those colonies based on the above information.

4.53 This method would produce estimated summer foraging areas for each species in each subarea. Data used for estimating these characteristic areas were derived where possible from the same subarea for which the data were needed. This was not always the case. Table 10(a) shows the origin of the data used for each species in each subarea.

4.54 Maximum foraging distance is the maximum distance, in nautical miles, from the centre of foraging in the areas encompassing 95% of the foraging activities of the species. The estimated distances are given in Table 10(b).

4.55 Characteristic foraging density was the density of foraging estimated as a function of distance from the centre of foraging to the maximum foraging distance. It is expressed as a proportion of the maximum intensity. The characteristic foraging densities are shown in Table 10(c). This table also shows the general spread of the distribution of characteristic summer foraging areas. In some cases, such as macaroni penguins in Subarea 48.3, almost all of the foraging effort occurs over a small area but a small amount of effort is spread over a large area.

4.56 The central point of most foraging areas was located at the position of the colonies and centres of biomass. The central points for chinstrap penguins in Subarea 48.1 were located half way between the colony and the shelf break. In addition, the central point for the Adélie penguin colony at Signy Island (Subarea 48.2) was moved south from the colony by the maximum foraging distance because it was believed that these penguins would primarily forage on the south side of the South Orkney Islands (WG-EMM-02/15). The coordinates of these foraging centres are given in Table 11.

4.57 Dr Ball provided the software 'Range Plotter', which placed a foraging distribution around a nominated foraging centre. In his earlier presentation of the use of 'Range Plotter', Dr Ball had indicated how the software could wrap the foraging area around the coast of land, including islands, and that the shape of the distribution could be altered.

4.58 The workshop thanked Dr Ball for providing such a useful piece of software to help complete its work. The software was archived with the CCAMLR Secretariat.

4.59 The workshop agreed that a circular foraging area placed around the nominated foraging centre was used in the absence of knowledge about the primary foraging directions of species at locations for which no foraging data were available (see paragraph 1.23). No limits were placed on the extrapolated foraging areas. The distribution of foraging density from the centre of foraging followed the characteristic foraging density for the appropriate species and region.

4.60 The workshop also agreed that this application of circular foraging areas could lead to having foraging extrapolated to areas where no foraging occurs.

4.61 Drs Sushin, Shust and Gasiukov stressed that this approximation of circular foraging areas gave a picture which is in contrast with the observed spatial foraging patterns described earlier in Subareas 48.2 and 48.3. This use of the method does not take into account observed direction of foraging trips or the effect of land on the foraging range. They requested that the method be evaluated at the next meeting of WG-EMM.

4.62 The workshop agreed to view the extrapolated foraging areas for each species within a subarea as well as the combined plots of all subject species. These would be plotted in two ways:

(i) overlap of foraging ranges, which would illustrate the total area likely to be used as well as overlap between foraging areas between colonies and between species; and

(ii) biomass-weighted foraging areas, which would have each foraging range weighted by the biomass of the colony (centre of biomass) and the characteristic foraging density, showing the areas of greatest use by predators.

4.63 The biomasses for each colony or centre of biomass were determined as the number in the colony multiplied by an estimate of the average weight of an adult of the respective species from the CCAMLR database (Attachment 2).

4.64 Dr Watters developed a function 'plot blobs' within S-Plus to plot these figures for the workshop. This function is able to:

(i) overlay other plots, such as bathymetric or coastline maps;

(ii) restrict a presentation to a given subarea;

(iii) plot foraging densities within the foraging range or simply indicate the foraging range using uniform colour;

(iv) rescale the foraging densities to a common relative scale across figures, where the relative scale is from zero to the maximum foraging density; and

(v) weight the foraging densities from each colony or species by a selected set of statistical weights, say colony biomass or consumption.

4.65 The function requires input data as an S-Plus data frame, 'In.Data' with the following columns (labels are case sensitive):

(i) Longitude;
(ii) Latitude;
(iii) Isopleth.Threshold; and
(iv) colony.

4.66 The statistical weights need to be included in an S-Plus list with all unique colony names from the input data table.

4.67 The workshop thanked Dr Watters for developing this function for use by the workshop. The workshop greatly appreciated his efforts to develop this flexible and useful plotting routine. The function was archived with the Secretariat.

4.68 The results are illustrated for each subarea in Figures 33 to 35.

Delineation of Foraging Areas

Subarea 48.1

4.69 The workshop considered the results in Figure 33 as well as the known abundance and foraging ranges described for Antarctic fur seals (Figures 13 and 25 to 27), chinstrap penguins (Figures 11 and 22), Adélie penguins (Figures 10 and 23), gentoo penguins (Figures 12 and 24) and finfish (Figure 21).

4.70 The workshop agreed that the predator foraging areas could be broadly divided between Elephant Island, Drake Passage to the north of the South Shetland Islands and Bransfield Strait. In addition, the workshop noted that the foraging of Adélie penguins was likely to be concentrated in the eastern end of Bransfield Strait while chinstrap and gentoo penguins were likely to be concentrated in the western end. It was also noted that the primary location of foraging in Drake Passage was to the north of Livingston Island from Cape Shirreff.

4.71 The workshop agreed that an additional division based on these foraging areas could be made between Greenwich and Roberts Islands perpendicular to the axis of the South Shetland Islands and dividing both the shelf area in Drake Passage as well as Bransfield Strait.

Subarea 48.2

4.72 The workshop considered the results in Figure 34 as well as the known abundance and foraging ranges described for Adélie penguins (Figures 14 and 29), chinstrap penguins (Figures 15 and 28), gentoo penguins (Figure 16) and finfish (Figure 21b). It also noted the foraging area of black-browed albatrosses to the west of the South Orkney Islands (Figure 30).

4.73 The workshop noted that the biomass of land-based predators was concentrated towards the eastern end and south of the South Orkney Islands. It also noted the observed foraging areas were to the south and southwest of Signy Island for Adélie penguins and south for chinstrap penguins, and to the west of the South Orkney Islands for black-browed albatrosses. In addition, the density of krill-eating finfish was observed to be split to the west, north and east of Coronation Island.

4.74 The workshop agreed that the area to the west of the western end of Coronation Island could be separated from the remaining shelf area to the east of that point. This separation appeared best to be perpendicular to the shelf break to the north of Coronation Island.

4.75 The workshop noted the uncertainty as to whether penguins were likely to forage to the north of Coronation Island. It is conceivable that the large colonies of penguins on Laurie and Powell Islands would have access to the northern waters, unlike the penguins on Signy Island. However, it was noted that the northern side may be differentiated from the southern side.

4.76 Given the uncertainty as to whether penguins concentrated their foraging on the southern side of the island, the workshop agreed that the north and south of South Orkney Islands be separated in the interim pending more information on the foraging activities of penguins from Laurie Island.

Subarea 48.3

4.77 The workshop considered the results in Figure 35 as well as the known abundance and foraging ranges described for macaroni penguins (Figures 17 and 31), gentoo penguins (Figure 18), Antarctic fur seals (Figures 19 and 32) and finfish (Figure 21c). It also noted the foraging areas of black-browed albatrosses (Figure 30).

4.78 The workshop agreed that the primary area of foraging was centred to the northwest of South Georgia due to the concentration of land-based predators in the region as well as the known foraging locations of fur seals, macaroni penguins and black-browed albatrosses. It was also recognised that the area to the east and southeast of South Georgia was an important foraging location due to the foraging activities of the black-browed albatrosses and the presence of gentoo penguins at the southeast end of the island.

4.79 The workshop agreed that the distribution and feeding activity of krill-eating finfish provided some evidence to support the division of the shelf region into east and west, and to separate South Georgia from Shag Rocks. However, it was noted that this was only one year of data with no diet data to help explain the distribution.

4.80 Dr Everson indicated that there was a body of knowledge on diet and foraging activities of *C. gunnari* in the published literature, including work led by Dr K.-H. Kock (Germany), as well as well as in papers tabled at WG-FSA that could be used to further explore the spatial segregation of krill-eating finfish in the South Georgia region.

4.81 Dr Kirkwood proposed that the division between areas be indicated by north–south boundaries so that they are consistent with the work of WG-FSA. Such boundaries had been considered for *C. gunnari* by WG-FSA in 2000 (SC-CAMLR-XIX, Annex 4, Figure 24), although these boundaries were determined to facilitate a simple separation of Shag Rocks and South Georgia, and to provide a means of analysing survey data from the region.

4.82 The workshop noted that there is some uncertainty as to whether land-based predators forage on the south side of South Georgia during the breeding season.

4.83 Dr Trathan drew the attention of the workshop to the paper submitted by Prof. I. Boyd (UK) last year (WG-EMM-01/26) which estimated areas of highest consumption of krill by fur seals in the region. Using a different method, but the same data, the results of that analysis were similar to the results of the extrapolated foraging areas shown in Figure 35.

4.84 As for Subarea 48.2, the uncertainty as to whether predators forage on the southern side of the island meant that the workshop agreed that the shelf to the south of South Georgia be separated in the interim pending more information on the foraging activities in the region.

SYNTHESIS

5.1 The workshop reviewed the analyses described above for each statistical subarea to integrate the observed divisions in spatial distributions of krill, the krill fishery and krill predators into a spatial subdivision of each subarea.

5.2 The workshop recalled its decision to establish a nested hierarchy of areas such that the first division would be between the pelagic area and the area considered important to the summer breeding colonies of land-based predators. This division was to be based on the maximum foraging distance of the land-based predators. The second set of divisions was to be based on local units in which aggregations of krill, fishing grounds and predator foraging areas, as defined earlier in the report, could be separated from other areas. The workshop also agreed that separation of areas specific to individual predator species may be needed. This would form the third level of the hierarchy of areas.

Subarea 48.1

5.3 The integrated results for Subarea 48.1 are presented in Figure 36. This figure shows the divisions between Elephant Island, the South Shetland Islands and the Western Antarctic Peninsula, derived from the analysis of krill aggregations and the fishery. The workshop agreed to also maintain a division between Bransfield Strait and Drake Passage on the basis of this analysis.

5.4 The division between the pelagic area and the land-based predator area is shown in Figure 36(d).

5.5 The assessment of the predator divisions based primarily on the known foraging grounds of Antarctic fur seals at Cape Shirreff and the differences between Adélie and chinstrap/gentoo penguin foraging areas is overlaid on the extrapolated foraging areas in Figures 36(e) and 36(f). This pattern of division is supported by the analysis of krill-eating finfish (Figure 36g).

5.6 The workshop noted that the division between Greenwich and Roberts Islands overlaps with part of the observed krill aggregations (Figure 36h).

5.7 The workshop agreed that this subarea could be divided into pelagic and land-based predator areas and that the land-based predator area could be further subdivided into four main zones: Western Antarctic Peninsula, Drake Passage, Bransfield Strait and Elephant Island. These four zones were considered to provide a reasonable separation between the spatial structures of krill, the fishery and predator foraging grounds in that region.

5.8 The workshop also agreed to a further subdivision of Drake Passage and Bransfield Strait areas on the basis of the separation of the foraging areas of individual species. Both these areas were divided into east and west components with a boundary between Greenwich and Roberts Islands perpendicular to the axis of the South Shetland Islands.

5.9 This agreed subdivision of Subarea 48.1 is shown in Figure 37.

5.10 Dr M. Naganobu (Japan) drew the attention of the workshop to the oceanography of the region and explained why he believed that the subdivision of Bransfield Strait and Drake Passage into eastern and western areas, as indicated by the dotted line, was likely not to be warranted because of the movement of krill through the region. He explained that part of the Antarctic Circumpolar Current divides near the western end of Livingston Island bringing a strong west–east flow of water into the northern side of Bransfield Strait. This water moves around the eastern end of King George Island to form an area of coastal upwelling to the north of Livingston and King George Island. This area has high productivity, supporting krill and its predators. This water movement also helps drive the difference between the South Shetland Islands and Elephant Island. An area of cold coastal water is retained on the south side of Bransfield Strait.

5.11 The workshop agreed that future work on how these proposed small-scale areas could be used for management will need to consider the oceanography of the region and the potential linkages between these areas, including the movement of krill.

Subarea 48.2

5.12 The integrated results for Subarea 48.2 are presented in Figure 38.

5.13 The aggregation of krill observed in the CCAMLR-2000 Survey was centred over the South Orkney Islands, including part of the northern shelf break and extending south over the larger area of shelf less than 500 m in depth (Figure 38a). The fishery is largely concentrated to the northwest of Coronation Island (Figure 38b).

5.14 The division between the pelagic area and the land-based predator area is shown in Figure 38(c).

5.15 The assessment of the predator divisions based primarily on the known foraging grounds of black-browed albatrosses and chinstrap and Adélie penguins shows a northeast to southwest division in foraging locations at the western tip of Coronation Island (Figure 38d).

5.16 This division is supported by the extrapolated foraging areas (Figure 38e) and the aggregations of krill-eating finfish (Figure 38f). The extrapolated foraging areas are very much influenced by the large number of penguins on Laurie and Powell Islands. The workshop noted that the fish distribution may vary over time but the evidence in the analysis presented here does support the division.

5.17 The workshop noted that it may be possible that penguins are restricted in their foraging to the south of the islands despite the extrapolated foraging grounds extending to the north of the islands (see paragraphs 4.59 to 4.61 for discussion of the method used for extrapolation). If this were the case, then it would be reasonable to separate the north side of the South Orkney Islands from the south side.

5.18 Dr Trivelpiece indicated to the workshop that such a division is likely, given that Adélie and chinstrap penguins forage over shelf areas and that the majority of the shelf area in the region is to the south of the islands.

5.19 Dr Everson indicated that it is conceivable that birds on Laurie or Powell Islands could forage to the north and south of Coronation Island. He suggested that satellite-tracking studies of these penguins would be very useful in identifying where the foraging locations are for these colonies.

5.20 The workshop agreed that an additional division along the axis of the South Orkney Islands to divide the southeastern foraging area identified above is warranted, pending further information on the foraging locations of birds in the east of the South Orkney Islands.

5.21 The agreed subdivision of Subarea 48.2 is shown in Figure 39.

Subarea 48.3

5.22 The integrated results for Subarea 48.3 are presented in Figure 40.

5.23 The workshop noted the two main areas of krill aggregations observed in the CCAMLR-2000 Survey and known from many UK surveys in the region (Figures 40a and 40b). The analysis of the USSR krill fishery from 1986 to 1990 showed a distinct pattern associated with the shelf break. There was a clear separation of these winter fishing grounds at 37.5°W. Although this separation was based on winter fishing patterns, the workshop agreed to use this as a basis for subdividing the region.

5.24 The division between the pelagic area and the land-based predator area is shown in Figure 40(c).

5.25 The assessment of predator divisions based primarily on the known foraging grounds of black-browed albatrosses, Antarctic fur seals and macaroni penguins shows that the division of the fishing grounds also divides the known foraging areas (Figure 40d).

5.26 A division of the South Georgia region at 37.5°W is supported by the extrapolated foraging areas (Figure 40e) and by the assessment of *C. gunnari* densities from surveys in 2000 (Figure 40f). The workshop noted that the fish distribution may vary over time but evidence in the analysis presented here does support the division.

5.27 The workshop also noted the separation of Shag Rocks and the South Georgia shelf by WG-FSA. However, it was noted that this separation was likely to be achieved by the boundary of the land-based predator foraging area and so did not warrant the addition of a new boundary as nearly all the Shag Rocks shelf region fell outside of the range of the South Georgia land-based predator foraging footprint.

5.28 The workshop noted that it may be possible that land-based predators are restricted in their foraging to the west and north of the island despite the extrapolated foraging grounds extending to the southwest of the island (see paragraphs 4.59 to 4.61 for discussion of the method used for extrapolation). If this were the case, then it would be reasonable to separate the southwestern side of South Georgia from the rest of the shelf areas. However, the workshop did not find sufficient reason to justify the separation of this part of the shelf.

5.29 The workshop agreed to a subdivision of the South Georgia area by a single north–south boundary at 37.5°W. This is shown in Figure 41.

5.30 The workshop noted that further work on the oceanography of the region and on the distribution of *C. gunnari* may provide insights into the relationship between these areas and how they may be used for management purposes.

ADVICE TO WG-EMM

5.31 The workshop recommended that the subdivisions of Subareas 48.1, 48.2 and 48.3 shown in Figures 37, 39 and 41 be considered as the best available advice on small-scale management units in the region.

5.32 The workshop noted the uncertainty surrounding the extrapolation of known foraging characteristics of land-based predators to colonies for which no foraging information was known. It was noted that the method for extrapolating predator foraging areas for colonies without foraging information might lead to the conclusion that foraging might occur in areas in which predators do not forage in reality. However, the proposals take account of the known information and are based, although not dependent, on the extrapolated results.

5.33 The workshop noted that these proposals provide a structure for considering how to subdivide the precautionary catch limit for krill in Area 48 as well as for developing management procedures for krill fisheries that can adequately take account of localised effects on predators.

5.34 The workshop noted that:

(i) this assessment is the first of its kind in CCAMLR;

(ii) this assessment used a variety of datasets that enabled the detailed analyses presented here, such that deficiencies in one dataset could be compensated by strengths in others;

(iii) fine-scale fisheries data were very important to the success of this assessment;

(iv) a number of uncertainties remain regarding the relationships between predators, krill and the fishery and further information on krill, krill movement, predator demand and predator foraging grounds may provide opportunities to refine these boundaries in the future;

(v) the next step is to develop an understanding of the linkages and dynamics between these areas in order to facilitate the subdivision of the precautionary catch limit for krill in Area 48, taking account of the oceanography and the environmental variability of the region;

(vi) this assessment has demonstrated the utility of satellite-tagging programs for an understanding of the relationships between predators, krill and the fishery, and, as a result, the workshop highly recommended further studies of this kind; and

(vii) the manner in which these proposed small-scale management units are used may have implications for monitoring that would need to be considered by the Commission.

CLOSE OF THE WORKSHOP

5.35 Dr Hewitt thanked all the participants for their diligence and hard work over the course of the meeting. In particular, he thanked Dr Trivelpiece and his steering committee for all their preparation and the thought they had put into ensuring the success of the workshop. He also thanked the providers of data, without which none of these assessments could have been undertaken.

5.36 Special thanks were given to the providers of software and statistical routines, Drs Ball and Watters.

5.37 The workshop also extended its special thanks to Dr Constable for his persistent vision, perseverance and hard work throughout all stages of the workshop.

5.38 The workshop closed on 15 August 2002.

REFERENCES

Barlow, K.E. and J.P. Croxall. 2001. Seasonal and interannual variation in foraging range and habitat of macaroni penguins at South Georgia. Document *WG-EMM-01/19*. CCAMLR, Hobart, Australia.

Boyd, I.L., D.J. McCafferty, K. Reid, R. Taylor and T.R. Walker. 1998. Dispersal of male and female Antarctic fur seals (*Arctocephalus gazella*). *Can. J. Fish. Aquat. Sci.*, 55: 845–852.

MacLennan, D.N. and P. Fernandez. 2000. Definitions, units and symbols in fisheries acoustics. Draft 03/04/00. Contr. FAST Working Group Meeting, Haarlem, USA, April 2000: 6 pp.

Trathan P.N., F.H.J. Daunt and E.J. Murphy. 1996. *South Georgia: an Ecological Atlas*. British Antarctic Survey, Cambridge, UK.

Trathan, P.N., I. Everson, E.J. Murphy and G.B. Parkes. 1998. Analysis of haul data from the South Georgia krill fishery. *CCAMLR Science*, 5: 9–30.

Vincent, C., B.J. McConnell, M.A. Fedak and V. Ridoux. 2002. Assessment of ARGOS location accuracy from satellite tags deployed on captive grey seals. *Mar. Mamm. Sci.*, 18 (1): 301–322.

Woehler, E. 1993. *The Distribution and Abundance of Antarctic and Sub-Antarctic Penguins*. SCAR, Cambridge, UK.

Wood, A.G., B. Naef-Daenzer, P.A. Prince and J.P. Croxall. 2001. Quantifying habitat use in satellite-tracked pelagic seabirds: application of kernel estimation to albatross locations. Document *WG-EMM-01/67*. CCAMLR, Hobart, Australia.

Worton, B.J. 1989. Kernel methods for estimating the utilisation distribution in home-range studies. *Ecology*, 70: 164–168.

Table 1: Summary details of data for penguin species tracked in Subarea 48.1, including site of colonies, number of replicates, year of sampling and season of tracking. KGI = King George Island, LI = Livingston Island.

Species	Site	N	Year	Period
Adélie penguin	Copa, KGI	8	1996	Oct–Nov
Adélie penguin	Copa, KGI	8	1997	Oct–Nov
Adélie penguin	Copa, KGI	3	2001	Feb–Apr
Adélie penguin	Copa, KGI	3	2002	Jan–Jul
Chinstrap penguin	Copa, KGI	3	2000	Mar–Jul
Chinstrap penguin	Cape Shirreff, LI	6	1999	Jan
Chinstrap penguin	Cape Shirreff, LI	2	2000	Feb–July
Chinstrap penguin	Cape Shirreff, LI	4	2000	Nov
Chinstrap penguin	Cape Shirreff, LI	3	2001	Jan–Feb
Chinstrap penguin	Cape Shirreff, LI	10	2002	Jan
Gentoo penguin	Cape Shirreff, LI	4	2002	Feb

Table 2: Number of ARGOS satellite uplinks by quality class code for Antarctic fur seals breeding at Cape Shirreff, South Shetland Islands.

Year	Season	Female	Total Uplinks	Quality 3	Quality 2	Quality 1	Quality 0	Quality A	Quality B
1999	Jan–Feb	35	3 122	13	62	463	1 325	511	748
2000	Jan–Feb	34	2 797	27	113	404	1 095	496	662
2001	Jan–Feb	25	5 237	149	321	852	1 567	836	1 512
2002	Jan–Feb	13	1 885	54	98	280	440	386	627

Table 3: Trip durations, foraging range, and total distance travelled by 95 female Antarctic fur seals foraging from Cape Shirreff, Livingston Island, from 1999 to 2002.

Parameter	1999	2000	2001	2002	All years
Female (N)	35	50	25	12	95
Trip (N)	39	42	55	34	170
Trip duration (days):					
Mean	4.5	4.4	3.8	3.3	4.0
SE	1.3	0.3	1.0	1.0	0.1
Min.	2.6	0.8	1.8	1.6	0.8
Max.	8.8	9.1	6.0	5.9	9.1
Foraging range (maximum distance travelled – km):					
Mean	106	83	78	67	83
SE	46	5	19	14	3
Min.	47	37	45	48	37
Max.	369	217	136	111	369
Total distance travelled (km):					
Mean	504	374	351	253	372
SE	197	25	95	86	14
Min.	154	99	164	109	99
Max.	1 258	814	561	448	1 258

Table 4: Deployment locations and PTT devices used for land-based predator species tracked in Subareas 48.2 and 48.3.

Species	Year	Period	Location	Device
Adélie penguin	1999	Summer	Signy Is	ST-10, ST-18
	2000	Summer	Signy Is	ST-10, ST-18
Chinstrap penguin	1999	Summer	Signy Is	ST-10, ST-18
	2000	Summer	Signy Is	ST-10, ST-18
Macaroni penguin	1999	Summer	Bird Is	ST-10, ST-18
	2000	Summer	Bird Is	ST-10, ST-18
	2001	Summer	Bird Is	ST-10, ST-18
Black-browed albatross	1992	Summer	Bird Is	Microwave, Toyocom
	1993	Summer	Bird Is	Microwave, Toyocom
	1994	Summer	Bird Is	Microwave, Toyocom
	1997	Summer	Bird Is	Microwave, Toyocom
Antarctic fur seal	1996	Summer	Bird Is	ST-10
	1997	Summer	Bird Is	ST-10
	1998	Summer	Bird Is	ST-10
	1998	Summer	Husvik	ST-10
	1999	Summer	Bird Is	ST-10
	2000	Summer	Bird Is	ST-10
	2001	Summer	Bird Is	ST-10

Table 5: Number of ARGOS satellite uplinks by quality class for Adélie penguins breeding at Signy Island, South Orkney Islands.

Year	Season	Male	Female	Male Uplinks	Female Uplinks	Quality 3	Quality 2	Quality 1	Quality 0	Quality A	Quality B	Quality Z
2000	Chick rearing*	3	6	349	498	18	70	260	175	155	166	3
2001	Chick rearing*	7	3	886	467	38	138	351	272	287	258	9

* Chick rearing is defined as 6 December to 20 February

Table 6: Number of ARGOS satellite uplinks by quality class for chinstrap penguins breeding at Signy Island, South Orkney Islands.

Year	Season	Male	Female	Male Uplinks	Female Uplinks	Quality 3	Quality 2	Quality 1	Quality 0	Quality A	Quality B	Quality Z
2000	Chick rearing*	3	7	179	487	15	44	174	109	172	149	3
2001	Chick rearing*	6	8	395	589	14	51	153	162	250	348	6

* Chick rearing is defined as 31 December to 20 February

Table 7: Number of ARGOS satellite uplinks by quality class for macaroni penguins breeding at Bird Island, South Georgia.

Year	Season	Male	Female	Male Uplinks	Female Uplinks	Sex not Known Trips	Sex not Known Uplinks	Quality 3	Quality 2	Quality 1	Quality 0	Quality A	Quality B	Quality Z
1999	Incubation[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chick rearing[2]	8	15	637	1 899	5	735	50	96	786	1 364	476	484	15
	Premoult[3]	1	-	433	-	-	-	4	4	84	208	70	59	2
2000	Incubation[1]	4	7	1 165	992	-	-	24	115	748	849	202	204	15
	Chick rearing[2]	6	18	585	1 238	-	-	17	75	443	759	243	274	12
	Premoult[3]	-	-	-	-	-	-	-	-	-	-	-	-	-
2001	Incubation[1]	3	3	1 552	682	-	-	29	113	665	817	302	302	6
	Chick rearing[2]	4	13	212	973	-	-	13	45	208	407	230	271	11
	Premoult[3]	2	3	574	1 497	-	-	16	62	369	775	389	440	20

[1] Incubation is defined as 1 November to 31 December [2] Chick rearing is defined as 1 January to 17 February [3] Premoult is defined as 18 February to 21 March

Table 8: Number of ARGOS satellite uplinks by quality class for black-browed albatrosses breeding at Bird Island, South Georgia.

Year	Season	Number Trips	Number Uplinks	Quality 3	Quality 2	Quality 1	Quality 0	Quality A	Quality B	Quality Z
1992	Incubation[1]	-	-	-	-	-	-			
	Brood guard[2]	-	-	-	-	-	-			
	Chick rearing[3]	1	184	-	12	57	115			
1993	Incubation[1]	-	-	-	-	-	-			
	Brood guard[2]	3	17	-	-	5	12			
	Chick rearing[3]	66	2 098	11	191	392	1 504			
1994	Incubation[1]	-	-	-	-	-	-			
	Brood guard[2]	1	46	-	-	-	-			
	Chick rearing[3]	-	-	-	2	6	38			
1997	Incubation[1]	10	750	2	10	36	323	177	158	44
	Brood guard[2]	-	-	-	-	-	-	-	-	-
	Chick rearing[3]	-	-	-	-	-	-	-	-	-

1 Incubation is defined as 1 November to 31 December
2 Brood guard is defined as 1 January to 24 January
3 Chick rearing is defined as 25 January to 15 April

Table 9: Number of ARGOS satellite uplinks by quality class for Antarctic fur seals breeding at Bird Island, South Georgia.

Year	Season	Female	Pup	Female Uplinks	Pup Uplinks	Quality 3	Quality 2	Quality 1	Quality 0	Quality A	Quality B	Quality Z
1996	Breeding season[1]	19	-	670	-	11	46	100	137	126	227	23
1997	Breeding season[1]	18	-	1 595	-	18	51	289	571	269	382	15
1998	Breeding season[1]	72	-	3 430	-	29	129	732	1 112	614	772	42
1999	Breeding season[1]	51	-	5 708	-	36	180	1 055	1 780	1 123	1 463	71
2000	Breeding season[1]	19	-	1 813	-	11	38	280	693	308	450	33
2001	Breeding season[1]	50	-	8 023	-	109	497	1 873	1 697	1 547	2 200	100

1 Breeding season is defined as 1 December to 31 March

Table 10: Details of characteristic summer foraging areas for land-based predators in Subareas 48.1, 48.2 and 48.3.

(a) Subareas from which data originated to estimate the characteristic area for each species (rows) in each subarea (columns).

Species	Subarea		
	48.1	48.2	48.3
Adélie	48.2	48.2	
Chinstrap	48.1	48.2	
Gentoo	48.1	48.1	48.1
Macaroni			48.3
Antarctic fur seals	48.1		48.3

(b) Maximum foraging distance, in nautical miles, estimated for five predators in Area 48.

Species	Subarea		
	48.1	48.2	48.3
Adélie	96	96	
Chinstrap	20	46	
Gentoo	15	15	15
Macaroni			191
Antarctic fur seals	48		115

(c) Characteristic foraging densities estimated for each species in each region. Each row is the characteristic foraging density as a function of distance for each of the species in each of the subareas. The values are distances (n miles) from the centre of the foraging distribution to the percentile for that column. For example, 75% of the foraging done by Adélie penguins in Subarea 48.1 occurs within 87.2 n miles of the centre of the foraging distribution.

Subarea/Species	Density as Proportion of Maximum Intensity					
	0.9	0.75	0.5	0.25	0.1	0.05
Subarea 48.1						
Adélie	87.2	87.2	87.5	91.4	95.7	95.7
Chinstrap	2.8	6.9	10.9	13.7	17.5	19.7
Gentoo	2.8	2.8	6.2	10.3	13.9	15.1
Antarctic fur seal	2.8	10.3	17.8	30.4	43.0	48.7
Subarea 48.2						
Adélie	87.2	87.2	87.5	91.4	95.7	95.7
Chinstrap	42.2	42.2	45.9	45.9	45.9	45.9
Gentoo	2.8	2.8	6.6	10.3	13.9	15.1
Subarea 48.3						
Gentoo	2.8	2.8	6.6	10.3	13.9	15.1
Macaroni	0	6.0	9.3	12.0	184.9	191.3
Antarctic fur seal	0	30.8	55.2	68.2	105.9	114.8

Table 11: Coordinates of central points of foraging areas for colonies that did not have this central point located at the site of the colony.

Subarea/Species	Colony Location		Centre of Foraging	
	Longitude	Latitude	Longitude	Latitude
Subarea 48.1				
Chinstrap	-59.70	-62.32	-59.75	-62.04
Chinstrap	-55.11	61.13	-55.12	-61.27
Chinstrap	-58.00	-61.90	-58.05	-61.63
Chinstrap	-58.37	-61.93	-58.42	-61.66
Chinstrap	-57.67	-61.90	-57.72	-61.64
Chinstrap	-60.18	-62.43	-60.23	-62.15
Chinstrap	-60.80	-62.47	-60.85	-62.18
Subarea 48.2				
Adélie	-45.58	-60.73	-45.58	-62.30

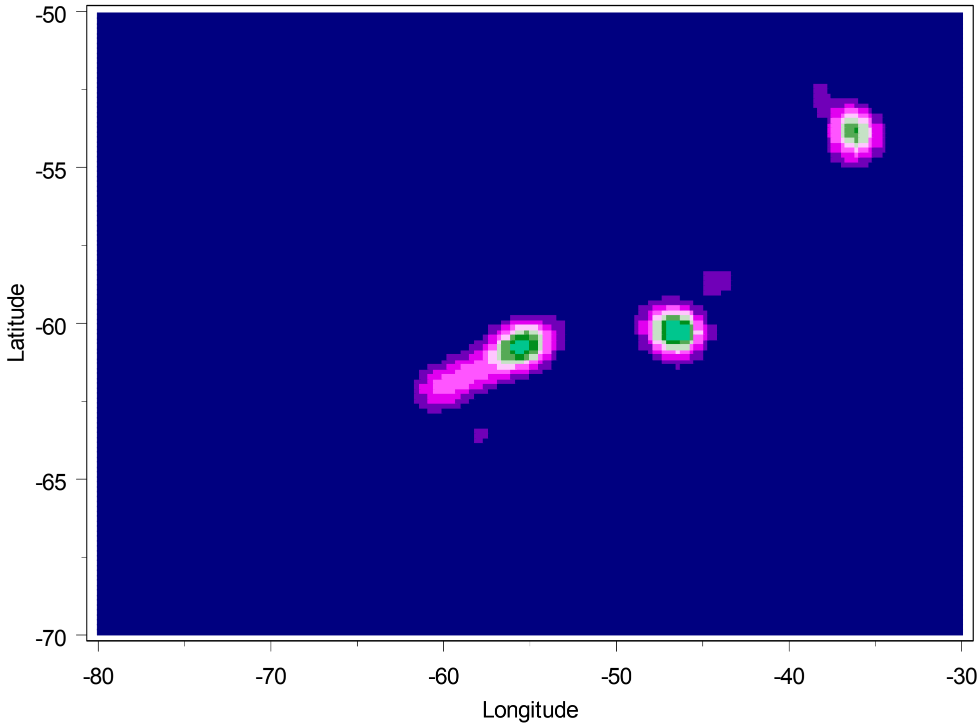


Figure 1*: Average importance of 10 x 10 n mile areas to the krill fishery from 1986 to 1990.

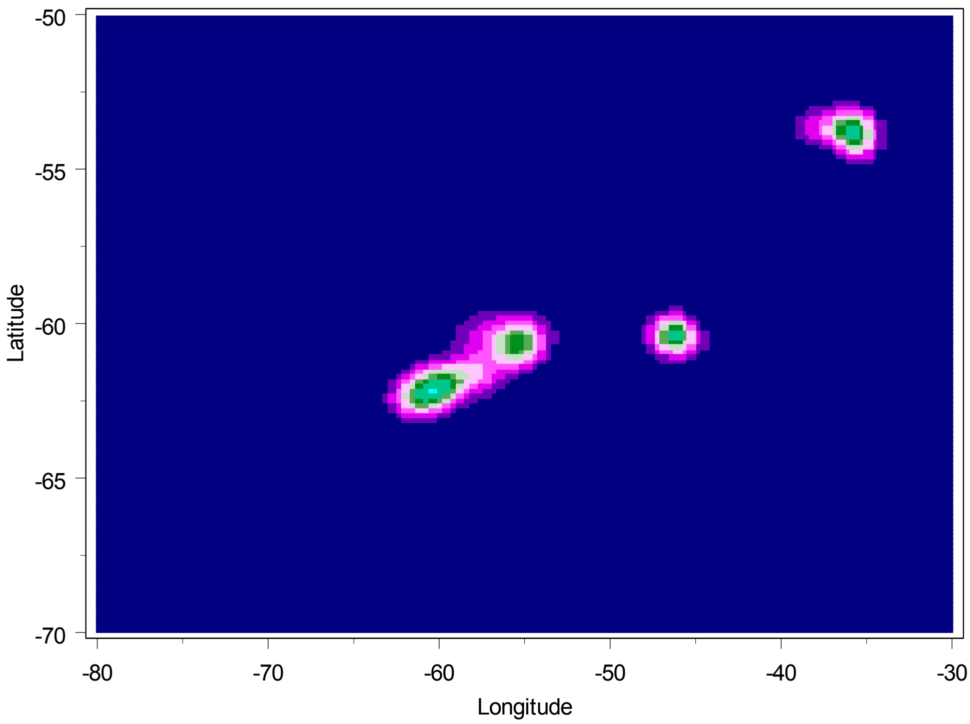


Figure 2: Average importance of 10 x 10 n mile areas to the krill fishery from 1996 to 2000.

* Figures 1 to 5 are presented in this publication in colour to ensure full representation of the dynamic range of data available. It should be noted that figures in working group reports are not customarily published in colour.

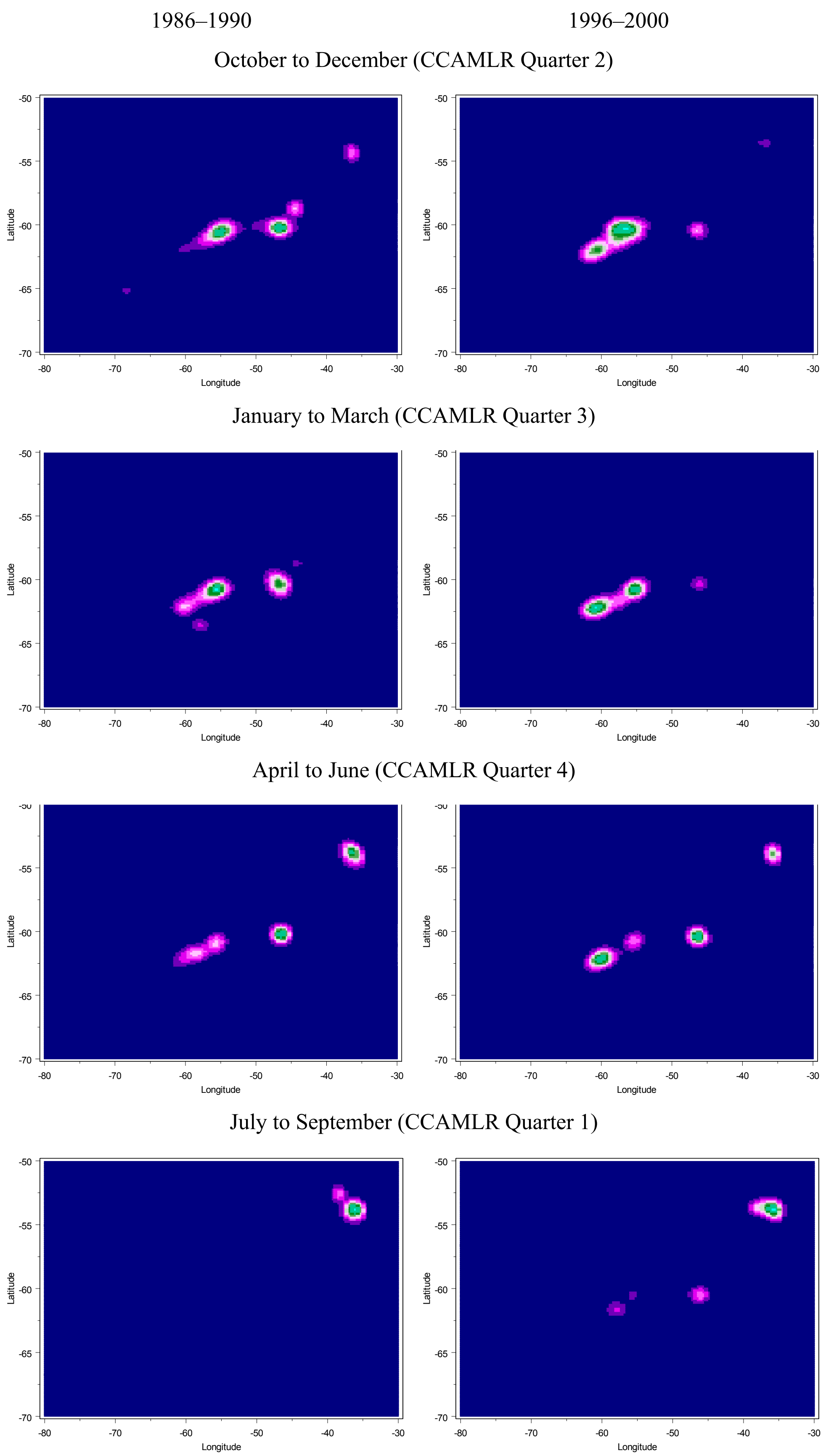


Figure 3: Average importance of 10 x 10 n mile areas for each quarter of two fishing periods.

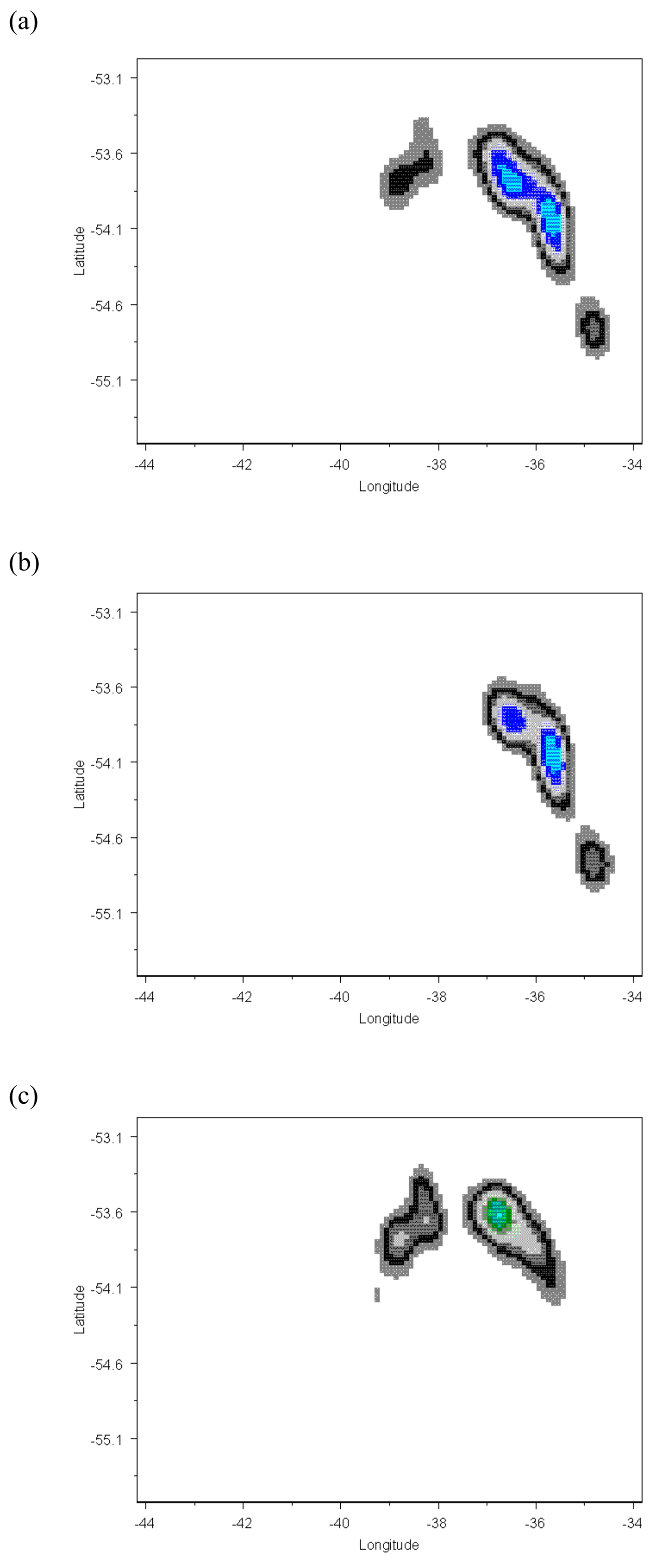


Figure 4: Average importance of 3 x 1.5 n mile areas to the USSR krill fishery: (a) from 1986 to 1990, (b) from 1986 to 1990 for the fourth quarter – April to June, and (c) from 1986 to 1990 for the first quarter – July to September. Grey indicates low importance, while light blue indicates high importance.

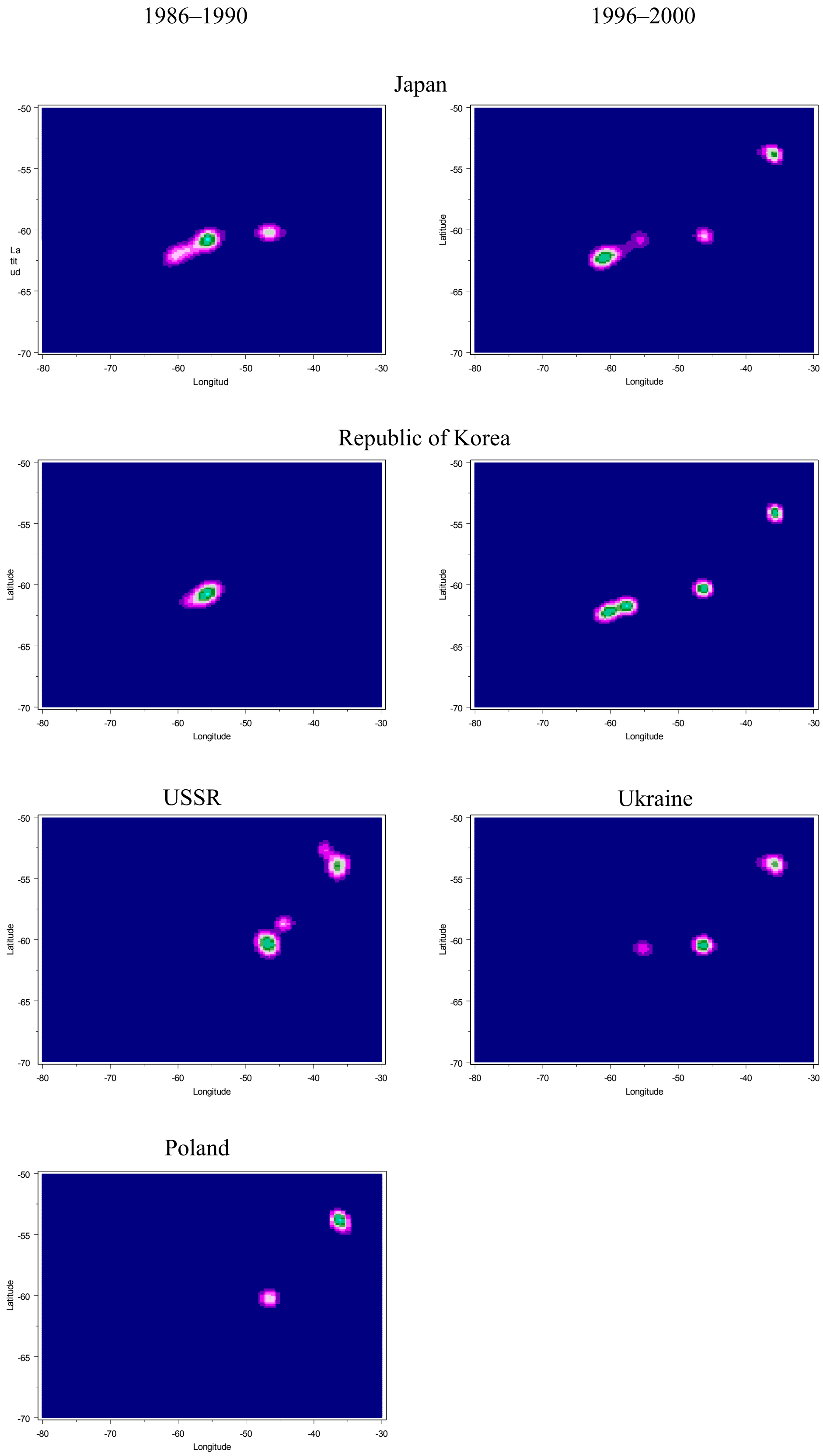


Figure 5: Average importance of 10 x 10 n mile areas for major krill-fishing countries during each of two fishing periods.

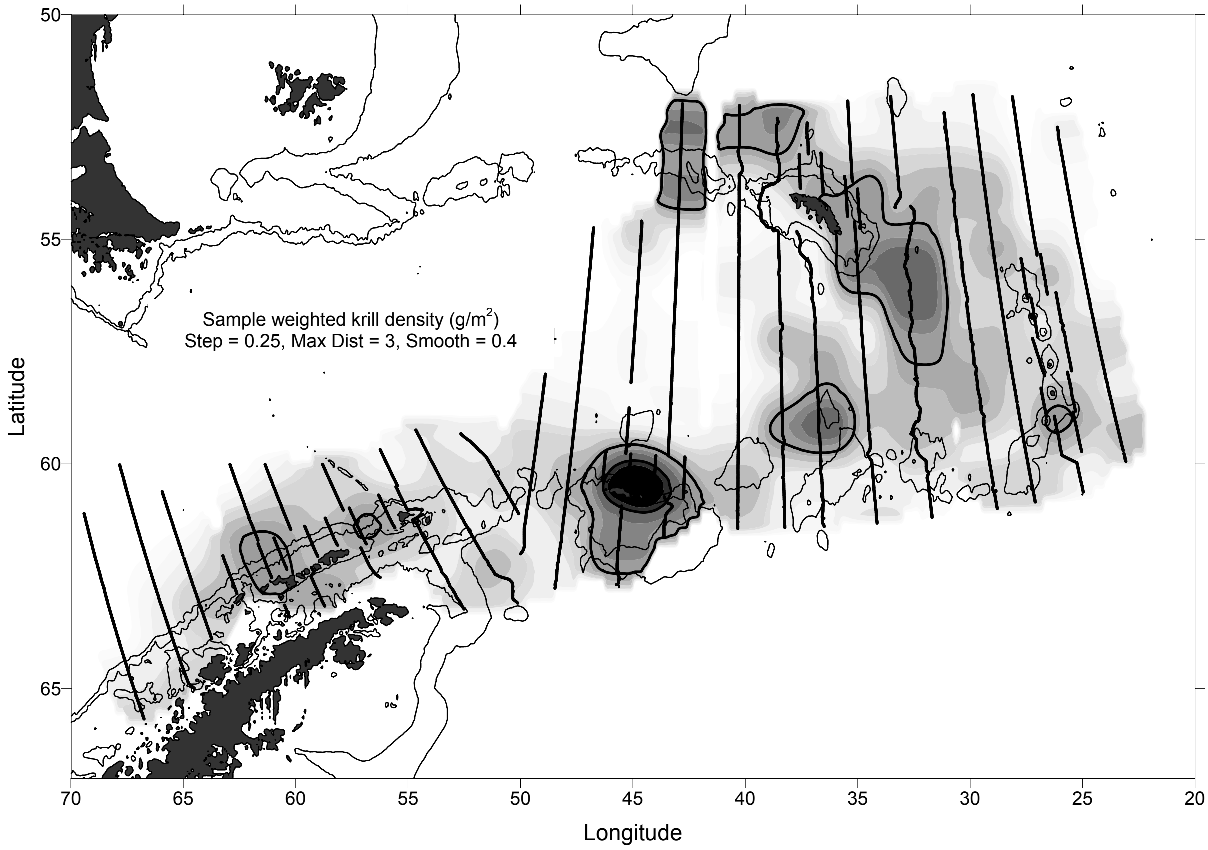


Figure 6: Sample weighted krill density (g m^{-2}) in Area 48 estimated from the CCAMLR-2000 Survey. Scale indicates relative density. Parameters show the values used in 'Tracks and Fields' for smoothing the data. Thin lines show the 500 m and 2 000 m isobaths. Thick lines denote areas where density is greater than 10 g m^{-2}.

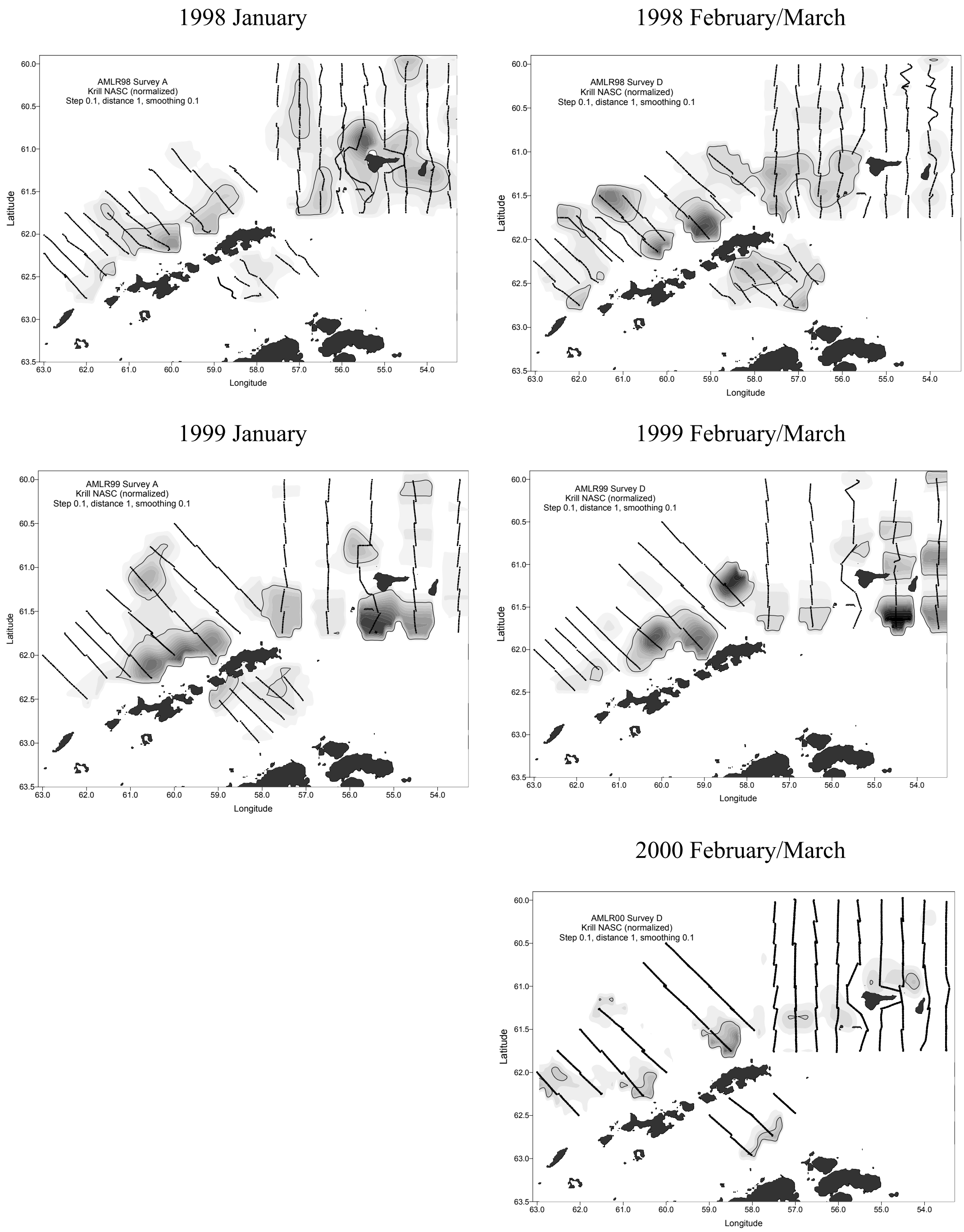
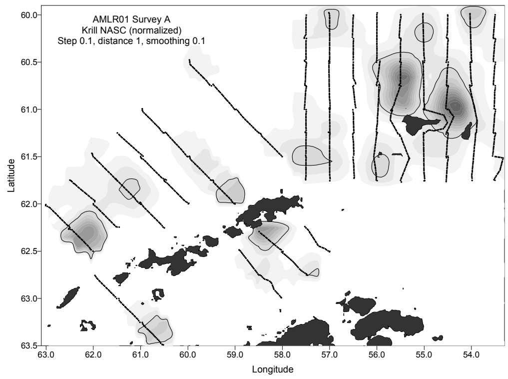


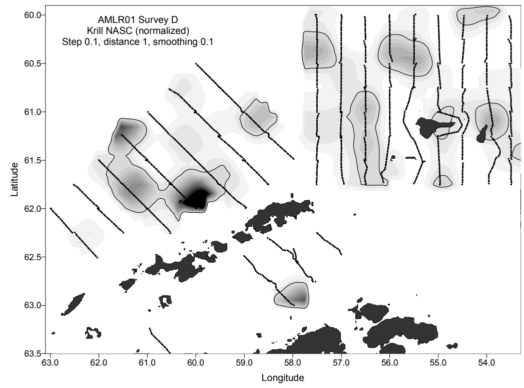
Figure 7: Relative densities of krill in Subarea 48.1 obtained from eight acoustic surveys by the US AMLR Program between 1998 and 2002. Thick lines indicate survey transects. Thin lines denote areas of relative high concentrations of krill. Parameters show the values used in 'Tracks and Fields' for smoothing and normalising the data.

Figure 7 continued

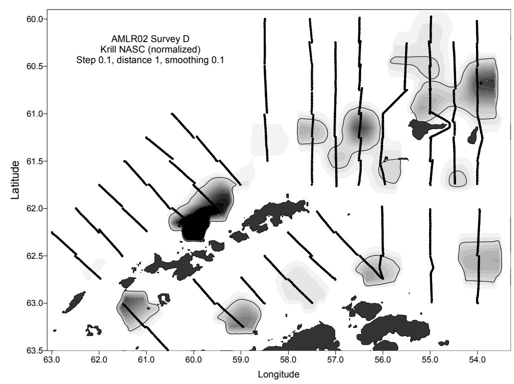
2001 January



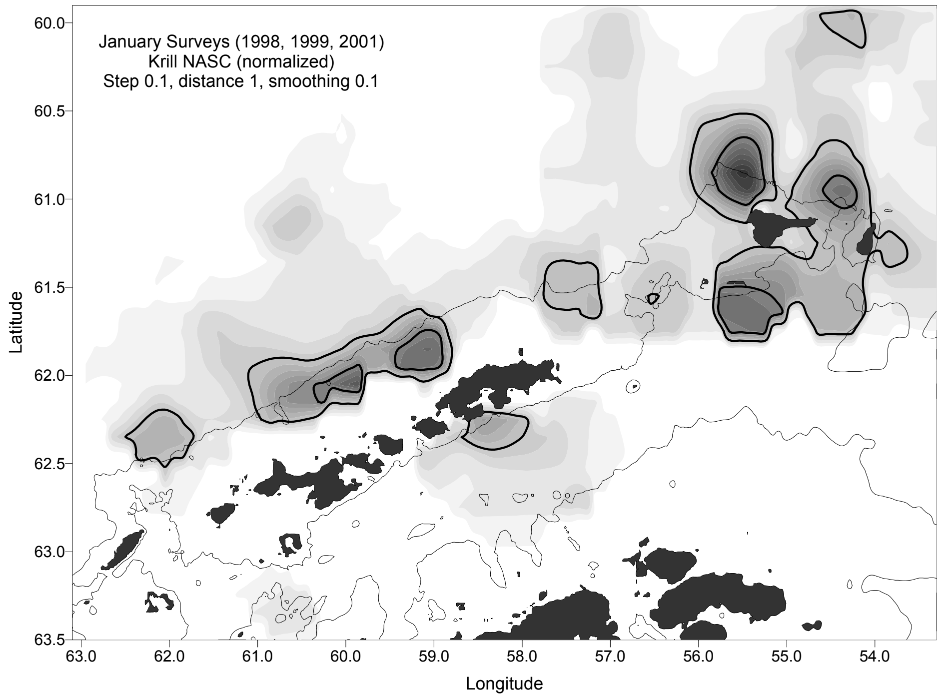
2001 February/March



2002 February/March



January (1998, 1999, 2001)



February–March (1998–2002)

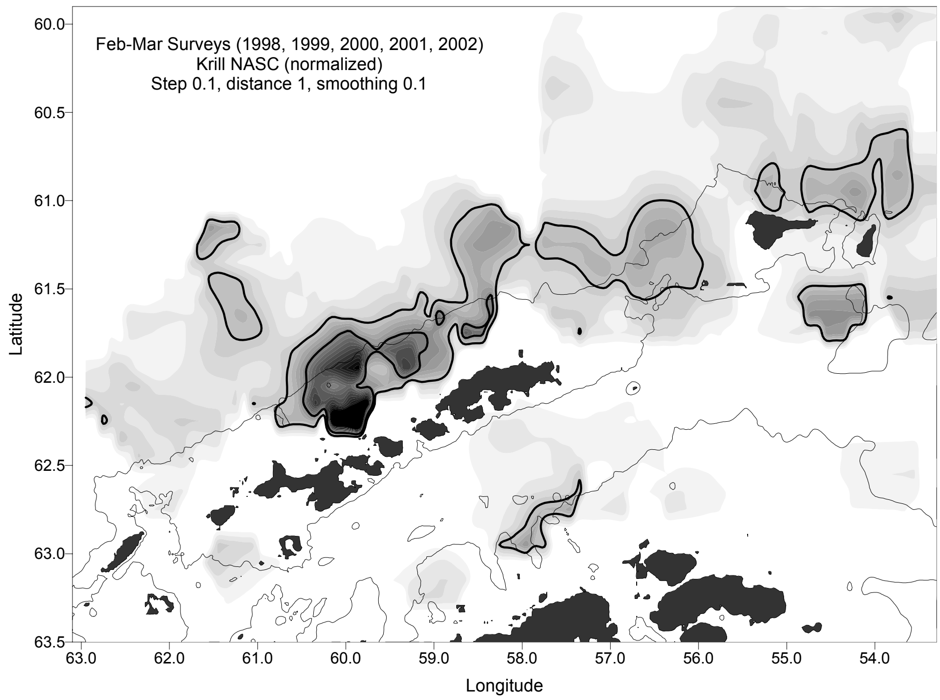


Figure 8: Relative densities of krill in Subarea 48.1 averaged over surveys by the US AMLR Program undertaken at the same time each year from 1998 to 2002. Thin lines indicate the 500 m isobath. Thick lines denote areas of relative high concentrations of krill. Parameters show the values used in 'Tracks and Fields' for smoothing and normalising the data.

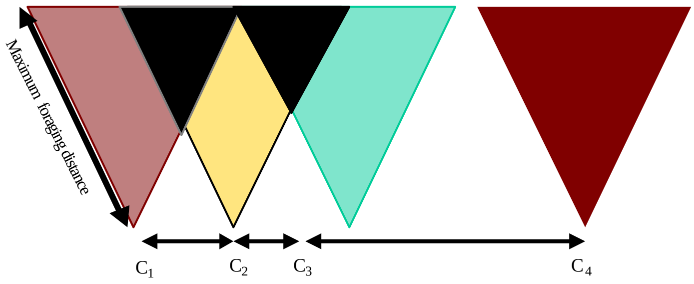
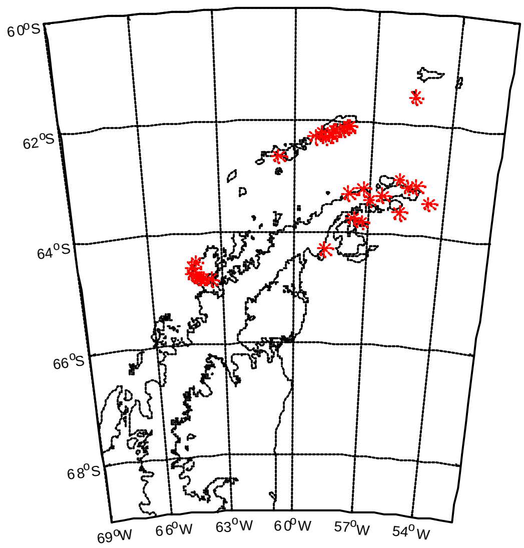


Figure 9: Colonies were considered to have a functional overlap where the distance between colonies was less than the maximum foraging distance. In this example, colonies C_1, C_2 and C_3 have a functional overlap.



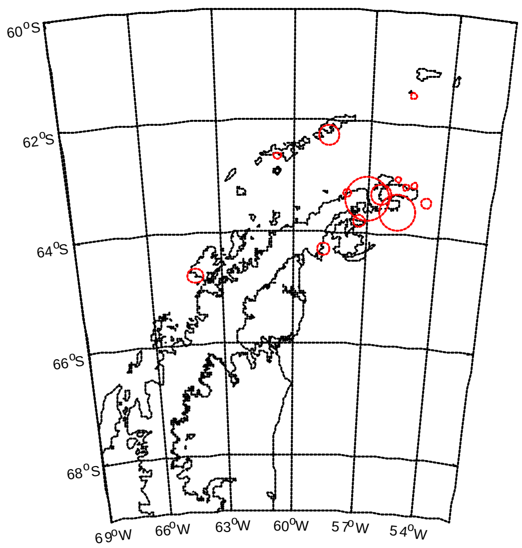


Figure 10: Adélie penguins in Subarea 48.1 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

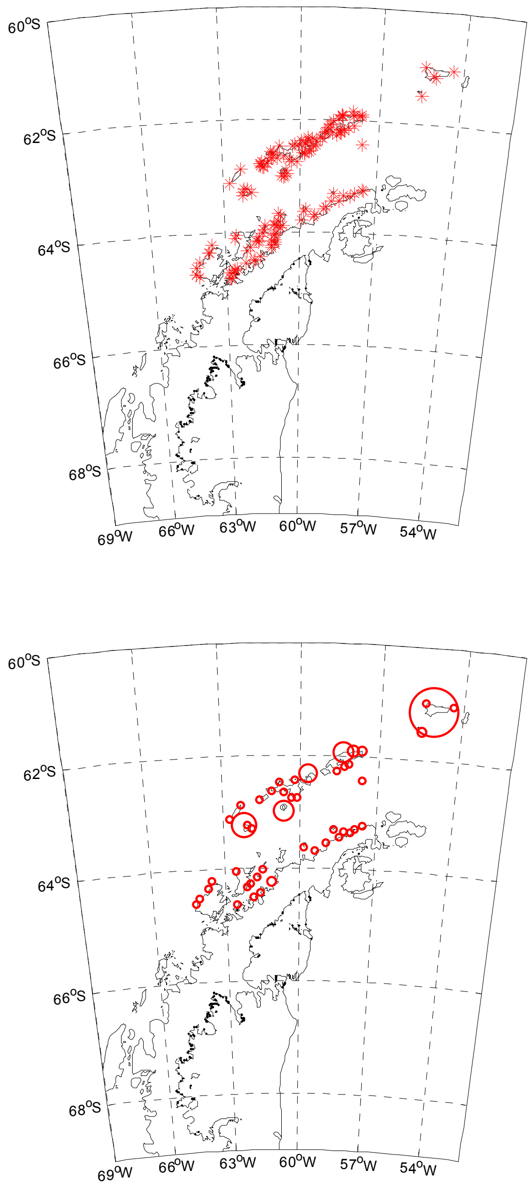


Figure 11: Chinstrap penguins in Subarea 48.1 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

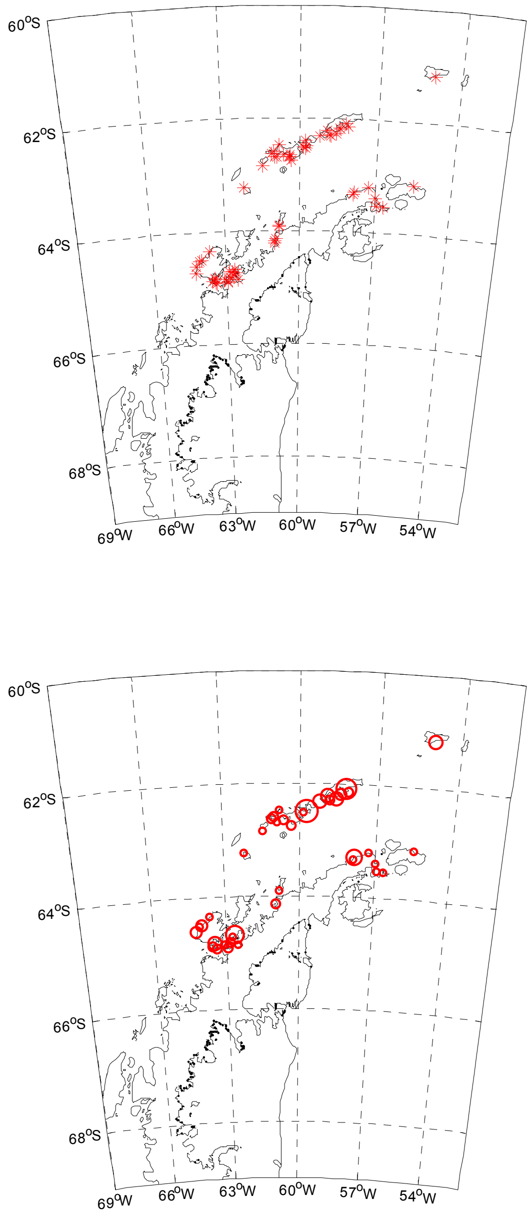


Figure 12: Gentoo penguins in Subarea 48.1 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

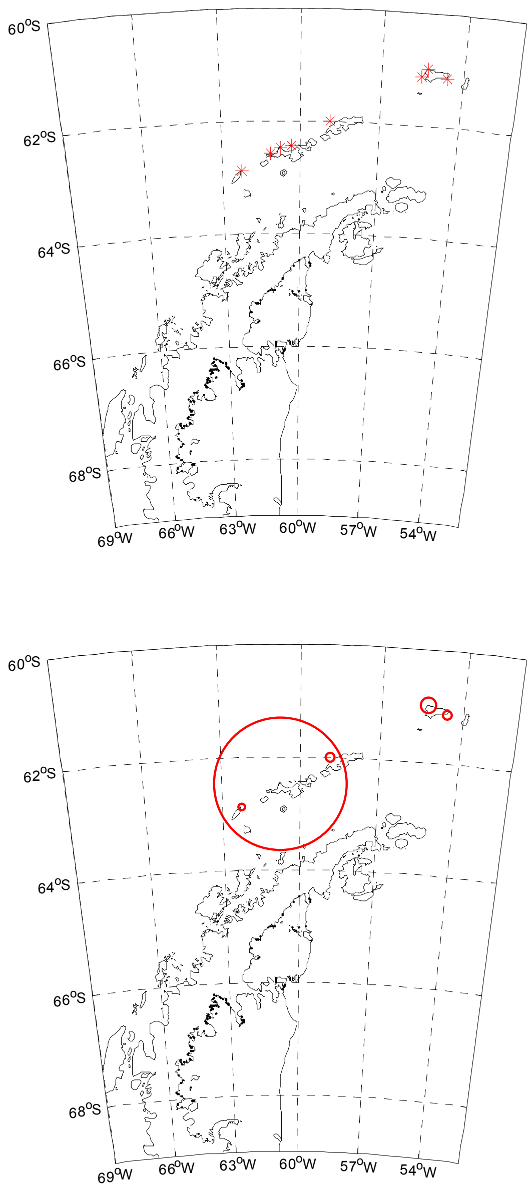
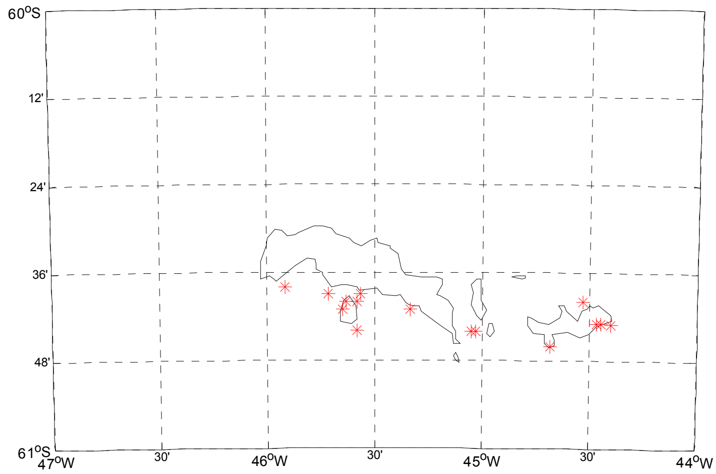


Figure 13: Antarctic fur seals in Subarea 48.1 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).



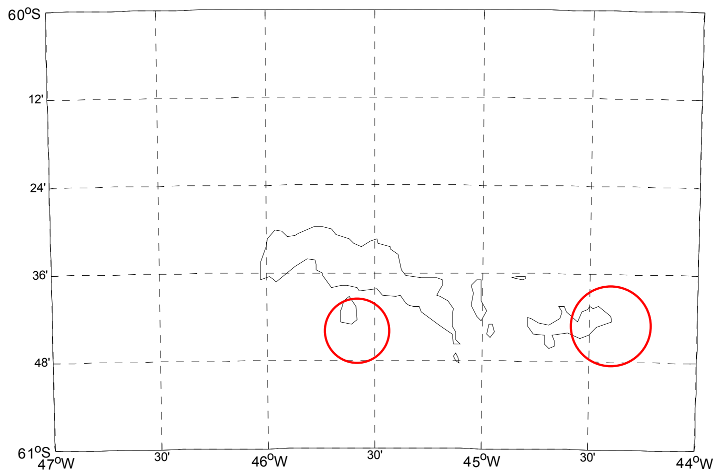


Figure 14: Adélie penguins in Subarea 48.2 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

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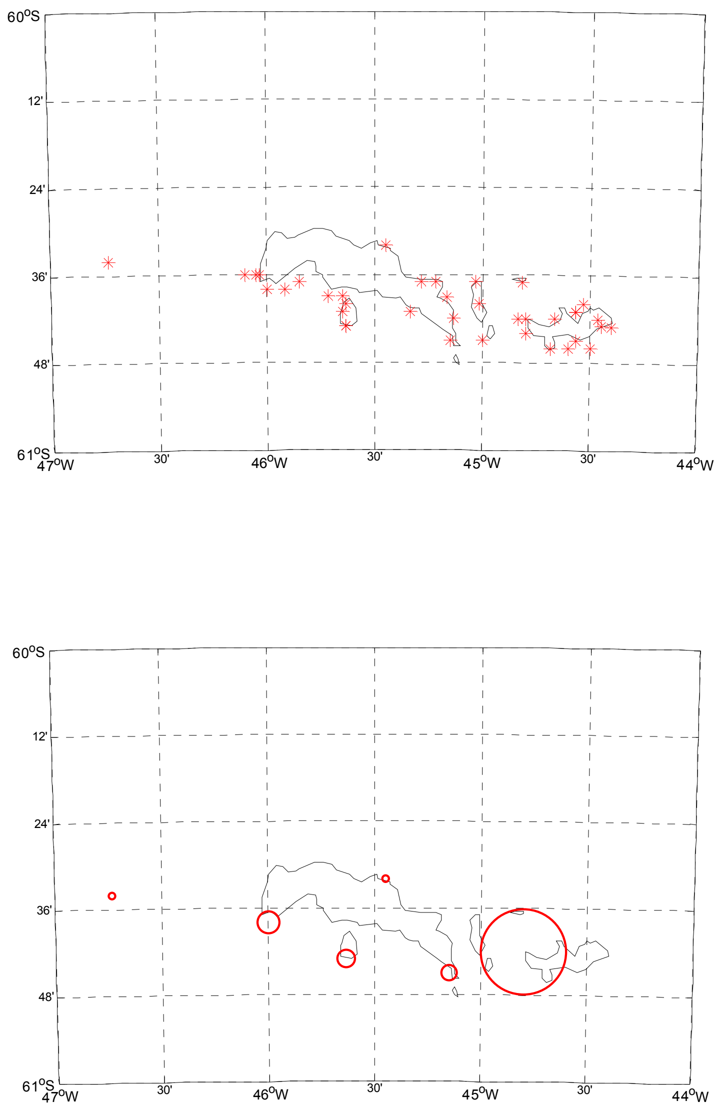


Figure 15: Chinstrap penguins in Subarea 48.2 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

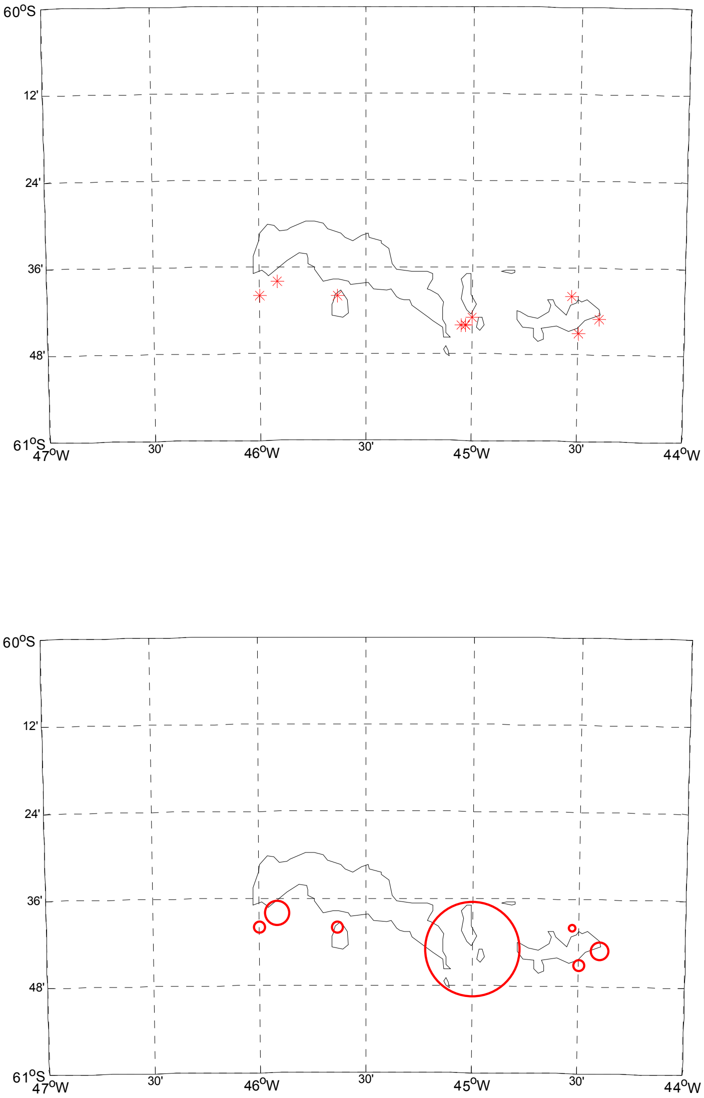


Figure 16: Gentoo penguins in Subarea 48.2 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

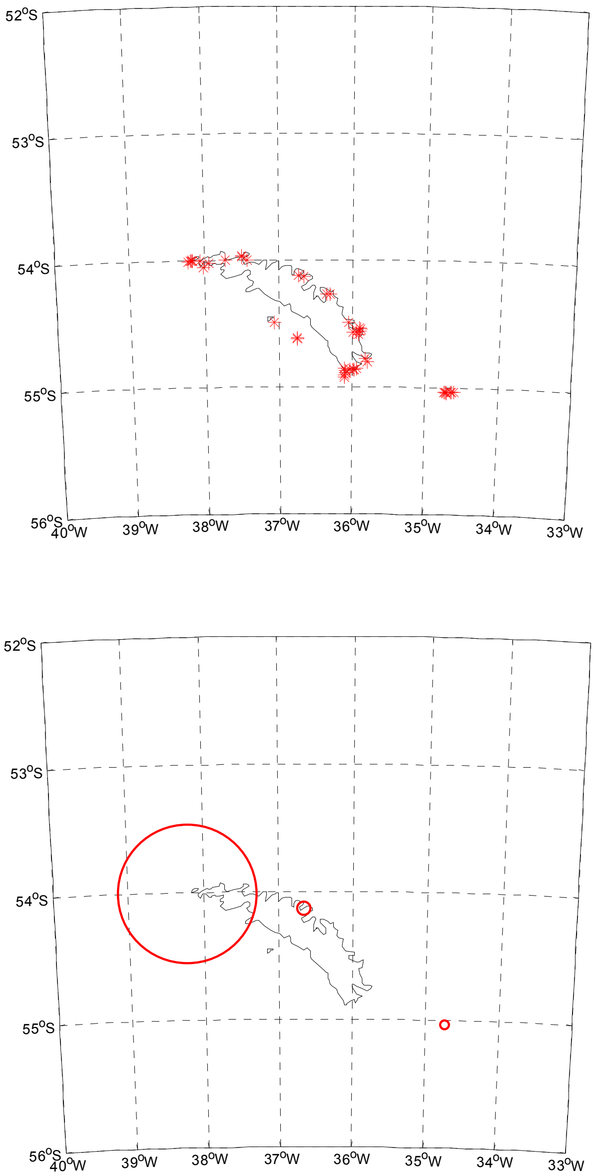
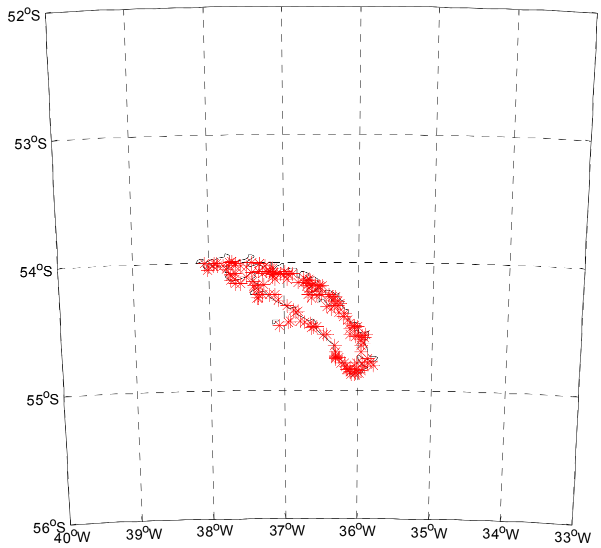


Figure 17: Macaroni penguins in Subarea 48.3 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).



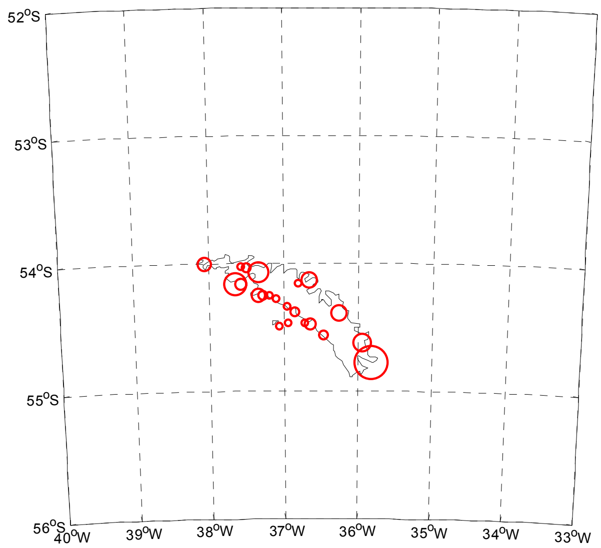


Figure 18: Gentoo penguins in Subarea 48.3 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

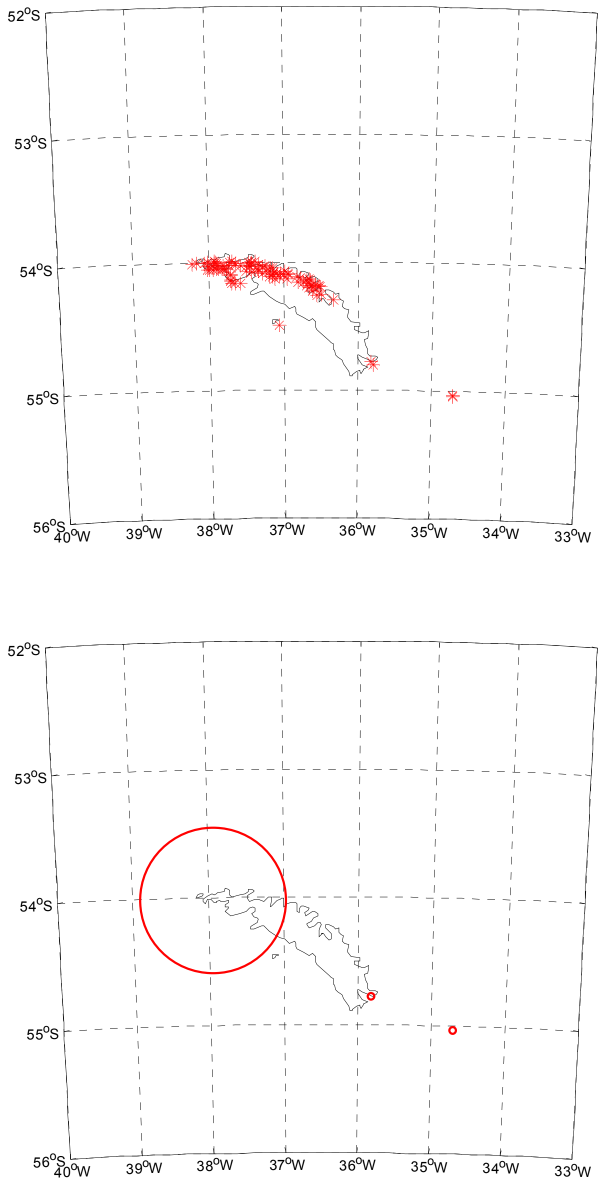


Figure 19: Antarctic fur seals in Subarea 48.3 – distribution of colonies and centres of biomass (stars indicate colony locations, size of circles indicates relative biomass).

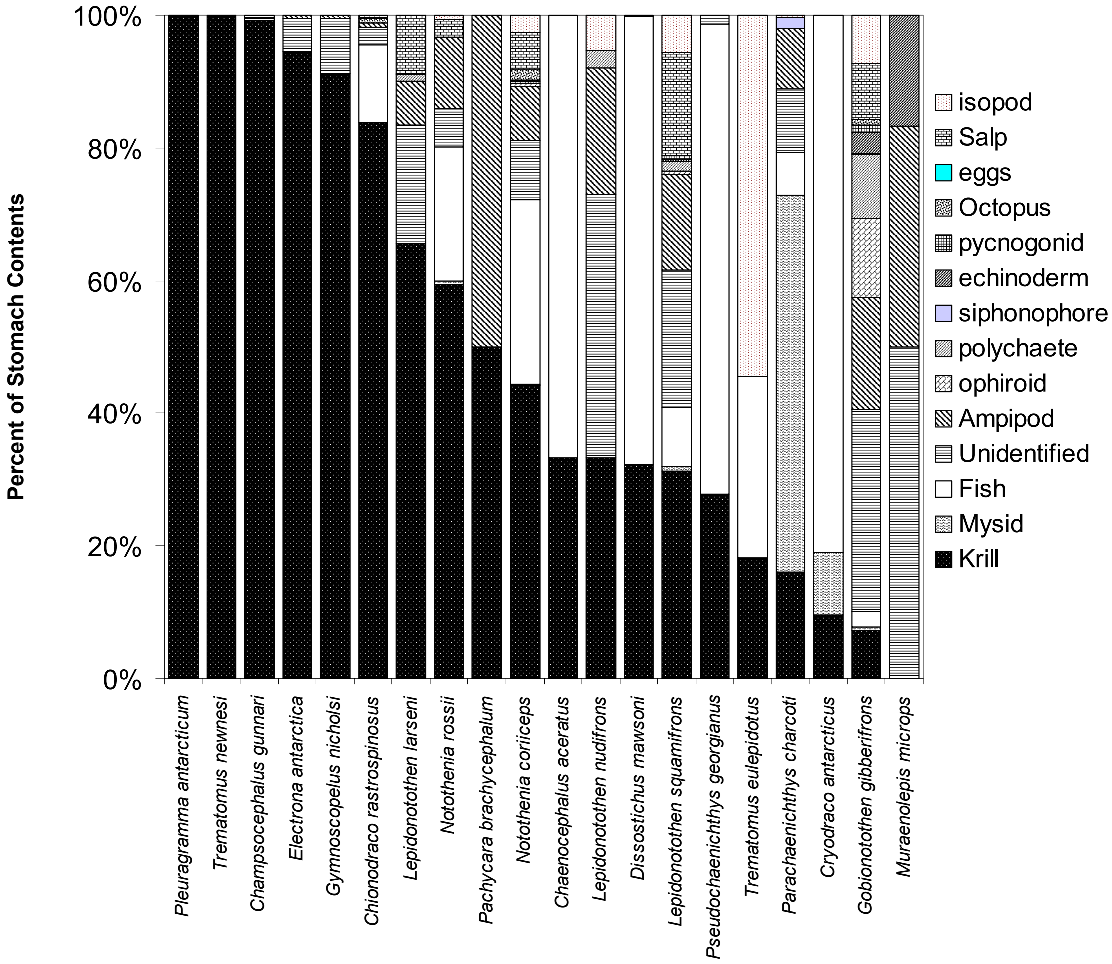
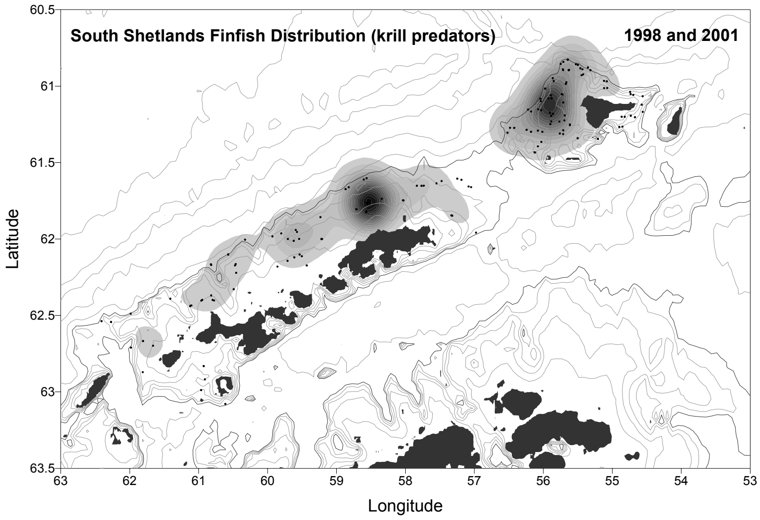
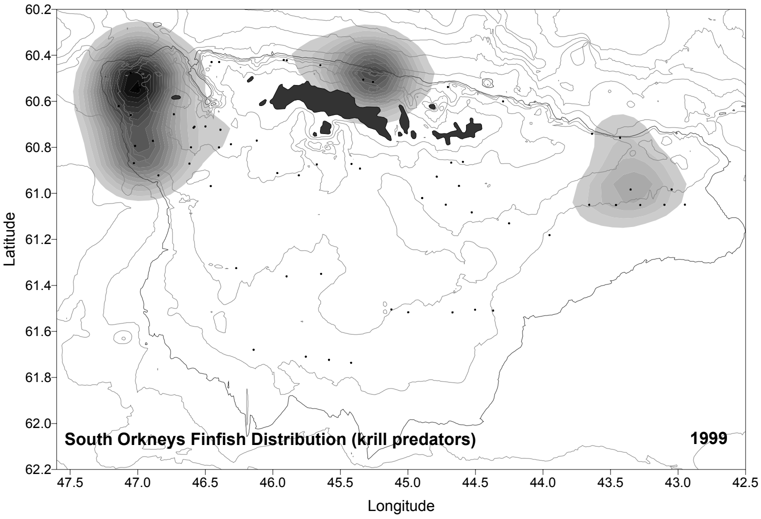


Figure 20: Summary of diet composition of 20 species of finfish, based on mean stomach content scores, from US AMLR finfish bottom trawl surveys conducted in the South Shetland Islands in 2001 (C. Jones, unpublished data).

(a)



(b)



(c)

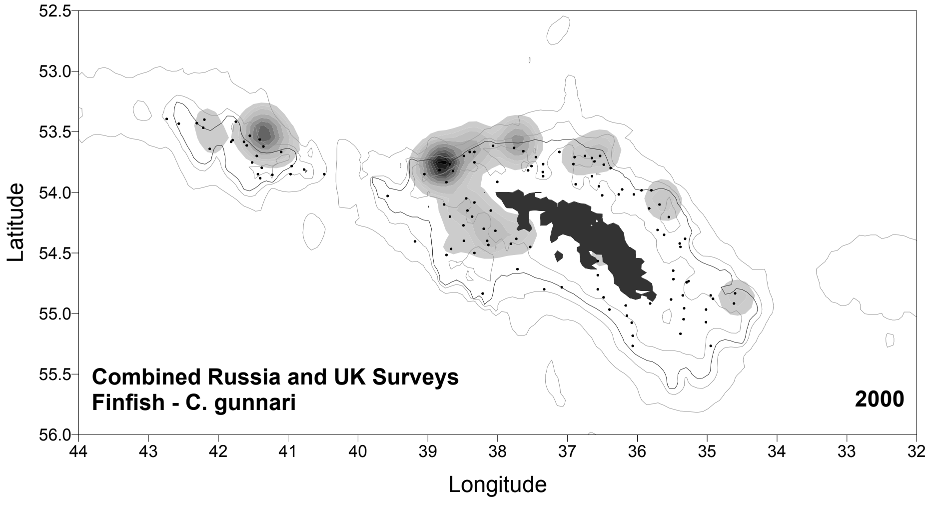


Figure 21: Spatial distribution of normalised krill-eating finfish around (a) South Shetland Islands (C. Jones, unpublished data), (b) the South Orkney Islands (C. Jones, unpublished data), and (c) South Georgia (CCAMLR database). Solid bathymetric line is the 500 m contour.

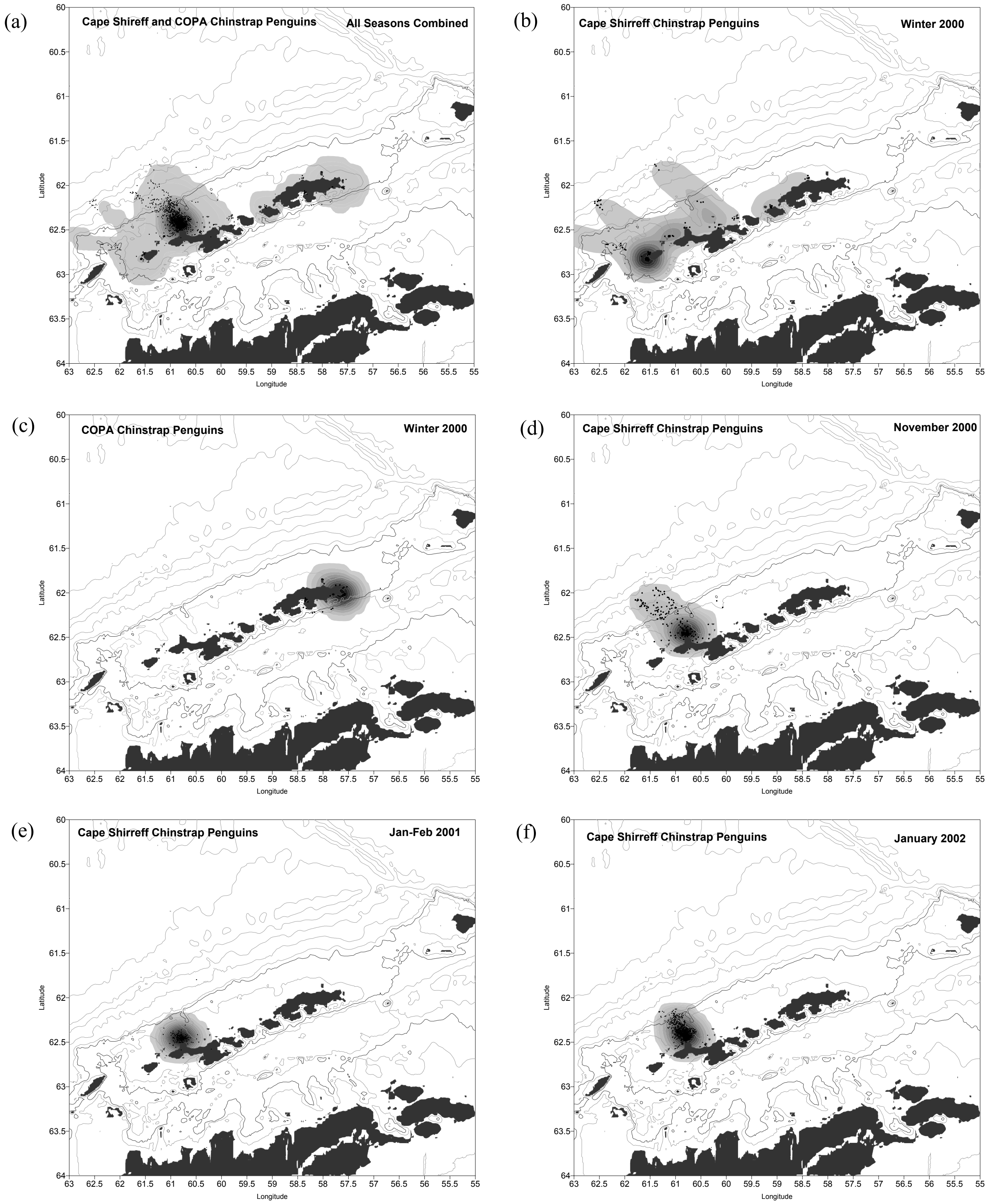


Figure 22: Foraging locations of chinstrap penguins in the South Shetland Islands (W. Trivelpiece, unpublished data): (a) Composite foraging distribution of penguins monitored at Cape Shirreff and Copa over the breeding and winter seasons from 2000 to 2002, (b) winter distribution (February to May 2000) of penguins tagged at Cape Shirreff, (c) winter foraging distribution of penguins from the Copa colony on King George Island from February to May 2000, (d) foraging distribution of penguins from Cape Shirreff during the incubation period in November 2000, (e) foraging distribution of penguins from Cape Shirreff during the chick-rearing stage in 2001, and (f) as for (e) but in 2002. Solid bathymetric line is the 500 m contour.

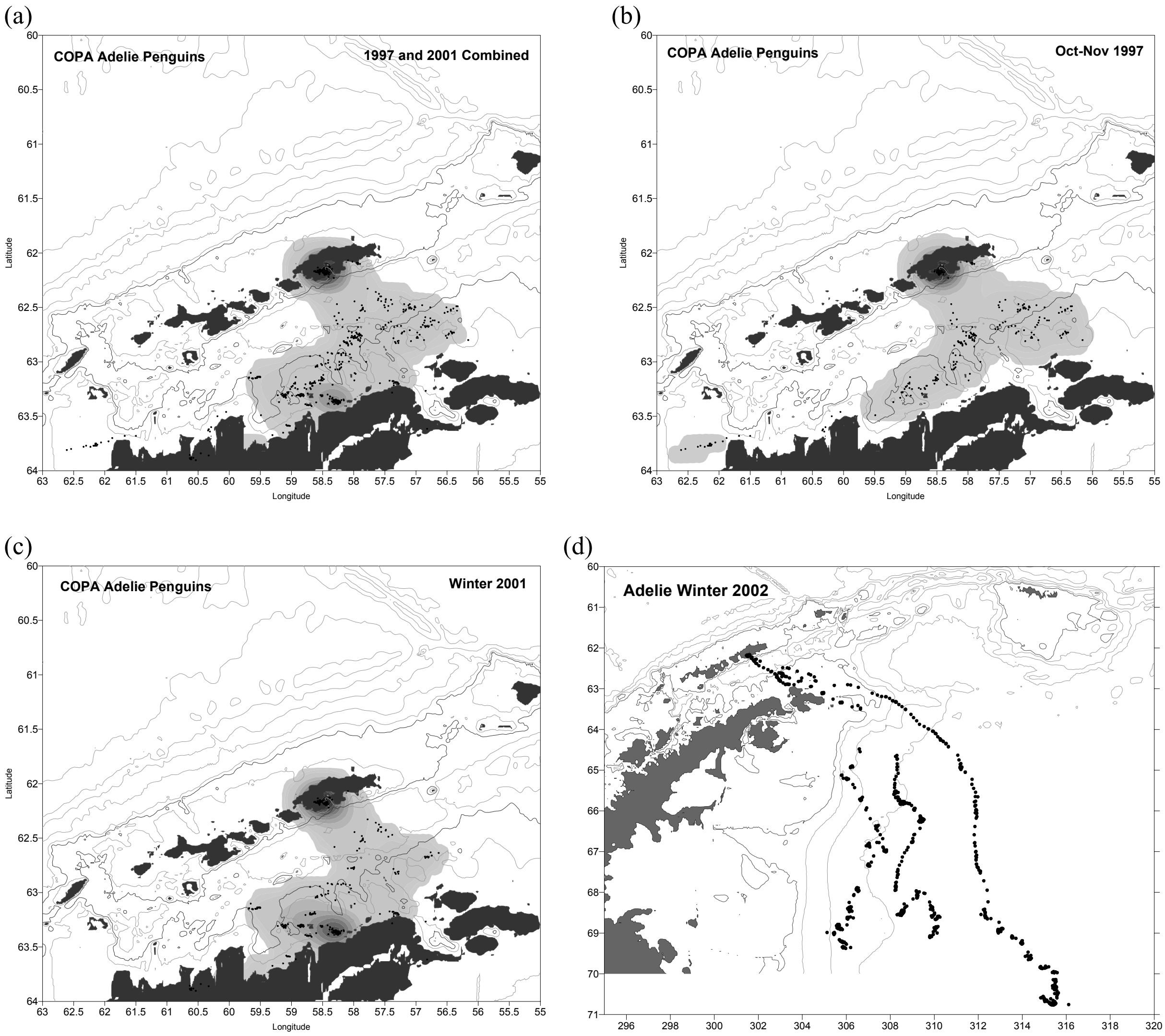


Figure 23: Foraging locations of Adélie penguins in the South Shetland Islands (W. Trivelpiece, unpublished data): (a) Combined winter and incubation period data for penguins at the Copa colony, King George Island, (b) foraging distributions of Adélie penguins from the Copa colony following clutch completion in November 1997, (c) early winter foraging distributions of penguins tagged at the Copa colony in 2001, (d) as for (c) but in 2002. Solid bathymetric line is the 500 m contour.

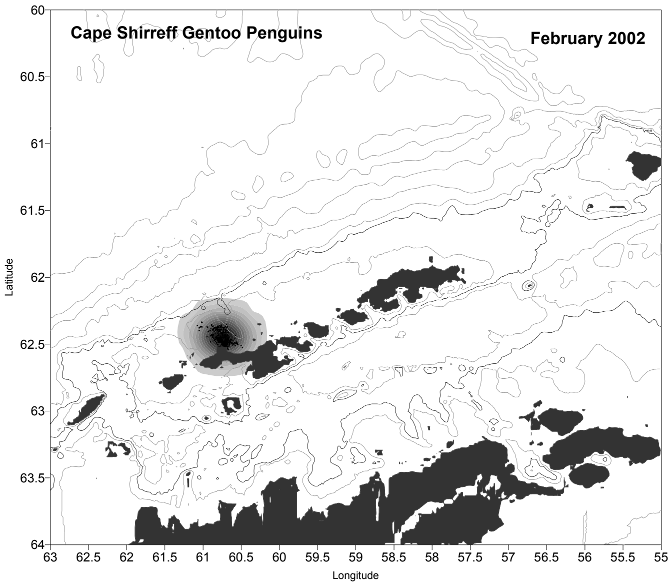


Figure 24: Foraging distribution of gentoo penguins in the South Shetland Islands during the chick-rearing period in 2002. Solid bathymetric line is the 500 m contour (W. Trivelpiece, unpublished data).

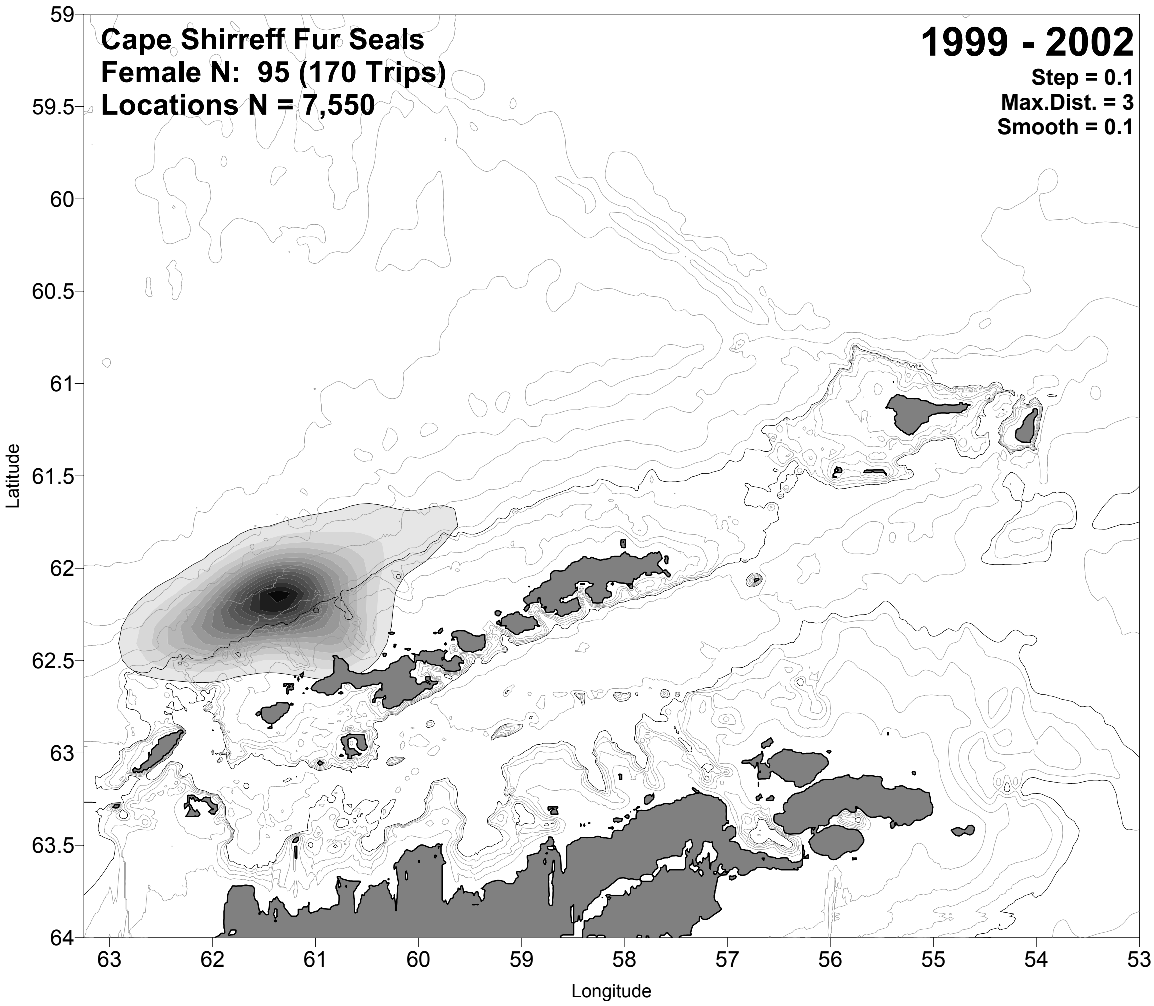


Figure 25: A shaded smoothed density plot for all at-sea locations of female Antarctic fur seals from 1999 to 2002 (N = 7 550 locations). The South Shetland Islands and the Antarctic Peninsula (lower right) are shaded dark grey. Isobaths are plotted for every 100 m up to 500 m and from every 1 000 m thereafter. The continental shelf break at 500 m is plotted with a heavier line. Fur seal locations were centred at the continental shelf slope and the highest densities of locations were found approximately 40 km northwest of Cape Shirreff. A line is drawn around the smoothed density plot at the 95 percentile.

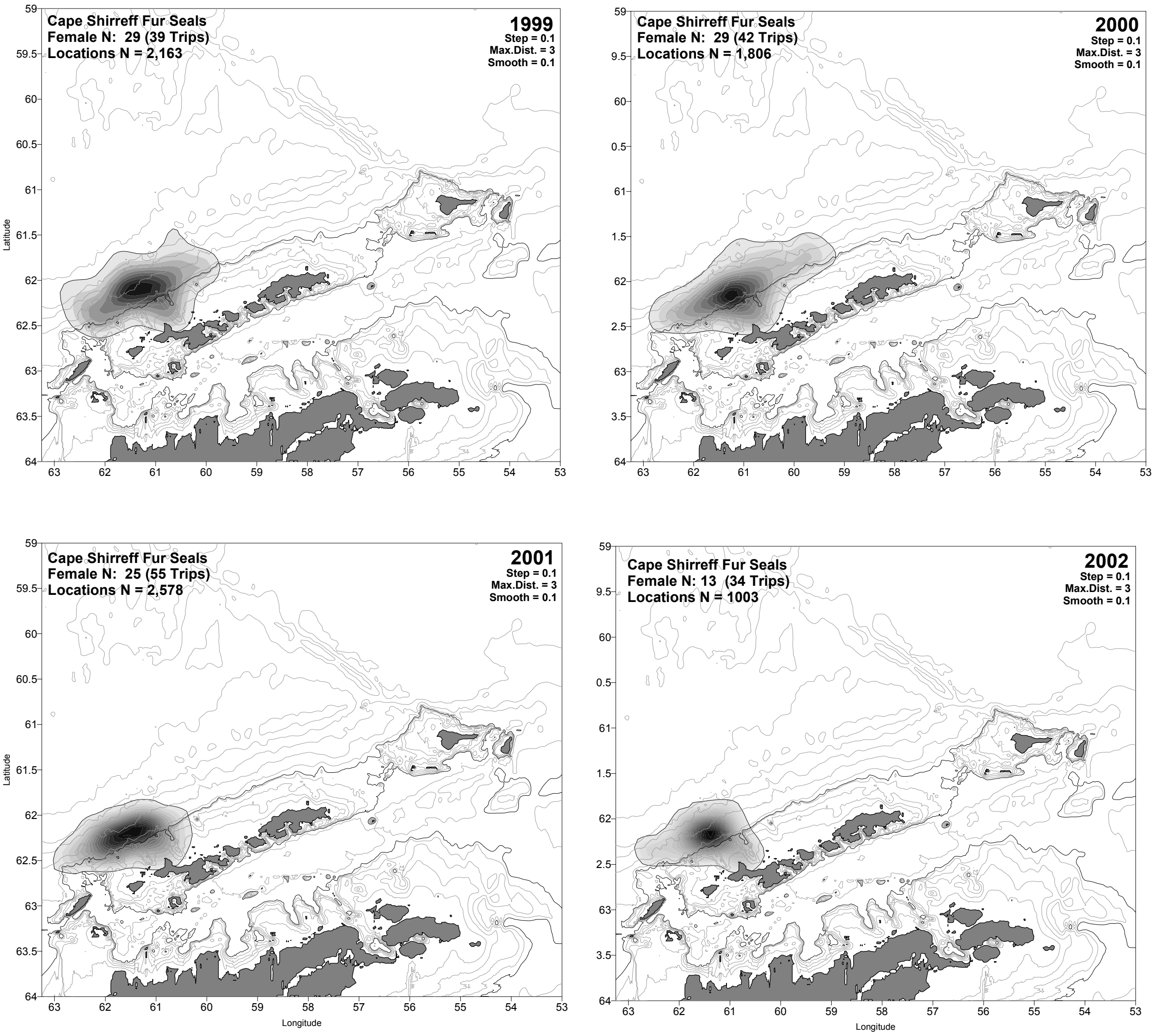


Figure 26: Shaded smoothed density plots of foraging areas as in Figure 25 for Antarctic fur seals tagged at Cape Shirreff in each year of the study. The year is identified at the top right in each plot. Although distributions and mean ranges varied by year, all four years had their highest densities of fur seal locations in the same general area (i.e. the continental shelf slope area) ~40 km northwest of Cape Shirreff.

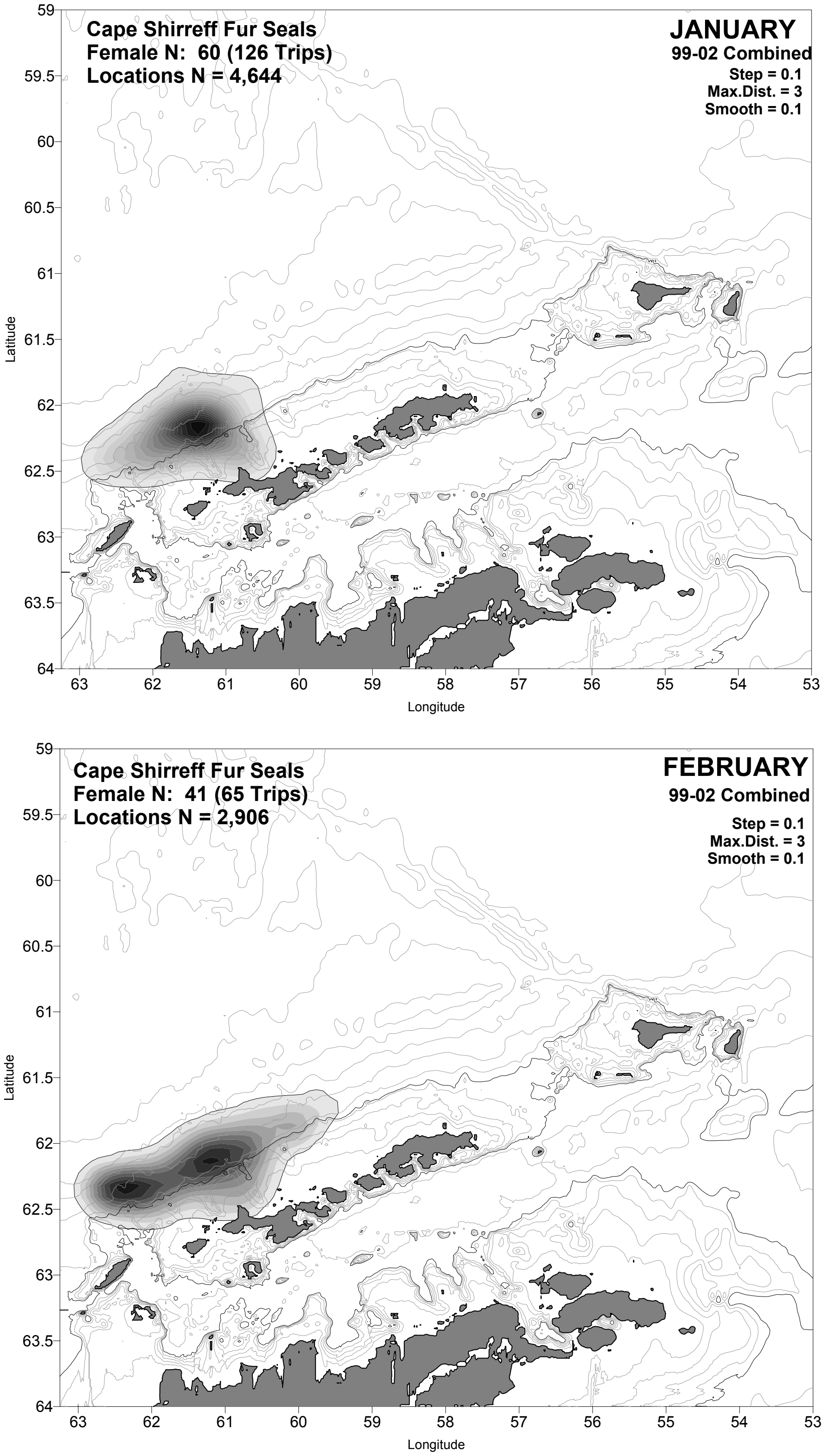


Figure 27: An intra-seasonal comparison of foraging fur seal locations at sea from seals tagged at Cape Shirreff, Livingston Island. All years (1999–2002) are combined; data for each year are normalised. The month is identified at the top right in each plot. The distribution of locations in February was broader than in January, was bimodal and was on average further west. However in both months the highest densities of fur seal locations were centred over the continental shelf slope area.

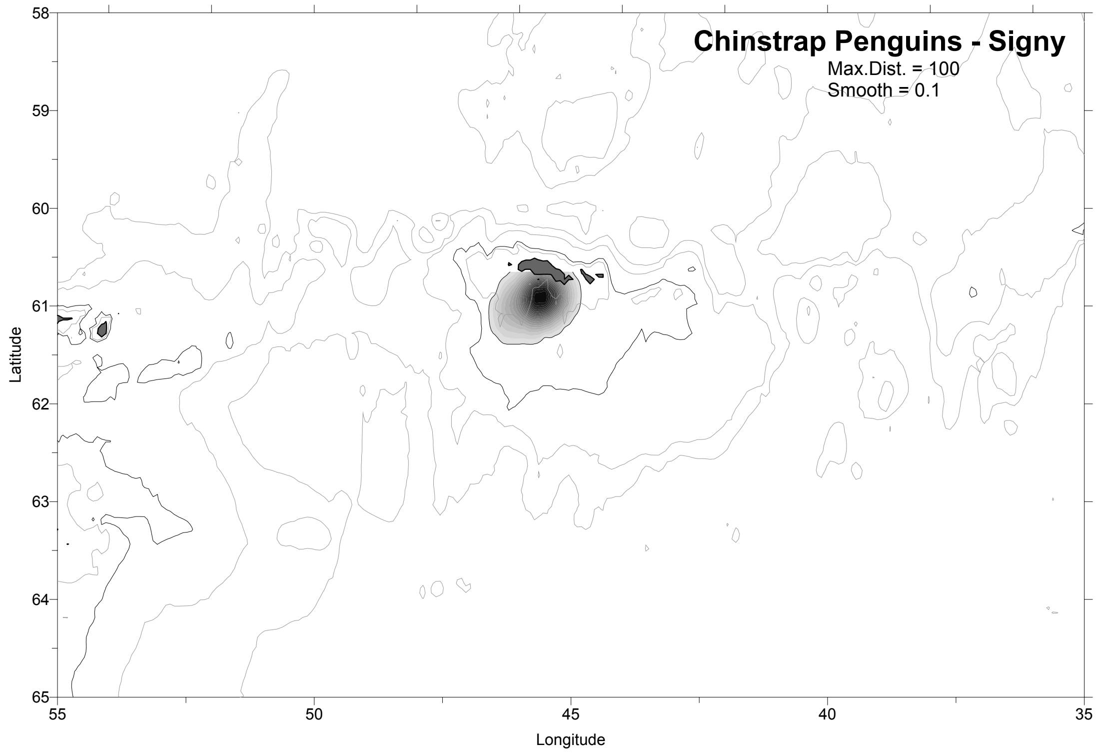


Figure 28: Average summer foraging distribution of chinstrap penguins tagged at Signy Island between 2000 and 2001 (see Table 6). The solid bathymetric line is the 500 m contour. A line is drawn around the smoothed density plot at the 95 percentile.

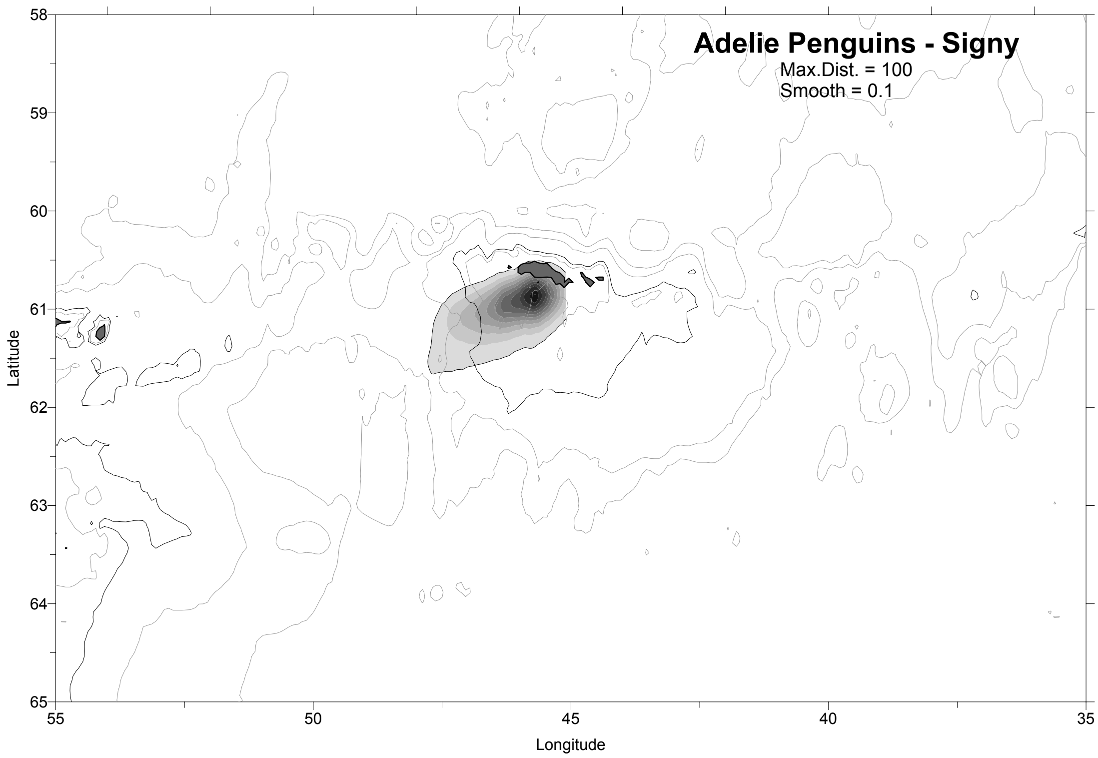


Figure 29: Average summer foraging distribution of Adélie penguins tagged at Signy Island between 2000 and 2001 (see Table 5). The solid bathymetric line is the 500 m contour. A line is drawn around the smoothed density plot at the 95 percentile.

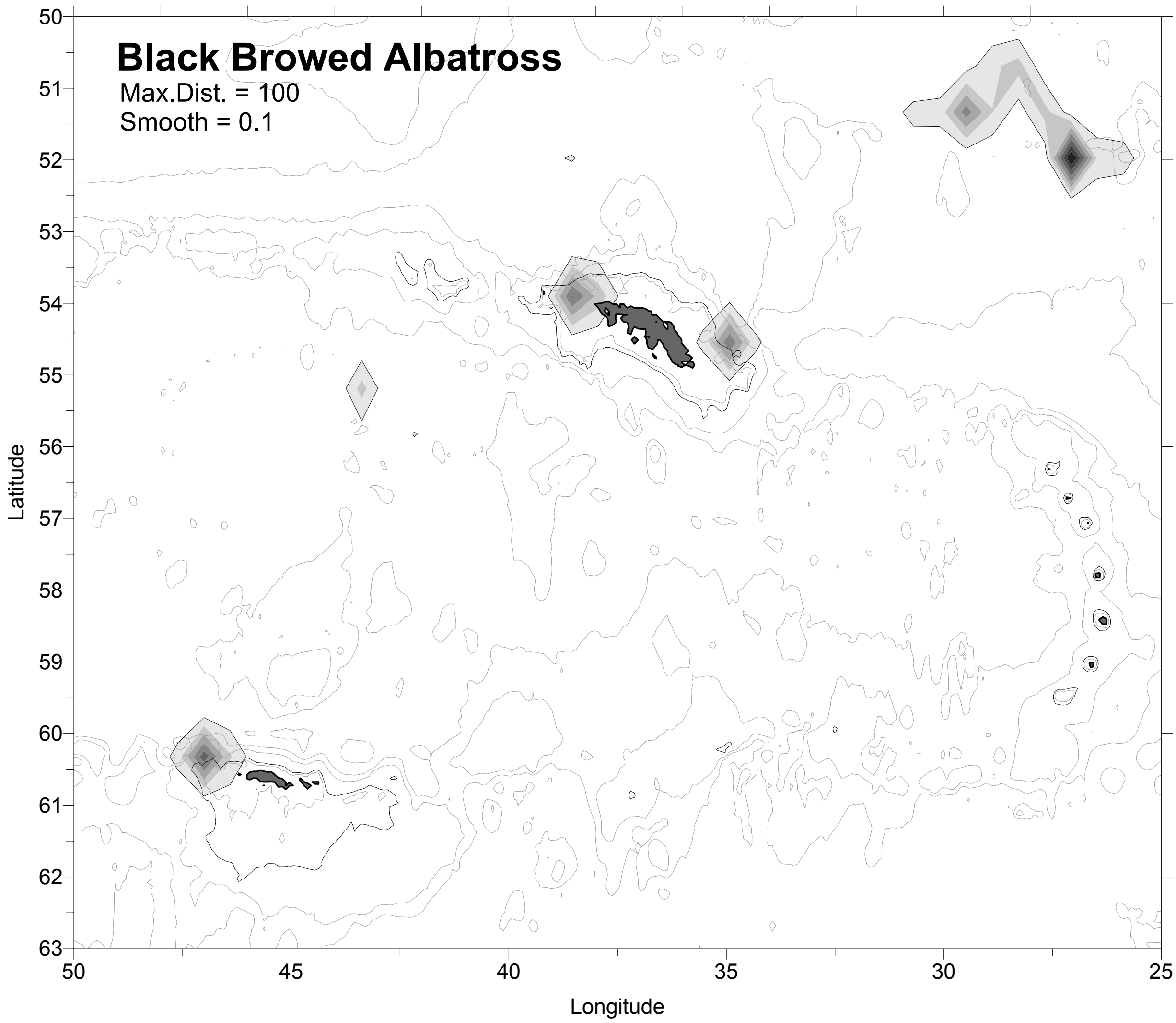


Figure 30: Average summer foraging distribution of black-browed albatrosses tagged at Bird Island during the breeding season between 1992 and 1997 (see Table 8). The solid bathymetric line is the 500 m contour. A line is drawn around the smoothed density plot at the 95 percentile.

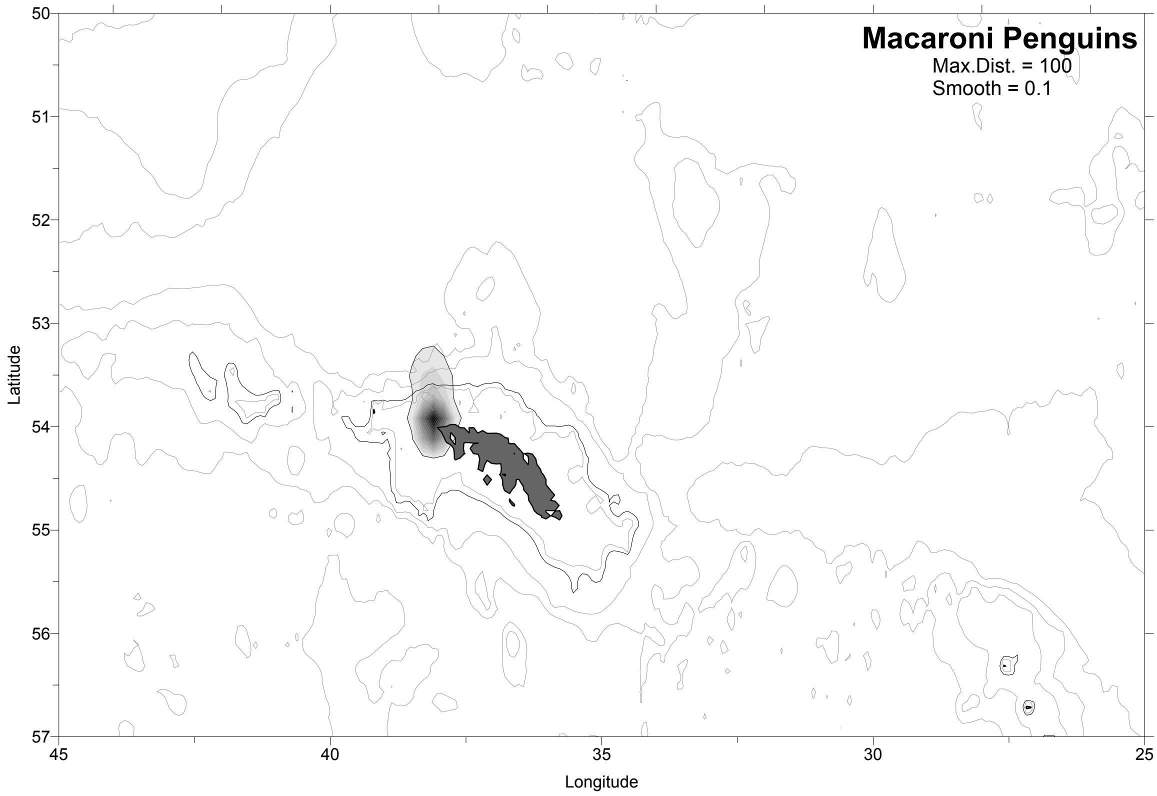


Figure 31: Average summer foraging distribution of macaroni penguins tagged at Bird Island between 1999 and 2001 (see Table 7). The solid bathymetric line is the 500 m contour.

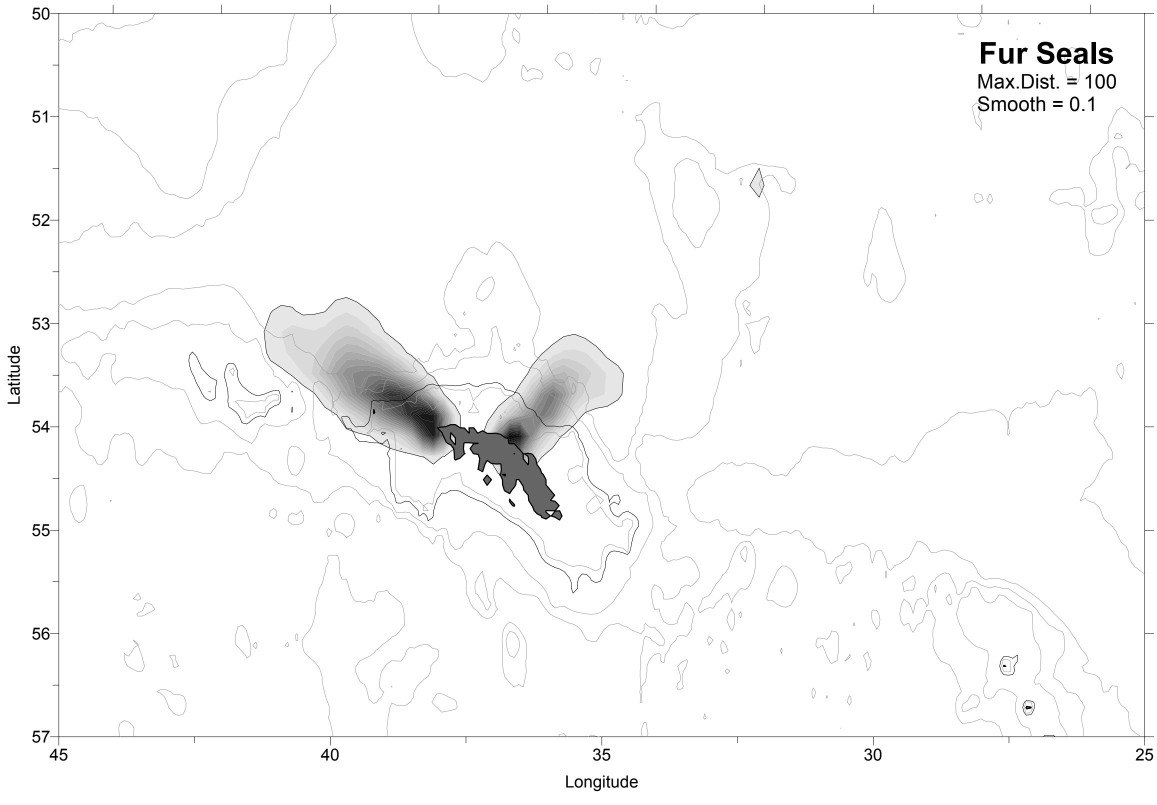


Figure 32: Average summer foraging distribution of Antarctic fur seals tagged at South Georgia between 1996 and 2001 (see Tables 4 and 9). The solid bathymetric line is the 500 m contour.

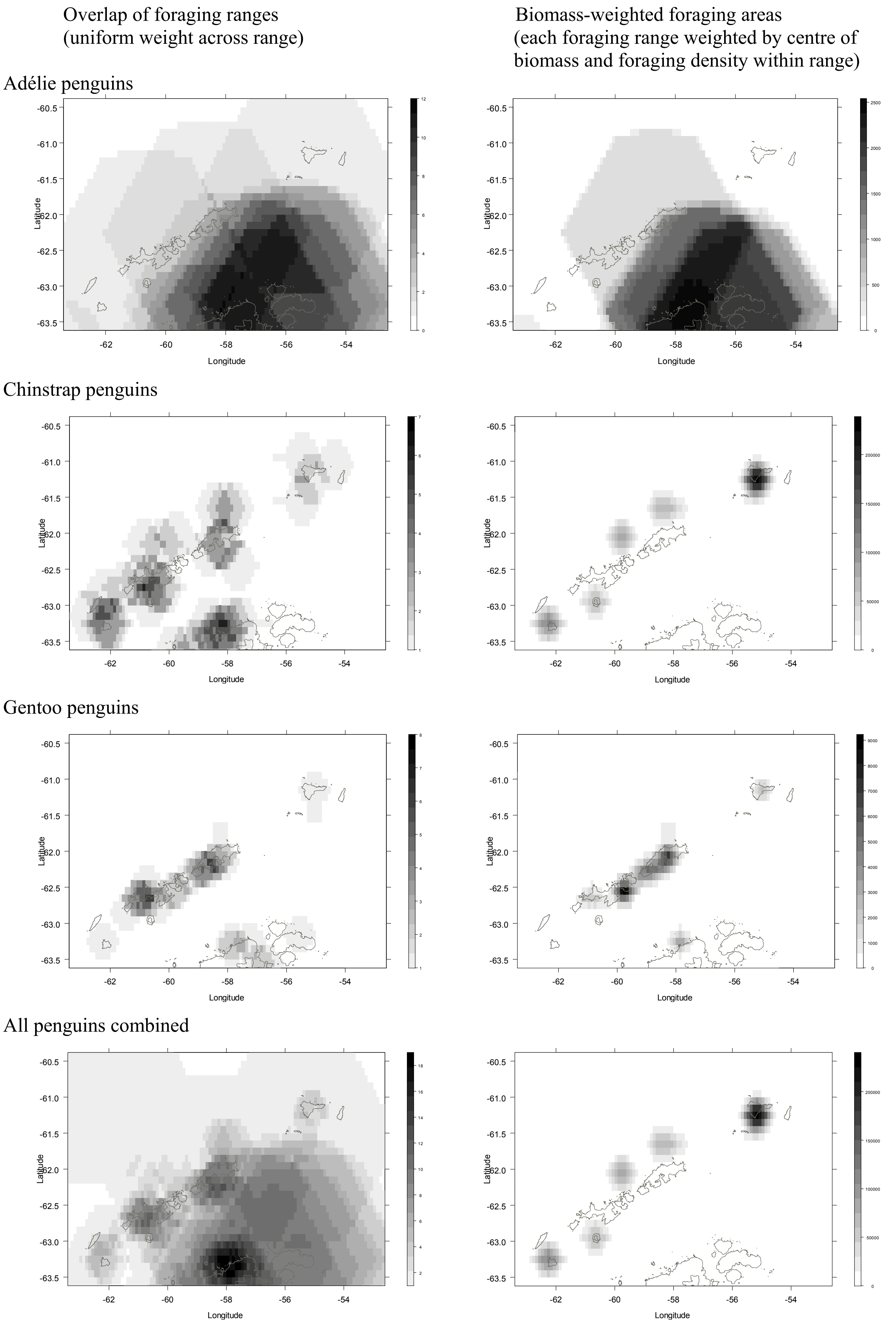
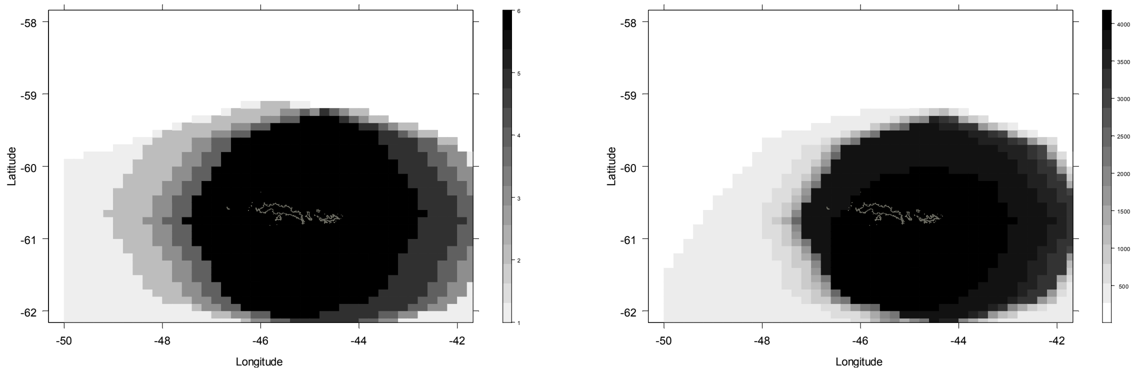


Figure 33: Extrapolated foraging areas for three land-based predator species in Subarea 48.1.

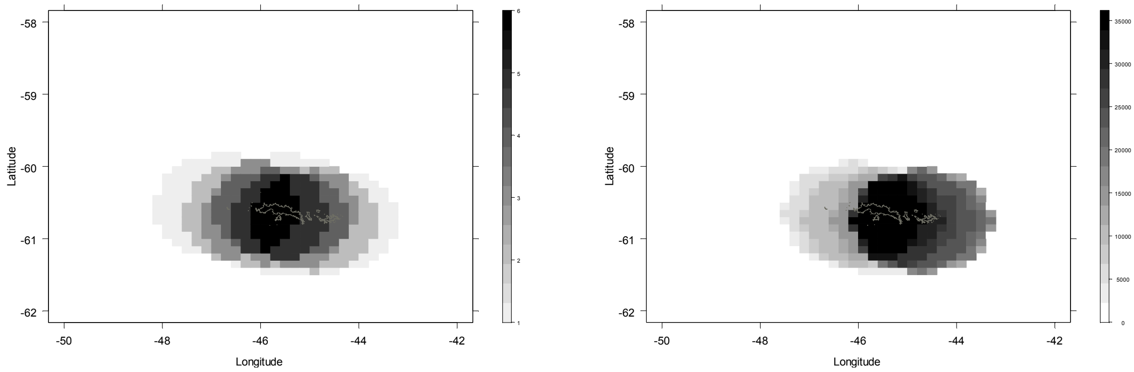
Overlap of foraging ranges
(uniform weight across range)

Biomass-weighted foraging areas
(each foraging range weighted by centre of biomass and foraging density within range)

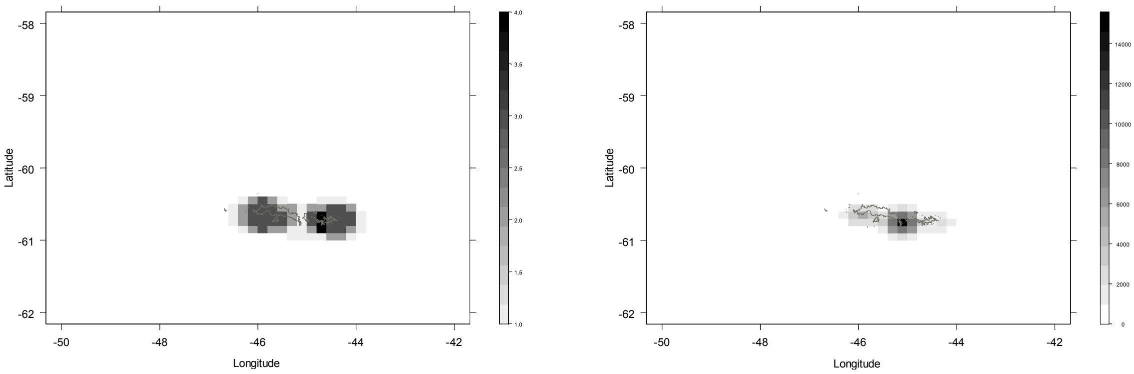
Adélie penguins



Chinstrap penguins



Gentoo penguins



All penguins combined

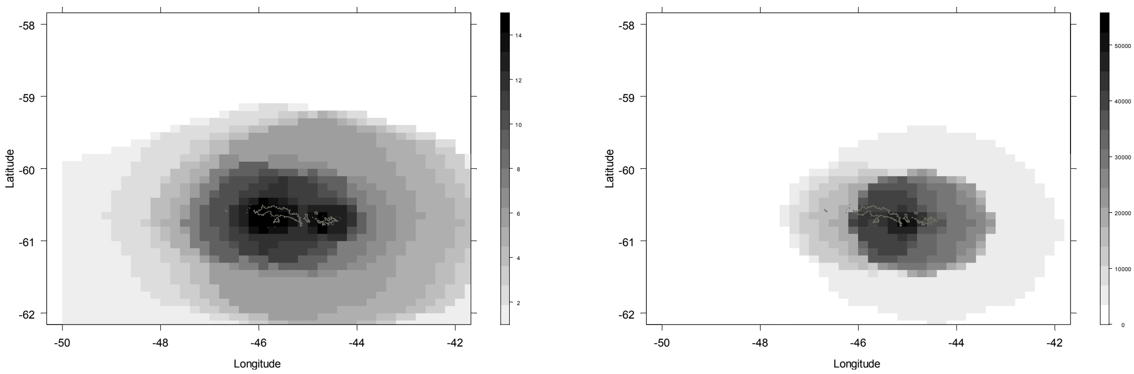
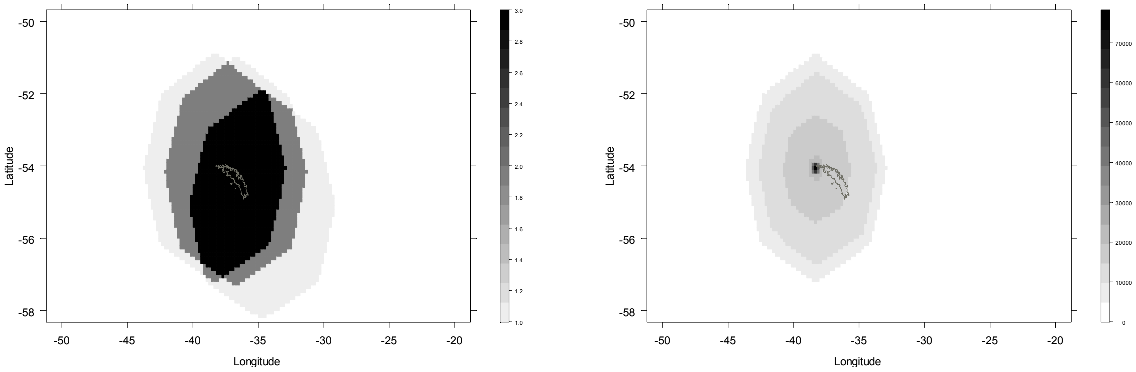


Figure 34: Extrapolated foraging areas for three land-based predator species in Subarea 48.2.

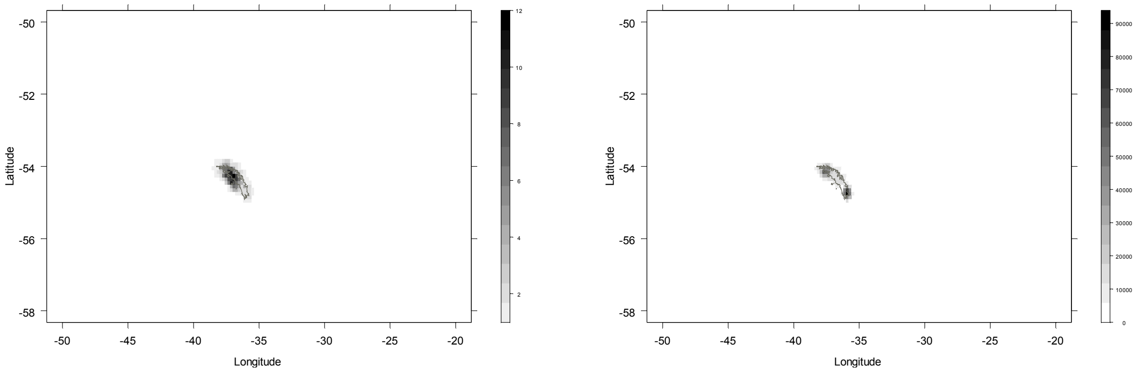
Overlap of foraging ranges
(uniform weight across range)

Biomass-weighted foraging areas
(each foraging range weighted by centre of biomass and foraging density within range)

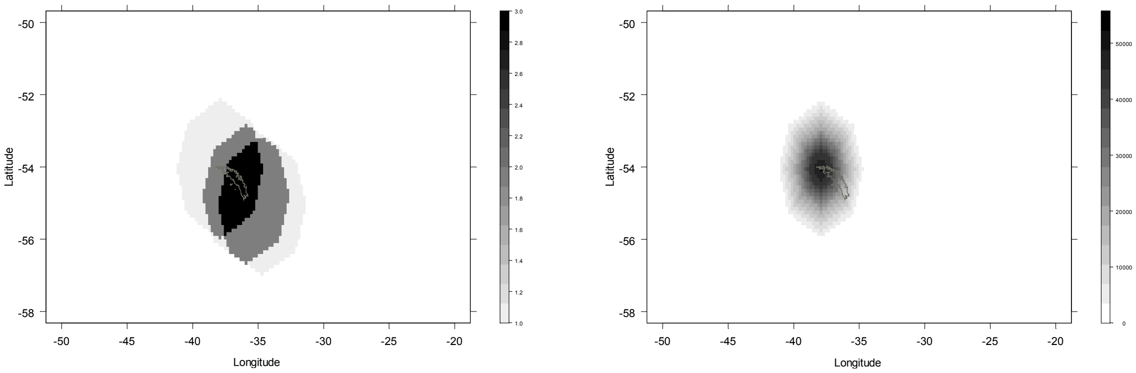
Macaroni penguins



Gentoo penguins



Antarctic fur seals



All species combined

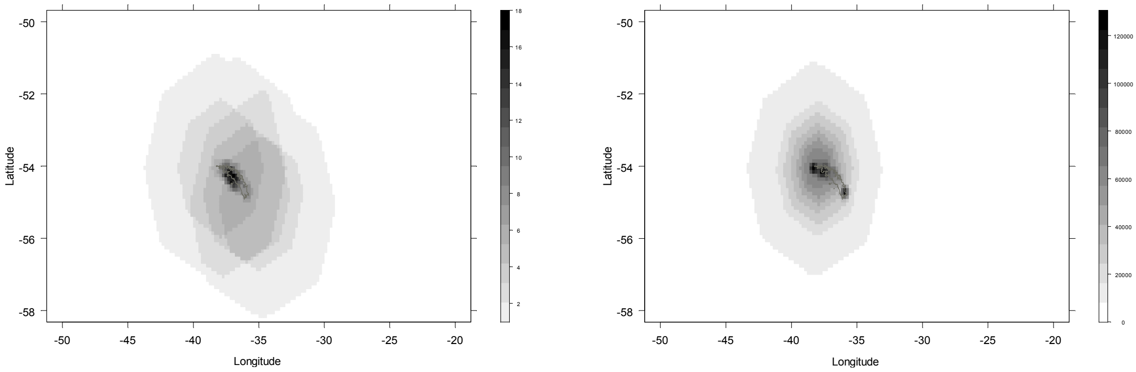


Figure 35: Extrapolated foraging areas for three land-based predator species in Subarea 48.3.

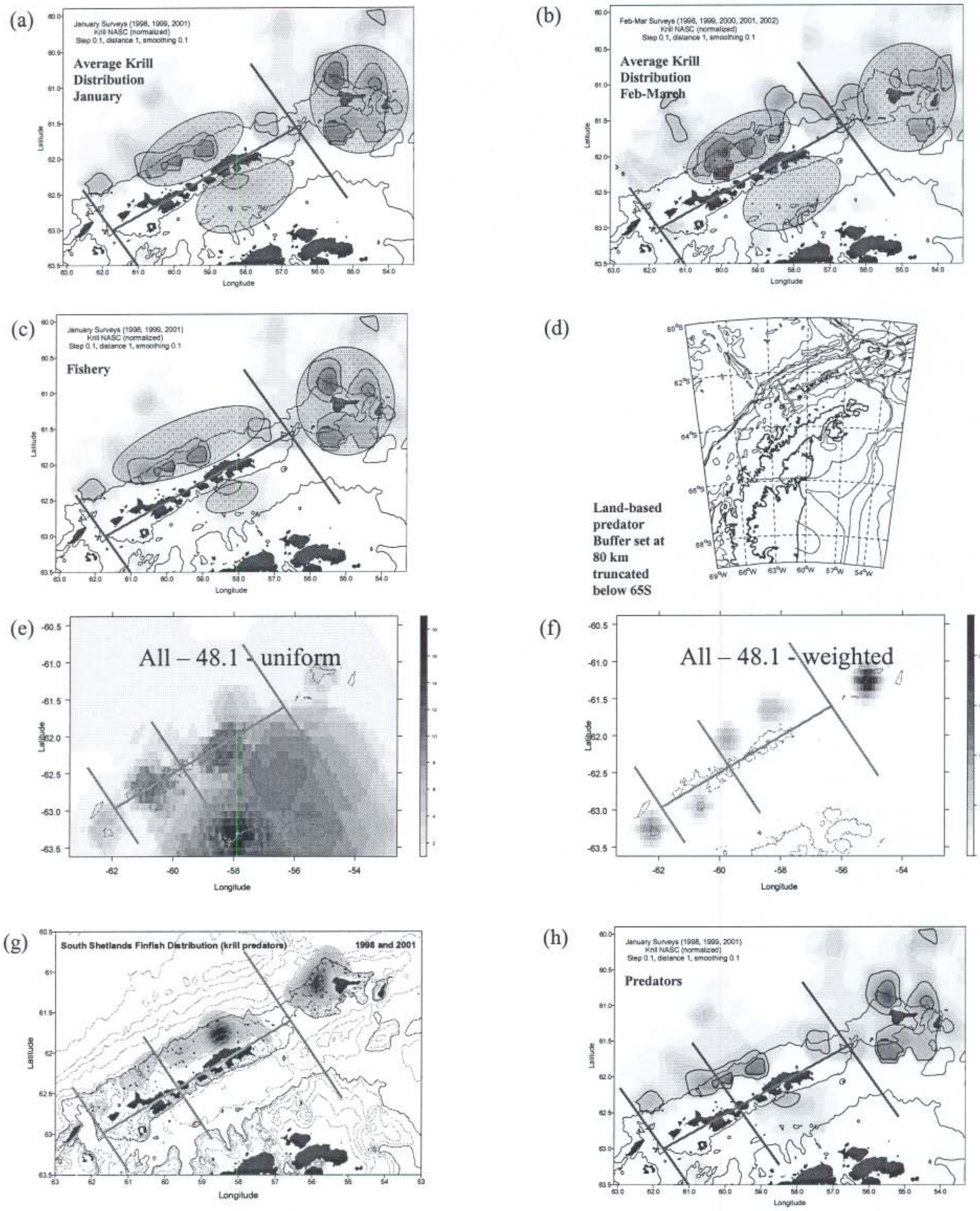


Figure 36: Subdivision of Subarea 48.1 based on: (a,b) krill aggregations (ovals show primary areas of aggregation), (c) the krill fishery (ovals show the primary locations of the krill fishery), (d) the maximum foraging distance and buffer for land-based predators around the land areas in Subarea 48.1, (e) the combined foraging ranges of land-based predators, (f) the aggregated foraging grounds of land-based predators (noting that known dominance of Cape Shirreff is not shown in this figure), (g) the aggregations of krill-eating finfish, and (h) the combined predator divisions and the krill distribution. Solid lines indicate divisions.

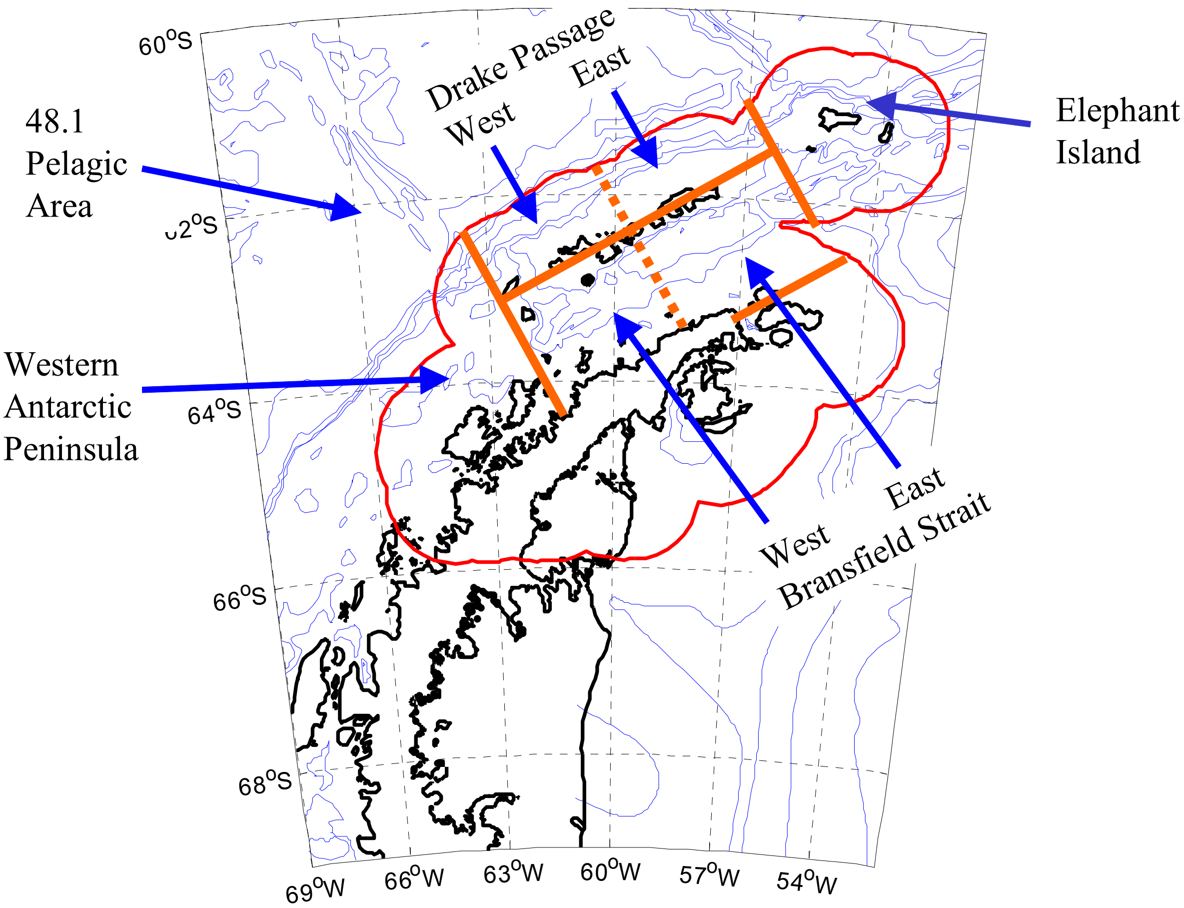


Figure 37: Proposed small-scale management units for Subarea 48.1. The subarea is divided between a pelagic area and the land-based predator area, with the latter area divided into four main units: Drake Passage, Elephant Island, Bransfield Strait and the Western Antarctic Peninsula. The Drake Passage and Bransfield Strait units are proposed to be divided into east and west components to delineate different foraging grounds of land-based predators.

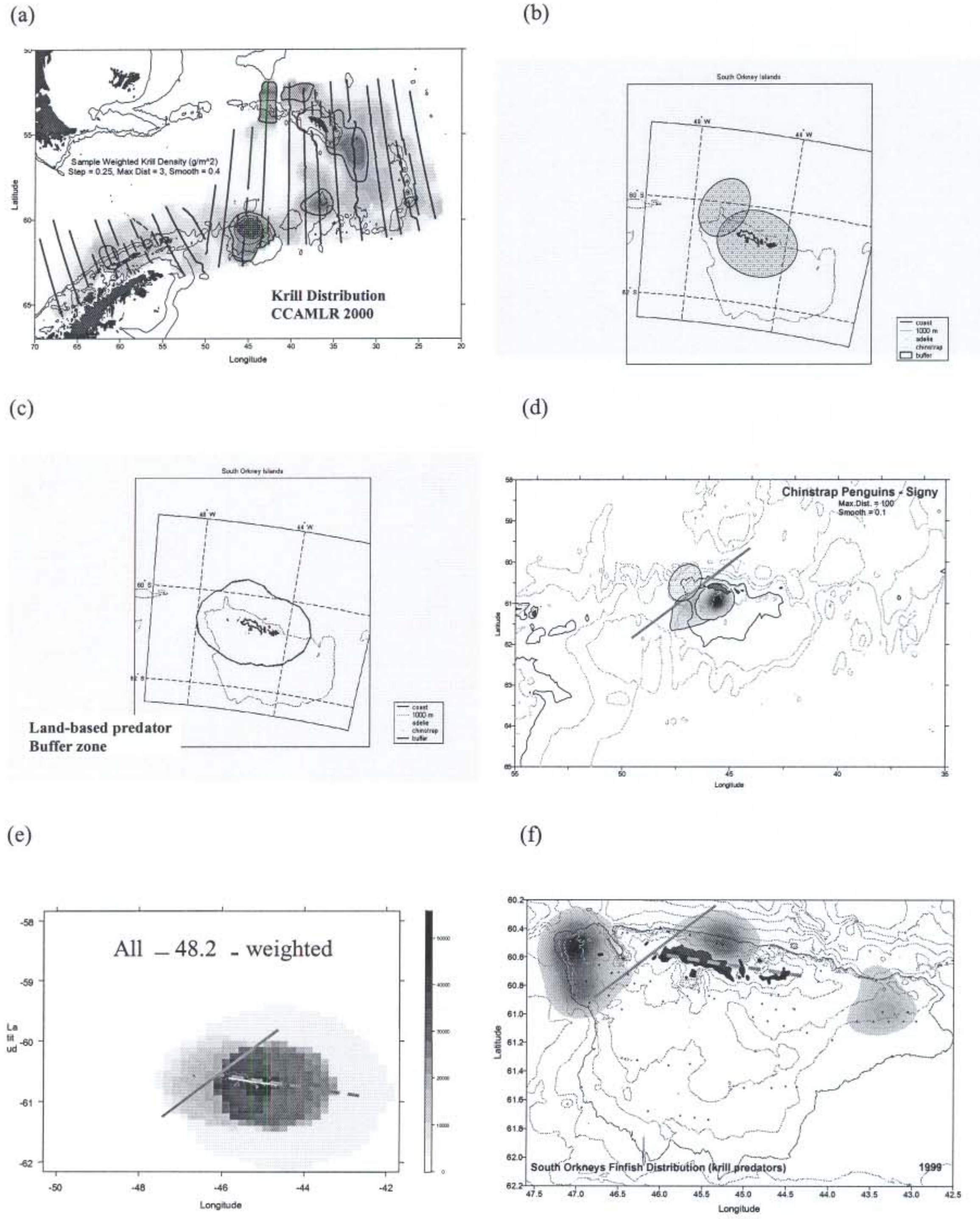


Figure 38: Subdivision of Subarea 48.2 based on: (a) krill aggregations (oval shows primary area of aggregation), (b) the krill fishery (right oval shows the observed krill aggregation while the left oval shows the primary location of the krill fishery), (c) the maximum foraging distance and buffer for land-based predators around the land areas in Subarea 48.2, (d) the combined known foraging ranges of land-based predators, including black-browed albatrosses, and chinstrap and Adélie penguins, (e) the aggregated extrapolated foraging grounds of land-based predators, and (f) the aggregations of krill-eating finfish. Solid lines indicate divisions.

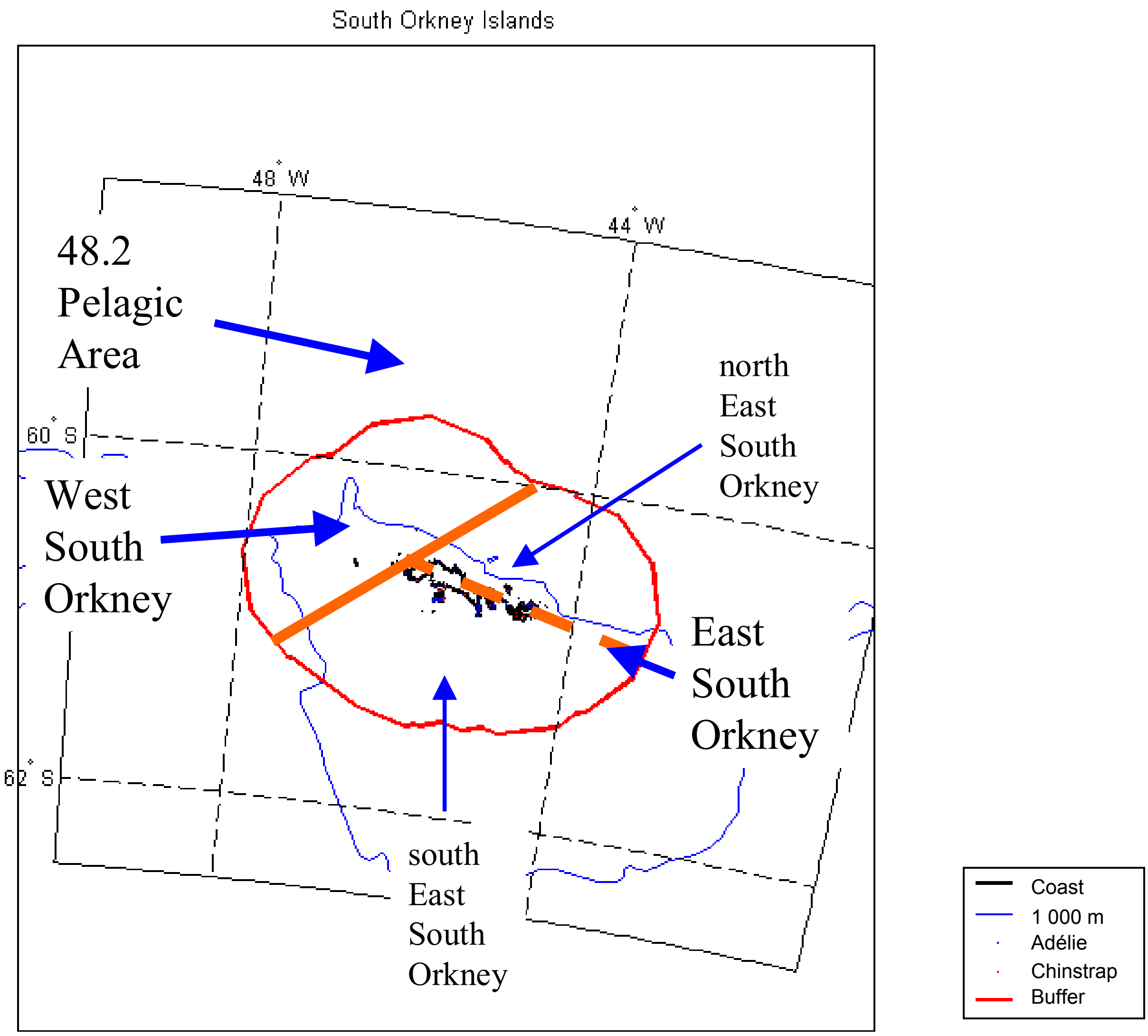


Figure 39: Proposed small-scale management units for Subarea 48.2. The subarea is divided between a pelagic area and the land-based predator area, with the latter area divided into two main units – West South Orkney and East South Orkney. The division between north and south East South Orkney areas is proposed in the interim, pending further information on foraging of penguins from the Laurie and Powell Islands.

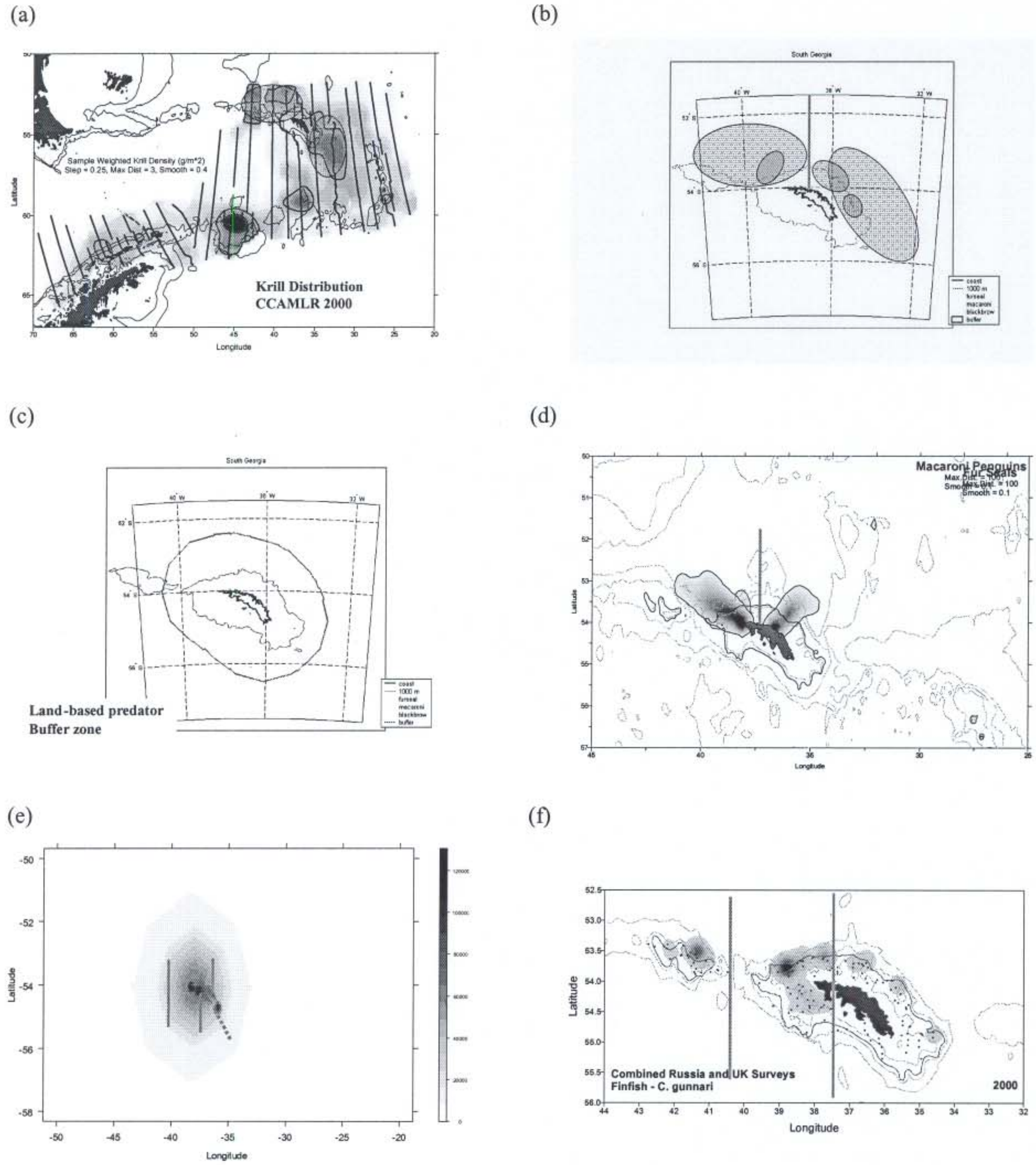


Figure 40: Subdivision of Subarea 48.3 based on: (a) krill aggregations approximated from the CCAMLR-2000 Survey (ovals show primary areas of aggregation), (b) krill aggregations approximately located according to CCAMLR-2000 Survey and experience from UK surveys (large ovals show expected primary areas of aggregation) and the winter krill fishery from 1986 to 1990 (small ovals show the primary locations of the krill fishery), (c) the maximum foraging distance and buffer for land-based predators around the land areas in Subarea 48.3, (d) the combined known foraging ranges of Antarctic fur seals and macaroni penguins (noting that black-browed albatrosses have foraging areas to the east and west of South Georgia), (e) the aggregated extrapolated foraging grounds of land-based predators, and (f) the observed aggregations of *Champsocephalus gunnari* in the 2002 surveys. Solid lines indicate divisions.

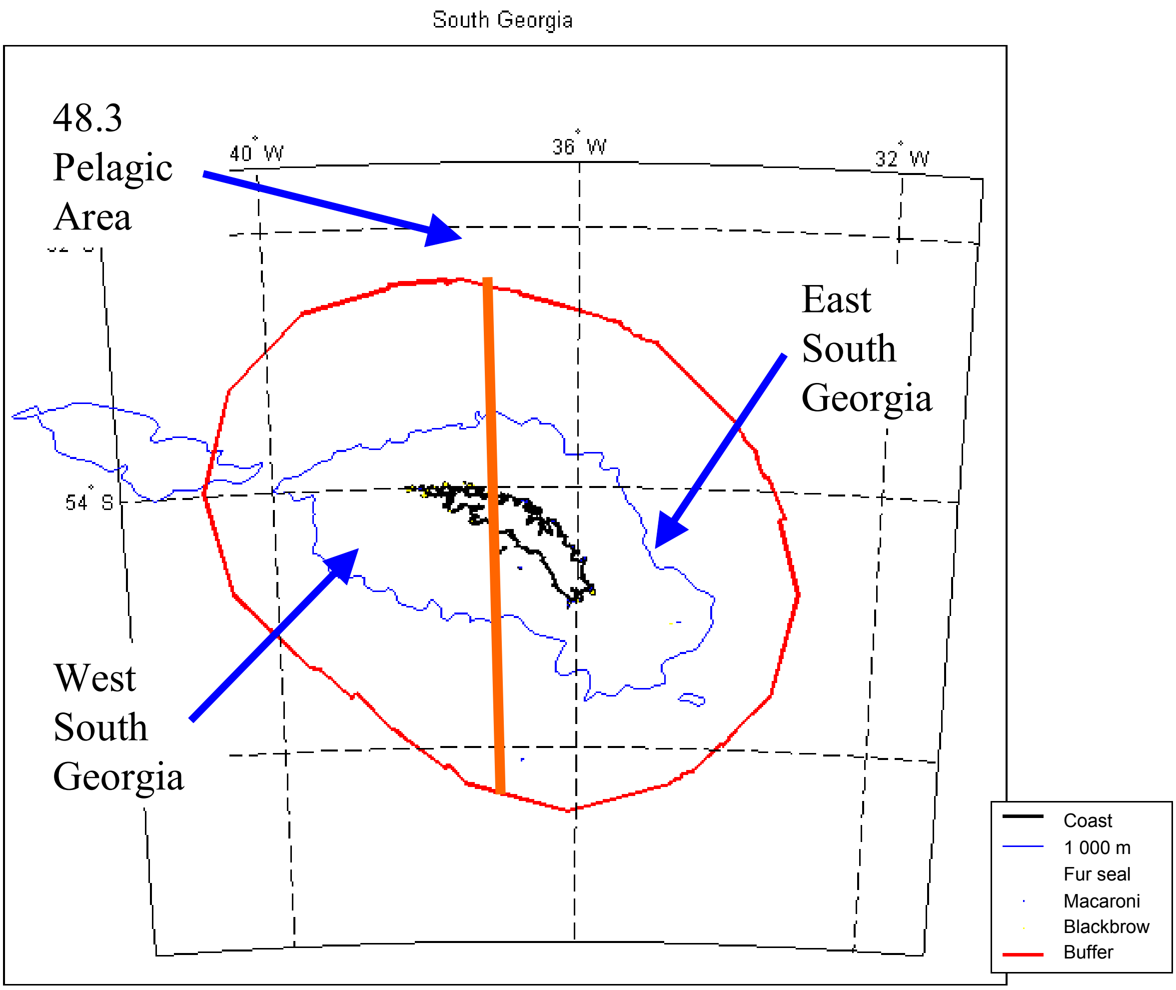


Figure 41: Proposed small-scale management units for Subarea 48.3. The subarea is divided between a pelagic area and the land-based predator area, with the latter area divided into two main units: East South Georgia and West South Georgia.

ATTACHMENT 1

AGENDA

Workshop on Small-scale Management Units, such as Predator Units
(Big Sky, Montana, USA, 7 to 15 August 2002)

1. Opening
   - (a) Agenda
   - (b) Work plan
   - (c) Rapporteurs

2. Principles on the development of predator units

3. Krill predators
   - (a) Patterns of distribution and abundance
   - (b) Spatial patterns of foraging
     - (i) Penguins
     - (ii) Flying birds
     - (iii) Seals
     - (iv) Other species including whales, fish and squid
   - (c) Seasonal and interannual variation
   - (d) Criteria for defining foraging/feeding grounds
   - (e) Analysis and methods

4. Krill fishery
   - (a) Patterns of fishing
   - (b) Interannual variation
   - (c) Criteria for defining fishing grounds
   - (d) Analysis and methods

5. Krill
   - (a) Patterns of abundance
   - (b) Dynamics of distribution
   - (c) Criteria for defining spatial distribution
   - (d) Analysis and methods

6. Environment
   - (a) Spatial patterns of the physical environment
   - (b) Interannual variability
   - (c) Points to be considered in the development of integrated units
   - (d) Analysis and methods

7. Synthesis
   - (a) Spatial relationships between predators and the krill fishery
   - (b) Methods for determining integrated predator units
   - (c) Development of a proposal

8. Advice to WG-EMM.

ATTACHMENT 2

BIOMASS CENTRES FOR LAND-BASED PREDATORS IN SUBAREAS 48.1, 48.2 AND 48.3

Subarea	Species	Centre No.	Long.	Lat.	Number*	Biomass
48.1	Adélie penguin	1	-57.8333	-63.3000	1 100	9 900
		2	-56.4833	-63.3000	35 000	315 000
		3	-55.8333	-63.0000	100	900
		4	-55.5167	-63.1333	1 000	9 000
		5	-55.1667	-63.1000	25	225
		6	-54.6333	-63.4000	15 000	135 000
		7	-57.0000	-63.3833	124 150	1 117 350
		8	-55.4833	-61.5000	2	18
		9	-64.0667	-64.7667	43 921	395 289
		10	-58.6167	-62.2667	55 691	501 219
		11	-55.7667	-63.5833	100 000	900 000
		12	-58.7500	-64.3000	21 954	197 586
		13	-60.6167	-62.6500	2	18
		14	-57.2833	-63.8000	10 320	92 880
	Chinstrap penguin	15	-61.0833	-62.6333	8 115	64 920
		16	-59.7000	-62.3167	214 636	1 717 088
		17	-58.6667	-63.3000	3 445	27 560
		18	-57.5333	-63.2333	930	7 440
		19	-55.1167	-61.1333	571 230	4 569 840
		20	-54.4000	-61.0167	2 200	17 600
		21	-55.4833	-61.5000	40 890	327 120
		22	-58.0000	-61.9000	62 158	497 264
		23	-58.1333	-62.1333	10	80
		24	-58.3000	-62.1833	2 083	16 664
		25	-58.3667	-61.9333	149 082	1 192 656
		26	-57.6167	-62.4333	16 278	130 224
		27	-57.6667	-61.9000	41 034	328 272
		28	-62.5667	-64.0500	5 250	42 000
		29	-62.5667	-64.6333	7 276	58 208
		30	-61.1333	-64.2333	16 882	135 056
		31	-64.2500	-64.6000	7 199	57 592
		32	-64.1167	-64.5000	24	192
		33	-61.9833	-64.2667	25	200
		34	-61.4667	-64.0167	1 620	12 960
		35	-61.7000	-64.1500	2 510	20 080
		36	-60.3333	-62.7500	10 260	82 080
		37	-60.6167	-62.9833	164 610	1 316 880
		38	-60.6167	-62.6500	1 500	12 000
		39	-60.1833	-62.4333	7 000	56 000
		40	-60.8000	-62.4667	3 000	24 000
		41	-58.9667	-63.5500	1 010	8 080
		42	-59.3833	-63.6833	152	1 216
		43	-59.8333	-63.6333	515	4 120
		44	-62.7333	-63.1167	5 000	40 000
		45	-62.1167	-64.3333	425	3 400
		46	-62.2167	-63.2333	285 000	2 280 000
		47	-62.3000	-62.8667	2 500	20 000
		48	-61.9167	-63.3000	10 000	80 000

Subarea	Species	Centre No.	Long.	Lat.	Number*	Biomass
48.1	Chinstrap penguin (continued)	49	-61.5833	-62.7833	6 550	52 400
		50	-62.0833	-63.2333	50	400
		51	-61.6000	-64.4333	40	320
		52	-60.1167	-62.7500	3	24
		53	-58.6167	-62.2667	495	3 960
		54	-55.4167	-60.9833	1 000	8 000
		55	-61.8500	-64.5167	550	4 400
		56	-63.5500	-64.2167	800	6 400
		57	-63.7000	-64.3500	8 500	68 000
		58	-58.0167	-63.3500	1 280	10 240
		59	-58.2833	-63.3500	15 000	120 000
		60	-58.4500	-63.4333	35	280
		61	-57.8333	-63.3000	9 400	75 200
	Gentoo penguin	62	-59.7500	-62.5000	9 257	111 084
		63	-60.8667	-62.6833	400	4 800
		64	-55.5167	-63.1333	200	2 400
		65	-57.0000	-63.3833	86	1 032
		66	-61.0000	-62.6000	904	10 848
		67	-61.0833	-62.6333	750	9 000
		68	-58.2500	-62.0833	5 944	71 328
		69	-59.8500	-62.5167	45	540
		70	-57.2833	-63.2000	50	600
		71	-55.0000	-61.1667	2 600	31 200
		72	-63.6000	-64.8833	1 500	18 000
		73	-62.8667	-64.8167	900	10 800
		74	-60.8083	-63.9083	600	7 200
		75	-60.9667	-64.1500	1 180	14 160
		76	-64.2500	-64.6000	1 600	19 200
		77	-58.9333	-62.2167	3 105	37 260
		78	-62.6333	-64.6833	7 918	95 016
		79	-62.7667	-64.7167	200	2 400
		80	-62.9500	-64.9000	740	8 880
		81	-58.8500	-62.2833	850	10 200
		82	-58.1333	-62.1333	1 105	13 260
		83	-60.3333	-62.7500	776	9 312
		84	-63.4333	-64.9167	1 200	14 400
		85	-60.8000	-62.4667	300	3 600
		86	-62.5333	-64.8500	250	3 000
		87	-61.4333	-62.8500	150	1 800
		88	-62.2167	-63.2333	250	3 000
		89	-60.6167	-62.6500	1 016	12 192
		90	-58.6167	-62.2667	2 584	31 008
		91	-63.5167	-64.8167	2 663	31 956
		92	-58.4500	-62.1833	2 254	27 048
		93	-63.0833	-64.8500	150	1 800
		94	-57.9000	-63.3333	6	72
		95	-57.8333	-63.3000	3 500	42 000
		96	-63.6833	-64.3500	42	504
		97	-64.1167	-64.5000	61	732
		98	-59.2333	-62.3167	3 347	40 164
		99	-56.6667	-63.5500	300	3 600
		100	-56.9167	-63.5333	200	2 400
		101	-64.0000	-64.5000	2 000	24 000

Subarea	Species	Centre No.	Long.	Lat.	Number*	Biomass
48.1	Antarctic fur seal	F1	-60.7417	-62.4680	9 131	319 585
		F2	-55.3422	-60.9908	562	19 670
		F3	-54.6332	-61.1274	188	6 580
		F4	-58.8577	-62.0045	158	5 530
		F5	-62.2836	-62.8840	7	245
48.2	Adélie penguin	102	-45.5833	-60.7333	95 675	861 075
		103	-44.4000	-60.7167	119 062	1 071 558
	Chinstrap penguin	108	-44.8000	-60.7000	420 877	3 367 016
		109	-45.6333	-60.7167	88 544	708 352
		110	-45.1500	-60.7500	76 230	609 840
		111	-45.4500	-60.5333	5 000	40 000
		112	-46.0000	-60.6333	111 244	889 952
		113	-46.7333	-60.5667	1 000	8 000
	Gentoo penguin	114	-44.4000	-60.7167	1 000	12 000
		115	-44.5000	-60.7500	430	5 160
		116	-46.0000	-60.6667	320	3 840
		117	-45.0000	-60.7167	7 907	94 884
		118	-45.6333	-60.6667	378	4 536
		119	-45.9167	-60.6333	2 185	26 220
		120	-44.5333	-60.6667	10	120
48.3	Macaroni penguin	121	-36.6636	-54.1304	144 960	1 304 640
		122	-34.7383	-55.0352	33 700	303 300
		123	-38.2128	-54.0038	3 166 805	28 501 245
	Gentoo penguin	127	-37.6443	-54.1575	21 344	256 128
		128	-37.3452	-54.2502	6 877	82 524
		129	-38.0516	-54.0042	5291	63 492
		130	-37.3437	-54.0701	12 784	153 408
		131	-37.4960	-54.0359	3 032	36 384
		132	-37.5722	-54.0254	752	9 024
		133	-36.6636	-54.1304	8 579	102 948
		134	-36.8087	-54.1602	376	4 512
		135	-37.2800	-54.2476	1 504	18 048
		136	-37.5746	-54.1578	4 500	54 000
		137	-37.0988	-54.2726	752	9 024
		138	-37.1918	-54.2469	752	9 024
		139	-36.2687	-54.3941	7 969	95 628
		140	-36.9616	-54.3354	926	11 112
		141	-36.8571	-54.3805	1 576	18 912
		142	-35.9507	-54.6175	16 363	196 356
		143	-36.6529	-54.4742	4 481	53 772
		144	-36.7200	-54.4656	407	4 884
		145	-36.9413	-54.4673	202	2 424
		146	-37.0685	-54.4890	376	4 512
		147	-36.4746	-54.5591	1 528	18 336
		148	-35.8239	-54.7779	30 979	371 748
	Antarctic fur seal	124	-37.9375	-54.0220	457 540	16 013 900
		125	-35.8239	-54.7779	4 500	157 500
		126	-34.7148	-55.0356	60	2 100

* For penguins – number of breeding pairs; for fur seals – number of pups

APPENDIX E

MEETING OF THE INTERIM STEERING COMMITTEE
FOR THE CEMP REVIEW
(Big Sky, Montana, USA, 3 August 2002)

CONTENTS

MEETING OF THE INTERIM STEERING COMMITTEE FOR THE CEMP REVIEW

(Big Sky, Montana, USA, 3 August 2002)

OPENING OF THE MEETING

1. The Convener, Prof. J. Croxall (UK), welcomed participants (Attachment 1) and thanked the US hosts and the local organiser, Dr W. Trivelpiece, for their assistance with the arrangements for the meeting, and the CCAMLR Secretariat for support during intersessional planning and at the meeting itself.

2. The draft agenda was adopted (Attachment 2).

3. The materials available for the meeting are listed in Attachment 3. They comprise:

(i) reports of the first three meetings of WG-CEMP, at which the CCAMLR Ecosystem Monitoring Program was developed;

(ii) papers selected from those tabled for the current meeting of WG-EMM; and

(iii) the papers by Drs A. Constable (Australia), I. Everson (UK) and D. Miller (South Africa), arising from the presentations invited for the 2001 meeting of WG-EMM.

In addition, lists of relevant publications prepared by Prof. Croxall, Dr M. Naganobu (Japan) and Dr S. Nicol (Australia) were available. The documents referenced in these lists, supplemented by additional relevant material, will be made available for intersessional consultation at an appropriate part of the CCAMLR website. Other important reference and source documents include Agnew (1997) and the Report of the Workshop on Area 48 (SC-CAMLR-XVII, Annex 4, Appendix D).

4. In opening the meeting the Convener remarked that the development and implementation of CEMP represented an outstanding achievement of CCAMLR. Major new programs of monitoring and directed research in support of CEMP had been initiated by Australia, Japan, South Africa, UK and the USA, together with significant additional contributions by Argentina, Chile, Germany, New Zealand and the former USSR. The value of these programs and of the time series of data collected in consistent fashion as part of CEMP was recognised worldwide.

5. Nevertheless, a review of CEMP was timely, particularly to take account of issues such as:

(i) the extent to which data from CEMP sites were representative of the areas in which they are located;

(ii) the ability (power) of CEMP data to distinguish between changes due to environmental variation and those due to commercial fishing;

(iii) the appropriateness of maintaining the focus on krill which characterises the current scope of CEMP; and

(iv) the ability to develop management advice based on CEMP data.

6. The aims of the workshop to be held in 2003 would, therefore, include:

(i) assessment of the strengths and weaknesses of the existing program and the limitations these might impose for meeting the original objectives;

(ii) potential additions and improvements to the existing program; and

(iii) identification of ways of using CEMP data to develop management advice.

7. The aim of the present meeting is to review the terms of reference and to prepare detailed plans for the workshop in 2003. A thorough discussion of the terms of reference was deemed essential in order to identify the intersessional preparations to address them adequately at the 2003 workshop.

REVIEW OF TERMS OF REFERENCE

8. The terms of reference (SC-CAMLR-XX, Annex 4, paragraphs 5.16 and 5.17) are:

(i) Are the nature and use of the existing CEMP data still appropriate for addressing the original objectives?

(ii) Do these objectives remain appropriate and/or sufficient?

(iii) Are additional data available which should be incorporated in CEMP or be used in conjunction with CEMP data?

(iv) Can useful management advice be derived from CEMP or be used in conjunction with CEMP data?

9. The original objectives of CEMP (SC-CAMLR-IV, paragraph 7.2) were to:

(i) detect and record significant changes in critical components of the ecosystem to serve as a basis for the conservation of Antarctic marine living resources; and

(ii) distinguish between changes due to the harvesting of commercial species and changes due to environmental variability, both physical and biological.

10. The original terms of reference for this work were (SC-CAMLR-III, paragraph 9.27):

(a) Review the objectives of ecosystem monitoring and review the life history characteristics of indicator species that are potentially suitable for monitoring studies, bearing in mind potential relationships between selected indicator species and harvested resources (especially krill).

(b) Consider sampling and data collection procedures, including the collection of baseline data, required to detect any effect of fisheries activities on components of the Antarctic marine ecosystem.

(c) Describe the types of studies that would be necessary to evaluate natural variation of relevant variables.

(d) Evaluate and recommend potential monitoring sites and areas.

(e) Consider the utility, feasibility, and design of controlled experiments undertaken in collaboration with fisheries activities to test hypotheses concerning cause/effect relationships and the possible effects of different methods and intensities of fisheries activities on components of the Antarctic marine ecosystem.

(f) Formulate and recommend specific actions for planning and implementing multi-national ecosystem monitoring programs to establish data baselines, monitor indicator species, and undertake controlled experiments.

Are the Nature and Use of the Existing CEMP Data Still
Appropriate for Addressing the Original Objectives?

11. It was agreed that most of the CEMP data were likely to be appropriate for detecting and recording significant change in critical components of the ecosystem. However, they were unlikely to be sufficiently comprehensive to serve on their own as an adequate basis for the conservation of Antarctic marine living resources. Furthermore, critical evaluation of the nature, magnitude and statistical significance of the changes indicated by the CEMP data is required.

12. The design of CEMP also needs evaluation, especially in terms of modern approaches to the construction of monitoring programs designed to assess changes before and after potential environmental perturbations or impacts. Particular concern was expressed at the extreme difficulty of designing a monitoring program, such as CEMP, which tried to address both the detection and measurement of change and also to understand the causes of this change.

13. In respect of the ability to distinguish between changes due to the harvesting of commercial species and changes due to environmental variability, both physical and biological, it was agreed that the design of CEMP and the nature of the data currently available to it was such that it was extremely unlikely that this would be feasible, at least at current levels of harvesting.

14. The intersessional work should include provision of appropriate documentation on the design of monitoring programs with analogous objectives to CEMP in order to facilitate the evaluation of this objective of the original CEMP Program. Dr Nicol agreed to coordinate this.

Do These Objectives Remain Appropriate and/or Sufficient?

15. It was agreed likely that the original objectives remained appropriate. However, it was suggested that the workshop should consider including an additional objective, directed at the development of appropriate management advice from CEMP and related data.

Are Additional Data Available which should be Incorporated in CEMP or be Used in Conjunction with CEMP Data?

16. It was agreed that there were a number of important types and sources of data which had either already been identified as important to incorporate in CEMP or which needed evaluation in this regard. There were also other data of potential high value for use in conjunction with CEMP data. These data, which would need to be investigated, assembled or analysed as part of the program of intersessional work, are reviewed in paragraphs 36 to 56.

17. In respect of expanding the scope of CEMP to include, for example, species dependent on commercially harvestable resources other than krill (e.g. squid, fish), it was felt that insufficient time would be available at the 2003 workshop to develop appropriate proposals.

18. It was suggested that a request be made for the submission to the workshop of outline proposals for appropriate monitoring programs in relation to predator–prey interactions involving squid or fish resources. The workshop would review all such proposals and identify those which it believed should be developed into more detailed descriptions of the nature and scope of potentially appropriate monitoring programs.

Can Useful Management Advice be Derived from CEMP or be Used in Conjunction with CEMP Data?

19. It was agreed that there were encouraging signs that useful management advice might be derived from CEMP, or that CEMP data could contribute to appropriate management advice. However, it was recognised that further progress would depend on critical evaluation (including modelling initiatives) and development of some or all of the proposed management procedures.

20. To assist in this process, the five examples of the proposed management procedures for krill fisheries (Constable, 2002) were evaluated from the standpoint of which were best suited to further (intersessional) development in terms of the variables to be monitored.

21. It was agreed that no further progress in this regard could be envisaged in respect of example 1 (precautionary catch limit for target species) or example 2 (target population size for predators). Consideration of example 5 (no interference by fisheries near colonies with land-based predators) would not be undertaken in the preparations for the CEMP review as further development, if desirable, would arise out of the deliberations following the Workshop on Small-scale Management Units, such as Predator Units (SSMU Workshop).

Nevertheless, it was recognised that this procedure offered considerable potential, for which experiences within CEMP would be valuable for developing appropriate monitoring procedures relevant to the management system adopted.

22. Example 3 (average fitness of predators maintained) and example 4 (maintaining median predator productivity arising from harvested species at above 80% of pre-exploitation level) were felt to be appropriate for further development during the intersessional period in order to improve consideration of this item at the workshop.

23. For example 3, Drs K. Reid (UK) and P. Trathan (UK) agreed to consider, with appropriate colleagues, how best to arrange further developments.

24. For example 4, the three main groups working on food-web and production issues (Australia, UK and the USA) agreed to develop these concepts further in relation to the areas and species of their particular interest. Drs R. Hewitt (USA), Nicol and Trathan agreed to coordinate this initiative.

PLANNING FOR THE 2003 WORKSHOP ON THE REVIEW OF CEMP

Intersessional Work Plan

25. A work plan, based on the tasks identified in this report, is appended as Attachment 4.

Workshop Arrangements

26. The UK offered to host this workshop as part of next year's WG-EMM meeting in Cambridge, UK, from 15 to 29 August 2003, for which it is extending an invitation. Detailed arrangements for the conduct of the meeting and for data submission and analysis would be developed by the workshop steering committee in consultation with the Secretariat, Data Manager and the local organisers of the Cambridge meeting.

Availability and Analysis of Data

CEMP Data

27. Recent work at the Secretariat had resolved a number of issues of validation and consistency with the CEMP data. The outstanding issues would be resolved by the Data Manager in consultation with the appropriate data holders.

28. All data would be analysed in terms of overall trends, together with levels of confidence and statistical significance. This would be undertaken by the Data Manager in consultation with the workshop steering committee.

29. To clarify understanding of the potential for additional analyses, matrices illustrating the availability of data in terms of species, sites, variables and duration of time series would be prepared by the Data Manager in consultation with Dr C. Southwell (Australia) (Attachment 5).

30. Issues relating to potential methodological differences between sites would be discussed as soon as possible by a subgroup comprising Mr M. Goebel (USA) and Drs Reid and Southwell. This group would also consider the extent to which potential fundamental biases inherent in the different standard methods could be evaluated or categorised.

31. Issues relating to the sensitivity and power of the data collected under each of the standard methods would be evaluated by appropriate statisticians. Drs Hewitt and Southwell undertook to investigate this further. This work should be able to develop the analyses commissioned for an earlier meeting of WG-CEMP (see WG-CEMP-91/8 and 91/36).

32. Notwithstanding the work to be undertaken in respect of paragraphs 29 to 31, it was envisaged that the following types of analysis would be undertaken:

(i) intersite variation –
this would involve consideration of both CEMP data and comparable data collected outside CEMP, to investigate both inter- and intra-regional variation, the latter with a view to assessing the extent to which local sites are representative of processes at regional scales;

(ii) interannual variation; and

(iii) correlation amongst indices –
this would involve further investigation of CSIs (see SC-CAMLR-XIX, Annex 4, paragraphs 3.50 to 3.52) and assessment of potential redundancy amongst indices integrating at similar spatial and temporal scales.

33. It was felt potentially less important for the moment to undertake intersessional work on topics relating to the identification of anomalies and missing values, though further work would be advantageous at some stage (see SC-CAMLR-XVI, Annex 4, Appendix D, paragraphs 2.5 to 2.23 and 5.1 to 5.8).

34. It was agreed that similar analytical approaches should be applied to other time-series data, collected by consistent methods, that could be made available to the meeting (see paragraphs 36 to 56).

35. Details of the nature of the analyses to be undertaken in respect of CEMP and appropriate non-CEMP data will need to be considered by a specialist subgroup. Members of the steering committee would propose appropriate members of this subgroup, who should be invited to hold early discussions by correspondence.

Other Data

36. To guide discussion in respect of relevant data currently not available within CEMP (see paragraph 16), a list of potentially relevant types of data was prepared (Table 1).

Krill

37. Priority data required for the workshop and derived from biological samples would include:

(i) indices of krill availability;
(ii) recruitment indices from at-sea surveys;
(iii) demographic data from predator samples; and
(iv) demographic data from fishery samples.

Valuable demographic data are collected by the US LTER Program and these should be incorporated as available.

38. A subgroup to coordinate the provision of these data and to consider appropriate analyses and comparisons between datasets would be set up following consultations between Drs Hewitt, Nicol and Trathan.

39. CPUE data from krill fishing operations would also be desirable. Papers tabled at recent and current WG-EMM meetings seem to indicate that an index based on catch per days fishing might serve as an appropriate interim indicator. WG-EMM was invited to advise on this, taking into account discussions during the SSMU Workshop.

Cetaceans

40. Data on the status and trends of baleen whales, especially minke whales, in the CCAMLR Convention Area were of obvious relevance to CCAMLR, including in the context of CEMP. It was agreed that Dr Hewitt should discuss with Dr S. Reilly (IWC) how the workshop might acquire the most relevant and appropriate data for its purposes.

41. Other time-series data from cetaceans in the Convention Area, some of which had been made available to the Workshop on Area 48, would also be valuable. Data holders were invited to make appropriate data available to the workshop.

Seals

42. It was agreed that the data on the status and trends of Antarctic seals recently supplied to CCAMLR by the SCAR Group of Specialists on Seals would be appropriate background information for the workshop. Dr Southwell indicated that the results of the Antarctic Pack-Ice Seal (APIS) survey program would be unlikely to be available in time for the 2003 workshop.

43. Holders of time-series data on Antarctic fur seals, additional to those already held in the CEMP database, were requested to make these available to the workshop at the earliest opportunity.

Seabirds

44. A recent review of the status and trends of Antarctic seabirds by the SCAR Bird Biology Sub-committee (Woehler et al., 2001) would be appropriate background information, particularly for populations and species not covered by CEMP.

45. Long time-series data, mainly on non-CEMP seabird species, were also available from studies carried out by French scientists working at sites in the sub-Antarctic Indian Ocean and in Adélie Land, Antarctica. Several recent publications from these researchers had evaluated fluctuations in breeding population size and performance of a range of seabird species in relation to physical environmental data (e.g. ENSO, sea-surface temperature, pack-ice extent). It was agreed that the relevant publications should be referenced on the CCAMLR website and made available to the workshop. Appropriate French scientists should also be specifically invited to participate in the workshop.

46. Data from South African research on seabirds at Marion Island (see WG-EMM-02/26) would also be valuable to the workshop and should be requested.

47. Holders of time-series data on any of the CEMP seabird indicator species (Adélie penguin, chinstrap penguin, gentoo penguin, macaroni penguin, Antarctic petrel, cape petrel, black-browed albatross) additional to those already held in the CEMP database were requested to make these available to the workshop at the earliest opportunity.

Icefish

48. Long-term data on icefish, particularly from studies in the South Georgia region, would be a valuable contribution to the workshop. Prof. Croxall would consult with Dr Everson, the author of the WG-FSA species profile of this species, to determine which were the most useful data to have available for analysis at the workshop.

Biological Environment

49. The utility and feasibility of analysing data on primary productivity (derived from SeaWiFS) in conjunction with CEMP or CEMP-related data on krill or dependent species, would be investigated by a subgroup comprising Drs Hewitt, Nicol and Trathan.

50. Appropriate time series data on former CEMP indicator species such as *Pleuragramma* and on other taxa potentially important as competitors or alternate prey to krill (e.g. salps, myctophids) were requested to be submitted to the workshop by appropriate data holders.

Physical Environment

51. It was agreed that it was important to have available at the workshop time-series data on key features of the physical environment for analysis in conjunction with data on krill and dependent species.

52. Data on sea-ice distribution, concentration and extent, sea-surface temperature (including measurements in relation to the heat content of Antarctic Surface Water) and appropriate composite indices (e.g. ACW, DPOI and ENSO) were likely to be of particular importance.

53. It was recognised, however, that particular attention should be given to matching the physical data to the scales at which the biological data are collected and/or integrated and to ensure that appropriate analyses of the physical environmental data are feasible in relation to workshop objectives.

54. A subgroup to evaluate the most important physical environmental data for the purposes of the 2003 workshop would be established following consultation between Drs Hewitt, Naganobu, Nicol and Trathan. Subgroup members should include individuals with expertise in analysis of physical datasets in biological contexts.

Data from Fisheries for Species other than Krill

55. Data derived from non-krill fisheries on variations in biological characteristics of stocks might proof useful for analysis at the workshop.

56. It was agreed to request WG-FSA to recommend any time-series data which might be suitable for the purposes of the 2003 workshop.

Availability of Reference Material

57. A listing of relevant publications (together with a pdf version wherever possible) and other material will be maintained by the Secretariat on part of the CCAMLR website. Potentially useful material should be submitted to the Website and Information Services Officer who will process the material in consultation with the steering committee.

Additional Attendees at the 2003 Workshop

58. Noting the particular need to develop and link appropriate ecological and statistical models (SC-CAMLR-XIX, Annex 4, paragraph 5.20), it was recommended that:

(i) Members be requested to assist the attendance at the workshop of appropriately qualified scientists; and

(ii) additional international experts in these fields be invited to attend.

59. WG-EMM was invited to suggest potential candidates for invitation, from which the steering committee would draw up a short list to approach with respect to availability. It was noted that the attendance of some experts could have budget implications.

ANY OTHER BUSINESS

60. It was recommended that the available members of the steering committee should hold a meeting to evaluate progress during the forthcoming meeting of the Scientific Committee.

REFERENCES

Agnew, D.J. 1997. Review: the CCAMLR Ecosystem Monitoring Program. *Ant. Sci.*, 9 (3): 235–242.

Constable, A.J. 2002. CCAMLR ecosystem monitoring and management: future work. *CCAMLR Science,* 9: 233–253.

Woehler, E., J. Cooper, J.P. Croxall, W.R. Fraser, G.L. Kooyman, G.D. Miller, D.C. Nel, D.L. Patterson, H.-U. Peter, C.A. Ribic, K. Salwicka, W.Z. Trivelpiece and H. Weimerskirch. 2001. *A Statistical Assessment of the Status and Trends of Antarctic and SubAntarctic Seabirds*. SCAR, Cambridge.

Table 1: Types of data of known or potential utility in relation to CEMP.

KRILL	METEOROLOGY AT CEMP SITE
Abundance	Precipitation
Distribution	Air temperature
Demographics	
Condition	PREDATOR PARAMETERS (non-CEMP)
Fisheries performance	Demographics
	Diet composition
PELAGIC PREDATORS	
Whales	DATA FROM OTHER BODIES/PROGRAMS
Crabeater seals	IWC
Icefish	SCAR
	France
BIOLOGICAL ENVIRONMENT	LTER
Primary productivity	
Other prey species	DATA FROM 'NON-KRILL' FISHERIES
Salps	IMAF
	Icefish
PHYSICAL ENVIRONMENT	Squid
Sea-ice	Myctophids
Frontal positions	
ENSO	
DPOI	
SST	
Surface-layer temperature	

ATTACHMENT 1

LIST OF PARTICIPANTS

Interim Steering Committee for the CEMP Review
(Big Sky, Montana, USA, 3 August 2002)

CROXALL, John (Prof.)	British Antarctic Survey High Cross, Madingley Road Cambridge CB3 0ET United Kingdom j.croxall@bas.ac.uk
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ATTACHMENT 2

AGENDA

Interim Steering Committee for the CEMP Review
(Big Sky, Montana, USA, 3 August 2002)

1. To review the terms of reference for the review of CEMP.

2. To prepare detailed plans for the workshop in 2003, including:

   (a) an appropriate program of intersessional preparatory work;

   (b) identification and ensuring availability of appropriately validated data, together with arrangements for analysis of such data as required;

   (c) identification and ensuring availability of appropriate reference material for the meeting; and

   (d) suggestions as to additional attendees at the 2003 meeting, taking particular account of the potential need to develop and link appropriate ecological and statistical models.

ATTACHMENT 3

MATERIAL AVAILABLE FOR THE MEETING

Interim Steering Committee for the CEMP Review
(Big Sky, Montana, USA, 3 August 2002)

Reports of first three meetings of WG-CEMP:

SC-CAMLR-IV, Annex 7	Report of the Ad Hoc Working Group on Ecosystem Monitoring, Seattle, Washington USA, 6 to 11 May 1985
SC-CAMLR-V, Annex 6	Report of the Working Group for the CCAMLR Ecosystem Monitoring Program, Hamburg, Federal Republic of Germany, 2 to 7 July 1986
SC-CAMLR-VI, Annex 4	Report of the Working Group for the CCAMLR Ecosystem Monitoring Program, Dammarie-les-lys, France, 10 to 15 June 1987

WG-EMM-2002 papers:

WG-EMM-02/5	CEMP indices 2002: analysis of anomalies and trends CCAMLR Secretariat
WG-EMM-02/7	A review and preliminary analysis of CEMP data CCAMLR Secretariat
WG-EMM-02/19	Combined standardised indices of predator performance at Bird Island, South Georgia, 1973–2002 K. Reid (United Kingdom)
WG-EMM-02/20	Are krill recruitment indices from meso-scale survey representative for larger areas? V. Siegel (Germany), R.M. Ross and L.B. Quetin (USA)
WG-EMM-02/26	Conserving seabirds competing with fisheries for food – observations from southern Africa and Marion Island R.J.M. Crawford, C.M. Duncombe Rae and D.C. Nel (South Africa)

WG-EMM-02/46	An assessment of temporal variability and interrelationships between CEMP parameters collected on Adélie penguins at Béchervaise Island L.M. Emmerson, J. Clarke, K. Kerry and C. Southwell (Australia) (*CCAMLR Science*, submitted)

WG-EMM-2001 presentation papers:

Miller, D.G.M. (2002)	Antarctic krill and ecosystem management – from Seattle to Siena *CCAMLR Science*, 9: 175–212
Everson, I. (2002)	Consideration of major issues in ecosystem monitoring and management *CCAMLR Science*, 9: 213–232
Constable, A.J. (2002)	CCAMLR ecosystem monitoring and management: future work *CCAMLR Science*, 9: 233–253

ATTACHMENT 4

INTERSESSIONAL WORK PLAN FOR THE WORKSHOP ON THE REVIEW OF CEMP

	Task/Topic	Paragraphs of Report	Responsibility	Start/ Completion Deadlines[1]	Priority[2]	Action
1.	Review of design of monitoring programs	14	Nicol		1	
2.	Submission of proposals for monitoring in respect of non-krill based interactions	18	Secretariat	After Scientific Committee	2	Request to Members
3.	Development of krill management model 3	22, 23	Reid, Trathan		2	
4.	Development of krill management model 4	22, 24	Hewitt, Nicol, Trathan		2	
5.	Workshop arrangements, including data submission and analysis	26	Steering Committee		1	
6.	CEMP data validation	27	Ramm		1	Interaction with data owners
7.	Basic analysis of CEMP data	28	Ramm, Steering Committee		1	
8.	Matrices of CEMP data availability	29	Ramm, Southwell	Immediate	1	
9.	Intersite methodological differences and biases	30	Goebel, Reid, Southwell		1	
10.	Standard method data: sensitivity and power analysis evaluation	31	Hewitt, Southwell		1	Find appropriate statisticians
11.	Establish subgroup for advising on and coordinating analysis of CEMP and non-CEMP data	35	Steering Committee		1	
12.	Establish subgroup for acquisition and analysis of krill data	38	Steering Committee		1	
13.	Acquire time-series data on krill fishery CPUE	39	Steering Committee		2	Discuss during WG-EMM

	Task/Topic	Paragraphs of Report	Responsibility	Start/ Completion Deadlines[1]	Priority[2]	Action
14.	Acquire IWC data on status and trends of baleen whales	40	Hewitt		2	Dialog with Dr S. Reilly (IWC)
15.	Acquire other indicator data on cetaceans	41	Secretariat	After Scientific Committee	2	Request to Members
16.	Acquire non-CEMP time-series data on Antarctic fur seals	43	Secretariat, Steering Committee	After Scientific Committee	2	Request to Members Steering Committee to approach data holders direct
17.	Acquire non-CEMP time-series data on seabirds	45–47	Secretariat, Steering Committee	After Scientific Committee	2	Request to Members Steering Committee to approach data holders direct Specific approach to French scientists
18.	Availability of relevant icefish data	48	Croxall		2	Dialog with Dr I. Everson (UK)
19.	Feasibility of using appropriate data on primary productivity	49	Hewitt, Nicol, Trathan		2	
20.	Acquire time-series data on e.g. *Pleuragramma*, myctophids, salps	50	Secretariat	After Scientific Committee	2	Request to Members
21.	Establish subgroup for evaluating relevant physical environment data	54	Hewitt, Naganobu, Nicol, Trathan		1	
22.	Advice on appropriate biological data from fisheries	56	Steering Committee	At WG-FSA	2	Request to WG-FSA
23.	Creation of workshop information area on CCAMLR website	57	WIS Officer, Steering Committee		1	
24.	Attendance of invited experts	59	Steering Committee	During WG-EMM After WG-EMM	1	Develop long list Create short list Establish availability and potential budget considerations
25.	Next meeting of Steering Committee	60	Steering Committee	During Scientific Committee	1	

	Task/Topic	Paragraphs of Report	Responsibility	Start/ Completion Deadlines[1]	Priority[2]	Action
26.	Inform all CEMP data holders of analyses planned and invite collaboration as appropriate	WG-EMM 6.7	Secretariat		1	
27.	Summary of spatial and temporal scales at which CEMP indices integrate and of degree to which CEMP parameters vary with consumption of krill	WG-EMM 6.11	Steering Committee		1	

[1] All start deadlines are as soon as possible, unless otherwise indicated.

[2] 1 – essential for CEMP review; 2 – very valuable for CEMP review.

ATTACHMENT 5

SPECIES BY SITE BY YEAR MATRIX OF CEMP DATA AVAILABLE FROM 1976 TO 2002

***Pygoscelis adeliae* (Adélie penguin)**

A1 Weight (g) of adult penguin on arrival

Site					1980										1990										2000		
Stranger Point (King George Island)	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Esperanza Station (Hope Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	X	-
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Verner Island (Mawson Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X

A2 Duration (day) of penguin incubation shift

Site					1980										1990										2000		
Admiralty Bay	-	-	-	-	-	-	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Esperanza Station (Hope Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	X	-
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
Magnetic Island (Prydz Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	X	-	-	-

A3 Penguin breeding population size (number of pairs)

Site					1980										1990										2000		
Anvers Island (Antarctic Peninsula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-	-
Admiralty Bay	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Stranger Point (King George Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X	X
Esperanza Station (Hope Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	X	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	-	X
Shirley Island (Casey Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Verner Island (Mawson Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Syowa Station	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
Magnetic Island (Prydz Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X
Ross Island	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

A5a Duration (h) of penguin foraging

Site					1980										1990										2000		
Anvers Island (Antarctic Peninsula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-
Shirley Island (Casey Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-

Pygoscelis adeliae **(Adélie penguin) – continued**

A5a Duration (h) of penguin foraging – continued

Site					1980										1990										2000		
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-

A6a Penguin breeding success (chicks fledged per egg laid)

Site					1980										1990										2000		
Admiralty Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Stranger Point (King George Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X	X
Esperanza Station (Hope Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	X	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	-	X
Shirley Island (Casey Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	-

A6c Penguin breeding success (chicks fledged per chicks hatched)

Site					1980										1990										2000		
Anvers Island (Antarctic Peninsula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-
Shirley Island (Casey Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
Magnetic Island (Prydz Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	X	X	X	-

A7 Penguin chick weight (g) at fledging

Site					1980										1990										2000		
Anvers Island (Antarctic Peninsula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-
Admiralty Bay	-	-	-	-	-	-	X	X	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Esperanza Station (Hope Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	X	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
Magnetic Island (Prydz Bay)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-

A8a Weight (g) of stomach contents of adult penguins

Site					1980										1990										2000		
Anvers Island (Antarctic Peninsula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Stranger Point (King George Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
Shirley Island (Casey Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	X	X	X	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-

Pygoscelis adeliae **(Adélie penguin) – continued**

A8b Composition (proportion) of diet of adult penguins

Site					1980										1990										2000		
Anvers Island (Antarctic Peninsula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Stranger Point (King George Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
Shirley Island (Casey Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	X	X	X	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-

A8c Composition (occurrence) of diet of adult penguins

Site					1980										1990										2000		
Anvers Island (Antarctic Peninsula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Stranger Point (King George Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
Shirley Island (Casey Station)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Béchervaise Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	X	X	X	-
Edmonson Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-

Pygoscelis antarctica **(chinstrap penguin)**

A1 Weight (g) of adult penguin on arrival

Site					1980										1990										2000		
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X

A2 Duration (day) of penguin incubation shift

Site					1980										1990										2000		
Admiralty Bay	-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	X	X	X	X	X	X	X	X	-	-	-	-

A3 Penguin breeding population size (number of pairs)

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

A5a Duration (h) of penguin foraging

Site					1980										1990										2000		
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

Pygoscelis antarctica **(chinstrap penguin) – continued**

A6a Penguin breeding success (chicks fledged per egg laid)

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X
Admiralty Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

A6c Penguin breeding success (chicks fledged per chicks hatched)

Site					1980										1990										2000		
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-

A7 Penguin chick weight (g) at fledging

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Admiralty Bay	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	X	X	-	X	X
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X

A8a Weight (g) of stomach contents of adult penguins

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	X	X	-	X	X	X	X	X	X	X	X	X	-	X	X
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

A8b Composition (proportion) of diet of adult penguins

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	X	X	-	X	X	X	X	X	X	X	X	X	-	X	X
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

A8c Composition (occurrence) of diet of adult penguins

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	X	X	-	X	X	X	X	X	X	X	X	X	-	X	X
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Laurie Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

***Pygoscelis papua* (gentoo penguin)**

A3 Penguin breeding population size (number of pairs)

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	X	X
Bird Island	-	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

A6a Penguin breeding success (chicks fledged per egg laid)

Site					1980										1990										2000		
Admiralty Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	X	X
Bird Island	-	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	-

A6c Penguin breeding success (chicks fledged per chicks hatched)

Site					1980										1990										2000		
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-

A7 Penguin chick weight (g) at fledging

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X
Admiralty Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	X
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	-	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

A8a Weight (g) of stomach contents of adult penguins

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-

A8b Composition (proportion) of diet of adult penguins

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-

A8c Composition (occurrence) of diet of adult penguins

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Admiralty Bay	-	-	X	-	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Signy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-

Eudyptes chrysolophus **(macaroni penguin)**

A1 Weight (g) of adult penguin on arrival

Site					1980										1990										2000		
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

A3 Penguin breeding population size (number of pairs)

Site					1980										1990										2000		
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Bird Island	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

A5a Duration (h) of penguin foraging

Site					1980										1990										2000		
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

A6a Penguin breeding success (chicks fledged per egg laid)

Site					1980										1990										2000		
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Bird Island	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

A6c Penguin breeding success (chicks fledged per chicks hatched)

Site					1980										1990										2000		
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X	-	-	-	-	-	-	-
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

A7 Penguin chick weight (g) at fledging

Site					1980										1990										2000		
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

A8a Weight (g) of stomach contents of adult penguins

Site					1980										1990										2000		
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

A8b Composition (proportion) of diet of adult penguins

Site					1980										1990										2000		
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

Eudyptes chrysolophus (macaroni penguin) – continued

A8c Composition (occurrence) of diet of adult penguins

Site					1980										1990										2000		
Elephant Island (Stinker Point)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
Marion Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-

Diomedea melanophrys (black-browed albatross)

B1a Albatross breeding population size (number of pairs)

Site					1980										1990										2000		
Bird Island	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

B1b Albatross breeding success

Site					1980										1990										2000		
Bird Island	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Thalassoica antarctica (Antarctic petrel)

B5c Petrel breeding population size (number of nests brooding)

Site					1980										1990										2000		
Svarthamaren	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	X	X	-	-	-	-

Arctocephalus gazella (Antarctic fur seal)

C1 Duration (h) of fur seal cow foraging

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X	-	-	-	-	-	-	-
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

C2b Growth rate (kg/month) of fur seal pups

Site					1980										1990										2000		
Cape Shirreff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X
Seal Island	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-
Bird Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X
Bouvetoya (Bouvet Island)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart Australia, 7 to 17 October 2002)

CONTENTS

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 7 to 17 October 2002)

OPENING OF THE MEETING

1.1 The meeting of WG-FSA was held in Hobart, Australia, from 7 to 17 October 2002. The Convener, Dr I. Everson (UK), welcomed participants.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1 Dr Everson outlined the work program for the meeting. A new work format had been developed in consultation with Members during the intersessional period (SC CIRCs 02/01 and 02/18 and COMM CIRC 02/56). Key elements of this new approach were:

- a reorganisation of the meeting format, so that information essential to the assessments is considered during days 1 and 2 of the meeting in order to allow assessments to be run and completed during the first week;

- a reorganisation of the meeting report, so that background information and advice on future work of WG-FSA is removed from the report and will not be translated. They will be disseminated as background papers to the Scientific Committee which will reduce the size of the report of the Working Group and improve readability and access to information and advice necessary to the Scientific Committee;

- the development of species profiles for *Champsocephalus gunnari* and *Dissostichus eleginoides* – these reference documents contain species parameters which will be reviewed and updated by WG-FSA as new information becomes available; and

- development of an assessment manual to be reviewed and updated each year.

2.2 The reorganisation of the meeting and intersessional work has consequential effects on the way in which the information discussed at the meeting is held and made available to Members. Dr Everson outlined his plans to achieve this. For the current year there would be an adopted report to the Scientific Committee and adopted background papers also to the Scientific Committee. These would be bound separately. During the intersessional period, the information in the background papers would be assimilated into the Species Profiles and Assessment Methods documents, both of which would be made available on the CCAMLR website. Reports of future meetings would consist of a report to the Scientific Committee and revisions to the Species Profiles and Assessment Methods. It was hoped that this process would lead to shorter reports and at the same time ensure that all relevant information was available to Members. The Working Group accepted this proposal.

2.3 Background information supporting the report of WG-FSA can be found in document SC-CAMLR-XXI/BG/27. The sections are arranged in agenda item order and numbered accordingly.

2.4 WG-FSA thanked Dr Everson for leading this initiative, and for his efforts in developing the extensive species profiles for *C. gunnari* and *D. eleginoides*. Dr A. Constable (Australia) was thanked for his work in the development of the assessment manual.

2.5 WG-FSA noted the successful electronic submission of meeting papers: 79 papers had been submitted by the deadline of 28 September (one week prior to the start of the meeting). WG-FSA thanked the Secretariat, and in particular Mrs R. Marazas, the Website and Information Services Officer, for promptly processing all papers and loading these onto the CCAMLR website.

2.6 WG-FSA agreed that a one-week deadline was the minimum amount of time required for participants to:

- read papers and prepare for the meeting;
- discuss tabled papers with colleagues prior to the meeting; and
- clarify with colleagues issues arising, including language difficulties.

2.7 WG-FSA also agreed that only papers submitted prior to the deadline would be accepted at future meetings, and only factual corrections to submitted papers would be permitted after the deadline. Accordingly:

- minor revisions to one paper were accepted;

- an addendum describing a major extension of a submitted paper was referred to the assessment group for consideration in the intersessional period; and

- one paper submitted after the deadline was rejected.

2.8 The Provisional Agenda was discussed and it was agreed to add the following subitems:

- 3.1.3 'Data Access';
- 5.3.2 '*Champsocephalus gunnari* South Shetlands (Subarea 48.1)';
- 5.3.3 'Myctophids South Georgia (Subarea 48.3)';
- 5.3.4 'Crabs South Georgia (Subarea 48.3)';
- 5.3.5 'Squid South Georgia (Subarea 48.3)';
- 5.3.6 'Other fisheries'; and
- 13.3 'Publication matters'.

Consequently, existing subitems 'Other' and 'Other matters' were renumbered as 3.1.4 and 13.4 respectively.

2.9 With these changes, the Agenda was adopted.

2.10 The Agenda is included in this report as Appendix A, the List of Participants as Appendix B and the List of Documents presented to the meeting as Appendix C.

2.11 The report was prepared by Dr D. Agnew (UK), Mr B. Baker (Australia), Dr M. Belchier (UK), Dr S. Candy (Australia), Dr M. Collins (UK), Dr A. Constable (Australia), Prof. J. Croxall (UK), Dr R. Gales (Australia), Dr S. Hanchet (New Zealand), Dr R. Holt (USA), Mr C. Jones (USA), Dr G. Kirkwood (UK), Dr K.-H. Kock (Germany), Ms J. Molloy (New Zealand), Dr D. Nel (South Africa), Dr R. O'Driscoll (New Zealand), Dr D. Ramm (Secretariat), Dr K. Reid (UK), Ms K. Rivera (USA), Dr E. Sabourenkov (Secretariat), Mr N. Smith (New Zealand), Dr G. Tuck (Australia), Ms E. van Wijk (Australia), Mr B. Watkins (South Africa) and Mr R. Williams (Australia).

REVIEW OF AVAILABLE INFORMATION

Data Requirements Specified in 2001

Development of the CCAMLR Database

3.1 The Data Manager reported that the redesign of the trawl survey components of the survey database had now been completed. The new structure is event rather than trawl based, allowing the inclusion of other data such as that derived from CTD and acoustic surveys. The database now includes data from 17 surveys, including all UK and Russian surveys in Subarea 48.3 and US and German surveys in Subareas 48.1 and 48.2.

3.2 The Working Group expressed its pleasure that this revision has now been undertaken, and urged the Secretariat to make every effort to complete the loading of the data from all surveys reported to CCAMLR before the next meeting of WG-FSA.

3.3 The Working Group reviewed the design documents that detailed the schema for the new survey database. It was noted that the new design was based on survey events (e.g. trawl tow, CTD cast, acoustic transect) rather than a survey haul (i.e. trawl tow). It was agreed that the new schema fulfils the current requirements for a CCAMLR survey database. It was also noted that the new database fulfilled the data analysis requirements for the current meeting.

3.4 It was agreed that the Secretariat would not be required to develop an at-sea database. Rather, individual country databases would continue to be used, and data transferred to the Secretariat Data Centre is the current procedure. The Secretariat will provide a new protocol for this data exchange, mediated by a series of interface programs developed separately for each national database.

3.5 The new protocol would cover the format of the data, the method of transmission and methods for verifying and validating the data. It was agreed that the protocol will be developed by Secretariat staff in liaison with nominated responsible IT staff from each of the Member countries.

3.6 The Secretariat should provide design documents and specifications to Member countries, to allow them to create software that exports data from their databases in the agreed format. This format is yet to be decided on, but is likely to be either as a MS-Access 2000 database, or a platform-independent format, such as extensible mark-up language (XML). The Secretariat would develop software to verify and validate data received, and to import the data into the survey database.

3.7 Modifications to national databases will involve changes to the export software. Modifications to the CCAMLR database may additionally involve changes to national databases if such data are not already collected nationally. The Working Group urged Members to consider the data requirements in the new CCAMLR survey database, and ensure that all essential data are recorded and submitted to the Secretariat.

3.8 Errors in the databases are often noted during the course of analyses conducted either at working groups or during intersessional work. At the moment there is no mechanism for correcting the database once these are found. The Data Manager was requested to create such a mechanism before WG-FSA-03, and data originators were urged to provide updates and corrections to CCAMLR.

Data Access and Software Updates

3.9 The Working Group recognised that there may be concerns about the general accessibility of confidential data during working group meetings. At the same time there is a need to enable access to the full data so that the work of the group is not impeded. The following procedure should be followed at WG-FSA meetings:

- participants wishing to undertake analyses should continue to make requests for data to the Data Manager;

- requested data will be made available to participants in password-protected files; and

- at the end of the working group meeting, all data used for analyses will be archived, again in password-protected files.

3.10 Considerable difficulty was experienced with the wide variety of versions of software and operating systems on participants' computers. Whilst recognising that the Secretariat attempted to maintain its systems with the latest versions of software and operating systems, the Working Group requested that the Secretariat retain some older versions of operating systems also, especially of programs that are not particularly backwards compatible.

Fisheries Information

Catch, Effort, Length and Age Data Reported to CCAMLR

3.11 Eight fisheries were carried out under conservation measures in force:

- trawl fishery for *Euphausia superba* in Area 48;
- trawl fishery for *C. gunnari* in Subarea 48.3;
- longline and pot fishery for *D. eleginoides* in Subarea 48.3;
- pot fishery for crab in Subarea 48.3;
- trawl fishery for *C. gunnari* in Division 58.5.2;
- trawl fishery for *D. eleginoides* in Division 58.5.2;
- exploratory longline fishery for *Dissostichus* spp. in Subarea 88.1; and
- exploratory longline fishery for *Dissostichus* spp. in Subarea 88.2.

3.12 In addition, five other fisheries were carried out in EEZs within the Convention Area in the 2001/02 season:

- trawl fishery for *D. eleginoides* in Division 58.5.1 (French EEZ);
- longline fishery for *D. eleginoides* in Division 58.5.1 (French EEZ);
- longline fishery for *D. eleginoides* in Subarea 58.6 (French EEZ);

- longline fishery for *D. eleginoides* in Subarea 58.6 (South African EEZ); and
- longline fishery for *D. eleginoides* in Subarea 58.7 (South African EEZ).

3.13 Catches of target species by fishing season are reported in Table 3.1. Length data have been reported from all fisheries by observers.

Estimates of Catch and Effort from IUU Fishing

3.14 Considerable confusion arises in examining data on total removals because of the varying time periods over which data are available – split-year (July–June), fishing season (December–November) and calendar year (January–December). To simplify the presentation of these data, it had been agreed by the Scientific Committee to standardise all calculations to fishing season. The Secretariat therefore converted the data in WG-FSA-02/81 (which followed a similar form to SC-CAMLR-XX, Annex 5, Tables 3 to 8) to fishing season using the following methods (Tables 3.2 and 3.3):

- for reported catches, STATLANT data were used for past seasons, and catch and effort reports were used for the current season (unless otherwise indicated);

- for estimates of IUU catch, catch was reassigned from split-year to fishing year on a pro rata basis; and

- for CDS-derived catch data, recalculation was possible from the reported dates of capture.

3.15 It should be noted that fishing season time periods are very nearly coincident with calendar year, which is the reporting period used by many States for catches in their waters.

3.16 One consequence of the move to reporting catches by fishing season is that at the time that the Working Group meets, data are only available from December to September. The Working Group agreed that while Tables 3.2 and 3.3 should report the data currently available, for the purposes of estimating total extraction for assessments it would be necessary to make pro rata adjustments to the estimated catch to the end of a fishing season.

Methods for Estimating IUU Catch

3.17 Dr Agnew introduced WG-FSA-02/4 which described a new method for estimating IUU catch of fish and birds. It utilises high-quality well-documented cruise data from fishery protection vessels. The method takes explicit account of both 'seen' and 'unseen' IUU fishing through a simulation model, utilising estimates of the encounter efficiency of the fishery protection vessel derived from data taken from legitimate vessels. It also uses a spatial model to estimate different fish and bird catch rates in different parts of Subarea 48.3. Using the model, the authors estimate IUU catches of toothfish in Subarea 48.3 to have been 667, 1 015 and 196 tonnes in the 1998/99, 1999/2000 and 2000/01 fishing seasons respectively.

3.18 Dr Agnew reported that the model estimates IUU catch in the current 2001/02 season to have been zero. This is essentially the same as the Secretariat's calculation of 3 tonnes (Table 3.2).

3.19 The Working Group welcomed the development of this method, which for the first time attempted to arrive at statistically rigorous estimates and confidence intervals of fish and bird catches by IUU vessels. The method is superior to the current CCAMLR methods of estimating IUU fishing and should be attempted in other areas. However, it was recognised that this would be dependent on the availability of suitable data sources.

3.20 It was noted that the method used to calculate the encounter rate assumed that legitimate vessels behaved in the same way as IUU vessels. While this may be generally true, it may also be the case that as IUU vessels gain more experience the encounter rate might drop. If the encounter rate is not re-estimated to account for this potential behaviour, it might introduce bias into the results.

3.21 WG-FSA-02/4 also showed that when coverage by a fishery protection vessel was low, the estimate of IUU fishing derived using the standard CCAMLR method (i.e. Table 3.2) provided underestimates of the extent of IUU fishing. For instance, CCAMLR estimates for 1998/99 and 1999/2000 (SC-CAMLR-XX, Annex 5, Table 6) were 369 and 356 tonnes respectively, lower than the estimates of 667 and 1 015 respectively in WG-FSA-02/4. When the protection vessel was present for more than 30% of the time, the statistical estimate was comparable with that derived by CCAMLR (for instance the CCAMLR estimate for 2000/01 was 176 tonnes and the statistical estimate was 196 tonnes). These results would imply that for CCAMLR subareas and divisions where coverage is low, the CCAMLR estimates of IUU catch may be underestimates of the total removals by IUU fishing.

3.22 The Working Group agreed for Subarea 48.3 to use the estimates of IUU fishing given in WG-FSA-02/4 for the fishing seasons 1998/99, 1999/2000 and 2000/01, and the Secretariat's calculation of 3 tonnes for the season 2001/02 to date.

Catch and Effort Data for Toothfish Fisheries in Waters adjacent to the Convention Area

3.23 The Working Group has usually had little information on catch rates of toothfish in areas immediately adjacent to the Convention Area. WG-FSA-02/67, describing observer-recorded data from fishing on William's Ridge (53°S 80.5°E), was therefore welcome. The paper reported that catch rates and the distribution of males, females and juveniles on the ridge was typical of areas in the Indian Ocean sector of the Convention Area. By-catch was typical for the Southern Ocean, consisting of rajids, *Muraenolepis* spp. and *Macrourus* spp.

3.24 In discussion, some questions were raised about the positions of these catches. The known bathymetry of William's Ridge shows that it is largely very deep (1 000–2 000 m) (SC-CAMLR-XXI/7). This would seem to run counter to the report in the paper that average fishing depth was 900 m. Further, the existence of large numbers of small fish in the catch was somewhat inconsistent with the very deep water that might be encountered. Clarification of these points from the Uruguayan observer would be welcome.

3.25 It was noted that William's Ridge extends to the west of 80°E, and therefore is both inside and outside the Convention Area. Toothfish living on the ridge are thus most likely a transboundary stock.

Scientific Observer Information

3.26 All information collected by scientific observers was summarised in WG-FSA-02/11 Rev. 1, 02/12 Rev. 1 and 02/14. Reports and longline data were submitted by international and national observers from a total of 40 cruises in the Convention Area and three longline cruises in FAO Areas 47 and 51. Target species were *Dissostichus* spp., *E. superba*, *C. gunnari* and *Paralomis* spp. on cruises comprising 24 longliners, 15 trawlers and 1 'pot' vessel. Longline cruises were represented in Subareas 48.3, 58.6, 58.7, 88.1 and 88.2, trawlers in Subarea 48.3 and Division 58.4.4 and 'pot' fishing in Subarea 48.3. Observers were deployed by eight Members: Australia (5), Chile (2), New Zealand (1), South Africa (7), Spain (2), Ukraine (2), UK (20) and Uruguay (1). Details are provided in Tables 1 of WG-FSA-02/11 Rev. 1, 02/12 Rev. 1 and 02/14.

3.27 Two logbooks and two cruise reports were outstanding from the longline fishery. All logbooks had been submitted in the standard CCAMLR format, but only three logbooks had been submitted in the new format in 2002.

3.28 In March 2002 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 (COMM CIRC 02/15). The Working Group recommended that all technical coordinators ensure that only the current versions of logbook forms be used. It was noted that further updates may take place at the request of the Scientific Committee.

3.29 Biological data were collected by observers in accordance with research priorities identified by the Scientific Committee in previous years (weight at length, length frequency, maturity, otolith/scales, CF, by-catch). The Working Group also noted that in WG-FSA-02/11 Rev. 1, Table 6, the main processing method for *D. eleginoides* was headed, gutted and tailed (HGT), with some observers also recording CF for headed and tailed (HAT) as well as headed and gutted (HAG) product. Observers reported a spread of CFs in the same fishing area and using the same processing method.

3.30 Background information and statistical analyses can be found in SC-CAMLR-XXI/BG/27.

Conversion of Processed Weight to Green Weight

3.31 Last year, the Working Group noted that detailed analyses of CFs need to be undertaken in order to better understand the patterns of differences between vessels and observers and what factors may be causing them, and that theoretical studies be carried out in an effort to derive better estimates of sampling precision and better procedures for estimating green weight caught from processed fish and landed weight (SC-CAMLR-XX, Annex 5, paragraphs 3.81 to 3.83).

3.32 The Working Group noted the new information available at this year's meeting (SC-CAMLR-XXI/BG/27, paragraphs 3.1 to 3.6).

3.33 Dr Candy used GLMs of available data to examine the factors that might influence estimates of CFs (SC-CAMLR-XXI/BG/27, paragraphs 3.7 to 3.12). The results of this analysis showed significant trends of CFs with the length of fish being processed (SC-CAMLR-XXI/BG/27, Figure 3.1). Other factors had significant influence but, of those, variation between cruises was most important.

3.34 The Working Group thanked Dr Candy for such a detailed analysis and noted that this work has addressed many of the questions asked at previous meetings. The Working Group noted that some of the variation in CFs might arise because of the broad categories used to describe processing types. The Working Group agreed that a refinement of those categories would be appropriate and requested that, where possible, observers provide more information on the processing categories used. This could be achieved through continued reporting using diagrams of the cuts used in processing as well as refined categories in the observer reports. The Working Group requested that, where possible, observers be asked to continue to provide this information for consideration at next year's meeting.

3.35 The Working Group agreed that the next phase of the work was to develop an appropriate protocol for estimating CFs in the future. It noted that CFs were required for both the five-day reporting scheme and for converting landed weights to green weight for the purposes of the CDS. In this respect, the protocols will need to take account of both these requirements.

3.36 In the interim of these protocols being developed, the Working Group recommended that the observations and reporting of CFs remain as they are except for, where possible, the inclusion of greater detail on processing categories as described above.

3.37 The Working Group agreed to establish a Subgroup on Conversion Factors including Drs Candy and Agnew and Mr Smith. It was agreed that the subgroup would coordinate work intersessionally and involve, wherever possible, observers from toothfish fisheries.

Research Surveys

3.38 Four trawl surveys and one acoustic survey of demersal fish species were completed in the Convention Area during the 2001/02 fishing year:

- an Australian trawl survey of demersal fish species (in particular *D. eleginoides* and *C. gunnari*) was carried out in Division 58.5.2 in May and June 2002 (WG-FSA-02/70 and 02/47);

- a German trawl survey of demersal fish species was made around Elephant Island and the South Shetland Islands (Subarea 48.1) in January and February 2002 (WG-FSA-02/24);

- a UK trawl survey of demersal fish species (in particular *D. eleginoides* and *C. gunnari*) was carried out in Subarea 48.3 in January 2002 (WG-FSA-02/34); and

- a Russian trawl survey of demersal fish species (in particular *C. gunnari*) was carried out off South Georgia in February and March 2002 (WG-FSA-02/19). Midway during the bottom trawl survey, the Russian vessel completed an acoustic survey of *C. gunnari* and krill in the same area (WG-FSA-02/44).

3.39 Further information on these surveys can be found in SC-CAMLR-XXI/BG/27.

3.40 The data presented in these papers were referred to the subgroups on assessment of *D. eleginoides* and *C. gunnari* to determine how they might be used in assessments for this year.

3.41 The Working Group noted that the biomass estimates for Subarea 48.1 from the 2002 survey were comparable to those obtained from previous surveys. There was no evidence that stocks of *Notothenia rossii* had recovered to historic levels even in the absence of commercial fishing for the past 20 years, and that the abundance of finfish determined in this study would not support a reopening of the commercial fishery. It was suggested that a specific survey targeting *N. rossii* be conducted in the near future to properly assess the status of this stock.

3.42 The Working Group also noted the results of the Russian acoustic survey of *C. gunnari*. The biomass estimate from the acoustic survey was almost double that from the bottom trawl survey. Of this, about 30% of the biomass was in the pelagic region 8–58 m above the bottom. The Working Group agreed that this provided strong evidence that a substantial proportion of the icefish biomass is in the pelagic zone and is unavailable to the bottom trawl survey. It encouraged the further development of the acoustic technique for assessing fish stocks.

3.43 The subgroup on acoustic and trawl surveys for icefish recognised the value of acoustic surveys, particularly as data indicate a considerable portion of the biomass is off the sea floor. The subgroup recommended the establishment of an intersessional subgroup (coordinators Drs Collins and P. Gasiukov (Russia)) on fisheries acoustics, with representation from all interested Members. The objectives of the subgroup would be to evaluate the application of acoustics methods in estimating biomass of exploited fish in the CCAMLR Convention Area. In particular, the subgroup would be asked to re-examine the acoustic data from the Russian and UK surveys to provide a robust estimate of biomass, confidence intervals and age composition. Further details on this topic can be found in SC-CAMLR-XXI/BG/27.

PREPARATION FOR ASSESSMENTS

4.1 Dr Constable introduced the report on intersessional work of the Subgroup on Assessment Methods (WG-FSA-02/80) and highlighted the summary of preparatory work for this year's assessments undertaken by the subgroup. The report of the subgroup outlined the methods that have been introduced to the Working Group this year and the papers relevant to different aspects of the assessments, including estimates of biomass, recruitment and biological parameters. Dr Constable thanked the members of the subgroup for their work and, in particular, Drs Kirkwood and Gasiukov for furthering the development of assessment methods for use by the Working Group.

4.2 The Working Group noted the further developments of assessment methods in their application to *D. eleginoides*. In this respect, the Working Group noted the further work of an assessment of toothfish status in Subarea 58.7 using an Age-Structured Production Model (ASPM) (WG-FSA-02/76). It agreed that some discussion on future aspects of this assessment, including reconciling model outputs with the known length structure of the catch, would be needed as well as consideration of target levels for recovery for the species in this area.

4.3 WG-FSA-02/78 provided an application of a Dynamic Production Model (DPM) to the assessment of toothfish in Subarea 48.3. This approach is applied elsewhere in the world and is described in Punt and Hilborn (1996). It relies on fewer parameters than the GYM. The Working Group noted that:

(i) this type of assessment may be difficult to apply in this case because of the biology and demography of toothfish, such as the high variability in recruitment and the need for the stock to be close to equilibrium prior to exploitation;

(ii) it is very difficult to identify the ratio of the status of the stock just prior to exploitation relative to an equilibrial status; and

(iii) the assessment using this method is sensitive to the magnitude of that ratio.

The Working Group agreed that some attention may need to be given to understanding how the dynamic nature of the environment in Subarea 48.3 might contribute to the dynamics of toothfish in the area. The Working Group encouraged further development of this work, particularly with respect to evaluating different approaches to assessing toothfish to be discussed in Item 9.

4.4 WG-FSA-02/64 updated a method presented to the Working Group last year (WG-FSA-01/48) for estimating length-based fishing selectivities of *D. eleginoides* in the longline fishery in Subarea 48.3. This revised method is based on an assumption that the proportions of the total CPUE in an area for a particular length class that are taken in different depth zones are Beta-distributed. This removes some of the ad hoc nature of the former estimation method. These length-based selectivities are then converted to age-based selectivities for use in the GYM. The Working Group welcomed this new development and agreed to apply this method this year.

4.5 The Working Group noted the developments of software provided by the Australian Antarctic Division (WG-FSA-02/68). It noted that the structure of the GYM had been modified so that the recruitment to the fish population occurred at the beginning of the projection year rather than at the end. This meant that the input of a time series of recruitments would correctly coincide with a time series of catches. This new structure (GYM401.EXE) was tested by the Working Group and it was agreed that it meant only slight changes to the assessments. It was accepted for use at this meeting.

4.6 A number of revisions and enhancements have been made to 'Fish Heaven', a general spatially-structured population projection model and tool for evaluating the effectiveness of management procedures. This includes an ability of Fish Heaven to utilise the GYM in its annual assessment procedure.

4.7 The Working Group welcomed the elaboration of detailed manuals and user interfaces for the GYM (WG-FSA-02/62), the software for estimating age composition from length-density data, CMIX (WG-FSA-02/61) and Fish Heaven (WG-FSA-02/63). Dr Constable provided tutorials on the use of the new interfaces for the GYM and for CMIX as well as tutorials on how to undertake the standard assessments using these software. The Working Group agreed that the combination of manuals, user interfaces and tutorials made the assessment process much more accessible to all members of the Working Group. In that regard, the Working Group thanked the authors of the manuals and the software for providing easier user interfaces and instructions for general users to follow.

4.8 In terms of its assessments this year, the Working Group agreed to undertake this work in a manner that would provide all members an opportunity to learn the different aspects of the process. In addition, the Working Group agreed to alter the archive of assessment materials so that it more closely related to the different parts of each assessment of a species in a given area. Dr Ramm provided a layout of the directory archive on the network that could be used to save all work relating to the assessments.

4.9 The Working Group also agreed to develop further summary descriptions of assessment methods that could be referenced in appropriate sections of the report. The first attempt at these summaries is provided in SC-CAMLR-XXI/BG/28. The Working Group also agreed to summarise the developments associated with the assessments in the Species Profiles (SC-CAMLR-XXI/BG/29 and BG/30).

ASSESSMENTS AND MANAGEMENT ADVICE

New and Exploratory Fisheries

New and Exploratory Fisheries in 2001/02

5.1 Thirteen conservation measures relating to exploratory fisheries were in force during 2001/02, but fishing only occurred in respect of three of these. Information on catches from active exploratory fisheries during 2001/02 is summarised in Table 3.1.

5.2 The Working Group observed that once again this year, only a small proportion of exploratory fisheries notifications made last year resulted in active fisheries. In this context, it appears rather surprising that many Members chose not to undertake notified exploratory fisheries inside the Convention Area, while CDS records submitted indicate considerable longline fishing by Members outside the Convention Area.

5.3 In most of the active exploratory fisheries, the numbers of days fished and the catches reported were relatively small. As was the case last year, the notable exception was the exploratory fishery for *Dissostichus* spp. in Subarea 88.1 conducted under Conservation Measure 235/XX. During 2001/02, New Zealand vessels took 1 275 tonnes of *Dissostichus* spp., although Russia, Japan and South Africa had made notifications but not fished.

5.4 The catches of by-catch species in the exploratory longline fishery for *Dissostichus* spp. in Subarea 88.1 all fell within the catch limits set in Conservation Measure 235/XX.

5.5 Data collected from the New Zealand exploratory longline fishery in Subareas 88.1 and 88.2 during the last five seasons are described and analysed in detail in WG-FSA-02/38 and related papers. The Working Group agreed that an assessment should be attempted for these subareas, using methods similar to those used for Subarea 88.1 last year.

5.6 The new bottom trawl fishery for *Macrourus* species notified by Australia last year was not activated. The Working Group noted that this fishery should therefore retain its ‘new’ status.

New and Exploratory Fisheries Notified for 2002/03

5.7 A summary of new and exploratory fisheries notifications for 2002/03 is given in SC-CAMLR-XXI/BG/9. The intended catches, numbers of vessels and gear for the notifications for new and exploratory fisheries for *Dissostichus* spp. in 2002/03 are shown, grouped by subarea or division, in Table 5.1. All notifications had been received by the Secretariat on or before the due date, with the exception of the Russian notification, for which only a statement of intent to submit a notification had been received. Subsequently it was clarified that Russia wished to carry forward their notification for the previous year and a formal notification was received on 6 September (CCAMLR-XXI/16). Dr Ramm advised that additional vessel details had been notified in relation to the notifications from New Zealand (CCAMLR-XXI/7) and Japan (CCAMLR-XXI/9). These are reflected in Table 5.2.

5.8 As was the case last year, there were multiple notifications of exploratory fisheries for *Dissostichus* spp. for several subareas or divisions (see Table 5.2). While this is of potential concern, the Working Group also noted that the experience of previous years suggested that a number of these may not be activated. In particular, it noted that notifications (often multiple) have been made for Subarea 48.6 each year since 1997, but so far no exploratory fishing has been reported for that subarea.

5.9 In reviewing Table 5.2, the Working Group observed that there remained inconsistencies in the way in which different notifications specified intended catches. Some notifications attempted to specify realistic levels of intended catches, while others simply specified an intended catch that was equal to the current precautionary catch limit. While this inconsistency continues, the task of assessing the likely effects of multiple exploratory fisheries in an area is made much more difficult. The Working Group emphasised that intended catch levels should be governed by what is required for economic viability and by operational and data acquisition considerations, as specified in Conservation Measure 65/XII.

5.10 There has been a large number of notifications for Subareas 48.6 (three notifications for up to seven vessels), 88.1 (five notifications for up to 15 vessels) and 88.2 (three notifications for up to seven 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. In addition, there is the potential in Subarea 88.2 for per-vessel catches to be sufficiently high that the catch limit may be reached in a very short period of time or be overshot if all notified vessels participated in the fishery.

5.11 There are additional administrative problems in managing conservation measure provisions for fishing in fine-scale rectangles and SSRUs when many vessels are fishing simultaneously in a subarea or division. In this context, the Working Group requested that the Scientific Committee clarify what precisely is meant by vessel residence when restrictions are placed on the number of vessels allowed in an area at any one time.

5.12 With regard to provision of advice on precautionary catch limits for stocks likely to be subject to new or exploratory fisheries in 2002/03, the Working Group agreed that this would only be possible this year for Subareas 88.1 and 88.2. Assessment of allowable by-catch limits for macrourids is described in paragraphs 5.154 to 5.159.

5.13 The updated assessment of *D. eleginoides* in the Prince Edward Islands EEZ in WG-FSA-02/76 and the Working Group's conclusions regarding it (see paragraphs 5.126

to 5.130), suggested that the stock in that area had been greatly reduced from its unexploited level primarily by IUU fishing. The Working Group agreed that this raised concerns about the status of *D. eleginoides* stocks throughout Subarea 58.6. In this respect, the Working Group noted that, despite its request last year, the fine-scale data necessary for carrying out an assessment of the stock around the Crozet Islands have not been submitted to CCAMLR.

5.14 Two notifications have been made for exploratory longline fisheries in Subarea 58.6 (see Table 5.7), involving up to five vessels. The Working Group observed that notification of an exploratory fishery in an area at least implicitly implies that there is an expectation that it would be economically viable to fish there and it requested that any available information on the status of stocks in Subarea 58.6 outside national EEZs be forwarded to it. The Working Group agreed that exploratory fisheries in Subarea 58.6 should not proceed until appropriate information, such as from a stock survey, became available.

Notification of a Longline Fishery in Division 58.5.2

5.15 Australia had notified its intent to conduct a longline fishery for *D. eleginoides* in Division 58.5.2 (CCAMLR-XXI/10). Although this would be the first time such a fishery has operated in this division, the existence of an established trawl fishery in the division and the availability of a full assessment for the *D. eleginoides* stock in the division imply that the longline fishery would not fall under the classification of a new or exploratory fishery. As indicated in CCAMLR-XXI/10, Australia's aim in making this notification was to give as much advance notice and information to WG-FSA and the Commission as possible.

5.16 Dr Constable advised the Working Group that combined allowable catches for both the existing bottom trawl fishery and the longline fishery would be expected to be subject to the catch limit dictated by the trawl fishery stock assessment, as this would be lower than an equivalent catch limit for both fisheries combined, given that the trawl fishery selects for smaller fish. CCAMLR-XXI/10 detailed an operational plan for the longline fishery that ensures that the requirements of all by-catch mitigation measures will be met or exceeded. The research plan defines fishing in specific small-scale research units. Management of the fishery will apply and be consistent with the principles of the regulatory framework.

5.17 Dr Constable also drew the Working Group's attention to SC-CAMLR-XXI/7, which outlined a proposal to modify the boundaries of Division 58.5.2 to define the William's Ridge area, and to the recent declaration by Australia of a HIMI marine reserve and conservation zone in the Australian EEZ around the territory of Heard Island and McDonald Islands (SC-CAMLR-XXI/BG/18).

5.18 The Working Group welcomed the approach taken by Australia in providing this advance notification of the proposed longline fishery and the detailed explanation of the management provisions for that fishery.

Precautionary Catch Limits for Subarea 88.1

5.19 An exploratory longline fishery by New Zealand for *D. mawsoni* and *D. eleginoides* took place in Subarea 88.1 in 2001/02. The precautionary catch limit of *Dissostichus* spp. in

Subarea 88.1 for 2001/02 was 2 508 tonnes, comprising catch limits of 171 tonnes north of 65°S and 584 tonnes in each of the four SSRUs to the south of 65°S (Conservation Measure 235/XX).

5.20 Further information on this fishery can be found in SC-CAMLR-XXI/BG/27.

5.21 A total of 1 321 tonnes of *D. mawsoni* and 12 tonnes of *D. eleginoides* was caught during 2001/02. The catch limit was almost reached in SSRU C, but was not approached in any of the other SSRUs. All of the catch was taken by New Zealand vessels, which have now been involved in this exploratory fishery for the past five seasons. During that time, the total catches have been 41 tonnes in 1998, 296 tonnes in 1999, 745 tonnes in 2000, 659 tonnes in 2001 and 1 333 tonnes in 2002.

5.22 The exploratory fishery over the last five seasons has seen a widespread distribution of effort. In the 2002 season all five SSRUs were fished and 14 new fine-scale rectangles were fished for the first time. From 28 to 91 fine-scale rectangles have been fished each year, and a total of 171 fine-scale rectangles have been fished overall (WG-FSA-02/38).

5.23 For the last two years the Working Group has used the approach for calculating precautionary catch limits for Subarea 88.1 outlined in SC-CAMLR-XIX, Annex 5, paragraphs 4.20 to 4.33. The Working Group agreed to continue to use this approach for this year's assessment of Subarea 88.1.

5.24 As in last year's assessment, separate yield estimates were calculated for each SSRU. Last year's yields were updated based on data collected during the 2001/02 fishing year (see SC-CAMLR-XXI/BG/27, paragraphs 5.1.8 to 5.1.15 for more details). Estimates of seabed area, fishing selectivity, relative CPUE, precautionary pre-exploitation harvest levels (?), and yield estimates for Subarea 88.1 are given in Table 5.3. The overall yield for Subarea 88.1 has more than doubled since last year. This increase was mainly due to the large increase in CPUE in Subarea 88.1 in 2001/02, and the increased recruitment estimates for Subarea 48.3.

5.25 The Working Group noted that the yields for Subarea 48.3 presented here are based on assumptions and parameters which seem appropriate for this assessment in Subareas 88.1 and 88.2 and should not be compared to the actual assessment undertaken for Subarea 48.3.

5.26 The Working Group noted that whilst the current assessment incorporates several improvements over earlier assessments of this area, there was still considerable uncertainty about the assessments. This stems from uncertainty in biological and fishery parameters for both *Dissostichus* spp., and in particular from the assumed relationship between CPUE and density.

5.27 The Working Group noted that there had been a large increase in CPUE in Subarea 88.1 during the 2001/02 fishing year (WG-FSA-02/38). This could be attributed to the good ice conditions encountered in the 2001/02 fishing year, which allowed the vessels access to some of the better fishing grounds, and to the presence of only the two most experienced vessels in the fishery. There is concern that the increased experience in fishing toothfish may have led to an upward bias in CPUE. This is because the high CPUE for one or two smaller grounds is extrapolated over the entire fished area. However, any such bias would be difficult to quantify without a better definition of the main fishing grounds. There was no time to complete a reanalysis of the main fishing grounds, and the Working Group recommended that this be investigated in the intersessional period.

5.28 The Working Group also considered that the existing approach could be further improved by treating selectivity differently. It recommended that estimates of selectivity in next year's assessment should try and take into account depths fished by the vessels, which is currently being used in the assessment of *D. eleginoides* in Subarea 48.3.

5.29 The Working Group considered that the CPUE series used in the current assessment should not be updated further because of potential biases as the fishers become more experienced. However, revision of this assessment would be appropriate with better information on area boundaries, fishing selectivities and other biological parameters.

5.30 Because of the problems outlined above, the Working Group agreed that the revised estimates of yield should be treated with caution and that a discount factor should again be applied to the results of this assessment. In this respect, the Working Group noted that discount factors of 0.3 and 0.5 had been used for *D. mawsoni* in Subarea 88.1 in the last two years.

5.31 The Working Group also noted that an analysis of the catch and effort data collected over the past five years would allow the identification of the main fishing grounds in the area. Such an analysis would provide a good basis for designating more appropriate SSRU boundaries.

Management Advice

5.32 Using new data resulting from the exploratory fishery in Subarea 88.1, estimates of precautionary yields for this subarea have been calculated by SSRU. These estimates are given in Table 5.3.

5.33 The estimated yield for Subarea 88.1 has more than doubled since last year to 13 882 tonnes. This increase was due to the large increase in CPUE in Subarea 88.1 in 2001/02, as well as the increased recruitment estimates for Subarea 48.3.

5.34 The Working Group agreed that the revised estimates of yield should be treated with caution and that a discount factor should again be applied to the results of this assessment. In this respect, the Working Group noted that discount factors of 0.3 and 0.5 had been used for *D. mawsoni* in Subarea 88.1 in the last two years. Recent catches, catch limits and estimated yields for each SSRU are given in Table 5.4.

Precautionary Catch Limits for Subarea 88.2

5.35 The same approach as taken above for Subarea 88.1 was used for calculating precautionary catch limits for *D. mawsoni* in Subarea 88.2.

5.36 Only 10 sets were completed in SSRU A in Subarea 88.2 in the 2001/02 fishing year. This was considered too few to carry out a bootstrap analysis. The Working Group therefore assumed the mean CPUE ratio for this area to be the same as that for the whole of Subarea 88.1 (Table 5.3).

5.37 Estimates of seabed area, fishing selectivity, relative CPUE and precautionary pre-exploitation harvest levels (?) for Subarea 88.2 are given in Table 5.3. Based on this assessment the resulting estimate of precautionary yield in Subarea 88.2 is given in Table 5.3. Equivalent estimates of yield, the catch limit adopted and the catch actually taken in 2001/02 are shown in Table 5.4.

5.38 The Working Group noted that there is also uncertainty about the assessment for Subarea 88.2 and agreed that a discount factor again needs to be applied.

Management Advice

5.39 Using new data resulting from the exploratory fishery in Subarea 88.2, an estimate of precautionary yield for this subarea has been calculated (Table 5.4). The Working Group agreed that a discount factor should be applied to this yield estimate. The Working Group noted that this yield estimate applies only to SSRU A.

Comments on Research Plans

5.40 In each of the exploratory fishery notifications, the research plans proposed at least met the minimum requirements specified in Conservation Measure 227/XX and in some aspects exceeded them.

5.41 The Working Group acknowledged the value of the research components of exploratory fisheries in the past and previous seasons, noting in particular the extent to which it has been possible to make progress towards a precautionary assessment of Subareas 88.1 and 88.2.

5.42 An important element of this was the development of time series of CPUE data in Subarea 88.1 obtained from research and exploratory sets in SSRUs. In view of the utility of these data, the Working Group encouraged further investigation of effective means of deploying effort in order to maintain and enhance this time series. Should vessels from more than one country participate in this fishery, it would also be valuable to consider how they could also contribute catch and effort information for the time series.

5.43 While standardised CPUE data will allow monitoring of trends in relative abundance, a thorough stock assessment for Subarea 88.1 will not be possible until an estimate of absolute abundance has been obtained. At present, the location and extent of juvenile *Dissostichus* habitat in Subarea 88.1 is unknown, so it is not possible to undertake trawl surveys similar to those undertaken in Subarea 48.3 and Division 58.5.2. On the other hand, the mark–recapture experiments undertaken over several years by New Zealand do show promise, and the Working Group strongly encouraged continuation of these by New Zealand and by any other Member participating in the exploratory fishery in this subarea.

5.44 Information presented in WG-FSA-02/35 suggested that the boundaries for the existing SSRUs in Subarea 88.1 may need revision. The Working Group encouraged further examination of this during the intersessional period.

Advice to the Scientific Committee

5.45 Thirteen conservation measures relating to exploratory fisheries were in force during 2001/02, but fishing only occurred in respect of three of these. In most of the active exploratory fisheries, the numbers of days fished and the catches reported were small. The notable exception was the exploratory fishery for *Dissostichus* spp. in Subarea 88.1 conducted under Conservation Measure 235/XX. During 2001/02 vessels from New Zealand took 1 275 tonnes of *Dissostichus* spp.

5.46 Eight notifications of new or exploratory fisheries were made for 2002/03 (Table 5.1), and Australia also notified the commencement of a longline fishery for *D. eleginoides* in Division 58.5.2. There were multiple notifications of exploratory fisheries for *Dissostichus* spp. for several subareas or divisions (Table 5.2). While this is of potential concern, the Working Group also noted that the experience of previous years suggested that many of these may not be activated.

5.47 Inconsistencies remain in the way in which different notifications specified intended catches. As was the case last year, some notifications attempted to specify realistic levels of intended catches, while others simply specified an intended catch that was equal to the current precautionary catch limit. While these inconsistencies continue, the task of assessing the likely effects of multiple new or exploratory fisheries in an area is made much more difficult.

5.48 There has been a large number of notifications for Subareas 48.6, 88.1 and 88.2. 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 in high latitudes where fishing imposes considerable operational difficulties. In Subarea 88.2 the likely catch limit could potentially be taken in a short time or to be overshot if all notified vessels participate.

5.49 There are additional administrative problems in managing conservation measure provisions for fishing in fine-scale rectangles and SSRUs when many vessels are fishing simultaneously in a subarea or division. In this context, the Working Group requested that the Scientific Committee clarify what precisely is meant by vessel residence when restrictions are placed on the number of vessels allowed in an area at any one time.

5.50 With regard to provision of advice on precautionary catch limits for stocks likely to be subject to new or exploratory fisheries in 2002/03, the Working Group agreed that this would only be possible this year for Subareas 88.1 and 88.2. For all the other subareas and divisions for which notifications have been made, the Working Group is unable to provide any new advice on precautionary catch limits.

5.51 Using new data resulting from the exploratory fishery in Subarea 88.1, estimates of precautionary yields for this subarea have been calculated by SSRU. These estimates are given in Table 5.3.

5.52 The estimated yield for Subarea 88.1 has more than doubled since last year to 13 882 tonnes. This increase was due to the large increase in CPUE in Subarea 88.1 in 2001/02, as well as the increased recruitment estimates for Subarea 48.3.

5.53 The Working Group agreed that the revised estimates of yield should be treated with caution and that a discount factor should again be applied to the results of this assessment. In this respect, the Working Group noted that discount factors of 0.3 and 0.5 had been used for *D. mawsoni* in Subarea 88.1 in the last two years. Recent catches, catch limits and estimated yields for each SSRU are given in Table 5.4.

5.54 Using new data resulting from the exploratory fishery in Subarea 88.2, an estimate of precautionary yield for this subarea has been calculated (Table 5.4). The Working Group agreed that a discount factor should be applied to this yield estimate. The Working Group noted that this yield estimate applies only to SSRU A.

5.55 The assessment of *D. eleginoides* in the Prince Edward Islands EEZ, which suggested that the stock in that area had been greatly reduced from its unexploited level primarily by IUU fishing, raises major concerns about the status of *D. eleginoides* stocks throughout Subarea 58.6. The Working Group agreed that exploratory fisheries notified for Subarea 58.6 in 2002/03 should not proceed until appropriate information on stock status, such as from a stock survey, became available.

5.56 The Working Group strongly encouraged continuation of mark–recapture experiments by New Zealand and by any other Member participating in the exploratory fishery in Subareas 88.1 and 88.2.

Assessed Fisheries

Dissostichus eleginoides South Georgia (Subarea 48.3)

Trends in Fishing Vulnerability

Estimating Age-specific Vulnerabilities for Subarea 48.3

5.57 At its 2001 meeting WG-FSA assumed in its calculation of long-term annual yields for the longline fishery for *D. eleginoides* in Subarea 48.3 that prior to 1998 all fish above 79 cm were fully selected. For fish below that length, a length-specific vulnerability ogive operated, with zero vulnerability at 55 cm. From 1998 onwards it assumed that fish were subject to the age-specific vulnerability function given in SC-CAMLR-XX, Annex 5, Table 25. These were calculated using the method described in WG-FSA-01/48.

5.58 WG-FSA-02/64 presented a revised method for estimating length- and age-specific vulnerabilities that used more statistically rigorous procedures than those in the previously described method. The new method was applied to historical data for 1997 to 2000 and revised data provided by the Secretariat for 2001 and 2002. Two sets of estimates of vulnerabilities were calculated initially: one in which the areas of depth and area strata were taken into account and one in which they were not. On review of these preliminary results and their underlying assumptions, WG-FSA agreed that analyses that assumed fish within a length class were evenly distributed across the entire bottom area contained within the shallower and deeper depth zones may lead to underestimates of the vulnerabilities of the smallest and largest fish. Accordingly, it agreed that the vulnerabilities should be calculated using the method that did not take areas into account.

5.59 Review of the length-specific vulnerabilities estimated for the years 1997–2001 and of the depth distribution of longline fishing around South Georgia and Shag Rocks since the early 1990s suggested there had been two typical patterns of fishing over that period: a 'deep' fishing pattern concentrating on depths around 1200 m, with little fishing shallower than 600 m, and a 'shallower' pattern in which fishing extended to depths down to 400 m and shallower. The 'deep' fishing pattern was used in years up to and including 1997 and since 2001, with the shallower fishing pattern applying from 1998 to 2000. The age-specific vulnerabilities estimated for the two fishing patterns are illustrated in Table 5.5 and Figure 5.1.

Recruitment and CPUE Series

5.60 The 2002 UK survey of South Georgia and Shag Rocks was used to update the recruitment series for Subarea 48.3. Length-density data (numbers/km^2 at each length) were derived for each haul, weighted by stratum, using the equation:

$$D'_{o,s} = D_{o,s} \frac{\sum_S n}{n_s} \frac{A_s}{\sum_S A}$$

where $D_{o,s}$ is the density of fish of a certain length in a single haul o in stratum s, n_s is the number of hauls taken in a given stratum, A_s is the corresponding area of the stratum, and S is the number of strata.

5.61 Stratification was by the three depth strata (50–150 m, 150–250 m and 250–500 m). This is consistent with the strata used to create the recruitment series for past years (Table 5.6). The new CMIX spreadsheet add-in was applied, with allowance for constant CV and mixture components set based on the growth curve used for the assessment (Table 5.7) starting at age 2. The bounds on the final bin were widened to take account of all other ages.

5.62 The fitted length-density plot (Figure 5.2) showed strong peaks at ages 2 and 3. Tables 5.6 and 5.8 show that the estimates of recruitment density for these age groups is high, indeed amongst the highest in the series.

5.63 Haul-by-haul catch and effort data for Subarea 48.3 (fine-scale data) for the 1985/86 to 2001/02 fishing seasons were examined. Details can be found in SC-CAMLR-XXI/BG/27, paragraphs 5.2.1 to 5.2.4. GLM analyses were conducted using this dataset (updated to August 2002), except for data for the first season (1985/86), when fishing had been restricted to very shallow depths (mainly less than 300 m). As in the previous year, WG-FSA agreed that data for all months be included in the analyses.

5.64 CPUE in kg/hook was used as the response variable, and nationality, season, month, area (East South Georgia, NW South Georgia, South Georgia, West Shag Rocks and Shag Rocks), depth and bait type were considered as predictor variables. Depth information was additionally treated as a categorical variable with four levels (0–500 m, 500–1 000 m, 1 000–1 500 m, 1 500 m and above). GLM analyses were conducted on positive CPUE data only, with an adjustment for zero catches being made afterwards.

5.65 The standardised time series of CPUEs in kg/hook is plotted in Figure 5.3. The standardisation is with respect to Chilean vessels fishing at depths of 1 000 to 1 500 m. This time series has also been adjusted for the presence of hauls with zero catches, by multiplying the standardised CPUEs predicted from the GLMs by the proportions of non-zero catches.

Adjusted standardised catch rates have fluctuated around a relatively constant level between 1986/87 and 1994/95. The adjusted standardised catch rates declined substantially between 1994/95 and 1996/97. Since this decline, catch rates have demonstrated a slightly increasing trend from 1997/98 to 2001/02.

5.66 Further information on standardisation of CPUE in this fishery can be found in SC-CAMLR-XXI/BG/27.

Assessment

5.67 The Working Group conducted assessments incorporating the following changes from the assessment conducted in 2001:

(i) the change in the GYM software to take account of the different timing of recruitment (paragraph 4.5);

(ii) the new catch series resulting from the change from split-year to fishing season (Table 5.9);

(iii) the addition of the 2002 UK survey estimates of toothfish recruitment;

(iv) the use of the Agnew and Kirkwood estimates of IUU catch from 1998/99 to 2000/01 (WG-FSA-02/5);

(v) the use of the new selectivity-at-age schedules indicated in Table 5.5;

(vi) a more precise definition of the fishing period as 1 May to 31 August from the 1994/95 fishing season onwards; and

(vii) the new CPUE series.

5.68 In order to investigate the influences of these various changes to the input data for the GYM, a number of runs were performed in which the changes were incrementally added. The first trial repeated the assessment conducted in 2001, to see what effect was caused by the change in GYM software to take account of fishing season (run 1 in Table 5.10). Secondly, the effects of the recruitment calculated from the UK 2002 survey were investigated by adding the recruitment for age 5, age 4 and age 3 sequentially (runs 2 to 4 in Table 5.10). Finally, the new fishing season catch series, selectivity at age and fishing period were added (runs 5 to 7 in Table 5.10). The most significant change was the addition of the new recruitment data, which created some large cohorts of age 4 in 2000/01, 2001/02 and 2002/03 and which thereby increased the size of the population over the subsequent 35 years in the projection. The results are therefore consistent with having a high estimate of recruitment in the current year. The change from split-year to fishing year, the addition of the new IUU catch data, and the use of the new selectivity and fishing period series, had relatively small effects.

5.69 Concern was expressed that the survey may have exhibited higher catchability for toothfish than previous surveys. Further intersessional examination of this aspect of survey design in Subarea 48.3, and how variability in survey catchability can be incorporated in the assessments, were encouraged.

5.70 The Working Group recognised that although it was not possible to determine whether the estimates of recruitment from 2002 were overestimates, additional estimates of the size of the cohorts represented in the 2002 survey would be likely to be made by future surveys. Thus the density of age-3 fish in the 2002 survey would be estimated again by the density of age-5 fish in a survey in 2004. Furthermore, recruitment for future cohorts (in the projections within GYM) is derived from a distribution parameterised using all past recruitment values, not just the most recent year.

5.71 In this context, it was emphasised that the currency of the assessment performed by the GYM is the end of the 35-year time period of the projection. Thus, the assessment indicated the catch that could sustainably be caught over the full 35-year future period, taking into account current data, even if no further assessments were undertaken. However, the Working Group would not expect to use the results of the assessment in this manner, but would normally expect to update the assessment each year as more information becomes available.

5.72 The point was also made that although Figure 5.2 indicated that the mixture analysis was easily able to separate cohorts from the survey data this year, this has not necessarily always been the case with past surveys in Subarea 48.3. Determination of the ages of toothfish caught on both present and (if possible) past surveys should therefore be undertaken.

5.73 It was noted that summary catch-weighted length-frequency plots from the fishery were presented in SC-CAMLR-XIX, Annex 5 (Figure 11). There was not enough time to do the calculations necessary for these plots at the 2002 meeting, but it was agreed that they should be produced by the Secretariat in the intersessional period.

5.74 Two final assessments were undertaken (runs 8 and 9 in Table 5.10). Each used the new catch series, the new recruitment series, the new fishing period and the new historical selectivities, as presented in Tables 5.6 to 5.9. They differed in the selectivity at age assumed for future years. The first assessment assumed that future selectivity was that characterised by deep-water fishing, and the second assumed that future selectivity was that characterised by shallow-water fishing.

5.75 Runs 8 and 9 (Table 5.10) show that the precautionary catch limit is lower if it is assumed that fishing will take place in shallow water for the next 35 years than if it is assumed to take place in deep water. This is consistent with the fact that shallow-water fishing takes more smaller fish (per tonne of catch) than does deep-water fishing. Since at the moment the fishery is not restricted to fish in any particular depth, the conservative assumption would be that it will take place in shallow water. The Working Group therefore calculated the final precautionary yield, including the CPUE adjustment, using the shallow-water selectivity at age for projected years in the assessment (Table 5.11).

5.76 Standard plots from the final run of the assessment are shown in Figure 5.4. Vulnerable biomass (the biomass in the fishing period that is available to fishing according to the vulnerability (selectivity) function) shows an initial decline at the start of the fishery. Following a period of unchanging biomass in the first half of the 1990s, vulnerable biomass shows a further decline around 1995/96 which coincides with the decline seen in the CPUE series (Figure 5.3). A gradual rise throughout the late 1990s and early 2000s is also consistent with the trends seen in the CPUE series. The peak in vulnerable biomass in about 2004/05 corresponds with the time at which one might expect 3- to 4-year-old fish detected by the 2002 UK survey to have recruited to the fishery as 6- to 7-year-old fish.

Management Advice

5.77 The Working Group recommended that the catch limit for *D. eleginoides* for the 2002/03 fishing season be set at 7 810 tonnes.

5.78 The Working Group noted that the overall yield for Subarea 48.3 (7 810 tonnes) has increased substantially from last year (5 820 tonnes). This is mostly due to the large recruitments estimated from the 2002 survey.

5.79 The remaining provisions of Conservation Measure 221/XX should be carried forward for the 2002/03 season.

5.80 Any catch of *D. eleginoides* taken in other fisheries (such as the pot fishery) in Subarea 48.3 should be counted against this catch limit.

Additional Comments on the Toothfish Assessment in Subarea 48.3

5.81 Dr Gasiukov drew the Working Group's attention to the fact that the GYM-based method used to assess the catch of *D. eleginoides* only gives potential yield but not the standing stock estimates. In his opinion, there is a high degree of uncertainty associated with the model input data, which are revised by WG-FSA almost every year. Therefore, there is no certainty that the derived yield estimates have a proper scientific basis. He further commented and drew attention to the results of stock assessments calculated using alternative methods as follows:

(i) First of all, there are serious doubts about the *D. eleginoides* recruitment estimates, which are based on trawl survey data and a mathematical technique for mixture distribution analysis based on the Δ-distribution. It is known (Syrjala, 2000) that if the hypothesised Δ-distribution is not correct, the estimates could be 2 to 3 times higher than the true values.

(ii) There are also serious doubts concerning the estimates of natural mortality rates and, in relation to selectivities-at-age, it is impossible to confirm that selectivity drops substantially below one for toothfish aged 10 years and older.

(iii) Application of other well-known assessment methods, widely used by other international organisations, indicates unsatisfactory status of the *D. eleginoides* stocks. For example, the DPM (WG-FSA-02/78), which does not use the same input data as listed above, shows a decrease in the toothfish biomass to less than 0.5 of its original size since 1989/90. At the same time, in 11 out of 16 years of the toothfish fishery, catches have exceeded MSY, and the fishing effort has exceeded E_{MSY} in 12 cases out of 16; on four occasions the difference was more than twofold.

(iv) When the ASPM was applied (WG-FSA-00/46) it showed a similar reduction in biomass. The method extensively uses data similar to the GYM input data.

(v) CCAMLR ought to give some attention to the contradiction existing between standing-stock estimates derived by different methods, showing a decrease in the toothfish stock in Subarea 48.3, and a constant increase of yield values estimated with the use of the GYM.

5.82 The Working Group noted Dr Gasiukov's comments, but it also noted that each of the issues raised had been discussed by the Working Group and they were scheduled for further detailed intersessional work by the assessment subgroup (paragraphs 9.1 and 9.10). In addition, further discussion on the use of the DPM and the ASPM is given in paragraph 4.3 and SC-CAMLR-XIX, Annex 5, paragraph 4.105 respectively.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

5.83 As was the case last year (SC-CAMLR-XX, Annex 5, paragraphs 4.127 and 4.128), the Working Group was unable to conduct an assessment or give advice on *D. eleginoides* in Division 58.5.1 because recent haul-by-haul data had not been provided.

5.84 The Working Group reaffirmed that the presence of a French scientist at the meeting and the submission of information from the fishery at WG-FSA were essential for undertaking assessments on the state of stocks in Division 58.5.1 and the area adjacent to the Crozet Islands in Subarea 58.6.

Dissostichus eleginoides Heard and McDonald Islands (Division 58.5.2)

5.85 The final catch of *D. eleginoides* for the trawl fishery in the 2000/01 CCAMLR fishing season was 2 987 tonnes (catch limit = 2 995 tonnes, Conservation Measure 197/XIX).

5.86 The catch limit of *D. eleginoides* in Division 58.5.2 for the 2001/02 season was 2 815 tonnes (Conservation Measure 222/XX) for the period from 1 December 2001 to the end of the Commission meeting in 2002. The catch reported for this division at the time of the 2002 WG-FSA meeting was 1 916 tonnes.

Determination of Long-term Annual Yields using the GYM

5.87 SC-CAMLR-XX, Annex 5, paragraphs 4.131 to 4.143 described the assessment of long-term annual yield for *D. eleginoides* in Division 58.5.2 used at the 2001 meeting. The same methodology was applied for the assessment at this meeting.

5.88 WG-FSA-02/70 set out a preliminary assessment of *D. eleginoides* for Division 58.5.2 based on the standard method of previous years. Tables of inputs for the assessment are given in Tables 5.12 to 5.15. Table 3.3 gives the time series of total removals. The reported catch for the 2001/02 season has been projected for the remainder of the season (2 815 tonnes).

Assessment

5.89 The input parameters for the GYM are shown in Table 5.12. The assessment of WG-FSA-02/70 was checked using the standard GYM assessment based on the recruitment series. The results of the paper were confirmed. The assessment was repeated using the updated series of total removals (reported according to fishing season) for Division 58.5.2 given in Table 3.3. The decision rule concerning escapement was binding in this assessment. The yield at which median escapement of 50% of median pre-exploitation spawning biomass level over 35 years was 2879 tonnes. The yield for which there is a 0.1 probability of depletion below 20% of the pre-exploitation median spawning biomass was 3 085 tonnes.

5.90 The Working Group noted SC-CAMLR-XXI/BG/18 on Australia's declaration of a marine reserve and conservation zone in its EEZ around Heard and McDonald Islands. It agreed that the assessments of *D. eleginoides* in Division 58.5.2 are not affected by this declaration.

5.91 The Working Group also noted SC-CAMLR-XXI/7 on the differentiation of William's Ridge from the Heard Island Plateau area by waters deeper than 2 000 m. It agreed that the assessments of yield for *D. eleginoides* arising from the survey and other work on the Heard Island Plateau were solely applicable to *D. eleginoides* on the plateau. Thus, it was agreed that the advice from these assessments pertains to the area in Division 58.5.2 west of 79°20'E.

Management Advice for *Dissostichus eleginoides* (Division 58.5.2)

5.92 The Working Group recommended that the catch limit for Division 58.5.2 in the 2002/03 season be revised to 2 879 tonnes, representing the long-term annual yield estimate from the GYM. This catch limit is recommended to pertain only to the assessment area, which is to the west of 79°20'E.

5.93 The Working Group noted that the introduction of longline fishing to Division 58.5.2 (CCAMLR-XXI/10) could involve a change in the assessment in future years. However, the Working Group recommended the general application of the catch limit above to trawl and longline operations as this is a suitable precautionary approach at this stage (paragraph 5.16).

5.94 The remaining provisions of Conservation Measure 222/XX should be carried forward for the 2002/03 season.

Champsocephalus gunnari South Georgia (Subarea 48.3)

Surveys

5.95 Biomass estimates were available from two bottom trawl surveys undertaken in 2002. The *Dorada* (UK) completed 63 stations in January 2002 (WG-FSA-02/34), whilst the *Atlantida* (Russia) completed 73 stations in February 2002 (WG-FSA-02/19). During both cruises acoustic biomass estimates were made either simultaneously with the trawl (*Atlantida*) or by repeating the trawl track after the trawl (*Dorada*) (WG-FSA-02/56). In addition the *Atlantida* undertook a dedicated icefish acoustic survey (WG-FSA-02/44) in February–

March. The Working Group acknowledged and welcomed the considerable amount of work that had gone into both these surveys and the workshop (WG-FSA-02/58) held by Russia and the UK which had attempted to analyse the various datasets (WG-FSA-02/59). The results of these various surveys, as described in the papers, are given in Table 5.16.

Acoustic Surveys

5.96 In WG-FSA-02/56 acoustic tracks which were run in parallel with trawls were analysed from both the *Dorada* and *Atlantida* surveys. The acoustic biomass estimates were approximately 1.5 times higher than the trawl estimates.

5.97 The dedicated acoustic survey on the *Atlantida* produced an estimate of 92 300 tonnes of icefish in Subarea 48.3, approximately twice the swept-area biomass estimate of 44 581 tonnes from the Russian trawl survey (WG-FSA-02/59, Table 5) and 2.1 times higher than the estimate of 43 915 tonnes from the UK trawl survey (WG-FSA-02/34, Table 4).

5.98 Summarising the results of both types of acoustic surveys it was clear that acoustic estimates were higher than trawl estimates because:

(i) about 30% of the estimated icefish biomass in the acoustic survey came from the pelagic region 8–58 m above the bottom, not sampled by the bottom trawl; and

(ii) acoustic estimates from the trawl zone (1–8 m above the bottom) were about 1.5 times higher than trawl estimates, suggesting the trawl does not catch all the fish in the swept area (catchability less than 1). The pelagic part of the biomass largely comprised 1+ and 2+ fish.

5.99 The Working Group identified areas of uncertainty in the application of acoustics to the assessment of icefish biomass. These were uncertainty associated with: mark identification and species composition, the decibel difference method for separating fish from krill, the TS of species used to partition acoustic backscatter from the fish fraction, and the TS of icefish. These four factors introduce uncertainty, and potentially bias, into the acoustic biomass estimate.

5.100 Time constraints and the absence of experts in fisheries acoustics from many nations, meant it was not possible to re-examine the data to resolve the issues presented above. Consequently, it was also not possible to derive new estimates of biomass and confidence intervals that would allow the use of these data in assessments.

5.101 The Working Group expressed its appreciation of the work of Russian and UK scientists in advancing this new aspect of survey work directed at estimating biomass of icefish, and strongly encouraged them to continue with their work on acoustics for icefish. It considered the resolution of the various issues raised above to be of a high priority, and therefore decided that a fish acoustic subgroup be convened in the intersessional period. The objectives of the subgroup would be to evaluate the application of acoustics methods in estimating biomass of exploited fish in the CCAMLR Convention Area. In particular the subgroup would be asked to re-examine the acoustic data from the Russian and UK surveys, if possible resolving the issues above and providing a robust estimate of biomass, confidence intervals and age composition. Should the subgroup be successful in deriving these quantities, the results would be incorporated in the 2003 icefish assessment.

Assessment at this Year's Meeting

5.102 The Working Group followed the short-term projection approach used previously to reassess catch limits for the 2002/03 season. The data inputs required for the short-term assessment are biomass estimate, distribution of numbers at age, an estimate of M, a selection function, von Bertalanffy growth parameters, a weight–length relationship and known catches since the time of the biomass estimate.

5.103 In 2001 the Working Group analysed all Russian and UK surveys from 1984 to 2000 which were likely to be comparable. It was concluded that the Russian gear had a higher catchability than the UK gear, by a factor of 2.59. Accordingly, the UK data were multiplied by this factor in the calculation of combined biomass estimates (SC-CAMLR-XX, Annex 5, paragraph 4.217). Unfortunately the surveys in the 1980s and 1990s did not always record details of the net geometry and comparison of these surveys are not always robust. The Working Group therefore recalculated the correction factor that should be applied to the UK survey using only the 2000 and 2002 survey data from the CCAMLR database and the methods outlined in WG-FSA-02/59. The UK and Russian surveys in these years were undertaken at similar times and accurately recorded net parameters, making comparison between them more valid. This produced a correction factor of 1.241. A difference of this magnitude is consistent with the differences between the trawl headline height of the UK (6.1 m) and Russian trawls (7.2 m).

5.104 Following this analysis, four estimates of biomass of icefish in Subarea 48.3 were calculated by area and depth sector using the bootstrap swept area method (Table 5.17). Separate biomass estimates were calculated using the haul-by-haul data from the Russian and UK surveys. A third estimate was calculated from a combined dataset of UK and Russian haul-by-haul data, without the application of any correction factor. The fourth estimate was calculated from a combined dataset, with the UK haul-by-haul data multiplied by the factor 1.241 reported above. This last approach is consistent with that adopted by the Working Group in 2000 and 2001, but uses the new estimate of the relative catchabilities of the Russian and UK surveys. For the estimates using the combined UK and Russian datasets, bootstrapping was performed by resampling within each survey separately. This is thought more appropriate than the method used to calculate the combined survey biomass in 2001, where the resampling was undertaken from within the complete combined dataset, because it did not assume the same population distribution across the two surveys. The geographic distribution of the strata is illustrated in SC-CAMLR-XIX, Annex 5, Figure 24.

5.105 Length densities from all three datasets (UK alone, Russian alone and combined) were corrected for sampling bias and analysed using the CMIX program to estimate numbers of fish at age. Initial bounds on the means of the distributions of length at age were set according to the von Bertalanffy parameters used in the previous year (SC-CAMLR-XX, Annex 5, Table 35). CMIX parameters were set with the component standard deviations linearly related to the means, with the slope constrained to be greater than zero. Initial runs on each set of data failed to converge, with CMIX not able to discriminate 4-year-old fish. Subsequent runs were undertaken omitting the 4-year-old component and fish at the extremes of the distribution (i.e. <180 and >410 mm). Runs produced SD to mean slopes close to zero (i.e. SDs approximately equal) and final runs were undertaken with the slope constrained to be greater than 0.02 and intercept <15.

5.106 The results of the CMIX analysis are presented in Table 5.18 and Figure 5.5. Concern was expressed by the Working Group that the CMIX program was unable to identify 4-year-old fish in either the Russian or UK data. Figure 5.5 clearly shows the lack of fish of 335 mm length, where one would expect 4-year-old fish. It was pointed out that the 2000 survey had identified a large number of 2 year olds (SC-CAMLR-XX, Annex 5, Table 40), so the apparent complete absence of 4 year olds in both the current surveys was puzzling. A number of issues may contribute to this including:

(i) ages of fish in either survey had been incorrectly attributed (for instance age-2 fish identified in 2000 were actually age 3);

(ii) density dependent growth has contributed to a mixing of the cohorts; and

(iii) survey design and timing may contribute to apparent differences between years.

Retrospective age determination from otolith samples from these cruises may help resolve some of these issues. The Working Group reiterated the importance of obtaining reliable age determinations in *C. gunnari* to assist with these assessments.

5.107 Short-term projections were undertaken according to methods that have been described in earlier reports. The input data are presented in Table 5.19. A value of 0.71 was used for natural mortality. The selection of this value was considered in detail at the previous Working Group meeting (SC-CAMLR-XX, Annex 5, paragraphs 4.207 to 4.210). The von Bertalanffy parameters were those approved by WG-FSA-01 (SC-CAMLR-XX, Annex 5, paragraphs 4.196 to 4.206) following the WAMI meeting.

5.108 Of the Subarea 48.3 commercial catch of 2656 tonnes, 471 tonnes were taken in February after the assumed time of application of the joint surveys (30 January) and this value was included in the projection.

5.109 The Working Group considered the results of the four projections (Table 5.20) and agreed that the most appropriate estimate of biomass was that calculated using combined data, with the UK survey data multiplied by 1.24. This is consistent with the approach taken in 2000 and 2001. This gives a projected yield of 2181 tonnes in year 1 and 1361 tonnes in year 2.

Management Advice

5.110 The Working Group recommended that the precautionary catch limit for *C. gunnari* in 2002/03 should be set at 2 181 tonnes.

5.111 The Working Group noted that the yield for Subarea 48.3 (2 181 tonnes) was only one-third of the yield calculated in 2001 (5 557 tonnes). This is due to the use of the 2002 survey estimates, which were lower than the 2000 survey estimates, and the use of the lower CF for the UK survey (1.241 compared with the factor 2.59 used in 2001).

5.112 The Working Group had no information from which to consider or revise its advice of 2001 in respect of the current seasonal limitation in Conservation Measure 219/XX. It therefore recommended that these aspects of the conservation measure should be unchanged.

5.113 The Working Group recommended the continuation of other aspects of Conservation Measure 219/XX, except for aspects subject to consideration of recommendations in paragraph 6.233, including that it may be appropriate to reconsider whether bottom trawl gear might be permitted under appropriate conditions (paragraphs 6.202 and 6.233(iii)).

Champsocephalus gunnari Kerguelen Islands (Division 58.5.1)

5.114 The Working Group noted that icefish surveys in Division 58.5.1 have been conducted regularly by two vessels between 1996/97 and 2001/02 (WG-FSA-02/65). Preliminary results indicated that the biomass of *C. gunnari* in the survey area has remained at low levels since 1996/97, with no sign of a recovery to previous high levels. Possible reasons for the observed continued low abundance of *C. gunnari* are discussed in SC-CAMLR-XXI/BG/27, paragraph 7.2. The Working Group understood that the fishery for *C. gunnari* within the French EEZ of Division 58.5.1 would remain closed in the 2002/03 season (see also paragraph 5.84).

Champsocephalus gunnari in Division 58.5.2

Commercial Catch

5.115 The commercial fishery for *C. gunnari* around Heard Island (Division 58.5.2) was open from the end of the Commission meeting in November 2001 to 30 November 2002. The catch limit agreed by the Commission for this period was 885 tonnes to be taken on the Heard Island Plateau area only (Conservation Measure 220/XX). This conservation measure included several other conditions applied to this fishery, including per haul by-catch limits, a provision to reduce the catch of small (<24 cm) fish, data reporting on a haul-by-haul basis, and the presence of a scientific observer on every vessel. Overall by-catch limits covering all fishing activities in Division 58.5.2 also applied (Conservation Measure 224/XX).

5.116 The commercial catch in the 2001/02 fishing season was 850 tonnes up to 7 October 2002, although the fishing season will remain open until 30 November 2002. This fishery was based on the strong cohort, now believed to be age 4, that was detected as 3 year olds in a survey in May 2001.

Surveys

5.117 A survey was conducted on the Heard Island Plateau and Shell Bank in May–June 2002 to assess the abundance and size structure of the *C. gunnari* populations. This survey used the same methodology as previous surveys in this area in 1997, 1998, 2000 and 2001 and detected a high abundance of fish of modal length 325 mm on the Heard Island Plateau. These fish were assumed to be 3 year olds in the previous year. No fish were caught on Shell

Bank, so this stratum was not included in the survey results. Compared to previous years, the population was more uniformly spread in the southeast with relatively high densities in that stratum.

Assessment at this Year's Meeting

5.118 WG-FSA-02/47 presented an assessment of short-term yield over the next two years based on the survey in May–June 2002. Survey results from 2002 indicated that a single large cohort dominated the population. Results from last year's survey would suggest that these fish should largely comprise age-4 fish. However, results of the mixture analysis gave a mean length for this cohort of 329 mm which is less than that expected of age-4 fish (340 mm) from an application of the growth curve (WAMI-01/4). The results of the mixture analysis are presented in Table 5.21 and Figure 5.6. Mean lengths at the time of the survey estimated from the growth curve are provided in Table 5.22. WG-FSA-02/47 suggested that age-4 fish may not have grown as fast as the 3 year olds in the last year, nor as fast as would be expected from the von Bertalanffy growth curve. The Working Group agreed to assume that the large cohort was composed of 4-year-old fish and apply the survey modal length of 325 mm for these fish as input to determine the initial numbers at age for the short-term projections. Data inputs for the short-term projections are provided in Table 5.23. It was agreed that intersessional work should be conducted to reconcile differences between mean lengths from the mixture analysis and mean lengths at age from the growth curve.

5.119 With a fishing mortality of 0.14 for 2002/03 and 2003/04, the catch limit satisfying the agreed criteria is 5 130 tonnes over two years. This is made up of 2 980 tonnes in the first year and 2 150 tonnes in the second year. The increase in yield from that presented last year (1 600 tonnes over two years) is largely due to an increase from 7 052 tonnes to 20 510 tonnes of the one-sided lower 95% confidence bound of biomass estimated from the trawl surveys in 2001 and 2002 respectively.

5.120 WG-FSA-02/47 suggested that a strong cohort may become legal size towards the end of the 2003/04 fishing season. This cohort will not be able to be assessed in the forthcoming season. The Working Group agreed that this issue needed further consideration and recommended that the Scientific Committee consider what issues may need to be addressed this year and what approaches it may wish to have considered.

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

5.121 The Working Group agreed that the total catch limit should be revised to 2 980 tonnes for the period from 1 December 2002 to 30 November 2003.

5.122 The remaining provisions of Conservation Measure 220/XX should be carried forward to the 2002/03 season.

Fishery Closure Mechanism

5.123 The Secretariat annually forecasts closure dates for fisheries by analysing the most recent three reporting periods and projecting those catch rates into the future. If the projection indicates that the catch limit will be exhausted before the Secretariat receives data from the next reporting period, the Secretariat informs Members that the fishery will be closed on this date. In this calculation the Secretariat assumes no change to fishing effort will occur in the future.

5.124 The Working Group recalled that when this rule was established, there was relatively little information available to the Secretariat on vessel movements. This situation has now changed, since vessels are now required to inform the Secretariat when they enter and exit fishing areas (Conservation Measure 148/XX).

5.125 In light of this, the Working Group recommended that the Secretariat continue to estimate future catches to predict closure dates, but that in applying the method it should incorporate information available to it on future vessel movements into its estimation of future effort. This will increase the accuracy of the prediction of closure dates, which in turn should reduce the level of under- or overshoot of the catch limit.

Other Fisheries

Dissostichus eleginoides in Subarea 58.7

Prince Edward Islands EEZ

5.126 WG-FSA-02/76 presented an assessment of the *D. eleginoides* resource in the South African EEZ around the Prince Edward Islands. The paper indicated that the stock of *D. eleginoides* was subject to high levels of illegal catch in the mid-1990s and a sharp decline in the longline catch rate. ASPMs fitted to catch rate data indicated a substantial decline in abundance since 1996, with spawning biomass estimated to have been depleted to only a few percent of its average pre-exploitation abundance.

5.127 Length-frequency data were incorporated into the model but fits showed some inconsistency with the trends shown in the catch rate data. Further model development is encouraged, in particular with regard to fits to the length-frequency data.

5.128 It was noted that projections based on results from WG-FSA-02/76 would suggest that the annual allowable catch in the Prince Edward Islands EEZ could be up to 400 tonnes, subject to target levels of recovery that might be adopted by the Commission. The Working Group also expressed grave concern about the continuation of this fishery given the extremely low estimated level of current spawning biomass relative to pre-exploitation levels.

Outside Prince Edward Islands EEZ

5.129 Following advice of recent years, the Scientific Committee's and Commission's attention is again drawn to the high levels of uncertainty associated with estimates of *D. eleginoides* stock levels in Subarea 58.7 in general. The negative role of illegal and unregulated fishing in increasing such uncertainty is also re-emphasised.

5.130 Given the prevailing circumstances, the prohibition of directed fishing for *D. eleginoides* in Subarea 58.7 (Conservation Measure 160/XVII) should continue.

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

5.131 Biomass estimates of finfish from the 2002 German survey with RV *Polarstern* around Elephant Island and in the South Shetland Islands (Subarea 48.1) were presented in WG-FSA-02/24. The authors concluded that, as in 2001, the overall biomass of all species in the area has yet to reach a level at which commercial exploitation would be advisable.

5.132 With respect to *N. rossii*, the authors suggested that further consideration should be given to the development of a survey strategy which takes account of the very patchy distribution of the species. They encouraged further work on this matter in the intersessional period.

5.133 There have been no bottom trawl surveys conducted in the South Orkney Islands (Subarea 48.2) since March 1999. A new survey is planned by the US AMLR Program to be conducted in March 2003.

Management Advice

5.134 There appears to be little scope to reopen the fishery in either of the two subareas in the near future given the comparatively low biomass of all abundant species. The Working Group therefore recommended that Conservation Measures 72/XVII and 73/XVII should remain in force.

South Sandwich Islands (Subarea 48.4)

5.135 No new information was made available to the Working Group on which an update of the previous assessment could be based.

Management Advice

5.136 The Working Group recommended that Conservation Measure 180/XVIII be retained until new information becomes available and a new assessment could be attempted.

Electrona carlsbergi South Georgia (Subarea 48.3)

5.137 The Working Group noted that the last year in which there were catches from the fishery for *E. carlsbergi* in Subarea 48.3 was 1992, and that this fishery was last assessed by WG-FSA in 1994. The precautionary catch limit for the fishery was derived from an assessment based on the krill yield model (precursor to GYM) which used a biomass estimate from a survey conducted in 1987/88. WG-FSA had expressed concern in 1994 that the biomass estimate was out of date and, as a consequence, the catch levels should be viewed with caution (SC-CAMLR-XIII, Annex 4, paragraph 4.93).

5.138 WG-FSA agreed that the assessment for *E. carlsbergi* should be revised at its 2003 meeting. In the meantime, it was agreed that the provisions of Conservation Measure 223/XX should be retained and carried forward to the 2002/03 season.

Crabs (*Paralomis spinosissima* and *P. formosa*) (Subarea 48.3)

General Information about the Fishery

5.139 On 15 April 2002 the Japanese fishing vessel *Kinpo Maru No. 58* initiated its first season of participation in the commercial crab fishery in Subarea 48.3 in accordance with Conservation Measure 225/XX. The vessel targeted and retained two species of crabs, *P. spinosissima* and *P. formosa*. Fishing activities ended on 31 May 2002.

5.140 The vessel conducted fishery-based research in accordance with the data requirements described in Annex 225/A of the measure and completed effort-spreading measures according to the experimental harvest regime for the crab fishery outlined in Conservation Measure 226/XX and Annex 226/A. A total of 112 sets were made, with 51 997 pots deployed for a combined 1.473 million pot hours of fishing effort.

5.141 Data from the 2001/02 crab fishing season were submitted to the Secretariat in accordance with the 10-day catch and effort reporting system set forth in Conservation Measure 61/XII, and monthly fine-scale catch and effort as set out in Conservation Measure 122/XIX (haul-by-haul form), and in the form of observer reports.

5.142 Further information regarding the crab fishery in Subarea 48.3 and details of the analyses undertaken during the Working Group meeting can be found in SC-CAMLR-XXI/BG/27.

Assessment

5.143 The Working Group agreed that the information submitted from the *Kinpo Maru No. 58* was valuable, particularly given the paucity of information on stocks of *P. formosa* around South Georgia. Nevertheless, there was insufficient information on which to conduct a rigorous stock assessment of either species of crab based on the 2001/02 commercial catch data.

5.144 The Working Group recognised the utility of the experiments on crab survivorship described in WG-FSA-01/32 and undertaken by the *Kinpo Maru No. 58*. It recommended that similar experiments be performed by all vessels when they first start fishing for crabs.

Management Advice

5.145 Although there was insufficient information on which to conduct an assessment, the Working Group recognised the value of the experimental harvest regime and recommended that Conservation Measure 226/XX remain in force.

5.146 The Working Group agreed that there was insufficient new biological information available on size and maturity of *P. formosa* and *P. spinosissima* that warranted a revision of Conservation Measure 225/XX pertaining to the minimum carapace width of crabs which may be retained. The Working Group recommended that the catch and effort limitations of Conservation Measure 225/XX remain in force until new information is made available that would scientifically support changes to the existing management scheme for the crab fishery in Subarea 48.3. The Working Group recommended that all existing data on male cheliped height and length be submitted to CCAMLR, and that a more comprehensive analysis of size of male maturity be conducted.

5.147 A proposal submitted by the Japanese Delegation to revise paragraph 6 of Conservation Measure 225/XX ('crab processed at sea shall be frozen as crab sections') was discussed by the Working Group. The proposed revision states that 'When crabs are processed at sea, the international scientific observer of CCAMLR on board shall carry out proper random sampling of crabs to be processed, and shall confirm that every carapace width of sampled crab is not less than minimum carapace width regulated'.

5.148 The reason that this request has been put forward is that the proposed processing method does not include the retention of crab sections. The current conservation measure specifies the retention of these sections so that observers can determine the size of retained crabs.

5.149 The Working Group recognised that paragraph 6 of Conservation Measure 225/XX was adopted prior to the requirement of an international observer on crab fishing vessels, and agreed that observers could sample crabs after sorting by the crew as long as the scientific observer is given unrestricted access to the catch for proper statistical random sampling. It was emphasised that the observer should continue to sample the whole catch prior to sorting as well as sampling after sorting.

Martialia hyadesi South Georgia (Subarea 48.3)

5.150 No notification had been submitted for this fishery in the 2002/03 season. The Working Group agreed that the provisions of Conservation Measure 238/XX should be retained and carried forward to the 2002/03 season.

By-catch

5.151 The long-term status of by-catch species has been identified as an issue for urgent attention by the Scientific Committee (SC-CAMLR-XX, paragraph 5.101). At last year's meeting, the Working Group identified several key issues that needed to be addressed in order to progress work on by-catch species, namely:

- assessments of the status of by-catch species or groups (particularly macrourids and rajids);
- assessments of the expected impact of fisheries on by-catch species; and
- consideration of mitigation measures.

5.152 WG-FSA-02/49 is the report of the intersessional subgroup on by-catch and presents the work plan of the group and a summary of completed work.

5.153 Further information on macrourids in Subarea 88.1 and Division 58.5.2 can be found in SC-CAMLR-XXI/BG/27.

Assessments of the Status of By-catch Species or Groups

5.154 The priority by-catch taxa for which assessments of status are required are the macrourids and rajids (SC-CAMLR-XX, Annex 5, paragraphs 4.311 and 4.315).

5.155 Biological information was available for *Macrourus holotrachys* and *Amblyraja* spp. in Subarea 48.3 (WG-FSA-02/26 and 02/54) and *Amblyraja* spp. in Subarea 88.1 (WG-FSA-02/42), however this was insufficient to calculate estimates of the precautionary pre-exploitation harvest level (γ).

Macrourus spp.

5.156 Sufficient biological data to calculate γ were available for *Macrourus whitsoni* in Subarea 88.1 (WG-FSA-02/32 and 01/43) and for *Macrourus carinatus* in Division 58.5.2 (WG-FSA-02/48 and van Wijk et al., 2000). Estimates of γ were calculated using the GYM and the input parameters presented in Table 5.24. A detailed description of the assessment method is provided in SC-CAMLR-XXI/BG/27.

5.157 The decision rule used to assess γ was that the median escapement of the spawning stock at the end of 20 years of exploitation is 50% of the pre-exploitation spawning stock biomass, and that the probability of depletion below 20% of the median pre-exploitation spawning biomass is no greater than 0.1 over a 20-year period.

Macrourus whitsoni (Subarea 88.1)

5.158 The estimate of γ for *M. whitsoni* in Subarea 88.1 was 0.02165. This resulted in a median escapement of 0.74 and probability of depletion of 0.10.

5.159 Estimating a precautionary yield for *M. whitsoni* in Subarea 88.1 using γ requires an estimate of B_0 for the population. There are currently no estimates of B_0 in Subarea 88.1 or adjacent areas. Thus the Working Group was not in a position to calculate an estimate of precautionary yield for *M. whitsoni*.

Macrourus carinatus (Division 58.5.2)

5.160 The estimate of γ for *M. carinatus* in Division 58.5.2 was 0.03226. This resulted in a median escapement of 0.51 and a probability of 0.10. This estimate of γ was very close to the value (0.033) determined in a previous assessment of *M. carinatus* in Division 58.5.2 (WG-FSA-99/69).

5.161 An estimate of B_0 for *M. carinatus* in Division 58.5.2 was calculated using the mean density of *M. carinatus* (176 ± 14 kg/km^2) obtained from a research survey of BANZARE Bank (van Wijk et al., 2000), prorated to the area of seabed in the same depth range (600–1 500 m) in Division 58.5.2. This gave a mean biomass for *M. carinatus* in Division 58.5.2 of 14 402 tonnes, with a range of 13 256 to 15 547 tonnes. Applying a value of γ of 0.03226, gives a mean estimate of yield of 465 tonnes, with a range of 428 to 502 tonnes.

5.162 The Working Group noted that the value of natural mortality used in this assessment was approximately 1–2 times *k* and that this range may be too low. The Working Group recommended that sensitivity tests of the GYM to variations in estimates of M and other parameters, such as age and growth, coefficient of variation of biomass and the standard deviation of the lognormal recruitment function, be undertaken for *M. carinatus* in Division 58.5.2 and *M. whitsoni* in Subarea 88.1 during the intersessional period.

5.163 Dr Hanchet noted that one of the vessels from the longline fishery in Subarea 88.1 may be involved in future longlining operations in Division 58.5.2 and flagged that this may afford the opportunity to obtain comparative CPUE estimates.

Management Advice

5.164 The Working Group noted that the estimates of γ for *M. whitsoni* and *M. carinatus* suggest that these species have relatively low productivity and thus may be vulnerable to overexploitation.

5.165 The Working Group reiterated the request made at last year's meeting (SC-CAMLR-XX, Annex 5, paragraphs 4.311 and 4.315) that in order to undertake assessments for by-catch species more information is required on:

- estimation of standing stock;
- taxonomic descriptions of species;
- length–mass relationships;
- total length to pre-anal length relationships;
- age and growth parameters;
- reproductive information; and
- tagging studies to investigate migration and growth.

5.166 The Working Group recommended that future work include research towards generating updated population parameters and estimates of standing stock for macrourids and rajids.

5.167 The Working Group recommended that the mean estimate of precautionary yield for *M. carinatus* in Division 58.5.2 (465 tonnes) be considered as the precautionary by-catch limit. Further intersessional work is recommended to improve the input parameters and to conduct sensitivity trials as discussed above.

5.168 The Working Group agreed that the application of by-catch limits is to provide adequate protection for by-catch species, with the understanding that the fishery takes steps to reduce by-catch rates. However it was agreed that these by-catch limits, with their attendant uncertainties, should not be used as a reflection of a long-term sustainable annual yield. In that context, sustained by-catch at these levels over a number of years would require a revised assessment.

5.169 In the absence of assessments for by-catch species, the Working Group recommended that precautionary measures that place upper limits on by-catch and reduce the potential for localised depletion be adopted.

Assessment of the Expected Impact of Target Fisheries on By-catch

Estimated Total Removals

5.170 In order to assess the impact of fisheries on by-catch species, accurate information is required on the total removals of by-catch taxa. At last year's Working Group meeting the by-catch subgroup attempted to calculate total removals from observer data for each fishery. Due to the limitations of the data, this was not achieved (SC-CAMLR-XX, Annex 5, paragraphs 4.277 to 4.286). The Scientific Committee recommended that the observers logbook and forms be revised intersessionally according to the recommendations in SC-CAMLR-XX, paragraph 5.97.

5.171 The observers electronic logbook and forms were revised at the beginning of the 2001/02 fishing season and distributed to technical coordinators in early 2002. An analysis of observer reports from the 2001/02 fishing season indicated most had been submitted to the Secretariat on the old forms. The Working Group reiterated the importance of observers using the current versions of the forms. Even though the new forms were not generally used, some nations have collected the data required to calculate total removals using their own versions of the observer database. The Working Group requested that these nations liaise with the Secretariat intersessionally to ensure that all by-catch data are adequately transferred.

5.172 Estimates of total removals of rajids and macrourids were available for Division 58.5.2 (WG-FSA-02/46) and Subarea 88.1 (WG-FSA-02/38 and 02/40) and were calculated from datasets submitted by Australia (Division 58.5.2), France (Subarea 58.6) and South Africa (Subareas 58.6 and 58.7). Total removals could not be estimated for Subarea 48.3 (WG-FSA-02/55).

5.173 WG-FSA-02/46 reviewed fish and invertebrate by-catch by split-year and fishing ground in the *D. eleginoides* and *C. gunnari* trawl fisheries in Division 58.5.2. From 1996/97 to 2001/02, a total of 95 tonnes of by-catch were caught in the *D. eleginoides* fishery and 46 tonnes in the *C. gunnari* fishery. These values represent 1 and 2% respectively of the total catch weight in each fishery. In the 2001/02 split-year 5 tonnes of macrourids and 2 tonnes of rajids were caught in both fisheries.

5.174 WG-FSA-02/38 gave an overview of by-catch in the *D. mawsoni* fishery in Subareas 88.1 and 88.2. *M. whitsoni* accounted for 10% of the total catch in 2002. Macrourids (as a percentage of total catch) have varied considerably between years and SSRUs from less than 1 to 27%. Rajids (*Bathyraja eatoni* and *Amblyraja georgiana*) comprised only 2% of the total catch in 2002. *A. georgiana* was the most abundant species with a catch rate more than 28 times higher than that for *B. eatoni*. The proportion of skates in the total catch varied between years and SSRUs from less than 1 to 15%. Other by-catch taxa contributed less than 1% to the total catch.

5.175 WG-FSA-02/55 provided preliminary estimates of catches of rajids in Subarea 48.3 in 2001. Estimates were calculated by vessel where reliable observer data on the number of hooks set, proportion of hooks observed and skate numbers (including discards) were available. The catch rate of rajids varied between vessels from 0.08 to 6.99 rays/thousand hooks. This translates to catches of rays by vessels (in numbers) between 65 and 5450. These estimates did not provide coverage of the whole fleet and were not scaled up to reflect total removals due to the lack of complete data. Many observers were experiencing difficulties in identifying rays to species level and in accurately observing discards.

5.176 Estimates of total removals of rajids and macrourids by the fishery for the 2001/02 split-year are in Tables 5.25 to 5.28. The data in these tables have been derived from the papers and datasets discussed in paragraph 5.172 and from the Secretariat database. Table 5.25 presents estimates of total removals of by-catch by fishery and as a percentage of target catch, obtained from observer data. By-catch removals as a percentage of the target catch are approximately 10% for macrourids and less than 10% for rajids. The high figure for macrourids in Subarea 58.7 is due to the low target species catch in this area.

5.177 The Working Group also noted the new standard of reporting by fishing season and not split-year. It therefore recommended that future estimates of by-catch removals be presented by fishing season.

5.178 The Working Group noted that the seabed area in Division 58.5.1 is roughly comparable to the seabed area in Division 58.5.2 and that the estimate of total removals for macrourids in Division 58.5.1 approaches the estimate of yield calculated for *M. carinatus* in Division 58.5.2.

5.179 The Working Group noted the very low estimates of by-catch removals in the current trawl fishery in Division 58.5.2 and flagged that these may increase if longlining proceeds in this division in the next fishing season.

Comparison of By-catch Datasets

5.180 By-catch data are reported to CCAMLR in three different forms: STATLANT data, fine-scale catch and effort data and observer data (Tables 5.26 and 5.27).

5.181 The Working Group noted that the various types of data used to estimate total removals of skates and rays (catch, discard and those cut from the longline) are reported inconsistently in observer data. The current versions of the observers logbook and forms allow for the inclusion of all types of by-catch data. The Working Group reiterated that complete information on by-catch of skates and rays should be reported in observer data.

5.182 The Working Group noted that STATLANT data grossly underestimate by-catch in most fisheries (Tables 5.26 and 5.27).

5.183 The quality of by-catch information from fine-scale catch and effort datasets is variable. In Division 58.5.1 and Subarea 88.1, the total removals estimated from fine-scale by-catch data (Table 5.26) are close to those from observer data. However in other areas, fine-scale data vary by vessel and can show significant departures from observer estimates. Thus caution should be applied when considering by-catch information derived from fine-scale catch and effort data.

Management Advice

5.184 The Working Group strongly emphasised the need for accurate reporting of by-catch.

5.185 The Working Group reiterated that discarded skates should be included in observer data.

5.186 The Working Group noted that IUU fishing is also likely to result in removals of by-catch species. In the absence of information, the estimates of total removals presented here should be treated as minimum estimates.

Operation of By-catch Precautionary Measures

5.187 WG-FSA-02/40 reported that the total by-catch limits imposed by fine-scale rectangle (50 tonnes for rajids and 100 tonnes for macrourids) were not exceeded during the 2001/02 fishing season. The number of times that the 1 tonne move-on rule was triggered during 2001/02 ranged from 0–22% of longline sets for macrourids and 0–4% of longline sets for rajids. Alternative trigger rates of 500 kg and 2 tonnes were examined, however the current 1 tonne trigger seems appropriate in Subarea 88.1.

5.188 WG-FSA-02/46 reviewed the operation of the move-on rule in the trawl fisheries in Division 58.5.2. The move-on rule was only triggered on two occasions over the last four fishing seasons and thus does not hinder fishing operations.

Correlation of By-catch with Target Catch and Other Variables

5.189 WG-FSA-02/40 examined the relationships between by-catch rates for macrourids and rajids with other variables such as fishing ground, depth, bait type and length of line. The most important variable in predicting high by-catch rates for both rajids and macrourids was fishing ground. Areas with high by-catch also yielded high catches of target species. For rajids, bait type and length of line were also important, while for macrourids, depth and longitude were important variables.

5.190 The Working Group noted that the CPUE analyses for by-catch species are influenced by the same issues that apply to toothfish and suggested that collaborative work continue intersessionally.

Consideration of Mitigation Measures

5.191 WG-FSA-02/24 described how changes to fishing gear minimised the by-catch of benthos, without reducing the catchability of finfish, during a bottom trawl survey by Germany around Elephant Island. Rubber disks replaced the steel bobbins of the ground tackle and size and weight of trawl doors were reduced. The tendency of the trawl to become hooked on the bottom was greatly decreased, and the by-catch of benthos at Elephant Island substantially reduced from 9.76 tonnes in 1996 (Kock et al., 1998) to 1.61 tonnes in 2002.

5.192 The potential impact of fishing operations on benthic habitats was raised as an important issue for future consideration. The Working Group encouraged the quantitative reporting of benthic invertebrate by-catch in all fisheries in order to improve the available information. Intersessional work could consider the methods used in other fisheries to deal with benthic by-catch, and how these might apply to CCAMLR.

5.193 WG-FSA-02/42 presented preliminary results from the first three years of a tagging program for rajids in the Ross Sea (Subarea 88.1). Skates were tagged in the water and were cut from the line. Fourteen skates were recaptured from a total of 6 014 (0.26%), indicating at least some long-term survival. This recapture rate is comparable to that for *D. eleginoides* in Subarea 88.1 (Table 5.29). Examination of skates recaptured between seasons showed that hooks were absent from mouth parts and that there was good healing around hook and tag wounds.

5.194 The by-catch subgroup noted anecdotal evidence from Members that the weighting of longlines and the height of hooks from the sea floor could have a large impact on the by-catch rate of rajids. Setting hooks a few metres above the bottom considerably reduced rajid by-catch in some cases.

Management Advice

5.195 The Working Group recommended that wherever possible during longlining operations:

- live rajids should be cut from the line whilst still in the water to increase chances of survivorship; and

- vessels should be encouraged to develop methods to minimise rajid by-catch, for instance setting hooks above the sea floor.

5.196 The Working Group recognised the issues surrounding by-catch of rajids and the need to obtain information on:

- the vulnerability of rajids to capture;
- methods for adequately assessing survivorship of animals released;
- methods for handling rajids that maximise survivorship; and
- methods for adequately documenting the biological characteristics, including size, of rajids hooked but not landed.

The Working Group encouraged intersessional work that might address these issues.

Regulatory Framework

5.197 The Working Group noted that the Scientific Committee has identified the establishment of fishery plans as being fundamental to the operation of the regulatory framework. For those fisheries with fishery plans, the regulatory and scientific requirements would be specified in the plan. For those without plans, the Commission would need to establish entry-level conditions, which has already been done in the context of new and exploratory fisheries (SC-CAMLR-XX, paragraph 7.9). This negates the need to define fishery types or stages (SC-CAMLR-XX, paragraph 7.10).

5.198 The Secretariat has made considerable progress with defining fishery plans. Fishery plans are now available for *C. gunnari* in Subarea 48.3 and Division 58.5.2, crabs in Subarea 48.3, krill in Area 48, *D. eleginoides* in Subarea 48.3 (longline and pot) and Division 58.5.2 and *D. mawsoni* in Subarea 88.1.

5.199 The Working Group expressed its appreciation of the development of the fishery plans by the Secretariat, and noted that they considerably assisted the Working Group in understanding and tracing changes that have taken place in the various fisheries over time. Specific comments were made that it would be useful to see, on the fishery plans, specification of the conservation measures that specifically relate to by-catch, the catch of the target species in other fisheries for that species, and the total catch of by-catch by species.

5.200 These changes are relatively minor. The Working Group suggested that further changes, which may involve rather more information being included on the forms, be considered carefully since their addition might lead to a loss of the current admirable simplicity of the forms.

5.201 Dr Constable observed that an essential part of the framework is notification of intent with regard to CCAMLR fisheries. He observed that the notification by Australia for a longline fishery for toothfish in Division 58.5.2 (CCAMLR-XXI/10) was conceived as part of the requirements of the new regulatory framework. The Working Group expressed its appreciation that Australia had taken this step.

Evaluation of the Threats Arising from IUU Activities

Review of Historical Trends in IUU Activity

5.202 Tables 3.3, 5.30 and 5.31 present various summaries of IUU fishing activity from 1995/96 to date. Taking the Convention Area as a whole, from a peak of about 32 673 tonnes in the 1996/97 fishing season, the level of IUU fishing appears to have declined to a low point in the 1998/99 fishing season and then increased again to 10 898 tonnes in 2001/02 (Table 5.31). However, these global trends mask a variety of patterns that have been evident in different subareas or divisions.

5.203 In Subarea 48.3, the start of the legitimate fishery in 1988/89 was followed by a rise in IUU catches in 1990/91 to a level of about 4 000 tonnes in 1992/93 and 1993/94 (Table 3.3). IUU catches then fell as IUU activity transferred to the Indian Ocean sector, but appears to have risen again in 1998/99 and 1999/2000. In 2000/01 IUU catches in Subarea 48.3 fell again, and in 2001/02 they were at negligible levels. These levels have been so low that the total extractions from Subarea 48.3 have been lower than the catch limit for both of the previous two years.

5.204 The Working Group recalled its previous discussion of WG-FSA-02/4 (paragraphs 3.17 to 3.22). The figures for IUU fishing in Subarea 48.3 in the years 1998/99, 1999/2000 and 2000/01 are the statistical estimates calculated by the methods detailed in that paper. Although changes to IUU vessel behaviour might introduce bias into the results of this model they are not reflected in changes to the encounter rate, the estimates remain considerably more robust than estimates made using the existing CCAMLR method (i.e. estimates of days fishing and catch rate in Table 3.2). The results of WG-FSA-02/4 also indicated that the CCAMLR estimates are likely to be underestimates of IUU fishing activity if the observing vessels (for instance fishery protection vessels) are not present in the area for substantial periods of time during the year.

5.205 Subareas 58.6 and 58.7 saw their greatest IUU catches in 1995/96 and 1996/97 (Table 3.3). Since then, IUU catches in Subarea 58.7 have been very low, at about the same level as legitimate catches. IUU catches in Subarea 58.6 have also been at the same level as legitimate catches since 1999/2000, although at a higher level than for Subarea 58.7.

5.206 Divisions 58.5.1 and 58.5.2 also saw high levels of IUU fishing in 1995/96 and 1996/97, but unlike Subareas 58.6 and 58.7, although they declined in 1998/99, IUU catch levels have recently increased to very high levels. In Division 58.4.4, IUU fishing appears to have started in 1996/97 and then stayed at a level of about 1 300 tonnes until 2001/02.

5.207 The Working Group noted that in the Indian Ocean sector, total catches for subareas or divisions (legitimate + IUU catches) have generally exceeded the catch limits that have been set (Table 5.30).

5.208 Finally, the Working Group noted with concern the recent appearance of IUU catches from areas adjacent to the Antarctic Continent, namely in Division 58.4.2 and Subarea 88.1 (Table 3.3).

5.209 Estimates of catches taken in high seas waters outside the Convention Area are derived from CDS data. Table 5.31 shows that 14 659 tonnes are estimated to have been taken outside the Convention Area in 2001/02. It is acknowledged that there is some potential for double counting of these catches. This will arise if IUU catches are estimated to have come from within the Convention Area but are subsequently declared as having come from outside the Convention Area on a *Dissostichus* catch document.

5.210 The Working Group noted that in 2001 the Scientific Committee had concluded that practically all the toothfish catches reported from Area 51 represented catches taken as a result of IUU fishing in other areas inside the Convention Area. The only information that the Working Group had to judge the veracity of this statement was the calculations of the area of seabed made by the Secretariat (Table 5.32 and Figure 5.7).

5.211 By way of illustration, for Area 51, 30 000 km^2 of seabed is within the depth range 0–1 800 m. If this were to be compared with Division 58.5.2, where the seabed area is 171 000 km^2, and a similar productivity was assumed for Area 51 as for Division 58.5.2, one might expect a spawning biomass of about 16 000 tonnes and a sustainable catch of about

500 tonnes. If this analogy were realistic, it is clear that the current CDS-recorded catches from Area 51 (14 168 tonnes in 2000/01 and 8 237 tonnes in 2001/02; Table 5.30) would not be sustainable. It is doubtful even if they could be obtained by 'mining' the biomass.

5.212 The above is offered simply by way of illustration. The Working Group agreed that in order to arrive at a more informed opinion of the likelihood of catches from Areas 51 and 57 actually being caught there it would be important to have information not only on the extent of fishable seabed areas north of the Convention Area, but also on the likely catch rates and size and productivity of stock in these areas. Thus scientific papers describing the biology and distribution of toothfish in areas north of the Convention Area would be particularly useful.

5.213 The Working Group drew attention to the fact that there are some high seas areas adjacent to the Convention Area where toothfish are known to occur. Examples of these areas would be Delcano Rise and William's Ridge in Areas 51 and 57 respectively (see paragraph 3.25). Where these areas straddle the boundary of the Convention Area, it is quite likely that the stocks they contain are transboundary stocks, i.e. stocks that occur both inside and outside the Convention Area.

5.214 There are two other FAO areas where substantial catches are declared in CDS data to have been taken in high seas waters: Areas 41and 87 (Table 5.30). In each of these, there seem to be significant fishable areas at depths at which toothfish might be found. In these two areas there are also substantial fisheries in areas under national jurisdiction. In particular, in Area 41 there are extensive well known high seas fishing grounds for toothfish (WG-FSA-02/66).

Evaluation of Future Threats of IUU Activity

5.215 The effects of IUU fishing can be both catastrophic and chronic.

5.216 Catastrophic effects are those such as were seen in Subarea 58.7. In 1995/96 and 1996/97 a total of 12 285 tonnes of IUU catch was taken from this subarea, which together with the legitimate catch of 2 061 tonnes depleted stocks severely (paragraphs 5.126 and 5.128; WG-FSA-02/69). This level of fishing effectively 'mined' the stock, resulting in very rapid depletion and a concomitant reduction in catch rates.

5.217 The Working Group noted that there was still considerable potential for such catastrophic mining to occur. The total IUU catch is now estimated to be 10 868 tonnes (Table 5.31), not dissimilar to that taken in 1996/97 in Subarea 58.7. If all this IUU catch was concentrated in a single subarea or division, it could have a catastrophic effect on the stock in that area. Such concentration would, however, require considerable coordination of all vessels and companies currently involved in IUU fishing.

5.218 WG-FSA-02/69 examined the chronic effects of IUU fishing on the catch limit indicated by the current GYM. In situations where the IUU catch was 33% of the catch limit, and was taken in addition to the catch, current assessment methods, using the GYM, would respond by slowly reducing the catch limit (Figure 5.8).

5.219 For IUU catches equal to or greater than the catch limit, current assessment methods will respond by reducing the catch limit more rapidly than in the previous case. This will continue until the stock is depleted to the point where there is a very high probability of stock being less than 20% of median pre-exploitation biomass. The assessment method will indicate a zero catch limit.

5.220 The Working Group recognised that the particular trajectory taken by the catch limits will depend on the time series of (both IUU and legitimate) catches. Thus it would not apply uniformly to all areas. However, for areas where there has been an extended period in which the combined IUU and legitimate catch has exceeded the catch limits, that combined catch would be unsustainable. Furthermore, the decline in the stock might be greater than indicated by the decline in the catch limit.

5.221 The reason that the GYM estimates a gradual rather than immediate reduction in catch limit following an IUU catch, is that the model takes account of past levels of IUU fishing by averaging out their effects over the future 35 years of the projections. Thus the effect of an IUU catch is spread over the future projection years, rather than reducing a single future year by an amount similar to the IUU catch.

5.222 The Working Group advised that, in situations where the IUU and legitimate catches together exceed the catch limit, the combined catch will not be sustainable and using current assessment methods, one would expect to see a decline in the catch limit in future years. The actual sustainable catch levels will also, of course, be influenced by the recruitment series and other data in the assessment.

5.223 Whilst past IUU catches are taken into account in the assessment, no allowance is made for the possibility of there being IUU catches in the future. The Working Group's advice is normally that the catch limit should be set to the sustainable catch limit calculated by the assessment. The Working Group suggested that the Scientific Committee might comment on whether the assessments currently conducted by the Working Group are adequate with respect to IUU fishing, and if not what additional calculations might be required.

Advice to the Scientific Committee

5.224 The Working Group recommended that the Scientific Committee take note of all subareas and divisions where the total catch is greater that the sustainable catch, and the consequences that this will have on the stock and on future trends in sustainable catch.

5.225 Whilst past IUU catches are taken into account in the assessment, no allowance is made for the possibility of there being IUU catches in the future. The Working Group's advice is normally that the catch limit should be set to the precautionary yield calculated by the assessment. The Working Group suggested that the Scientific Committee might comment on whether the assessments currently conducted by the Working Group are adequate with respect to IUU fishing, and if not what additional calculations might be required.

5.226 Scientific information from areas adjacent to the Convention Area where toothfish might occur is urgently needed to assess the likely origin of catches reported from high seas areas outside the Convention Area.

5.227 To assist with the interpretation of the origin of high seas catches taken outside the Convention Area, the Working Group recommended that the CDS be amended to include a requirement to report data by the smallest appropriate FAO statistical division. In the South Atlantic, this would mean attributing catches by division (41.3.1, 41.3.2 and 41.3.3) or by subarea (41.2, 47.4 and 47.3). If subdivision of Areas 51 and 57 were possible, this would also be an advantage in tracing the origin of catches on *Dissostichus* catch documents.

INCIDENTAL MORTALITY OF MAMMALS AND SEABIRDS ARISING FROM FISHING

Intersessional Work of Ad Hoc WG-IMAF

6.1 The Secretariat reported on the intersessional activities of ad hoc WG-IMAF according to the agreed plan of intersessional activities for 2001/02 (SC-CAMLR-XX, Annex 5, Appendix F). The report contained records of all activities planned and results of their completion (WG-FSA-02/83).

6.2 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 2001/02 fishing season.

6.3 The Working Group concluded that most tasks planned for 2001/02 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 2002/03, compiled by the Convener, be appended to its report (Appendix D).

6.4 The membership of ad hoc WG-IMAF was reviewed. The Working Group noted with regret that Mr J. Cooper (South Africa) had resigned from the group due to his changed commitments. The Working Group especially welcomed Ms T. Hewitt (Australia), Dr D. Nel (South Africa), Mr M. McNeill (New Zealand) and Dr Reid who attended the meeting for the first time. In particular, it was noted that, thanks to Mr McNeill's participation, expert advice on operational aspects of fishing vessels had become available to the group. Members were asked to review their representation on ad hoc 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 Fishing in the Convention Area

2002 Data

6.5 Data were available from 22 longline cruises conducted within the Convention Area during the 2001/02 season (details in WG-FSA-02/11 Rev. 1 and Table 6.1).

6.6 The Working Group noted that the proportion of hooks observed was similar to last year for Subareas 48.3 (22% (range 19–31) compared with 24% (10–81)), 58.6 and 58.7 (37% (range 9–59) compared with 39% (range 6–63)) and 88.1 and 88.2 (42% (range 40–45) compared with 56% (range 37–89)), but with generally greater consistency across vessels. Only for three cruises (*Suidor One* (9%), *Isla Camila* (19%), *Isla Santa Clara* (19%)) was the proportion of hooks observed lower than 20%.

6.7 The Working Group noted that WG-FSA-02/52 indicated that for the purposes of detecting a substantial (order-of-magnitude) change in by-catch rate from the present very low levels, observation of at least 25% of hooks would be appropriate. Technical coordinators were requested to try to ensure that this minimum level of hook observation is achieved by each vessel.

6.8 As usual, the total observed seabird catch rate was calculated using the total number of hooks observed and the total seabird mortality observed (Table 6.2). The estimated total catch of seabirds by vessel was calculated using the vessels observed catch rate multiplied by the total number of hooks set.

Subarea 48.3

6.9 The total estimated seabird mortality was 27 birds (Table 6.2) compared with 30 birds last year and 21 the year before (Table 6.3). The overall catch rate was 0.0015 birds/thousand hooks compared to 0.002 in the two previous years (Table 6.3). Of the six birds observed killed (all at night), four were southern giant petrels, one was a northern giant petrel and one a Cape petrel (Table 6.4).

South African EEZs in Subareas 58.6 and 58.7

6.10 No seabirds were observed killed in these parts of Subareas 58.6 and 58.7, compared to 199 and 516 birds estimated killed in the two previous years (Table 6.3). It was noted that WG-FSA-02/17, which also reported on the seabird by-catch in this fishery, included observations of two birds killed from fishing in the South African EEZs in these subareas, but that these records relate to fishing outside the Convention Area.

6.11 The effort in this fishery was substantially reduced from 2001, involving only three cruises and 1.67 million hooks set this year compared with 11 cruises and 6.56 million hooks last year.

6.12 There was no indication of the circumstances by which such a major reduction (to zero) of seabird by-catch within this fishery had been achieved. Nevertheless it was clearly a remarkable and encouraging achievement.

Subareas 88.1 and 88.2

6.13 No incidental mortality of seabirds was observed in fishing operations whose level and nature were closely similar to those in previous years. This was the fourth successive year of zero seabird by-catch in the fishery in Subarea 88.1.

French EEZs in Subarea 58.6 and Division 58.5.1

6.14 No data were received for the 2001/02 season. Given the high levels of seabird by-catch reported for these fisheries for 2000 and 2001, it was important that such data for the current season be submitted to the Secretariat as soon as possible, using the CCAMLR data reporting forms and formats.

6.15 Some data had been received for the 1999/2000 and the 2000/01 fishing seasons in respect of these areas but had arrived after the deadline for submission of papers for consideration at this year's meeting. These data would be evaluated by the Secretariat during the intersessional period.

General

6.16 The Working Group noted that the total numbers of birds reported as caught but released alive (42) was greater than the numbers landed dead (six). It noted that some proportion of birds landed alive were likely to have sustained injuries (e.g. broken wing) prejudicial to their subsequent survival. Such birds should be regarded as part of the total of birds killed. It was recommended that appropriate changes be made to the observer logbook to enable birds landed alive but with potentially fatal injuries to be distinguished from those released alive with no or minor injury.

Compliance with Conservation Measure 29/XIX

6.17 Data from observer reports on compliance with this conservation measure in 2001/02 are provided in WG-FSA-02/13 Rev. 1 and summarised in Tables 6.5 and 6.6. Comparison with similar data from previous years is provided in Table 6.7.

Streamer Lines

6.18 Compliance with streamer line design has markedly improved since last year, with observers reporting full compliance of the design of the streamer lines deployed on 19 of the 22 cruises (86%) (WG-FSA-02/13 Rev. 1 and Table 6.5). This compares with 66% overall compliance in 2000/01 and 33% in 1999/2000. The two vessels that did not fully comply failed on total length (*Eva 1*) and height of attachment point (*Koryo Maru No. 11* on one cruise) (Table 6.6).

6.19 All vessels fishing in Subareas 58.6, 58.7, 88.1 and 88.2 used streamer lines on all sets. In Subarea 48.3, 12 vessels undertook some sets without using a streamer line. Of these, four vessels (*Isla Camila, Argos Georgia, Polarpesca 1, Atlantic No. 52*) undertook 10 or more sets without a streamer line (Table 6.1 and WG-FSA-02/13 Rev. 1).

Offal Discharge

6.20 There was 100% compliance with the requirement to either hold offal on board, or to discharge on the opposite side to where the line was hauled (Table 6.5). All but one vessel complied fully with the requirement to not dump offal during setting; the *Viking Bay* was observed dumping offal during four (2%) sets (WG-FSA-02/13 Rev. 1).

Night Setting

6.21 Compliance with night setting has remained high in Subarea 48.3, up from 95% last season to 99% this season (Table 6.5). In Subareas 58.6 and 58.7 compliance was considerably higher than the previous season, up from 78% to 99% (Table 6.5). In Subarea 48.3 observers reported some difficulty in achieving exact compliance with this measure, due to the lack of sufficiently precise tables to define nautical twilight (paragraph 6.48).

6.22 In Subarea 88.1 night setting increased to 33%. However, vessels operating in this area do so under Conservation Measure 235/XX, which contains an exemption from night setting requirements south of 65°S for vessels which demonstrate a consistent minimum line sink rate of 0.3 m/s.

Line Weighting – Spanish System

6.23 In 2000 the Commission accepted WG-IMALF's recommendation for an alternative line-weighting regime for vessels using the Spanish method of longline fishing. Conservation Measure 29/XIX requires vessels to use either 8.5 kg weights spaced at no more than 40 m or 6 kg weights at no more than 20 m. The addition of the option of 8.5 kg weights at no more than 40 m was made because of concern that the existing regime placed practical constraints on fishers.

6.24 This year compliance with line weighting for Spanish longline systems (6 kg every 20 m or 8.5 kg every 40 m) had significantly improved (Table 6.5 and Figure 6.1). Ten (63%) cruises in Subarea 48.3 and 2 (66%) cruises in Subareas 58.6 and 58.7 complied with this line-weighting regime. All vessels met the weight spacing requirement and nine (53%) either met the weighting requirement or were within 95% of the required weight. The median weight and line spacing for Subareas 48.3, 58.6 and 58.7 were 8.6 kg every 40 m and 6.6 kg every 40 m respectively.

6.25 The results from last season strengthen the Working Group's conclusion that the current line-weighting requirements can be complied with. Once again it recommended that vessels unable to meet the line-weighting requirement of Conservation Measure 29/XIX should be prohibited from fishing in the Convention Area.

Line Weighting – Autoline System

6.26 In Subareas 88.1 and 88.2 vessels fishing south of 65°S in daylight were required to use line weights to achieve a consistent minimum line sink rate of 0.3 m/s (Conservation Measure 216/XX). The Working Group noted that both vessels complied with this measure.

Thawed Bait

6.27 Two vessels used frozen bait when setting longlines on more than one occasion; *Isla Santa Clara* (15%) and *Tierra del Fuego* (1%) (WG-FSA-02/13 Rev. 1).

General

6.28 The Working Group noted that if compliance with Conservation Measure 29/XIX is interpreted strictly (i.e. 100% in all elements of the conservation measure), only three vessels (*San Aotea II*, *Janas* and *Argos Helena*) fully complied with all elements at all times. Eight further vessels were within 95% of the minimum requirements of all elements of Conservation Measure 29/XIX (Table 6.5). The Working Group emphasised that the specifications in the conservation measure are minimum standards, and vessels should be advised to exceed these to prevent compliance failure due to marginal shortcomings.

6.29 The Working Group again recommended that vessels which do not comply with all elements of Conservation Measure 29/XIX should be prohibited from fishing in the Convention Area (SC-CAMLR-XX, paragraph 4.41).

Fishing Seasons

6.30 In 2000 the Scientific Committee advised the Commission that once full compliance with Conservation Measure 29/XIX was achieved, together with negligible levels of seabird by-catch, any relaxation of closed seasons should proceed in a stepwise fashion and the results of this carefully monitored and reported (SC-CAMLR-XIX, paragraph 4.42).

6.31 On the basis of the data for the 2001/02 fishing season in Subarea 48.3, seabird by-catch levels were very low (at levels negligible in terms of the population dynamics of the species concerned) for the third successive season. However, only one vessel (*Argos Helena*) fully complied with Conservation Measure 29/XIX.

6.32 In light of the fact that full compliance by the vessels fishing in Subarea 48.3 is possible in the near future if past trends continue, the Working Group considered options for the future that could allow a season extension with minimal risk to seabirds. A number of factors were taken into account.

6.33 The Working Group recalled the information obtained from the French EEZ in the 1999 and 2000 seasons when, despite reported use of Conservation Measure 29/XVI, 8 491 white-chinned petrels were killed. This indicates that the current conservation measures may not be able to adequately mitigate the capture of this species during the summer season.

6.34 The Working Group also recalled its advice to the Scientific Committee two years ago (SC-CAMLR-XIX, Annex 5, paragraph 7.150) that current indications are that allowing fishing in summer, at night, using streamer lines, proper offal discharge practices and c. 40 m between weights on longlines (existing practice for Spanish system vessels) will still result in unacceptably high mortality of seabirds, and further experimentation into the effectiveness of line-weighting concepts and underwater setting devices with the Spanish system is important. The Working Group proposed and outlined an experiment (WG-FSA-01/29), but funding to undertake this has not been found despite considerable effort (WG-FSA-02/30).

6.35 The Working Group also noted that information from Subareas 58.6 and 58.7 shows that white-chinned petrels are less susceptible to by-catch at the beginning of the breeding season during September when they are incubating eggs, compared to the chick-rearing period between January and April (WG-FSA-01/08, now Nel et al., 2002).

6.36 In the light of these considerations the Working Group proposed that a cautious and stepwise approach be taken in terms of a season extension, in order to minimise risk to seabirds.

6.37 Three options for season extension were considered by the Working Group:

(i) An extension of the season for two weeks in September, once there was full compliance with Conservation Measure 29/XIX, and subject to a limit of three birds per vessel, assuming fishing effort was maintained at current levels. Vessels would be required to carry two observers, so that the limit could be monitored accurately, and either two streamer lines or a single streamer line with a boom-and-bridle system would be required.

(ii) An extension of the season for the last two weeks in April once there was full compliance with Conservation Measure 29/XIX, and subject to a limit of three birds per vessel, assuming fishing effort was maintained at current levels. Vessels would be required to carry two observers, so that the limit could be monitored accurately, and either two streamer lines or a single streamer line with a boom-and-bridle system would be required.

(iii) In the forthcoming season to allow only vessels in Subarea 48.3 that were adjudged to have complied fully with Conservation Measure 29/XIX in 2001/02 to fish during the last two weeks of April to enable a preliminary assessment of seabird by-catch during this period. As part of the access arrangement during this period, the vessel would be required to collect data to allow a more reliable assessment of the risk to seabirds during this period. This would include collection of data on the sink rate of longlines, and observations of seabird behaviour around the vessel. A limit of three birds would be applied to the vessel; two observers would be required so that the limit could be monitored accurately; two streamer lines or a single streamer line with a boom-and-bridle system would be required.

6.38 The Working Group noted that of the two options (i) and (ii) outlined in paragraph 6.37 above, it regarded option (i) as preferable, in terms of leading to an extension to the fishing season at a time of lower potential risk to seabirds.

6.39 These options for extensions to the toothfish fishing season were further discussed. From the perspective of the assessments by WG-FSA, while there might be potential difficulties arising from CPUE overlap, mix of maturity stages and the need to incorporate season (rather than whole year) into the assessments, these did not present real obstacles.

6.40 It was noted that the toothfish fishery in Subarea 48.3 currently reaches the catch limit several weeks before the end of the fishing season.

6.41 Although extending the fishing season so that it more closely approaches the current timing of the meetings of WG-FSA, the Scientific Committee and the Commission, could create difficulties for ensuring that observer reports and fishing data were available in time for consideration at these meetings, it was likely that these issues could be addressed by appropriate changes to administrative and management practice. The Working Group agreed to address the topic of how to manage year-round fisheries for toothfish at its meeting next year.

6.42 It was recollected that one of the original aims of extending the toothfish fishing season was to avoid this fishery being restricted to the winter months when the weather was worst and vessel safety particularly critical.

6.43 However, in view of the experiences of fishing in winter over the last several years, the extent to which this argument still applied was not clear to the Working Group.

6.44 Nevertheless, safe fishing practice might affect the feasibility of option (iii) in paragraph 6.37 because current best practice in this fishery in Subarea 48.3 is for vessels to operate in pairs.

6.45 For all three options, concerns were also raised about the difficulties of ensuring compliance with the proposed bird by-catch limit, both in terms of the potential requirement for near real-time reporting and of the levels of observation needed to achieve accurate monitoring of the seabird by-catch.

6.46 The Working Group re-emphasised the importance of not compromising the status of scientific observers by their close involvement in issues of compliance, especially where these involve decisions as to whether or not a vessel continued fishing (SC-CAMLR-XX, paragraph 4.85).

Research into and Experiences with Longline Mitigation Measures

Night Setting

6.47 The Working Group noted that night setting continued to be one of the most effective methods of mitigating albatross incidental mortality (WG-FSA-02/36). In high-latitude areas of lower risk for seabird by-catch, full compliance with strict line-weighting requirements (e.g. as in Conservation Measure 216/XX) had resulted in some daylight setting without seabird by-catch.

6.48 The Working Group discussed the definition of nautical twilight (paragraph 6.21) and noted the revised tables available in the new observer logbooks. The Working Group encouraged technical coordinators to ensure the new forms are used.

Bait

6.49 No new research on bait relating to mitigating incidental seabird mortality was reported.

Line Weighting

6.50 Significant progress had been made during the intersessional period in exploring the application of longlines with integrated weight (IW) for autoline vessels (WG-FSA-02/22). Longlines with 0 g/m, 25 g/m, 50 g/m, 75 g/m and 100 g/m sank to 15 m depth at 0.11 m/s, 0.23 m/s, 0.27 m/s and 0.32 m/s respectively (the sink rate required under Conservation Measure 216/XX is 0.3 m/s). No adverse effects on fishing operations or on the catch rate of the target fish species (ling, *Genypterus blacodes*) were noted.

6.51 Dr G. Robertson (Australia) and Mr Smith indicated that the New Zealand Ling Longline Working Group, in collaboration with New Zealand Longline Ltd, the Australian Antarctic Division, New Zealand Department of Conservation and New Zealand Ministry of Fisheries, plans to conduct a trial in New Zealand waters in November 2002 of the effectiveness of the 50 g/m IW longline as a method for mitigating incidental seabird catches. The trial will also examine the effects of IW longlines on catch rates of target fish species, as well as operational aspects of fishing. Results of the trial will be presented to the 2003 meeting of CCAMLR. The Working Group welcomed this experiment.

6.52 One of the additional likely benefits of IW lines is that baits reach the ocean floor more quickly than on unweighted lines, and as a result baits are likely to retain their attractiveness for longer, resulting in increased effective fishing time.

6.53 WG-FSA-02/25 reported on the intrinsic sink rates (under controlled conditions) of the types of longlines most commonly used in the world's autoline fisheries. Silver line (mixture of dan line and polypropylene) sank at 0.18–0.21 m/s, whereas polyester line sank at 0.23 m/s. Polyester line set from a typical Norwegian-built autoliner sank at 0.16 m/s, 11% slower than the intrinsic sink rate; the difference is thought to be due to propeller turbulence and sea state. The paper provides a useful background against which future line-weight manipulation can be judged. In terms of new vessel design for autoliners, the direction of the propeller rotation and the side of the vessel from which the line is set are important considerations in relation to optimising longline sink rate.

6.54 Additional progress had been made during 2001/02 in the implementation of a practical line-weighting regime for vessels using the Spanish longline system. The line-weighting regime prescribed in Conservation Measure 29/XIX (8.5 kg weights spaced at no more than 40 m apart) was used during 10 cruises (up from five in 2000/01). No vessels using the Spanish longline system were active in the Convention Area where Conservation

Measure 216/XX applies, and no further data have been collected on how the Spanish longline system may perform in relation to the 0.3 m/s line sink rate requirement in this conservation measure.

6.55 Outside the Convention Area, research into the use of line weighting in pelagic longline fisheries was reported in Anderson and McArdle (2002). The research highlighted that the position of weight placement on pelagic longline snoods was an important variable. Considerable variability in sink rate was noted between individual hooks; with unweighted snoods, 10% of hooks were still less than 2 m deep at a distance beyond the areal coverage of the streamer line. Although weighting generally improved hook sink rate, further research was required into both sink characteristics and operational practicality of the method in pelagic longline fisheries.

6.56 The new method of measuring line sink rate (the 'bottle test' described in Conservation Measure 216/XX) had been successfully applied in the longline fisheries in Subareas 88.1 and 88.2 during the 2001/02 season. The method had provided real-time feedback on the actual line sink rate achieved. Observers reported that calculating line sink rate with the 'bottle test' was considerably easier and cheaper than using time depth recorders and had saved considerable time, whilst allowing more data to be collected (two vessels, 345 results in 2001/02 versus three vessels, and ~100 results in 2000/01).

6.57 One problem highlighted by observers was that the 15 m attachment of the 'bottle test' meant that by the time the bottle was pulled under, the distance of the bottle from the vessel made it sometimes invisible for recording the time of sinking. The use of a 10 m attachment was suggested. The Working Group noted that on the basis of previous research, the longline had reached terminal velocity at 10 m depth, and that it would be reasonable to monitor the sink rate at 10 m depth instead of at 15 m.

Line Shooter

6.58 No new research on line shooters relating to mitigating incidental seabird mortality was reported.

Underwater Setting

6.59 No further information on the effectiveness of underwater setting for Spanish or autoline vessels was available.

6.60 Mr Baker reported the results of a trial of an underwater setting device in the Australian domestic pelagic tuna fishery. The concept of setting baits under water was tested as a seabird mitigation measure in Australian conditions during the summer of 2001/02. The objective of the trial was to assess the effectiveness of an underwater line-setting chute under normal fishing conditions and without any other mitigation measures to mitigate seabird by-catch. The success of the trial was to be measured against the by-catch rate of 0.05 birds/thousand hooks specified in the Australian 'Threat Abatement Plan for the incidental catch (or by-catch) of seabirds during oceanic longline fishing operations' (Environment Australia, 1998).

6.61 A total of 253 observer seadays was completed, with 101 203 hooks (123 sets) observed. Of these, 58 323 hooks (58%) were deployed through the chute, 46 455 (46%) during daylight hours. The total incidental seabird by-catch rate for the period was 1.581 birds/thousand hooks, with 2.777 birds/thousand hooks for day sets and 0.889 birds/thousand hooks for night sets. Flesh-footed shearwaters (*Puffinus carneipes*) made up 97% of the total incidental seabird mortalities with wedge-tailed shearwaters (*P. pacificus*) and great-winged petrels (*Pterodroma macroptera*) making up the remainder.

6.62 Based on the limited data collected, the trial concluded that the chute, used alone, is not an effective seabird by-catch mitigation measure in Australian east coast pelagic fisheries. However, the chute did prove to be capable of setting lines under water by effectively setting baited hooks at a depth of approximately 5 m. The high incidental seabird by-catch rates indicate that the concept of only setting baits under water may not entirely remove the potential for some seabird species to see and attack baited hooks. To reduce or remove the potential for seabird interactions with baited hooks, additional measures may have to be used in conjunction with the concept of setting baited hooks under water. A preliminary report on the trial is available at www.afma.gov.au.

6.63 Ms Rivera reported that the same device was also tested at sea in waters off Hawaii in the pelagic longline fishery. Initial results from that trial indicate some reduction in incidental mortality is likely, and that the chute was operationally practical for this fishery. An additional benefit noted was an increase in the number of baits staying on hooks and a subsequent increase in fishing efficiency. Two key differences from the trial in Australia were that the device was used in conjunction with other mitigation measures (line weighting, offal control) in Hawaii, and a different suite of species with differing vulnerability to being incidentally caught are present in the two study areas. The final report is expected in late 2002.

6.64 Ms Molloy reported initial results of further trials of the capsule underwater setting device, in particular that operational elements of the device were still being refined. This device is quite different from the chute in that it sets baits to 10 m depth. The Working Group requested that results of these trials be reported to it next year and encouraged the further development of the underwater setting capsule.

Offal

6.65 Noting the successful experience of retaining offal on board in Subareas 88.1 and 88.2, the Working Group reiterated its previous advice that all vessels in all areas should use scupper screens to trap processing offal and discarded baits. The Working Group noted that where used, it was important to ensure that scupper screens are clean and functional, made of a material suitable for the saltwater environment, and kept clear to avoid vessel stability hazards. Dual scupper screens on board are recommended to allow scuppers to remain covered whilst dirty screens are cleaned. Spare covers should be on board in the event that one is lost.

6.66 The Working Group also noted that, wherever possible, offal retention, as occurs in the Subarea 88.1 fishery, is preferable. There may be practical difficulties in doing this on some vessels operating in other parts of the Convention Area; however, the Working Group strongly urged Members to ensure such issues were taken into consideration when new vessels were being built.

6.67 Based on detailed observation of processing operations on the *Argos Georgia* in Subarea 48.3 over an 82-day fishing period in 2001/02, the report of the scientific observer indicated that an estimated 15 828 fish heads were discarded with hooks still in them. This level of hook discard in fish heads is consistent with the continued high frequency of hooks found in the albatross colonies on Bird Island, South Georgia (SC-CAMLR-XXI/BG/7). The much greater frequency of hooks/line found in association with wandering albatrosses is consistent with their larger size and hence their ability to swallow entire fish heads. The hooks found in the albatross colonies were of the type used in the regulated toothfish fishery in Subarea 48.3 (SC-CAMLR-XXI/BG/7).

6.68 The Working Group attempted to investigate further the magnitude of this problem, but was unable to do so as observers do not currently report sufficient relevant data. The Working Group recommended that these data be collected in future.

6.69 The Working Group reiterated its previous advice that such potential hazards to albatrosses could be easily avoided by the removal of hooks from the fish heads, fish offal and fish by-catch prior to their discard. The Working Group again proposed that such a recommendation be added to existing conservation measures (SC-CAMLR-XX, Annex 5, paragraph 7.162), but noted that if Conservation Measure 29/XIX is not revised at CCAMLR-XXI, some alternative means of getting this message to the relevant fishers and fisheries should be considered.

6.70 The Working Group commended a scheme reported as operating on at least two vessels (*Polarpesca 1, Tierra del Fuego*) from Chile, whereby a bounty was paid for hooks collected by crew from processed fish heads.

Streamer Lines

6.71 The boom-and-bridle system (WG-FSA-01/44 and 01/60) was used by two New Zealand vessels in the fishery in Subareas 88.1 and 88.2 throughout the 2001/02 season. This system allows the skipper to move the position of the streamer line either to the starboard or port so that it is always directly over the longline during setting, irrespective of the wind direction. With zero seabird by-catch in the fishery in Subareas 88.1 and 88.2, data to support the effectiveness of this design in other circumstances are not readily available. However, Dr Robertson noted, from personal observation on a cruise outside the Convention Area, that this style of streamer line performed better than any other he had previously observed and was probably as effective as paired streamer lines.

6.72 Paired streamer lines have yet to be trialled in the Convention Area. Two studies on the effectiveness of multiple lines have been conducted outside the Convention Area. WG-FSA-02/36 reported on trials of paired/triple streamer lines in Falkland/Malvinas waters. Incidental seabird catch rates for single streamer lines were 0.72 birds/thousand hooks, for paired lines 0.18 birds/thousand hooks and 0.02 birds/thousand hooks for triple streamer lines, although sample sizes were small for some of the trials, and some elements of the streamer lines used were different from the specifications which apply in Conservation Measure 29/XIX. WG-FSA-02/53 reported on trials of paired lines in the Alaska demersal longline fishery and the subsequent revisions to seabird mitigation regulations that will be promulgated in that fishery. Paired streamer lines of specified areal coverage standards were found to reduce seabird incidental catch by 88–100% relative to controls with no deterrents.

6.73 The Working Group noted that given the effectiveness of paired/multiple streamer lines and boom-and-bridle design streamer lines outside the Convention Area, they would likely have considerable benefit if applied within the Convention Area.

6.74 The Working Group also attempted to investigate the effect of the areal coverage of streamer lines on their effectiveness from observer reports. Unfortunately, adequate data are not currently collected by observers to undertake such an analysis. The Working Group recommended that such data be collected to help with designing improvements to the streamer line specification in Conservation Measure 29/XIX.

6.75 Accordingly, the Working Group strongly recommended that fishing within the Convention Area be conducted using either paired streamer lines or boom-and-bridle design streamer lines, especially including trials to test their utility in reducing incidental seabird mortality, so that additional data are available to assist review of the streamer line specification in Conservation Measure 29/XIX.

Research Needs relating to the Spanish Method of Longline Fishing

6.76 Last year, on the basis of WG-FSA-01/29, strong support was given to a proposal to determine the effectiveness of mitigation measures either singly or in combination on vessels using the Spanish longline method (SC-CAMLR-XX, Annex 5, paragraphs 7.187 and 7.188). The research is important, as the Spanish system is the most common gear deployment system in the Convention Area as well as being commonly used in adjacent non-Convention waters frequented by Convention Area albatrosses and petrels. This experiment was strongly endorsed by the Scientific Committee (SC-CAMLR-XX, paragraph 4.63) and the Commission (CCAMLR-XX, paragraph 6.26). WG-FSA-02/30 reported that that the experimental design and project cost projections had been completed, vessel availability addressed and some 50 organisations approached for funding. A small amount of funding had been offered. However, at this time it was not possible to go ahead with the research, as considerable additional funding was still required.

6.77 The Working Group commended the considerable efforts to raise funds for this research. It reiterated that this experimentation is considered particularly important, and again urged Members to facilitate the financing, planning and undertaking of this study.

Research into and Experiences with Trawl Mitigation Measures

6.78 This topic is discussed, in relation to experiences in the Convention Area, in paragraphs 6.197 and 6.199.

6.79 WG-FSA-02/36 reported on trials on trawlers fishing around the Falkland/Malvinas Islands of a device designed to prevent birds colliding with trawl warps.

Revision of Conservation Measures 29/XIX and 216/XX

6.80 In light of the data and experiences reported above, the Working Group reviewed the relevant elements of Conservation Measures 29/XIX and 216/XX.

6.81 The following minor changes are recommended for Conservation Measure 216/XX:

(i) in paragraph B1(iii): 15 m be changed to 10 m;
(ii) in paragraph B2(v): 15 m be changed to 10 m;
(iii) in paragraph B5: 15 m be changed to 10 m; and
(iv) in paragraph B8: the numerator of the formula be adjusted to 10.

6.82 The review of Conservation Measure 29/XIX concluded that several elements of the measure, relating to line weighting for autoliners, streamer lines and hooks in discards and offal, will need to be reviewed in the near future; however, sufficient data with which to propose all potential improvements are not yet available.

6.83 The Working Group noted that as the incidental mortality of Convention Area seabirds both within and outside the Convention Area continues to be of concern, initiatives should be taken to:

(i) encourage the use of paired/multiple streamer lines, or a boom-and-bridle design streamer line in all Convention Area longline fisheries;

(ii) support experiments to determine the effectiveness of paired/multiple streamer lines, or boom-and-bridle design streamer lines;

(iii) encourage fishers to remove hooks from fish heads, fish offal and whole fish to be discarded in all Convention Area longline fisheries; and

(iv) provide additional data on the numbers of hooks discarded in fish heads, fish offal and whole fish in Convention Area longline fisheries.

6.84 The Working Group noted that in addition to the application of conservation measures to the issue of reducing incidental seabird mortality, the following issues should be taken into consideration when new vessels are built for longline fishing:

(i) Propeller rotation:
The deployment position of longlines in relation to the rotation direction of the propeller can have a major bearing on longline sink rates. Naval architects and engineers involved in vessel construction are encouraged to research the relationship between the rotation direction of the propeller and longline sink rates to identify the optimal position in the vessel from which longlines should be deployed. Computer modelling techniques and flume tank tests of scaled-down versions of vessels might identify such ‘sweet spots’.

(ii) Meal plants:
Offal from processed fish discharged into the sea attracts seabirds to fishing vessels. This practice maintains the interest of seabirds in vessels, and exposes them to line setting operations when baited hooks are deployed and to the risk of ingestion of hooks embedded in fish heads, offal and discarded fish. Fish processing plants would greatly reduce this problem while at the same time

providing fish meal product for sale. With vessels of suitable size, vessel designers are encouraged to build fish meal plants into new longline vessels to minimise the attractiveness of vessels to seabirds.

(iii) Vessel attachment points for streamer lines:
The greater the areal extent of streamer lines, the more effective they are in deterring seabirds. Areal coverage is improved if streamer lines can be attached to points high on the vessel superstructure. In the case of the boom-and-bridle system, capacity should exist for the components of this system to be fitted to vessels. Vessel designers are encouraged to consider these issues in new vessels, with particular attention given to the location and strength of anchor points of gear on vessels.

(iv) Through-the-hull line setting:
Longlines deployed deep under water (beneath the upwelling effects of the propeller) are likely to reduce contact between baited hooks and seabirds, particularly species that feed by surface seizure. This will have dividends for both seabird conservation and fishing efficiency, since fewer baits will be taken from hooks. Vessel designers are encouraged to incorporate underwater setting in the design and construction of new longline vessels.

(v) Moon pool:
Hauling aboard longlines in a manner that exposes seabirds to baited hooks increases the likelihood of live captures. Through-the-hull line hauling – or the 'moon pool' concept – would eliminate this problem; it would also reduce the contact between seabirds and non-target fish species flicked off longlines, because these species would sink out of reach of birds by the time they are clear of the vessel. Vessel designers are encouraged to adopt moon pool line hauling concepts in the construction of new longline vessels.

(vi) Deck lighting:
Lights that illuminate the water where longlines are deployed provide visual cues for night-feeding seabirds to attack baited hooks. Vessel designers are encouraged to locate lights in positions that minimise illumination astern, while maintaining suitable on-board illumination to ensure crew safety is not compromised.

6.85 The Working Group requested further information from France in relation to their statement last year concerning the design of their five new longline fishing vessels (CCAMLR-XX, paragraph 6.13).

Incidental Mortality of Seabirds during Unregulated Longline Fishing in the Convention Area

General

6.86 As no information is available on seabird by-catch rates 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.

6.87 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.

6.88 This year, a new method of estimating IUU catch of toothfish in Subarea 48.3 was presented in WG-FSA-02/4 and 02/5 (paragraphs 3.17 to 3.22).

6.89 The model described in WG-FSA-02/4 also estimates the numbers of seabirds caught by IUU fishing in Subarea 48.3, presenting mean and confidence limits for estimates rather than the minimum and maximum estimates currently presented in CCAMLR reports. The derivation of IUU seabird by-catch rates used in WG-FSA-02/4 was described in WG-FSA-02/5. Summer rates were calculated using the 1997 observer data up to the end of March, and winter rates were calculated using the data from 15 April (Table 6.8). It has been assumed in the past that, since regulated CCAMLR fishing vessels were operating largely without mitigation measures in 1997, their seabird by-catch rates would be indicative of those of IUU vessels.

6.90 One of the vessels fishing in 1997, the *Isla Isabel*, reported very high by-catch rates on one cruise but caution has previously been expressed about these data since only 10% of hooks were observed (SC-CAMLR-XVI, Annex 5, paragraph 7.55). WG-FSA-02/4 provided calculations with and without these data. The Working Group suggested that all the *Isla Isabel* data should be included, because very high seabird by-catch rates are not unknown in this and other fisheries, but that the seabird by-catch estimates should be included into the main model in WG-FSA-02/4 as weighted rather than unweighted bootstraps. Weighting could, for instance, use both total hooks set and hooks observed to reflect sampling density.

6.91 The Working Group agreed that these papers represented significant advances in the estimation of IUU catches of both seabirds and fish. It would be useful to see if the method could be applied to other CCAMLR areas. However, it was also recognised that there are many more data available from Subarea 48.3 than other CCAMLR areas, and this may limit its wider application.

6.92 The Working Group agreed to develop a simpler way of estimating potential by-catch of seabirds associated with IUU fishing in the Convention Area and a clearer way of presenting the results of this. Dr Agnew agreed to investigate this further intersessionally in collaboration with ad hoc WG-IMAF, the Secretariat and with Members who may hold appropriate data. In addition, the Secretariat was requested to implement the seasonal delimitation suggested in WG-FSA-02/4 and 02/5 for all the estimated seabird by-catch data available to date.

Unregulated Seabird By-catch in 2002

6.93 In view of the fact that:

(i) seabird by-catch rates in the regulated fishery have been reduced substantially since 1997, due to much better compliance with CCAMLR conservation measures, including those relating to closed seasons; and

(ii) it is unreasonable to assume that the unregulated fishery made comparable improvements to the timing and practice of its operations;

the Working Group decided that it should continue to use the seabird by-catch rates from 1997, as was done in previous assessments. The assessment this year, therefore, followed the identical procedure to that used in previous years, except that the calculation was prepared on a fishing season basis, in place of the split-season used in the past. The assessment has been incorporated into a background paper (SC-CAMLR-XXI/BG/23). It should be noted that applying some of the seabird catch rates used in SC-CAMLR-XXI/BG/23 to the whole unregulated fishery may produce a considerable overestimate of seabird by-catch, at least in some areas.

Results

6.94 It was noted that in addition to the change from split-year to fishing season, the review by WG-FSA of data on IUU removals of *Dissostichus* spp. resulted in several changes to historical data. Therefore the estimates of IUU removals of seabirds for all previous years show differences from previously reported values.

6.95 Commensurate with changes in IUU effort since last year, estimates of seabird by-catch have decreased in Subareas 48.3, 58.6 and 58.7 and Division 58.4.4, and increased in Divisions 58.5.1 and 58.5.2. For the first time, IUU catches were potentially taken from Subarea 88.1, producing a low level of assumed estimated seabird by-catch in this area.

6.96 The overall estimated totals for the whole Convention Area indicate a potential seabird by-catch in the unregulated fishery of 39 000–52 000 (lower level) to 70 000–93 000 seabirds (higher level) in 2001/02. These values, in relation to the estimates from previous years, are shown in Figure 6.2.

6.97 As in previous years, it was emphasised that the values in SC-CAMLR-XXI/BG/23 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.

6.98 Nevertheless, even taking this into account, the Working Group endorsed its conclusions of recent years that such levels of mortality continue to be unsustainable for the populations of albatrosses and giant and white-chinned petrels breeding in the Convention Area.

Summary Conclusion

6.99 Ad hoc WG-IMAF once again urgently drew the attention of WG-FSA, the Scientific Committee and the Commission to the numbers of albatrosses and petrels being killed by unregulated vessels fishing in the Convention Area. Since 1996, an estimated total of 278 000 to 700 000 seabirds have been killed by these vessels. Of these:

(i) 74 000 to 144 000 were albatrosses, including individuals of four species listed as globally threatened (Vulnerable) using the IUCN threat classification criteria (BirdLife International, 2000);

(ii) 13 000 to 24 000 were giant petrels, including one globally threatened (Vulnerable) species; and

(iii) 203 000 to 378 000 were white-chinned petrels, a globally threatened (Vulnerable) species.

6.100 These levels of loss of seabirds from the populations of these species and species groups are 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.

6.101 These and several other albatross and petrel species are facing potential extinction as a result of longline fishing. The Working Group again urgently requested the Commission to continue to take action to prevent further seabird mortality by unregulated vessels in the forthcoming fishing season.

Incidental Mortality of Seabirds during Longline Fishing outside the Convention Area

6.102 The Working Group considered papers reporting on seabird mortality from fisheries conducted outside the CCAMLR Convention Area but which affected birds that breed within it.

6.103 WG-FSA-02/36 reported on by-catch of seabirds in the longline fishery for *D. eleginoides* around the Falkland/Malvinas Islands (Area 41) during 2001/02. A total of 8 066 014 hooks was set in this fishery and a total of 25 dead birds was observed on 860 120 hooks (0.029 birds/thousand hooks[1]). These by-catch rates are much lower than earlier reports for this fishery. Almost all (23) mortalities were black-browed albatrosses, which were likely to have been from the local population. Only two white-chinned petrels were killed. Regression models suggest that by-catch of black-browed albatrosses increased with abundance of birds present during setting. This paper also provided a very useful historic summary of fishery–seabird interactions around the Falkland/Malvinas Islands.

6.104 WG-FSA-02/18 reported on by-catch of seabirds in the longline fishery for *D. eleginoides* around southern Chile (Area 87) from September 2001 to June 2002. Black-browed albatrosses were caught most frequently in this fishery. Sooty shearwaters, Cape petrels and white-chinned petrels were also caught in lesser numbers. The mortalities to the latter two species were likely to be from breeding populations within the Convention Area. Seabird by-catch rates increased markedly during October and November compared to earlier in the year.

6.105 WG-FSA-02/82 reported on by-catch of seabirds in the *D. eleginoides* longline fishery operating in Argentine waters on the Patagonian shelf (Area 41) from 1999 to 2001. A total of 9 696 196 hooks was observed during this period and 710 seabird mortalities (0.07 birds/thousand hooks) were reported. The annual by-catch rate varied between 0.04 and 0.27 birds/thousand hooks. Given a fishing effort of 20 million hooks per annum, the total seabird by-catch for this fishery could range between 800 and 5 400 birds per annum[2]. Black-browed albatrosses (53%) and white-chinned petrels (26%) were caught most

[1] Given as 0.017 birds/thousand hooks in WG-FSA-02/36

[2] Given as 1 500–8 000 birds in WG-FSA-02/82

frequently, the former from the breeding populations of the Falkland/Malvinas Islands, most or all of the latter from the populations breeding in the Convention Area. Wandering albatrosses, grey-headed albatrosses, southern royal albatrosses, southern giant petrels, Cape petrels, sooty shearwaters and grey petrels were also killed. Many of these birds are likely to have been from breeding populations within the Convention Area.

6.106 In a document submitted to the Secretariat, Uruguay reported that in six toothfish longline fishing voyages in FAO Statistical Areas 47, 51 and 57 during 2001/02, observers did not report any seabird mortality.

6.107 Two white-chinned petrels were killed in toothfish longline fishing operations by South Africa, within its EEZ but outside the Convention Area, during 2001/02 (WG-FSA-02/17).

6.108 WG-FSA-02/43 reviewed spatio–temporal trends of longline fishing effort in the Southern Ocean and implications for seabird by-catch. It described the extent and magnitude of demersal and pelagic longline fisheries (mainly for tuna) in southern waters and the deficiencies in management of some of these fisheries relating to both fishery and seabird by-catch monitoring and regulation. These deficiencies include the poor recording of effort statistics, a lack of adequate at-sea monitoring and an inability to control illegal fishing. The spatial and temporal distributions of effort in the pelagic and demersal fisheries have changed markedly over time. These distributions also differ between fleets (often depending on target species) and within a fleet over a season. Changes in the magnitude of effort and the major fleets of influence can have substantial implications for interactions with seabirds. Effort statistics presented in this paper underestimate the true level. However, it is clear that longline effort in southern waters has increased markedly since the late 1960s and early 1970s. The total reported effort from all longline fleets is now well over 250 million hooks per year and has been at this level since the early 1990s. Recent substantial increases in illegal fishing have occurred in both the pelagic and demersal longline fisheries. Estimates of by-catch from IUU fishing for toothfish alone would suggest that current levels of seabird mortality are not sustainable. When combined with the impacts from regulated fisheries, some of which show either inconsistent use of mitigation devices or none at all, the long-term viability of many Southern Ocean species of seabird may be in jeopardy. The Working Group noted the importance of this study in addressing the global impacts of longline fishing on seabirds occurring in the Convention Area.

6.109 The Working Group recommended that responses be sought by the Secretariat on seabird by-catch levels, mitigation measures in use (and whether voluntary or mandatory) and observer programs from all Members and other countries conducting or permitting longline fishing in areas where seabirds from the CCAMLR Convention Area are killed.

Research into the Status and Distribution of Seabirds

6.110 Following last year's request for information summarising national research on seabirds (albatrosses and *Macronectes* and *Procellaria* petrels) vulnerable to longline fisheries interactions, papers were presented by the USA (WG-FSA-02/72) and New Zealand (WG-FSA-02/37), and information submitted during the meeting by Chile and Australia. Reference to research on albatrosses by South Africa is included in WG-FSA-02/16 and research by Chile in WG-FSA-02/18. Of the countries known to be conducting relevant research on these species, no reports were received from the UK and France (both of which provided full reports last year) and Argentina.

6.111 The US report (WG-FSA-02/72) included details of current research into methods to monitor and mitigate seabird by-catch. This was viewed by the Working Group as an additional valuable contribution to its work. All Members are requested to include details of mitigation research in their annual update to the Working Group on the current status of relevant research programs.

6.112 Previously it was noted that the information regarding assessments of population dynamics and foraging ranges was insufficient for comparisons with levels of by-catch and fishing effort. Consequently Members were requested to provide additional details to assist these important assessments (SC-CAMLR-XIX, Annex 5, paragraphs 7.10 and 7.11). New Zealand (WG-FSA-02/37) and Chile were the only Members to provide new information this year.

6.113 All information provided to date was summarised in SC-CAMLR-XXI/BG/22, which updates SC-CAMLR-XX, Annex 5, Tables 49 and 50. All Members were again requested to provide any new or outstanding details of population dynamics studies and foraging ranges. The submission of the population and foraging research information to next year's meeting of WG-IMAF should enable a timely review of the level of information available for each population.

6.114 The most recent assessments of the global status of albatrosses, giant petrels and *Procellaria* petrels are reflected in SC-CAMLR-XXI/BG/22. This summary reflects the revised status of the black-browed albatross from Near-Threatened to Vulnerable (SC-CAMLR-XXI/BG/22). This change was principally based on population declines newly reported for the Falkland/Malvinas Islands where 70% of the world population breeds. The species now meets the IUCN criteria for Vulnerable status, whereby it is inferred that the species has declined in numbers by >30% over the last 30 years (probably owing to mortality caused by longline fisheries), and it is projected that declines will continue into the future.

6.115 To enable revisions to the population status of populations vulnerable to fishery-related mortality in the Convention Area, Members are requested to provide information on the most recent assessment of population size (year and population size estimate, and population trend) for each population, where this information is available. No new compiled datasets were received this year. New information was extracted for specific populations from information provided by Australia (WG-FSA-02/23), Chile (WG-FSA-02/18) and South Africa (WG-FSA-02/23). This information has been incorporated in SC-CAMLR-XXI/BG/22 to update SC-CAMLR-XX, Annex 5, Table 49.

6.116 Information on the breeding population of black-browed albatrosses at Heard Island between 1947 and 2000 (Woehler et al., 2002) was reviewed. Census data were collected on 16 of 53 visits, but all colonies were surveyed on only three occasions, albeit at different stages of the breeding season. Comparisons of the survey data were interpreted in the paper to reflect a trebling of the population since 1947, with approximately 600 pairs in 2000. The Working Group was cautious about the interpretation of the increasing trend given the disparate nature of the data. The Working Group commended the initiation of systematic surveys of the population and recommended the continuation of the monitoring of this population.

6.117 The population dynamics of wandering albatrosses at Marion Island were described with respect to the effects of environmental (ENSO) and anthropogenic (longlining) influences (WG-FSA-02/16). The proportion of first-time breeders was positively correlated with a maximum ENSO index, whereas the annual survival rates of breeding adults was negatively correlated with Japanese longline fishing effort in the Southern Indian Ocean. Survival rates of adult females were lower than those of adult males, although survival rates of juveniles were not gender specific. Overall, adult survival rates were consistent with those recorded at other Indian Ocean sites (Crozet) but differed from Atlantic sites (South Georgia), suggesting common factors operating at ocean-basin scale. The authors recommend the implementation of international conservation initiatives to reduce the impact of longline fishing on wandering albatrosses at Marion Island.

6.118 Of the 12 breeding sites for black-browed albatrosses, three occur in Chile – Diego de Almagro, Ildefonso and Diego Ramirez Islands. Populations at these locations have been censused only once previously. In light of decreases recorded elsewhere, an urgent need has been long recognised to recensus the Chilean populations and assess their conservation status. WG-FSA-02/23 reported on the results of a census in 2001 of the black-browed albatrosses on Diego de Almagro. Six colonies, and a total of 15 600 albatrosses were recorded for the island. To consolidate our knowledge of the status of albatrosses breeding in Chile, many of which forage in the Convention Area (paragraphs 6.120 and 6.121; SC-CAMLR-XXI/BG/22), the populations at Ildefonso and Diego Ramirez are in urgent need of reassessment.

6.119 The Working Group welcomed the progress report of Chilean research on albatross ecology and conservation (WG-FSA-02/18). Population surveys of black-browed albatrosses at Gonzalo Island have varied between 3 862 and 5 173 pairs, although interannual variation makes assessments of trends premature. Similarly, the high level of interannual variability of grey-headed albatrosses (range of 2 335 to 4 501 pairs between 1980 and 2001), together with their biennial breeding frequency, precludes confident assessment of trends.

6.120 The foraging distributions of black-browed and grey-headed albatrosses during the 2001/02 breeding seasons were reported in WG-FSA-02/18. Black-browed albatrosses prospected shelf waters during incubation and chick brooding stages, foraging in more southerly waters (south of 55°S) when foraging to feed large chicks. Grey-headed albatrosses showed a more extensive pelagic distribution during the breeding season, foraging in increasingly more southerly waters as the season progressed.

6.121 The foraging information was compared with the locations of longline setting operations in the toothfish fishery in southern Chile (WG-FSA-02/18). There was extensive overlap by black-browed albatrosses with fishing operations, whereas overlap by grey-headed albatrosses with the fishery was relatively limited. Both albatross species were foraging in CCAMLR Subareas 48.1 and 88.3 during summer months. Further tracking will be required to assess the risks faced by these populations at sea.

6.122 With the exception of the Chilean satellite-tracking studies, no new research programs focussing on populations relevant to the Convention Area have been started since 1999. Assessments of population size and trends of many populations and species affected by longline fishing remain absent. The most detailed studies are for the *Diomedea* albatrosses, with considerably less known for the *Thalassarche, Phoebetria, Macronectes* and *Procellaria* respectively. It is disturbing that, of all the species killed on longlines in southern waters, our understanding of the population size, trends and foraging ranges remains most deficient for white-chinned petrels, the species most commonly killed in the Convention Area.

6.123 The summary of foraging ranges of relevant albatross and petrel populations (at different times of year and stages of the breeding cycle), has been updated in SC-CAMLR-XXI/BG/22. Ultimately it is envisaged that these data will be assessed with respect to overlap with fisheries operations, and ultimately, to compare at-sea distributions with data on fishing effort. Incomplete provision and availability of data are preventing further progress. Further information on the CCAMLR areas prospected by the different populations will enable refined estimates of ranges of relevance to regional risk assessments.

6.124 The deficiencies resulting from the lack of relevant research into population dynamics and foraging ecology of most populations still persist, as noted last year (SC-CAMLR-XX, Annex 5, paragraph 7.21). If sufficient information is available next year, the Working Group intends to reassess the status of knowledge at a population level.

6.125 Recognising the importance of validating the species of birds killed, as well as determining their sex, age, and where possible provenance, the observer logbooks were modified in 1996 to require an entry indicating the place of deposition and the scientists responsible for relevant material (SC-CAMLR-XV, Annex 5, paragraph 7.20).

6.126 In view of the importance of trying to identify the population of origin of birds killed on longlines and the substantial progress with the ability to determine provenance via DNA profiles, the Working Group reiterated the requirement to retain specimens wherever possible. The Working Group also requested that Members be asked to supply information regarding the extent and location of their seabird by-catch collections.

International and National Initiatives relating to Incidental Mortality of Seabirds in relation to Longline Fishing

Second International Fishers' Forum (IFF2)

6.127 The Western Pacific Regional Fishery Management Council will host the Second International Fishers' Forum (IFF2) in Honolulu, Hawaii, USA, from 19 to 22 November 2002. In November 2000, New Zealand hosted the First International Fishers' Forum (IFF1) which focused on methods to solve the incidental catch of seabirds by longline fishing gear. IFF2 will build on the efforts made by the participants at IFF1, and will also include discussions on sea turtle biology and behaviour, and on reducing and minimising the harmful effects of interactions between sea turtles and longline gear.

6.128 The mission of the forum is to convene an international meeting of fishers to address possible solutions to incidental by-catch of sea turtles and seabirds by longline fishing gear. The primary objectives are to:

(i) increase the awareness of fishers that incidental longline catch of seabirds and sea turtles may pose a serious problem to these populations and to the continued operations of longline fishing;

(ii) promote the development and use of practical and effective seabird and sea turtle management and mitigation measures by longline fishers;

(iii) foster an exchange and dissemination of information among fishers, scientists, resource managers, and other interested parties on the use of mitigation measures, and the development of coordinated approaches to testing new measures;

(iv) promote the development and implementation of collaborative mitigation research studies by scientists, fishers, resource managers, and other interested parties; and

(v) build on IFF1 to encourage continued progress and new participants.

6.129 Detailed information on IFF2 can be found at www.wpcouncil.org/iff2.htm. Forms are available for registration, travel assistance applications, poster and exhibit registration. The Working Group encouraged CCAMLR Members to promote the active participation of their longline fishers, scientists, gear technologists, fishery managers and any other interested parties. Effective solutions to seabird (and sea turtle) by-catch problems can best be solved by collaborative and cooperative approaches such as those provided through this international forum.

Agreement on the Conservation of Albatrosses and Petrels (ACAP)

6.130 Since 1999, parties to CMS have been pursuing the development of ACAP (SC-CAMLR-XX, Annex 5, paragraphs 7.195 to 7.198). Progress was noted on ACAP's current status (SC-CAMLR-XXI/BG/20). To date, ACAP has eight signatories (Australia, Brazil, Chile, France, New Zealand, Peru, Spain and the UK) and two (Australia and New Zealand) of the necessary five ratifications required for entry into force.

6.131 In April 2002, Spain became the most recent signatory to ACAP. Spain is the first major fishing nation to recognise the importance of ACAP in the conservation of albatrosses and petrels in the southern hemisphere.

6.132 At the recent CMS Conference of Parties held in Bonn, Germany, two other parties (South Africa and the UK) both confirmed their intention to ratify shortly.

6.133 Australia, in its role as Interim Secretariat, has established a website for ACAP with the aim of keeping all Range States and interested organisations informed of current progress with ACAP and related issues. Further information can be obtained at www.ea.gov.au/biodiversity/international/index/html.

6.134 Australia is optimistic that ACAP will receive the remaining three ratifications required for the agreement to enter into force in 2003 (SC-CAMLR-XXI/BG/20).

FAO's International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds)

6.135 The Working Group noted the Commission's continued request to Members to develop and implement national plans in support of the FAO IPOA-Seabirds (CCAMLR-XX, paragraph 6.27).

6.136 Last year the Working Group requested CCAMLR Members, especially Argentina, Brazil, Chile, European Community, France (in respect of its overseas territories), Namibia, Norway, South Africa, UK (in respect of its overseas territories) and Uruguay to submit reports of their progress towards developing and implementing NPOA-Seabirds to the Working Group at its next meeting (SC-CAMLR-XX, Annex 5, paragraph 7.206).

6.137 The Working Group noted the following new information regarding the status of development on National Plans of Action (NPOA-Seabirds):

(i) New Zealand has spent two years working with a range of interests to develop a national plan of action to reduce albatross and petrel incidental catch in trawl and longline fishing. The NPOA has been consulted on once and submissions incorporated into a new version. This is currently being finalised for a last consultation. Provided that New Zealand approves the NPOA for consultation, this will occur in late 2002. Upon final approval, the NPOA will then be implemented early in 2003.

(ii) Falkland/Malvinas Islands, South Africa, Taiwan, Australia, Norway and Uruguay (WG-FSA-02/50), and Chile are at various stages of NPOA-Seabirds preparation.

(iii) the European Community is continuing to collect information on the seabird by-catch issue but further progress has apparently not occurred on its Preliminary Draft Proposal for a Community Plan of Action that was submitted to FAO's COFI in 2001.

(iv) Japan indicated it would review comments made by WG-IMAF on its NPOA (SC-CAMLR-XX, Annex 5, paragraphs 7.209 to 7.213) and would then modify and improve the plan if necessary and practicable (CCAMLR-XX, paragraph 6.29). CCAMLR has not yet received a response from Japan to a request on the status and content of its NPOA, and the nature and status of relevant mitigating measures.

6.138 FAO members will be reporting on the implementation status of IPOA-Seabirds at the next COFI biennial meeting in February 2003. The Working Group continued to highlight the need for nations and fishing entities to develop effective NPOAs for fisheries that interact with seabirds from the Convention Area. The Working Group encouraged the CCAMLR Observer to FAO to address this point at the COFI meeting.

Regional Fishery Management Organisations (RFMOs), Tuna Commissions and International Governmental Organisations

6.139 Last year, the Commission noted the view of the Scientific Committee 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). It agreed that there is an urgent need for collaborative work with appropriate regional fisheries organisations.

The Commission requested Members to give every assistance to developing appropriate collaboration and data exchange with the relevant tuna commissions and other regional fisheries organisations (SC-CAMLR-XX, paragraphs 4.73 and 4.74).

6.140 In pursuit of this endeavour, the CCAMLR Secretariat provided briefing materials on CCAMLR activities on seabird-related matters to CCAMLR Members attending meetings of the relevant regional fishery management organisations (RFMOs) and tuna commissions, and especially to those nominated to observe on behalf of CCAMLR. CCAMLR observers or, in the absence of nominated observers, Members of CCAMLR to whom information was sent, were requested, individually or collectively as appropriate, to provide feedback on the discussion of seabird by-catch in general, and the responses to the CCAMLR questions in particular, to the CCAMLR Secretariat.

6.141 Intersessionally, the CCAMLR Secretariat provided this seabird-related briefing material directly to appropriate RFMOs (CCSBT, ICCAT, IOTC, IATTC, SPC, FFA and CPPS) and requested the following information:

(i) existing data on levels of seabird by-catch;

(ii) the nature of measures to mitigate seabird by-catch currently in use and whether voluntary or mandatory; and

(iii) the nature and coverage of observer programs and whether these include observation of seabird by-catch and whether the observers are involved in assisting in the correct use of mitigating measures in relation to seabird by-catch.

6.142 The CCAMLR Observer to CCSBT (Australia) attended the meeting of its Working Group on Ecologically Related Species (ERSWG) in November 2001. Seabird-related information was discussed and would be of interest to CCAMLR. A report of the ERSWG meeting will be provided by the CCAMLR Observer once it is available from CCSBT. It was noted that the Republic of Korea is a recent member of CCSBT.

6.143 Although ICCAT has not directly responded to CCAMLR's requests for seabird-related information, the Working Group noted that three draft proposals for resolutions on seabird by-catch were presented at the ICCAT meeting in November 2001 and that this marked the first time that ICCAT had ever circulated draft proposals regarding seabirds. Due to lack of time, these proposals will be reconsidered at the November 2002 meeting. The Working Group encouraged CCAMLR Members that are also members of ICCAT to support the strongest possible resolution for taking action to address the seabird by-catch problem.

6.144 Additionally, the Working Group noted that BirdLife International presented information about its efforts to protect threatened seabirds to ICCAT's Scientific Committee on Research and Statistics at the Committee's meeting in September 2002 in Madrid.

6.145 IOTC had responded that there is no direct evidence from fishermen, observer programs, or experimental longline cruises (Russia, Japan, France and Seychelles) of any seabird by-catch in the fisheries monitored by IOTC, which cover mainly the tropical tunas and, to a lesser extent, the swordfish fishery extending to about 30°S.

6.146 However, fisheries data provided by IOTC (WG-FSA-02/43) does indicate pelagic longline effort by Japan and Taiwan in the Indian Ocean south of 40°S, areas overlapping with the foraging distribution of several albatross species that breed in the Convention Area. Based on knowledge of seabird by-catch associated with longline fisheries in analogous areas, the Working Group believed that, without use of appropriate mitigating measures, seabird by-catch was highly likely in fisheries monitored by IOTC, at least in the southern parts of its area. It urged IOTC and CCAMLR Members who are also members of IOTC to try to ensure that this topic receives serious attention at forthcoming IOTC meetings.

6.147 IATTC indicated that its observer program in the purse seine fishery has never documented the incidental catch of a seabird. IATTC has measures in place calling for the reduction of non-target catches which are not landed, but no impact on seabirds is noted given the lack of observations on seabird incidental catch.

6.148 As advised in the information provided by IATTC, the CCAMLR Secretariat requested information from the USA regarding its observer program of a pelagic longline fishery in the IATTC Convention Area. This information was provided (WG-FSA-02/39). The Working Group commended the example of an RFMO member establishing a voluntary observer program which collects information on seabird by-catch. It encouraged IATTC to establish observer programs in longline fisheries carried out within those parts of its area of responsibility which have risks of substantial associated seabird by-catch, including birds from the CCAMLR Convention Area.

6.149 The Science Officer reported that the response provided by SPC was very helpful. He had been informed in correspondence with members of IMAF that for some countries, however, the data holdings were not comprehensive.

6.150 Mr Smith informed the Working Group that the Standing Committee on Tuna and Billfish receives national reports that include non-target catch information, including seabird by-catch. This offers opportunities for sharing and exchanging relevant information with CCAMLR; the Working Group encouraged CCAMLR to pursue these opportunities.

6.151 To date, the CCAMLR Secretariat has not received responses to its seabird by-catch queries to FFA and CPPS.

6.152 With the entry into force of UNFSA in December 2001, it was noted that it is reasonable to anticipate an improved exchange of information between CCAMLR and other RFMOs on possible interactions between species for which CCAMLR is responsible and fisheries outside the Convention Area. UNFSA Articles 7 (‘Compatibility of Conservation Management Measures’) and 8 (‘Cooperation for Conservation and Management’) clearly mandate such improvement. In particular, UNFSA Article 8(6) provides for consultation between RFMOs, and through them with their members, on matters relating to living resources where management action may impact on measures already adopted by, or which are also within the competence of, more than one RFMO.

6.153 To promote this sharing of information, the Working Group requested that when CCAMLR Members submit seabird-related information to RFMOs, a courtesy copy should also be sent to CCAMLR.

6.154 The Working Group acknowledged the continuing importance of RFMOs in addressing seabird by-catch issues, particularly for distant water fleets. It encouraged the CCAMLR observers to these organisations to continue reporting on seabird-related activities and to press for inclusion of this seabird by-catch topic on RFMO agendas. This international collaboration is vital to addressing the identified threat to albatrosses and petrels of longline fishing activity in areas adjacent to the Convention Area.

6.155 The Working Group was pleased to learn that Chile is continuing to pursue submission of a proposal to the Fisheries Working Group of the Asia-Pacific Economic Cooperation (APEC) to address seabird by-catch issues in the longline fisheries. This proposal was initially discussed by several participants at IFF1 in 2000; support was noted from Australia, New Zealand and the USA.

Other International Organisations and Initiatives, including Non-governmental Organisations

6.156 Ms Molloy reported on the formation of Southern Seabird Solutions – a new alliance of government, fishing industry and environmental groups within New Zealand – created to work cooperatively with other countries on solving the incidental capture of birds. Southern Seabird Solutions members include pelagic and demersal longline skippers, fishing company managers, fishery skills trainers, ecotourism operators, international and national policy experts, environmental campaigners and communication experts. The group had recognised a critical need to accelerate progress on solving the issue within New Zealand.

6.157 The Working Group noted that Southern Seabird Solutions is addressing the by-catch issue of albatrosses and petrels that breed in the Convention Area and commended the group for its efforts. This multi-group initiative could represent a model for the effective implementation of regional efforts to address seabird by-catch. The Working Group commended New Zealand for establishing this innovative group.

6.158 Ms Molloy reported that the International Coalition of Fisheries Associations (ICFA) adopted a resolution at its annual meeting in September 2002 that supports the efforts of Southern Seabird Solutions including the development and adoption of industry driven Codes of Practice that provide practical ways to avoid seabird capture.

6.159 Dr Nel reported that the BirdLife International Seabird Conservation Programme has several ongoing activities of note that relate to albatrosses and petrels that breed in the Convention Area:

(i) regional workshops that focus on sharing technical and practical information on which mitigation methods work best and ways to further reduce seabird by-catch and improve fishing efficiency (a South American workshop recently held in Uruguay and an Asian-focused workshop being planned in Taiwan);

(ii) incentive programs to promote the development of more seabird-friendly fishing methods and raise awareness; and

(iii) participate in the development of various databases for the estimation of global by-catch levels for at-risk seabird species and for GIS satellite-tracking information on Procellariiformes.

National Initiatives

6.160 The USA reported on various aspects of its NPOA implementation (WG-FSA-02/50) which may be of interest to CCAMLR, including:

(i) revisions being made to regulations for Alaskan demersal longline fishers that call for the use of paired streamer lines with a specified areal coverage (paragraphs 6.72 to 6.74); and

(ii) promotion of IPOA-Seabirds implementation and NPOA development through bilateral fisheries meetings, intergovernmental communications with 23 longline nations (and entities) and participation in meetings of RFMOs.

6.161 Last year the Working Group received reports on recent developments in the use of video monitoring and urged Members to report on such developments and any trials undertaken (SC-CAMLR-XX, Annex 5, paragraphs 7.100 to 7.103). The USA reported on two current initiatives (WG-FSA-02/72) to evaluate the effectiveness of video technology to monitor seabird interactions on vessels. One is a collaboration with the International Pacific Halibut Commission (IPHC) to assess the feasibility of: (i) monitoring compliance with regulated use of bird avoidance devices, and (ii) detecting and identifying seabirds that are incidentally taken during longline fishing operations. Preliminary results suggest that it is possible to detect the seabirds coming up on the longlines and to differentiate between certain species groups (albatrosses can be differentiated from fulmars and shearwaters). The second initiative is a collaboration with Archipelago Research of British Columbia in Canada, a company with extensive experience of developing video monitoring applications in commercial fishery venues. The focus of this second project is to evaluate the feasibility of using video technology to detect and identify interactions of seabirds with trawl fishing operations. Results will be reported to WG-IMAF once they are available.

Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries

Assessment of Risk in CCAMLR Subareas and Divisions

6.162 As in previous years, the Working Group assessed the numerous proposals for new fisheries and the potential for these new and exploratory fisheries to lead to substantial increases in seabird incidental mortality.

6.163 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; and
(iii) magnitude of general potential risk of by-catch of albatrosses and petrels.

6.164 Comprehensive assessments on 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 previously combined into a background document for use by the Scientific Committee and the Commission (last year this was SC-CAMLR-XX/BG/11 Rev. 2).

6.165 This year new data on at-sea distribution of albatrosses and petrels from satellite-tracking and other studies was provided in WG-FSA-02/18. This information was used to update the assessment of potential risk of interaction between seabirds and longline fisheries for Subareas 48.1 and 88.3. Other changes were made to the advice provided for conservation measures that should be applied to all statistical areas. These largely reflect operational procedures for high-latitude areas, now accepted by CCAMLR and currently embodied in Conservation Measure 216/XX. These areas have been previously assessed as having a low to average risk of potential interaction between seabirds, especially albatrosses, and longline fisheries. Relevant subareas and divisions are 48.1, 48.2, 48.4, 48.5, 48.6, 58.4.1, 58.4.2, 58.4.3, 58.4.4, 88.1, 88.2 and 88.3. The revised assessments incorporating new information made available at the meeting (with changes/additions underlined) have been issued as SC-CAMLR-XX/BG/21.

New and Exploratory Longline Fisheries Operational in 2001/02

6.166 Of the 24 proposals last year for new and exploratory longline fisheries in seven subareas and divisions, only two were actually undertaken: by New Zealand in Subareas 88.1 and 88.2.

6.167 No seabird by-catch was reported to have been observed in any of these fisheries. Clearly the strict adherence in Subareas 88.1 and 88.2 to the specific requirements set out in Conservation Measure 216/XX with respect to line-weighting regimes, combined with fishing in areas of average-to-low, and average risk, has proven successful in achieving zero incidental by-catch of seabirds.

New and Exploratory Fisheries Proposed for 2002/03

6.168 The areas for which proposals for new and exploratory longline fisheries were received by CCAMLR in 2002 were:

Subarea 48.6 (north of 60°S)	South Africa
Subarea 48.6	Japan, New Zealand
Division 58.4.2	Australia
Division 58.4.3a	Australia, Japan
Division 58.4.3b	Australia, Japan
Division 58.4.4	Japan, South Africa
Division 58.5.2	Australia
Subarea 58.6	Japan, South Africa
Subarea 88.1	Japan, New Zealand, Russia, South Africa, Spain
Subarea 88.2	Japan, New Zealand, Russia.

6.169 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 paragraphs 6.163 and 6.165, and SC-CAMLR-XX/BG/11 Rev. 2. A summary of risk level, risk assessment, IMAF recommendations relating to fishing season and any inconsistencies between these and the proposals for new and exploratory longline fisheries in 2002, is set out in Table 6.9.

6.170 The only obvious inconsistency needing resolution (highlighted in Table 6.9), was that Russian proposals for Subareas 88.1 and 88.2 did not specify their intent to comply with Conservation Measure 235/XX.

6.171 In previous years, fishing proposals in exploratory fisheries in Subareas 48.6 (south of 60°S), 88.1 and 88.2 have received a derogation in respect of the requirement of Conservation Measure 29/XIX to set longlines at night. This exemption has been given providing that vessels complied fully with measures specified in Conservation Measure 216/XX, designed to ensure that a line sink rate of at least 0.3 m/s was achieved during daytime fishing operations.

6.172 To date all vessels fishing in the exploratory fisheries in Subareas 88.1 and 88.2 have experienced zero seabird mortalities. The Working Group believed that this result could be attributed largely to strict adherence to this requirement, although there is a need to exercise caution in this interpretation because seabird abundance and risk of incidental mortality is only low (risk level 1), or average to low (risk level 2), in the higher latitudes of Subareas 88.1 and 88.2.

6.173 Last year (SC-CAMLR-XX, Annex 5, paragraph 7.137) the Working Group agreed that this proven protocol could be extended to other vessels fishing experimentally in similar average-to-low risk areas (risk levels 1, 2 or 3). Accordingly, the Working Group recommended that the provisions of Conservation Measure 216/XX could be extended to exploratory fisheries proposed for Divisions 58.4.1, 58.4.3a, 58.4.3b and 58.4.4 in 2002/03. However, to extend this measure to higher-risk areas, such as Subarea 58.6, would be premature at this stage.

6.174 Setting longlines within the Convention Area during daylight hours using currently approved fishing gear still represents a risk for seabirds. In all instances where the provisions of Conservation Measure 216/XX 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 seabirds shall revert to night setting in accordance with Conservation Measure 29/XIX. Similar provisions were specified for the 2001/02 season in Conservation Measures 228/XX, 235/XX and 236/XX.

6.175 The Working Group noted that the proposal by Australia to fish in Division 58.4.2 during the breeding season of southern giant petrels may potentially pose a risk to the small populations of this species breeding in the area. The Australian proposal stated an intention to conduct line-weighting trials, and to adopt other mitigation measures such as the use of twin streamer lines and retention of offal. These provisions would exceed the requirements of Conservation Measure 29/XIX, and thus further reduce the potential for catching giant petrels during line setting. However, the potential for giant petrels to be caught during line hauling still remained, and the imposition of a total seabird catch of three seabirds during daylight operations would be an important element for managing incidental mortality in this fishery.

6.176 With respect to the prescription of a seabird by-catch level, the Working Group also noted there did not appear to exist a statement on the precise definition of the status of birds 'caught'. Accurate definition of this needs to be provided, *inter alia*, to assess more accurately in by-catch assessments the numbers of birds killed.

6.177 Agreement may also be needed on the level of observation necessary for accurate determination of the numbers of birds caught, specifically in relation to conservation measures which specify a limit on reaching which fishing should cease. This issue is clearly of relevance to fisheries where exemptions from elements of conservation measures have been made, dependent on prescribed performance criteria, as well as to other aspects of CCAMLR's work.

6.178 One approach would be to accept that full observer coverage (100% of hooks observed) would be required to reliably detect all birds caught. Thus if there was 100% coverage, a by-catch of three birds would be allowed. If observer coverage is less than 100%, we would expect that so long as it is greater or equal to about 25% over the course of a fishery, we could derive a reliable statistical estimate of the number of birds caught by a vessel over a season (paragraph 6.7). However, concern was expressed that levels of observer coverage less than 100% would not be sufficient to ensure a good estimate of birds. Therefore the by-catch limit would be prorated down if observer coverage was less. Taking into account that the by-catch should be set to integer birds, this would imply a limit of three birds for rates of observation of 100%, two birds for rates of 60–100% of hooks and one bird for rates of 25–60% of hooks. Once a cap has been reached at a certain level of coverage, daylight setting operations should cease. Coverage should not be increased to potentially meet a higher bird cap level.

Other Incidental Mortality

Interactions involving Marine Mammals with Longline Fishing Operations

6.179 There were no reports of marine mammal mortality associated with longline vessels.

6.180 Interactions with marine mammals, in which there was loss of fish, were reported from 73% of vessels fishing in Subarea 48.3 and 30% of vessels in Subareas 58.6/58.7 (WG-FSA-02/13 and summarised in Table 6.10 with comparison to previous years). However, the depth at which interactions with marine mammals occur means that direct observation of fish removal is often very difficult. While the quantification of the interactions is clearly problematic, all vessels operating in Subarea 48.3 provided anecdotal reports of reduced catches and/or damaged fish when large numbers of killer (*Orcinus orca*) and/or sperm (*Physeter catodon*) whales were present at the time of hauling.

6.181 No such interactions were reported for Subarea 88.1, despite sightings of killer whales from the fishing vessels on most cruises.

Interactions involving Marine Mammals and Seabirds with Trawl and Pot Fishing Operations

6.182 A single penguin was found dead in the net of a Japanese vessel fishing for krill in Subarea 48.2. Two Antarctic fur seals (*Arctocephalus gazella*) were released alive from a Japanese vessel fishing for krill in Subarea 48.3 (from Japan's Report of Member's Activities in 2001/02 as posted on the CCAMLR website).

6.183 The scientific observer recorded no incidental mortality associated with the single vessel (*Kinpo Maru No. 58*) that participated in the pot fishery for crabs in Subarea 48.3.

6.184 In respect of trawl fisheries for *C. gunnari* and *D. eleginoides* in Division 58.5.2 there was only one report of incidental mortality – that of a single southern elephant seal (*Mirounga leonina*) (WG-FSA-02/12).

6.185 In respect of trawl fisheries for *C. gunnari* in Subarea 48.3, there were no reports of marine mammal entanglement or incidental mortality.

6.186 The Working Group recollected that last year, in order to restrict seabird by-catch in this fishery to low levels, pending the collection of data to propose appropriate mitigation measures, the Commission decided that an interim precautionary seabird by-catch limit of 20 birds per vessel trawl fishing for icefish in Subarea 48.3 would be appropriate (CCAMLR-XX, paragraphs 6.38 and 6.39).

6.187 Last year a total of 132 seabird entanglements was reported, of which 92 were fatal, 40 birds being released alive (SC-CAMLR-XX, Annex 5, paragraph 8.5), by the five vessels engaged in this fishery.

6.188 This year, based on data from observer logbooks and supplementary material in the observer reports, a total of 125 seabird entanglements was reported, of which 73 were fatal and 52 birds were released alive (Table 6.11). The birds killed comprised 20 black-browed albatrosses, 52 white-chinned petrels and 1 Antarctic prion (*Pachyptila desolata*); the birds released comprised 13 black-browed albatrosses and 39 white-chinned petrels.

6.189 Two vessels (*In Sung Ho* and *Argos Vigo*) appeared to have reached the by-catch limit; a third vessel (*Robin M. Lee*) closely approached this limit.

6.190 The Working Group noted that the level of seabird mortality in the trawl fisheries for *C. gunnari* in Subarea 48.3 in 2002 was an order of magnitude greater than that in the regulated longline fishery in the same subarea.

6.191 Data from observer reports indicate that 25% of bird deaths in 2002 were recorded during setting; however, the Working Group noted that it was unlikely that birds captured during setting would be retained in the net until hauling.

6.192 There was no significant relationship between total fish catch and bird by-catch (r = -0.46, P < 0.05). The *Argos Vigo*, which had the equal greatest reported bird by-catch, fished for the shortest period of time and had the lowest fish catch (data from observer reports). The *Zakhar Sorokin* and the *Bonito* fished for a longer period and caught fewer birds than other vessels. Last year (SC-CAMLR-XX, Annex 5, paragraph 8.14) an indication was given that the operational characteristics of the *Zakhar Sorokin* may have contributed to its zero seabird by-catch in 2001; if these characteristics were maintained they may have contributed to its relatively low seabird by-catch in 2002.

6.193 Last year (SC-CAMLR-XX, Annex 5, paragraph 8.20) the Working Group requested that provision be made in the *Scientific Observers Manual* logbook data recording and reporting sheets and instructions to scientific observers, for recording:

(i) the nature and timing of offal discharge (noting that Conservation Measure 173/XVIII prohibits this during shooting and hauling of trawl gear);

(ii) the location, level and direction of deck lighting in use during hauling operations (for which recommendations are made in Conservation Measure 173/XVIII); and

(iii) any other details relevant to entanglement and mortality of seabirds, including video recording as feasible, together with suggestions as to how these could be avoided.

6.194 In addition, the Commission (CCAMLR-XX, paragraph 6.37) recommended that in respect of vessels trawl fishing for icefish in Subarea 48.3 in 2001/02:

(i) new data recording and reporting arrangements be put in place for scientific observers, to ensure that more data are available to investigate and resolve the causes of the problem; and

(ii) mitigating measures be tested with the aim of incorporating appropriate recommendations into Conservation Measure 173/XVIII.

6.195 Offal discharge during setting and hauling was recorded during a small number of hauls on the *Bonito* and *Argos Vigo* (Table 6.19). However, the amount of offal would be expected to be relatively small as the icefish catch was frozen whole. Information about deck lighting was received from three vessels and was consistent with safe vessel operation (Table 6.19). No video material accompanied any of the observer reports.

6.196 There were two scientific observers on board all vessels except the *Robin M. Lee*; however, the only vessel which indicated that there was a dedicated seabird observer was the *Argos Vigo*. The report from the *Argos Vigo* contained detailed information on observations of seabird interaction with nets during setting and hauling and of tests of mitigation measures.

6.197 Tests of mitigation measures conducted on the *Argos Vigo* included cable mitigation measures (consisting of two poles, 4 m in length, suspended from the A-frame, with streamers and bottles attached to produce a visible and audible deterrent). These measures may have reduced potential seabird interactions with trawl cables but they had limited impact on seabird interactions with nets, which generally occurred up to 150 m astern of the vessel. Ensuring that the net was cleaned of enmeshed fish prior to setting apparently made the net less attractive to birds; however, there were indications from other vessels that this made little difference to the level of seabird interactions, although this was not quantified. Scaring devices (fireworks) were also tested. Their deployment was restricted to the period of net hauling due to the limited number available. The average period that the net was at the surface during hauling was 26 minutes; deploying fireworks during this period dispersed feeding aggregations of seabirds for up to 7 minutes, but more often only for 1 minute.

6.198 Much of the mortality of the two main species involved, black-browed albatross and white-chinned petrel, arose as a result of seabirds diving into the net to obtain food and being unable to escape. As reported last year (SC-CAMLR-XX, Annex 5, paragraph 8.11) seabirds were primarily caught in the large mesh at the wings and mouth of the net. There was no reported mortality associated with seabirds colliding with warps; however, observation of seabird interactions with trawl vessels in Subarea 48.3 was primarily directed towards setting and hauling nets, rather than to trawl warp interactions. It is apparent from other studies of seabird interaction with trawl vessels that detection of particular incidents, such as impact with trawl warps, is likely to go unreported unless there is specific observation of warps during the period of fishing (WG-FSA-02/36 and 02/59).

6.199 WG-FSA-02/36 reported the results of a detailed investigation of seabird mortality associated with trawl fishing around the Falkland/Malvinas Islands. All the seabird mortality (mainly of black-browed albatrosses and giant petrels) occurred as a result of collisions with trawl warps, especially when birds became entangled with warp splices. There were no records of seabirds caught in the net; however, the mesh size of the mouth of the net was 120–140 mm compared to a 400 mm mesh width at the mouth of the nets used in the trawl fishery for icefish in Subarea 48.3.

6.200 Last year (SC-CAMLR-XX, Annex 5, paragraph 8.12) the Working Group indicated that high seabird by-catches might be related to specific aspects of vessels or fishing operations. This year's data indicate that all vessels operating in the fishery caught seabirds; of the three that did so in substantial numbers, two were new to the fishery and catch levels of the third (*Argos Vigo*) were similar to last year.

6.201 Mr Williams indicated that the trawl fishery for icefish in Division 58.5.2 did not experience a similar by-catch of seabirds (see also SC-CAMLR-XX, paragraph 4.82). He noted that the vessels operating in this fishery had fish meal plants on board and did not discharge offal, making them much less attractive as a source of food for seabirds. In addition, vessels used bottom trawl gear that is heavier, has a smaller mesh at the mouth and is present at the surface for a much shorter period of time than the midwater trawl gear used in Subarea 48.3.

6.202 It was noted that the use of bottom trawls is currently prohibited in Subarea 48.3 (Conservation Measure 219/XX). It may be appropriate to reconsider whether it is bottom trawling which was intended to be prohibited and whether the use of bottom trawl gear, fished off the bottom, might be permitted, under appropriate conditions.

6.203 It was suggested that the high seabird by-catches in Subarea 48.3 might reflect the much higher densities of breeding seabirds around South Georgia than in other areas where icefish are fished. However, this was not supported by experiences with high densities of seabirds associated with trawling operations elsewhere in the Convention Area and in adjacent areas.

6.204 On the basis of the discussion, the Working Group advised that the by-catch of seabirds associated with the icefish trawl fishery in Subarea 48.3 was likely related to the nature of the fishing gear, especially midwater trawls, being used. It recommended that this be investigated further by continuing the work recommended by the Commission last year (CCAMLR-XX, paragraph 6.37).

6.205 The Working Group recommended investigation into the effect of season and densities of seabirds on incidental mortality rates associated with trawling operations. Technical coordinators were asked to facilitate the collection of these data wherever possible.

6.206 The Working Group noted the comments of the Scientific Committee concerning the potential closure of the icefish fishery during critical periods, as specified for the longline fishery, in relation to reducing the levels of seabird by-catch (SC-CAMLR-XX, paragraph 4.90). It recognised that its evaluation of the problem was not complete. However, it recommended that unless the levels of seabird by-catch in the icefish fishery could be more effectively mitigated, consideration should be given to restricting the fishing season, at least during the main chick-rearing period of black-browed albatrosses and white-chinned petrels (January–April).

6.207 The Working Group also noted that as most seabirds captured during setting are unlikely to be recorded at hauling (see paragraph 6.191), some birds killed at hauling are not brought onto the vessel and that a proportion of the birds released alive have injuries prejudicial to their survival, it is necessary to define precisely what is meant by the number of birds caught (paragraph 6.176) and to take account of this in any review of the seabird by-catch limit.

6.208 It would also be necessary to make appropriate provision in the *Scientific Observers Manual* logbook data recording and reporting forms, and instructions to scientific observers, for distinguishing birds landed alive but with potentially fatal injuries from those released alive with no or minor injury (paragraph 6.16).

Advice to the Scientific Committee

General

6.209 The plan of intersessional work (Appendix D) summarises requests to Members and others for information of relevance to the work of the Working Group (paragraphs 6.1 to 6.3). 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 6.4).

Incidental Mortality of Seabirds during Regulated Longline Fishing in the Convention Area in 2002

6.210 (i) For Subarea 48.3 the total estimated seabird by-catch in 2002 was only 27 birds at a rate of 0.0015 birds/thousand hooks, very similar to the values of the last two years (paragraph 6.9).

(ii) No observed seabird by-catch was reported from within the South African EEZs in Subareas 58.6 and 58.7, a substantial reduction from the estimated 199 birds last year (paragraph 6.10). The causes of this marked improvement are unknown, although fishing effort was greatly reduced (paragraphs 6.11 and 6.12).

(iii) No incidental mortality of seabirds was observed in Subarea 88.1 for the fourth successive year, due to strict compliance with conservation measures (paragraph 6.13).

6.211 (i) No data were reported from longline fishing within the French EEZs in Subarea 58.6 and Division 58.5.1 in 2002; some data for the 2000 and 2001 seasons, when very high rates of seabird by-catch occurred, had recently been supplied to the Secretariat (paragraphs 6.14 and 6.15).

(ii) Submission to CCAMLR of 2002 data was requested, together with submission of 2003 data in time for analysis and evaluation at WG-IMAF (paragraph 6.14).

Compliance with Conservation Measure 29/XIX

6.212 (i) Overall compliance with this conservation measure this year, compared to last year, was substantially improved in all subareas and divisions and was again complete in Subarea 88.1. Elsewhere, one vessel fully complied with all elements of this measure at all times and eight other vessels were within 95% of the minimum requirements of all elements (paragraph 6.28).

(ii) Streamer lines – compliance with streamer line design was 86% compared with 66% last year (paragraph 6.18). In Subareas 58.6, 58.7, 88.1 and 88.2 all vessels used streamer lines on all sets; in Subarea 48.3 only four of 15 vessels did so.

(iii) Offal discharge – all vessels complied with the requirement either to hold offal on board, or to discharge on the opposite side to where the line was hauled. Only one vessel was observed to discharge offal during setting (paragraph 6.20).

(iv) Night setting – in Subarea 48.3 compliance improved from 95% last season to 99%; in Subareas 58.6 and 58.7 it improved from 78% to 99% (paragraph 6.21).

(v) Line weighting (Spanish system) – appropriate weighting was used in 63% and 66% of cruises in Subareas 48.3 and 58.6/58.7 respectively, compared with 21% and 18% in 2001 and zero in 2000 (paragraph 6.24).

(vi) Line weighting (autoline system) – the requirement to achieve a line sink rate of 0.3 m/s when fishing in daylight in Subareas 88.1 and 88.2 south of 65°S was met by both vessels (paragraph 6.26).

6.213 The Working Group again recommended that vessels which do not comply with all elements of Conservation Measure 29/XIX should be prohibited from fishing in the CCAMLR Convention Area (paragraphs 6.25 and 6.29).

Fishing Seasons

6.214 On the basis of the data for the 2001/02 fishing season in Subarea 48.3, seabird by-catch levels were very low (negligible in terms of the population dynamics of the species concerned), for the third successive season. Full compliance with Conservation Measure 29/XIX was only achieved by one vessel (paragraph 6.31). Recommendations relating to potential future extensions to the fishing season for Subarea 48.3 are provided in paragraphs 6.37 and 6.38 and discussed in paragraphs 6.39 to 6.46. Full compliance by all vessels should readily be achievable next year with small improvements to operational practice.

Research into and Experiences with Mitigating Measures

6.215 (i) Line weighting – significant progress is reported with the development of integrated weights for autoline vessels in achieving the sink rates required under Conservation Measure 216/XX; tests under operational conditions are due in November 2002 (paragraphs 6.50 and 6.51).

(ii) Underwater setting – tests of the chute were successful in the Hawaiian pelagic longline fishery but less so, at least as a sole mitigation measure, in the Australian demersal tuna fishery. Development of the underwater setting capsule continues (paragraphs 6.60 to 6.64).

(iii) Offal discharge – offal retention should be carried out whenever practicable (paragraph 6.66); appropriate scupper screens should be used at all times (paragraph 6.65); hooks should be removed from fish heads, fish offal and fish by-catch prior to their discard (paragraphs 6.67 to 6.69); a bounty scheme for retaining hooks was commended (paragraph 6.70).

(iv) Streamer lines – it is recommended, based on successful experiences outside the Convention Area, that paired streamer lines and boom-and-bridle design streamer lines should be used in the Convention Area (paragraphs 6.71 to 6.75).

(v) General – advice is provided on issues of particular importance for mitigating seabird by-catch, that should be taken into account when new longline vessels are built; information is sought from France on the relevant design specifications of their five new vessels (paragraphs 6.84 and 6.85).

6.216 The key experiment designed to determine the effectiveness of mitigation measures (either singly or in combination) for the Spanish method of longline fishing was developed, costed and submitted, with only limited success, to more than 50 funding organisations. Members were again encouraged to support this important experiment (paragraph 6.34).

Revision of Conservation Measure 216/XX

6.217 Based on its successful use last year, specific advice is provided for a minor revision to the bottle test element of this measure (paragraphs 6.56, 6.57 and 6.81).

Revision of Conservation Measure 29/XIX

6.218 Full proposals for revision of several elements of this measure (those relating to streamer lines, line weighting for autoliners and hooks in offal) are likely to be developed next year; some specific indications are given together with recommendations for data collection (paragraphs 6.68, 6.69, 6.82 and 6.83).

Assessment of Incidental Mortality of Seabirds during IUU Longline Fishing in the Convention Area

6.219 (i) The estimates of potential seabird by-catch by area for 2002 (SC-CAMLR-XXI/BG/23) were:

Subarea 48.3:	10–20 to 50–70 seabirds;
Subareas 58.6 and 58.7:	5 900–8 000 to 10 800–14 400 seabirds;
Divisions 58.5.1 and 58.5.2:	24 300–32 600 to 43 900–59 100 seabirds;
Division 58.4.4:	8 100–10 900 to 14 700–19 700 seabirds; and
Subarea 88.1:	100–200 seabirds.

(ii) The overall estimated totals for the whole Convention Area (paragraph 6.96) indicate a potential seabird by-catch in the unregulated fishery of 39 000–52 000 (lower level) to 70 000–93 000 birds (higher level) in 2001/02. This is broadly consistent with values from previous years (Figure 6.2; SC-CAMLR-XXI/BG/23).

(iii) Since 1996 the overall total estimated potential seabird by-catch is 278 000–700 000 seabirds, comprising 74 000–144 000 albatrosses, 13 000–24 000 giant petrels and 203 000–378 000 white-chinned petrels (paragraph 6.99).

(iv) The Working Group endorsed its conclusions of recent years that such levels of mortality remain entirely unsustainable for the populations of albatrosses, giant petrels and white-chinned petrels breeding in the Convention Area (paragraph 6.100), many of which are declining at rates where extinction is possible.

(v) The Working Group recommended that the Commission take even more stringent measures to combat IUU fishing in the Convention Area (paragraph 6.101).

Incidental Mortality of Seabirds during Longline Fishing
outside the Convention Area

6.220 (i) Reports were received from Argentina, Chile, Falkland/Malvinas Islands, South Africa and Uruguay on levels of seabird by-catch observed in longline fisheries operating in areas adjacent to the Convention Area (paragraphs 6.103 to 6.107).

(ii) A review of the spatio–temporal trends of longline fishing efforts in the Southern Ocean concluded that a combination of the consistently high effort (250 million hooks per annum) in the regulated fisheries and the substantial increase in IUU fishing, threatens the long-term viability of many Southern Ocean seabird species (paragraph 6.108).

(iii) The Working Group recommended that responses continue to be sought on seabird by-catch levels, mitigation measures in use (and whether voluntary or mandatory) and observer programs from all Members and other countries conducting or permitting longline fishing in areas where seabirds from the CCAMLR Convention Area are killed (paragraph 6.109).

Research into the Status and Distribution of Seabirds at Risk

6.221 Submitted data on:

(i) size and trends of populations of albatross species and of *Macronectes* and *Procellaria* petrels vulnerable to interactions with longline fisheries;

(ii) the foraging ranges of populations of these species adequate to assess overlap with areas used by longline fisheries; and

(iii) genetic research relevant to determining the origin of birds killed in longline fisheries;

are still insufficient for a comprehensive review of these topics. All Members are requested to submit relevant data to next year's meeting (paragraphs 6.110 and 6.112 to 6.115).

6.222 Important results from submitted information on the above topics are:

(i) potential increases in the population of black-browed albatrosses at Heard Island over the last 50 years (paragraph 6.116);

(ii) survival rates of adult wandering albatrosses breeding at Marion Island were negatively correlated with the Japanese longline fishing effort in the Southern Ocean (paragraph 6.117);

(iii) extensive data from recent research on albatrosses at breeding sites in Chile, establishing baseline population data and showing that birds forage in the Convention Area at certain times of year. Black-browed albatrosses are at particular risk from domestic toothfish longline fisheries (paragraphs 6.118 to 6.121); and

(iv) studies of population size, trends and foraging ranges are still inadequate for many seabird species in the Convention Area threatened by longline fishing mortality, especially white-chinned petrels (paragraph 6.122).

6.223 Members are requested to provide information on the extent and location of their seabird by-catch collections to facilitate the development of collaborative research to investigate the origins of birds killed (paragraphs 6.125 and 6.126).

International and National Initiatives relating to Incidental Mortality of Seabirds in relation to Longline Fishing

6.224 Information was reported on important new international initiatives under the auspices of:

(i) IFF2 – meeting in Hawaii, USA, in November 2002 (paragraphs 6.127 to 6.129);

(ii) ACAP – potential entry into force during 2003 (paragraphs 6.130 to 6.134); and

(iii) FAO-NPOAs – noting rather limited progress in development and even more so in implementation; Members reporting on implementation to COFI in February 2003 are requested also to report to CCAMLR (paragraphs 6.135 to 6.138).

6.225 Recollecting 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 made a particular effort to contact intersessionally all relevant RFMOs (paragraphs 6.140 and 6.141):

(i) CCSBT – report from November 2001 meeting still not released (paragraph 6.142);

(ii) ICCAT – no direct response but three draft resolutions relating to seabird by-catch may be discussed at the November 2002 meeting; Members encouraged to support strongest possible resolution (paragraphs 6.143 and 6.144);

(iii) IOTC – reported no evidence of seabird by-catch; however the Working Group noted extensive overlap of at-risk seabirds with longline fisheries in the southern part of the IOTC area (paragraphs 6.145 and 6.146); and

(iv) IATTC – no relevant data available; based on a US example, recommended establishment of observer programs in areas where Convention Area birds are likely to be caught (paragraphs 6.147 and 6.148).

6.226 To assist in fulfilling obligations under the newly ratified UNFSA, Members were requested to copy to CCAMLR submissions of relevant data and information to RFMOs (paragraphs 6.152 and 6.153).

6.227 The Working Group encouraged CCAMLR observers to RFMOs to continue reporting on seabird-related activities and to press for inclusion of this seabird by-catch topic on RFMO agendas (paragraph 6.154).

6.228 The Working Group commended recent initiatives addressing by-catch issues of albatrosses and petrels breeding in the Convention Area by New Zealand, USA and BirdLife International (paragraphs 6.156 to 6.161).

Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries

6.229 (i) Of the 24 exploratory longline fisheries approved for 2001/02, only two, in Subareas 88.1 and 88.2, were operational; no seabird by-catch was reported in either of these fisheries (paragraphs 6.166 and 6.167).

(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 in SC-CAMLR-XXI/BG/21. There were no changes to this advice in relation to levels of risk of seabird by-catch for any part of the Convention Area. However, the potential for exemptions for daylight setting in areas of lower risk to seabirds has been incorporated into the advice (paragraphs 6.171 to 6.174).

(iii) The 21 proposals by five Members for new and exploratory longline fisheries in eight subareas/divisions of the Convention Area in 2002/03 were addressed, in relation to advice, in SC-CAMLR-XXI/BG/21 and Table 6.9 (paragraphs 6.168 and 6.169).

(iv) The only potential problems apparently needing resolving (Table 6.9 and paragraphs 6.170 and 6.176 to 6.178) are:

(a) to check that Russia intends to comply with Conservation Measure 236/XX in Subareas 88.1 and 88.2;

(b) the need to define the nature and status of birds caught, in relation to the limits on seabird by-catch (paragraph 6.176); and

(c) the potential need to specify appropriate levels of observation to detect accurately low levels of bird by-catch (paragraphs 6.177 and 6.178).

Other Incidental Mortality

6.230 (i) In the Convention Area in 2002, there were no reports of marine mammal mortality in the longline fishery; one southern elephant seal was reported killed by a trawl vessel in Division 58.5.2 (paragraphs 6.179 and 6.184).

(ii) A single penguin was found dead in the net of a krill trawler in Subarea 48.2 (paragraph 6.182).

6.231 No instances of incidental mortality of marine mammals or seabirds had been recorded in the pot fishery for crabs in Subarea 48.3 in 2002 (paragraph 6.183).

6.232 (i) In trawl fishing for icefish in Subarea 48.3, 125 seabirds were entangled, at least 73 fatally, a total an order of magnitude greater than the reported total seabird by-catch mortality for all regulated longline fishing in Subarea 48.3 in 2002 (paragraphs 6.185 to 6.190).

(ii) All vessels engaged in the fishery caught seabirds; detailed observations indicate that seabirds were caught when they became entangled in the large mesh at the mouth of the midwater trawls (paragraphs 6.198 and 6.200).

(iii) Despite vessel-specific differences in levels of seabird by-catch the problem mainly appears to be gear-related and associated with the use of midwater trawls during the period December–March in Subarea 48.3 (paragraphs 6.199, 6.201 and 6.204).

6.233 The Working Group recommended that:

(i) further data be collected to try to define appropriate mitigating measures for the icefish trawl fisheries in Subarea 48.3, continuing the work recommended by the Commission last year (paragraph 6.204);

(ii) unless the levels of seabird by-catch in the icefish fishery can be more effectively mitigated, consideration should be given to restricting the fishing season, at least during the main chick-rearing period of black-browed albatrosses and white-chinned petrels (January–April) (paragraph 6.206);

(iii) it may be appropriate to reconsider whether Conservation Measure 219/XX seeks specifically to prohibit bottom trawling or the use of bottom trawl gear in Subarea 48.3 and whether the use of bottom trawl gear might be permitted under appropriate circumstances (paragraph 6.202); and

(iv) it is necessary to define precisely what is meant by the number of birds caught and to take account of this in any review of the seabird by-catch limit (paragraph 6.207).

BIOLOGY, ECOLOGY AND DEMOGRAPHY OF TARGET AND BY-CATCH SPECIES

7.1 A summary of papers submitted to WG-FSA dealing with aspects of the biology, demography or ecology of fish or invertebrates of interest to the Working Group is contained in SC-CAMLR-XXI-BG/27.

7.2 The Working Group welcomed the large number of contributions on a wide range of subjects. A number of contributions dealt with the biology of the important by-catch groups skates and rays and macrourids. These provided the basis to make a first attempt to determine some important parameters for some species and areas, but the parameters need refinement in most cases. Members were encouraged to continue to collect biological data on by-catch species. In particular, information on biomass of the important species is needed for the calculation of potential yield.

7.3 Length data for macrourids was still in some cases being recorded as total length, even though WG-FSA has recommended for several years that pre-anal length be recorded. Members are reminded to reiterate this instruction to their observers. The Working Group also felt that more information on invertebrate by-catch would be useful, particularly for those groups likely to be most affected by the fisheries. Specific examples are large sponges.

7.4 Several other papers dealt with age, growth, movements and reproductive biology of the target species *D. eleginoides*, *D. mawsoni* and *C. gunnari*. A number of laboratories have compared readings of otoliths of *D. eleginoides* under the CCAMLR Otolith Network (CON), and it is encouraging that differences in readings are generally small. However, an inherent bias may also be associated with identifying the age of the first annulus. It is important to resolve these biases especially when the age bracket in the important models used in assessments only spans about 10 years. It is important to understand why such a discrepancy exists and to resolve it.

7.5 The Working Group thanked those who have participated in CON and encouraged the continuation of this important work. It also recognised the need to establish criteria to decide at what stage the ageing techniques would be considered satisfactory. Even after this point is reached, CON will still be necessary to ensure proper quality control of the various readers.

7.6 Considerable progress has been made towards the validation of otolith ageing in *D. mawsoni*, however there is still a need to confirm growth zones in fish aged 3 to 10 years (WG-FSA-02/33). The Working Group encouraged further work on the validation of toothfish ageing for both species such as the use of otolith marking compounds in conjunction with tagging experiments, and comparison with length-frequency distributions in young fish.

7.7 Icefish otoliths were exchanged between laboratories following recommendations by WG-FSA in 2001 (SC-CAMLR-XX, Annex 5, paragraph 4.201). The preliminary results of these exchanges are outlined in WG-FSA-02/57. It was concluded that there were structures visible in the otoliths that might be used for age determination. Such a topic might be investigated through a practical workshop meeting. Dr Gasiukov noted that further whole otolith samples had been sent to Instituto Español de Oceanografía, Tenerife, Spain, for reading. Initial results suggest that there is great variability in age readings between institutes. It was recommended that the otolith exchange program should continue intersessionally involving laboratories currently involved in CON. Several of the issues which have been addressed for ageing *D. eleginoides* need to be assessed for icefish otoliths. Of particular importance are an assessment of the use of different otolith preparation methods, between-reader variability and inter-laboratory variability. The need for validation studies was also highlighted.

7.8 A significant decline in the condition of *D. mawsoni* in Subarea 88.1 was observed leading up to the spawning season in May. This had not been documented in *Dissostichus* spp. before and the Working Group encouraged observers to look out for this phenomenon in other fisheries for these species.

CONSIDERATIONS OF ECOSYSTEM MANAGEMENT

Interactions with WG-EMM

8.1 Last year, the Workshop on Approaches to the Management of Icefish requested that WG-EMM consider the importance of *C. gunnari* to predators in the Antarctic ecosystem in order to evaluate the escapement of *C. gunnari* required from the fishery to provide for predators (SC-CAMLR-XX, Annex 5, Appendix D, paragraph 8.7).

8.2 WG-EMM noted that information on the importance of *C. gunnari* to predators might be used to estimate a desired escapement. Along these lines, WG-EMM had noted that the 'species profile' of *C. gunnari* would also be useful for building models that describe the role of this fish in the ecosystem. Ultimately, a model that describes the role of *C. gunnari* in the ecosystem will need to examine the effects of fishing for both krill and the fish itself, and this will require collaborative work between WG-EMM and WG-FSA (Annex 4, paragraph 3.100).

8.3 Prof. Croxall noted that, in the context of the CEMP review, WG-EMM was requesting information regarding the potential suitability of icefish as an indicator species for CEMP. In addition, it would wish to consider any attributes of icefish which might be used to distinguish between changes due to natural and harvest-induced effects. Members of WG-FSA were encouraged to supply any relevant data in time for the WG-EMM meeting next year.

8.4 The Working Group noted that in two years' time WG-EMM will be focussing on food-web and trophic interaction models. It would be useful to identify the types and amounts of data (e.g. data pertaining to stock structure, production, distribution etc.) which would benefit the work of WG-EMM and to identify any potential products from the work of WG-EMM which would be of use to WG-FSA.

8.5 Therefore the Working Group agreed there is a need for additional discussions among WG-FSA members and members of WG-EMM.

8.6 WG-EMM also noted that time-series data are available for icefish (e.g. survey estimates of biomass), and these data might be useful in expanding the scope of CEMP to consider predator–prey interactions based on species other than krill and for furthering the work of the CEMP review (Annex 4, paragraph 3.101). The Working Group noted there exist data from Subareas 48.1, 48.2 and 48.3 and Division 58.5.2 which may provide icefish time series.

8.7 WG-EMM noted the proposal (WG-EMM-02/24) that the original invitation from the World Fisheries Congress (WFC) to Prof. I. Boyd (UK) to lead a session on 'Reconciling Fisheries with Conservation in the Antarctic' (Vancouver, Canada, 2 to 6 May 2004) might be extended to enable greater potential participation by CCAMLR scientists. WG-EMM agreed with this proposal and recommended that the conveners of WG-EMM and WG-FSA should join Prof. Boyd as co-leaders of this session. The Working Group concurred with this and recommended that CCAMLR should publicise the existence of this session at the WFC as an important opportunity to present CCAMLR science and management in a global context (Annex 4, paragraphs 7.1 to 7.4). Dr Everson noted that abstracts needed to be submitted by April 2003 to be considered for oral presentations.

8.8 From 7 to 15 August 2002, WG-EMM conducted a Workshop on Small-Scale Management Units, such as Predator Units (Annex 4, Appendix D). The distribution and indices of abundance of predators were used to help determine centres of foraging activity in the South Atlantic. These included four main groups of krill predators: Antarctic fur seals, penguins including macaroni, gentoo, chinstrap and Adélie, black-browed albatrosses and krill-eating fish species. The spatial distribution and abundance of krill-eating finfish biomass on shelf regions in Area 48 was assessed using data obtained from a recent research trawl survey conducted by the US AMLR Program in the South Shetland Islands (1998, 2001) and the South Orkney Islands (2000), and from Russian and UK surveys around South Georgia (2000) (Annex 4, Appendix D, paragraphs 4.7 to 4.13). These were used to define potential small-scale management units.

8.9 The Interim Steering Committee for the CEMP Review was convened by Prof. Croxall on 3 August 2002 (Annex 4, Appendix E). The Steering Committee noted that long-term data on icefish, particularly from studies in the South Georgia region, would be a valuable contribution to the workshop. Prof. Croxall would consult with Dr Everson, the author of the WG-FSA profile of this species, to determine which were the most useful data to have available for analysis at the workshop (Annex 4, Appendix E, paragraph 48). The Steering Committee also agreed to request WG-FSA to recommend any time-series data which might be suitable for the purposes of the 2003 workshop (Annex 4, Appendix E, paragraph 56 and Attachment 4, item 18).

FUTURE ASSESSMENTS

9.1 The Working Group used the report on intersessional work of the Subgroup on Assessment Methods (WG-FSA-02/80) as a basis for discussion of work on future assessments. It agreed that the main points for discussion concerned: (i) the preparation for assessments in 2003, (ii) the development of an agenda of intersessional work on assessment methods including the potential for holding an intersessional meeting of the subgroup, (iii) the means by which assessment methods might be introduced and adopted by the Working Group for use in its annual assessments, and (iv) a timetable of intersessional work leading up to the 2003 meeting of the Working Group.

9.2 The Working Group agreed that the outline provided in pages 3 to 14 of WG-FSA-02/80 was a useful contribution to planning assessment work for the meeting. As such, the Working Group requested the Subgroup on Assessment Methods to continue to provide such an outline of available assessment methods, data and other information in time for use by the Working Group next year. It was agreed that attempts should be made to compile this information well in advance of the meeting through circulars to members of the Working Group. The Working Group also asked the subgroup to continue the development of descriptions of the standard methods used by the Working Group as this is an important adjunct to this work.

9.3 In discussing the intersessional work plan of the Subgroup on Assessment Methods, the Working Group agreed that establishing an active correspondence group combined with the potential for holding an intersessional meeting of the subgroup would provide the opportunities not currently available for developing assessment methods for use by the Working Group. It was agreed that such a format might also allow the involvement of other specialists in this work without the necessity for attending the meeting of WG-FSA.

9.4 The Working Group agreed that an intersessional meeting of the subgroup of between 10 to 20 participants for four days would be a valuable step in this process. Notification of such a meeting would need to be made to the whole Working Group well in advance of the meeting. It was agreed that the timing of such a meeting was likely to be best adjacent to, probably before, WG-EMM. The Working Group noted that a host would need to be found for a meeting of this kind but also noted that there would be no expectation of the host to provide computing facilities and Secretariat support and that the subgroup would be relatively self sufficient. The Working Group also noted that the meeting would not require Secretariat support in terms of organisation or preparation of the report during the meeting. It was agreed that the report of such a meeting would be compiled and adopted by correspondence following the meeting. It was also noted that the outcomes of the work of the subgroup would need to be endorsed by the Working Group before implementation of recommendations could be accepted as outcomes of the Working Group.

9.5 With regard to the agenda of work of the subgroup, the Working Group agreed that it was important for the subgroup to begin examining and evaluating alternative methods of assessment and to determine what methods might be used for estimating stock status of toothfish, taking account of the difficulties the Working Group has had in the past of estimating stock status and applying short-term assessment methods. In this respect, the Working Group endorsed the work plan on pages 15 to 17 of WG-FSA-02/80 and agreed that assessments of stock status for toothfish remain to be developed and need to be added to the work plan. Also, recent published work indicates that the subgroup needs to include an evaluation of the use of the delta lognormal distribution in the mixture analyses (CMIX) and estimation of abundance from trawl surveys (TRAWLCI) (Annex 4, paragraphs 5.39 and 5.40). The Working Group noted that a number of methods and software are available to other fisheries assessment bodies and that the subgroup is encouraged to identify and evaluate candidate methods and software that could be used by WG-FSA.

9.6 The Working Group welcomed the discussion in the subgroup report (pages 18 to 24, WG-FSA-02/80) on an evaluation framework in which assessment methods could be evaluated and developed to meet the operational objectives of the Commission. It agreed that the subgroup needs to consider and evaluate appropriate candidate methods for assessments and that it would be difficult to develop a single simulation environment for testing these methods. The Working Group encouraged Members to provide evaluations of candidate methods that demonstrate the robustness of these methods to uncertainties and underlying assumptions in their potential application in CCAMLR. It was agreed that this would be an important part of the intersessional program of work of the subgroup. This would help ensure that CCAMLR remains open to using methods developed for purposes outside CCAMLR.

9.7 The Working Group agreed that this work is a priority and that an increase in resources of the Secretariat may be required over the next few years to help with the evaluation, computing, validation and archiving of this work.

9.8 The Working Group endorsed the timetable for preparation for assessments in 2003 provided in WG-FSA-02/80, included here as Table 9.1. It was noted that a circular to the Working Group early in the intersessional period would be helpful. The Working Group encouraged all Members to participate in the submission of information that will be requested for preparing for assessments in 2003. The Working Group agreed that the main sections of an intersessional meeting would address the following questions:

(i) What are the candidate assessments to be considered for use by WG-FSA and what is required to evaluate them?

(ii) What can be done for assessments in 2003?

(iii) What timetable can be developed for the short and long term in the development of assessment methods and the estimation of key parameters in the assessment process?

(iv) What resources will be needed from the Secretariat to help with this work?

9.9 The Working Group noted that the work of the subgroup will have budgetary implications in the form of reports, computing and support for participating in the work, including validation and archiving of the relevant materials associated with the evaluations.

9.10 In terms of preparation for next year, the Working Group noted the broader participation this year as a result of greater access and involvement in each of the assessment processes. The Working Group encouraged all Members to continue exploring and experimenting with the assessment tools and helping the subgroup further develop the descriptions of standard methodologies and the provision of new and improved tools. The Working Group requested that the subgroup include in the descriptions of standard methodologies, the methods used by the Secretariat for extracting data from the database for use in assessments. It also requested that the subgroup develop with the Secretariat a list of data extractions that could be undertaken prior to the meeting of WG-FSA in order to help streamline the assessment process during the meeting.

9.11 The Working Group thanked Dr Constable for coordinating the Subgroup on Assessment Methods and for advancing the process for preparing for assessments at this meeting.

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

Summary of Information Extracted from Observer Reports and/or provided by Technical Coordinators

10.1 A summary of information extracted from scientific observer reports was summarised in WG-FSA-02/11 Rev. 1, 02/12 Rev. 1 and 02/14 (paragraph 3.26).

Implementation of the Observer Program

10.2 The Working Group considered that it was technically feasible for observers to collect both pre-sorting and post-sorting data from the crab fishery. It noted that pre-sorting data provided important biological information and the observer would need unrestricted access to the catch to obtain these data. The Working Group agreed that all crabs that were measured should be sexed and male chelae measured. It recommended that these changes in sampling procedures be included in the *Scientific Observers Manual*.

10.3 Some observers reported difficulty in determining nautical twilight (paragraph 6.21); the Working Group encouraged technical coordinators to ensure that the new forms are used (paragraph 6.48). In addition, observers in high-latitude areas, where daily change in nautical dawn and nautical dusk is substantial during summer, have difficulty in extrapolating from the monthly 5° of latitude tables on a day-by-day basis. The Working Group requested that the algorithm used to develop the summary tables should be provided to technical coordinators to develop area-specific day-by-day, degree-by-degree tables; it noted, however, that the large size of such files made their inclusion in the observer logbook impractical.

10.4 Hook discard in fish heads is a substantial problem and more data collection is required from observers (paragraphs 6.67 and 6.68). On two Chilean vessels, a bounty was paid for hooks collected by crew from processed fish heads (paragraph 6.70). This worked successfully and the Working Group encouraged its wider use, where possible.

10.5 In 2001 the Working Group and the Commission requested provision be made in the *Scientific Observers Manual* to record offal discharge, level of deck lighting, entanglement of seabirds and video recording in trawl fisheries for icefish in Subarea 48.3 (paragraphs 6.193 and 6.194). Limited information on deck lighting had been reported and technical coordinators were requested to ensure that this part of the form was completed (paragraph 6.195).

10.6 Observers reported birds as being caught and released alive but the Working Group noted there was a need to distinguish between birds with potentially fatal injuries from those released with no or minor injury (paragraph 6.16). A clear definition was needed in the manual of the status of birds 'caught' as well as the development of a definition on what a dead seabird was. The latter definition had potentially similar implications for skates and rays. There may also be a need to indicate the level of observation necessary for accurate determination of the number of birds caught. This is of particular importance in fisheries for which closure is in part dependent on the number of birds killed (paragraphs 6.177 and 6.178).

10.7 The Working Group noted that in the trawl fishery for *C. gunnari* five-day catch and effort reports submitted to the Secretariat included fish by-catch levels but not those of seabirds.

10.8 The Working Group also noted that more detailed data collection by observers into seabird densities and mortalities in this trawl fishery would be helpful (paragraphs 6.204 and 6.205).

10.9 The Working Group agreed that the *Species Identification Sheets* should be updated with new information (WG-FSA-02/29, 02/32 and 02/54) (SC-CAMLR-XXI/BG/27, paragraph 7.20); further updates will be coordinated intersessionally by Dr Collins. It is planned that digital images will be put on disc to form a field guide.

10.10 The Working Group recommended that changes to the format of the *Scientific Observers Manual* should be coordinated through the technical coordinators.

10.11 WG-FSA-01 asked the intersessional subgroup on sampling catches from longlines to develop recommendations on: (i) subsampling methods using frames and sampling units based on time and gear, (ii) the allocation of observer effort within longline haul and between hauls, and (iii) the allocation of observer effort directed toward fishery target species versus ecological interactions. The results of this work using information from Subarea 48.3 are discussed in WG-FSA-02/52.

10.12 Both subsampling methods essentially follow a multi-stage cluster sampling design, which could be implemented more rigorously if the present objective was changed from sampling 60 fish/day to sampling a set length of each line or number of hours each day.

10.13 The subgroup had suggested that instead of sampling the first 60 fish in a biological sampling period, that all fish on a fixed number of hooks be sampled for biological data. This would be a gear-based sampling system. It was pointed out that this might lead to very large or very small samples of fish, in which case every third or fifth fish might be sampled.

10.14 The Working Group agreed that this would be a very difficult task to ask of observers. An alternative suggestion was that a gear-based method be undertaken only every fifth day of an observer cruise. The observer should monitor the average number of hooks required to obtain 60 fish in the previous four days, and then only monitor this number of hooks. Every fish would be sampled from this time, whether the sample was greater or less than 60 fish. The Working Group agreed that this procedure be tested in the 2002/03 period.

10.15 The subgroup had no data on sampling for age of *Dissostichus* spp. but noted it seemed reasonable, unless otherwise specified, to sample approximately every 30th fish for otoliths during each haul. However, the first fish to be sampled would be randomly selected from 1–30 and would result in an expected number of 112 fish sampled for otoliths in a 60-day voyage; approximating to two otoliths collected per day. The Working Group noted that where there are few vessels in an area, otolith collecting should be more intense. The Working Group also noted that sampling two otoliths/day may not account for segregation in the stock and that for this situation the design of otolith collection would need to be more stringent. Overall there is a need to obtain an unbiased sample and at the same time to collect additional samples in case future work is required.

10.16 Considering the current low level of seabird mortality, the Working Group noted that a 25% observation coverage of the hooks was sufficient (paragraph 6.7). There would be, however, a need for additional observers in the event that by-catch levels increased as higher observation rates are unlikely to be achieved by a single observer.

10.17 Observers are reminded that the standard unit of measurement for macrourids is pre-anal length.

10.18 The subgroup did not address sampling designs for trawling, either commercially or in research surveys.

10.19 The Working Group noted the advice of ad hoc WG-IMAF that Conservation Measure 29/XIX might be simplified, in respect of the streamer line element, if data were available on the areal coverage of streamer lines behind the vessel. The Working Group recommended that indicative values be collected by observers (paragraph 6.74).

Advice to the Scientific Committee

10.20 Additions and modifications to the *Scientific Observers Manual* logbooks data recording and reporting sheets, and instructions to scientific observers, should be made in respect of:

- (i) provision of algorithms for calculation of the times of nautical dawn and dusk (paragraph 10.3);
- (ii) measuring and sampling procedures for crabs (paragraph 10.2);
- (iii) collecting and reporting adequate data on hook discards in fish heads and offal (paragraph 10.4);
- (iv) better recording and reporting of offal discharge, deck lighting and entanglement of seabirds in the trawl fishery for icefish in Subarea 48.3 (paragraphs 10.5, 10.7 and 10.8);
- (v) data on areal coverage of streamer lines (paragraph 10.19);
- (vi) advice to observers on sampling fish and on observation of hooks to record seabird by-catch (paragraphs 10.15 and 10.16);
- (vii) measurement of pre-anal lengths for macrourids (paragraph 10.17);
- (viii) a revision of the observer protocols for by-catch as in section 5.4 (paragraphs 5.151 to 5.196);
- (ix) distinction between birds with potentially fatal injuries from those released with minor or no injury (paragraph 10.6); and
- (x) distinction between skates and rays released alive from those landed or discarded (paragraph 5.181).

10.21 The *Species Identification Sheets* should be updated in time for the 2002/03 season (paragraph 10.9).

10.22 In respect of by-catch such as seabirds, skates and rays there is a need to develop a definition of what constitutes a 'catch' and also to consider how the categories 'dead' and 'alive' might be defined (paragraph 10.6).

10.23 There is a need to consider levels of observations appropriate for accurate determination of the number of birds caught, especially in relation to fisheries for which closure is, in part, dependent on the number of birds killed (paragraph 10.6).

CCAMLR WEBSITE

11.1 The Working Group expressed its pleasure at the operation and use of the CCAMLR website. In particular, the Working Group appreciated the speed at which papers for the meeting had been placed on the website, and made available to participants. The Working Group thanked Mrs Marazas for her excellent work.

11.2 The Working Group noted that an electronic bibliography of WG-FSA working documents had been made available during the meeting. A similar bibliography, containing WG-EMM working documents, had been made available at WG-EMM-02 (WG-EMM-02/8). The Working Group encouraged the Secretariat to further develop this bibliography, including providing website access.

FUTURE WORK

12.1 Future work identified by the Working Group is summarised in Table 12.1 and Appendix D (ad hoc WG-IMAF), 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 contain only those tasks identified at the meeting, and do not include ongoing tasks undertaken by the Secretariat, such as data processing and validation, publications and routine preparations for meetings.

12.2 The Scientific Committee's attention is drawn to the following tasks which may have financial implications for the 2003 CCAMLR budget:

(i) for this year only, the Working Group agreed that the background papers arising from the meeting would be collated into a bound companion volume to the report of WG-FSA (paragraph 2.2); and

(ii) updates to the *Scientific Observers Manual* (paragraph 10.20 and Appendix D, Item 6.2).

12.3 The Working Group recommended that the Secretariat provide, if possible, a proper network facility for the meeting rather than an FTP site as has been used at this and previous meetings. This would facilitate the work of the group.

12.4 The Working Group reviewed the activities of subgroups that had worked during the intersessional period. 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 the activities of several of these groups should be extended during the 2002/03 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.

12.5 The Working Group reminded participants that membership to the subgroups was open.

12.6 The subgroups for the intersessional period are:

(i) a subgroup to review observer reports and information, coordinated by Dr E. Balguerías (Spain) and Mr Smith;

(ii) a subgroup to continue developing assessment methods coordinated by Dr Constable. This subgroup will interact and coordinate activities in the middle of the year (as detailed in Item 9);

(iii) a subgroup to review, and where necessary assess, the biology and demography of species considered by the Working Group (Convener to appoint coordinator);

(iv) a subgroup on by-catch coordinated by Ms van Wijk;

(v) a subgroup to identify, in conjunction with the SCAR EVOLANTA Program, up-to-date information on stock identity for species within the Convention Area, coordinated by Dr E. Fanta (Brazil);

(vi) a subgroup on conversion factors, coordinated by Mr Smith;

(vii) a subgroup on fisheries acoustics, coordinated by Drs Collins and Gasiukov;

(viii) a subgroup on estimation of IUU, coordinated by Dr Ramm; and

(ix) a subgroup on otolith exchange (CON), coordinated by Dr Belchier.

12.7 Each subgroup was requested to develop a work plan for the intersessional period, in consultation with the appropriate colleagues and with the Convener of WG-FSA and the Chair of the Scientific Committee.

12.8 The responsibilities for coordinating the intersessional activities of ad hoc WG-IMAF are set out in Appendix D.

OTHER BUSINESS

Consideration of a Proposal to list Toothfish under CITES Appendix II

13.1 This proposal was not submitted to the meeting so the Working Group did not consider this issue.

FAO's Fisheries Global Information System

13.2 SC-CAMLR-XXI/6 presented information on FAO's Fisheries Global Information System (FIGIS) and an outline for a possible partnership between CCAMLR and FIGIS.

13.3 The Working Group noted that FIGIS (www.fao.org/fi/figis) was a web-based network encompassing fisheries resources, biology, technology, aquaculture and trade which was intended to support the global analysis of fisheries issues. A key component of this system, which was being developed by FAO, was a Fishery Resources Monitoring System (FIRMS).

13.4 FIRMS sought to draw together a partnership of international organisations, regional fisheries bodies and national institutes collaborating within a formal agreement to report and share information on fishery resources.

13.5 The Working Group was unable to identify any obvious benefits which the proposed partnership may have for the future work of WG-FSA. The Working Group stressed that the proposed partnership should not impinge on the resources needed for the priority work of WG-FSA.

STATLANT Data

13.6 The Working Group considered three matters regarding STATLANT data:

- electronic access to the data;
- accuracy of the data; and
- publication of the *Statistical Bulletin*.

13.7 The Working Group thanked the Secretariat for developing an electronic version of the *Statistical Bulletin*. This version was developed in Excel format, and contained the complete time series of data (only the most recent 10-year period is published in the *Statistical Bulletin*).

13.8 The Working Group encouraged the Secretariat to further develop electronic access to STATLANT data. These data lie in the public domain, and it would be advantageous to users if the STATLANT database could be queried online, and if data could be extracted for any required combination of species, month and area.

13.9 The Working Group expressed concern at the inconsistencies which had been noted in the STATLANT data during the determination of total removals (Item 3) and the analysis of by-catch (Item 5). It is apparent that some STATLANT data do not reflect Members' official record of catches or may not contain information on all species caught in the Convention Area. The Working Group encouraged Members to review their submissions of STATLANT data and ensure that these data provide the complete and correct official record of catch and effort.

13.10 The Working Group also noted that, for the first time, its analyses were consistently based on the CCAMLR fishing season. Consequently, it was proposed that the next hard copy publication of the *Statistical Bulletin* (Volume 15, due in April 2003) should be arranged by season rather than split-year. The Working Group recognised that publication by season would require the Bulletin to be published later each year, possibly in June/July. The deadline for the submission of STATLANT data would also need to be amended. This proposal was referred to the Scientific Committee.

Publication Matters

13.11 The Working Group recalled last year's discussion regarding the provision of assistance with the preparation, in English, of manuscripts submitted to *CCAMLR Science* by non-native English-speaking authors (SC-CAMLR-XX, Annex 5, paragraphs 11.7 to 11.11). Concerns were expressed that *CCAMLR Science* may not be accepting valuable scientific contributions due to poor English composition. This matter had been further discussed by the Scientific Committee (SC-CAMLR-XX, paragraphs 14.2 and 14.3).

13.12 Although the Scientific Committee recognised the value of such a service, it was unable to reach consensus on which languages would be supported by such editorial assistance. This issue was referred to the Editorial Board of *CCAMLR Science* for further consideration.

13.13 WG-FSA-02 identified a range of possible solutions, including:

(i) reinstating a grey literature publication such as *Selected Scientific Papers*;
(ii) providing funds for editorial assistance by CCAMLR translators; and
(iii) developing a network of associated editors to *CCAMLR Science* to provide assistance.

13.14 The Working Group advised that this matter should be further discussed by the Editorial Board before being considered by the Scientific Committee.

Advice to the Scientific Committee

13.15 The Working Group was unable to identify any obvious benefits for WG-FSA in becoming a partner in FIGIS (paragraph 13.5).

13.16 Members of CCAMLR were encouraged to review their submissions of STATLANT data (paragraph 13.9).

13.17 The issue of assistance with preparation of manuscripts submitted to *CCAMLR Science* by non-native English-speaking authors was remitted to the Editorial Board for further consideration (paragraphs 13.11 to 13.14).

ADOPTION OF THE REPORT

14.1 The report of the meeting was adopted.

CLOSE OF MEETING

15.1 Details of the future convenership of WG-FSA were referred to the Scientific Committee.

15.2 In closing the meeting, the Convener thanked the participants and the Secretariat for a very successful meeting. He also thanked Dr Constable for his intersessional work which had contributed extensively to the new format of the meeting. Dr Holt, on behalf of WG-FSA, thanked Dr Everson for his continued hard work and leadership.

15.3 The meeting was closed.

REFERENCES

Alekseyeva, Ye.I., F.Ye. Alekseyeva, V.V. Konstantinov and V.A. Boronin. 1993. Reproductive biology of grenadiers, *Macrourus carinatus, M. whitsoni, Coelorinchus fasciatus* (Macrouridae), and *Patagonotothen guntheri shagensis* (Nototheniidae) and the distribution of *M. carinatus*. *J. Ichthyol.,* 33 (1): 71–84.

Anderson, A. and B. McArdle. 2002. Sink rate of baited hooks during deployment of a pelagic longline from a New Zealand fishing vessel. *New Zealand Journal of Marine and Freshwater Research*, 36: 185–195.

BirdLife International. 2000. *Threatened Birds of the World*. BirdLife International/Lynx-Edicions, Cambridge, Barcelona.

Environment Australia. 1998. *Threat Abatement Plan for the Incidental Catch (or By-catch) of Seabirds during Oceanic Longline Fishing Operations*. Environment Australia Biodiversity Group, Canberra.

Kock, K.-H., L. Döllefeld, P.A. Hulley, H.-P. Jährig, W. Petzel, C. Pusch, V. Siegel and M.G. White. 1998. The composition and abundance of the demersal fish fauna around Elephant Island. In: Kattner, G. (Ed.). *The Expedition Antarktis XIV/2 of RV 'Polarstern' in 1996/97*. *Berichte zur Polarforschung*, 274: 11–14.

Myers, R.A., J. Bridson and N.J. Barrowman. 1995. *Summary of Worldwide Spawner and Recruitment Data*. Department of Fisheries and Oceans, Northwest Atlantic Fisheries Centre, Canada.

Nel, D.C., P.G. Ryan and B.P. Watkins. 2002. Seabird mortality in the Patagonian toothfish longline fishery around the Prince Edward Islands. *Ant. Sci.*, 14: 151–161.

Punt, A.E. and R. Hilborn. 1996. Biomass dynamics model: users manual. *FAO Computerised Information Series*, 10: p. 62.

Syrjala, S.E. 2000. Critique on the use of the delta distribution for the analysis of trawl survey data. *ICES J. Mar Sci.*, 57: 831–842.

van Wijk, E.M., A.J. Constable, R. Williams and T. Lamb. 2000. Distribution and abundance of *Macrourus carinatus* on BANZARE Bank in the southern Indian Ocean. *CCAMLR Science*, 7: 171–178.

Woehler, E.J., H.J. Auman and M. Riddle. 2002. Long-term population increase of black-browed albatrosses *Thalassarche melanophrys* at Heard Island, 1947/1948–2000/2001. *Polar Biology*: published online www.link.springer.de/link/service/journals/00300/contents/02/004.

Table 3.1: Catches (tonnes) of target species reported for the 2001/02 fishing season to date. Source: Catch and effort reports submitted by 7 October 2002.

Target Species	Conservation Measure	Region	Gear	Catch of Target Species (tonnes)			
				Limit	Fishery	Other[1]	Total
Chaenodraco wilsoni (exploratory fishery)							
	237/XX	58.4.2	Trawl	500	0	0	0
Champsocephalus gunnari							
	219/XX	48.3	Trawl	5 557	2 656	0	2 656
	220/XX	58.5.2	Trawl	885	8 50[2]	-	850[2]
Dissostichus spp.							
	221/XX	48.3	Longline and pot	5 820	5 617	<1	5 617
	180/XVIII	48.4	Longline	28	0	0	0
	222/XX	58.5.2	Trawl	2 815	1 812[2]	-	1 812[2]
	na	58.5.1 (French EEZ)	Longline and trawl	-	-	-	2 930[3]
	na	58.6 (French EEZ)	Longline	-	-	-	989[3]
	na	58.6 (South African EEZ)	Longline	-	57	0	57
	na	58.7 (South African EEZ)	Longline	-	37	0	37
Dissostichus spp. (exploratory fisheries)							
	234/XX	58.6	Longline	450	0	0	0
	229/XX	48.6 North of 60°S	Longline	455	0	0	0
	229/XX	48.6 South of 60°S	Longline	455	0	0	0
	230/XX	58.4.2	Trawl	500	0	0	0
	233/XX	58.4.4 North of 60°S	Longline	103	0	0	0
	235/XX	88.1 North of 65°S	Longline	171	58	0	58
	235/XX	88.1 South of 65°S	Longline	2 337	1 275	0	1 275
	236/XX	88.2 South of 65°S	Longline	250	41	0	41
Electrona carlsbergi							
	223/XX	48.3	Trawl	109 000	0	0	0
Euphausia superba							
	32/XIX	48	Trawl	4 000 000	114 245	0	114 245
	106/XIX	58.4.1	Trawl	440 000	0	0	0
	45/XX	58.4.2	Trawl	450 000	0	0	0
Lithodidae							
	225/XX	48.3	Pot	1 600	113	0	113
Macrourus spp. (new fishery)							
	230/XX	58.4.2	Trawl	150	0	0	0
Martialia hyadesi (exploratory fishery)							
	238/XX	48.3	Jig	2 500	0	0	0

[1] Taken as by-catch in other fisheries in the region
[2] Verified landed weights reported by Australia
[3] 1 November 2001 to 31 August 2002 reported by France
na Not applicable

Table 3.2: Estimated effort (fishing days), mean catch rate (tonnes/day) and total catch (tonnes) by subarea and division in the unregulated fishery for *Dissostichus* spp. in the 2001/02 season to date, based on data submitted to the Secretariat. Estimates for the 2000/01 season, recalculated from split-year to season, are given in parentheses (adapted from WG-FSA-02/81 Rev. 1).

Area/ Subarea/ Division	Estimated Start of Unregulated Fishery	No. of Vessels Sighted in Unregulated Fishery[5,6]	No. of Licensed Fishing Vessels	Estimated No. of Vessels Fishing Illegally	Estimated No. of Days Fishing per Fishing Trip	No. of Trips/Year	Estimated Effort in Days Fishing[3] (1)	Mean Catch Rate per Day[2] (tonnes) (2)	Estimated Unreported Catch (1) x (2)[4]	Estimated Total Catch[1]
48.3	1991	2	14 (15)	1 (1)	30	1	2 (100)	1.5	3 (196)	5 620 (4 156)
58.4.2	Jan 2002	2[5] + 2[7] (-)	0 (0)	4 (-)	41	1.5	246 (-)	1.2	295 (-)	295
58.4.4	Sep 1996	0 (0)	0 (0)	4[8] (7)	40	2.5	400 (700)	2.2	880 (1 247)	880 (1 256)
58.5.1	Dec 1996	24 (18)	8						6 300 (4 550)	9 230 (9 297)
58.5.2	Feb–Mar 1997	2[5] + 8[8]	2	10[9]	27	1	270		2 500 (2 004)	4 312 (4 991)
58.6	Apr–May 1996	6	4 (6)	6[9] (6)	40	2.5	600 (600)	1.2	720 (685)	1 766 (1 812)
58.7	Apr–May 1996	1[10]	4 (4)	1[9]	40	1.5	60 (100)	1.3	78 (120)	115 (355)
88.1		0 (0)	2	1 (-)	40	1	40	2.3	92 (0)	1 425 (660)
88.2		0 (-)	1	0 (-)					0 (-)	42 (0)
Total		37							10 898 (8 802)	23 685 (22 527)

1 Estimated total catch = estimated unreported catch plus reported catch.
2 Catch and effort data from the Secretariat.
3 Calculated as number of vessels fishing illegally x number of fishing days/trip x number of trips/year.
4 Division 58.5.2 based on data provided by Australia; Subarea 48.3 based on data provided by the UK; Division 58.4.2 from CDS data.
5 Vessel sightings/apprehensions (sources): Australia, France, observers (South Africa, UK).
6 This may include more than one sighting of the same vessel.
7 CDS data from the Secretariat.
8 No sightings, but presence of vessels in the area otherwise reported.
9 Estimated number of vessels not in area throughout period, but moving between areas.
10 Minimum number of vessels detected on radar.

Table 3.3: Reported catch (tonnes) and estimated catch from IUU fishing for *Dissostichus* spp. in Subarea 48.3, Divisions 58.4.2, 58.4.4, 58.5.1 and 58.5.2 and Subareas 58.6, 58.7 and 88.1. Estimates of IUU catches go back as far as the 1988/89 season (see footnote c).

Season (Dec–Nov)	Subarea 48.3			Division 58.4.2			Division 58.4.4			Division 58.5.1		
	Reported Catch	Estimated IUU Catch	Total Removal	Reported Catch	Estimated IUU Catch	Total Removal	Reported Catch	Estimated IUU Catch	Total Removal	Reported Catch	Estimated IUU Catch	Total Removal
1988/89	7 060[a]	144[c]	7 204	0[a]		0	0[a]		0	1 311[a]		1 311
1989/90	6 785[a]	437[c]	7 221	1[a]		1	0[a]		0	1 243[a]		1 243
1990/91	1 756[a]	1 775[c]	3 532	0[a]		0	0[a]		0	3 008[a]		3 008
1991/92	3 809[a]	3 066[c]	6 875	0[a]		0	0[a]		0	7 758[a]		7 758
1992/93	3 020[a]	4 019[c]	7 039	0[a]		0	0[a]		0	3 597[a]		3 597
1993/94	658[a]	4 780[c]	5 438	0[a]		0	0[a]		0	5 381[a]		5 381
1994/95	3 371[a]	1 674[c]	5 045	0[a]		0	0[a]		0	5 596[a]		5 596
1995/96	3 602[a]	0[c]	3 602	0[a]		0	0[a]		0	4 710[a]	833[c]	5 544
1996/97	3 812[a]	0[c]	3 812	0[a]		0	0[a]	375[c]	375	5 059[a]	6 094[c]	11 153
1997/98	3 201[a]	146[c]	3 347	0[a]		0	0[a]	1 298[c]	1 298	4 714[a]	7 156[c]	11 870
1998/99	3 636[a]	667[d]	4 303	0[a]		0	0[a]	1 519[c]	1 519	4 730[a]	1 237[c]	5 967
1999/2000	4 941[a]	1 015[d]	5 956	0[a]		0	156[a]	1 254[c]	1 410	6 139[a]	2 600[c]	8 739
2000/01	3 960[a]	196[d]	4 156	0[a]		0	9[a]	1 247[e]	1 256	4 747[a]	4 550[e]	9 297
2001/02*	5 617[b]	3[e]	5 620	0[b]	295[e]	295	0[b]	880[e]	880	2 930[f]	6 300[e]	9 230

(continued)

Table 3.3 (continued)

Season (Dec–Nov)	Division 58.5.2			Subarea 58.6			Subarea 58.7			Subarea 88.1		
	Reported Catch	Estimated IUU Catch	Total Removal	Reported Catch	Estimated IUU Catch	Total Removal	Reported Catch	Estimated IUU Catch	Total Removal	Reported Catch	Estimated IUU Catch	Total Removal
1988/89	0[a]		0	0[a]		0	0[a]		0	0[a]		0
1989/90	1[a]		1	0[a]		0	0[a]		0	0[a]		0
1990/91	0[a]		0	0[a]		0	0[a]		0	0[a]		0
1991/92	0[a]		0	0[a]		0	0[a]		0	0[a]		0
1992/93	0[a]		0	0[a]		0	0[a]		0	0[a]		0
1993/94	0[a]		0	56[a]		56	0[a]		0	0[a]		0
1994/95	0[a]		0	115[a]		115	0[a]		0	0[a]		0
1995/96	0[a]	3 000[c]	3 000	76[a]	7 875[c]	7 951	869[a]	4 958[c]	5 827	0[a]		0
1996/97	1 868[a]	7 117[c]	8 985	466[a]	11 760[c]	12 226	1 193[a]	7 327[c]	8 520	0[a]		0
1997/98	3 671[g]	4 150[c]	7 821	1 053[a]	1 758[c]	2 811	637[a]	598[c]	1 235	42[a]		42
1998/99	3 659[g]	427[c]	4 086	1 152[a]	1 845[c]	2 996	301[a]	173[c]	474	297[a]		297
1999/2000	3 566[g]	1 154[c]	4 720	1 096[a]	1 430[c]	2 526	1 015[a]	191[c]	1 206	751[a]		751
2000/01	2 987[g]	2 004[e]	4 991	1 127[a]	685[e]	1 812	235[a]	120[e]	355	660[a]		660
2001/02*	1 812[g]	2 500[e]	4 312	1 046[h]	720[e]	1 766	37[b]	78[e]	115	1 333[b]	92[e]	1 425

* To date (based on data available to the Secretariat on 7 October 2002)
[a] STATLANT data
[b] Five-day catch and effort report
[c] Converted to season from IUU catches reported in SC-CAMLR-XV, Annex 5, Table 6 and SC-CAMLR-XX, Annex 5, Table 6.
[d] WG-FSA-02/4
[e] Table 3.2
[f] STATLANT data to June 2002 and catches for July and August 2002 reported by G. Duhamel (pers. comm. 11 October 2002).
[g] Verified weights provided by A. Constable (pers. comm. 11 October 2002).
[h] South African EEZ: five-day catch and effort reports (57 tonnes); French EEZ: STATLANT data to June 2002 and catches for July and August 2002 reported by G. Duhamel (989 tonnes; pers. comm. 11 October 2002).

Table 5.1: Summary of notifications for new and exploratory fisheries in 2002/03.

Member	Subarea/Division	Target Species	Fishery	Paper
Australia	58.4.2	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/12
Australia	58.4.3a, 58.4.3b	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/11
Australia	58.5.2	*Dissostichus eleginoides*	Longline	CCAMLR-XXI/10
Japan	48.6, 58.6, 58.4.3a, 58.4.3b, 58.4.4, 88.1, 88.2	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/9
New Zealand	48.6	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/8
New Zealand	88.1, 88.2	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/7
Russia*	88.1, 88.2	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/16
South Africa	48.6 (north of 60°S), 58.6, 58.4.4, 88.1	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/6
Spain	88.1	*Dissostichus* spp.	Exploratory longline	CCAMLR-XXI/5

* Summary of notification submitted to the Secretariat on 6 September 2002.

Table 5.2: Summary of intended catches and number of vessels per area in new and exploratory fisheries notifications for *Dissostichus* spp. in the 2002/03 season. In each cell: top figure – number of vessels nominated; middle letter L – longline, T – trawl; bottom figure – intended catch; N – north, S – south. Figures in parentheses in the 'Total notifications' and 'Maximum no. of vessels' rows are values for the 2001/02 season notifications.

Country	48.1	48.2	48.4	48.6	58.4.2	58.4.3a	58.4.3b	58.4.4	58.5.1	58.5.2	58.6	58.7	88.1	88.2	88.3
Australia					1 L 500 t	1 L 250 t	1 L 300 t			1 L 15–29% of TAC					
Japan[a]				2 L 250 t (N) 250 t (S)		2 L 100 t	2 L 100 t	2 L 60 t			2 L 100 t		2 L 60 t (N) 500 t (S)	2 L 60 t	
New Zealand[b]				2 L 455 t (N)* 455 t (S)*									6 L 1300 t*	6 L 40 t*	
Russia[c]													4 L 170 t (N) 1500 t (S)	4 L 250 t (S)	
South Africa				3 L 250 t (N)				3 L 60 t			3 L 100 t		2 L 60 t (N) 500 t (S)		
Spain													1 L 170 t (N) 480 t (S)		
Total notifications	0 (0)	0 (0)	0 (0)	3 (4)	1 (1)	2 (2)	2 (2)	2 (5)	0 (0)	1 (0)	2 (4)	0 (0)	5 (4)	3 (4)	0 (0)
Maximum no. of vessels	0 (0)	0 (0)	0 (0)	7 (8)	1 (2)	3 (3)	3 (3)	5 (10)	0 (0)	1 (0)	5 (7)	0 (0)	15 (11)	12 (7)	0 (0)
Catch limit set at CCAMLR-XX	0	0	28 t	455 t (N) 455 t (S)	500 t	250 t	300 t	103 t	N/A	2815 t	450 t	0	171 t (N) 2337 t (S)	250 t	0

* The figures stated represent minimum anticipated catches. New Zealand reserves the right to access on a competitive basis any precautionary catch limit established by the Commission for these fisheries.

[a] Details of a second vessel were notified on 30 September 2002.

[b] Details of six vessels were notified on 2 September 2002.

[c] Notification received 6 September 2002 (see also SC-CAMLR-XXI/BG/16 Rev. 1).

Table 5.3: Assessment of long-term annual yield for the exploratory fishery by SSRU for *Dissostichus* spp. in Subarea 88.1 and for all SSRUs combined in Subarea 88.2, based on fished seabed area.

	88.1					88.2	48.3
	A	B	C	D	E		
Fished seabed area (km^2)	3 407	10 484	13 041	11 668	28 074	2 384	32 035
Fishing selectivity (mean)	135	115	120	80	80	115	75
Fishing selectivity (range)	30	70	60	20	20	50	20
Ratio total: recruited biomass	2.551	1.683	1.818	1.131	1.131	1.651	1.158
γ	0.048	0.040	0.041	0.037	0.037	0.041	0.034
CPUE ratio	0.578	0.391	0.823	0.495	0.525	0.587	1.0
Estimated yield (tonnes)	1 536	1 772	5 129	1 533	3 912	602	(7 970)

Table 5.4: Summary of catch limits and catches for *Dissostichus* spp. in Subareas 88.1 and 88.2 for the 2000/01 and 2001/02 seasons and precautionary yields for 2002/03.

	2000/01		2001/02		2002/03		
	Catch Limit	Catch	Catch Limit	Catch	Yield	Yield *0.3	Yield *0.5
Subarea 88.1							
SSRU A	175	67	171	57	1 536	461	768
SSRU B	472	287	584	333	1 772	532	886
SSRU C	472	184	584	565	5 129	1 539	2 564
SSRU D	472	46	584	195	1 533	460	766
SSRU E	472	75	584	179	3 912	1 174	1 956
Total	2 063	659	2 508	1 319	13 882	4 164	6 941
Subarea 88.2[1]	-	-	250	41	602	181	301
Total				41	602	181	301

[1] Note Subarea 88.2 is divided into seven longitudinal sections each 10° apart, with a maximum 50 tonnes catch in any one SSRU. To date, only SSRU A has been fished.

Table 5.5: Average age-specific relative vulnerabilities for *Dissostichus eleginoides* in Subarea 48.3.

Age	Deep Pattern Vulnerability (1986–1997)	Shallower Pattern Vulnerability (1998–2000)
0	0.00	0.00
4.9	0.00	0.00
6.17	0.50	0.72
6.67	0.69	1.00
6.91	0.74	1.00
7.17	0.78	0.99
7.42	0.82	0.99
7.68	0.86	0.99
7.95	0.89	0.99
8.21	0.92	0.98
8.49	0.94	0.98
8.77	0.96	0.98
9.05	0.97	0.98
9.34	0.99	0.97
9.64	0.99	0.97
9.94	1.00	0.96
10.25	1.00	0.95
10.56	1.00	0.94
10.88	0.99	0.94
11.21	0.98	0.92
11.54	0.97	0.91
11.88	0.96	0.90
12.23	0.94	0.88
12.59	0.91	0.86
12.96	0.89	0.84
13.33	0.86	0.82
13.72	0.83	0.80
14.12	0.80	0.77
14.52	0.76	0.74
14.94	0.72	0.71
15.37	0.68	0.68
15.81	0.63	0.64
16.27	0.58	0.60
55.0	0.58	0.60

Table 5.6: Cohort strengths of *Dissostichus eleginoides* from surveys undertaken in Subarea 48.3 since 1987. Observed and expected data, the closeness of which indicates the quality of the fit, are from the mixture analyses.

Survey Year	Country	Time (years) since previous 1 December	Area (km^2)	Observed	Expected	Age 3		Age 4		Age 5		Age 6		Age 7	
						Density ($n.km^{-2}$)	SE	Density ($n.km^{-2}$)	SE	Density ($n.km^{-2}$)	SE	Density ($n.km^{-2}$)	SE	Density ($n.km^{-2}$)	SE
1987	USA/Poland	0.99	40 993	49.8	47.3	20.5	7.1	26.9	4.4						
1988	USA/Poland	0.08	40 993	21.3	22.1			14.5	11.3	8.7	12.6				
1990	UK	0.17	40 993	468.5	473.3	165.1	116.8	195.9	105.1	85.1	42.0	32.3	19.7		
1992	UK	0.17	40 993	287.6	281.2	281.4	174.4								
1994	Argentina	0.25	40 993	48.0	49.6	2.6	2.7	47.4	9.3						
1994	UK	0.17	40 993	122.5	125.9	36.3	20.1	89.8	32.6						
1995	Argentina	0.25	40 993	60.5	65.6	8.3	5.2	21.9	9.2	35.7	8.8				
1996	Argentina	0.33	40 993	167.9	165.3	114.6	44.2	16.9	6.0	22.7	9.8	18.5	10.0		
1997	Argentina	0.33	40 993	122.9	124.8	25.0	8.2	45.8	15.5	15.6	9.2	17.5	6.0	8.6	6.4
1997	UK	0.82	40 993	100.4	111.3	51.0	33.7	37.2	37.3	24.2	37.1				
2000	UK	0.17	40 993	140.3	126.0	38.2	11.6								
2002	UK	0.12	40 993	1148.7	1140.3	259.6	50.1	86.5	24.4	68.4	19.0				

Table 5.7: Input parameters for the GYM to assess the long-term annual yield of *Dissostichus eleginoides* taken by longline and pots in Subarea 48.3.

Category	Parameter	Values
Age structure	Recruitment age	4 years
	Plus class accumulation	35 years
	Oldest age in initial structure	55 years
Recruitment		See Table 5.6
Natural mortality	Mean annual M	0.132–0.198
von Bertalanffy growth	t_0	-0.21 years
	L_∞	1 946 mm
	k	0.066 year^{-1}
Weight at age	Weight–length parameter – A (kg)	3.96E-08 kg
	Weight–length parameter – B	2.8
Maturity	L_{m50}	930 mm
	Range: 0 to full maturity	780–1 080 mm
Fishing season	(years 1994 onwards only)	1 May–31 Aug
Spawning season		1 Aug–1 Aug
Simulation characteristics	Number of runs in simulation	1 001
	Depletion level	0.2
	Seed for random number generator	-24 189
Characteristics of a trial	Years to remove initial age structure	1
	Observations to use in median SB_0	1 001
	Year prior to projection	1987
	Reference start date in year	01/12
	Increments in year	24
	Vector of known catches	See Tables 5.5 and 5.9
	Years to project stock in simulation	35
	Reasonable upper bound for annual F	5.0
	Tolerance for finding F in each year	0.000001
Fishing mortality		See Tables 5.5 and 5.9

[1] Adjusted from estimated parameter of t_0 = -2.56 years to start of fishing season on 1 December.

Table 5.8: Time series of recruitments (millions of fish) for *Dissostichus eleginoides* in Subarea 48.3 from the assessments over the last three years. The year indicates the year at the birthday of the fish, which is likely to be the calendar year before the survey. These recruitment series are estimated from cohort densities in Table 5.6 based on a value for natural mortality, M = 0.165 y^{-1}.

Year Age 4 Birthday	Assessment			
	1999	2000	2001	2002
1986	1.146	1.108	1.347	1.349
1987	0.722	0.747	0.980	0.845
1988	4.106	4.377	4.187	4.214
1989	8.055	8.282	8.174	9.374
1990	5.786	5.739	5.842	6.700
1991	no obs	no obs	no obs	no obs
1992	10.19	5.815	10.287	11.799
1993	2.061	2.053	1.888	2.130
1994	0.961	1.006	0.950	1.003
1995	0.701	0.718	0.633	0.691
1996	2.649	2.405	2.652	2.947
1997	1.119	0.962	1.037	1.140
1998		0.386	no obs	no obs
1999		no obs	no obs	no obs
2000		1.496	1.522	2.504
2001		1.927		4.207
2002				10.694
Mean	3.185	2.517	3.292	4.257
CV	1.01	0.95	0.97	0.91

Table 5.9: Catch history for *Dissostichus eleginoides* in Subarea 48.3. Fishing seasons are given (i.e. 1988/89 is 1 December 1988 to 30 November 1989). * – estimates from Table 3.3 extended pro rata to the end of the fishing season in 2001/02. Although there were some removals prior to 1988/89, they were not from longliners and were not used in the assessment.

Fishing Season	Catch Series (Reported and IUU) used in 2001 (tonnes)	New Fishing Season Reported Catch	New Fishing Season IUU Catch (1998/99 to 2000/01 from WG-FSA-02/04, 2001/02 pro rata from Table 3.3)	Total Extractions used in 2002 Assessment
1988/89		7060	144	7204
1989/90	8501	6785	437	7221
1990/91	4206	1756	1775	3532
1991/92	7309	3809	3066	6875
1992/93	5589	3020	4019	7039
1993/94	6605	658	4780	5438
1994/95	6171	3371	1674	5045
1995/96	4362	3602	0	3602
1996/97	2619	3812	0	3812
1997/98	3201	3201	146	3347
1998/99	4300	3636	667	4303
1999/2000	5337	4941	1015	5956
2000/01	4354	3960	196	4156
2001/02*		5617	4	5621

Table 5.10: Sensitivity runs undertaken on the Subarea 48.3 toothfish assessment. The departure point was a re-run of the assessment conducted in 2001 and reported in SC-CAMLR-XX, Annex 5, Table 30. Note that the sustainable catch limits are rough interpolations in this table, whereas the final assessments (Table 5.11) are accurate results. Runs 1–7 were undertaken with the future projection selectivity at age unchanged from that used in 2001.

Trial Description	Interpolated Estimate of Sustainable Catch (tonnes)
1. 2001 run with the small change (paragraph 5.67(i)) to the GYM software. This should be comparable with the figure of 5 675 tonnes, trial 3 (without CPUE adjustment) from SC-CAMLR-XX, Annex 5, Table 30. This assessment has the split-year catch series up to 2000/01 only, the old selectivity-at-age series, and assumes fishing will take place over the whole year.	5726
2. Run 1 + 2001/02 catch and age-3 recruitment from the 2000 UK survey altered to take account of the 2002 UK age-5 survey results.	6461
3. Run 1 + 2001/02 catch and 2002 UK survey results only for ages 4 and 5.	6286
4. Run 1 + 2001/02 catch and full UK survey data for 2002 (ages 3, 4 and 5).	7461
5. Run 4 + changes to historical catch series associated with change to fishing season.	7617
6. Run 5 + changes to historical age-based selectivities according to Table 5.5.	7647
7. Run 6 + changes to fishing period.	7468
8. Run 7 + future (projected) years with deep-water selectivity at age.	7650
9. Run 7 + future (projected) years with shallow-water selectivity at age.	7580

Table 5.11: Final assessment of toothfish in Subarea 48.3, incorporating the CPUE adjustment. These assessments incorporated inputs presented in Tables 5.6 to 5.9.

	Sustainable Catch Limit (tonnes)	Depletion Probability	Median Escapement
Future (projected) years with shallow-water selectivity at age	7580	0.099	0.517
Including CPUE adjustment	7810	0.100	0.519

Table 5.12: Input parameters for GYM to assess the long-term annual yield of *Dissostichus eleginoides* taken by trawl in Division 58.5.2.

Category	Parameter	Values
Age structure	Recruitment age	4 years
	Plus class accumulation	35 years
	Oldest age in initial structure	55 years
Recruitment		See Tables 5.13 and 5.14
Natural mortality	Mean annual M	0.13–0.2
von Bertalanffy growth	t_0	-2.46[1] years
	L_8	2465 mm
	k	0.029 year^{-1}
Weight at age	Weight–length parameter – A (kg)	2.59E-09 kg
	Weight–length parameter – B	(mm^B) 3.2064
Maturity	L_{m50}	930 mm
	Range: 0 to full maturity	780–1080 mm
Spawning season		1 Jul–1 Jul
Simulation characteristics	Number of runs in simulation	1 001
	Depletion level	0.2
	Seed for random number generator	-24 189
Characteristics of a trial	Years to remove initial age structure	1
	Observations to use in median SB_0	1 001
	Year prior to projection	1985
	Reference start date in year	01/12
	Increments in year	24
	Vector of known catches	See Table 5.15
	Years to project stock in simulation	35
	Reasonable upper bound for annual F	5.0
	Tolerance for finding F in each year	0.000001
Fishing mortality		See Table 5.14

[1] Adjusted from estimated parameter of t_0 = -2.56 years to start of fishing season on 1 December.

Table 5.13: Cohort strengths from surveys undertaken in Division 58.5.2 since 1990. Observed and expected data are from the mixture analyses, the closeness of which indicates the quality of the fit.

Survey Year	Time	Area (km^2)	Observed	Expected		Density ($n.km^{-2}$)					
						Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1990	0.58	97 106	107.2	108.1	Mean	8.080	33.508	20.208	0.827	25.226	0.000
					SE	*5.897*	*13.552*	*11.251*	*11.505*	*14.082*	*0.000*
1992	0.25	70 271	51.7	51.8	Mean	14.117	13.200	14.501	3.430	0.019	2.117
					SE	*5.156*	*7.036*	*7.845*	*4.473*	*5.449*	*3.342*
1993	0.85	71 555	97.4	114.7	Mean	13.567	38.259	8.191	16.961	3.066	20.884
					SE	*8.804*	*18.172*	*13.483*	*12.606*	*30.294*	*16.333*
1999	0.41	85 428	366.2	357.9	Mean	17.741	16.206	138.11	56.785	60.897	40.323
					SE	*7.862*	*13.323*	*42.657*	*55.348*	*50.870*	*38.189*
2000	0.55	41 144	185.0	179.5	Mean	28.124	21.969	47.817	59.121	7.565	10.989
					SE	*5.298*	*7.996*	*14.885*	*20.578*	*15.142*	*11.383*
2001	0.56	85 169	247.5	252.4	Mean	19.542	34.018	38.172	45.538	32.165	16.738
					SE	*7.798*	*12.849*	*20.534*	*30.762*	*42.367*	*41.086*
2002	0.56	85 910	208.5	204.8	Mean	18.590	29.333	59.400	20.726	53.199	
					SE	*6.722*	*11.475*	*21.202*	*21.993*	*17.117*	

Table 5.14: Time series of recruitments (millions of fish) for *Dissostichus eleginoides* in Division 58.5.2 based on a mean natural mortality of 0.165 $year^{-1}$.

Year at Age 4 Birthday	WG-FSA-2000	WG-FSA-2001	Revised Estimates following 2002 Survey
1986		4.321	4.321
1987	1.550	0.120	0.120
1988	1.590	2.586	2.586
1989	3.649	3.790	3.790
1990	1.956	1.118	1.118
1991	1.793	0.667	0.667
1992	4.575	1.447	1.447
1993	2.435	0.825	0.825
1994	2.944	7.205	7.205
1995	5.674	9.226	9.226
1996	9.548	7.295	7.295
1997	21.557	15.043	15.043
1998	3.440	3.487	6.532
1999	1.059	2.291	2.332
2000	0.241	1.465	1.931
2001	0.152	1.632	2.236
2002			1.625
Mean	4.144	3.907	4.018
CV	1.297	1.021	0.975

Table 5.15: Catch histories and fishing vulnerabilities (selectivities) for *Dissostichus eleginoides* in Division 58.5.2.

Season	Catch (Reported and IUU) (tonnes)	Size/Age (Vulnerability)	Size/Age Units
1995/96	3000	550 (0), 790 (1)	mm
1996/97	8985	(0), 6.0 (0.0), 7.0 (1), 7.9 (1), 8.0 (0)	years
1997/98	7821	0.0 (0), 6.0 (0.0), 10.0 (1), 10.0 (1),12.0 (0)	years
1998/99	4086	0.0 (0), 5.5 (0.0), 6.0 (1), 13.0 (1), 15.0 (0)	years
1999/2000	4720	0.0 (0), 4.0 (0.0), 8.0 (1), 14.0 (1), 15.0 (0)	years
2000/01	4991	0.0 (0), 4.0 (0.0), 8.0 (1), 14.0 (1), 15.0 (0)	years
2001/02	Catch limit 2815 tonnes + illegal catch of 2500 tonnes = 5315 tonnes	0.0 (0), 4.0 (0.0), 8.0 (1), 14.0 (1), 15.0 (0)	years

Table 5.16: Estimates of mean biomass from Russian and UK surveys in 2002.

Survey (Country and Type)	Mean Biomass Estimate (tonnes)
UK 2002 trawl	43 915
Russia 2002 trawl	44 581
Russia 2002 acoustic	92 300
Russia bottom trawl and acoustic (bottom 8 m)	73 848

Table 5.17: Biomass estimates for *Champsocephalus gunnari* in Subarea 48.3 subdivided by strata. Data are given for the UK, Russian and combined surveys, and for the combined surveys with the UK survey multiplied by 1.241.

Stratum	Russian		UK		Combined		Combined with UK*1.241	
	Mean	One-Sided Lower 95% CI	Mean	One-Sided Lower 95% CI	Mean	One-Sided Lower 95% CI	Mean	One-Sided Lower 95% CI
SR 50–150 m	175.0	89.0	273.3	117.9	210.9	101	273.5	159.4
SR 150–250 m	201.5	63.9	232.7	114.9	217.6	86.4	257.6	152.9
SR 250–500 m	16.5	0.0	3.6	0.0	5.1	0	9.7	1.3
SG NW 50–150 m	4 795.6	36.4	1 482.2	184.3	2 197.7	153.8	3 481.7	484.9
SG NW 150–250 m	24 753.5	115.5	17 884.6	818.1	2 0704.3	521.7	23 656.9	568.7
SG NW 250–500 m	99.5	35.7	652.9	429.4	194	101.8	366.1	155.2
SG NE 50–150 m	1 645.5	223.8	3 643.8	175.9	2 112.4	162	2 724.1	489.1
SG NE 150–250 m	4 208.5	1 621.7	1 202.8	609.1	1760	838.3	2 770.7	1 418.9
SG NE 250–500 m	28.4	3.6	141.6	32.7	42.8	7.2	116.8	31.3
SG S 50–150 m	3 459.1	475.1	5 469.9	5 469.9			3 792.0	581.1
SG S 150–250 m	4 967.2	696.2	9 284.4	5 178.5	7 419.6	3 173.1	8 131.6	4 326.1
SG S 250–500 m	230.3	56.4	3 642.7	367.4	356.4	61.1	1 660.4	216.3
Shag Rocks	393.1	215.1	509.6	298.6	445.1	250.0	540.8	359.2
South Georgia	44 187.7	12 857.0	43 404.9	18 398.8	43 735.3	16 281.5	446 700.3	21 967.2
Subarea 48.3	44 580.7	13 145.9	43 914.5	18 899.0	44 197.6	16 336.0	47 241.1	22 705.6

Table 5.18: Cohort strength from surveys undertaken in Subarea 48.3 in 2002 estimated from the mixture analysis for *Champsocephalus gunnari*. Component standard deviations linearly related to cohort means (intercept constrained <15; slope constrained >0.02).

Combined UK and Russian Surveys 2002						
Sum of the observed densities = 66 486.7						
Sum of the expected densities = 63 329.9						
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Means of mixture components	-	240.787	292.27	-	361.244	409.884
Standard deviations of mixture components	-	20.889	22.148	-	23.835	25.02
Total density of each mixture component	-	41 601.5	16 621.7	-	4 188.7	940
SD of each mixture component density	-	89.878	3 575.3		1 067.9	1 089
Parameters of linear standard deviations	Intercept = 14.999	Slope = 0.244				
Length classes included	180–410 mm					
***Atlantida* (Russia) Survey 2002**						
Sum of the observed densities = 61 471.2						
Sum of the expected densities = 56 883.1						
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Means of mixture components	-	245.24	293.629	-	370.11	404.167
Standard deviations of mixture components	-	19.838	20.3358	-	22.3358	23.017
Total density of each mixture component	-	42 927.4	11 608.6	-	1 820.37	584.96
SD of each mixture component density	-	13 835.8	5 007.44	-	1 592.39	1 595.42
Parameters of linear standard deviations	Intercept = 14.933	Slope = 0.200				
Length classes included	180–440 mm					
***Dorada* (UK) Survey 2002**						
Sum of the observed densities = 108 975						
Sum of the expected densities = 104 496						
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Means of mixture components	-	233.853	289.422	-	352.69	394.606
Standard deviations of mixture components	-	21.1164	22.57	-	24.2253	25.322
Total density of each mixture component	-	53 977.3	36 889.5	-	11 689.1	2687.1
SD of each mixture component density	-	18 404.4	10 602.6	-	5 241.3	1 135.85
Parameters of linear standard deviations	Intercept = 14.9987	Slope = 0.26160				

Table 5.19: Data inputs for short-term projections of *Champsocephalus gunnari* in Subarea 48.3.

		UK Survey January 2002	Russian Survey February 2002	Combined Surveys (with UK multiplied by 1.24)
Lower single-sided 95% CI (tonnes)		18 899	13 146	22 706
		Numbers (%)	Numbers (%)	Numbers (%)
Numbers at age	2	8.385941×10^{7} (51.3)	1.247902×10^{8} (75.4)	1.140645×10^{8} (65.7)
	3	5.731126×10^{7} (35.0)	3.374485×10^{7} (20.4)	4.557261×10^{7} (26.2)
	4	0	0	0
	5	1.816019×10^{7} (11.1)	5.290802×10^{6} (3.2)	1.148295×10^{7} (6.6)
	6	4.17456×10^{6} (2.6)	1.697708×10^{6} (1.0)	2.577357×10^{6} (1.5)
	Total	1.6350542×10^{8}	1.6552356×10^{8}	1.73697417×10^{8}
Method		Length Density + CMIX	Length Density + CMIX	Length Density + CMIX
Natural mortality		0.71	0.71	0.71
Age when fully selected		3	3	3
Age when selection begins		2	2	2
von Bertalanffy	birthday (days since start of year)	245	245	245
	t_0	-0.58	-0.58	-0.58
	L_8	557.6	557.6	557.6
	k	0.17	0.17	0.17
Weight length	A (kg)	6.17E-10	6.17E-10	6.17E-10
	B	3.388	3.388	3.388
Survey timing: days since start of year		15	45	30
Catch since survey (to first year of projection)		471	471	471

Table 5.20: Yield estimates of *Champsocephalus gunnari* in Subarea 48.3 derived from the short-term projections based on the *Dorada* (UK), *Atlantida* (Russia) and the combined surveys. The final row is the combined data with the *Dorada* data multiplied by a factor of 1.24.

	Year 1 2003	Year 2 2004
Dorada (UK) Survey	1662	1006
Atlantida (Russian) Survey	1369	876
Combined survey (no correction)	1581	990
Combined (including UK*1.241)	2181	1361

Table 5.21: Densities ($n.km^{-2}$) of *Champsocephalus gunnari* (Division 58.5.2) by mean length for each component from mixture analysis derived from the 2002 survey.

Mean Length (mm)	Density
189	81
268	17
329	2539
372	16

Table 5.22: Mean length at age of *Champsocephalus gunnari* (Division 58.5.2) at the time of the 2002 survey from an application of the von Bertalanffy growth curve.

Age	Mean Length (mm)
2	234
3	296
4	340
5	373

Table 5.23: Data inputs for short-term projections of *Champsocephalus gunnari* in Division 58.5.2 (Heard Plateau population).

Category	Parameter	*C. gunnari* Heard Plateau
Survey details	Survey date	3 June 2002
	Biomass – lower 95% bound	20 510 tonnes
Mean length at age at time of survey	Age 4	325 mm
Age structure (density n.km^{-2})	Age 4	2 555
Biological parameters	Birthday	1 November
von Bertalanffy growth	t_0	0.358
	L_∞	457 mm
	k	0.323
Weight at age	Weight–length parameter A	2.629×10^{-10} kg
	Weight–length parameter B	3.515
Natural mortality	Mean annual M	0.4
Fishery parameters	Season	1 Dec–30 Nov
Selectivity	Age fully selected	3
	Age first selected	2.5

Table 5.24: Input parameters for GYM to assess γ of *Macrourus whitsoni* in Subarea 88.1 and *M. carinatus* in Division 58.5.2. All length parameters are given as total length in millimetres.

Input Parameters	*M. carinatus* 58.5.2	*M. whitsoni* 88.1		
		Both Sexes	Males	Females
L_8	635	857	783	870
k	0.088	0.048	0.05	0.068
t_0	-1.8	-3.89	-5.3	1.34
Maximum length	670+			
Oldest age in stock	55	80		
Last age in stock	25+	55		
Minimum age in stock	1	1		
Natural mortality range	0.09–0.17	0.05–0.12		
Length–weight				
A	2×10^{-9}	1.609×10^{-8}		
B	3.1159	2.8603		
Birthday	July			
Spawning season	May–September	May–September		
Fishing selectivity				
Minimum length 50%	320	440		
Maximum length 50%	320	470		
Range	160	160		
Maturity				
Minimum length 50%	417 (age 10)	460 (age 12)		
Maximum length 50%	512 (age 17)	500 (age 14)		
Range	150	260		
Recruitment*				
Minimum SD	0.099751	0.099751		
Maximum SD	0.312233	0.312233		
CV of B_0	0.5	1.184		
Data sources	WG-FSA-02/48 van Wijk et al., 2000 Alekseyeva et al., 1993	WG-FSA-02/32 WG-FSA-01/43 Alekseyeva et al., 1993		

* Standard deviation of lognormal recruitment (SD) calculated from recruitment coefficient of variation (CV) using equation:

$$SD = \sqrt{(\log_e(1+CV^2))}$$

Range given corresponds to CV of 0.1–0.32 from Myers et al. (1995). A sensitivity trial was also done using CV = 0.5–0.7 (equivalent to min SD = 0.472, max SD = 0.631).

Table 5.25: Total removals of macrourids and rajids by fishery from observer data (in tonnes). Data for Subarea 58.6 incorporates both South African and French catches. The '%' column is the by-catch as a percentage of the total target species catch.

Species Group	88.1		58.5.1		58.5.2		58.6		58.7	
	Observer	%	Observer	%	Observer	%	Observer	%	Observer	%
Macrourids	168	12	314	9	5	< 1	162	14	17	46*
Rajids	27	2	388	11	2	< 1	42	4	0.4	1

* This high figure is due to the low catch of the target species in Subarea 58.7.

Data for Subarea 88.1 derived from WG-FSA-02/40 (Table 4), WG-FSA-02/38 (Table 2) and the Secretariat database.
Data for Division 58.5.2 derived from WG-FSA-02/56 and the Secretariat database.
Data for Division 58.5.1 and French data for Subarea 58.6 derived from data files supplied to the by-catch subgroup by G. Duhamel and the Secretariat database.
Data for Subarea 58.7 and South African data for Subarea 58.6 derived from the Secretariat database and data files supplied by B. Watkins to the by-catch subgroup.
Data for Subarea 48.3 derived from the Secretariat database.

Table 5.26: Comparison of by-catch data from different sources; observer data (as total removals), fine-scale catch and effort (C2) data and STATLANT data (in tonnes).

Species Group	88.1			58.5.1			58.5.2		58.7	
	Observer	C2	STAT	Observer	C2	STAT	Observer	STAT	Observer	STAT
Macrourids	168	158	154	314	312	190	5	0	17	11
Rajids	27	25	25	388	382	118	2	0	0.4	0.2

Refer to footnotes of Table 5.25.

Table 5.27: Breakdown of total removals from Subarea 58.6 from observer and STATLANT data (in tonnes).

Species Group	France		South Africa		Total	
	Observer	STAT	Observer	STAT	Observer	STAT
Macrourids	155	150	7	8	162	158
Rajids	41	12	1	0.5	42	12.5

Refer to footnotes of Table 5.25.

Table 5.28: Comparison of by-catch data from three different sources: observer data, fine-scale catch and effort (C2) data and STATLANT data for the complete fishing season 2001/02 and the incomplete fishing season (to 30 June 2002) in Subarea 48.3 (in tonnes).

Species Group	Fishing Season 2001/02		Fishing Season 2001/02 to 30 June 2002		
	Observer*	C2	Observer*	C2	STATLANT
Macrourids	6	51	4	23	<1
Rajids	8	25	4	9	<1

* Observer data cannot be corrected for effort, i.e. observed weights only, the data is not scaled up to reflect total captures.

Refer to footnotes of Table 5.25.

Table 5.29: Number of toothfish and skate tagged and recaptured from Subarea 88.1 (from WG-FSA-02/42 and 02/38).

Species	Number Tagged	Number Recaptured	% Recaptured
Dissostichus mawsoni	1052	4	0.38%
Dissostichus eleginoides	345	1	0.29%
Amblyraja georgiana	5468	14	0.26%
Bathyraja eatoni	546	0	0%

Refer to footnotes of Table 5.25.

Table 5.30: Estimated total catch (tonnes) by subarea and division of *Dissostichus* spp. taken inside and outside the Convention Area for the 2001/02 and 2000/01 seasons[1].

2001/02 Season*

Area/Subarea/ Division	Reported Catch[2]	Estimated IUU Catch	Total CCAMLR	Catch Limit[5]
48.3	5 617	3	5 620	*5 820*
48.4	0	0	0	*28*
48.6	0	0	0	*910*
58.4.2	0	295	295	*500*
58.4.3a	0	0	0	*250*
58.4.3b	0	0	0	*300*
58.4.4	0	880	880	*103*
58.5.1	2 930	6 300	9 230	-
58.5.2	1 812	2 500	4 312	*2 815*
58.6	1 046	720	1 766	*450*
58.7	37	78	115	-
88.1	1 333	92	1 425	*2 508*
88.2	42	0	42	*250*
Total inside	12 817	10 868	23 685	
	Estimated EEZ Catch[4]	Estimated High Seas Catch	Total Outside CCAMLR[3]	
41	7 235	2 049	9 284	-
47	0	584	584	-
51	**46	***8 191	8 237	-
57	0	3 022	3 022	-
81	0	0	0	-
87	3 114	813	3 927	-
Total outside	10 395	14 659	25 054	
Global total			48 739	

(continued)

Table 5.30 (continued)

2000/01 Season

Area/ Subarea/ Division	Reported Catch[2]	Estimated IUU Catch[3]	Total CCAMLR	Catch Limit[5]
48.3	3 960	196	4156	*4 500*
48.4	0	0	0	*28*
48.6	0	0	0	*910*
58.4.2	0	0	0	*500*
58.4.3a	0	0	0	*500*
58.4.3b	0	0	0	*300*
58.4.4	9	1 247	1 256	*370*
58.5.1	4 747	4 550	9 297	-
58.5.2	2 987	2 004	4 991	*2 995*
58.6	1 127	685	1 812	*450*
58.7	235	120	355	-
88.1	660	0	660	*2 064*
88.2	0	0	0	*250*
Total inside	13 725	8 802	22 527	
	Estimated EEZ Catch[4]	Estimated High Seas Catch	Total Outside CCAMLR[3]	
41	8 358	2 784	11 142	
47		76	76	
51	24	14 168	14 192	
57		1 142	1 142	
81	26	1	27	
87	6 211	1 128	7 339	
Total outside	14 619	19 299	33 918	
Global total			56 445	

* To date (based on data available to the Secretariat on 7 October 2002)
** Reported from the South African EEZ (data from five-day catch and effort reports)
*** South African catch in EEZ was deducted from CDS data for Area 51

1 Estimated IUU catches for the 2000/2001 season were recalculated by season on a monthly pro-rata basis.
2 From catch and effort and STATLANT data. Division 58.5.1 estimated from CDS data.
3 From CDS data, converted to live weight.
4 Estimation based on CDS data and information provided to the Secretariat by Members.
5 Only as related to CCAMLR areas outside national jurisdiction.

Table 5.31: Reported catch (tonnes) and estimated catch from IUU fishing for *Dissostichus* spp. for the 1988/89 to 2001/02[1] seasons.

Season (Dec–Nov)	Inside Convention Area				Outside the Convention Area			Global Total Catch
	Reported Catch	Estimated IUU Catch	Total CCAMLR	Catch Limits[2]	Estimated EEZ Catch	Estimated High Seas Catch	Total CDS Reported Catch	
1988/89	8 652	144	8 796					8 796
1989/90	8 936	437	9 373					9 373
1990/91	5 488	1 775	7 264	2 500				7 264
1991/92	12 174	3 066	15 240	3 500				15 240
1992/93	8 357	4 019	12 375	3 590				12 375
1993/94	8 287	4 780	13 067	1 328				13 067
1994/95	10 920	1 674	12 594	3 125				12 594
1995/96	9 471	16 667	26 138	4 525				26 138
1996/97	12 398	32 673	45 071	22 138				45 071
1997/98	13 317	15 106	28 423	15 500				28 423
1998/99	13 775	5 867	19 642	13 789				19 642
1999/2000	17 664	7 644	25 308	14 293	10 236	11 116	21 352[3]	46 660
2000/01	13 725	8 802	22 527	12 867	14 619	19 299	33 918	56 445
2001/02[1]	12 817	10 868	23 685	13 934	10 395	14 659	25 054	48 739

1 To date (based on data available to the Secretariat on 7 October 2002)
2 Only as related to CCAMLR Convention Areas outside national jurisdiction
3 May to November 2000

Table 5.32: Seabed areas outside the CCAMLR Convention Area and within the likely geographic range of *Dissostichus eleginoides*. The geographic area covered in this table is depicted in Figure 5.7. Seabed areas in the CCAMLR Convention Area are published in the *CCAMLR Statistical Bulletin* (see Volume 14, Section E). Source: Sandwell and Smith bathymetry data (2 x 2 minute grids).

Region	Description	Boundaries				Seabed Area (km^2) within Depth Range (m)			
		North	South	West	East	0–300	300–500	500–600	600–1 800
Southeast Atlantic	in Area 41, adjacent to Subarea 48.6	47°S	50°S	20°W	30°E	71	197	178	10 703
Western Indian Ocean	in Area 51, adjacent to Area 58	40°S	45°S	30°E	80°E	2	0	12	30 007
Eastern Indian Ocean	in Area 57, adjacent Division 58.4.1	50°S	55°S	80°E	150°E	49	16	8	2 421
Southwest Pacific	in Area 81, adjacent Area 88 150–180°E	50°S	60°S	150°E	180°E	33 410	59 042	59 940	188 341
Southwest Pacific	in Area 81, adjacent Area 88 105–180°W	50°S	60°S	180°W	105°W	0	13	16	3 610
Southeast Pacific	in Area 87, adjacent Subarea 88.3 80–105°W	50°S	60°S	105°W	80°W	0	0	0	170
Southeast Pacific	in Area 87, adjacent Subarea 88.3 70–80°W	50°S	60°S	80°W	70°W	74 766	5 045	1 458	17 242
East Pacific	in Area 87, adjacent to southern Chile	35°S	50°S	80°W	coast	107 156	15 263	4 449	42 492
East Pacific	in Area 87, adjacent to Chile and Peru	20°S	35°S	80°W	coast	16 800	8 347	3 655	35 628
Southwest Atlantic	in Area 41, adjacent to Subarea 48.1	50°S	60°S	70°W	50°W	362 569	54 017	18 233	115 838
West Atlantic	in Area 41, adjacent to Argentina	35°S	50°S	coast	50°W	746 453	41 287	13 762	159 439
	Total					1 341 276	183 227	101 711	605 892

Table 6.1: Incidental mortality of seabirds in longline fisheries for *Dissostichus* spp. in Subareas 48.3, 58.6, 58.7, 88.1 and 88.2 during the 2001/02 season. Sp – Spanish method; A – autoliner; N – night setting; D – daytime setting (including nautical dawn and dusk); O – opposite side to hauling.

Vessel	Dates of Fishing	Method	Sets Deployed				No. of Hooks (thousands)			Hooks Baited (%)	No. of Birds Caught						Observed Seabird Mortality (birds/1 000 hooks)			Streamer Line in Use (%)		Offal Discharge during Haul (%)
											Dead		Alive		Total							
			N	D	Total	%N	Obs.	Set	% Observed		N	D	N	D	N	D	N	D	Total	N	D	
Subarea 48.3																						
Eva 1	20/5–28/6/02	Sp	57	3	60	95	133.0	518.2	25	100	0	0	0	0	0	0	0	0	0	93	100	O (97)
Isla Camila	2/5–6/7/02	Sp	142	7	149	95	153.5	792.6	19	100	0	0	0	0	0	0	0	0	0	93	100	O (77)
No. 1 Moresko	1/5–7/7/02	Sp	112	0	112	100	226.1	968.6	23	100	0	0	0	0	0	0	0	0	0	99		O (83)
Isla Santa Clara	1/5–25/7/02	Sp	163	0	163	100	231.1	1156.7	19	100	0	0	4	0	4	0	0	0	0	99		O (87)
Argos Georgia	1/5–31/7/02	Sp	298	0	298	100	211.9	970.0	21	100	0	0	0	0	0	0	0	0	0	96		O (70)
Lyn	1/5–18/7/02	Sp	176	0	176	100	292.1	1346.7	21	100	0	0	0	0	0	0	0	0	0	98		O (87)
Ibsa Quinto	1/5–21/8/02	Sp	166	0	166	100	406.8	1723.4	23	100	0	0	5	0	5	0	0	0	0	88		O (100)
Polarpesca 1	18/5–14/8/02	Sp	204	1	205	99.5	233.7	1020.4	22	100	0	0	4	0	4	0	0	0	0	100	100	O (100)
Isla Alegranza	6/5–9/8/02	Sp	160	0	160	100	370.3	1531.9	24	100	0	0	7	0	7	0	0	0	0	96		O (93)
Viking Bay	1/5–9/8/02	Sp	221	3	224	99	242.8	1152.2	21	100	0	0	4	0	4	0	0	0	0	100	100	O (87)
Koryo Maru No. 11	1/5–2/8/02	Sp	147	0	147	100	299.9	1409.2	21	100	0	0	2	0	2	0	0	0	0	97		O (83)
Atlantic No. 52	26/5–22/8/02	Sp	154	0	154	100	240.4	1137.8	21	100	4	0	2	0	6	0	0.017	0	0.017	82		O (98)
Jacqueline	1/5–218/02	Sp	149	7	156	96	408.4	1713.2	23	100	2	0	3	0	5	0	0.005	0	0.005	100	100	O (86)
Argos Helena	1/5–6/8/02	Sp	191	0	191	100	397.3	1275.1	31	100	0	0	6	0	6	0	0	0	0	100		O (100)
Eva 1	2/7–11/8/02	Sp	75	0	75	100	120.7	564.5	21	98	0	0	0	0	0	0	0	0	0	89		O (96)
Tierra del Fuego	22/5–11/8/02	Sp	134	5	139	96	168.3	740.2	22	100	0	0	0	0	0	0	0	0	0	96	100	O (98)
Total						99	3968.0	17280.5	22		6	0	37	0	43	0	0.0015	0.0	0.0015			
Subareas 58.6 and 58.7																						
Suidor One	13/11–8/12/01	Sp	24	0	24	100	24.0	259.7	9	100	0	0	0	0	0	0	0	0	0	100		O (100)
Koryo Maru 11	8/2–4/4/02	Sp	87	2	89	98	538.3	909.3	59	100	0	0	4	0	4	0	0	0	0	100	100	O (100)
Suidor One	27/4–16/5/02	Sp	18	0	18	100	60.6	143.0	42	100	0	0	1	0	1	0	0	0	0	100		O (100)
Total						99	622.9	1312.0	37		0	0	5	0	5	0	0	0	0			
Subareas 88.1 and 88.2																						
Janas	8/1–21/3/02	A	18	157	175	10	415.0	1034.7	40	94	0	0	0	0	0	0	0	0	0	100	100	(0)
San Aotea II	17/1–19/5/02	A	33	160	193	17	463.0	1031.7	44	88	0	0	0	0	0	0	0	0	0	100	100	(0)
Janas	4/4–2/6/02	A	49	17	66	74	159.7	354.1	45	92	0	0	0	0	0	0	0	0	0	100	100	(0)
Total						33	1037.7	2420.5	43		0	0	0	0	0	0	0	0	0			

Table 6.2: Estimated total seabird mortality by vessel for Subarea 48.3 during the 2001/02 season.

Vessel	Hooks Observed (thousands)	Hooks Set (thousands)	% Hooks Observed	% Night Sets	Estimated Number of Birds Caught Dead		
					Night	Day	Total
Eva 1	133.0	518.2	25	95	0	0	0
Isla Camila	153.5	792.6	19	95	0	0	0
No. 1 Moresko	226.1	968.6	23	100	0	0	0
Isla Santa Clara	231.1	1156.7	19	100	0	0	0
Argos Georgia	211.9	970.0	21	100	0	0	0
Lyn	292.1	1346.7	21	100	0	0	0
Ibsa Quinto	406.8	1723.4	23	100	0	0	0
Polarpesca 1	233.7	1020.4	22	99.5	0	0	0
Isla Alegranza	370.3	1531.9	24	100	0	0	0
Viking Bay	242.8	1152.2	21	99	0	0	0
Koryo Maru No. 11	299.9	1409.2	21	100	0	0	0
Atlantic No. 52	240.4	1137.8	21	100	19	0	19
Jacqueline	408.4	1713.2	23	96	8	0	8
Argos Helena	397.3	1275.1	31	100	0	0	0
Eva 1	120.7	564.5	21	100	0	0	0
Tierra del Fuego	168.3	740.2	22	96	0	0	0
Total					27	0	27

Table 6.3: Total estimated seabird by-catch and by-catch rate (birds/thousand hooks) in longline fisheries in Subareas 48.3, 58.6 and 58.7 from 1997 to 2002.

Subarea	Year					
	1997	1998	1999	2000	2001	2002
48.3						
Estimated by-catch	5 755	640	210*	21	30	27
By-catch rate	0.23	0.032	0.013*	0.002	0.002	0.0015
58.6, 58.7						
Estimated by-catch	834	528	156	516	199	0
By-catch rate	0.52	0.194	0.034	0.046	0.018	0

* Excluding *Argos Helena* line-weighting experiment cruise.

Table 6.4: Species composition of birds killed in longline fisheries in Subareas 48.3 during the 2001/02 season. N – night setting; D – daylight setting (including nautical dawn and dusk); MAI – southern giant petrel; PRO – white-chinned petrel; DAC – Cape petrel; MAH – giant petrel; ( ) – % composition.

Vessel	Dates of Fishing	No. Birds Killed by Group						Species Composition (%)			
		Albatross		Petrels		Total					
		N	D	N	D	N	D	MAI	PRO	DAC	MAH
Eva 1	20/5–28/6/02	0	0	0	0	0	0				
Isla Camila	2/5–6/7/02	0	0	0	0	0	0				
No. 1 Moresko	1/5–7/7/02	0	0	0	0	0	0				
Isla Santa Clara	1/5–25/7/02	0	0	0	0	0	0				
Argos Georgia	1/5–31/7/02	0	0	0	0	0	0				
Lyn	1/5–18/7/02	0	0	0	0	0	0				
Ibsa Quinto	1/5–21/8/02	0	0	0	0	0	0				
Polarpesca 1	18/5–14/8/02	0	0	0	0	0	0				
Isla Alegranza	6/5–9/8/02	0	0	0	0	0	0				
Viking Bay	1/5–9/8/02	0	0	0	0	0	0				
Koryo Maru No. 11	1/5–2/8/02	0	0	0	0	0	0				
Atlantic No. 52	26/5–22/8/02	0	0	4	0	4	0	2 (50)		1 (25)	1 (25)
Jacqueline	1/5–218/02	0	0	2	0	2	0	2 (100)			
Argos Helena	1/5–6/8/02	0	0	0	0	0	0				
Eva 1	2/7–11/8/02	0	0	0	0	0	0				
Tierra del Fuego	22/5–11/8/02	0	0	0	0	0	0				
Total %		0	0	6	0	6	0	4 (66)		1 (17)	1 (17)

Table 6.5: Vessel compliance (%) with Conservation Measure 29/XIX during the 2001/02 season based on data from scientific observers. Those vessels that reached 95% of the minimum requirement of all elements of the conservation measure are in bold. Values for night setting and streamer line setting are absolute proportions for all sets by each vessel. Values for offal discharge and streamer line design are averages across all cruises by each vessel; line weighting is expressed as a percentage of the minimum requirement (6 kg every 20 m or 8.5 kg every 40 m). CHL – Chile; ESP – Spain; GBR – United Kingdom; KOR – Republic of Korea; NZL – New Zealand; RUS – Russia; URY – Uruguay; ZAF – South Africa.

Area/Vessel	Number of Cruises	Night Setting	Offal Discharge	Line Weighting		Streamer Line	
				Distance	Weight	Setting	Design
Subarea 48.3							
Eva 1 (RUS)	2	98	100	100	90	91	0
Isla Camila (CHL)	1	95	100	100	100	93	100
***No. 1 Moresko* (KOR)**	**1**	**100**	**100**	**100**	**99**	**99**	**100**
***Isla Santa Clara* (CHL)**	**1**	**100**	**100**	**100**	**100**	**99**	**100**
***Argos Georgia* (GBR)**	**1**	**100**	**100**	**100**	**100**	**96**	**100**
***Lyn* (GBR)**	**1**	**100**	**100**	**100**	**100**	**98**	**100**
Ibsa Quinto (ESP)	1	100	100	100	96	88	100
***Polarpesca 1* (CHL)**	**1**	**99.5**	**100**	**100**	**100**	**100**	**100**
Isla Alegranza (URY)	1	100	100	100	92	96	100
Viking Bay (ESP)	1	99	100	100	76	100	100
Koryo Maru No. 11 (ZAF)	1	100	100	100	100	97	0
Atlantic No. 52 (URY)	1	100	100	100	65	82	100
***Jacqueline* (GBR)**	**1**	**96**	**100**	**100**	**100**	**100**	**100**
***Argos Helena* (GBR)**	**1**	**100**	**100**	**100**	**100**	**100**	**100**
***Tierra del Fuego* (CHL)**	**1**	**100**	**100**	**100**	**100**	**96**	**100**
Subareas 58.6 and 58.7							
Suidor One (ZAF)	2	100	100	100	71	100	100
***Koryo Maru No. 11* (ZAF)**	**1**	**98**	**100**	**100**	**100**	**100**	**100**
Subareas 88.1 and 88.2							
Janas* (NZL)	**2**	**28**	**100**	**Autoline**		**100**	**100**
San Aotea II* (NZL)	**1**	**17**	**100**	**Autoline**		**100**	**100**

* Conservation Measure 216/XX allows fishing in Subarea 88.1 during daylight periods if the vessel can demonstrate a minimum sink rate of 0.3 m/s.

Table 6.6: Compliance, as reported by scientific observers, of streamer lines with the minimum specifications set out in Conservation Measure 29/XIX during the 2001/02 season. Y: yes; N: no; -: no information; A: autoliner; Sp: Spanish; CHL – Chile; ESP – Spain; GBR – United Kingdom; KOR – Republic of Korea; NZL – New Zealand; RUS – Russia; URY – Uruguay; ZAF – South Africa.

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 (%)	
				Attachment, Height above Water (m)	Total Length (m)	No. Streamers per Line	Spacing of Streamers per Line (m)		Night	Day
Subarea 48.3										
Eva 1 (RUS)	20/5–28/6/02	Sp	N	Y (7)	N (125)	Y (5)	Y (5)	-	93	100
Isla Camila (CHL)	2/5–6/7/02	Sp	Y	Y (5.5)	Y (150)	Y (5)	Y (5)	Y (3–1.5)	93	100
No. 1 Moresko (KOR)	1/5–7/7/02	Sp	Y	Y (6)	Y (165)	Y (5)	Y (5)	Y (4–2)	99	
Isla Santa Clara (CHL)	1/5–25/7/02	Sp	Y	Y (5)	Y (150)	Y (5)	Y (5)	Y (3.5–1.5)	99	
Argos Georgia (GBR)	1/5–31/7/02	Sp	Y	Y (6.3)	Y (150)	Y (30)	Y (5)	Y (3.5–1.5)	96	
Lyn (GBR)	1/5–18/7/02	Sp	Y	Y (10)	Y (155)	Y (7)	Y (5)	Y (3)	98	
Ibsa Quinto (ESP)	1/5–21/8/02	Sp	Y	Y (8)	Y (162)	Y (6)	Y (5)	-	88	
Polarpesca 1 (CHL)	18/5–14/8/02	Sp	Y	Y (5.7)	Y (150)	Y (5)	Y (5)	Y (3.7–1.4)	100	100
Isla Alegranza (URY)	6/5–9/8/02	Sp	Y	Y (6.5)	Y (163)	Y (5)	Y (5)	-	96	
Viking Bay (ESP)	1/5–9/8/02	Sp	Y	Y (8)	Y (162)	Y (5)	Y (5)	Y (3.8–1.4)	100	100
Koryo Maru No. 11 (ZAF)	1/5–2/8/02	Sp	N	N (4)	Y (155)	Y (10)	Y (5)	Y (5–2.5)	97	
Atlantic No. 52 (URY)	26/5–22/8/02	Sp	Y	Y (5)	Y (154)	Y (10)	Y (5)	Y (3.5–1.3)	82	
Jacqueline (GBR)	1/5–22/8/02	Sp	Y	Y (7)	Y (150)	Y (5)	Y (5)	Y (3.9–2)	100	100
Argos Helena (GBR)	1/5–6/8/02	Sp	Y	Y (5)	Y (150)	Y (5)	Y (5)	Y(3.5–1.5)	100	
Tierra del Fuego (CHL)	15/5–19/8/02	Sp	Y	Y (5)	Y (153)	Y (30)	Y (5)	Y (5–1)	89	
Eva 1 (RUS)	30/6–31/8/02	Sp	N	Y (6.9)	N (110)	Y (7)	Y (5)	Y (4–1.2)	96	100
Subareas 58.6 and 58.7										
Suidor One (ZAF)	13/11–8/12/01	Sp	Y	Y (4.5)	Y (150)	Y (5)	Y (5)	Y(3.5–1.2)	100	
Koryo Maru No. 11 (ZAF)	8/2–4/4/02	Sp	Y	Y (6)	Y (155)	Y (5)	Y (5)	Y(5.5–3.5)	100	100
Suidor One (ZAF)	27/4–16/5/02	Sp	Y	Y (5.3)	Y (160)	Y (7)	Y (5)	Y(3.0–.4)	100	
Subarea 88.1										
Janas (NZL)	8/1–21/3/02	A	Y	Y (6)	Y (170)	Y (21)	Y (5)	Y (5–1.5)	100	100
San Aotea II (NZL)	17/1–19/5/02	A	Y	Y (4.5)	Y (155)	Y (12)	Y (4)	Y (9–1.6)	100	100
Janas (NZL)	4/4–2/6/02	A	Y	Y (6)	Y (200)	Y (21)	Y (25)	Y (3.8–1)	100	100

Table 6.7: Summary of compliance with Conservation Measure 29/XIX, based on data from scientific observers from 1996/97 to 2001/02 season. Values in parentheses are % of observer records that were complete. na – not applicable.

Subarea/ Time	Line Weighting (Spanish System Only)				Night Setting (% Night)	Offal Discharge (%) Opposite Haul		Streamer Line Compliance (%)										Total Catch Rate (birds/1 000 hooks)	
	Compliance %		Median Weight (kg)	Median Spacing (m)				Overall		Attached Height		Total Length		No. Streamers		Distance Apart		Night	Day
Subarea 48.3																			
1996/97	0	(91)	5	45	81	0	(91)	6	(94)	47	(83)	24	(94)	76	(94)	100	(78)	0.18	0.93
1997/98	0	(100)	6	42.5	90	31	(100)	13	(100)	64	(93)	33	(100)	100	(93)	100	(93)	0.03	0.04
1998/99	5	(100)	6	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	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
Division 58.4.4																			
1999/00	0	(100)	5	45	50	0	(100)	0	(100)	100	(100)	0	(100)	Y	(100)	100	(100)	0	0
Subareas 58.6 and 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
Subarea 88.1																			
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

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 and 216/XX allowed vessels to undertake daytime setting south of 65°S in Subarea 88.1 if they could demonstrate a sink rate of 0.3 m/s.

Table 6.8: Bird by-catch (death rate) calculated from 1997 data from the *Dissostichus* spp. fishery in Subarea 48.3, assuming a summer end date of 1 April, used to bootstrap the model in WG-FSA-02/04 (taken from WG-FSA-02/05, Table 5).

Season	Vessel Name	Cruise ID	Hooks Set (thousand)	Hooks Observed (thousand)	Number of Birds Dead	Death Rate (n/1 000 hooks)
Summer	*Argos Helena*	9	303.49	91.91	142	1.545
Summer	*Cisne Verde*	6	99.84	10.244	4	0.390
	Elqui	7	183.6	73.2	36	0.492
	Isla Camila	17	322.72	58.055	43	0.741
	Isla Isabel	11	186.56	21.648	252	11.641
Winter	*Argos Helena*	9	949.35	189.3	14	0.074
	Cisne Verde	6	366.34	89.329	4	0.045
	Cisne Verde	8	951.88	411.41		0.000
	Elqui	7	324	152	15	0.099
	Elqui	29	695.42	639.17		0.000
	Elqui	10	456.94	326.08		0.000
	Ercilla	14	512.35	316.91	24	0.076
	Ercilla	15	343.98	157.94		0.000
	Ercilla	16	243.74	152.42		0.000
	Ibsa Quinto	25	1178.1	353.05	34	0.096
	In Sung 66	28	1345.8	328.26		0.000
	Isla Camila	18	489.29	93.45	9	0.096
	Isla Camila	19	459.84	44.268		0.000
	Isla Isabel	12	537.1	289.8	4	0.014
	Isla Isabel	13	431.21	199.7		0.000
	Jacqueline	20	380.93	19.84	10	0.504
	Jacqueline	21	683.03	41.71	6	0.144
	Koryo Maru No. 11	39	820.4	820.4	1	0.001
	Pescarosa Primero	26	288.52	236.04	2	0.008
	Pescarosa Primero	27	163.2	137.73		0.000

Table 6.9: Summary of IMAF risk level and assessment in relation to proposed new and exploratory longline fisheries in 2002/03. Risk scales are as follows: 1 – Low; 2 – Average-to-Low; 3 – Average; 4 – Average-to-High; 5 – High. Text in bold indicates issues needing resolution.

Area	Risk Scale	IMAF Risk Assessment	Notes
48.6 north of 60°S	2	Average-to-low risk – southern part of area (south of c. 55°S) of low risk; no obvious need for restriction of longline fishing season. Ensure strict compliance with Conservation Measure 29/XIX as a seabird by-catch precautionary measure. Fishing during daytime only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• South Africa (CCAMLR-XXI/6) proposes to fish during a season to be established at CCAMLR-XXI. State their acceptance of IMAF assessments and intent to comply with Conservation Measure 29/XIX. Proposal does not conflict with advice provided.
48.6	2	Average-to-low risk – southern part of area (south of c.55°S) of low risk; no obvious need for restriction of longline fishing season. Ensure strict compliance with Conservation Measure 29/XIX as a seabird by-catch precautionary measure. Fishing during daytime only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• Japan (CCAMLR-XXI/9) proposes to fish during a season to be established at CCAMLR-XXI. Intend to comply with Conservation Measure 29/XIX noting that 'some variation to application of paragraph 3 within Subareas 88.1 and 88.2 has been allowed by the Commission.' Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX). • New Zealand (CCAMLR-XXI/8) proposes to fish north of 60°S from 1 March 2003 to 31 August 2003, and south of 60°S from 15 February 2003 to 15 October 2003. Two scientific observers, 24-hour observer coverage proposed. Intend to comply fully with Conservation Measure 29/XIX north of 60°S. For fishing south of 60°S, a variation to Conservation Measure 29/XIX is sought consistent with the approaches approved by CCAMLR in Conservation Measures 216/XX (line-weighting trials) and 229/XX (three-bird limit for daylight setting). Proposal does not conflict with advice provided.

(continued)

Table 6.9 (continued)

Area	Risk Scale	IMAF Risk Assessment	Notes
58.4.2	2	Average-to-low risk. Ensure strict compliance with Conservation Measure 29/XIX. Prohibit longline fishing during the breeding season of giant petrels (October to March). Fishing at other times only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• Australia (CCAMLR-XXI/12) proposes to fish from 1 January to 31 March 2003. Intend to 'comply with or exceed Conservation Measure 29/XIX', specifically through offal retention and use of twin streamer lines. Seek exemption to night-setting requirements through achieving a sink rate of at least 0.3 m/s to a depth of 15 m as specified in Conservation Measure 216/XX. Proposal does not conflict with advice provided. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX).
58.4.3a	3	Average risk. Ensure strict compliance with Conservation Measure 29/XIX. Prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (September to April). Fishing at other times only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• Japan (CCAMLR-XXI/9) proposes to fish during a season to be established at CCAMLR-XXI. Intend to comply with Conservation Measure 29/XIX noting that 'some variation to application of paragraph 3 within Subareas 88.1 and 88.2 has been allowed by the Commission.' Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX). • Australia (CCAMLR-XXI/11) proposes to fish from 1 May to 31 August 2003. Intend to 'comply with or exceed Conservation Measure 29/XIX', specifically through offal retention, use of twin streamer lines, and achieving a sink rate of at least 0.3m/s to a depth of 15 m as specified in Conservation Measure 216/XX. Proposal does not conflict with advice provided.
58.4.3b	3	Average risk. Ensure strict compliance with Conservation Measure 29/XIX. Prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (September to April). Fishing at other times only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• Japan (CCAMLR-XXI/9) proposes to fish during a season to be established at CCAMLR-XXI. Intend to comply with Conservation Measure 29/XIX noting that 'some variation to application of paragraph 3 within Subareas 88.1 and 88.2 has been allowed by the Commission.' Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX).

(continued)

Table 6.9 (continued)

Area	Risk Scale	IMAF Risk Assessment	Notes
58.4.4	3	Average risk. Ensure strict compliance with Conservation Measure 29/XIX. Prohibit longline fishing during the breeding season of albatrosses and petrels (September to April). Fishing at other times only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• Japan (CCAMLR-XXI/9) proposes to fish during a season to be established at CCAMLR-XXI. Intend to comply with Conservation Measure 29/XIX noting that 'some variation to application of paragraph 3 within Subareas 88.1 and 88.2 has been allowed by the Commission.' Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX). • South Africa (CCAMLR-XXI/6) proposes to fish during a season to be established at CCAMLR-XXI. State their acceptance of IMAF assessments and intent to comply with Conservation Measure 29/XIX. Proposal does not conflict with advice provided. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (e.g. Conservation Measures 235/XX and 236/XX).
58.5.2	4	Average-to-high risk. Prohibit longline fishing within the breeding season of the main albatross and petrel species (September to April). Ensure strict compliance with Conservation Measure 29/XIX.	• Australia (CCAMLR-XXI/11) proposes to fish from 1 May to 31 August 2003. Intend to 'comply with or exceed Conservation Measure 29/XIX', specifically through offal retention, use of twin streamer lines, and achieving a sink rate of at least 0.3 m/s to a depth of 15 m as specified in Conservation Measure 216/XX. Proposal does not conflict with advice provided.
58.6	5	High risk. Prohibit longline fishing during the main albatross and petrel breeding season (September to April); ensure strict compliance with Conservation Measure 29/XIX.	• Japan (CCAMLR-XXI/9) proposes to fish during a season to be established at CCAMLR-XXI. Intend to comply with Conservation Measure 29/XIX noting that 'some variation to application of paragraph 3 within Subareas 88.1 and 88.2 has been allowed by the Commission.' Proposal does not conflict with advice provided. • South Africa (CCAMLR-XXI/6) proposes to fish during a season to be established at CCAMLR-XXI. State their acceptance of IMAF assessments and intent to comply with Conservation Measure 29/XIX. Proposal does not conflict with advice provided.

(continued)

Table 6.9 (continued)

Area	Risk Scale	IMAF Risk Assessment	Notes
88.1	3	Average risk overall. Average risk in northern sector (*D. eleginoides* fishery), average-to-low risk in southern sector (*D. mawsoni* fishery). Longline fishing season limits of uncertain advantage. Ensure strict compliance with Conservation Measure 29/XIX as a seabird by-catch precautionary measure. Fishing during daytime only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• Japan (CCAMLR-XXI/9) proposes to fish during a season to be established at CCAMLR-XXI. Intend to comply with Conservation Measure 29/XIX noting that 'some variation to application of paragraph 3 within Subareas 88.1 and 88.2 has been allowed by the Commission.' Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX). • New Zealand (CCAMLR-XXI/7) proposes to fish from 1 December 2002 to 31 August 2003. State their intent to comply with Conservation Measures 29/XIX and 10/XIX. Intend to comply fully with Conservation Measure 29/XIX north of 65°S. For fishing south of 65°S, a variation to Conservation Measure 29/XIX is sought to allow daytime setting consistent with the approaches approved by CCAMLR in Conservation Measures 235/XX and 236/XX (three-bird limit for daylight setting). New Zealand also proposes that all vessels fishing are subject to Conservation Measure 216/XX (line-weighting trials). New Zealand also proposes fishing be prohibited within 10 n miles of 23 significant seabird and marine mammal breeding sites, and within 10 n miles of the Antarctic coastline on a precautionary basis. Proposal does not conflict with advice provided by IMAF, but IMAF has no data to assess the utility of the 10 n miles exclusion zones. • Russia (CCAMLR-XXI/16) proposes to fish from 1 December 2002 to 31 August 2003. State their intent to comply with Conservation Measure 29/XIX. **Compliance with Conservation Measure 235/XX (three-bird limit for daylight setting) uncertain.** Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX).

(continued)

Table 6.9 (continued)

Area	Risk Scale	IMAF Risk Assessment	Notes
88.1 (continued)			• South Africa (CCAMLR-XXI/6) proposes to fish during a season to be established at CCAMLR-XXI. State their acceptance of IMAF assessments and note some relaxation of daytime setting has been accepted by CCAMLR in Conservation Measure 235/XX. State intent to comply with Conservation Measure 29/XIX. Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX). • Spain (CCAMLR-XXI/6) proposes to fish from 1 December 2002 to 31 August 2003, subject to changes imposed by CCAMLR. State their acceptance of all conservation measures developed for this fishery, and in particular Conservation Measures 29/XIX, 216/XX (line weighting trials) and 235/XX (three-bird limit for daylight setting). Proposal does not conflict with advice provided.
88.2		Low risk. No obvious need for restriction of longline fishing season. Ensure strict compliance with Conservation Measure 29/XIX as a seabird by-catch precautionary measure. Fishing during daytime only permitted under the provisions currently prescribed under Conservation Measure 216/XX. In addition, vessels that catch a total of three (3) birds shall revert to night setting.	• Japan (CCAMLR-XXI/9) proposes to fish during a season to be established at CCAMLR-XXI. Intend to comply with Conservation Measure 29/XIX noting that 'some variation to application of paragraph 3 within Subareas 88.1 and 88.2 has been allowed by the Commission.' Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX). • New Zealand (CCAMLR-XXI/7) proposes to fish from 1 December 2002 to 31 August 2003. State their intent to comply with Conservation Measures 29/XIX and 210/XIX. Intend to comply fully with Conservation Measure 29/XIX north of 65°S. For fishing south of 65°S, a variation to Conservation Measure 29/XIX is sought to allow daytime setting consistent with the approach approved by CCAMLR in Conservation Measure 236/XX (3-bird limit for daylight setting). New Zealand also proposes that all vessels fishing are subject to Conservation Measure 216/XX (line-weighting trials).

(continued)

Table 6.9 (continued)

Area	Risk Scale	IMAF Risk Assessment	Notes
88.2 (continued)			New Zealand also proposes fishing be prohibited within 10 n miles of the Antarctic coastline on a precautionary basis. Proposal does not conflict with advice provided by IMAF, but IMAF has no data to assess the utility of the 10 n miles exclusion zones. • Russia (CCAMLR-XXI/16) proposes to fish from 1 December 2002 to 31 August 2003. State their intent to comply with Conservation Measure 29/XIX. **Compliance with Conservation Measure 236/XX (three-bird limit for daylight setting) uncertain.** Proposal does not conflict with advice provided by IMAF, subject to acceptance of provisions of Conservation Measure 216/XX. A maximum limit of three birds caught should be applied to daylight setting as required for fishing in other lower risk areas (Conservation Measures 235/XX and 236/XX).

Table 6.10: Interactions between marine mammals and longline vessels fishing for toothfish, taken from WG-FSA-02/12 Rev. 1 and reports of scientific observers.

Subarea	Year	Cruises where Interaction Occurred	Killer Whale	Sperm Whale	Fur Seal	Unknown
Subarea 48.3	1999	13 of 17	12	1	5	0
	2000	9 of 26	6	3	3	1
	2001	11 of 15	5	4	4	0
Subareas 58.6/58.7	1999	9 of 12	6	4	0	3
	2000	9 of 11	7	6	0	2
	2001	1 of 3	1	0	0	0

Table 6.11: Details of the number of seabirds captured in trawl fisheries in Subarea 48.3, taken from WG-FSA-02/12 Rev. 1 and reports of scientific observers. DIM – black-browed albatross, PRO – white-chinned petrel, PAC – Antarctic prion; nr – not recorded.

Vessel	Dates	Days Fishing	No. of Trawls	% Trawls Ob-served	Birds Dead	DIM	PRO	PAC	Birds Re-leased	DIM	PRO
Zakhar Sorokin	20/12–05/02	48	185	94	7	3	4		nr		
In Sung Ho	31/12–18/02	37	87	100	21	3	17	1	18	1	17
Robin M. Lee	23/12–15/02	32	85	94	19	4	15		25	7	18
Bonito	15/12–09/02	40	68	100	5	2	3		1	1	
Argos Vigo	15/12–16/02	29	60	100	21	8*	13*		8	4	4
Total					73	20	52	1	52	13	39

* Includes two birds observed killed but not brought on board

Table 6.12: Nature and timing of offal discharge (proportion of total sets/hauls) and status of deck lighting of vessels involved in trawl fisheries for icefish in Subarea 48.3, taken from reports of scientific observers.

Vessel	Offal Discharged Setting/Hauling	Deck Lighting
Zakhar Sorokin	0 / 0	No information
In Sung Ho	No information	Details provided
Robin M. Lee	0 / 0	Details provided
Bonito	9% / 7%	Details provided
Argos Vigo	7% / 0	No information

Table 9.1: Draft timetable for the Subgroup on Assessment Methods to prepare for WG-FSA in October 2003.

December 2002	Circular on the workplan of the subgroup.
1 June	Receive papers for consideration at an August meeting, including papers on: (i) new and existing assessment methods and, where possible, evaluations of the methods; (ii) new data and/or estimates of parameters; and (iii) proposed timetable for providing new data and/or estimates of parameters with details as to the methods being used to obtain/develop them. These could be used for preparing for WG-FSA in October 2003.
Early August	Four-day meeting of Subgroup on Assessment Methods prior to WG-EMM (a host will be needed). Report will be available following WG-EMM.
Early September	Receive updates on progress to provide methods and estimates of parameters for use at WG-FSA.
Beginning of WG-FSA	Report of the subgroup (not including the report of the meeting), including: (i) available methods and parameters estimates for use at WG-FSA; and (ii) a provisional work plan for assessments to be undertaken at WG-FSA in October 2003.

Table 12.1: List of tasks identified by WG-FSA for the 2002/03 intersessional period. The paragraph numbers (Ref.) refer to this report unless stated otherwise. Tasks identified by ad hoc WG-IMAF are listed in Appendix D. Priority: high priority (1); general request (2). Subgroups: Subgroup on assessment methods (SGassessment), Subgroup on biology, ecology and demography (SGbiology); Subgroup on sampling catches from longlines (SGsampling); Subgroup on fisheries acoustics (SGacoustic); CCAMLR Otolith Network (CON).

	Task	Ref.	Priority	Action Required	
				Members/Subgroups	Secretariat
	Organisation of the meeting				
1.	For this year only, collate background papers arising from the meeting into a bound companion volume to the report of WG-FSA.	2.2	1		Coordinate and implement
2.	Submit papers to WG-FSA-03 one week before meeting.	2.6	1	Members to implement	Coordinate and implement
	Review of available information				
3.	Complete loading of all fishery surveys reported to CCAMLR.	3.2	1		Implement
4.	Create database shell for submission of survey data.	3.3	1	Data originators to use	Coordinate and implement
5.	Develop protocol for updating and correcting data in the survey database.	3.4–3.8	1	Data originators to collaborate	Coordinate and implement
6.	Provide data files with password protection during meetings, and then archive these files.	3.9	1	Participants to be aware of the Rules of Access and Use of CCAMLR Data	Coordinate and implement
7.	Retain some older versions of operating systems to allow use of older software.	3.10	2		Implement
8.	Update information on catches of target species.	3.13	1		Implement
9.	Update estimates of reported catches, catches from IUU fishing and total removals by season and area within the Convention Area.	3.16	1	Members to provide information on IUU fishing	Coordinate and implement
10.	Update estimates of catches reported in CDS data by season and area outside the Convention Area.	3.16	1		Implement
11.	Update information on scientific observations.	3.26	1		Implement
12.	Provide a program to calculate times of nautical dawn and dusk.	10.3	1	Technical coordinators to distribute to observers	Coordinate and implement

(continued)

Table 12.1 (continued)

	Task	Ref.	Priority	Action Required	
				Members/Subgroups	Secretariat
13.	Development of acoustic techniques for assessing fish stocks.	3.43	2	SGassessment to implement	
14.	Provide accurate reporting of by-catch by vessels and Flag States.	5.184, 13.9	1	Members to implement	Remind
	Preparation of assessments				
15.	Prepare catch-weighted length-frequency plots for the fishery for *D. eleginoides* in Subarea 48.3.	5.73	1		Implement
16.	Develop species profiles.	2.1, 4.9	1	SGbiology to implement	
17.	Develop assessment manual.	2.1, 4.9, 9.2	1	SGassessment to imp lement	
	Assessments and management advice				
18.	Further examine survey design and how variability in survey catchability may be incorporated in assessments.	5.69	2	Members to implement	Remind
19.	Re-examine acoustic data for *C. gunnari* and provide robust estimate of biomass.	3.43	1	SGacoustic to coordinate and implement	
20.	Conduct experiments on crab survival.	5.144	2	Members and Technical coordinators to implement	Remind
21.	Submit data on male cheliped height and length for *Paralomis* spp. in Subarea 48.3.	5.146	1	Data originator to implement	Coordinate and implement
22.	Conduct a more comprehensive analysis of size of male maturity of *Paralomis* spp. in Subarea 48.3.	5.146	2	Members to implement	Remind
23.	Transfer all relevant national data on by-catch to the CCAMLR database.	5.171	2	Members to implement	Remind
24.	Conduct further studies of survivorship of discarded rajids.	5.195, 10.20	2	Members to implement	Remind
25.	Conduct further studies on issues surrounding the by-catch of rajids.	5.196	2	Members to implement	Remind

(continued)

Table 12.1 (continued)

	Task	Ref.	Priority	Action Required	
				Members/Subgroups	Secretariat
26.	Designate more appropriate boundaries for SSRUs in Subarea 88.1.	5.31, 5.44	2	Members to implement	Remind
27.	Reanalyse the CPUE data from the fishery for *D. mawsoni* in Subarea 88.1, including consideration of depth fished and revised boundaries for SSRUs.	5.27, 5.28	2	Members to implement	Remind
28.	Amend the CDS to include requirement to report data by smallest appropriate FAO subarea or division, both inside and outside the CCAMLR Convention Area.	5.227	1	Members to implement	Coordinate and implement
	Biology, ecology and demography of target and by-catch species				
29.	Continue to collect biological data on by-catch species, including invertebrate species, and in particular information on biomass of the important species.	5.165, 5.171, 5.192, 7.2, 7.3	2	Members to implement	Remind
30.	Conduct further validation of ageing of *Dissostichus* spp.	7.4–7.6	1	CON to implement	
31.	Conduct further work on ageing of *C. gunnari*.	7.7	2	CON to implement	
32.	Collect observer information on the condition of *Dissostichus* spp. during the period leading up to spawning.	7.8	2	Technical coordinators to implement	Coordinate and implement
33.	Allocate separate species codes for *A. georgiana* and *A. sp. anon*.	BG/27 7.20	1	Technical coordinators to implement	Implement
	Consideration of ecosystem management				
34.	Provide information on *C. gunnari* of relevance to the CEMP Review.	8.2	2	Members to implement	Remind
35.	Publicise the World Fisheries Congress session on 'Reconciling Fisheries with Conservation in the Antarctic' and submit abstracts by April 2003.	8.7	2	Members to implement	Remind
	Future assessments				
36.	Evaluate alternative methods of assessment.	9.5, 9.6	1	SGassessment to implement	Provide support

(continued)

Table 12.1 (continued)

	Task	Ref.	Priority	Action Required	
				Members/Subgroups	Secretariat
37.	Develop a list of data extractions which could be undertaken prior to the next meeting.	9.10	1	SGassessment to advise	Coordinate and implement
38.	Consider holding an intersessional meeting to further the development of assessment methods.	9.3, 9.4	1	SGassessment to coordinate and implement	
	Scheme of International Scientific Observation				
39.	Updates and additions to the *Scientific Observers Manual*.	10.20	1		Coordinate and implement
40.	Review the codes used to describe processing of fish.	3.34	1	Technical coordinators to implement	Coordinate and implement
41.	Use latest forms for nautical twilight.	10.3	1	Technical Coordinators to implement	Remind
42.	Complete part of observer logbook and report dealing with deck lighting.	10.5	1	Technical Coordinators to implement	Remind
43.	Update the *Species Identification Sheets*.	10.9	1	Dr Collins to coordinate, Technical Coordinators to implement	Implement
44.	Revisions to the format of the *Scientific Observers Manual*.	10.10	2	Technical Coordinators to coordinate	Implement
45.	Implement agreed sampling procedure for the 2002/03 season.	10.14	1	Technical coordinators to implement	Remind
46.	Collect tissue samples and measure pre-anal lengths from macrourids.	10.17, 5.154, 5.166	1	Technical coordinators to implement	Remind

(continued)

Table 12.1 (continued)

	Task	Ref.	Priority	Action Required	
				Members/Subgroups	Secretariat
	CCAMLR website				
47.	Further develop the bibliography of CCAMLR working documents and make available online.	11.2	1		Coordinate and implement
	Other business				
48.	Further develop electronic access to STATLANT data, including online queries.	13.8	2		Coordinate and implement

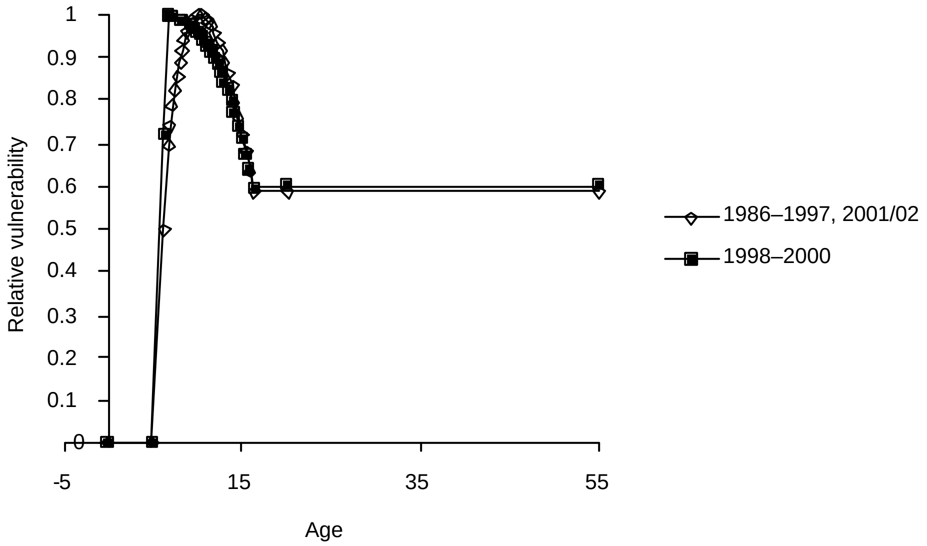

Figure 5.1: Estimated relative age-specific vulnerabilities for longline-caught *Dissostichus eleginoides* in Subarea 48.3.

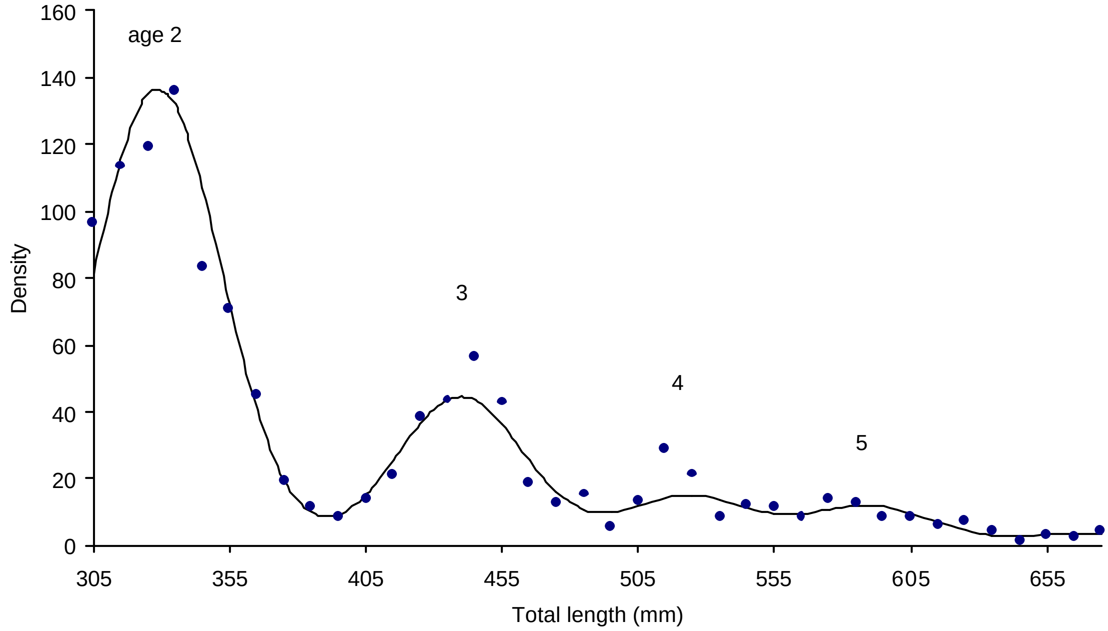

Figure 5.2: Length-density plot for *Dissostichus eleginoides* in Subarea 48.3 from the UK trawl survey in 2002. Peaks corresponding to ages 2–5 are indicated.

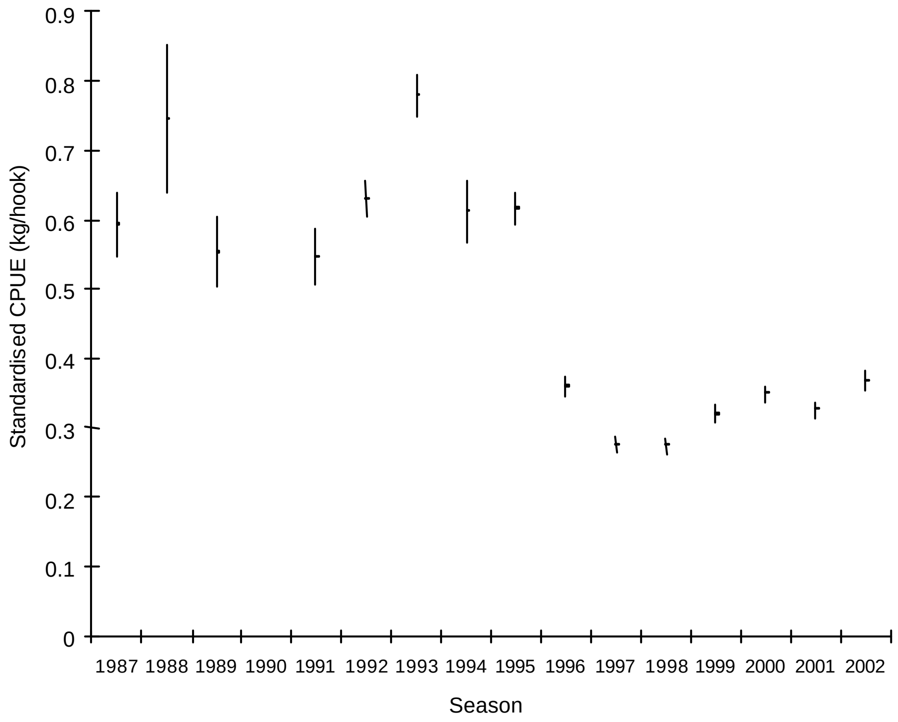

Figure 5.3: Standardised CPUEs and 95% confidence intervals in kg/hook for *Dissostichus eleginoides* in Subarea 48.3.

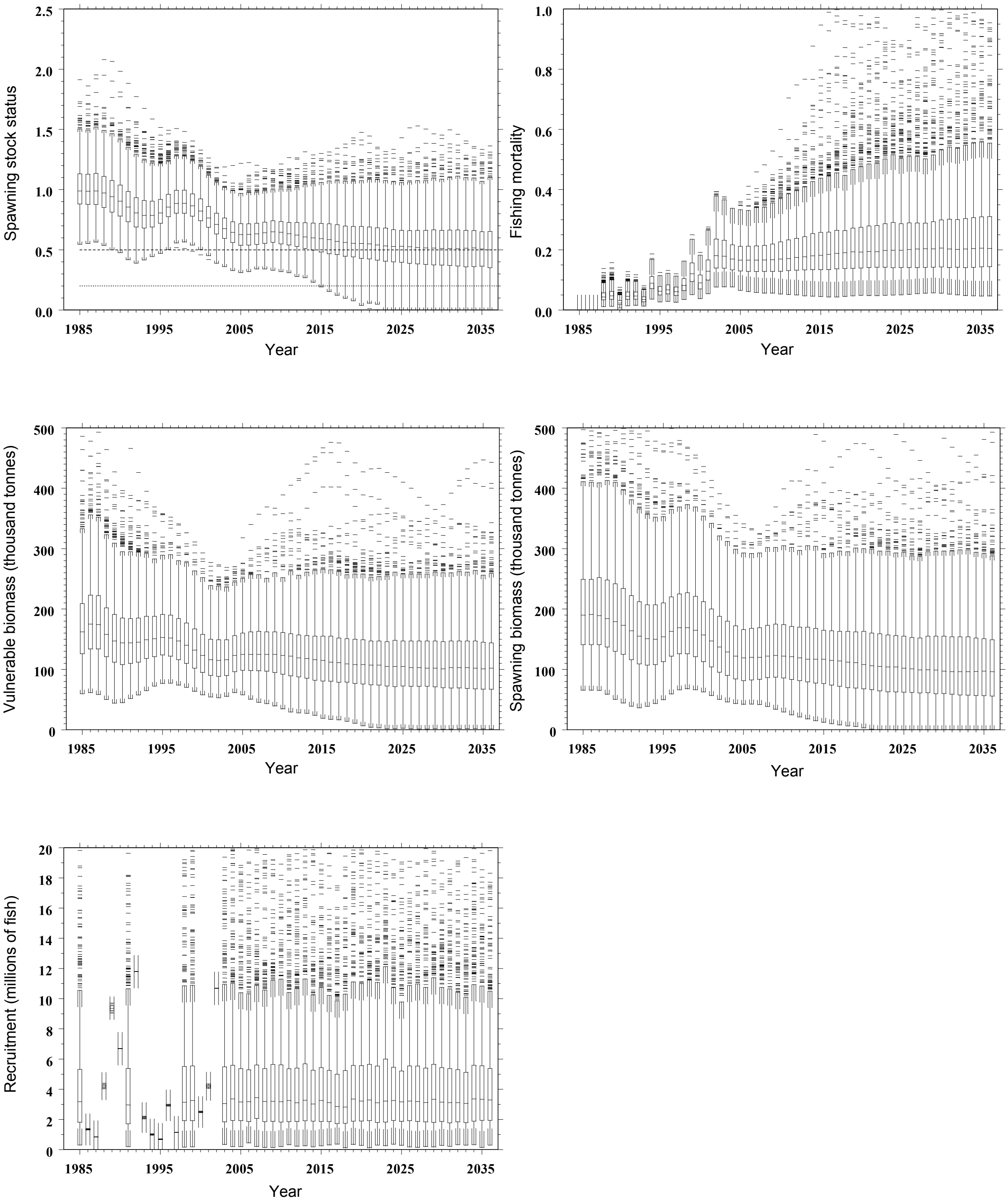

Figure 5.4: Historical and projected trajectories for the final GYM run for *Dissostichus eleginoides* in Subarea 48.3 using shallow water future vulnerabilities (giving a precautionary yield of 7 810 tonnes).

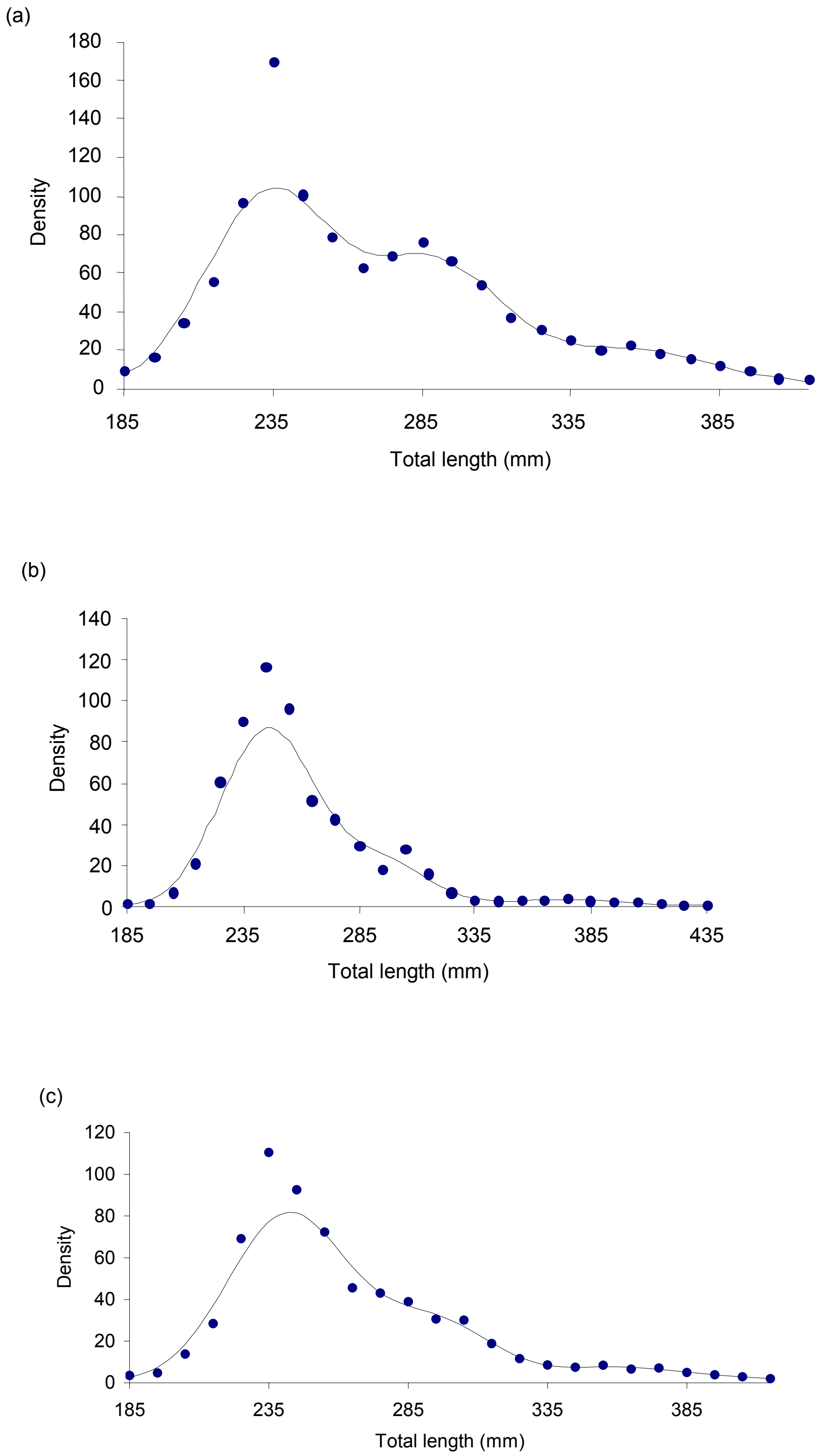

Figure 5.5: Output from the mixture analyses of *Champsocephalus gunnari* length at age in Subarea 48.3 in 2002 from (a) UK survey (*Dorada*), (b) Russian survey (*Atlantida*), and (c) combined (UK and Russian) datasets.

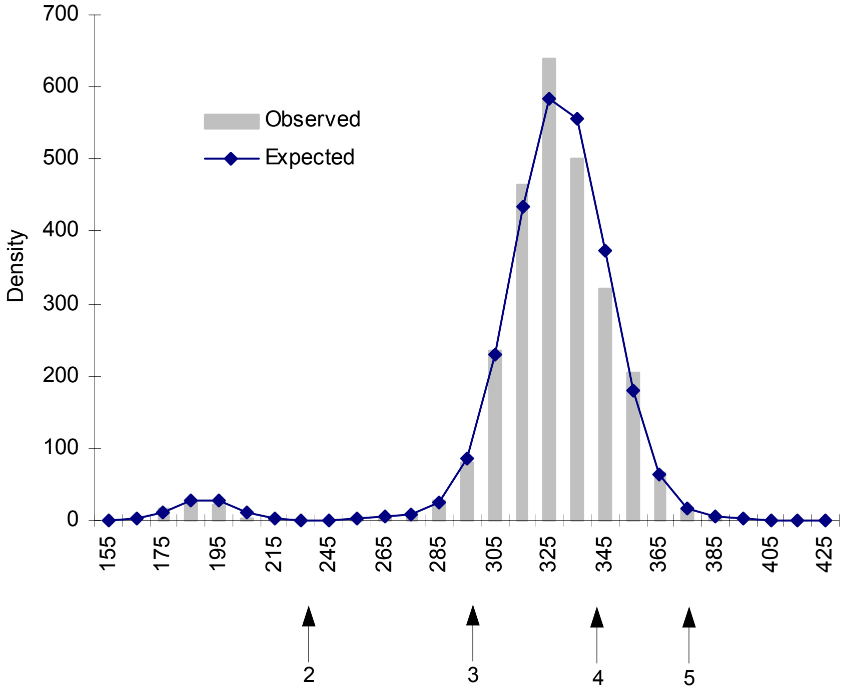

Figure 5.6: Observed densities at length for *Champsocephalus gunnari* with fitted mixtures of distributions for the Australian survey in Division 58.5.2 in 2002. Also shown are the approximate positions of the mean length at age from the von Bertalanffy growth curve.

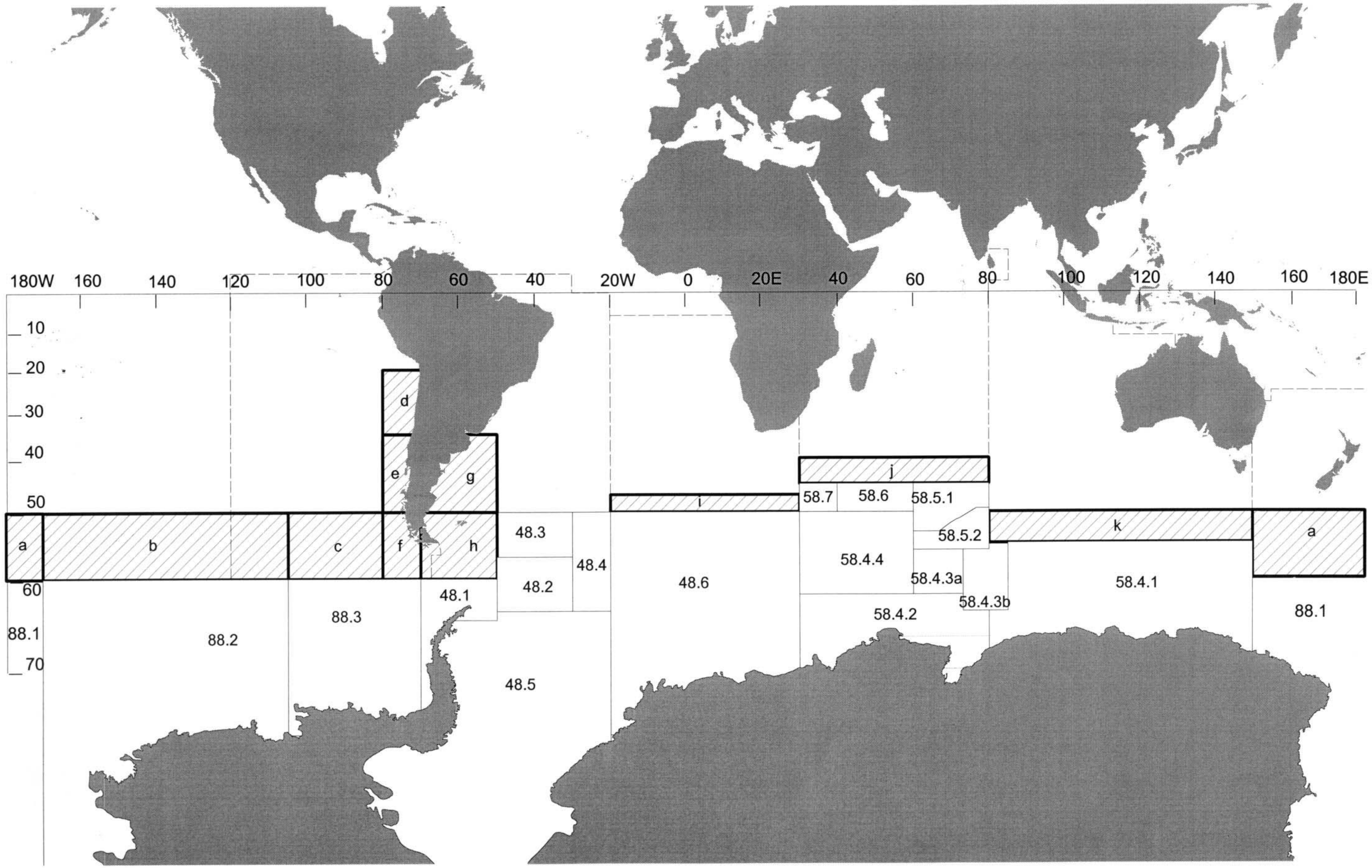

Figure 5.7: Regions outside the CCAMLR Convention Area and within the likely geographic range of *Dissostichus eleginoides*. (a) Southwest Pacific 150–180°E; (b) Southwest Pacific 105–180°W; (c) Southeast Pacific 80–105°W; (d) East Pacific 20–35°S; (e) East Pacific 35–50°S; (f) Southeast Pacific 70–80°W; (g) West Atlantic 35–50°S; (h) Southwest Atlantic 50–70°W; (i) Southeast Atlantic; (j) Western Indian Ocean; (k) Eastern Indian Ocean. Seabed areas for these regions within the depth range 0–1 800m are reported in Table 5.32.

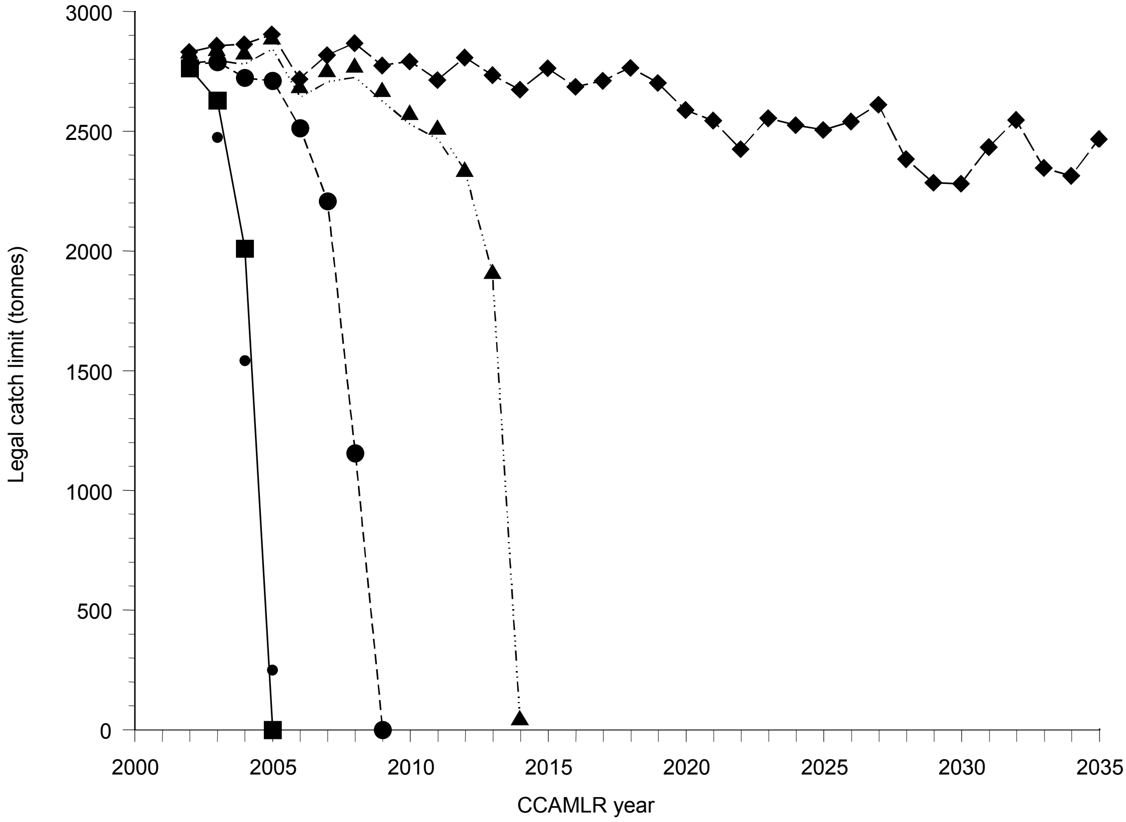

Figure 5.8: Projections of the legal catch limit for *Dissostichus eleginoides*, using the CCAMLR assessment process under the following scenarios of IUU fishing in which the annual IUU catch is: (♦) approximately 0.33x the legal catch limit for 2001, (▲) approximately 1x the legal catch limit for 2001, (●) approximately 2x the legal catch limit for 2001, and (■) approximately 4x the legal catch limit for 2001.

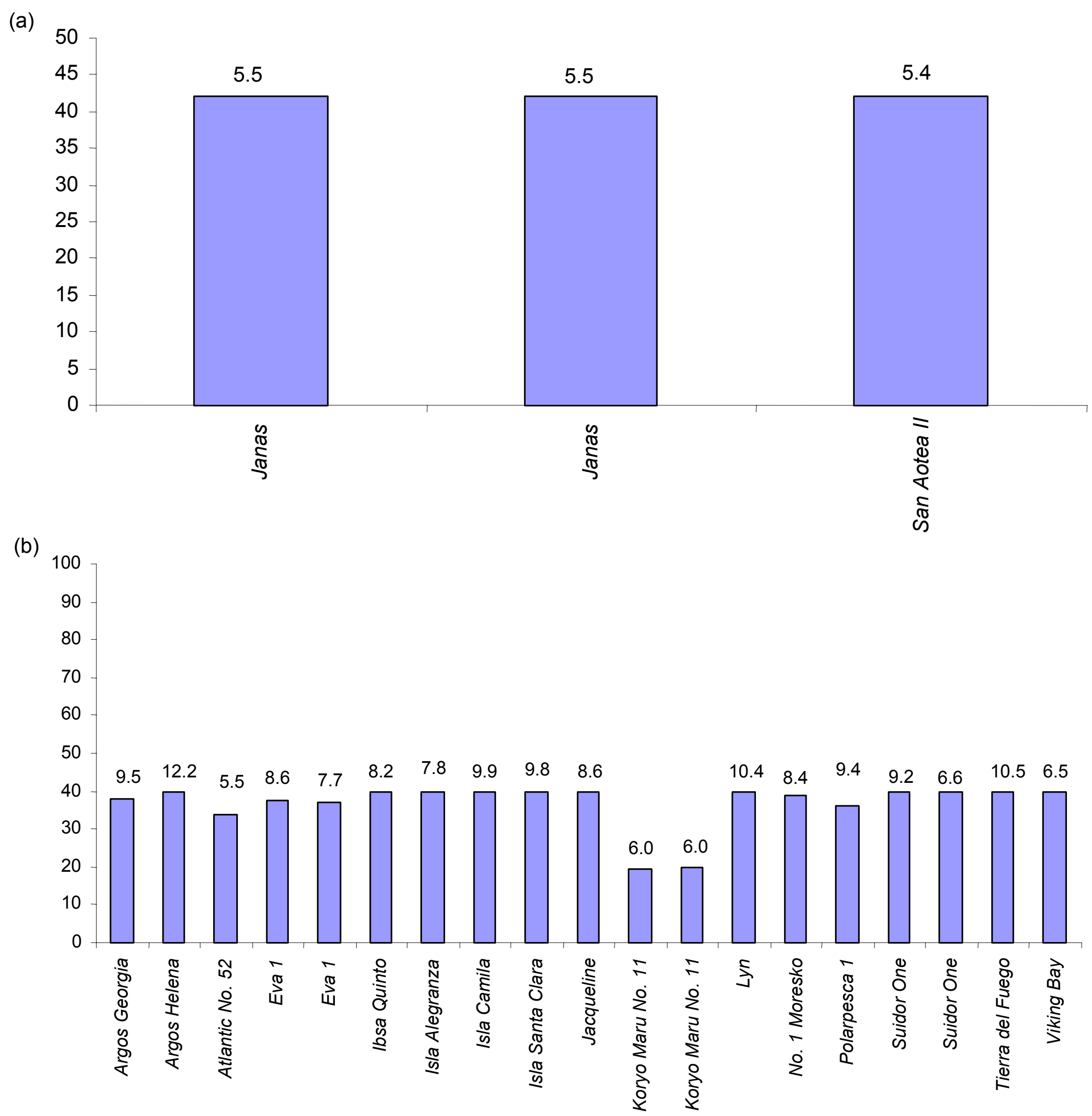

Figure 6.1: Longline weight spacing (y-axis in metres) and weights used (kilograms) by (a) auto and (b) Spanish systems during the 2002 season.

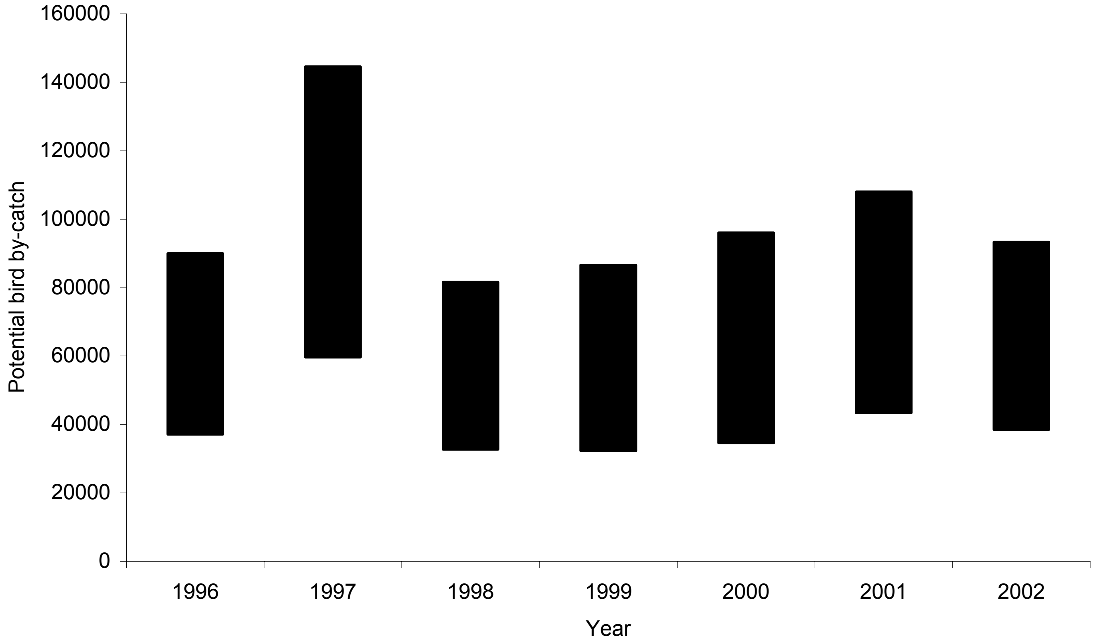

Figure 6.2: The range of estimated potential by-catch of birds in IUU longline fisheries in the Convention Area from 1996 to 2002. The solid bars represent the range from the lower limit of the lower estimate to the upper limit of the upper estimate (see paragraph 6.96).

APPENDIX A

AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 17 October 2002)

1. Opening of the meeting

2. Organisation of the meeting and adoption of the agenda

3. Review of available information

    3.1 Data requirements specified in 2001
        3.1.1 Development of the CCAMLR database
        3.1.2 Data processing
        3.1.3 Data access
        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
        3.2.5 Research surveys
        3.2.6 Mesh/hook selectivity and related experiments affecting catchability

4. Preparation for assessments

    4.1 New information extending time series
        4.1.1 Estimation of total removals
        4.1.2 Standing stock
        4.1.3 Recruitment series
        4.1.4 CPUE

    4.2 Other parameters

    4.3 Status of current assessment methods

5. Assessments and management advice

5.1 New and exploratory fisheries in 2001/02 and for 2002/03
- 5.1.1 New and exploratory fisheries in 2001/02
- 5.1.2 New fisheries notified for 2002/03
- 5.1.3 Exploratory fisheries notified for 2002/03
- 5.1.4 Progress towards assessments of new and exploratory fisheries

5.2 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 *Champsocephalus gunnari* South Georgia (Subarea 48.3)
- 5.2.5 *Champsocephalus gunnari* Heard Island (Division 58.5.2)

5.3 Other fisheries
- 5.3.1 *Dissostichus eleginoides* Prince Edward and Marion Islands (Subarea 58.7) and Crozet Islands (Subarea 58.6)
- 5.3.2 *Champsocephalus gunnari* South Shetlands (Subarea 48.1)
- 5.3.3 Myctophids South Georgia (Subarea 48.3)
- 5.3.4 Crabs South Georgia (Subarea 48.3)
- 5.3.5 Squid South Georgia (Subarea 48.3)
- 5.3.6 Other fisheries

5.4 By-catch
- 5.4.1 Assessments of the status of by-catch species or groups
- 5.4.2 Assessments of the expected impact of target species fisheries on the by-catch species or groups
- 5.4.3 Consideration of mitigation measures
- 5.4.4 Advice to the Scientific Committee

5.5 Regulatory framework

5.6 Evaluation of the threats arising from IUU activities
- 5.6.1 Review of historical trends in IUU activity
- 5.6.2 Evaluation of future threats of IUU activity
- 5.6.3 Advice to the Scientific Committee

6. Incidental mortality of mammals and seabirds arising from fishing (ad hoc WG-IMAF Report)

6.1 Intersessional work of ad hoc WG-IMAF

6.2 Incidental mortality of seabirds during regulated longline fishing in the Convention Area

   6.2.1 Data submitted for the 2001/02 and the beginning of the 2002/03 seasons
   6.2.2 Evaluation of levels of incidental mortality
   6.2.3 Implementation of Conservation Measure 29/XIX
   6.2.4 Research into and experience with mitigating measures
   6.2.5 Revision of Conservation Measure 29/X1X

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

6.4 Incidental mortality of seabirds during longline fishing outside the Convention Area

6.5 Research into the status of seabirds

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

6.7 Incidental mortality of seabirds in relation to new and exploratory fisheries

   6.7.1 Assessments of risk in CCAMLR subareas and divisions
   6.7.2 New and exploratory fisheries operational in 2001/02
   6.7.3 New and exploratory fisheries proposed for 2002/03

6.8 Other incidental mortality

   6.8.1 Interactions involving marine mammals with longline fishing operations
   6.8.2 Interactions involving marine mammals and seabirds with trawl or pot fishing operations

6.9 Advice to the Scientific Committee

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

   7.1 Information available to the meeting
   7.2 Update species profiles
   7.3 Identify gaps in the knowledge

8. Considerations of ecosystem management

   8.1 Interactions with WG-EMM
   8.2 Ecological interactions (e.g. multi-species, benthos etc.)

9. Future Assessments

    9.1 New and planned assessment methods

10. Scheme of International Scientific Observation

    10.1 Summary of information extracted from observer reports and/or provided by technical coordinators

    10.2 Implementation of the observer program
        10.2.1 Scientific Observers Manual
        10.2.2 Sampling strategies
        10.2.3 Priorities

    10.3 Information relevant to SCOI

    10.4 Advice to the Scientific Committee

11. CCAMLR website

12. Future work

    12.1 Data requirements
    12.2 Organisation of intersessional activities in subgroups
    12.3 Plans for WG-FSA-2003

13. Other business

    13.1 Consideration of a proposal to list toothfish under CITES Appendix II
    13.2 FAO's Fisheries Global Information System (FIGIS)
    13.3 Publication matters
    13.4 Other matters

14. Adoption of the report

15. Close of the meeting.

APPENDIX B

LIST OF PARTICIPANTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 17 October 2002)

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APPENDIX C

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 17 October 2002)

WG-FSA-02/1	Provisional and Annotated Provisional Agenda for the 2002 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-02/2	List of participants
WG-FSA-02/3	List of documents
WG-FSA-02/4	A statistical method for analysing the extent of IUU fishing in CCAMLR waters: application to Subarea 48.3 D.J. Agnew and G.P. Kirkwood (United Kingdom) (*CCAMLR Science*, submitted)
WG-FSA-02/5	The rate of incidental mortality of birds in the IUU longline fishery in Subarea 48.3 D.J. Agnew and G.P. Kirkwood (United Kingdom) (*CCAMLR Science*, submitted)
WG-FSA-02/6	The role of fish in the Antarctic marine food web: differences between inshore and offshore waters in the southern Scotia Arc and west Antarctic Peninsula E. Barrera-Oro (Argentina)
WG-FSA-02/7	Fish species profiles – mackerel icefish I. Everson (United Kingdom)
WG-FSA-02/8	Fish species profiles – toothfish I. Everson (United Kingdom)
WG-FSA-02/9	Fishery Information for WG-FSA-02 Secretariat
WG-FSA-02/10	CCAMLR Survey Database: development during 2002 Secretariat
WG-FSA-02/11 Rev. 1	A summary of observations on board longline vessels operating within the CCAMLR Convention Area Secretariat

WG-FSA-02/12 Rev. 1	Summary of observations aboard trawlers operating in the Convention Area during the 2001/02 season Secretariat
WG-FSA-02/13 Rev. 2	A summary of scientific observations related to Conservation Measures 29/XIX, 63/XV and 173/VIII Secretariat
WG-FSA-02/14	Summary of an observation aboard a pot vessel operating in the Convention Area during the 2001/02 season Secretariat
WG-FSA-02/15	Observations on the diet of Antarctic toothfish (*Dissostichus mawsoni*) from the Ross Sea, Antarctica (CCAMLR Statistical Subarea 88.1) J.M. Fenaughty, D.W. Stevens and S.M. Hanchet (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-02/16	Population dynamics of wandering albatrosses *Diomedea exulans* at sub-Antarctic Marion Island: longline fishing and environmental influences D.C. Nel, P.G. Ryan and J. Cooper (South Africa)
WG-FSA-02/17	Seabird by-catch in the Patagonian toothfish longline fishery at the Prince Edward Islands: 2001–2002 B.P. Watkins (South Africa)
WG-FSA-02/18	Progress report of Chilean research on albatross ecology and conservation J. Arata and C.A. Moreno (Chile)
WG-FSA-02/19	Brief information on the results of the bottom trawl and trawl–acoustic surveys carried out by STM *Atlantida* in the South Georgia subarea (48.3) during January to March 2002 V.N. Shnar, V.A. Khvichia and A.P. Malyshko (Russia)
WG-FSA-02/20	Some biological characteristics of Antarctic fish stocks in the Elephant Island–South Shetland Island region in January–February 2002 K.-H. Kock (Germany), C.D. Jones (USA), J. Appel (Germany), G. von Bertouch (CCAMLR Secretariat), D.F. Doolittle (USA), M. la Mesa (Italy), L. Psenichnov (Ukraine), R. Riehl (Germany), T. Romeo (Italy), S. Schöling (Germany) and L. Zane (Italy)

WG-FSA-02/21	Mesoscale abundance of fish in a 'box' west of Elephant Island K.-H. Kock (Germany), C.D. Jones (USA), J. Appel (Germany), G. von Bertouch (CCAMLR Secretariat), D.F. Doolittle (USA), M. la Mesa (Italy), L. Psenichnov (Ukraine), R. Riehl (Germany), T. Romeo (Italy), S. Schöling (Germany) and L. Zane (Italy)
WG-FSA-02/22	Demersal longlines with integrated weight: a preliminary assessment of sink rates, fish catch success and operational effects G. Robertson (Australia), M. McNeill, B. King (New Zealand) and R. Kristensen (Norway)
WG-FSA-02/23	The status of black-browed albatrosses *Thalassarche melanophrys* at Diego de Almagro Island, Chile K. Lawton, G. Robertson (Australia), J. Valencia (Chile), B. Wienecke and R. Kirkwood (Australia)
WG-FSA-02/24	Standing stock estimates of finfish biomass from the 2002 *Polarstern* bottom trawl survey around Elephant Island and the South Shetland Islands (Subarea 48.1) with some notes on the composition of catches taken north of Joinville Island – D'Urville Island K.-H. Kock (Germany), C.D. Jones (USA), J. Appel (Germany), G. von Bertouch (CCAMLR Secretariat), D.F. Doolittle (USA), M. la Mesa (Italy), L. Psenichnov (Ukraine), R. Riehl (Germany), T. Romeo (Italy), S. Schöling (Germany) and L. Zane (Italy)
WG-FSA-02/25	How fast do demersal longlines sink? G. Robertson (Australia), E. Moe, R. Haugen (Norway) and B. Wienecke (Australia)
WG-FSA-02/26	Fecundity and size at sexual maturity of the bigeye grenadier (*Macrourus holotrachys*) at South Georgia (CCAMLR Subarea 48.3) T. Mulvey, S.A. Morley, M. Belchier and J. Dickson (United Kingdom)
WG-FSA-02/27	Fecundity and egg size of Lithodid crabs from CCAMLR Subarea 48.3 S.A. Morley, M. Belchier, J.D. Dickson and T.M. Mulvey (United Kingdom)
WG-FSA-02/28	Movement and growth of tagged toothfish around South Georgia and Shag Rocks (Subarea 48.3) T.R. Marlow, D.J. Agnew and I. Everson (United Kingdom) (*CCAMLR Science*, submitted)

WG-FSA-02/29	Notes for identifying the three macrourid species, *M. holotrachys*, *M. whitsoni* and *M. carinatus* in CCAMLR Subarea 48.3 S.A. Morley, M. Belchier, M.G. Purves, T. Mulvey and J. Dickson (United Kingdom)
WG-FSA-02/30	Progress report on attempts to conduct an experiment on the effectiveness of mitigation measures used with the double-line system of longline fishing G. Robertson and P. Virtue (Australia)
WG-FSA-02/31	Information on the spawning season and gonadosomatic indices of *Dissostichus mawsoni* from Subarea 88.1 in the 2001/02 season G.J. Patchell (New Zealand)
WG-FSA-02/32	Review of identity and biology of species of the family Macrouridae, from the CCAMLR fishery in the Ross Sea, Antarctica P.M. Marriott and P. McMillan (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-02/33	Evidence to support the annual formation of growth zones in otoliths of Antarctic toothfish (*Dissostichus mawsoni*) P.L. Horn, C.P. Sutton (New Zealand) and A.L. DeVries (USA) (*CCAMLR Science*, submitted)
WG-FSA-02/34	Fish stock assessment survey in Subarea 48.3 E. Everson, T. Marlow, M. Belchier, R. Forster, S. Morley, A. North, J. Szlakowski and S. Wilhelms (United Kingdom)
WG-FSA-02/35	Bottom trawls used in UK fish surveys in Subarea 48.3 I. Everson, P. Hicken, T. Marlow, T. North, M. Belchier, C. Jones and T. Daw (United Kingdom)
WG-FSA-02/36	Seabird interactions/mortality with longliners and trawlers in the Falkland/Malvinas Island waters Delegation of the United Kingdom
WG-FSA-02/37	Research under way in New Zealand on seabirds vulnerable to fisheries interactions S. Moore and J. Molloy (New Zealand)
WG-FSA-02/38	The New Zealand toothfish fishery in Subareas 88.1 and 88.2 from 1997/98 to 2001/02 S.M. Hanchet, P.L. Horn, M.L. Stevenson and N.W. McL. Smith (New Zealand)

WG-FSA-02/39	Information on incidental mortality of seabirds and other protected species in the US west coast pelagic longline fishery Delegation of the USA
WG-FSA-02/40	Review of rattail and skate by-catch and analysis of rattail standardised CPUE from the Ross Sea toothfish fishery in Subarea 88.1 from 1997/98 to 2001/02 R.G. Blackwell and S.M. Hanchet (New Zealand)
WG-FSA-02/41	Preliminary standardised CPUE analysis of the New Zealand toothfish fishery in Subarea 88.1 from 1997/98 to 2001/02 R.G. Blackwell and S.M. Hanchet (New Zealand)
WG-FSA-02/42	Morphometrics, maturity and movement of the Antarctic skates *Amblyraja georgiana* and *Bathyraja eatonii* in the Ross Sea M.P. Francis and N.W. McL. Smith (New Zealand)
WG-FSA-02/43	Spatio-temporal trends of longline fishing effort in the Southern Ocean and implications for seabird by-catch G.N. Tuck, T. Polacheck and C.M. Bulman (Australia)
WG-FSA-02/44	Mackerel icefish biomass and distribution on the results of acoustic survey carried out in February–March 2002 S.M. Kasatkina, V.Yu. Sunkovich, A.P. Malyshko and Zh.A. Frolkina (*CCAMLR Science*, submitted)
WG-FSA-02/45	Methods of comparative tests of bottom trawls (trawls systems) A.S. Myskov, Zh.A. Frolkina, S.M. Kasatkina and P.S. Gasyukov (Russia)
WG-FSA-02/46	Review of fish and invertebrate by-catch in trawl fisheries in Division 58.5.2 E.M. van Wijk and R. Williams (Australia)
WG-FSA-02/47	Preliminary assessment of *Champsocephalus gunnari* on the Heard Island Plateau (Division 58.5.2) based on a survey in May 2002 A.J. Constable, R. Williams and T. Lamb (Australia)
WG-FSA-02/48	Age, growth and size at sexual maturity of *Macrourus carinatus* from the CCAMLR fisheries in division 58.5.2 E.M. van Wijk, R. Williams and A.J. Constable (Australia) (*CCAMLR Science*, submitted)
WG-FSA-02/49	CCAMLR Working Group on Fish Stock Assessment – Report of the Intersessional Subgroup on By-catch

WG-FSA-02/50	Implementation of the United States National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (NPOA-Seabirds) K.S. Rivera (USA)
WG-FSA-02/51	First Annual Report of the CCAMLR Otolith Network, 2002
WG-FSA-02/52	Report of the WG-FSA Intersessional Subgroup on Sampling Catches from Longlines
WG-FSA-02/53	Changes to seabird avoidance regulations in Alaska demersal longline fisheries based on scientific research on effectiveness of mitigation measures K.S. Rivera (USA)
WG-FSA-02/54	Identification of *Amblyraja* species in the longline fishery in Subarea 48.3 – CCAMLR M. Endicott (United Kingdom), L.J.V. Compagno (South Africa) and D.J. Agnew (United Kingdom)
WG-FSA-02/55	Preliminary estimation of ray by-catch in the longline fishery in Subarea 48.3 D.J. Agnew, J. Pearce and M. Endicott (United Kingdom)
WG-FSA-02/56	A study of UK and Russian surveys using acoustics to augment trawling methods in shelf waters off South Georgia (Subarea 48.3) S. Kasatkina, P. Gasiukov (Russia), C. Goss, I. Everson, M. Belchier, T. Marlow, A. North and M. Collins (United Kingdom) (*CCAMLR Science*, submitted)
WG-FSA-02/57	Progress report on age determination of mackerel icefish using otoliths P. Gasiukov, K. Shust (Russia) and I. Everson (United Kingdom)
WG-FSA-02/58	Workshop on austral summer 2002 fish surveys at South Georgia carried out by Russia and the UK
WG-FSA-02/59	Standing stock estimates of mackerel icefish (*Champsocephalus gunnari*) from the UK and Russian bottom trawl survey in the 2001/02 season within Subarea 48.3
WG-FSA-02/60	Behaviour of *Dissostichus eleginoides* fitted with archival tags at Heard Island: preliminary results R. Williams and T. Lamb (Australia)

WG-FSA-02/61	CMIX: User's Manual and Specifications W. de la Mare, A. Constable, E. van Wijk, T. Lamb and B. Ronai (Australia)
WG-FSA-02/62	Generalised Yield Model: User's Manual and Specifications A.J. Constable, A.T. Williamson and W.K. de la Mare (Australia)
WG-FSA-02/63	Fish Heaven Manual I. Ball and A.T. Williamson (Australia)
WG-FSA-02/64	Revised selectivities for *Dissostichus eleginoides* taken by longliners in Subarea 48.3 G.P. Kirkwood (United Kingdom)
WG-FSA-02/65	Preliminary analysis on the Kerguelen shelf icefish *Champsocephalus gunnari* stock from 1996/97 to 2001/02: no evidence in the recovery! G. Duhamel and J. Claudet (France)
WG-FSA-02/66	Informe sobre la operación del B/P nasero Viking Sky durante Setiembre–Octubre del 2001: Atlántico sudoccidental (latitudes 37°–38° sur y 42° sur) Área estadística 41 O.D. Pin y H. Nión (Uruguay)
WG-FSA-02/67	Informe preliminar sobre un viaje de pesca de merluza negra (*Dissostichus eleginoides*) del B/P Viarsa I, en el Océano Indico oriental (Área Estadística 57) – Abril–junio 2002 H. Nion y O.D. Pin (Uruguay)
WG-FSA-02/68	Short note: some software developments within the Australian Antarctic Division I. Ball and A. Constable (Australia)
WG-FSA-02/69	Evaluation of the effects of illegal, unregulated and unreported (IUU) fishing on the legal catch of fisheries for *Dissostichus eleginoides* A.J. Constable (Australia)
WG-FSA-02/70	Preliminary assessment of *Dissostichus eleginoides* on the Heard Island Plateau (Division 58.5.2) based on a survey in May 2002 A.J. Constable, R. Williams and T. Lamb (Australia)
WG-FSA-02/71	An update on conversion factors for toothfish in the Ross Sea (Subareas 88.1 and 88.2) J.M. Fenaughty and N.W. McL. Smith (New Zealand)

WG-FSA-02/72	United States research under way on seabirds vulnerable to fisheries interactions K.S. Rivera (USA)
WG-FSA-02/73 Rev. 1	Food and feeding of two Channichthyids, *Champsocephalus gunnari* and *Chaenocephalus aceratus*, around Elephant Island and in the South Shetland Islands (Subarea 48.1) in 2001 and 2002 H. Flores, K.-H. Kock, S. Wilhelms (Germany) and C.D. Jones (USA)
WG-FSA-02/74	Age-at-length of Patagonian toothfish from the Falkland/Malvinas Islands J. Ashford, A. Arkhipkin, C. Jones and S. Bobko
WG-FSA-02/75	Age-at-length of Patagonian toothfish from South Georgia J. Ashford, M. Belchier, C. Jones and S. Bobko
WG-FSA-02/76	An updated assessment of the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity and extension taking commercial catch-at-length data into account A. Brandão, D.S. Butterworth, B.P. Watkins and L. Staverees (South Africa)
WG-FSA-02/77	Age and growth of Scotia Sea icefish *Chaenocephalus aceratus* (Lönnberg, 1906), from the South Shetland Islands M. La Mesa, J. Ashford, E. Larson and M. Vacchi (*CCAMLR Science*, submitted)
WG-FSA-02/78	Stock assessment of *D. eleginoides* in Subarea 48.3 using dynamic production models P.S. Gasiukov and R.S. Dorovskich (Russia) (*CCAMLR Science*, submitted)
WG-FSA-02/79	Distribution, biological characteristic and biomass of icefish from the results of inventory trawling survey carried out by STM-8390 *Atlantida* in January–March 2002 Zh.A. Frolkina and P.S. Gasiukov (Russia)
WG-FSA-02/80	Subgroup on Assessment Methods: Report to the Working Group on Fish Stock Assessment 2002 A.J. Constable (Subgroup Coordinator)
WG-FSA-02/81 Rev. 1	Estimates of the total removal of *Dissostichus* spp. from inside and outside the Convention Area for the 2001/02 fishing season Secretariat

WG-FSA-02/82	Preliminary data on seabird by-catch along the Patagonian shelf by Argentine longline fishing vessels: period 1999–2001 Delegation of Argentina

Other Documents

WG-EMM-02/8	Database of CCAMLR working documents CCAMLR Secretariat
WG-EMM-02/24	World Fisheries Congress J.P. Croxall (United Kingdom)
CCAMLR-XXI/5	Notification of Spain's intention to initiate an exploratory fishery in Subarea 88.1 for *Dissostichus* spp. in the 2002/03 season Delegation of Spain
CCAMLR-XXI/6	Notification of exploratory fisheries for *Dissostichus* spp. in the 2002/2003 season Delegation of South Africa
CCAMLR-XXI/7	Notification by New Zealand of its intention to continue an exploratory fishery for *Dissostichus* spp. in CCAMLR Subareas 88.1 and 88.2 for the 2002/03 season Delegation of New Zealand
CCAMLR-XXI/8	Notification by New Zealand of its intention to continue an exploratory fishery for *Dissostichus* spp. in CCAMLR Subarea 48.6 for the 2002/03 season Delegation of New Zealand
CCAMLR-XXI/9	Notification of exploratory fisheries for *Dissostichus* spp. in the 2002/03 season Delegation of Japan
CCAMLR-XXI/10	Notification of Australia's intention to conduct a longline fishery in Division 58.5.2 for *Dissostichus eleginoides* Delegation of Australia
CCAMLR-XXI/11	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.3a and 58.4.3b for *Dissostichus* spp. Delegation of Australia
CCAMLR-XXI/12	Notification of Australia's intention to conduct an exploratory longline fishery in Division 58.4.2 for *Dissostichus* spp. Delegation of Australia

CCAMLR-XXI/16	Notification of Russia's intention to conduct an exploratory longline fishery in 2002/03 in Subareas 88.1 and 88.2 Delegation of Russia
CCAMLR-XXI/BG/4	Rapport de la Dix-Septieme Reunion Annuelle de L'iccat (Murcia, Espagne, novembre 2001) Observateur de la CCAMLR (Communauté européenne)
SC-CAMLR-XXI/6	Proposed partnership between CCAMLR and FIGIS-FIRMS Secretariat
SC-CAMLR-XXI/7	A proposal to modify the boundaries of Statistical Division 58.5.2 to define William's Ridge Delegation of Australia
SC-CAMLR-XXI/BG/7	Fishing gear, marine debris and oil associated with seabirds at Bird Island, South Georgia, 2001/02 Delegation of the United Kingdom
SC-CAMLR-XXI/BG/9	Summary of notifications of new and exploratory fisheries in 2002/03 Secretariat
SC-CAMLR-XXI/BG/18	Conservation of marine areas in the Australian EEZ around the territory of Heard Island and McDonald Islands: notice of intent by Australia to declare a HIMI Marine Reserve and conservation zone Delegation of Australia
SC-CAMLR-XXI/BG/19 Rev.1	Information on the crab fishery in Subarea 48.3 in 2001/02 and notification for 2002/03 Delegation of Japan
SC-CAMLR-XXI/BG/20	Progress toward an agreement on the conservation of albatrosses and petrels Delegation of Australia

INTERSESSIONAL WORK PLAN FOR AD HOC WG-IMAF FOR 2002/03

APPENDIX D

INTERSESSIONAL WORK PLAN FOR AD HOC WG-IMAF FOR 2002/03

The Secretariat will coordinate the intersessional work of the IMAF group. An interim review of work will be conducted in June 2003 and advised to ad hoc WG-IMAF at the time of WG-EMM (August 2003). The outcome of the intersessional work will be reviewed in September 2003 and reported as a tabled paper to WG-IMAF in October 2003.

[1] In addition to work coordinated by the Science Officer (Secretariat)   * SODA: Scientific Observer Data Analyst

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance[1]	Start/ Completion Deadlines	Action
1.	**Planning and coordination of work:**				
1.1	Circulate materials on IMAF matters as contained in reports of current meetings of CCAMLR.	Standing request		Dec 2002	Circulate all relevant sections of CCAMLR-XXI to IMAF group members, and technical coordinators and (via them) to scientific observers.
1.2	Circulate papers submitted to WG-FSA on IMAF matters.	Standing request		Dec 2002	Circulate the list of papers submitted to WG-FSA on IMAF matters and advise that copies of papers may be provided on request. Circulate the papers requested.
1.3	Acknowledge work of technical coordinators and scientific observers.	Standing request		Dec 2002	Commend technical coordinators and all observers for their efforts in the 2001/02 fishing season.
1.4	Review new and exploratory fishery notifications.	Standing request	B. Baker (Australia)	At submission deadline	Transmit hard copies of notifications to Mr Baker to prepare initial draft of IMAF table.
1.5	Membership of WG-IMAF.	Standing request 6.4	Members	Nov 2002/ as required	Request nomination of new members to IMAF. Request all Members to send their representatives to the next IMAF meeting.
2.	**Members' research and development activities:**				
2.1	Update information on national research programs on albatrosses, giant petrels and white-chinned petrels, in relation to: (i) status and trends of populations; (ii) foraging range and distribution; (iii) genetic profiles of albatrosses, giant petrels and white-chinned petrels; and (iv) number and nature of by-catch specimens and samples.	Standing request 6.113 6.116	Members, IMAF members, technical coordinators, nominated scientists	Nov 2002/ Sep 2003	Use existing standard formats for this submission, where available. Secretariat to develop new formats as appropriate.

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance[1]	Start/ Completion Deadlines	Action
2.2	Risk assessment of seabird by-catch in the Convention Area.	Standing request	IMAF members	Nov 2002/ Sep 2003	Further work as appropriate to update SC-CAMLR-XXI/BG/21 for the Scientific Committee. Circulate any new tabled papers relating to seabird at-sea distributions to Mr Baker, Prof. Croxall and Dr Gales – and to other WG-IMAF members as requested. Liaise with BirdLife International (Dr Nel) in respect of outputs from seabird range workshop.
2.3	Information on the development and use of fisheries-related methods of the avoidance of incidental mortality of seabirds. In particular, information is sought on the following:	Standing request 6.111	Members, IMAF members, technical coordinators	Nov 2002/ Sep 2003	Request information, collate responses for IMAF-2003.
	• seabird capture rates in relation to artificial bait, snoodline and mainline colour, bait depth and sink rates;				
	• optimum configuration of line-weighting regimes and equipment;				
	• automated methods for adding and removing weights to and from the line;				
	• line-setting devices for autoline vessels;				
	• underwater longline setting devices;	6.64	Ms Molloy		Report to IMAF-2003.
	• feasibility of using video recording of line hauling operations for observations on seabird incidental catch;	6.161	USA (Ms Rivera)		Report to IMAF-2003.
	• tests of/experiences with paired streamer lines and boom-and-bridle arrangements; and	6.75			
	• experiences with revised requirements for line weighting for Spanish system vessels.				
2.4	Experimental research to test effectiveness of mitigation measures in Spanish system vessels.	6.35	Appropriate IMAF scientists, Members	By Oct 2003, if possible	Report to IMAF-2003.
2.5	Information on measures for mitigating incidental seabird mortality in trawl fisheries, especially for icefish in Subarea 48.3.		Members as appropriate	Nov 2002/ Sep 2003	Collate responses for IMAF-2003.
2.6	Information on new vessel design.	6.85	France	By Oct 2003	

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance[1]	Start/ Completion Deadlines	Action
3.	**Information from outside the Convention Area:**				
3.1	Information on longline fishing effort in the Southern Ocean to the north of the Convention Area.	Standing request	Members, non-Contracting Parties, international organisations	Sep 2003	Request information intersessionally from those Members known to be licensing fishing vessels in areas adjacent to CCAMLR (e.g. Argentina, Brazil, Chile, UK [in respect of Falkland/Malvinas Islands and Tristan da Cunha], South Africa, Uruguay, New Zealand, Australia); review situation at IMAF-2003. Request information from other parties (Members and non-Contracting Parties, e.g. Republic of Korea, Taiwan, Japan, China; international organisations, e.g. CCSBT, ICCAT, IOTC) known to be fishing, or collecting data on fishing in areas adjacent to the Convention Area.
3.2	Information on incidental mortality outside the Convention Area of seabirds breeding within the area.	Standing request 6.109	Members, IMAF members	Sep 2003	Repeat request to all IMAF members, especially to those relevant to item 3.1 above; review at IMAF 2003.
3.3	Reports on use and effectiveness of mitigating measures outside the Convention Area.	Standing request 6.111	Members, non-Contracting Parties, international organisations	Sep 2003	Request information on use/implementation of mitigating measures, especially provisions in Conservation Measure 29/XIX, as under item 3.1 above; review responses at IMAF-2003.
3.4	Reports on nature of observer programs, including observer coverage.	Standing request	Members, non-Contracting Parties, international organisations	Sep 2003	Request information intersessionally from those Members known to be licensing fishing vessels in areas adjacent to CCAMLR (e.g. Argentina, Brazil, Chile, UK [in respect of Falkland/Malvinas Islands and Tristan da Cunha], South Africa, Uruguay, New Zealand, Australia); review situation at IMAF-2003. Request information from other parties (Members and non-Contracting Parties, e.g. Republic of Korea, Taiwan, Japan, China; international organisations, e.g. CCSBT, ICCAT, IOTC) known to be fishing, or collecting data on fishing in areas adjacent to the Convention Area.
3.5	Request information on the current requirements for the use of measures to mitigate by-catch of seabirds on Japanese longline fishing vessels.	SC-XIX 4.35		Sep 2003	Request again specific information from Japan.

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance[1]	Start/ Completion Deadlines	Action
4.	**Cooperation with international organisations:**				
4.1	Participation at the 2003 meeting of CCSBT-ERSWG; invite CCSBT to attend WG-IMAF.	Standing request	CCSBT Secretariat	As required	Invite and nominate observers as decided by the Scientific Committee.
4.2	Cooperation with ICCAT, IATTC and IOTC on specific issues regarding incidental mortality of seabirds.	Standing request 6.143, 6.146, 6.148	CCAMLR observers	Nov 2002/ Sep 2003	Brief CCAMLR observers on desired feedback on IMAF matters (seabird by-catch levels and mitigating measures).
4.3	Input to ICCAT agenda, especially in relation to seabird resolutions and issues.	6.143	Relevant Members, IMAF members, EC	Nov 2002/ May 2003	
4.4	Collaboration and interaction with all tuna commissions and regional fishery management organisations with responsibility for fisheries in areas where Convention Area seabirds are killed.	6.153, 6.154	Relevant Members, CCAMLR observers	Nov 2002 and at specific meetings	Request information on: (i) existing data on levels of seabird by-catch; (ii) mitigating measures currently in use and whether voluntary or mandatory; and (iii) nature and coverage of observer program. Support regulations for use of mitigating measures at least as effective as Conservation Measure 29/XIX.
4.5	Progress with National Plans of Action in respect of FAO IPOA–Seabirds.	Standing request 6.138	Relevant Members, IMAF members	By Oct 2003	Solicit reports to CCAMLR on progress for information and make review.
4.6	Input to CWP agenda, concerning coordination of fishery reporting on seabird by-catch.	SC-XXI 9.13	Data Manager	At CWP meeting	Place item on agenda; table appropriate CCAMLR/IMAF papers; report back to IMAF.
4.7	Assist Japan in improving its NPOA and use of mitigating measures.	SC-XX 4.58, 4.66, CC-XX 6.29, 6.137(iv)	Members, IMAF	As feasible	Discuss progress at IMAF-2003.
4.8	Second International Fishers' Forum	6.127–6.129	Members, IMAF members	As feasible	Disseminate information on forum outputs to fishers, IMAF etc.
4.9	IUCN Red List: Seabirds	Standing request	Secretariat	Jan 2003 onwards	Obtain from BirdLife International, circulate to IMAF members and table for SC-CAMLR-XXII, any proposals for revision to the conservation status of albatross, *Macronectes* and *Procellaria* species.

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance[1]	Start/ Completion Deadlines	Action
4.10	BirdLife International	Standing request		Nov 2002/ Sep 2003	Request information from BirdLife International about its activities of relevance to IMAF, in particular its Seabird Program and 'Save the Albatross Campaign'.
4.11	Southern Seabird Solutions	6.156–6.157	Ms Molloy	Oct 2003	Report to IMAF-2003.
5.	**Data acquisition and analysis:**				
5.1	Preliminary analyses of data from the current fishing season.	Standing request	Technical coordinators	Sep–Oct 2003	Standing request: summarise and analyse current year data at a level adequate to undertake a preliminary assessment at IMAF-2003.
5.2	Acquisition from EEZs and elsewhere as appropriate, of seabird incidental mortality data for trawl fisheries.	Standing request	Members, especially France	Nov 2002/ Sep 2003	Request Members for appropriate data.
5.3	Acquisition of original data on seabird incidental mortality for French EEZs in Subarea 58.6 and Division 58.5.1 for 2001 and 2002.	6.14	France	Sep 2003	Request France to submit reports and data logbooks prepared by national observers for the current and past fishing seasons, preferably using CCAMLR reporting formats.
5.4	Provision by France of details of mitigation measures in use in their EEZs, details of by-catch statistics for white-chinned petrels, for intersessional evaluation.	SC-XXI 5.6	France, IMAF	as soon as possible	
5.5	Analysis of seabird incidental mortality data for EEZ in Subareas 58.6/58.7.	Standing request	South Africa	Nov 2002/ Sep 2003	Request South Africa to undertake analysis and report to IMAF-2003.
5.6	Estimation of IUU seabird by-catch.	6.92	Dr Agnew, Secretariat, Members	For Oct 2003	Report to IMAF-2003.
5.7	Data on seabird densities and by-catch rates in trawl fisheries.	6.205	Members	For Oct 2003	Report to IMAF-2003.
6.	**Scientific observer issues:**				
6.1	Preliminary analysis of data from 2002/03 fisheries.	Standing request	SODA*	IMAF meeting	Produce draft tables equivalent to Tables 6.1 to 6.8 of the FSA-2002 report.

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance[1]	Start/ Completion Deadlines	Action
6.2	Review and revise instructions in *Scientific Observers Manual* and address identified issues:		IMAF/FSA observer subgroup, technical coordinator	Nov 2002	Report, as necessary, to IMAF-2003.
	(i) distinguish status of birds released alive;	6.16, 6.208			
	(ii) reporting of hook loss;	6.26, 6.27			
	(iii) streamer line areal coverage;	6.76			
	(iv) levels of observation;	6.177, 6.178			
	(v) improved reporting from trawl fishing; and	6.195, 6.196			
	(vi) more/better data on seabird densities associated with trawl fishing.	6.205			
7.	**Revision of Conservation Measure 29/XIX**		IMAF		Review at IMAF-2003. Prepare draft text in advance, if possible.

ANNEX 6

AD HOC SUBGROUP ON DATA ACCESS

AD HOC SUBGROUP ON DATA ACCESS

The subgroup noted the underlying principle for data access is to ensure data is freely available for the work within CCAMLR and that the Rules for Access and Use of CCAMLR Data were developed primarily for the purposes of the Scientific Committee in the past. The subgroup also noted that there are separate rules governing CDS data (CCAMLR-XIX, paragraph 5.23). The subgroup agreed that it would be preferable that a single set of data access and management rules govern all data, including CDS data, held by the Secretariat.

2. The subgroup agreed that there are a variety of issues relating to the provision of data to CCAMLR and the use of such data by CCAMLR working groups, intersessional subgroups and individuals of Member countries needing to be addressed. The subgroup considered in general how to improve the current practices and procedures that might facilitate appropriate use of data in all of the work of CCAMLR.

3. Two main issues were identified by the subgroup that need to be addressed:

(i) how to provide to CCAMLR data which are commercially confidential and/or may have restrictions in national legislation on its transmission to other Parties and how to ensure that such restrictions are maintained during and after any data analysis undertaken by CCAMLR; and

(ii) how to ensure that data owners have an opportunity for involvement with analyses incorporating their data, especially where such work takes place outside the framework of the agreed program of intersessional work by CCAMLR working groups.

4. The subgroup considered the provision of data and noted that:

(i) it would be expected that data required to be reported to CCAMLR, would be submitted to the Secretariat and archived in a manner that provides the necessary level of security and allows access only in accordance with specified guidelines;

(ii) submission of certain types of data might be accompanied by stringent specifications as to the circumstances of their use. This could require, *inter alia*:

(a) the analysis of those data be conducted in consultation with the data owners (or expressly with data owner representatives present);

(b) that such work be undertaken at a venue with appropriate data security provisions;

(c) for access to be restricted to specific and nominated password holders;

(d) for the original restricted access data to be returned to data owners in its entirety at the conclusion of the analysis (and/or without any copies being retained centrally); and

(e) that results of all analyses involving the original data be submitted to CCAMLR in a form in which the commercial confidentiality or legislative restriction is fully protected or respected;

(iii) irrespective of the storage location of the source data, provision will need to be made for satisfactorily archiving in the Secretariat the outcomes of analyses along with sufficient documentation and, where necessary, summary data to provide for future reviews of the analyses undertaken.

5. The subgroup recognised the need to distinguish between the use and analysis of data for tasks identified by CCAMLR working groups and endorsed by the Scientific Committee or the Commission and those arising from intersessional requests by individual Members that are not expressly and explicitly related to the endorsed intersessional work program of CCAMLR.

6. In respect of analyses and use of data endorsed by the Scientific Committee or the Commission, it was recognised that such endorsement would need details of the type of data to be used, the degree of aggregation of the data appropriate for the analysis and a specification of how much spatial or temporal information may be required to satisfactorily undertake the agreed analyses. It was also recognised that, in some instances, the general form of presentation of the results will need to be specified to maintain the necessary security on information. The subgroup agreed that with such guidelines the existing rules for data access could be used by the Secretariat to administer requests by Members to use the data in their participation in such analyses.

7. In respect of requests for data outside the prescribed, endorsed work of CCAMLR working groups, requirements should include:

(i) that the original request specifies clearly the nature of the work to be undertaken, including the types and detail of data required, the analytical approaches to be used and the manner and detail of the results to be presented;

(ii) that all owners of data requested for such purposes should have the opportunity to require that any analysis be undertaken in full consultation with appropriate scientists and/or data owners;

(iii) that the consultation and collaboration include full opportunity for data owners to review the appropriateness of analytical approaches and to comment on the content and conclusions of the report submitted to CCAMLR; and

(iv) that Members' CCAMLR Commissioners, or their designated representative, should be the sole point of contact in respect of requests for access to CCAMLR data.

8. The subgroup recommended that the Commission also consider the following points in terms of access to data:

(i) consent required for different kinds of data;

(ii) accreditation of individuals that have access to data, recognising that this may involve issues concerning, *inter alia*, commercial and scientific sensitivity and confidentiality, compliance with conservation measures and IUU enforcement;

(iii) rules governing access to spatial and temporal information;

(iv) rules governing access to commercial information, such as company or vessel identifying characteristics;

(v) appropriate limits to the period necessary for consultation with data owners in paragraph 6;

(vi) the need to develop a mechanism to resolve disputes concerning data access; and

(vii) the need to maintain a distinction between enforcement and scientific purposes when access to data is requested and the purposes for which data are collected.

Advice to the Scientific Committee

9. The subgroup recommended that the guidelines in paragraphs 4 to 6 should be used by the Secretariat in place of the existing rules of access until a new set of rules are agreed.

10. The subgroup recommended that the Secretariat be asked to develop, as soon as practicable, in consultation with Members, a draft set of rules based on these guidelines. The resulting draft should be circulated to Members for comment prior to submitting a new draft for review by the Commission and Scientific Committee, including its working groups, as soon as possible.

11. The subgroup also recommended that during this process it would be appropriate for the Secretariat to review data handling procedures and security within the Secretariat and to consider the requirements needed to maintain data security when data are circulated outside the Secretariat.

ANNEX 7

SPECIFIC TASKS IDENTIFIED BY THE SCIENTIFIC COMMITTEE FOR THE 2002/03 INTERSESSIONAL PERIOD

SPECIFIC TASKS IDENTIFIED BY THE SCIENTIFIC COMMITTEE FOR THE 2002/03 INTERSESSIONAL PERIOD

No.	Task	Reference to paragraphs in SC-CAMLR-XXI	Deadline	Action Required	
				Secretariat	Members
1.	**Scheme of International Scientific Observation**				
1.1	Submit all data according to the most recent data formats.	2.3, 5.60	Ongoing	Advise Members	Implement
1.2	Synthesise the information contained in the questionnaire on fishing strategies in the krill fisheries for consideration by WG-EMM.	2.6	August	Analyse and report	Submit data
1.3	Revise the *Scientific Observers Manual* and the instructions to scientific observers, in consultation with technical coordinators.	2.9 to 2.12, 2.15, 2.18, 2.20, 2.21	January	Coordinate, revise and distribute	Distribute and implement
1.4	Apply protocols on sampling fish to the longline fishery in Subarea 48.3.	2.20	May	Advise Members	Implement
1.5	Develop protocols on sampling fish for other fisheries.	2.20	August	Advise Members	Implement
2.	**Ecosystem monitoring and management**				
2.1	Undertake tasks identified by WG-EMM.	Annex 4: 6.33–6.40, Tables 3, 4, Appendix E, Attachment 4	August	Implement	Implement
2.2	Revise CEMP Standard Method C2, Procedure B.	3.12	December	Revise and distribute	Distribute and implement
2.3	Prepare proposals to subdivide precautionary catch limit for krill in Area 48 among SSMUs.	3.16–3.20	August	Advise Members	Implement
3.	**Harvested species**				
3.1	Undertake tasks identified by WG-FSA.	Annex 5: 12.1–12.8, Table 12.1	October	Implement	Implement
3.2	At future meetings, consider only catches within the Convention Area available at the start of the Scientific Committee meeting.	4.29	October	Implement	Note
3.3	Report analyses of sea floor bathymetry and area in Area 51 to WG-FSA.	4.36	October	Advise Russia	Russia to implement
3.4	Conduct further work on estimating the age of icefish from otoliths, leading to a workshop meeting in 2004 at which age determination methods can be agreed.	4.43	October	Advise Members	Implement
3.5	Establish an intersessional subgroup on fisheries acoustics to evaluate the application of acoustics methods in estimating biomass of exploited fish in the Convention Area.	4.47, 4.83	August	Assist subgroup	Implement

No.	Task	Reference to paragraphs in SC-CAMLR-XXI	Deadline	Action Required	
				Secretariat	Members
3.6	Send a French expert to the meetings of WG-FSA.	4.62	October	Advise France	France to implement
3.7	Review methodology used to assess *C. gunnari*.	4.75, 4.91	October	Advise Members	WG-FSA to implement
3.8	Continue age and growth studies of *C. gunnari*.	4.76	October	Advise Members	Implement
3.9	Revise assessment of *E. carlsbergi*.	4.96	October	Advise Members	WG-FSA to implement
3.10	Continue to estimate future catches to predict closure dates, but incorporate information available on future vessel movements on a trial basis.	4.98, 12.9	Ongoing	Implement and report	Submit catch and effort reports and notification of vessel movements
3.11	Conduct further research on recruitment of *Dissostichus* spp. in Subareas 88.1 and 88.2 and on the most effective means of deploying effort in those areas.	4.114	October	Advise Members fishing in Subareas 88.1 and 88.2	Implement
3.12	Continue experiments on mark–recapture of *Dissostichus* spp. in Subareas 88.1 and 88.2.	4.114	December	Advise Members fishing in Subareas 88.1 and 88.2	Implement
3.13	Submit data on cheliped height and length of male crabs so that a comprehensive analysis of male size at maturity may be conducted.	4.118	October	Advise Members	Submit data
4.	**Incidental mortality**				
4.1	Undertake tasks identified by WG-FSA and WG-IMAF.	Annex 5: 12.1–12.8, Table 12.1, Appendix D	October	Implement	Implement
4.2	Assist in facilitating the financing and undertaking of experimental research to determine the most appropriate mitigation measures for use on vessels employing the Spanish longlining method.	5.13		Advise Members	Implement
4.3	Consider how estimates of cumulative potential seabird by-catch might be presented.	5.18	October	Advise Members	WG-IMAF to implement
4.4	Assess the effect of the removal by IUU fishing of large numbers of seabirds on the populations of albatrosses, giant petrels and white-chinned petrels breeding in the Convention Area.	5.20	October	Advise Members	WG-IMAF to implement
4.5	Continue reporting on activities relating to seabird by-catch and press for inclusion of this topic on RFMO agendas.	5.33	Ongoing	Advise Members and RFMOs	Implement

No.	Task	Reference to paragraphs in SC-CAMLR-XXI	Deadline	Action Required	
				Secretariat	Members
4.6	Report on progress towards developing and implementing NPOAs with particular reference to actions that would mitigate by-catch of seabirds from the Convention Area.	5.36	October	Advise Members	Implement
4.7	Review relevant conservation measures and develop advice on the use of bottom trawl gear, taking into account issues relating to the by-catch of seabirds and non-target fish species, and potential damage to benthos.	5.50	October	Advise Members	Implement
4.8	Report on the level of by-catch, including discarded skates, as accurately as possible in all forms of data submission.	5.77	Ongoing	Advise Members	Implement and submit data
4.9	Whenever possible during longlining operations, live skates and rays should be cut from the line while still in the water, and vessels should be encouraged to develop methods to minimise by-catch of these species.	5.78	Ongoing	Advise Members	Implement and report
5.	**Additional monitoring and management issues**				
5.1	Report on status and trends relating to all of the main aspects of marine debris related observations following procedures and principles analogous to those used in the preparation of reports of the status and trends arising from the data submitted to CEMP.	6.4, 6.8	October	Implement and report	Submit data
5.2	Update the CCAMLR database on marine debris with historical and current data collected using standard methods.	6.9, 6.23	Ongoing	Advise Members and process data	Submit data
5.3	Enter into the CCAMLR database historical data, collected using standard methods that have already been reported to the Scientific Committee, and consult with relevant Members to ensure appropriate data validation.	6.9	Ongoing	Implement	Advise and submit data as required
5.4	Consider the designation of a marine protected area in Division 58.4.4.	4.106	August	Advise Members and Subgroup on Protected Areas	Implement
6.	**Management under uncertainty**				
6.1	Revise fishery plans and include summary statements of decision rules and requirements for ecosystem assessment.	4.14, 7.7	October	Implement and report	Note
7.	**Cooperation with other organisations**				
7.1	Raise with CWP the issue of improving and standardising the reporting of by-catch of non-fish species, drawing attention to CCAMLR's work in this area.	9.13	October	Implement and report	Note
7.2	Keep the Scientific Committee and its working groups informed of relevant developments in FIGS-FIRMS.	9.30	October	Implement and report	Note

No.	Task	Reference to paragraphs in SC-CAMLR-XXI	Deadline	Action Required	
				Secretariat	Members
7.3	Contribute to a session on the Southern Ocean at the Fourth World Fisheries Congress, 2 to 6 May 2004, Vancouver, Canada.	9.33	April	Advise Members	Implement
7.4	Consider only those reports from Observers which had been submitted to the Secretariat by 0900 h on the opening day of the meeting.	9.34, 13.19	October	Advise Observers	Observers to implement
8.	**Secretariat supported activities**				
8.1	Complete the acoustic components of the survey database so that data from the CCAMLR-2000 Survey could be archived along with other acoustic survey data such as the BIOMASS dataset.	12.5	October	Implement and report	Note
8.2	Consult with Members planning acoustic surveys for icefish to ensure that the CCAMLR survey database was also able to capture these types of acoustic data.	12.5	March	Coordinate and implement	Advise as required
8.3	Review submissions of STATLANT data and ensure that these data provide the complete and correct official record of catch and effort.	12.7	March	Advise Members	Review and submit data as required
8.4	Submit available datasets from fishery surveys conducted in Subarea 48.3, as well as haul-by-haul catch and effort data from trawl and longline fishing targeting *D. eleginoides* between 1970 and 1995.	12.10	October	Advise Ukraine	Ukraine to implement
8.5	Continue developing the database of CCAMLR working documents and make available via the secure pages of the CCAMLR website.	12.14	August	Implement and report	Note
8.6	Re-schedule the submission deadline of STATLANT data.	12.15	December	Advise Members	Submit data
8.7	Publish the *Statistical Bulletin* on the basis of a season rather than a split-year.	12.15	June	Coordinate and implement	Note
8.8	Implement agreed steps to overcome problems with publication in *CCAMLR Science* of papers for which English is not the author's primary language, and which may need additional language editing assistance.	12.17	Ongoing	Coordinate and implement	Implement and note
9.	**Scientific Committee activities**				
9.1	Provide the Secretariat with a list of activities in 2002/03 which should be considered as high priority.	13.17	December	Prepare list and seek advice	Chair of Scientific Committee and conveners of working groups to implement
9.2	Review meeting agendas with the aim of further enhancing the flow of information and advice from the working groups to the Scientific Committee.	13.20	Ongoing	Advise Members	Working groups to implement
9.3	Invite observers at the 2002 meeting to participate in SC-CAMLR-XXII.	13.21	July	Invite Observers	Observers to implement

ANNEX 8

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN SC-CAMLR REPORTS

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN SC-CAMLR REPORTS

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)
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AMD	Antarctic Master Directory
AMLR	Antarctic Marine Living Resources (USA)
APEC	Asia-Pacific Economic Cooperation
APIS	Antarctic Pack-Ice Seals Program (SCAR-GSS)
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
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks (SCAR/SCOR)
BROKE	Baseline Research on Oceanography, Krill and the Environment

CAF	Central Ageing Facility
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
CCAS	Convention on the Conservation of Antarctic Seals
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CCSBT-ERSWG	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
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)
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
CWP	Coordinating Working Party on Fishery Statistics (FAO)
DCD	*Dissostichus* Catch Document
DPM	Dynamic Production Model
DPOI	Drake Passage Oscillation Index
DWBA	Distorted wave Born approximation model
EASIZ	Ecology of the Antarctic Sea-Ice Zone
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
EPOS	European *Polarstern* Study
EPROM	Erasable Programmable Read-Only Memory
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)
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
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
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
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
IDCR	International Decade of Cetacean Research
IFF	International Fishers' Forum (New Zealand)
IGBP	International Geosphere Biosphere Programme
IHO	International Hydrographic Organisation
IKMT	Isaacs-Kidd Midwater Trawl
IMAF	Incidental Mortality Arising from Fishing
IMALF	Incidental Mortality Arising from Longline Fishing
IMO	International Maritime Organization
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-Seabirds	FAO International Plan of Action on the Reduction of Incidental Catch of Seabirds in Longline Fisheries
IRCS	International Radio Call Sign
ISCU	International Council of Scientific Unions
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, Unregulated and Unreported
IW	Integrated Weight
IWC	International Whaling Commission
IWC-IDCR	IWC International Decade of Cetacean Research
JGOFS	Joint Global Ocean Flux Studies (SCOR/IGBP)
KYM	Krill Yield Model
LADCP	Lowered Acoustic Doppler Current Profiler (lowered through the water column)
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
MEA	Multilateral Environmental Agreement
MFTS	Multiple-Frequency Method for *in situ* TS Measurements
MIA	Marginal Increment Analysis
MPA	Marine Protected Area
MRAG	Marine Resources Assessment Group (UK)
MSY	Maximum Sustainable Yield
MV	Merchant Vessel
MVBS	Mean Volume Backscattering Strength
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
NRT	Net Registered Tonnage
NSF	National Science Foundation (USA)
NSIDC	National Snow and Ice Data Center (USA)
OECD	Organisation for Economic Cooperation and Development
PBR	Permitted Biological Removal
PCA	Principal Component Analysis
PCR	Per Capita Recruitment
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
SACCF	Southern Antarctic Circumpolar Current Front
SCAF	CCAMLR Standing Committee on Administration and Finance
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-COMNAP	SCAR Council of Managers of National Antarctic Programs
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
SC-IWC	Scientific Committee for IWC
SCOI	CCAMLR Standing Committee on Observation and Inspection
SCOR	Scientific Committee on Oceanic Research
SD	Standard Deviation
SeaWiFS	Sea-viewing Wide field-of-view Sensor
SIBEX	Second International BIOMASS Experiment
SIC	Scientist-in-Charge
SIOFC	Southern Indian Ocean Fisheries Commission
SIR Algorithm	Sampling/Importance Resampling Algorithm
SO-GLOBEC	Southern Ocean GLOBEC
SOI	Southern Oscillation Index
SO-JGOFS	Southern Ocean JGOFS
SOWER	Southern Ocean Whale Ecology Research Cruises
SPA	Specially Protected Area

SPC	Secretariat of the Pacific Community
SSMU Workshop	Workshop on Small-scale Management Units, such as Predator Units
SSSI	Site of Special Scientific Interest
SST	Sea-Surface Temperature
TDR	Time Depth Recorder
TEWG	Transitional Environmental Working Group
TIRIS	Texas Instruments Radio Identification System
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 Environmental Programme
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
VMS	Vessel Monitoring System
VPA	Virtual Population Analysis
WAMI	CCAMLR Workshop on Assessment Methods for Icefish

WCO	World Customs Organization
WFC	World Fisheries Congress
WG-CEMP	CCAMLR Working Group for the CCAMLR Ecosystem Monitoring Program
WG-EMM	CCAMLR Working Group on Ecosystem Monitoring and Management
WG-FSA	CCAMLR Working Group on Fish Stock Assessment
WG-IMALF	CCAMLR ad hoc Working Group on Incidental Mortality Arising from Longline Fishing
WG-IMAF	CCAMLR ad hoc Working Group on Incidental Mortality Arising from Fishing
WG-Krill	CCAMLR Working Group on Krill
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WSC	Weddell–Scotia Confluence
WS-Flux	CCAMLR Workshop on Evaluating Krill Flux Factors
WS-MAD	CCAMLR Workshop on Methods for the Assessment of *D. eleginoides*
WTO	World Trade Organization
WWD	West Wind Drift
WWW	World Wide Web
XBT	Expendable Bathythermograph
XML	Extensible Mark-up Language
Y2K	Year 2000