

SC-CAMLR-XX

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

**REPORT OF THE TWENTIETH MEETING
OF THE SCIENTIFIC COMMITTEE**

HOBART, AUSTRALIA
22–26 OCTOBER 2001

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Abstract

This document presents the adopted report of the Twentieth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, from 22 to 26 October 2001. 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.

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**REPORT OF THE TWENTIETH MEETING
OF THE SCIENTIFIC COMMITTEE**

(Hobart, Australia, 22 to 26 October 2001)

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 22 to 26 October 2001 at the Wrest Point Hotel, Hobart, Australia.

1.2 Representatives from the following Members attended the meeting: Argentina, Australia, Belgium, Brazil, Chile, European Community, France, Germany, India, Italy, Japan, Republic of Korea, Namibia, New Zealand, Norway, Poland, Russian Federation, South Africa, Spain, Sweden, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America and Uruguay.

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

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

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

- Dr K. Sullivan (New Zealand) – Fishery Status and Trends;
- Dr P. Penhale (USA) – Species Monitored in the CCAMLR Ecosystem Monitoring Program;
- Prof. J.P. Croxall (UK) – Assessment of Incidental Mortality;
- Prof. C. Moreno (Chile) – Marine Mammal and Bird Populations;
- Dr S. Nicol (Australia) – Krill Resources;
- Dr G. Parkes (UK) and Mr C. Jones (USA) – Fish Resources;
- Dr E. Marschoff (Argentina) – Crab and Squid Resources;
- Dr A. Constable (Australia) – Ecosystem Monitoring and Management;
- Dr K.-H. Kock (Germany) – Management under Conditions of Uncertainty about Stock Size and Sustainable Yield;
- Dr D. Miller and Mr B. Watkins (South Africa) – New and Exploratory Fisheries;
- Prof. B. Fernholm (Sweden) – Cooperation with Other Organisations;
- Drs R. Hewitt (USA) and I. Everson (UK) – Revision of the Scientific Committee Agenda; and
- Dr D. Ramm (Secretariat) – all other matters.

Adoption of Agenda

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

Report of the Chairman

Intersessional Meetings

1.7 Six CCAMLR meetings were held during the 2000/01 intersessional period:

- The International Coordination Subgroup held a three-day workshop in Seoul, Republic of Korea, in June 2001. The workshop was co-convened by Prof. S. Kim and Dr Y. Lee (Republic of Korea), and analysed data from five hydroacoustic surveys conducted in Subarea 48.1 from December 1999 to March 2000. These surveys had been conducted in conjunction with the CCAMLR-2000 Survey.
- A workshop to consider options for publishing a special issue of papers arising from the CCAMLR-2000 Survey was held in Cambridge, UK, from 30 May to 6 June 2001. It was convened by Dr J. Watkins (UK) and was attended by 15 participants.
- The seventh meeting of WG-EMM was held from 2 to 11 July in Fiskebäckskil, Sweden. It was convened by Dr Hewitt and was attended by 30 participants, representing 14 Members.
- A Workshop on Estimating Age in Patagonian Toothfish (*Dissostichus eleginoides*) was held from 23 to 27 July 2001 at the Centre for Quantitative Fisheries Ecology (CQFE), Old Dominion University, Norfolk, Virginia, USA. The workshop was convened by Dr Everson and was attended by 17 participants.
- The Workshop on Approaches to the Management of Icefish (WAMI) was held from 3 to 5 October in Hobart, immediately prior to the meeting of WG-FSA. This workshop was co-convened by Drs Parkes and Kock, and was attended by 15 participants.
- The meeting of WG-FSA was held from 8 to 19 October 2001 in Hobart prior to the Scientific Committee meeting. It was convened by Mr R. Williams (Australia). This meeting included a meeting of ad hoc WG-IMALF, convened by Prof. Croxall.

1.8 On behalf of the Scientific Committee, the Chair thanked the conveners for their significant contributions to the meetings. The report of WG-EMM is attached as Annex 4 and that of WG-FSA as Annex 5. Reports from WAMI and the Workshop on Estimating Age in Patagonian Toothfish are included in Annex 5.

Fisheries

1.9 CCAMLR Member countries actively participated in eight fisheries in the Convention Area during the 2000/01 season (1 December 2000 to 30 November 2001) under conservation measures in force:

- exploratory jig fishery for squid (*Martialia hyadesi*) in Subarea 48.3;
- exploratory longline fishery for toothfish (*Dissostichus* spp.) in Subarea 88.1;

- exploratory trawl fishery for spiny icefish (*Chaenodraco wilsoni*) in Division 58.4.2;
- longline and pot fishery for toothfish (*D. eleginoides*) in Subarea 48.3;
- trawl fishery for icefish (*Champscephalus gunnari*) in Division 58.5.2;
- trawl fishery for icefish (*C. gunnari*) in Subarea 48.3;
- trawl fishery for toothfish (*D. eleginoides*) in Division 58.5.2; and
- trawl fishery for krill (*Euphausia superba*) in Area 48.

Other fisheries for *D. eleginoides* had taken place within the EEZs of France in Subarea 58.6 and Division 58.5.1, and the EEZ of South Africa in Subareas 58.6 and 58.7.

1.10 Fourteen Members fished: Australia, Chile, France, Japan, Republic of Korea, New Zealand, Poland, Russia, South Africa, Spain, Ukraine, UK, USA and Uruguay. Details are reported in Sections 2 and 9.

CCAMLR Scheme of International Scientific Observation

1.11 Scientific observers conducted 60 trips on board fishing vessels, and provided complete coverage of longlining, potting and trawling for finfish and jigging for squid, and partial coverage of the krill fishery (SC-CAMLR-XX/BG/23). The Scientific Committee thanked all scientific observers for their great efforts during the past season, and for continuing to develop and improve the amount and quality of data collected (see Section 3).

Other Highlights

1.12 Representatives of the Scientific Committee attended various international meetings. Details are provided in Section 11.

1.13 *CCAMLR's Management of the Antarctic*, the synopsis of *Understanding CCAMLR's Approach to Management*, was published and distributed to Members in September 2001. The latest issue of *CCAMLR Science* (Volume 8) was made available at the meeting.

FISHERY STATUS AND TRENDS

Krill

Harvest Levels for the 2000/01 Season and Intentions for the 2001/02 Season

2.1 Reported catches of krill (*E. superba*) from catch and effort reports are shown in Table 1. A total of 98 414 tonnes was caught during the 2000/01 season (to 18 October 2001), all from Area 48. Catches were highest in Subarea 48.1 (South Shetland Islands) but also substantial in Subarea 48.2 (South Orkney Islands). The catch was taken by Japan, Republic of Korea, Poland, Ukraine and the USA.

2.2 Fishing activity in Area 48 has shifted towards Subareas 48.1 and 48.2 during the austral autumn and winter since 1996. Easier access through reduced sea-ice extent was recognised as a major factor influencing this change in the fishery.

2.3 The Scientific Committee noted the growing value of catch and effort data from the Japanese fishery and encouraged submission of similar data from other participants in the fishery. The value of data reported in a systematic and compatible fashion was emphasised and a high priority was assigned to re-examining the use of indices derived from these data.

2.4 The Scientific Committee also requested updated information on krill processing, market developments, economic analyses and any other information that may assist WG-EMM in monitoring the development of the krill fishery. Japan noted that the market price of krill in Japan is not available publicly.

2.5 The following plans for krill fishing during the 2001/02 season were reported: Japan expects to have three vessels catching ~65 000 tonnes; Republic of Korea, one vessel catching ~8 000 tonnes; Poland, three vessels; Ukraine, three to four vessels catching ~40 000 to 50 000 tonnes; Uruguay, one vessel; USA, two vessels.

2.6 Dr E. Goubanov (Ukraine) indicated that in 2002 the Ukraine fishery will be carried out in the traditional sectors of Area 48 (Subareas 48.1, 48.2 and 48.3). On board every vessel (or at least on board one vessel of the group operating in the same sector) there will be a national scientific observer.

2.7 The Scientific Committee noted that the expected catch in 2001/02 could be about 50% higher than the catch last year based on these fishing plans. At this stage no other interest in the krill fishery from non-Member countries was known to the Secretariat.

Fish

Fishing Activity in the 2000/01 Season

2.8 Eight fisheries, including three exploratory fisheries, were prosecuted under conservation measures in force during the fishing season of 2000/01, including fisheries for *D. eleginoides* and *C. gunnari* in Subarea 48.3 and Division 58.5.2, and exploratory fisheries for *Dissostichus* spp. in Subarea 88.1, for *C. wilsoni* and other species in Division 58.4.2, and for the squid *M. hyadesi* in Subarea 48.3. 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). Details of the catches in these fisheries are found in Annex 5, Table 2.

Reported Catches of *Dissostichus* spp.

2.9 Reported catches of *Dissostichus* spp. are shown in Tables 1 and 2. Inside the CCAMLR Convention Area a total of 10 619 tonnes (9 995 tonnes of *D. eleginoides* and 624 tonnes of *D. mawsoni*) was reported during the 2000/01 season (to 18 October 2001) compared with 16 395 tonnes in the previous year. Catches outside the Convention Area were 30 152 tonnes during the 2000/01 split-year compared with 11 553 tonnes in the

previous year (Annex 5, Table 3). Much of this additional catch appears attributable to increased catch reporting (especially from Areas 41 and 51) arising from entry into force of the CDS in May 2000 (Table 3).

Estimates of Catch and Effort from IUU Fishing

2.10 WG-FSA used the approach adopted in recent years to estimate the magnitude of IUU fishing effort and catches of *Dissostichus* spp. in various subareas and divisions during the 2000/01 split-year. The results of this analysis indicate that the estimated unreported catch for all subareas and divisions in the Convention Area was 7 599 tonnes (Annex 5, Table 5). This compares to an estimated IUU catch of 6 546 tonnes in the 1999/2000 split-year and 4 913 tonnes in 1998/99. The estimated unreported catch within the Convention Area was some 39% of the total catch in 2000/01 compared with 32% in 1999/2000. When the 30 152 tonnes of toothfish reported via the CDS as caught outside the Convention Area are added, the total removal of toothfish in the 2000/01 split-year is estimated at 51 129 tonnes.

2.11 The Scientific Committee noted the discussion of CDS data provided by WG-FSA (Annex 5, paragraphs 3.17 to 3.25) and the conclusion that Area 51 has assumed importance as a source of *D. eleginoides*. However, it was not possible to conclude whether this was a true indication of increased catches in this area or whether it may include fish taken from inside the Convention Area. Illegal fishing persists around Crozet, Kerguelen and Heard Islands, but has fallen to low levels around Prince Edward Islands, probably due to low stock levels of toothfish. The estimates of IUU catches are considered to be minimum estimates and any catches attributed to Area 51 increase this uncertainty.

2.12 Prof. G. Duhamel (France) pointed out to the Scientific Committee that for a large number of reasons he did not believe the catches reported from Area 51 were possible. These reasons included:

- (i) there were no reports of landings for *D. eleginoides* in recent FAO annual landings (FAO, 1998) from Area 51 (Indian Ocean, western area);
- (ii) geographical distribution of *D. eleginoides* in Area 51 is not known in the more recent publications (Fischer and Hureau, 1985; Gon and Heemstra, 1990);
- (iii) fisheries surveys in the Indian Ocean (southwest) by Australia, France, South Africa and Ukraine, both trawling and longlining, have never found fishing concentrations and commercial catches of *D. eleginoides* in Area 51. Conversely, other subtropical species such as alfonsino (*Beryx splendens*), orange roughy (*Hoplostethus atlanticus*), blue-eye (*Hyperoglyphe antarctica*), armourheads (*Pentaceros capensis*) and grouper (*Polyprion oxygeneois*) are currently found in this area;
- (iv) oceanographic barriers (sub-Antarctic and subtropical hydrological fronts) stop the northern distribution of *D. eleginoides* north of about 44°S; and
- (v) more recent surveys of *D. eleginoides* from open ocean areas closest to Area 51, such as in the area north of the Marion Islands, show negligible biomass of the species (WG-FSA-01/72).

2.13 The Scientific Committee agreed with Prof. Duhamel and concluded that practically all the toothfish catches reported from Area 51 represent catches taken as a result of IUU fishing in other areas inside the Convention Area.

2.14 The Scientific Committee recommended:

- (i) the Secretariat be tasked with providing information to WG-FSA in time for the 2002 meeting on the extent of catches both within and outside the Convention Area using CDS, vessel sightings and reported catch data; and
- (ii) that the Commission investigate more closely the CDS records which pertain to catches from Area 51 and those other areas where reported catches have increased since the implementation of the CDS.

2.15 The Chair conveyed to SCOI the concerns of the Scientific Committee.

Crabs

2.16 Crab species were taken as by-catch of the pot fishery in Subarea 48.3 during the 2000/01 season with 14 tonnes reported.

2.17 Japan and the USA have notified their interest, under Conservation Measure 215/XIX, to fish for crab in Subarea 48.3 during the 2001/02 season. Japan has not carried out an experimental harvest regime as set out in Conservation Measure 214/XIX and so will be obliged to conduct this experimental regime.

Squid

2.18 The exploratory fishery on *M. hyadesi* in Subarea 48.3 carried out by the UK and the Republic of Korea during the 2000/01 season caught 2 tonnes.

2.19 There were no notifications of intention to fish for squid in 2001/02.

CCAMLR SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

3.1 In the 2000/01 season, 60 fishing trips in the Convention Area were observed by CCAMLR-designated international scientific observers, or national observers, from Argentina, Australia, Brazil, Chile, France, Japan, New Zealand, South Africa, Spain, Ukraine, UK and Uruguay (SC-CAMLR-XX/BG/23). So far this season, scientific observers have provided 100% coverage of all trips undertaken in CCAMLR fisheries targeting *C. gunnari*, *Dissostichus* spp. and *M. hyadesi*, as well as partial coverage of the fisheries for *E. superba*.

3.2 The Scientific Committee noted that the national observer on board a Japanese-flagged trawler fishing for krill had followed the sampling protocols described in CCAMLR's *Scientific Observers Manual*.

3.3 The Scientific Committee noted that all but four of the logbooks, and all but five of the observer cruise reports, had been submitted before the start of the meeting of WG-FSA (Annex 5, paragraph 3.36). The Scientific Committee noted apologies from Argentina and Australia for the delayed submission of observer data from one trip by an Argentinean observer on board a Uruguayan-flagged longliner in Subarea 88.1 and two trips by national observers on board Australian-flagged trawlers in Division 58.5.2. Both Australia and Argentina had taken steps to ensure that these data would be submitted after the meeting.

3.4 Mr A. Lozano (Uruguay) stated that the Uruguayan Delegation regretted that the Secretariat had not received the observer's report for the *Isla Alegranza* (Annex 4, Table 12), but this matter had been rectified. He also went on to say that both the *Isla Alegranza* (Spanish system) and the *Isla Gorriti* (autosetting system) complied with the line-sinking regime as stipulated in Conservation Measure 210/XIX, although only the former vessel is noted in paragraph 7.78 of the WG-FSA report (Annex 5).

3.5 Dr Marschoff commented on a misunderstanding about the submitting mechanism of reports in the case when two observers are on board. He agreed that it was the designating country's responsibility to submit the international observer's report. This situation has been resolved and the complete report and datasets have been submitted to the Secretariat.

3.6 Dr Goubanov outlined the program of observation undertaken by Ukrainian observers during the 2000/01 season. Ukraine had deployed both national and international observers on board vessels fishing in the Convention Area. The logbooks and reports had been submitted to the Secretariat and recently analysed by WG-FSA and WG-IMALF. Dr Goubanov and his team of scientific observers thanked Dr E. Sabourenkov (Science Officer) for his excellent work in coordinating CCAMLR's System of International Scientific Observation and his assistance during 2000/01.

3.7 The Scientific Committee thanked all scientific observers for their work during the 2000/01 fishing season and for the great deal of very useful information and material collected. In doing so, it also recognised the importance of technical coordinators participating at the meetings of WG-FSA. The Scientific Committee noted that WG-FSA had suggested that a workshop for technical coordinators and scientific observers to deal with matters of their common interest, including the revision of the list of priorities of the observers' tasks (Annex 5, paragraph 3.50), might be held in the future.

3.8 Developments in scientific observations in the krill fishery in Area 48 in the 2000/01 season were reviewed by WG-EMM. The Scientific Committee endorsed the advice provided by WG-EMM (Annex 4, paragraphs 2.36 to 2.41), and reminded Members involved with krill fisheries to provide further information on:

- (i) the spatial and temporal distribution of these fisheries (Annex 4, paragraph 2.10);
- (ii) krill processing factors, particularly from modern processing machinery (Annex 4, paragraph 2.23); and
- (iii) the economics of the krill fisheries and on the market developments that might affect the development of such fisheries (Annex 4, paragraph 2.28).

3.9 The Scientific Committee gratefully acknowledged receipt of completed questionnaires on krill fishing tactics from the master of the Polish fishing vessel *Acmar*. This information was considered to be of substantial value for an analytical description of fishing activities. The Scientific Committee recognised that some of the data requested on the questionnaire may be commercially sensitive and that modification of the questionnaire may be required for different fishery operations. It was noted that the data would be used to describe the tactics of various krill fisheries and in the interpretation of catch and effort data, and that CCAMLR has provisions for the protection of proprietary data. Accordingly, other fishing operators were encouraged to make similar submissions and/or provide practical suggestions as to how the forms may be modified. The Scientific Committee noted that WG-EMM recommended that the questionnaire be incorporated into the *Scientific Observers Manual*, recognising that the questionnaire may need modification and that some portions may need to be completed by scientific observers. Most Members agreed with the Working Group's recommendations.

3.10 However, Dr S. Kawaguchi (Japan) expressed the following reservations:

- (i) most of the information could be obtained by the methods already included in the *Scientific Observers Manual*. These methods include haul-by-haul records as well as the recording system of krill fishing vessel activity;
- (ii) the quality of the data expected to be collected may be subjective and premature, especially the diagram for the positions of krill aggregations, tracks and tows; and
- (iii) before incorporating the questionnaire form in the *Scientific Observers Manual*, its usefulness should be established on a voluntary basis.

3.11 Logbooks and reports from scientific observers on board vessels targeting *C. gunnari*, *Dissostichus* spp. and *M. hyadesi* had been reviewed and analysed by WG-FSA. The Scientific Committee welcomed the developments provided by WG-FSA and WG-IMALF (Annex 5, paragraphs 3.35 to 3.52, 3.69 to 3.83, 7.94 to 7.103, 8.25 and 8.26), including the following points.

- (i) WG-FSA had reviewed current protocols for sampling catches from longlines (Annex 5, paragraphs 3.53 to 3.66), and had provided interim advice to observers working on longliners as well as trawlers (Annex 5, paragraphs 3.67 and 3.68). WG-FSA had tasked a subgroup to further examine these issues during the 2001/02 intersessional period.
- (ii) Species identification sheets, drafted in 2000/01, would be finalised, published as laminated waterproof sheets, and sent to technical coordinators for distribution to observers on board longliners in 2001/02 (Annex 5, paragraphs 4.299 and 4.300). Copies of the species identification sheets would also be included in the *Scientific Observers Manual*.
- (iii) New protocols had been defined for measuring the length of macrourids (Annex 5, paragraph 4.301) and skates (Annex 5, paragraph 3.136). The new standardised body length measurement to be used for *Macrourus* spp. should be

from the tip of the snout to the anus. The Working Group suggested that total length and total width 'wingspan' should be recorded for all specimens of skates and rays measured.

- (iv) WG-IMALF had identified a number of desirable updates and revisions to the *Scientific Observers Manual*, endorsed by WG-FSA, which are set out in detail in Annex 5, paragraphs 7.95 to 7.99 and 8.20. Information on the potential use of video monitoring as a substantial adjunct to parts of the work of scientific observers are contained in Annex 5, paragraphs 7.100 to 7.103.

3.12 The Scientific Committee also noted that data on conversion factors (from processed weight to whole live weight) for *Dissostichus* spp. caught in 2000/01 had been analysed by WG-FSA. The Scientific Committee reminded both the designating countries (providing the observers) and the Flag States that the CCAMLR guidelines provided to scientific observers and skippers for collecting data on conversion factors should be followed (Annex 5, paragraph 3.78). Further, observers should record the conversion factors used by the vessels in their reports. The Scientific Committee agreed that conversion factors should be regularly evaluated throughout the season to take into account biological variability such as seasonal changes due to spawning condition.

3.13 Prof. Moreno cautioned the Scientific Committee on the use of conversion factors of finfish adjusted for season and location. Experience in Chile had shown that conversion factors were highly variable, and that it may be difficult for the Scientific Committee to reach agreement on values to be used. Prof. Moreno proposed that the Scientific Committee consider each fishery, setting a single conversion factor to be used throughout the season and area of fishing.

3.14 Finally, the Scientific Committee recommended that information on tagging studies on *Dissostichus* spp., and other species of interest, be listed in the *Scientific Observers Manual*. Guidelines for the recording of recaptured fish should also be included to assist observers with the recovery of data on tagged fish. The Scientific Committee requested that Members currently conducting tagging studies provide this type of information to the Secretariat no later than 31 January 2002, so that this information may be included in revision of the *Scientific Observers Manual* for the 2001/02 season.

DEPENDENT SPECIES

Species Monitored under the CCAMLR Ecosystem Monitoring Program

4.1 Dr Hewitt began the presentation of the WG-EMM report (Annex 4) by noting that the Working Group had reviewed the summary report on CEMP indices (WG-EMM-01/05). The Working Group concluded that the year 2000/01 had been average with respect to CEMP indices over the last 20 years. There were no indications of important differences in the indices among subareas within Area 48.

4.2 The Scientific Committee reviewed WG-EMM's discussions regarding the interpretation of CEMP indices and their usefulness in addressing management issues.

4.3 CEMP was established in 1985 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.

4.4 WG-EMM agreed to consider whether:

- (i) the nature and use of the existing CEMP data continued to be appropriate for addressing the original objectives;
- (ii) these objectives remain appropriate and/or sufficient; and
- (iii) additional data were available which should be incorporated into CEMP or be used in conjunction with CEMP data.

4.5 WG-EMM recognised that there would be a need, as part of the overall review of CEMP, to develop and link appropriate statistical and ecological models. This would require the involvement of specialists with relevant experience.

4.6 WG-EMM agreed to hold a preliminary session at its 2002 meeting to develop and link the models, address the terms of reference, and make detailed plans for a workshop to be held in conjunction with the 2003 meeting.

4.7 The Working Group agreed that a correspondence group convened by Prof. Croxall should be established to act as a steering committee both for the pre-workshop session in 2002 and to initiate planning for the workshop in 2003.

4.8 Dr Hewitt reported discussion of CEMP standard methods, by noting the potential for misinterpretation arising from the use of the growth rate of Antarctic fur seals following Standard Method C2.6, and by noting the proposal for a new index to replace the existing formulation (Annex 4, paragraphs 3.91 and 3.92).

4.9 It was noted that there are no CEMP standard methods relating to indices of prey abundance. It was agreed the sampling protocols and data analysis for the CCAMLR-2000 Survey should be considered as the CEMP standard method for collection of acoustic data.

4.10 The Scientific Committee agreed that the Subgroup on Methods, convened by Mr K. Reid (UK), should:

- (i) consider new, and revisions to existing, CEMP standard methods;
- (ii) advise on and review new techniques for the analysis of parameters; and
- (iii) develop criteria to evaluate the methods used in the collection of non-CEMP parameters identified by WG-EMM as relevant to its work.

4.11 Dr Hewitt reported discussion on the request by the Commission to the Scientific Committee (CCAMLR-XIX, paragraphs 11.20 and 11.21) to develop scientific advice regarding protected area proposals for marine areas from the ATCPs, on steps to be taken to determine:

- (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.

4.12 Dr Hewitt reported that WG-EMM noted that not all proposals will require the same information. The future assessment of the two questions from the Commission should include an assessment of available information relevant to CCAMLR and its objectives, such as location of breeding sites of seals and seabirds, location of foraging areas of seabirds and seals, description of known marine fauna, description of current or potential fisheries, location and details of research directly relevant to CEMP, as well as any other matters which may be relevant to the implementation of Article II of the Convention. WG-EMM would value having the Commission identify any additional questions it has regarding a specific proposal (Annex 4, paragraphs 4.30 and 4.31).

4.13 Dr E. Fanta (Brazil) noted that the Commission had previously endorsed the Scientific Committee recommendation of items which should be considered during such assessments (SC-CAMLR-XIX, paragraphs 11.21 and 11.22; CCAMLR-XIX, paragraph 11.17).

4.14 The Scientific Committee noted that further development of the general procedure should await a specific proposal. It was requested that the Commission consider whether any further work is required on this matter and whether the values of a proposal need to be assessed with respect to the two issues identified by the Commission (CCAMLR-XIX, paragraph 11.20).

4.15 A request for clarification arose concerning the current status of the Italian proposal for an ASPA at Terra Nova Bay, following recommendations for improvement provided by the 2000 meeting of WG-EMM (SC-CAMLR-XIX, Annex 4, paragraph 5.37).

4.16 At the time of adoption of the report, Italy informed the Scientific Committee that a research program has been initiated to obtain additional background data for the establishment of an ASPA at Terra Nova Bay. Previous work has provided a map of the distribution of benthic communities. Research in the 2001 summer season will produce a bottom morphology map.

4.17 A draft management plan for establishing the Terra Nova Bay ASPA will be prepared and forwarded in time for review by the appropriate working group(s) of the Scientific Committee in 2002.

4.18 The Scientific Committee requested the Commission to confirm whether it would be appropriate for proposals submitted to CCAMLR by ATCPs to be considered by the Scientific Committee and its working groups independently of any review process under way within SCAR.

4.19 The Scientific Committee noted that the Commission requested that it provide advice on the application of the provisions in Article IX.2(g) of the Convention, '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).

4.20 In response to this request, the Scientific Committee noted the global interest in the use of marine protected areas (WG-EMM-01/31) and that a major review would be published in the journal *Ecological Applications* later in 2001. The Scientific Committee noted that consideration of Article IX.2(g) could be included in discussions of management options for fisheries. It also noted that such consideration would require the development of a framework for assessing the value of different management options in terms of achieving the objectives of the Convention.

4.21 The discussion by the Scientific Committee on the procedures to be followed in the review of draft management plans forwarded to CCAMLR for comment indicated a lack of clarity in the process. In particular, some Members felt that the values identified as the rationale for protection identified in a particular plan should be assessed by CCAMLR and others disagreed. Some Members raised questions regarding the pathway and timeline for review. The Scientific Committee expressed concern that the lack of clarity in the review process could result in proposals being given a less than timely and appropriate review.

Advice to the Commission

4.22 The Scientific Committee requested clarification from the Commission on several specific issues involved in the review of draft management plans for ASPAs or ASMAs under the Protocol of Environmental Protection to the Antarctic Treaty, that contain a marine component, forwarded to CCAMLR for comment:

- (i) Should the Scientific Committee review the values of protection identified in an Antarctic Treaty management plan or limit its comments to issues related to items in paragraph 4.11 above?
- (ii) What is the pathway of submission and referral to the Scientific Committee and its working group(s) for review of proposals received for comment by CCAMLR?
- (iii) Should the Scientific Committee review proceed independently of any review process under way within SCAR?
- (iv) What is the timeline for CCAMLR review of an ATCM management plan?

4.23 In addition, the Scientific Committee recommended that CCAMLR advise the ATCM of the time that will be required for review of draft management plans, taking into account the annual schedule of CCAMLR working groups, the Scientific Committee and the Commission to ensure a timely review.

Assessment of Incidental Mortality

Incidental Mortality in Longline Fisheries

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

Research into the Status of Seabirds at Risk

4.25 The Scientific Committee encouraged Members to complete the submission of data requested for the review of:

- (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 (Annex 5, paragraphs 7.3, 7.14, 7.21 and 7.23).

4.26 Prof. Moreno regretted that a report from Chile had not been submitted in time for the WG-IMALF meeting; he had passed a copy to the Convener for the Working Group to consider next year.

4.27 The Scientific Committee noted that important results from data so far submitted include:

- (i) a 25% decline in the population of black-browed albatrosses at the Falkland/Malvinas Islands, 18% in the last five years, is likely to result in the global conservation status of this species being changed from Near-threatened to Vulnerable (Annex 5, paragraph 7.13);
- (ii) substantial recent (1990s) declines (of 8–15%) in populations of wandering and grey-headed albatrosses, northern and southern giant petrels and white-chinned petrels at Marion Island (Subarea 58.6) reversing or halting previous recoveries. The main causes are believed to be increased mortality in the recently increasing tuna longline fisheries in areas adjacent to the Convention Area and the recent large-scale IUU fisheries for toothfish closer to the breeding site (Annex 5, paragraphs 7.15 and 7.16);
- (iii) substantial (28%) declines of white-chinned petrel populations at South Georgia since the mid-1980s, attributed to similar causes to the above (Annex 5, paragraph 7.17);

- (iv) the suggestion that mortality of adult female wandering albatrosses from Marion Island in temperate Southern Hemisphere tuna longline fisheries is the single most important factor compromising the conservation status of this population (Annex 5, paragraph 7.22);
- (v) potential problems in using genetic data to ascribe origins of grey-headed albatrosses to any particular island population and of black-browed albatrosses beyond distinguishing specimens from the Falkland/Malvinas Islands and Campbell Island from other breeding sites (Annex 5, paragraph 7.23); and
- (vi) declines in wandering albatross populations at Crozet and South Georgia and the recovery since 1986 of the Crozet population, both correlate with data on tuna longline fishing effort in adjacent regions of the Convention Area. The continuing decline of the South Georgia population is attributed to some combination of by-catch associated with longline fishing for tuna in the poorly documented South Atlantic and for toothfish both inside and outside the Convention Area. Attempts to correlate seabird population changes with fishing effort are likely to be limited by the quality of the latter data (Annex 5, paragraphs 7.27 to 7.31).

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

4.28 The Scientific Committee commended the prompt submission by observers of good quality data, which ensured comprehensive analysis of the data for 2001 (Annex 5, Tables 51 to 55). It noted that the main results were:

- (i) for Subarea 48.3 the total estimated seabird by-catch was only 30 birds, at a rate of 0.0014 birds/thousand hooks (Annex 5, paragraphs 7.38 and 7.39), very similar to last year's values; fishing season restrictions and continued improved compliance with Conservation Measure 29/XIX have kept by-catch in the regulated fishery in this subarea to negligible levels for the second successive year (Annex 5, paragraph 7.55);
- (ii) for fishing within the South African EEZ in Subareas 58.6 and 58.7, the total estimated seabird by-catch was 199 birds (a 61% reduction over last year), at a rate of 0.018 birds/thousand hooks (compared with 0.022 birds/thousand hooks last year) (Annex 5, paragraphs 7.40 and 7.41). Reduced by-catch this year was mainly due to changes in fishing area (Annex 5, paragraph 7.45), but improved compliance with Conservation Measure 29/XIX also contributed (Annex 5, paragraph 7.56); and
- (iii) no incidental mortality of seabirds was observed in Subarea 88.1 for the fourth successive year due to strict compliance with conservation measures (Annex 5, paragraph 7.53).

4.29 The Scientific Committee noted and commended that, in respect of seabird by-catch, the operation of the main regulated longline fisheries in 2000/01 had maintained the high standard of last year in Subarea 48.3 and had shown considerable improvement in the South African EEZ in Subareas 58.6 and 58.7.

4.30 The Scientific Committee endorsed the recommendation of WG-IMALF that fishing within 200 n miles of the Prince Edward Islands be prohibited in the months of September to April inclusive. However, if South Africa still considered it necessary to maintain a regulated fishing presence within its EEZ around the Prince Edward Islands in order to deter IUU fishing, then regulated fishing within 200 n miles of the islands should be prohibited at least from January to April (Annex 5, paragraphs 7.49 to 7.52).

4.31 In response to a question from Dr K. Sullivan (New Zealand), Mr Watkins reported that observers had indicated that birds caught and released alive (see Annex 5, paragraph 7.44) had been only lightly hooked and were in good condition when released.

4.32 The Scientific Committee noted that, as requested last year (SC-CAMLR-XIX, paragraph 4.21), data on seabird by-catch associated with longline fishing within the French EEZs in Subarea 58.6 and Division 58.5.1 in the 1999 and 2000 seasons had been submitted. This indicated that:

- (i) overall by-catch rates for the Crozet Islands (Subarea 58.6) were 0.736 birds/thousand hooks for 1998/99 and 0.184 birds/thousand hooks for 1999/2000, and for the Kerguelen Islands (Division 58.5.1) 2.937 birds/thousand hooks for 1998/99 and 0.304 birds/thousand hooks for 1999/2000 (Annex 5, paragraph 7.59); and
- (ii) a total of 8 491 white-chinned petrels (99% of all birds) was reported killed in the two years (Annex 5, paragraph 7.60). The totals of birds killed in the French EEZs in 1999 and 2000 were 17.2 and 4.2 times greater, respectively, than the total estimated seabird by-catches for the rest of the Convention Area; some monthly seabird by-catch rates exceed those used by WG-IMALF to estimate by-catch in the IUU fishery (Annex 5, paragraphs 7.62 and 7.63).

4.33 The Scientific Committee also noted the Working Group's recommendation that longline fishing within the French EEZs should be prohibited during the months of September to April inclusive (Annex 5, paragraph 7.64) and the request for the submission to CCAMLR of the original data for 1999 and 2000, in a form comparable to those reported for all other parts of the Convention Area, together with similar data from 2001, including information on mitigation measures in use in all three years (Annex 5, paragraph 7.65).

4.34 Prof. Duhamel regretted he had been unable to attend the meeting of WG-IMALF to provide fuller explanation concerning the data from the French EEZs. He confirmed that the numbers were entirely accurate, that CCAMLR conservation measures are in use in these EEZs, and that French scientists had been actively addressing the problems of seabird by-catch posed by fishing in summer (which was essential if IUU fishing in this region is to be deterred) around the Crozet and Kerguelen Islands. He noted that the mitigating measures in use on French vessels were very successful in avoiding by-catch of albatrosses, but that Kerguelen in particular has a very large population of white-chinned petrels (second only to South Georgia), so the problem is particularly acute there and all methods tried to date

(including laser multi-beam techniques and pressurised waterjets) to reduce incidental mortality of white-chinned petrels at night to acceptable levels have failed. Further work on mitigation measures was in progress. Prof. Duhamel also noted that the proposal above (paragraph 4.33), prohibiting fishing from September to April, could encourage IUU fishing and consequently increase bird mortality. In addition, the sea conditions in winter in these areas, known for the largest waves (from satellite altimetry records of sea levels), create a potential problem for the safety of fishing crews.

4.35 Prof. Croxall also noted that, in respect of Subarea 48.3, the UK shared France's concern for the safety of fishing vessels and crews in winter. This was an important element in its desire to see longline vessels fishing in this area enabled to use seabird by-catch mitigating measures that would allow them to fish at other times of year.

4.36 On behalf of WG-IMALF, Prof. Croxall noted that the French data indicated a peak in by-catch of white-chinned petrels between January and April and indicated that as with the recommendations with respect to the South African EEZ in Subarea 58.6, a prohibition on fishing during this period might represent an appropriate compromise between deterring IUU fishing and reducing by-catch of white-chinned petrels.

Compliance with Conservation Measure 29/XIX

4.37 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 (Annex 5, Table 56). It noted that the situation in respect of the different elements of Conservation Measure 29/XIX was as follows:

- (i) Streamer lines – compliance with streamer line design was 66%, double that last year. Vessels which have not complied with this element of the conservation measure over at least the last two years include *Argos Helena*, *Eldfisk*, *Isla Santa Clara*, *No. 1 Moresko* and *Aquatic Pioneer* (Annex 5, Tables 54 and 58 and paragraphs 7.67 to 7.69). Several vessels new to the fishery (*Polarpesca I*, *Suidor One* and *Rustava*) failed to comply with this simple and important measure (Annex 5, Table 58).
- (ii) Offal discharge – in the whole Convention Area only the *Maria Tamara* (Subarea 48.3) failed to comply with the requirement either to hold offal on board, or to discharge on the opposite side to where the line was hauled; in Subareas 58.6, 58.7 and 88.1 there was again 100% compliance in this regard (Annex 5, Table 59 and paragraph 7.71). Although Conservation Measure 29/XIX requests vessels in Subareas 48.3, 58.6 and 58.7 to avoid the discharge of offal during the haul, on 86% of cruises there was discharge during hauls on an average of 91% of sets (Annex 5, paragraph 7.72) In Subarea 88.1 no vessels discharged offal at any time, as required under Conservation Measure 210/XIX, indicating that offal processing or retention is feasible for at least some vessels.
- (iii) Night setting – compliance improved in Subarea 48.3 from 87% last season to 95% and was maintained at 78% in Subareas 58.6 and 58.7.

- (iv) Line weighting (Spanish system) – unlike all previous years when no vessel complied with the use of weights of 6 kg spaced at 20 m intervals, with the change in Conservation Measure 29/XIX to require weights of 8.5 kg spaced at 40 m intervals, this requirement was met on 21% of cruises in Subarea 48.3 and 18% of cruises in Subareas 58.6 and 58.7. Eight other vessels used line weightings that were close to compliance. Uruguay reported that the *Isla Alegranza* had complied with the 0.3 m/s line sink rate required in Subarea 88.1 (Annex 5, paragraphs 7.77 to 7.80 and Figure 35).
- (v) Line weighting (autoline system) – the requirement to achieve a line sink rate of 0.3 m/s when fishing in daylight in Subarea 88.1 south of 65°S was met by all vessels (Annex 5, paragraph 7.81).

4.38 Prof. Moreno reported that in-port inspection in Chile of the *Maria Tamara*, prior to permitting her entry into the fishery, had confirmed that she was configured so as to discharge offal on the opposite side to the haul (see Annex 5, paragraph 7.71). Subsequent review of the report of the international scientific observer from Uruguay had confirmed that this stated that the vessel did discharge offal on the opposite side to the haul. Therefore only the logbook entry was at variance. It was agreed to correct this record and to indicate that the *Maria Tamara* had complied with this element of Conservation Measure 29/XIX.

4.39 The Scientific Committee noted that four (*Isla Gorriti*, *Janas*, *San Aotea II* and *Sonrisa*) of the 24 vessels longline fishing in the Convention Area complied fully with all elements of the conservation measures that were applicable in the areas they fished (Annex 5, Table 59 and paragraph 7.84), but that some vessels (*Isla Camila*, *Isla Santa Clara*, *Koryo Maru 11*, *No. 1 Moresko*, *Argos Helena*, *Aquatic Pioneer* and *Isla Alegranza*) have not complied with two or more of the elements of Conservation Measure 29/XIX for two or more consecutive years, and some vessels (*Polarpesca I*, *Suidor One*, *Maria Tamara*, *In Sung 66* and *Rutsava*) in their first year in the fishery had failed to comply with two or more measures (Annex 5, paragraph 7.89).

4.40 Overall, the Scientific Committee welcomed the substantial improvements in compliance with Conservation Measure 29/XIX achieved this year and noted the advice that all practical constraints relating to conforming with Conservation Measure 29/XIX in respect of night setting, offal discharge, streamer line use and line weighting have essentially been overcome (Annex 5, paragraph 7.86).

4.41 The Scientific Committee recollected its advice to the Commission last year (SC-CAMLR-XIX, paragraph 4.41(i)) that vessels unable or failing to comply with the offal discharge, night setting and streamer line elements of Conservation Measure 29/XIX should be prohibited from fishing in the Convention Area. In view of the progress with line weighting for Spanish-system vessels, it now 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 (Annex 5, paragraphs 7.87 and 7.88).

4.42 Several Members commended the efforts made by Members, technical coordinators, fishing companies and fishers to improve compliance with Conservation Measure 29/XIX, while regretting that it had taken so long to reach a situation where full compliance was a realistic prospect.

4.43 Prof. Moreno, while agreeing with this, expressed concern that recommending exclusion of vessels from fishing in the Convention Area, based on persistent failure to comply with Conservation Measure 29/XIX, could result in such vessels fishing in waters outside the Convention Area where risk of seabird by-catch was high and where the use of mitigating measures, such as those in Conservation Measure 29/XIX, was not a requirement.

4.44 The Scientific Committee recognised this as a potential problem, for which a large part of the solution was stricter requirements, in respect of the use of mitigating measures, governing longline fishing in areas adjacent to the Convention Area, including appropriate EEZs (paragraph 4.73). It was also noted that most, if not all, vessels engaged in longline fishing in the Convention Area had substantially improved their performance with respect to the use of mitigating measures over the last two years. It was hoped that technical coordinators and scientific observers would continue to work with fishing companies and fishers to ensure further improvements, many of which would also help to reduce seabird by-catch and improve fishing performance when used outside the Convention Area.

4.45 In response to a question from Prof. Duhamel, Prof. Croxall indicated it was noted that the incorporation into Conservation Measure 29/XIX of specific requirements for line sink rates on autoline vessels was expected to be proposed next year, following completion of experimental research by New Zealand (Annex 5, paragraphs 7.182 and 7.231).

4.46 Dr Fanta summarised the requirements imposed by Brazil on vessels seeking to conduct longline fishing in the Convention Area (CCAMLR-XX/BG/22), indicating that these not only required full compliance with Conservation Measure 29/XIX (including as a condition of re-licensing for fishing in the Convention Area), but specified the use of an on-board offal processing plant and recommended the use of underwater setting.

4.47 The Scientific Committee commended Brazil's initiatives as exemplary in this regard.

Fishing Seasons

4.48 The Scientific Committee noted that, on the basis of the data for the 2000/01 fishing season in Subarea 48.3, seabird by-catch levels were negligible, for the second successive season. However, full compliance with Conservation Measure 29/XIX was not achieved so it was not possible to recommend an extension to the fishing season for 2001/02 in Subarea 48.3 (Annex 5, paragraphs 7.91 and 7.92). It also noted the advice that full compliance could be achieved next year with relatively small improvements to operational practice (Annex 5, paragraph 7.93).

4.49 It was noted that if, in the future, the Commission accepts advice from the Scientific Committee for an extension of the longline fishing season for *Dissostichus*, it would need carefully to consider how to proceed if subsequently there was failure to comply with Conservation Measure 29/XIX or more than negligible levels of seabird by-catch.

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

4.50 The Scientific Committee noted that:

- (i) As in past years, estimates of potential seabird by-catch have been made using two alternative catch rates; the average catch rate for all cruises in the regulated fishery (lower level) and the highest catch rate for any cruise in the regulated fishery for that period (higher level). The estimates for 2001 (Annex 5, paragraphs 7.109 to 7.113, Tables 60 and 61) were:

Subarea 48.3:	1 600–2 100 to 5 900–7 700 seabirds;
Subareas 58.6 and 58.7:	12 100–16 000 to 22 000–29 000 seabirds;
Divisions 58.5.1 and 58.5.2:	13 500–17 800 to 24 600–32 400 seabirds; and
Division 58.4.4:	9 300–12 500 to 17 100–22 700 seabirds.

- (ii) The overall estimated totals for the whole Convention Area (Annex 5, paragraph 7.114 and Table 61) indicate a potential seabird by-catch in the unregulated fishery of 36 000–69 000 (lower level) to 48 000–90 000 birds (higher level) in 2000/01. This compares with totals of 17 000–27 000 (lower level) to 66 000–107 000 (higher level) in 1996/97, 43 000–54 000 (lower level) to 76 000–101 000 (higher level) in 1997/98, 21 000–29 000 (lower level) to 44 000–59 000 (higher level) in 1998/99, and 33 000–63 000 (lower level) to 43 000–83 000 (higher level) in 1999/2000.
- (iii) The species composition of the estimated potential seabird by-catch (Annex 5, Table 62) indicates a potential by-catch of 40 500–89 500 albatrosses, 7 000–15 000 giant petrels and 109 000–275 000 white-chinned petrels in the IUU fishery in the Convention Area over the last five years (Annex 5, paragraph 7.120).

4.51 Prof. J. Beddington (UK) enquired whether the estimates of seabird by-catch included those potentially related to the IUU catches of toothfish reported from Area 51.

4.52 Prof. Croxall replied that this was not the case. He indicated that if these IUU catches of toothfish had originated from the Convention Area, as now seems likely (paragraphs 2.12 and 2.13), and the seabird by-catch rates from the adjacent Convention subareas (58.6 and 58.7) were applied, then the additional estimated potential incidental mortality of seabirds would have been about 25 000–60 000 individuals.

4.53 The Scientific Committee endorsed its conclusions of recent years that the levels of mortality reported in paragraph 4.50 remain entirely unsustainable for the populations of albatrosses, giant petrels and white-chinned petrels breeding in the Convention Area (Annex 5, paragraph 7.122), many of which are declining at rates where extinction is possible. It recommended that the Commission take even more stringent measures to combat IUU fishing in the Convention Area (Annex 5, paragraph 7.123).

Incidental Mortality of Seabirds in relation
to New and Exploratory Fisheries

4.54 The Scientific Committee noted that:

- (i) of the seven exploratory longline fisheries approved for 2000/01, only that in Subarea 88.1 was operational; no seabird by-catch was reported in this fishery (Annex 5, paragraphs 7.129 and 7.130);
- (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-XX/BG/11. There had been no changes to this advice in relation to levels of risk of seabird by-catch for any part of the Convention Area (Annex 5, paragraph 7.128);
- (iii) the 24 proposals by eight Members for new and exploratory longline fisheries in 14 subareas/divisions of the Convention Area in 2001/02 were addressed, in relation to advice in SC-CAMLR-XX/BG/11 and Annex 5, Table 63;
- (iv) the potential problems which needed resolving (Annex 5, paragraphs 7.133 to 7.137) were:
 - (a) to check that France intends to comply with Conservation Measure 29/XIX, rather than Conservation Measure 29/XVI as indicated, for Subarea 58.6 and Divisions 58.4.3 and 58.4.4. France indicated that this was an error in the text submitted, and confirmed that it firmly intended to comply with Conservation Measure 29/XIX;
 - (b) whether or not Japan intends to comply with Conservation Measure 29/XIX and to use an international scientific observer in Subareas 48.6, 58.6, 88.1 and 88.2, and Divisions 58.4.1, 58.4.3 and 58.4.4. Japan drew attention to CCAMLR-XX/10 Addendum which indicated its intention of complying with both of the above measures;
 - (c) clarification of fishing season in respect of South Africa's applications for Subarea 58.6 and Division 58.4.4; and
 - (d) applications for variations from Conservation Measure 29/XIX (e.g. similar to Conservation Measure 210/XIX) for Subareas 48.6, 88.1, 88.2 and Division 58.4.4.

4.55 The Scientific Committee endorsed recommendations for:

- (i) the continuation of Conservation Measure 210/XIX for exploratory fishing in Subarea 88.1 (Annex 5, paragraph 7.136) and an extension of this measure to the area north of 65°S in Subarea 88.1;
- (ii) the development of similar conservation measures for exploratory fishing in Subareas 48.6 and 88.2 and Division 58.4.4, retaining a strict precautionary limit on seabird by-catch (Annex 5, paragraphs 7.137 to 7.139); and

- (iii) the adoption of an additional simpler method for testing line sink rates (Annex 5, paragraph 7.140 and Appendix G).

Incidental Mortality of Seabirds during Longline Fishing outside the Convention Area

4.56 The Scientific Committee noted the information:

- (i) from South Africa that Japanese and Taiwanese vessels longline fishing for tuna in the South African mainland EEZ are estimated to kill annually 19 000–30 000 seabirds, including black-browed albatrosses and white-chinned petrels from the Convention Area. By-catch rates on Japanese vessels were 2.64 birds/thousand hooks; failure to use required mitigation measures, including streamer lines, was reported (Annex 5, paragraphs 7.143 to 7.146);
- (ii) from New Zealand and Falkland/Malvinas Islands on low levels of seabird by-catch observed in longline fisheries (Annex 5, paragraphs 7.148 and 7.149); and
- (iii) from Australia, indicating a 48% increase in tuna longline fishing effort in the AFZ in 1999 but, without observers, the lack of reliable by-catch data for this fishery (Annex 5, paragraph 7.150).

4.57 Japan noted that estimating the total seabird by-catch, simply by multiplying the by-catch rate by the number of hooks may be misleading, since the value may be dependent on the characteristics of the area and the vessels. Therefore, Japan would like to address this problem in relevant fora in the future.

4.58 The Scientific Committee welcomed the response by Japan and encouraged Members to provide relevant advice and, where possible, to assist Japan to implement and monitor the success of mitigating measures, similar to those successfully used in the Convention Area, to minimise seabird by-catch.

4.59 The Scientific Committee endorsed the recommendation 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 (Annex 5, paragraph 7.158).

Research into and Experience with Mitigating Measures

4.60 The Scientific Committee noted and endorsed, as appropriate, the advice concerning mitigating measures, and indicated its support for incorporating appropriate advice into Conservation Measure 29/XIX, when this is next revised. Specifically it noted:

- (i) offal discharge – scupper screens should be used to prevent discharge of offal and bait from vessels while processing catch (Annex 5, paragraph 7.161). Hooks, increasingly abundant in regurgitates from albatross chicks, should be removed from fish heads prior to discard (Annex 5, paragraph 7.162);
- (ii) streamer lines – a video of the successful New Zealand boom and bridle system should be circulated to fishers via technical coordinators (Annex 5, paragraph 7.163); paired lines have proved superior to single lines when tested in Alaskan demersal longline fisheries and should be tested in the Convention Area (Annex 5, paragraph 7.164);
- (iii) bait – further trials (Annex 5, paragraphs 7.165 to 7.168) are recommended and more data requested on circumstances of bait loss (Annex 5, paragraph 7.169);
- (iv) underwater setting – *Eldfisk* continues to use the Mustad funnel with success on day sets in the Convention Area and the same device performed well in Alaskan trials (Annex 5, paragraph 7.170); full trials of the Australian chute system are in progress on 10 vessels, earlier trials giving a 96% reduction in baits taken (Annex 5, paragraph 7.171);
- (v) line weighting –
 - (a) several vessels fishing in the Convention Area last year were able to comply with the revised line weighting system of 8.5 kg at 40 m intervals (Annex 5, paragraphs 7.75 to 7.78 and 7.173); when complying, only one of seven cruises recorded seabird by-catch, whereas six of 15 cruises recorded seabird by-catch when not complying (Annex 5, paragraph 7.174);
 - (b) all autoliners (and one Spanish system vessel) fishing in Subarea 88.1 achieved line sink rates of 0.3 m/s. The predictive model of sink rate was further developed (Annex 5, paragraphs 7.173 and 7.182);
 - (c) a new simple means of measuring line sink rate should enable predictive sink rate models to be developed for the Spanish longline system (Annex 5, paragraphs 7.176 and 7.183); and
 - (d) trials in New Zealand of a Norwegian-manufactured sample integrated autoline weighting system will take place shortly (Annex 5, paragraphs 7.179 and 7.180). It was noted that if trials were successful and such a system becomes commercially available, this would greatly simplify compliance with Conservation Measures 29/XIX and 210/XIX.

4.61 The Scientific Committee requested Members to support further research and development on the above topics, together with reports to the next meeting of WG-IMALF.

4.62 In response to the Scientific Committee's request last year, a proposal has been developed for rigorous experiments on the effects of the different elements of Conservation Measure 29/XIX, when applied to the Spanish longline system, in reducing seabird mortality (Annex 5, paragraphs 7.186 to 7.188).

4.63 The Scientific Committee noted the importance of the proposed study in terms of its potential to improve and simplify Conservation Measure 29/XIX. The research would also make a contribution to advice on appropriate mitigating measures for use by vessels employing the Spanish system of longlining in other parts of the world, especially in areas where birds from the Convention Area are currently being killed in large numbers. It recommended that Members able to help in carrying out the study, whether in terms of financial, logistic or other assistance, should accord this high priority.

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

4.64 The Scientific Committee endorsed advice in respect of:

- (i) the International Fishers' Forum – Members were encouraged to disseminate information on this successful meeting by way of articles in fishery magazines and journals (Annex 5, paragraphs 7.191 to 7.194); and
- (ii) the Agreement on the Conservation of Albatrosses and Petrels (ACAP) – CCAMLR Members who are range states (including distant-water fishing nations that interact with Southern Hemisphere albatrosses and petrels on the high seas) were encouraged to sign and ratify the agreement as soon as possible (Annex 5, paragraphs 7.195 to 7.198).

4.65 The Scientific Committee expressed concern at the lack of progress by CCAMLR Members towards implementation of FAO NPOA–Seabirds (requested by the Commission for February 2001), with the exception of Japan, New Zealand and the USA, who had either adopted or developed plans, and Australia, whose Threat Abatement Plan serves in lieu for the time being. The other relevant CCAMLR Members were urged to produce, adopt and implement plans as soon as possible (Annex 5, paragraphs 7.195 to 7.206). It noted that the Japanese plan was regarded as inadequate, in respect of mitigation measures, to reduce seabird by-catch to acceptably low levels, specifically in areas frequented by seabirds from the Convention Area (Annex 5, paragraph 7.212). It also noted that further details on the status and content of the plan and on details of mitigation measures relating to all Japanese longline fisheries relevant to Convention Area seabirds were requested (Annex 5, paragraph 7.213).

4.66 Japan shares the view that bird by-catch should be minimised. The important point is how to minimise the by-catch. Japan is now making a great effort to achieve this objective. For example, Japan has introduced a mandatory measure for tuna longliners to use tori (streamer) lines while targeting southern bluefin tuna. If there is further constructive advice, Japan would certainly welcome it and pay due consideration to improve mitigation (see paragraph 4.57).

4.67 Dr Fanta stated that Brazil's NPOA–Seabirds is to be sent to FAO shortly (SC-CAMLR-XX/BG/28). She indicated that as part of contribution towards the implementation of its NPOA–Seabirds, Brazil had already established collaborative research

between fisheries and conservation scientists and fishing companies, masters and crews to test by-catch mitigating measures and to establish a project for the training of fishers and scientific observers in relation to their use (SC-CAMLR-XX/BG/28).

4.68 Dr Marschoff reported that studies reviewing seabird by-catch in Argentine waters would be submitted to WG-IMALF next year. He indicated that of five longline vessels currently fishing in these waters, three were using the Mustad underwater setting funnel.

4.69 In respect of the BirdLife International Regional Workshop held in Uruguay in September 2001, Dr Fanta introduced a summary (SC-CAMLR-XX/BG/27) of the new South American Strategy for the Conservation of Albatrosses and Petrels (ESCAPE).

4.70 Prof. Moreno, who had been present at the workshop which was attended by representatives of fishing conservation and research interests from Argentina, Brazil, Chile, Ecuador, Falklands/Malvinas, Peru and Uruguay, in addition to BirdLife International staff from South Africa, Spain and the UK, gave details of many aspects of this meeting. He described it as perhaps the most significant development of its kind to have occurred in South America. He indicated that several papers describing the results of by-catch studies and assessments had been contributed, especially by scientists from Argentina, Brazil and Uruguay, and that a workshop volume publishing these was envisaged.

4.71 The Scientific Committee commended these initiatives and requested that relevant Members ensure that copies of their publications are submitted to WG-IMALF to assist its work next year.

4.72 The ASOC Observer stated that ASOC has grave concerns about the high levels of seabird by-catch and mortality. ASOC thanked WG-IMALF for its very comprehensive, but disturbing, report to CCAMLR. During the session of the Scientific Committee meeting, it had been heartening to hear from delegates of some of the very useful initiatives under way to understand and deal with these issues. ASOC requested, as a matter of urgency, that CCAMLR Members, many of whom have been present through the development of FAO IPOAs and ACAP, turn their efforts into developing and implementing NPOAs and ratifying ACAP which requires only four more ratifications for it to enter into force.

4.73 In concluding the presentation of the report of WG-IMALF, Prof. Croxall noted that, given the considerable success in reducing seabird incidental mortality in most regulated longline fisheries in the Convention Area to low, even negligible levels, 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 fishing for toothfish in the Convention Area, and with longline fishing for other species in areas adjacent to the Convention Area. Although the Commission is according high priority to combatting IUU fishing in the Convention Area, from the point of view of mortality of seabirds breeding in the Convention Area, by-catch in fishing operations outside the Convention Area is likely to be just as significant. It is encouraging to note progress in developing mitigation measures to address this problem by Members with EEZs in areas adjacent to the Convention Area; however there is an urgent need for collaborative work with appropriate regional fisheries organisations to ensure that effective mitigating measures are used throughout longline fisheries within the areas of their jurisdiction.

4.74 The Scientific Committee endorsed these views and requested Members to give every assistance possible to developing appropriate collaboration and data exchange with the relevant tuna commissions and other regional fisheries organisations (Annex 5, paragraphs 7.214 to 7.217).

4.75 The Scientific Committee thanked WG-IMALF and all associated with it for its work throughout the intersessional period and during its meeting.

Incidental Mortality of Marine Mammals in Longline Fisheries

4.76 The Scientific Committee noted that only one (unidentified) marine mammal was reported killed by a longline vessel in the Convention Area in 2001 (Annex 5, paragraph 8.1).

Incidental Mortality in Trawl Fisheries

4.77 The Scientific Committee noted that:

- (i) one Antarctic fur seal was reported killed by a trawl vessel in Division 58.5.2 (Annex 5, paragraph 8.4);
- (ii) no instances of incidental mortality of seabirds were reported from trawl fisheries in Divisions 58.4.2 and 58.5.2 in 2000/01 (Annex 5, paragraph 8.4); and
- (iii) in trawl fishing for icefish in Subarea 48.3, 132 seabirds were entangled, at least 92 fatally. This represents a total of three times the estimated total seabird by-catch mortality for all regulated longline fishing in the subarea in 2001 (Annex 5, paragraphs 8.5, 8.6 and 8.18).

4.78 The Scientific Committee noted that one of the vessels responsible, the *Betanzos*, was the same vessel responsible for all seabird trawl mortality (19 black-browed albatrosses) in Subarea 48.3 last year and recollected the concern regarding this vessel expressed in last year's report (SC-CAMLR-XIX, paragraph 4.49).

4.79 It noted, however, the advice of WG-IMALF that insufficient data were available to determine the precise cause of the high levels of seabird by-catch associated with certain vessels fishing for icefish in Subarea 48.3 and the consequent difficulty in proposing appropriate remedies, e.g. in the form of a binding conservation measure (Annex 5, paragraphs 8.19 and 8.20).

4.80 Accordingly, the Scientific Committee endorsed the recommendation that:

- (i) new data recording and reporting arrangements be devised for scientific observers on trawl vessels fishing in Subarea 48.3 commencing in the 2001/02 season, in order to determine the nature of offal discharge and deck lighting (see Conservation Measure 173/XVIII) and other details relevant to incidental entanglement and mortality of seabirds (Annex 5, paragraph 8.20);

- (ii) mitigation measures, similar to those in use in New Zealand domestic trawl fisheries, be tested on vessels trawl fishing for icefish in Subarea 48.3 in 2001/02 (Annex 5, paragraph 8.21); and
- (iii) seabird by-catch limits be placed on each vessel trawl fishing for icefish in Subarea 48.3 in 2001/02 (Annex 5, paragraph 8.22).

4.81 It also recommended that the Secretariat should seek to acquire recent data on seabird by-catch for French trawl fisheries in Division 58.5.1 and in any other relevant parts of the Convention Area (Annex 5, paragraph 8.23).

4.82 In regard to paragraph 4.81, Prof. Duhamel noted that there had been no seabird mortality associated with experimental trawl fishing for icefish and commercial longline fishing around Kerguelen (Division 58.5.1) between 1998 and 2000 and only a single bird killed in 2001. Mr Williams recollected the consistently very low or zero levels of seabird by-catch in the same fishery in Division 58.5.2 in recent years.

4.83 The Scientific Committee discussed further the advice of WG-IMALF that, until appropriate mitigating measures can be recommended, vessels participating in the trawl fishery for icefish in Subarea 48.3 be subject to an interim precautionary limit on the number of seabirds killed. If this limit is reached, fishing by the vessel responsible would cease. This would provide a strong incentive for vessels to develop effective mitigation measures to avoid being excluded from this fishery.

4.84 Prof. Beddington noted that despite the low absolute numbers of seabirds killed in this trawl fishery this year (92), in relation to the tens of thousands of birds potentially killed annually in IUU fishing for toothfish, and the numbers killed in regulated fisheries for toothfish operating during summer in analogous areas (e.g. 516 and 2 241 birds killed in the South African and French EEZs respectively in Subareas 58.6 and 58.7 in 2000), it was nevertheless important to take this issue seriously and to seek to identify an appropriate limit on seabird by-catch, which would encourage prompt changes in fishing practice.

4.85 Several Members emphasised the practical problems of implementing a vessel-specific by-catch limit, not least the difficulties of ensuring regular reporting from each vessel to CCAMLR. Concern was also expressed over the role of the scientific observers, who, although explicitly not involved in this reporting, would nevertheless be recording, and eventually reporting on, seabird by-catch as part of their normal duties (*Scientific Observers Manual*, Section 1, Annex 1).

4.86 It was noted that the procedures for ensuring compliance with the seabird by-catch limit set for vessels participating in the exploratory longline fishery for toothfish in Subarea 88.1 were not explicit in Conservation Measure 210/XIX and it was recommended that the Commission consider carefully how to achieve compliance with any seabird by-catch limit set for the trawl fishery for icefish in Subarea 48.3.

4.87 Dr K. Shust (Russia) suggested that it was unreasonable to penalise vessels that had consistently operated with zero or negligible levels of reported seabird by-catch in the trawl fishery for icefish in Subarea 48.3.

4.88 Prof. Moreno indicated that while the problems with the *Betanzos* may reflect aspects of its gear configuration or use, they did not relate to the acoustic cable linking the paravane to the net.

4.89 In response to a question from Dr Hewitt, Prof. Croxall indicated that the proposal to abolish the closed season for this fishery (currently 1 March to 31 May) would have a very limited effect on potential seabird by-catch levels and almost certainly none at all after mid-April, when black-browed albatrosses and white-chinned petrels migrate out of the area.

4.90 While a closure of the fishery during critical periods, as specified for the longline fishery in SC-CAMLR-XX/BG/11, would be effective in reducing these levels, the Scientific Committee noted that the problem seems to be confined to the performance of individual vessels rather than a fishery-wide problem. To that end, the Scientific Committee indicated that a closure would be premature at this stage pending research through the coming season and an evaluation of the problem at next year's meetings of WG-IMALF and WG-FSA.

4.91 In this context, it was suggested that approaches to addressing the by-catch of seabirds in trawl fisheries might be similar to the approaches taken for longline fisheries. It was noted that WG-IMALF considered the catch of 30 birds in the most recent longline fishing season in Subarea 48.3 (Annex 5, paragraph 7.39) to be sufficiently negligible in that fishery (Annex 5, paragraph 7.226) to warrant extending the fishing season, pending full compliance with Conservation Measure 29/XIX. In that regard, an interim catch rate at a similar level for the trawl fishery may be appropriate for one year, pending the review described above.

4.92 However, other Members noted that the mortality levels of 20 to 30 birds in 2000 and 2001 in longline fisheries in Subarea 48.3 were the product of by-catch rates of 0.002 birds/thousand hooks in both years. These rates are an order of magnitude lower than in any other regulated longline fishery in the Convention Area where the risk of seabird by-catch is comparable and are the result of several years of research and management in respect of mitigation measures now of proven efficacy, especially in relation to fishing in winter, when the risk of seabird by-catch is already low.

4.93 Thus, while a by-catch limit of 30 birds for trawl fishing in the whole of Subarea 48.3 may be a highly desirable aim, given that the problem with vessels in this trawl fishery was only discovered in 2000 and the first mitigating measures will only be tested in 2001, some Members felt it was unrealistic to set such a limit for next year.

4.94 Although the Scientific Committee could not offer advice based on scientific data or analysis, it agreed that a catch limit per vessel of 20 birds should not restrict most of the fishing fleet, but could suffice as an appropriate interim measure this year for protecting seabirds, while maintaining by-catch rates at levels not dissimilar from the longline fishery in the area and requiring improvements in fishing practice.

Incidental Mortality in Other Fisheries

4.95 The Scientific Committee noted that no instances of incidental mortality of marine mammals or seabirds had been recorded for the exploratory squid fishery or the *D. eleginoides* pot fishery in Subarea 48.3 (Annex 5, paragraph 8.24).

4.96 The Scientific Committee thanked WG-IMALF for its work on this topic. It requested the Working Group to continue to address these issues and recommended that its title be changed to the Working Group on Incidental Mortality Associated with Fishing (WG-IMAF).

Marine Debris

4.97 The Scientific Committee recollected its review last year of all aspects of data submitted by Members to CCAMLR under this agenda item (CCAMLR-XIX, paragraphs 4.51 to 4.59).

4.98 In respect of each of the six topics listed in SC-CAMLR-XIX, paragraph 4.56, the Secretariat had been requested to:

- (i) review all data submitted to CCAMLR;
- (ii) review and/or develop as necessary forms (and associated instructions or guidelines) for standardised reporting of data to CCAMLR;
- (iii) summarise status and trends for such topics as is feasible with available data;
- (iv) compile a list of papers submitted by Members on marine debris-related matters since 1983. (This was subsequently made available on the CCAMLR website.); and
- (v) prepare a consolidated report for the current meeting.

4.99 The Scientific Committee thanked the Secretariat for its report (SC-CAMLR-XX/BG/22). It considered how best to proceed towards its target of having:

- (i) all relevant data collected in standard fashion;
- (ii) all such data submitted to CCAMLR on standard recording forms;
- (iii) where desirable and feasible, these data incorporated into the CCAMLR database; and
- (iv) an annual report on status and trends relating to all the main aspects of marine debris-related observations provided to the Scientific Committee.

4.100 In response to the request from the Commission (CCAMLR-XIX, paragraph 6.7) the Scientific Committee recommended discontinuing the current system of reporting on collection of marine debris by vessels at sea. Few reports had been received and all were essentially anecdotal. The Scientific Committee would prefer to receive data from standardised quantitative surveys from vessels of debris at sea and encouraged any Members engaged in such activities to report on this and their methods to the Secretariat.

4.101 In respect of the other topics, the Scientific Committee recommended that:

- (i) the current versions of instructions for collecting data should be adopted, subject to any amendments notified to the Secretariat before the end of the Commission meeting;
- (ii) the current versions of the standard recording/reporting forms for these data should be adopted, subject to any amendments notified to the Secretariat before the end of the Commission meeting;
- (iii) the CCAMLR Secretariat should only accept data on these topics which are submitted on the standard reporting forms and which have been collected according to the prescribed standard methods;
- (iv) the submission of Members' Reports on Assessment and Avoidance of Incidental Mortality should now be discontinued; and
- (v) data provided by Members on:
 - (a) surveys of marine debris on beaches;
 - (b) entanglement of mammals in marine debris; and
 - (c) marine debris associated with seabird colonies;

should be incorporated into the CCAMLR database once appropriate consultation and validation with relevant Members had been undertaken (paragraph 4.102), for sites where at least five years of data exist. Other submitted data would be archived in appropriate electronic formats.

4.102 In addition, the Scientific Committee recommended that for data already submitted to the CCAMLR database (e.g. on surveys of marine debris on beaches), the Secretariat should correspond intersessionally with appropriate Members to validate in detail their submitted data and to encourage submission of any additional current, recent or historical data, where such data have been collected by a method consistent with the approved standard method and where data will be submitted on the standard reporting forms.

4.103 The Scientific Committee requested the Secretariat to prepare a report, as indicated in paragraph 4.99(iv) for its consideration each year.

4.104 Members are still encouraged to provide reports to the Scientific Committee on their own data, where these contain information that would amplify and assist the interpretation of trends and/or when they are reporting on data not yet submitted in part or in full to the CCAMLR database.

4.105 Any issues relating to the procedures involved in submission or validation of data should be discussed intersessionally with the Secretariat by Members.

4.106 The Scientific Committee noted the report on CCAMLR work on monitoring marine debris and its impact on marine living resources in Antarctic waters, prepared by the Secretariat as requested by the Scientific Committee (SC-CAMLR-XIX, paragraph 4.73) and submitted to CEP last year (SC-CAMLR-XX/BG/16). It thanked the Secretariat for this excellent review.

4.107 The CCAMLR Observer to CEP (Dr Holt as Chair of the Scientific Committee) noted that this report was very favourably received by CEP and was clearly the current benchmark for such studies in Antarctic sites and waters.

4.108 The Scientific Committee encouraged continuing collaboration with CEP on this topic, though it was noted that there would be some limitations associated with the different geographical areas covered by CEP and CCAMLR.

4.109 The Scientific Committee then considered reports on marine debris-related topics submitted by Members this year, together with related comments.

Surveys of Marine Debris on Beaches

4.110 Mr Lozano reported that Uruguay (SC-CAMLR-XX/BG/21) had undertaken surveys, using the CCAMLR standard method, of beaches near Artigas Station, King George Island (Subarea 48.1). The debris recorded came from a wide variety of sources potentially including tourists, scientific activities, logistic activities and fishing.

4.111 Prof. D. Torres (Chile) reported that Chile (SC-CAMLR-XX/BG/25), acknowledging assistance from the USA, had conducted the eighth annual survey at Cape Shirreff (Subarea 48.1) during the austral summer of 2000/01. A total of 1 774 articles (98% plastics) included 589 plastic bands (34% of all plastics). Of these, 40 were uncut and another 48 had been knotted into a loop, both in contravention of Conservation Measure 63/XV (and Annex IV of the Madrid Protocol). Several articles were totally or partially oiled; some plastic articles were partially burnt. The overall level of debris was an increase compared with the values of the last four years.

4.112 Prof. Croxall reported on UK surveys. At Bird Island, South Georgia (Subarea 48.3), (SC-CAMLR-XX/BG/2) the 10th consecutive annual survey revealed 408 items, a 92% increase over last year (and a three-fold increase in winter levels), reverting to levels of two to three years ago. Most items clearly originated from fishing vessels. At Signy Island, South Orkney Islands (Subarea 48.2) (SC-CAMLR-XX/BG/5), the 11th consecutive annual survey produced only 16 items, the lowest total ever recorded, with only one packaging band, continuing a declining trend since 1993/94.

4.113 Dr Fanta reported that although Brazil had collected marine debris at Admiralty Bay, King George Island (Subarea 48.1) as reported in its Member's Activities for 2000/01, the material had been disposed of before it could be analysed; most debris was of local origin and unrelated to fishing vessels.

4.114 Mr Watkins reported that South Africa had not undertaken any beached debris surveys in 2001 (SC-CAMLR-XX/BG/13).

4.115 Dr Holt reported that the USA had included data from surveys at Palmer Station (Subarea 48.1) within its report on Members' Activities for 2000/01; it would endeavour to submit these and previous data from this site to CCAMLR as soon as possible.

Entanglement of Marine Mammals in Marine Debris

4.116 Prof. Croxall reported on the UK surveys. At Bird Island, South Georgia (Subarea 48.3) (SC-CAMLR-XX/BG/3), the number of entanglements had increased, with 20 in winter (three times 1999 values) and 22 in summer (a 51% increase over last year). In both seasons, plastic packaging bands accounted for the majority of entanglements, the incidence having increased to levels comparable with those before the CCAMLR ban on their use on fishing vessels. At Signy Island (Subarea 48.2) (SC-CAMLR-XX/BG/4), for the first time in the five years of surveys, no seal entanglement was reported.

Marine Debris associated with Seabird Colonies

4.117 Prof. Croxall reported on the eighth year of standard surveys at Bird Island, South Georgia (Subarea 48.3) (SC-CAMLR-XX/BG/7). An unprecedented quantity of monofilament longline and hooks (67 hooks in a total of 99 items) was recorded in association with wandering albatrosses, a 55% increase over last year. This suggests that the discarding by fishing vessels of gear and offal (e.g. toothfish heads) complete with hooks and line is occurring on a large scale. He noted that similar findings had been reported from Marion Island; the recommendation from WG-IMALF in respect of discarding hooks had been noted earlier (paragraph 4.60(i)).

4.118 Dr Marschoff stated that there was a report from the Argentine station on the South Orkney Islands of a giant petrel with a fishing hook embedded in its wing (Subarea 48.2).

External Contamination of Animals

4.119 Two wandering albatrosses with red paint, apparently deliberately applied, were reported from Bird Island, South Georgia (Subarea 48.3); there were no reports of oil contamination of animals at this site (SC-CAMLR-XX/BG/27).

4.120 The reports by Chile on beached debris surveys (SC-CAMLR-XX/BG/25) included evidence of oil pollution in adjacent waters, albeit with no evidence that live animals were affected.

4.121 The Scientific Committee thanked Members for these reports, indicating considerable activity concerning marine debris-related topics. It noted that the overall trend this year was of increasing levels of debris and entanglement at most sites. It also noted reports of relatively high levels of plastic bands at many sites. It endorsed the comments made in several reports (SC-CAMLR-XX/BG/2, BG/3, BG/21, BG/25) that the Commission should enhance its efforts to require Members to improve their standards of disposal and treatment of debris, particularly in respect of plastic packaging bands.

Trends in Marine Mammals and Bird Populations

4.122 In respect of bird populations, this topic was reviewed last year by the Scientific Committee following a detailed report from the SCAR Bird Biology Subcommittee (SC-CAMLR-XIX, paragraphs 4.79 to 4.89). A similar report on Antarctic fur seals by the SCAR Group of Specialists on Seals was reviewed by the Scientific Committee last year (SC-CAMLR-XIX, paragraphs 4.90 and 4.91).

4.123 The next scheduled full review of this topic would normally be three to five years after 2000 (SC-CAMLR-XIX, paragraph 4.78).

4.124 The Scientific Committee noted that the WG-EMM report (Annex 4) contained new information relating to status and trends of marine mammal and bird populations in the Convention Area, specifically:

- (i) changes in Adélie penguin populations at Ross Island (Subarea 88.1) relating to the extent of winter sea-ice (Annex 4, paragraph 3.41);
- (ii) declines in Adélie penguin breeding populations at King George Island (Subarea 48.1) concurrent with reductions in krill biomass estimates from the same area (Annex 4, paragraph 3.42);
- (iii) decreases in gentoo and macaroni penguin breeding populations at Bird Island, South Georgia (Subarea 48.3), related to potential changes in krill availability (Annex 4, paragraphs 3.72 and 3.73); and
- (iv) possible reduction in rates of increases of fur seal breeding populations at Cape Shirreff (Subarea 48.1) (Annex 4, paragraphs 3.47 and 3.50).

4.125 The report of WG-IMALF also contained recent information on the status and trends of seabird populations relevant to the Convention Area, viz:

- (i) major recent declines of black-browed albatrosses at the Falkland/Malvinas Islands which may result in the species being reclassified (by IUCN) as Vulnerable in respect of its global conservation status (Annex 5, paragraph 7.13). This has potential implications for CCAMLR with respect to Article II of the Convention;
- (ii) recent substantial declines in populations of wandering and grey-headed albatrosses, southern and northern giant petrels and white-chinned petrels at Marion Island (Subarea 58.6), halting or reversing population recoveries of the first four species (Annex 5, paragraph 7.15). These changes were attributed to increased incidental mortality as a result of changes in longline fishing effort for tuna outside the Convention Area and IUU fishing for *Dissostichus* spp.;
- (iii) a major decline in the white-chinned petrel population at Bird Island, South Georgia, between 1981 and 1998, attributed to high levels of incidental mortality in longline fisheries within and adjacent to the Convention Area (Annex 5, paragraph 7.17); and

- (iv) a request to Members for their latest data on the population status of albatrosses and petrels to enable WG-IMALF to complete a review at its next meeting.

4.126 Dr Goubanov stated that Ukraine intends to collect new data on the status of marine birds and seals in the area of Vernadsky Station (Argentine Islands Archipelago, Bellingshausen Sea (Subarea 48.1)) and to monitor changes in their populations.

4.127 Dr Constable outlined that the history of the agenda item has been to review from time to time the long-term trends in populations of seabirds and marine mammals not monitored in CEMP, but for which SCAR could provide information and reviews on their status and trends. Given that the time series of the status of some of these populations is now quite long, including the recent reports on populations on albatrosses and petrels contained within the report of WG-FSA (Annex 5), he suggested that WG-EMM might review how such information could be included in the assessment of the marine ecosystem as part of their program of work to be undertaken over the next few years.

HARVESTED SPECIES

Krill Resources

Krill Status in 1999/2000

5.1 The Scientific Committee noted with pleasure the progress towards publication of the

Small-scale Management Units

5.5 The Scientific Committee noted that discussion of appropriate management units for fisheries in the Convention Area has a long history. WG-EMM had examined two types of management units:

- small-scale ‘predator units’, based on local predator demand, local krill distribution and fishing fleet patterns (Annex 4, paragraphs 4.4 to 4.11); and
- larger-scale ‘harvesting units’ which were formed by subdividing the large existing statistical areas (Annex 4, paragraphs 4.12 to 4.15).

Discussion on predator units is presented in paragraphs 6.15 to 6.19.

Harvesting Units

5.6 WG-EMM had drawn attention to the size of several of the large CCAMLR statistical areas and had suggested that they might be able to be subdivided into ‘harvesting units’ on ecological grounds. The rationale for establishing such harvesting units was that these large areas are currently too large to survey with ease, some boundaries may artificially divide populations, and many existing areas contain large areas where krill are generally thought to be absent (Annex 4, paragraphs 4.10 to 4.15).

5.7 In response to a request from WG-EMM (Annex 4, paragraph 4.14), a paper was provided to the Scientific Committee highlighting an approach to the subdivision of these large areas using historical data on krill distribution and abundance (SC-CAMLR-XX/BG/24). The paper adopted several general principles:

- areas where krill were abundant were separated from areas where krill were scarce;
- boundaries were located between ‘stocks’ of krill; and
- consistency with Conservation Measure 200/XIX was aimed for.

The overall aim was to produce a series of harvesting units of <400 000 km², which could be surveyed by a single ship in a summer season.

5.8 This approach was welcomed by the Scientific Committee and it was suggested that additional data should be taken into account in further developing this proposal. These could include: satellite information, bathymetry, the position of the Polar Front, oceanographic data and additional data on krill distribution and abundance, particularly further evidence of the existence of sub-populations of krill.

5.9 The Scientific Committee recommended that an intersessional group, co-convened by Drs M. Naganobu (Japan) and Constable, should develop this approach to harvesting units, and report to the 2002 meeting of WG-EMM.

5.10 The Scientific Committee noted that requests for altering management units from existing statistical boundaries to ones more related to ecological or physical boundaries have arisen a number of times. The Scientific Committee requests the Commission to advise

whether it would wish to receive advice on appropriate ecological or physical units, and whether it would prefer the boundaries for different species be harmonised where possible, or whether there might be a need for separate schemes for different species.

5.11 The Scientific Committee recommended that this work on harvesting units should proceed, noting, however, that WG-EMM's highest priority had been to the smaller predator units, which were to be the focus of a workshop at the 2002 meeting of WG-EMM.

Consideration of Existing Conservation Measures

Submission of Catch and Effort Data

5.12 The Scientific Committee noted WG-EMM's advice that the future work identified during the workshop on the future agenda of WG-EMM would require catch and effort data on the finest space and time scales practicable, and in a consistent format across all krill fleets (Annex 4, paragraph 4.44).

5.13 Historically, fine-scale data for the krill fishery has referred to aggregated data from fine-scale rectangles (0.5° latitude x 1.0° longitude). However, the Scientific Committee noted that there was no consistency in the reporting of data from the krill fishery. In the past, data have been provided by fine-scale rectangles, or by finer-scale rectangles (10 n miles x 10 n miles), or as haul-by-haul data. In many instances, no data have been submitted at all.

5.14 The Scientific Committee noted that none of the specific conservation measures adopted for krill to date specified the submission of catch and effort data on any scale. In order to further the work of the Scientific Committee, it was essential that consistent submission of data on the krill fishery be provided by all operators on the finest standardised scale practicable.

5.15 The Scientific Committee noted that for all fisheries other than krill in the Convention Area, the Commission had specified the appropriate level of fine-scale data submission (Conservation Measure 122/XIX).

5.16 Dr Kawaguchi indicated that although Japan supported the concept of consistent reporting of catch and effort data from the krill fishery from all operators, he indicated that his view was that the submission of such data should be on a voluntary basis, and guidelines on data submission rather than a conservation measure would suffice. Japan would have great difficulty supplying haul-by-haul data from the point of view of commercial confidentiality.

5.17 The Scientific Committee reiterated the urgent need for these data to be reported, and to be reported in a consistent format, as they were critical for the development of smaller management units which will need to take into account the behaviour of the fishing fleets. Most Members felt that a requirement to report haul-by-haul data in a consistent format would be the appropriate form of data submission from the krill fishery.

5.18 Dr Goubanov indicated that haul-by-haul data on krill fisheries carried out by the Ukrainian vessel from May to October 2001 will be submitted once the vessel returns and the data have been processed.

Method of Forecasting Closure Dates

5.19 The Scientific Committee noted WG-EMM's caution on the potential for overshooting the catch limit because of the current method of forecasting the closing date based on catch rates. The Secretariat was requested to review mechanisms that could be used for managing the krill fishery based on periodic reports from the fishery that would be able to ensure that overshoot of the catch limit was unlikely to occur. Although the potential to overshoot currently might not appear critical given the low level of overall catch compared to the precautionary catch limits, it would be important when considering catches in relation to smaller management units.

Catch Limits in Subareas 48.5 and 48.6

5.20 WG-EMM had sought clarification on catch limits for krill in Subareas 48.5 and 48.6 since these had not been surveyed as part of the CCAMLR-2000 Survey. The Scientific Committee indicated that the wording of Conservation Measure 32/XIX specified that the total catch of krill in Area 48 should be limited to 4 million tonnes. Furthermore, all of that catch had been allocated to Subareas 48.1, 48.2, 48.3 and 48.4. Thus, there was no catch allocated to Subareas 48.5 and 48.6.

5.21 Catch limits for Subareas 48.5 and 48.6 could be established either through new synoptic surveys or through analysis of existing data from previous krill biomass surveys, and the Scientific Committee encouraged the investigation of both these approaches. Without the analysis of such survey data, any proposals for krill fisheries in these areas would have to provide notification under the rules established for new fisheries (Conservation Measure 31/X).

Conservation Measure 45/XIV

5.22 The Scientific Committee recommended that the Commission revise the fishing season in Conservation Measure 45/XIV (precautionary catch limit on krill in Division 58.4.2) to bring it into line with the fishing seasons adopted by the Commission in Area 48 and Division 58.4.1.

Advice to the Commission

5.23 The Scientific Committee's advice to the Commission is contained in paragraphs 5.10 and 5.22.

Fish Resources

Fish, Squid and Crab Biology/Demography/Ecology

5.24 The Scientific Committee welcomed a number of important contributions on the biology, demography, and ecology of finfish and crab resources which had been presented to WG-FSA (Annex 5, paragraphs 3.92 to 3.142):

- (i) The results of an intersessional Workshop on Estimating Age in Patagonian Toothfish are discussed in Annex 5, paragraphs 3.92 to 3.102.
- (ii) Other results on the biology of *D. eleginoides*, including tagging studies, are presented in Annex 5, paragraphs 3.103 to 3.107. The Scientific Committee recognised the value of tagging experiments, and encouraged further tagging of *D. eleginoides*. The Scientific Committee emphasised the need for all scientific observers to be aware of the possibility that tagged fish may be in catches.
- (iii) Aspects of the biology, including new information on reproduction and population structure of *D. mawsoni* are discussed in Annex 5, paragraphs 3.108 to 3.111.
- (iv) New information on aspects of *C. gunnari* biology, demography and ecology were presented by WAMI in Annex 5, paragraphs 3.112 to 3.127. The entire WAMI report is contained in Appendix D of Annex 5.
- (v) Information on growth parameters of *C. gunnari* is presented in Annex 5, paragraphs 4.196 to 4.199. The Scientific Committee endorsed the recommendations of WG-FSA that an otolith exchange system be established and a reference collection of otoliths be prepared similar to what has been established for the CCAMLR Otolith Network for *Dissostichus* spp.
- (vi) Information on the distribution, sizes and survival after discarding of crabs from the experimental pot fishery for *D. eleginoides* in Subarea 48.3 is given in Annex 5, paragraphs 3.128 to 3.131.
- (vii) New biological information on skates and rays is summarised in Annex 5, paragraphs 3.133 to 3.136.
- (viii) New information on macrourids is summarised in Annex 5, paragraphs 3.137 to 3.140.

5.25 Dr Goubanov stated that Ukraine possesses data on several scientific surveys in Subarea 48.3 targeting *C. gunnari* and other fish species. Submission of these data will contribute to the better understanding of the biology, demography and interannual variability of *C. gunnari* in the area. Ukraine has a problem with submission of haul-by-haul data from scientific research trawl surveys for the period from 1970 to 1995, because of lack of financing.

Developments in Assessment Methods

5.26 The Scientific Committee welcomed a number of papers dealing with new assessment methods, which are described in Annex 5, paragraphs 3.143 to 3.150. Several new methods addressed the estimation of selectivity or ‘fishing vulnerability’, a term that includes both availability of fish to the fishery and selectivity by the fishery, and its effect on calculating growth parameters. The GYM had been revised to make the estimate of natural mortality and recruitment internally consistent in computations (Annex 5, paragraph 3.145). In addition, an age-structured production model was applied to the *D. eleginoides* fishery at Prince Edward Island (Annex 5, paragraph 3.148).

Assessment and Management Advice

Assessed Fisheries

Dissostichus spp.

5.27 Assessments of long-term annual yield for *Dissostichus* spp. were reviewed for Subarea 48.3 and Division 58.5.2. Several input parameters to the GYM were reassessed, the recruitment series updated, and catches updated for both Subarea 48.3 and Division 58.5.2. These assessments are detailed in Annex 5, paragraphs 4.84 to 4.155.

D. eleginoides at South Georgia (Subarea 48.3)

5.28 The catch limit for the fishery for *D. eleginoides* in Subarea 48.3 in the 2000/01 season was 4 500 tonnes (Conservation Measure 196/XIX). The total catch of *D. eleginoides* from this fishery, as reported by 7 October 2001 in the catch and effort reporting system, was 4 050 tonnes, of which 3 991 tonnes were taken by longline and 59 tonnes were taken by pot. The longline fishing season closed on 31 August 2001, and the pot fishing season will remain open until 30 November 2001 or until the catch limit is reached, whichever is the sooner.

Standardisation of CPUE

5.29 Analysis of CPUE data was undertaken for Subarea 48.3 using a GLM. New longline haul-by-haul data from most vessels were available from the 2000/01 season for vessels operating in Subarea 48.3. Details of the standardisation of the CPUE at South Georgia are described in Annex 5, paragraphs 4.87 to 4.91. The Scientific Committee endorsed the CPUE analysis undertaken by WG-FSA this year.

5.30 The Scientific Committee noted that the standardised catch rates were relatively constant from 1986/87 to 1994/95, decreased substantially between 1994/95 and 1996/97, and that there has been very little change since the 1996/97 season. The Scientific Committee observed that the trend in recent seasons towards increased longline fishing effort at shallow depths (300–700 m) was not observed in the 2000/01 season.

Determination of Long-term Annual Yield using the GYM

5.31 The Scientific Committee endorsed the analysis undertaken at this year's meeting of WG-FSA to revise the estimate of long-term annual yield using the GYM. The Scientific Committee further endorsed the refinements to the assessment procedures, including the use of the final parameters in Annex 5, Table 28 in this year's assessment. The Scientific Committee agreed to include three changes toward the final calculation of long-term yield compared to last year:

- the estimation of the different fishing vulnerabilities (selectivity);
- refinements to the recruitment estimates; and
- an updated time series of catches and standardised CPUE estimates.

5.32 Methods used in the assessment of long-term yield in Subarea 48.3 are described in Annex 5, paragraphs 4.94 to 4.114. The Scientific Committee endorsed the recommendation that a new selectivity curve was more appropriate for the fishery for 1998 onwards, whereas the previously used curve was still appropriate for 1997 and earlier.

5.33 A revised recruitment series was used in the GYM which produced similar estimates of yield to the 1999 assessment and a greater estimated yield than last year's assessment. The increase in yield also resulted from using the cohort densities directly so as to vary the recruitment series whenever the value of M is changed in the projection, rather than estimating the recruitment series using a mean value of M prior to the assessments. The outcome was that the estimated yield of *D. eleginoides* in Subarea 48.3 was 5 820 tonnes. As in previous years, the decision rule concerning the probability of depletion was binding.

5.34 The Scientific Committee welcomed the progress made at this year's meeting in refining the data inputs into the GYM, particularly with respect to progress made in estimating fishing vulnerability and incorporating internal consistency between parameters in the GYM. The Scientific Committee encouraged the continued development and testing of methods to integrate different indicators of stock status into assessments.

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

5.35 The Scientific Committee recommended that the catch limit for the 2001/02 season should be 5 820 tonnes. Other management measures for *D. eleginoides* in Subarea 48.3 in the 2001/02 season should remain as for the 2000/01 season.

5.36 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)

5.37 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)

5.38 The Scientific Committee recommended that Conservation Measure 180/XVIII be carried forward for 2001/02. 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 reviewed the advice of WG-FSA and concluded that given the high workload at its meetings, it was unlikely to be able to review this measure in the near future.

D. eleginoides at Kerguelen (Division 58.5.1)

5.39 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 have not been provided. The Scientific Committee endorsed the recommendation of WG-FSA that these data should be made available for assessment purposes, as well as any other information that would help determine the current stock status.

5.40 The Scientific Committee 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 state of *Dissostichus* spp. stocks in Division 58.5.1 and adjacent areas such as the Crozet Island region (see also Annex 5, paragraph 4.126).

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

5.41 The catch limit of *D. eleginoides* in Division 58.5.2 for the 2000/01 season was 2 995 tonnes (Conservation Measure 197/XIX) for the period from 1 December 2000 to the end of the Commission meeting in 2001. The catch reported for this division at the time of the WG-FSA-01 meeting was 2 490 tonnes. Two Australian vessels are participating in the fishery.

5.42 The Scientific Committee welcomed new data from the *D. eleginoides* fishery in Division 58.5.2, the details of which are described in Annex 5, paragraphs 4.129 to 4.144. New information included a revision of growth parameters. The mixture analyses used to determine cohort densities were therefore reassessed, providing a revised set of cohort densities.

5.43 Similar to the Subarea 48.3 assessment, the new method for estimating age-based fishing vulnerability was applied to the available catch data for Division 58.5.2, using revised growth and mortality parameters. The Scientific Committee encouraged the further development of this method to take account of fishing mortality, but noted that the results for this year are an improvement on the function used previously. The function used this year takes better account of the presence of large fish in the catch.

5.44 Based on the revisions of the inputs to the GYM, the yield estimate for Division 58.5.2 was 2 815 tonnes. The decision rule concerning the 50% escapement of median pre-exploitation biomass was binding.

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

5.45 The Scientific Committee recommended that the catch limit by trawling for Division 58.5.2 in the 2001/02 season be revised to 2 815 tonnes. The remaining provisions of Conservation Measure 197/XIX should be carried forward for the 2001/02 season.

D. eleginoides at Prince Edward Islands
(Subarea 58.7)

5.46 The Scientific Committee welcomed the assessment of *D. eleginoides* in the South African EEZ around the Prince Edward Islands described in Annex 5, paragraph 3.120. 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 projections suggest that the annual allowable catch in the Prince Edward Islands EEZ should be reduced to about 400 tonnes.

Management Advice for *D. eleginoides*
(Subarea 58.7)

5.47 The Scientific Committee acknowledged the high levels of uncertainty associated with estimates of *D. eleginoides* stocks in this area, especially in the light of IUU fishing. The Scientific Committee recommended that annual allowable catches in the Prince Edward Islands EEZ should be reduced to 400 tonnes.

D. eleginoides at Crozet Islands (Subarea 58.6)

5.48 WG-FSA did not undertake an assessment of *D. eleginoides* in the French EEZ around the Crozet Islands. France was encouraged to undertake such an assessment and inform WG-FSA of the results.

General Management Advice for *D. eleginoides*
(Subareas 58.6 and 58.7)

5.49 Following advice of recent years, the Commission's attention is again drawn to the high levels of uncertainty associated with estimates of *D. eleginoides* stock levels in Subareas 58.6 and 58.7 in general. The negative role of IUU fishing in increasing such uncertainty is also re-emphasised.

5.50 Given the prevailing uncertainties, the Scientific Committee recommended a continuation of the prohibition of directed fishing for *D. eleginoides* in Subarea 58.7 outside the EEZ of South Africa (Conservation Measure 160/XVII).

General Advice on *D. eleginoides* Assessments

5.51 The Scientific Committee was encouraged by the progress made this year on methods for reducing uncertainty in important assessment parameters. It endorsed the priority work on estimating growth and natural mortality (Annex 5, paragraph 4.142; SC-CAMLR-XIX, Annex 5, paragraphs 4.143 to 4.146) and consideration of the consequences of different growth rates between males and females on the assessment of yield (SC-CAMLR-XIX, Annex 5, paragraphs 4.122 and 4.123).

5.52 The Scientific Committee noted that the application of new methods in these fisheries will cause some variation from time to time in the estimates of parameters and, consequently, estimates of yield, and agreed that the inter-dependence of estimates of recruitment, growth, selectivity and natural mortality means that, if possible, estimation of these parameters should not be undertaken in isolation.

Champscephalus gunnari

Workshop on Approaches to the
Management of Icefish

5.53 The Scientific Committee noted the conclusions of WAMI, reported by WG-FSA (Annex 5, paragraphs 4.159 to 4.189). In particular, the Scientific Committee noted that fisheries for *C. gunnari* in Subarea 48.3 and Divisions 58.5.1 and 58.5.2 share many characteristics, including:

- (i) large fluctuations in catch;
- (ii) periods of low or zero commercial catches;
- (iii) a recent resurgence in interest in the fishery in the mid- to late 1990s with modest levels of fishing effort and catches in Subarea 48.3 and Division 58.5.2;
- (iv) reliance of the commercial fishery on a few age classes: mainly ages 3 and 4; and

- (v) age 5+ fish are poorly represented in survey and commercial catches, suggesting an age-specific increase in natural mortality (M).

5.54 The Scientific Committee endorsed the recommendations of WG-FSA on issues relating to current management measures (Annex 5, paragraph 4.165), ecological interactions (Annex 5, paragraph 4.175), surveys (Annex 5, paragraphs 4.176 to 4.183) and alternative approaches to management (Annex 5, paragraph 4.189).

5.55 The Scientific Committee noted that changes in the ecosystem in the recent past may be affecting the dynamics of *C. gunnari* stocks. The Scientific Committee advised the Commission that for the first time a CCAMLR working group had concluded that, in the context of Article II, it is possible that changes have occurred in the ecosystem, which may not be reversible over two or three decades. In particular, the Scientific Committee noted:

- (i) increases in populations of fur seals and some penguin species at South Georgia;
- (ii) increases in populations of fur seals and king penguins in the Indian Ocean;
- (iii) increases in mean annual air temperature at the Antarctic Peninsula; and
- (iv) decreases in the mean annual extent of sea-ice in the southern Scotia Arc.

5.56 Dr Marschoff noted that the past history of heavy fishing in the 1970s and 1980s was not discussed by WG-FSA in this context as a possible contributing factor to these changes.

5.57 The Scientific Committee recognised that high short-term variability in the size of *C. gunnari* stocks exists, and that there is potential for recovery following an event of high recruitment.

5.58 Dr Constable noted similarities between the program of work proposed by WG-FSA on ecological interactions between the *C. gunnari* fishery, *C. gunnari* and its predators and prey and other elements of the ecosystem (Annex 5, paragraph 4.175), and future work proposed by WG-EMM (paragraph 6.20). In particular, simulation studies are needed to examine plausible scenarios which could explain observed abundances of *C. gunnari*, krill and the predators. For example, a simulation study of the impact of seal predation may help determine what future work is required. Members of WG-FSA and WG-EMM were encouraged to work together on these issues to better understand the dynamics of *C. gunnari* and its fisheries in the Convention Area in the context of the ecosystem approach.

5.59 Dr Everson noted the information on by-catch of *C. gunnari* in krill trawls reported to WG-FSA from the fishery by Ukraine in Subarea 48.2 (Annex 5, paragraph 4.173). He noted that this report appeared to refer to catches of krill taken over the shelf to the south of the South Orkney Islands. The bulk of krill fishing in this subarea takes place to the north and west of the South Orkneys over deeper water. The Scientific Committee noted that it is rare to find *C. gunnari* in plankton hauls over deeper water.

5.60 Dr Kawaguchi noted that Japan has been continuing to deploy fish by-catch observers on krill trawlers around the South Shetland Islands area for nearly 10 years. The results of these analyses, presented in WG-EMM every year, show a low fish by-catch rate.

5.61 Dr Shust drew the Scientific Committee's attention to WG-FSA's discussion of survey methodology including the acoustic methods to better estimate the abundance of *C. gunnari*

(Annex 5, paragraphs 4.176 to 4.180). The Scientific Committee agreed that research surveys need to be as representative as possible of the true status of the stock as they are now the primary means of measuring the current status of the stock and form the starting point for the subsequent calculation of catch limits using the short-term projection method. The Scientific Committee recognised the value of combined acoustic and bottom trawl surveys to assess the abundance of fish in the water column both in the near-bottom layer sampled by the bottom trawl, and in the layers above the trawl. WG-FSA had agreed, however, that there were many issues that would need to be resolved before quantitative estimates of *C. gunnari* biomass could be derived from acoustic data (listed in Annex 5, Appendix D, paragraph 7.23), and discussion would be necessary at next year's meeting of WG-FSA to determine ways in which abundance estimates from the bottom trawl and acoustic surveys might be combined. Although there are limitations to the bottom trawl method, it is important to continue these surveys as they provide a continuous time series conducted using similar techniques.

5.62 Methods of setting catch limits were reviewed in paragraphs 4.184 to 4.189 of WG-FSA's report (Annex 5). The Scientific Committee endorsed the continued use of the current short-term projection method to provide advice on catch limits for *C. gunnari*, pending the development of alternative methods. It also noted that with the fishery based mainly on two age classes, the currency of assessments is two years. If there is no survey information from the most recent two seasons, the advice on catch limits becomes unreliable.

5.63 Dr Marschoff noted that the short-term projection will always result in a catch limit even if it is applied to a very low estimate of biomass from a survey.

5.64 The Scientific Committee agreed that the types of assessment methods and decision rules that could be used for *C. gunnari* should be evaluated in a simulation framework to test the performance of the procedures before suggesting modifications to the current management system. Proposals for the evaluation of alternative approaches to management, as set out in Annex 5, paragraph 4.189, were endorsed by the Scientific Committee.

C. gunnari at South Georgia (Subarea 48.3)

5.65 The Scientific Committee noted the details of the 2000/01 fishing season for *C. gunnari* in Subarea 48.3 (Annex 5, paragraphs 4.190 and 4.191). The season was split into two periods: the first from 1 December 2000 to 28 February 2001 and the second from 1 June 2001 to 30 November 2001. There was a closed season from 1 March to 31 May to protect spawning concentrations. The catch limit was 6 760 tonnes. The reported catch during the first part of the season was 1 427 tonnes, taken by four trawlers: one from France, one from Chile and two from the UK. There was negligible catch taken during the second part of the season.

5.66 The assessment of *C. gunnari* in Subarea 48.3 undertaken by WG-FSA in 2001 is described in Annex 5, paragraphs 4.190 to 4.242. The short-term projection method first used in 1997 was used to estimate yield in 2001/02. No new survey was undertaken in Subarea 48.3 during the 2000/01 season, however, WG-FSA decided to update the advice on catch limits in 2001/02 based on new information on growth parameters, mortality and survey catchability. The decision criteria agreed previously by the Working Group were used (Annex 5, paragraphs 4.194 to 4.217).

5.67 As last year, WG-FSA had combined the data from two surveys in January–February 2000 to generate a single stock size estimate from which to project yield for the 2001/02 season. At last year’s meeting, the surveys had been combined assuming they had the same catchability. At this year’s meeting, a GLM approach had been used to estimate relative differences in catchability between the two surveys.

5.68 The Scientific Committee welcomed the advice that two surveys would be undertaken in Subarea 48.3 during the forthcoming season; one by the UK and one by Russia. These surveys will overlap in January 2002, providing a valuable opportunity to compare the results of the two survey vessels fishing in the same small area at the same time. This could provide very useful additional information on relative catchability to reconcile data from different surveys. The Scientific Committee encouraged scientists from Russia and the UK to cooperate on the planning of their respective surveys.

5.69 The Scientific Committee noted discrepancies between age data derived from otolith readings by different readers reported by WG-FSA (Annex 5, paragraphs 4.196 to 4.199). The Scientific Committee endorsed the decision by the Working Group to use the results of age determinations by Russian scientists of otolith material collected during the Russian survey in February 2000. The Scientific Committee also noted the importance of obtaining reliable age determinations for *C. gunnari*. In this regard, the Scientific Committee endorsed the recommendation of WG-FSA that an otolith exchange program should be started among interested scientists as a first step in 2002 (see paragraph 5.24(v)). The exchange program will be prepared by Russian scientists supported by Dr Kock. The program will be based on otoliths collected during cruises in January–February 2002 at South Georgia and will start in late spring 2002. An interim report will be submitted to the 2002 meeting of WG-FSA. No financial support is needed from CCAMLR for the exchange program. However in 2003, a workshop was planned in Kaliningrad, Russia, which will require CCAMLR support (see paragraph 14.1).

5.70 The Scientific Committee endorsed the reassessment of catch limits for the 2001/02 season by WG-FSA. The yield projected for 2001/02, satisfying the previously agreed criteria and using the data inputs agreed this year, was 5 557 tonnes.

5.71 The Scientific Committee recalled that an important aspect of the short-term projection approach is that the yield estimate is conditional on the maintenance of the spawning biomass and on the escapement of a certain percentage of the population. In line with the management of krill, an escapement level of 75% has been used to leave a notional amount for predators. However, as for krill, the predator requirements for this species need to be reviewed as data become available in order to determine the appropriate level of escapement that takes account of ecosystem interactions (Annex 5, paragraphs 4.165 to 4.175).

5.72 The Scientific Committee endorsed WG-FSA’s plan with respect to the evaluation of alternative approaches to management of *C. gunnari* (Annex 5, paragraph 4.189). In particular, the Scientific Committee requested that the Working Group continue to investigate appropriate reference points and the development of decision rules that take account of changes in the relative status of the stock.

5.73 WG-FSA had discussed again the use of closed seasons for the *C. gunnari* fishery in Subarea 48.3 for the protection of spawning concentrations (Annex 5, paragraphs 4.232

to 4.242). New information provided strong evidence that spawning is concentrated mainly in the inshore areas and bays of South Georgia. The Scientific Committee agreed that a complete closure of Subarea 48.3 during the spawning season is therefore unnecessary. Substantial protection of spawning concentrations is provided by preventing fishing from taking place in the bays and near-shore areas.

5.74 However, the Scientific Committee further agreed that in order to collect information on the condition of fish offshore during the spawning season, each vessel intending to undertake fishing in Subarea 48.3 between 1 March and 31 May should conduct 20 research hauls in the manner described in Annex 5, paragraphs 4.236 to 4.240.

5.75 WG-FSA had also recommended that the level of catch that can be taken within the spawning season should be limited in some way so as to avoid a concentration of fishing on the shelf at that time of year. Mr Jones suggested that this could be achieved by limiting the catch in the period 1 March to 31 May to 25% of the total catch limit, representing an even spread of the catch limit over the year. This suggestion was accepted by the Scientific Committee.

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

5.76 The Scientific Committee endorsed the advice of WG-FSA regarding the management of the *C. gunnari* fishery in Subarea 48.3 during the 2001/02 season.

5.77 The total catch limit should be revised to 5 557 tonnes for the period from 1 December 2001 to 30 November 2002.

5.78 There should not be a closed season for *C. gunnari* in Subarea 48.3 during the 2001/02 season. Each vessel intending to undertake fishing in Subarea 48.3 between 1 March and 31 May should conduct 20 research hauls in the manner described in Annex 5, paragraphs 4.236 to 4.240.

5.79 The catch that can be taken in the period 1 March to 31 May should be limited to 25% of the total catch limit.

5.80 A closed area within 12 n miles of South Georgia should be established to protect spawning concentrations during the spawning season (1 March to 31 May).

5.81 The remaining provisions in Conservation Measure 194/XIX should be carried forward for the 2001/02 season.

C. gunnari at Kerguelen Islands
(Division 58.5.1)

5.82 No commercial fishing for *C. gunnari* took place in Division 58.5.1 during the 2000/01 season and no surveys were reported.

5.83 WG-FSA had not undertaken a new assessment this year, and based its advice on information from a survey in the 1998/99 season that indicated very low biomass in the traditional northeastern fishing ground.

5.84 Prof. Duhamel reported to the Scientific Committee that fine-scale data reported to the Commission for November 2000 and April 2001 showed very low abundance. A new survey will be undertaken during the 2001/02 season.

5.85 The Scientific Committee thanked Prof. Duhamel, and expressed the hope that it will be possible for a French scientist to attend the next meeting of WG-FSA to present the results of the survey.

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

5.86 The Scientific Committee reiterated its advice from last year. Prior to any resumption of commercial fishing, a survey of *C. gunnari* abundance should be conducted and the results analysed by WG-FSA.

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

5.87 The Scientific Committee noted the details of the 2000/01 fishing season for *C. gunnari* in Division 58.5.2 (Annex 5, paragraphs 4.251 and 4.252). The season was open from 1 December 2000 to 30 November 2001 with a catch limit of 1 150 tonnes. The reported catch up to 7 October was 938 tonnes, taken by two trawlers from Australia.

5.88 The assessment by WG-FSA of *C. gunnari* yield in Division 58.5.2 used the same methods as used for this species in Subarea 48.3, and is described in Annex 5, paragraphs 4.253 and 4.254. Biomass was estimated from a survey conducted by Australia in 2001. New growth parameters reported to the Working Group in a background paper were used in the projection.

5.89 With a projected fishing mortality of 0.14 for 2001/02 and 2002/03, the catch limit satisfying the agreed criteria is 1 600 tonnes over two years. This is made up of 885 tonnes in the first year and 715 tonnes in the second year.

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

5.90 The total catch limit should be revised to 885 tonnes for the period from 1 December 2001 to 30 November 2002.

5.91 The remaining provisions in Conservation Measure 195/XIX should be carried forward to the 2001/02 season.

Other Finfish Fisheries

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

5.92 The Scientific Committee noted that WG-FSA considered other finfish fisheries in Subareas 48.1 (Antarctic Peninsula) and 48.2 (South Orkney Islands). 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

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

Fish By-catch

By-catch Levels and Species Identification

5.94 The Scientific Committee noted the discussion by WG-FSA of by-catch in longline and trawl fisheries in the Convention Area (Annex 5, paragraphs 4.277 to 4.286). Data were available from three different sources: STATLANT data, observer reports and fine-scale catch and effort data. However, difficulties were encountered in compiling accurate figures on by-catch due to inconsistent reporting from commercial fisheries and differences in the way in which by-catch data have been recorded by different observers.

5.95 Table 13 of the WG-FSA report (Annex 5) records the total biological records for all species recorded by scientific observers during the 2000/01 season. This provides an indication of the presence/absence of a by-catch species in a given area, however, the observer data could not be used to estimate by-catch quantities, due to insufficient information on sampling fractions.

5.96 Current information on by-catch levels for longline fisheries and trawl fisheries from 1986 to the present, based on fine-scale catch and effort data, is provided in Annex 5, Tables 45 and 46. The Scientific Committee agreed that these should be regarded as minimum estimates of by-catch due to inconsistent reporting from some commercial fisheries. As such, it recommended that masters of vessels give special attention to the reporting of by-catch in their catch and effort data.

5.97 The Scientific Committee endorsed the recommendations of WG-FSA to improve the quality and usefulness of by-catch data submitted to CCAMLR through the Scheme of International Scientific Observation. Specifically, the Scientific Committee recommended that:

- (i) observers be asked to indicate the number of longline sets and trawl hauls actually observed for by-catch;

- (ii) observers be asked to indicate the proportion of each longline set actually observed for by-catch;
- (iii) observer reports should clearly indicate the type of observation being made at a particular time;
- (iv) by-catch sampling should be according to the same regime as that applied to target species;
- (v) revised species identification sheets be prepared to assist observers in making accurate identification of species; and
- (vi) a revision of the *Scientific Observers Manual* and the electronic observer logbook be undertaken intersessionally to improve the information collected on fish and invertebrate by-catch in all fisheries.

5.98 Dr Goubanov reminded the Scientific Committee that some species that are presently regarded as by-catch may eventually become target species. As for target species, the Commission sets by-catch limits based on assessments of yield wherever possible. Consequently, the collection of data to facilitate assessments is a priority for both by-catch and target species. These data would also facilitate the transition of a species from by-catch to target status if considered appropriate.

5.99 In response to requests from observers, identification sheets of common by-catch species in the longline fisheries have been developed. WG-FSA recommended some revisions to these sheets and revised versions will be prepared and copies sent to technical coordinators. The Scientific Committee agreed that sufficient funds should be included in the budget for the sheets to be laminated in waterproof material. Copies of the species identification sheets should be included in the *Scientific Observers Manual*.

5.100 The Scientific Committee endorsed the advice of WG-FSA regarding revised species identification sheets and the standard measure of length for macrourids (Annex 5, paragraphs 4.299 to 4.301).

By-catch Limits for *Macrourus* spp. and Skates and Rays

5.101 The Commission has identified measures to ensure the long-term status of by-catch species as an issue for urgent attention by the Scientific Committee (CCAMLR-XIX, paragraph 9.39).

5.102 In reviewing existing measures to limit by-catch in the Convention Area, the Scientific Committee noted that for certain by-catch species, there are catch limits based on stock assessments. These include finfish by-catch in the trawl fishery for *C. gunnari* in Subarea 48.3 (Conservation Measure 95/XIV), crab by-catch in the pot fishery for toothfish in Subarea 48.3 which counts towards the catch limit (Conservation Measure 215/XIX), and two species caught as by-catch in trawl fisheries in Division 58.5.2 (Conservation Measure 198/XIX). For by-catch species without a formal assessment, there are interim precautionary measures in place. These are the limitation on by-catch in Division 58.5.2

(Conservation Measure 198/XIX) and the limitations on by-catch incorporated into the general measures for exploratory fisheries for *Dissostichus* spp. (Conservation Measure 200/XIX). The Scientific Committee noted that these precautionary measures included examples of overall catch limits as well as 'move-on' rules to reduce the likelihood of localised depletion, as proposed in the mixed strategy recommended by the Scientific Committee as a general policy in 1998 (SC-CAMLR-XVI, paragraph 4.139).

5.103 In considering fisheries for which there are no precautionary limits at present, the Scientific Committee noted that there are no specific limits for the finfish by-catch in the longline fishery for *Dissostichus* spp. in Subarea 48.3, which comprises *Macrourus* spp. and skates and rays (Annex 5, Table 45). Whilst there is a move-on rule addressing the concern of localised depletion of *Macrourus* spp. in exploratory fisheries for *Dissostichus* spp. (Conservation Measure 200/XIX), this measure does not include an upper limit on the catch of this species.

5.104 The Scientific Committee further noted the request from the Commission for advice on the by-catch of skates and rays in longline fisheries to provide the foundation for conservation measures on this species (CCAMLR-XIX, paragraph 9.33).

5.105 WG-FSA attempted an assessment of the precautionary yield of skate and ray species in Subarea 48.3 based on information from several sources, including observer data from South Georgia and recent research from the Falkland/Malvinas Islands (Annex 5, paragraphs 4.302 to 4.307). A figure for the precautionary pre-exploitation harvest level (γ) as a proportion of a survey estimate of biomass (B_0) was estimated on the basis of a target median escapement of the spawning stock at the end of 20 years of exploitation of 75%, and the probability of depletion below 20% of the pre-exploitation spawning stock biomass being no greater than 0.1 over a 20-year period. The resulting estimate of γ for skates and rays in Subarea 48.3 is 0.026, which under a B_0 CV of 1.003 results in a median escapement of 0.749 and a probability of depletion of 0.094.

5.106 There are currently no estimates of biomass (B_0) for skates and rays at South Georgia and WG-FSA had insufficient time to adapt information from other areas to use as a proxy. It is therefore not possible to calculate a value of precautionary yield at present. It was also not possible to undertake an assessment of *Macrourus* spp. in Subarea 48.3 due to insufficient information.

5.107 The Scientific Committee noted these attempts by WG-FSA to provide the information requested by the Commission and endorsed the list of key topics for further investigation provided in the WG-FSA report (Annex 5, paragraphs 4.311 and 4.315). Assessments of catch limits for these species should be given a high priority for the next meeting of WG-FSA.

5.108 The Scientific Committee agreed that interim precautionary measures should be adopted for the forthcoming year to place upper limits on the by-catch of *Macrourus* spp. and skates and rays and reduce the potential for local depletion of these species groups.

5.109 In this regard, the Scientific Committee endorsed the advice of WG-FSA that any such measures will of necessity be somewhat arbitrary but should take account of the following criteria:

- (i) the fishery should not adversely impact the by-catch species;
- (ii) measures should not constrain fishing on the target species without due cause; and
- (iii) data and samples from the by-catch should be used in support of future assessments.

5.110 To address the possibility of local depletion, the Scientific Committee endorsed the recommendation of WG-FSA for *Macrourus* spp. and skates and rays caught as by-catch in any fishery in the Convention Area:

If any vessel catches more than 1 tonne of a by-catch species in a longline set or haul, it must move its fishing position (defined as the midpoint of the set or haul) by at least 5 n miles. It may not return to the position of the high by-catch to fish within five days.

5.111 For the purposes of this measure, ‘*Macrourus* spp.’ and ‘skates and rays’, should each be counted as a single species.

By-catch Limits in Assessed Fisheries

5.112 Regarding an overall by-catch limit, the Scientific Committee agreed that for each assessed fishery, an interim precautionary by-catch limit for each species group could be set at a percentage of the total allowable catch of the target species. WG-FSA had suggested that the information in Tables 45 and 46 of its report could be used to set these percentages for longline fisheries (Annex 5, paragraph 4.332). However, the Scientific Committee noted that there was some concern over the accuracy of these figures due to inconsistent reporting of by-catch from the commercial fishery. The Scientific Committee agreed that in the absence of a clear scientific basis on which to set a percentage level, a figure of 5% would be a reasonable interim measure for longline fisheries for the forthcoming year. In addition, to avoid undue constraints on fisheries with small catch limits of target species, the by-catch limit should have a minimum level of 50 tonnes.

By-catch of *Macrourus* spp. in Exploratory Fisheries

5.113 Regarding the overall catch limits for *Macrourus* spp. in exploratory fisheries, the Scientific Committee recognised that imposition of the interim measure proposed for longline fisheries in Subarea 48.3 might unduly constrain exploration in these fisheries. Due to their exploratory nature there is a greater risk of a vessel inadvertently taking a large by-catch in a few hauls that would lead to the closure of the fishery in the area where the by-catch was taken.

5.114 In considering an alternative approach, the Scientific Committee noted the existing limits on all species other than *Macrourus* spp. set out in Conservation Measure 200/XIX. In SSRUs in Subarea 48.6, Division 58.4.2 and Subarea 88.1 south of 65°S, and on BANZARE

Bank, the by-catch of any species other than *Macrourus* spp. is limited to 50 tonnes. In all other SSRUs, the per species by-catch limit for species other than *Macrourus* spp. is 20 tonnes.

5.115 Recognising the likely higher productivity of *Macrourus* spp. compared to some other by-catch species, such as skates and rays, the Scientific Committee recommended that precautionary limits be adopted for this species group at levels double those existing for other species. The proposed levels are therefore 100 tonnes in SSRUs in Subarea 48.6, Division 58.4.2 and Subarea 88.1 south of 65°S, and on BANZARE Bank, and 40 tonnes in all other SSRUs.

5.116 The Scientific Committee reiterated that the precautionary by-catch limits proposed for this year are interim measures designed to encourage avoidance of excessive by-catch, and stressed the importance of undertaking assessments to develop scientifically based measures for by-catch species as a matter of urgency.

5.117 Dr Kock noted that differences in levels of by-catch of skates and rays on longlines occur, depending on the rigging of the longline. Lines with the hooks set on the bottom tend to catch more skates and rays than those with hooks set several metres above the bottom. Effects of gear configuration on species composition should be investigated further to determine optimal approaches to minimising by-catch.

Advice to the Commission

5.118 The Scientific Committee made several recommendations regarding methods to improve the quality and usefulness of by-catch data submitted to CCAMLR as set out in paragraph 5.97.

5.119 New species identification sheets have been developed to assist scientific observers. The Scientific Committee agreed that sufficient funds should be included in the budget for the sheets to be laminated in waterproof material.

5.120 The Scientific Committee recommended that interim precautionary measures should be adopted for the forthcoming year to place upper limits on the by-catch of *Macrourus* spp. and skates and rays and reduce the potential for local depletion of these species groups.

5.121 With respect to *Macrourus* spp. and skates and rays, the Scientific Committee recommended that if any vessel catches more than 1 tonne of a by-catch species in a longline set or haul, it should be required to move its fishing position (defined as the midpoint of the set or haul) by at least 5 n miles. It should not return to the position of the high by-catch to fish within five days. For the purposes of this recommendation, ‘by-catch’ refers to *Macrourus* spp. and skates and rays. ‘*Macrourus* spp.’ and ‘skates and rays’ should each be counted as a single species.

5.122 For the longline fishery in Subarea 48.3, an interim precautionary by-catch limit for *Macrourus* spp. and skates and rays should be set at 5% for each by-catch species group of the catch limit of the target species, or 50 tonnes, whichever is the greater.

5.123 The upper limit on by-catch of *Macrourus* spp. in exploratory fisheries is recommended to be 100 tonnes in SSRUs (as defined in Table 1 and Figure 1 of Annex 200/B to Conservation Measure 200/XIX) in Subarea 48.6, Division 58.4.2 and Subarea 88.1 south of 65°S, and on BANZARE Bank, and 40 tonnes in all other SSRUs.

5.124 Existing by-catch measures for species other than *Macrourus* spp. and skates and rays should remain in force.

Crab Resources

5.125 The Scientific Committee noted that while Conservation Measures 214/XIX and 215/XIX were in force during 2000/01, no direct fishing was conducted on crab species, although 14 tonnes were caught as by-catch in the pot fishery for *D. eleginoides*.

5.126 Japan and the USA had notified their intention to conduct a fishery for crabs in the coming season (paragraph 2.17). The Scientific Committee acknowledged that the Japanese vessel involved should conduct an experimental harvest regime in accordance with Conservation Measure 214/XIX.

5.127 The Scientific Committee noted WG-FSA's deliberations contained in Annex 5, paragraphs 3.128 to 3.131 dealing with crabs caught as by-catch in the *D. eleginoides* pot fishery, covering their distribution, sizes and survivorship, and endorsed the assessment and management advice provided in Annex 5, paragraphs 4.264 to 4.274.

5.128 The Scientific Committee recalled the large discard of undersized crabs in the pot fishery (SC-CAMLR-XIX, paragraph 5.111). Only crabs retained on board count towards the catch limit. Regarding the survival of discarded crabs, the Scientific Committee noted new information reported by WG-FSA this year. Most crabs were lively on arrival on deck after pot hauling (99% *P. spinosissima*, 97% *P. formosa* and >90% of *P. anamerae*). Mortality rates estimated from reimmersion experiments indicated that on the vessel which emptied pots directly onto the factory conveyor belt, 85–90% of crabs would survive discarding, whereas survival was reduced on the vessel where crabs were emptied down a vertical chute prior to sorting (39–58% survivorship).

Management Advice

5.129 The Scientific Committee reiterated its advice (SC-CAMLR-XIX, paragraph 5.113) that since crab stocks have not been fully assessed, the conservative management scheme contained in Conservation Measures 214/XIX and 215/XIX is still appropriate. It recommended that the minimum legal size be revised to 94 mm (Annex 5, Table 44).

5.130 The Scientific Committee also recommended that all vessels participating in the crab fishery, which had not done so, should conduct Phase 1 of the experimental harvest regime specified in Conservation Measure 214/XIX, and that a CCAMLR international observer should be carried on board every vessel participating in the fishery. To date, only a US vessel has fulfilled these requirements (SC-CAMLR-XIX, paragraph 5.114).

5.131 The Scientific Committee agreed that crabs caught as by-catch in other fisheries should be counted against the catch limit set for the directed fishery.

Squid Resources

5.132 A limited fishery that took place in the 2000/01 season (catching 2 tonnes) was considered by WG-FSA (Annex 5, paragraph 3.132). The fishery for *M. hyadesi* in Subarea 48.3 remains at an exploratory stage and there is little indication of significant commercial interest in the fishery.

Management Advice

5.133 Conservation Measure 213/XIX is currently in force to regulate this fishery. There was no notification of intention to conduct a fishery for the coming season. The Scientific Committee agreed that all conservation measures are to be retained.

ECOSYSTEM MONITORING AND MANAGEMENT

Advice from WG-FSA

6.1 The Scientific Committee noted the discussion on this item by WG-FSA (Annex 5, paragraphs 5.1 to 5.13).

6.2 The Scientific Committee agreed that this item no longer needs to be considered as a specific item on the agenda of WG-FSA and that the considerations on this issue be taken up under respective items on its agenda, understanding that an ecosystem approach to the consideration of each harvested species will be taken.

6.3 Noting paragraphs 5.6 to 5.8 in Annex 5, the Scientific Committee requested that WG-EMM consider *C. gunnari* and *Pleuragramma antarcticum* as possible indicator species in CEMP.

Advice from WG-EMM

6.4 The seventh meeting of WG-EMM was held at the Kristineberg Marine Research Station, Fiskebäckskil, Sweden, from 2 to 11 July 2001. The Scientific Committee sincerely thanked the host of the meeting, Dr B. Bergström, for a well organised and enjoyable meeting, and the Convener, Dr Hewitt, for chairing the meeting.

6.5 The Scientific Committee congratulated WG-EMM and Dr Hewitt on implementing the changes to the meeting format as discussed last year (SC-CAMLR-XIX, paragraphs 6.18, 13.4 to 13.6; Annex 4, paragraphs 1.4 to 1.9), and on the success of the first workshop in planning the future work of the Working Group, the electronic submission of papers and their distribution via the CCAMLR website (Annex 4, paragraphs 1.10 to 1.25), and the revised

agenda considering the krill fishery, status of the krill-centric ecosystem and management advice. It endorsed the deadline for papers to be considered at WG-EMM meetings of two weeks prior to the start of the meeting and that papers received after that date, or papers submitted as abstracts only prior to that date, would not be considered at that meeting. It encouraged the continued use of the website as a means of circulating papers prior to the meeting.

Krill-centred Interactions

6.6 The Scientific Committee noted progress in a number of areas (Annex 4, paragraphs 3.34 to 3.47), including several studies on delineating the foraging ranges of krill predators, understanding the geographic variation in the influence on biological processes of environmental factors, such as wintertime sea-ice, and the identification of important habitats for adult land-based predators both during the period of rearing offspring and during the post-fledging, post-weaning winter periods. It encouraged further studies on critical factors that might influence krill predators outside the breeding season.

6.7 The Scientific Committee noted the recognition by WG-EMM that an increasing body of evidence suggests that a substantial change had occurred in aspects of the dynamics of the krill-based system, perhaps most noticeably in relation to processes operating in Subareas 48.1 and 48.3 (e.g. Annex 4, paragraphs 3.72 to 3.75). While the ultimate origin of these changes probably reflects changes in physical environmental conditions in the Southern Ocean system, the proximate effects of these changes are almost certainly mediated through changes in food-web processes leading to consequent changes in abundance of krill and krill-dependent species, and to changes in the dynamics of these predator-prey interactions. The Scientific Committee agreed that appropriate fishery-management frameworks need to be developed that can account for long-term changes in the relationships between krill and its predators (Annex 4, paragraphs 3.80 to 3.83).

6.8 The Scientific Committee encouraged further work in this area, agreeing with WG-EMM that the following general points need to be considered in this future work (e.g. Annex 4, paragraph 3.74):

- (i) methods underpinning analyses of long-term changes need to be reviewed by WG-EMM; and
- (ii) consideration be given to alternative hypotheses that may explain changes in abundance of krill predators, such as changes in krill demography, transport or availability.

Viral Antibodies in Antarctic Seals

6.9 The Scientific Committee noted the review of WG-EMM of several reports of viral antibodies present in Antarctic fur seals and Weddell seals (Annex 4, paragraphs 3.48, 3.49 and 3.114). Also, Prof. Torres presented SC-CAMLR-XX/BG/18 Rev. 1 to the Scientific Committee reporting on further work in this area. The Scientific Committee agreed that disease may play an important role in the dynamics of populations but acknowledged the

conclusions of WG-EMM that there is as yet no evidence that animals are infected or that such pathogens may influence reproductive performance and population trends of marine mammals in the Antarctic. WG-EMM had noted that until such evidence became available, the potential influence of pathogens could not be incorporated into management models. The Scientific Committee noted that such evidence could include assessments of the probability that disease will affect populations in a substantial way. The Scientific Committee agreed that in the meantime future submissions on this topic could be directed to CEP.

Future Work of WG-EMM

6.10 The Scientific Committee noted the success of the first workshop of WG-EMM on its future agenda (Annex 4, paragraphs 5.1 to 5.36). Three presentations were given to initiate discussion. Dr Miller reviewed how the concepts embodied in the Convention were translated into operational definitions, the work of WG-CEMP to establish an environmental monitoring program, and the work of WG-Krill to establish a yield model for krill that incorporates a precautionary approach. Dr Everson reviewed progress toward the definition of an ecosystem approach to management of the krill fishery since WG-Krill and WG-CEMP were combined into WG-EMM. Dr Constable outlined the issues that remain to be addressed before a complete management procedure for krill can be elaborated. The Scientific Committee thanked these speakers for their contributions to the successful discussions of the workshop and endorsed the recommendation of WG-EMM to encourage the authors to submit manuscripts of their presentations to *CCAMLR Science*.

6.11 A list of twelve topics related to developing management procedures was developed and split into two broad categories: those that required theoretical development and those that required consideration of more practical issues (Annex 4, paragraph 5.5). The Scientific Committee endorsed the approach of WG-EMM to work on three topics of highest priority:

- (i) definition of small-scale management units, such as 'predator units', to be accomplished at a workshop in conjunction with the meeting of WG-EMM in 2002. This work will be guided by a steering committee convened by Dr W. Trivelpiece (USA) (Annex 4, paragraphs 5.9 to 5.13);
- (ii) a review of the utility of CEMP, to be coordinated by a steering committee convened by Prof. Croxall, with a planning session to be convened in conjunction with the 2002 meeting of WG-EMM, and a workshop to be held in conjunction with the 2003 meeting of WG-EMM (Annex 4, paragraphs 5.14 to 5.29); and
- (iii) further development of prey-predator-fishery-environment models for use in an ecosystem approach to management of the krill fishery, to be coordinated through a correspondence group convened by Dr Constable (Annex 4, paragraph 5.8).

6.12 The Scientific Committee endorsed the plans for these priority areas. The Scientific Committee thanked the subgroup conveners for taking on these tasks and wished their groups well in their deliberations.

6.13 The Scientific Committee noted that a management approach using data arising from CEMP and modelling work is described in Annex 4 (paragraphs 3.58 to 3.71), but that this approach would require further work before its utility could be determined. This approach illustrates the linking of objectives, reference points and triggers for management action based on a relationship between a combined measure of predator performance and krill density.

6.14 The Scientific Committee noted the work of WG-EMM in response to its request from last year (SC-CAMLR-XIX, paragraph 6.26) to investigate the feasibility of a synoptic survey of krill predators (Annex 4, paragraphs 5.30 and 5.31). A task group, convened by Dr C. Southwall (Australia), was formed to advise as to what extent surveys of land-based krill predators are possible and which techniques should be accorded the highest priority. The Scientific Committee noted that a short workshop would be held in conjunction with the meeting of WG-EMM in 2002 if it was agreed to be necessary by the task group.

Small-scale Management Units

6.15 In response to requests from the Scientific Committee (SC-CAMLR-XIX, paragraphs 5.14 and 5.15) and the Commission (CCAMLR-XIX, paragraph 10.11), WG-EMM considered various alternatives for subdividing the precautionary yield of krill in Area 48 so as to avoid the concentration of fishing effort in, and hence excessive catch from, small but critical areas. The existing statistical subareas are too large for this purpose and a method was sought to divide these areas into smaller-scale management units. As described above, the concept of defining 'predator units' as an approach to establishing smaller-scale management units will be investigated.

6.16 Definition of predator units will require information on: (i) local predator foraging ranges and consumption; (ii) krill abundance, dispersion and movement; and (iii) fishing fleet behaviour and patterns of fishing. Available data will be considered at the workshop to be convened during the 2002 meeting of WG-EMM.

6.17 In so doing, the Scientific Committee noted that the development of small-scale management units might benefit from the following intersessional work:

- (i) Approach the IWC Secretariat for documents relating to the IWC Scientific Committee discussions on small-scale management units. The Scientific Committee agreed that the Secretariat should undertake this on its behalf.
- (ii) Develop analyses appropriate for fisheries data prior to the workshop in order to determine what fisheries data are required for the workshop and whether the data provided in the CCAMLR database are sufficient. Correspondence between Dr Kawaguchi and the convener of the workshop, Dr Trivelpiece, the convener of WG-EMM, Dr Hewitt, the CCAMLR Data Manager, Dr Ramm, the convener of the correspondence modelling group, Dr Constable, and other interested scientists was requested to help facilitate this work.

6.18 The Scientific Committee also noted that the workshop on the definition of predator units would primarily be working to provide advice on appropriate boundaries for such units and that the manner in which the overall catch limit for Area 48 is to be subdivided between these units would be determined at a future meeting.

6.19 Dr Naganobu questioned the need for small-scale management units and indicated that the workshop should not consider the management implications of the predator units being investigated.

Timeline for Work of WG-EMM

6.20 In addition, the Scientific Committee endorsed the timeline of WG-EMM for the development of a management procedure for krill (Annex 4, paragraphs 6.3 to 6.5) as set out below:

Issues	Year			
	2002	2003	2004	2005
Harvested species–environment models	D	D	W4	
Predator–prey–environment models	S		W4	
Fishery–prey–environment models	S		W4	
Objectives, decision rules	D	D	D	W5
Performance measures	D	D	D	W5
Assessment methods		*W2		
Utility of CEMP	*IW2	*W2		
Small-scale management units, such as predator units	*W1			
Predator demand	D	W3		
Ecological division of precautionary catch limit		W3		
Field test CEMP, precautionary catch limit	D	W3		
Evaluation of candidate management procedures	D	D	D	W5

D – Developments received by WG-EMM; S – Scoping paper; IW – Interim planning for workshop; W – Workshop; * – Workshops agreed to be held (numbers refer to workshop numbers).

6.21 The Scientific Committee noted that the development of management procedures requires work on all these issues which Members could develop in preparation for the workshops. It noted that more than one workshop may be required to satisfactorily investigate some of these issues and that the timeline may require revision over the next one or two years as work proceeds on the first two workshops. It also accepted that the planned workshops may result in larger annual reports of WG-EMM over the next four years. In so doing, the Scientific Committee encouraged WG-EMM to continue its work in developing management procedures within this timeframe.

MANAGEMENT UNDER UNCERTAINTY

Regulatory Framework

7.1 The Scientific Committee noted the further progress in developing a unified framework for providing management advice on all fisheries in the Convention Area (Annex 5, paragraph 4.333).

7.2 The Secretariat has developed fishery plans for krill and *C. gunnari* in the intersessional period. These plans were scrutinised by WG-EMM and WG-FSA respectively at their annual 2001 meetings. Comments are provided in Annex 4, paragraphs 4.16 to 4.22

and Annex 5, paragraphs 4.333 to 4.345. Furthermore, WAMI had commented on the fishery plan for *C. gunnari* (Annex 5, Appendix D). The Scientific Committee agreed that these comments be incorporated into the fishery plans, and final versions of the two plans should be available early next year.

7.3 The Scientific Committee agreed that the next step should be to prepare these fishery plans for other fisheries in the Convention Area. Priority fisheries are those for *D. eleginoides* in Subarea 48.3 and Division 58.5.2, *Dissostichus* spp. in Subarea 88.1 and *C. gunnari* in Division 58.5.2. Other fisheries were considered of a lower priority.

7.4 The Scientific Committee recalled that an important aim of the framework was to streamline the process of an annual review of fisheries by the Scientific Committee and its working groups. In this regard, when addressing new and exploratory fisheries notifications, WG-FSA had developed a summary table (Annex 5, Table 19) incorporating recent information on all fisheries in the Convention Area. This table includes information on most recently reported catches, notifications of intentions to take part in the fishery and advice about the currency of the most recent assessment for each fishery.

7.5 Notification is an essential component of the framework. Problems arising from multiple notifications in the same area need to be highlighted to the Commission, for example there is a comparatively low catch limit in Division 58.4.4 of 103 tonnes. However, the Secretariat received notifications from Members indicating that 10 vessels wished to fish in this area in the forthcoming season (paragraph 9.5).

7.6 The fisheries summary should be considered annually both in the context of the assessments conducted and as an important item in the regulatory framework. Dr Parkes stressed that for many of the CCAMLR fisheries, the most recent assessment is described in Annex 5, Table 19 as the 'prospecting default arrangement'. This refers to the default exploratory harvesting arrangements that have been put in place by the Commission in the absence of a formal assessment of these fisheries. The currency of this advice is described in Table 19 as 'multi-year in the absence of surveys or fishery-based research information'. In many cases, despite multiple notifications of intentions to fish over several years, there has been little or no fishing. For those fisheries notified previously, and for which notifications were received again this year, but for which no new information was available, no new assessment was undertaken. The Scientific Committee agreed that until new information is received, WG-FSA should not attempt to undertake any further work on these fisheries. Hence, the 'prospecting default arrangement' would remain in place as the current advice.

7.7 The Scientific Committee agreed that the fishery summary was a useful complement to the fishery plans developed under the framework, and that it should continue to be developed and used routinely to provide guidance to the Scientific Committee and WG-FSA on priorities for assessment work.

7.8 Regarding future development of the framework, the Scientific Committee recalled the extensive discussion at last year's meeting recorded in SC-CAMLR-XIX, paragraphs 7.2 to 7.20. The Scientific Committee provided a detailed plan of action for future work, particularly with respect to the generalisation of the notification process, research and fishery operation plans and data collection procedures (SC-CAMLR-XIX, Tables 7 and 8). The Scientific Committee agreed that this guidance remained the basis for future developments of the framework and looked forward to further progress at next year's meeting.

Review of Existing Conservation Measures by the Secretariat

7.9 The Secretariat had prepared two papers in advance of the meeting in order to provide suggestions on how the process of establishing conservation measures could be further streamlined and unified: CCAMLR-XX/20 Rev. 1 and BG/4. Both papers were reviewed by WG-FSA and comments have been provided in Annex 5, paragraphs 4.339 to 4.443.

7.10 CCAMLR-XX/20 Rev. 1 described two alternative approaches on how this process of streamlining could be simplified. The Scientific Committee thanked the Secretariat for preparing these documents and agreed that the first of the two approaches was preferable because it was easier to follow than the second without having to refer to other documents. This approach followed a standard format for providing management advice which included the setting of catch limits and other regulatory measures. However, non-standard approaches will still be possible. The same formats which apply to finfish fisheries are envisaged to apply to krill fisheries. The headings in the proposal were found to be very useful. Dr Constable suggested that a different numbering system might be needed in order to better group the conservation measures.

7.11 The Scientific Committee agreed to suggest to the Commission to adopt this approach for future descriptions of conservation measures.

SCIENTIFIC RESEARCH EXEMPTIONS

8.1 The Scientific Committee noted the notifications of scientific research surveys planned for the 2001/02 intersessional period (Table 4, see also Annex 5, paragraphs 6.8 to 6.12). These notifications were made under Conservation Measure 64/XIX, and the total catch from each survey listed in Table 4 was expected to be less than 50 tonnes of finfish, including no more than 10 tonnes of *Dissostichus* spp.

8.2 The Scientific Committee noted that the minimum level of expected catch which required notification under Conservation Measure 64/XIX was not specified. Some Members felt that, in general, surveys which only used small scientific sampling equipment, such as RMT-8, may not be required to be notified under this measure. The Scientific Committee sought further advice from the Commission on this matter.

NEW AND EXPLORATORY FISHERIES

New and Exploratory Fisheries in 2000/01

9.1 Fourteen conservation measures relating to exploratory fisheries were in force during 2000/01, but fishing only occurred in respect of four 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, where 417 vessel days of effort were reported, taking 658 tonnes of *Dissostichus* spp. Vessels from New Zealand (3 vessels), South Africa (2 vessels) and Uruguay (2 vessels) participated in this fishery.

New and Exploratory Fisheries Notified for 2001/02

9.2 Thirteen notifications of new or exploratory fisheries were made for 2001/02. All of the notifications this year referred to fisheries or regions that have been considered previously by WG-FSA. The Scientific Committee noted that two Members (Japan and Russia) had made notifications of new or exploratory fisheries for the first time this year.

9.3 As was the case last year, there were multiple notifications of exploratory fisheries for *Dissostichus* spp. for several subareas or divisions (Annex 4, Table 18). While this is of potential concern, and takes considerable time to consider, the Scientific Committee also noted that the experience of previous years suggested that many of these notifications may not be activated.

9.4 The Scientific Committee also noted that there are still inconsistencies in the way in which notifications specified intended catch levels in particular. 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 this inconsistency continues, the task of assessing the likely effects of multiple new or exploratory fisheries in an area is made much more difficult. In the time available, the Scientific Committee was unable to develop criteria for determining whether the information contained in the notifications regarding intended catches was adequate.

9.5 This year, once again, there has been a large number of notifications for Division 58.4.4 (five notifications for a maximum of up to 10 vessels). As the recommended precautionary catch limit is only 103 tonnes (Annex 5, paragraph 4.78), there is a clear potential for the catch limit to be taken in a very short time and with the extreme likelihood of it being exceeded.

9.6 With regard to the provision of new advice on precautionary catch limits for stocks likely to be subject to new or exploratory fisheries in 2001/02, the Scientific Committee agreed that this would only be possible in 2001 for Subarea 88.1 and Division 58.4.4, as these were the only areas for which sufficient data were available. For all other subareas and divisions for which notifications had been made, the Scientific Committee was unable to provide any new advice on precautionary catch limits.

9.7 Dr Parkes pointed out that the fishery summary in Annex 5, Table 19 addressed the context of assessment and management of fisheries, and indicated those exploratory fisheries for which advice remains in place in the absence of surveys or fishery-based research information.

9.8 An assessment of *D. eleginoides* in the Prince Edwards Islands EEZ suggested that the stock in that area had been greatly reduced from its unexploited level primarily by IUU fishing. This raised major concerns about the status of *D. eleginoides* stocks throughout Subarea 58.7. The Scientific Committee recommended that France be requested to submit fine-scale haul-by-haul data from waters adjacent to the Crozet Islands so that an assessment of the stock in that area could be carried out to determine whether the same problems may exist throughout Subarea 58.6.

Precautionary Catch Limits

Subarea 88.1

9.9 Using new data resulting from the exploratory fishery in Subarea 88.1, estimates of precautionary yields for this subarea had been calculated for each SSRU. These estimates are given in Annex 4, Table 20 and total 5 016 tonnes.

9.10 While the current assessment incorporates several improvements over earlier assessments of this subarea, considerable uncertainty still exists. In light of this, a discount factor still needs to be applied. If the same discount factor as last year (0.5) is used, the resulting catch limit for *Dissostichus* spp. in Subarea 88.1 would be 2 508 tonnes. Individual catch limits for each SSRU are shown in Annex 4, Table 22.

9.11 Dr Sullivan stated New Zealand's support for the general concept of estimating yield in exploratory fisheries for each SSRU based on the method used. However, from a management perspective he noted that two points need to be considered, when recommending catch limits to the Commission:

- (i) Was there any necessity to increase overall catch limits to achieve the objectives of the exploratory fishery? For example, in Subarea 88.1 the fishery has not been constrained by the previous catch limit with catches in 2000/01 at about 30% of the limit.
- (ii) If the rate of information gathering was to be increased, would it not be preferable to spread the yield more evenly across SSRUs rather than concentrate the catch in the areas of highest density?

9.12 Mr Jones considered whether the separate yield estimates calculated for each SSRU in Subarea 88.1 and the estimation of relative fish density between the subareas (Annex 4, paragraphs 4.27 and 4.30) was an improvement on last year and endorsed the current precautionary approach. Dr Constable stated that the assessments were based on the best available data and that the Commission should proceed from information available in Annex 5.

9.13 The Scientific Committee noted that the western boundary for SSRU D in Subarea 88.1 does not extend to the Antarctic coast, and recommended that the western boundary of this SSRU be moved to 160°E (Annex 4, paragraph 4.79).

Division 58.4.4

9.14 Using a similar method, an estimate of precautionary yield for Division 58.4.4 had also been calculated. This estimate, which is subject to even more uncertainty than those for Subarea 88.1, is 206 tonnes (Annex 4, Table 20). If the same discount factor of 0.5 was used as in last year, the resulting catch limit for *D. eleginoides* in Division 58.4.4 would be 103 tonnes (Annex 4, Table 22).

Research Requirements

9.15 The Scientific Committee also welcomed and endorsed the additional research activities proposed in the Australian and New Zealand notifications above the minimum requirements as set out in Conservation Measure 200/XIX.

9.16 Conservation Measure 200/XIX currently requires that research sets or trawls must be separated by a minimum of 10 n miles. Experience in both the Australian and New Zealand exploratory fisheries suggests that this requirement may be too restrictive, given the topography of the areas being fished. Analyses of covariance and bias in CPUE of vessel longline sets (Annex 5, paragraphs 4.30 to 4.37) indicated that a minimum separation distance of 5 n miles appeared to be appropriate. The Scientific Committee recommended that the minimum distance between research hauls should be reduced to 5 n miles. In making this recommendation, the Scientific Committee recognised that this may compromise the effort-spreading objective of the conservation measure. The Scientific Committee agreed that a maximum number of research sets also needed to be applied for each fine-scale rectangle. However, no information is available at the moment to allow specification of such a maximum number. This matter needs to be examined during the next intersessional period (Annex 4, paragraph 4.81).

9.17 Also, Conservation Measure 200/XIX currently specifies a minimum number of 3 500 hooks per research longline set but the maximum number of hooks is omitted. The Scientific Committee agreed that a maximum number of 10 000 hooks should also be prescribed for research sets (Annex 4, paragraph 4.82) to accommodate requirements set out in paragraph 9.16.

9.18 Dr Constable noted that the Commission in 2000 (CCAMLR-XIX, paragraph 9.45) requested that the Scientific Committee and WG-FSA provide advice on the ability of the proposed research plan relative to Conservation Measure 200/XIX. The Scientific Committee also advised that the value of including a research component in Conservation Measure 200/XIX had been amply demonstrated by the use of the CPUE estimates from the research, exploratory, and commercial sets in assessments of *Dissostichus* spp. in Subarea 88.1, and of *D. eleginoides* in Division 58.4.4. Further collection of data from research sets will be essential for any assessments that are carried out next year.

Management Areas

9.19 In 2000 the Commission requested that the Scientific Committee review the definition of the boundaries of subareal division of Divisions of 58.4.1 and 58.4.3 (CCAMLR-XIX, paragraph 9.47). The request came about because new and exploratory fisheries proposed for Division 58.4.3 in the 1999/2000 and 2000/01 seasons were given separate catch allocations for BANZARE and Elan Banks. These banks are separated by a trough of deep water at least 130 n miles wide. Each bank had to be specifically defined in the conservation measures in order to allocate individual catch limits, rather than apportioning a catch limit to an entire statistical division. Various options for modifying the boundaries were reviewed in SC-CAMLR-XX/5 with two separate catch limits.

9.20 The eastern boundary of Division 58.4.3 almost bisects BANZARE Bank, while there is no current distinction within Division 58.4.3 between Elan and BANZARE Banks.

9.21 The revised boundaries are shown on Figure 2 of SC-CAMLR-XX/5 and are the minimum required to comply with the Commission's request to separate and define adequately the banks of Division 58.4.3. Further adjustments could be made to better contain natural features within statistical divisions in this area during this process. The first would be to move the boundary between Divisions 58.4.3 and 58.5.2 southwards from 55° to 56°S so that it runs through the deep trough separating the Kerguelen–Heard Plateau from BANZARE and Elan Banks. A further amendment could be to extend the eastern boundary of Subarea 58.5 (which also defines the outer boundary of the CCAMLR Convention Area) from 80° to 85°E in order to include William's Ridge that currently lies outside the CCAMLR Convention Area.

9.22 The Scientific Committee considered that it would be preferable to take the boundary between Divisions 58.4.3 and 58.5.2 to an area of deep water further away from the eastern edge of BANZARE Bank. Therefore the Scientific Committee agreed that moving the boundary to 86°E would be a more appropriate delimitation.

9.23 Concerns were raised regarding the potential difficulties in ascribing historical catches to the revised subdivisions, but the Secretariat confirmed that there are no reported catches from the original Division 58.4.3 apart from the exploratory fishery conducted by Australia a few years ago that yielded a catch of three *D. eleginoides*.

9.24 The Scientific Committee recommended that the alterations to the boundaries of Divisions 58.4.3 and 58.5.2 as discussed in the above paragraphs be adopted by the Commission.

9.25 The Scientific Committee agreed that extension of the boundaries of the CCAMLR Convention Area should be further considered to include areas in the Indian Ocean immediately adjacent to the Convention Area in which target species may be present, albeit in low numbers, and for which CCAMLR is primarily responsible. As well as the extensions to include William's Ridge, an area where *D. eleginoides* is known to occur and where IUU vessels have been observed to operate, Dr Miller stated that a similar situation exists to the north of Subareas 58.6 and 58.7 on the portions of the Marion Rise and Del Cano/Africana Rise which are in Area 51.

9.26 The FAO Observer (Dr R. Shotton) stated that he could not foresee problems from his organisation's point of view in amending the Convention Area boundaries.

9.27 The Scientific Committee recommended that the Commission consider extensions to the boundaries of the Convention Area to include as much as possible of the distribution range of the species for which it has primary responsibility, e.g. toothfish. This is because it would facilitate the accumulation of data, observations and the provision of management advice on whole stocks.

Incidental Mortality

9.28 Consideration of new and exploratory fisheries from the perspective of seabird incidental mortality was undertaken by WG-IMALF (Annex 5, paragraphs 7.131 to 7.141) and is reported in paragraphs 4.54 and 4.55.

CCAMLR DATA MANAGEMENT

10.1 Dr Ramm reported on the main activities of the Data Centre during the 2000/01 intersessional period (SC-CAMLR-XX/BG/14). The Data Centre had continued to support the work of the Commission, Scientific Committee and working groups, including the recently held WAMI. Major activities and analyses were reported in meeting papers and publications produced by the Data Centre during 2000/01.

10.2 The Scientific Committee noted that the Data Centre's activities during the 2000/01 intersessional period had included:

- (i) assistance with the development and operation of the CDS database – this work included further development of the database structure and the addition of a web-based interface;
- (ii) further development and consolidation of data processing and extraction routines – this work included the initial development of a routine to transfer data from the electronic data forms to the database;
- (iii) further development of data queries in the research survey database to facilitate extraction of data for CMIX and TrawlCI for all surveys; and
- (iv) further transfer and validation of data from old or non-CCAMLR formats to the new research survey database.

10.3 The Scientific Committee also noted that the use of CCAMLR research survey data has been impeded, historically, by:

- (i) storage of research survey data in the format used for holding fine-scale catch and effort data, with the resultant loss of research-specific fields (e.g. ground distance, trawl net width);
- (ii) the lack of an agreed CCAMLR format for submitting research data; and
- (iii) the absence of a mechanism whereby data originators can provide corrections and updates to CCAMLR data.

10.4 The Scientific Committee agreed that the Data Centre complete the development of a standard CCAMLR format for the submission of research data in 2001/02.

10.5 The Scientific Committee noted that most of the data submitted to the Secretariat are now sent in electronic format using CCAMLR formats and codes. However, a considerable

amount of time is still spent detecting data which have not been submitted by their deadlines, and then requesting their submission. For example, only 45% of all fine-scale data collected in 2000/01 were submitted by the deadlines (CCAMLR-XX/BG/7 Rev. 1, Table 3).

10.6 One of the Data Centre's key functions was the monitoring of all fisheries conducted under the conservation measures in force. Fishing activities are monitored using the catch and effort reporting system established under Conservation Measures 51/XIX (five-day catch and effort reporting system), 61/XII (10-day catch and effort reporting system) and 40/X (monthly catch and effort reporting system).

10.7 Despite the majority of catch and effort reports being submitted to the Secretariat by the deadlines (CCAMLR-XX/BG/7 Rev. 1, Table 2), the Scientific Committee noted with concern that overdue catch and effort reports continued to jeopardise the Secretariat's ability to monitor fisheries in accordance with conservation measures in force. Twice in 2000/01, Members failed to advise the Secretariat of a vessel's entry into a CCAMLR fishery, and failed to submit five-day catch and effort reports by their respective deadlines. The Secretariat had detected the operation of these vessels through ancillary information. Formal notices were issued under Conservation Measure 51/XIX (paragraph 9), and data were subsequently submitted.

10.8 The Scientific Committee agreed that this problem may be alleviated if the Secretariat was to be notified each time a fishing vessel entered or left a statistical subarea or division within the Convention Area. Such a requirement may be included, for example, in Conservation Measure 148/XVII (automated satellite-linked VMS). The type of information needed may include: date, vessel name and call sign, subarea or division and vessel's intention (e.g. start fishing for *C. gunnari*, departing area etc.). The Scientific Committee wished to draw the attention of the Commission to this matter.

10.9 The Scientific Committee noted that Mrs L. Bleathman (Data Administrative Assistant) had resigned in December 2000, and Mr N. Williams (Computer Systems Administrator) had resigned in July 2001. A search was under way for a replacement Computer Systems Administrator. The Scientific Committee joined the Secretariat in thanking Mrs Bleathman and Mr Williams for their dedication and contribution to the work of CCAMLR.

10.10 Dr Goubanov noted the excellent support provided by the Data Centre, and the Scientific Committee joined in thanking Dr Ramm and his staff for their work. The Scientific Committee also noted with pleasure that the computing support provided to its working groups and during this meeting was a great improvement on that available in 2000.

COOPERATION WITH OTHER ORGANISATIONS

11.1 The Scientific Committee was chaired during this section by Dr Fanta, Vice-Chair of the Scientific Committee. Reports under Agenda Items 11(i) and 11(iii) were reported in brief to the meeting by the rapporteur of this section.

Cooperation with the Antarctic Treaty System

CEP

11.2 Dr Holt, Chair of the Scientific Committee, participated in CEP-IV in St Petersburg, Russia, from 9 to 13 July 2001 (CCAMLR-XX/BG/3). The most important issues of relevance to CCAMLR were:

- (i) a report of an open-ended intersessional contact group of CEP reported on progress to find appropriate criteria for and a mechanism to ensure consistency in, the designation of Antarctic Specially Protected Species. The contact group will continue under specified terms of reference;
- (ii) a report from an intersessional contact group on Diseases of Antarctic Wildlife provided a document that would be useful for parties when developing or improving national procedures to avoid introduction of diseases in the Antarctic. It noted that the risk that human activities in Antarctica might introduce diseases was currently assessed to be very low;
- (iii) the CCAMLR Scientific Committee Chair presented a paper (SC-CAMLR-XX/BG/9) prepared by the Secretariat presenting CCAMLR's experience with data management;
- (iv) the CCAMLR Scientific Committee Chair also presented a paper (SC-CAMLR-XX/BG/16) prepared by the Secretariat on monitoring marine debris;
- (v) Australia, the CEP Observer to CCAMLR-XIX and SC-CAMLR-XIX, presented a report on CCAMLR activities at its 2000 meetings; and
- (vi) CEP agreed to consider more extensively CEP/CCAMLR cooperation at CEP-V.

Reports of Observers from International Organisations

ASOC

11.3 The ASOC Observer drew attention to SC-CAMLR-XX/BG/23 and gave the following recommendations to CCAMLR:

- (i) establish fishing seasons and limited fishing areas for krill based on available scientific information;
- (ii) divide the krill fishery into smaller management units to prevent concentration of fishing effort;
- (iii) amend Conservation Measure 148/XVII to require operation of VMS on all krill fishing vessels;

- (iv) undertake a synoptic survey of land-based predators; and
- (v) include the krill questionnaire in the *Scientific Observers Manual*.

IWC

11.4 Dr D. Thiele (Australia), Chair of the Steering Committee for IWC/SO-GLOBEC collaboration, provided the CCAMLR Scientific Committee with updated reports on progress on IWC/CCAMLR and IWC/SO-GLOBEC research activities. Two papers from the 53rd IWC Scientific Committee Meeting in London in July 2001 were distributed:

- (i) SC-CAMLR-XX/BG/30, on analysis from the IWC/CCAMLR collaboration during the synoptic surveys in the Antarctic Peninsula 1999/2000 season; and
- (ii) SC-CAMLR-XX/BG/29, outlining preliminary results from four of the five SO-GLOBEC surveys in 2001 conducted under US SO-GLOBEC and the German SO-GLOBEC cruises to Marguerite Bay.

11.5 The IWC/SO-GLOBEC collaboration involved cetacean research using visual surveys from ships and helicopters, tissue biopsy and passive acoustic studies. Dr Thiele noted that the US SO-GLOBEC surveys involved an intensive effort using the *Laurence M. Gould* and the *Nathaniel B. Palmer* with survey and process cruises in the autumn and winter, to be repeated in 2002. The German survey on the *Polarstern* was partially conducted in the study area from April to May. A timetable of cruises, analyses and presentations to be made in the coming years by IWC as part of the SO-GLOBEC analysis process is given in SC-CAMLR-XX/BG/29.

11.6 Both the IWC Scientific Committee and Commission have emphasised the importance of current and future collaboration with CCAMLR to their work. They encourage national CCAMLR programs to include collaboration with the IWC wherever possible. The IWC thanked the CCAMLR Scientific Committee and WG-EMM members for ensuring the success of the CCAMLR-2000 Survey and analysis so far.

IUCN

11.7 The IUCN Observer drew the Scientific Committee's attention to CCAMLR-XX/BG/28 and BG/29, which contained reports by the TRAFFIC Network on the results of its trade analyses of *D. eleginoides* and *D. mawsoni*.

11.8 The IUCN Observer advised the Scientific Committee that the trade analyses undertaken by TRAFFIC had concluded that CCAMLR had significantly underestimated the level of IUU catches of *D. eleginoides* and *D. mawsoni*. In relation to *D. eleginoides* the analysis indicated that the global level of IUU catch in the year 2000 was up to four times that estimated by CCAMLR. The trade analysis of *D. mawsoni* showed that the level of removals may be 70% higher than the level of catch reported to the Commission and could be as much

as 147% higher. The IUCN representative expressed concern over the increase in exploratory fishing proposals in areas where *D. mawsoni* are more likely to occur, given the possibility that reported catches were significantly lower than the actual level of removals.

11.9 The IUCN Observer stressed the need for the Scientific Committee to consider the recommendations of the two reports and take into account when preparing stock assessments and advice on allowable catches the fact that the level of removals of both species may be significantly higher than that estimated by CCAMLR. Further, the IUCN Observer recommended that the Scientific Committee consider further the role that independent analyses, such as that undertaken by TRAFFIC, could play in enhancing knowledge about the fishery.

11.10 Mr M. Paterson (New Zealand) welcomed the IUCN paper as well as the FAO Observer's report, CCAMLR-XX/BG/33, and pointed out the value of independent information and reviews. However, he noted that FAO trade data, referred to in the report, contained discrepancies.

FAO

11.11 Referring to CCAMLR-XX/BG/33, which is the report from the FAO Observer, Prof. Croxall indicated that on behalf of WG-IMALF, he would like clarification from FAO on how collation of data on fishing efforts in the areas adjacent to the CCAMLR Convention Area was undertaken by FAO and the availability of such data to CCAMLR. Depending on the response, there might be questions to pose to CWP.

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

CWP

11.12 The Data Manager had prepared a report (SC-CAMLR-XX/BG/8) for the Nineteenth Session of CWP, 10 to 13 July 2001, Noumea, New Caledonia, in which, due to overlap with WG-EMM, he could not participate this year. The report elaborates on major developments since the last meeting of CWP in July 1999, i.e. the CDS, the species identification sheets for scientific observers and the vessel registry.

CMS

11.13 The Final Negotiation Session for an Albatross and Petrel Agreement under the auspices of CMS was held from 26 January to 9 February 2001 in Cape Town, South Africa. Reports are given in SC-CAMLR-XX/BG/17 and BG/20, which are discussed in Annex 5, paragraphs 7.195 to 7.198.

ICES

11.14 Attention was drawn to SC-CAMLR-XX/BG/31 reporting from the ICES Annual Science Conference, 26 September to 9 October 2001, Oslo, Norway.

11.15 ICES has as main objectives to stimulate biological and technical fishery research in its member states and advise international organisations on fisheries management and pollution.

11.16 The meeting was attended by more than 550 scientists from 19 member states and a number of international organisations. 350 scientific presentations and posters were given.

11.17 The following conclusions of relevance to CCAMLR arose from this ICES meeting:

- (i) improve the sampling strategy for collection of data on age, length and maturity in the European fisheries management;
- (ii) collect data about fish diseases and produce trend analyses of these data;
- (iii) reveal and investigate the impact of bottom fisheries on the in- and epifauna;
- (iv) undertake selectivity research in the light of fisheries management;
- (v) report on chemical and biological effects of pollution; and
- (vi) ensure good participation at a number of specific ICES meetings.

International Fishers' Forum

11.18 New Zealand reported on the International Fishers' Forum – Solving the Incidental Capture of Seabirds in Longline Fishing Operations, 6 to 9 November 2000, Auckland, New Zealand (SC-CAMLR-XX/BG/19). Details are given in Annex 5, paragraphs 7.191 to 7.194.

IWC

11.19 The IWC Observer, Dr Kock, reported on the meeting of the IWC Scientific Committee held in London, UK, from 4 to 16 June 2001, and ongoing IWC/CCAMLR cooperation (CCAMLR-XX/BG/32).

11.20 A total of 440 minke whales were caught within the CCAMLR Convention Area under the remit of the IWC in 2000/01. This catch was similar to the previous season. These whales were taken under a Special Scientific Permit issued by Japan.

11.21 The joint workshop between IWC and CCAMLR scientists (paragraphs 11.4 to 11.6) was briefly discussed and the Scientific Committee agreed to endorse Annex 4, paragraphs 3.11 and 3.109 where further collaboration between scientists from CCAMLR and the IWC is encouraged.

SCAR

11.22 The SCAR/CCAMLR Observer and Liaison Officer, Dr Fanta, reported those matters of interest to CCAMLR in CCAMLR-XX/BG/31:

- (i) The year 2001 is an intersessional year for SCAR. Its next meeting will be held from 15 to 26 July 2002 in Shanghai, People's Republic of China.
- (ii) During the last intersessional period, the main event was the SCAR VIII Biology Symposium 'Antarctic Biology in a Global Context' held from 27 August to 1 September 2001 in Amsterdam, Netherlands. The presentations enabled the Antarctic biology community to become aware of the present status of Antarctic research in biology and future trends. More than 230 scientists, including a great number of young scientists, from more than 24 countries were present. Several presentations (oral and posters) included themes of direct or indirect interest to CCAMLR.
- (iii) A meeting of the SCAR Subcommittee on Evolutionary Biology of Antarctic Organisms was held from 25 to 26 August 2001 in Amsterdam, Netherlands. Having received the approval of the EVOLANTA project at the last SCAR meeting, the group is now implementing its objectives. The group will meet in September 2002 in Italy, when a workshop on Evolutionary Adaptation in Antarctic Organisms will take place.
- (iv) There was no meeting of GOSEAC in 2000/01. The next meeting will take place in the USA in April 2002. On its agenda is the preparation of the State of the Antarctic Environment Report (SAER). CCAMLR has provided assistance by contributing several CCAMLR publications that contain data and describe CCAMLR's understanding of what is required to assess the status of the Antarctic marine ecosystem.
- (v) Information about SCAR and coming meetings can be obtained from its website www.scar.org.

FAO

11.23 Referring to CCAMLR-XX/BG/13, which is a report by the Executive Secretary from the 24th Session of COFI, Dr Hewitt, on behalf of WG-EMM, noted Japan's intention to organise a Conference on Management and Sustainable Development of Fisheries in the Antarctic. The Executive Secretary had indicated that WG-EMM could address the issue at its July 2002 meeting. Dr Hewitt asked if Japan wished to comment on this matter.

11.24 Dr Naganobu indicated that the matter will be raised in the Commission and Japan preferred that it not be discussed by the Scientific Committee.

11.25 Prof. Croxall regretted that Japan did not present this proposal to the Scientific Committee since he felt that it would have been a very appropriate body to discuss it and provide comment and advice to the Commission.

Future Cooperation

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

- (i) First Meeting of the Pacific Rim Debris Commission, March 2002, Hawaii, USA – no nomination;
- (ii) 54th Annual Meeting of the IWC, 25 April to 24 May 2002, Shimonoseki, Japan – Dr Kock;
- (iii) SCAR-GOSEAC, April, USA (dates and venue to be confirmed) – Dr Fanta;
- (iv) XXVII SCAR Meeting, 15 to 26 July 2002, Shanghai, People's Republic of China – Dr Fanta;
- (v) World Congress on Aquatic Protected Areas 2002 (to be held in conjunction with the 31st Annual Conference of the Australian Society of Fish Biology), 14 to 17 August 2002, Cairns, Australia – Australia;
- (vi) CEP-V – Antarctic Treaty, 3 to 14 September 2002, Warsaw, Poland – Chair of the Scientific Committee;
- (vii) EVOLANTA, September, Italy (dates and venue to be confirmed) – Dr Fanta;
- (viii) Seventh Conference of the Parties to CMS, 15 to 28 September 2002, Bonn, Germany – no nomination;
- (ix) ICES Annual Science Conference, 1 to 8 October 2002, Copenhagen, Denmark – Belgium; and
- (x) GLOBEC Second Open Science Meeting, 15 to 18 October 2002, Qingdao, People's Republic of China – Dr Nicol.

11.27 In addition to the nominations for meetings in the intersessional period, Dr Everson drew attention to the Fourth World Fisheries Congress which is planned to take place from 2 to 6 May 2004 in Vancouver, Canada. The theme of the congress is likely to be 'Reconciling Fisheries with Conservation: The Challenge of Managing Aquatic Ecosystems'. These themes, along with the precautionary approach, have been given particular attention by the Commission and the Scientific Committee in establishing a management regime. The congress will provide a valuable opportunity for the CCAMLR experience to be brought to a wider international audience.

PUBLICATIONS

12.1 The eighth edition of *CCAMLR Science* had been published just prior to CCAMLR-XX and was made available at the Scientific Committee meeting. The Scientific Committee extended its sincere thanks to Dr Sabourenkov (Editor) and all the Secretariat staff involved in this publication.

12.2 As agreed by the Scientific Committee last year (SC-CAMLR-XIX, paragraph 12.3), the synopsis of the electronic book *Understanding CCAMLR's Approach to Management* was published and distributed to Members and interested parties during the intersessional period. The booklet is entitled *CCAMLR's Management of the Antarctic* and has been produced in the four official languages.

12.3 The following documents were also published in 2001:

- (i) *CCAMLR Scientific Abstracts*, covering abstracts of papers presented in 2000;
- (ii) *Statistical Bulletin*, Volume 13 (1991–2000); and
- (iii) Revisions of *Scientific Observers Manual*, *CCAMLR Inspectors Manual* and *CEMP Standard Methods*.

12.4 The Scientific Committee agreed that the website had evolved into a useful tool, and that the present format and contents of material on the website met its needs and that of its working groups (Annex 5, paragraph 9.1). The Secretariat was thanked for these further developments.

SCIENTIFIC COMMITTEE ACTIVITIES DURING THE 2001/02 INTERSESSIONAL PERIOD

13.1 The following activities of the Scientific Committee are planned in 2001/02:

- meeting of WG-EMM (5 to 16 August 2002, Montana, USA); and
- meeting of WG-FSA (7 to 16 October 2002, Hobart, Australia).

13.2 The Scientific Committee gratefully accepted the offer made by Dr Hewitt on behalf of the USA, to host the seventh meeting of WG-EMM in Bozeman, USA, in August 2002. The Scientific Committee also thanked the local organiser, Dr Trivelpiece, for arranging the meeting.

13.3 The Scientific Committee noted that the intersessional activities of the Secretariat and working groups in 2000/01 had been reviewed during the meetings of WG-EMM and WG-FSA. The future work of WG-EMM was detailed in Annex 4, Section 7, and that of WG-FSA in Annex 5, Section 10. In addition, major activities scheduled by the Scientific Committee in the 2001/02 intersessional period are listed in Annex 6. The Chair of the Scientific Committee, together with the conveners of the working groups, agreed to provide the Secretariat with lists of activities in 2001/02 which should be considered as high priority.

13.4 The Scientific Committee gratefully accepted Dr Everson's offer to convene the 2002 meeting of WG-FSA. Dr Everson had agreed to undertake this role on the understanding that Dr S. Hanchet (New Zealand) would be able to assist with this task, as well as accepting a term as Convener of the Working Group commencing in 2003. The Scientific Committee congratulated Dr Everson on his appointment, and thanked Dr Hanchet for his valuable support. The Scientific Committee also thanked Mr Williams for leading WG-FSA since 1999; his contribution had been very much appreciated.

13.5 The Scientific Committee endorsed the recommendation of WG-FSA that an intersessional forum be established to prepare a program of work for the next meeting, in

parallel with the process of developing the agenda, that takes account of the likely submission of new data, the need to evaluate new methods if they are being developed and the need to complete the assessments in a thorough, accurate and timely way.

13.6 The Scientific Committee also endorsed the recommendation of WG-FSA that a framework for evaluating assessment methods be developed in order to be confident that results arising from the application of these methods will be robust to the uncertainties surrounding the management of the fisheries. The Scientific Committee agreed that this be given a high priority for coordination and assistance by the Secretariat, including validation of assessment methods and software, peer review and archiving of documentation (see also SC-CAMLR-XIX, paragraph 5.70).

13.7 The Scientific Committee urged Member countries to support participation by experts at future meetings of WG-EMM and WG-FSA. WG-EMM had outlined a schedule of workshops for the period from 2002 to 2005 (Annex 4, paragraph 6.3) so as to assist Members in planning such expert participation. WG-FSA had also urged scientists from France and Ukraine, along with other experts, to assist with its work at future meetings.

13.8 Dr Goubanov advised the Scientific Committee that YugNIRO would be celebrating its 80th anniversary in 2002. A conference would be scheduled in Kiev during the northern summer. The theme of the conference would be 'From the Antarctic to the Arctic'. Dr Goubanov agreed to provide details to the Secretariat, for dissemination to Members, as soon as these were available. The Scientific Committee encouraged Members to participate in this event.

13.9 Dr Kawaguchi reminded the Scientific Committee that Japan would be hosting a Workshop on Krill Culturing Techniques during September 2002 (Annex 4, paragraph 7.2). The Scientific Committee encouraged Members to participate in this workshop.

BUDGET FOR 2002 AND FORECAST BUDGET FOR 2003

14.1 The budget of the Scientific Committee for 2002, and the forecast budget for 2003 is summarised in Table 5. The following points were agreed:

- (i) The 2002 meeting of WG-EMM will include two workshops: consideration of small-scale management units and interim planning for the 2003 workshop on the utility of CEMP. It is expected that the findings from these workshops will be appended to the report of WG-EMM, resulting in a report in 2002 of approximately the same size as the report in 2000.
- (ii) WG-FSA's newly formed otolith exchange network would look into the feasibility of holding a workshop in 2003. The approximate cost of this workshop was included in the 2003 forecast budget.

14.2 The Scientific Committee also considered a proposal by WG-FSA for the Secretariat to provide assistance with the preparation, in English, of manuscripts submitted to *CCAMLR Science* by authors whose native language is not English (Annex 5, paragraphs 11.7 to 11.11). The proposal addressed WG-FSA's concern that *CCAMLR Science* may not accept valuable scientific contributions due to poor English composition.

14.3 There was considerable divergence of views regarding this issue. Although Members of the Scientific Committee recognised the value of such a service, they were unable to reach consensus on the question regarding the languages involved. WG-FSA's proposal did not meet the needs of all Members, and the inclusion of languages other than the official languages of the Commission would require the Secretariat to acquire, or outsource, additional language expertise, thereby increasing the cost of such a service. This issue was referred to the Editorial Board of *CCAMLR Science* for further consideration.

14.4 The Scientific Committee endorsed the following expenditures under the Commission's budget for 2002:

- participation by the Chair in the 2002 meeting of CEP;
- participation of the Data Manager in the 2002 intersessional meeting of CWP;
- development of computing facilities in support of data management;
- publication of laminated waterproof species identification sheets; and
- a contribution to the cost of publishing the results of the CCAMLR-2000 Survey in a special issue of *Deep Sea Research*.

ADVICE TO SCOI AND SCAF

15.1 The Chair presented the Scientific Committee advice to SCOI and SCAF during the meeting. This advice is detailed in Sections 3 and 14.

ELECTION OF VICE-CHAIRS OF THE SCIENTIFIC COMMITTEE

16.1 Dr Nicol nominated Dr Kawaguchi as Vice-Chair of the Scientific Committee; this was seconded by Dr Fanta. Dr Fanta nominated Mr L. López Abellán (Spain) as Vice-Chair of the Scientific Committee; this was seconded by Dr Nicol. No further nominations were received. Dr Kawaguchi and Mr López Abellán were elected unanimously to these positions for 2002 and 2003, and both were congratulated by the Scientific Committee. The Scientific Committee also expressed its appreciation for the dedicated work of Drs Fanta and Nicol during their term as Vice-Chairs in 2000 and 2001.

NEXT MEETING

17.1 The next meeting of the Scientific Committee would be held from 21 to 25 October 2002.

OTHER BUSINESS

Revision of the Scientific Committee Agenda

18.1 In recent years the tasks undertaken by the Scientific Committee, and the way it has organised its work, have changed in response to the extent and type of advice required by the

Commission. A primary concern is that the size and complexity of the working group reports has restricted the time available for debate within the Scientific Committee. Accordingly, the Scientific Committee reviewed its agenda, preparations prior to the meeting, and the conduct of business within the meeting.

18.2 The Scientific Committee reaffirmed that its role is to provide advice to the Commission with respect to the conservation of living marine resources that fall under the competence of CCAMLR, taking into account ecosystem approaches to management and the precautionary principle. In order to accomplish this function, the Scientific Committee relies on information provided by its working groups, by the Secretariat and by attendees to its annual meeting. Accordingly, the agenda should focus on those considerations that pertain to the following actions:

- (i) providing advice to the Commission;
- (ii) defining the issues to be addressed by the working groups;
- (iii) reviewing and acting upon advice, recommendations, notations and requests from the working groups; and
- (iv) identifying issues relating to fisheries observation, budget, CCAMLR publications and other organisations.

18.3 It was further agreed that the conveners of the working groups prepare and circulate summaries of their reports as they pertain to the Scientific Committee agenda. Such summaries would contain references to the appropriate paragraphs in the reports of the working groups. It was also agreed that the annotated agenda be revised to include references to all paragraphs in the reports of the working groups that invite comment from the Scientific Committee. With the current intersessional arrangements this would mean that the first circulation of the annotated agenda would include references to all appropriate paragraphs in the WG-EMM report, and that a revised version of the annotated agenda would be prepared on completion of the WG-FSA report.

18.4 It was also suggested that the working groups consider whether it would be desirable to assemble the synopses of working papers, pending notification and agreement of authors, and circulate these to the Scientific Committee as a background paper. The preparation of such synopses by contributors of working papers is the current practice in WG-EMM.

18.5 The Scientific Committee agreed that its advice needed to be set in context such that the Commission may understand its rationale. This need to provide background material must be balanced against the desire to keep the report of the Scientific Committee as brief as possible and focused towards the issues of resource management. It was recognised that in any one particular year, portions of this agenda might be expanded or, conversely, treated in a brief manner.

18.6 The Scientific Committee was unable to reach agreement on a provisional agenda for its 2002 meeting. The Chair of the Scientific Committee offered to continue the task of developing an agenda for the 2002 meeting through correspondence.

Application by ASOC for Observer Status at Meetings of Subsidiary Bodies

18.7 The Scientific Committee considered an application by ASOC for observer status at meetings of the Scientific Committee's subsidiary bodies. Most Members agreed to this application on the proviso that ASOC sends scientists with appropriate expertise to the meetings of the Working Groups, and that such observers participate as individual scientists. Scientific expertise was valued by the Scientific Committee and its working groups. Participation by ASOC at the meetings of the Scientific Committee had been valuable. Participation by ASOC in the work of the working groups was seen as potentially beneficial.

18.8 Japan and Russia objected to ASOC's participation in the working groups on the basis that ASOC was primarily concerned with developing policies dealing with fisheries and conservation, and did not conduct its own research.

18.9 The Scientific Committee examined the possibility of ASOC contributing to the working groups through the submission of meeting papers. Again, most Members agreed that this would be a valuable contribution to the scientific endeavours of the working groups. However, Japan objected to such a proposal.

18.10 The Scientific Committee was unable to reach consensus on this matter, and the application by ASOC for observer status at meetings of its subsidiary bodies was rejected.

ADOPTION OF THE REPORT

19.1 The report of the Twentieth Meeting of Scientific Committee was adopted.

CLOSE OF THE MEETING

20.1 In closing the meeting, Dr Holt thanked all Members of the Scientific Committee and the staff of the Secretariat for their relentless work during the meeting and over the past intersessional period. The Scientific Committee was especially indebted to the work of the conveners of the working groups and the other CCAMLR meetings held in 2000/01 and the rapporteurs.

20.2 Dr Holt also thanked Dr Fanta for chairing a section of the meeting while he was called away to attend SCOI. He noted that, to his knowledge, it was the first time a woman had chaired the Scientific Committee.

20.3 Dr Holt also thanked Dr Miller for his long-standing contribution to the work of the Scientific Committee, and Members of the Committee joined in congratulating Dr Miller on his new appointment as Executive Secretary of the CCAMLR Secretariat.

20.4 The Scientific Committee also thanked Dr Everson for agreeing to convene the 2002 meeting of WG-FSA.

20.5 Prof. Croxall, on behalf of the Scientific Committee, thanked Dr Holt for an outstanding meeting. This had been the first meeting of the Scientific Committee chaired by Dr Holt, and his leadership had been greatly appreciated by all.

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LIST OF DOCUMENTS

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- SC-CAMLR-XX/1 Provisional Agenda for the Twentieth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
- SC-CAMLR-XX/2 Provisional Annotated Agenda for the Twentieth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
- SC-CAMLR-XX/3 Report of the Working Group on Ecosystem Monitoring and Management
(Fiskebäckskil, Sweden, 2 to 11 July 2001)
- SC-CAMLR-XX/4 Report of the Working Group on Fish Stock Assessment
(Hobart, Australia, 8 to 19 October 2001)
- SC-CAMLR-XX/5 A proposal to modify the boundaries of Statistical Division 58.4.3 and neighbouring divisions to define Elan and BANZARE Banks
Delegation of Australia
- *****
- SC-CAMLR-XX/BG/1 Catches in the Convention Area in the 2000/2001 split-year
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- SC-CAMLR-XX/BG/2 Beach debris survey – Main Bay, Bird Island, South Georgia
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Delegation of the United Kingdom
- SC-CAMLR-XX/BG/3 Entanglement of Antarctic fur seals *Arctocephalus gazella* in
man-made debris at Bird Island, South Georgia during the 2000
winter and the 2000/01 breeding season
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- SC-CAMLR-XX/BG/4 Entanglement of Antarctic fur seals *Arctocephalus gazella* in
man-made debris at Signy Island, South Orkney Islands 2000/01
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- SC-CAMLR-XX/BG/5 Beach debris survey, Signy Island, South Orkney Islands
2000/2001
Delegation of the United Kingdom
- SC-CAMLR-XX/BG/6 United Kingdom report on the assessment and avoidance of
incidental mortality in the Convention Area 2000/01
Delegation of the United Kingdom

SC-CAMLR-XX/BG/7	Anthropogenic feather soiling, marine debris and fishing gear associated with seabirds at Bird Island, South Georgia, 2000/01 Delegation of the United Kingdom
SC-CAMLR-XX/BG/8	CCAMLR Report to the Nineteenth Session of the Coordinating Working Party on Fisheries Statistics (CWP) Secretariat
SC-CAMLR-XX/BG/9	Data Management Report to the Fourth Meeting of the Committee for Environmental Protection (CEP) Secretariat
SC-CAMLR-XX/BG/10	Summary of Notifications for New and Exploratory Fisheries in 2001/02 Secretariat
SC-CAMLR-XX/BG/11 Rev. 2	IMALF assessment of new and exploratory fisheries by statistical area (Working Group on Fish Stock Assessment)
SC-CAMLR-XX/BG/12	Report on the assessment and avoidance of incidental mortality – 2000/01 Delegation of South Africa
SC-CAMLR-XX/BG/13	Report on beach debris surveys – 2000/01 Delegation of South Africa
SC-CAMLR-XX/BG/14	Data Management report on activities during 2000/01 Secretariat
SC-CAMLR-XX/BG/15 Rev. 1	Calendar of meetings of relevance to the Scientific Committee in 2001/02 Secretariat
SC-CAMLR-XX/BG/16	Monitoring marine debris and its impact on marine living resources in Antarctic waters Secretariat
SC-CAMLR-XX/BG/17	Report to the Scientific Committee on the final drafting meeting for the Agreement on the Conservation of Albatrosses and Petrels (Cape Town, 27 January to 2 February 2001) Delegation of South Africa
SC-CAMLR-XX/BG/18 Rev. 1	Importancia de los estudios patológicos en depredadores tope del ecosistema marino Antártico Delegación de Chile

- SC-CAMLR-XX/BG/19 Summary report of the International Fishers' Forum – Solving the Incidental Capture of Seabirds in Longline Fisheries
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- SC-CAMLR-XX/BG/20 Progress toward an Agreement on the Conservation of Albatrosses and Petrels
Delegation of Australia
- SC-CAMLR-XX/BG/21 Relevamiento de desechos marinos en la costa de la base científica Antártica Artigas (BCAA) en la Isla Rey Jorge / 25 de Mayo – temporada 2000/01
Delegación de Uruguay
- SC-CAMLR-XX/BG/22 Review of data submitted by Members on marine debris and its impact on marine living resources
Secretariat
- SC-CAMLR-XX/BG/23 Summary of observations conducted in the 2000/01 season by designated CCAMLR Scientific Observers
Secretariat
- SC-CAMLR-XX/BG/24 Subdivision of large CCAMLR Statistical Areas for the management of the krill fishery
Delegation of Australia
- SC-CAMLR-XX/BG/25 Marine debris collected at Cape Shirreff during the Antarctic season 2000/01
Delegation of Chile
- SC-CAMLR-XX/BG/26 Conservative management of the Antarctic krill fishery
The Antarctic and Southern Ocean Coalition
- SC-CAMLR-XX/BG/27 South American strategy for the conservation of albatrosses and petrels 'ESCAPE'
Delegation of Brazil
- SC-CAMLR-XX/BG/28 Measures taken by Brazil to minimise the incidental mortality of seabirds outside the Convention Area
Delegation of Brazil
- SC-CAMLR-XX/BG/29 Preliminary report on IWC-SO GLOBEC collaborative research in the western Antarctic Peninsula study area, March–June 2001
Observer (IWC)
- SC-CAMLR-XX/BG/30 Modelling whale distribution: a preliminary analysis of data collected on the CCAMLR-IWC Krill Synoptic Survey, 2000
Observer (IWC)

- SC-CAMLR-XX/BG/31 The ICES Annual Science Conference
CCAMLR Observer (Belgium)
- SC-CAMLR-XX/BG/32 Observer's report from the 53rd Meeting of the Scientific
Committee of the International Whaling Commission
(London, 4 to 16 July 2001)
CCAMLR Observer (K.-H. Kock, Germany)
- *****
- CCAMLR-XX/1 Provisional Agenda for the Twentieth Meeting of the Commission
for the Conservation of Antarctic Marine Living Resources
- CCAMLR-XX/2 Provisional Annotated Agenda for the Twentieth Meeting of the
Commission for the Conservation of Antarctic Marine Living
Resources
- CCAMLR-XX/3 Examination of the audited financial statements for 2000
Executive Secretary
- CCAMLR-XX/4 Review of the 2001 budget, draft 2002 budget and forecast budget
for 2003
Executive Secretary
- CCAMLR-XX/5 Notification of Australia's intention to continue an exploratory
trawl fishery in Division 58.4.2 for *Chaenodraco wilsoni*,
Lepidonotothen kempfi, *Trematomus eulepidotus* and
Pleuragramma antarcticum
Delegation of Australia
- CCAMLR-XX/6 Notification of Australia's intention to continue an exploratory
trawl fishery in Division 58.4.2 for *Dissostichus* spp.
Delegation of Australia
- CCAMLR-XX/7 Notification of Australia's intention to initiate a new trawl fishery
in Division 58.4.2 for *Macrourus* spp.
Delegation of Australia
- CCAMLR-XX/8 Notification of Chile's intention to initiate an exploratory longline
fishery in Subarea 58.6 for *D. eleginoides*
Delegation of Chile
- CCAMLR-XX/9 Notification of France's intention to initiate an exploratory
longline fishery in Subarea 58.6 and Divisions 58.4.3 and 58.4.4
Delegation of France

CCAMLR-XX/10	Notification of exploratory fisheries for <i>Dissostichus</i> spp. in the 2001/2002 season Delegation of Japan
CCAMLR-XX/10 Addendum	To be read in conjunction with Japan's notification for exploratory fisheries in the 2001/02 season Delegation of Japan
CCAMLR-XX/11	Notification by New Zealand of its intention to continue an exploratory fishery for <i>Dissostichus</i> spp. in CCAMLR Subareas 88.1 and 88.2 for the 2001/2002 season Delegation of New Zealand
CCAMLR-XX/12	Notification of New Zealand's intention to undertake exploratory fishing in Subareas 48.6 and 88.3 and Division 58.4.4 Delegation of New Zealand
CCAMLR-XX/11 CCAMLR-XX/12 Addendum	To be read in conjunction with New Zealand's notifications for exploratory fisheries in the 2001/02 season Delegation of New Zealand
CCAMLR-XX/13	Notification of Russia's intention to conduct an exploratory longline fishery in 2001/2002 in Subarea 88.1 Delegation of Russia
CCAMLR-XX/14	Notification by Russia of its intention to initiate a new or exploratory fishery for <i>Dissostichus</i> spp. in Subarea 88.2 Delegation of Russia
CCAMLR-XX/15	Notification of exploratory fisheries for <i>Dissostichus</i> spp. in the 2001/2002 season Delegation of South Africa
CCAMLR-XX/16	Notification of Uruguay's intention to conduct an exploratory fishery in Subarea 48.6 Delegation of Uruguay
CCAMLR-XX/17	Notification of Uruguay's intention to conduct an exploratory fishery in Division 58.4.4 Delegation of Uruguay
CCAMLR-XX/18	Application by ASOC for observer status at meetings of subsidiary bodies of the Commission and the Scientific Committee Secretariat
CCAMLR-XX/19 Rev. 1	Draft statement for the commemoration of 20 years of CCAMLR Delegation of Chile

CCAMLR-XX/20 Rev. 1	CCAMLR conservation measures: alternative approaches for fishery measures Secretariat
CCAMLR-XX/21	Cooperation with the Committee on Trade and the Environment of the World Trade Organization Secretariat
CCAMLR-XX/22	Venues for future meetings of the Commission and the Scientific Committee Secretariat
CCAMLR-XX/23	Revision of the formula for calculating CCAMLR Member contributions Chairman of SCAF (Spain)
CCAMLR-XX/24	CCAMLR staff and higher education contribution scheme Secretariat
CCAMLR-XX/25	Report of the Standing Committee on Observation and Inspection (SCOI)
CCAMLR-XX/25 Corrigendum	Report of the Standing Committee on Observation and Inspection (SCOI)
CCAMLR-XX/26	Report of the Standing Committee on Finance and Administration (SCAF)

CCAMLR-XX/BG/1 Rev. 2	List of documents
CCAMLR-XX/BG/2	List of participants
CCAMLR-XX/BG/3	Report on attendance at the Fourth Meeting of the Committee for Environmental Protection Under the Madrid Protocol Chairman of the Scientific Committee
CCAMLR-XX/BG/4	CCAMLR conservation measures: a review Secretariat
CCAMLR-XX/BG/5	Report on inspection and implementation of sanctions – 2000/2001 Delegation of South Africa

CCAMLR-XX/BG/6	Observer report to CCAMLR on meetings of the Commission for the Conservation of Southern Bluefin Tuna (November 2000 and April 2001) CCAMLR Observer (New Zealand)
CCAMLR-XX/BG/7 Rev. 1	Implementation of conservation measures in 2000/2001 Secretariat
CCAMLR-XX/BG/8	Summary of current conservation measures and resolutions 2000/2001 Secretariat
CCAMLR-XX/BG/9	Continued development of the Secretariat communications policy Secretariat
CCAMLR-XX/BG/10 Rev. 1	Calendar of meetings of relevance to the Commission in 2001/02 Secretariat
CCAMLR-XX/BG/11	Report of the CCAMLR Observer to ATCM-XXIV Executive Secretary
CCAMLR-XX/BG/12	Statement of the CCAMLR Observer at the Twenty-fourth session of the FAO Committee on Fisheries Executive Secretary
CCAMLR-XX/BG/13	Report of the CCAMLR Observer at the 24th session of the Committee on Fisheries of FAO (Rome, 26 February to 2 March 2001) Executive Secretary
CCAMLR-XX/BG/14	Vacant
CCAMLR-XX/BG/15	Reunión de 'Pacon International' – Identificación y contabilidad de desechos marinos (San Francisco, 8–12 de Julio 2001) Delegación de Chile
CCAMLR-XX/BG/16	Observer's report from the 53rd Meeting of the International Whaling Commission London, 23–27 July 2001 CCAMLR Observer (United Kingdom)
CCAMLR-XX/BG/17	Évaluation de la pêche illicite dans les eaux françaises adjacentes aux îles Kerguelen et Crozet pour la saison 2000/2001 (1 ^{er} juillet 2000–30 juin 2001). Informations générales sur la zone CCAMLR 58 Délégation française

CCAMLR-XX/BG/17 Additif	Évaluation de la pêche illicite dans les eaux françaises adjacentes aux îles Kerguelen et Crozet pour la saison 2000/2001 (1 ^{er} juillet 2000–30 juin 2001). Informations générales sur la zone CCAMLR 58 Délégation française
CCAMLR-XX/BG/18	Problems and prospects for the Convention on the Conservation of Antarctic Marine Living Resources twenty years on The Antarctic and Southern Ocean Coalition
CCAMLR-XX/BG/19	Illegal, unregulated, unreported toothfish catch estimates for the Australian EEZ around Heard and McDonald Islands 1 July 2000–30 June 2001 Delegation of Australia
CCAMLR-XX/BG/20	ASOC evaluation of the CDS The Antarctic and Southern Ocean Coalition
CCAMLR-XX/BG/21	Report on training conducted by Australia in Mauritius and Namibia to assist their implementation of the CCAMLR Catch Documentation Scheme Delegation of Australia
CCAMLR-XX/BG/22 Rev. 2	Implementation and operation of the Catch Documentation Scheme in 2000/2001 Secretariat
CCAMLR-XX/BG/23 Rev. 1	Report of the Antarctic and Southern Ocean Coalition (ASOC) to the XX Meeting of the Convention on the Conservation of Antarctic Marine Living Resources The Antarctic and Southern Ocean Coalition
CCAMLR-XX/BG/24	Implementation of the System of Inspection and other CCAMLR enforcement provisions, 2000/2001 Secretariat
CCAMLR-XX/BG/25	Report on court process in Chile for infraction of CCAMLR's conservation measures in September 2001 Delegation of Chile (Available in Spanish and English)
CCAMLR-XX/BG/26	Vacant
CCAMLR-XX/BG/27	Vacant
CCAMLR-XX/BG/28	Patagonian toothfish – are conservation and trade measures working? IUCN

CCAMLR-XX/BG/28 Addendum	Patagonian toothfish – are conservation and trade measures working? IUCN
CCAMLR-XX/BG/29	Antarctic toothfish – an analysis of management, catch and trade IUCN
CCAMLR-XX/BG/29 Addendum	Antarctic toothfish – an analysis of management, catch and trade IUCN
CCAMLR-XX/BG/30	Secrétariat général de la Communauté du Pacifique Deuxième conférence des directeurs des pêches (Nouméa, Nouvelle-Calédonie, 23–27 juillet 2001) Recommandations – révision 1 Version de travail Délégation française
CCAMLR-XX/BG/31	Report on the activities of the Scientific Committee on Antarctic Research (SCAR) 2000/2001 Observer (E. Fanta, Brazil)
CCAMLR-XX/BG/32	Measures taken by Brazil in preparation for longline fisheries in the Convention Area Delegation of Brazil
CCAMLR-XX/BG/33	FAO Observer's Report FAO Observer (R. Shotton)
CCAMLR-XX/BG/33 Addendum	Revised Table 1 FAO Observer's Report FAO Observer (R. Shotton)
CCAMLR-XX/BG/34	Observer's report from the 53rd Meeting of the International Whaling Commission CCAMLR Observer (B. Fernholm, Sweden)
CCAMLR-XX/BG/35	Revised draft guide to the completion of <i>Dissostichus</i> catch documents Secretariat
CCAMLR-XX/BG/36	Information on proposed expert consultation of Regional Fisheries Bodies on the harmonisation of catch documentation FAO Observer (R. Shotton)
CCAMLR-XX/BG/37	Implementation of the objective of the Convention: institutional overview and issues Delegation of Chile

CCAMLR-XX/BG/38 Advice to CCAMLR on the International Network for Fisheries
Monitoring, Control and Surveillance
Secretariat

CCAMLR-XX/BG/39 International conference/workshop organised by the Government
of Japan on conservation and sustainable use of living marine
resources in the Antarctic
Delegation of Japan

**AGENDA FOR THE TWENTIETH MEETING
OF THE SCIENTIFIC COMMITTEE**

**AGENDA FOR THE TWENTIETH 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. Fishery Status and Trends
 - (i) Krill
 - (ii) Fish
 - (iii) Crab
 - (iv) Squid

3. CCAMLR Scheme of International Scientific Observation
 - (i) Scientific Observations Conducted in the 2000/01 Fishing Season
 - (ii) Advice to the Commission

4. Dependent Species
 - (i) Species Monitored under the CCAMLR Ecosystem Monitoring Program (CEMP)
 - (a) Advice from WG-EMM
 - (b) Proposals for Extension of CEMP Activities
 - (c) Proposals for CEMP Sites
 - (d) Data Requirements
 - (e) Advice to the Commission

 - (ii) Assessment of Incidental Mortality
 - (a) Incidental Mortality in Longline Fisheries
 - (b) Incidental Mortality in Trawl Fisheries
 - (c) Marine Debris
 - (d) Advice to the Commission

 - (iii) Marine Mammal and Bird Populations
 - (a) Advice to the Commission

5. Harvested Species
 - (i) Krill
 - (a) Advice from WG-EMM
 - (b) Data Requirements
 - (c) Advice to the Commission
 - (ii) Fish Resources
 - (a) Advice from WG-FSA
 - (b) Data Requirements
 - (c) Advice to the Commission
 - (iii) Crab Resources
 - (a) Advice from WG-FSA
 - (b) Data Requirements
 - (c) Advice to the Commission
 - (iv) Squid Resources
 - (a) Advice from WG-FSA
 - (b) Data Requirements
 - (c) Advice to the Commission
6. Ecosystem Monitoring and Management
 - (i) Advice from WG-EMM
 - (ii) Data Requirements
 - (iii) Advice to the Commission
7. Management under Conditions of Uncertainty about Stock Size and Sustainable Yield
8. Scientific Research Exemption
9. New and Exploratory Fisheries
 - (i) New Fisheries in the 2000/01 Season
 - (ii) Exploratory Fisheries in the 2000/01 Season
 - (iii) Proposals for New and Exploratory Fisheries for the 2001/02 Season
10. CCAMLR Data Management

11. Cooperation with Other Organisations
 - (i) Cooperation with the Antarctic Treaty System
 - (ii) Reports of Observers from International Organisations
 - (iii) Reports of SC-CAMLR Representatives at Meetings of Other International Organisations
 - (iv) Future Cooperation
12. Publications
13. Scientific Committee Activities during the 2001/02 Intersessional Period
14. Budget for 2002 and Forecast Budget for 2003
15. Advice to SCOI and SCAF
16. Election of Vice-Chairs of the Scientific Committee
17. Next Meeting
18. Other Business
 - (i) Revision of the Scientific Committee Agenda
 - (ii) Application by ASOC for Observer Status at Meetings of Subsidiary Bodies
19. Adoption of the Report of the Twentieth Meeting of the Scientific Committee
20. Close of the Meeting.

**REPORT OF THE WORKING GROUP ON
ECOSYSTEM MONITORING AND MANAGEMENT**
(Fiskebäckskil, Sweden, 2 to 11 July 2001)

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**REPORT OF THE WORKING GROUP ON
ECOSYSTEM MONITORING AND MANAGEMENT**
(Fiskebäckskil, Sweden, 2 to 11 July 2001)

INTRODUCTION

Opening of the Meeting

1.1 The seventh meeting of WG-EMM was held at the Kristineberg Marine Research Station, Fiskebäckskil, Sweden, from 2 to 11 July 2001. The meeting was convened by Dr R. Hewitt (USA).

1.2 Participants were welcomed by Admiral C. Tornberg (President of the Kristineberg Marine Research Station Board), Mrs D. Edmar (former Swedish CCAMLR Commissioner) and Ambassador E. Kettis (CCAMLR Commissioner, Swedish Foreign Ministry). Reflections were made on the work of CCAMLR and developments since the 1990 meeting of WG-CEMP in Stockholm. It was noted that 2001 is an important year in the history of CCAMLR and Antarctica: CCAMLR will be celebrating its 20th annual meeting; it is the 40th anniversary of the Antarctic Treaty; and it is the 100th anniversary of the 1901–1903 Swedish Antarctic Expedition.

1.3 Prof. J. Rydzy (Italy) recalled last year's meeting of WG-EMM in Taormina, Italy, and hoped that progress made at that meeting would be successfully extended at the 2001 meeting.

1.4 Dr Hewitt welcomed participants and outlined the program for the meeting. He noted that the Scientific Committee had endorsed a plan by WG-EMM to change the format of its meetings in an effort to address both short-term and long-term issues in the provision of management advice (SC-CAMLR-XIX, Annex 4, paragraphs 4.127, 4.128 and 7.14; SC-CAMLR-XIX/6 and SC-CAMLR-XIX, paragraphs 13.4 to 13.6).

1.5 The new format is a hybrid one, consisting of a plenary session where the core work of WG-EMM will be developed and a short symposium or workshop on a specific topic will be held. The rationale is that sessions on the core work would allow WG-EMM to address the requests of the Scientific Committee, while workshops would allow the Working Group to focus more energy on a specific problem, and symposia would expose the work of WG-EMM to a broader community as well as expose the Working Group to fresh ideas and approaches.

1.6 At its 2000 meeting the Scientific Committee reiterated that WG-EMM should consider as its core business (SC-CAMLR-XIX, paragraph 13.5):

- reviewing the status and trends in krill fisheries;
- assessing the krill-centric ecosystem; and
- developing management advice.

1.7 The Scientific Committee also highlighted two issues of high priority for consideration by WG-EMM:

- (i) Subdividing krill potential yield. The Scientific Committee acknowledged the statement made by WG-EMM-00 that it may take 5 to 10 years to develop a management scheme for krill that would take into account local as well as regional-scale processes. In the meantime, the Scientific Committee reiterated its request that WG-EMM investigate methods for subdividing the potential yield as a precautionary measure to avoid concentrating fishing effort (SC-CAMLR-XIX, paragraphs 5.15 and 5.27).
- (ii) Development of a unified regulatory framework. A key element of this framework would be a Fishery Plan, envisioned as a comprehensive summary of information on each fishery. This would include notifications to fish, harvest controls, fishing activity, data collection plans etc. (SC-CAMLR-XIX, paragraphs 7.2 to 7.20). The Secretariat had been asked to develop a draft plan for the krill fishery in Area 48 and WG-EMM was asked to provide comments and advice.

1.8 The workshop described in paragraph 5.1 was devoted to the development of a multi-year agenda for the future work of WG-EMM. The goals were to: review earlier discussions and consensus within CCAMLR regarding the development of an ecosystem approach to management of the krill fishery; outline the major issues relevant to the work of WG-EMM that require focused attention; and develop a list of prioritised topics. A subset of topics will then be selected and a plan developed to address each of them.

1.9 Implementing the new format does not necessarily mean that a distinction must be drawn between those issues that require immediate comment and those that can be best resolved through a concentration of effort or iteratively over time. There is a large overlap between the core business of WG-EMM and potential symposium/workshop topics. The expectation is that short-term advice will be modified by improvements in the management scheme. It is also expected that these improvements will be developed over several years as a consequence of ideas and information exchanged at the symposia and workshops.

Procedure for Electronic Submission of WG-EMM Papers

1.10 In recent years the increase in the number of meeting papers submitted at the beginning of WG-EMM meetings has meant that participants have not had sufficient time to give papers the full consideration required. At last year's meeting, WG-EMM agreed on a new set of rules which stipulated that papers must be submitted in electronic form to the Secretariat at least two weeks before the meeting. This would allow the placement of documents on the CCAMLR website (SC-CAMLR-XIX, Annex 4, paragraphs 9.4 to 9.7).

1.11 The intention was to allow meeting participants sufficient time to download and read the documents prior to the meeting. In anticipation of increased traffic to the CCAMLR website, the Secretariat had improved its access to the internet during the intersessional period. Initial discussions indicated that the procedure had been successful, and that 69 documents for the 2001 meeting had been submitted by the deadline. Of these papers, 70% were received in the last few days before the deadline. Several papers were received without the requested proforma synopsis.

1.12 A number of problems were encountered. The most common were problems with inappropriate file types, large files, multiple files for single papers, incorrect email address specified, papers submitted as hard-copy form only (published papers), incomplete papers (abstract only) and late arrival of papers.

1.13 The Secretariat indicated that as a result of receiving the majority of papers near the deadline and the effort required to overcome problems relative to file formats, not all papers were available on the CCAMLR website until one week after the deadline. This only allowed one week for participants to download papers prior to the meeting.

1.14 The Working Group noted it was not feasible to move the deadline for paper submission forward to three weeks prior to the start of the meeting because it would be extremely difficult for the participants whose native language was not English to translate their documents in time for an earlier deadline. In addition, an earlier deadline was difficult for those Members submitting numerous papers because the process of assembling and posting documents is currently very time consuming.

1.15 The Working Group reaffirmed its policy that papers not received by the agreed deadline would not be considered. In addition, papers received as abstract only would not be considered because it was not possible to evaluate statements made in the abstracts.

1.16 Working Group members were pleased to learn that meeting documents would remain on the CCAMLR website for the foreseeable future.

1.17 The Secretariat agreed that it would be possible to add zip files every two or three days as papers were placed on the website and that the date of doing so would be indicated. In addition, the Secretariat will, soon after the deadline has passed, provide on the website information on how many papers were received and when it was anticipated they would be available for downloading. This information was provided to participants at the 2001 meeting.

1.18 The Working Group agreed that the proforma synopsis need not include the paper's abstract, but should continue to include a summary of findings as they pertain to particular agenda items. This will allow more room, if required, on the one-page proforma for a summary of findings and eliminate the need to reproduce the abstract which should be on the first page of the paper.

1.19 The Working Group thanked the Secretariat for its efforts to make this a productive exercise and agreed to continue the policy in future years.

1.20 Dr A. Constable (Australia) suggested that all papers may not require in-depth analyses at the meeting. Some might serve as background papers, while others would serve as core papers addressing specific agenda items. This would create two classes of papers (such as presently employed by the Scientific Committee). Dr Hewitt agreed to provide guidelines which might be used by authors to determine the appropriate category. These will be reviewed at the next meeting.

1.21 Dr Hewitt suggested that participants adopt two guidelines to their work at the meeting:

- remain focused on issues that will lead to resource management advice; and
- structure the report such that it leads to a set of well-referenced paragraphs that clearly summarise the advice, requests, notations and comments that the Working Group wishes to bring forward to the Scientific Committee.

1.22 In order to achieve these results it will be necessary for both contributors and rapporteurs to recognise their responsibilities:

- contributors should provide a synopsis of each working paper containing an abstract and a summary of findings as they relate to specific agenda item(s); and
- rapporteurs will organise summaries, present an overview of key points to the Working Group and summarise discussion.

1.23 In this regard WG-EMM considered the fate of four papers that had been submitted after the deadline (WG-EMM-01/70 to 01/73). WG-EMM-01/70 contained data submitted to the Secretariat but was not received on time because of ship-to-shore email problems; it was agreed to consider this document during the meeting. WG-EMM-01/73 was submitted as a complement to an invited presentation at the workshop; it was agreed to consider this document as well. It was agreed to acknowledge receipt of the remaining two papers but not to consider them at the meeting.

1.24 WG-EMM also considered four abstracts which had been submitted by the deadline, but for which detailed papers had not been submitted, or had been submitted after the deadline. It was agreed that the details of these papers would not be considered at the meeting, and that information presented in the abstracts would be given limited consideration.

1.25 Finally, WG-EMM noted that a number of papers had been submitted without a complete synopsis. It was also noted that this placed an extra burden on both participants and rapporteurs in their effort to draw out the relevance of the document to the agenda of WG-EMM, resulting in a disservice to both the contributors and the work of CCAMLR. WG-EMM urged contributors to submit full papers, including complete synopses, at future meetings.

Key Points for Consideration by the Scientific Committee

1.26 The Working Group noted that the electronic submission of papers had, despite some initial difficulties due to the volume of near-deadline submissions, been most successful in facilitating the conduct of the Working Group's business (paragraphs 1.10 to 1.13).

1.27 The Working Group reaffirmed its policy in respect of not considering papers submitted after a deadline of two weeks before the start of its meeting. It also resolved that papers received as abstract only would not be considered (paragraph 1.15).

Adoption of the Agenda and Organisation of the Meeting

1.28 The Provisional Agenda was discussed and adopted without change (Appendix A).

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

1.30 The report was prepared by Dr A. Constable (Australia), Prof. J. Croxall (UK), Dr I. Everson (UK), Prof. B. Fernholm (Sweden), Mr M. Goebel (USA), Drs R. Holt (USA), D. Miller (South Africa), S. Nicol (Australia) and D. Ramm (Data Manager), Mr K. Reid (UK), and Drs E. Sabourenkov (Science Officer), V. Siegel (Germany), W. Trivelpiece (USA) and P. Wilson (New Zealand).

STATUS AND TRENDS IN THE FISHERY

Fishing Activity

1999/2000 Season

2.1 A total of 104 259 tonnes of krill was caught by 14 vessels between July 1999 and June 2000, of which 69 954 tonnes were taken from Subarea 48.1, 28 649 tonnes from Subarea 48.2, 4 671 tonnes from Subarea 48.3, and 985 tonnes from within Area 48 (subarea not specified) (WG-EMM-01/7).

2.2 Vessels fished for krill in Subarea 48.1 in all months except July 1999. Vessels fished in Subarea 48.2 in July, August and December 1999 and January, March, May and June 2000. Fishing occurred in Subarea 48.3 in June 2000.

2.3 Compared to fishing levels reported over the past 10 years, levels of catch and effort in 1999/2000 were high in Subarea 48.1, low in Subarea 48.2, and the lowest reported in Subarea 48.3.

2000/01 Season (intermediate period, July to November 2000)¹

2.4 The total catch of krill reported during the intermediate period was 30 175 tonnes, caught by 11 vessels. Fishing only took place in Area 48. The following Member countries reported fishing: Poland (5 vessels, 4 360 tonnes); Japan (4 vessels, 23 931 tonnes); Republic of Korea (1 vessel, 1 816 tonnes); and the USA (1 vessel, 70 tonnes).

2000/01 Season

2.5 Reports were available only for December 2000, and January–April 2001. The total krill catch reported to 17 June 2001 was 45 223 tonnes (WG-EMM-01/7). Fishing has only been reported in Area 48. The following Member countries are known to have been fishing in 2000/01: Poland (3 vessels, 5 072 tonnes reported to end of April); Japan (3 vessels,

¹ From 2000 the fishing season has been brought into line with other CCAMLR fisheries. The 2000/01 fishing season for krill began on 1 December 2000 and ends on 30 November 2001. The intermediate period covers that period between the end of the old reporting period (June 2000) and the start of the new reporting period (December 2000).

39 057 tonnes reported to end of May); Republic of Korea (1 vessel, 1 095 tonnes reported to end of April); Ukraine (1 vessel, started fishing in April, no reports); and the USA (1 vessel, started fishing in May, no reports).

2.6 Information on the US krill fishing venture indicated that it was in a developmental phase whilst the vessel was being brought into full operational mode and its operators were becoming familiar with the operations of the krill fishery. The single US vessel was likely to be joined by a second over the next year and the operation would be producing products for human consumption and meal.

2.7 Other nations indicated that their operations would be at approximately the same level as last year (Japan, 3 vessels catching ~65 000 tonnes; Republic of Korea, 1 vessel catching ~8 000 tonnes; Poland, 3 vessels).

2.8 There were indications that the fishery had been moving south in recent years. WG-EMM-01/52 analysed fine-scale catch data which showed that catches in the Antarctic Peninsula area started to be taken in autumn 1996 and in winter 1997. This trend has continued since. This could be a result of environmental conditions; sea-ice has been absent from the South Orkney Islands in recent years and this has been a favoured fishing area for vessels from a number of nations. There may also be economic reasons for vessels fishing in certain areas or avoiding other areas.

Earlier Years

2.9 In the 1999/2000 split-year four Japanese krill fishing vessels operated in Area 48. In Subarea 48.1 the operation started in December and lasted until June. In Subarea 48.2 fishing took place in December, March and May to June. In Subarea 48.3 fishing took place only in June. Two types of CPUEs were calculated for each 10-day period: catch per tow (tonne/tow) and average catch per towsing time (kg/min). These measures fluctuated over the season; from 8–20 tonnes/tow, and from 200–700 kg/min (WG-EMM-01/36).

2.10 The Working Group recognised the importance of the growing dataset on CPUE from the Japanese krill fishing fleet and considered that re-examining the use of such fisheries indices should be a priority task for a future meeting. The Working Group also noted that further information on the spatial and temporal distribution of the fishery from all participants would be very useful for its future work and encouraged the submission of such data.

2.11 Information on the distribution, density and length composition of krill in concentrations from a Polish commercial vessel in the summers of 1997, 1998 and 1999 in the Atlantic sector indicated that concentration densities varied with area and season (WG-EMM-01/13).

2.12 The highest krill densities in 1997 were found near South Georgia and the South Orkney Islands and the lowest near the South Shetland Islands. Commercial krill concentrations generally occurred at depths of 125–250 m but depth varied regionally: at Elephant Island ~125 m, at South Georgia ~150 m, at the South Shetland Islands ~175 m, and at the South Orkney Islands ~250 m. The density of night concentrations of krill was several

times lower than the density of day concentrations but there were no systematic patterns of vertical migration. The average density of krill concentrations increased between February and April–May and then it decreased.

2.13 An analysis of data on the Soviet krill fishery from 1977 to 1992 in Subareas 48.1, 48.2 and 48.3 (WG-EMM-01/57) indicated that the fishing effort could be divided into three types:

Type I: 1981 and 1982, partly 1979/80. Effort was concentrated in Subarea 48.1 in January–April, then moved to Subarea 48.3 via Subarea 48.2.

Type II: 1983–1986. Effort was mostly in Subarea 48.2; after 1985 the role of Subarea 48.3 increased.

Type III: 1987–1989. Effort was mostly in Subarea 48.3, from March–April to September–November.

The distribution of fishing effort corresponds to the spatial and temporal variability of the zonal and meridional atmospheric processes.

2.14 A total of 16 Soviet vessels operated during this period and the CPUE varied according to vessel type, crew experience, fleet ownership and product, amongst other factors. The maximum fishing effort did not always correspond to the maximum catch: the maximum catch of krill was obtained in 1982 (368 182 tonnes from 3 212 days of fishing), whereas the maximum fishing effort occurred in 1988, resulting in only 262 736 tonnes.

2.15 Three main factors influenced the Soviet fishing fleet distribution in Area 48:

- (i) the presence of available krill aggregations of certain quality. Quality was determined by size and feeding intensity: very small and intensively feeding krill may only be processed into meal. For this period the highest priority for the Soviet fleet was maximal catches, krill quality was generally not important;
- (ii) ice and weather conditions; and
- (iii) operational factors: bunkers and supplies, political changes, changes from krill to other target species etc.

2.16 A revised analysis of the Japanese fishery described the relationship between commercial trawling positions and bottom topography in the Antarctic Peninsula area (WG-EMM-01/35). Trawling positions seemed to be primarily governed by the distribution of larger mature krill, especially at the beginning of the operation each season. The trawling positions followed a pattern of movement from the outer shelf towards on shelf from high summer onwards. Whenever salp densities are high, the fisheries operation may shift towards the shelf to avoid salp by-catch.

Krill Fishery Operation

By-catch

2.17 Scientific observations on fish incidentally caught during commercial krill fisheries by the FV *Niitaka Maru* (3 910 tonnes) were made from 16 December 2000 to 26 January 2001 in the vicinity of the South Shetland Islands (WG-EMM-01/50). Fish by-catch was found in 41 out of 103 trawl catches. *Lepidonotothen larseni* was the most abundant fish in number and weight and occurred in 20.4% of hauls sampled for by-catch. *Pleuragramma antarcticum* and *Champocephalus gunnari* were the second in number and weight respectively. There was a negative correlation between by-catch of fish and the krill CPUE.

Conversion Factors

2.18 Three papers addressed the Scientific Committee's request for information on CFs from the krill fishery (SC-CAMLR-XIX, paragraphs 2.7 to 2.9). There was, however, little new information available and no information on CFs from modern processing machinery.

2.19 Reviews of published information on CFs were provided indicating that there is a large degree of variation resulting from the type of processing plant, size of krill and probably the operators (WG-EMM-01/39 and 01/ 44).

Processed Product	Yield (%)	CF
Whole	80–90	1.11–1.25
Peeled (attrition)	10–25	4–10
Peeled (roller)	10–16	10–6.25
Meal	10–15	10–6.67

2.20 In order to estimate total removals, the total catch and the quantity of discards need to be quantified. Two methods are currently used to estimate the total catch in trawl fisheries. The first is by direct estimation where the catch is estimated by the length of the codend filled and by its distension. The second is to use a scaling factor to convert product mass to total mass of species caught.

2.21 The scientific observer on board a Japanese krill fishing vessel provided information on the product types and quantities during the fishing operations (WG-EMM-01/38).

Krill Product Type	Fresh/Frozen	Peeled/Frozen	Meal	Total
Estimated green weight (kg)	2 062 500	231 000	2 077 000	4 370 500
Percentage of catch (%)	47.19	5.29	47.52	
Assumed product recovery rates*	1:1	1:10	1:10	
Round green weight (kg) from fishpond scale				4 248 000

* Maximum values

This paper noted a good agreement between total weight estimated from fishpond scale and total weight estimated from products using a CF of 10 for peeled and meal products.

2.22 The proportion of each product is a result of a number of factors. If the frozen krill are required for aquaculture, the vessel does not have to target non-feeding krill. As krill undergo rapid enzymatic autolysis once they are caught, they must be processed (i.e. frozen or boiled) within about 60 minutes after they enter the factory or they are sent to the meal plant. The Japanese krill fishery rarely discards krill as lower quality catches are sent to the meal plant and any discards are recorded by the vessel's crew. Discards are included in the total catch reported.

2.23 The Working Group reiterated that it required more information on krill processing factors, particularly from modern processing machinery and from all Members fishing for krill.

Economics

2.24 Information on the economics of the krill fishery was produced in response to the Scientific Committee's request (SC-CAMLR-XIX, paragraph 2.6). WG-EMM-01/44 drew attention to the International Market Insight Paper from the US Department of Commerce (USDC), 'Krill Market' (www.csjapan.doc.gov/imi0011/krill.html), and to a website highlighting difficulties in marketing krill (www.foreview.com/frame.shtml, www.foreview.com/magazine/articles/Nunaat_to_Enter_NAFTA.html).

2.25 Production of krill meal alone is still thought to be uneconomic (WG-EMM-01/44). Current (2001) market prices for krill meal range from 60–90% of break-even production cost depending on the pigment, protein and general quality standards. There is no established market price for krill meat but an ex-vessel price of US\$3.50/kg or less was suggested and it was expected that a market price will be established in the next two years.

2.26 The current ex-vessel market price for whole frozen krill can be inferred from the USDC document referenced in paragraph 2.24 at the upper range of the figure reported at US\$0.08–0.21/lb of frozen krill. A general ex-vessel price of US\$500/tonne for whole frozen krill was estimated.

2.27 WG-EMM-01/44 indicated that the US fishing vessel (*FV Top Ocean*) is capable of processing more than 150 tonnes of green krill per sea day. Such well-equipped vessels complying with all safety and crew regulations set down by the IMO are expensive to operate (~US\$23 000 per sea day).

2.28 The Working Group repeated its request for more information on the economics of the krill fishery and on the market developments that might affect the development of the fishery.

Information from the CCAMLR International Scheme of Scientific Observation

2.29 Despite the presentation of standard methods for measurement of length, maturity and feeding status in the *Scientific Observers Manual*, there are differences in the standard methods that are used by researchers (WG-EMM-01/16). This topic was discussed further under agenda item 3.5 (see paragraphs 3.97 to 3.100).

2.30 The Working Group agreed that it was necessary for information to be collected from the fishery in a systematic and comparable way. This information would not only include length and maturity information from the krill catch, but also information on CPUE that could be used to explore patterns of the fishery in space and time.

2.31 It was pointed out that fine-scale catch and effort data was available from other fisheries in the Convention Area and that this had provided useful information in their management. Additionally, to date, Japan had provided considerable information from its krill fishery, yet other Members fishing have provided little information on their operations (see also paragraph 2.10).

Fishing Strategies

2.32 The first examples of completed questionnaires on krill fishing strategies were received from the Polish krill fishery (WG-EMM-01/70). The Working Group thanked the master of the vessel (*Acamar*) for supplying the completed questionnaires and for the effort that had gone into them.

2.33 The Working Group noted that the completed questionnaires contained a wealth of information which would enable an analytical examination of fishing activities and encouraged further regular submissions by other nations' fisheries.

2.34 Members were encouraged to examine the questionnaires and to provide feedback on any difficulties they saw in using the form, on the uses to which such information might be put and any modifications to the form that might make it more useful. The Working Group acknowledged that some of the information on the questionnaire might be commercially sensitive. Fishing operators should examine the forms and indicate the areas where such sensitivities might occur. The Working Group also suggested that in future some sections of the forms might be completed by scientific observers so reducing the burden placed on the vessels' crews.

2.35 The Working Group recommended that the Scientific Committee adopt the questionnaire and incorporate it into the *Scientific Observers Manual* with some clear instructions on its completion, recognising that the questionnaire may require modification for different fishery operations.

Key Points for Consideration by the Scientific Committee

2.36 The Working Group noted that there was increasing fishing activity in Subarea 48.1 during austral autumn and winter since 1996. A combination of factors may influence the location of the fishing fleet in any one year but the Working Group recognised that easier access through reduced sea-ice extent was a major factor contributing to this trend (paragraph 2.8).

2.37 The Working Group recognised the importance of the growing dataset on CPUE from the Japanese krill fishing fleet and considered that re-examining the use of such fisheries indices should be a priority task for a future meeting (paragraph 2.10).

2.38 The Working Group also noted that further information on the spatial and temporal distribution of the fishery from all participants would be very useful for its future work and encouraged the submission of such data (paragraphs 2.10 and 2.30).

2.39 The Working Group reiterated that it required more information on krill processing factors, particularly on modern processing machinery and from all Members fishing for krill (paragraph 2.23).

2.40 The Working Group repeated its request for more information on the economics of the krill fishery and on the market developments that might affect the development of the fishery (paragraph 2.28).

2.41 The Working Group recommended that the Scientific Committee adopt the questionnaire on krill fishing strategies and incorporate it into the *Scientific Observers Manual* with some clear instructions on its completion, recognising that the questionnaire may require modification for different fishery operations (paragraph 2.35).

STATUS AND TRENDS IN THE KRILL-CENTRIC ECOSYSTEM

CEMP Indices

3.1 Updated information on the status and trends of CEMP indices was reported in WG-EMM-01/05. WG-EMM expressed its appreciation for the new data and updates which had been submitted to the CEMP databases since the 2000 meeting. The Working Group also thanked Dr Ramm for a comprehensive report and presentation of the CEMP indices.

3.2 WG-EMM reviewed the various developments which the Secretariat had undertaken this year, including (SC-CAMLR-XIX, Annex 4, Section 3):

- flagging data conformity with standard methods; and
- investigating ways to include summary data in the CEMP database.

3.3 All CEMP dataforms now include a box which data providers should tick to indicate that data have been collected according to the CEMP standard methods. In addition, a flag had been added to the right margin of the CEMP indices data report (WG-EMM-01/05, Appendix) to indicate conformity with standard methods. WG-EMM recognised that in order to implement this flag, data providers will have to indicate whether or not standard methods were followed for all data previously submitted to the Secretariat. The issue of data conformity was referred to the Subgroup on Methods for further consideration (see section 3.5).

3.4 Discussion was also held on the reasons for including summary data, or data collected using methods other than the CEMP standard methods, in the CEMP database. Summary data for Index A5a had been added as a trial (WG-EMM-01/05, Appendix, Table 4.04). The Working Group recalled that the CEMP database was designed to hold raw data submitted in accordance with the CEMP standard methods. It was noted that summary data may be included in the CEMP database on a case-by-case basis. However, the current structure of the

database would need to be modified substantially so as to allow the general inclusion of summary data. This matter was referred to the Subgroup on Methods for further consideration (see section 3.5).

3.5 WG-EMM also reviewed a new rule for selecting core colonies used in the calculation of Index A3 (WG-EMM-01/05). This new rule (select colonies where data are available >80% of the years of the study) made greater use of data than was possible under the existing rule (select colonies where data are available over all years of the study) (see WG-EMM-01/05, Table 7). WG-EMM agreed that the new rule was an improvement and should be used in future calculations of Index A3. It also noted that this dataset could be used to determine how many core colonies are required to estimate the trend in the overall population.

3.6 In reviewing trends and anomalies in the CEMP indices, the Working Group returned to discussions initiated at previous meetings regarding the interpretation of CEMP indices and their usefulness in addressing management issues. For example: What methods should be used to identify anomalies? Should baseline periods be established? How long should such a period be? What constitutes a good year, or a bad year? What action should be taken when an anomaly is detected? These types of issues were further considered in the workshop sessions (section 5).

3.7 Based on WG-EMM-01/05 the Working Group concluded that both overall, and in respect of individual indices, 2000/01 had been an average year in comparison with the time series of data available to WG-EMM. In Area 48 there were no particular indications of important differences between the subareas in 2000/01.

3.8 The Secretariat's review of CEMP indices and the development of ecosystem assessments (WG-EMM-01/9), which had been requested last year (SC-CAMLR-XIX, Annex 4, paragraph 3.55 and Table 3), was considered under section 7.

CCAMLR-2000 Survey

3.9 WG-EMM considered the report of the recent workshop convened by Dr J. Watkins (UK), and held in Cambridge, UK (WG-EMM-01/60). This workshop assessed the status of a set of papers arising from the CCAMLR-2000 Survey of Area 48. The Working Group noted that this set of papers would be aimed at a special issue of *Deep-Sea Research*. That journal had been contacted and had agreed in principle that the suggested topic and set of papers would be suitable for publication.

3.10 WG-EMM also noted that a letter to *Nature* describing the estimate of krill biomass in the Scotia Sea had been turned down by the editors of *Nature*. The CCAMLR-2000 Steering Committee now planned to amplify the paper by explaining how the information from the survey had been used by CCAMLR to set revised catch limits. That manuscript would be submitted to *Science*. The Working Group suggested that an accompanying letter should link the CCAMLR-2000 Survey with the forthcoming CCAMLR-XX meeting.

3.11 WG-EMM noted that the collaboration between CCAMLR and the IWC had been productive, and had extended the analyses of data from the CCAMLR-2000 Survey. WG-EMM agreed to encourage further collaboration between scientists from CCAMLR and the IWC.

3.12 Finally, WG-EMM noted that the papers arising from the CCAMLR-2000 Survey demonstrated the breadth of science associated with the survey. WG-EMM congratulated Dr Watkins and other participants on the success of the workshop.

Regional Surveys associated with the CCAMLR-2000 Survey

3.13 The Working Group noted that the International Coordination Subgroup, led by Prof. S. Kim (Republic of Korea), had arranged four vessels from Japan, Republic of Korea, Peru and the USA to conduct five hydroacoustic surveys in Subarea 48.1 from December 1999 to March 2000 (WG-EMM-01/68). These surveys had been conducted in conjunction with the CCAMLR-2000 Survey, and had used the acoustic protocols agreed for the synoptic survey. Acoustic data from the coordinated surveys were analysed at a three-day workshop held in Seoul, Republic of Korea, in June 2001. The subgroup appreciated the financial support for this workshop provided by the Korea Ocean Research and Development Institute (KORDI).

3.14 The Working Group noted the extensive analyses conducted at the workshop, and the usefulness of the data collected during the five surveys. WG-EMM congratulated participants and thanked Prof. Kim for taking on the responsibility of coordinator. WG-EMM endorsed further work outlined in WG-EMM-01/68 (see paragraph 3.22).

Krill Resource

3.15 The Working Group confined its discussion to new information on the ecology of krill relevant to making an ecosystem assessment.

Krill Distribution and Abundance

2000/01 Season

3.16 Results from an RMT net survey in January–February 2001 around Elephant Island, Subarea 48.1, from the FRV *Polarstern* and reported in WG-EMM-01/10, indicated that krill density was high relative to previous recent surveys. This was mainly due to the presence of large numbers of juvenile krill. Two US AMLR surveys in January and February–March 2001, reported in WG-EMM-01/45, noted that the krill density was higher than in 1996 but lower than in 1998. Moderate numbers of small krill were present in the catches from both these surveys although small krill were absent from the samples in February–March. In discussion it was noted that during this season the smaller krill were found down to 63°S, beyond the southern limit of the US AMLR surveys.

3.17 The results of a series of three acoustic surveys conducted near South Georgia were reported in WG-EMM-01/15. These represent an extension of the annual surveys in the existing BAS Core Programme and are designed to examine temporal variability in krill biomass in relation to the assessment of intra-annual variability and relationships with response variables of dependent species. In the area to the northwest of Bird Island, krill density was low (3.5 gm^{-2}) in October, had increased by January (34.7 gm^{-2}) and had decreased again by March (7.7 gm^{-2}). Given these differences it was concluded that the interpretation of interannual variability of krill density may be strongly dependent on the timing of surveys.

1999/2000 Season

3.18 Following analysis of the results from the CCAMLR-2000 Survey reported last year by WG-EMM (SC-CAMLR-XIX, Annex 4, paragraphs 2.84 to 2.95) several papers reported further analysis of the data. In addition, papers were tabled reporting work on small-scale surveys associated with the CCAMLR-2000 Survey.

3.19 Using the same analytical protocols as had been used to identify krill targets from the acoustic survey (SC-CAMLR-XIX, Annex 4, Appendix G), data from Subarea 48.4 had been analysed to indicate the distribution of krill and myctophids. These results were presented in WG-EMM-01/61. The results indicated that the bulk of the krill were present in Weddell Sea water whilst myctophids were restricted to waters to the north in Antarctic Circumpolar Current (ACC) water.

3.20 A further analysis of these data, reported in WG-EMM-01/42, indicated that 64% of the krill biomass present during the survey in Subarea 48.4 was present in swarms and that the bulk of the krill were present in only 14% of the area. These high-density locations were also identified as the only major localities suitable for commercial trawling. The predicted catch rates were low, of the order of approximately two tonnes per hour towing, but the locations were more or less congruent with the traditional trawling grounds in the area.

3.21 Results from net hauls made during the CCAMLR-2000 Survey were compared with those from similar studies from Soviet mesoscale surveys in seasons 1983/84, 1984/85 and 1987/88 and presented in WG-EMM-01/28. The density estimates were similar from which it was concluded that there had been little change in standing stock over the period.

3.22 Based on the results from the workshop referred to in paragraph 3.13, acoustic data from a series of surveys to the north of the South Shetland Islands undertaken by Japan, Republic of Korea, Peru and the USA were reported in WG-EMM-01/68. Prof. Kim gave a brief presentation outlining the key findings. The study had been conducted as five survey legs with the first starting on 14 December 1999 and the last ending on 26 February 2000. Excluding the results from the second survey leg, during which the acoustic results were thought to have been compromised by electronic problems, the density estimates were broadly similar over the period ($39\text{--}68 \text{ gm}^{-2}$). The transects were aligned perpendicular to the shelf break and the net sampling indicated that the larger krill were present offshore and smaller krill on the shelf.

Krill Demography

3.23 Central to many studies of krill demography is information on size frequency. Such information is available from scientific and commercial nets as well as from food samples from dependent species and had been discussed at WG-EMM last year (SC-CAMLR-XIX, Annex 4, paragraphs 2.58 to 2.60). Each of these sources of information has its own attendant bias but since the general shape of the distributions derived from sampling by different methods at the same time and location appeared small, the error caused by these biases was thought to be small relative to other sampling errors. The Working Group noted that attention needs to be given to methods for comparing length-frequency samples obtained using methods for which the data cannot be transformed to length densities.

Growth

3.24 An examination of the length of krill in the diet of Antarctic fur seals at South Georgia between October and December for four years, reported in WG-EMM-01/18, indicated consistent changes in the modal size from c. 42 mm to c. 54 mm. The growth rate required to achieve this change was higher than reported for other regions but was consistent with the work of Mackintosh (1972) from an examination of the 'Discovery' samples from the Scotia Sea.

3.25 It was noted that krill growth rates had recently been reviewed by Siegel and Nicol (2000). To achieve the reported size at age for some of the krill around South Georgia, growth rates would have to be at the higher end of the reported values. The implications of incorporating different growth rates into yield models was discussed. Whilst it was accepted that this would be possible for local assessment models it would be very difficult currently to incorporate more than one growth function into the GYM.

3.26 Some members of the Working Group expressed the opinion that there were other possible explanations for the observed changes in size structure, such as variable meridional transport and influx into the western South Georgia area or that the krill might originate from different regions; for example, Weddell or Bellingshausen Sea.

3.27 Comparisons of krill length-frequency distributions from net samples collected in January and February 2000 at South Georgia were presented in WG-EMM-01/40. These showed greater differences between the locations and smaller differences with time. These differences were attributed to a different origin and not due to growth.

3.28 WG-EMM-01/53 presented a model of krill population structure that examined the rôle of changes in krill demography in generating variability in the South Georgia ecosystem. Comparison of the model output with data on krill size structures in the diet of Antarctic fur seals showed good congruence and demonstrated the importance of biologically based recruitment failures in generating the observed variability. The analysis indicates that mortality rates for the South Georgia region may be relatively high ($M = 1.25 \text{ y}^{-1}$). It was noted that this value is not necessarily inconsistent with that currently used for a whole krill population ($M = 0.6 \text{ y}^{-1}$).

3.29 If the interpretation of growth rates is realistic, then there are implications for other demographic factors. It was noted that a higher growth rate would most likely be associated with a higher rate of natural mortality. In turn, this would have some effect on the value of γ to be used in yield models.

Recruitment

3.30 WG-EMM-01/10 reported values for recruitment indices in Subarea 48.1. This indicated that recruitment from the 1999/2000 year class had been high and was a major factor in the high standing stock reported above. WG-EMM-01/10 and 01/45 also reported spawning had been early and extensive in the 2000/01 season and both papers forecast that recruitment from spawning in 2000/01 would most likely be high. In WG-EMM-01/45 this conclusion was supported by the observed status of salps and copepods in the region.

3.31 In discussion it was noted that the recruitment indices were strongly affected by the area from which the samples were obtained. Bearing in mind that it is impractical to sample adequately over the whole range of krill, it was agreed that sampling should be representative of the local region. In the Elephant Island region it was suggested that, to ensure this, the surveys should extend south to 63°S around that meridian to prevent underestimation of R1 recruits. Due to logistic constraints this would be likely to affect other sampling programs and the extent to which this might be achieved needs to be incorporated into survey plans. The Working Group agreed that the recruitment series in this region needs to be reviewed in light of this recent survey.

3.32 It was also noted that the small krill encountered at the southern portion of the survey could have arisen from another source (i.e. Weddell or Bellingshausen Sea).

Stock Identity

3.33 WG-EMM-01/12 presented a progress report on a study on krill mitochondrial DNA. The study had shown that there were significant genetic differences between samples of *Euphausia crystallorophias* taken within one region, whereas samples from other localities of the Antarctic indicated a high degree of homogeneity. Arising from this it was noted that, to assess genetic variability between samples, future sampling strategies for examining stock structure of krill should, at a minimum, consist of 10 samples of at least 100 individuals from each region.

Predators

3.34 Prof. Croxall summarised recent work on foraging ranges and distribution of Antarctic fur seals, macaroni penguins and black-browed and grey-headed albatrosses at South Georgia, studied using satellite-tracking techniques (WG-EMM-01/19, 01/22, 01/26 and 01/67).

3.35 WG-EMM-01/19 addressed seasonal variation in macaroni penguin foraging and reported larger foraging ranges during the incubation phase of the breeding cycle, which contracted to more inshore areas during chick rearing. In the former period, ranges extended well into the Antarctic Polar Frontal Zone to the northwest of South Georgia.

3.36 WG-EMM-01/22 examined overlap in foraging areas between fur seals and macaroni penguins. Although there was a large potential overlap between species with similar trophic niches, at-sea foraging distributions showed significant spatial segregation. However, the implications of this with respect to potential interspecies competition still depends critically on the distribution, abundance and movements of the krill population in the area.

3.37 WG-EMM-01/67 used a new approach (kernel estimation) to quantify habitat use within the overall foraging ranges of black-browed and grey-headed albatrosses. This technique revealed that the mean foraging areas of these two albatross species are very distinct.

3.38 WG-EMM-01/26 presented data on the satellite tracking of foraging by female Antarctic fur seals from Bird Island, South Georgia. These were used to derive a foraging density map of Antarctic fur seals at South Georgia which was combined with energetic requirements and indicates that female Antarctic fur seals have the ability to locally deplete prey resources during the lactation period. Therefore, in some years, the reproductive success may be food-limited.

3.39 WG-EMM-01/26 also presented the first information on the distribution of female Antarctic fur seals during the over-winter period. At the end of lactation females dispersed from South Georgia to areas of high productivity associated with the Patagonia Shelf and the northern boundary of the sea-ice zone. The availability of prey in these areas may have an important influence on subsequent survival and reproductive output.

3.40 All these papers illustrated how satellite-tracking data can be used to delineate the foraging ranges of krill-dependent predators and to define the areas of priority use within these ranges. WG-EMM-01/26 also provided a new approach to the generalisation of foraging ranges and habitat use at larger scales based on extrapolation from data collected at smaller scales. In the case of fur seals, foraging range and habitat use data from two sites at South Georgia were used, in conjunction with bathymetric characteristics and the known distribution and size of fur seal breeding populations around South Georgia, to produce an overall density-distribution map of foraging range and habitat use for the whole South Georgia population.

3.41 WG-EMM-01/23 examined changes in Adélie penguin populations breeding on Ross Island, in the Ross Sea region. Annual changes in Adélie penguin population growth were best explained by the extent of sea-ice five years earlier. The authors suggested that extensive sea-ice in winter negatively affects subadult survival and that this is expressed five years later, when these birds, on average, return to breed for the first time. The recent increases in Adélie populations in this region imply that sea-ice extent has changed significantly over recent decades.

3.42 WG-EMM-01/32 reported declines in Adélie penguin populations at King George Island in the Antarctic Peninsula region that were best described by a piece-wise linear regression model that suggested two periods of population stability (1978–1988 and 1991–2000) separated by a dramatic decline in population in the late 1980s. This decline was driven by a 50% reduction in cohort survival between the earlier and later periods. The Adélie penguin population decline occurred concurrently with a significant reduction in krill biomass estimates in the adjacent marine region.

3.43 WG-EMM-01/23 and 01/32 concur that the winter period is of vital importance in influencing predator population dynamics and both papers suggest that sea-ice extent is the primary variable affecting these populations. However, reduced sea-ice in the Ross Sea region has positively affected Adélie populations, through affording better access to productive winter habitat in the eastern Ross Sea, while reduced sea-ice in the Antarctic Peninsula region has negatively affected Adélie populations via reductions in krill biomass.

3.44 WG-EMM-01/32 further examined gentoo penguin population changes and found no correlation between changes in gentoo population size and either sea-ice extent or krill biomass estimates. Gentoo penguins experienced several rapid changes in the number of breeding pairs, interspersed with decadal periods of population stability. Demographic data suggest that gentoo populations are strongly affected by rare, strong cohorts that arise and dominate the population for 10–12 years, then decline as birds from the cohort die.

3.45 WG-EMM-01/32 also reports the results of the winter distributions of Adélie and chinstrap penguins as determined by satellite tracking. Adélie penguins from the Admiralty Bay colony left the breeding grounds and spent February to June of 1999 and 2001 close to the western shore of the Antarctic Peninsula and in the upper Weddell Sea basin. Chinstrap penguins spent the winter of 2000 distributed off the northern coast of the South Shetland Islands. The winter distribution of chinstrap penguins overlapped extensively with the krill fishery during the March to May period.

3.46 These studies from South Georgia, the South Shetland Islands and the Ross Sea identify important habitats for adult land-based predators, both during the period of rearing offspring and in the post-fledging/weaning winter periods. As more demography data become available, it is increasingly apparent that the winter period is critical for the survival and recruitment of predators to their respective populations. For penguins, the post-fledging period is a time of increased predator demand as young enter the marine environment and adults spend two to three weeks at sea in preparation for their annual moult. The identification of critical periods outside of the breeding season and the potential for overlap with krill fisheries warrants further investigation.

3.47 WG-EMM-01/43 presented a general overview of pinniped research at Cape Shirreff by the US AMLR Program and gave a brief synopsis of conditions for fur seals at Cape Shirreff in the 2000/01 season. It reported that pup production had increased 6.8% over the last year for an area that represents approximately one third of total pup production on the Cape. The mean trip duration for adult females was 2.7 days; significantly shorter than in previous years. The proportion of krill in the diet was higher than in previous years and the mean length of krill increased over the last year. Return rates and natality were 90.4% and 87.2% respectively.

3.48 WG-EMM-01/46, 01/47, 01/48 and 01/59 presented data on the incidence of *Brucella* and herpes virus antibodies in Antarctic fur seals and Weddell seals from Cape Shirreff. There is no direct evidence for the presence of *Brucella* or herpes in this area, or that these pathogens have influenced pinniped numbers in the Antarctic. However, these four papers serve to heighten awareness that predator abundance can potentially be influenced by pathogens.

3.49 The Working Group recommended that, until evidence of the effects of disease at levels potentially relevant to population trends and performance became available, further submissions on this topic would be more appropriately directed to the Committee for Environmental Protection of the ATCM.

3.50 WG-EMM-01/49 presented the latest estimates of fur seal pup production for Cape Shirreff. It provided confidence limits for the most recent count and reported a 3% decline in pup production for SSSI No. 32 over the last year. However, the overall decline can be attributed to the San Telmo Island portion of the SSSI, and when only counts of Cape Shirreff are considered there was an increase in pup production of 1% over the previous year. There was a request for more information on how the carrying capacity, presented in the paper, was derived and for confidence limits for this parameter to be provided in the future.

Environmental Influences

3.51 WG-EMM-01/11 compares SST obtained from satellite data and krill catches in the years around 1990 and 10 years later in the South Georgia area. During the positive SST anomaly of $+0.7^{\circ}\text{C}$ in 1990/91 the krill catch was 123 562 tonnes while during the negative anomaly of -0.6°C in 1999/2000 the krill catch was only 4 671 tonnes.

3.52 While acknowledging that there were more fishing vessels in the fishery in 1990 than in 2000, the paper explains that the absence of predictable krill concentrations in 1999/2000 is due to an intensification of the Weddell Sea water advection. This increased inflow of Weddell Sea water causes lowering of the SST and, through interaction with the ACC, also results in a weakening of the eddies typically associated with predictable krill concentrations around South Georgia. The author suggests that SST data from early in the summer season can be used to predict the potential of the krill fishery for the coming year.

3.53 The Working Group noted the limitation of drawing conclusions from two points in time separated by 10 years.

3.54 Vertical distribution of temperature, salinity, density and flow down to a depth of 1 000 m were recorded in the Drake Passage (WG-EMM-01/30). Knowledge of the physical characteristics of the Drake Passage is important because it is a narrow passage for the ACC and also because north of the South Shetland Islands there is an important fishing ground for krill. In that area the data indicate upwelling of warm deep water. The Polar Front was identified by a steep temperature gradient between 58 and 59°S . The water flow was eastward along the whole transect with a maximum speed of 30 cm/s at the Polar Front.

3.55 WG-EMM-01/34 used satellite image data of sea-ice concentrations to calculate polynia extent per day from 1978 to 1998. These data were converted into yearly means for the whole of the Antarctic Ocean. The time series of yearly means in the whole of the Antarctic show an increasing trend from the latter half of the 1980s (Figure 4 in the paper). The time series of the yearly means of polynia extent around the Antarctic Peninsula show a pulsating pattern with peak years in 1980, 1987, 1991 and 1995 (Figure 5 in the paper) while for the whole of the Antarctic Ocean, the peak years were 1980, 1987, 1991, 1995 and 1998 (Figure 4 in the paper).

3.56 In the discussion, attention was drawn to similarities to other Antarctic cyclical events and also to the conspicuous anomalies seen in 1987 for the monthly means of sea-ice cover of $\pm 50\%$ coverage as demonstrated by WG-EMM-01/34, Figures 6 and 7.

3.57 The Working Group concluded that WG-EMM-01/11, 01/30 and 01/34 demonstrate the increasing usefulness of satellite data and also provide valuable baseline information of relevance to the work of the group and encourages further work on elaborating oceanographic conditions using remote sensing.

Further Approaches to Ecosystem Assessment and Management

3.58 Last year the Working Group initiated a reappraisal of its approaches to ecosystem assessment (SC-CAMLR-XIX, Annex 4, paragraphs 4.86 to 4.117). Three papers were provided to guide and develop discussion (WG-EMM-00/22, 00/43 and 00/60); these are still very pertinent to the work of WG-EMM.

3.59 These papers:

- (i) characterised the main elements of the approach to ecosystem assessment as:
 - (a) identification and monitoring of key processes governing krill recruitment and transport, and those controlling the viability of krill predator populations;
 - (b) elaboration of resource management rules based on monitoring results; and
 - (c) research activities designed to reduce uncertainty, monitor performance and improve the management scheme;
- (ii) conceptualised a potential decision-making process, based on addressing four simple, fundamental questions:
 - (a) Is the availability of krill changing?
 - (b) Are populations of dependent species in decline?
 - (c) How much krill is required by the dependent species?
 - (d) What is the extent of overlap between krill fishing and foraging by dependent species?
- (iii) developed the potential for a set of decision rules, designed to achieve conservation objectives for krill-dependent species, based on specified target levels of the production of the species.

3.60 The Working Group recognised that substantial data were available for providing quantitative answers to the questions in 3.59(ii)(a) to (d). Similarly, considerable data were available on key processes relating to the demography of krill and dependent species; however, further work on processes governing krill recruitment and transport was required.

3.61 Nevertheless, little, if any, practical progress had been achieved in developing potential decision rules (based, for example, on critical values of key processes) in relation to spatial scales of relevance to dependent species; this would be an important topic for the discussion workshop developing the future work plan for WG-EMM (see section 5).

3.62 Several submitted papers contributed to the development of further approaches to ecosystem management. The Working Group regretted that it had insufficient time to evaluate these at the present meeting but indicated that this should be an important element of its future deliberations on this topic. In the meantime the meeting provided some preliminary comments on the papers concerned.

3.63 WG-EMM-01/25 reported an application of the approach developed in WG-EMM-00/14 for combining CEMP data into simple indices (CSIs). The data used comprised up to 27 variables measured over 22 years for three krill-dependent CEMP indicator species (gentoo penguin, macaroni penguin and Antarctic fur seal) at Bird Island, South Georgia.

3.64 The variables used were either CEMP indices, part of CEMP indices or used data submitted to CEMP, except for timing of breeding, number of pups born and pregnancy and survival rates for Antarctic fur seals. Data for these additional variables are collected annually by standard methods but, as yet, no formal standard method has been developed for their submission to CEMP.

3.65 The paper also addressed some methodological issues (including two which were identified last year as needing further work (SC-CAMLR-XIX, Annex 4, paragraph 3.51)), showing that:

- (i) sensitivity analysis indicated that missing values substantially effect the CSI but this effect is reduced if variables are highly correlated; and
- (ii) the influence on the CSI of individual variables differs widely but, in general, those with longer time series have greater influence.

3.66 WG-EMM-01/25 concluded that:

- (i) variables representing offspring growth explained the greatest proportion of the variability in the CSI, followed by those representing diet;
- (ii) variables representative of changing population size indicated a statistically significant decline between 1977 and 1998;
- (iii) variables representing foraging conditions during the breeding season showed no overall trend;
- (iv) the CSI showed extreme and significantly low values in three years. (These are those frequently exemplified in past WG-EMM discussion as reflecting very poor predator performance in years of very low krill biomass); and
- (v) there was a non-linear functional relationship between the overall CSI and krill biomass and this was also the case when each species was treated individually.

3.67 Prof. Croxall indicated that further work was in progress to refine the approach in this paper, particularly in respect of examining the inter-relationships within and between variables representing processes at similar spatial and temporal scales and more critical examination of variables relating to population size and demography. In addition, there are methodological issues, particularly in respect of indices of offspring growth, where WG-EMM-01/20 suggested that the existing formulation of the CEMP index may be inappropriate.

3.68 Part of WG-EMM-00/27 developed this approach further, by means of an illustration of how the relationship between a predator performance index (the Bird Island, South Georgia CSI derived in WG-EMM-01/25) and krill biomass might be used to manage levels of krill fishing. If the management objective was to minimise the chances of below-average predator fitness (predator performance index of 0 or less), then no or reduced fishing would be allowed in years when the krill biomass was below 24 gm⁻². The paper noted that this would require estimating or predicting krill biomass in advance of exploitation and also raised issues concerning the relationship between recruitment and population levels of krill. It would also imply, in the illustrative example, potential closure (or substantial reduction in level) of the fishery at South Georgia every two to three years.

3.69 In considering this paper the Working Group raised the following points:

- (i) further development of management approaches, especially decision rules, based on the above illustration, requires careful consideration of the nature and magnitude of the errors in estimating both CSI and krill biomass;
- (ii) an approach based solely on a predator performance index averaged across variables for several different species might be insufficiently precautionary in circumstances where one or more of the species showed a significant population decrease and for which management objectives might include the desire to restore depleted populations as provided for under Article II of the Convention; and
- (iii) in the illustrative example, the krill biomass data came from the western acoustic survey box at South Georgia (that in closest proximity to Bird Island), whereas the main fishing grounds for krill have usually been associated with the eastern acoustic survey box. Knowledge of the oceanography in the region, at scales relevant to inter-relationships between the krill survey boxes and at larger scales relevant to krill advection, would be important in addressing the implications of this and related issues. In addition, the authors of WG-EMM-01/57 suggested that oceanographic data, especially in relation to meridional transport, might even assist in predicting likely levels of krill biomass.

3.70 Several members noted that given the current low level of krill fishing, particularly in relation to estimates of overall krill biomass, management decision rules that could invoke closure of fishing every two to three years were unnecessary and inappropriate. It was recollected that some time ago the Commission had indicated a desire to maintain approximately consistent levels of krill fishing and to avoid substantial interannual variations in this.

3.71 However, other members indicated that:

- (i) most of the fishing, at least in some subareas, is concentrated in relatively small areas, which overlap extensively the core foraging areas of key krill-dependent predators at potentially critical times of year. Indeed, the results of the CCAMLR-2000 Survey suggested that two thirds of the krill biomass is outside the areas currently subject to fishing (SC-CAMLR-XIX, Annex 4, Appendix G);
- (ii) a time when fishing levels are low might be very appropriate for developing mechanisms designed to limit the uncontrolled expansion of krill fishing;
- (iii) at least in some subareas, substantial interannual variation in krill biomass is a characteristic feature which has already produced similar magnitudes of variation in catches. Furthermore, the Commission had agreed that fishing in years of low krill biomass should not be at levels likely to exacerbate the effects on dependent predators (CCAMLR-XIII, paragraphs 3.9 and 3.10);
- (iv) avoiding unnecessary dislocation to the krill fishery would, hopefully, be achieved by employing adaptive management strategies, in particular by devising and implementing appropriate management frameworks at scales smaller than statistical areas and subareas; and
- (v) precedents exist in fisheries management for the inclusion, either implicitly or explicitly, of 'exceptional circumstance rules', which strive to balance conservation needs against potential disruption of fishing.

3.72 WG-EMM-01/21 used data on body mass at arrival to breed and at offspring independence, and aspects of the reproductive performance of Antarctic fur seal, macaroni and gentoo penguin and black-browed albatross at Bird Island, South Georgia, together with data on population sizes for these species and data on krill demography (previously presented in WS-Area48-98/15 and WG-EMM-99/37), to provide an overview of potential changes in the South Georgia region of the Southern Ocean marine system over the last 23 years.

3.73 The paper concluded that:

- (i) there has been a change from a situation with a relatively large krill supply compared to the predator demand, linked to a krill population structure that effectively buffered predators against the underlying variability in krill recruitment;
- (ii) a distinct change occurred around 1990, since when the supply of krill appears to have been sufficiently close to the level of predator demand to cause the local mortality rate of krill and, consequently, the local krill population structure to be substantially altered; and
- (iii) predator-induced mortality of krill has effectively removed the buffering that previously existed with a consequently significant increase in the frequency of

years when the amount of krill is insufficient to support predator demand and results in reduced predator performance and, concomitantly, declines in populations.

3.74 The Working Group welcomed review work such as in WG-EMM-01/21 and noted:

- (i) that careful attention needs to be given to the methods underpinning such analyses;
- (ii) the potential relevance of contemporaneous changes in oceanographic processes, for example, the relatively abrupt change in the meridional transport signal around 1990, as indicated in WG-EMM-01/57;
- (iii) the possibility that krill transported to South Georgia before and after 1990 represent different, or a different balance of, source stocks;
- (iv) that account may need to be taken of the apparent paradox that for predator consumption rates to influence krill population structure, the krill population must be resident around South Georgia for a considerable time, whereas to sustain the South Georgia predator population requires a consumption of krill of 8 to 10 times the instantaneous estimate of standing stock (implying a relatively rapid accumulation and/or turnover of krill); and
- (v) that urgent attention needs to be given to appropriate fishery-management frameworks that can account for long-term changes in the relationship between krill and its predators.

3.75 The authors of WG-EMM-01/21 indicated that:

- (i) system changes of this magnitude would involve, if not originate in, substantial changes in oceanographic conditions and processes. However it was unlikely that a switch in source krill stocks was responsible;
- (ii) regardless of the underlying ultimate causal factors, the proximate effect on krill and predator populations was a real one, which supported the urgent need to develop and implement appropriate fishery-management frameworks and practices; and
- (iii) current ideas on the krill population at South Georgia are that it reflects complex interactions between large-scale oceanographic transport of krill into the region, associated with the Southern Antarctic Circumpolar Current Front and its retroflexion north of the island, and local-scale processes in which krill may be retained for extended periods.

3.76 WG-EMM-01/66 represented the culmination of a modelling exercise initiated at the joint meeting of WG-Krill and WG-CEMP in Chile in 1992. Earlier developments and elements of this model were presented as WG-Krill-93/43 and 94/24 and as WG-EMM-95/39, 95/42 and 97/70. The objective of this exercise is to investigate the extent to which the

current value (75%) of the median escapement of the unexploited krill biomass, which, when incorporated into the KYM gives a value for the proportion of the biomass estimate (γ) of 0.116, is sufficient to meet the needs of predators.

3.77 The dataset used in this model is that for Antarctic fur seals at South Georgia. After an extensive review, involving several candidate species, this was the only species with data comprising a sufficiently long time series, adequate data on survival rates and reproductive performance and without significant potential biases from krill-independent effects on predator demography, to be suitable for the purpose.

3.78 The paper's conclusions were that the level of krill fishing intensity (γ) that would reduce the fur seal population to half its equilibrium size in the absence of krill fishing (γ_{half}) lies between 0.03 and 0.18, which includes the level currently recommended by CCAMLR. While this large range results primarily from the sensitivity of the model to the maximum growth rate parameter, use of plausible values for this produces estimated (γ_{half}) values of 0.04 to 0.23. Although stochastic calculations (to take account of interannual fluctuations in krill abundance due to recruitment variability) yield higher estimated (γ_{half}) values, simulation tests indicated that these values are biased upward. A potential implication of these results is that the current value of median krill escapement might be insufficient to provide a krill catch limit which is sufficiently precautionary in accounting for the needs of krill-dependent predators.

3.79 In its discussion the Working Group noted that:

- (i) WG-EMM-01/66 was the result of very extensive collaborative research generated and sustained within WG-EMM. It thanked the authors for their work in investigating this approach to potential decision rules to ensure that CCAMLR's management of krill takes sufficient account of the needs of dependent species;
- (ii) the approach is complementary to other initiatives in progress within the Working Group (see section 5);
- (iii) in order to save simulation time, the model used an abbreviated version of the KYM rather than a version of the current GYM (which was not available at the time);
- (iv) the model incorporates no feedback with respect to the effect of predator consumption;
- (v) a considerable volume of data is necessary to undertake such an assessment and even in cases where this is possible, substantial uncertainties in the underlying model remain. Nevertheless, the results suggest that decision rules underpinning estimates of γ could be based on explicit objectives for predators; and
- (vi) any recent new data which could improve estimates for variables considered uncertain in the paper should be incorporated into future analyses to assess further the implications of this approach for accounting for the needs of krill-dependent predators.

3.80 Taking into account the information presented in a number of papers submitted to this and previous meetings of WG-EMM, there was a recognition of an increasing body of evidence suggesting that a substantial change had occurred in aspects of the dynamics of the krill-based system, perhaps most noticeably in relation to processes operating in Subareas 48.1 and 48.3.

3.81 The ultimate origin of these changes probably reflects changes in physical environmental conditions in the Southern Ocean system, including endogenous ocean-atmosphere processes and possibly also even teleconnections with analogous process originating outside the Southern Ocean system (e.g. ENSO effects).

3.82 The proximate effects of these changes are almost certainly mainly mediated through changes in food-web processes leading to consequent changes in abundance of krill and krill-dependent species, and to changes in the dynamics of these predator-prey interactions.

3.83 The Working Group reiterated the importance of developing appropriate fishery-management frameworks that can account for long-term changes in the relationships between krill and its predators.

Other Prey Species

3.84 In respect of data relating to predator-prey interactions and processes not involving the krill-centric system, both of this year's contributions relate mainly to myctophid fish.

3.85 WG-EMM-01/58 reported the results of the analysis of 153 stomach lavage samples collected from southern elephant seals at King George Island in six years between 1994 and 2000. Overall frequency of occurrence of cephalopods and fish was 98% and 14% respectively. Within the fish element, myctophids, chiefly *Gymnoscopelus nicolsi*, represented 76.5% of items and the nototheniid *P. antarcticum* comprised 12% by numbers and 31% by frequency of occurrence. Myctophids were inferred to be taken close to the seal hauling out sites on King George Island with *P. antarcticum* taken at higher latitudes during post-breeding southward migrations.

3.86 The Working Group noted that these results were broadly consistent with studies at other sites. It noted that, after squid, myctophids are of considerable importance in the diet of southern elephant seals. Sustaining the energy requirements of this species implied that a considerable biomass of myctophids must be available.

3.87 Further support for the importance of myctophids in the Southern Ocean system was provided by WG-EMM-01/61, reporting aspects of the results of multi-frequency echosounder surveys in Subarea 48.4 in January-February 2000 (see also paragraph 3.19). Analysis of the existing samples identified as nektonic organisms indicated that 90% of samples were in the Δ MVBS (38-120 kHz) range of -5 to +2 dB, regarded as characteristic of myctophid fish.

3.88 Dr Miller noted that the myctophid species involved had not been identified (e.g. from net hauls targeted at appropriate acoustic signals) and indicated that the correct identification of net-caught specimens of myctophids remains a highly specialised task.

Methods

3.89 Prof. I. Boyd (UK) and Dr Siegel had informed WG-EMM that they were unable to continue as members of the Subgroup on Methods. It was agreed that the membership and relevant expertise of the subgroup be as follows: Dr Constable (statistics), Mr Goebel (dependent species – seals), Dr S. Kawaguchi (Japan) (krill), Dr E. Murphy (UK) (environment), Mr Reid (convener), Dr Trivelpiece (dependent species – birds).

New CEMP Standard Methods and Proposed Revisions to Existing Methods

3.90 There were no proposed new standard methods, or revisions of existing standard methods, for parameters collected as part of the CEMP program.

3.91 WG-EMM-01/20 outlined the potential for misinterpretation arising from the use of the growth rate of Antarctic fur seals following Standard Method C2.2. Assumptions of linearity of growth were not supported by the data and biases associated with cross-sectional sampling produced counter-intuitive results when compared with other indicators of environmental conditions. A new index is proposed that is not dependent on the same assumptions and has a more logical relationship in comparison with other parameters.

3.92 In the discussion of WG-EMM-01/20 the Working Group noted that the collection of data on fur seal growth rates at Cape Shirreff submitted to CEMP was not initiated 30 days after the median date of pupping and that samples were collected at two-week, rather than at 30-day intervals in accordance with Standard Method C2.2B. It was noted that the sampling regime was implemented because in some years researchers were not present at the site long enough after the first sampling to get more than just two samples if they used a 30-day interval. The Working Group felt that the decreased sampling interval was not a concern; however, it was stressed that only those data collected in accordance with the CEMP standard methods should be submitted on the CEMP dataform. Mr Goebel agreed to examine the relevant part of Standard Method C2.2 to clarify issues related to timing of sampling and selection of animals to weigh. The subgroup agreed to correspond intersessionally with a view to presenting a revised standard method at the next meeting.

Consideration of Non-CEMP Parameters

3.93 It was noted that there are no CEMP standard methods relating to indices of prey abundance. Protocols for the collection of data using analogue echosounders and integrators had been produced for the FIBEX Survey (BIOMASS, 1980) and for digital systems for the CCAMLR-2000 Survey (www.ccamlr.org). 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.

3.94 The Working Group agreed that in order to develop functional relationships between krill and dependent species it was necessary to provide information not just on standing stock but also on krill availability. This would need to be addressed through studies on vertical distribution and spatial structure that are relevant to the foraging behaviour of the dependent

species. This topic has been addressed initially at the WG-Krill Subgroup on Survey Design (1991), but improvements in technology and current ideas on predator foraging highlighted the need for further consideration of this topic.

3.95 WG-EMM-01/14 described the use of an autonomous underwater vehicle (AUV), fitted with an EK500 scientific echosounder, to assess krill avoidance of survey vessels. The acoustic determination from the AUV and from the research vessel detected the same amount of krill, indicating that no detectable avoidance of the vessel was taking place. Although these observations were made at slow speed, evidence was presented which indicated that, arising from the noise spectrum of the ship, the results would be valid at the normal speed under which acoustic surveys are conducted. The use of this platform was recognised as an exciting new development and opened a number of new possibilities for krill research.

3.96 WG-EMM-01/41 reported on the analysis of the Subarea 48.4 data from the CCAMLR-2000 Survey according to the survey protocol and also by a method as close as practical to the FIBEX protocols. During FIBEX most acoustic data were collected using analogue systems with no thresholding, high signal saturation and target classification from a visual examination of echocharts taking account of catches in targeted net hauls. The multi-frequency digital acoustic sampling and processing systems using Simrad® EK500 and SonarData® software in use during the CCAMLR-2000 Survey meant that target identification was made according to a rigorous protocol. Also the increased dynamic range of digital systems meant that bias due to thresholding and saturation was minimised. The analysis indicated that improvements in acoustic survey methodology could have a considerable influence on the biomass estimate. It has been demonstrated that application of different methods to krill species identification realised by single-frequency algorithms could cause a marked difference in krill biomass estimates. The analysis indicated that the FIBEX methodology gave a biomass figure approximately 1.8 times greater than that from using the CCAMLR-2000 Survey methodology. This result highlights the need for caution when comparing the results of historical surveys.

3.97 WG-EMM-01/16 presented a synopsis of the response to a series of questions regarding the methods used to determine the length, maturity/sex stage and colour of krill. While a number of different methods exist to measure krill length the most widely used is the measurement of total length. The subgroup considered that biases introduced by the different measurement methods currently used were unlikely to be significant. Methods used in the determination of maturity and sex were related to the types of samples collected and the level of detail required. There were considerable difficulties in the assessment of colour, using the guide in the CCAMLR *Scientific Observers Manual*.

3.98 It was recognised that the instructions for CCAMLR krill fishing observers in the *Scientific Observers Manual* required clarification, particularly in relation to the methods used to assess the status of krill. It was agreed that it was important to recognise the operational constraints on observers, in terms of facilities and time, and that the expectation of data deliverable from observers should reflect this.

3.99 WG-EMM recommended that, as a minimum requirement, data on the total length of fresh samples, be collected from 100 krill from up to three separate hauls per day. The data on krill length were agreed to be mandatory; additional information on maturity/sex stage and colour was considered as desirable, depending on available expertise and facilities. A number

of issues related to potential biases associated with access of observers to samples of krill were discussed. The importance of potential bias, both in terms of krill length and assessment of by-catch, of the restrictions imposed on observers from sampling krill directly from the factory fishpond was discussed.

3.100 Dr Kawaguchi agreed to investigate these issues further and clarify the methods in the *Scientific Observers Manual*.

Future Role of the Subgroup

3.101 WG-EMM-01/17 described the existing role of the Subgroup on Methods and outlined a proposal for how the remit of this subgroup might develop in the future. WG-EMM agreed that the subgroup should:

- (i) consider new, and revisions to existing, CEMP standard methods;
- (ii) advise on and review new techniques for the analysis of parameters; and
- (iii) develop criteria to evaluate the methods used in the collection of non-CEMP parameters identified by WG-EMM as relevant to its work.

3.102 In respect of paragraph 3.101(iii), the Working Group requested the Subgroup on Methods to prepare intersessionally a questionnaire for the Secretariat to circulate to Members concerning the availability of non-CEMP time-series data on predator, prey and environment of particular relevance to WG-EMM, together with information on the methods used to acquire such data.

3.103 There was a recognition that, in order for the subgroup to consider some issues, there is a need to identify sources of expertise and to develop a suitable timetable for relevant experts to be included in the work of the subgroup.

Future Surveys

3.104 The Working Group considered two proposals for future surveys: aerial surveys of land-based predators at South Georgia (WG-EMM-01/24) and an acoustic survey of krill in the Ross Sea (WG-EMM-01/64).

3.105 The proposal for aerial surveys of land-based predators at South Georgia was submitted in response to a request of the Scientific Committee (SC-CAMLR-XIX, paragraphs 6.24 to 6.26). WG-EMM agreed that this proposal was an important development in improving estimates of the population size of land-based marine predators dependent on krill. The proposal was considered further under item 5.2.

3.106 WG-EMM was pleased to note further development of the proposal for an acoustic survey of krill in the Ross Sea in 2002. Last year WG-EMM had requested that plans for the survey be brought forward for approval at the 2001 meeting for a standardised survey design in the Ross Sea (SC-CAMLR-XIX, Annex 4, paragraphs 2.77 and 2.78). Unfortunately, WG-EMM-01/64 contained only an abstract, and the detailed paper was not available at the meeting. WG-EMM was unable to evaluate the survey design.

3.107 Correspondence with Dr M. Azzali (Italy) during the meeting indicated that the survey would be postponed one year. Dr Azzali had advised that details of the survey would be presented at the next meeting of WG-EMM.

Key Points for Consideration by the Scientific Committee

3.108 A specially convened workshop to prepare and publish a set of papers describing the pelagic ecosystem of the Scotia Sea, arising from analysis of data collected during the CCAMLR-2000 Survey, had made good progress (paragraphs 3.9 to 3.12).

3.109 Collaboration with the IWC for the CCAMLR-2000 Survey had been productive and had extended the scope of the survey. WG-EMM encouraged further collaboration between scientists from CCAMLR and the IWC (paragraph 3.11).

3.110 A productive workshop had been held in June 2001 for the analysis of data from surveys conducted by the International Coordination Subgroup in 2000 in conjunction with the CCAMLR-2000 Survey; the future work plan of the subgroup was endorsed (paragraph 3.13).

3.111 Based on data collected on predators and environment as part of CEMP and submitted to the CCAMLR database (paragraph 3.7), and on standard annual surveys for krill in Subareas 48.1 and 48.3 (paragraphs 3.16 and 3.17), 2000/01 had been an average year in comparison with the time series of data available to WG-EMM.

3.112 Based on krill spawning surveys conducted in Subarea 48.1 in 2000/01 it was predicted that recruitment in 2002/03 (from spawning in 2000/01) would be high (paragraph 3.30).

3.113 There was increasing potential use to WG-EMM of satellite-derived environmental data (paragraph 3.57).

3.114 The Working Group recommended that, until evidence of the effects of disease at levels potentially relevant to population trends and performance became available, further submissions on this topic would be more appropriately directed to the Committee for Environmental Protection of the ATCM (paragraph 3.49).

3.115 In respect of the development of further approaches to ecosystem assessment and management, the Working Group recognised that it needed to set aside more time for detailed evaluation of relevant approaches and analyses (paragraphs 3.62, 3.74(v) and 3.83).

3.116 There were increasing indications, based on reviews and analyses of scientific data, that a substantial change may have occurred over the last 20 years in aspects of the dynamics of the krill-based system in Area 48 (paragraphs 3.80 to 3.82). The basis and implications of this need further investigation.

3.117 The WG-EMM Subgroup on Methods was reconstituted with the terms of reference as set out in paragraph 3.101.

STATUS OF MANAGEMENT ADVICE

Small-scale Management Units

4.1 In response to a request from the Scientific Committee (SC-CAMLR-XIX, paragraph 5.15), WG-EMM considered methods for the subdivision of the krill potential yield into small-scale management units. The primary aims are to avoid concentrating fishing effort in small but critical areas and also to consider the level at which appropriate 'trigger levels' might be set.

4.2 Conservation Measure 32/XIX states that when the total catch within Area 48 exceeds 620 000 tonnes, precautionary catch limits appropriate to small-scale management units would be applied. The Working Group agreed that it would be prudent to consider as many options as possible to achieve this so that when the 620 000 tonne threshold is reached, there can be a smooth transition to a more closely defined management regime.

4.3 The Working Group examined two papers discussing methods to subdivide CCAMLR areas into small-scale management units. The first paper (WG-EMM-01/29) was originally submitted to WG-Krill in 1992 and published in *SC-CAMLR Selected Scientific Papers* (Watters and Hewitt, 1992). It discussed trade-offs between different approaches of subdivision. The favoured approach in that paper was to consider providing protection to critical zones and/or critical periods. This may require adjustment of current fishing patterns.

4.4 WG-EMM-01/52 examined the issue of small-scale management units in principle. It defined two types of management units: 'harvesting units' which are defined as areas in which the CCAMLR objectives will need to be achieved, and 'predator units' which are potentially smaller-scale units within harvesting units that are used to subdivide the catch (in space and/or time) and will help (i) to reduce the potential for undesirable local effects on predators; and (ii) to ensure undesirable effects do not arise.

4.5 A conceptual model for the South Atlantic illustrates how predator units can be used to subdivide the catch limit in the harvesting unit (Area 48). As well, these units can be used to provide strategic advice on the potential effects of fishing as intended through CEMP. The paper suggests that these units should be established in the early phases of a fishery, integrating knowledge of local populations of harvested species, predator foraging density (number of predators, location and foraging areas) and fishing grounds. Predator units do not have to be self-contained ecosystems but should be sufficiently self-contained such that fishing in that unit does not inadvertently affect predators being monitored in other units.

4.6 Analyses of predator foraging areas around South Georgia (WG-EMM-01/19, 01/22 and 01/26) and around the Antarctic Peninsula (WG-EMM-01/32) suggest that a subdivision following the approach set out in paragraph 4.4 is tractable.

4.7 A number of papers on the South Georgia system suggest that spatial differences in the requirements of krill by predators and how this relates to the productivity and flux of krill in foraging areas need to be accounted for in subdividing the overall catch limit for krill in Area 48. These papers included WG-EMM-01/18, 01/21, 01/27 and 01/53.

4.8 The Working Group welcomed the approach described in WG-EMM-01/52 and noted that it provided a potential framework for integrating fishery, predator and prey information,

developing earlier approaches when fewer data were available (WG-EMM-01/29). The Working Group noted that further elaboration of small-scale management units, such as predator units, may need to include details of the behaviour of fisheries, environmental factors, such as interannual variation in the location of gyres and ice, and seasonal (summer–winter) variation in predator foraging areas. As discussed in WG-EMM-01/52, the Working Group recognised that not all predators could be monitored or assessed for the designation of these units. Dr Constable indicated that, as these units do not have to be ecosystem units but are simply units to help management, then many of these issues of large-scale variation could probably be overcome.

4.9 Dr M. Naganobu (Japan) expressed doubt about the need for such subdivisions and that the objectives of the subdivision need to be determined before this work continues.

4.10 In response to the request of the Scientific Committee (SC-CAMLR-XIX, paragraphs 5.14 and 5.15) and the Commission (CCAMLR-XIX, paragraph 10.11), the Working Group agreed to use WG-EMM-01/52 as a guide for further work next year to develop small-scale management units, such as predator units. The program of work for next year is discussed in paragraphs 5.9 to 5.12. It noted that WG-EMM-01/52 included discussion of subdividing the krill catch limit between these units as well as providing other opportunities for the Commission to help achieve the objectives of CCAMLR, such as in the field evaluation of CEMP. The Working Group agreed that the priority at present is to subdivide the catch between units.

4.11 The Working Group noted that the use of the approach by Everson and de la Mare (1996) may help subdivide the catch limit into smaller areas. This method uses estimates of abundance of predators and their consumption requirements. In part, these calculations ensure that uncertainty in estimates of natural mortality of krill is accounted for in the calculations because the same estimate of M used to determine γ is used in these calculations. The Working Group noted that other methods may be available and invited contributions on determining local catch limits in these smaller areas.

4.12 With respect to harvesting units, the Working Group agreed that there is a need to further subdivide some of the large statistical subareas for management purposes. The history of the subdivision of the Southern Ocean into statistical units began with the paper by Everson (1977). When originally designated, the northern boundary for Areas 48, 58 and 88 was 60°S, in line with the northern limit of the Antarctic Treaty zone. Arising from the development of commercial fishing for krill and finfish in the Southern Ocean it was recognised that the Antarctic Polar Frontal Zone was a better ecological descriptor of the Southern Ocean and the northern limit was revised to take account of this (Everson, 1977). The main fishing grounds in the Southern Ocean at that time were known to be associated with the shelf and shelf break. Subarea boundaries were designated by Everson (1977) to delineate these main fishing locations. Since that time, a number of revisions have been made to include finer-scale delimitation of fishing areas based primarily on ecological grounds. The most recent division has been that concerned with SSRUs in exploratory toothfish fisheries (Conservation Measure 200/XIX).

4.13 With respect to harvesting units, WG-EMM-01/52 proposed that a number of CCAMLR statistical areas could be divided on ecological grounds to complete the division of the Convention Area into manageable harvesting units, including Subareas 48.6, 88.1 and 88.2 and Division 58.4.2.

4.14 The Working Group noted that further subdivision would make large-scale krill surveys of these areas, such as Subarea 48.6, more tractable. It agreed that further consideration of subdividing the statistical areas as outlined in WG-EMM-01/52 required a paper to be submitted to the Scientific Committee detailing the ecological justification of such divisions. The authors of WG-EMM-01/52 agreed to provide a more detailed paper to the Scientific Committee this year. The Working Group requested that the authors consider developing a framework that is consistent with the framework adopted in Conservation Measure 200/XIX and asked that suggestions by some members of the Working Group for greater subdivision than proposed in WG-EMM-01/52 be considered.

4.15 Some members noted that it may not be possible to determine appropriate subdivision of statistical areas at this stage. This is because of the difficulty in matching ecological features and statistical units.

Draft Fishery Plan

4.16 WG-EMM noted the Scientific Committee's progress in developing a unified regulatory framework for CCAMLR fisheries (SC-CAMLR-XIX, paragraphs 7.2 to 7.19). At the request of the Scientific Committee (SC-CAMLR-XIX, paragraph 7.20), WG-EMM considered a Fishery Plan for the krill fishery which had been drafted by the Secretariat (WG-EMM-01/7).

4.17 WG-EMM agreed that the draft Fishery Plan was an excellent beginning to the documentation of the development and implementation of management measures in the krill fishery and other fisheries. The plan provided a suitable vehicle for tracking such measures, as well as references to relevant documents and information. The Working Group envisaged that such information would be updated each year.

4.18 WG-EMM noted that the Fishery Plan documented the status of a fishery and was not specifically intended to forecast what may happen to that fishery.

4.19 WG-EMM recognised that, once developed, Fishery Plans may highlight differences in management measures between CCAMLR fisheries. Where this occurred, the rationale for such differences would also need to be documented, or at least referenced to relevant paragraphs of the Scientific Committee or Commission reports.

4.20 WG-EMM recognised the need for consistency in the headings of the plan and that not all of the categories in the plan would be applicable to all fisheries. The Working Group suggested a number of changes to the draft Fishery Plan; these were incorporated in the revised plan given in Appendix D.

4.21 The changes were as follows:

- (i) the mandatory data reporting requirements were placed in Section 2;
- (ii) the section dealing with requirements for CCAMLR scientific observations was moved out of Section 2 'Data Reporting Requirements' into a new section;

- (iii) the heading 'Notification Received by CCAMLR' was moved from Section 6 'Data Reported to CCAMLR' to Section 3 'Notification Requirements'; and
- (iv) the types of data reported to the CCAMLR database were summarised in Section 6.

4.22 In further discussion WG-EMM agreed that the concept of the Fishery Plan may be extended, in the long term, to document the management of non-target species. For example, a 'predator summary' could document management measures and data and research requirements for land-based predators.

Designation of Protected Areas

CEMP Site Maps

4.23 The Working Group reviewed CEMP site maps submitted so far to the Secretariat.

4.24 There were still outstanding maps for CEMP sites. These maps should be submitted to the Secretariat as soon as possible. Members are reminded that those maps which are prepared in colour should be readable when reproduced in black and white.

4.25 Last year maps were received from Australia, Japan, New Zealand, Norway and the UK. Maps from New Zealand, Norway and the UK all met the criteria for CEMP site maps. The map provided by Australia was fine when viewed in colour on the website, but found to be difficult to read when printed in black and white. The map from Japan needed minor technical improvements.

4.26 This year, improved maps from Australia and Japan were received and met the criteria. Maps from South Africa and Chile were also submitted for evaluation.

4.27 The Working Group considered that the maps from South Africa met the criteria but suggested changes be made to address possible confusion over shading. The maps from Chile met the criteria; however, since colour was used, the legend is difficult to follow in black and white print. The Working Group commented that titles should be included on maps rather than just included in the accompanying text.

4.28 It was also clarified that where CEMP colonies have moved to another location, merged or split, the principal CEMP researchers should inform the Secretariat so changes can be adequately recorded and tracked in the CEMP database. The Working Group felt that it was not necessary to record these changes on the CEMP site maps unless the colony had moved outside the existing CEMP site.

ATCM Proposals

4.29 The Working Group noted that the Commission had considered the advice of the Scientific Committee regarding the consideration of management plans forwarded by the ATCM (SC-CAMLR-XIX, paragraphs 11.20 to 11.26; CCAMLR-XIX, paragraphs 11.20

and 11.21). It noted a request by the Commission to the Scientific Committee (CCAMLR-XIX, paragraphs 11.20 and 11.21) to develop scientific advice regarding proposals from the ATCM for marine protected areas on steps to be taken to determine:

- (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.

4.30 In order to answer the two questions posed by the Commission (CCAMLR-XIX, paragraph 11.20), and taking into account the agreement of the Scientific Committee on the types of information useful for assessing these proposals (SC-CAMLR-XIX, paragraphs 11.21 and 11.22), the Working Group reviewed the information requirements and general procedure. Following receipt of a proposal by the Commission, the proposal should be assessed by both WG-EMM and WG-FSA with respect to scientific consideration of whether the proposal affects actual or potential harvesting of marine resources or prevents or restricts CCAMLR-related activities (CCAMLR-XIX, paragraph 11.20). WG-EMM would value having the Commission identify any additional questions it has regarding a specific proposal.

4.31 Not all proposals will require the same information. The future assessment of the two questions from the Commission should include an assessment of available information relevant to CCAMLR and its objectives, such as those listed in paragraphs 11.21 and 11.22 of SC-CAMLR-XIX.

4.32 The Working Group agreed that further development of the general procedure is difficult at this stage until a specific proposal is presented. Given the discussion at SC-CAMLR-XIX, the Working Group requested that the Scientific Committee consider whether any further work is required on this matter. In particular, the Working Group asked for advice on whether the values of a proposal need to be assessed with respect to the two questions posed by the Commission.

CCAMLR Article IX.2(g)

4.33 The Commission also requested the Scientific Committee to provide advice on the application of the provisions in Article IX.2(g) of the Convention, ‘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).

4.34 With regard to advice on the application of the provisions in Article IX.2(g) of the Convention, the Working Group noted the global interest in the use of marine protected areas (WG-EMM-01/31) and that a major review would be published in the journal *Ecological Applications* later this year. The Working Group requested that this volume be available to participants for review at the next meeting of WG-EMM. The Working Group noted that consideration of Article IX.2(g) could be included in discussions of management options for

fisheries. The Working Group agreed that such consideration will require the development of a framework for assessing the value of different management options in terms of achieving the objectives of the Convention.

4.35 The Working Group wished to convey its thanks to the Subgroup on the Designation and Protection of CEMP Sites for its work, to Dr Wilson for acting as interim coordinator and to Dr Sabourenkov for his valuable contribution.

Generalised Yield Model

4.36 A number of papers on the South Georgia system indicate that some parameters in the krill yield calculations may need to be revised, including growth and natural mortality (WG-EMM-01/18, 01/21, 01/27 and 01/53). The Working Group noted that work over the last 10 years has indicated that the growth rates estimated in the 1980s and used in the krill yield calculations may need updating (see Siegel and Nicol, 2000). There were different opinions expressed about interpretation of changes in the size structure in the krill stock (paragraph 3.26). Therefore, the Working Group requested that work be undertaken intersessionally to analyse available information to provide new estimates of growth and natural mortality for use in estimating krill yield.

4.37 The Working Group welcomed the work of the Secretariat on a web-based description of the history of the KYM and GYM (WG-EMM-01/8). It looked forward to the further documentation of this information as requested by the Scientific Committee last year (SC-CAMLR-XIX, paragraph 5.17). This is discussed further in paragraph 7.1.

4.38 With respect to the coordination between WG-FSA and WG-EMM of the development of the GYM, the Working Group requested that the coordination proposed by the Scientific Committee last year (SC-CAMLR-XIX, paragraph 5.18) be undertaken as soon as possible. Members were requested to communicate with Dr Constable as to their involvement in the coordinated development of the GYM and testing to be carried out on the GYM in future (SC-CAMLR-XIX, Annex 4, paragraph 2.110). In addition, the Working Group encouraged members to become familiar with the GYM and how it is used in assessments.

4.39 The Working Group reiterated its request to undertake intersessionally the following work highlighted last year:

- (i) to develop a proforma format for the submission and archiving of any tests of the GYM (SC-CAMLR-XIX, Annex 4, paragraph 2.97);
- (ii) to revise the time series of recruitment information for inclusion in the GYM (SC-CAMLR-XIX, Annex 4, paragraph 2.98) and to include new information arising from recent surveys (WG-EMM-01/10); and
- (iii) to assess the sensitivity of the estimation of γ to the nominated time of the CCAMLR-2000 Survey (SC-CAMLR-XIX, Annex 4, paragraph 2.107).

Conservation Measures

4.40 WG-EMM reviewed Conservation Measures 32/XIX, 45/XIV and 106/XIX which are in force for krill fisheries in Area 48, Division 58.4.2 and Division 58.4.1 respectively. Conservation measures detailing CCAMLR's catch and effort reporting system (40/X, 51/XIX and 61/XII) and fine-scale data requirements (121/XIX and 122/XIX) were also considered. The Working Group noted for comparison the data requirements specified in a typical conservation measure (194/XIX) for a finfish fishery in the Convention Area.

4.41 The data reporting requirement for krill fisheries, as agreed by the Commission, is that catches shall be reported to the Commission on a monthly basis (e.g. Conservation Measure 32/XIX, paragraph 5). WG-EMM noted that this requirement was open to interpretation because it was not linked to a specific set of requirements, such as those of the catch and effort reporting system (see Appendix D, Section 2). As a result, Contracting Parties had submitted various types of data at varying levels of spatial and temporal resolution (see Appendix D, Section 6).

4.42 All Contracting Parties reported catches of krill at monthly intervals to the Secretariat, and these reports were used to monitor the fishery, and also to forecast, if needed, the closure date for the season. This reporting practice followed the principle set out in Conservation Measure 40/X. Most Contracting Parties also reported data at a finer level of resolution, such as catch by 10-day period and 10 x 10 n mile rectangles.

4.43 Some Contracting Parties report effort; however, these data are neither consistent between parties nor complete.

4.44 WG-EMM advised the Scientific Committee that future work identified during the workshop (section 5) would require detailed catch and effort data from the krill fisheries. This future work would include investigating the behaviour of fishing fleets, characterising predator units and developing indices of abundance based on catch per unit effort. Ideally, data would need to be submitted at the finest scale practicable, and in a consistent format across all fleets. Guidelines set out in Conservation Measure 122/XIX, for example, would suit WG-EMM's requirement for catch and effort data.

4.45 Dr Naganobu advised that Japan's annual submission to CCAMLR of aggregated catch data from the krill fishery was difficult under current domestic rule.

4.46 WG-EMM thanked all parties who had submitted data to the CCAMLR database and at the Working Group meetings. This information had allowed WG-EMM to reach its present understanding of the krill fishery, and develop objectives for future work. WG-EMM continued to encourage all Member countries involved in krill fisheries to submit to the Working Group, and/or bring with them to future meetings and workshops, detailed data and information on krill fisheries.

4.47 Two other elements of the conservation measures in force were considered in relation to the krill fisheries: (i) catch limits in Subareas 48.5 and 48.6; and (ii) the timely provision of data for managing a fishery when catches approached a trigger level or catch limit.

4.48 WG-EMM noted that the Commission had set a catch limit of 4.0 million tonnes of krill in Area 48 (Conservation Measure 32/XIX). Further, this catch limit had been

subdivided into catch limits for Subareas 48.1, 48.2, 48.3 and 48.4 (i.e. the region of the CCAMLR-2000 Survey), and the sum of the catch limits in these four subareas equalled 4.0 million tonnes. To assist in future work, the Working Group sought clarification from the Scientific Committee on the catch limits for krill in Subareas 48.5 and 48.6.

4.49 Some Members of the Working Group noted that the catch limit of 4.0 million tonnes of krill in Area 48 was estimated based on the result of the CCAMLR-2000 Survey which was carried out only in four subareas but not in Subareas 48.5 and 48.6, and reiterated the recommendation for a future krill biomass survey in these subareas (SC-CAMLR-XIX, paragraph 5.28).

4.50 WG-EMM also noted that the agreed regression method for forecasting the closure date of the fishery was based on the last three reporting periods for which all catch data had been submitted. Given that the catch data are reported at monthly intervals in the krill fisheries, a revision of the closure date would require catch data collected over a period of three months. This lengthy period could result in a high risk of overshooting the catch limit. WG-EMM noted that the regression method is regularly applied by the Secretariat to the toothfish and icefish fisheries in Subarea 48.3 where catch and effort reports were submitted every five days in accordance with Conservation Measure 51/XIX.

4.51 The Working Group requested the Secretariat to review the mechanisms that could be used for managing the krill fishery based on reports from the fishery.

4.52 The Working Group noted that the fishing season in Division 58.4.2 (Conservation Measure 45/XIV) is not in accordance with fishing seasons adopted by the Commission in Area 48 and Division 58.4.1.

Key Points for Consideration by the Scientific Committee

Small-scale Management Units

4.53 In response to the request of the Scientific Committee (SC-CAMLR-XIX, paragraphs 5.14 and 5.15) and the Commission (CCAMLR-XIX, paragraph 10.11), the Working Group agreed to use WG-EMM-01/52 as a guide for further work next year to develop small-scale management units, such as 'predator' units (paragraph 4.10). The program of work for next year is discussed in paragraphs 5.9 to 5.12. The Working Group envisaged that a method to divide the precautionary catch limit between such units will be developed in the following year (paragraph 4.11).

4.54 The Working Group noted that a number of CCAMLR statistical areas including Subareas 48.6, 88.1 and 88.2 and Division 58.4.2 could be divided on ecological grounds to complete the division of the Convention Area into manageable harvesting units (paragraph 4.13). The Working Group noted that such subdivision would make large-scale krill surveys of these areas, such as Subarea 48.6, more tractable. The Working Group requested that a paper should be submitted to the Scientific Committee this year by the authors of WG-EMM-01/52 detailing the ecological justification of such divisions, and considering how such subdivisions could be made consistent with the framework adopted in Conservation Measure 200/XIX (paragraph 4.14).

Draft Fishery Plan

4.55 WG-EMM agreed that the draft Fishery Plan was an excellent beginning to the documentation of the development and implementation of management measures in the krill fishery and other fisheries. The plan provides a suitable vehicle for tracking such measures and the references to relevant documents and information. Such information would be updated each year (paragraph 4.17).

4.56 WG-EMM noted that the Fishery Plan documents the status of a fishery, and is not specifically intended to forecast what may happen to that fishery in future years (paragraph 4.18).

4.57 WG-EMM recognised the need for consistency in the headings of the plan, and that not all of the categories in the plan would be applicable to all fisheries. The Working Group suggested a number of changes to the Draft Fishery plan and these are illustrated in Appendix D (paragraph 4.20).

Designation of Protected Areas

4.58 Regarding ATCM proposals, WG-EMM identified a procedure for considering those proposals and would value having the Commission identify additional questions it has regarding a specific proposal (paragraph 4.30).

4.59 The Working Group agreed that further development of the general procedure is difficult at this stage until a specific proposal is presented. Given the discussion at SC-CAMLR-XIX, the Working Group requested that the Scientific Committee consider whether any further work is required on this matter. In particular, the Working Group asked for advice on whether the values of a proposal need to be assessed with respect to the two questions posed by the Commission (paragraphs 4.29 and 4.32).

4.60 With regard to advice on the application of the provisions in Article IX.2(g) of the Convention, the Working Group noted the global interest in the use of marine protected areas (WG-EMM-01/31) and that a major review would be published in the journal *Ecological Applications* later this year. The Working Group noted that consideration of Article IX.2(g) could be included in discussions of management options for fisheries and would require the development of a framework for assessing the value of different management options in terms of achieving the objectives of the Convention (paragraphs 4.33 and 4.34).

Existing Conservation Measures

4.61 WG-EMM advised the Scientific Committee that future work identified during the workshop (section 5) would require detailed catch and effort data from the krill fisheries. This future work would include investigating the behaviour of fishing fleets, characterising predator units and developing indices of abundance based on catch per unit effort. Ideally, data would need to be submitted at the finest scale practicable, and in a consistent format across all fleets. Guidelines set out in Conservation Measure 122/XIX, for example, would suit WG-EMM's requirement for catch and effort data (paragraph 4.44).

4.62 Given the discussion in paragraphs 4.48 and 4.49, WG-EMM requested clarification to assist in its future work on the catch limits for krill in Subareas 48.5 and 48.6.

4.63 WG-EMM also noted that the current method for forecasting the closure date of fisheries would, if applied to the krill fishery, be based on catch data collected over a period of three months. This lengthy period could result in a high risk of overshooting the catch limit (paragraph 4.50).

4.64 The Working Group requested the Secretariat to review the mechanisms that could be used for managing the krill fishery based on reports from the fishery (paragraph 4.51).

4.65 The Working Group noted that the fishing season in Division 58.4.2 (Conservation Measure 45/XIV) is not in accordance with fishing seasons adopted by the Commission in Area 48 and Division 58.4.1 (paragraph 4.52).

WORKSHOP ON FUTURE AGENDA OF WG-EMM

5.1 Following its agreement last year (SC-CAMLR-XIX, Annex 4, paragraphs 4.127, 4.128 and 7.14), WG-EMM held a two-day workshop during the current meeting. This workshop focused attention on reviewing monitoring data and identifying new monitoring requirements and approaches for analysing/integrating information relevant to WG-EMM's work.

5.2 Three invited presentations provided the workshop with information and ideas for discussion. All the presentations focused on the krill-centred component of the Antarctic marine ecosystem.

5.3 The first presentation by Dr Miller reviewed early discussions within, and agreements reached by, CCAMLR concerning the development of an ecosystem approach to management of the krill fishery. Developments during the period 1984 to 1995 were considered and key CCAMLR actions were highlighted. These included the introduction of CEMP and the work undertaken by WG-CEMP, WG-Krill and WG-DAC. Attempts to interpret the Convention's language (particularly Article II) in operational and scientific terms were emphasised.

5.4 The second presentation by Dr Everson also outlined the requirements attached to implementing an ecosystem approach to the management of Southern Ocean resources. The need for information on the fishery and on harvested and dependent species, as well as various interactions between these components was highlighted. CCAMLR's approaches to obtain such information were discussed and a mechanism to bring the various components together as an ecosystem approach to management was suggested.

5.5 The final presentation by Dr Constable outlined the major issues relevant to WG-EMM's work which required additional attention or focus, particularly in relation to the development of procedures for managing the krill fishery using an ecosystem approach. Twelve subject areas were identified and these were divided into topics of a more 'theoretical' nature and those with 'practical' implications as follows:

Theory	Practical
1. Harvested species–environment models	7. Evaluation of candidate management procedures
2. Predator–prey–environment models	8. Utility of CEMP
3. Fishery–prey–environment models	9. Small-scale management units, such as predator units
4. Objectives, decision rules	10. Predator demand
5. Performance measures	11. Ecological division of precautionary catch limit
6. Assessment methods	12. Field test CEMP, precautionary catch limit

These topics were used as a basis for discussing the major issues to be addressed by future WG-EMM workshops in the short to medium term.

5.6 In thanking the three presenters, WG-EMM encouraged them to submit their manuscripts to *CCAMLR Science*. It was felt that the three presentations provided a useful record of where ecosystem management in CCAMLR had come from, the direction it had assumed and where it was likely to go in the future.

Prioritised Topics for Future WG-EMM Workshops and Symposia

5.7 In considering topics for future workshops and symposia, WG-EMM agreed that taking into account the twelve topics set out in paragraph 5.5, the following four topics require priority development to further the work of the group:

- identification of small-scale management units, such as predator units;
- utility of CEMP;
- predator–krill–environment models; and
- fishery–krill–environment models.

5.8 It was recognised that the activities necessary to address these topics may be able to run in parallel. However, it was agreed that their development is likely to be iterative which could involve a stepwise approach. Predator units and the utility of CEMP were afforded top priority for workshops in 2002 and 2003. Dr Constable was tasked with convening an intersessional correspondence group to consider the latter two items above to ensure that the development of the necessary models is carried forward. Key issues:

- status of existing models including data requirements;
- variety of modelling approaches being undertaken; and
- modelling approaches which may be useful in management.

Identification of Small-scale Management Units

5.9 It was recognised that the Scientific Committee (SC-CAMLR-XIX, Annex 4, paragraphs 5.14 and 5.15) and Commission (CCAMLR-XIX, paragraph 10.11) had clearly indicated that, as a matter of priority, WG-EMM should provide guidelines for approaches to divide the krill potential yield in all areas as a precautionary measure to avoid concentrating fishing effort in small but critical areas, and to consider the level at which appropriate ‘trigger levels’ might be set. The identification of appropriate management units to take account of such considerations therefore is a key area for WG-EMM to address.

5.10 WG-EMM-01/52 discussed the principles required for the development of small-scale management units for the krill fishery, which involves the integration of local krill populations, foraging areas of related predators, fishing ground information and potential influences of the environment (see also paragraphs 4.4 and 4.5).

5.11 WG-EMM agreed that to take account of the types of ideas highlighted by WG-EMM-01/52 and the concerns of the Scientific Committee, it would be appropriate to include a workshop on small-scale management units in the agenda of the Working Group's next meeting. The following key aspects would serve as the terms of reference for such a workshop:

(i) Purpose:

The workshop would collate and compare information on:

- (a) fishing fleet behaviour and patterns of fishing;
- (b) predator foraging ranges (especially of land-based predators); and
- (c) krill abundance and distribution.

Information on the environmental influences affecting (a) to (c) would also be collated. Results from analyses of the information will then be used to determine appropriate boundaries for small-scale management units, such as predator units. The practical steps and considerations attached to implementing such units were identified as a task to be held over until 2003.

(ii) Data Required:

Data on the information requirements outlined in (i) above will be required and WG-EMM made a general call for such data to be provided in good time and in an appropriate format for the workshop to consider. The Data Manager was tasked with coordinating and standardising the data received prior to the workshop.

(iii) Additional Facilities and Resources:

The need for appropriate computer hardware and software to be available at the workshop was recognised. It was also noted that data should be collated into a standardised format (see (ii) above).

(iv) Duration and Format:

Collation of necessary information – two to three days.
Consideration of suitable unit boundaries – one day.
Total duration – four days.

(v) Participants:

Participants with experience in Geographical Information Systems (GIS) and spatial analysis techniques were encouraged to attend the workshop.

(vi) Product:

Demarcated small-scale management units, such as predator units, for consideration at a subsequent workshop in 2003.

5.12 WG-EMM agreed that a steering committee convened by Dr Trivelpiece, and comprising Drs Constable, Hewitt, Kawaguchi, V. Sushin (Russia) and P. Trathan (UK) should operate intersessionally to guide the workshop. The CCAMLR Data Manager would serve on this group to ensure coordination and data standardisation.

5.13 WG-EMM agreed that data presented to the workshop would be considered the 'best available' at the time. The Scientific Committee would be informed of the workshop results at its 2002 meeting.

Review of the Utility of CEMP

5.14 CEMP was established in 1985 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.

5.15 CEMP uses indices derived from data on indicator species and the environment collected by standard methods within the three Integrated Study Regions of the CCAMLR Convention Area and at network sites outside these regions. The indicator species chosen were those which were believed to have the greatest potential for detecting responses to changes in harvested resources (to date specifically krill), or were the subject of a commercial harvest (to date only krill has been considered in this context). At present, the environmental data consist of regional sea-ice distribution and SST.

5.16 The Working Group agreed to consider whether:

- (i) the nature and use of the existing CEMP data continued to be appropriate for addressing the original objectives;
- (ii) these objectives remain appropriate and/or sufficient; and
- (iii) additional data were available which should be incorporated into CEMP or be used in conjunction with CEMP data.

5.17 In addition, the Working Group particularly wished to consider whether useful management advice could be derived from CEMP (and/or CEMP-related) data and, if so, how best to do this.

5.18 The Working Group recognised that a review under the above terms of reference would, in due course, also address most of the key questions posed at last year's meeting of WG-EMM (e.g. SC-CAMLR-XIX, Annex 4, paragraphs 4.14, 4.23, 4.29, 4.41 and 4.62) and that it would be essential to identify which of these questions are important to the development of management procedures.

5.19 It also noted that the outlined work plan in respect of further development of CSIs (SC-CAMLR-XIX, Annex 4, paragraph 3.51) might have relevance to work that would develop within, or arise from, any review of CEMP.

5.20 It was recognised that there would be a need, as part of the overall review process, to develop and link appropriate statistical and ecological models. This would require the involvement of scientists with relevant experience. Expertise of particular importance would include time-series analysis, demographic analysis and modelling and development of assessment frameworks, as well as practical and theoretical experience of research on environment-prey-predator interactions.

5.21 The Working Group agreed that in order to prepare for a workshop whose tasks should include detailed analysis of appropriate data and which could be held in conjunction with the WG-EMM meeting in 2003, a preliminary session should be held at the 2002 meeting of WG-EMM to address the terms of reference and to make detailed plans for such a workshop.

5.22 In order for this session, envisaged to last not more than two days, to be successful, it was essential for appropriate documentation and other relevant materials to be available for the 2002 meeting of WG-EMM.

5.23 Members were invited to submit appropriate reviews, papers and other materials which would assist in addressing the draft terms of reference (paragraphs 5.15 and 5.16) and the key questions developed last year (see paragraphs 5.17 and 5.18) in advance of the next meeting of WG-EMM.

5.24 It was noted that the report of the Area 48 Workshop (SC-CAMLR-XVII, Annex 4, Appendix D) provided considerable relevant background information and, in some cases, examples of appropriate analyses and models. Members with similar data from other parts of the Convention Area were encouraged to provide WG-EMM with the results of similar analyses and investigations.

5.25 Dr Nicol indicated that analysis of CEMP data collected by Australia, principally at Béchervaise Island, would be undertaken intersessionally and the results made available to the next meeting of WG-EMM.

5.26 The Working Group agreed that a correspondence group convened by Prof. Croxall and comprising Mr Goebel, Drs Miller, Naganobu and Nicol and Mr Reid should be established to act as an interim steering committee both for the pre-workshop session in 2002 and to initiate planning for the workshop in 2003. The CCAMLR Data Manager would also serve on this group.

5.27 Dr Sushin indicated that in his view, any future review of CEMP should consider whether predator indices could be used to identify reference points to be applied in the ongoing evaluation of predator performance. Suitable predator reference points also need to be identified.

5.28 WG-EMM agreed that the identification of suitable reference points is an important consideration attached to many indices likely to be used in ecosystem management by CCAMLR. In this respect, the median krill escapement of 75% of its unexploited biomass to

meet the needs of predators used in the GYM provides a reference point with regard to protecting predators. WG-EMM recognised that further implications of reference points for Antarctic fur seals were demonstrated in WG-EMM-01/66 (see also paragraphs 3.76 to 3.78). Acknowledgement was also given to the important role that reference points play in efforts to restore depleted populations to levels consistent with those described in Article II.

5.29 WG-EMM made a general call for submission on 'reference' points to be used in ecosystem management. These will be revised after the review of CEMP's utility.

Survey of Land-based Marine Predators

5.30 The Scientific Committee had requested WG-EMM to review SC-CAMLR-XIX/6 and develop terms of reference for a workshop in 2002 on the feasibility of a synoptic survey, survey methodologies and the need for estimating the circum-Antarctic abundances of land-based predators.

5.31 To facilitate the above work, WG-EMM tasked Dr C. Southwall (Australia) with coordinating a group (comprising Mr Goebel and Drs Trathan, Trivelpiece and Wilson) to consider how marine predator surveys could be undertaken. This group would advise on to what extent surveys of land-based predators are feasible and the priorities for the techniques to be used. It was agreed that if the correspondence group considered that such a workshop was necessary by 1 May 2002, then a one- to two-day workshop could be scheduled in combination with WG-EMM's 2002 meeting.

Key Points for Consideration by the Scientific Committee

5.32 The Working Group has developed a timetable for its future work on major issues (paragraph 5.5) and prioritised topics (paragraph 5.7), including subjects for future WG-EMM workshops and symposia (see also paragraph 6.3).

5.33 The first three topics to be addressed are:

- (i) further development of prey-predator-fishery-environmental models for ecosystem management through an intersessional correspondence group (paragraph 5.8);
- (ii) define small-scale management units, such as predator units, through a workshop at WG-EMM's meeting in 2002, organised by an intersessional correspondence group (paragraphs 5.11 and 5.12); and
- (iii) a review of the utility of CEMP (paragraph 5.16), coordinated by an interim steering committee arranging a preliminary workshop on the matter at the WG-EMM meeting in 2002 and undertaking detailed planning for a second workshop in 2003 (paragraphs 5.21 and 5.26).

5.34 The data considered at the small-scale management unit workshop in 2002 will be considered the best available (paragraph 5.13).

5.35 WG-EMM has made a call for submissions on reference points to be used in ecosystem management (paragraph 5.29).

5.36 With respect to the request of the Scientific Committee (SC-CAMLR-XIX, paragraph 6.26), a task group has been formed to advise on the extent to which surveys of land-based predators are feasible as well as on the priorities for the techniques to be used. If agreed, a short workshop will be scheduled for WG-EMM's 2002 meeting (paragraph 5.31).

FUTURE WORK

Intersessional Work of WG-EMM

6.1 Future work identified by the Working Group is detailed in the relevant sections of this report. This work is summarised in Table 1, together with the persons identified to take the work forward and the references to paragraphs where the task is described. High priority items are shown in the table.

6.2 Attention of the Scientific Committee is drawn to the following task which could have financial implications for the CCAMLR budget: translation and publication in the *Scientific Observers Manual* of a questionnaire on krill fishing strategies (paragraph 2.35).

Planning of Future Meetings

6.3 The Working Group agreed that a notional timeline for the development of management procedures and the elaboration of issues considered in paragraph 5.5 could be the following:

Issues	Year			
	2002	2003	2004	2005
Harvested species–environment models	D	D	W4	
Predator–prey–environment models	S		W4	
Fishery–prey–environment models	S		W4	
Objectives, decision rules	D	D	D	W5
Performance measures	D	D	D	W5
Assessment methods		*W2		
Utility of CEMP	*IW2	*W2		
Small-scale management units, such as predator units	*W1			
Predator demand	D	W3		
Ecological division of precautionary catch limit		W3		
Field test CEMP, precautionary catch limit	D	W3		
Evaluation of candidate management procedures	D	D	D	W5

D – Developments received by WG-EMM; S – Scoping paper; IW – Interim planning for workshop; W – Workshop; * – Workshops agreed to be held (numbers refer to workshop numbers).

6.4 The development of management procedures requires work on all these issues. The Working Group noted that more than one workshop may be required to satisfactorily investigate some of these issues. The Working Group also noted that this timeline may require revision over the next one or two years as work proceeds on the first two workshops.

6.5 The Working Group recognised that because of planned workshops its annual reports in the next four years are expected to be at least the size of previous reports when, e.g. the Area 48 and B₀ Workshops were held. This should be drawn to the attention of the Scientific Committee as having potential financial implications.

OTHER BUSINESS

Documentation of the KYM and Development of CEMP Indices

7.1 At its 2000 meeting WG-EMM requested the Secretariat to review the historical development of the CEMP indices and ecosystem assessments (SC-CAMLR-XIX, Annex 4, paragraph 3.55 and Table 3) and to compile the documentation of the KYM (SC-CAMLR-XIX, Annex 4, paragraph 2.110 and Table 3). The Secretariat, therefore, prepared WG-EMM-01/9 and 01/8 respectively to address these two topics. These web documents are to be considered as works in progress and have been placed on the CCAMLR website so that members can provide additional advice and suggestions for revisions. The Working Group congratulated the Secretariat for its efforts on these topics and found the documents to be instructive and urged the Secretariat to continue with their development.

Workshop on Krill Culturing Techniques

7.2 Dr Kawaguchi presented WG-EMM-01/37 which provided an announcement that Japan's Port of Nagoya Public Aquarium will sponsor a Workshop on Krill Culturing Techniques during September 2002. The workshop will assemble researchers who are active in this field to address common problems. The Working Group, therefore, recognised that the successful development of these techniques could have positive benefits to the work of CCAMLR. The Working Group encouraged and supported this workshop.

Course on Krill Survey Design and Execution

7.3 Dr B. Bergström (Sweden) presented a proposal (WG-EMM-01/51) to arrange a CCAMLR course in survey design and execution. This proposed course would incorporate the experience gained in planning and executing the CCAMLR-2000 Survey and would illustrate both theoretical and practical aspects of krill surveys. It would also include the execution of a 'miniature survey'. Students from Member countries would be recruited.

7.4 The Working Group recognised the need to recruit and train a core group of young scientists to continue the work of CCAMLR in future years. The proposed course was supported and Dr Bergström was encouraged to continue in his efforts to assemble experienced teachers and students from Member countries.

Collaboration between the Global Ocean Observing System (GOOS) and CCAMLR

7.5 WG-EMM-01/54 presented a proposal from Dr A. McEwan (representative of GOOS), to discuss collaboration between his organisation and CCAMLR. GOOS is a

permanent global system for observation, modelling and analysis of marine and ocean variables to support operational ocean services worldwide. It is sponsored by IOC, WMO, UNEP and ICSU. Dr McEwan proposed that he would be willing to make a brief presentation to the Scientific Committee if appropriate. He also suggested it may be appropriate for a CCAMLR observer to attend the next meeting of the GOOS Steering Committee from 15 to 17 May 2002 in Paris, France.

7.6 WG-EMM indicated that some objectives of GOOS appeared to be related to CCAMLR's work but that the Scientific Committee would be the best venue to consider the feasibility of this proposed collaborative effort. The Working Group did, however, note that the proposed work is ambitious and probably will require considerable resources to undertake. It felt a specific plan of work must be presented before it would be possible to fully evaluate its effects on CCAMLR's work.

7.7 As Chair of the Scientific Committee, Dr Holt agreed to write to Dr McEwan and advise that a succinct proposal on cooperation could be submitted by GOOS to the Scientific Committee for further consideration.

Southern Ocean GLOBEC

7.8 Prof. Kim reported briefly that the SO-GLOBEC Program was currently under way. The Working Group noted the common interests with SO-GLOBEC and wished it success in its program of work (www.ccpo.odu.edu/research/globec_menu.html).

Ecosystem Modelling for the Antarctic Krill Fishery using Ecopath with Ecosim 4.0

7.9 WG-EMM noted that, in a pilot study, Ecopath with Ecosim 4.0 is being used to develop two mass-balance models of the Antarctic ecosystem, one for Subarea 48.1 and another for Subareas 48.2 and 48.3 combined (WG-EMM-01/65). Prof. T. Antezana (Chile) attended the latter portion of WG-EMM and briefed individual attendees as to the preliminary status of the study. Several colleagues expressed their gratitude to Prof. Antezana for information on this study and to Chile for its involvement in the work of WG-EMM.

Key Points for Consideration by the Scientific Committee

7.10 The Working Group wished to bring to the attention of the Scientific Committee the educational materials being developed by the Secretariat to be placed on the CCAMLR website (paragraph 7.1). These materials provide the background instruction, history and details of methods now being used by the Working Group, including the KYM and GYM and approaches used in CEMP. These materials will form the basic archive of the development of assessment methods of the Working Group.

7.11 The Working Group also wished to bring the attention of the Scientific Committee to the initiative to recruit and train young scientists to continue the work of CCAMLR in future years (paragraph 7.4). Such courses are essential for the long-term maintenance of the scientific work of CCAMLR. In addition, the Working Group requested that the Scientific

Committee call on Members to involve specialists on resource assessment, statistics and modelling in the work of WG-EMM. This urgent request is particularly important for the successful implementation of the program of work detailed in paragraph 6.3 and reiterates past requests (SC-CAMLR-XIX, paragraph 13.6).

ADOPTION OF THE REPORT

8.1 The report of the seventh meeting of WG-EMM was adopted.

CLOSE OF THE MEETING

9.1 In closing the meeting, Dr Hewitt thanked all those involved in the meeting for their contributions and discussions which had resulted in the definition of a multi-year agenda and future work for WG-EMM. The Working Group had identified significant areas of new work which would facilitate major advances in ecosystem monitoring and management.

9.2 Dr Hewitt thanked the local meeting organisers, Dr Bergström and Ms M. Thomasson, and their colleagues at the Kristineberg Marine Research Station, for providing such excellent facilities and setting for the meeting. This had greatly contributed to the success of the meeting. Dr Hewitt also thanked Mrs R. Marazas and Ms G. Tanner, and Drs Ramm and Sabourenkov for their significant work in support of WG-EMM, both at the meeting and during the intersessional period.

9.3 Dr Miller, on behalf of the Working Group, thanked Dr Hewitt for his continued leadership and contribution to WG-EMM.

9.4 The meeting was closed.

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Table 1: List of tasks identified by WG-EMM for the 2001/02 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.	Submit further information on the spatial and temporal distribution of the krill fishery.	2.10	√	Members	Remind
2.	Re-examine the use of CPUE indices in krill fisheries.	2.10, 2.37	√	Continue data submission	Remind/coordinate
3.	Submit information on krill processing factors, including krill discards.	2.23	√	Continue data submission	Remind/coordinate
4.	Submit information on the economics of the krill fishery and market developments.	2.28	√	Continue data submission	Remind/coordinate
5.	Examine the questionnaires on krill fishing strategies and provide feedback.	2.34	√√	Members	Remind/implement
6.	Incorporate questionnaire and instructions on its completion into the <i>Scientific Observers Manual</i> .	2.35	√	Continue data submission	Remind/coordinate, implement
Status of the krill-centric ecosystem					
7.	Use the agreed new rule for the calculation of Index A3.	3.5	√		Implement
8.	Review the recruitment series taking into account results of surveys conducted in Subarea 48.1.	3.31	√	Members	Remind
9.	Request more information on the derivation of carrying capacity for seal pup production as presented in WG-EMM-01/49.	3.50	√	Chile	Implement
10.	Examine Standard Method C2 to clarify issues related to timing of sampling and selection of animals to weigh; present a revised method to WG-EMM-02.	3.92	√	Mr Goebel (USA), Subgroup on Methods	Remind
11.	Clarify methods detailed in the <i>Scientific Observers Manual</i> and used to determine the length, maturity/sex stages and colour of krill.	3.97–3.100	√	Dr Kawaguchi (Japan), Subgroup on Methods	Remind
12.	Prepare a questionnaire for the Secretariat to circulate to Members concerning the availability of non-CEMP time-series data on predators, prey and environment.	3.102	√	Subgroup on Methods	Remind
Status of management advice					
13.	Revise WG-EMM-01/52 in relation to harvesting units including ecological justification; submit it for consideration by the Scientific Committee.	4.14	√√	Drs Constable and Nicol (Australia), Members	Remind/coordinate
14.	Submit outstanding maps of CEMP sites; place maps on the website.	4.24	√	Members	Remind/implement

(continued)

	Task	Ref.	Priority	Action Required	
				Members	Secretariat
15.	Obtain a copy of the special issue of <i>Ecological Applications</i> on marine protected areas; make it available to the next meeting of WG-EMM.	4.34	√√		Implement
16.	Review the mechanisms that could be used for managing the krill fishery based on reports from the fishery.	4.51	√√		Secretariat
17.	Invite the three presenters at the WG-EMM-2001 workshop to submit their manuscripts to <i>CCAMLR Science</i> prior to the 2001 meeting of WG-FSA.	5.6	√	Drs Miller (South Africa), Everson (UK) and Constable (Australia)	Implement
Future work of WG-EMM					
18.	Submit and circulate working group documents by means of the CCAMLR website – add dates of papers' submission, ZIP files of papers, information on the total number of papers received and their availability, revise proforma synopsis.	1.16–1.18	√	Continue the policy	Implement
19.	Prepare guidelines for determining categories of papers to be submitted; review categories at WG-EMM-02.	1.20	√	Convener, Members	Coordinate
20.	Develop further appropriate management frameworks that can account for long-term changes in the relationships between krill and its predators.	3.83	√	Members	Remind
21.	Continue documenting the historical development of CEMP indices and ecosystem assessments.	4.37, 7.1	√		Implement
22.	Coordinate development of the GYM and testing of the GYM to be carried out in future; encourage Members to become familiar with the GYM.	4.38	√	Members	Remind/coordinate
23.	Develop a proforma format for the submission and archiving of the GYM tests.	4.39	√	Members	Implement
24.	Revise the time series of recruitment information for inclusion in the GYM, and include new information from recent surveys.	4.39	√	Members	Remind/coordinate
25.	Assess the sensitivity of the estimation of γ to the nominated time of the CCAMLR-2000 Survey.	4.39	√	Members	Remind/coordinate
26.	Prepare and conduct further thematic workshops and symposia in accordance with the topics agreed (see table in paragraph 6.3).	5.7, 5.8	√	Convener, Members	Coordinate/implement
27.	Convene an intersessional correspondence group to prepare advice to WG-EMM and the Scientific Committee on further development of prey–predator–environment models for ecosystem management.	5.8	√√	Dr Constable (Australia)	Remind

(continued)

	Task	Ref.	Priority	Action Required	
				Members	Secretariat
28.	Prepare and conduct during WG-EMM-02 a workshop on the identification of small-scale management units such as predator units, coordinate submission of data and their standardisation, provide appropriate software and hardware.	5.11	√√	Dr Trivelpiece (Chair, Steering Committee)	Coordinate/ implement
29.	Arrange a workshop on the review of the utility of CEMP at WG-EMM-03, and conduct at WG-EMM-02 a preliminary session to consider submitted review papers and other materials.	5.20–5.24	√√	Dr Trivelpiece (Chair, Steering Committee)	Coordinate/implement
30.	Call for submission of papers on ‘reference points’ to be used in ecosystem management.	5.29	√	Members	Remind/coordinate
31.	Coordinate a group to consider how marine predator surveys could be undertaken, and consider a planning workshop during the 2002 meeting of WG-EMM.	5.31	√	Dr Southwell (Australia)	Remind
32.	Continue efforts to arrange a CCAMLR course in krill survey design and execution – evaluate availability of lecturers and students.	7.3, 7.4	√	Dr Bergström (Sweden)	
33.	Write to GOOS and advise that a succinct proposal on cooperation could be submitted by GOOS to the Scientific Committee for further consideration.	7.7	√	Chair, Scientific Committee	Coordinate

AGENDA

Working Group on Ecosystem Monitoring and Management
(Fiskebäckskil, Sweden, 2 to 11 July 2001)

1. Introduction
 - 1.1 Opening of the meeting
 - 1.2 Organisation of the meeting and adoption of the agenda

CORE BUSINESS

2. Status and trends in the 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, Part I
 - 3.2 Status of predators, krill resource and environmental influences, Part II
 - 3.3 Further approaches to ecosystem assessment and management
 - 3.4 Other prey species
 - 3.5 Methods
 - 3.6 Future surveys
 - 3.7 Key points for consideration by the Scientific Committee
4. Status of management advice
 - 4.1 Smaller management units
 - 4.2 Draft fishery plan
 - 4.3 Designation of protected areas
 - 4.4 Generalised yield model
 - 4.5 Existing conservation measures
 - 4.6 Key points for consideration by the Scientific Committee

WORKSHOP

5. Workshop on the future agenda of WG-EMM
 - 5.1 Defining an ecosystem approach to management of the krill fishery
 - 5.2 Major issues to be addressed
 - 5.3 Planning

CORE BUSINESS

6. Future work
7. Other business
8. Adoption of the report
9. Close of meeting.

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(Fiskebäckskil, Sweden, 2 to 11 July 2001)

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LIST OF DOCUMENTS

Working Group on Ecosystem Monitoring and Management
(Fiskebäckskil, Sweden, 2 to 11 July 2001)

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WG-EMM-01/3	List of documents
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WG-EMM-01/9	CEMP indices and the development of ecosystem assessments Secretariat
WG-EMM-01/10	Demography of Antarctic krill in the Elephant Island area (Antarctic Peninsula) during austral summer 2001 V. Siegel (Germany), B. Bergström (Sweden), U. Mühlenhardt-Siegel (Germany) and M. Thomasson (Sweden)

- WG-EMM-01/11 Comparison of temperature situation near South Georgia in December–February, 1989–1990, 1990–1991, 1999–2000 and 2000–2001 on satellite data and information about krill catches in Subarea 48.3
G. Vanyushin (Russia)
(*CCAMLR Science*, submitted)
- WG-EMM-01/12 Sources of variance in studies of krill population genetics
S.N. Jarman and S. Nicol (Australia)
(*CCAMLR Science*, in press)
- WG-EMM-01/13 Distribution and size of Antarctic krill (*Euphausia superba* Dana) in the Polish commercial catches in the Atlantic sector of Antarctica in 1997–1999
E. Jackowski (Poland)
(*CCAMLR Science*, in press)
- WG-EMM-01/14 An investigation of avoidance by Antarctic krill of RRS *James Clark Ross* using the *Autosub-2* autonomous underwater vehicle
A.S. Brierley, P.G. Fernandes, M.A. Brandon, E. Armstrong, D.G. Bone and the *Autosub* Team (United Kingdom)
- WG-EMM-01/15 Multiple acoustic estimates of krill density at South Georgia during 2000/2001 reveal significant intra-annual and spatial variability
A.S. Brierley, C. Goss, S.A. Grant, J.L. Watkins, K. Reid, M. Belchier, I. Everson, M.J. Jessop, V. Afanasyev and J. Robst (United Kingdom)
(*CCAMLR Science*, in press)
- WG-EMM-01/16 Notes on methods for measuring and estimating the status of krill
I. Everson (United Kingdom)
- WG-EMM-01/17 The development of the role of the WG-EMM Subgroup on Methods
K. Reid (United Kingdom)
- WG-EMM-01/18 Growth of Antarctic krill *Euphausia superba* at South Georgia
K. Reid (United Kingdom)
(*Marine Biology*, 138: 57–62)
- WG-EMM-01/19 Seasonal and interannual variation in foraging range and habitat of macaroni penguins at South Georgia
K.E. Barlow and J.P. Croxall (United Kingdom)
(*Marine Ecology Progress Series*, submitted)

- WG-EMM-01/20 Growth rates of Antarctic fur seals as indices of environmental conditions
K. Reid (United Kingdom)
(*Marine Mammal Science*, submitted)
- WG-EMM-01/21 Environmental response of upper trophic level predators reveals a system change in an Antarctic marine ecosystem
K. Reid and J.P. Croxall (United Kingdom)
(*Proceedings of the Royal Society Ser B*, 268: 377–384)
- WG-EMM-01/22 Are penguins and seals in competition for Antarctic krill at South Georgia?
K.E. Barlow, I.L. Boyd, J.P. Croxall, I.J. Staniland, K. Reid and A.S. Brierley (United Kingdom)
(*Marine Biology*, submitted)
- WG-EMM-01/23 Adélie penguin population change in the pacific sector of Antarctica: relation to sea-ice extent and the Antarctic Circumpolar Current
P.R. Wilson (New Zealand), D.G. Ainley, N. Nur, S.S. Jacobs (USA), K.J. Barton (New Zealand), G. Ballard and J.C. Comiso (USA)
(*Marine Ecology Progress Series*, 213: 301–309)
- WG-EMM-01/24 Outline details of the proposed aerial photographic survey at South Georgia for estimating breeding population sizes of land-based predators
P. Trathan and D. Briggs (United Kingdom)
- WG-EMM-01/25 Monitoring a marine ecosystem using responses of upper trophic level predators
I.L. Boyd and A.W.A. Murray (United Kingdom)
(*Journal of Animal Ecology*, in press)
- WG-EMM-01/26 Spatial distribution of foraging by female Antarctic fur seals
I.L. Boyd, I.J. Staniland and A.R. Martin (United Kingdom)
(*Ecology*, submitted)
- WG-EMM-01/27 Integrated environment–prey–predator interactions off South Georgia: implications for management of fisheries
I.L. Boyd (United Kingdom)
(*Aquatic Conservation: Marine and Freshwater Ecosystems*, in press)
- WG-EMM-01/28 Variability of krill biomass estimates in repeated mesoscale surveys in relation to CCAMLR-2000 Survey
V.A. Sushin, F.F. Litvinov (Russia) and V. Siegel (Germany)

- WG-EMM-01/29 Alternative methods for determining subarea or local area catch limits for krill in Statistical Area 48
G. Watters and R. Hewitt (USA)
(In: *Selected Scientific Papers, 1992 (SC-CAMLR-SSP/9)*: 237–249)
- WG-EMM-01/30 Distribution of temperature, salinity, density and flow across the Drake Passage in December 1994
M. Naganobu and K. Kutsuwada (Japan)
- WG-EMM-01/31 Sources of information on Global Marine Protected Areas (MPAs)
WG-EMM Subgroup on Designation and Protection of CEMP Sites
- WG-EMM-01/32 Penguin demography and winter distributions in the Antarctic Peninsula region
W. Trivelpiece and S. Trivelpiece (USA)
(*NSF Progress Report 2000/01*)
- WG-EMM-01/33 Seabird research on Cape Shirreff, Livingston Island, Antarctica, 2000/01
M. Taft, I. Saxer and W. Trivelpiece (USA)
(*US AMLR Field Season Report 2000/01*, in press)
- WG-EMM-01/34 Interannual variability of polynya extent in the Antarctic Ocean
M. Naganobu and K. Segawa (Japan)
- WG-EMM-01/35 Analysis of krill trawling positions north of the South Shetland Islands (Antarctic Peninsula area), 1980/81–1999/2000
S. Kawaguchi and K. Segawa
(*CCAMLR Science*, 8: 25–36 (2001))
- WG-EMM-01/36 CPUEs and body length of Antarctic krill during the 1999/2000 season in Area 48
S. Kawaguchi and M. Naganobu (Japan)
- WG-EMM-01/37 Preliminary announcement of ‘Workshop on Krill Culturing Techniques’
Delegation of Japan
- WG-EMM-01/38 Final report of scientific observation of commercial krill harvest aboard the Japanese stern trawler *Niitaka Maru*, 13 December 2000–26 January 2001
T. Hayashi, S. Kawaguchi and M. Naganobu (Japan)
- WG-EMM-01/39 Krill conversion factors
I. Everson (United Kingdom)

- WG-EMM-01/40 Changes observed in krill length frequency distribution during repeated sampling on the South Georgia shelf in 2000 January–February
V.A. Sushin and F.F. Litvinov (Russia)
(*CCAMLR Science*, submitted)
- WG-EMM-01/41 On influence of acoustic survey methodology improvement on krill biomass estimation. (A comparison of results of acoustic surveys based on single-frequency and double-frequency algorithms)
S.M. Kasatkina and A.P. Malyshko (Russia)
(*CCAMLR Science*, submitted)
- WG-EMM-01/42 Characteristics of krill aggregations in 48.4 subdivision during January–February 2000
S.M. Kasatkina, A.P. Malyshko, V.N. Shnar and O.A. Berezinskiy (Russia)
(*CCAMLR Science*, submitted)
- WG-EMM-01/43 Pinniped research at Cape Shirreff, Livingston Island, Antarctica, 2000–2001
M.E. Goebel, B.W. Parker, A.R. Banks, D.P. Costa and R.S. Holt (USA)
(*US AMLR Field Season Report 2000/01*, in press)
- WG-EMM-01/44 Krill processing factors
D. Rogers (USA)
- WG-EMM-01/45 Seasonal and interannual variability of krill, salp and other zooplankton populations in the northwest Antarctic Peninsula region: summer 2001 in relation to the Long-Term AMLR Data Set
V. Loeb (USA)
- WG-EMM-01/46 Detection of anti-*brucella* antibodies in pinnipeds from the Antarctic Territory
P. Retamal, O. Blank, P. Abalos and D. Torres (Chile)
(*Veterinary Record*, 146: 166–167 (2000))
- WG-EMM-01/47 Withdrawn – see ‘Other Documents’
- WG-EMM-01/48 Detection of anti-*brucella* antibodies in Weddell seals (*Leptonychotes weddellii*) from Cape Shirreff, Antarctica
O. Blank, P. Retamal, P. Abalos and D. Torres (Chile)

- WG-EMM-01/49 Antarctic fur seal population dynamics update and assessment of census error at SSSI No. 32, Livingston Island, South Shetlands, Antarctica (2000/2001)
R. Huccke-Gaete (Chile)
- WG-EMM-01/50 Some notes on by-catch of fishes caught by the fishery vessel *Niitaka Maru* in the vicinity of the South Shetland Islands (December 2000 to January 2001)
T. Iwami, S. Kawaguchi and M. Naganobu (Japan)
- WG-EMM-01/51 CCAMLR course in survey design and execution – a possible way to assure intellectual continuity and renewal in WG-EMM
B. Bergström and M.A. Thomasson (Sweden)
- WG-EMM-01/52 Defining smaller management areas within CCAMLR
A.J. Constable and S. Nicol (Australia)
(*CCAMLR Science*, submitted)
- WG-EMM-01/53 Modelling Southern Ocean krill population dynamics: biological processes generating fluctuations in the South Georgia ecosystem
E. Murphy and K. Reid (United Kingdom)
(*Marine Ecology Progress Series*, in press)
- WG-EMM-01/54 Collaboration between GOOS and CCAMLR Secretariat
- WG-EMM-01/55 Note on demography of Antarctic seabirds
J.P. Croxall (United Kingdom)
(*Comité National Français des Recherches Antarctiques*, 51: 479–488)
- WG-EMM-01/56 Measurement of ocean temperatures using instruments carried by Antarctic fur seals
I.L. Boyd, E.J. Hawker, M.A. Brandon and I.J. Staniland (United Kingdom)
(*Journal of Marine Systems*, 27: 277–288 (2001))
- WG-EMM-01/57 Soviet krill fishery in 1977–1992, Part 1. Distribution, fishing effort, interannual situation patterns
F.F. Litvinov, V.A. Sushin, G.A. Chernega and O.A. Berezhinskiy (Russia)
(*CCAMLR Science*, submitted)
- WG-EMM-01/58 Predation on fish by the southern elephant seal, *Mirounga leonina*, at King George Island, South Shetland Islands, as reflected by stomach lavage
G.A. Daneri and A.R. Carlini (Argentina)

- WG-EMM-01/59 Herpes virus antibodies in *Arctocephalus gazella* from Cape Shirreff, Livingston Island, Antarctica
O. Blank, J.M. Montt, M. Celedón and D. Torres (Chile)
- WG-EMM-01/60 Report of CCAMLR-2000 Special Issue Workshop
British Antarctic Survey, Cambridge, 30 May–6 June 2001
J.L. Watkins (Convener)
- WG-EMM-01/61 On dispersion of different pelagic organisms, forming Antarctic backscattering in South Sandwich subarea during January–February 2000
S.M. Kasatkina and A.P. Malyshko (Russia)
- WG-EMM-01/62 Seasonal relationships in biological parameters and in spatial distribution in the euphausiid populations sampled during the XIIIth and XVth expedition to the Ross Sea
M. Azzali, J. Kalinowski, G. Lanciani, I. Leonori and A. Sala (Italy)
(abstract only)
- WG-EMM-01/63 A three-frequency method to determine the abundance and the size of two euphausiid species (*Euphausia superba* and *Euphausia crystallorophias*)
M. Azzali, J. Kalinowski, G. Lanciani and I. Leonori (Italy)
(abstract only)
- WG-EMM-01/64 Design of the Italian acoustic survey in the Ross Sea
M. Azzali and A. Sala (Italy)
(abstract only)
- WG-EMM-01/65 Ecosystem modelling for the Antarctic krill fishery
T. Antezana, J. Cornejo, E. Bredesen, P. Faundez (Chile), A.W. Trites and T. Pitcher (Canada)
(abstract only)
- WG-EMM-01/66 Modelling the consequences of Antarctic krill harvesting of Antarctic fur seals
R.B. Thomson, D.S. Butterworth (South Africa), I.L. Boyd and J.P. Croxall (United Kingdom)
(*Ecological Applications*, 10 (6): 1806–1819 (2000))
- WG-EMM-01/67 Quantifying habitat use in satellite-tracked pelagic seabirds: application of kernel estimation to albatross locations
A.G. Wood (United Kingdom), B. Naef-Daenzer (Switzerland), P.A. Prince and J.P. Croxall (United Kingdom)
(*Journal of Avian Biology*, 31: 278–286 (2000))

WG-EMM-01/68	Report of the Workshop for the International Coordinated Survey in conjunction with CCAMLR-2000 Survey Delegations of Japan, Republic of Korea, USA and Peru
WG-EMM-01/69	Procedure for electronic submission of WG-EMM papers Secretariat
WG-EMM-01/70	Data from krill questionnaire Secretariat
WG-EMM-01/71	Aide memoire: Balleny Islands Delegation of New Zealand
WG-EMM-01/72	Do fish prey size affect the foraging patterns and breeding output of the Antarctic shag <i>Phalacrocorax bransfieldensis</i> ? R. Casaux and A. Baroni (Argentina)
WG-EMM-01/73	Consideration of major issues in ecosystem monitoring and management I. Everson (United Kingdom)
Other Documents	
SC-CAMLR-XIX/5	Regional surveys of land-based predators, and a future synoptic survey of land-based predators report of correspondence on behalf of the SC-CAMLR Working Group on Ecosystem Monitoring and Management Delegation of Australia
SC-CAMLR-XIX/BG/10	Additional data on anti- <i>brucella</i> antibodies in <i>Arctocephalus gazella</i> from Cape Shirreff, Livingston Island, Antarctica O. Blank et al. (<i>CCAMLR Science</i> , 8: 147–154 (2001))

REVISED DRAFT FISHERY PLAN FOR THE KRILL FISHERY IN AREA 48

CCAMLR Fishery Plan – Draft		Species: Krill Area 48		Closed Fisheries
Fishery details Area, subarea or division, or subdivision: Gear types:		CCAMLR Season		
		1999/2000	2000/2001 (expectations)	
Conservation measure adopted?		32/X	32/XIX	
1. Harvest Controls Closed areas Open and/or closed seasons Total allowable catch Effort limitation (no. of vessels, Member States etc.) Fish size limits By-catch limits		None All-year fishing Overall 1 500 000 t <u>Trigger level</u> 620 000 t None None	None All-year fishing Overall 4 000 000 t <u>Trigger level</u> 620 000 t <u>Subarea limits</u> 48.1: 1 008 000 t 48.2 : 1 104 000 t 48.3 : 1 056 000 t 48.4 : 832 000 t None None	
2. Data Reporting Requirements <u>Catch Data</u> Monthly reporting (CM 32/XIX) <u>Catch and Effort Reporting System</u> 5-day reporting period (CM 51/XIX) 10-day reporting period (CM 61/XII) Monthly reporting period (CM 40/X) <u>Fine-scale Data</u> Catch and effort data (CM 122/XIX) Biological data (CM 121/XIX) <u>Other Data</u> STATLANT data Scientific observer data Data collection plan Research plan Fishery operations plan		Yes None None None None None Yes None None None None	Yes None None None None None Yes None None None None	
2a. Scientific Observer Requirements International CCAMLR scientific observer requirements Other observer requirements Any other provisions (specify)		None None None	None None None	
3. Notification Requirements Notification required? Notification deadline Notifications received by CCAMLR Notification preferences (i) Research and fishery operations plan The nature of the proposed fishery including target species, methods of fishing, proposed region.		None na na None	None na na None	

<p>Any minimum level of catches that would be required to develop a viable fishery. Biological information from comprehensive research/survey cruises, such as distribution, abundance, demographic data and information on stock identity. Details of dependent and associated species and the likelihood of them being affected by the proposed fishery. Information from other fisheries in the region or similar fisheries elsewhere that may assist in the valuation of potential yield. Other requirements (specify)? (ii) Limits on fishing capacity and effort. (iii) The name, type, size, registration number and radio call sign of each vessel participating. (iv) Other notification preferences (specify)?</p>	<p>None Required None</p>	<p>None Required None</p>	
<p>4. Data Collection Plan (in addition to standard CCAMLR reporting requirements) Data collection plan required/prepared? Data collection plan contents A description of the catch, effort and related biological, ecological and environmental data required to undertake an evaluation of the status and potential of the fishery, in accordance with Article II. A plan for directing fishing effort during the exploratory phase. An evaluation of the time scales involved in determining the responses of harvested, dependent and related populations to fishing activities.</p>	<p>None na</p>	<p>None na</p>	
<p>5. Fishing Activity Total allowable catch Total reported catch No. of vessels Days fished Period of season Major by-catch species</p>	<p>1 500 000 t 104 259 t (STATLANT data) 14 Incomplete data Jul 1999–Jun 2000 None reported</p>	<p>4 000 000 t 45 223 t (STATLANT data) 9 Incomplete data Dec 2000–Nov 2001 None reported</p>	
<p>6. Data Reported to CCAMLR Monthly catch reports (CM 32/XIX) Monthly effort reports Catch data by fine-scale rectangle or smaller rectangle Effort data by fine-scale rectangle or smaller rectangle Haul-by-haul catch and effort data Biological data by fine-scale rectangle or smaller rectangle Observer data STATLANT data</p>	<ul style="list-style-type: none"> • Reported by all Contracting Parties • Reported by some Contracting Parties • Reported at varying levels of spatial and temporal resolution • Reported by some Contracting Parties • Not reported • Not reported <p>One trip Reported by all Contracting Parties</p>	<p>Two trips – data to be submitted To be submitted</p>	
<p>7. Assessment Most recent assessment performed? Method of discounting for lapse since last assessment</p>		<p>B₀ Workshop 2000 None</p>	

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT
(Hobart, Australia, 8 to 19 October 2001)

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**REPORT OF THE WORKING GROUP
ON FISH STOCK ASSESSMENT**
(Hobart, Australia, 8 to 19 October 2001)

INTRODUCTION

1.1 The meeting of WG-FSA was held at CCAMLR Headquarters, Hobart, Australia, from 8 to 19 October 2001. The Convener, Mr R. Williams (Australia), chaired the meeting.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1 The Convener welcomed participants to the meeting. He advised, with regret, that colleagues Drs E. Barrera-Oro, E. Marschoff and O. Wöhler from Argentina, and Prof. G. Duhamel from France, would be unable to attend this year's meeting.

2.2 The Convener introduced the Provisional Agenda which had been circulated prior to the meeting. Following discussions, it was agreed that the following subitems be added:

- 3.2.3a 'Potential for Toothfish Fisheries';
- 3.2.4a 'Structure of Scientific Observer Reports';
- 3.3.1 'Workshop on Estimating Age in Patagonian Toothfish';
- 3.3.2 'Results of WAMI relating to Biology, Demography and Ecology';
- 4.2.4 '*Dissostichus eleginoides* Prince Edward and Marion Islands (Subarea 58.7)';
- 4.2.5 'Results of WAMI relating to the Assessment and Management of *Champscephalus gunnari*'; and
- 11.3 'Publication Matters'.

Consequently, existing subitems '*Champscephalus gunnari* South Georgia (Subarea 48.3)' and '*Champscephalus gunnari* Heard Island (Division 58.5.2)' were renumbered as 4.2.6 and 4.2.7 respectively.

2.3 With these changes the Agenda was adopted.

2.4 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.

2.5 The report was prepared by Mr B. Baker (Australia), Dr E. Balguerías (Spain), Dr M. Belchier (UK), Dr A. Constable (Australia), Mr J. Cooper (South Africa), Prof. J. Croxall (UK), Dr I. Everson (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), Dr D. Miller (South Africa), Ms J. Molloy (New Zealand), Dr G. Parkes (UK), Ms K. Rivera (USA), Dr K. Sainsbury (Australia), Mr N. Smith (New Zealand), Ms E. van Wijk (Australia) and the Secretariat.

REVIEW OF AVAILABLE INFORMATION

Data Requirements Endorsed by the Commission in 2000

3.1 Dr D. Ramm (Data Manager) reported on the availability of data at the meeting and major developments in the CCAMLR Data Centre during the intersessional period.

3.2 Reconciliation of catch and effort reports with fine-scale data from CCAMLR fisheries in the 2000/01 season was undertaken during the year to assess the completeness of the fishery datasets. The majority of the fishery and observer data from the 2000/01 season was available at the meeting, and details were reported in WG-FSA-01/6, 01/20, 01/21, 01/42, WAMI-01/15 Rev. 1 and CCAMLR-XX/BG/7 Rev. 1.

3.3 All catch and effort reports, fine-scale data and scientific observer logbooks and reports had been submitted for the 2000/01 season, with the exception of:

- (i) two five-day catch and effort reports (September A and B) from a Russian trawler operating in the fishery for *C. gunnari* in Subarea 48.3;
- (ii) one monthly catch and effort report (August) from the Polish fleet trawling for krill in Area 48;
- (iii) fine-scale catch and effort data from the fishery for *D. eleginoides* in Subarea 48.3 (Chile: 1 monthly period; Republic of Korea: 4 monthly periods, Russia: 3 monthly periods and Ukraine: 4 monthly periods); and
- (iv) observer data from fisheries for *D. eleginoides* in Subarea 48.3 (1 logbook), Subarea 88.1 (1 logbook and 1 report) and Division 58.5.2 (1 logbook and 2 reports).

3.4 A number of vessels fished late in the 2000/01 season, or are still fishing, in some of the fisheries, and data from these operations are yet to be submitted.

3.5 Major work in the Data Centre in support of WG-FSA and ad hoc WG-IMALF during the 2000/01 intersessional period has included:

- assistance with the development and operation of the CDS database – this work included further development of the database structure and the addition of a web-based interface;
- further development and consolidation of data processing and extraction routines – this work included the initial development of a routine to transfer data from the electronic data forms to the database;
- further development of data queries in the research survey database to facilitate extraction of data for CMIX and TrawlCI for all surveys; and
- further transfer and validation of data from old or non-CCAMLR formats to the new research survey database.

3.6 As reported previously (e.g. WG-FSA-00/11), the use of CCAMLR research survey data has been impeded, historically, by:

- storage of data in the format used for holding fine-scale catch and effort data, with the resultant loss of research-specific fields (e.g. ground distance, trawl net width);
- the lack of an agreed CCAMLR format for submitting research data; and
- the absence of a mechanism whereby data originators can provide corrections and updates to the CCAMLR data.

Further work is planned in 2001/02 on the new research survey database so as to complete the transfer and validation of available data in old or non-CCAMLR formats to the new format, develop a CCAMLR format for the submission of research data, and liaise with data originators so that corrections and updates may be provided as a routine. The Working Group's priority for future data requirements is described under 'Future Work'.

Fisheries Information

Catch, Effort, Length and Age Data Reported to CCAMLR

3.7 Eight fisheries, including three exploratory fisheries, were prosecuted under conservation measures in force during the fishing season of 2000/01 (CCAMLR-XX/BG/7 Rev. 1):

- exploratory jig fishery for *Martialia hyadesi* in Subarea 48.3;
- exploratory longline fishery for *Dissostichus* spp. in Subarea 88.1;
- exploratory trawl fishery for *Chaenodraco wilsoni* in Division 58.4.2;
- longline and pot fishery for *D. eleginoides* in Subarea 48.3;
- trawl fishery for *C. gunnari* in Division 58.5.2;
- trawl fishery for *C. gunnari* in Subarea 48.3;
- trawl fishery for *D. eleginoides* in Division 58.5.2; and
- trawl fishery for *Euphausia superba* in Area 48.

3.8 With the exception of the fisheries for krill in Divisions 58.4.1 and 58.4.2 (for which the 2000/01 season started on 1 July 2000 and ended on 30 June 2001), all fishing seasons in 2000/01 fell between 1 December 2000 and 30 November 2001. Catches of target species reported by the start of the meeting are summarised in Table 1.

3.9 Catches reported from the Convention Area during the 2000/01 split-year (1 July 2000 to 30 June 2001) are summarised in Table 2. These catches, reported in STATLANT data submitted by 7 October, included catches taken within South Africa's EEZ in Subareas 58.6 and 58.7, and within France's EEZ in Subarea 58.6 and Division 58.5.1 which are not subject to conservation measures. WG-FSA agreed that the presentation and/or utilisation of information contained in Table 2 by the Working Group and the Scientific Committee would be reviewed at the Working Group's next meeting.

3.10 Catches of target species for the immediate past fishing season (1999/2000) reported to WG-FSA in 2000 (SC-CAMLR-XIX, Annex 5, Table 1) were based on catch and effort reports submitted to the Secretariat by 7 October 2000. WG-FSA agreed that revised catches from the immediate past season be presented at future meetings.

3.11 Length-frequency data submitted during 2000/01 were collected mostly by scientific observers, and submitted in their logbooks and reports. No age data were submitted.

Estimates of Catch and Effort from IUU Fishing

Landings and Catches from the Regulated and Unregulated Fishery

3.12 The green weight of *Dissostichus* spp. caught by Members and Acceding States both within and outside the Convention Area was reported as 43 531 tonnes for the 2000/01 split-year (Table 3). This constituted an increase of 11 773 tonnes from the 1999/2000 split-year (31 758 tonnes) (SC-CAMLR-XIX, Annex 5, Table 3). However, the latter did not include a reported catch of 5 765 tonnes of *D. eleginoides* provided by Mauritius immediately following the Commission meeting in 2000. It was not possible to allocate this catch either within or outside the Convention Area.

3.13 Reported catches for 2000/01 from waters outside the Convention Area totalled 30 152 tonnes (Table 3) compared with 11 553 tonnes in 1999/2000. Much of the former reported catch appears attributable to increased catch reporting (especially from Area 41) arising from entry into force of the CDS in May 2000.

3.14 WG-FSA again used the approach employed in recent years to estimate the magnitude of IUU fishing effort and catches in various subareas and divisions during the 2000/01 split-year. The results of this analysis are presented in Tables 4 and 5. The estimated total catch for all subareas and divisions within the Convention Area in 2000/01 was 20 870 tonnes, comprising 13 271 tonnes of reported catch and 7 599 tonnes of estimated unreported catch (Table 5). These figures compared with a total estimated catch of 19 937 tonnes, a reported catch of 14 441 tonnes and an estimated unreported catch of 6 546 tonnes for 1999/2000. The estimated unreported catch within the Convention Area was some 39% of the total catch in 2000/01 compared with 32% in 1999/2000.

3.15 The estimated catch outside the Convention Area in 2000/01 was 30 151 tonnes, giving a total estimated catch of *Dissostichus* spp. of 51 129 tonnes including 108 tonnes from an unknown area (Table 5).

3.16 Reported, estimated unreported and estimated total catches since the 1996/97 split-year in various subareas and years are presented in Table 6. The estimated total catch from the Indian Ocean during that period was 122 136 tonnes compared with 19 597 tonnes at South Georgia (Table 7). The proportion of unreported catches in the two areas is 54% and 36% of the reported catches respectively.

CDS-derived Catches by Area

3.17 CDS-reported landings from Area 51 (Indian Ocean adjacent to the Convention Area boundary) in the 2000/01 split-year are presented in Table 8. Some 73% of these landings were confined to Port Louis. The Working Group noted that this information has improved knowledge on the potential location of the fishery as well as its operational characteristics. Such information is extremely valuable in improving estimates of total removals of *Dissostichus* spp. from both within the Convention Area and adjacent areas.

3.18 The Working Group agreed that it would be useful to extract such information from the CDS as that presented in Table 8 for ports close to Areas 41 and 87.

3.19 Subject to the views expressed in paragraph 3.17 above, WG-FSA agreed that available information from the CDS suggests that Area 51 has assumed importance as a source of *D. eleginoides*. It was not possible to conclude whether this observation was a true indication of increased catch in Area 51 or whether it was a reflection of improved information on catch location arising from improved reporting through the CDS.

3.20 Estimated live weights of *Dissostichus* spp. from CDS data by month for 2000 and 2001 are detailed in Table 9. The areas with the highest attributed catches in 2001 were in Area 51 (12 028 tonnes) followed by Area 41 (7 115 tonnes), Subarea 48.3 (3 992 tonnes), Area 87 (3 681 tonnes), Division 58.5.1 (2 585 tonnes) and Division 58.5.2 (1 614 tonnes).

3.21 The Working Group agreed that the data in Table 9 are potentially useful as they highlight the contribution of the CDS to improving information on the origin of *Dissostichus* spp. These data indicate significant levels of catch during 2000/01 from outside the Convention Area, in particular Area 51. The Working Group noted that it would be important to separate catches taken outside the Convention Area into those taken within national EEZs, and those taken on the high seas. For example, the bulk of the catches reported for Area 41 is from EEZs in the Southwest Atlantic, while catches reported for Area 51 are apparently from the high seas.

3.22 The Working Group noted that the mean CPUE for *D. eleginoides* implied by CDS data for Area 51 was some 23% higher than that in Subarea 48.3, and 44% higher than in Subarea 58.6 (a CCAMLR subarea adjacent to Area 51) during both 2000 and 2001. This suggests that Area 51 may be more productive than other areas. However, compared with other potential toothfish fishing grounds within the Convention Area, Table 10 shows that areas of likely toothfish productivity in Area 51 are relatively small. The Working Group agreed that there may be some inaccuracies in the CDS-reported *Dissostichus* spp. catches from Area 51. CDS-reported catches from Area 51 may be misreporting of catches taken elsewhere. This could imply transshipment of catches at sea rather than accounting for catches actually originating in Area 51.

3.23 The Working Group was unable to comment further on possible links between the productivity of Area 51 and reported catches attributed thereto. Members were urged to examine the situation further and the Working Group agreed to review the matter at its 2002 meeting.

3.24 The Working Group noted the apparent time lag associated with reporting of CDS data. For example, there was a total of 879 tonnes reported for Subarea 48.3 in September

2001 after the closure (on 31 August) of the longline fishery in that area. Time lags in the compilation of CDS data compared with reported catches for *D. eleginoides* in Area 48 during 2000 and 2001 are shown in Table 11. Substantive agreement is also shown between reported catch and CDS landings data, especially for 2001. This suggests that CDS landings (at least in Area 48) serve as a useful proxy for information on catches.

3.25 The Working Group recommended that future examination of information of the type presented in Table 9 would be useful to highlight possible cycles in fishing patterns.

Total IUU Catch and IUU Catches in Assessments

3.26 WG-FSA noted that, consistent with its observation last year (SC-CAMLR-XIX, Annex 5, paragraph 3.27), illegal activities around the Prince Edward Islands have fallen to very low levels. This is probably the result of very low *D. eleginoides* stock levels resulting in decreasing catches within the South African EEZ (see paragraph 4.121). It was agreed that any future recovery of such stocks around the Prince Edward Islands will be crucially dependent on the extent of future IUU catches in the region.

3.27 Illegal fishing still persists in the waters adjacent to the Crozet and Kerguelen Islands as well as around Heard Island.

3.28 As already noted, the total IUU catch for *Dissostichus* spp. in the Convention Area was 7 599 tonnes in 2000/01 compared with 6 546 tonnes in 1999/2000 (Table 5).

3.29 The Working Group agreed that the introduction of the CDS, and the submission of additional data by Mauritius in particular, are likely to have improved estimates of total toothfish removals and IUU catches.

3.30 It was also agreed that estimates of IUU catches of *Dissostichus* spp. are still only minimum estimates. Any potential relationship between current IUU estimates and catches attributed to Area 51 (paragraph 3.22) increases the uncertainty of present estimates. Therefore IUU estimates for 2000/01 should again only be compared with previous years with caution.

3.31 The IUU input assessments for *D. eleginoides* fisheries used the estimates of unreported catches of 300 tonnes for Subarea 48.3 (South Georgia) and 1 649 tonnes for Division 58.5.2 (Heard Island).

Recommendations to the Scientific Committee

3.32 The Secretariat should be tasked with providing information in time for the Working Group's 2002 meeting similar to that used here to estimate the extent of *Dissostichus* spp. catches both within and outside the Convention Area using CDS, vessel sightings and reported catch data.

3.33 The Scientific Committee's and Commission's attention is drawn to the persistent high levels of unreported *Dissostichus* spp. catches, although the general level of uncertainty surrounding estimation of such catches appears to have been reduced as a result of the implementation of the CDS.

3.34 The Scientific Committee's and Commission's attention is also drawn to the apparent and growing attribution of *Dissostichus* spp. catches to Area 51.

Scientific Observer Information

3.35 The available information collected by scientific observers was summarised in WG-FSA-01/20, 01/21, 01/22 and 01/42. International and national scientific observers provided 100% coverage of fishing operations of vessels targeting *Dissostichus* spp., *C. gunnari*, *C. wilsoni*, *E. superba* and *M. hyadesi* in the Convention Area during 2000/01. Reports and logbook data were submitted from a total of 60 cruises, comprising 38 longliners, 16 trawlers, 5 pot vessels and 1 jigger. These cruises covered longlining in Subareas 48.3, 58.6, 58.7 and 88.1; trawling in Area 48, Subareas 48.1, 48.3 and Divisions 58.4.2 and 58.5.2; and 'potting' and jigging in Subarea 48.3. Scientific observers were deployed by 12 Members: Argentina (1), Australia (6), Brazil (1), Chile (2), France (2), Japan (1), New Zealand (2), South Africa (16), Spain (3), Ukraine (4), UK (18) and Uruguay (4). Details of the observations are given in Table 12.

3.36 All but four of the logbooks (two from the longline fishery and two from the trawl fishery), and all but five of the observer cruise reports (one from the longline fishery and four from the trawl fishery) were submitted before the start of the meeting. All logbooks were prepared using the standard CCAMLR format and most of them were presented using the CCAMLR electronic logbook forms (Excel spreadsheet format) that allowed a faster entry into the CCAMLR database.

3.37 The Working Group also noted the good quality of all the observer cruise reports which were submitted in accordance with the guidelines laid out in Part 1, Section 5 of the *Scientific Observers Manual*. These reports contained detailed information on vessel characteristics, cruise itinerary, fishing gear and fishing operations, meteorological conditions and biological observations carried out on fish. Comprehensive information on seabird incidental mortality, marine mammal observations, garbage disposal and loss of fishing gear at sea is also provided (see Section 7).

3.38 Despite the quality and the utility of the information contained in the abovementioned cruise reports, the Working Group felt that there was a need for improving their precision and clarity in order to obtain a better and quicker understanding of fishing operations as well as of compliance with conservation measures in force (see paragraphs 7.94 to 7.99). A subgroup was therefore tasked to look at different types of presentation to improve the current format of the observer report.

3.39 The subgroup reviewed the guidelines for the observer report as set out in Part 1, Section 5 of the *Scientific Observers Manual*. A new mixed format of tick-boxes that must be filled in with key relevant information for the Working Group, and free text boxes where the observers may express their observations in a more extended way, was recommended. The

first draft of this observer report template should be prepared by the Secretariat by the end of November 2001 for comments from technical coordinators and members of the Working Group particularly involved or interested in the work of observers. The final version of the template should be available to technical coordinators for use by scientific observers by the end of February to be tested in the field.

3.40 The subgroup also noted that feedback on issues such as the use of various materials supplied by CCAMLR (see paragraph 7.5) could also easily be built into such a standard report.

3.41 The Working Group acknowledged the results of the subgroup deliberations and recognised the utility of the proposed approach. However it was noted that the optimisation of the new format could not be concluded immediately and that several Working Group meetings may be needed before obtaining the desired product.

3.42 The Working Group also noted the need for the correct understanding of the information that is requested from the observers and therefore recommended that the new observer report template, as well as the CCAMLR electronic logbooks should be translated into all the official languages of the Commission. This would also better facilitate rapid adoption of the new forms across all Members. The tick-box elements of the form could also be rapidly summarised across languages without translation.

3.43 Collection of biological samples of fish by observers continued to be done in accordance with research priorities identified by the Scientific Committee in previous years (by-catch, length frequency, weight at length, maturity, CF, otolith/scales).

3.44 Considering the tables prepared by the Secretariat which contain summaries of the data and biological material gathered by scientific observers during the last season (Table 13) and accumulated over the years of scientific observations (Table 14), it is clear that the amount of information and material already held at the CCAMLR database or deposited at the different laboratories in the Member countries is huge.

3.45 This information and material concerns not only target species but also by-catch and discarded species in the different fisheries and areas, subareas and divisions within the Convention Area. Their quality and quantity is not homogeneous and there are even data and material from species that have been identified only to a genus, family or higher taxonomic level.

3.46 The Working Group recognised the great importance of this information and discussed its usefulness as a basis for studies relevant to the objectives of the Commission and for academic studies that may be carried out by research institutions. Nevertheless, the Working Group was unable to comment further on this matter and recommended that a workshop should be held prior to, or during, next year's meeting to adequately discuss the priorities of the observers' tasks and the use of the information and the material collected by them.

3.47 The issue of the observers' priority tasks was also discussed by WG-IMALF. Details of their deliberations are contained in Section 7.

3.48 There were no significant problems reported by observers on the use of the *Scientific Observers Manual*. Some observers continued to report problems with the completion of

Forms L3 'Daily Work Schedule of Observers' and L4 'Estimating Seabird and Marine Mammal Abundance'. However, for the two last years it has been stated that the completion of these forms is not compulsory (SC-CAMLR-XVIII, Annex 5, paragraphs 3.44(ix) and (x); SC-CAMLR-XIX, Annex 5, paragraph 3.46). It was reiterated that technical coordinators should continue to bring these changes to the attention of the observers.

3.49 Other feedback from some observers in their reports related to the question of the random sampling of the longline during the hauling (SC-CAMLR-XIX, Annex 5, paragraph 3.48) and the need for simple keys for the identification of fish, similar to those already prepared and in use for seabirds. Both matters have been specifically addressed in the course of the Working Group by two ad hoc subgroups. The results of the deliberations of these groups are contained in paragraphs 3.53 to 3.67 and 4.287 to 4.297.

3.50 The Working Group thanked all scientific observers for their work during the 2000/01 fishing season and for the great deal of very useful information and material collected. In doing so, it also recognised the importance of technical coordinators participating at the meetings of the Working Group. The Working Group discussed the opportunity of organising a workshop for technical coordinators and scientific observers to deal with matters of their common interest, including the revision of the list of priorities of the observers' tasks.

3.51 The Working Group recommended that the participation of technical coordinators should be encouraged for future meetings and that other modalities of cooperation, such as the exchanges of training manuals prepared at a national level, the participation of technical coordinators in training courses conducted by other Members etc., should be sought as a goal to try to harmonise as much as possible the methods and the criteria followed by the observers in their work.

3.52 Finally, the Working Group highlighted the potential for the use of observers in all longline, trawl, pot and jigging fisheries under the CCAMLR Scheme of International Scientific Observation and congratulated the Secretariat for the excellent job carried out during the intersessional period in processing and analysing the information related to this Scheme. This assisted considerably the work of the Working Group at the meeting.

Sampling Catches from Longlines

3.53 In 1999 WG-FSA recognised that there were a number of different sampling protocols in use for observer subsampling of longline catches. Some use 'gear-unit' based approaches, based on WG-FSA-98/60, in which units of the longline are defined and randomly sampled as they are hauled. Others use 'time-unit' based approaches, based on WG-FSA-98/58, in which the expected haul time is divided into units and randomly sampled. In 1999 WG-FSA also received reports that some observer teams had experienced difficulties with the implementation of the gear-unit based approach, which is generally more complex than the time-unit approach. In 2000 WG-FSA requested that these issues be examined so as to allow revision and standardisation of the methods used by observers for sampling longline catches.

3.54 An intersessional subgroup of WG-FSA compiled information on the current practices by observers (reported in WG-FSA-01/50) and the issues relating to sampling protocols were further examined by a subgroup at this year's meeting of WG-FSA.

3.55 Current practices for observer sampling of longline catches differ among observers designated by various Members. There were many reports of difficulties in finding a practical work plan for sampling the longline catch and in finding a reasonable division of effort between sampling of the target species and sampling for by-catch and other ecological interactions (i.e. the interactions with, or effects of, fishing on other species).

3.56 The subgroup identified the need to develop specific recommendations for WG-FSA in 2002 on three issues:

- (i) the subsampling protocol;
- (ii) the sampling fraction; and
- (iii) the balance of observer effort directed towards fishery target species versus ecological interactions.

3.57 An outline of the intersessional work needed to address each of these was developed. The subgroup also identified some interim advice for observers to use.

3.58 It was recommended that the subgroup develop the parameters that will be calculated from the observer program to support the work of WG-FSA, the statistical properties that are desired in each parameter, and the priority assigned to each parameter. These parameters would be reviewed each year. WG-FSA should receive a standard report each year providing the estimates from the observer program for the elements identified to support the review and update process each year.

3.59 Intersessional analysis on the subsampling protocol should address the question of whether the gear-unit based approach, as described in WG-FSA-01/7 and WG-FSA-98/60, is a statistically sound methodology but difficult to implement, while the time-unit based approach is more easily implemented but may not sample the catch randomly. The existing data should be analysed, and used in conjunction with theoretical considerations, to determine for the time-unit based approaches:

- (i) the extent of bias under current longline operations and possible future operations;
- (ii) the appropriate methods to account for varying sampling fractions across hauls; and
- (iii) whether there is a reasonable method of statistically correcting for the bias, if the level of bias is important under current or possible future longline operations.

The subgroup was requested to advise on the application of the gear-unit versus the time-unit based approaches.

3.60 A major use of the information from longline subsampling is to estimate the quantity of by-catch and whether the by-catch exceeds a specified limit. Scientific advice is required on the sampling fraction (i.e. the proportion of longline hauls that are observed and the proportion of each individual observed haul that is subsampled) to reasonably meet this need. The existing data should be analysed to determine the relationship between the sampling fraction and:

- (i) the precision of the estimated number caught; and
- (ii) the probability of concluding that the number caught is greater than the specified limit.

3.61 This analysis should be repeated for the key by-catch species, and the specified limits should be based on CCAMLR recommendations where these exist, or on reasonable interpretation of the CCAMLR by-catch principles where these specific CCAMLR limits have not yet been set.

3.62 Based on these analyses the subgroup should recommend a subsampling fraction for use in general, and provide procedures for varying it in certain circumstances as necessary.

3.63 There are two related issues regarding the balance of observers' effort directed to fishery or ecological interactions:

- (i) the allocation of time between sampling the fishery target species and sampling to measure ecological interactions; and
- (ii) specification of the sampling activities within each.

3.64 This recognises that the sampling of target and by-catch species mostly draws from the aggregated catch from a haul, is concerned with estimating properties that are not expected to vary systematically within hauls (e.g. the distribution of age conditional on length), and uses the total catch to scale up estimates. By contrast, the ecological interactions sampling does rely strongly on observing and subsampling portions of the haul and scaling up the observations by measures of fishing effort. Consequently, the issue of observing and subsampling portions of the haul is important in this context.

3.65 Evaluation of the appropriate balance of effort requires full specification of the statistical requirements for all the proposed monitoring (e.g. level of precision required). Rather than attempt to determine the balance based on these requirements, which are poorly known at this stage, the analysis should, in the first instance, examine the consequences of the balance that has evolved over the past few years in situations of one and two observers. In both cases the effort is about equally divided between observing fishery target species and ecological interactions.

3.66 The Working Group requested the subgroup to identify the high-priority observations for each fishery target species and ecological interactions, and calculate the statistical properties of the parameters of interest, based on about equal effort to the two types of sampling and for one and two observers. The resulting estimates can then be compared with the statistical requirements with respect to these parameters. This would provide the basis for identifying major failings of the present sampling protocols and effort allocations, and for suggesting desired changes.

Interim Advice to Observers

3.67 Until such time as the intersessional work above is completed, it is recommended that observer sampling be based on the following:

- (i) For most biological aspects of the target species (e.g. length and age at length) which are unlikely to show systematic variation within a gear unit and are aimed at providing an estimate relating to the aggregated catch from each haul, two alternative methods of sampling are appropriate:
 - (a) based on sampling from the aggregate catch, e.g. samples taken from the aggregated catch in the processing room and weighted up to the total catch of that haul; or
 - (b) a simplified method of sampling gear units, for example sampling the first n fish from sampling unit y (where y is randomly selected and n is a constant number).
- (ii) Most sampling for by-catch and ecological interactions is aimed at providing an estimate of a catch rate per set, which is then to be weighted up by the number of sets to represent the total catch and must ensure that the samples are representative of the full extent of the longline. The sampling protocol would be all hooks in gear unit y are observed (where y is randomly selected).
- (iii) Where gear-unit based sampling is undertaken, a form is needed that records the number of gear units in the haul, the number of gear units observed and the elements that were observed in that for each observed gear unit (e.g. birds, fish by-catch, invertebrate by-catch, bait condition, hook loss), and the units of measurement for each element observed (e.g. numbers, weight, presence/absence).
- (iv) Based on accumulated experience to date, the time allocation should be about 60% observing target species and 40% observing ecological interactions.
- (v) A table of the parameters to be estimated from data collected by the observer program, as outlined in paragraph 3.66, should be provided and updated by WG-FSA each year.

Sampling Catches from Trawlers

3.68 A protocol to use for random subsampling catches from research trawl surveys was described in WG-FSA-01/68. The Working Group considered that this might also have some application for observers sampling in commercial trawl fisheries. The subgroup was requested to investigate this and other components of sampling from trawl catches.

Conversion Factors

3.69 Analyses carried out on about 6 000 CF records for individual fish (CCAMLR observer database) show that the data are highly variable, with values mostly ranging from around 1.2 to around 2.5. This variability is apparently not explained by differences in CFs between products (HAG and HGT), sexes or years. The highest variability is observed at the

vessel level (Figure 1) and a definite trend is noticeable according to month, with values reaching a maximum in August (Figure 2). There are also differences in the mean CF values by statistical area.

3.70 High variability in the CFs may result in part from inter-vessel differences in processing practices. At least two types of cuts have been identified for removing the head of the fish: a 'straight cut' or a 'V cut' (WG-FSA-01/66). The increasing trend of CF values within a season may reflect the stage of sexual maturity of the fish. Differences in CFs between statistical areas may be due to the effect of one or more of the factors discussed above and/or to the existence of different populations.

Differences between Vessel and Observer Values of CFs

3.71 At the 1998 meeting of the Working Group it was noted that differences between CFs calculated by observers and those used by the fishing vessels to report their catches might cause a significant error in estimates of catches (SC-CAMLR-XVII, Annex 5, paragraphs 3.74 to 3.76). A draft protocol for collecting observer data on CFs was prepared at that meeting (SC-CAMLR-XVII, Annex 5, Appendix D). The Scientific Committee endorsed this proposal and the procedure was evaluated during the next fishing season (SC-CAMLR-XVII, paragraph 3.6).

3.72 Analyses were carried out using those data during the Working Group meeting in 1999. Results showed that there were no significant differences in CFs between male and female fish or between headed and gutted product (HAG) and headed, gutted and tailed product (HGT) (SC-CAMLR-XVIII, Annex 5, paragraphs 3.86 and 3.87). However, differences between CFs used by the vessels and those calculated by the observers remained important.

3.73 The Working Group considered that the differences might be due to differences in definitions of products by vessel skippers as opposed to scientific observers and agreed that the fish being sampled by the observers should be subject to the same processing methods as used during commercial processing of the catch (SC-CAMLR-XVIII, Annex 5, paragraphs 3.90 and 3.91). It also recommended that the Scientific Committee consider steps to ensure that appropriate CFs were used when reporting catches to CCAMLR (SC-CAMLR-XVIII, Annex 5, paragraph 3.93).

3.74 As a result of those requests, the Scientific Committee recommended that vessel skippers adopt the procedure set out in the *Scientific Observers Manual* to calculate CFs at the beginning of the season (SC-CAMLR-XVIII, paragraph 5.50). This resulted in a better agreement between the vessel and the observer CFs in the 1999/2000 fishing season (SC-CAMLR-XIX, Annex 5, paragraph 3.63).

3.75 Information provided by scientific observers on the CFs during the 2000/01 fishing season is summarised in Table 15. Only 45 cruise reports of the 60 cruises conducted during the season contained information on CFs. Among them 30 reports included data provided by both the vessel skipper and the observer, 14 provided only the observer CFs and one provided only the vessel CF. The comparison between the 30 simultaneous values of vessel and

observer CFs shows that only three were equal and that in most of the cases (20), the CFs calculated by the observers were higher than those used by the vessels. Only seven of the CFs used by the vessels were higher than their corresponding observer CFs (Figure 3).

3.76 The Working Group noted that the reported data indicate that differences remain between CFs calculated by vessel skippers and observers. The Working Group also recognised with concern the potential difficulties inherent in inconsistent CFs and the implications of this problem for the calculation of accurate catch levels, which is particularly relevant to the assessment work.

3.77 The Science Officer also noted that the use of CFs is important for the analysis of CDS data. Green weight is being used as a standard unit in the analysis. This is related to the necessity to reconcile weights of landings with weights of fish exported and re-exported. Landed fish comprise a number of fish products, each having a specific CF. At present, the CDS uses a set of standard CFs agreed by the Scientific Committee in the past. Therefore, information that CFs of fish products vary between fishing companies is of importance. If more information becomes available, it would allow the CDS to use area/subarea/division-specific CFs. The Science Officer also recalled that the use of green weight as a standard unit assists in the evaluation of the total catch of *Dissostichus* spp. and, in particular, in the evaluation of levels of IUU fishing for *Dissostichus* spp. inside and outside the Convention Area.

3.78 The Working Group reiterated that specific guidelines were provided to both the observers and the vessel skippers for calculating CF values, namely:

- (i) the continuation of the program by observers using the current format as in the *Scientific Observers Manual* and concentrating efforts on the product constituting the largest fraction of the fish being processed (SC-CAMLR-XIX, Annex 5, paragraph 3.64);
- (ii) to conduct the calculations of CFs reported by scientific observers on a fish-by-fish basis (SC-CAMLR-XIX, Annex 5, paragraph 3.65);
- (iii) the procedure set out in the *Scientific Observers Manual* should be adopted by vessel skippers as a standard method for measuring CFs and the cooperation between scientific observers and vessel skippers should be encouraged in the establishment of CFs to avoid duplication of work and possible inconsistencies in results (SC-CAMLR-XVIII, paragraph 5.50); and
- (iv) CFs estimated at the start of each fishing trip using the standard procedure should be used in the calculation of total catches to be reported to the Commission during the season (SC-CAMLR-XVIII, paragraph 5.51).

3.79 The Working Group urged observers and skippers to strictly follow the above guidelines. Observers were also urged to record the values of CFs used by the vessel along with their own observations, and submit these in their scientific observer reports.

3.80 The Working Group recommended that forms dealing with CFs in the *Scientific Observers Manual* should be modified to avoid misunderstandings on the processing types and to consider different methods within the same process (e.g. types of cuts).

3.81 The Working Group encouraged Members to undertake detailed analyses of CFs reported by vessels and observers during the intersessional period to better understand the patterns of differences and what factors may be causing them. It also recommended theoretical studies to be carried out in an effort to derive better estimates of the sampling precision of procedures to be applied in CF calculation.

3.82 The Working Group recognised that potential deviations may occur in the estimation of actual green weight catches by fishing vessels during the fishing season because the CFs seem to change according to the maturity stage of fish. Several options for periodically updating CFs during the season were discussed, along with procedures for timely submission of these data to the Secretariat.

3.83 The Working Group therefore recommended that the Scientific Committee consider steps to ensure that CFs are regularly and routinely evaluated throughout the season in order to adequately convert catches reported to CCAMLR into their corresponding green weight.

Research Surveys

3.84 WG-FSA-01/72 presented the results of a pilot bottom trawl survey carried out in the South African EEZ around the Prince Edward Islands in April 2001. The maximum operating depth of the survey vessel was 1500 m. Over 90% of the survey area was deeper than 1500 m and could not be surveyed by bottom trawl. Depths less than 1500 m were mainly restricted to 28 hills and seamounts. This, in combination with a paucity of bathymetric data and the roughness of the seabed, meant that a random stratified trawl survey could not be conducted. Fifty-five trawls were completed in as representative a manner as possible by dividing the area into four sectors. There was a strong relationship between density and latitude. A preliminary biomass estimate of 1118 tonnes of *D. eleginoides* was obtained. Due to problems with the survey design, this estimate should not be regarded as either absolute or representative of the area as a whole. Bottom trawl surveys may provide usable estimates of recruits for this area, but the survey design will need to be modified if abundance estimates are required.

3.85 WG-FSA-01/33 details a US bottom trawl survey undertaken during March 2001 around the South Shetland Islands (Subarea 48.3). The survey was undertaken within the 500 m depth contour to provide biomass estimates for eight species of finfish. Species and size composition, diet and spatial distribution were also recorded. Acoustic data was logged during the survey to define the distribution of krill and seabed characteristics. The biomass estimates derived from this survey were compared to those from the 1998 US AMLR survey. The biomass of most species had decreased slightly when compared to the 1998 survey, although the 95% confidence limits were considerably decreased for most species. 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. The abundance of finfish determined in this study would not support a reopening of the commercial fishery.

3.86 WG-FSA-01/04 detailed the results of a trawl survey conducted in May 2001 in Division 58.5.2 to determine the abundance of *C. gunnari*. This survey was conducted at the same time of year and with the same gear types as the 2000 survey. The 2-year-old fish

determined in the 2000 survey were identified in this survey as a less abundant cohort of 3-year-olds. A new age-2 cohort was also evident, although this was not as abundant as the age-2 cohort noted in the 2000 survey.

3.87 WG-FSA-01/73 described the results for *D. eleginoides* from the 2001 survey in Division 58.5.2. Stratum areas were slightly different compared to those of previous surveys. The biomass on Shell Bank is no different from previous estimates. Over the series of surveys, lower biomass is evident in the shallow areas of the Heard Island Plateau with greater biomass in deeper water. This is probably a result of the size distribution of *D. eleginoides* (with a positive relationship between size and depth). The survey stratification is now well described and will most likely not change in the near future. As with icefish, age classes in the stock appear to have reasonably predictable distribution in space.

3.88 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.

Mesh/Hook Selectivity and related Experiments affecting Catchability

3.89 A declining trend in the mean lengths of toothfish caught around South Georgia and Shag Rocks from 1995 to 1999 was noted at last year's meeting. Mean lengths of toothfish were reanalysed in WG-FSA-01/48 and the same declines in mean lengths were found from 1997 to 1999. A GLM analysis showed that depth and area explained part of the variation over time, but not all of it. Mean lengths appear to be variable both within and between seasons but with no clear trend. The analysis suggests that both toothfish length distribution and fishing effort distribution is spatially and temporally heterogeneous. Effort distribution by area and depth has a significant effect on the overall length-specific selectivity of toothfish. If the fishery changes its depth of operations from year to year, then different size components of the stock are targeted, which will lead to different length-specific selectivity curves applying in different years. This paper provided preliminary estimates of length-specific selectivity curves for each year from 1997 to 2000. A consistent feature was that larger fish had a lower relative selectivity than smaller fish.

3.90 The Working Group noted that this information will be taken into account in assessments for Subarea 48.3. In addition, it noted that the results of this study would have implications for the simulation studies presented in WG-FSA-01/17 which estimates length at age of the population from commercial fishery information (see paragraphs 3.143 to 3.150).

Conversion Factors

3.91 CFs are considered in paragraphs 3.69 to 3.83.

Dissostichus eleginoides

Age and Growth

3.92 During WG-FSA in 2000 it had been thought that some of the differences in length-at-age information might be due to variations in the methods for preparing and reading otoliths that were in use. Dr Everson had been invited to organise a program to investigate this problem. He had prepared SC CIRC 00/21 arising from which it had been agreed that an otolith exchange project should be set in train immediately, leading to a workshop meeting to consider *inter alia* the results.

3.93 Three laboratories, the Central Ageing Facility (CAF) in Australia, the Centre for Quantitative Fisheries Ecology (CQFE) in the USA and the National Institute of Water and Atmospheric Research (NIWA) in New Zealand, offered to participate in the exchange program and had submitted prepared otolith samples. Each otolith was given a reference number and no further information was given to the individual readers. All otoliths in the scheme were read at each institute. The results were collated centrally and discussed at the workshop.

3.94 The Workshop on Estimating Age in Patagonian Toothfish took place from 23 to 27 July 2001 at CQFE, Old Dominion University, Norfolk, Virginia, USA. Dr Everson introduced the report of the meeting (Appendix H). The main aims of the workshop were to consider and advise WG-FSA on:

- (i) otolith collection protocols;
- (ii) otolith preparation protocols;
- (iii) agreed definitions of otolith structures used for age determination;
- (iv) quality control and quality assurance; and
- (v) validation.

3.95 The workshop advised WG-FSA that:

- (i) although age determination of *D. eleginoides* was difficult, it could be achieved using otolith sections;
- (ii) key features to be taken into account when reading otoliths are set out in Appendix H, paragraphs 4.9 to 4.15;
- (iii) three otolith preparation protocols had been discussed and were all considered suitable for the purpose;
- (iv) a routine program to exchange otoliths between laboratories should be established;
- (v) all protocols for age determination should be subject to quality assurance and quality control;
- (vi) reference sets of otoliths should be prepared in order to monitor the precision of experienced and new readers; and

- (vii) a revised otolith collection protocol should be initiated for the CCAMLR Scheme of International Scientific Observation.

These views were endorsed by the Working Group.

3.96 The workshop had agreed that further research was needed on the following topics:

- (i) determine more precisely the time interval between the formation of the primordium and the formation of the distal edge of the first translucent zone or the edge of the nucleus;
- (ii) validation of the timing of annulus deposition through Marginal Increment Analysis (MIA);
- (iii) develop other validation methods specifically to estimate accuracy; and
- (iv) follow modal progression of length density of pre-recruits from a single area with otolith ground truthing, with the aim of better defining their growth.

The Working Group endorsed these views.

3.97 In order to further the tasks identified by the workshop and outlined in paragraphs 3.95 and 3.96 above, the workshop had proposed to establish a CCAMLR Otolith Network (CON) to which all participants at the workshop, along with anyone interested in studies on otoliths of Southern Ocean fish, could join. It was noted that CON would meet initially through email correspondence, although meetings might be arranged in the margins of symposia or CCAMLR meetings. Dr K. Krusic-Golub (CAF, Australia) had initially agreed to lead CON.

3.98 The Working Group thanked Dr Everson for organising the workshop and thanked the participants for their cooperation and input.

3.99 The analysis of the age composition of juvenile *D. eleginoides* caught during the 2000 UK groundfish survey at South Georgia is reported in WG-FSA-01/16. This study directly follows the recommendation in paragraph 3.96(iv). The age of fish estimated from otolith readings closely matched modal size groups from length-frequency distributions. It was confirmed that one annulus band on the otolith corresponded to one year's growth in juvenile fish.

3.100 Several members, whilst agreeing that it was clear that successive bands were likely to indicate annual growth, suggested that the length, 19.8 cm, of the '0+' group was larger than might be expected for the first year's growth of the species of Antarctic fish. Dr Everson noted that this reflected the timing of formation of the first annulus and was in line with the workshop proposal set out in paragraph 3.96(i). Dr Kock noted that examination of scales of smaller juvenile fish revealed a weak annulus at about 10 cm length and a stronger one at about 20 cm. This would indicate that fish of about 20 cm were age class 1+. Several members suggested that this might also be investigated through examination of otolith micro-increments, larval fish otoliths and the scales of juvenile fish.

3.101 The study reported in WG-FSA-01/16 had been restricted to juvenile fish and it was noted that further work was required to validate growth in older fish. It was noted that the workshop report contained information on a mark-recapture experiment in which Strontium

Chloride had been used to provide a clear marker in otoliths. Mr Williams reported on progress with this study which had indicated that successive annuli were representative of annual growth. He further noted that a report on the study should be available to WG-FSA in 2002.

3.102 A summary of the findings of a study of age and growth in *D. eleginoides* undertaken by Dr J. Ashford at CQFE was presented in WG-FSA-01/70.

Population Structure

3.103 The population structure of *D. eleginoides* at three locations in Division 58.5.2 and two locations at Macquarie Island (outside the Convention Area) were compared with a small sample of fish from Subarea 48.3 by using mitochondrial and micro-satellite analyses and was reported in WG-FSA-01/38. Marked heterogeneity between the populations was observed suggesting restricted gene flow between the locations.

Tagging

3.104 The results of the tagging program for *D. eleginoides* in Division 58.5.2 were described in WG-FSA-01/76. Approximately 10% of the releases have been recaptured. The aims of the program were to:

- (i) investigate the extent of movement of *D. eleginoides* within the Heard Island fishing area and beyond;
- (ii) estimate the growth rate of fish between release and recapture; and
- (iii) provide an alternative method of stock assessment through mark-recapture techniques.

3.105 A large number of tag-recaptures were obtained (>500). The majority of fish were shown to have dispersed over relatively small distances (up to 15 miles). However three fish were observed to have dispersed over much greater distances to Kerguelen and Crozet Islands.

3.106 The management implications of the movement of fish between fishing grounds was discussed and it is hoped that further work to be undertaken on the genetics of fish from these areas will provide further insight into the subject.

3.107 Tagging of small numbers of *D. eleginoides* had been undertaken on board New Zealand vessels in Subarea 88.1 during the tagging program for *D. mawsoni* (see paragraph 3.111).

Dissostichus mawsoni

General

3.108 Fishery data obtained during the 2001 season from the exploratory fishery for *D. mawsoni* in the Ross Sea (Subarea 88.1) were presented in WG-FSA-01/63. Heavy ice meant that the 2001 fishery occurred in different locations and depths to previous years. *D. mawsoni* were recorded caught at depths ranging from 300 to 1900 m but were most abundant at depths between 600 and 1300 m. Otolith age estimations obtained from 500 *D. mawsoni* suggested that fish aged 5–20 years dominated the catch. Fish of both sexes appear to be fully selected by age 8. Von Bertalanffy parameters and length–weight coefficients were updated.

Reproduction

3.109 The first recorded spawning activity of *D. mawsoni* was reported from studies on gonad maturation in *D. mawsoni* in WG-FSA-01/51. The spawning season appears to begin in late May and extends through the winter months. A histological investigation of ovaries from 84 randomly selected fish was undertaken. Continuing discrepancies between macroscopic and microscopic staging were reported. It was also noted in this study that the spawning locations were further north than had been expected. Microscopical investigations suggested an L_{m50} for females of 100 cm. Pending further studies on maturity stages, the Working Group agreed that L_{m50} of 100 cm was appropriate for both sexes.

Population Structure

3.110 The results of a study on the genetic diversity within and between geographically disparate populations of *D. mawsoni* were presented in WG-FSA-01/69. High levels of genetic similarity were observed within and between fish obtained from McMurdo Sound (Subarea 88.1) and Brabant Island (Subarea 48.1). However, significant population structure was observed, including fixed differences among populations.

Tagging

3.111 WG-FSA-01/64 described the commencement of a tagging program for *D. mawsoni* in the Ross Sea (Subarea 88.1). In the 2000/01 fishing season, 259 *D. mawsoni* and 67 *D. eleginoides* were tagged from New Zealand vessels operating in the Subarea 88.1 exploratory fishery. Two tagged *D. mawsoni* were recaptured this season. One had been at liberty for only three days. The other fish had been at liberty for at least 10 years having been double-tagged by US scientists at McMurdo Sound. It was recaptured north of 72°S, over 350 miles from the location of tagging. The program has the short-term aim of providing information on movement and growth of toothfish species in the Ross Sea. A longer-term aim is to provide an alternative method of stock assessment through mark–recapture techniques, and New Zealand encouraged other countries participating in the fishery to carry out tagging studies.

Champscephalus gunnari

3.112 New information on aspects of icefish biology, demography and ecology were presented and discussed at WAMI. The available information is summarised in the WAMI report (Appendix D, paragraphs 5.1 to 5.18).

3.113 The Working Group thanked Drs Kock and Parkes for convening the workshop and all the participants for their input.

Mortality

3.114 There have been several studies attempting to estimate natural mortality (M) in *C. gunnari*. A review of mortality estimation methodologies was presented in WAMI-01/7. There appear to be large differences between estimates using different methods. Nevertheless, it is not known how reliable these estimates are. The methodologies considered to be most reliable by the authors of WAMI-01/7 resulted in a range of estimates of M from 0.7 to 0.87, with a mean value of 0.76.

3.115 The workshop agreed that the value of M for *C. gunnari* is considerably higher than in other Antarctic fish species. However, the value of M is not likely to be constant and may vary in areas, such as South Georgia, between years. At South Georgia, annual variation in M may change as influenced by 'good' and 'poor' krill years.

3.116 The workshop agreed that M is likely to be age specific. Young fish are more likely to have a higher M rate. This probably decreases during age 2–3 and then increases again at older ages when post-spawning mortality contributes to M.

Reproduction

3.117 Historical information on the distribution of spawning and larval *C. gunnari* in Subarea 48.3 (South Georgia and Shag Rocks) is assessed in Everson et al. (2001). It is concluded that there is strong evidence of inshore spawning at South Georgia during April within and close to the bays on the north side of the island. Some spawning almost certainly occurs over much of the island shelf, although this appears to be at a very much lower intensity than inshore. There is some evidence of spawning at Shag Rocks. There are also indications of a possible second spawning season in January, although the evidence is weak. Concentrations of larval *C. gunnari* within Cumberland Bay are an order of magnitude higher than in adjacent coastal waters and their density declines exponentially offshore. All this evidence indicates that the most important spawning locations are within the bays.

3.118 Differences in spawning seasonality for the Heard Plateau and Shell Bank were described in WAMI-01/4. The spawning season at Shell Bank appears to take place in April and May, whereas spawning at Heard Plateau and Gunnari Ridge occurs in August and September.

Shelf Distribution and Movements

3.119 WAMI-01/6 and 01/10 analysed the relationship between the spatial distribution of *E. superba* and the distribution of *C. gunnari*. Both studies concluded that the spatial distribution of krill is highly influential on the distribution of *C. gunnari*. WAMI-01/10 modelled the relationship between the spatial distribution of prey density with the distributions of *C. gunnari* abundance, mean size, and average stomach fullness, and found significantly positive relationships between these factors and krill density.

3.120 The workshop recommended that during finfish trawl surveys, a component for krill acoustic surveys should be incorporated into the experimental design. This can provide important insight into a potentially important mechanism that influences spatial distribution of *C. gunnari*.

3.121 WAMI-01/4 presented evidence that there are two separate stocks around Heard Island. More stocks may have existed on other banks, such as Pike or Discovery Bank, which now appear to be absent. Around Kerguelen there appear to be two stocks (Kerguelen Shelf, Skif Bank) as well. Spawning times between stocks may differ by five months, such as on the Kerguelen Shelf and Skif Bank, and Heard Island and Shell Bank. Results from recent DNA studies indicate that all populations in the Indian Ocean sector may be genetically homogeneous. This suggests that separation into the various populations could have occurred only recently or that there is a limited exchange of individuals between the populations.

3.122 The workshop recommended that additional DNA samples should be collected from as many areas as possible to further elucidate stock identity and structure in *C. gunnari*.

3.123 WAMI-01/8 described vertical and horizontal patterns of distribution of *C. gunnari* around South Georgia. There are strong seasonal effects on the distribution, with the winter season yielding no fishable concentrations. The seasonal changes in temperature appear to be one of the important factors that influence the formation of concentrations. The workshop recommended that it would be useful to collect CTD data on as many trawl stations as possible in order to help understand the role of the physical environment in the formation of aggregations.

3.124 Diurnal changes in the vertical distribution of *C. gunnari* around Heard Island were investigated in WAMI-01/5 using a bottom trawl in conjunction with acoustic methods. The results indicate that vertical distribution is linked to the diel light signal (dusk, dawn). The study suggests that bias in abundance estimates of *C. gunnari* from bottom trawl surveys is negligible if hauls are conducted only during daylight hours between sunrise and sunset. *C. gunnari* tend to leave the bottom layers at sunset.

3.125 The workshop recommended, where possible, the use of acoustic devices in conjunction with bottom trawls to obtain information on the proportion of fish off the bottom.

3.126 Factors that influence the horizontal distribution of *C. gunnari* in the South Shetland Islands were presented in WAMI-01/10. In this analysis, a relationship was drawn between the depth, krill availability and bathymetry.

3.127 There appear to be segregations of size and age classes around South Georgia Island, and there is evidence that in certain regions, fishing may be occurring on only one age class

spanning a limited length range. This is likely to have an important effect on the assessment of the stock. WAMI-01/16 examined the depth distribution of *C. gunnari* from nine bottom trawl surveys. Results indicate that the depth of maximum abundance increased as fish size increased. Small icefish tend to be congregated in the shallow water and there is a progressive increase in size with increasing water depth. The workshop recommended that future surveys should be designed to provide a uniform sampling intensity over the depth range from 100 to 300 m. WAMI-01/4 provided similar results for the Heard Island region.

Crabs

3.128 Large numbers of crabs (*Paralomis* spp.) again appeared in the experimental pot fishery for *D. eleginoides* conducted in Subarea 48.3. WG-FSA-01/32 provided further information on the distribution, demography and discard mortality of crabs caught in the experimental pot fishery. Crabs accounted for 69.5% of the total catches by weight (including *D. eleginoides*) and made up 98.2% of the total catch by number of individuals caught.

Distribution

3.129 Two species of crab were recorded in high numbers in catches. Large numbers of *Paralomis spinosissima* occurred in shallow water, generally less than 700 m, whereas *P. formosa* was present at high densities at a depth of 800–1 400 m. Differences were noted in the sex and size of crabs with depth. Three other species of crab were recorded in catches of which *P. anamerae* was the most abundant.

Sizes

3.130 Very few crabs were males above the legal landing size limits as described by Conservation Measure 181/XVIII. Only 5.7% of *P. spinosissima* and 11.6% of *P. formosa* were greater than 102 mm and 90 mm carapace width respectively. Male size at maturity (S_{m50}) for the Shag Rocks area was determined at 67.3 mm and 64 mm carapace length (CL) for *P. spinosissima* and *P. formosa* respectively. Based on these figures, the authors suggest a revision of minimum landing size of 83 mm and 78 mm carapace width for *P. spinosissima* and *P. formosa* respectively for the Shag Rocks.

Survivorship

3.131 Most crabs were lively on arrival on deck after pot hauling (99% *P. spinosissima*, 97% *P. formosa* and >90% of *P. anamerae*). Mortality rates estimated from reimmersion experiments indicated that on the vessel which emptied pots directly onto the factory conveyor belt, 85–90% of crabs would survive discarding, whereas survival was reduced on the vessel where crabs were emptied down a vertical chute prior to sorting (39–58% survivorship).

Martialia hyadesi

3.132 The results of an exploratory jig fishery for squid (*M. hyadesi*) in Subarea 48.3 undertaken jointly by the Republic of Korea and the UK in June 2001 were described in WG-FSA-01/31. A total of 2154 kg of *M. hyadesi* was caught, principally in the Polar Frontal Zone and in temperatures of 2–2.5°C, although some squid were also caught to the south and north of this area. The largest catches were associated with the Polar Frontal Zone and not with the South Georgia shelf as in previous years. It was concluded that the fishery for *M. hyadesi* in Subarea 48.3 remains at an exploratory stage, and catch rates appear to be highly variable. There is little indication at present of significant commercial interest in the fishery.

Skates

3.133 Information on methods of age determination for two species of Antarctic skates (*Bathyraja eatonii* and *Amblyraja georgiana*) from the Ross Sea were described in WG-FSA-01/52. Best results were obtained from X-radiographs of thorns and vertebral half-centra. Difficulties in identifying the first band or annulus in thorns and vertebrae were highlighted, however, both species were shown to grow at similar rates and reach at least 10 years of age.

3.134 The distribution of *A. georgiana* in Subarea 48.3 was described in WG-FSA-01/37. Two sequential groundfish surveys undertaken in January–February 2000 revealed different patterns of distribution of *A. georgiana*. In the first survey, 18 rays ranging in length from 177 to 950 mm TL were caught, whereas during the second survey nine specimens with a size range of 173 to 206 mm TL were caught. The authors suggest that larger fish may have migrated off the shelf in the period between surveys, thus giving rise to the observed differences in length distributions.

3.135 Further information on the tagging program for skates in Subarea 88.1, as described in WG-FSA-00/55, was outlined in WG-FSA-01/65. During the 2000/01 and 1999/2000 seasons 1017 and 2058 skates respectively were tagged on board New Zealand vessels. Also, during the 2000/01 season 68 skates were tagged from South African vessels in Subarea 88.1. Further tagging studies are proposed for the 2001/02 season. One skate was recovered in the 2000/01 season that had been tagged in the previous season, further indicating that at least some skates survive recapture and release. Most of the areas in which skates were tagged in 1999/2000 were not fished in 2000/01 making it difficult to draw further conclusions.

3.136 The Working Group discussed the need to standardise length measurements of skates and rays. It was suggested that total length and total width ‘wingspan’ should be recorded for all specimens measured.

Macrourids

Age and Growth

3.137 Preliminary results from a project to determine age and growth estimates of the main macrourid by-catch species from the toothfish fishery in the Ross Sea were presented in WG-FSA-01/43. The majority of fish were identified as *Macrourus whitsoni* following expert examination, however the difficulties observers experience in correctly identifying macrourids was highlighted.

3.138 Otolith readings gave an observed, unvalidated maximum age of 55 years suggesting that fish are slow growing and have a high age of maturity. Growth curves fitted to *M. whitsoni* length-at-age data gave rise to the following von Bertalanffy growth parameters:

$$\begin{aligned} \text{males } L_8 &= 78.3 \text{ cm, } k = 0.050 \text{ and } t_0 = -5.30 \\ \text{females } L_8 &= 87 \text{ cm, } k = 0.068 \text{ and } t_0 = 1.34. \end{aligned}$$

Best estimates of instantaneous M based on the minimum age of the oldest 1% of fish in the longline catch were 0.08 for males and 0.09 for females. However because of the uncertainty associated with these estimates, a range of 0.05 to 0.12 is recommended.

3.139 Because of the uncertainties that exist over the identification of macrourids, the authors suggested that observers should randomly select two fish from each set for further meristic and morphometric investigation over the next fishing season.

3.140 Information on otolith size/fish size relationships for *Macrourus holotrachys* caught as by-catch in the Subarea 48.3 longline toothfish fishery was presented in WG-FSA-01/39. The authors note that otolith mass can provide a good index of fish length. A length-weight relationship for this species was also provided.

Other Species

3.141 Information on the ecology of seven fish species caught as by-catch in the toothfish and icefish fisheries at Kerguelen was given in WG-FSA-01/34. Biological information on two shark species (*Lamna nasus* and *Somniosus microcephalus*), three species of ray (*Bathyraja murrayi*, *B. eatonii* and *B. irrasa*), a macrourid (*M. whitsoni*) and *Muraenolepis marmorata* was presented.

3.142 Information on the diversity of by-catch species collected during the 2000/01 exploratory fishery for toothfish in Subarea 88.1 were described in WG-FSA-01/45. Fifty-four species from 16 families were described, although identification to species was difficult for nearly half (20) of the species. Two new species were described as well as two new records for the Ross Sea.

Developments in Assessment Methods

3.143 WG-FSA-01/48 presented a preliminary method for estimating length-specific fishing selectivities from longline catch data based on the relative proportions in the catch of fish at length. The method and its application to the South Georgia longline fishery for *D. eleginoides* are discussed in detail in paragraphs 4.94 to 4.99. The Working Group welcomed this development as it takes better account of changes in the size structure of catches in the South Georgia fishery. It accepted the use of the method for assessments of that fishery and looked forward to further development of the method for application in the future.

3.144 The Working Group noted that the term ‘fishing vulnerability’ provides an independent term that encapsulates the combination of availability of fish to the fishery (i.e. the relative locations of the fishery and different parts of the stock) and gear selectivity, and agreed to use this term when discussing the final inputs to assessments that are a combination of availability and selectivity.

3.145 Another preliminary method for estimating fishing vulnerability was presented in WG-FSA-01/73, based on a model of vulnerability at age. This method combines estimates of length at age, the variation of mean length at age and a recruitment series to compare expected frequencies at length in the population at a given time with the observed length-frequency information from the fishery at that time. The method uses a least-squares approach to minimise the differences between observed and expected frequencies based on an age-based vulnerability function. The assessment software is currently written in a Mathcad worksheet. The Working Group welcomed this development, noting that a number of refinements are required, including estimates of fishing mortality in deriving numbers at age. Nevertheless, the Working Group accepted this approach as a means for revising fishing vulnerability for the *D. eleginoides* fishery in Division 58.5.2.

3.146 The effect of vulnerability on the estimates of growth parameters, particularly L_8 , are described in WG-FSA-01/17 which shows through simulation trials that the growth rate can be overestimated and L_8 underestimated if the effects of length-based selectivity are not taken into account. The Working Group thanked Dr Everson for his work in highlighting this problem.

3.147 WG-FSA-01/73 provides a negative log-likelihood method for estimating von Bertalanffy growth parameters, while taking account of fishing vulnerability (age-based availability and length-based selectivity) and the likelihood of observing individuals at age. The function also endeavoured to provide a method for pooling a number of different types of samples, including samples taken from different age-length ranges of the stock and targeted samples, such as from the taking of as many large fish as possible. The Working Group evaluated the method in WG-FSA-01/73 and suggested that the method for combining samples might be made more explicit in the likelihood function. Dr Constable provided an alternative likelihood model to better account for weighting of different samples, particularly length-at-age data that cannot be weighted by catch data. He provided an addendum to WG-FSA-01/73 to describe the revised approach and to illustrate the importance of different elements of the model to take account of the biases discussed in WG-FSA-01/73 and in WG-FSA-01/17. The Working Group welcomed the introduction of this approach to its work

and encouraged further refinements for taking account of the biases in length-at-age samples. The method was approved for use in estimating a length at age for the toothfish stock in Division 58.5.2.

3.148 WG-FSA-01/54 presented an assessment of *D. eleginoides* in the Prince Edward Islands EEZ of South Africa based on an age-structured production model (ASPM). The Working Group recalled its discussions surrounding the application of this method to the South Georgia toothfish fishery last year (WG-FSA-00/46). It welcomed the potential application of new methods to CCAMLR fisheries and encouraged members to undertake evaluations of different methods (SC-CAMLR-XIX, Annex 5, paragraphs 4.104 to 4.105). The Working Group noted the sensitivity trials undertaken by the authors to examine the effects of different parameter values on the outcome, including the steepness parameter h that describes stock recruitment and the estimates of M and growth parameters. The Working Group noted the sensitivity of the results to these parameters and encouraged members to further evaluate this method before adopting the method as a routine assessment tool. The Working Group agreed that this paper provided a useful first assessment for considering management options for this fishery.

3.149 WG-FSA-01/75 provided a description of modifications to 'Fish Heaven', which was first introduced to the Working Group last year (SC-CAMLR-XIX, Annex 5, paragraphs 3.121 to 3.122). The software has been developed to assess research strategies in exploratory longline fisheries given various spatial structures to the preferred fish habitat and methods of fishing that might be employed. The Working Group welcomed the enhancements to this software, discussing its application further in paragraphs 4.30 to 4.38.

3.150 WG-FSA-01/74 detailed revisions to the GYM (version 3.04) to provide for re-estimating the recruitment series from survey data for each value of M used in the assessments, whenever it is altered over the range of uncertainty in M that is factored into the assessment process. Outputs from mixture analyses from surveys are now input to the GYM in raw form. Consequently, endeavouring to predetermine the recruitment series with an average value of M is no longer necessary for inputting to the GYM. In addition, provision is now made for inputting different fishing selectivity functions for different years in the assessment model as requested last year (SC-CAMLR-XIX, Annex 5, paragraph 4.128). The Working Group endorsed the use of this new version of the GYM in this year's assessments but requested that it be further validated by the Secretariat.

ASSESSMENTS AND MANAGEMENT ADVICE

New and Exploratory Fisheries

New and Exploratory Fisheries in 2000/01

4.1 Fourteen conservation measures relating to exploratory fisheries were in force during 2000/01, but fishing only occurred in respect of four of these. Information on active exploratory fisheries during 2000/01 is summarised in Table 16.

4.2 In most of the active exploratory fisheries, the numbers of days fished and the catches reported were 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 210/XIX. During 2000/01, 417 vessel days of effort were reported, taking 658 tonnes of *Dissostichus* spp. Vessels from New Zealand, South Africa and Uruguay participated in this fishery.

4.3 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 200/XIX (see CCAMLR-XX/BG/7 Rev. 1, Table 5).

4.4 The Working Group noted that the western boundary for SSRU D in Subarea 88.1 does not extend to the Antarctic Coast. The Working Group recommended that the western boundary be moved to 160°E.

4.5 Conservation Measure 200/XIX also requires that, once the catch in a SSRU has exceeded a trigger level, then research hauls must be carried out and the results reported to CCAMLR. CCAMLR-XX/BG/7 Rev. 1, Table 5 summarises the catches and number of research hauls undertaken in accordance with this conservation measure.

4.6 Data collected from the New Zealand exploratory longline fishery in Subarea 88.1 during the last four seasons are described and analysed in detail in WG-FSA-01/63. The Working Group agreed that sufficient data had been accumulated for this subarea for an assessment to be attempted (see paragraphs 4.17 to 4.48). An assessment was also attempted for Division 58.4.4 (see paragraphs 4.49 to 4.57).

New and Exploratory Fisheries Notified for 2001/02

4.7 A summary of new and exploratory fisheries notifications for 2001/02 is given in Table 17. The intended catches, numbers of vessels and gear for the notifications for new and exploratory fisheries for *Dissostichus* spp. in 2001/02 are shown, grouped by subarea or division, in Table 18. All notifications had been received by the Secretariat on or before the due date. Dr Ramm advised that minor amendments had been made to the New Zealand (CCAMLR-XX/12) and Japanese (CCAMLR-XX/10) notifications. These are reflected in Table 17 and amendments to the associated tables in SC-CAMLR-XX/BG/10.

4.8 In addition to these tables, the Working Group agreed that it would be useful to prepare an overall summary table for all fisheries, whether they be new, exploratory or established. This is given in Table 19.

4.9 The Working Group noted that two Members (Japan and Russia) had made notifications of new or exploratory fisheries for the first time this year. However, it also noted that none of the notifications this year referred to fisheries or regions that have not been considered previously by the Working Group.

4.10 As was the case last year, there were multiple notifications of exploratory fisheries for *Dissostichus* spp. for several subareas or divisions (see Table 18). 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.

4.11 Reviewing Table 18, the Working Group observed that there remained inconsistencies in the way in which different notifications specified intended catches. As 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. In the time available, the Working Group was unable to develop criteria for determining whether the information contained in the notifications regarding intended catches was acceptable, as had been requested by the Scientific Committee last year (SC-CAMLR-XIX, Annex 5, paragraph 9.30).

4.12 Once more this year, there has been a large number of notifications for Division 58.4.4 (five notifications for a maximum of up to 10 vessels). If the precautionary catch limit remains at a level similar to last year (370 tonnes), there is a clear potential for the catch limit to be taken in a very short time or to be overshoot.

4.13 Dr Miller noted that, as in previous years, some of the notifications for new or exploratory fisheries in Division 58.4.4 have still neglected to specify that they applied only to areas outside national EEZs.

4.14 With regard to provision of advice on precautionary catch limits for stocks likely to be subject to new or exploratory fisheries in 2001/02, the Working Group agreed that this would only be possible this year for Subarea 88.1 and Division 58.4.4, as these were the only areas for which sufficient data were available.

4.15 However, in the light of the assessment of *D. eleginoides* in the Prince Edward Islands EEZ in WG-FSA-01/54, which 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 agreed that a current assessment of the stock around the Crozet Islands would be extremely valuable. Unfortunately, the fine-scale data necessary for carrying out such an assessment have not been submitted to CCAMLR, so the Working Group was unable to undertake such an assessment.

4.16 In view of these concerns, the Working Group recommended that France should be requested to submit fine-scale haul-by-haul data from the area around Crozet Island so that such an assessment may be carried out.

Precautionary Catch Limits for Subarea 88.1

4.17 An exploratory longline fishery by New Zealand, South Africa and Uruguay for *D. mawsoni* and *D. eleginoides* took place in Subarea 88.1 in 2000/01. The precautionary catch limit of *Dissostichus* spp. in Subarea 88.1 for the 2000/01 season was 2063 tonnes, comprising catch limits of 175 tonnes north of 65°S and 472 tonnes in each of the four SSRUs to the south of 65°S (Conservation Measure 210/XIX).

4.18 Totals of 626 tonnes of *D. mawsoni* and 34 tonnes of *D. eleginoides* were caught during the 2000/01 season. The catch limits were not reached in any of the SSRUs. The majority of the catch (93%) was taken by New Zealand vessels, some of which have now been involved in this exploratory fishery for the past four seasons. During that time, the total catches have been 41 tonnes in 1998, 296 tonnes in 1999, 745 tonnes in 2000 and 659 tonnes in 2001 (CCAMLR-XX/BG/7 Rev. 1).

4.19 A total of 25 tonnes was taken in 81 hauls by two South African vessels, and a total of 23 tonnes was taken in 51 hauls by two Uruguayan vessels which only fished the northern SSRUs. The remaining catch of 590 tonnes was taken from New Zealand vessels which fished in all five SSRUs.

4.20 New Zealand vessels completed a total of 204 research sets, South African vessels 42 research sets and Uruguay 21 research sets in the 2000 season (CCAMLR-XX/BG/7 Rev. 1).

4.21 Research activities associated with the New Zealand exploratory fishery are summarised in WG-FSA-01/63, which also includes a comprehensive analysis of data collected by this fishery from 1997/98 to 2000/01.

4.22 The exploratory fishery over the last four seasons has seen a widespread distribution of effort with at least four SSRUs and from 28 to 91 fine-scale rectangles fished each year, and a total of 150 fine-scale rectangles fished overall (WG-FSA-01/63). This has contributed significantly to the knowledge and distribution of both *Dissostichus* spp. and other fish fauna in this subarea.

4.23 Observer length-frequency data for *D. mawsoni* were examined for variation in area, trip and set type (commercial/research), and were then stratified and scaled up to the commercial catch for each of the past three seasons (WG-FSA-01/63). The resulting catch-weighted length frequencies are shown in Figure 4. Most fish in the catch ranged from 70 to 160 cm, with two broad modal peaks at 80–110 cm and 130–140 cm.

4.24 About 500 otoliths have been read from *D. mawsoni* each year and the resulting ages have been compiled into year-specific age–length keys. These were then applied to the scaled length-frequency distributions to produce catch-at-age distributions for each year (WG-FSA-01/63) (Figure 5). Most *D. mawsoni* in the catch were from 8 to 16 years old (range 3–35 years).

4.25 Last year the Working Group developed a new approach for calculating precautionary catch limits for Subarea 88.1 (SC-CAMLR-XIX, Annex 5, paragraphs 4.20 to 4.33). Yields were estimated by relating the CPUE from research sets and biological parameters for *D. mawsoni* to the CPUE, biological parameters and yield estimate for *D. eleginoides* in Subarea 48.3. For this year's assessment, the Working Group agreed to use the same approach for Subarea 88.1.

4.26 The formula used for estimating the precautionary long-term yield was

$$\text{Yield} = \gamma B_0.$$

CPUE was assumed to be an index of biomass density. These can be combined to give the formula relating yields in Subareas 48.3 and 88.1:

$$Y_{881} = \frac{g_{881} f_{881} A_{881}}{g_{483} f_{483} A_{483}} Y_{483}$$

where γ is the precautionary pre-exploitation harvest level for each area, f is the relative density (a function of CPUE and fishing selectivity), A is the seabed area, and Y is the

long-term precautionary yield. This assumes that the catchability and the relationship between CPUE and actual density is the same for the species/fisheries in Subareas 48.3 and 88.1.

4.27 While the general approach adopted was similar to last year, there were several key improvements. The first was that for Subarea 88.1, separate yield estimates were calculated for each SSRU. Following last year's assessment, the Working Group agreed to base the proportional adjustment on the actual fished area (Table 20). However, it also noted that this should be regarded as a minimum estimate of the area of *Dissostichus* spp. habitat.

4.28 The area fished was derived by inputting all the New Zealand catch and effort data into a GIS system to determine polygons of fished area, and applying a bathymetric grid using Lambert_Azimuthal equal area projection, to calculate the amount of seabed area over which *Dissostichus* spp. were located. Preliminary analysis of the data showed that catches of *Dissostichus* spp. outside the 600–1 800 m depth range were minimal. Therefore, the area fished outside those depths was excluded. The CPUE analysis below was also restricted to data from this depth range.

4.29 The Working Group noted that the known distribution area for *D. mawsoni* in Subarea 88.1 has been substantially increased between 1999/2000 and 2000/01 from 49 692 km² to 63 879 km² as a result of the exploratory fishery. It is expected the distribution area will be expanded again in 2001/02.

4.30 The second major improvement was in the estimation of relative fish density between the subareas. About 367 research and 1 484 commercial sets have now been completed in Subarea 88.1. The research sets have a stipulated minimum separation of 10 n miles (Conservation Measure 200/XIX). However, the commercial sets were known to include a mixture of exploratory sets and targeted commercial sets. Taking only research sets as a measure of mean fish density in the entire SSRU could bias the results because they may only have been done in a small part of the total fished area. To do so would also mean that the exploratory sets made in this fishery would be ignored. To make sure the entire fished area was used in the estimation of mean fish density (CPUE), all the research and commercial data were used in the analysis, provided that a minimum separation distance between sampling points was retained.

4.31 A computer program called 'Dataloser' was written to sample the combined research and commercial dataset. The program and documentation have been lodged with the Secretariat. As in Conservation Measure 200/XIX, the location of the set was defined as the geographic midpoint of the set. Sets were randomly chosen from the combined data, provided a minimum distance separated them.

4.32 The choice of the minimum separation distance involved a trade-off between ensuring that hot-spots would not be over-represented in the analysis and avoiding the removal of too much data from the dataset. To determine the appropriate separation distance, two approaches were used. The first was the generation of covariograms of the catches across the region. The second was the examination of the CPUE for varying separation distances.

4.33 For the covariogram approach, the CPUE data were combined for all SSRUs in Subarea 88.1. Covariograms for the years 2000 and 2001 were generated using the spatial statistics module in S-Plus. The range of possible separation distances that were of interest were those smaller than 20 n miles and the output was restricted to that range (Figure 6).

4.34 The results show that a separation distance of 10 n miles is satisfactory. After that the benefit gained from increasing the separation distance diminishes. They also show that the minimum separation distance should be no less than 5 n miles; below that the covariation begins to get relatively large.

4.35 The other method used to examine the question of suitable separation distance combined the data from every year into a single dataset. Separation distances from 1 to 20 n miles were tested and the resulting CPUE (total catch over total effort) and average CPUE per set were calculated.

4.36 The CPUE and average CPUE decreased with increasing separation, because at low separation distances they include many commercial sets located at areas with a high catch rate (Figure 7). As the separation distance increased, the proportion of sets of this type decreased. This is a similar pattern to that predicted in WG-FSA-01/75. A separation distance of 5 n miles appeared to be large enough to avoid the apparent bias that occurs with smaller values.

4.37 The Working Group agreed that a minimum separation distance of 5 n miles appeared to be appropriate for an analysis of this kind. They also noted that it could be a useful minimum separation distance for research sets in the longline fishery (see paragraphs 4.61 to 4.63). The minimum distance was applied to the CPUE data from Subarea 88.1 but not from Subarea 48.3. The Working Group also agreed to apply the minimum separation distance criterion to Subarea 48.3 in future years.

4.38 The CPUE estimates from each SSRU were then resampled with replacement, averaged and the ratio of CPUE between the areas was calculated. This was repeated 10 000 times and the one-sided lower 95% confidence bound of this ratio was calculated.

4.39 As in last year's assessment, a third adjustment was made to adjust for fishing selectivity. The ratio of total biomass to recruited biomass was calculated from each of the fisheries using the appropriate biological parameters. The fishing selectivity was estimated from the left side of the scaled commercial length-frequency distributions for each SSRU (and all SSRUs combined – see Figure 8) in Subarea 88.1 and the earliest reliable commercial length-frequency data (from 1995) for Subarea 48.3.

4.40 The final adjustment was made by comparing the precautionary pre-exploitation harvest levels (?) between the areas. These were calculated using the biological and fishery parameters for each of the areas. Biological and fishery parameters for *D. eleginoides* were the same as that used for the Subarea 48.3 assessment (Table 28). However, the fishing selectivity pattern was again taken from the left side of the 1995 commercial length-frequency distribution for Subarea 48.3. The corresponding mean fishing selectivities (and ranges) are given for each area in Table 20.

4.41 Updated biological parameters for *D. mawsoni* were provided in WG-FSA-01/63. Biological and fishery parameters used for *D. mawsoni* in the GYM calculations are shown in Table 21.

4.42 Estimates of γ from the GYM for *D. mawsoni* and *D. eleginoides* are given in Table 20.

4.43 The pre-exploitation precautionary yield for Subarea 48.3 was calculated using the recruitment parameters from the results of the CMIX analyses, together with the other biological parameters used for the calculations of γ , using zero catches. This yield (5 000 tonnes) was then adjusted by the ratio of γ s, densities (a function of CPUE and fishing selectivity), and seabed areas to give estimates of precautionary yield for *D. mawsoni* in Subarea 88.1.

4.44 It was noted that the catch in SSRU A in Subarea 88.1 comprised a mixture of *D. mawsoni* and *D. eleginoides*. It was difficult to apportion areas fished between the two species in this subarea, so for the purposes of the assessment the yields were calculated assuming the selectivity patterns and biological parameters for *D. mawsoni*, and the combined CPUE from both species.

4.45 The resulting estimates of precautionary yields are given by SSRU in Table 20. Equivalent estimates of yields, the catch limits adopted and the catches actually taken from each SSRU in 2000/01 are shown in Table 22.

4.46 The Working Group accepted the methods used to estimate the precautionary yields and agreed that catch limits should be set for each individual SSRU.

4.47 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 the assumed relationship between CPUE and density. Furthermore, the assessment still bases estimates of productivity for Subarea 88.1 on comparisons with those for Subarea 48.3. On these grounds, the Working Group agreed that the current assessment of Subarea 88.1 remained less rigorous than those conducted for Subarea 48.3.

4.48 In light of this, the Working Group agreed that a discount factor needs to be applied to the results of this assessment. In this respect, the Working Group noted that a discount factor of 0.5 was used for *D. mawsoni* in Subarea 88.1 last year. If the same factor were to be used again this year, the resulting catch limits by SSRU would be as shown in the last column of Table 22.

Precautionary Catch Limits for Division 58.4.4

4.49 The same approach as taken above for Subarea 88.1 was used for calculating precautionary catch limits for *D. eleginoides* in Division 58.4.4.

4.50 The formula used for calculating precautionary yields was that given in paragraph 4.26, but with the values for Subarea 88.1 in the equation being replaced with the relevant values for Division 58.4.4.

4.51 In calculating relative densities between Subarea 48.3 and Division 58.4.4, a minimum separation distance of 5 n miles for selecting CPUE values was adopted for Division 58.4.4, as for Subarea 88.1.

4.52 The adjustment made for fishing selectivity was estimated using the left side of the scaled commercial length-frequency distribution for the 2000 season for Division 58.4.4 (Figure 9), and the earliest reliable commercial length-frequency data (from 1995) for Subarea 48.3.

4.53 A final adjustment was made by comparing the precautionary pre-exploitation harvest levels (?) between Subarea 48.3 and Division 58.4.4. These were calculated from the biological and fishery parameters for each of the areas. Biological and fishery parameters for *D. eleginoides* were the same as that used for the Subarea 48.3 assessment (Table 28). However, the fishing selectivity pattern was again taken from the left side of the 2000 commercial length-frequency distribution for Division 58.4.4. The corresponding mean fishing selectivities (and ranges) are given for each area in Table 20.

4.54 The pre-exploitation long-term precautionary yield for Subarea 48.3 was calculated using the recruitment parameters from the results of the CMIX analyses, together with the other biological parameters used for the calculations of ?, using zero catches. This yield (5 000 tonnes) was then adjusted by the ratio of γ s, densities (a function of CPUE and fishing selectivity), and seabed areas to give estimates of yield for *D. eleginoides* in Division 58.4.4.

4.55 The resulting estimate of precautionary yield in Division 58.4.4 is given in Table 20. Equivalent estimates of yield, the catch limit adopted and the catch actually taken from each SSRU in 2000/01 are shown in Table 22.

4.56 In comparison with the assessment of Subarea 88.1, the Working Group noted that there is even more uncertainty about the assessment for Division 58.4.4. The Working Group agreed that a discount factor needs to be applied. If the same factor used last year (0.5) were to be used again this year, the resulting catch limit for Division 58.4.4 would be as shown in the last column of Table 22.

4.57 The precautionary yield estimated for Division 58.4.4 for 2001/02 is nearly 50% lower than that listed in Table 22 for 2000/01 (actually this estimate was first obtained for 1999/2000). There have been some improvements and adjustments to the estimation methods used, however the primary reason for the reduction is that the CPUEs in this division for the most recent season are considerably lower than those in 1999/2000. Such a reduction in CPUE is not unexpected, given the IUU activity in the region in recent years.

Subarea 88.2

4.58 Seabed areas for Subarea 88.2 were revised to include data from 72° to 80°S, to include the eastern Ross Sea. The analysis was prepared by Seabed Mapping International using ETOPO5 data and recorded depths from research vessels. The permanent ice-shelf

boundary was taken from GMT version 3.0 coastline. The area in the 600–1 800 m depth range has increased from 30 986 km² to 175 180 km². The revised areas have been lodged with the Secretariat.

Comments on Research Plans

4.59 In each of the exploratory fishery notifications, the research plans proposed at least met the minimum requirements specified in Conservation Measure 200/XIX. However, the notifications by Australia (CCAMLR-XX/5, XX/6 and XX/7) and New Zealand (CCAMLR-XX/11 and XX/12) contained detailed research plans that in some aspects exceeded the requirements in Conservation Measure 200/XIX and in one aspect suggested amendments to them.

4.60 The Working Group welcomed and endorsed the additional research activities proposed in the Australian and New Zealand notifications over the minimum set out in Conservation Measure 200/XIX.

4.61 Both Australia and New Zealand experienced practical difficulties with the minimum 10 n mile distance separation currently specified for research sets or trawls in Conservation Measure 200/XIX. This is particularly a problem when fishing is carried out on small seamounts and narrow ridges, and has led to the setting of research sets in sub-optimal areas. An alternative approach to avoid these problems would be to reduce the minimum distance between sets, whilst maintaining an effort-spreading criterion.

4.62 The Working Group agreed that the analysis carried out on Subarea 88.1 data (paragraphs 4.30 to 4.37) suggested that the minimum distance could be reduced to 5 n miles.

4.63 To maintain the effort-spreading objective of the conservation measure, the Working Group agreed that a maximum number of research sets also needed to be applied for each fine-scale rectangle. However, it noted that it had no information available to it at the moment to allow specification of such a maximum number. The Working Group agreed that this matter should be examined during the next intersessional period.

4.64 Currently, Conservation Measure 200/XIX specifies a minimum number of hooks per research longline set (3 500) but no maximum. The Working Group agreed that a maximum of 10 000 hooks should also be prescribed for research sets.

4.65 The Working Group agreed that the value of including a research component in Conservation Measure 200/XIX has been demonstrated by the use of the CPUE estimates from the research, exploratory and commercial sets in the assessments of *D. mawsoni* in Subarea 88.1, and of *D. eleginoides* in Division 58.4.4. The Working Group agreed that further collection of data from research sets would be essential for any assessments that are undertaken next year. This use of research sets was considered to be vital both for Subarea 88.1 and Division 58.4.4, and for other new and exploratory fisheries generally. Members were also requested to investigate further during the intersessional period the application of research set data in assessments.

4.66 The Working Group agreed that it would be desirable to develop a time series of research sets in the various areas to provide indices of abundance. The simulation program

reported in WG-FSA-01/75 will provide a very useful tool for examining the optimal design to the further implementation of the research sets. The Working Group encouraged the further development during the intersessional period of the work initiated in that paper.

4.67 The Working Group also agreed that tagging studies initiated early in the fisheries would help in long-term assessments.

Apportioning Catch Limits between Trawl and Longline Fisheries

4.68 As there were no cases this year where trawl and longline fisheries for *D. eleginoides* were notified for the same area or division, the Working Group did not consider further the difficult problem of how to apportion precautionary catch limits between these gears.

Advice to the Scientific Committee

4.69 Fourteen conservation measures relating to exploratory fisheries were in force during 2000/01, but fishing only occurred in respect of four 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 210/XIX. During 2000/01, 417 vessel days of effort were reported, taking 658 tonnes of *Dissostichus* spp. Vessels from New Zealand, South Africa and Uruguay participated in this fishery.

4.70 Thirteen notifications of new or exploratory fisheries were made for 2001/02 (see Table 17). Two Members (Japan and Russia) had made notifications of new or exploratory fisheries for the first time this year. However, none of the notifications this year referred to fisheries or regions that have not been considered previously by the Working Group.

4.71 As was the case last year, there were multiple notifications of exploratory fisheries for *Dissostichus* spp. for several subareas or divisions (see Table 18). While this is of potential concern, and takes considerable time to consider, the Working Group also noted that the experience of previous years suggested that many of these may not be activated.

4.72 Inconsistencies remained 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 this inconsistency continues, the task of assessing the likely effects of multiple new or exploratory fisheries in an area is made much more difficult. In the time available, the Working Group was unable to develop criteria for determining whether the information contained in the notifications regarding intended catches was acceptable.

4.73 Again, there has been a large number of notifications for Division 58.4.4 (five notifications for a maximum of up to 10 vessels). As the recommended precautionary catch limit is only 103 tonnes, there is a clear potential for the catch limit to be taken in a very short time or to be overshot.

4.74 With regard to provision of advice on precautionary catch limits for stocks likely to be subject to new or exploratory fisheries in 2001/02, the Working Group agreed that this would only be possible this year for Subarea 88.1 and Division 58.4.4, as these were the only areas for which sufficient data were available. 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.

4.75 The assessment of *D. eleginoides* in the Prince Edward Islands EEZ in WG-FSA-01/54, 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 recommended that France should be requested to submit fine-scale haul-by-haul data from the area around the Crozet Islands so that an assessment of the stock in this area can be carried out to determine whether the same problems may exist throughout the subarea.

4.76 Using new data resulting from the exploratory fishery in Subarea 88.1 (primarily from New Zealand), estimates of precautionary yields for this subarea have been calculated by SSRU. These estimates are given in Table 20.

4.77 While the current assessment incorporates several improvements over earlier assessments of this subarea, there is still considerable uncertainty about it. In light of this, a discount factor still needs to be applied. If the same discount factor as used last year (0.5) is used, the resulting catch limit for *Dissostichus* spp. in Subarea 88.1 is shown in the last column of Table 22.

4.78 Using a similar method, an estimate of precautionary yield for Division 58.4.4 has also been calculated. This estimate, which is subject to even more uncertainty than those for Subarea 88.1, is given in Table 20. If the same discount factor as used last year (0.5) is used, the resulting catch limit for *D. eleginoides* in Division 58.4.4 is as shown in the last column of Table 22.

4.79 The Working Group noted that the western boundary for SSRU D in Subarea 88.1 does not extend to the Antarctic Coast. The Working Group recommended that the western boundary of this SSRU be moved to 160°E.

4.80 The Working Group welcomed and endorsed the additional research activities proposed in the Australian and New Zealand notifications over the minimum set out in Conservation Measure 200/XIX.

4.81 Conservation Measure 200/XIX currently requires that research sets or trawls must be separated by a minimum of 10 n miles. Experience in both the Australian and New Zealand exploratory fisheries suggests that this requirement may be too restrictive, given the topography of the areas being fished. The Working Group recommended that the minimum distance between research hauls should be reduced to 5 n miles. In making this recommendation, the Working Group recognised that this may compromise the

effort-spreading objective of the conservation measure. The Working Group agreed that a maximum number of research sets also needed to be applied for each fine-scale rectangle. However, no information is available at the moment to allow specification of such a maximum number. This matter needs to be examined during the next intersessional period.

4.82 Currently, Conservation Measure 200/XIX specifies a minimum number of hooks per research longline set (3 500) but no maximum. The Working Group agreed that a maximum of 10 000 hooks should also be prescribed for research sets.

4.83 The value of including a research component in Conservation Measure 200/XIX has been amply demonstrated by the use of CPUE estimates from research, exploratory and commercial sets in the assessments of *Dissostichus* spp. in Subarea 88.1, and of *D. eleginoides* in Division 58.4.4. Further collection of data from research sets will be essential for any assessments that are carried out next year.

Assessed Fisheries

Dissostichus spp.

4.84 This year the Working Group assessed the fisheries for *D. eleginoides* in Subarea 48.3 and Division 58.5.2. New methods for estimating demographic and fishery-related parameters of *D. eleginoides* are described in paragraphs 3.143 to 3.150. Background papers on the biology and ecology of the species are described in paragraphs 3.92 to 3.111. In addition, a number of papers were available to the Working Group which were directly related to the assessment of these species.

Dissostichus eleginoides

South Georgia (Subarea 48.3)

4.85 The catch limit for the fishery for *D. eleginoides* in Subarea 48.3 in the 1999/2000 season was 5 310 tonnes (Conservation Measure 179/XVIII). The total catch of *D. eleginoides* from this fishery, as reported in the five-day catch and effort reporting system (Conservation Measure 51/XIX), was 5228 tonnes and the fishery was closed on 21 July 2000. Fine-scale catch and effort data and STATLANT data, now available for the complete fishing season, reported a total catch of *D. eleginoides* of 5068 tonnes and 4941 tonnes respectively.

4.86 The catch limit for the fishery for *D. eleginoides* in Subarea 48.3 in the 2000/01 season is 4500 tonnes (Conservation Measure 196/XIX). The total catch of *D. eleginoides* from this fishery, as reported by 7 October 2001 in the catch and effort reporting system, was 4 050 tonnes, of which 3 991 tonnes were taken by longline and 59 tonnes were taken by pot (Table 1). The longline fishing season closed on 31 August 2001, and the pot fishing season will remain open until 30 November 2001 or until the catch limit is reached, whichever is the sooner.

Standardisation of CPUE

4.87 Haul-by-haul catch and effort data for Subarea 48.3 were submitted on C2 forms (fine-scale data) for the 1991/92 to 2000/01 fishing seasons. GLM analyses were conducted using this dataset (updated to August 2001), except for data for the first season (1985/86), when fishing had been restricted to very shallow depths (mainly less than 300 m). WG-FSA agreed last year that data for all months be included in the analyses.

4.88 CPUE in kg/hook was used as the response variable, and nationality, season, month, area (east South Georgia, northwest South Georgia, South Georgia, west Shag Rocks and Shag Rocks) (SC-CAMLR-XVIII, Annex 5, Figure 5), 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 deeper). GLM analyses were conducted on positive CPUE data only, with an adjustment for zero catches being made afterwards. Because of the frequency of hauls for which catch numbers were not reported, no analyses were conducted using CPUE in numbers/hook as the response variable.

4.89 The approach used to fit the GLMs was the same as that used last year, with a square root transformation being applied and a robust quasi-likelihood form of GLM fitted. Models were first fitted using all listed predictor variables as main effects. Of these, the statistically significant predictors were nationality, season and depth. Models incorporating area, month, and bait and interactions between predictor variables were not considered, as these factors provided no statistically significant contributions to the GLM. Thus the model form used was $cpue \sim season + nationality + depth.class, family = robust(quasi(link = sqrt))$. A QQ-plot of residuals from the fitted model (Figure 10) revealed some departures from the assumed error model, but these were not sufficient to reject the fit. As was noted last year, the dataset remains very unbalanced in terms of the seasonal fishing patterns, and there remains doubt about how well the relative levels of standardised CPUEs in early and later seasons have been estimated.

4.90 The standardised time series of CPUEs in kg/hook is plotted in Figure 11 and given in Table 23. The standardisation is with respect to Chilean vessels fishing at depths of 1 000–1 500 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 given in Table 24. Adjusted standardised catch rates have fluctuated around a relatively constant level between 1986/87 and 1994/95. As was seen last year, the adjusted standardised catch rates declined substantially between 1994/95 and 1996/97, increased each season until 1999/2000, and decreased very slightly in 2000/01. However, the magnitude of changes in the last few years has been minimal, and trajectories suggest very little change in abundance since the 1996/97 season.

4.91 Examination of the distributions of depths fished in Subarea 48.3 by season and area reveals that the trend in recent seasons towards increased longline effort at shallow depths (300–700 m) noted in the 1999/2000 season was not observed in the 2000/01 season. Histograms of depths fished (sets) by season are shown in Figure 12. The decrease in the number of sets in more shallow depths in 2000/01 was particularly apparent in areas north of Shag Rocks. The depth distribution of effort by area around South Georgia for the 1999/2000 and 2000/01 seasons are presented in Figure 13.

Determination of Long-term Annual Yields using the GYM

4.92 The Working Group noted the trials undertaken last year to investigate the sensitivity of the assessments to different mortality and growth parameters (SC-CAMLR-XIX, Annex 5, paragraphs 4.143 to 4.147). It decided to use the final parameters in Table 34 of SC-CAMLR-XIX, Annex 5 as a starting point for this year's assessment. The revised assessment included three changes compared to last year:

- the estimation of the different fishing vulnerabilities (selectivity);
- refinements to the recruitment estimates; and
- an updated time-series of catches and standardised CPUE estimates.

As last year, the assessment assumes that the pot fishery has the same fishing pattern as the longline fishery.

Growth

4.93 Estimates of the von Bertalanffy parameters were obtained from the analysis conducted in 1999 (SC-CAMLR-XVIII, Annex 5, paragraph 4.116) of length-at-age data first used in 1995. The Working Group examined the data and analyses available, such as in WG-FSA-01/16, but found these insufficient to estimate new growth parameters. It noted that an analysis of length at age based on the otoliths available from the observer program is a high priority.

Trends in Fishing Vulnerability

Estimating Age-specific Vulnerabilities for Subarea 48.3

4.94 At its 2000 meeting, WG-FSA assumed in its calculation of long-term annual yields for the longline fishery for *D. eleginoides* in Subarea 48.3 that all fish above 79 cm were fully selected. For fish below that length, a length-specific selectivity ogive operated, with zero selectivity at 55 cm.

4.95 WG-FSA-01/48 presented a preliminary method for estimating length-specific vulnerabilities that attempted to take account of the observed increases of mean lengths of fish taken in depth zones of increasing depth and the different amounts of fishing effort expended in different areas and depth zones around South Georgia and Shag Rocks. Application of this method suggested that the relative selectivity of fish of different lengths has varied since 1997. In recent years, there has been a greater tendency for fish smaller than 80 cm to be vulnerable to the fishery, and a reduced tendency for larger fish to be taken. These changes have largely been driven by changes in the effort distribution by depth zone and area.

4.96 The results presented in WG-FSA-01/48 used only three depth zones (200–600 m, 600–1 600 m and 1 600–2 000 m). During the current meeting, the analysis was repeated using a fuller set of depth zones (every 200 m from 200–2 000 m). Coping with this larger set of depth zones also necessitated an adjustment to the method, to allow for strata where there

was no fishing. Essentially, this involved assuming that the annual proportions of the population in the different depth zones for each area and length class were equal to those estimated in 2000, when all depth zones and areas were fished. Due to time constraints, the areas of fishable seabed found in each depth zone and area were also assumed equal, unlike the approach taken in WG-FSA-01/48.

4.97 Examination of the results suggested that the assumptions used last year for length-specific selectivity would be appropriate for 1997, and earlier years when no data were available to apply the method directly. However, from 1998 onwards, the conclusions of WG-FSA-01/48 were generally confirmed. Accordingly, an average length-specific vulnerability curve was estimated for the years 1998 to 2000, along with an approximate equivalent age-specific curve. The length-specific curve is shown in Figure 14 and the age-specific curve in Figure 15. Estimates of vulnerability at age for possible use in the GYM are given in Table 25.

4.98 In discussing these results, the Working Group agreed with the general conclusions regarding possible changes in length-specific vulnerability outlined in paragraphs 4.96 and 4.97. It also agreed, however, that the ad hoc method of analysis used during the meeting required considerable further development and evaluation before the reliability and likely precision of estimates of selectivity it provides could be evaluated. It also noted that several simplifying assumptions had been necessary for the work to be completed during the meeting (e.g. ignoring differences between areas of seabed of different depth zones and the use only of year 2000 data when estimating proportions at depth).

4.99 Nevertheless, the Working Group agreed that the estimated age-specific vulnerabilities should be used at this year's meeting when estimating long-term annual yields using the GYM for this stock, along with the selectivity assumptions used last year. This sensitivity test would allow preliminary evaluation of the likely effects of changes in vulnerability of the type envisaged.

Recruitment and Natural Mortality

4.100 No new data were available to add to the time series of recruitments following the inclusion of data from the 2000 survey around South Georgia by the UK (SC-CAMLR-XIX, Annex 5, paragraphs 4.130 to 4.138). The results last year suggested that the growth rates may be slower than that described by the current von Bertalanffy growth function. A reassessment of the cohort strengths should be done once a length-at-age relationship is estimated based on otolith data.

4.101 In the interim, the Working Group agreed to use the estimates of cohort strengths from last year based on $k = 0.066 \text{ year}^{-1}$. On re-examining the results of mixture analyses performed last year, the Working Group noted that some cohort abundances may have been poorly estimated. Some of the previous analyses had resulted in the standard deviations of length at age declining or remaining the same with increasing age. This result is contrary to the expectation of variation in length at age as reported for *D. eleginoides* at Heard Island in WG-FSA-01/73. Consequently, the Working Group agreed to re-estimate cohort strength from three surveys affected by this problem: the surveys by Argentina in 1996 and 1997 and

the survey by the UK in 1997. The Working Group recommended that a complete revision be undertaken when the von Bertalanffy parameters have been re-estimated, based on new age-length data.

4.102 The results of the mixture analyses performed this year are shown in Figure 16, compared to the 1999 results. There is little variation between the two results but some cohorts are now better represented. The overall mixture outputs are given in Table 26. These are incorporated directly into the GYM assessment. The results can be compared to those from last year in SC-CAMLR-XIX, Annex 5, Table 31.

4.103 Although the cohort strength data are input directly into the GYM (paragraph 3.150), the time series of recruitments for $M = 0.165 \text{ year}^{-1}$ is given in Table 27 for comparison with previous years. Other than the revised surveys, the Working Group decided that recruitment inputs to the assessment would not include the cohorts estimated to be age 2 from the current growth parameters. The evidence from Heard Island indicates that this age class is not fully available to the surveys of the shelf area. As a consequence, the large recruitment of age 4 fish in 1992, previously estimated in the 1999 assessment, has reappeared in the time series as well as a reduction in the time series by one year. The mean recruitment is similar to the 1999 estimate. The Working Group noted that the actual age class may be revised in the future, e.g. WG-FSA-01/16, when the age of these fish is confirmed by current research in this area.

4.104 The Working Group noted that ages of fish in this report are derived from the relationship between length at age estimated using the current growth parameters. Designation of age classes will be reviewed at the next meeting. The Working Group agreed that the assessments this year are not affected by this issue.

4.105 In the absence of estimates of M , the Working Group accepted that the range between $2k$ and $3k$ from the von Bertalanffy growth function would be used this year. The Working Group reiterated the urgent priority for obtaining estimates of M independently from the estimation of the growth parameter, k , such as by using the methods presented to the Working Group last year (WG-FSA-00/52).

Assessment

4.106 In light of the new analyses, a new assessment of yield was undertaken using the GYM. The parameters used in the assessment are given in Table 28. The other input parameters are for cohort strength (Table 26) and the fishery information, including fishing vulnerabilities and the catch history (Table 29).

4.107 Three assessment trials were undertaken to determine how the new parameters affect the assessment of yield:

- (i) revised recruitment series based on mean $M = 0.165 \text{ year}^{-1}$, as per last year, with all other parameters remaining the same as last year;

- (ii) input data on cohort strength for determination of recruitments using each value of M chosen across the range during the assessment process, i.e. M is integrated across a range for each trajectory, while all other parameters remain the same as last year; and
- (iii) input data on cohort strength alter the fishing vulnerability such that the old length-based function is retained for each year up to and including 1997, thereafter the new vulnerability function applies.

4.108 The results of these trials are given in Table 30, which shows, as expected from the similarities in the recruitment series, that the revised recruitment series provides similar yield estimates to the 1999 assessment and greater than last year's assessment. The trial where the cohort strengths were input to ensure internal consistency between estimates of recruitment and M shows an increase in yield. The final trial was with the new vulnerability parameters. This shows a lower yield, probably because of the greater proportion of smaller fish vulnerable to the fishery.

4.109 As in previous years, the decision rule concerning the probability of depletion was binding. The Working Group agreed that the estimate of yield based on the input of cohort densities and the revised fishing vulnerability represented the best scientific evidence available.

4.110 The large increase in yield from the first to the second trial resulted from using the cohort densities directly so as to vary the recruitment series whenever the value of M is changed. This is compared to estimating the recruitment series using a mean value of M prior to the assessments. The Working Group noted that the depletion rule was the binding rule for this fishery. As such, the change to the new treatment of recruitments has reduced the likelihood of triggering the depletion rule. This might arise because the estimate of recruitment at age 4 is generated by projecting older cohorts observed in surveys back to the year of the age 4 birthday. In so doing, the initial abundance of the cohort may be underestimated from the pre-processed recruitment series based on a mean M , when the M in a simulation trial is higher than the mean. Consequently, the probability of that cohort becoming depleted is inadvertently higher. The Working Group agreed that work should continue on understanding how changes in the input parameters influence estimates of yield.

Integration of CPUE into Assessment

4.111 The Working Group agreed that the procedure used last year for integrating the time series of standardised CPUE for Subarea 48.3 into the long-term yield assessment should be used again this year (see SC-CAMLR-XIX, Annex 5, paragraphs 4.148 to 4.152). This procedure involved weighting each of the 1 001 trajectories simulated by the GYM by their likelihood with respect to the standardised CPUE time series, rather than giving them equal weights as was done in past assessments. A histogram of weights assigned to each of the 1 001 trajectories is shown in Figure 17, which indicates that a greater proportion of the trajectories are similar to the CPUE series.

4.112 The effect of using this procedure was to increase the estimate of the long-term yield to 5 820 tonnes, with an adjusted median escapement of 0.54. As indicated last year, there was an increase in yield compared to the unadjusted estimate because the trials given least weight are those with a generally upwards trajectory (in contrast to the CPUE) and are most likely to have started near to or below 0.2 of the pre-exploitation median spawning biomass. Given their reduced weight in the assessment, the probability of depletion for the unadjusted estimate is reduced, thereby resulting in a slight increase in yield.

4.113 The Working Group noted that the estimated long-term annual yield was higher than in 2000 primarily because under-represented young fish were omitted from the estimation of the recruitment series and the inclusion of the cohort densities. The Working Group agreed that this procedure was likely to provide a more accurate time series of recruitments in each simulation trial.

4.114 Summary box and whisker plots of the time series of spawning biomass, vulnerable biomass and recruitments are shown in Figure 18. It should be noted that the changes in vulnerable biomass parallel the changes in CPUE. The stepwise changes in the box plots reflect the changes in the vulnerability function. The box plot present in the middle of the known recruitment series is due to the missing observation.

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

4.115 The Working Group welcomed the progress made at this year's meeting in refining the inputs on fishing vulnerability and recruitments into the GYM. The Working Group reiterated its advice from last year that the development of methods to integrate different indicators of stock status into assessments is a high priority.

4.116 The Working Group agreed that the catch limit for the 2001/02 season should be 5 820 tonnes. The remaining provisions of Conservation Measure 196/XIX should be carried forward for the 2001/02 season.

4.117 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.

South Sandwich Islands (Subarea 48.4)

4.118 Despite a catch limit of 28 tonnes for *D. eleginoides* (Conservation Measure 180/XVIII), no fishing in this subarea was reported to the Commission during the 2000/01 season. No new information was made available to the Working Group on which to base an update of the assessment. The Working Group was also unable at this year's meeting to consider the period of validity of the existing assessment.

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

4.119 The Working Group recommended that Conservation Measure 180/XVIII be carried forward for the 2001/02 season. As last year, it was also recommended that the situation in this subarea be reviewed with a view to considering the period of validity of the existing assessment. Given the high workload at its meetings, the Working Group agreed that it was unlikely to be able to review this measure in the near future.

Subareas 58.6 and 58.7

Prince Edward Islands EEZ

4.120 A first assessment of *D. eleginoides* in the South African EEZ around the Prince Edward Islands was presented in WG-FSA-01/54 (see also paragraph 3.148). A trawl survey of the EEZ was also undertaken in April 2001 (WG-FSA-01/72 and paragraph 6.5).

4.121 The Working Group noted that this assessment indicated that *D. eleginoides* stocks in the EEZ since 1996 have been subject to high levels of illegal catch and 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 at most.

4.122 It was further noted that projections based on the results presented in WG-FSA-01/54 suggest that the annual allowable catch in the Prince Edward Islands EEZ should be reduced to about 400 tonnes at most. Such reduction may have some implications for the presence of licensed vessels in the EEZ as a means to bolster efforts to monitor illegal fishing.

Crozet Islands EEZ

4.123 No assessment of *D. eleginoides* in the French EEZ around the Crozet Islands was available to the Working Group. France was encouraged to undertake such an assessment and inform WG-FSA of the results.

Management Advice

4.124 Following advice of recent years, the Scientific Committee and Commission's attention is again drawn to the high levels of uncertainty associated with estimates of *D. eleginoides* stock levels in Subareas 58.6 and 58.7 in general. The negative role of illegal and unregulated fishing in increasing such uncertainty is also re-emphasised.

4.125 Given the prevailing circumstances, the prohibition of directed fishing for *D. eleginoides* in Subarea 58.7 (Conservation Measure 160/XVII) should continue.

4.126 Annual allowable catches of *D. eleginoides* in both the Crozet and Prince Edward Islands EEZs should be reduced to a few hundred tonnes until such time that assessments improve. In the former case, this would also be subject to the availability of catch and effort data (see paragraph 4.75) and an assessment of *D. eleginoides* in the Crozet Islands EEZ.

Kerguelen Islands (Division 58.5.1)

4.127 The Working Group discussed the role of WG-FSA in assessment and management decisions regarding Kerguelen. At present, WG-FSA is not able to conduct assessments or give advice concerning *D. eleginoides* population status or exploitation in Division 58.5.1. There is currently no capacity to revise the stock assessment because recent haul-by-haul data have not been provided. The Working Group recommended that these data should be made available for assessment purposes, as well as any other information that would help determine the current stock status.

4.128 The Working Group 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 state of *Dissostichus* spp. stocks in Division 58.5.1 and other adjacent areas such as the Crozet Island region (see also paragraph 4.126).

Heard and McDonald Islands (Division 58.5.2)

4.129 The catch of *D. eleginoides* for the trawl fishery in the 1999/2000 CCAMLR fishing season was 3 566 tonnes (catch limit = 3 585 tonnes, Conservation Measure 176/XVIII).

4.130 The catch limit of *D. eleginoides* in Division 58.5.2 for the 2000/01 season was 2 995 tonnes (Conservation Measure 197/XIX) for the period from 1 December 2000 to the end of the Commission meeting in 2001. The catch reported for this division at the time of the 2001 WG-FSA meeting was 2 490 tonnes. Two Australian vessels are participating in the fishery.

Determination of Long-term Annual Yields using the GYM

4.131 Two papers were submitted this year that provided information for consideration in assessing the long-term annual yield for *D. eleginoides* in Division 58.5.2. WG-FSA-01/76 provided background information on the results of a tagging program undertaken during the commercial fishery. The authors cited that tagged toothfish of total length 600–900 mm can grow up to 50 mm per annum. WG-FSA-01/73 presented a number of new analyses including estimates of abundance from the recent survey in 2001, an analysis of length at age, revision of the recruitment time series based on length at age, an estimate of M and an approach for estimating age-specific selectivities for *D. eleginoides* in the trawl fishery. The results presented in these papers were used to help revise the input parameters to the GYM.

4.132 Following modifications to the negative log-likelihood function for estimating von Bertalanffy growth parameters (paragraph 3.147, WG-FSA-01/73 Addendum), the growth parameters were re-estimated with the same rationale as provided in WG-FSA-01/73. The results are illustrated in Figure 19 and included in Table 28. $L_8 = 2\,465$ mm, $k = 0.029$ year⁻¹, $t_0 = -2.56$ and CV of length at age = 0.12. The Working Group agreed that these parameters provided reliable estimates of length at age for the size ranges of the fish sampled, and accordingly can be used in the GYM assessment. It was encouraged by the similarity between the annual growth increment predicted by the model and the estimated growth increment from the tagging study. However, the relatively flat likelihood profiles suggest that L_8 and k are likely to vary with the addition of new data, particularly in the lower size ranges. While this would not affect greatly the mean lengths at age estimated from these data, the Working Group agreed that the use of the k value as a guide to the value of M would be inappropriate at this stage.

4.133 As a result of the revised growth parameters, the mixture analyses used to determine cohort densities were re-assessed using the approach described in WG-FSA-01/73. This analysis resulted in a revised set of cohort densities from those in that paper. The results are displayed in Figure 20 and Table 31. The Working Group noted the improved fits of the mixture components to the observed data. On the basis of the distribution of the different age classes described in WG-FSA-01/73, the Working Group agreed that only fish in the age range 3–8 years should be included in the assessment of the recruitment series because older and younger fish are likely to be poorly represented in the samples. In addition, the Working Group agreed to include only age 3 fish from the 1992 and 2000 surveys as the older fish were unlikely to have been well sampled because of the exclusion of the deep stratum (500–1 000 m) from these surveys.

4.134 WG-FSA-01/73 also applied the method for estimating M from last year (SC-CAMLR-XIX, Annex 5, paragraphs 3.130 and 3.131), which uses repeated observations of a number of cohorts to jointly estimate M and recruitment strength. As the cohort densities had been re-estimated, the method was reapplied to the cohorts observed in both the 1990 and 1992 surveys. While this analysis is limited to only three cohorts (age 4 in 1989, 1990 and 1991) the resultant value of $M = 0.165$ year⁻¹ was the same as the implied M in Subarea 48.3 (which had been derived at WG-FSA-1995 and had been implied from the range of 2–3 k). The results are presented in Figure 21, which shows that M might vary quite widely.

4.135 The Working Group agreed that, in the absence of other independent assessments of M , this estimate provides a guide as to what magnitude of M might be influencing this stock. It decided to apply a range of M in the assessment. Given the consistency with the value of M in Subarea 48.3, the Working Group agreed to use a range of M between 0.13 and 0.2, the same as for the assessment in Subarea 48.3. It also agreed to run a sensitivity trial to see what the outcome might be with a lower range of M (0.1–0.16 year⁻¹). The Working Group recommended that further studies to estimate M independently of the growth parameters should have a high priority.

4.136 Although the assessment now uses the direct estimates of cohort density directly in order to keep the parameters for each simulation trial consistent, a calculation of the time series of recruitments based on $M = 0.165$ year⁻¹ was undertaken in order to compare the

revised time series with the time series of recruitments from last year. This is presented in Table 32. The resultant time series of recruitments is very similar, although less variable overall and a mean recruitment of approximately 5% less than that estimated last year.

4.137 The proposed method for estimating age-based fishing vulnerability detailed in WG-FSA-01/73 and evaluated in paragraph 4.133 was applied to the available catch data for Division 58.5.2, using the revised growth and mortality parameters. The catch-weighted length frequencies from each voyage between 1997 and 2000 were used in the assessment. An age-based fishing vulnerability function was estimated for each year of the fishery. The results are displayed in Figure 22 and functions presented in Table 33. The Working Group encouraged the further development of this method to take account of fishing mortality but noted that the results for this year improve the function applied in previous years because it takes better account of the presence of large fish in the catch.

4.138 A comparison of the maturity-at-length functions between South Georgia and Heard Island showed no difference between them. Consequently, the simpler function from South Georgia was adopted for the Heard Island assessments.

4.139 The analysis of long-term annual yield was updated with these parameters, which are collated in Table 28.

4.140 As for Subarea 48.3, a sequence of trials was undertaken to determine the effect of these revised parameters on the estimate of yield. The results of the trials are presented in Table 34. The first trial is to incorporate all the new parameters, including the cohort densities, except for the revised vulnerability functions. This revision showed a decline in estimated yield since last year of approximately 680 tonnes. The effect of having the IUU catch from 1996/97 as coming from the trawl fishery when it is caught by longlining could now be explored by setting the IUU catch to the previous year in which no fishing occurred. The selectivity function from Subarea 48.3 was applied to the IUU catch (see Table 29). This constituted the second trial and showed that the IUU catch had little effect on the outcome, although its effect is immediately apparent in causing a decline in the spawning stock (Figure 23).

4.141 The third trial was to have a complete updated set of parameters including annual variation in the vulnerability function and the application of the 2000 vulnerability function to the forward projection. This differs from last year by including larger age classes in the catch. This resulted in a yield estimate of 2 815 tonnes which was approximately 20% higher than the yield from trials 1 and 2.

4.142 A sensitivity trial to examine the effect of a lower M on the estimate of yield was undertaken as a fourth trial. This showed that a lower range of M would result in a higher yield.

4.143 Summary box plots of spawning biomass, vulnerable biomass and the recruitment series for the catch level of 2 815 tonnes are shown in Figure 23. The illustrated decline in spawning biomass over the last five years may have resulted from the effects of IUU fishing. The effects of the strong recruitments in the mid-1990s is evident in the predicted upward trend of the spawning biomass after 2005, at which time the known recruitment series will explain much of the abundance of the spawning stock (indicated by the declining variation until that time). The pattern of vulnerable biomass is very much influenced by the changing

vulnerability function over the course of the fishery. The large biomass in 1995 is due to the vulnerability function for the longline fishery, while the subsequent small biomasses are due to the vulnerability function taking only ages 6- to 8-year-old fish. The vulnerability function used to project the stock forward includes fish from ages 4 to 15 years. The trend in vulnerable biomass is due to the passage of the strong recruitments into the vulnerable part of the stock and out again over the next five years.

Assessment

4.144 The input parameters for the GYM are shown in Table 28, giving the updated parameters as derived above. The decision rule concerning escapement was binding in this assessment, although the yields for this and the depletion rule were very similar. The yield at which median escapement is 50% of the median pre-exploitation spawning biomass level over 35 years was 2 815 tonnes. The yield for which there is a 0.1 probability of depletion below 20% of the pre-exploitation median spawning biomass was 2 959 tonnes.

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

4.145 The Working Group recommended that the catch limit by trawling for Division 58.5.2 in the 2000/01 season be revised to 2815 tonnes, representing the long-term annual yield estimate from the GYM.

4.146 The remaining provisions of Conservation Measure 197/XIX should be carried forward for the 2001/02 season.

General Advice

4.147 The Working Group noted the general advice of the Scientific Committee to the Commission at its last meeting (SC-CAMLR-XIX, paragraphs 5.64 to 5.71) and wished to advise the Scientific Committee of achievements and further recommendations arising from consideration of that advice.

4.148 The Working Group has made progress this year on methods for reducing uncertainty in important assessment parameters. It noted that the yield estimates are sensitive to the values of M (paragraph 4.142; SC-CAMLR-XIX, Annex 5, paragraphs 4.143 to 4.146). The Working Group emphasised that a reassessment of growth and M for Subarea 48.3 remains a very high priority as well as the estimation of M in Division 58.5.2. It recommended that continued survey and other research be given a high priority for providing the data for estimating these parameters. In addition, it recommended that the potential differences in the growth rates of male and female toothfish be considered in relation to the consequence of such differences for assessments (SC-CAMLR-XIX, Annex 5, paragraphs 4.122 to 4.123).

4.149 The Working Group has made much progress in estimating fishing vulnerability functions (availability combined with selectivity) for both trawl and longline fisheries with the application of two new methods. Both methods are in the early stages of development and the Working Group encouraged further development of these methods in time for assessments next year.

4.150 The Working Group wished to advise the Scientific Committee that, apart from natural variations in recruitment strength, the application of new methods in these fisheries will cause some variation from time to time in the estimates of parameters and, consequently, estimates of yield. The inter-dependence of estimates of recruitment, growth, selectivity and M means that estimating these parameters cannot be undertaken in isolation. The Working Group endeavoured to ensure that all input parameters to the assessment process are consistent. The further developments of the GYM this year has meant that the interdependence of recruitment estimates and M is now incorporated directly into the assessment process. Similarly, changes to growth parameters can be readily incorporated into the analysis of length-density data used for estimating cohort strength. The Working Group recommended that further progress be made on methods to ensure consistency in the estimation of these parameters.

4.151 The Working Group noted the recognition of the Scientific Committee that the assessment process for *D. eleginoides* has become quite complex. It wished to advise the Scientific Committee that the development of new methods for assessing these stocks is continuing. The Working Group noted in particular that the assessment of *D. eleginoides* in Subarea 48.3 involves the use of many sources of data from the fishery and research surveys, including estimates of recruitment strength, standardised CPUE and other biological samples. As a result, there is the potential for the Working Group to examine whether conventional methods for estimating yield could be applied such that assessments might be expected to revise yield according to short-term sustainable levels of harvest rather than estimating long-term annual yields. Consequently, the assessments of this species using the standard methods of assessment will be compounded by the evaluation of new methods as happened this year.

4.152 The Working Group recommended that an intersessional forum be established to prepare a program of work for the next meeting, in parallel to the process of developing the agenda, that takes account of the likely submission of new data, the need to evaluate new methods if they are being developed and the need to complete the assessments in a thorough, accurate and timely way.

4.153 The Working Group 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 state of *Dissostichus* spp. stocks in Division 58.5.1 and other adjacent areas such as the Crozet Island region (see also paragraph 4.126).

4.154 The Working Group also recommended that a framework for evaluating assessment methods be developed in order to be confident that results arising from the application of these methods will be robust to the uncertainties surrounding the management of fisheries on these species. The Working Group requested that this be given a high priority for coordination and assistance by the Secretariat, including validation of assessment methods and software, peer review and archiving of documentation (see also SC-CAMLR-XIX, paragraph 5.70).

4.155 In this context, it was noted that assessments of krill are undertaken in WG-EMM and that there would be merit in coordinating these assessments with those undertaken by WG-FSA. This might be achieved by a meeting of specialists around the time of WG-EMM's 2002 meeting, which could also provide an opportunity to discuss, develop and validate assessment methods generally.

Champscephalus gunnari

Workshop on Approaches to the Management of Icefish

4.156 In accordance with SC-CAMLR-XIX, paragraphs 5.91 and 5.92, the Workshop on Approaches to the Management of Icefish (WAMI) was held in Hobart from 3 to 5 October 2001. A total of 14 participants from seven countries took part in the meeting and 16 papers were submitted for consideration. The papers discussed by the workshop were made available to the Working Group as necessary for the completion of assessments at this year's meeting. A report from this meeting was presented to the Working Group and is attached as Appendix D.

4.157 The workshop addressed the terms of reference agreed by the Scientific Committee at meetings between 1997 and 2000. The assessment and management of *C. gunnari* was discussed under the following headings:

- (i) Review and Characterisation of Fisheries;
- (ii) Management Needs and Current Measures;
- (iii) Review of Data on Biology and Demography, Age, Growth, Mortality, Reproduction, Diet and Stock Identity and Structure;
- (iv) Ecosystem Considerations, including Ecosystem Changes since the Start of the Fishery (early 1970s);
- (v) Assessment Methods; and
- (vi) Management Procedures.

4.158 Each part of the report of the meeting was presented to the Working Group under the appropriate item on the Working Group's agenda. Items discussed under point (iii) are reported in paragraphs 3.112 to 3.127. Items discussed under the remaining points are reported below.

Review and Characterisation of Fisheries

4.159 The Working Group noted that fisheries for *C. gunnari* in Subarea 48.3 and Divisions 58.5.1 and 58.5.2 share many characteristics in common. These fisheries may be characterised by:

- (i) large fluctuations in catch;
- (ii) periods of low or zero commercial catches;
- (iii) a recent resurgence in interest in the fishery in the mid- to late 1990s with modest levels of fishing effort and catches in Subarea 48.3 and Division 58.5.2;
- (iv) reliance of the commercial fishery on a few age classes: mainly ages 3 and 4; and
- (v) age 5+ fish are poorly represented in survey and commercial catches, suggesting an age-specific increase in M.

The Working Group endorsed the recommendation of the workshop that the recently compiled bibliography on *C. gunnari* should be developed as an electronic database (Appendix D, paragraph 2.1), and that this could be expanded to include papers on other species of importance to WG-FSA such as toothfish.

4.160 The workshop had discussed time series of catch-weighted length frequencies for *C. gunnari* for Subarea 48.3 and Division 58.5.2 presented in WAMI-01/15 Rev. 1. The Working Group recognised the value of these data, and the need to extend these time series so as to include the periods of high catches from the fisheries during the 1970s and 1980s. It was understood that data from this early period of fishing in Subarea 58.5 were collected and that the raw data are now held by Dr V. Herasymchuk, State Committee for Fisheries of Ukraine. The Working Group discussed how these important data might be processed and made available to CCAMLR. This matter was referred to the Scientific Committee for further consideration.

Management Needs and Current Measures

4.161 The Working Group agreed that the main objective of the management of *C. gunnari* in the Convention Area is to provide rational and sustainable use of the *C. gunnari* resource with the following three requirements, in accordance with Article II of the Convention:

- (i) maintenance of spawning stock at a size that recruitment is not impeded;
- (ii) maintenance of the ecological relationships between harvested, dependent and related species; and
- (iii) prevention of changes in the ecosystem that are not reversible over 20 to 30 years.

4.162 The Working Group noted that these objectives have been implemented using measures available to the Commission under Article IX. These include catch limits, by-catch limits, closed seasons, closed areas, gear regulations and minimum fish sizes. The workshop report described how these measures have been used (Appendix D, paragraphs 4.2 to 4.11). The Working Group confirmed that these types of measures were appropriate means by which to achieve the stated objectives and that assessment work should continue to be focused on generating management advice on such measures for forthcoming seasons.

4.163 The history of different methods used by the Working Group to develop advice on catch limits is described in Appendix D, paragraphs 4.2 to 4.5 and 7.1 and 7.2. The short-term projection, used since 1997, represented a change in management approach from the management of the population as a whole (with associated biological reference points) to the management of individual cohorts. An important aspect of this approach is that the yield estimate is still conditional on the maintenance of the spawning biomass and on the escapement of a certain percentage of the population. In line with the management of krill, an escapement level of 75% has been used to leave a notional amount for predators. However, as for krill, the predator requirements for this species need to be reviewed as data become available in order to determine the appropriate level of escapement that takes account of ecosystem interactions (paragraphs 4.165 to 4.175).

4.164 The Working Group endorsed the following recommendations of the workshop with respect to current management measures:

- (i) the Fishery Plan for each area needs to list the information (research) requirements for the management approach adopted. The currency of the assessment should also be stated (Appendix D, paragraph 3.7);
- (ii) reporting requirements must be met to enable catch limits to be monitored (Appendix D, paragraphs 4.2 to 4.6);
- (iii) where possible, WG-FSA should update the short-term projections annually (Appendix D, paragraphs 4.4 and 4.5); and
- (iv) where stock structure is uncertain, stocks should be managed as smaller units (Appendix D, paragraph 5.21).

Ecosystem Considerations

4.165 The Working Group noted the workshop's brief review of predator-prey relationships and the importance of *C. gunnari* in the diets of land-based marine predators in the southern Scotia Arc, and at South Georgia and Heard Island.

4.166 At last year's meeting the Working Group discussed whether a closed season might be appropriate during peak periods of foraging activity and requested that this be considered further at the workshop.

4.167 The workshop described how fur seals at South Georgia may take *C. gunnari* at various times throughout the year depending on the availability of krill. Both fur seals and penguins can switch their feeding preferences, feeding on krill in periods of high krill abundance, and increasing the proportion of *C. gunnari* in periods of low krill abundance. Analysis of otoliths present in scats indicates that male fur seals present around South Georgia in winter target their foraging on both krill and fish associated with krill aggregations, with *C. gunnari* being the most important component of the fish portion of the diet (Reid, 1995).

4.168 Dietary studies of Antarctic fur seals and king penguins at Heard Island indicate that both these species feed on *C. gunnari* at certain times of the year. However, fur seals at Heard Island, and also in the Kerguelen Islands, feed mainly on myctophids.

4.169 Regarding predator–prey interactions, the Working Group noted the conclusions of the workshop that:

- (i) there is a strong relationship between krill, *C. gunnari* and land-based predators at South Georgia;
- (ii) the importance of *C. gunnari* in the diet of land-based predators may be high in years of low krill abundance at South Georgia; and
- (iii) *C. gunnari* may be an important prey item during critical phases of the life history of some predators, particularly in the Indian Ocean sector.

4.170 The Working Group further noted the conclusions of the workshop with respect to changes in the ecosystem in the recent past that may be affecting the dynamics of *C. gunnari* stocks. In particular, the Working Group noted:

- (i) increases in populations of fur seals and some species of penguins at South Georgia;
- (ii) increases in populations of fur seals and king penguins in the Indian Ocean;
- (iii) increases in mean annual air temperature at the Antarctic Peninsula; and
- (iv) decreases in the mean annual extent of sea-ice in the southern Scotia Arc.

4.171 The Working Group agreed that, in the context of Article II, it is possible that a change has occurred in the ecosystem which may not be reversible over two or three decades. However, the workshop recognised the high variability in the size of *C. gunnari* stocks, and the potential for recovery following an event of high recruitment.

4.172 The Working Group noted the review by the workshop of information on the incidental catches, and associated mortality, of seabirds taken in the fishery for *C. gunnari* in Subarea 48.3 in the 1998/99 and 2000/01 seasons (WG-FSA-01/30). This issue was considered further by WG-IMALF (paragraphs 8.5 to 8.23).

4.173 With respect to the by-catch of young *C. gunnari* in krill trawls, the Working Group noted the discussion in the workshop report, including new information on the abundance of *C. gunnari* in the by-catch from the krill fishery in Subarea 48.2, reported in WAMI-01/11. Dr Everson commented that the occurrence of *C. gunnari* was relatively low, but that occurrence levels may be related to water depth. The paper did not indicate the depth of water in the area where the samples were taken. It is rare to find *C. gunnari* in plankton hauls over deep water.

4.174 The Working Group noted the discussion of the workshop with respect to the rationale behind the ban on bottom trawling in Subarea 48.3. Concern about the impact of fishing gear on the seabed, and the potential taking of species of depleted stocks of demersal fish, such as *N. rossii*, led to the prohibition of bottom trawling in this region. As a result, commercial

fisheries for *C. gunnari* in Subarea 48.3 operate midwater trawls. In contrast, the use of bottom trawls in commercial fishing is permitted and does occur in other parts of the Indian Ocean, including Divisions 58.5.1 and 58.5.2. Although the workshop noted that the composition of the fish fauna, and potential for by-catch taken by trawl in Division 58.5.2 was different to those in Subarea 48.3, Dr Everson pointed out that whilst the fish species may be different, the types of fish found in the two areas are quite similar. Dr Parkes also noted the occurrence of rays in the by-catch in Division 58.5.2, which does not occur in Subarea 48.3.

4.175 The Working Group endorsed the following recommendations of the workshop regarding ecosystem interactions between the *C. gunnari* fishery, *C. gunnari* and its predators and prey and other elements of the ecosystem:

- (i) Studies are needed to further quantify the relationship between krill, *C. gunnari* and land-based predators. Possible interactions between the *C. gunnari* fishery, *C. gunnari* and its predators should be examined, including quantification of any overlap which may occur. WG-EMM has previously determined an overlap index for krill. Predator-dependence studies are required to determine how important *C. gunnari* are to predators (seals, penguins etc.) (Appendix D, paragraph 6.7). Foraging ranges of predators should be provided (Appendix D, paragraphs 5.11 to 6.7).
- (ii) Further work was needed to compile information on long-term, large-scale changes in populations and the environment in Areas 48 (Atlantic Ocean) and 58 (Indian Ocean) (Appendix D, paragraph 6.10). A comparison over time should be made of the population abundance of predators–icefish–krill in each area (Appendix D, paragraph 5.11). Information is needed on the likely effects on the ecosystem of the observed increase in temperature and other ecological changes over the last 20 years (Appendix D, paragraph 6.10). The Working Group requested assistance from WG-EMM in addressing these issues.
- (iii) Simulation studies were also needed to examine plausible scenarios which could lead to observations on the abundance of *C. gunnari*, krill and the predators (Appendix D, paragraph 6.10). A simulation study of the impact of seal predation may help determine what future work is required (empirical studies) (Appendix D, paragraph 6.7).
- (iv) WG-FSA should review commercial by-catch rates in each fishery and review survey by-catch rates in each area (analyse trends) (Appendix D, paragraph 6.12). A consistent approach to by-catch issues should be taken across the various fisheries (Appendix D, paragraphs 6.13 to 6.15).
- (v) Further information is required from the krill fishery on by-catch rates of juvenile *C. gunnari* (Appendix D, paragraph 6.15).
- (vi) WG-IMALF should consider development of a protocol for observers concerning seabird interactions with trawl fisheries (see paragraph 8.20). The relative vulnerability of each species to trawl fisheries should be determined (Appendix D, paragraph 6.17).

Assessment Methods

Survey Techniques

4.176 Regarding assessment methods, there was extensive discussion by the workshop of the design of surveys used to measure the abundance of *C. gunnari* (Appendix D, paragraphs 7.17 to 7.29). The Working Group recalled discussion from last year's meeting regarding survey designs that would avoid bias in abundance estimates resulting from the variable distribution of *C. gunnari* in the water column above the level sampled by the bottom trawl (SC-CAMLR-XIX, Annex 5, paragraphs 4.198 to 4.203). Two proposals were put before the Working Group in 2000; a preliminary acoustic survey aimed at assessing the distribution and movements of fish in the water column, and the undertaking of bottom trawl surveys during the winter season (in South Georgia) when previous observations suggested that the vertical migration of fish is much less pronounced.

4.177 The Working Group agreed that research surveys need to be as representative as possible of the true status of the stock as they are now the primary means of measuring the current status of the stock and form the starting point for the subsequent calculation of catch limits using the short-term projection method. Although there are limitations to the bottom trawl method, it is important to continue these surveys as they provide a continuous time series conducted using similar techniques.

4.178 In terms of the seasonality of vertical migration behaviour in *C. gunnari*, evidence was presented in WAMI-01/8 which suggests that in winter the fish feed poorly and do not appear to form large aggregations. During spring, *C. gunnari* begin to form aggregations near the bottom and to migrate vertically in order to feed more intensively. In summer, fish appear to perform extensive vertical and horizontal migrations and are intensively feeding, densely aggregating in some years. Finally, in autumn, fish are near the bottom areas and feeding intensity decreases significantly when fish approach spawning. Thus, seasonality can bias the indices of abundance and potentially also affect the estimates of mortality derived from survey data.

4.179 The Working Group noted that evidence presented to the workshop in WAMI-01/5 indicated that at Heard Island (Division 58.5.2), providing bottom trawls were conducted between the times of sunrise and sunset, bias should not be a problem.

4.180 Regarding future surveys, the workshop had discussed the design of a combined trawling/acoustic survey of the *C. gunnari* stock in Subarea 48.3 planned by Russia for January–February 2002. The survey will aim to improve quantitative assessments for *C. gunnari* by combining an acoustic and bottom trawl survey to resolve the pelagic and benthic components of the stock respectively. The original bottom trawl survey design used in previous years will be repeated to maintain continuity of the time series. The Working Group agreed that there were many issues that would need to be resolved before quantitative estimates of *C. gunnari* biomass could be derived from acoustic data (listed in Appendix D, paragraph 7.23), and discussion would be necessary at next year's meeting to determine ways in which abundance estimates from the bottom trawl and acoustic surveys might be combined.

4.181 The Working Group was advised that the UK also plans to carry out a bottom trawl survey in Subarea 48.3 in January 2002. To maintain continuity of the data series, the survey design will be the same as that used previously, but will also collect acoustic information using a hull-mounted EK500 echosounder.

4.182 The Working Group recognised the value of combined acoustic and trawl surveys and encouraged discussion between the UK and Russia to explore options to coordinate the two surveys in Subarea 48.3. A two-vessel collaborative survey collecting concurrent acoustic and trawl data would yield a very valuable dataset that may address issues such as bias and the most appropriate survey techniques for *C. gunnari*. There might also be a valuable opportunity to conduct an experiment with the two vessels fishing in a small area at the same time to investigate their relative catchabilities (Appendix D, paragraphs 7.11 to 7.13).

4.183 The Working Group also agreed that whenever possible, continuous acoustic recording should be undertaken during bottom trawl surveys for *C. gunnari* to allow potential bias to be determined in survey catch rates.

Setting Catch Limits

Biological Reference Points

4.184 WAMI-01/13 presented the results of an analysis of *C. gunnari* catch-at-age data from the early phase of the fishery in Subarea 48.3 (ending in 1990) using Extended Survivors Analysis (XSA), which provided estimates of biological reference points (RPs) (Appendix D, paragraphs 7.7 to 7.10). The Working Group thanked the author, Dr P. Gasiukov (Russia), for his work noting that this technique is very useful in giving an overview of stock dynamics. In particular, these techniques can be used to derive recruitment time series and estimates of catchability, although it was noted that the diagnostics suggested that many of the problems encountered by WG-FSA in its previous attempts to perform VPA using ADAPT remained with the XSA approach.

Short-term Projection

4.185 The Working Group endorsed the continued use of the current short-term projection method to provide advice on catch limits for *C. gunnari* and noted the lack of alternative methods. It also noted that with the fishery based on two age classes, the currency of assessments is two years. If there is no survey information from the most recent two seasons, the advice on catch limits becomes unreliable.

Management Procedures incorporating Longer-term Approaches

4.186 The Working Group noted the discussion by the workshop regarding decision rules and operational objectives required to develop a management procedure incorporating stock dynamics and ecological relationships over the longer term (Appendix D, paragraphs 8.1

to 8.7). Previous attempts to use the GYM to undertake long-term projections to estimate precautionary catch limits for *C. gunnari* have not provided useable results. High recruitment variability, and consequently highly variable stock size, even in the absence of fishing, result in very low precautionary catch limits using a constant yield strategy under current assumptions regarding predator requirements and target escapement (75%).

4.187 The Working Group agreed that issues such as the importance of *C. gunnari* as a prey species and the consequences to predators of a fluctuating availability of this species need to be investigated in more detail in order to guide future applications of this approach (paragraph 4.175).

4.188 The Working Group agreed that the types of assessment methods and decision rules that could be used for *C. gunnari* should be evaluated in a simulation framework to test the performance of the procedures before suggesting modifications to the current management system. Evaluation requires the elaboration of plausible models of the ecological and fishery system against which the performance of management procedures can be measured. In this regard, the Working Group endorsed the program of work proposed by the workshop in Appendix D, paragraph 8.4.

4.189 The Working Group also endorsed the evaluation of alternative approaches to management proposed by the workshop in Appendix D, paragraph 8.6:

- (i) the development of decision rules that take account of changes in the relative status of the stock in order that assessments of long-term annual yield can be made;
- (ii) the development of short-term methods that take account of uncertainty in parameters such as M;
- (iii) consideration of the components of the existing decision rule for the short-term assessments, such as the confidence bound on the biomass estimate and the escapement of the cohorts following fishing, to identify whether any part of the decision rule could be made less stringent while still ensuring a high probability of maintaining productivity of the stock and its predators;
- (iv) consideration of medium-term assessment methods such as those used in ICES that endeavour to account for the probability of recruitment success in subsequent years;
- (v) consideration of closed seasons to safeguard predators and therefore not require a specific provision for predators in the decision rule; and
- (vi) consideration of how to ensure the conservation of the stock if the fishery pursues the catch limit after the assessed cohorts have disappeared. (The workshop noted the risk of exploiting unassessed cohorts if they enter the fishery at this time.)

South Georgia (Subarea 48.3)

Fishery in 2000/01

4.190 The 2000/01 season for the commercial fishery for *C. gunnari* around South Georgia (Subarea 48.3) was split into two periods: the first from 1 December 2000 to 28 February 2001 and the second from 1 June 2001 to 30 November 2001. There was a closed season from 1 March to 31 May to protect spawning concentrations. The catch limit agreed by the Commission for the 2000/01 season was 6 760 tonnes (Conservation Measure 194/XIX). Several other conditions applied to this fishery, including overall by-catch limits (Conservation Measure 95/XIV), per haul by-catch limits, a provision to reduce the catch of small (<24 cm) fish and data reporting on a haul-by-haul basis. All vessels carried international scientific observers designated in accordance with the CCAMLR Scheme of International Scientific Observation, and observer reports and data were submitted to the Secretariat.

4.191 The reported catch during the first part of the season was 1 427 tonnes of *C. gunnari*, taken by four trawlers: one from France, one from Chile and two from the UK. Fishing in the second part of the season was very limited. There was no fishing taking place at the time of the Working Group meeting. The Russian trawler *Zakhar Sorokin* fished for just 10 days from 1 to 9 September taking negligible catch. As in the 1999/2000 season, fishing was concentrated primarily on the shelf to the west and northwest of South Georgia. Catch rates were again highly variable, ranging from zero to more than 7 tonnes per hour towed.

2000/01 Assessment

4.192 The catch limit for the 2000/01 season was calculated using the short-term cohort projection method first performed at the 1997 meeting of WG-FSA (paragraph 4.231; SC-CAMLR-XVI, Annex 5, paragraphs 4.179 to 4.182). The starting point for this projection was an abundance and age structure estimated from two surveys in January and February 2000 by the UK and Russia respectively. The projection was used to calculate catch limits for a period of two years: 2000/01 and 2001/02.

4.193 The estimated catch limit for 2001/02 was 5 135 tonnes.

New Information Available in 2001

4.194 Although the Working Group in 2000 had provided advice on a catch limit for the forthcoming season, there was a range of new information available at this year's meeting that could be used to reassess the status of the *C. gunnari* stock in Subarea 48.3 and revise this advice. No new survey had been conducted in 2000/01, however, there were revised estimates of growth parameters and *M* presented in WAMI-01/7. In addition, the commercial catch in 2000/01 was well below the catch limit, hence actual fishing mortality was probably lower than that projected at last year's meeting.

Age Composition of Commercial Fishing

4.195 A catch-weighted length distribution for the first part of the 2000/01 fishing season is provided in Figure 24. On the basis of age estimates from previous analyses and the age-length key from the Russian survey in February 2000 (WG-FSA-00/51), the length distributions indicate that the bulk of the catch was composed of fish aged 3 and 4.

Growth Parameters

4.196 A von Bertalanffy growth curve was fitted to age-length data arising from readings of otoliths collected during the Russian survey in February 2000 (WG-FSA-00/51 and WAMI-01/7) using a least squares fit. Two curves were fitted: one using all data and a second using data up to age 8+ only. Another curve was fitted to age-length data arising from readings by Polish scientists of otoliths collected during the UK/Polish and UK surveys in 1989, 1990, 1991 and 1992. These data and curves are plotted in Figure 25, alongside the growth curve used for the short-term projection at last year's meeting. The parameters of the four curves are given in Table 35.

4.197 The Working Group noted a marked difference between the Russian and UK/Polish age-length datasets and the growth curves fitted to them. These differences were considered to be too great to be due to changes in growth characteristics over the period between the surveys, but were more likely due to differences in the interpretations of rings on the otoliths.

4.198 Substantial differences were also noted between the curves fitted at this year's meeting and the growth curve used previously. These differences were so great that the Working Group agreed that irrespective of whether the Russian or Polish age readings were correct, the growth parameters used previously were no longer representative of the growth of *C. gunnari* in Subarea 48.3 and should not be used in the short-term projection.

4.199 The Working Group was unable to reconcile the differences between Russian and Polish age reading. They felt, however, that the Russian age readings tended to be more reliable and were more in line with results from age determinations using modes in length-frequency distributions followed over a number of months and seasons.

4.200 The Working Group reiterated the importance of obtaining reliable age determinations in *C. gunnari*.

4.201 In order to develop a more reliable approach to ageing, the Working Group recommended that an otolith exchange program should be started among interested scientists as a first step in 2002. The exchange program will be organised by AtlantNIRO in Kaliningrad, Russia. The program will be based on otoliths collected during a cruise in January-February 2002 at South Georgia and will start in late spring 2002. An interim report will be submitted to the 2002 meeting of WG-FSA. No financial support is needed from CCAMLR for the exchange program.

4.202 A second step will be a 'Workshop on Age Reading Methods and their Application in *C. gunnari*' envisaged to take place in summer 2003. This workshop should provide ample

opportunity to discuss the several approaches of ageing *C. gunnari* and come up with an agreed method to be used inside CCAMLR. Details of the organisation of the workshop and financial implications for CCAMLR are currently under consideration.

4.203 The Working Group noted that estimates of growth parameters depend on how many ages classes are included in the calculations. If ages as high as 11 are included L_8 is close to the observed value of L_{max} . If only ages up to 8 are used, k increases while L_8 consequently decreases (Table 35).

4.204 Dr Kock pointed out that only a small fraction of the population of *C. gunnari* at South Georgia survive to ages 6 and 7. In addition, there are very few age-length data for fish older than these ages. In practice, there was little difference between the two curves fitted to the Russian age-length data up to age 7+, after which the curves deviated moderately. The Working Group agreed that the growth curve fitted to data up to age 8 should be used to describe the growth of the population in the short-term projection.

4.205 Parameters for growth curves fitted previously by various authors are presented in Table 36. These curves are compared with the curves fitted to the Russian and Polish age-length datasets in Figure 26.

4.206 In addition to their use in the projection, the growth parameters are also used to set reasonable bounds on the means of distributions of length at age in the analysis of length-density data using the CMIX program. The Working Group decided to undertake the mixture analyses using the growth curves from both the Russian and Polish age-length datasets to set these bounds. This would provide a test of which was most consistent with the modes in the length-density data. The results of these analyses are described in paragraphs 4.222 and 4.223.

Mortality

4.207 WAMI-01/7 also provided new estimates of M using several different methods to analyse survey data from the 1999/2000 season. These analyses were based on the premise that with the virtual absence of commercial fishing since January 1990, the population sampled by surveys in that year was unaffected by fishing mortality. The paper investigated the application of seven different methods: Baranov, 1918; Beverton and Holt, 1956; Rikhter-Efanov, 1976; Pauly, 1980; Alverson-Carney, 1975; Heincke, 1913; Robson-Chapman, 1961. These methods were applied to data from the UK survey in 1997, the Russian survey in 2000 and the combined UK and Russian survey dataset used at last year's meeting of WG-FSA. Four of the methods applied yielded results: Beverton and Holt, Heincke, Robson-Chapman and Baranov. The authors rejected the values from the UK survey in 1997 as being unrealistically high compared to the others. The range of all the other values was 0.57 to 0.99, with an average of 0.76.

4.208 The Working Group agreed that the results of the analysis of catchability discussed by WAMI (Appendix D, paragraphs 7.12 to 7.16) indicated that the UK and Russian survey data should not be considered to have the same catchability. Some adjustment is needed if they are to be combined for use in the assessment. This issue is discussed further in relation to the assessment in paragraphs 4.211 to 4.217. However, the Working Group agreed that in light of

these new results, it was no longer appropriate to use the combined dataset from last year's meeting. Hence, the mortality estimates derived from that dataset should not be used. The remaining values in WAMI-01/7 were estimated from the Russian survey in 2000. The Working Group agreed that of these values, the result for ages 1 to 6 (M average 0.71) was likely to be more representative of the age classes considered in the short-term projection.

4.209 An attempt was made to estimate M from data obtained during surveys in Division 58.5.2. Several surveys were available in successive years in two periods: the early 1990s and the late 1990s to early 2000s. Using these data it may be possible to track the decline of numbers in individual cohorts over time, in a period when the stock was relatively unaffected by fishing mortality. However, due to some gaps in the survey series, only three cohorts could be used in the analysis and no reliable estimates of M could be obtained.

4.210 The Working Group was concerned about the likely sensitivity of the short-term projection to differences in M and agreed to run the assessment this year using two estimates: the value used at last year's meeting (0.42) and the value presented in WAMI-01/7 (0.71) estimated for fish of ages 1 to 6 from the Russian survey in 2000.

Survey Catchability

4.211 At last year's meeting WG-FSA combined trawl data from different vessels to obtain a single dataset from which to derive abundance and biomass estimates. The assumption in this approach was that the survey vessels fished with equal efficiency. A combined ranking of the catch densities indicated that the densities of fish encountered over the shelf were broadly similar between the two surveys, with the exception of a few large catches. The Working Group had taken this to indicate that combining the two surveys was a valid approach. However, following discussion at WAMI, the Working Group agreed that it is unlikely that the two surveys would sample with equal efficiency, due to differences including vessel size, gear size and operation, experience of crew etc.

4.212 The Working Group noted discussions at the WAMI meeting regarding the relative catchabilities of survey series in Subarea 48.3 and ways in which data from different surveys could be combined (Appendix D, paragraphs 7.12 to 7.16). Following the advice of the workshop, this issue was considered further by the Working Group. The GLM analysis presented in WAMI-01/12 was reworked using survey data available in the CCAMLR database from Russia, former USSR and UK surveys for the years 1974, 1975, 1984 to 1989, 1991, 1992, 1998 and 2000. The set of survey data for 1990 were excluded due to abnormally high values of CPUE in that season. The GLM assumed that surveys have been stratified as in the WG-FSA-2000 assessment (SC-CAMLR-XIX, Annex 5, Figure 24).

4.213 The GLM used had the following form:

$$\begin{aligned} &glm(Cpue \sim Country + SplitYear + Stratum, data = Rv1, \\ &family = robust(quasi(power(x)))) \end{aligned}$$

where the exponent in a link function was 0.1, 0.3, 0.5. The last value transformed the link function to the *sqrt*.

4.214 Akaike information criterion (AIC) was used for model selection:

Link Function	Power (0.1)	Power (0.3)	<i>Sqrt</i>
AIC	28 224	27 330	26 184

which was a GLM with *sqrt* link function. The ANOVA table from the model (Table 37) shows that all factors were significant.

4.215 The diagnostics of the model are provided in Figure 27 and the QQ-plot in Figure 28. The time series of standardised CPUE indices with two options for the factor country (UK and Russia) are presented in Figure 29. This analysis indicated that the catchability of the Russian survey series for the 2000 season was 2.59 times that of the UK series.

4.216 The Working Group discussed possible reasons for this apparently large difference between the surveys. The surveys are of a similar design and the sampling gear (i.e. a bottom trawl) is also similar. Vessel effects are known to be responsible for differences in some time series, but the UK and Russian surveys have used a variety of different vessels, hence it is unlikely that such effects are the sole cause of the differences. The Working Group recommended more detailed studies of the design and implementation of these surveys to investigate why the difference between them might be so great. The Working Group also endorsed the advice of WAMI that an experiment be designed to compare the results of two vessels fishing in the same small area at the same time could provide useful information to solve this problem.

4.217 The Working Group welcomed this first attempt to estimate relative differences in catchability and noted that it is very important to provide methods that can reconcile data from different surveys. The Working Group agreed to use the factor of 2.59 when undertaking analyses on the combined dataset from the UK and Russian surveys in 2000 at this year's meeting.

Assessment at this Year's Meeting

4.218 The Working Group followed the short-term projection approach used previously to reassess catch limits for the 2001/02 season, with the new information discussed in the preceding paragraphs. 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.

4.219 Biomass estimates were available from two surveys in 2000. Concern had been expressed at last year's meeting over the small number of stations sampled by the UK survey on the South Georgia shelf, and whether it was possible to obtain a reliable estimate of stock status from such a small number of hauls. The short-term projection had therefore been based on a biomass estimate and age structure from the combined survey dataset. Following concerns over this approach expressed in paragraph 4.221, the Working Group decided to consider three biomass estimates for starting the projections, derived from:

- the UK survey;
- the Russian survey; and
- a combined survey dataset, combined using the relative catchability factor of 2.59 to increase the catch densities recorded on the UK survey.

4.220 The stratification, number of stations in each stratum and the results of the bootstrap analysis to estimate the one-sided lower 95% confidence bound for each of these datasets are presented in Table 38. The geographic distribution of the strata is illustrated in Figure 24 of last year's report (SC-CAMLR-XIX, Annex 5).

4.221 The bootstrap on the combined dataset was performed using the same method as used to analyse the UK and Russian surveys separately at last year's meeting. The Working Group noted the increase in the single-sided lower 95% confidence bound of the combined dataset (42 807 tonnes) compared to last year (35 085 tonnes). This resulted from the standardisation of the catchabilities to the Russian survey.

4.222 Length densities from all three survey datasets were 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 two growth curves (curves 1 and 3 in Table 35). In all cases, the fitting routine did not converge on a result when using the bounds given by the growth curve fitted to the Polish age-length readings from the UK surveys (curve 3 in Table 35). This implies that this curve is incompatible with the modal lengths in the distributions from the surveys in 2000. The Working Group agreed that the growth curve fitted to the Russian age readings (curve 1 in Table 35), was the most appropriate to use for the assessment at this year's meeting.

4.223 The results of the CMIX analysis are presented in Table 39 and Figure 40. The means of the mixture components from Table 39 are compared with the growth curve in Figure 31.

4.224 The data inputs for the short-term projection are presented in Table 40. The Working Group noted that the catch level for 2000/01 used in the projection assumed that there would be no additional catch taken between the time of the meeting and the end of the season on 30 November 2001.

4.225 The Working Group considered these various input data, noting that three estimates of biomass and two levels of M would result in six possible outcomes of the projection. The Working Group agreed that it was important to discuss criteria which could be used to select the best option for providing recommendations on the catch level at South Georgia in the forthcoming season.

4.226 Regarding the biomass estimate, the Working Group recalled the discussion at last year's meeting that led to the decision to combine the data from the two surveys (SC-CAMLR-XIX, Annex 5, paragraphs 4.189 to 4.192 and 4.205 to 4.209), and agreed that this rationale was still valid. The difference at this year's meeting was that the Working Group had undertaken an analysis of the relative catchabilities of the survey series by the UK and Russia and thereby developed an improved approach to combining the two surveys. There were some problems indicated in the analysis, as shown by the diagnostics of the GLM

(Table 37 and Figure 28), which might be solved through a refined analysis. However the Working Group agreed that for the purposes of the assessment at this meeting, the surveys should be combined using the factor of 2.59 to adjust the results of the UK survey.

4.227 The Working Group agreed that a high priority should be given to further analyses looking at the catchabilities of different vessels and gears. In addition, countries planning to undertake surveys in Subarea 48.3 in 2001/02 were requested to consider ways in which survey plans could include comparative hauls by different vessels fishing in the same small area at the same time to provide direct information on relative catchability.

4.228 Regarding the value of M , the Working Group noted the limited amount of data from which it was possible to estimate M for *C. gunnari* at the current time. The Working Group also noted the large difference between the estimates available for the assessment, and the high level of uncertainty in this parameter. Dr Gasiukov expressed concern regarding the level of 0.42, which had been estimated on the basis of very few data (Everson, 1998). It was also noted that the level of 0.71 appeared to be high in view of the current estimate of k , which is 0.17.

4.229 The Working Group noted that the higher level of M would result in a lower level of yield projected for the forthcoming year, because a larger number of fish would be assumed to have died between the time of the survey and the time of fishing. This would therefore be the more precautionary of the two options available. The Working Group agreed that the value of 0.71 should be used for the short-term projection at this year's meeting. Analyses to refine the estimate of M , and the incorporation of uncertainty in M into the short-term projection remain a high priority.

4.230 The output of the short-term projections are provided in Table 41. The catch limit for 2001/02 satisfying the previously agreed criteria and using the data inputs agreed this year by the Working Group is 5 557 tonnes.

4.231 The Working Group recalled its discussions from previous years, and discussion by WAMI regarding the conservative nature of the short-term projection method used currently to assess catch levels for *C. gunnari*. The Working Group agreed that this method is essentially an interim approach and further analysis of the operational objectives and overall management procedures for *C. gunnari* remained a high priority. A number of recommendations had been made by WAMI to investigate the appropriateness of the various assumptions in the decision rule as it is currently applied (Appendix D, paragraph 8.6). The Working Group agreed that these issues be given a high priority for consideration at next year's meeting.

Closed Season

4.232 At its meetings in 1999 and 2000, the Working Group discussed measures to protect spawning concentrations of *C. gunnari* in Subarea 48.3 (Parkes, 2000; SC-CAMLR-XVIII, Annex 5, paragraph 4.183; SC-CAMLR-XIX, Annex 5, paragraph 4.214). In 1999 the Commission adopted a change in the closed season for the *C. gunnari* fishery in Subarea 48.3, based on a review of information regarding the timing of the spawning season. In the 2000/01 season the fishery was closed between 1 March and 31 May 2001.

4.233 At this year's meeting the Working Group considered new information regarding the distribution of spawning and larval *C. gunnari* (paragraph 3.117; Everson et al., 2001). There is strong evidence that spawning is concentrated mainly in the inshore areas and bays of South Georgia (Kock, 1981). A complete closure of Subarea 48.3 during the spawning season may therefore be unnecessary. Substantial protection of spawning concentrations would be provided by preventing fishing from taking place in the bays and near-shore areas.

4.234 The Working Group noted, however, that although spawning on the shelf is considered to be of much lower intensity than that occurring inshore, it is presently unknown to what extent Shag Rocks is important as a spawning area. Fish have been found in near-spawning condition in this area, but larvae and early juvenile stages have very rarely been observed in plankton hauls.

4.235 In view of the need for information on the condition of fish offshore during the spawning season, the Working Group agreed that detailed biological information should be collected from catches by all vessels fishing in Subarea 48.3 during this period. This information would be more useful if it came from an area wider than just areas where fish concentrations, and therefore target fishing, might occur. The Working Group proposed a scheme of distribution of fishing effort that would require all vessels fishing in Subarea 48.3 during the spawning season to undertake a limited number of tows for scientific purposes in specific areas. The proposed scheme is set out in paragraphs 4.236 to 4.240.

4.236 All fishing vessels taking part in the fishery for *C. gunnari* in Subarea 48.3 between 1 March and 31 May 2002 should be required to conduct a minimum of 20 research hauls, to be completed during that period. Twelve research hauls should be carried out in the Shag Rocks–Black Rocks area. These should be distributed between the four sectors illustrated in Figure 32: four each in the NW and SE sectors, and two each in the NE and SW sectors. A further eight research hauls should be conducted on the northwestern shelf of South Georgia over water less than 300 m deep, as illustrated in Figure 32.

4.237 Each research haul should be at least 5 n miles distant from all others. The spacing of stations is intended to be such that both areas are adequately covered in order to provide information on the length, sex, maturity and weight composition of *C. gunnari*.

4.238 If concentrations of fish are located en route to South Georgia, they should be fished in addition to the research hauls.

4.239 The duration of research hauls should be of a minimum of 30 minutes with the net at fishing depth. During the day, the net should be fished close to the bottom.

4.240 The catch of all research hauls should be sampled by the international scientific observer on board. Samples should comprise at least 100 fish, sampled using standard random sampling techniques. All fish in the sample should be at least examined for length, sex and maturity determination, and where possible weight. More fish should be examined if the catch is large and time permits.

4.241 Dr Holt expressed concern that some disruption of spawning might occur if fishing effort were concentrated on the shelf during the spawning period (1 March to 31 May). To address this concern, it was suggested that some means of limiting the level of catch that can be taken within the spawning period could be considered.

4.242 The Working Group agreed that with these measures in place, it would be appropriate to leave the *C. gunnari* fishery open throughout the 2001/02 season, or until the catch limit is taken. However, it would still be necessary to devise some mechanism of preventing fishing in inshore areas during the spawning season, such as a closed area around the island. The Working Group recalled a conservation measure previously adopted by the Commission (Conservation Measure 1/III), which closed the area around South Georgia up to 12 n miles offshore. Such a closure during the spawning season would provide protection to spawning concentrations in the bays and near-shore area.

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

4.243 The Working Group agreed that the total catch limit should be revised to 5 557 tonnes for the period from 1 December 2001 to 30 November 2002.

4.244 The Working Group agreed that there should not be a closed season for *C. gunnari* in Subarea 48.3 during the 2001/02 season. Each vessel intending to undertake fishing in Subarea 48.3 between 1 March and 31 May 2002 should conduct 20 research hauls in the manner described in paragraphs 4.236 to 4.240.

4.245 The Working Group recommended that a closed area within 12 n miles of South Georgia be established to protect spawning concentrations during the spawning season (1 March to 31 May) and to limit the catch that can be taken during the spawning period (paragraph 4.241).

4.246 The remaining provisions in Conservation Measure 194/XIX should be carried forward for the 2001/02 season.

Kerguelen Islands (Division 58.5.1)

4.247 No commercial fishing for *C. gunnari* took place in Division 58.5.1 during the 2000/01 season and no surveys were reported.

4.248 The Working Group recalled that the most recent data available remain from a brief survey conducted in February 1998 which indicated that the previous cohort which formed the backbone of the fishery in 1995 had disappeared. A new year 1+ cohort (~170 mm long fish) was present in some abundance in 1997/98. A survey in the 1998/99 season revealed practically zero biomass on the traditional northeastern fishing ground. Only a few mature specimens (36 cm cohort) and some immature fish (22 cm cohort) were caught from late April to early May.

4.249 More recent information from this division is missing. There appears to be little prospect of a fishery for *C. gunnari* during the 2001/02 season.

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

4.250 In the absence of recent data from this division, the Working Group is unable to offer any new management advice. It is strongly recommended that a survey of *C. gunnari* abundance is conducted and the results analysed by the Working Group before commercial fishing is recommenced.

Heard and McDonald Islands (Division 58.5.2)

Commercial Catch

4.251 The commercial fishery for *C. gunnari* around Heard Island (Division 58.5.2) was open from the end of the Commission meeting in November 2000 to 30 November 2001. The catch limit agreed by the Commission for this period was 1 150 tonnes to be taken on the Heard Island Plateau area only (Conservation Measure 195/XIX). This conservation measure included several other conditions to be 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 198/XIX).

4.252 The commercial catch in the 2000/01 fishing season was 938 tonnes up to 7 October 2001, although the fishing season will remain open until 30 November 2001. This fishery was based on the strong cohort, now aged 3, that was detected as 2 year olds in a survey in May 2000.

Surveys

4.253 A survey was conducted on the Heard Island Plateau and Shell Bank in May 2001 to assess the abundance and size structure of the *C. gunnari* populations. The abundance by stratum is listed in Table 42. This survey used the same methodology as previous surveys in this area in 1997, 1998 and 2000 and detected a high abundance of 3-year-old fish on the Heard Plateau that were seen as 2 year olds in the previous year, and a lower abundance of 2 year olds. As in the 2000 survey, very few fish were detected on Shell Bank (WAMI-01/04). As in previous years, fish were concentrated on the southeast part of the plateau, including Gunnari Ridge.

Assessment at this Year's Meeting

4.254 An assessment of short-term yield over the next two years using the same methods as applied for Subarea 48.3 was performed during the Working Group meeting. Biomass was estimated from a survey conducted by Australia in 2001. New growth parameters for *C. gunnari* in Division 58.5.2 were provided in WAMI-01/04. Estimates of yield for Shell Bank were not made because of the very low abundance of this population. The results of the mixture analysis are presented in Figure 33. Data inputs for the short-term projection are

provided in Table 43. The Working Group noted that the catch level for 2000/01 used in the projection assumed that there would be no additional catch taken between the time of the meeting and the end of the season on 30 November 2001.

4.255 With a projected fishing mortality of 0.14 for 2001/02 and 2002/03, the catch limit satisfying the agreed criteria is 1 600 tonnes over two years. This is made up of 885 tonnes in the first year and 715 tonnes in the second year.

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

4.256 The Working Group agreed that the total catch limit should be revised to 885 tonnes for the period from 1 December 2001 to 30 November 2002.

4.257 The remaining provisions in Conservation Measure 195/XIX should be carried forward to the 2001/02 season.

Other Fisheries

Other Finfish Fisheries

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

4.258 Standing stock biomass estimates of finfish from the 2001 US AMLR bottom trawl survey of the South Shetland Islands (Subarea 48.1) were presented in WG-FSA-01/33. The authors concluded that the overall abundance of finfish in the South Shetland Islands has yet to reach a level at which commercial exploitation would be advisable.

4.259 A bottom trawl survey around Elephant Island and the lower South Shetland Islands originally planned for November–December 2001 by Germany will now take place during January and February 2002.

Management Advice

4.260 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. The Working Group therefore recommended that Conservation Measures 72/XVII and 73/XVII should remain in force.

South Sandwich Islands (Subarea 48.4)

4.261 No new information was made available to the Working Group on which an update of the assessment could be based.

Management Advice

4.262 The Working Group recommended that Conservation Measure 180/XVIII be retained until new information becomes available and a new assessment could be attempted.

Antarctic Coastal Areas of Divisions 58.4.1 and 58.4.2

4.263 A notification for the 2001/02 season was submitted for Division 58.4.2 by Australia. Details of the plan can be found in CCAMLR-XX/5.

Crabs

4.264 Five species of crabs currently occur in catches around South Georgia: *P. spinosissima*, *P. formosa*, *P. anemerae*, *Neolithodes diomedae* and *Lithodes murrayi*. Only the three species of the genus *Paralomis* are of interest to the crab fishery.

4.265 Conservation measures in force in the crab fishery are Conservation Measure 214/XIX which regulates the experimental harvest regime on crabs, and Conservation Measure 215/XIX which sets limits on the catch at 1 600 tonnes green weight per season of all species combined and limits the number of vessels to one per country.

4.266 Japan has notified its intention to conduct crab fishing in the 2001/02 season; Japan has not carried out an experimental harvest regime as set out in Conservation Measure 214/XIX and so will be obliged to conduct this experimental regime this season. It was highlighted that there is a requirement to carry a CCAMLR international observer on board every vessel that participates in the crab fishery.

4.267 WG-FSA-01/32 presented further information on the distribution, demography and discard mortality of crabs caught as by-catch in an experimental pot fishery for toothfish in Subarea 48.3. Biological data on crabs are presented in paragraphs 3.128 to 3.131.

4.268 The Working Group addressed concerns about the potential spatial overlap of the crab fishery and toothfish pot fishery in Subarea 48.3. Data were presented indicating that previous crab fishing had taken place at shallower depths than those currently fished by the exploratory pot fishery for toothfish. The Working Group agreed that the small overlap in areas targeted by the two fisheries was not likely to be a cause for concern.

4.269 The Working Group reviewed minimum legal landing sizes for *Paralomis* spp. for Subarea 48.3. Conservation measures have continued, largely unchanged, since they were first introduced at CCAMLR-XI in 1992 (Conservation Measure 60/XI). The basis for the selection of the current minimum legal landing sizes, as described in WG-FSA-92/29, was discussed. It was noted that existing size limits for *P. spinosissima* (102 mm carapace width) were established largely on the catch processing requirements of the fishery at that time.

4.270 Data and methodologies used to attain the minimum size limits for crabs suggested in WG-FSA-01/32 were compared to those derived using the same criteria in 1992 (WG-FSA-92/29). These comparisons are shown in Table 44. The Working Group agreed

that, given the similarities in the recommended size limits, the reduction in size limit would be supportable. WG-FSA-01/32 was only able to produce results for Shag Rocks hence it was deemed appropriate to use the WG-FSA-92/29 values for a revision of legal minimum size.

4.271 There is currently no minimum size limit specified for *P. anamerae*. The Working Group was unable to suggest a minimum landing size for this species, as new data were unavailable.

4.272 It was noted that the survivorship of discarded crabs was highly influenced by the catch processing and discard methods employed by vessels (WG-FSA-01/32). Mortality was greater when crabs were unloaded into a chute prior to processing.

Management Advice

4.273 The Working Group agreed that the minimum legal landing size for male *P. spinosissima* should be reduced from 102 mm carapace width to 95 mm carapace width for South Georgia and Shag Rocks whilst the legal size for *P. formosa* males should remain unchanged at 90 mm carapace width.

4.274 All other conservation measures are to be retained.

Squid

4.275 Conservation Measure 213/XIX is currently in force to regulate this fishery. The UK and the Republic of Korea have advised that they would be undertaking an exploratory fishery on *M. hyadesi* in waters north of South Georgia (Subarea 48.3) in the 2000/01 season (WG-FSA-01/31). It was concluded that the fishery for *M. hyadesi* in Subarea 48.3 remains at an exploratory stage, and catch rates appear to be highly variable. There is little indication at present of significant commercial interest in the fishery.

Management Advice

4.276 There was no notification of intention to conduct a fishery for the 2001/02 season. All conservation measures are to be retained.

Subgroup on By-catch

Estimated Catches

4.277 The subgroup on by-catch extracted data from the CCAMLR databases in order to try and estimate total removals of by-catch species for trawl and longline fisheries by fine-scale area and split-year. Due to the problems experienced by the group and the limitations of the data, this was not achieved. The issues are discussed below.

4.278 Data on by-catch are available in three different formats, STATLANT data, observer reports and fine-scale catch and effort data.

4.279 The by-catch subgroup noted that there were differences between countries in the data submitted via STATLANT reports. STATLANT data are presented in the CCAMLR *Statistical Bulletin* and should be a complete record of total catches for the split-year for both commercial and by-catch species. It is unclear how many countries are submitting the correct data. For example, Australia has only submitted commercial catches and very little information on by-catch via STATLANT reports for the 2000/01 split-year.

4.280 The data that are recorded and submitted to CCAMLR on fish and invertebrate by-catch in the observer reports varies between countries. Two specific examples are:

- New Zealand – observers record the percentage of each set observed for fish by-catch and scale up all records so that they represent total removals for the fishery.

The data are submitted as total by-catch estimates to CCAMLR, however the Secretariat was not aware that the data had already been scaled up.

- Australia – observers record for all hauls whether they are observed and whether catch-composition information of fish and invertebrate by-catch is recorded. A double flag is needed because in some instances a haul may be observed, i.e. for length–weight information on a target species but no by-catch is recorded. This is an easy method of discriminating between hauls with zero by-catch and hauls where by-catch is not recorded. However the catch-composition flag does not appear in the CCAMLR version of the Australian observer database and it is therefore not possible to determine the correct proportion of hauls that are observed for fish by-catch. In addition, the data from the last trip in the 2000/01 split-year has not yet been submitted and thus the dataset is incomplete.

4.281 Additional problems that apply to the by-catch data from the observer database are:

- (i) In some cases no information is provided as to what percentage of hauls/sets are observed. In other cases, information on the percentage of longline sets/hauls is provided but no record is made as to what that set was observed for, i.e. bird interactions, fish by-catch, biologicals of target species etc. Hence by-catch can not be scaled up to the total fishery.
- (ii) It is also unclear in some cases how many fish are discarded or lost before being brought on board. In the case of skates that are discarded or lost during longline fishing, survival is uncertain. These concerns do not apply to tagging studies, such as are currently being undertaken in Subarea 88.1, where skates and rays are tagged and released in the water, thus minimising damage to the mouth of the fish.
- (iii) Within a haul that is observed for by-catch, amounts can be recorded as either weights or numbers. The information provided in numbers can not be used at present as length–mass keys are not available for a number of species.

4.282 Similar problems that exist in the observer data also apply to the fine-scale catch and effort data.

4.283 Tables 14 and 15 in Annex 5 of SC-CAMLR-XIX have been provided every year in the Working Group report. Fifty-four fish species are recorded as by-catch in the targeted fisheries for *C. gunnari*, *D. eleginoides* and *D. mawsoni*. The information in these tables comes from the observer reports submitted to CCAMLR. When constructing Table 14, only records with weights are used, hence all information on by-catch provided as numbers is not included. Given the problems noted above, the subgroup flagged that these tables are really only an indication of presence/absence of by-catch species in a given area. The updated tables have been prepared at the meeting but have not been included in the report. They have been retained along with other data extracted for the by-catch subgroup in a reference file at the Secretariat.

4.284 Tables 45 and 46 are derived from the fine-scale catch and effort data supplied by vessels. These by-catch values are likely to provide minimum estimates.

4.285 It is not possible at present to determine the total removals of by-catch species. The subgroup noted that if the Scientific Committee wanted advice on by-catch species, then these problems would need to be resolved first. The subgroup discussed various methods for improving the quality and usefulness of the data provided to CCAMLR.

4.286 The Working Group recommended that:

- (i) observers be asked to indicate the number of longline sets and trawl hauls actually observed for by-catch;
- (ii) observers be asked to indicate the proportion of each longline set actually observed for by-catch;
- (iii) observer reports should clearly indicate the type of observation being made at a particular time;
- (iv) by-catch sampling should be according to the same regime as that applied to target species;
- (v) revised species identification sheets be prepared to assist observers in making accurate identification of species; and
- (vi) a revision of the *Scientific Observers Manual* and the electronic observer logbook be undertaken intersessionally to improve the information collected on fish and invertebrate by-catch in all fisheries.

Species Identification Sheets

4.287 To assist observers in making accurate identifications of target and by-catch species, WG-FSA had decided to develop species identification sheets. The main requirement of these

sheets was that they should be clear and concise and enable observers to identify individual fish accurately and quickly in the field. A subgroup, led by Dr Everson, had been tasked with preparing draft identification sheets in time for distribution to observers for the 2000/01 longline season.

4.288 Drawing on information provided by the subgroup and taking illustrations from published taxonomic keys, draft identification sheets had been prepared and sent to the Secretariat. Unfortunately, these do not appear to have been received by technical coordinators in time to be distributed to observers for the past 2000/01 season. In spite of a request for feedback on the utility of the identification sheets, no comments appeared in any of the observers' reports. WG-FSA-01/32 does make mention of the need for such sheets and from the comments in that report it appears that most of the problems associated with identification of lithodid crabs taken during that cruise might have been resolved had the identification sheets been available.

4.289 The content and presentation of the identification sheets was discussed.

4.290 Very little information on geographical distribution of individual species had been included in the sheets. In circumstances where the distribution had been well described from earlier research surveys, it was felt that such information could assist observers by reducing the options for individual species. However, much of the current fishery activity is using longlines in deep water with the result that new geographical distributions are being discovered for certain species. Geographical information for such poorly described species might introduce bias and consequently affect the ability of observers to make accurate identifications.

4.291 The Working Group agreed that a record should be kept by WG-FSA of the localities in which individual species have been reported by observers, so that over a period of time descriptions of the distribution of these species could be developed. For those species for which there is strong evidence that their distribution is restricted, to for example shelf regions, it was thought useful to include a note on the range on the identification sheets.

4.292 Mr B. Watkins (South Africa) noted that large numbers of slickheads (Alepocephalidae) had been caught in a recent deep-water trawl survey off the Prince Edward Islands. It was agreed that these and chimaerids should be included when the identification sheets are revised.

4.293 It was noted that species such as macrourids and *Muraenolepis* spp. present major problems for identification even for experienced taxonomists. To address this problem Dr Hanchet has arranged for observers working in Area 88 to collect two *Macrourus* specimens from each longline set, these to be frozen for examination in a laboratory ashore (WG-FSA-01/63). Dr Belchier indicated that specimens of macrourids and skates from Subarea 48.3 could be analysed at the new UK Research Station at King Edward Point, South Georgia.

4.294 The Working Group discussed the use of photographs in the identification sheets. It was agreed that good photographs depicting key diagnostic characters would be very useful. However it was recognised that suitable photographs are currently not available for many of the species. Members were encouraged to provide to the Secretariat good quality photographs for consideration in revising the sheets. Such photographs should include, as a minimum,

dorsal and lateral views of the fish and in addition detailed pictures of key diagnostic features. Developments in photographic equipment mean that detailed digital images can now be produced. It was suggested that in the future a collection of such images might be prepared on CD ROM to be given to observers.

4.295 The Working Group agreed to revise the draft identification sheets prepared for the 2000/01 season for circulation to observers via technical coordinators. It was also agreed that observers should be encouraged to provide comments on the identification sheets.

4.296 The text on the species identification sheets currently is in English. It was noted that some of the terms used were of a technical nature and not clear to observers whose mother tongue was not English. The Working Group agreed that the text should be simplified and, if possible, translated into the four official CCAMLR languages.

4.297 It was agreed that some simple revisions should be made to the identification sheets. Dr Everson agreed to undertake this task and provide revised versions to the Secretariat by the end of December 2001. Members were encouraged to provide suitable amendments to Dr Everson as soon as possible.

Standardisation of Measurement

4.298 The Working Group discussed the length measurements in use and agreed that:

- (i) for macrourids, because the tail is very often damaged, the length measurement to be used should be from the tip of the snout to the anus; and
- (ii) for all other fish species the total length should be reported.

Advice to the Scientific Committee

4.299 The Working Group recommended that revised versions of the species identification sheets be prepared and copies sent to technical coordinators. These identification sheets are to be laminated in waterproof material. The Working Group recommended that sufficient funds be included in the budget for this purpose.

4.300 Copies of the species identification sheets should be included in the *Scientific Observers Manual*.

4.301 The Working Group recommended that the standardised body length measurement to be used for *Macrourus* spp. should be from the tip of the snout to the anus.

Skates and Rays

Population Parameters

4.302 Population parameters needed for assessing the precautionary pre-exploitation harvest level (γ) in Subarea 48.3 for skate and ray species were based on several sources. Most sources were specific to skate and ray species from South Georgia. Where no information was available, the Working Group relied on recent research on skates conducted around the Falkland/Malvinas Islands.

4.303 The estimates of the length of 50% recruitment ($L_{50\%}$) was set at 70 cm, and the length at 50% maturity ($L_{m50\%}$) was 85 cm. These estimates were based on information collected during toothfish longlining operations in Subarea 48.3 during 2000, and were reported in WG-FSA-00/59. The age at 50% maturity was set at 8 years, based on length at age from the assumed growth parameters.

4.304 The length–weight regression relationship used was $W = 0.00000646 * L^{3.06}$, based on information collected for the ray species *Raja georgiana* collected around South Georgia, and reported in WG-FSA-00/22.

4.305 Growth parameters were particularly difficult to estimate. Although there was some information on growth of *B. eatonii* and *A. georgiana* presented in WG-FSA-01/52, there were no von Bertalanffy parameters estimated. The Working Group relied on the largest (total) length for all skates from observations presented in WG-FSA-00/59 for an estimate of L_8 (= 150 cm). The growth parameter k was estimated at 0.1, and was drawn from averaging estimates taken from three species of skates in the Falkland/Malvinas Islands fishery (Agnew et al., 2000). The t_0 was assumed to be 0. The natural mortality used was $M = 0.2$, also drawn from estimates around the Falkland/Malvinas Islands.

Determination of Precautionary Pre-exploitation Harvest Level (γ) in Subarea 48.3

4.306 The decision rule used to assess the precautionary pre-exploitation harvest level (γ) was that the median escapement of the spawning stock at the end of 20 years of exploitation is 75% of the pre-exploitation spawning stock biomass, and the probability of depletion below 20% of the median pre-exploitation spawning biomass is no greater than 0.1 over a 20-year period. The parameters and simulation characteristics used to compute γ are presented in Table 47.

4.307 Meeting the conditions of the two-part decision rule is influenced by a number of factors. One of the necessary measures with the greatest uncertainty was the estimate of the coefficient of variation for B_0 . The estimates of CV were computed from the combined skate and ray by-catch reported in haul-by-haul longline data from Subarea 48.3. These estimates ranged from 2.009 for the entire data series to 1.006 for the year 2000. A plot of the effect of various levels of B_0 CV with increasing levels of γ reveals extremely high sensitivity on levels of median escapement (Figure 34). However, the probability of depletion is insensitive to B_0 CV > 0. Thus, the probability of depletion appears to be a better rule in terms of estimation of γ for skates and rays.

4.308 The resulting estimate of γ for skates and rays in Subarea 48.3 is 0.026, which under a B_0 CV of 1.003 results in a median escapement of 0.749 and probability of depletion of 0.094.

4.309 Estimating a precautionary yield for skates and rays in Subarea 48.1 using γ requires an estimate of B_0 for the population. Because there are currently no estimates of this parameter, the Working Group discussed various options of how this could be estimated using other B_0 estimates for skates and rays from other areas of the Southern Ocean. Values of B_0 have been computed from Heard Island (Constable et al., 1998), and the Falkland/Malvinas Islands (Agnew et al., 2000). The Working Group considered the feasibility of using these values and pro-rating the estimate to the area of seabed in Subarea 48.3. However, both estimates of B_0 were derived over shelf areas <500 m, and the data obtained using trawl gear. The South Georgia skate and ray distribution is likely to be very different than that over Heard Island or the Falkland/Malvinas Islands. Further, since the skate by-catches from longline gear in Subarea 48.3 occur largely off the shelf >500 m, the Working Group felt that the estimates of B_0 derived from the other areas were not sufficiently compatible for pro-rating to seabed areas within Subarea 48.3. Thus, the Working Group was not in a position to compute a precautionary yield with the available information.

4.310 The Working Group recommended that the decision rule regarding the probability of depletion below 20% of the median pre-exploitation spawning biomass be re-examined for skates and rays. Skates and rays have low fecundity and therefore are likely to have a stronger stock–recruit relationship than teleosts. Arising from this, it may be appropriate to adjust the 20% depletion rule upwards.

4.311 It was agreed that insufficient information was available to make assessments of skates and rays in any of the current fisheries. Key topics for further investigation are:

- (i) estimation of standing stock;
- (ii) length–mass relationships covering a good representation of all size classes – particularly at the lower end of the spectrum;
- (iii) tagging studies to investigate migration and growth;
- (iv) estimation and validation of age leading to estimation of growth parameters and age–length keys;
- (v) taxonomy; and
- (vi) biological information, in particular observations on sex, maturity stage and fecundity.

It was noted that the information for (ii), (v) and (vi) could be derived from existing sampling by observers.

Advice to the Scientific Committee

4.312 The Working Group recommended that further steps be taken to estimate standing stocks of skates and rays in order to generate estimates of precautionary yield.

4.313 In the absence of any formal estimates of precautionary yield for skates and rays, the Working Group recommended that interim precautionary measures be adopted (see paragraph 4.332).

Macrourus spp.

4.314 The subgroup considered available information on macrourids suitable for incorporation in assessments models. The information is summarised in Table 48.

4.315 It was agreed that insufficient information was available to make assessments of these species in any of the current fisheries. It was agreed that further information would be essential before assessments could be made. Key topics for further investigation are:

- length–mass relationships covering a good representation of all size classes – particularly at the lower and upper end of the size spectrum;
- otolith collection in order to develop age–length keys over the full size range of the species. Ultimately this will need to be supported by validation studies; and
- biological information, in particular observations on sex and maturity stage.

It was noted that much of this information could be derived from the observer program.

Advice to the Scientific Committee

4.316 The Working Group recommended that further steps be taken to estimate standing stocks of macrourids in order to generate estimates of precautionary yield.

4.317 In the absence of any formal assessments of macrourids, the Working Group recommended that interim precautionary measures be adopted (see paragraph 4.332).

Consideration of Management Measures for By-catch Species

4.318 The Working Group discussed the questions from the Commission on possible steps to be taken in the management of by-catch (CCAMLR-XIX, paragraph 9.39).

4.319 The Working Group agreed that at this time the research requirements aimed at assessing by-catch are unlikely to be in conflict with commercial fishing activities (CCAMLR-XIX, paragraph 9.39(ii)).

4.320 In relation to links between by-catch provisions and specific areas (CCAMLR-XIX, paragraph 9.39(i)), it was noted that the problems of making by-catch assessments are exacerbated by the number of species involved. The Working Group agreed that some simplification in the approach would be essential. Accordingly, for the purposes of making

assessments, species would be amalgamated into groups such as ‘Rajids’ for all skate and ray species and ‘Macrourids’ for all *Macrourus* spp. In spite of this, biological information will still need to be analysed by species.

4.321 The Working Group had insufficient information available to make assessments on individual species or groups. Attention was therefore focussed on a consideration of the general approaches that might be used to develop management measures.

4.322 Accepting that fishing on target species will result in some by-catch, the Working Group considered action that should be taken in the absence of information with which to make an assessment. It was agreed that any such measures will of necessity be somewhat arbitrary but should take account of the following criteria:

- (i) the fishery should not adversely impact the by-catch species;
- (ii) measures should not constrain fishing on the target species without due cause; and
- (iii) data and samples from the by-catch should be used in support of future assessments.

4.323 It was also noted that the Commission had indicated that management measures should be such as to ensure that the productivity of by-catch species is not adversely affected. It was also noted that management measures should aim to minimise the risk of local depletion of by-catch stocks (CCAMLR-XIX, paragraph 9.39).

4.324 With this in mind, the Working Group agreed that management measures for by-catch species should contain two major components. Firstly a limit on the total catch of each species or group and secondly a ‘move on’ rule to minimise the risk of local depletion.

Total Catch Limits for By-catch Species

4.325 Information in Tables 45 and 46 indicate that there are major differences in the reported by-catch from season to season and also between fishing grounds. Such differences might arise due to differences in fishing method, the fishable grounds as well as fish density and production. Accordingly a single figure, whether expressed as a percentage of the target species catch or a total by-catch tonnage, was considered inappropriate. The Working Group therefore recommended that, using Tables 45 and 46 as a guide, limits for by-catch species be set for each subarea and division based on a percentage of the total catch by mass in the fishery.

4.326 As is the case with the target fisheries, decisions on the closure of a particular fishery would be made using the reported catches. Providing the observer program is implemented in line with the recommendations set out in paragraph 4.286, information from that program could be used by the Working Group to determine how effectively by-catch had been reported.

Minimisation of the Risk of Local Depletion

4.327 The Working Group agreed that the most effective mechanism by which local depletion of by-catch species could be minimised was through the imposition of a rule whereby if an individual set or haul caught more than a set amount of given by-catch species, the vessel should move to a position at least some specified distance away before recommencing fishing. Furthermore, the vessel should not return to the locality at which the high by-catch was made for a specified period.

4.328 With this in mind, the Working Group recommended that in order to minimise the risk of local depletion of by-catch species, the following measure should be applied to all vessels operating in longline, pot or trawl fisheries:

If any vessel catches more than 1 tonne of a by-catch species in a longline or pot set or individual trawl haul, it must move its fishing position (defined as the midpoint of the set or haul) by at least 5 n miles. It may not return to the position of the high by-catch to fish within five days.

Application to New and Exploratory Fisheries

4.329 The Working Group noted the by-catch provisions of Conservation Measure 200/XIX in relation to the proposals set out in paragraphs 4.326 and 4.328. The Working Group had no scientific basis on which to recommend any changes to this conservation measure.

Advice to the Scientific Committee

4.330 The Working Group recommended that the Scheme of International Scientific Observation be amended to incorporate the proposals set out in paragraph 4.286.

4.331 Revised species identification sheets should be prepared and circulated to all observers (paragraph 4.286).

4.332 The Working Group recommended that, as interim measures for the forthcoming year, the following management measures with respect to by-catch species in assessed fisheries be introduced:

- (i) for each assessed fishery, a by-catch limit for each species group be set at a percentage of the total catch by mass of all species within the fishery; the percentage to be based on the information in Tables 45 and 46; and
- (ii) if any vessel catches more than 1 tonne of any by-catch species group in a longline or pot set or individual trawl haul, it must move its fishing position (defined as the midpoint of the set or haul) by at least 5 n miles. It may not return to the position of the high by-catch to fish within five days.

The Working Group had no scientific basis on which to recommend any changes to Conservation Measure 200/XIX in its application to new and exploratory fisheries.

Management Under Uncertainty

Unified Regulatory Framework

4.333 Over the past three years the Scientific Committee and Commission have been developing a unified framework for providing management advice on all fisheries in the Convention Area (CCAMLR-XVII, paragraphs 10.3 to 10.7; SC-CAMLR-XIX, paragraphs 7.2 to 7.20). At last year's meeting the Commission agreed that a key component of the generalised mechanism was a new reference document prepared and maintained by the Secretariat for each fishery in the Convention Area, to be known as the Fishery Plan (CCAMLR-XIX, paragraphs 10.2 to 10.8). It also agreed that the Secretariat should develop two example fishery plans, one for the krill fishery in Area 48 and the other for the *C. gunnari* fishery in Subarea 48.3.

4.334 The draft Fishery Plan for the *C. gunnari* fishery in Subarea 48.3 (WAMI-01/15 Rev. 1) was reviewed by WAMI. After incorporating WAMI suggestions, the revised plan was presented to WG-FSA (Appendix E).

4.335 The Working Group expressed appreciation to the Secretariat for completing the draft plan and felt it was an excellent approach to accomplish the Commission objective.

4.336 Participants felt the fishery plan will allow its work relative to the many new and exploratory fisheries notifications to be conducted in a standard form. The final plan should allow information to be retained in a concise and standard format until it needs to be modified.

4.337 Participants looked forward to seeing similar plans completed for all fisheries which would also incorporate information over the last several years of the fishery.

4.338 The Working Group advised the Scientific Committee that the method used to present the information to the Commission should be considered. For example, it might be in the style of the *Statistical Bulletin* and/or on the CCAMLR website.

Review of CCAMLR Conservation Measures

4.339 In 2000 the Commission recognised that the suite of conservation measures that it regularly reviews and adopts had become large and extremely complex. The Commission agreed that there was considerable merit in reviewing the structure of the conservation measures and their presentation, and remitted the task to an intersessional group including the Secretariat (CCAMLR-XIX, paragraph 9.72).

4.340 During the 2000/01 intersessional period, the Secretariat reviewed the development and structure of conservation measures adopted by the Commission (CCAMLR-XX/BG/4). Based on that review, it concluded that some of the work of the Commission may be simplified by the use of standard text in conservation measures dealing with many of the fisheries within the Convention Area. It then developed two alternative options for simplifying the process of drafting conservation measures (CCAMLR-XX/20 Rev. 1).

4.341 The Secretariat document proposed two methods for simplifying the process of drafting conservation measures dealing with fisheries. The first method would identify relevant standard paragraphs and the specifications to be used in each fishery conservation measure. It would also include 'non-standard' requirements, if any. The paragraphs, specifications, and special requirements, if any, would then be combined to produce the conservation measure in a format similar to that used in previous years.

4.342 In the second method, relevant standard paragraphs, specifications and 'non-standard' requirements, if any, for each fishery would be identified but would be listed in table format.

4.343 The Working Group welcomed the work completed by the Secretariat. In particular, the proposed changes would help simplify the work of WG-FSA. To complement the new approach, the Working Group could develop a standard format for management advice, perhaps in the form of a checklist, which would address the standard provisions of conservation measures.

4.344 Participants, however, also cautioned that management advice must have the flexibility to include non-standard approaches and diverse opinions where agreements are not reached.

Standardisation of Management Measures across all CCAMLR Fisheries

4.345 Participants noted that management advice for all fisheries in the Convention Area, except the krill fishery, was provided by WG-FSA. Participants recommended that, as is the case with all finfish, crab and squid fisheries, it would be desirable for the krill fishery to also be managed under standardised rules common to other fisheries.

CONSIDERATIONS OF ECOSYSTEM ASSESMENT

Interactions with WG-EMM

By-catch of Young Fish in the Krill Fishery

5.1 WG-FSA considered a single contribution documenting the by-catch of juvenile *C. gunnari* in the krill fishery at the South Orkney Islands from May to July 1999 (WAMI-01/11). The by-catch was not large and was usually in the range of a few tens of fish per haul to several thousands of fish in one haul.

5.2 Few papers on the by-catch of fish in the krill fishery have been submitted to CCAMLR since a major review was undertaken of available information and the amount of fish by-catch in krill fishing activities in 1995 (Iwami et al., 1996). CCAMLR encouraged Members to submit more observations on the by-catch of fish in krill fisheries.

Other Information arising from WG-EMM's
Deliberations of relevance to WG-FSA

5.3 *C. gunnari* can become an important food item in the diet of predators in certain months as, for example, in king penguins at Heard Island (Moore et al., 1998) or Antarctic fur seals at South Georgia in years when krill is scarce around the island, as in 1990/91 (Everson et al., 1999). This has been discussed at some length in the report of WAMI which preceded the meeting of WG-FSA. Readers are referred to this report for further information on this matter (Appendix D).

5.4 WG-EMM has recently considered a draft fishery plan which the Secretariat had prepared for the krill fishery in Area 48. Another fishery plan was drafted by the Secretariat for the fishery for *C. gunnari* in Subarea 48.3. WG-FSA reviewed the progress made by the Secretariat to this end, and incorporated a number of changes and amendments to the current version of the plan (Appendix D).

5.5 Information on effects of squid fishing was briefly discussed. This discussion is provided in more detail in paragraph 3.132.

Ecological Interactions

5.6 More attention needs to be paid to quantifying the interactions of krill, *C. gunnari* and Antarctic fur seals at South Georgia to follow up an initial study by Everson et al. (1999). Antarctic fur seals, which number more than 1 million at South Georgia for most of the year, may contribute significantly to natural mortality in *C. gunnari*, particularly in those years when krill tends to be scarce around the island. This needs to be taken into consideration in stock assessments of *C. gunnari*. The consumption of more fish by fur seals may mean that less fish are available for the fishery in a particular year.

5.7 Some consideration has been given to include *C. gunnari* and *Pleuragramma antarcticum* as indicator species to be monitored by CEMP. Sufficient data are being collected on an annual basis to justify the inclusion of *C. gunnari* although certain requirements, such as a data collection plan, need to be developed before the species can be considered for incorporation into the CEMP activities.

5.8 *P. antarcticum* was considered as a potential indicator species when CEMP was established in the mid-1980s, because of its importance as a prey item for various predators such as penguins and seals. However, the suggestion to include *P. antarcticum* never went beyond that stage and very few data on *P. antarcticum* have been submitted to CCAMLR since then. If *P. antarcticum* is to be considered seriously as a possible CEMP species, a considerable amount of work will have to be done in order to develop regular sampling programs for the species in key areas and a data collection plan to fulfil CCAMLR requirements. The Ross Sea might be an area where this is possible.

Interactions of Marine Mammals with Fishing Operations

5.9 This item is considered in more detail in section 7.

The Benthic Fauna in relation to Fishing

5.10 WG-FSA-01/33 provided some information on seafloor mapping and the distribution of the benthic fauna in the South Orkney Islands and the Elephant Island–South Shetland Islands collected during the US AMLR demersal fish surveys in 1999 and 2001. The two broad communities could be separated from each other on the Elephant Island shelf: one on the western shelf was considered to be young and still maturing, while old and mature communities were present on the eastern part of the shelf. This is consistent with past fishing activities. These took part mostly on the northern and western part of the shelf and most of the area has been trawled once if not more often according to fishing maps available from the area. This would have damaged or destroyed a considerable amount of benthos. Comparatively little trawling was done on the eastern part of the shelf where fish biomass was found to be considerably lower.

General Considerations

5.11 The item ‘Ecosystem Considerations to Management’ has been on the agenda of WG-FSA for a considerable amount of time. More and more aspects have been discussed under other items of the agenda, such as Item 3 (Fish and Squid Biology/Demography/Ecology) or Item 7 (IMALF), leaving little to discuss under this agenda item. The Working Group suggested that the Scientific Committee should delete this item from the forthcoming agenda of WG-FSA and refer relevant discussions to relevant sections of the report, such as section 3 or 7.

5.12 The objective of the CCAMLR Convention is to protect ecosystems in their entirety and its primary aim is not to protect single stocks from over-exploitation. It was felt that WG-FSA should increase its effort in the near future to consider groups of species in its assessments for an area rather than individual stocks. This would better comply with the ecosystem approach to be followed in CCAMLR.

5.13 Attempts for a more ecosystem-orientated approach have been made in the past when considering the fishery in the South Orkney Islands–South Shetland Islands. The fishery was closed eventually to protect by-catch species such as *Gobionotothen gibberifrons* or *Chaenocephalus aceratus* which could only sustain a low level of fishing. The prohibition of bottom trawling when fishing for *C. gunnari* at South Georgia offers another example of a more ecosystem-driven approach.

RESEARCH SURVEYS

Simulation Studies

6.1 A method of examining the efficacy of various toothfish longline survey patterns is described in WG-FSA-01/75. The paper presents a spatially explicit model that can be used to identify optimal patterns of set locations and attempts to illustrate how different survey designs, including minimum set distances and number of hauls, quantify population and fishery characteristics in a simulated environment.

6.2 A protocol for ensuring random subsampling on board research trawl surveys is described in WG-FSA-01/68. Using hierarchical methods, a simple, flexible methodology is described that provides a foundation for estimation of parameters while optimising for logistical constraints such as available amount of labour and size of haul without a loss of statistical rigour.

Recent and Proposed Surveys

6.3 Studies were undertaken by Australia, South Africa, Ukraine and the USA. Four research surveys were undertaken in the Convention Area in 2000/01, covering Subareas 48.1 and 58.7, and Divisions 58.4.4 and 58.5.2.

6.4 The Australian bottom trawl survey in Division 58.5.2 on board the *Southern Champion* studied the abundance and length distribution of *C. gunnari* and pre-recruit *D. eleginoides* (WAMI-01/4, WG-FSA-01/73).

6.5 A bottom trawl survey of *D. eleginoides* resources within the South African EEZ of Subarea 58.7 was conducted by South Africa. The results of this survey are presented in WG-FSA-01/72 and the population assessed in WG-FSA-01/54.

6.6 A longline survey of *D. eleginoides* was conducted by Ukraine in Division 58.4.4.

6.7 The results of a bottom trawl survey of Subarea 48.1 conducted by the USA are presented in WG-FSA-01/33 and WAMI-01/10. Biological information and biomass estimates were presented for eight species of finfish: *C. gunnari*, *C. aceratus*, *Chionodraco rastrospinosus*, *G. gibberifrons*, *Lepidonotothen larseni*, *Lepidonotothen squamifrons*, *Notothenia coriiceps* and *N. rossii*.

Proposed Surveys

6.8 Australia plans to repeat the *C. gunnari* and *D. eleginoides* pre-recruit survey in Division 58.5.2 during the coming season. Experimental toothfish pot trials will also be conducted in Divisions 58.4.2 and 58.4.3.

6.9 Germany plans to conduct a bottom trawl survey and other finfish and benthic investigations in Subarea 48.1 on the RV *Polarstern*.

6.10 Russia has notified that it will conduct a trawl and acoustic survey of *C. gunnari* resources in Subarea 48.3.

6.11 The UK intends to conduct a bottom trawl survey for *C. gunnari* and pre-recruit *D. eleginoides* in Subarea 48.3. Some tagging work and larval sampling are planned as well during the forthcoming year.

6.12 Other tagging experiments will be conducted by New Zealand in Subarea 88.1 on *Dissostichus* spp. and skates, and South Africa in Subarea 58.6 on *D. eleginoides*.

INCIDENTAL MORTALITY ARISING FROM LONGLINE FISHING

Intersessional Work of Ad Hoc WG-IMALF

7.1 The Secretariat reported on the intersessional activities of ad hoc WG-IMALF according to the agreed plan of intersessional activities for 2000/01 (SC-CAMLR-XIX, Annex 5, Appendix D). The report contained records of all activities planned and their results. These were reviewed and appropriate details appear in the 2001/02 plan of intersessional activities of WG-IMALF (Appendix F).

7.2 The Working Group noted the extensive work accomplished intersessionally by ad hoc WG-IMALF, details of which were presented in a number of tabled papers. The Working Group thanked the Science Officer for his work on the coordination of IMALF 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 2000/01 fishing season.

7.3 The Working Group concluded that most tasks planned for 2000/01 had been successfully implemented. In reviewing the report, it noted that responses from Members had been poor to requests concerning information on population, genetics and foraging data for albatrosses and petrels, particularly in the format requested. The response to the standing request on national research programs had also been poor and all Members were asked to provide both reports in full next year.

7.4 The Working Group also noted the lack of response to a number of standing requests to technical coordinators of scientific observation programs, in particular, on the development and use of fisheries-related methods for the avoidance of incidental mortality of seabirds. The Working Group urged all technical coordinators to respond to such requests, even if they are unable to report progress.

7.5 The Working Group noted the continuing absence of any feedback on the use on board longline vessels of the book *Identification of Seabirds of the Southern Ocean*, published jointly by CCAMLR and New Zealand in 1999. The Secretariat reported a continued demand for the book from many CCAMLR Members. For this reason the book has already been reprinted in English. Mr Smith advised that crews of fishing vessels had expressed interest in having the book on board. Scientific observers nominated by New Zealand regularly used the book at sea in conjunction with their national bird identification field guide.

7.6 The Working Group welcomed a report from Brazil of the planned publication of educational material based on the CCAMLR book *Fish the Sea Not the Sky*.

7.7 The membership of ad hoc WG-IMALF was reviewed. The updated list of members has been placed on the CCAMLR website (Scientific Committee ? Fisheries Interaction ? Membership). The Working Group especially welcomed Ms Rivera who attended the meeting for the first time. However the Working Group noted that some CCAMLR Member countries which are involved in longline fishing and/or seabird research in the Convention Area (e.g. Chile, France, European Community, Ukraine and Uruguay) were not, or were still not, represented at meetings of ad hoc WG-IMALF. Members were asked to review their representation on WG-IMALF intersessionally, to suggest additional members and to facilitate the attendance of their representatives at the meetings.

Research into the Status of Seabirds

7.8 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-01/36), France (WG-FSA-01/41), Australia (WG-FSA-01/47), UK (WG-FSA-01/67) and New Zealand (WG-FSA-01/77). Reference to research on albatrosses by South Africa is included in WG-FSA-01/10, 01/11, 01/12 and 01/14. Of the countries known to be conducting relevant research on these species, no reports were received from Argentina and Chile.

7.9 All Members were requested to table annual updates on the current status of relevant research programs to next year's meeting of the Working Group.

7.10 Previously it was noted that the information regarding seabird population dynamics and foraging ranges was insufficient for comparisons with levels of by-catch and fishing effort. Consequently Members were requested to provide additional detail to enable these important assessments (SC-CAMLR-XIX, Annex 5, paragraphs 7.10 and 7.11). A proforma of the information requested was circulated intersessionally. The UK and Australia were the only Members to provide the information requested, although New Zealand provided additional information on their albatross population research programs.

7.11 The information provided is summarised in Tables 49 and 50, which update Table 47 in SC-CAMLR-XIX, Annex 5. All Members were requested to provide the details of population dynamics studies and foraging ranges as requested last year. Complete submission of the population and foraging research proformas to next year's meeting of the Working Group will enable a timely and comprehensive review of the level of information available for each population.

7.12 The most recent assessments (using the IUCN criteria) of the global status of albatrosses, giant petrels and *Procellaria* petrels are included in Table 49 as extracted from the information contained in WG-FSA-01/55. Given the population trends for some species, the status assessments are likely to require revision.

7.13 Of particular relevance to CCAMLR is a current application to IUCN (via BirdLife International) to upgrade the status of the black-browed albatross from Near-Threatened to Vulnerable. This reassessment is based on recent data from the Falkland/Malvinas Islands (which contain 70% of the world population), where it is estimated that the breeding population has declined by 25% (from 506 000 to 382 000 pairs) over the last 20 years. In the last five years this population has declined from 468 000 to 382 000 pairs, a decrease of 18% (Huin, 2001).

7.14 To enable revisions of the status of albatross and petrel populations vulnerable to fishery-related mortality in the Convention Area, Members are required to provide information on the most recent assessment of population size (year and population size estimate and population trend) for each population, wherever this information is available. This information should be tabled at next year's meeting of the Working Group.

7.15 A review of population trends of albatrosses and petrels at Marion Island (WG-FSA-01/11) illustrates the requirement for timely review of trends of vulnerable populations. The authors report on the dramatic recent population declines of five species

(wandering and grey-headed albatrosses, northern and southern giant petrels, and white-chinned petrels). The albatross and giant petrel populations were all stable or decreasing during the 1980s, prior to a recovery period during the early 1990s. The population recoveries have subsequently halted or reversed in all four of these species. Wandering albatrosses increased in numbers steadily between 1990 and 1997, after which the population has decreased at -8.2% p.a. The grey-headed albatross population has been variable during the 1990s but the 1999/2000 data showed a 28% decrease from the previous season. The late 1990s also showed dramatic declines for both northern giant petrels (-11.3% p.a. since 1997) and southern giant petrels (-14.6% p.a. since 1995). White-chinned petrels have been monitored annually since the 1996/97 season, during which time the population has decreased by an alarming 34%, at an annual rate of -14.1%. Continued monitoring is essential to determine if the recent population decreases are sustained.

7.16 The population trends of the five species at Marion Island are similar to trends of wandering albatrosses at other Indian Ocean breeding locations, suggesting a common underlying cause, possibly changes in effort in the Southern Ocean tuna fisheries. A recent increase in tuna longlining, as well as recent large-scale IUU longline fishing for *D. eleginoides* (including in areas close to the breeding grounds), are likely contributing to the recent population decreases (WG-FSA-01/11).

7.17 The results of the South Georgia research program on white-chinned petrels, reported verbally last year (SC-CAMLR-XIX, Annex 5, paragraph 7.8), were made available at the meeting (WG-FSA-01/26 Rev. 1). A decline of over 28% in the breeding numbers for this population between 1981 and 1998 was attributed to changes in the marine environment, particularly relating to incidental mortality in longline fisheries. The results of analyses of the foraging range of white-chinned petrels breeding at South Georgia (WG-FSA-01/25) confirmed that they are amongst the most wide ranging of seabirds (travelling 3 000 to 8 000 km between incubation bouts). This wide-ranging dispersal places this population at substantial risk of high mortality rates in Southern Ocean longline fisheries, both in waters within, and adjacent to, the Convention Area. Importantly for by-catch considerations, this study also confirmed that nocturnal and diurnal activity of this species was approximately equal.

7.18 Tristan albatrosses, breeding only on the Gough and Tristan da Cunha group of islands, are the most genetically distinct of the wandering albatross complex, and are currently listed as Endangered. WG-FSA-01/14 provided data on population demographic parameters, including age at return to the island (4–5 years of age), modal age of first breeding (8 years), and average breeding success (63% in 1999/2000). The study reports that of the nine birds recovered away from the island, at least four were killed by longline fishing. Despite mortality on longlines, the authors suggest that the population may not have declined dramatically since the early 1980s and that its Threatened status might be revised to Vulnerable. The Working Group, however, felt that more caution may be warranted for this, the third rarest of all albatross species, given the lack of repeatable surveys to date, the small size of the annual breeding population (<1 200 pairs) and the restricted number of breeding sites (essentially one).

7.19 With the exception of the satellite tracking studies of the Macquarie Island albatrosses and the survey of Tristan albatrosses, no research programs focussing on relevant populations have been initiated 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 *Diomedea* albatrosses, with considerably less known for *Thalassarche*, *Phoebetria*, *Macronectes* and *Procellaria* species (in that order). It is unfortunate that, of all the species killed on longlines in southern waters, our understanding of the population size, trends and foraging ranges are most deficient for white-chinned petrels, the species most commonly killed in the Convention Area.

7.20 A summary of foraging distributions as determined by satellite tracking was attempted to enable an assessment of the foraging ranges of affected populations (at different times of year and stages of the breeding cycle), adequate to assess overlap with areas used by longline fisheries, and ultimately, to compare at-sea distributions with data on fishing effort (Table 50). Incomplete provision of information prevented the completion of this task. Compilation of the CCAMLR areas prospected by the different populations, with an indication of level of use, will enable better estimates of ranges of relevance to regional risk assessments (see SC-CAMLR-XX/BG/11).

7.21 In respect of the deficiencies resulting from the lack of relevant research into population dynamics and foraging ecology of most populations, little has changed since last year (SC-CAMLR-XIX, Annex 5, paragraph 7.10). If sufficient information is provided to the Working Group next year, it should be possible to provide assessments of the state of knowledge at a population level.

7.22 The foraging interactions between wandering albatrosses breeding on Marion Island and longline fisheries in the southern Indian Ocean were explored in WG-FSA-01/10. Adults tracked during the summer months showed affinity to mesoscale oceanographic features, as well as seasonal and gender differences in foraging behaviours. During the shorter foraging trips made during chick rearing, the authors noted a greater spatial overlap with the local *D. eleginoides* fishing area, as well as an increased reliance on offal produced by these vessels. During 1997 almost 60% of samples contained fisheries-related items (offal and fisheries litter). Fisheries-related debris observed to occur in the regurgitates from chicks has increased significantly, occurring in 25% of the samples collected in 1997. The most frequently occurring pollutants derived from fisheries were toothfish hooks (17% of samples) and rope nooses used when processing toothfish (8% of samples). Consistent with other populations of this species, the females foraged both further afield and in more northern waters. Although this population is exposed to a wide range of longline fisheries, the authors suggest that it is the mortality experienced by adult females in more temperate tuna fisheries which is the single most important factor compromising the conservation status of this population. The Working Group, however, noted with alarm the increasing incidence of toothfish hooks in regurgitates and were seriously concerned about the combined impact of fisheries on this population.

7.23 In 1999 and 2000 the Working Group requested information from Members on genetic research relevant to determining the provenance of birds killed in longline fisheries. Despite the knowledge that relevant studies have been conducted in Australia, New Zealand, South Africa, UK and the USA, detailed information was only provided by the UK. All other Members were again requested to supply relevant information on their research.

7.24 The results of research on population genetics of black-browed and grey-headed albatrosses (WG-FSA-01/19) are extremely relevant to the characterising of the profiles of these species, as well as to the ability to ascribe provenance to by-catch samples. Black-browed albatrosses form three distinct groups: Falklands/Malvinas; Diego Ramirez,

South Georgia and Kerguelen; and Campbell Island (*Thalassarche impavida*). *T. melanophrys* from Campbell Island contain genetic markers from all of the three groups, indicating high levels of mixture and hybridisation. In contrast, grey-headed albatrosses form one globally panmictic population. Ability to ascribe provenance for this species is therefore limited at present.

7.25 In recognition of the importance of validating the species of birds killed, as well as determining their sex, age, and where possible provenance, scientific observer logbooks were modified in 1996 to require an entry indicating the place of deposition and the scientists responsible for the material (SC-CAMLR-XV, Annex 5, paragraph 7.20).

7.26 The Working Group felt it was now appropriate to assess the number and location of specimens and samples retained from seabird by-catch. It requested the Secretariat to correspond with the scientists responsible in order to obtain summary data on the number and nature of specimens in their collections.

7.27 WG-FSA-01/18 reported the results of relating population data for wandering albatrosses at South Georgia and the Crozet Islands to longline effort data for tuna fisheries south of 30°S. The model from this paper predicted reasonably closely the observed data from the Crozet Islands, but the fit to the South Georgia population was substantially poorer. This probably reflects:

- (i) greater overlap in the Indian Ocean than in the Atlantic Ocean between the main areas of tuna longline fishing and the foraging ranges of wandering albatrosses from the Crozet Islands and South Georgia respectively; and
- (ii) greater impact of poorly documented longline fisheries, especially the tuna fisheries in the South Atlantic and the *D. eleginoides* fisheries (outside the CCAMLR Convention Area) within the foraging range of wandering albatrosses from South Georgia.

7.28 The model results suggest that the marked decline in both populations (late 1960s to c. 1986), and subsequent recovery of the Crozet Islands population (but not the continued decline of the South Georgia population), can be explained by the tuna longline by-catch. The model indicates that populations may be able to sustain some level of incidental mortality. However, the likely under-reporting of fishing effort (especially in non-tuna longline fisheries) and the delicate balance between a sustainable level of by-catch for these long-lived populations suggest great caution in any such application of the findings.

7.29 The Working Group commended this initiative, involving collaboration between Australian, UK and French scientists, which addressed issues of particular interest to CCAMLR. The results had a direct bearing on the question, posed by the Scientific Committee last year, as to the potential impact of longline fishing (including IUU fishing) on albatross populations in the Convention Area (see SC-CAMLR-XIX, paragraph 4.29).

7.30 The Working Group noted that although the approach in WG-FSA-01/18 could be refined by using recently available data on the distribution of effort within the foraging range of wandering albatrosses, the deficiencies noted above in the fishing effort data made it unlikely that significant improvements in model fit would result.

7.31 Given that the albatross data used in this study came from the most detailed and longest-running studies worldwide and that fishing effort data for tuna longline fisheries are relatively well documented by the standards of international waters fisheries, the Working Group noted the inevitable limitations for other attempts to establish causal relationships between incidental mortality in longline fisheries and responses by albatross populations in the Convention Area. The study also indicated that attempts to correlate seabird population changes with fishing effort are likely to be limited by the quality of the latter data. This is likely to be particularly true in respect of data for IUU fishing, despite the very large seabird by-catches potentially involved.

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

2001 Data

7.32 Data were available from 38 longline cruises conducted within the Convention Area during the 2000/01 season (for details see WG-FSA-01/21; Tables 12 and 51).

7.33 The Working Group noted that the average proportion (percentage with range in parentheses) of hooks observed was similar to last year (SC-CAMLR-XIX, paragraph 7.28), except in Subarea 88.1 where it was 23% higher, viz: Subarea 48.3 – 24 (10–81); Subareas 58.6/58.7 – 39 (6–61); Subarea 88.1 – 56 (37–89).

7.34 There were still concerns that the proportions of hooks observed on some vessels/cruises were unacceptably low (e.g. *Isla Graciosa* (6% and 8%) and *No. 1 Moresko* (10% on second cruise)).

7.35 WG-FSA-01/40 indicated that when bird catches are at low levels, it does not necessarily follow that increased observer coverage will increase the accuracy of bird by-catch estimates. The paper showed that when scientific observer coverage is about 20%, the absolute level of confidence intervals attached to estimates of mean bird catch are low when catch rates are less than 0.01 birds/thousand hooks (c. 8 birds per vessel per 100 days fishing). As a result, efforts to increase observer coverage beyond c. 20% should be balanced against perceived gains in the absolute accuracy of bird by-catch estimates rather than gains in the relative (CV) accuracy.

7.36 Problems with incorrect reporting of the proportions of hooks observed were much reduced compared with last year (SC-CAMLR-XIX, paragraph 7.29), with only the values for *Polarpesca I* (81%) and *Isla Gorriti* (89%) giving cause for concern.

7.37 The total observed catch rate was calculated using the total number of hooks observed and the total seabird mortality observed (Table 51). The estimated total catch of seabirds by vessel was calculated using the vessel's observed catch rate multiplied by the total number of hooks set.

Subarea 48.3

7.38 The overall catch rate of birds killed in Subarea 48.3 was 0.002 birds/thousand hooks, essentially the same as last year. All birds were killed during night setting; that no birds were killed during day setting presumably reflects the very small proportion (c. 5%) of sets starting in daylight.

7.39 The total estimated seabird mortality in Subarea 48.3 was 30 birds (Table 52), compared with 21 last year. Of the six birds observed killed, three were southern giant petrels, two were black-browed albatrosses and one was a cape petrel (Table 53).

South African EEZs in Subareas 58.6 and 58.7

7.40 For Subareas 58.6 and 58.7, the overall observed catch rate of birds killed was 0.018 birds/thousand hooks from 11 fishing voyages (Table 51). The night-time rate was lower (0.014 birds/thousand hooks) than during the day (0.037 birds/thousand hooks). The catch rate was slightly less than the previous year (0.022 birds/thousand hooks).

7.41 The total estimated seabird mortality in Subareas 58.6 and 58.7 for this year was 199 seabirds (Table 54), a marked decrease from the 516 estimated killed in the previous year. The white-chinned petrel was, as in previous years, the most commonly observed of three species reported killed, comprising 92% of the total observed mortality, with black-browed albatross and grey petrel each comprising 4% (Table 53).

7.42 Further analysis of seabird by-catch in the South African EEZ around the Prince Edward Islands in 2000/01 was presented in WG-FSA-01/61. This paper reported on observer data from 12 fishing voyages, eight of which were also included in the Secretariat's report (WG-FSA-01/21), setting a total of 8.07 million hooks. A total of 76 birds of six species was reported killed, substantially less than the 268 reported in the previous season. Most birds reported killed were white-chinned petrels (86%), with very small numbers of grey-headed and black-browed albatrosses, giant petrels, grey petrels and macaroni penguins (*Eudyptes chrysolophus*).

7.43 The average catch rate was 0.009 birds/thousand hooks, considerably lower than in the previous season (0.036), and also lower than in three earlier seasons (1998/99 (0.016), 1997/98 (0.117) and 1996/97 (0.289)). Catch rate per voyage varied from zero to 0.046 birds/thousand hooks. Most birds were killed during the summer months.

7.44 Most birds killed were hooked on the wing or body during setting. A total of 81 birds was released alive after being caught during hauling, mainly white-chinned petrels and southern giant petrels. This is an increase from 17 in 1999/2000 and was thought to be due to increased observer vigilance.

7.45 The observed reduction in bird mortality is thought to be due to vessels targeting seamounts at a distance from and to the west of the Prince Edward Islands where fewer birds were present.

7.46 The Working Group noted differences between WG-FSA-01/21 and 01/61 which reflected that:

- (i) as in the previous season, WG-FSA-01/61 included reports of dead birds not directly recorded by the observer, resulting in higher by-catch totals; and
- (ii) only eight fishing voyages were common to the two datasets. Three recent voyages covered by WG-FSA-01/21 were not available to the authors of WG-FSA-01/61 at the time of writing.

7.47 WG-FSA-01/8 reviewed seabird by-catch around the Prince Edward Islands over the four-year period 1996 to 2000. Observers were present on all but two of 52 voyages by 12 vessels.

7.48 During this period, the annual by-catch rate decreased from 0.19 birds/thousand hooks to 0.034 birds/thousand hooks. White-chinned petrels were the most frequently killed species (80% of 1 761) over the period, with albatrosses, particularly grey-headed albatrosses, being killed in numbers only in the first year. Improved compliance with CCAMLR regulations and an increasing distance of fishing from the islands were thought responsible for the reduction in by-catch over time.

7.49 Birds were caught almost exclusively during their breeding seasons, primarily during the austral summer. Mortality of white-chinned petrels was almost exclusively restricted to the months of October to April from 1996 to 2000. Most birds killed were breeding adult males, assumed to be from the Prince Edward Islands. Albatrosses were caught closer to the islands than white-chinned petrels. Most petrels were foul-hooked, whereas albatrosses were mainly hooked by their bills.

7.50 WG-FSA-01/8 estimated that about 7 000 seabirds were killed around the Prince Edward Islands from 1996 to 2000, when the estimated numbers of birds killed by IUU fishing (5 239 birds) were added to those killed by the regulated fishery (1 761 birds). This level of mortality was considered to have had significant impacts on the breeding populations of several species of albatrosses and petrels at the islands (see WG-FSA-01/11).

7.51 The Working Group recollected its recommendation of the two previous years (SC-CAMLR-XVIII, Annex 5, paragraph 7.46 and SC-CAMLR-XIX, Annex 5, paragraph 7.44) to prohibit fishing within 200 n miles of the Prince Edward Islands during the months of January to March inclusive, especially to reduce further by-catch of the summer-breeding white-chinned petrel.

7.52 In view of information provided by South Africa (paragraphs 7.12 and 7.47 to 7.50) on timing of mortality of white-chinned petrels, the Working Group recommended that fishing within 200 n miles of the Prince Edward Islands be prohibited in the months of September to April inclusive, in line with its advice for all other areas of the highest risk of seabird incidental mortality. However, if South Africa still considered it necessary to maintain a regulated fishing presence within its EEZ around the Prince Edward Islands in order to deter IUU fishing (WG-FSA-01/8), then regulated fishing within 200 n miles of the islands (which would include the seamounts to the west) should be prohibited at least from January to April.

Subarea 88.1

7.53 No incidental mortality of seabirds was observed in Subarea 88.1. The only bird caught (by *San Aotea II*) apparently came on board independently of the longlining operation and was released alive.

General

7.54 Table 55 summarises data on seabird by-catch and by-catch rates for the last five years (1997–2001), for the best documented subareas. There has been no seabird by-catch in the new and exploratory longline fishery in Subarea 88.1 in the three years (1999–2001) since this fishery commenced.

7.55 In Subarea 48.3, by-catch rate and estimated total seabird by-catch were, for the second successive year, at negligible levels. This has been achieved in large part by restricting fishing to winter months, but consistently improving compliance with Conservation Measure 29/XIX, particularly in respect of night setting and line weighting in 2000/01.

7.56 In the fisheries within the South African EEZ in Subareas 58.6 and 58.7, the by-catch rate in 2000/01 was the lowest yet reported (an order of magnitude lower than in 1997/98) and the total estimated seabird by-catch is, at 199 birds, close to the lowest total ever (156 birds in 1998/99). The improvements this year are due in part to improved compliance with Conservation Measure 29/XIX, but also to vessels targeting areas further from and to the west of the Prince Edward Islands where fewer seabirds occur (paragraph 7.45).

1999 and 2000 Data

French EEZs in Subarea 58.6 and Division 58.5.1

7.57 Information on seabird by-catch from within its EEZs around the Crozet (Subarea 58.6) and Kerguelen (Division 58.5.1) Islands was supplied by France for 1998/99 and 1999/2000 (WG-FSA-01/21, Appendix 1). A total of 11.57 million hooks was set in the two years.

7.58 The Working Group welcomed this information, coming as it does from areas identified as being of the highest risk for seabird mortality (SC-CAMLR-XX/BG/11), and also because such information had not been provided to CCAMLR for several years. However, it noted that the data had not been supplied in the standard format and that none of the original data had been submitted to the CCAMLR database as requested (SC-CAMLR-XIX, paragraph 4.22). In addition, the lack of information on mitigation measures in use in this fishery made interpretation difficult.

7.59 The data presented revealed most alarming by-catch rates, reaching as high as 8.584 birds/thousand hooks in one month, when no less than 3 226 birds were killed around Kerguelen. Overall, by-catch rates were 0.736 birds/thousand hooks for 1998/99 and 0.184 birds/thousand hooks for 1999/2000 for Crozet Islands and 2.937 birds/thousand hooks

for 1998/99 and 0.304 birds/thousand hooks for 1999/2000 for the Kerguelen Islands. The reason for the reduction in by-catch rate at the two island groups from 1998/99 to 1999/2000 is not known.

7.60 A total of 8 491 white-chinned petrels was reported killed. In both years and at both islands, this species formed over 99% of all birds reported killed. The few other species were nearly all albatrosses and giant petrels. More birds (6 848) were killed around the Kerguelen Islands than around the Crozet Islands (1 686).

7.61 By-catch occurred in nearly all months of fishing, which was spread over most of the year at both island groups, but levels were highest in the summer months of January to April, when white-chinned petrels are rearing chicks. However, appreciable numbers of white-chinned petrels were also killed, especially at the Kerguelen Islands, in October to December, when the species is prospecting and incubating.

7.62 The Working Group noted that the total of 2 241 birds estimated killed in the French EEZs in 1999/2000 is 4.2 times greater than the combined total (537 birds) for Subarea 48.3 (21 birds) and for the South African fishery in Subareas 58.6 and 58.7 (516 birds) for that year. Similar figures for 1998/99 are 6 293 birds estimated killed in the French EEZs, 17.2 times greater than the combined total of 366 birds estimated killed in Subarea 48.3 and by the South African fishery in Subareas 58.6 and 58.7.

7.63 The by-catch rates within the French EEZs in some cases exceeded those that are used to estimate by-catch for these areas in the IUU fishery (1.049 and 1.88 birds/thousand hooks; SC-CAMLR-XIX, Annex 5, Table 56).

7.64 It was noted that the mortality of white-chinned petrels would have been reduced from 8 491 to only 32 birds if fishing had not taken place during the eight months of high mortality during summer. The Working Group therefore recommended that longline fishing within the French EEZs should be prohibited during the months of September to April inclusive, in line with its advice for all other areas of the highest risk of seabird incidental mortality.

7.65 The Working Group requested France to supply the original data for 1999 and 2000, together with data for 2001, to CCAMLR at the earliest opportunity, together with information on by-catch mitigation measures in use in each of these three years.

Compliance with Conservation Measure 29/XIX

7.66 Compliance with this conservation measure, as set out in WG-FSA-01/22, is summarised in Table 56 in comparison with similar data from previous years, when Conservation Measures 29/XV and 29/XVI applied. The only substantive difference between Conservation Measures 29/XVI and 29/XIX is that the line weighting specification was relaxed from 6 kg at 20 m to 8.5 kg at 40 m.

Streamer Lines

7.67 This year 66% of the streamer lines deployed complied fully with the specifications in Conservation Measure 29/XIX (Table 57). In the last four years the highest compliance was 33% in 1999/2000, so this year there has been a substantial improvement. It was noted that several vessels complied fully with the streamer line specifications on some cruises but not on others. All vessels fishing in Subarea 88.1 used streamer lines that fully complied with the specifications.

7.68 Several vessels still have persistently poor compliance with this element of Conservation Measure 29/XIX (see Table 58), notably *Isla Santa Clara*, *No. 1 Moresko*, *Argos Helena*, *Aquatic Pioneer* and *Eldfisk*. It was disappointing that several vessels new to the fishery (*Polarpesca I*, *Suidor One* and *Rustava*) have failed to comply with this simple and important measure.

7.69 As in previous years the element of the conservation measure that was most commonly not met was length of streamer line. In Subareas 58.6 and 58.7 only 64% of the lines complied with the 150 m requirement and in Subarea 48.3 only 53% complied. Streamer line length in combination with height of attachment of the line both have an important bearing on the aerial length of the streamer line. Because the aerial section acts as a protection zone for seabirds, streamer line length is very important and the Working Group re-emphasised the importance of compliance with this element of the measure.

7.70 The Working Group noted that the observer reports for four vessels fishing in Subarea 48.3 did not provide full details of streamer line specifications (Table 57). It is essential that observers do this and it was recommended that the instructions to observers should emphasise this.

Offal Discharge

7.71 All vessels fishing in the Convention Area except one (*Maria Tamara* in Subarea 48.3) complied with the requirement to either hold offal on board or discharge on the opposite side to where the line is hauled and not discharge during setting. In 1999/2000 all vessels in Subareas 58.6, 58.7 and 88.1 complied with this conservation measure and in Subarea 48.3 four vessels contravened the measure so there has been a significant improvement. The case of the *Maria Tamara* is complicated by the fact that comments in the observer report are not entirely consistent with the logbook entry. This requires further investigation.

7.72 Although Conservation Measure 29/XIX calls for avoiding the discharge of offal during the haul, attempts to comply with this have been inconsistent. Thus, in Subarea 88.1 (where it is mandatory under Conservation Measure 210/XIX), no vessel discharged during the haul. In Subareas 48.3, 58.6 and 58.7, on four cruises (*Isla Camila*, *Viking Bay*, *Eldfisk*, *Isla Graciosa*), no offal was discharged during hauls; on the other 25 cruises there was discharge during hauls at an average of 91% of sets. Paradoxically, some vessels discharged at the haul on some cruises but not on others. It is not clear what factors are contributing to this.

Night Setting

7.73 In accordance with Conservation Measure 29/XIX, longline setting shall occur at night only. Daylight is defined as the period from nautical dawn through to nautical dusk. If more than 20% of the set occurs in daylight hours, it is then considered to be a daylight set.

7.74 Compliance with night setting has improved in Subarea 48.3 from 87% in 1999/2000 to 95% in 2000/01. On five cruises, no sets were made in the daytime, on 12 cruises between two and nine sets were set in the daytime and on two cruises 18 and 34 sets were made in the daytime (on *Isla Alegranza* and *RK-1* respectively).

7.75 In Subareas 58.6 and 58.7 compliance, at 78%, remained about the same as in 1999/2000 (77%). The South African Government permit conditions for the *Eldfisk* allowed this vessel to fish during the daytime if a Mustad underwater funnel was used. This vessel deployed 50%, 64% and 94% of sets at night over three cruises. The *Koryo Maru II* deployed a significant number of sets (47%) during daylight hours on one cruise and caught the highest number of seabirds of any vessel fishing in these subareas.

7.76 Fishing in Subarea 88.1 (where only 18% of lines were set at night) operated under Conservation Measure 210/XIX which contained an exemption from night setting requirements for vessels fishing south of 65°S in order to conduct line weighting trials (see paragraph 7.80).

Line Weighting – Spanish System

7.77 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.

7.78 Line weighting that complied with the new conservation measure was used on four (21%) cruises in Subarea 48.3 and two (18%) cruises in Subareas 58.6 and 58.7 (Figure 35). It was reported that one vessel (*Isla Alegranza*) operating a Spanish longline system in Subarea 88.1 complied with the measure, using line weighting equivalent to about 12 kg at 40 m intervals (and a setting speed of 7 knots).

7.79 Eight other vessels used a line weighting regime that was close to that required in Conservation Measure 29/XIX on at least one cruise (Figure 35). This situation compares to 1999/2000 when no vessels complied with the line weighting requirement that was in place at the time (6 kg at no more than 20 m).

7.80 The Working Group concluded from this year's results that the new alternative line weighting requirement could be complied with. It recommended to the Scientific Committee and the Commission 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

7.81 In Subarea 88.1 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 210/XIX). The Working Group noted that all vessels complied with this measure.

Thawed Bait

7.82 All except three vessels (*Eldfisk*, *Ural*, *No. 1 Moresko*) complied with the requirement to use thawed bait on all occasions. This compared to last year when all but two vessels used thawed bait (WG-FSA-01/22).

General

7.83 Table 58 summarises compliance with Conservation Measure 29/XIX regarding night setting, streamer lines, line weighting and offal discharge on a vessel-specific basis.

7.84 Four vessels (*Isla Gorriti*, *Janas*, *San Aotea II* and *Sonrisa*) all complied fully with the elements of the conservation measures that were applicable in the areas they fished. The Working Group commended the efforts of these vessels and noted that these vessels were particularly suitable for involvement in new and exploratory fisheries.

7.85 Table 59 provides more detail, in an attempt to quantify performance, on the extent to which each vessel complied with each element of Conservation Measure 29/XIX in 2000/01. In addition to the vessels that fully complied with night setting, five vessels completed 95% or more of their sets at night.

7.86 Historical compliance data and reports received by CCAMLR from observers and fishers indicate that all practical constraints relating to streamer line use and line weighting have now been overcome. There is now no reason why all vessels cannot fully comply with these measures.

7.87 The Working Group therefore recommended that vessels which do not fully comply with night setting, streamer line, offal discharge and line weighting measures should be prohibited from fishing in the CCAMLR Convention Area.

7.88 It recollected that the Scientific Committee (SC-CAMLR-XIX, paragraph 4.41(i)) had made a similar recommendation last year (excluding line weighting for which the conservation measure was being modified).

7.89 Particular attention is drawn to vessels that have not complied with two or more of the elements of Conservation Measure 29/XIX for two or more consecutive years. These are: *Isla Camila*, *Isla Santa Clara*, *Koryo Maru 11*, *No. 1 Moresko*, *Argos Helena*, *Aquatic Pioneer* and *Isla Alegranza*. In addition, vessels in their first year in the fishery that failed to comply with two or more measures are *Polarpesca I*, *Suidor One*, *Maria Tamara*, *In Sung 66* and *Rutsava*.

7.90 It was noted that several vessels narrowly failed to achieve compliance with Conservation Measure 29/XIX, particularly in relation to streamer line design and night setting. It was recommended that technical coordinators be reminded of the precise specifications of these elements of the conservation measure and given encouragement to ensure that all vessels for which they have responsibility are able to comply with the stipulated provisions as a minimum. Improvements to the instructions and recording sheets for scientific observers should help to ensure comprehensive and accurate reporting on by-catch mitigating measures in use on each vessel (paragraph 7.96).

Fishing Seasons

7.91 Last year the Scientific Committee advised the Commission that once full compliance with Conservation Measure 29/XVI was achieved, together with negligible levels of seabird by-catch, 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 carefully monitored and reported (SC-CAMLR-XIX, paragraph 4.42).

7.92 On the basis of the data for the 2000/01 fishing season in Subarea 48.3, seabird by-catch levels were negligible, for the second successive season. However, full compliance with Conservation Measure 29/XIX was not achieved so it is not possible to recommend an extension to the fishing season for 2001/02 in Subarea 48.3.

7.93 However, the Working Group noted that full compliance would have been achieved:

- (i) if the offal discharge by the *Maria Tamara* had been on the opposite side from the haul (or if she had been excluded from the fishery as recommended by the Commission (CCAMLR-XVII, paragraph 6.42(i)), or if she was configured so as to be unable to discharge on the opposite side);
- (ii) with small improvements in setting of lines at night, notably by the *RK-1*, *Polarpesca I* and *Isla Alegranza*;
- (iii) with relatively small improvements to the line weighting regimes of all vessels, except *Argos Georgia* and *Ural*. It was noted that the *Isla Graciosa* and *No. 1 Moresko* achieved the standard on at least one cruise and *Viking Bay* only failed to do so by 0.6 kg; and
- (iv) with very minor improvements to the use and specification of streamer lines by *Argos Helena*, *Isla Camila*, *Isla Santa Clara*, *Polarpesca I* and *No. 1 Moresko*.

Scientific Observer Reports

7.94 In reviewing the Secretariat summaries of observations on board vessels operating in the Convention Area during the 2000/01 season (WG-FSA-01/20, 01/21 and 01/22), the following observer-related issues were noted (see also paragraphs 3.35 to 3.52).

Defining Incidental Mortality Events

7.95 One incident of seabird interaction in the longline fishery was reported as both an entanglement and an incidental capture. The Working Group noted that this type of confusion could be resolved by the development of a standard format for the written observer report.

Using Observer Data for Compliance Purposes

7.96 As the reporting of compliance with conservation measures is increasingly scrutinised, the accuracy of the data provided by observers becomes more crucial. This was highlighted in discussion of the accuracy of measurement of the length of streamer lines, and failure to report on specifications relating to certain elements of Conservation Measure 29/XIX (see paragraph 7.70) resulting in blanks in the tables in WG-FSA-01/22. The Working Group noted that observers needed to be clearly instructed by technical coordinators on the elements of conservation measures that they are reporting on.

Monitoring Line Sink Rate

7.97 CCAMLR observers reported on the implementation of Conservation Measure 210/XIX in relation to line sink rate prior to entering the Subarea 88.1 exploratory fishery and whilst participating in the Subarea 88.1 fishery in their written reports. However, the line sink rate data from both the pre-fishery testing and the in-fishery monitoring were not reported. The Working Group recommended that observer forms be modified to capture these data in future.

Determining Nautical Twilight in High Latitude Areas

7.98 Feedback was received from technical coordinators that observers had difficulty in determining nautical twilight in high latitude areas as current tables provided to observers stop at 75 degrees of latitude. The Working Group recommended that in future, tables covering the full extent of the Convention Area are provided to observers, preferably degree by degree rather than in 5 degree blocks.

Recording Seabird Interaction Data in Trawl Fisheries

7.99 The trawl forms currently used by observers do not capture seabird-interaction data in the same way as the longline forms. This lack of data makes the analysis of seabird-trawl interactions difficult (see paragraphs 8.19 and 8.20). The Working Group recommended that the observer trawl forms should be modified to capture the data needed for analysis of these interactions in a similar way to the current longline forms.

Use of Video Monitoring

7.100 WG-FSA-01/57 reported on recent developments in the use of video monitoring. The Working Group noted that the use of video monitoring systems is developing rapidly in fisheries for a variety of purposes. It was noted that such systems had the potential advantage of providing greater levels of coverage of fisheries for seabird interactions whilst allowing observers more time to work on other tasks.

7.101 Current video monitoring systems, so long as the camera is correctly positioned, should adequately record all incidents of seabird capture on demersal longline vessels. However, such systems leave at least four unresolved issues: data storage (tape or digital) on long trips, viewing of tapes to check for incidental captures, identification of the seabird species captured, and collection of specimens.

7.102 Rapid advances in digital video and data warehousing should resolve the data storage issue in the near future. Onshore viewing of tapes is possible, but likely expensive and time consuming. This needs further investigation, including assessment of costs. It is hoped that video recognition software may resolve this issue within the next few years (WG-FSA-01/57). Future advances in video recognition software may also allow rapid identification to the level of genus; however, species identification will likely require collection of actual specimens for quite some time. By collecting the required specimens, either observers or fishers could resolve this issue.

7.103 In summary, current systems do not yet appear able entirely to replace observer coverage with respect to assessing the incidental mortality of seabirds. However the Working Group noted that systems are being developed that may allow video monitoring systems to be used to assess the incidental mortality of seabirds in the near future and urged Members to report on such developments and any trials undertaken.

Incidental Mortality of Seabirds during Unregulated Longline Fishing in the Convention Area

Unregulated Seabird By-catch

7.104 As no information is available on seabird by-catch rates from the unregulated fishery, estimates have been made using both the average catch rate for all cruises from the appropriate period of the regulated fishery 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 set at night, to use streamer lines or to use any other mitigation measure. Therefore catch rates, on average, are likely to be considerably higher than in the regulated fishery. For Subarea 48.3, the worst-case catch rate was nearly four times the average value and applies only to a single cruise in the regulated fishery. Using this catch rate to estimate the seabird catch rate of the whole unregulated fishery may produce a considerable overestimate.

7.105 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 this assessment for the last three years. The assessment this year, therefore, followed the identical procedure to that used last year (SC-CAMLR-XIX, Annex 5, paragraphs 7.66 to 7.68).

Unregulated Effort

7.106 To estimate the number of hooks deployed by the unregulated fishery, it is assumed that the fish catch rate in the regulated and unregulated fisheries is the same. Estimates of fish catch rate from the regulated fishery and estimated total catch from the unregulated fishery can then be used to obtain an estimate for the total number of hooks using the following formula:

$$\text{Effort}(U) = \text{Catch}(U)/\text{CPUE}(R),$$

where U = unregulated and R = regulated.

Catch rates for Divisions 58.4.4 and 58.5.2 were assumed to be identical to those for Division 58.5.1.

7.107 The fishing year was divided into two seasons, a summer season (S: September to April) and a winter season (W: May to August), corresponding to periods with substantially different bird by-catch rates. There is no empirical basis on which to split the unregulated catch into summer and winter components. Three alternative splits (80:20, 70:30 and 60:40) were used.

7.108 The seabird by-catch rates used were:

Subarea 48.3 –

summer: mean 2.608 birds/thousand hooks; maximum 9.31 birds/thousand hooks;
winter: mean 0.07 birds/thousand hooks; maximum 0.51 birds/thousand hooks.

Subareas 58.6, 58.7, Divisions 58.5.1 and 58.5.2 –

summer: mean 1.049 birds/thousand hooks; maximum 1.88 birds/thousand hooks;
winter: mean 0.017 birds/thousand hooks; maximum 0.07 birds/thousand hooks.

Division 58.4.4 –

summer: mean 0.629 birds/thousand hooks; maximum 1.128 birds/thousand hooks;
winter: mean 0.010 birds/thousand hooks; maximum 0.042 birds/thousand hooks.

Results

7.109 The results of these estimations, based on estimates of IUU catches in Tables 3 to 11, are shown in Tables 60 and 61.

7.110 For Subarea 48.3, depending on the proportionate split of catches into summer and winter, estimates of the seabird by-catch in the unregulated fishery range from a lower level (based on the mean by-catch rate of regulated vessels) of 1 600–2 100 birds in summer (and 10–30 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 5 600–7 400 birds in summer (and 100–200 in winter).

7.111 For Subareas 58.6 and 58.7 combined, depending on the proportionate split of catches into summer and winter, estimates of the seabird by-catch in the unregulated fishery range from a lower level (based on the mean by-catch rate of regulated vessels) of 11 900–15 800 birds in summer (and 70–130 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 21 200–28 300 birds in summer (and 260–530 in winter).

7.112 For Divisions 58.5.1 and 58.5.2, depending on the proportionate split of catches into summer and winter, estimates of the seabird by-catch in the unregulated fishery range from a lower level (based on the mean by-catch rate of regulated vessels) of 13 200–17 600 birds in summer (and 70–150 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 23 700–31 500 birds in summer (and 300–590 in winter).

7.113 For Division 58.4.4, depending on the proportionate split of catches into summer and winter, estimates of the seabird by-catch in the unregulated fishery range from a lower level (based on the mean by-catch rate of regulated vessels) of 9 200–12 300 birds in summer (and 50–100 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 16 500–22 100 birds in summer (and 210–410 in winter).

7.114 The overall estimated totals for the whole Convention Area (Tables 60 and 61) indicate a potential seabird by-catch in the unregulated fishery of 36 000–69 000 (lower level) to 48 000–90 000 birds (higher level) in 2000/2001.

7.115 This compares with totals of 17 000–27 000 (lower level) to 66 000–107 000 (higher level) in 1996/97; 43 000–54 000 (lower level) to 76 000–101 000 (higher level) in 1997/98; 21 000–29 000 (lower level) to 44 000–59 000 birds (higher level) in 1998/99; and 33 000–63 000 (lower level) to 43 000–83 000 birds (higher level) in 1999/2000. Attempts to draw inferences regarding changes in by-catch levels in the IUU fishery should be viewed with caution, given the uncertainties and assumptions involved in these calculations.

7.116 Note that the overall total figures for 1999/2000 have been adjusted to take into account revised figures for estimated unregulated *Dissostichus* spp. catch in Subarea 48.3 (396 tonnes in place of 350 tonnes) and revised figures for the regulated catch rates of *Dissostichus* spp. in Subarea 48.3 (0.31 in place of 0.32), Subarea 58.6 (0.09 in place of 0.081), Subarea 58.7 (0.10 in place of 0.13) and Divisions 58.4.4, 58.5.1 and 58.5.2 (0.24 in place of 0.063, 0.236 and 0.236 respectively).

7.117 The composition of the estimated potential seabird by-catch based on data since 1997 is set out in Table 62. This indicates a potential by-catch in 2000/01 of 10 000–19 000 albatrosses, 1 700–3 000 giant petrels and 26 000–49 000 white-chinned petrels in the unregulated fishery in the Convention Area.

7.118 As in the last four years, it was emphasised that the values in Tables 60 to 62 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.

7.119 Nevertheless, even taking this into account, the Working Group endorsed its conclusions of recent years that such levels of mortality remain entirely unsustainable for the populations of albatrosses and giant and white-chinned petrels breeding in the Convention Area. Recent decreases in populations of these species in Subareas 58.6 and 58.7 (paragraphs 7.15 and 7.16), a region particularly affected by IUU fishing, are potential evidence of this.

7.120 The Working Group noted that substantial IUU catches of toothfish had been reported from Area 51 (adjacent to CCAMLR Subareas 58.6 and 58.7). If these catches represented mis-reporting of catches actually taken within the Convention Area, then the estimated by-catch of seabirds would be commensurately higher than estimated. On the other hand, if the provenance of the toothfish catches was accurately reported, then the associated seabird by-catch is likely to include substantial numbers of birds breeding in the Convention Area.

Summary Conclusion

7.121 Ad hoc WG-IMALF 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. In the last five years an estimated total of 276 000 to 438 000 seabirds have been killed by these vessels. Of these:

- (i) 40 500 to 89 500 were albatrosses, including individuals of four species listed as globally threatened (Vulnerable) using the IUCN threat classification criteria (BirdLife International, 2000);
- (ii) 7 000–14 600 were giant petrels, including one globally threatened (Vulnerable) species; and
- (iii) 109 000–235 000 were white-chinned petrels, a globally threatened (Vulnerable) species.

7.122 These levels of loss of birds from the populations of these species and species-groups are broadly consistent with such data as exist on the population trends of these taxa (paragraphs 7.15 and 7.16), including deterioration in conservation status as measured through the IUCN criteria.

7.123 These and several other albatross and petrel species are facing potential extinction (e.g. as measured by the IUCN criteria) as a result of longline fishing. The Working Group again urgently requested the Commission to take all action possible to prevent further seabird mortality by unregulated vessels in the forthcoming fishing season.

Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries

Assessment of Risk in CCAMLR Subareas and Divisions

7.124 As in previous years, concerns were raised relating to the numerous proposals for new fisheries and the potential for these new and exploratory fisheries to lead to substantial increases in seabird incidental mortality.

7.125 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.

7.126 The Working Group again noted that the need for such assessments would be largely unnecessary if all vessels were to adhere to all elements of Conservation Measure 29/XIX. It is considered that these measures, if fully employed, and if appropriate line weighting regimes could be devised for autoliners, should permit longline fishing activities to be carried out in any season and area with negligible seabird by-catch.

7.127 In 1999 the Working Group carried out comprehensive assessments on the potential risk of interaction between seabirds, especially albatrosses, and longline fisheries for all statistical areas in the Convention Area. These assessments were combined into a background document for use by the Scientific Committee and Commission (SC-CAMLR-XVIII/BG/29) and it was agreed that a similar document should be tabled annually for the Scientific Committee.

7.128 This year new data on at-sea distribution of albatrosses and petrels from satellite-tracking and other studies was provided in WG-FSA-01/10, 01/11, 01/12, 01/25, 01/26 and 01/67. This information was used to update the assessment of potential risk of interaction between seabirds and longline fisheries for Statistical Areas 48.6, 58.4.4, 58.5.1, 58.5.2, 58.6 and 58.7. The revised assessments are incorporated in full into SC-CAMLR-XX/BG/11; changes are noted below:

- (i) Subarea 48.6:

Breeding species known to visit this area: wandering albatross and grey-headed albatross from Marion Island.

Breeding species inferred to visit this area: wandering albatross, grey-headed albatross and light-mantled albatross from Prince Edward Island; light-mantled

albatross from Marion Island; black-browed albatross, grey-headed albatross, sooty albatross, white-chinned petrel from elsewhere within the Convention Area.

(ii) Division 58.4.4:

Breeding species known to visit this area: wandering albatross, light-mantled albatross from the Crozet Islands, wandering albatross and grey-headed albatross from Marion Island.

(iii) Division 58.5.1:

Breeding species known to visit this area: wandering albatross from the Crozet Islands, wandering albatross from Marion Island, black-browed albatross from the Kerguelen Islands, Amsterdam albatross from Amsterdam Island.

Breeding species inferred to visit this area: all the remaining species breeding at the Kerguelen Islands; most, if not all, species breeding at Heard/McDonald Islands; many species breeding at the Crozet Islands, wandering albatross from Prince Edward Island.

(iv) Division 58.5.2:

Breeding species known to visit this area: wandering albatrosses from the Crozet Islands; wandering albatross from Marion Island; black-browed albatrosses from the Kerguelen Islands; Amsterdam albatross from Amsterdam Island.

Breeding species inferred to visit this area: all species breeding at Heard/McDonald Islands; wandering albatross, grey-headed albatross, yellow-nosed albatross, sooty albatross, light-mantled albatross, northern giant petrel, white-chinned petrel from the Kerguelen Islands; yellow-nosed albatross from Amsterdam Island; wandering albatross from Prince Edward Island.

(v) Subarea 58.6:

Breeding species known to visit this area: wandering albatross, sooty albatross, light-mantled albatross from the Crozet Islands; wandering albatross from Marion Island.

Breeding species inferred to visit this area: in addition to all the Crozet Islands breeding species, wandering albatross from Prince Edward Island and the Kerguelen Islands; black-browed, yellow-nosed, sooty, light-mantled albatrosses, northern giant petrel, southern giant petrel, white-chinned petrel, grey petrel from the Prince Edward Islands; grey-headed albatross, white-chinned petrel, grey petrel from the Kerguelen Islands.

(vi) Subarea 58.7:

Breeding species known to visit this area: wandering albatross from the Crozet Islands; wandering albatross from Marion Island.

The Working Group noted that there had been no changes to the advice to the Scientific Committee on the levels of risk of seabird by-catch for any part of the Convention Area.

New and Exploratory Longline Fisheries Operational in 2000/01

7.129 Of the 36 proposals last year for new and exploratory longline fisheries, only three were actually undertaken: by New Zealand, South Africa and Uruguay, all in Subarea 88.1.

7.130 No seabird by-catch was reported to have been observed in any of these fisheries. Clearly the strict adherence in Subarea 88.1 to Conservation Measure 29/XIX and to the specific requirements set out in Conservation Measure 210/XIX with respect to line weighting regimes, combined with fishing in an area of average-to-low, and average risk, proved successful in eliminating the incidental by-catch of seabirds in Subarea 88.1 to date.

New and Exploratory Fisheries Proposed for 2001/02

7.131 The areas for which proposals for new and exploratory longline fisheries were received by CCAMLR in 2001 were:

Subarea 48.6	(Japan, New Zealand, South Africa, Uruguay)
Division 58.4.1	(Japan)
Division 58.4.3	(France, Japan)
Division 58.4.4	(France, Japan, New Zealand, South Africa, Uruguay)
Subarea 58.6	(Chile, France, Japan, South Africa)
Subarea 88.1	(Japan, New Zealand, Russia, South Africa)
Subarea 88.2	(Japan, New Zealand, Russia, South Africa)

7.132 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 paragraph 7.125, SC-CAMLR-XX/BG/11 and paragraph 7.128. A summary of risk level, risk assessment, IMALF recommendations relating to fishing season and any inconsistencies between these and the proposals for new and exploratory longline fisheries in 2001/02, is set out in Table 63.

7.133 In summary, the main issues to be resolved in relation to seabird incidental mortality are:

- (i) to check that France intends to comply with Conservation Measure 29/XIX, rather than Conservation Measure 29/XVI as indicated, for Subarea 58.6 and Divisions 58.4.3 and 58.4.4;
- (ii) whether or not Japan intends to comply with Conservation Measure 29/XIX and to use an international scientific observer in Subareas 48.6, 58.6, 88.1 and 88.2, and Divisions 58.4.1, 58.4.3 and 58.4.4;
- (iii) clarification of fishing season in respect of South Africa's applications for Subarea 58.6 and Division 58.4.4; and

- (iv) applications for variations from Conservation Measure 29/XIX (e.g. similar to Conservation Measure 210/XIX) for Subareas 48.6, 88.1, 88.2 and Division 58.4.4.

7.134 Mr T. Inoue (Japan) stated that Japan would be tabling an addendum to its notification (CCAMLR-XX/10) for new and exploratory fisheries in 2001/02, indicating its intention to use international scientific observers and to comply with Conservation Measure 29/XIX.

7.135 In previous years vessels fishing in exploratory fisheries in Subarea 88.1 have received a variation from the requirement of Conservation Measure 29/XIX to set longlines at night. This variation was given providing that vessels complied fully with measures specified in Conservation Measure 210/XIX, designed to ensure that a line sink rate of at least 0.3 m/s was achieved during daytime fishing operations.

7.136 All vessels participating in the exploratory fisheries in Subarea 88.1 reported no seabird mortalities. The Working Group attributed this result largely to strict adherence to Conservation Measure 210/XIX, although low levels of seabird abundance and associated risk of incidental mortality are likely to have contributed, especially at higher latitudes. The Working Group recommended that Conservation Measure 210/XIX should be continued in 2001/02.

7.137 The Working Group believed that the provisions of Conservation Measure 210/XIX could be extended to other vessels undertaking new or exploratory fishing in areas of similar classification of risk of seabird mortality (risk levels 1, 2 or 3). The Working Group recommended that conservation measures analogous to Conservation Measure 210/XIX (including Annex A) should be applied to exploratory fisheries proposed for Subareas 48.6 (risk level 2), 88.2 (risk level 1), and Division 58.4.4 (risk level 3) in 2001/02. It was noted that South Africa had indicated, in their proposals for exploratory fishing in each of these subareas and divisions in 2001/02, their preparedness to conduct line weighting experiments as approved by the Scientific Committee.

7.138 The Working Group emphasised, however, that it would be premature to extend similar provisions to exploratory fisheries in areas of higher risk of seabird by-catch.

7.139 The Working Group recommended that in any conservation measures, analogous to Conservation Measure 210/XIX, developed for new and exploratory fisheries, a strict precautionary limit on seabird by-catch should be set, which, if attained would result in the vessel reverting to night setting. It felt that a limit of three birds per vessel would still be appropriate.

7.140 The Working Group noted that WG-FSA-01/46 provided details of an alternative, simpler method to the use of TDRs for testing line sink rates. The working group recommended that Annex A of Conservation Measure 210/XIX be revised to incorporate use of this method. Draft text of an appropriate revision of Annex A of Conservation Measure 210/XIX is provided in Appendix G.

7.141 The Working Group noted that the revised paragraphs 2 to 4 and 5 to 10 of Appendix G could apply equally to the use of TDRs. A summary of the TDR information required for equivalent paragraphs 6 to 8 is contained in WG-FSA-01/44.

Incidental Mortality of Seabirds during Longline Fishing outside the Convention Area

7.142 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.

7.143 WG-FSA-01/28 reported on seabird by-catch by tuna longline fisheries within the EEZ of South Africa from 1998 to 2000. Information was collected by observers on domestic and foreign-licensed vessels from Japan and Taiwan. A total of 11.85 million hooks was set, of which South African vessels set only 0.46 million.

7.144 The number of observed hooks was 143 000 (1.2% of the total). By-catch was high at 0.77 birds/thousand hooks in the domestic fishery and very high at 2.64 birds/thousand hooks by Japanese vessels. No information was available for Taiwanese vessels.

7.145 Most of the 229 birds recorded by observers as killed were albatrosses and white-chinned petrels, including a number of species that breed within the CCAMLR Convention Area, notably black-browed albatrosses and white-chinned petrels. Based on the 1998/99 fishing effort, it was estimated that 19 000–30 000 seabirds, of which 70% are albatrosses, are killed annually in South Africa's EEZ.

7.146 The Working Group noted that compliance with required mitigation measures was reported as being incomplete, including the failure to use streamer lines.

7.147 The continued collection of data by observers in the South African fishery was encouraged. Further information from foreign-licensed vessels, including those of Taiwan, would be most valuable in assessing the mortality in South African waters of seabirds originating from the CCAMLR Convention Area.

7.148 Pelagic and demersal longline fisheries, chiefly targeting tuna and ling in New Zealand waters during 1999/2000, continued to cause mortality of seabirds, including some breeding within the CCAMLR Convention Area (WG-FSA-01/59).

7.149 A description of plans to quantify and mitigate seabird by-catch around the Falkland/Malvinas Islands was presented in WG-FSA-01/79. Initial observations reported a low by-catch of three black-browed albatrosses in five months of fishing during winter by two vessels. Seabirds from the Convention Area, including wandering albatrosses and white-chinned petrels, are known to visit this area (WG-FSA-01/25).

7.150 During 1999 all pelagic longline fishing in the Australian Fishing Zone (AFZ) was performed by domestic vessels (WG-FSA-01/82). The effort by these vessels continues to increase, with almost 14 million hooks set in 1999, an increase of 48% compared with the 1998 effort. This fishery is carried out in the absence of an observer scheme, and levels of by-catch are unknown. Seabirds from the Convention Area are known to have been killed in the AFZ in the past.

7.151 During 1999 most observations in the AFZ were focused on investigations of efficacy of mitigation measures (WG-FSA-01/80 and 01/81). Therefore by-catch rates were not sampled randomly, nor extrapolated across fishing zones.

7.152 Spatio-temporal trends in longline fisheries in the Southern Ocean adjacent to the CCAMLR Convention Area since the late 1960s show a marked increase in effort, especially by Taiwanese pelagic vessels, although Japanese effort decreased in the 1990s (WG-FSA-01/49). The data presented in this review paper are potentially highly relevant for analyses of by-catch of seabirds breeding within the CCAMLR Convention Area in relation to their foraging ranges and to fishing effort.

7.153 Dr E. Fanta (Brazil) reported that Brazilian scientists were investigating seabird by-catch which included birds from within the CCAMLR Convention Area, from longline fisheries within its waters. It was understood that information on by-catch was also being collated for Argentinean waters. These and other CCAMLR Members were encouraged to report the results of such initiatives to future meetings of the Working Group.

7.154 The Working Group recollected the inquiry initiated last year into by-catch mitigation measures on Japanese vessels in respect of by-catch of Convention Area birds in Tristan da Cunha waters (SC-CAMLR-XIX, Annex 5, paragraphs 7.104 to 7.106; SC-CAMLR-XIX, paragraph 4.35).

7.155 The Secretariat had, as requested, contacted Japan to seek to clarify the current obligations of Japanese longline fishing vessels relating to the use of mitigating measures in respect of seabird by-catch.

7.156 The response to the Secretariat to date was that Japan did not regard this as a CCAMLR matter; however, it would respond to the Scientific Committee and may indicate that it follows measures under ICCAT and CCSBT.

7.157 The Working Group noted that the mortality of birds from the Convention Area in fisheries outside the area was highly relevant to CCAMLR. It was disappointed not to have appropriate information from Japan, particularly as this was also relevant to the seabird mortality in South African waters reported in WG-FSA-01/28. It hoped that the Japanese report to the Scientific Committee would indicate the precise nature of the mitigation measures in use in each of the relevant longline fisheries and the extent to which the use of these measures is voluntary or mandatory.

7.158 The Working Group recollected its comments last year (SC-CAMLR-XIX, Annex 5, paragraph 7.11) and noted increasing evidence this year of the importance of seabird by-catch in areas adjacent to the Convention Area. It considered that it was now very timely to request all Members and other countries conducting or permitting longline fishing in areas outside the CCAMLR Convention Area where seabirds from the Convention Area are killed, to provide summary data 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) nature of observer programs, including observer coverage, associated with each fishery.

7.159 The Working Group agreed also to summarise data on the above topics which had previously been submitted to CCAMLR and to review this at its next meeting.

Research into and Experiences with Mitigation Measures

Night Setting

7.160 WG-FSA-01/08 reported that around the Prince Edward Islands (Subarea 58.7) seabird mortality rates were significantly higher for lines set during the day (0.106 birds/thousand hooks) than those set at night (0.073 birds/thousand hooks). This was due to the large difference in mortality rates of albatrosses and giant petrels during the day (0.031 birds/thousand hooks) compared to the night (0.004 birds/thousand hooks). There was no significant difference in the mortality rates of white-chinned petrels during the night and day. This demonstrates that night setting continues to be one of the most effective and simple methods of reducing albatross mortalities. Although night setting is one of the most efficient means to reduce incidental seabird mortalities, it is insufficient in isolation to reduce white-chinned petrel mortalities.

Offal

7.161 WG-FSA-01/60 reported on the use of scupper screens to prevent discharge of offal and bait from a vessel while processing catch. This measure acts to reduce the attractiveness of vessels to seabirds. The Working Group recommended that vessels ensure 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. The Working Group also recommended that vessels install a tray below the baiting head to collect unused baits and install screens over scuppers to collect baits that are on the floor.

7.162 SC-CAMLR-XX/BG/7 reported the incidence of hooks and associated lines found in regurgitates, diet samples and around nests of several albatross and other species at Bird Island, South Georgia, and that the numbers of hooks found had steadily increased over several years to an all-time high in 2000/01. Hooks were chiefly those used in the toothfish fishery. Mr Cooper indicated that hooks are increasingly common in similar situations at the Prince Edward Islands (WG-FSA-01/10 and paragraph 7.22). It was likely that the main source of hooks was from heads discarded by longliners, including vessels operating in the regulated fisheries in Subareas 48.3 and 58.6/58.7 (WG-FSA-01/22, Table 2). Such potential hazards to albatrosses could be easily avoided by the removal of hooks from the fish heads prior to their discard. The Working Group proposed that such a recommendation be added to existing conservation measures.

Streamer Lines

7.163 WG-FSA-01/44 and 01/60 both provided detailed diagrams of the boom and bridle system used by the New Zealand vessel *San Aotea II*. This system allows the skipper and crew to move the position of the streamer line either to the starboard or port so that it is always directly over the longline, irrespective of the wind direction. A short video demonstrating the system had been prepared by the skipper of the vessel. The Working Group recommended that a final edited version of the video be made available to the Secretariat for distribution to technical coordinators to provide to longline fishers in the Convention Area. WG-FSA-01/60 reported that two new innovations are being investigated: a line shaker (termed a 'gigolo') and two long poles with streamers that extend directly aft from both stern quarters. The Working Group requested reports on the new innovations prior to its next meeting.

7.164 Last year the Working Group noted (SC-CAMLR-XIX, paragraphs 7.123 and 7.139) that the use of paired streamer lines should provide additional longline protection when setting gear in crosswinds and urged Members to investigate this, particularly for vessels which fish in summer in Subareas 58.6 and 58.7. WG-FSA-01/35 reported on a study in the Alaskan demersal longline fishery to evaluate the effectiveness of various deterrent devices tested, including paired streamer lines. Experiments conducted over two years in the Pacific cod autoliner fleet (over 6 million hooks, almost 500 sets) indicated that paired streamer lines reduced seabird by-catch rates by 88% to 100% relative to controls with no deterrents. Single streamer lines were slightly less effective at reducing seabird by-catch (71%). Seabird abundance and attack rates during single streamer sets were not significantly different from controls of no deterrent. This research suggests that paired streamer lines may be more effective than single streamer lines at reducing seabird mortalities in the Convention Area. WG-FSA-01/29 suggested the testing of paired streamer lines in Spanish longline systems used in the Convention Area. The Working Group encouraged this and recommended that Members support testing of paired streamer lines in the Convention Area.

Bait

7.165 The use of artificial bait in longline fisheries may help reduce the incidental mortality of seabirds. From a mitigation perspective at least two potential advantages exist with artificial bait: the colour of the bait can be altered to make it less attractive or visible to seabirds, and the bait could be manufactured so that it is negatively buoyant.

7.166 Mr Smith reported that some trials with artificial bait had been undertaken in New Zealand domestic autoline fisheries. Initial results indicated lower fish catch rates when using artificial bait. Colouring artificial bait blue was also attempted by using a dye post-thawing. Unfortunately, the artificial bait was not robust enough to survive the soak in the dye solution required to colour the bait blue. New Zealand fishers are in contact with the manufacturers of the bait and are attempting to resolve fish catch rate issues initially, prior to progressing alterations to bait colour and buoyancy.

7.167 The Working Group noted the trials conducted to date in New Zealand and encouraged any further research be reported to it next year.

7.168 Dr Fanta reported to the Working Group that tests are currently being conducted on dyed bait (see paragraph 7.185) to determine if the colour reduces the visibility of the bait to birds during pelagic longline fishing, thereby reducing the likelihood of birds becoming hooked. The Working Group requested that Brazil report the results of this study to it next year.

7.169 WG-FSA-01/08 reported that a high proportion (76%) of white-chinned petrels caught on vessels fishing around the Prince Edward Islands were foul hooked in their wings and bodies. WG-FSA-01/44 reported similar observations with grey petrels and suggested that intense feeding activity on loose baits made these birds vulnerable to getting caught on nearby hooks. This behaviour is characterised by feeding on a trail of unused loose baits that forms behind the vessel during setting. On occasion this trail may drift over the setting longline. The trail is formed from baits flicked off hooks after passing through the autobaiter. This represents an additional means by which birds are attracted to the vessel and hooked. The Working Group recommended that, in circumstances where a dedicated seabird observer is present, appropriate data are collected on the baits that are flicked off to understand better the nature of the problem and to help devise potential solutions.

Underwater Setting

7.170 Further information on the effectiveness of the Mustad underwater setting funnel (lining tube) is contained in WG-FSA-01/35. This study, which was undertaken on autoline vessels in Alaskan waters, found that the funnel reduced seabird captures by 69% compared to the control of no mitigation measures. The authors report that results of a similar study in the Norwegian demersal longline fishery were highly variable and that this may have been due to the funnel delivering the line at shallow depths when the vessel hull lifted out of the water in rough conditions. The dominant seabird species caught in both of these studies is the northern fulmar, which is primarily a surface feeder. Because many of the seabird species vulnerable to incidental capture in the CCAMLR Convention Area are proficient divers, the results of these studies may not apply. However, it appears that the *Eldfisk* has continued to use the Mustad funnel with success in Subareas 58.6 and 58.7 in 2000/01 during day sets. When the funnel was used in conjunction with a streamer line during day sets, the seabird catch rate was 0.008 birds/thousand hooks. This compared to 0.005 birds/thousand hooks for night sets with streamer lines.

7.171 Results of preliminary trials of an underwater setting device in the Australian domestic pelagic tuna fishery were reported last year in WG-FSA-00/64. WG-FSA-01/80 reported on final results for the testing at sea of two underwater setting devices – a chute and a capsule. Both devices adequately demonstrated their capacity to minimise seabird interactions during line setting in pelagic longline fishing. Both showed dramatically lower rates of baits taken (0.3 baits/thousand hooks for the chute, 1.5 baits/thousand hooks for the capsule) in comparison to baited hooks set in the standard manual way (8.0 baits/thousand hooks). Most or all baits that were taken were the direct result of tangles on board the vessel. Once operational problems encountered during the first cruise were corrected, no birds were taken in the second cruise. The chute is currently being trialled at sea on 10 vessels. The Working Group requested that results of these sea trials be reported to it next year and encouraged the further development of the underwater setting capsule.

Line Shooter

7.172 Norwegian trials (WG-FSA-01/78) examined the effect of a line shooter on line sink rate. The line shooter is a pair of hydraulically operated wheels that pull the line through the auto-baiter and deliver the line into the water in a slack state rather than under tension. This means the line enters the water directly behind the vessel and begins sinking immediately, thus reducing the time during which the hooks are available to seabirds. This study found that the time for the line to reach 3 m was 4 seconds (15%) faster with the shooter than without. In Alaskan trials (WG-FSA-01/35), the line shooter significantly increased the rate of seabird by-catch (54%, fulmars and shearwaters) compared to a control of no deterrent. The authors cited a Norwegian study whereby seabird by-catch rates were reduced with the line shooter (59%), but not as much when compared to streamer lines (98–100%) or an underwater setting funnel (72–92%). Birds were able to take baits when the line shooter was in use. The Working Group noted that the line shooter's ability to set slack line is impeded when the hull of the vessel lifts on a wave, and that this could be overcome if the shooter speed was controlled by a governor. The Working Group encouraged the manufacturer to address this problem, after which further testing of the line shooter was recommended.

Line Weighting

7.173 Significant progress had been made during 2000/01 in the implementation of a practical line weighting regime for vessels using the Spanish longline system. The new line weighting regime prescribed in Conservation Measure 29/XIX (8.5 kg weights spaced at no more than 40 m) was used during five cruises. On eight other cruises, the weighting regimes were close to that prescribed but not fully in compliance. One vessel using the Spanish longline system complied with the requirement to attain a sink rate of 0.3 m/s while daylight setting in Subarea 88.1, using weights equivalent to about 12 kg every 40 m.

7.174 Of vessels which complied with the line weighting provisions of Conservation Measure 29/XIX, on only one cruise (by the *Koryo Maru II* in summer around the Prince Edward Islands) of seven was any seabird mortality reported (8 birds at 0.014 birds/thousand hooks), compared with on six of 15 cruises of vessels not complying with the measure (involving 37 birds at rates of 0.003 to 0.212 birds/thousand hooks).

7.175 A new simple means of measuring line sink rate has been devised (WG-FSA-01/46). The Working Group recommended that measurements of line sink rate be made by observers using this simple technique ('bottle test' described in WG-FSA-01/46; see Appendix G). This will provide data that can be used to develop a predictive sink rate model for the Spanish longline system similar to that developed for autoline fishing gear (WG-FSA-01/56).

7.176 WG-FSA-01/44 reported on an experiment undertaken in New Zealand waters on autoline vessels to determine the sink rate of unweighted lines, and of lines with 5 kg weights spaced 400 m apart. The results show that the sink rate of the line is not significantly increased with this weighting regime, and for both treatments, the line is only between 2 and 5 m deep at the end of aerial section of the streamer line. This means that baited hooks are still available to a number of albatross and petrel species despite the use of a streamer line.

Line weighting experiments in Subarea 88.1 have subsequently found that weights of around 5 kg need to be 30 to 40 m apart to achieve the sink rate requirement of 0.3 m/s (WG-FSA-01/56).

7.177 WG-FSA-01/35 reported on experiments to assess the effectiveness of a number of mitigation measures in the Alaskan demersal longline fisheries, including line weighting on autoline vessels. Line sink rates were measured with unweighted lines, and compared with lines with 4.5 kg weights spaced 90 m apart. This weighting regime did not significantly increase line sink rate and vessel speed had a much greater influence on the distance at which longlines were vulnerable to bird attacks. This result is in accord with all line sink rate research reported to CCAMLR to date (Robertson, 2000, Figure 3). The authors concluded that for weighting to be practical and effective at reducing seabird by-catch, the weight must be integrated into the line.

7.178 Integrated line weighting should allow target sink rates to be achieved for autoline vessels without the manual addition of weights. Integrated line weighting would therefore alleviate the labour and safety issues raised by fishers with respect to manual line weighting (WG-FSA-01/60).

7.179 One of the autoline equipment manufacturers, Fiskevegn (Norway), has agreed to make samples of longline with the weight integrated into the backbone. Five different weights of longline will be manufactured for testing in New Zealand domestic fisheries. The first aim of this project is to test the prototype line for operational effectiveness and fishing efficiency.

7.180 If the operational effectiveness and fishing efficiency of heavy longline are proven, seabird specialists will then be used to design and conduct an experiment to determine the effectiveness of this gear in the reduction of incidental seabird mortality. The Working Group supported this initiative and requested to be kept informed of progress.

7.181 WG-FSA-01/81 reported on tests to investigate the effects of line weighting on sink rates of pelagic longline gear in the Australian tuna and billfish fisheries. The report concludes that the addition of an 80 g weight within 3 m of the hook, or 40 g at the hook, will achieve a sink rate of 0.26 to 0.30 m/s. Mr Baker indicated that at-sea trials will soon be commencing in the tuna fleet. The Working Group requested that the at-sea trial results be reported to it next year.

7.182 WG-FSA-01/56 reported on continued progress of analysis of longline sink rates of autoline vessels fishing in Subarea 88.1. This initiative was strongly supported by the Working Group (SC-CAMLR-XIX, paragraph 7.148) and preliminary results were reported in 1999/2000 (SC-CAMLR-XIX, paragraph 7.128). A model was developed which identified a range of values required to achieve the minimum required sink rate with 90–95% confidence; use of this model at sea may eliminate the need for routine deployment of TDRs in this or other fisheries. The 2001 preliminary predictive model comprised two variables that explained 60% of the overall variability in sink rate to 15 m, due to added weight (45%) and setting speed (15%). This is less than the variability accounted for by these two variables and swell height in last year's model run (72%). The change is probably attributable to recent changes in fishing gear (increased diameter of backbone) and calm weather conditions during much of the 2000/01 season. This preliminary model will be investigated further intersessionally. WG-FSA-01/56, Figure 7, illustrates the added weights which should be

used at various vessel setting speeds. Weights should be spaced approximately 30 to 40 m apart. To monitor the accuracy of this predictive model, bottle tests (see paragraph 7.183) should be conducted to provide real-time feedback on the actual line sink rate achieved.

7.183 WG-FSA-01/46 reported on the 'bottle test', a simple alternative method to measure line sink rate. TDRs have been used in Subarea 88.1 for three years to measure the line sink rate as required in Conservation Measure 210/XIX. Observers reported that calculating line sink rates with TDRs can be time consuming, technical problems are frequent, and the interpretation of results can be difficult. Additionally, fishers have raised concerns about the costs involved with the high loss rate of TDRs. In contrast to TDRs, the bottle test is inexpensive, simple to use, and provides real-time data.

7.184 The Working Group discussed the potential for seabird mortalities associated with an autoline gear malfunction commonly referred to as 'hookups'. Hookups occur when hooks on the autoline magazine racks get out of order and cause the autobaiting and hook deployment system to malfunction. When this occurs, the deploying line is lifted out of the water, greatly reducing its sink rate and increasing the exposure of baited hooks to seabirds. The Working Group encouraged gear manufacturers to address this gear malfunction and to develop an engineering solution.

7.185 Dr Fanta reported that a collaborative project in Brazil involving government and university scientists and fishers is under way to test multiple deterrent measures. Five measures have been suggested for testing: streamer lines, bait colour, underwater setting, artificial bait and night setting. Tests are currently being conducted on dyed bait (see paragraph 7.168) to determine if the colour reduces the visibility of the bait to the birds, thereby reducing the likelihood of a bird becoming hooked. The Working Group requested a report on this research, when available.

Research Needs relating to the Spanish Method of Longline Fishing

7.186 Although Conservation Measure 29/XIX details a number of measures required of vessels using the Spanish method, insufficient information exists on the effectiveness of these measures, singly or in combination. The Spanish system is the most common gear deployment system in the Convention Area as well as commonly used in adjacent non-Convention waters frequented by Southern Ocean albatrosses and petrels.

7.187 The Scientific Committee noted last year (SC-CAMLR-XIX, paragraph 4.41(iv)) that:

- (i) its goal of fisheries management as it relates to seabird by-catch in the Convention Area will be to allow fishing at any time of day without seasonal closure of fishing grounds;
- (ii) 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
- (iii) further experimentation into the effectiveness of line weighting concepts and underwater setting devices with the Spanish system is important.

The Working Group noted that such experimentation is also critical if the by-catch of foraging seabirds in adjacent non-Convention Areas is to be addressed effectively.

7.188 WG-FSA-01/29 proposed and outlined such experiments. It suggested that the effects of measures for reducing seabird mortalities, used singly or in combination, should be determined in a rigorous controlled experiment conducted on a chartered commercial vessel across a range of sea and wind conditions. Mitigation measures to be tested, each at multiple levels, include: time of day, streamer lines, line weights, and bait and snood colour. The Working Group strongly supported this experimentation and recommended that Members facilitate the planning and undertaking of this study.

Industry Involvement in Research Initiatives

7.189 The Working Group noted and commended several collaborative research efforts, particularly projects in Australia, Brazil, New Zealand and the USA, involving direct input and participation by fishers (paragraphs 7.163, 7.164, 7.166 and 7.171).

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

IV Marine Science Congress

7.190 The IV Marine Science Congress, held in Argentina in September 2000, included presentations on seabird and marine mammal by-catch in fisheries, and the use of the Patagonian Shelf by South Atlantic seabirds. Selected abstracts are included in WG-FSA-01/27.

International Fishers' Forum

7.191 The International Fishers' Forum on Solving the Incidental Capture of Seabirds in Longline Fisheries was held in Auckland, New Zealand, in November 2000. The report on the forum is available in English at www.fishersforum.org and in Spanish from jmolloy@doc.govt.nz. The forum was attended by fishers, scientists, technologists and government representatives from 12 countries, including 10 CCAMLR Members (SC-CAMLR-XX/BG/19).

7.192 The forum discussed mitigation measures to reduce seabird by-catch, agreeing that the use of multiple measures was the most effective approach to adopt. The need for effective education campaigns and observer programs was also highlighted. Participants agreed to share the results of research programs. Members of WG-IMALF who attended the forum indicated that it had facilitated highly constructive dialogue with fishers and fishery managers, including representatives from countries which infrequently attend such meetings (e.g. China, Taiwan).

7.193 Specific commitments made by participants are listed in the forum's report. Participants agreed to undertake such activities over a two-year period and to communicate via a listserv and by reporting to a second forum, planned to be held in Hawaii, USA, in late 2002.

7.194 Members were encouraged to disseminate information on the forum by way of articles in fishery magazines and journals.

Agreement on the Conservation of Albatrosses and Petrels

7.195 The final negotiation meeting for the Agreement on the Conservation of Albatrosses and Petrels (ACAP) was held in Cape Town, South Africa, in January/February 2001 (SC-CAMLR-XX/BG/17 and BG/20). Twelve range states and five international organisations, including CCAMLR, attended the meeting that successfully adopted by consensus the text of an Agreement and associated action plan (see www.ea.gov.au/biodiversity/international/index.html and wcmc.org.uk/cms/nw012906.htm). The Agreement, originally intended to be restricted to the Southern Hemisphere, allows for the later expansion to include albatrosses and petrels of the Northern Hemisphere, although it is intended that the focus will remain in the Southern Hemisphere in the short- to medium-term. Currently, the Agreement covers all the Southern Hemisphere albatrosses and all members of the genera *Macronectes* (giant petrels) and *Procellaria*.

7.196 In its role as Interim Secretariat, Australia arranged for the Agreement to be open for signature at a ceremony in Canberra, Australia, on 19 June 2001. Seven countries then signed (Australia, Brazil, Chile, France, New Zealand, Peru and the UK). Australia became the first range state to ratify the Agreement on 27 September 2001. The Agreement will enter into force upon ratification by five countries.

7.197 The Agreement's Action Plan (ACAP) describes conservation measures to be implemented by the parties. These include research and monitoring, reduction of seabird by-catch by fisheries, eradication of non-native species at breeding sites (especially cats and rats), reduction of disturbance and habitat loss and reducing pollution.

7.198 The Working Group recognised that the development of the ACAP was a most significant step to the further protection of albatrosses and petrels breeding within the CCAMLR Convention Area. CCAMLR Members who are range states (including distant-water fishing nations that interact with Southern Hemisphere albatrosses and petrels on the high seas) were encouraged to sign and ratify the Agreement and adopt its action plan provisions as soon as is feasible.

BirdLife International Seabird Conservation Programme

7.199 The intention of BirdLife South Africa to submit a medium-sized grant proposal to the Global Environment Facility to conduct activities to reduce the levels of mortality due to longlining throughout the range of those species of globally threatened seabirds that occur in

southern African waters was noted (WG-FSA-01/13). This initiative follows an international workshop held in Cape Town, South Africa, in April 2001. The workshop was attended by invitees from nine countries, all Members of CCAMLR.

7.200 A South American regional workshop held by BirdLife International in Montevideo, Uruguay, in September 2001 further developed the GEF proposal (WG-FSA-01/13). The Working Group asked that the Secretariat request a report of this meeting to consider at its 2002 meeting.

7.201 The Working Group noted that this proposal could lead to the adoption of measures that would improve the conservation status of seabirds that are affected by longlining and that breed within the CCAMLR Convention Area.

7.202 The Working Group requested information from BirdLife International on relevant activities of its seabird conservation program and its 'Save the Albatross Campaign' to consider at its next meeting.

FAO International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries

7.203 The Working Group recollected the Commission's request (CCAMLR-XVII, paragraph 6.27; CCAMLR-XVIII, paragraph 6.15) that Members implement by 2001 their NPOAs in support of the FAO IPOA–Seabirds. Last year the information available (SC-CAMLR-XIX, paragraphs 4.43 and 4.44) was that:

- (i) New Zealand and the USA already had draft plans available for consultation and that Australia's Threat Abatement Plan contained the essence of its NPOA (which would be prepared in due course);
- (ii) Brazil and Chile were commencing to prepare plans; and
- (iii) Japan was working to finalise its NPOA through dialogue with fishers and industries and intended to submit it to the FAO COFI meeting in 2001.

The Working Group encouraged other Members, particularly the European Community, which it was understood had only just embarked on the assessment process, to develop and implement their plans as soon as possible.

7.204 Progress on developing National Plans of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (NPOA–Seabirds) was reported by Member States at the 24th Session of FAO COFI (WG-FSA-01/62).

7.205 At the COFI session, progress to produce NPOA–Seabirds was reported by several CCAMLR Members. These included Australia, Brazil, the European Community, Japan, New Zealand, Norway, South Africa, USA and Uruguay. Argentina stated that it did not consider it needed to produce a NPOA–Seabirds. Namibia stated that it would require funding to produce its NPOA–Seabirds. No report was given by Chile.

7.206 The Working Group considered it essential that Argentina and Chile develop NPOA–Seabirds, based on high levels of seabird incidental mortality known to occur in their waters. It requested CCAMLR Members to submit reports of their progress towards developing and implementing NPOA–Seabirds to the Working Group at its next meeting.

7.207 The final USA plan was adopted in February 2001 (www.fakr.noaa.gov/protectedresources/seabirds/npoa/npoa.pdf) and was provided to the Working Group by the Secretariat as a reference document. Although not intended to cover seabird by-catch in the Southern Hemisphere, the USA's NPOA–Seabirds can serve as a valuable source of information on mitigation measures, especially for reducing by-catch of albatrosses and petrels, for CCAMLR fishing Members.

7.208 Intersessionally, Working Group members had had the opportunity to consider the draft New Zealand NPOA–Seabirds, which is also intended to cover trawling operations. It was noted that the document was a thorough, appropriate and detailed one, and that it is now under revision. Members intending to produce their own NPOA–Seabirds were encouraged to consult the draft document.

7.209 The Working Group reviewed a document entitled 'Japan's National Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries', supplied as a reference document by the Secretariat via its FAO Observer. This document had been made available to attendees at the 24th COFI Session, but its current status was uncertain.

7.210 The Working Group noted that the document did not refer specifically to fishing within the Convention Area, clearly a significant omission, considering Japan's activities within CCAMLR. However, it did address longlining for southern bluefin tuna within the Southern Hemisphere, a fishery known to kill many seabirds originating from the Convention Area. No information was given on longlining for other species of tuna in the Southern Hemisphere fisheries, several of which also kill seabirds from the Convention Area (see WG-FSA-01/28).

7.211 The Japanese NPOA–Seabirds contained no assessment of the scale of the past and current by-catch by Japanese longliners. It also contained some errors of fact, for example on sizes of albatross populations.

7.212 It was unclear whether the application of any of the mitigation measures described was other than purely voluntary. Further, the Working Group considered that the mitigation measures described were generally inadequate to reduce seabird by-catch to acceptably low levels, especially in areas frequented by seabirds from the Convention Area.

7.213 The Working Group noted that several research activities relevant to mitigation of seabird by-catch, especially underwater setting, were mentioned in the Japanese NPOA–Seabirds; it requested that Japan supply the Working Group with details for its next meeting. It also requested further information on the status of mitigation measures in all Japanese fisheries relevant to Convention Area seabirds, together with clarification as to whether these measures were mandatory or voluntary.

Tuna Commissions

7.214 The report of the CCAMLR Observer to two CCSBT meetings held in 2000 and 2001 did not mention any activities relevant to seabird by-catch (CCAMLR-XX/BG/6). However, it did note that the CCSBT Ecologically-Related Species Working Group planned to reconvene in late 2001, after a long break, when it was expected that seabird by-catch would be discussed. The Working Group looked forward to receiving a detailed report in due course on mitigating measures in use and relevant observer programs in fisheries under the jurisdiction of CCSBT.

7.215 The Working Group was informed by a BirdLife International observer to a recent meeting of ICCAT's Scientific Committee that discussions of by-catch had been confined to shark and non-target fish species. The Working Group recommended that the Secretariat should be asked to write to ICCAT to place the issue of seabird by-catch and mitigating measures in use in fisheries under its jurisdiction on the agenda of the next meeting of its Scientific Committee. The Working Group would correspond intersessionally to provide an appropriate background paper for that meeting.

7.216 The Working Group considered it appropriate to receive information from the IOTC as seabird by-catch is known to occur in fisheries under its jurisdiction. The Working Group recommended that CCAMLR nominate an observer to meetings of the IOTC.

7.217 The Working Group requested the Scientific Committee to review interactions with fishery organisations, particularly newly established bodies, with responsibility for the conduct of fisheries in areas adjacent to the Convention Area, with a view to enhancing communication and collaboration with CCAMLR, particularly on seabird by-catch issues.

Advice to the Scientific Committee

General

- 7.218 (i) The plan of intersessional work (Appendix F) summarises requests to Members and others for information of relevance to the work of the Working Group (paragraphs 7.1 to 7.5).
- (ii) 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 7.7).

Research into the Status of Seabirds at Risk

7.219 The review of the 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;

concluded that a comprehensive review of any of these topics cannot be completed until more Members have submitted details of their data. Relevant data are urgently requested for next year's meeting (paragraphs 7.3, 7.14, 7.21 and 7.23).

7.220 Important results from submitted information on the above topics are:

- (i) a 25% decline in the population of black-browed albatrosses at the Falkland/Malvinas Islands, 18% in the last five years, is likely to result in the global conservation status of this species being changed from Near-Threatened to Vulnerable (paragraph 7.13);
- (ii) substantial recent (1990s) declines (of 8-15%) are reported in populations of wandering and grey-headed albatrosses, northern and southern giant petrels and white-chinned petrels at Marion Island. The main causes are believed to be increased mortality in the recently increasing tuna longline fisheries in areas adjacent to the Convention Area and the recent large-scale IUU fisheries for toothfish close to the breeding site (paragraphs 7.15 and 7.16);
- (iii) substantial (28%) declines of white-chinned petrel populations at South Georgia since the mid-1980s, attributed to similar causes to the above (paragraph 7.17);
- (iv) the suggestion that mortality of adult female wandering albatrosses from Marion Island in temperate Southern Hemisphere tuna longline fisheries is the single most important factor compromising the conservation status of this population (paragraph 7.22);
- (v) potential problems in ascribing origins of grey-headed albatrosses to any particular island population and of black-browed albatrosses beyond distinguishing specimens from the Falkland/Malvinas Islands and Campbell Island from other breeding sites (paragraph 7.23); and
- (vi) declines in wandering albatross populations at Crozet and South Georgia and the recovery since 1986 of the Crozet population, both correlate with data on tuna longline fishing effort in adjacent regions of the Convention Area. The continuing decline of the South Georgia population is attributed to some combination of longline fishing for tuna in the poorly documented South Atlantic and for toothfish both inside and outside the Convention Area. Attempts to correlate seabird population changes with fishing effort are likely to be limited by the quality of the latter data (paragraphs 7.27 to 7.31).

Incidental Mortality of Seabirds during Regulated
Longline Fishing in the Convention Area in 2001

- 7.221 (i) Prompt submission by observers of good quality data ensured comprehensive analysis of this year's data (Tables 51 to 55).
- (ii) For Subarea 48.3 the total estimated seabird by-catch was only 30 birds at a rate of 0.0014 birds/thousand hooks (paragraphs 7.38 and 7.39), very similar to last year's values; fishing season restrictions and continued improved compliance with Conservation Measure 29/XIX have kept by-catch in the regulated fishery in this subarea to negligible levels for the second successive year (paragraph 7.55).
- (iii) For fishing within the South African EEZ in Subareas 58.6 and 58.7, the total estimated seabird by-catch was 199 birds (a 61% reduction over last year) at a rate of 0.018 birds/thousand hooks (compared with 0.022 birds/thousand hooks last year) (paragraphs 7.40 and 7.41). Reduced by-catch this year was mainly due to changes in fishing area (paragraph 7.45), but improved compliance with Conservation Measure 29/XIX also contributed (paragraph 7.56).
- (iv) Based on analysis of timing of seabird incidental mortality in Subareas 58.6 and 58.7, the Working Group recommended that fishing within 200 n miles of the Prince Edward Islands be prohibited in the months of September to April inclusive. However, if South Africa still considered it necessary to maintain a regulated fishing presence within its EEZ around the Prince Edward Islands in order to deter IUU fishing, then regulated fishing within 200 n miles of the islands should be prohibited at least from January to April (paragraphs 7.49 to 7.52).
- 7.222 (i) Data from longline fishing within the French EEZs in Subarea 58.6 and Division 58.5.1 in the 1999 and 2000 seasons revealed a very serious seabird by-catch situation.
- (ii) Overall by-catch rates were 0.736 birds/thousand hooks for 1998/99 and 0.184 birds/thousand hooks for 1999/2000 for the Crozet Islands and 2.937 birds/thousand hooks for 1998/99 and 0.304 birds/thousand hooks for 1999/2000 for the Kerguelen Islands (paragraph 7.59).
- (iii) A total of 8491 white-chinned petrels (99% of all birds) was reported killed (paragraph 7.60).
- (iv) The totals of birds killed in the French EEZs in 1999 and 2000 were 17.2 and 4.2 times greater, respectively, than the total estimated seabird by-catches for the rest of the Convention Area; some monthly seabird by-catch rates exceed those used to estimate by-catch in the IUU fishery (paragraphs 7.62 and 7.63).
- (v) The Working Group recommended that longline fishing within the French EEZs should be prohibited during the months of September to April inclusive (paragraph 7.64).

- (vi) Submission to CCAMLR of the original data for 1999 and 2000, together with data from 2001, including information on mitigation measures in use in all three years, was requested (paragraph 7.65).

7.223 No incidental mortality of seabirds was observed in Subarea 88.1 for the fourth successive year due to strict compliance with conservation measures (paragraph 7.53).

Compliance with Conservation Measure 29/XIX

- 7.224 (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 (Table 56).
- (ii) Streamer lines – compliance with streamer line design was 66%, double that last year. Vessels which have not complied with this element of the conservation measure over at least the last two years include *Argos Helena*, *Eldfisk*, *Isla Santa Clara*, *No. 1 Moresko* and *Aquatic Pioneer* (Tables 54 and 58 and paragraphs 7.67 to 7.69). Several vessels new to the fishery (*Polarpesca I*, *Suidor One* and *Rustava*) failed to comply with this simple and important measure (Table 58).
- (iii) Offal discharge – in the whole Convention Area only the *Maria Tamara* (Subarea 48.3) failed to comply with the requirement either to hold offal on board, or to discharge on the opposite side to where the line was hauled; in Subareas 58.6, 58.7 and 88.1 there was again 100% compliance in this regard (Table 59 and paragraph 7.71). Although Conservation Measure 29/XIX requests vessels in Subareas 48.3, 58.6 and 58.7 to avoid the discharge of offal during the haul, on 86% of cruises there was discharge during hauls on an average of 91% of sets (paragraph 7.72). In Subarea 88.1 no vessels discharged offal at any time, as required under Conservation Measure 210/XIX.
- (iv) Night setting – compliance improved in Subarea 48.3 from 87% last season to 95% and was maintained at 78% in Subareas 58.6 and 58.7. The *Koryo Maru II* made 47% of sets during daylight hours on one cruise in Subareas 58.6 and 58.7 and caught more seabirds than any other vessel fishing in these subareas (paragraphs 7.73 to 7.75).
- (v) Line weighting (Spanish system) – unlike all previous years when no vessel complied with the use of weights of 6 kg spaced at 20 m intervals, weights of 8.5 kg at 40 m were used on 21% of cruises in Subarea 48.3 and 18% of cruises in Subareas 58.6 and 58.7. Eight other vessels used line weightings that were close to compliance. One vessel complied with the 0.3 m/s line sink rate required in Subarea 88.1 (paragraphs 7.77 to 7.80 and Figure 35).
- (vi) Line weighting (autoline system) – the requirement to achieve a line sink rate of 0.3 m/s when fishing in daylight in Subarea 88.1 south of 65°S was met by all vessels (paragraph 7.81).

- 7.225 (i) Four of 24 vessels (*Isla Gorriti*, *Janas*, *San Aotea II* and the *Sonrisa*) complied fully with all elements of the conservation measures that were applicable in the areas they fished (Table 59 and paragraph 7.84).
- (ii) Historical compliance data (Table 59) and reports received by CCAMLR from observers and fishers indicate that all practical constraints relating to night setting, offal discharge, streamer line use and line weighting have now been overcome (paragraph 7.86).
- (iii) Particular attention is drawn to vessels that have not complied with two or more of the elements of Conservation Measure 29/XIX for two or more consecutive years. These are: *Isla Camila*, *Isla Santa Clara*, *Koryo Maru II*, *No. 1 Moresko*, *Argos Helena*, *Aquatic Pioneer* and *Isla Alegranza*. In addition, vessels in their first year in the fishery that failed to comply with two or more measures are *Polarpesca I*, *Suidor One*, *Maria Tamara*, *In Sung 66* and *Rutsava* (paragraph 7.89).
- (iv) The Working Group 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 7.87 and 7.88).

Fishing Seasons

7.226 On the basis of the data for the 2000/01 fishing season in Subarea 48.3, seabird by-catch levels were negligible for the second successive season. However, full compliance with Conservation Measure 29/XIX was not achieved so it was not possible to recommend an extension to the fishing season for 2001/02 in Subarea 48.3 (paragraphs 7.91 and 7.92). Nevertheless, full compliance should readily be achievable next year with small improvements to operational practice (paragraph 7.93).

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

- 7.227 (i) The estimates of potential seabird by-catch by area for 2001 (paragraphs 7.109 to 7.113, Tables 60 and 61) were:

Subarea 48.3:	1 600–2 100 to 5 900–7 700 seabirds;
Subareas 58.6 and 58.7:	12 100–16 000 to 22 000–29 000 seabirds;
Divisions 58.5.1 and 58.5.2:	13 500–17 800 to 24 600–32 400 seabirds; and
Division 58.4.4:	9 300–12 500 to 17 100–22 700 seabirds.

- (ii) The overall estimated totals for the whole Convention Area (paragraph 7.114 and Table 61) indicate a potential seabird by-catch in the unregulated fishery of 36 000–69 000 (lower level) to 48 000–90 000 birds (higher level) in 2000/01. This compares with totals of 17 000–27 000 (lower level) to 66 000–107 000 (higher level) in 1996/97, 43 000–54 000 (lower level) to 76 000–101 000

(higher level) in 1997/98, 21 000–29 000 (lower level) to 44 000–59 000 (higher level) in 1998/99, and 33 000–63 000 (lower level) to 43 000–83 000 (higher level) in 1999/2000.

- (iii) The species composition of the estimated potential seabird by-catch (Table 62) indicates a potential by-catch of 40 500–89 500 albatrosses, 7 000–15 000 giant petrels and 109 000–275 000 white-chinned petrels in the IUU fishery in the Convention Area over the last five years (paragraph 7.120).
- (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 7.122), 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 7.123).

Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries

- 7.228
- (i) Of the seven exploratory longline fisheries approved for 2000/01, only that in Subarea 88.1 was operational in 2000/01; no seabird by-catch was reported in this fishery (paragraphs 7.129 and 7.130).
 - (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-XX/BG/11. There had been no changes to this advice in relation to levels of risk of seabird by-catch for any part of the Convention Area (paragraph 7.128).
 - (iii) The 24 proposals by eight Members for new and exploratory longline fisheries in 14 subareas/divisions of the Convention Area in 2001/02 were addressed, in relation to advice in SC-CAMLR-XX/BG/11 and Table 63.
 - (iv) The potential problems which need resolving (paragraphs 7.133 to 7.137) are:
 - (a) to check that France intends to comply with Conservation Measure 29/XIX, rather than Conservation Measure 29/XVI as indicated, for Subarea 58.6 and Divisions 58.4.3 and 58.4.4;
 - (b) whether or not Japan intends to comply with Conservation Measure 29/XIX and to use an international scientific observer in Subareas 48.6, 58.6, 88.1 and 88.2, and Divisions 58.4.1, 58.4.3 and 58.4.4 (note that Japan's intention is clarified, positively, in paragraph 7.134);

- (c) clarification of fishing season in respect of South Africa's applications for Subarea 58.6 and Division 58.4.4; and
 - (d) applications for variations from Conservation Measure 29/XIX (e.g. similar to Conservation Measure 210/XIX) for Subareas 48.6, 88.1, 88.2 and Division 58.4.4.
- 7.229 (i) The Working Group recommended the continuation of Conservation Measure 210/XIX for exploratory fishing in Subarea 88.1 (paragraph 7.136).
- (ii) It recommended that similar conservation measures should be developed for exploratory fishing in Subareas 48.6 and 88.2 and Division 58.4.4, retaining a strict precautionary limit on seabird by-catch (paragraphs 7.137 to 7.139).
- (iii) It recommended the adoption of a simpler method for testing line sink rates (paragraph 7.140 and Appendix G).

Incidental Mortality of Seabirds during Longline Fishing outside the Convention Area

- 7.230 (i) Japanese and Taiwanese vessels longline fishing for tuna in the South African mainland EEZ are estimated to kill annually 19 000–30 000 seabirds, including black-browed albatrosses and white-chinned petrels from the Convention Area. By-catch rates on Japanese vessels were 2.64 birds/thousand hooks; failure to use streamer lines was reported (paragraphs 7.143 to 7.146).
- (ii) Reports were received from New Zealand and the Falkland/Malvinas Islands on low levels of seabird by-catch observed in domestic longline fisheries; a report from Australia indicated a 48% increase in tuna longline fishing effort in the AFZ in 1999, but without observers no reliable by-catch data were available for this fishery (paragraphs 7.148 to 7.150).
- (iii) 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 (paragraph 7.158).

Research into and Experience with Mitigating Measures

- 7.231 (i) Offal discharge – scupper screens should be used to prevent discharge of offal and bait from vessels while processing catch (paragraph 7.161). Hooks, increasingly abundant in regurgitates from albatross chicks, should be removed from fish heads prior to discard; this recommendation should be added to appropriate conservation measures (paragraph 7.162).

- (ii) Streamer lines – a video of the successful New Zealand boom and bridle system should be circulated to fishers via technical coordinators (paragraph 7.163); paired lines have proved superior to single lines when tested in Alaskan demersal longline fisheries and should be tested in the Convention Area (paragraph 7.164).
- (iii) Bait – further trials (paragraphs 7.165 to 7.168) are endorsed and more data requested on circumstances of bait loss (paragraph 7.169).
- (iv) Underwater setting – *Eldfisk* continues to use the Mustad funnel with success on day sets in the Convention Area and the same device performed well in Alaskan trials (paragraph 7.170); full trials of the Australian chute system are in progress on 10 vessels, earlier trials giving a 96% reduction in baits taken (paragraph 7.171).
- (v) Line weighting –
 - (a) several vessels fishing in the Convention Area last year were able to comply with the revised line weighting system of 8.5 kg at 40 m intervals (paragraphs 7.75 to 7.78 and 7.173); when complying, only one of seven cruises recorded seabird by-catch, whereas six of 15 cruises recorded seabird by-catch when not complying (paragraph 7.174);
 - (b) all autoliners (and one Spanish system vessel) fishing in Subarea 88.1 achieved line sink rates of 0.3 m/s. The predictive model of sink rate was further developed (paragraphs 7.173 and 7.182);
 - (c) a new simple means of measuring line sink rate should enable predictive sink rate models to be developed for the Spanish longline system (paragraphs 7.176 and 7.183);
 - (d) several reports of other investigations of line sink rates were received, all broadly confirming existing results for the Convention Area (paragraphs 7.176, 7.177 and 7.181); and
 - (e) trials in New Zealand of a Norwegian-manufactured sample integrated autoline weighting system will take place shortly (paragraphs 7.179 and 7.180).

7.232 In response to the Scientific Committee's request last year, a proposal has been developed for rigorous experiments on the effects of the different elements of Conservation Measure 29/XIX, when applied to the Spanish longline system, in reducing seabird mortality. The Working Group strongly requested Members to support this proposed study (paragraphs 7.186 to 7.188).

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

- 7.233 (i) International Fishers' Forum – Members were encouraged to disseminate information on this successful meeting by way of articles in fishery magazines and journals (paragraphs 7.191 to 7.194).
- (ii) Agreement on the Conservation of Albatrosses and Petrels – CCAMLR Members who are range states (including distant-water fishing nations that interact with Southern Hemisphere albatrosses and petrels on the high seas) were encouraged to sign and ratify the agreement as soon as possible (paragraphs 7.195 to 7.198).
- (iii) FAO NPOA–Seabirds – concern was expressed at the lack of progress by CCAMLR Members towards implementation of NPOAs (requested by the Commission for February 2001), with the exception of Japan, New Zealand and the USA, who had either adopted or developed plans, and Australia, whose Threat Abatement Plan serves in lieu for the time being. The other relevant CCAMLR Members were urged to produce, adopt and implement plans as soon as possible (paragraphs 7.195 to 7.206). The Japanese plan was regarded as inadequate, in respect of mitigation measures, to reduce seabird by-catch to acceptably low levels, specifically in areas frequented by seabirds from the Convention Area (paragraphs 7.209 to 7.212); further details were requested in this regard (paragraph 7.213).
- (iv) Tuna Commissions – details of seabird by-catch, mitigation measures in use and relevant observer programs were requested from forthcoming meetings of CCSBT, ICCAT and IOTC (paragraphs 7.214 to 7.216).
- (v) Other fishery organisations – request to develop links with organisations responsible for fisheries in areas adjacent to the Convention Area (paragraph 7.217).

OTHER INCIDENTAL MORTALITY

Longline Vessels – Marine Mammals

8.1 One unidentified marine mammal drowned after becoming entangled by the *Suidor One* in Subarea 58.7 (WG-FSA-01/22 and Table 64).

8.2 Interactions with marine mammals resulting in observed loss of fish were reported in Subareas 48.3 and 58.6/58.7 (WG-FSA-01/22 and Table 64). These are summarised below in comparison with values for 1999/2000:

		Cruises where Interaction Occurred	Killer Whale	Sperm Whale	Seal	Unknown
Subarea 48.3	1999	13 of 17	12	1	5	0
	2000	9 of 26	6	3	3	1
Subareas 58.6/58.7	1999	9 of 12	6	4	0	3
	2000	9 of 11	7	6	0	2

No such interactions were reported for Subarea 88.1, despite sightings of killer whales from the fishing vessels on most cruises.

Trawl Fishing – Marine Mammals and Seabirds

8.3 No entanglements or incidental mortality of marine mammals or seabirds were reported by vessels engaged in krill fishing in Area 48 (WG-FSA-01/20).

8.4 In respect of trawl fisheries for *C. gunnari* and *D. eleginoides* in Division 58.5.2 and *C. wilsoni* in Division 58.4.2, there was only one report of incidental mortality – that of a single Antarctic fur seal (WG-FSA-01/22 and Table 64).

8.5 In respect of trawl fisheries for *C. gunnari* in Subarea 48.3, there were no reports of marine mammal entanglement or incidental mortality. However, a total of 132 seabird entanglements was reported, of which 92 were fatal, 40 birds being released alive (WG-FSA-01/20). The Working Group noted, however, that scientific observer reports indicated that many of the birds released alive were in poor condition; at least one quarter were thought unlikely to survive.

8.6 The majority (98%) of the bird deaths occurred on two vessels: the *Betanzos* (2 grey-headed albatrosses, 21 black-browed albatrosses and 30 white-chinned petrels (misidentified as great-winged petrels)) and the *Argos Vigo* (1 grey-headed albatross, 25 black-browed albatrosses and 11 white-chinned petrels). All the incidental mortality for the *Argos Vigo* was on its February cruise, none on its December cruise, the same observer being on board on both occasions. The *Zakhar Sorokin* reported no birds caught, dead or alive, and the *Saint Denis* only 2 grey-headed albatrosses dead and 2 black-browed albatrosses alive. No data had yet been received from the *Sil* but its observer report indicated that no incidental mortality had been observed.

8.7 The Working Group noted that the vessels involved had fished for different periods and durations. The *Argos Vigo* fished for six days (12 tows) in December (with no seabird by-catch) and 20 days (68 tows) in February (average seabird by-catch of 1.8 birds/day), the *Betanzos* for 53 days (165 tows) in November–February (average seabird by-catch of 1 bird/day), the *Saint Denis* for 13 days (113 tows) in December/January (average seabird by-catch of 0.15 birds/day) and the *Zakhar Sorokin* for 9 days (18 tows) in September (with no seabird by-catch). It also noted that the *Zakhar Sorokin* had fished extensively in the 1999/2000 season in Subarea 48.3 without any reported seabird by-catch.

8.8 The circumstances of seabird by-catch in the icefish fishery in Subarea 48.3 was investigated further in WG-FSA-01/30. This preliminary analysis suggested that month and vessel were significant factors affecting the probability of a haul catching birds. There were, however, insufficient data statistically to resolve the situation further.

8.9 The Working Group noted that although WG-FSA-01/30 had failed to find any correlation between seabird by-catch and fish catch, it was interesting that in December the *Argos Vigo* caught almost no fish and no birds, whereas in February its fish catches were substantially higher (averaging at least 500 kg/hour), as was its seabird by-catch.

8.10 The scientific observer reports on the *Betanzos* and *Argos Vigo* provide additional relevant information. On the *Betanzos* during setting, white-chinned petrels were seen to dive through the larger meshes with wings folded, becoming entrapped subsequently. Although most seabird activity was at the codend, the meshes there were too small for birds to enter and become trapped. Most entanglement occurred in the larger mesh areas of the net, despite these having apparently been cleaned of enmeshed fish. On hauling, birds fought to free fish from the codend but were rarely, if ever, entangled there. Most entanglements of white-chinned petrels resulted from birds diving through the large mesh portion. Black-browed albatrosses were usually entangled by the *Betanzos* when sitting on the water above the net and were caught when it lifted as the vessel pitched.

8.11 The report from the *Argos Vigo* was similar, indicating birds being caught in meshes of about 400 mm with the wings and mouth of the net being the main sites. The observer noted that faster hauling of the trawl and complete extraction of the enmeshed fish before resetting could substantially improve the situation.

8.12 The Working Group felt it unlikely that seabird abundance in the vicinity of vessels would have changed substantially over the months of fishing. It seemed likely, therefore, that the high seabird by-catches were related to specific aspects of vessel (or cruise) operations.

8.13 The Working Group recollected that WG-FSA-99/72 had demonstrated very low levels of incidental mortality associated with trawl fishing in Divisions 58.4.2 and 58.5.2; experience in subsequent years has confirmed this. Vessels trawl fishing in these areas are required to have an on-board processing plant.

8.14 Dr V. Senioukov (Russia), who had been a scientific observer on the *Zakhar Sorokin*, noted three characteristics of this vessel which may contribute to its having no records of entangled seabirds. First, no fish offal is produced, fish being frozen whole. Second, low levels of deck illumination are used. Third, it is a much larger vessel (7 765 GRT) than the other trawlers (1 100–2 200 GRT) operating in the area. Its more powerful engine enables it to steam during hauling, permitting an unbroken and faster operation. Gear configuration is also different, particularly to that of the *Betanzos*.

8.15 The offal production and disposal characteristics of the other trawlers fishing in Subarea 48.3 is unknown. It is possible that their offal discharge practices might attract birds during the set and haul. The slow rate of hauling of the trawl of the *Argos Vigo* had been identified by the scientific observer as potentially contributing to the attraction and entanglement of seabirds.

8.16 WG-FSA-01/59 reported incidental mortality of seabirds in midwater trawl fisheries in the New Zealand region, especially involving albatrosses and sooty shearwaters. Mr Smith indicated that many albatrosses were entangled following collision with the trawl warp, whereas most shearwaters were caught when diving into the mouth of the net to retrieve fish at the haul. The problem with the trawl warp is being addressed by using streamer lines and other devices to restrict access to the danger area.

8.17 New Zealand was encouraged to circulate intersessionally and to table next year further details of its mitigation work on trawl fishing vessels.

8.18 In reviewing the overall situation, the Working Group noted with concern that the incidental mortality due to trawl fishing in Subarea 48.3 in 2000/01 was three times the estimated mortality caused by the longline fishery in the same subarea in 2000/01. It recollected that the *Betanzos* was the vessel responsible for all the seabird trawl by-catch (19 black-browed albatrosses) in Subarea 48.3 last year and the concern at this expressed by the Scientific Committee and Commission (SC-CAMLR-XIX, paragraph 4.49 and CCAMLR-XIX, paragraph 6.28).

8.19 However the Working Group noted that, without more data and information, it was difficult to determine the cause of the high level of seabird by-catch associated with certain vessels fishing for icefish in Subarea 48.3. It was therefore difficult to propose appropriate remedies at this time.

8.20 Accordingly, the Working Group requested that provision be made in the *Scientific Observers Manual*, logbook, data recording and reporting sheets (see paragraph 7.99) 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.

8.21 The Working Group also recommended that details of the mitigating measures used on New Zealand vessels (paragraph 8.16) be obtained by the Secretariat and circulated to technical coordinators with the request that trials of similar devices be undertaken on trawl vessels fishing for icefish in Subarea 48.3 in 2001/02 and the results be reported to the Working Group.

8.22 Until it is possible to recommend appropriate measures to mitigate seabird by-catch in midwater trawl fisheries for icefish in Subarea 48.3, the Working Group recommended that each vessel entering this fishery be subject to a limit on seabirds killed, and on reaching such limit, fishing by that vessel would cease.

8.23 Given the potential significance of seabird by-catch associated with trawl fishing, the Working Group recommended that the Secretariat should seek to acquire recent data on seabird by-catch for French trawl fisheries in Division 58.5.1 and in any other relevant parts of the Convention Area.

Squid and Pot Fishing

8.24 WG-FSA-01/42 reported that no instances of incidental mortality of marine mammals or seabirds had been recorded for the exploratory squid fishery or the *D. eleginoides* pot fishery in Subarea 48.3.

Advice to the Scientific Committee

- 8.25 (i) In the Convention Area in 2001, one unidentified marine mammal was killed by a longline vessel and one Antarctic fur seal by a trawl vessel (paragraphs 8.1 and 8.4).
- (ii) No instances of incidental mortality of seabirds were reported from trawl fisheries in Divisions 58.4.2 and 58.5.2 in 2000/01 (paragraph 8.4).
- 8.26 (i) In trawl fishing for icefish in Subarea 48.3, 132 seabirds were entangled, at least 92 fatally, a total three times the estimated total seabird by-catch mortality for all regulated longline fishing in the Convention Area in 2001 (paragraphs 8.5 to 8.6 and 8.18).
- (ii) The Working Group recommended that:
- (a) new data recording and reporting arrangements be devised for scientific observers on trawl vessels fishing in Subarea 48.3, in order to determine the nature of offal discharge and deck lighting and other details relevant to incidental entanglement and mortality of seabirds (paragraph 8.20);
 - (b) mitigation measures, similar to those in use in New Zealand trawl fisheries, be trialled on vessels trawl fishing for icefish in Subarea 48.3 in 2001/02 (paragraph 8.21); and
 - (c) seabird by-catch limits be placed on each vessel trawl fishing for icefish in Subarea 48.3 in 2001/02 (paragraph 8.22).
- (iii) The Working Group recommended that the Secretariat should seek to acquire recent data on seabird by-catch for French trawl fisheries in Division 58.5.1 and in any other relevant parts of the Convention Area (paragraph 8.23).
- (iv) No instances of incidental mortality of marine mammals or seabirds had been recorded for the squid fishery or the *D. eleginoides* pot fishery in Subarea 48.3 (paragraph 8.24).

CCAMLR WEBSITE

9.1 WG-FSA reviewed its usage of the CCAMLR website. It was agreed that the website had evolved into a useful tool, and that the present format and contents of material on the website met the needs of the Working Group. WG-FSA also noted a marked increase in the connection speed and access times to the website since the 2000 meeting; faster download times had provided better access to meeting material. The Secretariat was thanked for these further developments.

FUTURE WORK

Research Needs for *C. gunnari*

10.1 The Working Group recognised that there continues to be a substantial number of additional research needs for *C. gunnari* stocks. At this year's meeting a number of specific issues arose during discussions of the assessment of *C. gunnari* that would benefit from additional investigations. These included:

- (i) sensitivity trials of natural mortality rates on currently used methods of assessment to better understand the consequences of changes and uncertainties in this population parameter;
- (ii) further refinement of methods for assessing standing stock of *C. gunnari*, including the use of acoustic survey techniques;
- (iii) age and growth studies of *C. gunnari*. Drs Kock and K. Shust (Russia) recommended setting up an otolith exchange network similar to what was carried out for *D. eleginoides* last year;
- (iv) a compilation of historical catch-weighted length frequencies for the Indian Ocean Sector (paragraph 4.160);
- (v) ecosystem interactions (paragraph 4.175); and
- (vi) alternative approaches to management (paragraph 4.189).

Total Removals of Toothfish

10.2 The Working Group recommended that the Secretariat compile tables of total toothfish removals as up-to-date as possible prior to WG-FSA following the approach used this year (see paragraph 3.32 and Tables 3 to 11). These tables should be compiled by season, as well as by split-year (as defined in the context of conservation measures) for Subarea 48.3 and Division 58.5.2.

Intersessional Work of Subgroups

10.3 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 2001/02 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.

10.4 The Working Group reminded participants that the membership to the subgroups was open, and that the reason for nominating coordinators and others at the meeting was to facilitate the establishment of subgroups.

10.5 WG-FSA assigned some of the major tasks arising from the 2001 meeting to the following groups:

- (i) A subgroup to review observer reports and information, coordinated by Dr Balguerías 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 (well prior to WG-FSA). There are two primary tasks of this subgroup:
 - (a) explore and test any new quantitative assessment procedures, identify data requirements, and establish a general work plan to be followed at the subsequent WG-FSA meeting. Individuals who plan to table new assessment techniques or new estimates of population parameters are highly encouraged to participate in the intersessional activities of the subgroup; and
 - (b) circulate and discuss the most likely population input parameters that will be used during the upcoming assessment. A list of these parameters should be made available at least two weeks prior to the WG-FSA meeting.
- (iii) A subgroup to review, and where necessary assess, the biology and demography of species considered by the Working Group. The subgroup was tasked with:
 - (a) coordinating the *C. gunnari* otolith exchange network: Drs Gasiukov, Shust and Kock;
 - (b) continuing the development of guidelines for determining maturity stage in *D. mawsoni* (paragraph 3.78): Mr G. Patchell (New Zealand); and
 - (c) continuing the development of fish identification guides for scientific observers: Dr Everson.

- (iv) Dr Everson will prepare a file containing all working papers on by-catch developed at this meeting; the file to be deposited at the Secretariat. This information will be considered by a subgroup on by-catch to be coordinated by Ms van Wijk.
- (v) A subgroup to continue refining methods used by scientific observers to subsample by-catch and collect information on ecological interactions from longline and trawl fisheries, coordinated by Dr D. Agnew (UK), Dr Ashford and Mr Watkins.
- (vi) A subgroup to identify in conjunction with the SCAR EVOLANTA Program up-to-date information on stock identity for species within the Convention Area, to be coordinated by Dr Fanta.

10.6 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.

10.7 The responsibilities for coordinating the intersessional activities of ad hoc WG-IMALF are set out in Appendix F.

Other Intersessional Work

10.8 The Working Group identified a number of tasks that should be carried out by participants and the Secretariat during the intersessional period. The main tasks are listed below with reference to paragraphs in the report that contain details of these tasks; routine tasks are not included.

10.9 The following tasks were identified as part of the development of the Scheme of International Scientific Observation:

Secretariat:

- (i) Consult with technical coordinators and seek their comments and proposals on solutions to difficulties experienced in the completion of the observer duties (paragraph 3.48).

Members:

- (ii) Request that scientific observers submit data on electronic bgbooks developed in Microsoft Excel format by the CCAMLR Secretariat (paragraph 3.42).
- (iii) Encourage technical coordinators to continue to bring changes and updates of the *Scientific Observers Manual* to the attention of the scientific observers (paragraph 3.48).
- (iv) Encourage scientific observers to label and store, deep frozen, all specimens whose identification was uncertain, for subsequent forwarding to appropriate taxonomists (paragraph 4.293).

- (v) Encourage scientific observers and fishing masters to continue collecting information on CFs using the CCAMLR format and concentrating on product which constitutes the largest fraction of the fish processed (paragraph 3.78).
- (vi) Remind scientific observers that data on CFs should be collected on a fish-by-fish basis (paragraph 3.78).

10.10 Various other tasks were identified as follows:

Secretariat:

- (i) Maintain a watching brief on IUCN, CITES and FAO in relation to new developments in the Red List (paragraph 11.6), and report these to the Working Group during the intersessional period.
- (ii) Examine the feasibility of creating a database of CCAMLR working documents that could be indexed by keywords and accessed by Members when requested.

Members:

- (iii) Consider options for reorganising the work of the Working Group during its meetings (paragraphs 11.1 to 11.5).
- (iv) Submit documents electronically to the Secretariat at least one week prior to the start of the 2002 meeting of WG-FSA. The Working Group agreed that papers submitted after this deadline will not be considered during the course of the WG-FSA meeting.
- (v) Submit data on by-catch which can be used to estimate catch rates in terms of both numbers and weight per unit of effort (paragraph 4.286).

Secretariat Support at Future Meetings

10.11 The Working Group recognised the difficulties under which the Secretariat operates when several meetings are taking place simultaneously at the CCAMLR Headquarters. The Working Group noted that the assessments have been ending on Thursday for the past few years, and agreed that every effort should continue to be made in the future to complete all activities of WG-FSA by Wednesday. The attention of the Scientific Committee was drawn to this scheduling.

10.12 Dr Ramm updated the Working Group on recent progress made toward the CCAMLR Research Survey Database, including the transfer and validation of data to the new format. Future work will include:

- (i) development of a pro-forma for survey data; and
- (ii) a method of allowing contributors to make corrections to their survey database.

10.13 The Working Group suggested that it would be valuable to integrate data validation routines into the data query process used by the Working Group.

10.14 The Working Group suggested that the Secretariat create a standardised research survey database that would be available to Members who conduct research surveys.

OTHER BUSINESS

Options for Reorganising the Work of WG-FSA

11.1 The Working Group discussed strategies that could streamline the organisation of WG-FSA. It was noted that the data facilities available at the Secretariat have improved, and this has helped facilitate the work of WG-FSA.

11.2 The performance and success of various intersessional activities that took place prior to WG-FSA were discussed. The Working Group noted that certain intersessional activities, such as the otolith exchange program and toothfish ageing workshop, were very successful while some other intersessional activities had more limited results. The Working Group recognised that the success of various activities was related, in part, to how well the tasks were defined to the subgroups. The need to clearly define the tasks of intersessional groups was underscored. Dr Constable suggested that it would be useful to develop a framework for evaluating the success of intersessional activities.

11.3 The Working Group noted that there are substantial difficulties added to the work of the assessment subgroup when new quantitative methodologies are introduced and incorporated into assessments undertaken during the time of WG-FSA. Issues related to the current procedures and new assessment techniques should be introduced to the assessment subgroup and tested prior to WG-FSA. The Working Group suggested that the best way to achieve this is for the assessment subgroup to have intersessional communication to identify and discuss concerns, requirements and new methods. The activities of the assessment subgroup should be prioritised before the meeting to increase the efficiency and quality of the assessments.

11.4 The specific activities of WG-FSA under the present framework were reviewed with respect to whether the Working Group should focus tasks towards a more strict assessment agenda. The Working Group agreed that the present organisational philosophy is satisfactory, and that no major changes should be made to the broad structure of the tasks undertaken at WG-FSA. However, it would be valuable for conveners and subgroup conveners to exchange ideas and identify key questions that may modify the structure of future WG-FSA activities.

11.5 Dr Holt recommended that items contained in the current agenda should be reviewed. Elements of the agenda may be consolidated, and some should be eliminated if they are no longer of consequence to WG-FSA.

IUCN List of Globally Threatened Species

11.6 The IUCN's Red List of endangered and vulnerable species was reviewed. There are currently no fish species in the Red List that are considered by WG-FSA. However, Dr Miller noted that the CITES list for marine species is currently being finalised. As was recommended last year, the Secretariat was requested to monitor any new developments in endangered and vulnerable species listings that pertain to Antarctic fish, as restrictions placed by CITES have the potential to affect the work undertaken by WG-FSA.

Publication Matters

11.7 Dr Gasiukov raised concerns expressed by several non-English speaking scientists at WG-FSA that there are language difficulties for non-English speakers when preparing and submitting papers for potential publication in *CCAMLR Science*. He further expressed concern that *CCAMLR Science* may not accept valuable scientific contributions due to poor English composition. There was agreement by the Working Group that this was a valid concern. The Working Group noted that this problem is not necessarily limited to the work of WG-FSA, but to all participants who could potentially make scientific contributions to *CCAMLR Science*.

11.8 The Working Group agreed that it would be beneficial to set aside part of the CCAMLR budget that could be earmarked to fund translation of scientific papers into high quality English prior to submission to *CCAMLR Science*. However, the Working Group agreed that caution should be used if the scope of other reports currently used by CCAMLR participants needs to be altered in order to fund translations for *CCAMLR Science*.

11.9 The Editor of *CCAMLR Science*, Dr E. Sabourenkov, acknowledged that there is a problem, and pointed out that a number of papers submitted to the journal often have to be heavily edited for English even before sending them to reviewers. It takes considerable time, and results in delaying in publication of such papers, often for a year. He offered several steps that could be useful in overcoming the problem with papers whose authors prefer to write in English although this is not their primary language, and for those authors whose papers are first written in other languages and then translated into English:

- (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 the most poorly written sections from the original in the other language; and
- (v) reviewers of papers should also be requested to assist in further editing and English improvement.

11.10 It was agreed that the solutions to these problems were largely outside the scope of WG-FSA. Dr Holt noted budgeting requests for translations must be presented to, and approved by, the Commission. He suggested that it would be worthwhile to conduct a cost analysis of the labour required to perform the translations at the Secretariat.

11.11 The Working Group agreed that the English composition of a *CCAMLR Science* submission is much less important than the scientific content, and that it is important that steps be taken to ensure submissions of high scientific quality reach a broad audience through publication.

ADOPTION OF THE REPORT

12.1 The report of the meeting was adopted.

CLOSE OF THE MEETING

13.1 In closing the meeting, the Convener thanked the participants and the Secretariat for another very successful meeting. All had worked long hours and made major contributions to the discussions, work of the subgroups and preparation of the report. Mr Williams confirmed that this meeting marked the end of his three-year term as Convener. Dr Holt, Chair of the Scientific Committee, thanked Mr Williams for leading the Working Group since 1999; his contribution had been very much appreciated.

13.2 Dr Miller, on behalf of WG-FSA, presented Mr Williams with a gift as a token of the Working Group's appreciation. The Working Group also joined in thanking Dr Everson, who would be retiring in 2001, for his contribution to the work of WG-FSA and CCAMLR. The Working Group also presented a small gift to Dr Everson.

13.3 The meeting was closed.

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Table 1: Catches (tonnes) of target species by region and gear reported for the 2000/01 fishing season. Source: catch and effort reports submitted by 7 October 2001.

Fishery and Target Species	Conservation Measure	Region	Gear	Catch (tonnes) of Target Species			
				Limit	Fishery	Other ¹	Total
<i>Chaenodraco wilsoni</i> (exploratory fishery)							
	212/XIX	58.4.2	Trawl	500	11	0	11
<i>Champscephalus gunnari</i>							
	194/XIX	48.3	Trawl	6 760	1 427	0	1 427
	195/XIX	58.5.2	Trawl	1 150	938	0	938
<i>Dissostichus</i> spp.							
	196/XIX	48.3	Pot	4 500 ²	59	3 991	4 050
	196/XIX	48.3	Longline	4 500 ²	3 991	59	4 050
	180/XVIII	48.4	Longline	28	0	0	0
	197/XIX	58.5.2	Trawl	2 995	2 058	5	2 063
		58.5.1 (French EEZ)	Trawl	-	-	-	2 834 ³
		58.5.1 (French EEZ)	Longline	-	-	-	2 381 ³
		58.6 (French EEZ)	Longline	-	-	-	1 419 ³
		58.6 (South African EEZ)	Longline	-	-	-	18
		58.7 (South African EEZ)	Longline	-	-	-	206
<i>Dissostichus</i> spp. (exploratory fisheries)							
	202/XIX	48.6 north of 60°S	Longline	455	0	0	0
	202/XIX	48.6 south of 60°S	Longline	455	0	0	0
	203/XIX	58.4 BANZARE Bank	Trawl	150	0	0	0
	204/XIX	58.4 BANZARE Bank	Longline	300	0	0	0
	207/XIX	58.4.2	Trawl	500	0	0	0
	206/XIX	58.4.3 Elan Bank	Longline	250	0	0	0
	205/XIX	58.4.3 Elan Bank	Trawl	145	0	0	0
	208/XIX	58.4.4 North of 60°S	Longline	370	0	0	0
	209/XIX	58.6	Longline	450	0	0	0
	210/XIX	88.1 north of 65°S	Longline	175	66	0	66
	210/XIX	88.1 south of 65°S	Longline	1 889	592	0	592
	211/XIX	88.2 south of 65°S	Longline	250	0	0	0
<i>Electrona carlsbergi</i>							
	199/XIX	48.3	Trawl	109 000	0	0	0
<i>Euphausia superba</i>							
	32/XIX	48	Trawl	4 000 000	95 919	0	95 919
	106/XIX	58.4.1	Trawl	440 000	0	0	0
	45/XIV	58.4.2	Trawl	450 000	0	0	0
Lithodidae							
	214/XIX	48.3	Pot	1 600	0	14	14
<i>Martialia hyadesi</i> (exploratory fishery)							
	213/XIX	48.3	Jig	2 500	2	0	2

¹ Other fisheries in the region

² Combined (pot and longline) catch limit of 4 500 tonnes

³ 1 July 2000 to 30 June 2001, reported in STATLANT data

Table 2: Catches (tonnes) by species and region reported for the 2000/01 split-year (1 July 2000 to 30 June 2001). Source: STATLANT data submitted by 7 October 2001.

Species Name	All Regions	Region								
		48.1	48.3	58.4.2	58.4.4	58.5.1	58.5.2	58.6	58.7	88.1
Elasmobranchs										
<i>Amblyraja georgiana</i>	7									7
<i>Bathyraja eatonii</i>	1		<1							<1
<i>Bathyraja murrayi</i>	<1								<1	
<i>Bathyraja</i> spp.	<1								<1	
Rajiformes	91	<1	13			58		12	7	
Bony Fishes										
<i>Antimora rostrata</i>	26		<1					7	15	4
<i>Chaenocephalus aceratus</i>	1	1								
<i>Chaenodraco wilsoni</i>	11	<1		11						
<i>Champsocephalus gunnari</i>	1 890	1	959				930			
Channichthyidae	3	<1	<1							3
<i>Channichthys rhinoceratus</i>	1						1			
<i>Chionodraco rastrospinosus</i>	1	1								
<i>Dissostichus eleginoides</i>	12 645		3 259		164	5 215	1 765	1 476	732	34
<i>Dissostichus mawsoni</i>	626	<1								626
<i>Gobionotothen gibberifrons</i>	2	2	<1							
<i>Macrourus</i> spp.	252		2			31		84	128	6
<i>Macrourus whitsoni</i>	48		<1							48
<i>Muraenolepis microps</i>	<1								<1	<1
<i>Muraenolepis</i> spp.	3									3
<i>Notothenia neglecta</i>	2	2								
<i>Notothenia rossii</i>	<1	<1								
<i>Notothenia squamifrons</i>	<1	<1	<1				<1			
Nototheniidae	2	<1	<1	<1						1
<i>Nototheniops nudifrons</i>	<1	<1								
Osteichthyes	<1	<1							<1	
<i>Pleuragramma antarcticum</i>	<1	<1								
<i>Pogonophryne permitini</i>	<1									<1
<i>Pseudochaenichthys georgianus</i>	6	<1	6							
<i>Trematomus</i> spp.	<1	<1								
Crustaceans										
<i>Euphausia superba</i>	97 602	77 858	19 744							
<i>Lithodes murrayi</i>	<1							<1	<1	
Lithodidae	<1							<1	<1	
<i>Paralomis aculeata</i>	<1								<1	
Molluscs										
<i>Martialia hyadesi</i>	2		2							
Other										
Asteroidea	2									2
Total	113 225	77 866	23 986	12	164	5 304	2 696	1 579	883	735

Table 3: Reported catches (tonnes) of *Dissostichus eleginoides* and *Dissostichus mawsoni* by Members and Acceding States, and estimates of unreported catches by Members and Acceding States in the 2000/01 split-year. Catches for the 1999/2000 split-year are given in parentheses. The information in this table may be incomplete¹.

Flag State	Outside Convention Area		Convention Area				Estimated Catch All Areas	
			Reported Catch		Estimates of Unreported Catches by Members			
Chile	9 044	(2 704)	531	(1 609)	0	(0)	9 575	(4 313)
Argentina	6 413	(4 667)	0	(0)	0	(0)	6 413	(4 667)
France	0	(0)	6 634	(5 503)	0	(0)	6 634	(5 503)
Australia	26	(82)	1 765	(2 579)	0	(0)	1 791	(2 661)
South Africa	0	(180) ²	1 040	(1 239)	0	(0)	1 040	(1 419)
UK	1 286 ³	(3 919) ³	900	(1 221)	0	(0)	2 186	(5 140)
Uruguay	4 359	(0)	582	(767)	0	(0)	4 941	(767)
Ukraine	24	(0)	164	(128)	0	(0)	188	(128)
Spain	213	(0)	487	(264)	0	(0)	700	(264)
Rep. of Korea	3 170	(0)	467	(380)	0	(0)	3 637	(380)
Peru	167	(0)	0	(0)	0	(0)	167	(0)
New Zealand	0	(<1)	612	(751)	0	(0)	612	(751)
Russia	2 612	(-)	89	(-)	0	(-)	2 701	(-)
Seychelles	2 838						2 838	
Various countries							108 ⁴	
Unknown								(5 765) ⁵
All countries	30 152	(11 553)	13 271	(14 441)	0	(0)	43 531	(31 758) ⁵

¹ Data from CDS and CCAMLR catch reports

² Catch in EEZ

³ From Falkland/Malvinas Islands and St Helena

⁴ CDS data, area of catch not known

⁵ Revised estimate to include landing data reported by Mauritius for January–October 2000 after WG-FSA-2000, pro-rated for the relevant portion of the split-year. Catch areas are an unknown combination of inside and outside the CCAMLR Convention Area.

Table 4: Estimated effort, mean catch rates/day and total catches by subarea/division in the unregulated fishery on *Dissostichus eleginoides* in the 2000/01 split-year. Estimates for the 1999/2000 split-year are given in parentheses. The total estimated unreported catch in 2000/01 is 7 599 tonnes. The total reported catch for the CCAMLR Convention Area in 2000/01 is 13 271 tonnes. The estimated total catch for the CCAMLR Convention Area in 2000/01 is 20 870 tonnes.

Area/ Subarea/ Division	Estimated Start of Unregulated Fishery	No. of Vessels Sighted in Unregulated Fishery ^{4,5}		No. of Licensed Fishing Vessels		Estimated No. of Vessels Fishing Illegally		No. of Days Fishing per Fishing Trip	No. of Trips/Year	Estimated Effort in Days Fishing ² (1)		Mean Catch Rate per Day ³ (tonnes) (2)	Estimated Unreported Catch (1) x (2)		Estimated Total Catch ¹	
48.6	No info															
48.3	1991	0	(5)	15	(18)	1	(5)	40	2.5	100	(180)	3.0	300 ⁶	(396)	3 559	(5 090)
58.7	Apr–May 1996	1 ⁷	(1)	4	(3)	1	(2)	40	2.5	100	(200)	1.5	150	(220)	882	(940)
58.6	Apr–May 1996	5 ⁷	(7)	6	(5)	6 ⁸	(11) ²	40	2.5	600	(1 100)	1.1	660	(1 980)	2 136	(2668)
58.5.1	Dec 1996	18	(7)	0	(0)	11	(7)	40	2.5	1 100	(700)	3.0	3 300	(2 100)	8 515	(7 109)
58.5.2	Feb–Mar 1997	5	(2) ⁹	2 ¹⁰	(2)	5	(4)						1 649 ¹¹	(800)	3 414	(3 379)
58.4.4	Sep 1996	0	(1)	1	(1)	7 ¹²	(7)	40	2.5	700	(700)	2.2	1 540	(1 050)	1 704	(no data)
88.1															660	(751)
Total													7 599	(6 546)	20 870	(19 937)

¹ Estimated total catch = estimated unreported catch plus reported catch

² Calculated as number of vessels fishing illegally x number of fishing days/trip x number of trips/year

³ Data from Secretariat. Subareas 58.7/58.6 based on data from South Africa's EEZ

⁴ Vessel sightings (sources): Prof. G. Duhamel (France), observers (South Africa), AFMA

⁵ This may include more than one sighting of the same vessel

⁶ Estimated upper limit

⁷ Minimum number vessels detected on radar

⁸ Estimated number of vessels not in area throughout period, but moving between areas

⁹ Two vessels sighted; one with 125 tonnes on board and the other estimated to have 346 tonnes on board

¹⁰ Trawl fishery by sanctioned vessels

¹¹ Calculated from verified catch weights of two arrested vessels and an estimated catch of 1 290 tonnes from three unidentified vessels with an estimated hold capacity of 430 tonnes green weight. By contrast, by applying a similar estimation procedure as for other subareas, an estimated catch of 600 tonnes was obtained assuming a fishing trip duration of 40 days, a catch per day of 2 tonnes and 2.5 fishing trips per year.

¹² No sightings, but reports of vessels in area

Table 5: Estimated total catch (tonnes) by subarea/division of *Dissostichus eleginoides* and *Dissostichus mawsoni* inside¹ and outside² the Convention Area for the 2000/01 split-year. Estimates for the 1999/2000 split-year, where available, are in parentheses.

Subarea/ Division	Estimated Total Catch		Reported Catch 2000/01		Estimated Unreported Catch		Unreported Catch as % of the Estimated Total Catch
48.1	-	(-)	0	(-)	probably low		
48.2	-	(-)	0	(-)	probably low		
48.3	3 559	(5 090)	3 259	(4 694)	300	(396)	9
58.4.4	1 704	(-)	164	(-)	1 540	(1 050)	90
58.5.1	8 515	(7 109)	5 215	(5 009)	3 300	(2 100)	39
58.5.2	3 414	(3 379)	1 765	(2 579)	1 649	(800)	48
58.6	2 136	(2 668)	1 476	(688)	660	(1 980)	31
58.7	882	(940)	732	(720)	150	(220)	17
88.1	660	(751)	660	(751)	probably low		
CCAMLR subareas ¹	20 870 ¹	(19 937) ¹	13 271	(14 441)	7 599	(6 546)	39
41	11 839 ³						
47	292						
51	9 469 ⁴						
57	731						
81	27						
87	7 793						
Non-CCAMLR subareas ²	30 151						
Unknown area	108	(5 765) ⁵					
Total all subareas	51 129	(25 702)	13 271	(14 441)	7 599	(6 546)	

¹ CCAMLR catch report data

² Data from CDS, rounded to the nearest tonne

³ Includes 1 412 tonnes reported by Chile

⁴ Includes an undetermined catch from the portion of the South African EEZ around the Prince Edward Islands which falls within Area 51.

⁵ 5 765 tonnes reported by Mauritius at CCAMLR-XIX after WG-FSA-2000

Table 6: Catches by subarea and year for reported, estimated unreported and estimated total catches (tonnes) of *Dissostichus eleginoides*.

Year	Reported	Estimated Unreported	Estimated Total
Subarea 58.6			
1996/97	333	18 900	19 233
1997/98	175	1 765	1 940
1998/99	1 852	1 748	3 600
1999/00	688	1 980	2 668
2000/01	1 476	660	2 136
Total	4 524	25 053	29 577
Subarea 58.7			
1996/97	2 229	11 900	14 129
1997/98	576	925	1 501
1998/99	205	140	345
1999/00	720	220	940
2000/01	732	150	882
Total	4 462	13 335	17 797
Division 58.5.1			
1996/97	4 681	2 000	6 681
1997/98	4 751	11 825	16 576
1998/99	5 402	620	6 022
1999/00	5 009	2 100	7 109
2000/01	5 215	3 300	8 515
Total	25 058	19 845	44 903
Division 58.5.2			
1996/97	837	7 200	8 037
1997/98	2 418	7 000	9 418
1998/99	5 451	160	5 611
1999/00	2 579	800	3 379
2000/01	1 765	1 649	3 414
Total	13 050	16809	29 859
Subarea 48.3			
1996/97	2 389	0	2 389
1997/98	3 328	0	3 328
1998/99	4 581	350	4 931
1999/00	4 694	396	5 090
2000/01	3 559	300	3 859
Total	18 551	1 046	19 597

Table 7: Reported, estimated unreported and estimated total catches (tonnes) of *Dissostichus eleginoides* by subarea/division for the period 1996/97 to 2000/01.

Subarea/Division	Reported	Estimated Unreported	Estimated Total
Subarea 58.6	4 524	25 053	29 577
Subarea 58.7	4 462	13 335	17 797
Division 58.5.1	25 058	19 845	44 903
Division 58.5.2	13 050	16809	29 859
Total	47 094	75 042	122 136
Subarea 48.3	18 551	1 046	19 597

Table 8: Reported *Dissostichus* spp. landings in FAO Area 51 by Flag State and port of landing for the 2000/01 split-year. (CDS data from the Secretariat.)

Port	No. of Flag States	No. of Landings	Verified Product Weight Landed (tonnes) ²	Estimated ¹ Live Weight (tonnes) ²
Port Louis	4	5	4 704	6 887
Jakarta	1	1	248	397
Singapore	1	1	575	577
Walvis Bay	2	2	260	369
Montevideo	1	2	216	274
Priok	1	1	602	965
Total	6	12	6 605	9 469

¹ Conversion factors used were FLT = 2.3, GUT = 1.1, HAG = 1.6, HAT = 1.7, HGT = 1.7, OTH = 0, WHO = 1

² Rounded to the nearest whole tonne

Table 9: Estimated live weight (tonnes) of *Dissostichus* spp. reported in the CDS data for the 2000 and 2001 calendar years.

Year/Month	Area/Subarea/Division																			Total
	41	47	47.4	48	48.3	48.4	48.5	51	57	58.4.4	58.5.1	58.5.2	58.6	58.6/7	58.7	81	83	87	88.1	
2000																				
January	9											518							351	877
February	367																		781	1 148
March	465										489								444	670 2 069
April	564	308							6		234	1 096							147	2 355
May	635				36						542		419		44				212	1 888
June	862	28		258	1 847			657			1 227	1 007	4	221					198	6 309
July	578				2 001			560	83		1 035								168	4 424
August	1 368				1 461	36		982	8	98	280		219		131				352	4 936
September	1 238												330	41					404	2 013
October	2 231	287						630	189	21	499	442			82				1 337	5 717
November	2 535							928	141		751	82	144	109	94				1 090	5 875
December	1 081							87			750		488		61				1 201	3 668
Total for 2000	11 933	624	0	258	5 345	36	0	3 844	427	118	5 807	3 144	1 603	371	412	0	0	6 685	670	41 280
2001																				
January	1 075							1 853	168	34	69		369						941	4 508
February	351							220			587	609							562	2 329
March	1 279	5			9			867			292				1	1			482	314 3 249
April	657				8			4 182	292		989		210	13	42				524	223 7 139
May	1 396				130			361			274	607	122	1	26				243	62 3 223
June	728				800							205		31					547	2 310
July	422		71		1 088			1 823			373	193	8		75				137	4 190
August	777				1 076			1 886	340						35				176	4 291
September	429				879			837						33					71	2 249
Total for 2001	7 115	5	71	0	3 992	0	0	12 028	799	34	2 585	1 614	708	78	152	27	1	3 681	599	33 489

Table 10: Seabed areas within the geographic range of *Dissostichus eleginoides*. Bathymetry data source: Sandwell and Smith 2 x 2 minute grids; analysis of seabed areas within the CCAMLR Convention Area: *Statistical Bulletin*, Vol. 13 (2001); analysis of seabed areas outside the CCAMLR Convention Area: CCAMLR Secretariat, April 1999.

Ocean	Area	Boundaries				Seabed Area (km ²) within depth range		
		North	South	West	East	0–500 m	500–600 m	600–1 800 m
Within the CCAMLR Convention Area								
Southwest Atlantic	48.3 Maurice Ewing Bank	50°S	52.3°S	50°W	30°W	0	0	34 608
Southwest Atlantic	48.3 south of Maurice Ewing Bank	52.3°S	57°S	50°W	30°W	0	2 415	32 025
Western Indian	58.7	45°S	50°S	30°E	40°E	1 650	273	12 655
Western Indian	58.6	45°S	50°S	40°E	60°E	18 148	1 964	71 295
Western Indian	58.5.1	45°S	49–53°S	60°E	80°E	117 768	31 416	124 428
Western Indian	58.5.2	49–53°S	55°S	60°E	80°E	46 627	10 974	111 106
Total						184 193	47 042	386 117
Outside the CCAMLR Convention Area								
Western Indian	51	40°S	45°S	30°E	80°E	2	12	30 007
Southwest Atlantic	41	50°S	60°S	70°W	50°W	416 586	18 233	115 838
Total						416 588	18 245	145 845

Table 11: Reported catch versus landed weights (tonnes) for *Dissostichus eleginoides* in Area 48 for the 2000 and 2001 calendar years. It should be noted that the CDS entered into force in May 2000 and no information on landings is therefore available prior to that date. In addition, there is likely to be a time lag between catch reports and landing reports from the CDS.

Year/Month	Catch	Cumulative Catch	Landing	Cumulative Landing
2000				
March	4	4	0	0
April	13	17	0	0
May	1 698	1 715	36	36
June	2 211	3 926	2 105	2 141
July	1 303	5 229	2 001	4 142
2001				
January	4	4	0	0
February	6	10	0	0
March	7	17	9	9
April	20	37	8	17
May	1 294	1 331	130	147
June	989	2 320	800	947
July	970	3 290	1 088	2 035
August	748	4 038	1 076	3 111
September	11	4 049	879	3 990
October	1	4 050	0	3 990

Table 12: Summary of observations on fisheries conducted in the 2000/01 season by designated CCAMLR scientific observers. OTB – bottom trawl, OTM – midwater trawl, LLS – longline system, * – national observers.

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report/Date Submitted	Data Reported
Longline fisheries							
Chile	<i>Isla Camila</i>	LLS Spanish	Y. Marín Uruguay	48.3 <i>D. eleginoides</i>	1/5–3/6/01	Logbook 23/7/01 Report 4/7/01	Cruise, vessel and IMALF details
Chile	<i>Isla Camila</i>	LLS Spanish	C. Tambasco Uruguay	48.3 <i>D. eleginoides</i>	9/6–17/8/01	Logbook 2/10/01 Report 2/10/01	Cruise, vessel and IMALF details
Chile	<i>Isla Santa Clara</i>	LLS Spanish	S. Hutton UK	48.3 <i>D. eleginoides</i>	25/4–1/7/01	Logbook 18/9/01 Report 13/9/01	Cruise, vessel and IMALF details
Chile	<i>Isla Santa Clara</i>	LLS Spanish	S. Miney UK	48.3 <i>D. eleginoides</i>	1/7–18/7/01	Logbook 24/9/01 Report 13/9/01	Cruise, vessel and IMALF details
Chile	<i>Maria Tamara</i>	LLS Spanish	C. Berriolo Uruguay	48.3 <i>D. eleginoides</i>	28/6–30/8/01	Logbook 2/10/01 Report 2/10/01	Cruise, vessel and IMALF details
Chile	<i>Polarpesca I</i>	LLS Spanish	M. Lozano Uruguay	48.3 <i>D. eleginoides</i>	11/6–28/8/01	Logbook 2/10/01 Report 2/10/01	Cruise, vessel and IMALF details
Spain	<i>Ibsa Quinto</i>	LLS Spanish	M. Gandolfi UK	48.3 <i>D. eleginoides</i>	3/5–12/7/01	Logbook 18/9/01 Report 13/9/01	Cruise, vessel and IMALF details
Spain	<i>Viking Bay</i>	LLS Spanish	M. Endicott UK	48.3 <i>D. eleginoides</i>	1/5–30/8/01	Logbook 5/10/01 Report 9/10/01	Cruise, vessel and IMALF details
UK	<i>Argos Georgia</i>	LLS Spanish	M. Purves South Africa	48.3 <i>D. eleginoides</i>	23/4–2/8/01	Logbook 4/10/01 Report 23/9/01	Cruise, vessel and IMALF details
UK	<i>Argos Helena</i>	LLS Spanish	G. Morano Spain	48.3 <i>D. eleginoides</i>	1/5–29/8/01	Logbook 26/9/01 Report 26/9/01	Cruise, vessel and IMALF details
Korea, Rep. of	<i>In Sung 66</i>	LLS Spanish	M. Durham UK	48.3 <i>D. eleginoides</i>	26/4–7/7/01	Logbook 13/9/01 Report 13/9/01	Cruise, vessel and IMALF details
Korea, Rep. of	<i>In Sung 66</i>	LLS Spanish	N. Mynard UK	48.3 <i>D. eleginoides</i>	8/7–11/9/01	Logbook 4/10/01 Report 5/10/01	Cruise, vessel and IMALF details
Korea, Rep. of	<i>No. 1 Moresko</i>	LLS Spanish	J. Hooper UK	48.3 <i>D. eleginoides</i>	30/4–21/7/01	Logbook 13/9/01 Report 22/8/01	Cruise, vessel and IMALF details
Korea, Rep. of	<i>No. 1 Moresko</i>	LLS Spanish	J. Bailey UK	48.3 <i>D. eleginoides</i>	13/7–11/9/01	Logbook 13/9/01 Report 3/10/01	Cruise, vessel and IMALF details

(continued)

Table 12 (continued)

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report/Date Submitted	Data Reported
New Zealand	<i>Janas</i>	LLS Auto	B. Fairhead South Africa	88.1 <i>Dissostichus</i> spp.	3/1–28/3/01	Logbook 19/4/01 Report 16/5/01	Cruise, vessel and IMALF details
New Zealand	<i>San Aotea II</i>	LLS Auto	M. Dixon South Africa	88.1 <i>Dissostichus</i> spp.	2/1–23/5/01	Logbook 30/5/01 Report 30/5/01	Cruise, vessel and IMALF details
New Zealand	<i>Sonrisa</i>	LLS Auto	F. Stoffberg South Africa	88.1 <i>Dissostichus</i> spp.	10/1–10/3/01	Logbook 9/4/01 Report 18/4/01	Cruise, vessel and IMALF details
Russia	<i>Rutsava</i>	LLS Spanish	Z. Uvajeniem Ukraine	48.3 <i>D. eleginoides</i>	17/5–25/5/01	Logbook 2/10/01 Report 2/10/01	Cruise, vessel and IMALF details
Russia	<i>Ural</i>	LLS Spanish	A. Williams UK	48.3 <i>D. eleginoides</i>	22/4–22/8/01	Logbook 18/9/01 Report 28/9/01	Cruise, vessel and IMALF details
Ukraine	<i>RK-1</i>	LLS Auto	R. Gater UK	48.3 <i>D. eleginoides</i>	21/4–23/6/01	Logbook 13/9/01 Report 13/9/01	Cruise, vessel and IMALF details
Ukraine	<i>RK-1</i>	LLS Auto	A. Watson UK	48.3 <i>D. eleginoides</i>		Report 9/10/01	Cruise details
Uruguay	<i>Isla Alegranza</i>	LLS Spanish	C. Remaggi Argentina	88.1 <i>Dissostichus</i> spp.	6/3–18/3/01	OVERDUE	
Uruguay	<i>Isla Alegranza</i>	LLS Spanish	H. Hernández Chile	48.3 <i>D. eleginoides</i>	1/5–30/8/01	Logbook 4/10/01 Report 4/10/01	Cruise, vessel and IMALF details
Uruguay	<i>Isla Gorriti</i>	LLS Auto	C. Vera Chile	88.1 <i>Dissostichus</i> spp.	14/1–19/3/01	Logbook 5/6/01 Report 23/8/01	Cruise, vessel and IMALF details
South Africa	<i>Aquatic Pioneer</i>	LLA Auto	L. Koen* South Africa	58.6, 58.7 <i>D. eleginoides</i>	20/9–20/11/00	Logbook 22/12/00 Report 22/12/00	Cruise, vessel and IMALF details
South Africa	<i>Eldfisk</i>	LLS Auto	Stander, Van de Berg* South Africa	58.6, 58.7 <i>D. eleginoides</i>	29/11/00–1/1/01	Logbook 9/3/01 Report 9/3/01	Cruise, vessel and IMALF details
South Africa	<i>Eldfisk</i>	LLS Auto	M. Saunders New Zealand	88.1 <i>Dissostichus</i> spp.	5/2–17/3/01	Logbook 3/5/01 Report 16/5/01	Cruise, vessel and IMALF details
South Africa	<i>Eldfisk</i>	LLS Auto	B. Fairhead, H. Crous* South Africa	58.6, 58.7 <i>D. eleginoides</i>	2/9–12/11/00	Logbook 22/12/00 Report 22/12/00	Cruise, vessel and IMALF details

(continued)

Table 12 (continued)

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report/Date Submitted	Data Reported
South Africa	<i>Eldfisk</i>	LLS Auto	B. Fairhead, H. Crous* South Africa	58.6, 58.7 <i>D. eleginoides</i>	7/8–6/9/01	Logbook 11/9/01 Report 5/10/01	Cruise, vessel and IMALF details
South Africa	<i>Eldfisk</i>	LLS Auto	F. Stoffberg, L. Koen* South Africa	58.6, 58.7 <i>D. eleginoides</i>	6/5–11/7/01	Logbook 24/8/01 Report 31/7/01	Cruise, vessel and IMALF details
South Africa	<i>Isla Graciosa</i>	LLS Spanish	M. Vercueil* South Africa	58.6, 58.7 <i>D. eleginoides</i>	2/10–17/12/00	Logbook 2/4/01 Report 11/1/01	Cruise, vessel and IMALF details
South Africa	<i>Isla Graciosa</i>	LLS Spanish	N. Du Plooy* South Africa	58.6, 58.7 <i>D. eleginoides</i>	1/4–1/6/01	Logbook 6/7/01 Report 17/7/01	Cruise, vessel and IMALF details
South Africa	<i>Isla Graciosa</i>	LLS Spanish	P. Kenney New Zealand	88.1 <i>Dissostichus</i> spp.	24/2–26/3/01	Logbook 26/3/01 Report 25/6/01	Cruise, vessel and IMALF details
South Africa	<i>Isla Graciosa</i>	LLS Spanish	D. Cole* South Africa	58.6, 58.7 <i>D. eleginoides</i>	11/6–7/8/01	Logbook 14/8/01 Report 30/8/01	Cruise, vessel and IMALF details
South Africa	<i>Koryo Maru 11</i>	LLS Spanish	H. Crous* South Africa	58.6, 58.7 <i>D. eleginoides</i>	24/1–9/4/01	Logbook 24/4/01 Report 24/4/01	Cruise, vessel and IMALF details
South Africa	<i>Koryo Maru 11</i>	LLS Spanish	M. Dixon* South Africa	58.6, 58.7 <i>D. eleginoides</i>	16/10–6/12/00	Logbook 27/3/01 Report 21/12/00	Cruise, vessel and IMALF details
South Africa	<i>Koryo Maru 11</i>	LLS Spanish	L. Fearnough UK	48.3 <i>D. eleginoides</i>	1/5–13/9/01	Logbook 28/9/01 Report 2/10/01	Cruise, vessel and IMALF details
South Africa	<i>Suidor One</i>	LLS Spanish	J. Newton* South Africa	58.6, 58.7 <i>D. eleginoides</i>	30/7–17/9/01	Logbook 4/10/01 Report 5/10/01	Cruise, vessel and IMALF details
Pot fisheries							
UK	<i>Argos Georgia</i>	Pot	M. Purves South Africa		20/1–22/2/01	Logbook 3/4/01 Report 3/4/01	Cruise, vessel and IMALF details
UK	<i>Argos Helena</i>	Pot	G. Moreno Spain		15/1–13/2/01	Logbook 3/4/01 Report 3/4/01	Cruise, vessel and IMALF details
UK	<i>Argos Helena</i>	Pot	G. Moreno Spain		6/4–26/4/01	Logbook 26/9/01 Report 26/9/01	Cruise, vessel and IMALF details

(continued)

Table 12 (continued)

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report/Date Submitted	Data Reported
Uruguay	<i>Viking Sky</i>	Pot	K. Passfield UK		9/3–2/4/01	Logbook 9/5/01 Report 10/5/01	Cruise, vessel and IMALF details
Uruguay	<i>Viking Sky</i>	Pot	N. Lock UK		18/5–12/7/01	Logbook 24/9/01 Report 22/8/01	Cruise, vessel and IMALF details
Jig fisheries							
Korea, Rep. of	<i>In Sung 707</i>	Jig	S. Miney UK		6/6–1/7/01	Logbook 13/9/01 Report 13/9/01	Cruise, vessel and IMALF details
Trawl fishery							
Australia	<i>Austral Leader</i>	OTB	M. Baron* Australia	58.5.2 <i>D. eleginoides</i>	12/8–19/10/00	Logbook 22/1/01 Report 30/5/01	Cruise, vessel and IMALF details
Australia	<i>Austral Leader</i>	OTM	L. Pshenichnov Ukraine	58.4.2	15/1–26/2/01	Logbook 16/3/01 Report 16/3/01	Cruise, vessel and IMALF details
Australia	<i>Austral Leader</i>	OTB	M. Tucker* Australia	58.5.2 <i>D. eleginoides</i>	27/2–15/4/01	Logbook 28/6/01 Report 9/10/01	Cruise, vessel and IMALF details
Australia	<i>Austral Leader</i>	OTB	J. Taylor* Australia	58.5.2 <i>D. eleginoides</i> <i>C. gunnari</i>	11/5–17/6/01	Logbook 28/8/01 Report 24/9/01	Cruise, vessel and IMALF details
Australia	<i>Southern Champion</i>	OTB	J. Parkinson* Australia	58.5.2 <i>D. eleginoides</i> <i>C. gunnari</i>	9/10–3/11/00	Logbook 22/1/01 Report 28/9/01	Cruise, vessel and IMALF details
Australia	<i>Southern Champion</i>	OTB	B. Stanley* Australia	58.5.2	13/12/00–1/3/01	Logbook 27/7/01	Cruise, vessel and IMALF details
Australia	<i>Southern Champion</i>	OTB/OTM	M. Baron* Australia	58.5.2 <i>D. eleginoides</i> <i>C. gunnari</i>	9/5–26/6/01	OVERDUE	
Chile	<i>Betanzos</i>	OTM	J. Bailey UK	48.3 <i>C. gunnari</i>	7/12/00–26/2/01	Logbook 3/4/01 Report 4/4/01	Cruise, vessel and IMALF details
France	<i>Saint Denis</i>	OTM	M. Endicott UK	48.3 <i>C. gunnari</i>	4/12/00–18/1/01	Logbook 5/3/01 Report 6/3/01	Cruise, vessel and IMALF details

(continued)

Table 12 (continued)

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report/Date Submitted	Data Reported
Japan	<i>Nitaka Maru</i>	OTM	T. Hatashi* Japan	48	1/12/00–26/1/01	Logbook 31/7/01	Cruise, vessel and IMALF details
Russia	<i>Zakhar Sorokin</i>	OTM	E. McManus UK	48.3 <i>C. gunnari</i>	1/9–8/9/01	Logbook 26/9/01 Report 9/10/01	Cruise, vessel and IMALF details
UK	<i>Argos Vigo</i>	OTM	R. Verge France	48.3 <i>C. gunnari</i>	21/12/00–20/1/01	Logbook 7/5/01 Report 7/5/01	Cruise, vessel and IMALF details
UK	<i>Argos Vigo</i>	OTM	R. Verge France	48.3 <i>C. gunnari</i>	1/2–20/2/01	Logbook 7/5/01 Report 7/5/01	Cruise, vessel and IMALF details
UK	<i>Sil</i>	OTM	R. Wahrlich Brazil	48.3 <i>C. gunnari</i>	1/6–13/6/01	Logbook 24/9/01 Report 24/9/01	Cruise, vessel and IMALF details
Ukraine	<i>Foros</i>	OTM	M. Savich* Ukraine	48	1/5/01–28/10/01		
USA	<i>Top Ocean</i>		V. Bibik Ukraine	48.1 <i>E. superba</i>	20/5–28/6/01	Logbook 20/6/01 Report 2/10/01	Cruise, vessel and IMALF details

Table 13: Total number of biological records collected by scientific observers during the 2000/01 season.

Species	Length Count	Length range (cm)		Weight Count	Sex Count	Maturity Count	Otolith Count
		Min.	Max.				
Subarea 48.3							
<i>Amblyraja georgiana</i>	1 066	8	186	962	1 069	473	0
<i>Bathyraja eatonii</i>	5	114	135	5	4	4	0
<i>Bathyraja maccaini</i>	1	15	15	1	1	1	0
<i>Bathyraja meridionalis</i>	199	58	165	185	197	58	0
<i>Bathyraja</i> spp.	2	100	126	2	2	0	0
<i>Raja taaf</i>	266	5	110	266	266	250	0
Rajiformes	6	90	139	6	5	1	0
<i>Electrona carlsbergi</i>	55	9	27	50	26	23	0
<i>Gymnoscopelus nicholsi</i>	15	13	18	0	15	1	0
Myctophidae	16	13	26	16	16	15	0
<i>Muraenolepis microps</i>	11	25	41	7	7	7	0
<i>Muraenolepis</i> spp.	58	22	50	16	2	2	0
<i>Antimora rostrata</i>	289	23	72	105	99	90	24
<i>Macrourus holotrachys</i>	1 331	16	83	409	656	562	175
<i>Macrourus</i> spp.	385	44	85	328	290	283	62
<i>Macrourus whitsoni</i>	65	46	76	40	20	20	0
<i>Dissostichus eleginoides</i>	74 952	42	220	19 252	26 339	26 233	8 475
<i>Gobionotothen gibberifrons</i>	931	27	46	575	863	567	0
<i>Notothenia rossii</i>	40	21	73	38	39	38	0
<i>Notothenia squamifrons</i>	145	28	44	52	12	12	5
Nototheniidae	24	15	52	22	19	18	0
<i>Nototheniops larseni</i>	32	14	23	32	32	28	0
<i>Nototheniops nudifrons</i>	2	20	21	2	2	2	0
<i>Parachaenichthys georgianus</i>	29	13	49	29	29	20	0
<i>Patagonotothen brevicauda</i>	35	11	38	28	31	30	0
<i>Trematomus</i> spp.	1	22	22	1	1	1	0
<i>Chaenocephalus aceratus</i>	220	13	70	215	218	181	0
<i>Chaenodraco wilsoni</i>	99	15	68	99	99	87	0
<i>Champsocephalus gunnari</i>	3 855	10	50	3 378	3 808	3 181	0
<i>Pseudochaenichthys georgianus</i>	792	13	61	773	792	761	0
<i>Mancopsetta maculata</i>	10	19	41	2	1	1	0
Elasmobranchii	4	198	209	4	4	0	0
Osteichthyes	1	39	39	1	1	1	0
<i>Lithodes murrayi</i>	58	10	133	30	58	10	0
<i>Lithodes</i> spp.	14	83	142	14	14	0	0
Lithodidae	11	84	146	11	11	1	0
<i>Paralithodes</i> spp.	479	35	91	55	498	0	0
<i>Paralomis aculeata</i>	27	48	94	11	27	11	0
<i>Paralomis formosa</i>	3 054	5	160	1 435	5 013	1 947	0
<i>Paralomis anamerae</i>	47	6	85	46	60	11	0
<i>Paralomis spinosissima</i>	2 004	39	114	1 240	2 668	604	0
<i>Ommastrephes, Illex</i>	7	12	26	4	0	0	0
Subareas 58.6 and 58.7							
<i>Dissostichus eleginoides</i>	25 224	37	200	19 536	25 179	23 706	3 509
Division 58.4.2							
<i>Bathyraja maccaini</i>	2	61	62.5	2	2	0	0
<i>Macrourus whitsoni</i>	16	38.8	63.4	16	16	16	0
<i>Dissostichus mawsoni</i>	52	32	57.8	52	52	52	0
<i>Notothenia kempfi</i>	106	11	41	53	53	53	0

(continued)

Table 13 (continued)

Species	Length Count	Length range (cm)		Weight Count	Sex Count	Maturity Count	Otolith Count
		Min.	Max.				
Division 58.4.2 (continued)							
<i>Pagothenia hansonii</i>	3	23.4	27.6	3	3	3	0
<i>Pleuragramma antarcticum</i>	192	11.5	24.4	43	43	43	0
<i>Trematomus eulipidotus</i>	384	15.4	30.9	232	200	200	0
<i>Trematomus lepidorhinus</i>	6	16.4	29.4	6	4	4	0
<i>Chaenodraco wilsoni</i>	1 381	23	34.6	464	423	423	0
<i>Chionodraco hamatus</i>	25	29.9	45	17	17	17	0
Division 58.5.2							
<i>Sommiosus pacificus</i>	1	15.2	15.2	1	1	0	0
<i>Bathyraja eatonii</i>	668	0	119	664	663	0	0
<i>Bathyraja irrasa</i>	136	21.4	139	135	136	0	0
<i>Bathyraja maccaini</i>	4	45.1	104.4	4	4	0	0
<i>Bathyraja murrayi</i>	307	0	88.5	307	304	0	0
<i>Bathyraja</i> spp.	3	31.4	42.4	3	2	0	0
Rajiformes	6	26.4	44.8	6	6	0	0
<i>Macrourus carinatus</i>	199	19.5	67	199	198	162	0
<i>Dissostichus eleginoides</i>	19 636	20	168	19 633	14 986	14 969	0
<i>Champocephalus gunnari</i>	6 591	17.6	37.7	5 639	1 419	1 418	0
<i>Channichthys rhinoceratus</i>	28	33.3	51.1	28	5	5	0
Subarea 88.1							
Rajiformes	46	41	102	46	44	0	0
<i>Muraenolepis</i> spp.	70	29	54	49	64	64	32
<i>Antimora rostrata</i>	101	39	69	60	70	70	19
<i>Macrourus</i> spp.	1 629	29	94	468	962	962	168
<i>Dissostichus eleginoides</i>	7 028	45	188	6 812	7 028	6 852	2 502
<i>Dissostichus mawsoni</i>	9 353	51	198	8 675	8 490	7 880	3 022
<i>Notothenia kempii</i>	13	29	33.5	13	13	13	13
Nototheniidae	2	42	46	1	0	0	0
Channichthyidae	113	30	61	36	90	90	17

Table 14: Total count of all biological records collected by scientific observers (1996–2001).

Species	Length Count	Length range (cm)		Weight Count	Sex Count	Maturity Count	Otolith Count
		Min.	Max.				
Subareas 48.1 and 48.2							
<i>Dissostichus eleginoides</i>	80	37	168	77	77	77	0
<i>Dissostichus mawsoni</i>	51	41	164	51	51	51	0
Subarea 48.3							
<i>Amblyraja georgiana</i>	1 139	8	186	1 037	1 145	483	29
<i>Bathyraja eatonii</i>	22	69	135	22	21	7	6
<i>Bathyraja irrasa</i>	2	117	124	2	2	0	2
<i>Bathyraja maccaini</i>	8	15	127	8	8	2	1
<i>Bathyraja meridionalis</i>	217	58	165	202	215	58	18
<i>Bathyraja murrayi</i>	45	52	104	45	45	17	8
<i>Bathyraja</i> spp.	2	100	126	2	2	0	0
<i>Raja taaf</i>	266	5	110	266	266	250	0
Rajiformes	20	73	139	52	51	15	0
<i>Electrona carlsbergi</i>	55	9	27	50	26	23	0
<i>Gymnoscopelus nicholsi</i>	15	13	18	0	15	1	0
Myctophidae	16	13	26	16	16	15	0
<i>Muraenolepis microps</i>	11	25	41	7	7	7	0
<i>Muraenolepis</i> spp.	58	22	50	16	2	2	0
<i>Antimora rostrata</i>	327	23	72	142	129	120	53
Moridae	1	46	46	1	1	1	0
<i>Macrourus carinatus</i>	15	59	84	9	10	7	9
<i>Macrourus holotrachys</i>	1 364	16	84	430	670	570	188
<i>Macrourus</i> spp.	588	44	85	530	424	414	188
<i>Macrourus whitsoni</i>	494	44	86	154	171	164	8
<i>Dissostichus eleginoides</i>	352 869	31	240	81 022	127 118	100 382	46 501
<i>Gobionotothen gibberifrons</i>	939	27	46	583	871	575	0
<i>Notothenia neglecta</i>	11	38	67	11	11	11	11
<i>Notothenia rossii</i>	77	21	89	75	76	75	0
<i>Notothenia squamifrons</i>	195	16	44	87	47	47	5
Nototheniidae	117	15	66	22	19	18	0
<i>Nototheniops larseni</i>	32	14	23	32	32	28	0
<i>Nototheniops nudifrons</i>	2	20	21	2	2	2	0
<i>Pagothenia hansonii</i>	1	26	26	1	0	0	0
<i>Parachaenichthys georgianus</i>	29	13	49	29	29	20	0
<i>Patagonotothen brevicauda</i>	90	11	38	83	86	79	0
<i>Trematomus</i> spp.	1	22	22	1	1	1	0
<i>Chaenocephalus aceratus</i>	319	13	70	296	299	261	0
<i>Chaenodraco wilsoni</i>	99	15	68	99	99	87	0
<i>Champsocephalus gunnari</i>	11 897	10	50	11 419	11 850	11 217	0
<i>Pseudochaenichthys georgianus</i>	1 104	13	61	1 085	1 104	1 073	1
<i>Mancopsetta maculata</i>	10	19	41	2	1	1	0
Elasmobranchii	4	198	209	4	4	0	0
Osteichthyes	1	39	39	1	1	1	0
<i>Euphausia</i> spp.	1	76	76	1	1	1	0
<i>Lithodes murrayi</i>	58	10	133	30	58	10	0
<i>Lithodes</i> spp.	14	83	142	14	14	0	0
Lithodidae	11	84	146	11	11	1	0
<i>Paralithodes</i> spp.	479	35	91	55	498	0	0
<i>Paralomis aculeata</i>	27	48	94	11	27	11	0
<i>Paralomis formosa</i>	3 055	5	160	1 435	5 014	1 947	0
<i>Paralomis anamerae</i>	47	6	85	46	60	11	0
<i>Paralomis spinosissima</i>	2 004	39	114	1 240	2 668	604	0
Ommastrephes, Illex	7	12	26	4	0	0	0

(continued)

Table 14 (continued)

Species	Length Count	Length range (cm)		Weight Count	Sex Count	Maturity Count	Otolith Count
		Min.	Max.				
Subareas 58.6 and 58.7							
Rajiformes	29	59	100	0	29	0	0
<i>Antimora rostrata</i>	106	41	68	0	0	0	0
<i>Macrourus whitsoni</i>	24	47	73	0	0	0	0
<i>Dissostichus eleginoides</i>	164 793	33	223	62 439	11 8258	90 226	20 277
Divisions 58.5.2 and 58.4.3							
<i>Bathyraja eatonii</i>	239	43	114.7	239	239	65	0
<i>Bathyraja irrasa</i>	8	81	137	8	8	5	0
<i>Bathyraja murrayi</i>	87	21	48.3	87	87	47	0
<i>Macrourus whitsoni</i>	50	40.6	73.7	50	50	50	0
<i>Dissostichus eleginoides</i>	3 890	30.8	141	3 890	3 890	3 890	0
<i>Dissostichus mawsoni</i>	3	61.4	83.9	3	3	3	0
<i>Notothenia rossii</i>	1	55.3	55.3	1	1	1	0
<i>Pleuragramma antarcticum</i>	3	15.8	20.8	3	3	3	0
<i>Trematomus eulepidotus</i>	59	19.4	24.8	59	59	59	0
<i>Chaenodraco wilsoni</i>	43	23.1	34.1	43	43	43	0
<i>Champsocephalus gunnari</i>	1 544	19.5	64.1	1 544	1 544	1 544	0
<i>Channichthys rhinoceratus</i>	195	31.7	62.8	195	195	195	0
<i>Chionodraco hamatus</i>	11	28.4	34	11	11	11	0
<i>Neopagetopsis ionah</i>	13	34.3	51.1	13	13	13	0
Division 58.4.2							
<i>Bathyraja maccaini</i>	2	61	62.5	2	2	0	0
<i>Macrourus</i> spp.	410	44	101	184	149	159	0
<i>Macrourus whitsoni</i>	16	38.8	63.4	16	16	16	0
<i>Dissostichus eleginoides</i>	2 171	41	185	301	1 227	1 227	318
<i>Dissostichus mawsoni</i>	52	32	57.8	52	52	52	0
<i>Notothenia kempfi</i>	106	11	41	53	53	53	0
<i>Pagothenia hansonii</i>	3	23.4	27.6	3	3	3	0
<i>Pleuragramma antarcticum</i>	192	11.5	24.4	43	43	43	0
<i>Trematomus eulepidotus</i>	384	15.4	30.9	232	200	200	0
<i>Trematomus lepidorhinus</i>	6	16.4	29.4	6	4	4	0
<i>Chaenodraco wilsoni</i>	1381	23	34.6	464	423	423	0
<i>Chionodraco hamatus</i>	25	29.9	45	17	17	17	0
Division 58.5.2							
<i>Somniosus pacificus</i>	1	15.2	15.2	1	1	0	0
<i>Bathyraja eatonii</i>	1 128	9	150	1 126	1 123	9	0
<i>Bathyraja irrasa</i>	200	21.4	139	199	200	8	0
<i>Bathyraja maccaini</i>	15	9.4	140	5	15	1	0
<i>Bathyraja murrayi</i>	449	9.4	105	434	439	6	0
<i>Bathyraja</i> spp.	3	31.4	42.4	3	2	0	0
Rajiformes	6	26.4	44.8	6	6	0	0
<i>Macrourus carinatus</i>	199	19.5	67	199	198	162	0
<i>Dissostichus eleginoides</i>	59 665	19.2	172	56 603	44 401	43 886	0
<i>Notothenia squamifrons</i>	1 884	8.2	87.4	1 360	1 321	1 196	0
<i>Champsocephalus gunnari</i>	20 211	9.6	88.7	8 780	5 106	4 998	0
<i>Channichthys rhinoceratus</i>	2 623	9.8	77	1 342	681	664	0
<i>Chionodraco rastrospinosus</i>	13	12.6	34.3	0	0	0	0
Subarea 88.1							
Rajiformes	46	41	102	46	44	0	0
<i>Muraenolepis</i> spp.	70	29	54	49	64	64	32
<i>Antimora rostrata</i>	94	39	68	55	67	67	19
<i>Macrourus</i> spp.	1 629	29	94	468	962	962	168

(continued)

Table 14 (continued)

Species	Length Count	Length range (cm)		Weight Count	Sex Count	Maturity Count	Otolith Count
		Min.	Max.				
Subarea 88.1 (continued)							
<i>Dissostichus eleginoides</i>	7 118	45	188	6 871	7 112	6 933	2 582
<i>Dissostichus mawsoni</i>	32 335	45	205	23 796	31 332	26 727	6 381
<i>Notothenia kemp</i>	13	29	33.5	13	13	13	13
Nototheniidae	2	42	46	1	0	0	0
Channichthyidae	113	30	61	36	90	90	17

Table 15: Conversion factors (CFs) obtained from scientific observers and vessel skippers during the 2000/01 fishing season.

Vessel	Dates	Observer CF	Vessel CF		Observations
Subarea 48.3					
<i>Argos Georgia</i>	7/6–25/7/01	1.67	1.67		Averaged value
<i>Argos Helena</i>	4/5–21/8/01	1.73	1.64	1.74	Start and end of the season
<i>Ibsa Quinto</i>	3/5–11/7/01	1.74	1.64	1.74	Start and end of the season
<i>In Sung 66</i>	1/5–6/7/01	1.8	1.64	1.74	Start and end of the season
<i>In Sung 66</i>	8/7–11/9/01	1.88	1.74		
<i>Isla Alegranza</i>	1/5–30/8/01	1.72	1.64	1.74	Start and end of the season
<i>Isla Camila</i>	12/6–20/7/01	1.52	1.43		
<i>Isla Camila</i>	1/5–28/5/01	1.53	1.43		
<i>Isla Santa Clara</i>	30/6–17/7/01	1.91	1.74		
<i>Isla Santa Clara</i>	1/5–30/6/01	1.8	1.64	1.74	Start and end of the season
<i>Koryo Maru 11</i>	21/5–31/8/01	1.74	1.64	1.74	Start and end of the season
<i>Maria Tamara</i>	14/7–20/7/01	1.53	1.43		
<i>No. 1 Moresko</i>	17/7–30/8/01	1.9	1.74		
<i>No. 1 Moresko</i>	5/5–6/7/01	1.71	1.64	1.74	Start and end of the season
<i>Polarpesca I</i>	10/6–27/6/01	1.69	1.69		
<i>RK-1</i>	4/5–19/6/01	1.67	1.64		Averaged value
<i>RK-1</i>	24/6–30/8/01	1.71	1.74		
<i>Rutsava</i>	17/5–25/5/01		1.56		
<i>Ural</i>	6/5–7/8/01	1.68	1.64	1.74	Start and end of the season
<i>Viking Bay</i>	1/5–30/8/01	1.84	1.64	1.74	Start and end of the season
Subareas 58.6 and 58.7					
<i>Aquatic Pioneer</i>	25/9–12/11/00	1.67	1.6		
<i>Eldfisk</i>	7/9–6/11/00	1.76	1.6		
<i>Eldfisk</i>	11/5–4/7/01	1.6	1.65		
<i>Eldfisk</i>	9/8–11/9/01	1.67	1.7		
<i>Eldfisk</i>	4/12–10/12/00	1.56			
<i>Isla Graciosa</i>	7/10–11/12/00	1.7			
<i>Isla Graciosa</i>	22/4–25/5/01	1.8			
<i>Isla Graciosa</i>	15/6–30/7/01	1.84			
<i>Koryo Maru 11</i>	5/2–2/4/01	1.77			
<i>Koryo Maru 11</i>	20/10–29/11/00	1.71			
<i>Suidor One</i>	30/7–7/9/01	1.69	1.7		
<i>Viking Sky</i>	16/3–4/4/01	1.59			Averaged value
<i>Viking Sky</i>	18/5–14/7/01	1.57			
Subarea 88.1					
<i>Eldfisk</i>	20/2–17/3/01	1.56			
<i>Isla Alegranza</i>	6/3–18/3/01				Report overdue
<i>Isla Gorriti</i>	29/1–3/3/01	1.57	1.57		
<i>Isla Graciosa</i>	12/3–18/3/01	1.84			
<i>Janas</i>	14/1–26/3/01	1.51	1.6		
<i>San Aotea II</i>	14/1–17/5/01	1.56			
<i>Sonrisa</i>	22/1–28/2/01	1.61	1.75		
<i>Sonrisa</i>	22/1–28/2/01	1.67	1.6		
Division 58.5.2					
<i>Austral Leader</i>	27/2–7/5/01	1.69			
<i>Austral Leader</i>	12/8–19/10/00	1.77	1.74		Averaged value
<i>Austral Leader</i>	11/5–20/6/01	1.75	1.74		
<i>Southern Champion</i>	9/10–5/11/00	1.8			
<i>Southern Champion</i>	9/10–5/11/00	1.78			

Table 16: Total catches (tonnes) for exploratory fisheries of target species reported from CCAMLR fisheries managed under conservation measures in force in 2000/01. Source of data: 5-day, 10-day or monthly catch and effort reports submitted by 7 October 2001 (COMM CIRC 01/61).

Target Species	Region	Fishery Gear	Fishing Season		Conservation Measure	Catch (tonnes) of Target Species				Catch (% Limit)
			Start	End		Limit	Fishery	*Other	Total	
<i>Chaenodraco wilsoni</i>	58.4.2	Trawl	1 Dec 00	30 Nov 01	212/XIX	500	11	0	11	2
<i>Dissostichus</i> spp.	48.6 north of 60°S	Longline	1 Mar 01	31 Aug 01	202/XIX	455	0	0	0	0
<i>Dissostichus</i> spp.	48.6 south of 60°S	Longline	15 Feb 01	15 Oct 01	202/XIX	455	0	0	0	0
<i>Dissostichus</i> spp.	58.4 BANZARE Bank	Trawl	1 Dec 00	30 Nov 01	203/XIX	150	0	0	0	0
<i>Dissostichus</i> spp.	58.4 BANZARE Bank	Longline	1 May 01	31 Aug 01	204/XIX	300	0	0	0	0
<i>Dissostichus</i> spp.	58.4.2	Trawl	1 Dec 00	30 Nov 01	207/XIX	500	0	0	0	0
<i>Dissostichus</i> spp.	58.4.3 Elan Bank	Longline	1 May 01	31 Aug 01	206/XIX	250	0	0	0	0
<i>Dissostichus</i> spp.	58.4.3 Elan Bank	Trawl	1 Dec 00	30 Nov 01	205/XIX	145	0	0	0	0
<i>Dissostichus</i> spp.	58.4.4 north of 60°S	Longline	1 May 01	31 Aug 01	208/XIX	370	0	0	0	0
<i>Dissostichus</i> spp.	58.6	Longline	1 May 01	31 Aug 01	209/XIX	450	0	0	0	0
<i>Dissostichus</i> spp.	88.1 north of 65°S	Longline	1 Dec 00	31 Aug 01	210/XIX	175	66	0	66	38
<i>Dissostichus</i> spp.	88.1 south of 65°S	Longline	1 Dec 00	31 Aug 01	210/XIX	1 889	592	0	592	31
<i>Dissostichus</i> spp.	88.2 south of 65°S	Longline	15 Dec 00	31 Aug 01	211/XIX	250	0	0	0	0
<i>Martialia hyadesi</i>	48.3	Jig	1 Dec 00	30 Nov 01	213/XIX	2 500	2	0	2	0

* Other fisheries in the region

Table 17: Summary of notifications for new and exploratory fisheries in 2001/02. The reference to the individual notifications is included. These notifications are summarised in SC-CAMLR-XX/BG/10.

Member	Subarea/Division	Target Species	Fishery	Notification
Australia	58.4.2	<i>Macrourus</i> spp.	New bottom trawl	CCAMLR-XX/7
Australia	58.4.2	<i>C. wilsoni</i> <i>L. kempi</i> <i>T. eulepidotus</i> <i>P. antarcticum</i>	Exploratory midwater trawl	CCAMLR-XX/5
Australia	58.4.2	<i>Dissostichus</i> spp.	Exploratory bottom trawl	CCAMLR-XX/6
Chile	58.6	<i>D. eleginoides</i>	Exploratory longline	CCAMLR-XX/8
France	58.4.3, 58.4.4, 58.6	<i>D. eleginoides</i>	Exploratory longline	CCAMLR-XX/9
Japan	48.6, 58.4.1, 58.4.3, 58.4.4, 58.6, 88.1, 88.2	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/10 ^b
New Zealand	88.1, 88.2	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/11 ^b
New Zealand	48.6, 58.4.4, 88.3 ^a	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/12 ^b
Russia	88.1	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/13
Russia	88.2	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/14
South Africa	48.6, 58.4.4, 58.6, 88.1, 88.2	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/15
Uruguay	48.6	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/16
Uruguay	58.4.4	<i>Dissostichus</i> spp.	Exploratory longline	CCAMLR-XX/17

^a Notification withdrawn for this subarea

^b See also addendum

Table 18: Summary of intended catches and number of vessels per area in new and exploratory fisheries notifications for *Dissostichus* spp. in the 2001/02 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 2000/01 season notifications.

Country	48.1	48.2	48.4	48.6	58.4.2	58.4.1/58.4.3	58.4.4	58.5.1	58.5.2	58.6	58.7	88.1	88.2	88.3	Intended Catch
Australia					2 T 500 t										
Chile										1 L ^a 200 t					
France						2 L ^b	2 L			2 L ^a					CCAMLR-XX
Japan				1 L 250 t (N) 250 t (S)		1 L 100 t	1 L 60 t			1 L 100 t		1 L 60 t (N) 500 t (S)	1 L 60 t		
New Zealand				2 L 455 t (N) 455 t (S)			2 L 370 t					4 L 175 t (N) 1 889 t (S)	3 L 250 t	2 L 455 t	
Russia												4 L 175 t (N) 1 889 t (S)	1 L 250 t		
South Africa				Up to 3 L 250 t (N) 250 t (S)			Up to 3 L 60 t			Up to 3 L ^a 100 t		Up to 2 L 60 t (N) 500 t (S)	Up to 2 L 100 t		
Uruguay				1 or 2 L 400 t			1 or 2 L 400 t								
Total notifications	0 (1)	0 (2)	0 (1)	4 (3)	1 (2)	2 (3)	5 (6)	0 (3)	0 (2)	4 (3)	0 (1)	4 (4)	4 (3)	1 (2)	
Maximum no. of vessels	0 (3)	0 (5)	0 (2)	8 (8)	2 (5)	3 (8)	10 (14)	0 (8)	0 (5)	7 (9)	0 (3)	11 (10)	7 (7)	2 (5)	
Catch limit set at CCAMLR-XIX	0	0	28 t	455 t (N of 60°S) 455 t (S of 60°S)	Trawl: 500 t	Trawl: 145 t Elan 150 t BANZARE Longline: 250 t Elan 300 t BANZARE	370 t (N of 60°S)	0 ^c	0 ^c	450 t	0	175 t (N of 65°S) 1 889 t (S of 65°S)	250 t (S of 65°S)	0	

^a Outside EEZs

^b French proposal is for Division 58.4.3 only

^c Based on Scientific Committee advice that these fisheries are unlikely to be viable

Table 19: Fishery summary. ANI – *Champocephalus gunnari*, ELC – *Electrona carlsbergi*, GRV – *Macrourus* spp., KCX – Lithodidae, KRI – *Euphausia superba*, MZZ – *Osteichthyes* spp., NOS – *Lepidonotothen squamifrons*, NOT – *Patagonotothen guntheri*, SQS – *Martialia hyadesi*, TOP – *Dissostichus eleginoides*, TOT – *Dissostichus* spp., T – trawl, L – longline, P – pot, J – jig.

Subarea/ Division	Target Species	Fishery Type	Year of Notification(s)	First Year of Reported Catches	Mean Annual Catch ^a	Most Recent Assessment	Year of Assessment	Assessment Currency	Fishery Plan	Current Year			
										No. of Notifications	No. of Vessels Notified	Recommended Catch Limit (tonnes)	Modifications to Existing CMs
48	KRI	T		1972	91 676	GYM	2000	Multi-year in absence of surveys	Yes				
48.1	TOT	L	1997, 2000	1997	1	Prospecting default arrangement	1997	Multi-year in absence of surveys or fishery-based research information	No				
48.2	TOT	L	1997, 2000	1997	<1	Prospecting default arrangement	1997	Multi-year in absence of surveys or fishery-based research information	No				
48.3	ANI	T		1972	1 452	Short-term Assessment	2000	2 years following survey	Yes			5 557	No closed season, research hauls, closed area, see paragraphs 4.244 to 4.246
48.3	ELC	T		1992	0				No				
48.3	KCX	P	1993	1995	3				No			1 600	Change in minimum legal size, see paragraph 4.273
48.3	NOT	T	1990						No				
48.3	SQS	J	1995, 1996, 1997, 2000	1995	81				No			2 500	
48.3	TOP	L		1987	4 024	GYM	2000	Multi-year in absence of surveys	No			5 820	
48.3	TOP	P		2000	60	GYM – combined with longline	2000	Multi-year in absence of surveys	No				
48.4	TOP	L		1993	0				No			28	Validity of existing assessment, see paragraph 4.118
48.6	TOP	L	1996, 1997, 1998, 1999, 2000, 2001	1998	<1	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	4	8	^b	
58.6	TOP	L	1996, 1997, 1998, 1999, 2000, 2001	1997	3	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	4	7	^b	Concern about stock, see paragraph 4.15
58.7	TOP	L	1995, 1996, 1997, 1998, 2000	1997	<1	Fishery closed		Until survey and reassessment	No				
88.1	TOT	L	1996, 1997, 1998, 1999, 2000, 2001	1996	348	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	4	11	2 508	Boundary of SSRU D, see paragraph 4.79

(continued)

Table 19 (continued)

Subarea/ Division	Target Species	Fishery Type	Year of Notification(s)	First Year of Reported Catches	Mean Annual Catch ^a	Most Recent Assessment	Year of Assessment	Assessment Currency	Fishery Plan	Current Year			
										No. of Notifications	No. of Vessels Notified	Recommended Catch Limit (tonnes)	Modifications to Existing CMs
88.2	TOT	L	1996, 1997, 1999, 2000, 2001	1996	<1	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	4	7	b	
88.3	TOT	L	1997, 2000	1997	<1				No				
58.4.1	KRI	T		1976	0				No				
58.4.1	TOT	L	2000						No				
58.4.1	TOT	T	1998	1998	<1				No				
58.4 BANZARE (58.4.1/58.4.3)	TOT	T	1999, 2000	1999	<1	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No				
58.4 BANZARE (58.4.1/58.4.3)	TOT	L	1999, 2000, 2001			Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	1	2	b	
58.4.2	KRI	T		1974	0				No				
58.4.2	GRV	T	2001						No	1	2	b	
58.4.2	TOT	L	2000			Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No				
58.4.2	mix ^c	T	1999, 2000	1999	5	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	1	2	b	
58.4 Elan (58.4.3)	TOT	L	1996, 1997, 1998, 1999, 2000			Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	2	3	b	
58.4 Elan (58.4.3)	TOT	T	1995, 1996, 1997, 1998, 2000	1996	<1	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No				
58.4.4	NOS	T	1991		0				No				
58.4.4	TOP	L	1997, 1998, 1999, 2000, 2001	1999	50	Prospecting default arrangement	2000	Multi-year in absence of surveys or fishery-based research information	No	5	10	103	
58.5.1	TOP	L	2000										
58.5.2	ANI	T		1999		Short-term assessment	2000	2 years following survey	No			885	
58.5.2	TOP	L	2000										
58.5.2	TOP	T		1996		GYM	2000	Multi-year in absence of surveys	No			2 815	
58.5.2	MZZ	T	1995, 1996	1995	<1				No				

Table 20: Assessment of precautionary long-term annual yield for the exploratory fishery by SSRU for *Dissostichus* spp. in Subarea 88.1 and for all SSRUs combined for *Dissostichus eleginoides* in Division 58.4.4 based on fished seabed area.

	88.1					58.4.4	48.3
	A	B	C	D	E		
Fished seabed area (km ²)	3 109	12 197	10 141	27 347	11 085	10 893	32 035
Selectivity (mean)	135	100	115	80	80	55	75
Selectivity (range)	30	80	50	20	20	30	20
Ratio total: recruited biomass	2.550	1.393	1.651	1.131	1.131	1.056	1.158
γ	0.0485	0.040	0.042	0.038	0.038	0.032	0.034
CPUE ratio	0.225	0.259	0.520	0.348	0.479	0.133	1.0
Precautionary yield	342	698	1 450	1 621	905	206	(5 000)

Table 21: Parameters input to the GYM for evaluation of γ for the exploratory fishery for *Dissostichus mawsoni* in Subarea 88.1.

Category	Parameter	<i>D. mawsoni</i> Longline
Age structure	Recruitment age	4
	Plus class accumulation	35
	Oldest age in initial structure	55
Recruitment	SD log _e (recruits)	0.803
Natural mortality	Mean annual M	0.15–0.22
von Bertalanffy growth	t_0	0.04
	L_8	180.2
	k	0.095
Weight at age	Weight–length parameter – A	0.000007
	Weight–length parameter – B	3.0965
Maturity	L_{m50}	100.0
	Range: 0 to full maturity	30.0
Spawning season		01/08
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	1997
	Reference start date in year	01/12
	Increments in year	180
	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	Length, 50% recruited	80.0
	Range over which recruitment occurs	30.0

Table 22: Summary of precautionary yields, catch limits and catches for *Dissostichus* spp. in Subarea 88.1 and *Dissostichus eleginoides* in Division 58.4.4 for the 2000/01 and 2001/02 seasons.

	2000/01			2001/02	
	Yield ¹	Catch limit	Catch	Yield	Yield*0.5
Subarea 88.1					
SSRU A	175	175	67	342	171
SSRU B	} 1 889	472	287	698	349
SSRU C		472	184	1 450	725
SSRU D		472	46	1 621	811
SSRU E		472	75	905	453
Total	2 063	2 063	659	5 016	2 508
Division 58.4.4					
Total	(370)	370	164	206	103

¹ Yield in 2000/01 multiplied by a 0.5 discount factor

Table 23: Standardised series of CPUEs in kg/hook for *Dissostichus eleginoides* in Subarea 48.3.

Season	Std. CPUE	SE
1986/87	0.582	0.025
1987/88	0.739	0.057
1988/89	0.537	0.027
1989/90	-	-
1990/91	0.529	0.023
1991/92	0.648	0.015
1992/93	0.771	0.018
1993/94	0.635	0.025
1994/95	0.615	0.012
1995/96	0.362	0.007
1996/97	0.280	0.006
1997/98	0.280	0.006
1998/99	0.320	0.007
1999/00	0.347	0.006
2000/01	0.338	0.007

Table 24: Proportion of non-zero catches by season in the haul-by-haul data for *Dissostichus eleginoides* in Subarea 48.3.

Season	Proportion
1985/86	0.977
1986/87	0.976
1987/88	0.975
1988/89	1.000
1989/90	-
1990/91	0.960
1991/92	0.965
1992/93	0.973
1993/94	0.946
1994/95	0.993
1995/96	0.978
1996/97	0.977
1997/98	0.981
1998/99	0.988
1999/00	0.983
2000/01	0.994

Table 25: Average age-specific vulnerabilities from 1998 to 2001 for Subarea 48.3.

Age	Vulnerability
4-5	0.00
5-6	0.29
6-7	0.89
7-8	1.00
8-9	1.00
9-10	1.00
10-11	0.97
11-12	0.91
12-13	0.85
13-14	0.79
14-15	0.73
15-16	0.67
16-17	0.64
17-18	0.64
18-19	0.64
19-20	0.64
20+	0.64

Table 27: 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 16 based on a value for natural mortality, $M = 0.165 \text{ y}^{-1}$.

Year Age 4 Birthday	Assessment		
	1999	2000	2001
1986	1.146	1.108	1.347
1987	0.722	0.747	0.980
1988	4.106	4.377	4.187
1989	8.055	8.282	8.174
1990	5.786	5.739	5.842
1991	no obs	no obs	no obs
1992	10.19	5.815	10.287
1993	2.061	2.053	1.888
1994	0.961	1.006	0.950
1995	0.701	0.718	0.633
1996	2.649	2.405	2.652
1997	1.119	0.962	1.037
1998		0.386	no obs
1999		no obs	no obs
2000		1.496	1.522
2001		1.927	
Mean	3.185	2.517	3.292
CV	1.01	0.95	0.97

Table 28: Input parameters for the GYM to assess the long-term annual yield of *Dissostichus eleginoides* taken by longline and pots in Subarea 48.3 and by trawl in Division 58.5.2.

Category	Parameter	Subarea 48.3 Longline and Pots	Division 58.5.2 Trawl
Age structure	Recruitment age	4	4
	Plus class accumulation	35	35
	Oldest age in initial structure	55	55
Recruitment		See Table 26	See Table 32
Natural mortality	Mean annual M	0.132–0.198	0.132–0.198
von Bertalanffy growth	t_0	-0.21 years	-2.46 ¹ years
	L_∞	1 946 mm	2 465 mm
	k	0.066 year ⁻¹	0.029 year ⁻¹
Weight at age	Weight–length parameter – A (kg)	3.96E-08 kg	2.59E-09 kg
	Weight–length parameter – B	2.8	3.2064
Maturity	L_{m50}	930	930
	Range: 0 to full maturity	780–1 080	780–1 080
Spawning season		1 Aug–1 Aug	1 Jul–1 Jul
Simulation characteristics	Number of runs in simulation	1 001	1 001
	Depletion level	0.2	0.2
	Seed for random number generator	-24 189	-24 189
Characteristics of a trial	Years to remove initial age structure	1	1
	Observations to use in median SB ₀	1 001	1 001
	Year prior to projection	1988	1985
	Reference start date in year	01/12	01/12
	Increments in year	365	365
	Vector of known catches	See Table 29	See Table 29
	Years to project stock in simulation	35	35
	Reasonable upper bound for annual F	5.0	5.0
	Tolerance for finding F in each year	0.000001	0.000001
Fishing mortality		See Table 29	See Table 29

¹ Adjusted from estimated parameter of $t_0 = -2.56$ years to start of fishing season on 1 December

Table 29: Catch history and fishing vulnerabilities for *Dissostichus eleginoides* in Subarea 48.3. Year corresponds to first year of season. A single-vulnerability function to be applied over a number of years is only shown in the first year of that series.

First Year of Season	Catch (Reported and IUU) (tonnes)	2000 Assessment Single Function for Whole Catch Series	2001 Assessment
1989	8 501	mm (vuln) 550 (0), 790 (1)	mm (vuln) 550 (0), 790 (1)
1990	4 206		
1991	7 309		
1992	5 589		
1993	6 605		
1994	6 171		
1995	4 362		
1996	2 619		age (vuln) 0–4 (0), 5–6 (0.29), 6–7 (.89), 7–10 (1.0), 10–11 (.97), 11–12 (.91), 12–13 (.85), 13–14 (.79), 14–15 (.73), 15–16 (.67), 16+ (.64)
1997	3 201		
1998	4 300		
1999	5 337		
2000	4 354		

Table 30: Results of assessments of yield according to the CCAMLR decision rules for *Dissostichus eleginoides* in Subarea 48.3 using the GYM.

Trial	Lowest Catch giving 0.1 Probability of Depletion to 20% (tonnes)	Median Escapement
1. Only revised recruitment series based on mean $M = 0.165 \text{ year}^{-1}$, last year's selectivity	4 438	0.54
2. Cohort densities used in place of recruitment series (internal consistency with M)	5 868	0.56
3. Cohort densities plus varying fishing vulnerability after 1997 – with CPUE adjustment	5 675 5 820	0.55

Table 31: Cohort strengths of *Dissostichus eleginoides* 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	Age 3		Age 4		Age 5		Age 6		Age 7		Age 8	
					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	Density (n.km ⁻²)	SE
1990	0.58	97 106	107.2	108.1	8.1	5.9	33.5	13.6	20.2	11.3	0.8	11.5	25.2	14.1		
1992	0.25	70 271	51.7	51.8	14.1	5.2	13.2	7.0	14.5	7.9	3.4	4.5	0.02	5.5	2.1	3.3
1993	0.85	71 555	97.4	1 14.7	13.6	8.8	38.3	18.2	8.2	13.5	17.0	12.6	3.1	30.3	20.9	16.3
1999	0.41	85 428	366.2	357.9	17.7	7.9	16.2	13.3	138.1	42.7	56.8	55.3	60.9	50.9	40.3	38.2
2000	0.55	41 145	185.0	179.5	28.1	5.3	22.0	8.0	47.8	14.9	59.1	20.6	7.6	15.1	11.0	11.4
2001	0.56	85 170	247.5	252.4	19.5	7.8	34.0	12.9	38.2	20.5	45.5	30.8	32.2	42.4	16.7	41.1

Table 32: Time series of recruits (millions of fish) for *Dissostichus eleginoides* in Division 58.5.2 based on a mean M of 0.165 year⁻¹.

Year at Age 4 Birthday	WG-FSA (2000)	Revised Time Series based on New Growth Parameters
1986		4.321
1987	1.550	0.120
1988	1.590	2.586
1989	3.649	3.790
1990	1.956	1.118
1991	1.793	0.667
1992	4.575	1.447
1993	2.435	0.825
1994	2.944	7.205
1995	5.674	9.226
1996	9.548	7.295
1997	21.557	15.043
1998	3.440	3.487
1999	1.059	2.291
2000	0.241	1.465
2001	0.152	1.632
Mean	4.144	3.907
CV	1.297	1.021

Table 33: Catch history and fishing vulnerabilities for *Dissostichus eleginoides* in Division 58.5.2. Year corresponds to first year of season. A single-vulnerability function to be applied over a number of years is only shown in the first year of that series.

First Year of season	2000 Assessment		2001 Assessment	
	Catch (Reported and IUU) (tonnes)	Vulnerability (vuln.) Single Function for Whole Catch Series	Catch (Reported and IUU) (tonnes)	Vulnerability (vuln.)
1995		age (vuln) 0(0.), 3(0), 3.92(0.016), 4.88(0.207),	17 094	mm (vuln) 550 (0), 790 (1)
1996	18 960	5.54(0.473), 5.88(0.512), 6.57(0.708), 7.29(0.886), 7.65(0.909),	1 866	age (vuln) 0.0 (0), 6.0 (0.0), 7.0 (1), 7.9 (1), 8.0 (0)
1997	3 913	8.02(0.745), 8.40(0.691), 8.78(0.642), 9.56(0.485), 9.96(0.325),	3 913	age (vuln) 0.0 (0), 6.0 (0.0), 10.0 (1), 10.0 (1),12.0 (0)
1998	3 628	10.37(0.222), 11.2(0.099), 11.63(0.066), 12.07(0.049), 12.51(0.033),	3 628	age (vuln) 0.0 (0), 5.5 (0.0), 6.0 (1), 13.0 (1), 15.0 (0)
1999	4 385	13.43(0.014), 14.87(0.011), 16.40(0.008), 21.04(0.005), 25.21(0.002),	4 385	age (vuln) 0.0 (0), 4.0 (0.0), 8.0 (1), 14.0 (1), 15.0 (0)
2000	4 644	31.0(0.0)	4 644	

Table 34: Results of assessments of yield according to the CCAMLR decision rules for *Dissostichus eleginoides* in Division 58.5.2 using the GYM.

Trial	Lowest Catch giving 0.1 Probability of Depletion to 20% (tonnes)	Median Escapement is 50% (tonnes)
1. New parameters with vulnerability from last year; IUU included with trawl catch in 1996/97.	2 574	2 314
2. As for 1. but IUU separated from 1996/97 catch and projected in 1995/96 year with 48.3 selectivity from that time, trawl fishery has vulnerability as applied last year.	2 521	2 395
3. As for 2. but with trawl fishery having separate vulnerabilities each year.	2 959	2 815
4. As for 3. but with $M = 0.1-0.16$.	3 750	3 369

Table 35: Growth parameters for *Champocephalus gunnari* in Subarea 48.3 estimated during the 2001 meeting and used previously by WG-FSA for the short-term projection.

Parameters	Curve Fitted to Russian Data Age 8+	Curve Fitted to Russian Data Age 11+	Curve Fitted to Polish Age Readings	Curve used 1997–2000
t_0	-0.58	-0.98	-0.63	0.00
L_∞	55.76	65.33	83.54	45.50
k	0.17	0.12	0.12	0.33

Table 36: Growth parameters reported previously for *Champocephalus gunnari* in Subarea 48.3 and methods used.

Parameters	Olsen 1955, Ford-Walford	Kock 1981, Ford-Walford	Kock 1981, Non-linear Regression	Shust and Kochkin 1985, Hohendorf	Frolkina and Dorovskich 1991, Non-linear Regression
t_0	-1.36	0.38	0.27	-0.67	-0.28
L_∞	43.10	65.10	64.30	64.30	68.90
k	0.40	0.16	0.15	0.13	0.13

Table 37: Standardisation of catchability for Russian and UK surveys of *Champocephalus gunnari* in Subarea 48.3: ANOVA table for GLM with the link function *sqrt*. Terms added sequentially from first to last.

	Df	Deviance	Resid. Df	Resid. Dev.	F Value	Pr(F)
NULL			1 250	70 276e+6		
Country	1	17 713e+6	1 249	52 564e+6	1 331.8	0
Split-year	10	19 668e+6	1 239	32 895e+6	147.9	0
Stratum	14	9 221e+6	1 225	23 674e+6	49.5	0

Table 38: Lower one-sided 95% confidence bounds of biomass of *Champscephalus gunnari* from the UK, Russian and combined survey datasets (2000). Results for the UK and Russian surveys are the same as those calculated at the 2000 meeting. Results for the combined survey dataset include the factor of 2.59 for standardising the UK survey (paragraphs 4.212 to 4.217).

Stratum	Mean Biomass	SE	Two-sided Lower 95% CI	Two-sided Upper 95% CI	One-sided Lower 95% Confidence Bound
UK survey January 2000					
SR1	12 555.4	12 007.9	155.9	36 478.0	180.0
SR2	1 315.2	1 026.4	75.4	3 405.3	117.7
SR3	3.0	3.0	0.0	6.0	0.0
SG1	1 925.9	878.1	722.5	3 731.5	818.3
SG2	7 639.8	3 463.9	3 159.1	15 092.7	3 394.8
SG3	1 371.1	591.6	409.3	2 547.2	531.2
SR	13 873.6	12 015.3	520.4	38 667.8	726.8
SG	10 936.9	3 679.5	5 578.1	19 131.8	6 051.0
Total	24 810.5	12 432.7	7 933.0	52 941.4	8 916.0
Russian survey February 2000					
S1	2 573.3	1 614.6	47.7	5 578.7	729.7
S2	3 736.1	2 216.0	220.7	8 456.0	426.6
S3	5 314.1	5 168.3	85.0	15 675.9	99.7
S4	15 338.7	10 191.2	2 685.4	35 257.5	2 718.3
S5	4 696.8	3 458.6	486.5	11 886.5	577.0
S6	10 892.5	2 681.2	5 828.9	16 069.7	6 683.9
S8	2 001.0	1 420.0	334.8	4 905.3	394.6
S9	540.0	389.8	66.4	1 350.3	87.2
S10	1 652.4	1 414.9	104.7	4 510.6	137.8
S11	1 062.4	1 062.4	0.0	3 187.1	0.0
SG	45 092.5	13 288.0	23 306.0	73 812.0	26 036.6
SR	2 714.8	1 686.6	162.7	6 270.9	231.0
Total	47 807.3	13 448.6	25 624.3	77 242.7	28 098.1
Combined surveys 2000 with UK survey * 2.59					
S1	194.7	95.9	39.0	376.0	50.4
S2	25 103.4	12 527.7	6 764.2	51 014.5	8 365.5
S3	3 903.5	1 773.2	2 130.3	5 676.6	2 130.3
S4	4 050.7	1 682.8	1 296.6	7 683.3	1 553.1
S5	4 219.2	2 638.4	580.3	9 723.4	796.6
S6	2 421.4	1 554.5	540.1	5 644.2	608.4
S8	13 587.4	3 466.0	7 271.1	20 524.4	8 173.3
S9	13 694.5	12 473.1	261.0	39 096.3	519.0
S10	2 593.1	1 546.5	317.4	5 870.3	469.4
S11	1 896.2	659.8	788.3	3 315.3	935.4
Georgia	67 174.9	19 182.4	34 962.7	109 265.4	38 639.7
Shag	4 489.2	1 730.8	1 766.3	8 359.2	2 025.7
Total	71 664.1	19 601.7	38 956.6	114 459.3	42 806.6

Table 39: Cohort strength from surveys undertaken in Subarea 48.3 in 2000 estimated from the mixture analysis for *Champscephalus gunnari*.

ANI00V4 combined UK and Russian surveys 2000						
Sum of the observed densities =	16 803.5					
Sum of the expected densities =	16 151.6					
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Means of mixture components	148.648	221.553	272.153	321.232	367	381
Standard deviations of mixture components	9.83139	14.1627	17.169	20.0848	22.804	23.6357
Total density of each mixture component	468.766	8 804.08	3 777.17	2 157.99	658.397	307.061
SD of each mixture component density	448.38	2 762.54	1 118.56	740.809	1 078.37	781.624
	Rescaled expected densities					
Parameters of linear standard deviations	Age 1	Age 2	Age 3	Age 4+		
Intercept = 1.00000	487.69	9 159.42	3 929.62	3 249.51		
Slope = 0.594114E-01						
ANI00V5A Russian survey 2000						
Sum of the observed densities =	17 624.7					
Sum of the expected densities =	17 802.8					
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Means of mixture components	153.111	225.544	272.624	320.658	368	
Standard deviations of mixture components	8.85106	12.5652	14.9794	17.4424	19.87	
Total density of each mixture component	5.9562	9 412.47	5 086.02	1 582.21	1 813.46	
SD of each mixture component density	2.64244	3 426.22	1 952.31	762.582	1 173.97	
	Rescaled expected densities					
Parameters of linear standard deviations	Age 1	Age 2	Age 3	Age 4+		
Intercept = 1.00000	5.90	9 318.31	5 035.14	3 361.70		
Slope = 0.512771E-01						
ANI00V6 UK survey 2000						
Sum of the observed densities =	5 100.12					
Sum of the expected densities =	4 703.03					

(continued)

Table 39 (continued)

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Means of mixture components	147.588	214.979	265.477	316.845	360.957	395.995
Standard deviations of mixture components	10.919	15.4482	18.8421	22.2944	25.2591	27.6139
Total density of each mixture component	383.466	2 199.91	692.989	1 114.85	286.16	35.353
SD of each mixture component density	463.307	1 285.94	403.105	569.404	475.468	184.491
	Rescaled expected densities					
Parameters of linear standard deviations	Age 1	Age 2	Age 3	Age 4+		
Intercept = 1.00000	415.84	2 385.65	751.50	1 557.64		
Slope = 0.672077E-01						

Table 40: Data inputs for short-term projections of *Champsocephalus gunnari* in Subarea 48.3.

		UK Survey January 2000	Russian Survey February 2000	Combined Surveys with UK * 2.59
Lower single-sided 95% CI (tonnes)		8 916	28 098	42 807
Numbers at age	1	17 046 781.31	241 721.663	19 991 859
	2	97 795 853.28	381 988 163.9	375 475 030
	3	30 806 465.07	206 406 973	161 088 157
	4+	63 852 769.07	137 807 158.9	133 208 323
	Total	209 501 869	726 444 017	689 763 369
		%	%	%
	1	8	0	3
	2	47	53	54
	3	15	28	23
	4+	30	19	19
Method		Length Density + CMIX	Length Density + CMIX	Length Density + CMIX
Natural mortality		0.42 or 0.71	0.42 or 0.71	0.42 or 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	55.76	55.76	55.76
	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	31
Catch since survey	between survey and first year of projection	144	144	144
	between first and second years of projection	1 283	1 283	1 283

Table 41: Results of short-term projections for *Champocephalus gunnari* in Subarea 48.3 undertaken at the 2001 year meeting. The projected fishing mortality in 2001/02 is 0.14. The recommended catch limit is 5 557 tonnes, corresponding to the combined survey biomass projected using an M of 0.71.

	Lower 95% CI Biomass in 2000	Actual Catch in 2000/01	Projected Catch in 2002	
			Natural Mortality	
			0.42	0.71
UK survey January 2000	8 916	1 427	1 635	1 053
Russian survey February 2000	28 098	1 427	5 466	3 555
Combined surveys with UK * 2.59	42 807	1 427	8 533	5 557

Table 42: Estimates of abundance (kg) of *Champocephalus gunnari* at Heard and McDonald Islands in 2001 (from WAMI-01/4).

Stratum	No. of Hauls	Value	SE	Lower CI	Upper CI
Plateau southeast	15	22 070 400	16 104 700	4 469 740	442 820 000
Plateau west	3	3 479 340	2 987 150	405 145	1 558 030 000
Gunnari Ridge	10	6 331 510	4 747 920	1 193 960	199 443 000
Shell Bank	13	740	502	131	1 950
All strata combined		31 882 000	17 053 700	9 855 650	1 586 410 000

Table 43: Data inputs for short-term projections of *Chamsocephalus gunnari* in Division 58.5.2 (Heard Plateau population).

Category	Parameter	<i>C. gunnari</i> Heard Plateau
Survey details	Survey date	30 May 2001
	Biomass – lower 95% bound	7 052 tonnes
Mean length at age at time of survey	Age 2	245
	Age 3	305
	Age 4	348
Age structure (density n.km ²)	Age 2	105
	Age 3	1 834
	Age 4	150
Biological parameters von Bertalanffy growth	Birthday	1 November
	t_0	0.358
	L_8	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 Selectivity	Season	1 Dec–30 Nov
	Age fully selected	3
	Age first selected	2.5
	Catch since last year	5 tonnes

Table 44: Comparison of estimates of minimum legal size of male crabs (*Paralomis* spp.).

Source	<i>P. spinosissima</i>		<i>P. formosa</i>	
	South Georgia	Shag Rocks	South Georgia	Shag Rocks
WG-FSA-92/29	94	84	90	
WG-FSA-01/32		83		78

Table 45: Reported by-catch (tonnes) of major species groups by fine-scale area and split-year from longline fisheries targeting *Dissostichus eleginoides* in the Convention Area.

Fine-scale Area	Split-year	Total Catch of Target Species	Total Catch of <i>D. eleginoides</i> (tonnes)	Total Catch of <i>D. mawsoni</i> (tonnes)	Total By-catch (tonnes)	By-catch as % of Total Catch	Skates/Rays	<i>Macrourus</i> spp.
48.3	1986	96.7	96.7	0.0	6.9	6.7	6.3	0.0
48.3	1987	184.3	184.3	0.0	7.1	3.7	6.7	0.0
48.3	1988	101.2	101.2	0.0	3.1	3.0	3.0	0.1
48.3	1989	767.5	767.5	0.0	13.0	1.7	11.9	1.1
48.3	1990	8 156.0	8 156.0	0.0	0.0	0.0	0.0	0.0
48.3	1992	4 017.0	4 017.0	0.0	6.4	0.2	5.0	1.4
48.3	1993	3 765.9	3 765.9	0.0	1.7	0.0	0.6	1.1
48.3	1994	927.2	927.2	0.0	14.6	1.6	12.3	2.1
48.3	1995	3 260.9	3 260.9	0.0	111.2	3.3	89.9	10.8
48.3	1996	3 107.8	3 107.8	0.0	83.3	2.6	48.0	34.9
48.3	1997	2 575.0	2 575.0	0.0	63.8	2.4	35.1	25.1
48.3	1998	2 940.4	2 940.4	0.0	52.4	1.7	21.3	28.2
48.3	1999	4 159.5	4 159.5	0.0	32.3	0.8	16.6	15.3
48.3	2000	4 665.2	4 665.2	0.0	29.7	0.6	12.2	14.7
48.3	2001	3 943.5	3 943.5	0.0	12.9	0.3	10.4	1.9
48.3	2002*	510.9	510.9	0.0	0.0	0.0	0.0	0.0
48.3	Total	43 179.0	43 179.0	0.0	438.3	1.0	279.4	136.7
58.5.1	1996	1 271.7	1 271.7	0.0	0.5	0.0	0.5	0.0
58.5.1	1997	449.5	449.5	0.0	3.4	0.8	0.6	0.0
58.5.1	1998	1 117.7	1 117.7	0.0	24.3	2.1	12.1	11.9
58.5.1	1999	1 575.0	1 575.0	0.0	10.3	0.6	9.2	1.1
58.5.1	2000	2 615.0	2 615.0	0.0	336.2	11.4	164.4	169.5
58.5.1	2001	2 377.9	2 377.9	0.0	326.4	12.1	221.4	105.0
58.5.1	Total	9 406.6	9 406.6	0.0	701.1	6.9	408.2	287.4
58.6	1997	192.6	192.6	0.0	0.0	0.0	0.0	0.0
58.6	1998	247.2	247.2	0.0	13.0	5.0	0.6	12.0
58.6	1999	1 762.4	1 762.4	0.0	44.3	2.5	5.5	36.9
58.6	2000	489.1	489.1	0.0	78.9	13.9	21.3	49.3
58.6	2001	1 448.8	1 448.8	0.0	169.8	10.5	35.2	128.8
58.6	Total	4 140.1	4 140.1	0.0	306.0	6.9	62.6	226.9
58.7	1997	1 765.5	1 765.5	0.0	0.0	0.0		0.0
58.7	1998	737.3	737.3	0.0	1.6	0.2	0.7	0.0
58.7	1999	85.6	85.6	0.0	0.0	0.0		0.0
58.7	2000	13.2	13.2	0.0	0.4	2.7		0.4
58.7	2001	288.0	288.0	0.0	40.4	12.3	0.3	36.5
58.7	2002*	17.2	17.2	0.0	3.8	18.2		3.8
58.7	Total	2 906.7	2 906.7	0.0	46.2	1.6	1.1	40.7
88.1	1997	0.1	0.1	0.0	0.0	0.8	0.0	0.0
88.1	1998	41.5	0.5	41.0	14.9	26.4	4.8	9.3
88.1	1999	296.8	0.6	296.2	45.1	13.2	18.8	21.7
88.1	2000	752.3	0.0	752.2	118.3	13.6	41.2	70.1
88.1	2001	650.1	45.8	604.3	83.7	11.4	8.8	61.3
88.1	Total	1 740.8	47.1	1 693.7	262.0	13.1	73.6	162.4

* 2001/02 split-year data are incomplete

Table 46: Reported by-catch (tonnes) of major species groups by fine-scale area and split-year from trawl fisheries in the Convention Area. GRV – *Macrourus* spp., NOR – *Notothenia rossii*, NOS – *Lepidonotothen squamifrons*, TOP – *Dissostichus eleginoides*, ANI – *Champrocephalus gunnari*, SSI – *Chaenocephalus aceratus*, LXX – Myctophidae, NOG – *Gobionotothen gibberifrons*, NOT – *Patagonotothen guntheri*, SGI – *Pseudochaenichthys georgianus*.

Target Species	Fine-scale Area	Split-year	Total Catch of ANI	Total Catch of TOP	Total By-catch (tonnes)	By-catch as % of Total Catch	Skates/Rays	GRV	NOR	NOS	TOP	ANI	SSI	LXX	NOG	NOT	SGI
ANI	48.3	1987	804		26	3							10.5		15.3		
ANI	48.3	1988	29 453		10 102	26			47.1	746.9	1 027.2		114.8	2 570.0	3 249.9	1 366.0	78.0
ANI	48.3	1990	8 030		288	3			2.0	24.0				1 07.0	10.0	143.0	
ANI	48.3	1991	41		0	0											
ANI	48.3	1998	6		0	0											
ANI	48.3	1999	265		9	3							0.0	5.2		3.7	0.1
ANI	48.3	2000	4 041		0	0										0.2	
ANI	48.3	2001	1 433		7	0							0.0		0.1		6.2
ANI	48.3	Total	44 073		10 432	19			49.1	770.9	1 027.2		125.4	2 687.2	3 275.3	1 512.9	84.4
ANI	58.5.2	1997	207		5	2	0.5	0.0			0.8						
ANI	58.5.2	1998	19		7	28	0.0	0.0			1.6						
ANI	58.5.2	1999	72		6	8	0.0	0.0			1.6						
ANI	58.5.2	2000	81		3	4	0.2	0.0			0.2						
ANI	58.5.2	2001	829		6	1	0.2	0.0			4.8						
ANI	58.5.2	Total	1 208		28	2	1.0	0.0			8.8						
TOP	58.5.2	1997		808	12	1	2.3	0.4		1.3		0.3					
TOP	58.5.2	1998		2 262	29	1	0.0	0.0				28.0					
TOP	58.5.2	1999		5 195	15	0	3.4	0.8		7.5							
TOP	58.5.2	2000		2 543	10	0	2.8	3.3		0.1		0.0					
TOP	58.5.2	2001		1 362	11	1	4.3	1.0		3.6		0.3					
TOP	58.5.2	Total		12 170	78	1	12.8	5.6		12.5		28.6					

Table 47: Input parameters for generalised yield model (GYM) to assess γ (yield = γB_0) of skates and rays in Subarea 48.3 based on parameters as described in paragraphs 4.303 to 4.305.

Category	Parameter	Estimate
Age structure	Minimum age in stock	1
	Maximum age (plus class)	20
	Years in plus class	11
Times within year	Number of increments	360
Natural mortality	Mean annual M	0.2
Fishing mortality	Length, 50% recruited to fishery	700 mm
	Upper bound for fishing mortality	5.0
	Tolerance (error) for determining fishing mortality each year	1E-05
Fishing season		All Year
von Bertalanffy growth	t_0	0
	L_8	1 500 mm
	k	0.1
Weight-length $W = aL^b$	a	6.46E-6
	b	3.06
Maturity	L_{m50}	850 mm
	Length range over which maturity occurs	-
	Age of first maturity	8
	Increment in year when spawning occurs	1 March
Recruitment	Coefficient of variation	0.4–0.5
	Proportion of median SB_0 when depletion begins to occur	0.0
Total biomass	Coefficient of variation	1.006 ¹
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
	Years to project stock in simulation	20

¹ Refer to Figure 34

Table 48: Demographic information on *Macrourus* spp.

Growth	<i>M. carinatus</i>	<i>M. whitsoni</i>			<i>M. holotrachys</i>
		Sexes combined Refn (M)	Male Refn (M)	Female Refn (M)	
L_8	1 000 (G, C)	857	783	870	
k^8	No info	0.048	0.05	0.068	
t_0	No info	-3.89	-5.3	1.34	
Max length	950 (V)				
Max age	19 years	55 years			
Natural mortality (based on oldest 1% of fish on longlines)	No info		0.08	0.09	
Length to mass $W(\text{kg})=aL(\text{mm})^b$					
A	1.546E-09 (V)			8×10^{-9} (B)	
B	3.168 (V)			2.930 (B)	
Spawning Season	May – Sept (Falkland/Malvinas) (A)				
L_{m50}	580–590 (A)				
L_{m100}	700–710 (A)				

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Table 49: Summary of data on seabird species at risk from longline fisheries in the Convention Area, indicating the level of information available on population parameters, DNA profile and conservation status (BirdLife International (2000) and WG-FSA-01/55). (Information extracted from documents cited in SC-CAMLR-XVIII, Annex 5; SC-CAMLR-XIX, Annex 5; SC-CAMLR-XX, Annex 5; also Gales, 1998; Marchant and Higgins, 1990).

Species	Conservation Status	Study Location	DNA Profile	Population Information					
				Annual Pairs	Year Started	Population Estimate	Trend	Adult Survival	Juvenile Survival
<i>Wandering albatross</i> <i>Diomedea exulans</i>	Vulnerable	South Georgia	√	2 178	1972	√	√	√	√
		Marion	√	1 794	1998	√	√		
		Prince Edward	√	1 277	1979	√			
		Crozet	√	1 734	1966	√	√	√	√
		Kerguelen		1 455	1973	√	√	√	√
		Macquarie	√	10	1994	√	√	√	
<i>Antipodean albatross</i> <i>Diomedea antipodensis</i>	Vulnerable	Auckland	√	65	1991	√	√	√	
		Adams		5 762					
		Antipodes	√	5 148	1994	√	√	√	
<i>Amsterdam albatross</i> <i>Diomedea amsterdamensis</i>	Critically Endangered	Amsterdam		13	1983	√	√	√	√
<i>Southern royal albatross</i> <i>Diomedea epomophora</i>	Vulnerable	Campbell	√ ?	7 800	1995	√	√		
		Auckland Islands	√ ?	<100					
<i>Northern royal albatross</i> <i>Diomedea sanfordi</i>	Endangered	Chatham	√ ?	5 200	1990s	√	√	check	check
		Taiaroa	√ ?	18	1950s	√	√	√	√
<i>Grey-headed albatross</i> <i>Thalassarche chrysostoma</i>	Vulnerable	Diego Ramirez	√	10 000	1999	√			
		South Georgia	√	54 218	1976	√	√	√	√
		Marion	√	6 217	1984	√	√	√	√
		Prince Edward		1 500					
		Crozet		5 946	1980				
		Kerguelen	√	7 900					
		Macquarie	√	84	1994	√	√	√	
Campbell	√	6 400	1987	√					

(continued)

Table 49 (continued)

Species	Conservation Status	Study Location	DNA Profile	Population Information					
				Annual Pairs	Year Started	Population Estimate	Trend	Adult Survival	Juvenile Survival
Black-browed albatross <i>Thalassarche melanophrys</i>	Near-Threatened	Diego Ramirez	√	32 000	1999	√			
		Falklands/Malvinas	√	550 000	1990	√	√	√	√
		South Georgia	√	96 252	1976	√	√	√	√
		Crozet		980					
		Kerguelen	√	3 115	1978	√	√	√	√
		Heard, McDonald		750					
		Macquarie	√	38	1994	√	√	√	
		Campbell Antipodes	√	<30 100	1995 1995	√			
Campbell albatross <i>Thalassarche impavida</i>	Vulnerable	Campbell	√	26 000	1987	√		√	
Atlantic yellow-nosed albatross <i>Thalassarche chlororhynchos</i>	Near-Threatened	Tristan da Cunha	√	27 000					
		Gough	√	46 000	1982		√	√	
Indian yellow-nosed albatross <i>Thalassarche carteri</i>	Vulnerable	Amsterdam		25 000	1978	√	√	√	√
		Prince Edward		7 000					
		Crozet		4 430					
Buller's albatross <i>Thalassarche bulleri</i>	Vulnerable	Snares		8 460	1992	√	√	√	
		Solander		4 000–5 000	1992	√			
Chatham albatross <i>Thalassarche eremita</i>	Critically Endangered	Chatham	√	4 000	1998	√			
Salvin's albatross <i>Thalassarche salvini</i>	Vulnerable	Bounty Ile des Pingouins, Crozet Snares		76 000 4 4 650	1998	√			
White-capped albatross <i>Thalassarche steadi</i>	Vulnerable	Antipodes	√	75	1972	√	√		
		Disappointment	√	72 000					
		Adams	√	100					
		Auckland		3 000	1994	√			

(continued)

Table 49 (continued)

Species	Conservation Status	Study Location	DNA Profile	Population Information					
				Annual Pairs	Year Started	Population Estimate	Trend	Adult Survival	Juvenile Survival
Light-mantled albatross <i>Phoebastria palpebrata</i>	Near-Threatened	South Georgia	√	6 500					
		Marion		201					
		Prince Edward							
		Crozet		2 151	1966	√	√	√	√
		Kerguelen		3 000–5 000	1994	√	√	√	
		Heard, McDonald		500–700					
		Macquarie		1 100	1993	√	√	√	
		Campbell		>1 500	1995	√	√		
		Auckland		5 000	1972	√			
Antipodes	<1 000	1995	√						
Sooty albatross <i>Phoebastria fusca</i>	Vulnerable	Tristan da Cunha		2 750					
		Gough		5 000–10 000	2000	√			
		Marion		2 055					
		Prince Edward		700					
		Crozet	2 298	1968	√	√	√	√	
Amsterdam	300–400	1992	√	√	√				
Southern giant petrel <i>Macronectes giganteus</i>	Vulnerable	Antarctic Peninsula		1 125					
		Enderby Land		no estimate					
		Frazier		250					
		Adélie Land		9–11	1964	√			
		South Shetland		7 185					
		South Orkney		8 755	1976	√			
		South Sandwich		800					
		Falklands/Malvinas		5 000					
		South Georgia	5 000	1980	√	√	√		
		Gough							
		Marion	1 500	1984	√	√			
		Prince Edward							
		Crozet	1 017	1981	√	√			
Kerguelen	3–5								
Heard	2 350								
Macquarie	2 300	1994	√	√					

(continued)

Table 49 (continued)

Species	Conservation Status	Study Location	DNA Profile	Population Information					
				Annual Pairs	Year Started	Population Estimate	Trend	Adult Survival	Juvenile Survival
Northern giant petrel <i>Macronectes halli</i>	Near-Threatened	South Georgia		3 000	1980	√	√	√	
		Marion		350	1984	√	√		
		Prince Edwards							
		Crozet				1981	√		
		Kerguelen		1 450–1 800	1986	√			
		Macquarie		1 313	1994	√	√		
		Campbell		230+					
		Auckland		no estimate					
		Antipodes		320					
		Chatham		no estimate					
White-chinned petrel <i>Procellaria aequinoctialis</i>	Vulnerable	Falklands/Malvinas		1 000–5 000					
		South Georgia		2 000 000	1995	√	√		
		Prince Edwards		10 000s	1996	√	√		
		Crozet		10 000s	1968	√	√		
		Kerguelen		100 000s					
		Auckland, Campbell, Antipodes							
Grey petrel <i>Procellaria cinerea</i>	Near-Threatened	Tristan da Cunha		1 000s					
		Gough		100 000s					
		Prince Edwards		1 000s					
		Crozet		1 000s					
		Kerguelen		1 000s					
		Macquarie		<100					
		Campbell		10 000s					
Antipodes		10 000s							

Table 50: Summary of data on seabird species at risk from longline fisheries in the Convention Area, indicating the level of information available on foraging ecology in respect of years of study, stage of breeding cycle, CCAMLR areas visited and risk assessment (SC-CAMLR-XX/BG/11) of these areas. (Information extracted from documents cited in SC-CAMLR-XVIII, Annex 5; SC-CAMLR-XIX, Annex 5; SC-CAMLR-XX, Annex 5; also Gales, 1998; Marchant and Higgins, 1990). nr – not recorded.

Species	Study Location	Foraging Ecology					CCAMLR Area Prospected (<i>IMALF risk assessment</i>)																		
		Data	Years	Trips			48.1	48.2	48.3	48.4	48.5	48.6	58.4.1	58.4.2	58.4.3	58.4.4a	58.4.4b	58.5.1	58.5.2	58.6	58.7	88.1	88.2	88.3	
				Incubation	Chick	Brood																			Non-Breeding
Wandering albatross <i>Diomedea exulans</i>	South Georgia	v	1990–2000	15	152																				
	Marion	v	1996–1998	nr	nr	●	●	●	●	●															●
	Prince Edward																								
	Crozet	v	nr	nr	nr								●	●	●		●	●	●	●					
	Kerguelen	v	nr	nr	nr																				
	Macquarie																								
Antipodean albatross <i>Diomedea antipodensis</i>	Auckland	v	nr																						
	Adams																								
	Antipodes	v	nr																						
Amsterdam albatross <i>Diomedea amsterdamensis</i>	Amsterdam	v	nr														●	●							
Southern royal albatross <i>Diomedea epomophora</i>	Campbell	v	nr																						
	Auckland Islands																								
Northern royal albatross <i>Diomedea sanfordi</i>	Chatham	v	nr																						
	Taiaroa	v	nr																						
Grey-headed albatross <i>Thalassarche chrysostoma</i>	Diego Ramirez	v	1991–2000	4	240	●	●	●	●	●															
	South Georgia	v	1997–1998	nr	nr																				
	Marion																								
	Prince Edward																								
	Crozet																								
	Kerguelen																								
	Macquarie	v	2000–2001	9	3																			●	
	Campbell																								
Black-browed albatross <i>Thalassarche melanophrys</i>	Diego Ramirez	v	1999	nr	nr																				
	Falklands/Malvinas	v	nr	nr	nr																				
	South Georgia	v	1993–1994	11	73	●	●	●	●																
	Crozet																								
	Kerguelen	v	nr	nr	nr																				
	Heard, McDonald																								
	Macquarie	v	2000–2001	10	5																			●	
	Antipodes																								
	Campbell																								
Atlantic yellow-nosed albatross <i>Thalassarche chlororhynchos</i>	Tristan da Cunha																								
	Gough																								
Campbell albatross <i>Thalassarche impavida</i>	Campbell	v	1995	nr	nr																				

(continued)

Table 50 (continued)

Species	Study Location	Foraging Ecology				CCAMLR Area Prospected (<i>IMALF risk assessment</i>)																		
		Data	Years	Trips			48.1	48.2	48.3	48.4	48.5	48.6	58.4.1	58.4.2	58.4.3	58.4.4a	58.4.4b	58.5.1	58.5.2	58.6	58.7	88.1	88.2	88.3
				Incubation	Chick	Brood																		
Indian yellow-nosed albatross <i>Thalassarche carteri</i>	Prince Edward Crozet Amsterdam	v	nr	nr	nr																			
Buller's albatross <i>Thalassarche bulleri</i>	Snares Solander	v	nr	nr	nr																			
Chatham albatross <i>Thalassarche eremita</i>	Chatham	v	nr	nr	nr																			
Salvin's albatross <i>Thalassarche salvini</i>	Ile des Pingouins, Crozet Bounty Snares																							
White-capped albatross <i>Thalassarche steadi</i>	Antipodes Disappointment Adams Auckland																							
Light-mantled albatross <i>Phoebastria palpebrata</i>	South Georgia Marion Prince Edward Crozet Kerguelen Heard, McDonald Macquarie Campbell Auckland Antipodes	v	nr	nr	nr																			
Sooty albatross <i>Phoebastria fusca</i>	Tristan da Cunha Gough Marion Prince Edward Crozet Amsterdam	v	nr	nr	nr																			

(continued)

Table 50 (continued)

Species	Study Location	Foraging Ecology				CCAMLR Area Prospected (<i>IMALF risk assessment</i>)																		
		Data	Years	Trips			48.1	48.2	48.3	48.4	48.5	48.6	58.4.1	58.4.2	58.4.3	58.4.4a	58.4.4b	58.5.1	58.5.2	58.6	58.7	88.1	88.2	88.3
				Incubation	Chick	Brood	Non-Breeding	3	2	5	3	1	2	3	2	3	3	3	5	4	5	5	3	1
Southern giant petrel <i>Macronectes giganteus</i>	Antarctic Peninsula																							
	Enderby Land																							
	Frazier																							
	Adélie Land																							
	South Shetland																							
	South Orkney																							
	South Sandwich																							
	Falklands/Malvinas																							
	South Georgia	v	1996-1998	13		1	•	•	•	•	•					•								
	Gough																							
	Marion																							
	Prince Edward																							
	Crozet																							
	Kerguelen																							
Heard																								
Macquarie																								
Northern giant petrel <i>Macronectes halli</i>	South Georgia	v	1998	18			•	•	•	•														
	Marion																							
	Prince Edward																							
	Crozet																							
	Kerguelen																							
	Macquarie																							
	Campbell																							
	Auckland																							
	Antipodes																							
	Chatham																							
White-chinned petrel <i>Procellaria aequinoctialis</i>	Falklands/Malvinas	v	1996-1998	5	20	•	•	•																
	South Georgia																							
	Prince Edwards	v	nr	nr	nr																			
	Crozet	v	nr	nr	nr																			
	Kerguelen																							
Auckland, Campbell, Antipodes																								
Grey petrel <i>Procellaria cinerea</i>	Tristan da Cunha																							
	Gough																							
	Prince Edwards																							
	Crozet																							
	Kerguelen																							
	Macquarie																							
	Campbell																							
Antipodes																								

Table 51: Incidental mortality of seabirds in the longline fisheries for *Dissostichus* spp. in Subareas 48.3, 58.6, 58.7 and 88.1 during the 2000/01 season. Sp – Spanish method; Auto – autoliner; N – night setting; D – daylight setting (including nautical dawn and dusk); O – opposite side to hauling; S – same side as hauling; * – information obtained from cruise report; + – all daylight settings in Subarea 88.1 were in compliance with the provisions of Conservation Measure 210/XIX.

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 (%)		
			N	D	Total	%N	Obs.	Set	% Observed		Dead	Alive	Total	N	D	Total	N	D				
											N	D	N	D	N	D						
Subarea 48.3																						
<i>Argos Georgia</i>	7/6–25/7/01	Sp	212	2	214	99	229.5	1 083.3	21	100	0	0	1	0	1	0	0	0	92	100	O (83)	
<i>Argos Helena</i>	4/5–21/8/01	Sp	171	0	171	100	299.3	1 343.6	22	100	3	0	11	0	14	0	0.010	0	0.010	99	O (100)	
<i>Ibsa Quinto</i>	3/5–11/7/01	Sp	115	0	115	100	190.2	1 161.1	16	100	2	0	8	0	10	0	0.011	0	0.011	100	O (85)	
<i>In Sung 66</i>	1/5–6/7/01	Sp	101	4	105	96	148.1	795.9	18	100	0	0	0	0	0	0	0	0	99	100	O (98)	
<i>In Sung 66</i>	8/7–11/9/01	Sp	88	5	93	95	111.4	729.2	15	100	0	0	0	0	0	0	0	0	92	100	O (96)	
<i>Isla Alegranza</i>	1/5–30/8/01	Sp	161	18	179	90	380.1	1 550.9	24	100	1	0	6	0	7	0	0.003	0	0.003	25	17	O (99)
<i>Isla Camila</i>	12/6–20/7/01	Sp	40	2	42	95	53.1	205.1	25	100	0	0	0	0	0	0	0	0	89	0	O (0)	
<i>Isla Camila</i>	1/5–28/5/01	Sp	52	2	54	96	67.5	359.8	18	100	0	0	0	0	0	0	0	0	96	100	O (96)	
<i>Isla Santa Clara</i>	30/6–17/7/01	Sp	40	2	42	95	43.2	259.8	16	100	0	0	0	0	0	0	0	0	100	100	O (93)	
<i>Isla Santa Clara</i>	1/5–30/6/01	Sp	106	9	115	92	131.7	855.0	15	100	0	0	0	0	0	0	0	0	95	89	O (96)	
<i>Koryo Maru 11</i>	21/5–31/8/01	Sp	218	8	226	96	265.9	1 769.6	15	100	0	0	0	0	0	0	0	0	93	100	O (76)	
<i>Maria Tamara</i>	14/7–20/7/01	Sp	5	0	5	100	21.0	66.6	31	100	0	0	0	0	0	0	0	0	100		S (100)	
<i>No. 1 Moresko</i>	17/7–30/8/01	Sp	76	0	79	100	142.4	646.1	22	100	0	0	4	0	4	0	0	0	96		O (99)	
<i>No. 1 Moresko</i>	5/5–6/7/01	Sp	83	6	89	93	79.4	779.6	10	100	0	0	0	0	0	0	0	0	98	100	O (87)	
<i>Polarpesca I</i>	10/6–27/6/01	Sp	23	3	26	88	152.5	187.9	81	100	0	0	0	0	0	0	0	0	100	100	O (88)	
<i>RK-1</i>	4/5–19/6/01	Auto	173	34	207	84	220.5	739.2	29	82	0	0	0	0	0	0	0	0	2	68	O (11)	
<i>RK-1*</i>	24/6–30/8/01	Auto			304		236.6	1 070.4	22		0	0	0	0	0	0	0	0			O (0)	
<i>Rutsava</i>	17/5–25/5/01	Sp	10	0	10	100	49.7	119.5	41	100	0	0	0	0	0	0	0	0	100		O (80)	
<i>Ural</i>	6/5–7/8/01	SP	125	2	127	98	114.8	842.7	13	100	0	0	0	0	0	0	0	0	99	100	O (96)	
<i>Viking Bay</i>	1/5–30/8/01	Sp	150	9	159	94	226.3	1 066.7	21	100	0	0	1	0	1	0	0	0	96	89	O (0)	
Total						95	2 926.6	14 561.6	24								0.002	0	0.002			
Subareas 58.6 and 58.7																						
<i>Aquatic Pioneer</i>	25/9–12/11/00	Sp	52	0	52	100	165.2	629.8	26	89	13	0	2	0	15	0	0.079	0	0.079	100		O (96)
<i>Eldfisk</i>	7/9–6/11/00	Auto	129	127	256	50	290.2	778.1	37	89	0	2	2	0	2	2	0	0.009	0.004	99	100	O (95)
<i>Eldfisk</i>	11/5–4/7/01	Auto	163	92	255	64	447.3	880.2	58	89	1	0	0	0	1	0	0.005	0	0.003	100	100	O (98)
<i>Eldfisk</i>	9/8–11/9/01	Auto	63	4	67	94	143.8	234.2	61	81	1	0	0	0	1	0	0.007	0	0.007	100	100	O (100)
<i>Eldfisk</i>	4/12–10/12/00	Auto	4	28	32	13	34.2	104.0	32	85	1	1	0	2	1	3	0.250	0.033	0.058	100	100	O (0)
<i>Isla Graciosa</i>	7/10–11/12/00	Sp	80	0	80	100	625.5	1 062.2	58	100	1	0	5	0	6	0	0.002	0	0.002	100		O (100)
<i>Isla Graciosa</i>	22/4–25/5/01	Sp	39	0	39	100	43.6	627.7	6	100	0	0	0	0	0	0	0	0	100		O (0)	
<i>Isla Graciosa</i>	15/6–30/7/01	Sp	41	3	44	93	39.5	492.2	8	100	0	0	4	0	4	0	0	0	100	100	O (98)	
<i>Koryo Maru 11</i>	5/2–2/4/01	Sp	97	1	98	99	559.0	878.9	63	100	8	0	36	0	44	0	0.014	0	0.014	100	100	O (100)
<i>Koryo Maru 11</i>	20/10–29/11/00	Sp	20	18	38	53	89.6	593.3	15	100	6	13	4	1	10	14	0.144	0.270	0.212	100	100	O (100)
<i>Suidor One</i>	30/7–7/9/01	Sp	30	1	31	97	169.4	280.1	60	100	0	0	6	0	6	0	0	0	0	100	100	O (100)
Total						78	2 607.3	6 560.7	39								0.014	0.037	0.018			
Subarea 88.1+																						
<i>Eldfisk</i>	20/2–17/3/01	Auto	25	44	69	36	90.5	234.0	37	79	0	0	0	0	0	0	0	0	0	100	100	(0)
<i>Isla Alegranza</i>	6/3–18/3/01	Sp																				
<i>Isla Gorriti</i>	29/1–3/3/01	Auto	2	36	38	5	251.4	280.8	89	86	0	0	0	0	0	0	0	0	0	100	100	(0)
<i>Isla Graciosa</i>	12/3–18/3/01	Sp	3	9	12	25	32.5	45.0	72	100	0	0	0	0	0	0	0	0	0	100	100	(0)
<i>Janas</i>	14/1–26/3/01	Auto	13	199	212	6	454.8	1 069.0	42	89	0	0	0	0	0	0	0	0	0	100	100	(0)
<i>San Aotea II</i>	14/1–17/5/01	Auto	85	180	265	32	595.7	1 317.7	45	88	0	0	0	1	0	1	0	0	0	100	100	(0)
<i>Sonrisa</i>	22/1–28/2/01	Auto	3	71	74	4	136.2	275.5	49	75	0	0	0	0	0	0	0	0	0	100	100	(0)
Total						18	1 561.1	3 222	56								0	0	0			

Table 52: Estimated total seabird mortality by vessel for Subarea 48.3 during the 2000/01 season.

Vessel	Hooks Observed (thousands)	Hooks Set (thousands)	% Hooks Observed	% Night Sets	Estimated Number of Birds Caught Dead		
					Night	Day	Total
<i>Argos Georgia</i>	229.5	1 083.3	21	99	0	0	0
<i>Argos Helena</i>	299.3	1 343.6	22	100	13	0	13
<i>Ibsa Quinto</i>	190.2	1 161.1	16	100	13	0	13
<i>In Sung 66</i>	148.1	795.9	18	96	0	0	0
<i>In Sung 66</i>	111.4	729.2	15	95	0	0	0
<i>Isla Alegranza</i>	380.1	1 550.9	24	90	4	0	4
<i>Isla Camila</i>	53.1	205.1	25	95	0	0	0
<i>Isla Camila</i>	67.5	359.8	18	96	0	0	0
<i>Isla Santa Clara</i>	43.2	259.8	16	95	0	0	0
<i>Isla Santa Clara</i>	131.7	855.0	15	92	0	0	0
<i>Koryo Maru 11</i>	265.9	1 769.6	15	96	0	0	0
<i>Maria Tamara</i>	21.0	66.6	31	100	0	0	0
<i>No. 1 Moresko</i>	142.4	646.1	22	100	0	0	0
<i>No. 1 Moresko</i>	79.4	779.6	10	93	0	0	0
<i>Polarpesca I</i>	152.5	187.9	81	88	0	0	0
<i>RK-1</i>	220.5	739.2	29	84	0	0	0
<i>RK-1</i>	236.6	1 070.4	22		0	0	0
<i>Rutsava</i>	49.7	119.5	41	100	0	0	0
<i>Ural</i>	114.8	842.7	13	98	0	0	0
<i>Viking Bay</i>	226.3	1 066.7	21	94	0	0	0
Total	2 926.6	14 561.6	24	90	30	0	30

Table 53: Species composition of birds killed in longline fisheries in Subareas 48.3, 58.6 and 58.7 during the 2000/01 season. N – night setting; D – daylight setting (including nautical dawn and dusk); DIM – black-browed albatross; MAI – southern giant petrel; PRO – white-chinned petrel; DAC – cape petrel; PCI – grey petrel; () – % composition.

Vessel	Dates of Fishing	No. Birds Killed by Group						Species Composition (%)				
		Albatross		Petrels		Total		DIM	MAI	PRO	DAC	PCI
		N	D	N	D	N	D					
Subarea 48.3												
<i>Argos Georgia</i>	7/6–25/7/01	0	0	0	0	0	0					
<i>Argos Helena</i>	4/5–21/8/01	0	0	3	0	3	0		3 (100)			
<i>Ibsa Quinto</i>	3/5–11/7/01	2	0	0	0	2	0	2 (100)				
<i>In Sung 66</i>	1/5–6/7/01	0	0	0	0	0	0					
<i>In Sung 66</i>	8/7–11/9/01	0	0	0	0	0	0					
<i>Isla Alegranza</i>	1/5–30/8/01	0	0	1	0	1	0				1 (100)	
<i>Isla Camila</i>	12/6–20/7/01	0	0	0	0	0	0					
<i>Isla Camila</i>	1/5–28/5/01	0	0	0	0	0	0					
<i>Isla Santa Clara</i>	30/6–17/7/01	0	0	0	0	0	0					
<i>Isla Santa Clara</i>	1/5–30/6/01	0	0	0	0	0	0					
<i>Koryo Maru 11</i>	21/5–31/8/01	0	0	0	0	0	0					
<i>Maria Tamara</i>	14/7–20/7/01	0	0	0	0	0	0					
<i>No. 1 Moresko</i>	17/7–30/8/01	0	0	0	0	0	0					
<i>No. 1 Moresko</i>	5/5–6/7/01	0	0	0	0	0	0					
<i>Polarpesca 1</i>	10/6–27/6/01	0	0	0	0	0	0					
<i>RK-1</i>	4/5–19/6/01	0	0	0	0	0	0					
<i>RK-1</i>	24/6–30/8/01	0	0	0	0	0	0					
<i>Rutsava</i>	17/5–25/5/01	0	0	0	0	0	0					
<i>Ural</i>	6/5–7/8/01	0	0	0	0	0	0					
<i>Viking Bay</i>	1/5–30/8/01	0	0	0	0	0	0					
Total %		2	0	4	0	6	0	2 (33)	3 (50)		1 (17)	
Subareas 58.6 and 58.7												
<i>Aquatic Pioneer</i>	25/9–12/11/00	0	0	0	13	0	13			13 (100)		
<i>Eldfisk</i>	7/9–6/11/00	1	0	0	1	1	1	1 (50)		1 (50)		
<i>Eldfisk</i>	11/5–4/7/01	0	0	1	0	1	0				1 (100)	
<i>Eldfisk</i>	9/8–11/9/01	0	0	1	0	1	0				1 (100)	
<i>Eldfisk</i>	4/12–10/12/00	0	0	1	1	1	1			2 (100)		
<i>Isla Graciosa</i>	7/10–11/12/00	1	0	0	0	1	0	1 (100)				
<i>Isla Graciosa</i>	22/4–25/5/01	0	0	0	0	0	0					
<i>Isla Graciosa</i>	15/6–30/7/01	0	0	0	0	0	0					
<i>Koryo Maru 11</i>	20/10–29/11/00	0	0	6	13	6	13			19 (100)		
<i>Koryo Maru 11</i>	5/2–2/4/01	0	0	8	0	8	0			8 (100)		
<i>Suidor One</i>	30/7–7/9/01	0	0	0	0	0	0					
Total %		2	0	17	28	19	28	2 (4)		43 (92)		2 (4)

Table 54: Estimated total seabird mortality by vessel for Subareas 58.6 and 58.7 during the 2000/01 season.

Vessel	Hooks Observed (thousands)	Hooks Set (thousands)	% Hooks Observed	% Night Sets	Estimated Number of Birds Caught Dead		
					Night	Day	Total
<i>Aquatic Pioneer</i>	165.2	629.8	26	100	50	0	50
<i>Eldfisk</i>	290.2	778.1	37	50	0	4	4
<i>Eldfisk</i>	447.3	880.2	58	64	3	0	3
<i>Eldfisk</i>	143.8	234.2	61	94	2	0	2
<i>Eldfisk</i>	34.2	104.0	32	13	3	3	6
<i>Isla Graciosa</i>	625.5	1 062.2	58	100	2	0	2
<i>Isla Graciosa</i>	43.6	627.7	6	100	0	0	0
<i>Isla Graciosa</i>	39.5	492.2	8	93	0	0	0
<i>Koryo Maru 11</i>	559.0	878.9	63	99	12	0	12
<i>Koryo Maru 11</i>	89.6	593.3	15	53	45	75	120
<i>Suidor One</i>	169.4	280.1	60	97	0	0	0
Total	2 607.3	6 560.7	39	78	117	82	199

Table 55: 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 2001.

Subarea	Year				
	1997	1998	1999	2000	2001
48.3					
Estimated by-catch	5 755	640	210*	21	30
By-catch rate	0.23	0.032	0.013*	0.002	0.002
58.6, 58.7					
Estimated by-catch	834	528	156	516	199
By-catch rate	0.52	0.194	0.034	0.046	0.018

* Excluding *Argos Helena* line-weighting experiment cruise.

Table 56: Summary of compliance with Conservation Measure 29/XV (1996/97), Conservation Measure 29/XVI (1997/98 to 1999/2000) and Conservation Measure 29/XIX (2000/01), based on data from scientific observers, for the 1996/97, 1997/98, 1998/99, 1999/2000 and 2000/01 seasons. 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	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
Division 58.4.4																			
1999/00	0	(100)	5	45	50	0	(100)	0	(100)	100	(100)	0	(100)	100	(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
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		100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0
2000/01	1	(100)	12	40	18 ⁵	No Discharge		100	(100)	100	(100)	100	(100)	100	(100)	100	(100)	0	0

¹ Includes daylight setting – and associated seabird by-catch – as part of line-weighting experiments on *Argos Helena* (WG-FSA-99/5).

² Includes some daylight 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 daylight setting south of 65°S in Subarea 88.1 to conduct a line-weighting experiment.

⁴ Conservation Measure 190/XVIII allowed New Zealand vessels to undertake daylight setting south of 65°S in Subarea 88.1 to conduct a line-weighting experiment.

⁵ Conservation Measure 210/XIX allows vessels to undertake daylight setting south of 65°S in Subarea 88.1, if they can demonstrate a sink rate of 0.3 m/s.

Table 57: Compliance, as reported by scientific observers, of streamer lines with the minimum specifications set out in Conservation Measure 29/XIX during the 2000/01 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, UKR – Ukraine, URY – Uruguay, ZAF – South Africa.

Vessel Name (Nationality)	Dates of Trip	Fishing Method	Compliance with CCAMLR Specifications	Compliance with Details of Streamer Line Specifications					Spare Streamers on Board
				Attachment, Height above Water (m)	Total Length (m)	No. Streamers per Line	Spacing of Streamers per Line (m)	Length of Streamers (m)	
Subarea 48.3									
<i>Argos Georgia</i> (GBR)	23/4–2/8/01	Sp	Y	Y (6)	Y (150)	Y (7)	Y (5)	Y (3.5-1)	Y
<i>Argos Helena</i> (GBR)	3/5–29/8/01	Sp	N	Y (4.5)	N (85)	Y (14)	Y (5)	N (1-1.5)	Y
<i>Ibsa Quinto</i> (ESP)	25/4–16/7/01	Sp	Y	Y (7)	Y (160)	Y (5)	Y (7)	-	-
<i>In Sung 66</i> (KOR)	26/4–7/7/01	Sp	Y	Y (4.5)	Y (165)	Y (10)	Y (5)	-	Y
<i>In Sung 66</i> (KOR)	7/7–6/9/01	Sp	Y	Y (6)	-	Y (5)	Y (5)	-	-
<i>Isla Alegranza</i> (URY)	28/4–5/9/01	Sp	Y	-	Y (160)	-	-	-	-
<i>Isla Camila</i> (CHL)	1/5–29/5/01	Sp	N	Y(7)	N (90)	Y (13)	Y (3)	Y (3.2-2)	Y
<i>Isla Camila</i> (CHL)	8/6–17/8/01	Sp	N	Y (7)	N (80)	Y (30)	Y (2.5)	-	-
<i>Isla Santa Clara</i> (CHL)	25/4–1/7/01	Sp	N	N (3)	Y (150)	Y (6)	Y (5)	-	-
<i>Isla Santa Clara</i> (CHL)	1/7–24/7/01	Sp	Y	Y (6)	Y (150)	Y (5)	Y (5)	-	-
<i>Koryo Maru II</i> (ZAF)	19/4–13/9/01	SP	N	N (2.5)	N (120)	Y (8)	N (2)	-	-
<i>Maria Tamara</i> (CHL)	30/6–31/8/01	SP	Y	Y (5)	Y (150)	Y (5)	Y (5)	Y (3.5-1)	Y
<i>No. 1 Moresko</i> (KOR)	1/5–12/7/01	Sp	N	Y (5.2)	N (95)	Y (5)	N (4)	-	Y
<i>No. 1 Moresko</i> (KOR)	13/7–6/9/01	Sp	N	Y (5.2)	N (95)	Y (5)	N (4)	-	Y
<i>Polarpesca I</i> (CHL)	7/6–27/8/01	Sp	N	Y (4.5)	N (125)	Y (20)	Y (3)	-	-
<i>RK-1</i> (UKR)	21/4–23/6/01	A	Y	Y (15)	Y (150)	Y (25)	Y (4)	-	-
<i>RK-1</i> (UKR)	23/6–5/9/01	Auto	Y	-	Y (150)	Y (7)	-	-	-
<i>Rutsava</i> (RUS)	25/4–12/6/01	Sp	N	Y (5)	N (100)	N (4)	Y (5)	-	-
<i>Ural</i> (RUS)	22/4–22/8/01	Sp	Y	-	Y (150)	Y (5)	Y (5)	Y (3.5-1)	Y
<i>Viking Bay</i> (ESP)	13/5–31/8/01	Sp	Y	Y (5)	Y (150)	Y (50)	Y (2)	-	-
Subareas 58.6 and 58.7									
<i>Aquatic Pioneer</i> (ZAF)	20/9–20/11/00	Sp	N	Y (7.5)	N (117)	Y (6)	Y (5)	Y (3-2)	-
<i>Eldfisk</i> (ZAF)	2/9–12/11/00	A	Y	Y (6)	Y (151.5)	Y (7)	Y (5)	Y (3.5)	Y
<i>Eldfisk</i> (ZAF)	29/11–3/1/01	A	N	Y (6)	N (100)	Y (5)	Y (5)	Y (2-6)	Y
<i>Eldfisk</i> (ZAF)	5/5–11/7/01	A	Y	Y (5)	Y (150)	Y (6)	Y (2.5)	Y (5-1)	-
<i>Eldfisk</i> (ZAF)	4/8–6/9/01	A	Y	Y (6)	Y (155)	Y (12)	Y (2)	Y (3-1.5)	Y
<i>Isla Graciosa</i> (ZAF)	2/10–17/12/00	Sp	Y	Y (5)	Y (150)	Y (5)	Y (5)	-	Y
<i>Isla Graciosa</i> (ZAF)	28/3–1/6/01	Sp	Y	Y (7.5)	Y (160)	Y (12)	Y (1.25)	Y (4-1)	-
<i>Isla Graciosa</i> (ZAF)	11/6–7/8/01	Sp	Y	Y (5)	Y (155)	Y (8)	Y (3.5)	-	-
<i>Koryo Maru II</i> (ZAF)	16/10–6/12/00	Sp	N	Y (8)	N (115)	Y (8)	Y (5)	-	Y
<i>Koryo Maru II</i> (ZAF)	24/1–9/4/01	Sp	Y	Y (8)	Y (155)	Y (8)	Y (5)	-	Y
<i>Sudior One</i> (ZAF)	24/7–17/9/01	Sp	N	Y (4.5)	N (125)	Y (5)	Y (5)	Y (3.5-1)	Y
Subarea 88.1									
<i>Eldfisk</i> (ZAF)	20/2–17/3/01	A	Y	Y (5)	Y (150)	Y (9)	Y (5)	Y (3.5-1)	-
<i>Isla Gorriti</i> (URY)	14/1–19/3/01	A	Y	Y (4.5)	Y (150)	Y (5)	Y (5)	-	Y
<i>Isla Graciosa</i> (ZAF)	25/2–27/3/01	Sp	Y	Y (5)	Y (199)	Y (7)	Y (2.5)	-	Y
<i>Janas</i> (NZL)	1/1–3/4/01	A	Y	Y (8)	Y (200)	Y (16)	Y (4)	Y (5-1.5)	-
<i>San Aotea II</i> (NZL)	2/1–23/5/01	A	Y	Y (6)	Y (150)	Y (25)	Y (5)	-	Y
<i>Sonrisa</i> (NZL)	6/1–1/3/01	A	Y	Y (11)	Y (150)	Y (5)	Y (5)	Y (4.5-2)	-

Table 58: Summary of compliance with Conservation Measure 29/XVI (1998 to 2000) and Conservation Measure 29/XIX (2000/01) regarding night setting, correct configuration and use of streamer lines and offal discharge practices in the Convention Area, from 1998 to 2001. Vessels with a history of non-compliance (at least two elements of the conservation measure in two consecutive years, including the current year) with a conservation measure are indicated in bold. Vessels in their first year in the fishery that failed to comply with two elements of the conservation measures are indicated in italics in the column for the current year (2001). Nationality: CHL – Chile, ESP – Spain, GBR – United Kingdom, KOR – Republic of Korea, NZL – New Zealand, RUS – Russia, UKR – Ukraine, URY – Uruguay, ZAF – South Africa, Y – complied, N – did not comply, -- did not fish, na – not applicable.

Vessel (Nationality)	Subarea/ Division	Night Setting				Streamer Line				Offal Discharge				Line Weighting			
		1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001
<i>Aquatic Pioneer</i> (ZAF)	58.6, 58.7	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N	N	N
<i>Argos Georgia</i> (GBR)	48.3	-	-	Y	N	-	-	N	Y	-	-	Y	Y	-	-	N	Y
<i>Argos Helena</i> (GBR)	48.3	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	N	N	N	N
<i>Eldfisk</i> (ZAF) #	58.6, 58.7	-	N	N	N	-	N	N	N	-	Y	Y	Y	N	N	na	na
<i>Ibsa Quinto</i> (ESP)	48.3	-	Y	Y	Y	-	Y	N	Y	-	Y	Y	Y	-	N	N	N
<i>In Sung 66</i> (KOR)	48.3	-	-	-	N	-	-	-	Y	-	-	-	Y	-	-	-	N
<i>Isla Alegranza</i> (URY)	48.3	-	-	N	N	-	-	N	Y	-	-	N	Y	-	-	N	N
<i>Isla Camila</i> (CHL)	48.3	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N
<i>Isla Gorriti</i> (URY)	48.3/88.1	-	N/-	N/-	-/na	-	N/-	N/-	-/Y	-	Y/-	Y/-	-/Y	-	na	na	-/Y
<i>Isla Graciosa</i> (ZAF)	58.6, 58.7/88.1	-/-	-/-	-/-	N/na	-/-	-/-	-/-	Y	-/-	-/-	-/-	Y	-/-	-/-	-/-	-/Y
<i>Isla Santa Clara</i> (CHL)	48.3	-	-	N	N	-	-	N	N	-	-	Y	Y	-	-	N	N
<i>Janas</i> (NZL)	88.1	-	na	na	na	-	Y	Y	Y	-	Y	Y	Y	-	na	na	Y
<i>Koryo Maru II</i> (ZAF)	58.6, 58.7/48.3	Y/-	Y/Y	N/Y	N/N	N/-	N/Y	N/Y	N/N	Y/Y	Y/Y	Y/Y	Y/Y	N/N	N/Y	N/Y	N/N
<i>Maria Tamara</i> (CHL)	48.3	-	-	-	Y	-	-	-	Y	-	-	-	N	-	-	-	N
<i>No. 1 Moresko</i> (KOR)	48.3	-	N	N	N	-	N	N	N	-	Y	Y	Y	-	N	N	N
<i>Polarpesca 1</i> (CHL)	48.3	-	-	-	N	-	-	-	N	-	-	-	Y	-	-	-	N
<i>RK-1</i> (UKR)	48.3	-	-	Y	N	-	-	Y	Y	-	-	Y	Y	-	-	na	na
<i>Rutsava</i> (RUS)	48.3	-	-	-	Y	-	-	-	N	-	-	-	Y	-	-	-	N
<i>San Aotea II</i> (NZL)	88.1	-	na	na	na	-	Y	Y	Y	-	Y	Y	Y	-	na	na	Y
<i>Sonrisa</i> (NZL)	88.1	-	-	na	na	-	-	Y	Y	-	-	Y	Y	-	-	na	Y
<i>Suidor One</i> (ZAF)	58.6, 58.7	-	-	-	N	-	-	-	N	-	-	-	Y	-	-	-	N
<i>Ural</i> (RUS)	48.3	-	-	-	N	-	-	-	Y	-	-	-	Y	-	-	-	Y
<i>Viking Bay</i> (ESP)	48.3	-	-	-	N	-	-	-	Y	-	-	-	Y	-	-	-	Y

Eldfisk set all lines during the day using an underwater setting funnel in Subareas 58.6 and 58.7, in accordance with South African fishing permit conditions.

Table 59: Vessel compliance (%) with Conservation Measure 29/XIX during the 2000/01 season. Values for night setting and streamer line setting are absolute proportions for all sets by each vessel. Values for offal discharge, line weighting and streamer line design are averages across all cruises by each vessel.

Vessel	Number of Cruises	Night Setting	Offal Discharge	Line Weighting	Streamer Line Setting	Streamer Line Design
Subarea 48.3						
<i>Argos Georgia</i> (GBR)	1	99	100	100	92	100
<i>Argos Helena</i> (GBR)	1	100	100	0	99	0
<i>Ibsa Quinto</i> (ESP)	1	100	100	0	100	100
<i>In Sung 66</i> (KOR)	2	96	100	0	96	100
<i>Isla Alegranza</i> (URY)	1	90	100	0	24	100
<i>Isla Camila</i> (CHL)	2	96	100	0	91	0
<i>Isla Santa Clara</i> (CHL)	2	94	100	0	96	50
<i>Koryo Maru 11</i> (ZAF)	1	96	100	0	93	0
<i>Maria Tamara</i> (CHL)	1	100	0	0	100	100
<i>No. 1 Moresko</i> (KOR)	2	97	100	50	95	0
<i>Polarpesca I</i> (CHL)	1	88	100	0	100	0
<i>RK-1</i> (UKR)	2	84	100	Autoline	13	100
<i>Rutsava</i> (RUS)	1	100	100	0	100	0
<i>Ural</i> (RUS)	1	98	100	100	99	100
<i>Viking Bay</i> (ESP)	1	94	100	100	96	100
Subareas 58.6 and 58.7						
<i>Aquatic Pioneer</i> (ZAF)	1	100	100	0	100	0
<i>Eldfisk</i> (ZAF)#	4	69	100	Autoline	100	75
<i>Isla Graciosa</i> (ZAF)	3	98	100	34	100	100
<i>Koryo Maru 11</i> (ZAF)	2	76	100	50	100	50
<i>Suidor One</i> (ZAF)	1	97	100	0	100	0
Subarea 88.1						
<i>Eldfisk</i> (ZAF)*	1	36	100	Autoline	100	100
<i>Isla Alegranza</i> (URY)*	1	No data	No data	No data	No data	No data
<i>Isla Gorriti</i> (URY)*	1	5	100	Autoline	100	100
<i>Isla Graciosa</i> (ZAF)*	1	25	100	100	92	100
<i>Janas</i> (NZL)*	1	6	100	Autoline	100	100
<i>San Aotea II</i> (NZL)*	1	32	100	Autoline	100	100
<i>Sonrisa</i> (NZL)*	1	74	100	Autoline	100	100

* Conservation Measure 210/XIX allows fishing in Subarea 88.1 during daylight periods if the vessel can demonstrate a minimum sink rate of 0.3 metres per second.

Eldfisk set all lines during the day using an underwater setting funnel in Subareas 58.6 and 58.7, in accordance with South African fishing permit conditions.

Table 60: Estimate of seabird by-catch in the unregulated *Dissostichus* spp. fishery in Subareas 48.3, 58.6 and 58.7 and Divisions 58.4.4, 58.5.1 and 58.5.2 in 2000/01. S – summer, W – winter.

Subarea/ Division	Total Unregulated Catch (tonnes)	Split S:W		Unregulated Catch (tonnes)		<i>Dissostichus</i> spp. Regulated Catch Rate (kg/hooks)	Unregulated Effort (1 000 hooks)		Seabird By-catch Rate (birds/1 000 hooks)				Estimated Total Unregulated Seabird By-catch			
		S	W	S	W		S	W	Mean		Max		Mean		Max	
									S	W	S	W	S	W	S	W
48.3	300	80	20	240	60	0.301	797	199	2.608	0.07	9.31	0.51	2 079	14	7 423	102
	300	70	30	210	90	0.301	698	299	2.608	0.07	9.31	0.51	1 820	21	6 495	152
	300	60	40	180	120	0.301	598	399	2.608	0.07	9.31	0.51	1 560	28	5 567	203
58.4.4	1 540	80	20	1 232	308	0.063	19 556	4 889	0.629	0.01	1.128	0.042	12 300	49	22 059	205
	1 540	70	30	1 078	462	0.063	17 111	7 333	0.629	0.01	1.128	0.042	10 763	73	19 301	308
	1 540	60	40	924	616	0.063	14 667	9 778	0.629	0.01	1.128	0.042	9 225	98	16 544	411
58.5.1	3 300	80	20	2 640	660	0.236	11 186	2 797	1.049	0.017	1.88	0.07	11 735	48	21 031	196
	3 300	70	30	2 310	990	0.236	9 788	4 195	1.049	0.017	1.88	0.07	10 268	71	18 402	294
	3 300	60	40	1 980	1 320	0.236	8 390	5 593	1.049	0.017	1.88	0.07	8 801	95	15 773	392
58.5.2	1 649	80	20	1 319	330	0.236	5 590	1 397	1.049	0.017	1.88	0.07	5 864	24	10 509	98
	1 649	70	30	1 154	495	0.236	4 891	2 096	1.049	0.017	1.88	0.07	5 131	36	9 195	147
	1 649	60	40	989	660	0.236	4 192	2 795	1.049	0.017	1.88	0.07	4 398	48	7 882	196
58.6	660	80	20	528	132	0.04	13 200	3 300	1.049	0.017	1.88	0.07	13 847	56	24 816	231
	660	70	30	462	198	0.04	11 550	4 950	1.049	0.017	1.88	0.07	12 116	84	21 714	347
	660	60	40	396	264	0.04	9 900	6 600	1.049	0.017	1.88	0.07	10 385	112	18 612	462
58.7	150	80	20	120	30	0.064	1 875	469	1.049	0.017	1.88	0.07	1 967	8	3 525	33
	150	70	30	105	45	0.064	1 641	703	1.049	0.017	1.88	0.07	1 721	12	3 084	49
	150	60	40	90	60	0.064	1 406	938	1.049	0.017	1.88	0.07	1 475	16	2 644	66

Note: No data are available for longline fishing in Divisions 58.4.4, 58.5.1 and 58.5.2 in 2000/01. The figures used for CPUE (kg/hook) are derived from fine-scale catch and effort data (C2), and are revised figures for 1999/2000.

Table 61: Estimates of potential seabird by-catch in unregulated longline fishing in the Convention Area in 2000/01.

Subarea/ Division	Potential By-catch Level	Summer	Winter	Total ¹
48.3	Lower (mean)	1 600–2 100	10–30	1 600–2 100
	Higher (max)	5 600–7 400	100–200	5 800–7 500
58.4.4	Lower	9 200–12 300	50–100	9 300–12 400
	Higher	16 500–22 100	210–410	16 900–22 300
58.5.1	Lower	8 800–11 700	50–100	8 900–11 800
	Higher	15 800–21 000	200–390	16 200–21 200
58.5.2	Lower	4 400–5 900	20–50	4 500–5 900
	Higher	7 900–10 500	100–200	8 100–10 600
58.6	Lower	10 400–13 800	60–110	10 500–13 900
	Higher	18 600–24 800	230–460	19 100–25 000
58.7	Lower	1 500–2 000	10–20	1 500–2 000
	Higher	2 600–3 500	30–70	2 700–3 500
Total	Lower	35 900–67 000 ¹	200–900 ¹	36 000–69 000 ²
	Higher	47 800–89 300 ¹	400–1 700 ¹	48 000–90 000 ²

¹ Rounded to nearest hundred birds

² Rounded to nearest thousand birds

Table 62: Composition of estimated potential by-catch in unregulated longline fisheries in the Convention Area from 1997 to 2001.

Area/Year	Estimated Total Potential Seabird By-catch ¹ (lower level above, higher level below)	Composition of Potential Seabird By-catch ²		
		Albatrosses	Giant Petrels	White-chinned Petrels
Subarea 48.3³				
1996/97	-	-	-	-
1997/98	-	-	-	-
1998/99	3 000–4 000	1 505	70	1 680
	12 000–16 000	6 020	280	6 720
1999/00	1 900–2 600	967	45	1 080
	7 200–9 300	3 547	165	3 960
2000/01	1 600–2 100	795	37	888
	5 800–7 500	2 860	133	3 192
Divisions 58.5.1, 58.5.2⁴				
1996/97	-	-	-	-
1997/98	34 000–45 000	8 690	1 580	24 885
	61 000–81 000	15 620	2 840	44 730
1998/99	2 000–3 000	550	100	1 575
	4 000–5 000	990	180	2 835
1999/00	7 800–10 300	1 991	362	5 701
	14 100–18 600	3 597	654	10 300
2000/01	13 400–17 700	3 421	622	9 796
	24 300–31 800	6 171	1 122	17 671
Division 58.4.4⁴				
1996/97	-	-	-	-
1997/98	-	-	-	-
1998/99	3 000–5 000	880	160	2 520
	4 000–7 000	1 210	220	3 465
1999/00	6 400–8 400	1 628	296	4 662
	11 600–15 100	2 937	534	8 410
2000/01	9 300–12 400	2 387	434	6 835
	16 900–22 300	4 312	784	12 348
Subareas 58.6, 58.7⁴				
1996/97	17 000–27 000	4 840	880	13 860
	66 000–107 000	19 030	3 460	54 495
1997/98	9 000–11 000	2 200	400	6 300
	15 000–20 000	3 850	700	11 025
1998/99	24 000–32 000	6 160	1 120	17 640
	13 000–17 000	3 300	600	9 450
1999/00	16 700–22 000	4 257	774	12 190
	30 200–39 600	7 678	1 396	21 987
2000/01	12 000–15 900	3 069	558	8 788
	21 800–28 500	5 533	1 006	15 844
Total				
1996/97	17 000–27 000	4 840	880	13 860
	66 000–107 000	19 030	3 460	54 495
1997/98	43 000–54 000	10 890	1 980	30 185
	76 000–101 000	19 470	3 540	55 755
1998/99	21 000–29 000	6 235	930	15 225
	44 000–59 000	14 380	1 800	30 660
1999/00	33 000–63 000	8 843	1 477	23 633
	43 000–83 000	17 759	2 749	44 657
2000/01	36 000–69 000	9 672	1 651	26 307
	48 000–90 000	18 876	3 045	49 055
Overall Total				
	147 000–237 000	40 480	6 918	109 210
	276 000–438 000	89 515	14 594	234 622

¹ Rounded to nearest thousand birds² Based on averages for lower (above) and higher (below) level values³ Based on 43% albatrosses, 2% giant petrels, 48% white-chinned petrels (7% unidentified petrels) (SC-CAMLR-XVI, Annex 5, Table 44).⁴ Based on 22% albatrosses, 4% giant petrels, 63% white-chinned petrels (10% unidentified petrels) (SC-CAMLR-XVI, Annex 5, Table 42).

Table 63: Summary of IMALF risk level and assessment in relation to proposed new and exploratory longline fisheries in 2001/02.

Area	Risk Level	IMALF Risk Assessment (see SC-CAMLR-XX/BG/11)	Notes
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. Apply Conservation Measure 29/XIX as a seabird by-catch precautionary measure.	<ul style="list-style-type: none"> • Japan (CCAMLR-XX/10) proposes to fish on 'dates as established by CCAMLR'. Intent to comply with Conservation Measure 29/XIX not specified. Observer coverage to be provided by Japanese monitoring observer, contrary to existing practice and Conservation Measure 200/XIX. • New Zealand (CCAMLR-XX/12) proposes to fish from 1 December 2001 to 30 November 2002, both south and north of 55°S. Intends to comply fully with Conservation Measure 29/XIX. Proposal does not conflict with advice provided. • South Africa (CCAMLR-XX/15) proposes to fish during a season to be established at CCAMLR-XX. States intent to comply with Conservation Measure 29/XIX, and to conduct line-weighting experiments, as approved by the Scientific Committee e.g. as per Conservation Measure 210/XIX (Annex). Proposal does not conflict with advice provided. • Uruguay (CCAMLR-XX/16) proposes to fish from 1 March to 31 August 2002 and to comply with Conservation Measure 29/XIX. Proposal does not conflict with advice provided.
58.4.1	3	Average risk. Apply all elements of Conservation Measure 29/XIX. Much of the risk to seabirds in this area arises in the region of the BANZARE Rise in the west of the region, adjacent to Division 58.4.3.	<ul style="list-style-type: none"> • Japan (CCAMLR-XX/10) proposes to fish on 'dates as established by CCAMLR'. Intent to comply with Conservation Measure 29/XIX not specified. Observer coverage to be provided by Japanese monitoring observer, contrary to existing practice and Conservation Measure 200/XIX.
58.4.3	3	Average risk. Prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (September to April). Maintain all elements of Conservation Measure 29/XIX.	<ul style="list-style-type: none"> • France (CCAMLR-XX/9) proposes to fish from 1 May to 31 August 2002 and to comply with Conservation Measure 29/XVI, not Conservation Measure 29/XIX. • Japan (CCAMLR-XX/10) proposes to fish on 'dates as established by CCAMLR'. Intent to comply with Conservation Measure 29/XIX not specified. Observer coverage to be provided by Japanese monitoring observer, contrary to existing practice and Conservation Measure 200/XIX.

(continued)

Table 63 (continued)

Area	Risk Level	IMALF Risk Assessment (see SC-CAMLR-XX/BG/11)	Notes
58.4.4	3	Average risk. Prohibit longline fishing during the main breeding season of albatrosses and petrels (September to April). Maintain all elements of Conservation Measure 29/XIX.	<ul style="list-style-type: none"> • France (CCAMLR-XX/9) proposes to fish from 1 May to 31 August 2002 and to comply with Conservation Measure 29/XVI, not Conservation Measure 29/XIX • Japan (CCAMLR-XX/10) proposes to fish on ‘dates as established by CCAMLR’. Intent to comply with Conservation Measure 29/XIX not specified. Observer coverage to be provided by Japanese monitoring observer, contrary to existing practice and Conservation Measure 200/XIX. • New Zealand (CCAMLR-XX/12) proposes to fish from 1 December 2001 to 30 November 2002, both south and north of 55°S. States intent to comply with Conservation Measure 29/XIX. • South Africa (CCAMLR-XX/15) proposes to fish during a season to be established at CCAMLR-XX. States intent to comply with Conservation Measure 29/XIX, and to conduct line-weighting experiments, as approved by the Scientific Committee e.g. as per Conservation Measure 210/XIX (and Annex A). Proposal does not conflict with advice provided, assuming that fishing season is between 1 May and 31 August. • Uruguay (CCAMLR-XX/17) proposes to fish from 1 May to 31 August 2002 and to comply with Conservation Measure 29/XIX. Proposal does not conflict with advice provided.
58.6	5	High risk. Prohibit longline fishing during the main albatross and petrel breeding season (i.e. September to April). Ensure strict compliance with Conservation Measure 29/XIX.	<ul style="list-style-type: none"> • Chile (CCAMLR-XX/8) proposes to fish from 1 May to 31 August 2002 and comply with Conservation Measure 29/XIX. Proposal does not conflict with advice provided. • France (CCAMLR-XX/9) proposes to fish from 1 May to 31 August 2002 and to comply with Conservation Measure 29/XVI, not Conservation Measure 29/XIX. • Japan (CCAMLR-XX/10) proposes to fish on ‘dates as established by CCAMLR’. Intent to comply with Conservation Measure 29/XIX not specified. Observer coverage to be provided by Japanese monitoring observer, contrary to the Convention and Conservation Measure 200/XIX. • South Africa (CCAMLR-XX/15) proposes to fish during a season to be established at CCAMLR-XX. States intent to comply with Conservation Measure 29/XIX, and to conduct line-weighting experiments, as approved by the Scientific Committee e.g. as per Conservation Measure 210/XIX (and Annex A). Proposal does not conflict with advice provided, assuming that fishing season is between 1 May and 31 August.

(continued)

Table 63 (continued)

Area	Risk Level	IMALF Risk Assessment (see SC-CAMLR-XX/BG/11)	Notes
88.1	3	<p>Average risk overall. Average risk in northern sector (<i>D. eleginoides</i> fishery), average to low risk in southern sector (<i>D. mawsoni</i> fishery).</p> <p>Longline fishing season limits of uncertain advantage.</p> <p>Ensure strict adherence to the provisions of Conservation Measures 29/XIX and 210/XX including Annex A.</p>	<ul style="list-style-type: none"> • Japan (CCAMLR-XX/10) proposes to fish on ‘dates as established by CCAMLR’. Intent to comply with Conservation Measure 29/XIX or Conservation Measure 210/XIX not specified. Observer coverage to be provided by Japanese monitoring observer, contrary to existing practice and Conservation Measure 200/XIX. • New Zealand (CCAMLR-XX/11) proposes to fish from 1 December 2001 to 31 August 2002. States intent to comply with Conservation Measures 29/XIX and 210/XIX. Proposal does not conflict with advice provided. • Russia (CCAMLR-XX/13) proposes to fish from 1 December 2001 to 31 August 2002. States intent to comply with Conservation Measure 29/XIX. Compliance with Conservation Measure 210/XIX not mentioned. • South Africa (CCAMLR-XX/15) – proposal does not conflict with advice provided. Fishing season to be as established at CCAMLR-XX. States intent to comply with Conservation Measure 29/XIX and to conduct line-weighting experiments, as approved by the Scientific Committee e.g. as per Conservation Measure 210/XIX (and Annex A).
88.2	1	<p>Low risk.</p> <p>No obvious need for restriction of longline fishing season.</p> <p>Apply Conservation Measure 29/XIX as a seabird by-catch precautionary measure.</p>	<ul style="list-style-type: none"> • Japan (CCAMLR-XX/10) proposes to fish on ‘dates as established by CCAMLR’. Intent to comply with Conservation Measure 29/XIX not specified. Observer coverage to be provided by Japanese monitoring observer, contrary to existing practice and Conservation Measure 200/XIX. • New Zealand (CCAMLR-XX/11) proposes to fish from 1 December 2001 to 31 August 2002. States intent to comply with Conservation Measures 29/XIX and 210/XIX. Proposal does not conflict with advice provided. • Russia (CCAMLR-XX/14) proposes to fish from 1 December 2001 to 31 August 2002. States intent to comply with Conservation Measure 29/XIX. Compliance with Conservation Measure 210/XIX not mentioned. • South Africa (CCAMLR-XX/15) – proposal does not conflict with advice provided. Fishing season to be as established at CCAMLR-XX. States intent to comply with Conservation Measure 29/XIX and to conduct line-weighting experiments, as approved by the Scientific Committee e.g. as per Conservation Measure 210/XIX (and Annex A).

Table 64: Marine mammal incidental mortality and interactions with fishing operations reported by observers during the 2000/01 season. Y – yes; N – No; DLP – dolphin; KIW – killer whale; SPW – sperm whale; SEA – Antarctic fur seal; MIW – minke whale; UNK – unknown. Nationality: AUS – Australia, CHL – Chile, ESP – Spain, GBR – United Kingdom, KOR – Republic of Korea, NZL – New Zealand, RUS – Russia, UKR – Ukraine, URY – Uruguay, USA – United States of America, ZAF – South Africa.

Vessel Name (Nationality)	Dates of Trip	Observation Reported	Mammal Killed	(Species) Entangled	Fish Loss Observed (Species)
Subarea 48.3					
<i>Argos Georgia</i> (GBR)	17/1–25/2/01	Y	N	N	N
<i>Argos Georgia</i> (GBR)	23/4–2/8/01	Y	N	N	Y (KIW, SPW)
<i>Argos Helena</i> (GBR)	12/1–11/3/01	Y	N	N	N
<i>Argos Helena</i> (GBR)	3/5–29/8/01	Y	N	N	Y (SEA)
<i>Argos Helena</i> (GBR)	2/4–28/4/01	Y	N	N	N
<i>Argos Vigo</i> (GBR)	21/12–26/12/00	Y	N	N	N
<i>Argos Vigo</i> (GBR)	1/2–20/2/01	Y	N	N	N
<i>Betanzos</i> (CHL)	26/11/00–27/2/01	Y	N	N	N
<i>Ibsa Quinto</i> (ESP)	25/4–16/7/01	Y	N	N	Y (KIW)
<i>In Sung 66</i> (KOR)	26/4–7/7/01	Y	N	Y (SEA)	Y
<i>In Sung 66</i> (KOR)	7/7–6/9/01	Y	N	N	N
<i>In Sung 707</i> (KOR)	6/6–1/7/01	Y	N	N	N
<i>Isla Alegranza</i> (URY)	28/4–5/9/01	Y	N	N	Y (SPW, KIW)
<i>Isla Camila</i> (CHL)	1/5–29/5/01	Y	N	N	N
<i>Isla Camila</i> (CHL)	8/6–17/8/01	Y	N	N	N
<i>Isla Santa Clara</i> (CHL)	25/4–1/7/01	Y	N	N	N
<i>Isla Santa Clara</i> (CHL)	1/7–24/7/01	Y	N	N	N
<i>Koryo Maru 11</i> (ZAF)	19/4–13/9/01	Y	N	N	Y (KIW, SEA)
<i>Maria Tamara</i> (CHL)	30/6–31/8/01	Y	N	N	N
<i>No. 1 Moresko</i> (KOR)	1/5–12/7/01	Y	N	Y (SPW)	N
<i>No. 1 Moresko</i> (KOR)	13/7–6/9/01	Y	N	N	N
<i>Polarpesca I</i> (CHL)	7/6–27/8/01	Y	N	N	Y (SPW)
<i>RK-1</i> (UKR)	21/4–23/6/01	Y	N	N	N
<i>RK-1</i> (UKR)	23/6–5/9/01	Y	N	N	N
<i>Rutsava</i> (RUS)	25/4–12/6/01	Y	N	N	N
<i>Saint Denis</i> (FRA)	6/12/00–18/1/01	Y	N	N	N
<i>Sil</i> (GBR)	1/6–13/6/01	Y	N	N	N
<i>Ural</i> (RUS)	22/4–22/8/01	Y	N	N	Y (KIW)
<i>Viking Bay</i> (ESP)	13/5–31/8/01	Y	N	N	Y (KIW, SEA)
<i>Viking Sky</i> (GBR)	16/3–4/4/01	Y	N	N	N
<i>Viking Sky</i> (URY)	18/5–12/7/01	Y	N	N	N
<i>Zakhar Sorokin</i> (RUS)	22/8–14/9/01	Y	N	N	N
Subarea 58.6 and 58.7					
<i>Aquatic Pioneer</i> (ZAF)	20/9–20/11/00	Y	N	N	Y
<i>Eldfisk</i> (ZAF)	2/9–12/11/00	Y	N	Y (SPW)	Y (KIW, SPW)
<i>Eldfisk</i> (ZAF)	29/11/00–3/1/01	Y	N	N	Y
<i>Eldfisk</i> (ZAF)	5/5–11/7/01	Y	N	N	Y (KIW, SPW)
<i>Eldfisk</i> (ZAF)	4/8–6/9/01	Y	N	N	Y (KIW, SPW)
<i>Isla Graciosa</i> (ZAF)	2/10–17/12/00	Y	N	N	Y (KIW, SPW)
<i>Isla Graciosa</i> (ZAF)	28/3–1/6/01	Y	N	N	N
<i>Isla Graciosa</i> (ZAF)	11/6–7/8/01	Y	N	N	Y (KIW, SPW)
<i>Koryo Maru 11</i> (ZAF)	16/10–6/12/00	Y	N	N	Y (KIW, SPW)
<i>Koryo Maru 11</i> (ZAF)	24/1–9/4/01	Y	N	N	Y (KIW)
<i>Suidor One</i> (ZAF)	24/7–17/9/00	Y	Y (UNK)	Y	N

(continued)

Table 64 (continued)

Vessel Name (Nationality)	Dates of Trip	Observation Reported	Mammal Killed	(Species) Entangled	Fish Loss Observed (Species)
Subarea 88.1					
<i>Eldfisk</i> (ZAF)	20/2–17/3/01	Y	N	N	N
<i>Isla Gorriti</i> (URY)	14/1–19/3/01	Y	N	N	N
<i>Isla Graciosa</i> (ZAF)	25/2–27/3/01	Y	N	N	N
<i>Janas</i> (NZL)	1/1–3/4/01	Y	N	N	N
<i>San Aotea II</i> (NZL)	2/1–23/5/01	Y	N	N	N
<i>Sonrisa</i> (NZL)	6/1–1/3/01	Y	N	Y (MIW)	N
Division 58.5.2					
<i>Austral Leader</i> (AUS)	12/8–19/10/00	Y	Y (SEA)	Y (SEA)	N
<i>Austral Leader</i> (AUS)	11/5–26/6/01	Y	N	N	N
<i>Austral Leader</i> (AUS)	27/2–7/5/01	Y	N	Y (SEA)	N
<i>Southern Champion</i> (AUS)	9/10–3/11/00	Y	N	N	N
Division 58.4.2					
<i>Austral Leader</i> (AUS)	20/12/00–23/2/01	N			
Subarea 48.1					
<i>Top Ocean</i> (USA)	25/5–3/7/01	Y	N	N	N

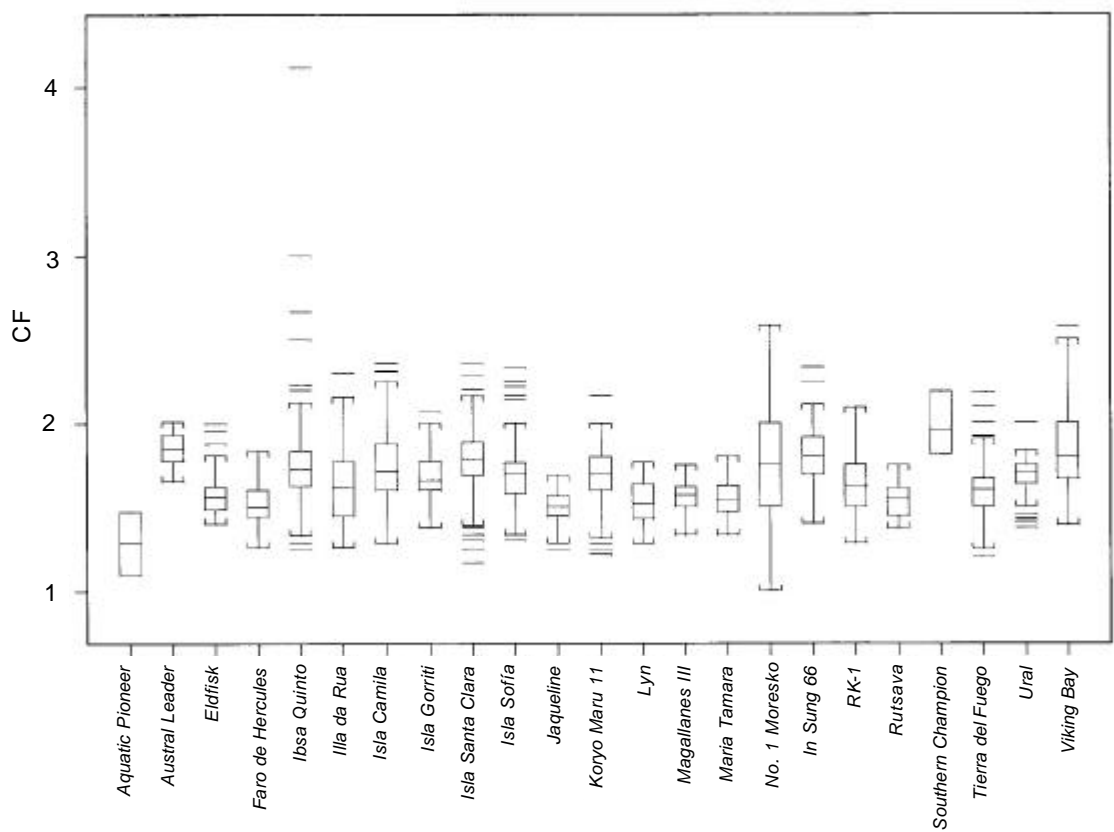


Figure 1: Box plot of CFs obtained by scientific observers on board vessels fishing in the Convention Area. CFs refer to headed and gutted (HAG) and headed, gutted and tailed (HGT) products.

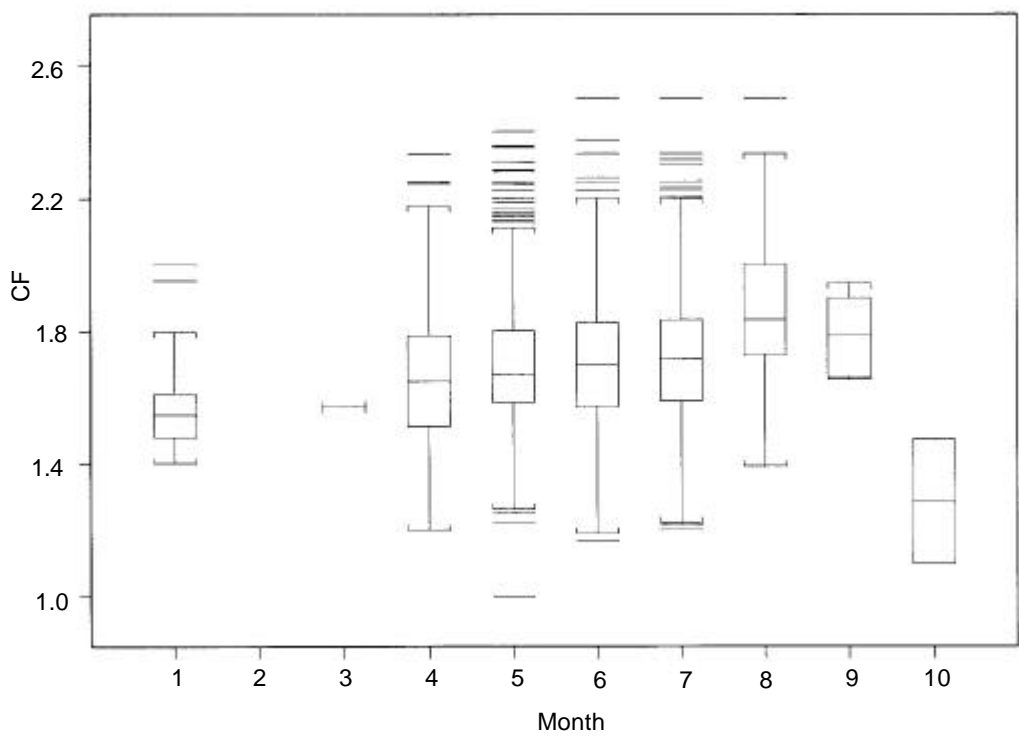


Figure 2: Box plots of monthly CFs obtained by scientific observers. CFs refer to headed and gutted (HAG) and headed, gutted and tailed (HGT) products.

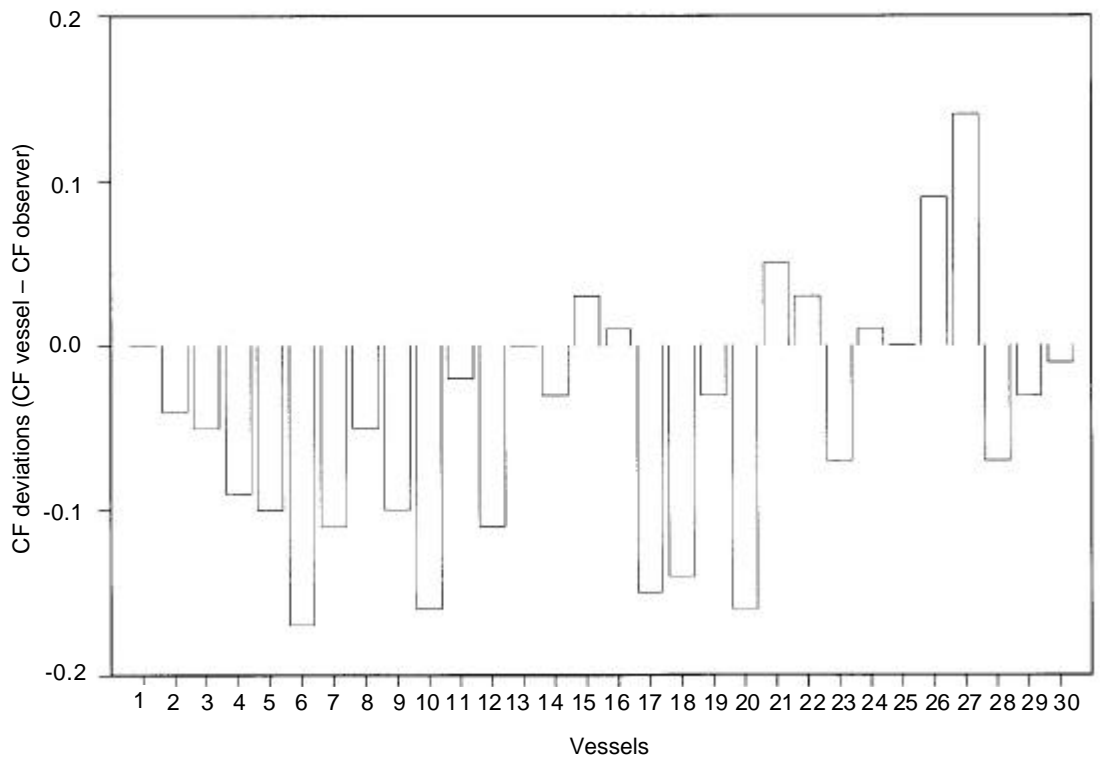


Figure 3: Deviations of CFs obtained by scientific observers and by vessel skippers during the 2000/01 fishing season.

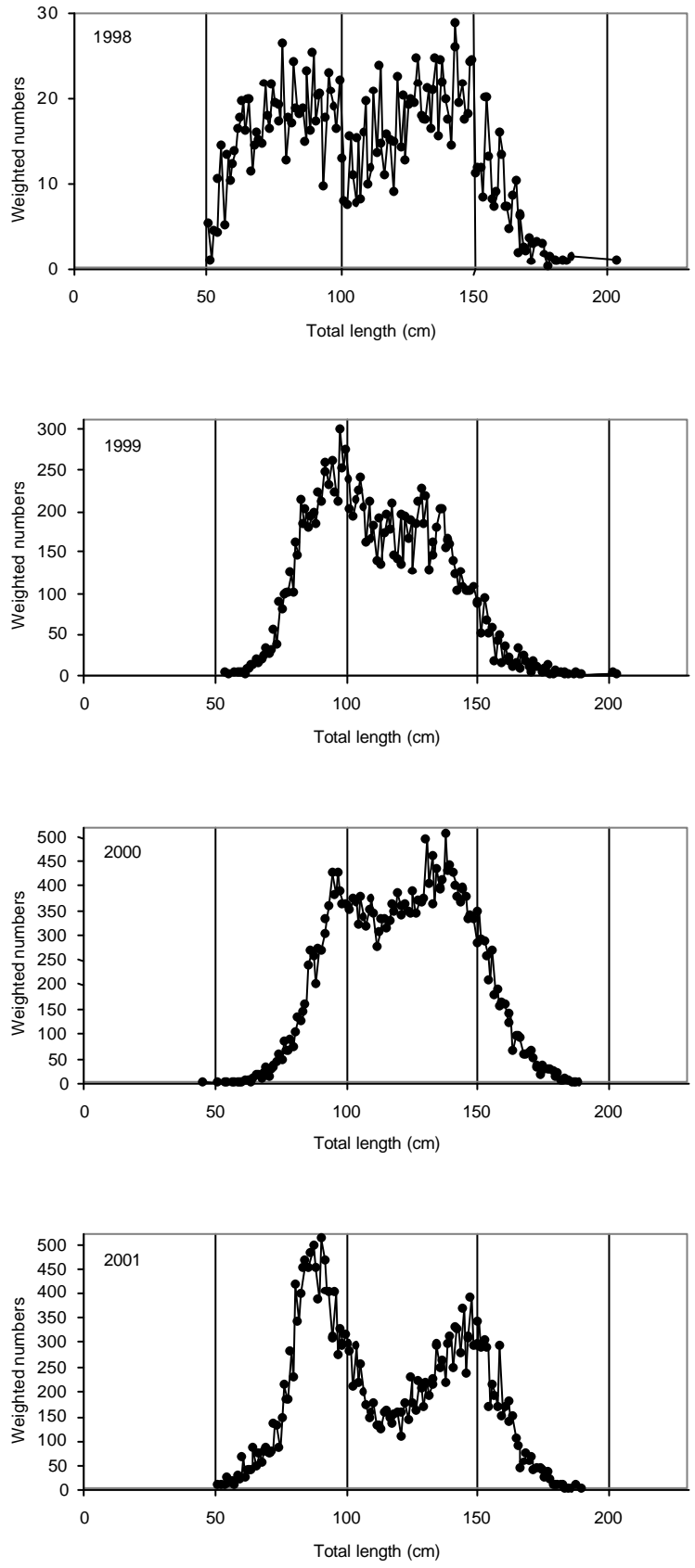


Figure 4: Catch-weighted length frequencies of *Dissostichus mawsoni* by year in the exploratory longline fishery in Subarea 88.1.

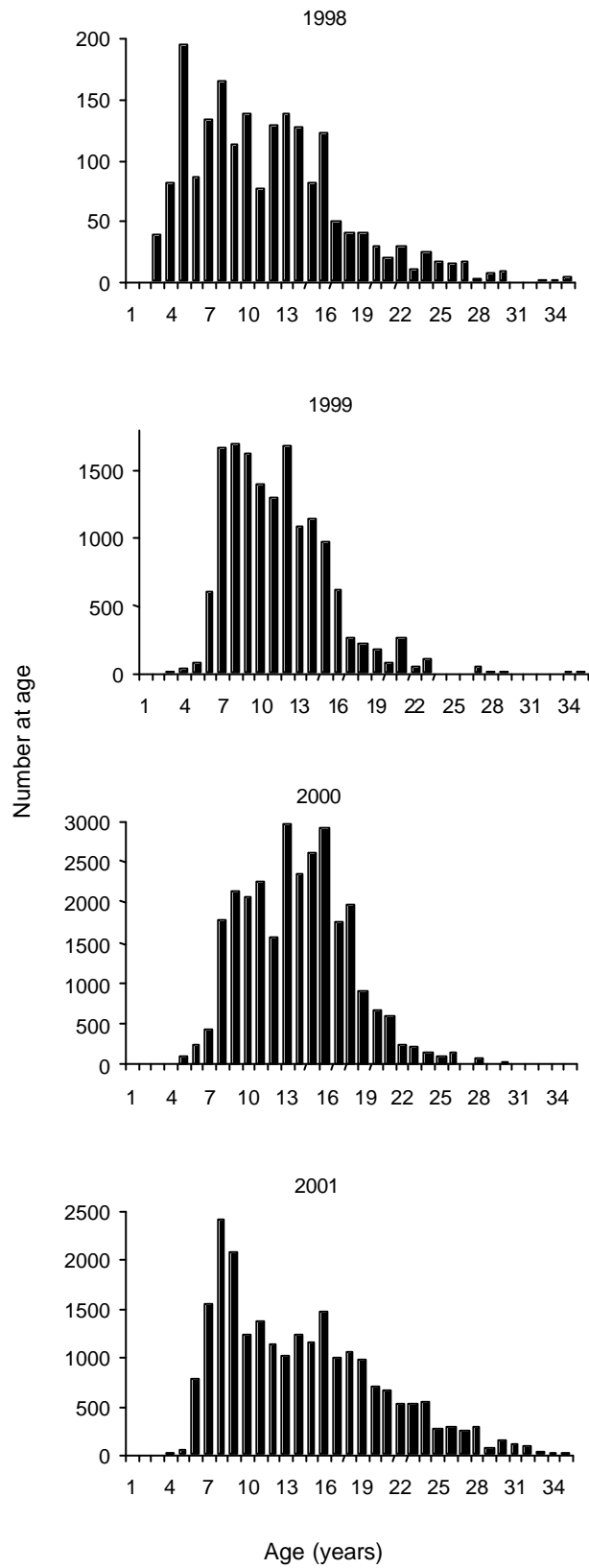


Figure 5: Estimated numbers at age of *Dissostichus mawsoni* by year in the exploratory longline fishery in Subarea 88.1.

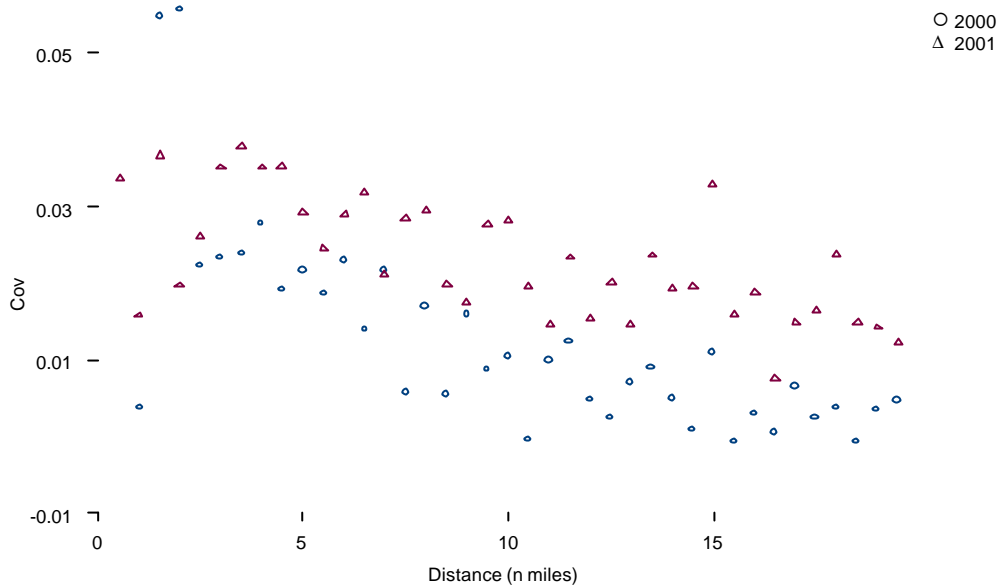


Figure 6: The covariogram of CPUE of *Dissostichus mawsoni* in Subarea 88.1 in 2000 and 2001.

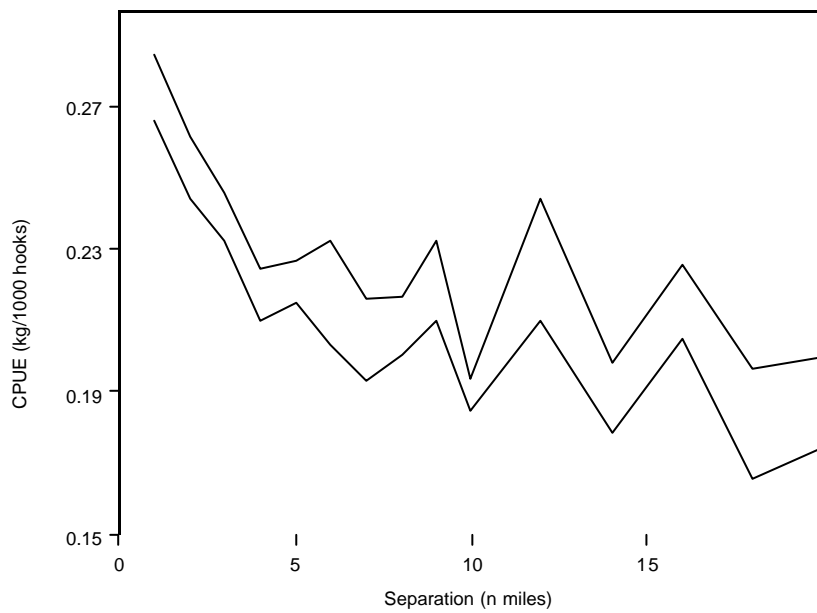


Figure 7: The result of sampling at different densities for *D. mawsoni* in Subarea 88.1. The top line is the CPUE from the sample (total catch over total effort), the bottom is the average of the CPUEs from each catch.

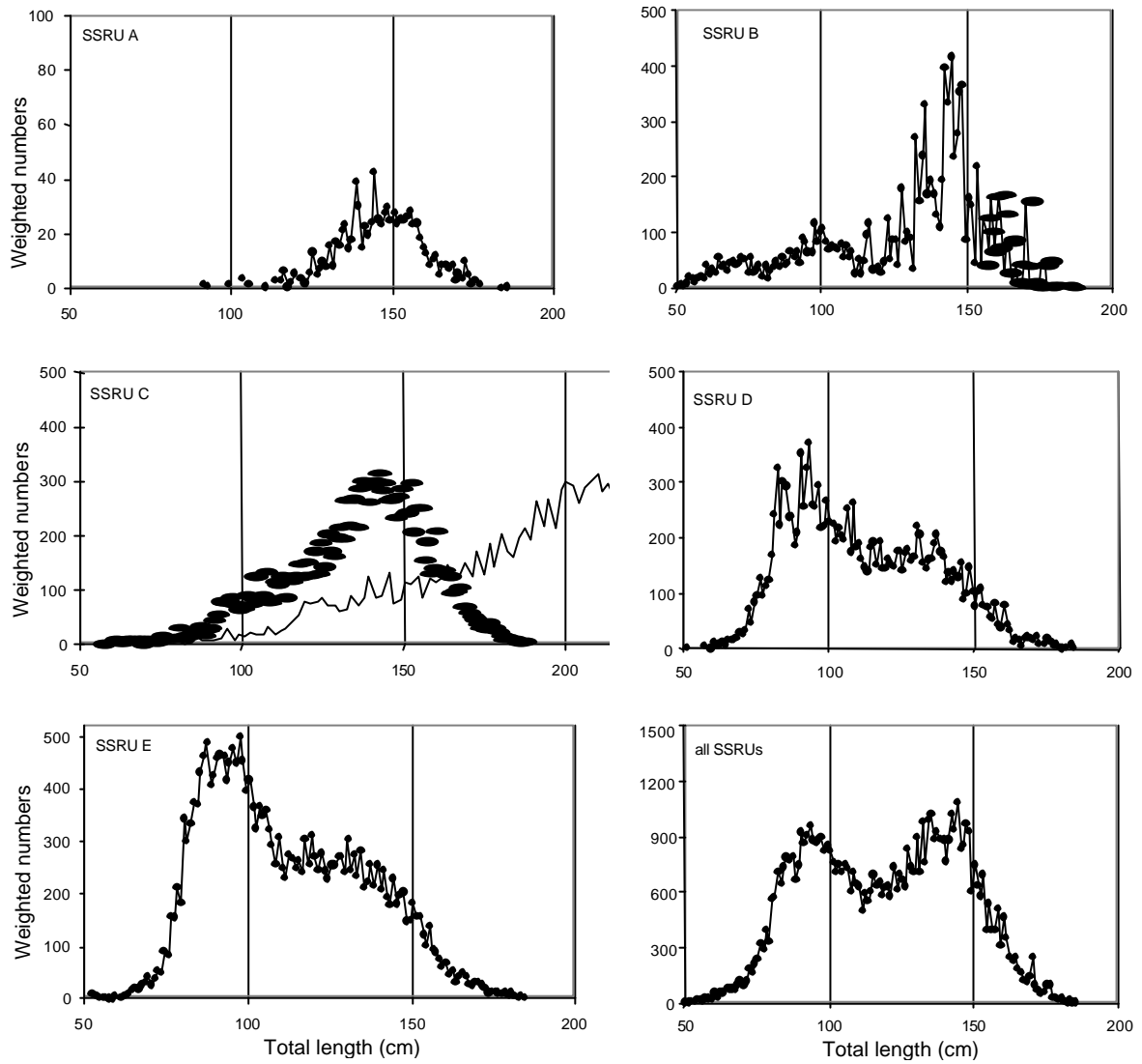


Figure 8: Scaled length-frequency distributions of *Dissostichus mawsoni* in Subarea 88.1 by SSRU.

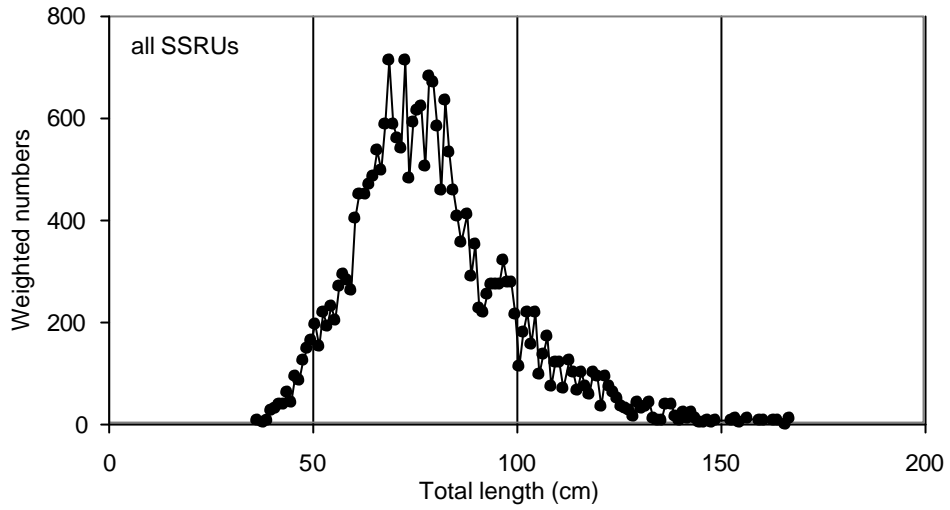


Figure 9: Catch-weighted length frequency for *Dissostichus eginoides* caught by longline in Division 58.4.4 in the 2000 season for all SSRUs combined.

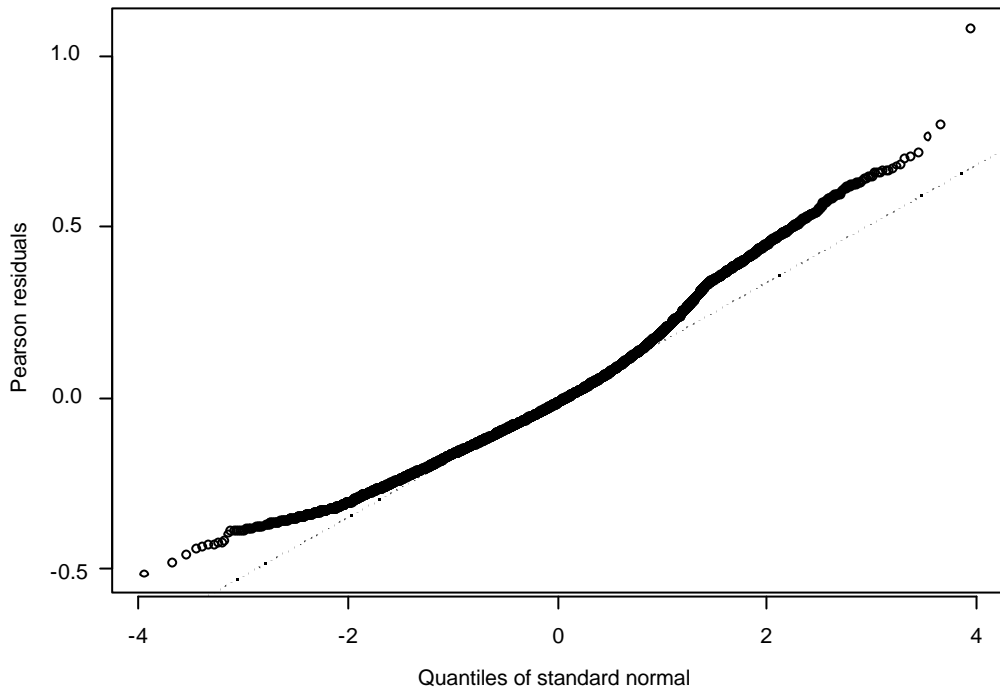


Figure 10: QQ plot of standardised residuals for the GLM fitted to CPUEs (kg/hook), for *Dissostichus eleginoides* in Subarea 48.3 using a robust GLM with the quasi distribution and a square root link.

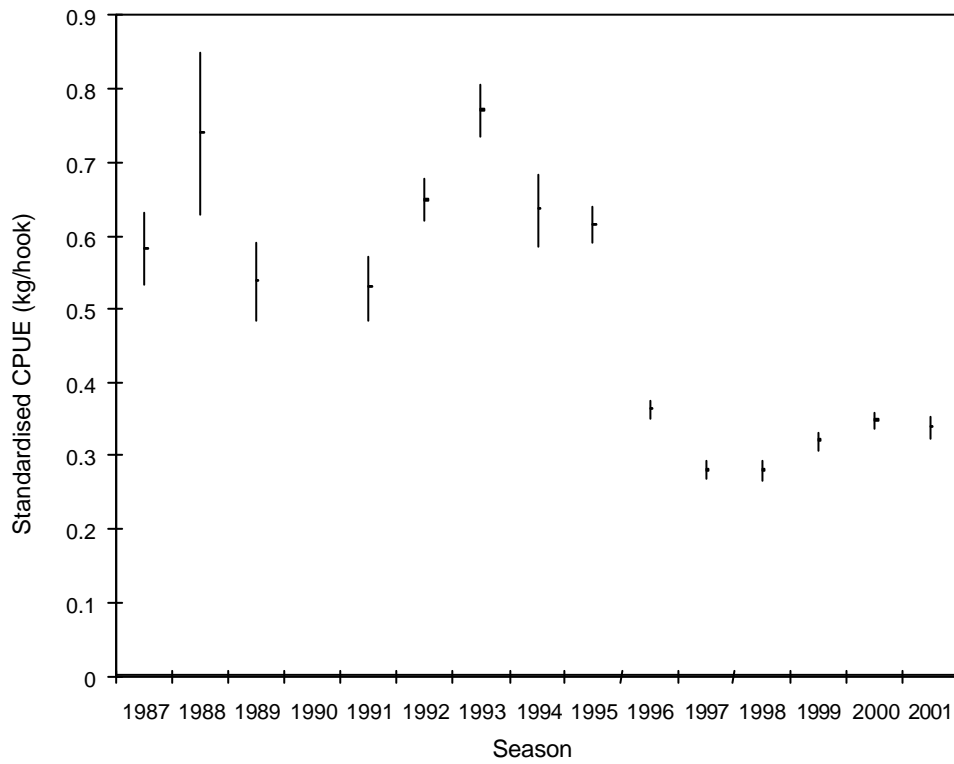


Figure 11: Standardised CPUEs and 95% confidence intervals in kg/hook for *Dissostichus eleginoides* in Subarea 48.3.

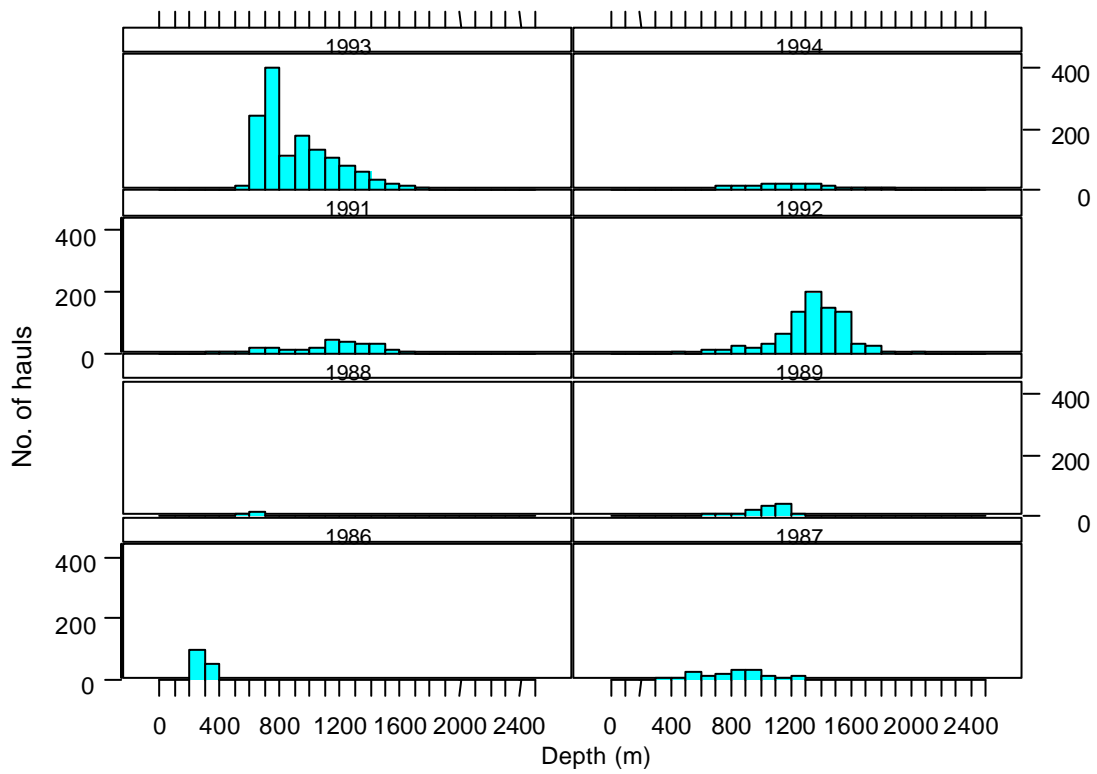
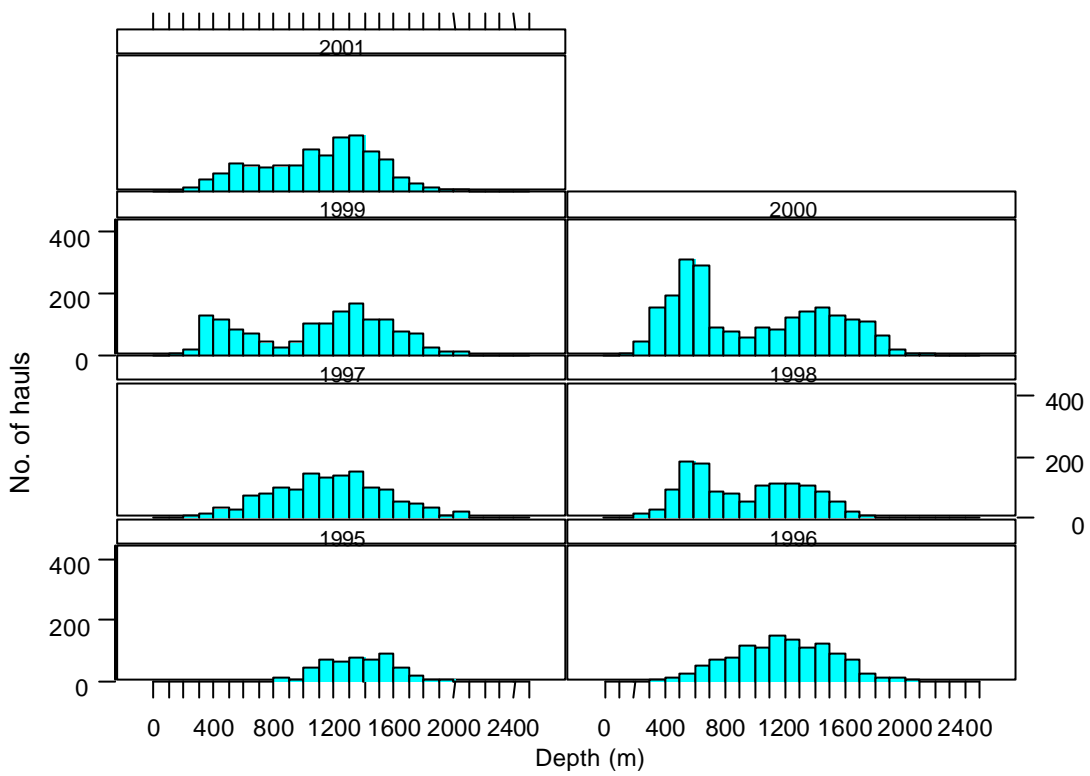


Figure 12: Histograms of number of hauls by depths fished by season for *Dissostichus eleginoides* in Subarea 48.3.

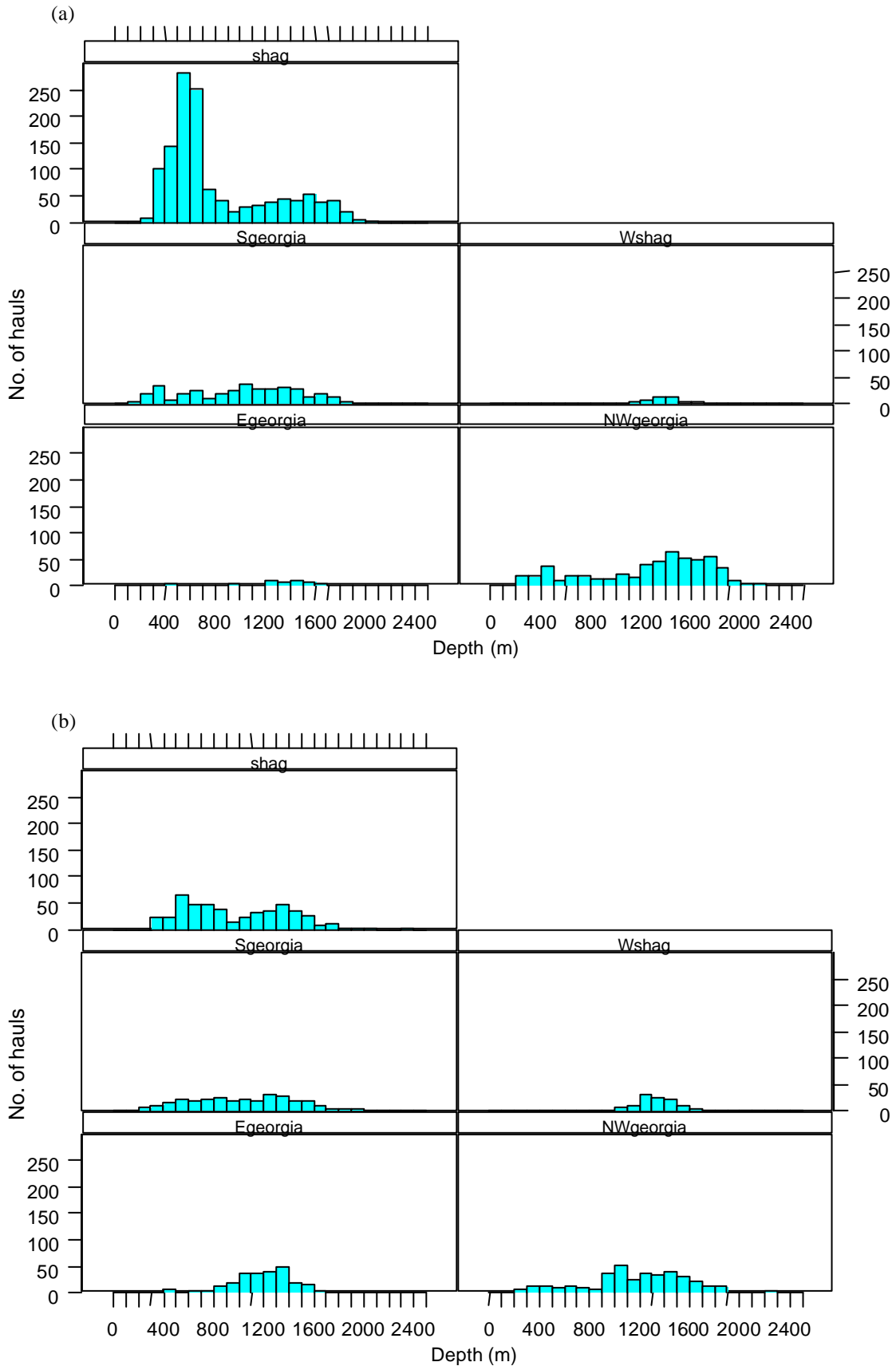


Figure 13: Depth distributions of effort for *Dissostichus eleginoides* around South Georgia for (a) the 1999/2000 season, and (b) for the 2000/01 season.

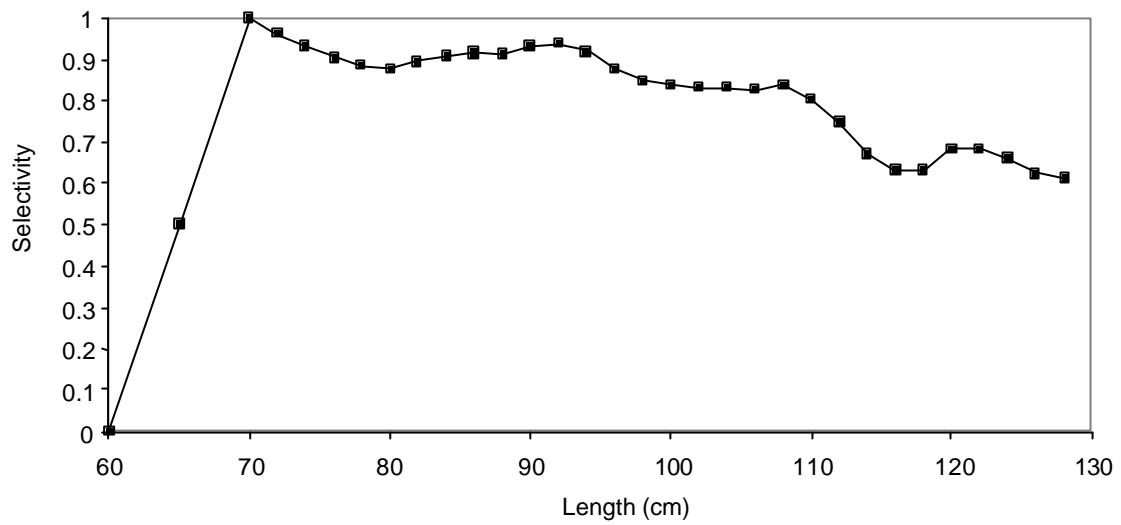


Figure 14: Average length-specific vulnerabilities for *Dissostichus eleginoides* in Subarea 48.3 from 1988 to 2001.

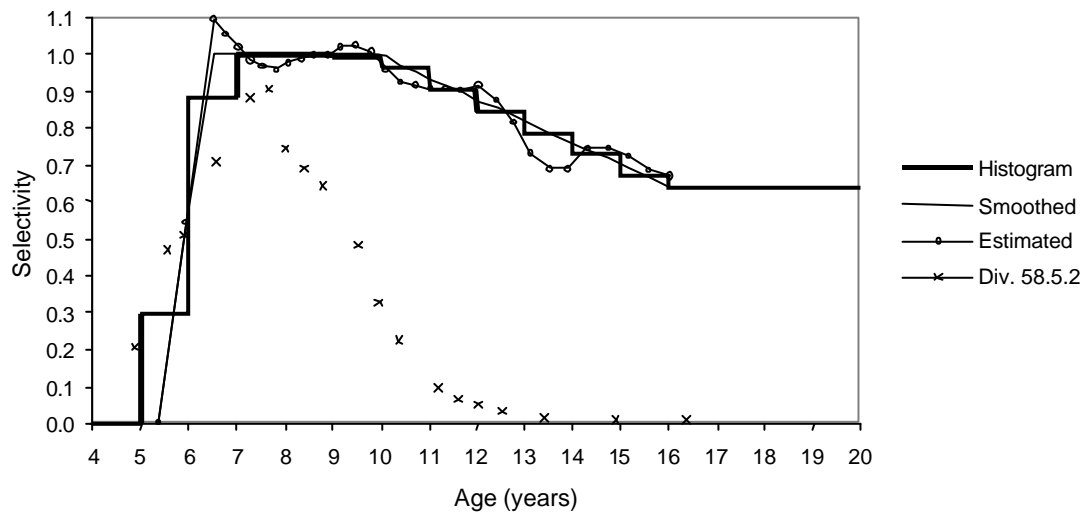


Figure 15: Average age-specific vulnerabilities for *Dissostichus eleginoides* in Subarea 48.3 from 1988 to 2001.

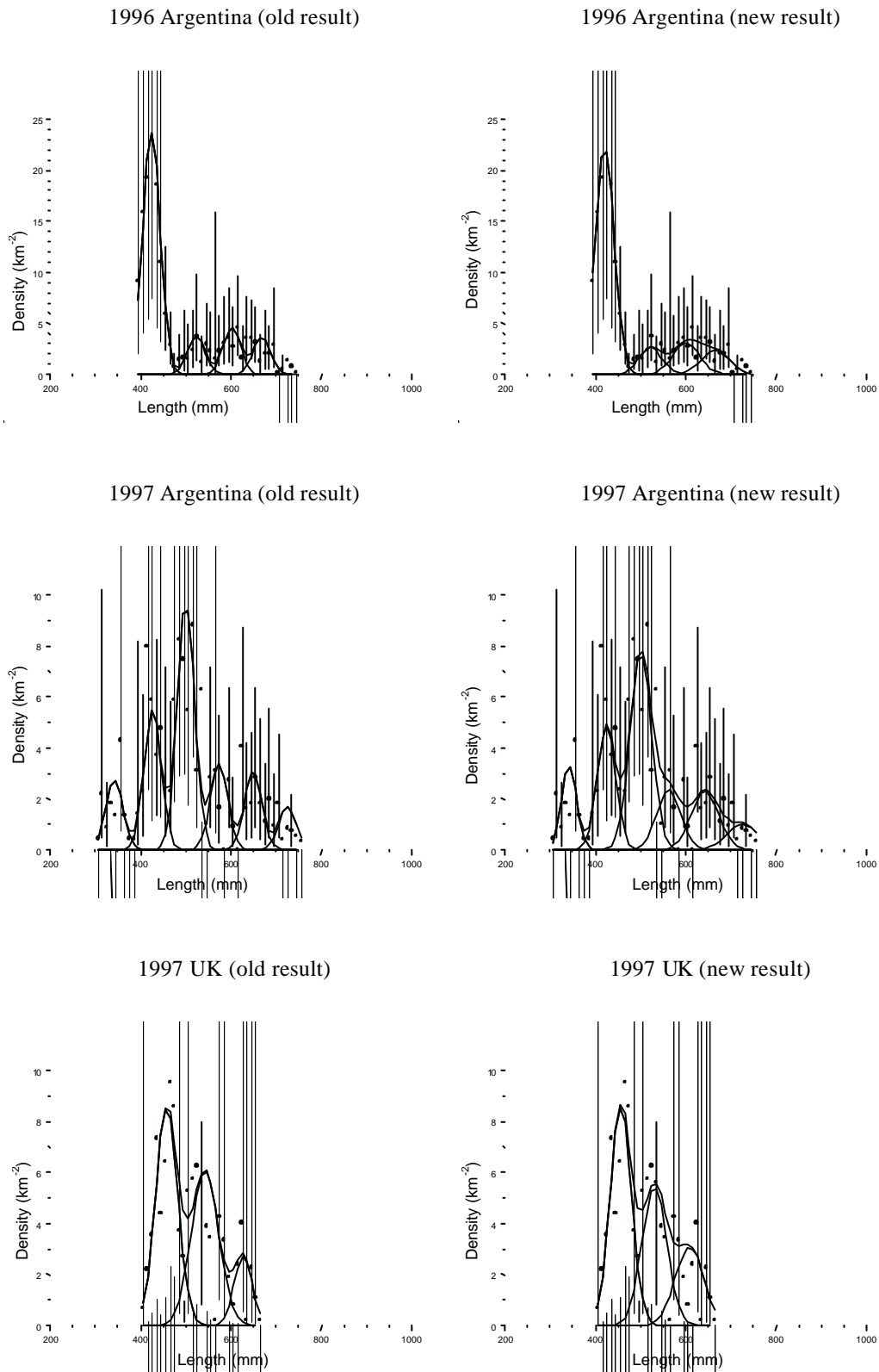


Figure 16: Revised assessments of cohort strength for three surveys of *Dissostichus eleginoides* at South Georgia, based on the 1999 analysis and growth parameters with a von Bertalanffy $K = 0.066$.

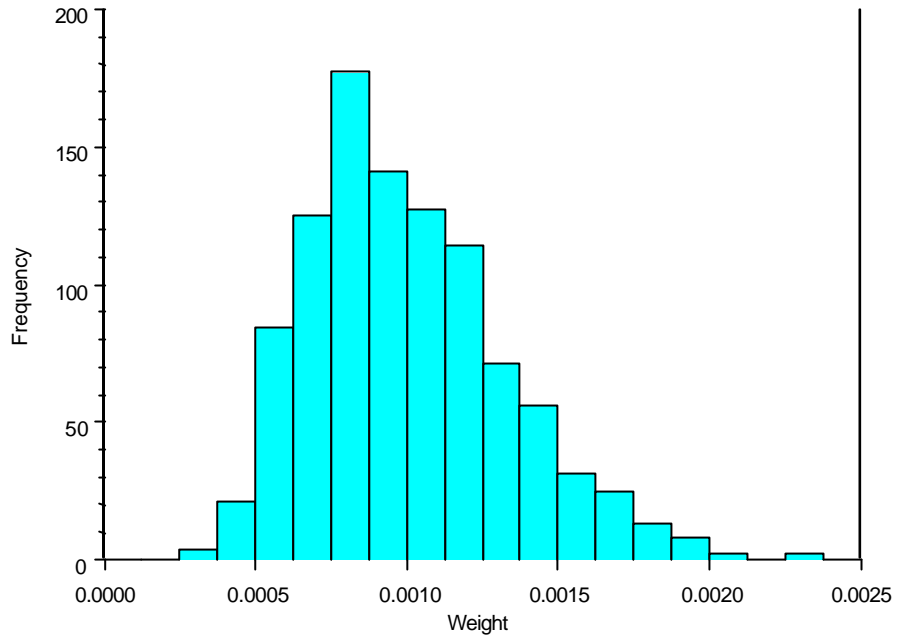


Figure 17: Histogram of estimated statistical weights based on the standardised CPUE series for Subarea 48.3 GYM trajectories of *Dissostichus eleginoides*.

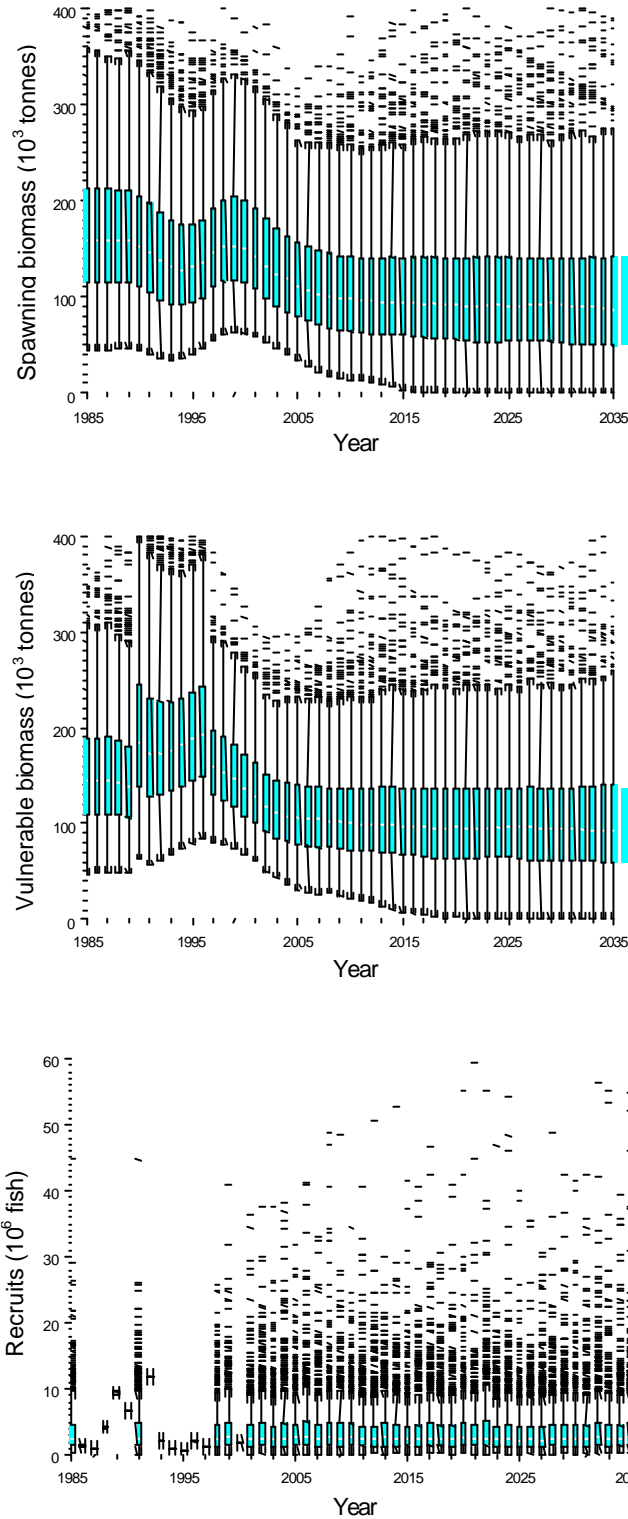


Figure 18: Time series of spawning biomass, vulnerable biomass and recruitments summarised from a GYM assessment of constant annual yield (5 820 tonnes) for *Dissostichus eleginoides* in Subarea 48.3. Each box and whisker plot summarises the status of the variable for a year over 1001 trials. The recruitment and known catch period are up to and including 2001. The remaining period is the forward projection for determining yield. The constant annual yield taken in this projection is 5 820 tonnes.

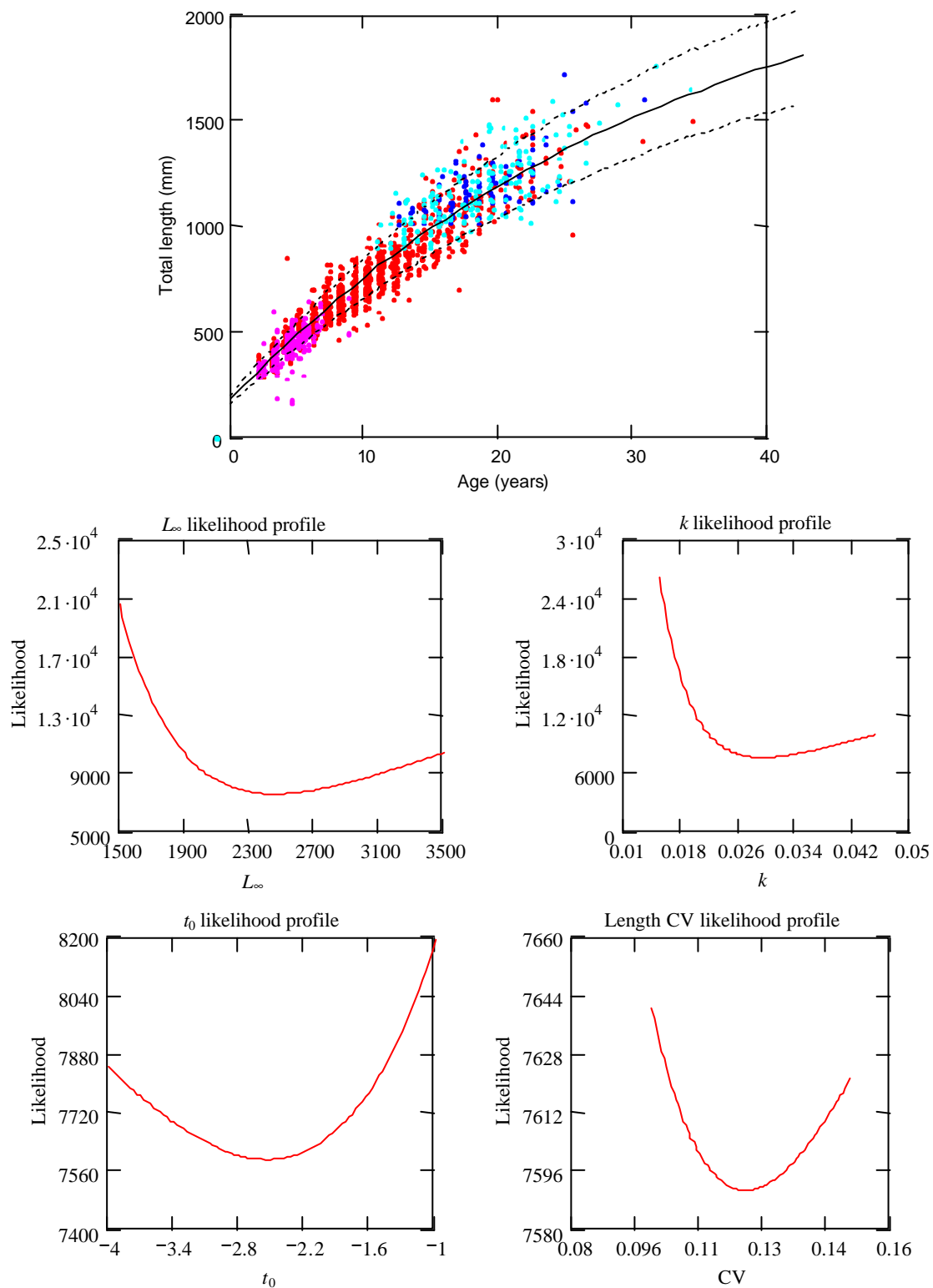


Figure 19: Length at age for *Dissostichus eleginoides* in Division 58.5.2. Data are from commercial and research voyages since 1990. The von Bertalanffy growth curve has the parameters: $L_\infty = 2465$ mm, $K = 0.029$ year⁻¹, $t_0 = -2.46$ years. Likelihood profiles are shown to indicate how well each parameter is estimated (a flat bottom profile shows a large error around the estimate).

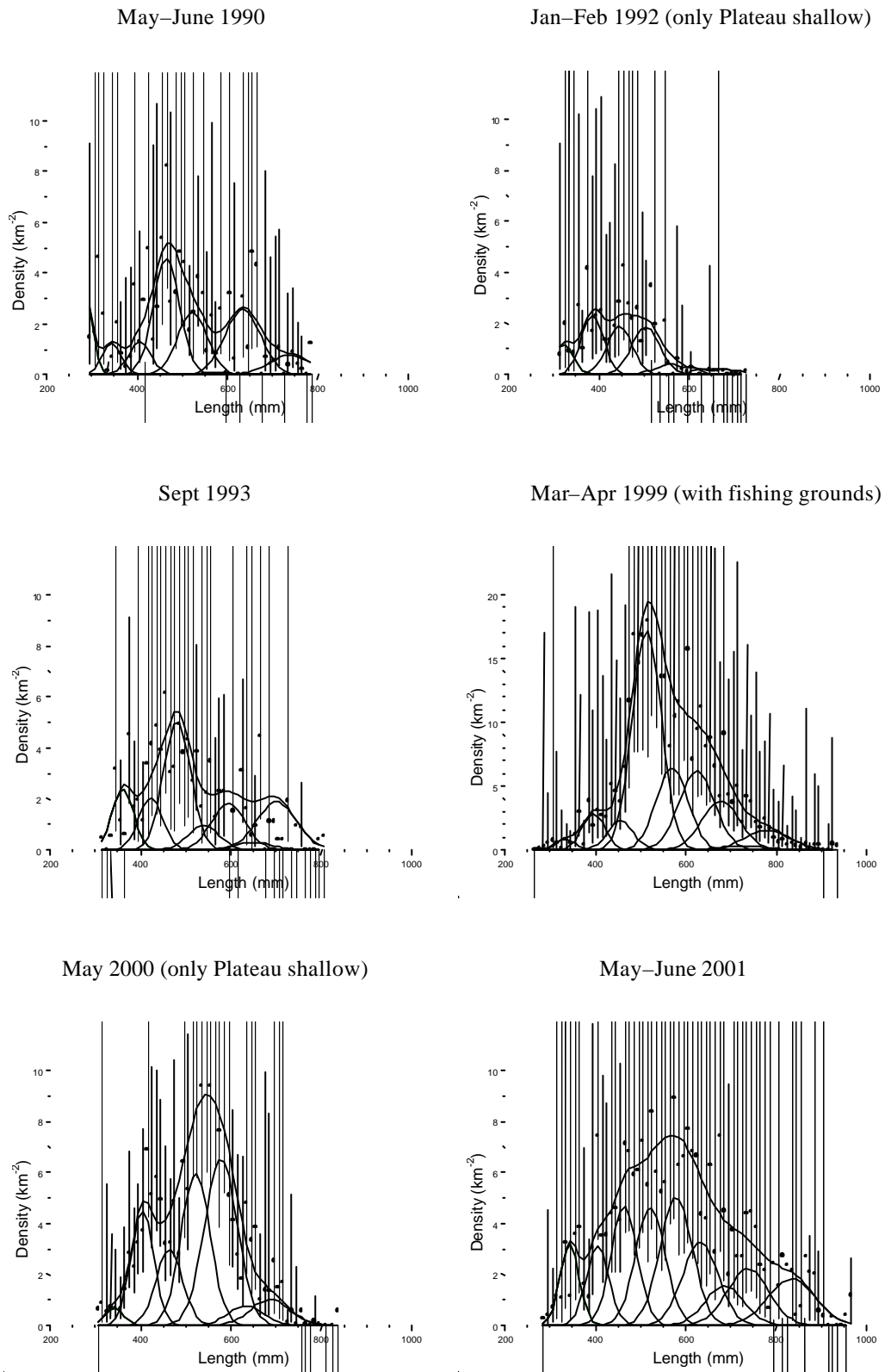


Figure 20: Results of mixture analyses estimating cohort densities of *Dissostichus eleginoides* sampled in research voyages in Division 58.5.2. Mean lengths at age of these analyses are based on growth parameters $L_{\infty} = 2\,465$ mm, $K = 0.029$ and $t_0 = -2.54$ years (see WG-FSA-01/73 for a description of the method).

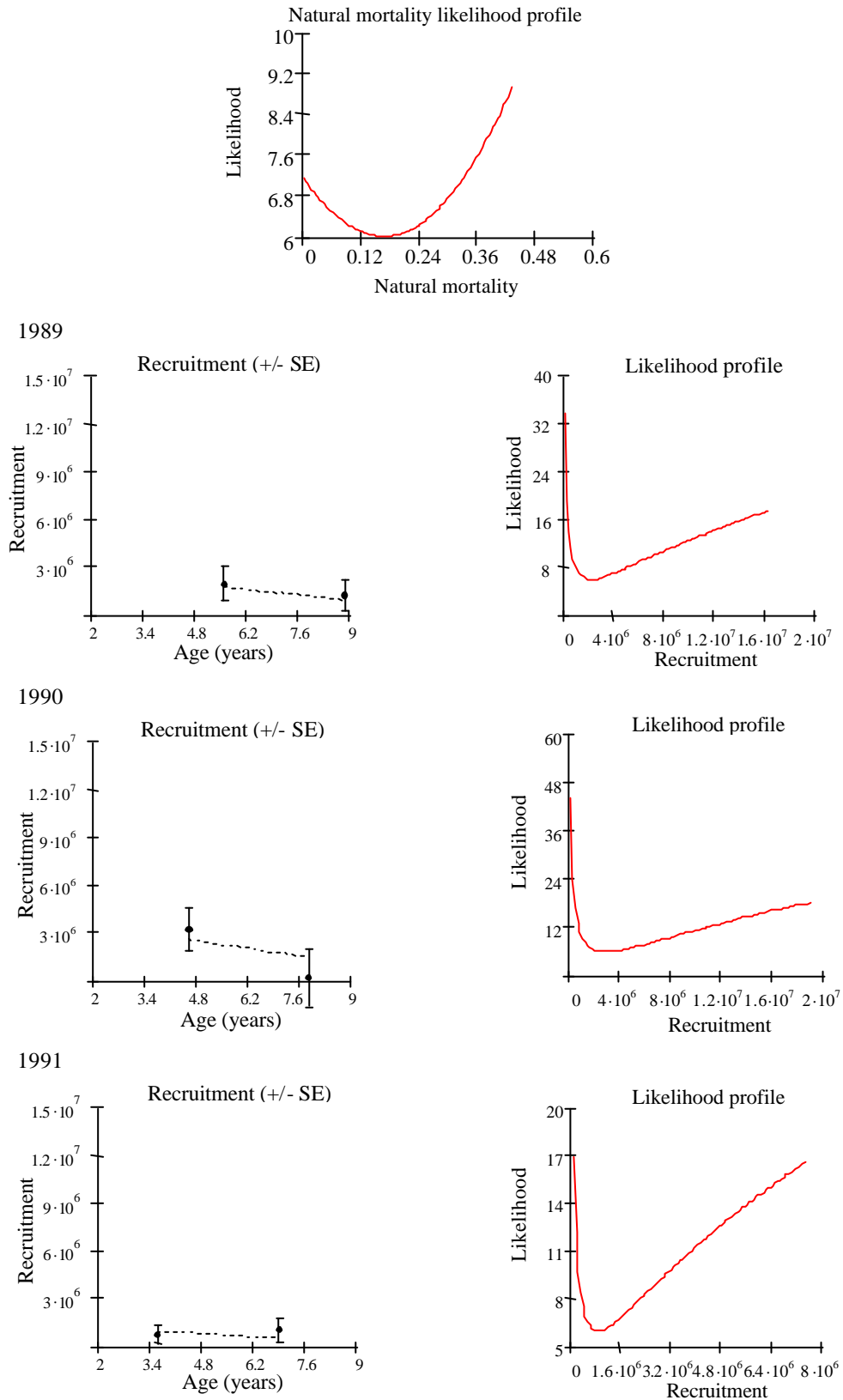


Figure 21: Estimated projections of three cohorts used to estimate natural mortality (0.165 year^{-1}) in *Dissostichus eginoides* in Division 58.5.2. Cohorts were observed in both the 1990 and 1993 surveys. The likelihood profiles for each estimated parameter are shown.

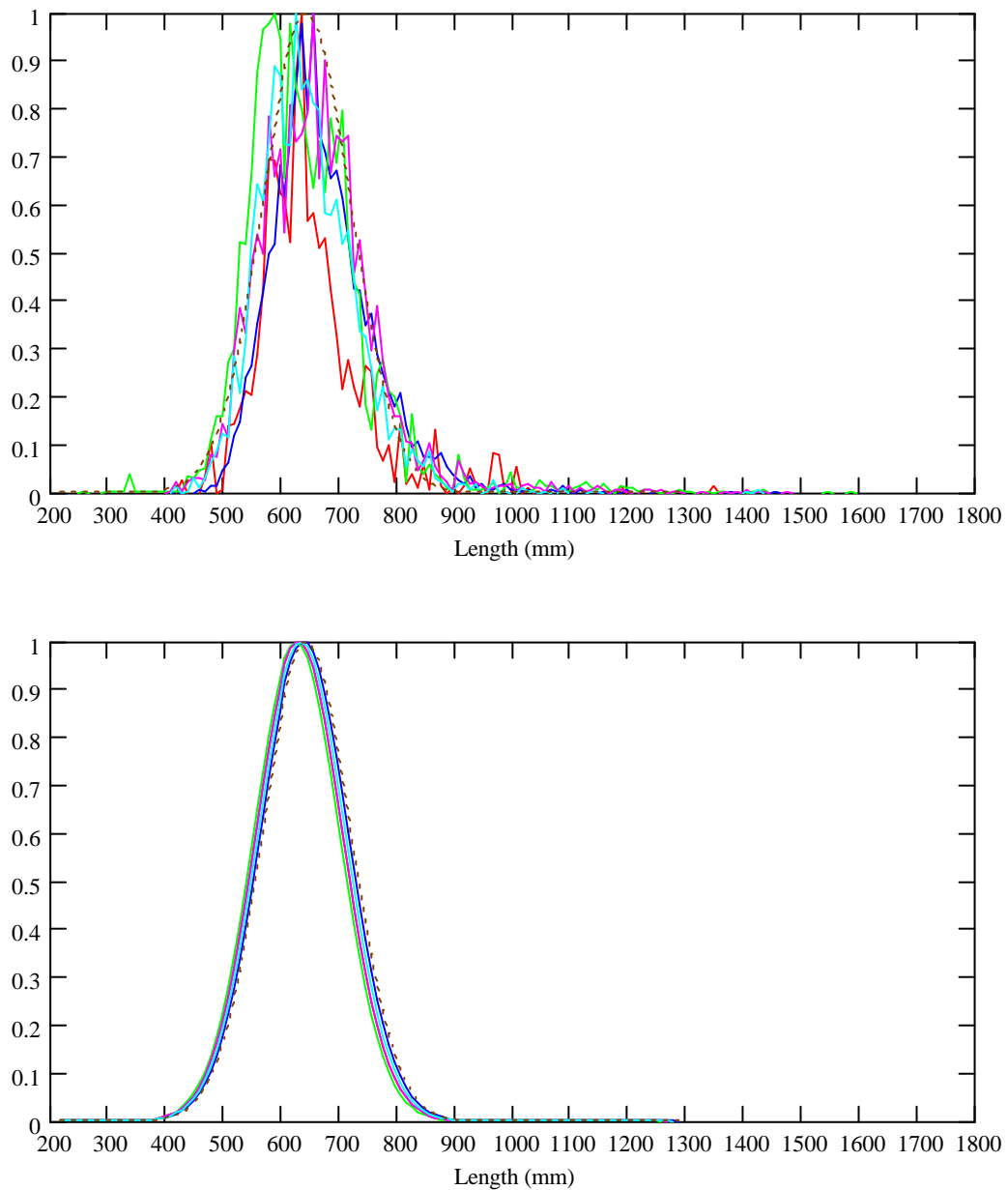


Figure 22: Catch-weighted length frequencies (top panel) for each of four years for *Dissostichus eleginoides* in the trawl fishery in Division 58.5.2. Each line represents a voyage of approximately eight weeks duration. The lower panel for each year is the estimated age-based fishing vulnerability function plotted as it is represented at the time of each voyage. (See WG-FSA-01/73 for details of the method.)

(continued)

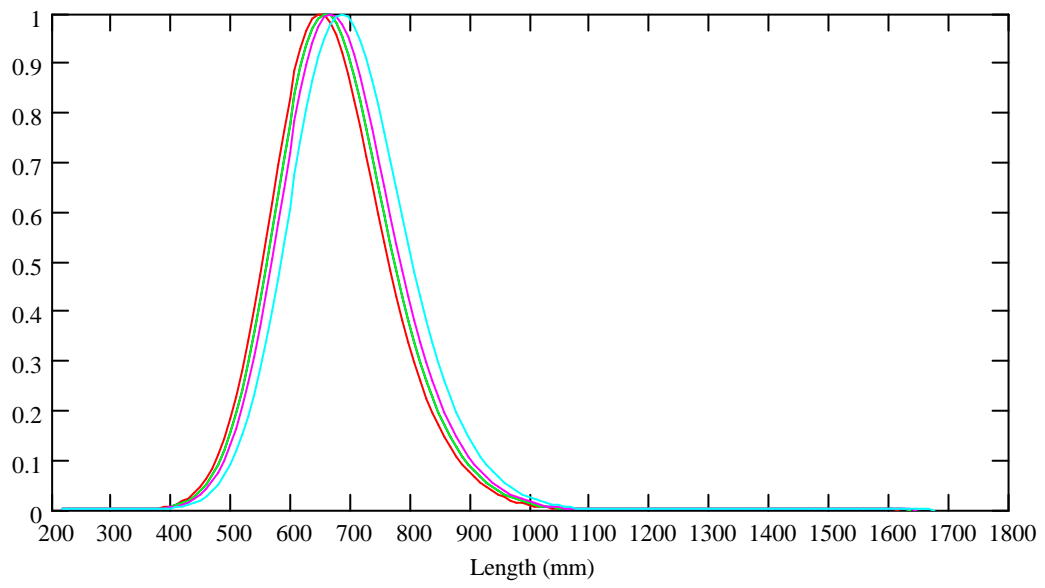
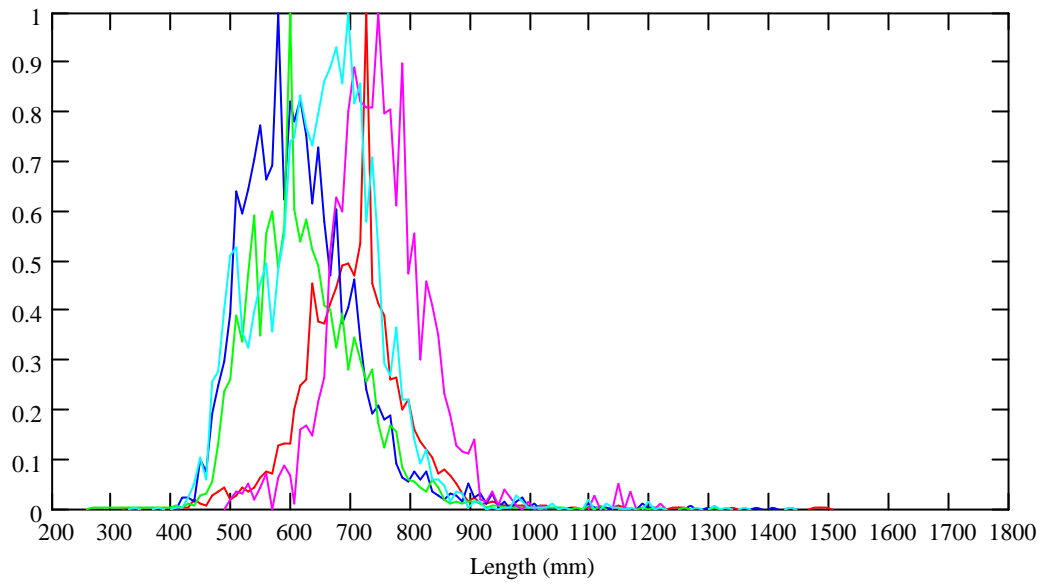


Figure 22 (continued)

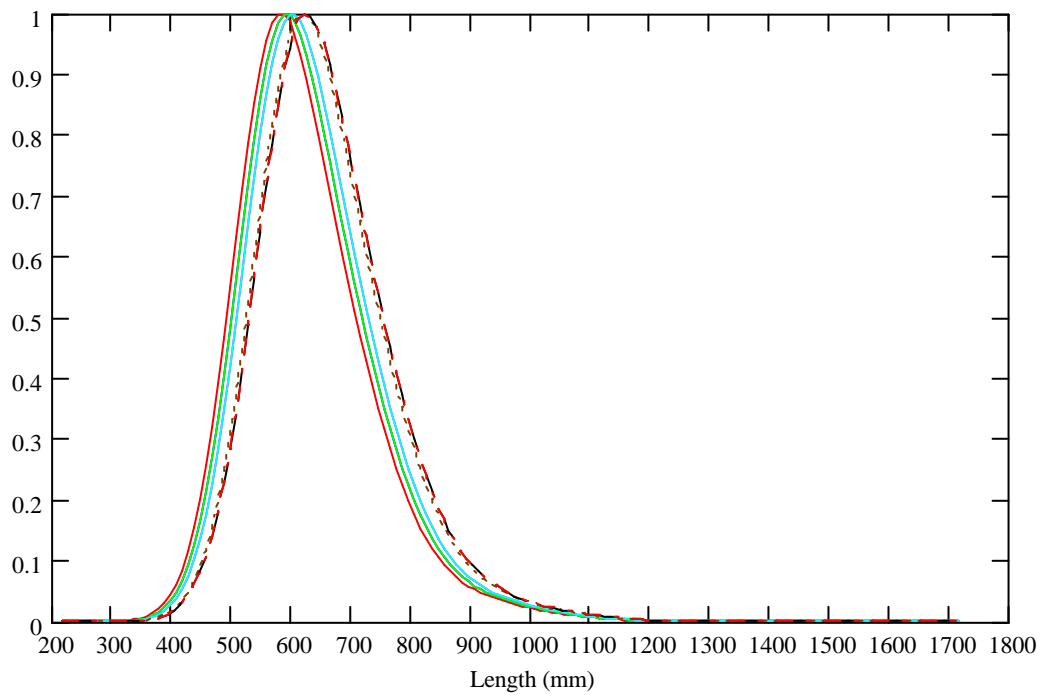
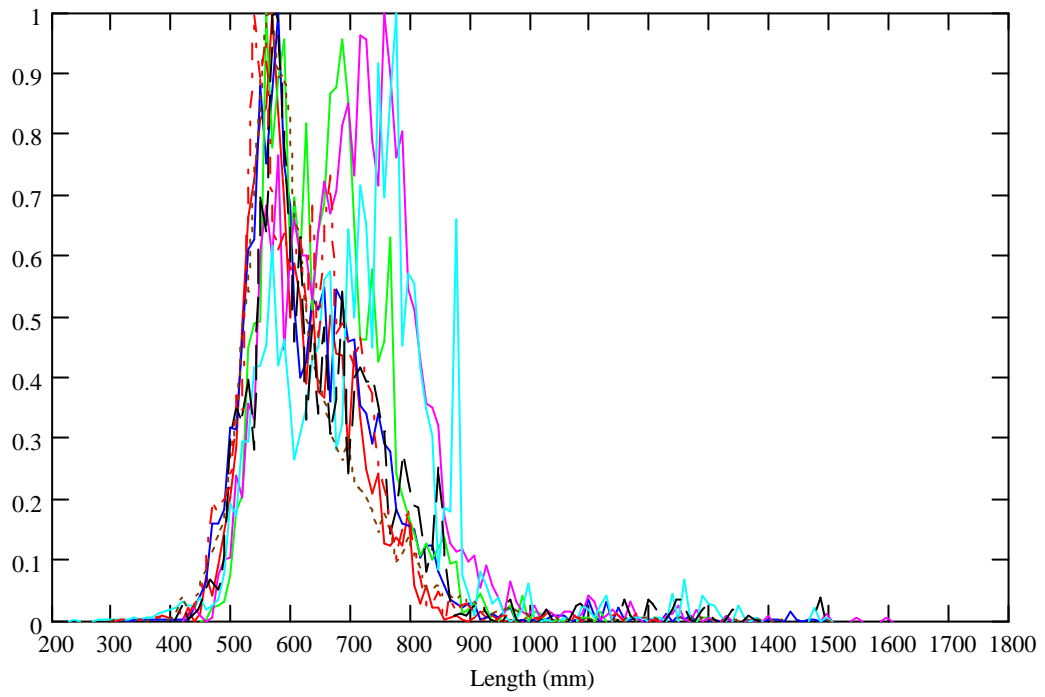


Figure 22 (continued)

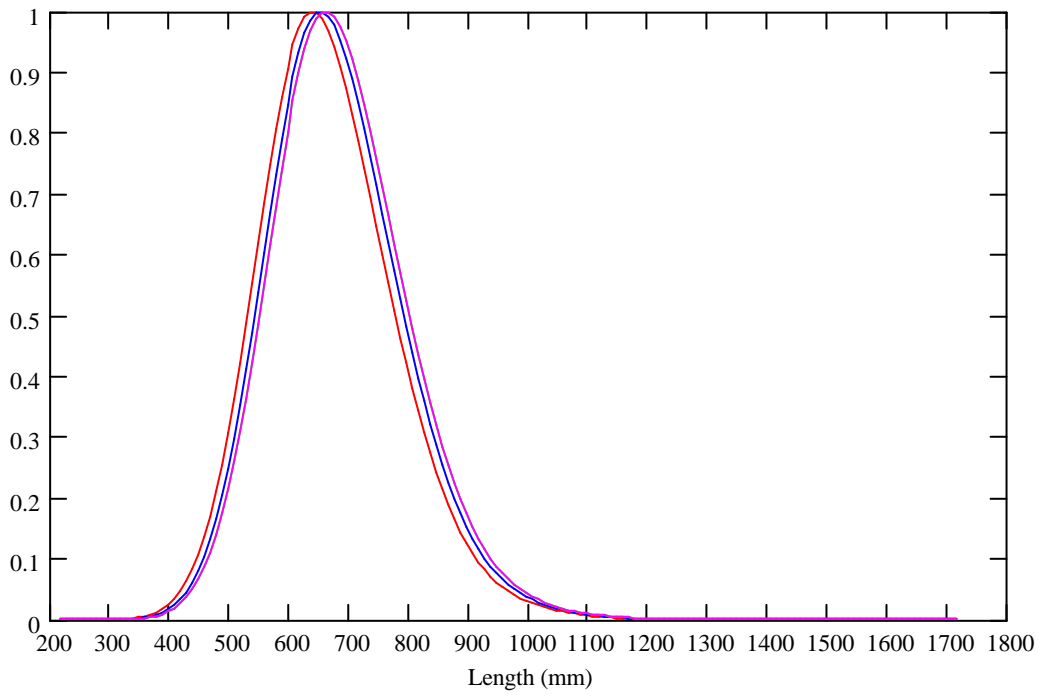
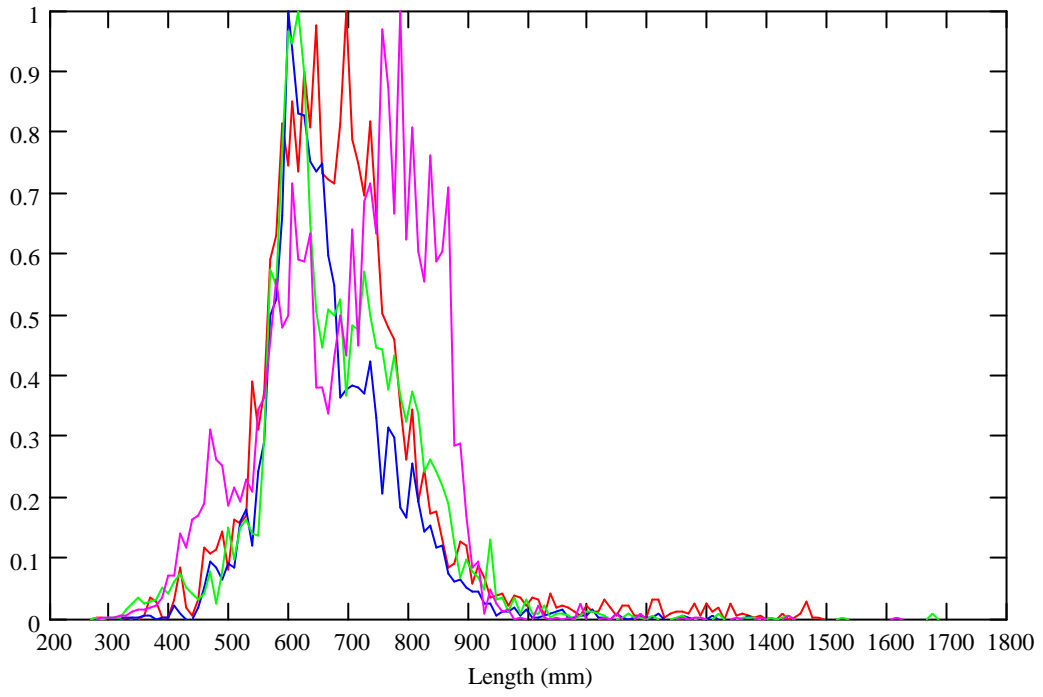


Figure 22 (continued)

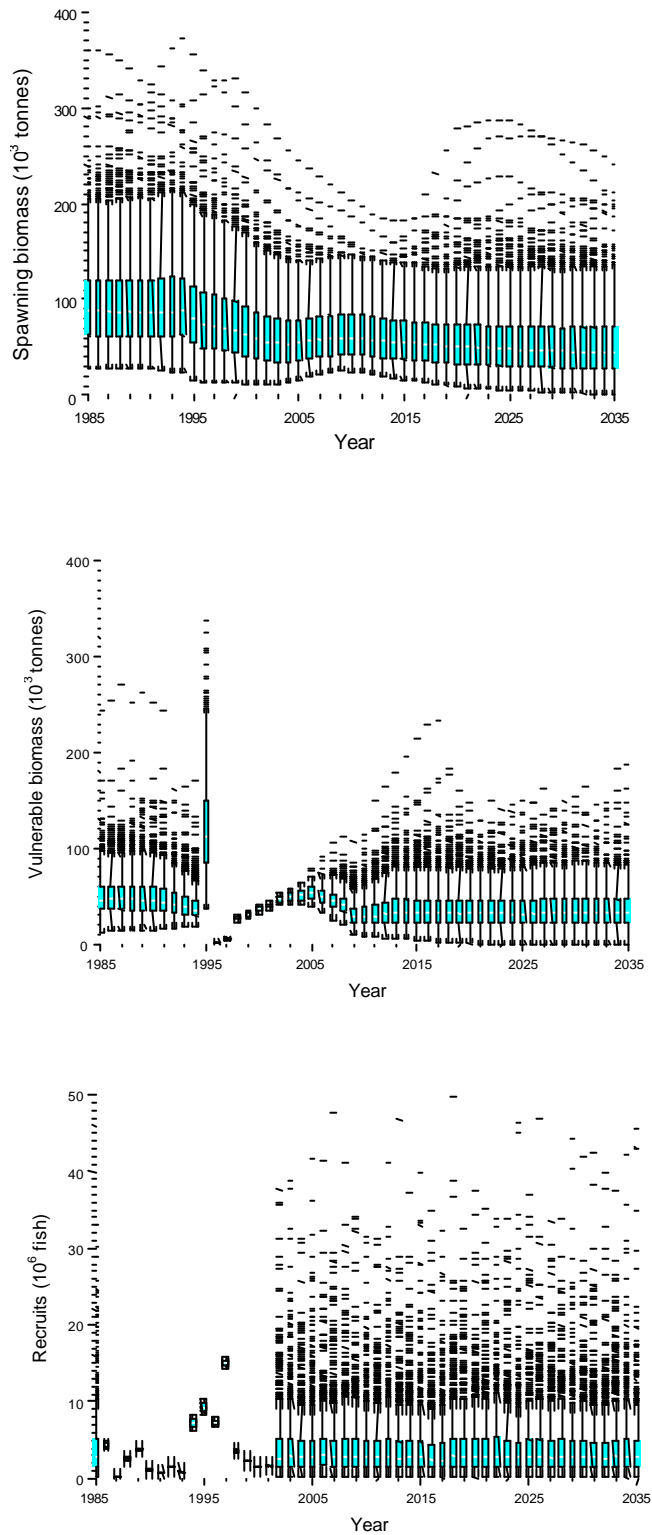


Figure 23: Time series of spawning biomass, vulnerable biomass and recruitments summarised from a GYM assessment of constant annual yield for *Dissostichus eleginoides* in Division 58.5.2. Each box and whisker plot summarises the status of the variable for a year over 1 001 trials. The recruitment and known catch period are up to and including 2001. The remaining period is the forward projection for determining yield. The constant annual yield taken in this projection is 2 815 tonnes.

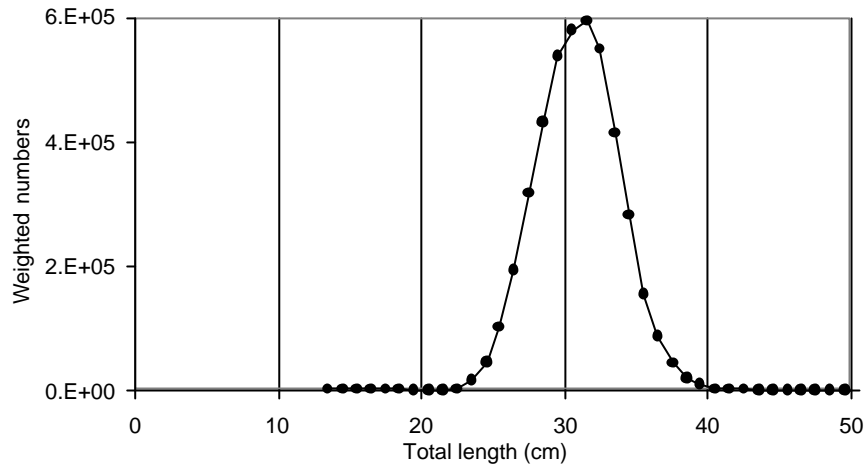


Figure 24: Catch-weighted length distribution for *Champsocephalus gunnari* from commercial fishing in Subarea 48.3 in the 2000/01 season.

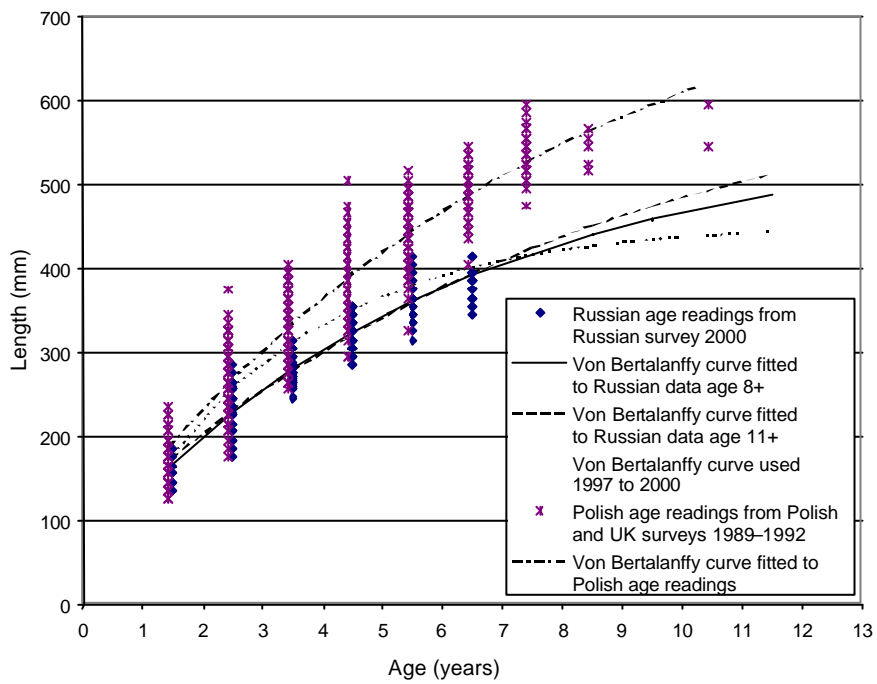


Figure 25: Growth curves for *Champsocephalus gunnari* fitted to age-length data derived from otolith readings by Russian and Polish scientists (data sources: WG-FSA-00/51 and WAMI-01/7 for Russian data; Parkes, 1993 for Polish data).

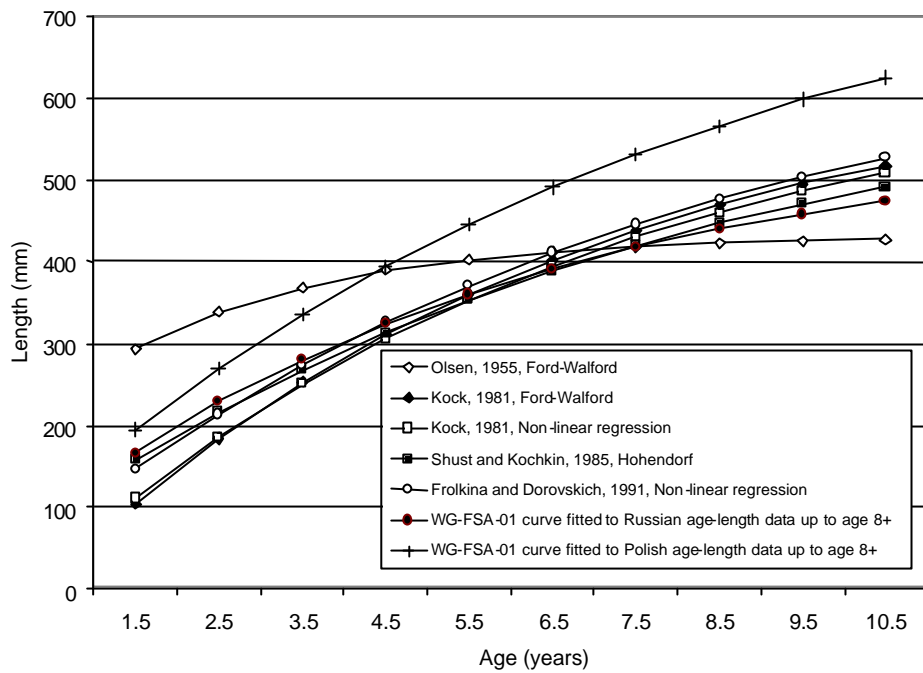


Figure 26: Comparison of growth curves for *Champsocephalus gunnari* estimated at this year's meeting with those estimated previously.

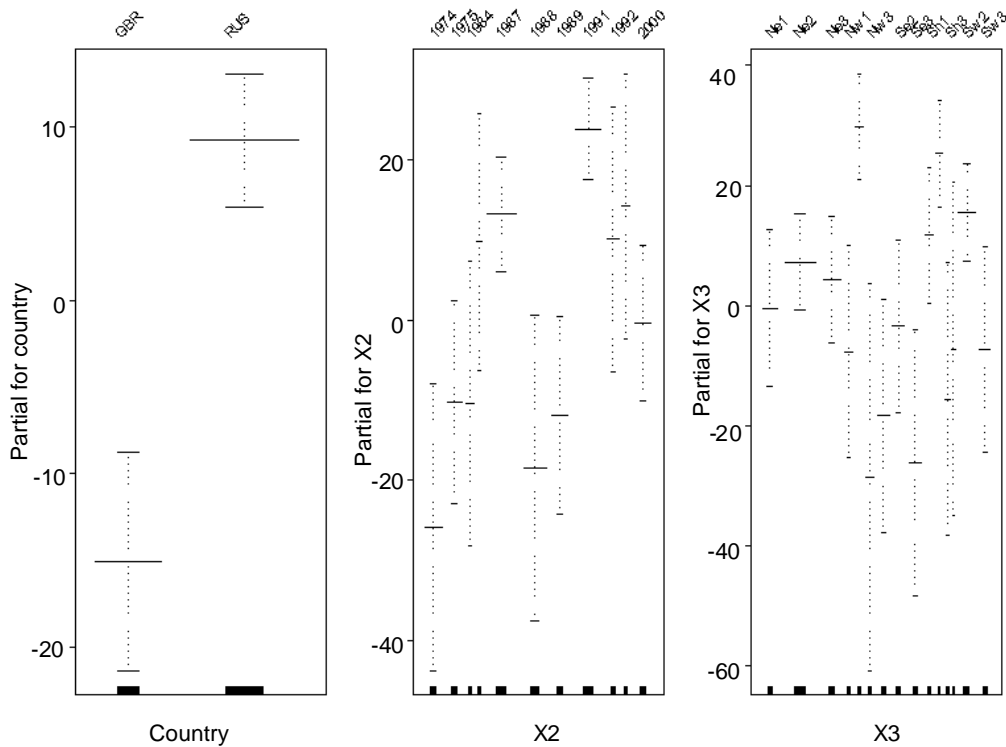


Figure 27: Diagnostic diagrams of GLM standardisation for UK and Russian (including former Soviet Union) survey indices of *Champsocephalus gunnari* in Subarea 48.3. Variable X2 is split-year, X3 is stratum.

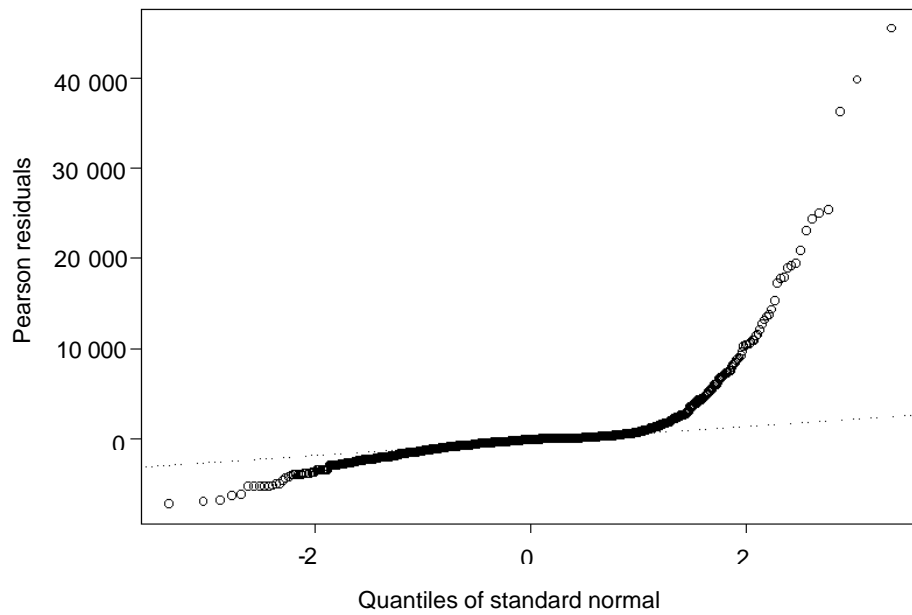


Figure 28: QQ plot of GLM standardisation for UK and Russian (including former Soviet Union) survey indices of *Champsocephalus gunnari* in Subarea 48.3.

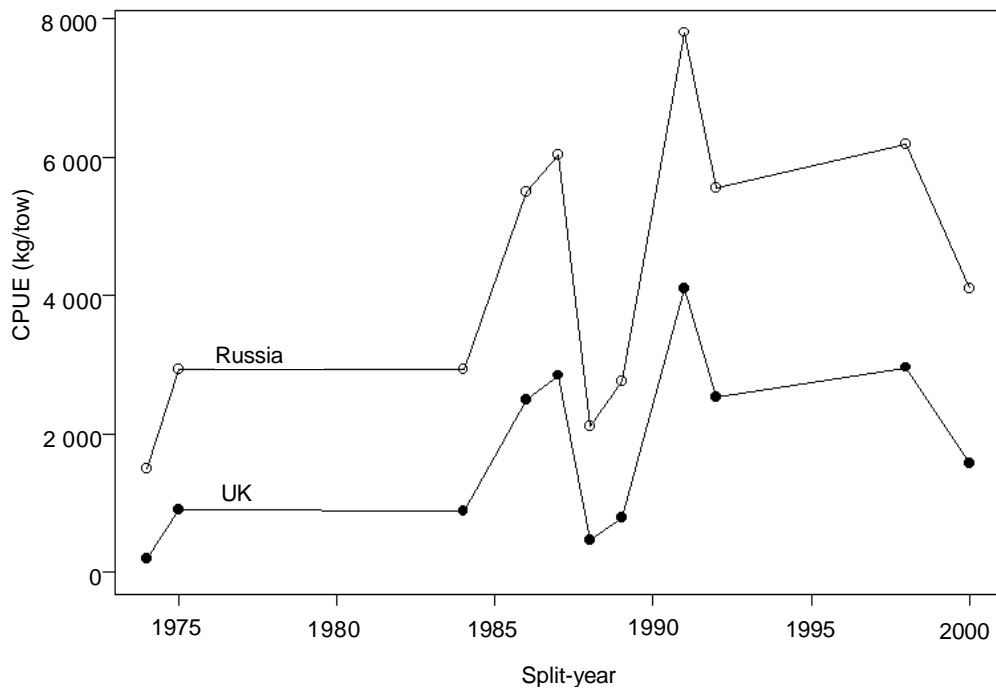


Figure 29: Time series of standardised abundance index for *Champsocephalus gunnari* in Subarea 48.3 from GLM.

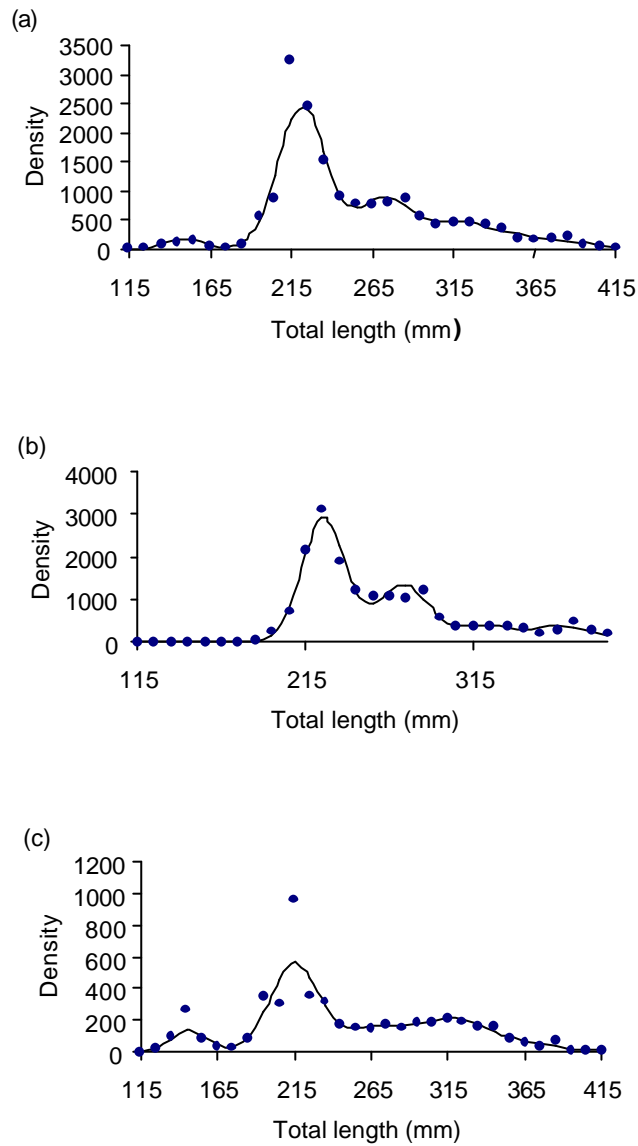


Figure 30: Outputs from the mixture analysis of *Champtocephalus gunnari* length at age in 2000: (a) combined dataset, (b) Russian survey, and (c) UK survey.

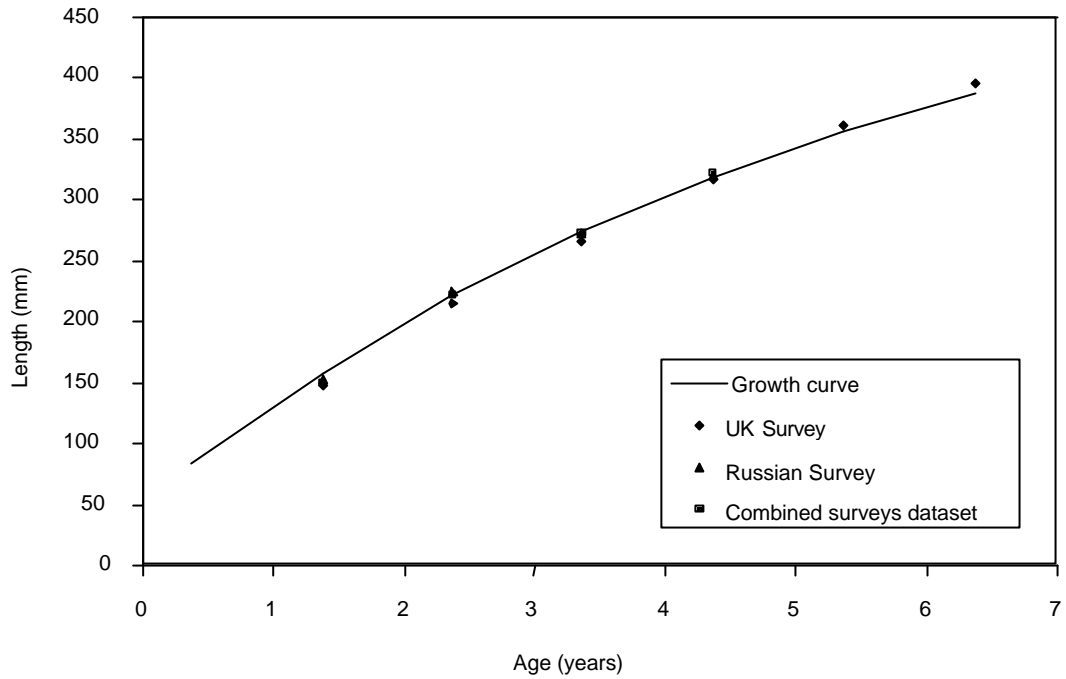


Figure 31: Comparison of the growth curve used in the short-term assessment of *Champsocephalus gunnari* in Subarea 48.3 with the mean lengths of the mixture components from the mixture analysis of 2000 survey data.

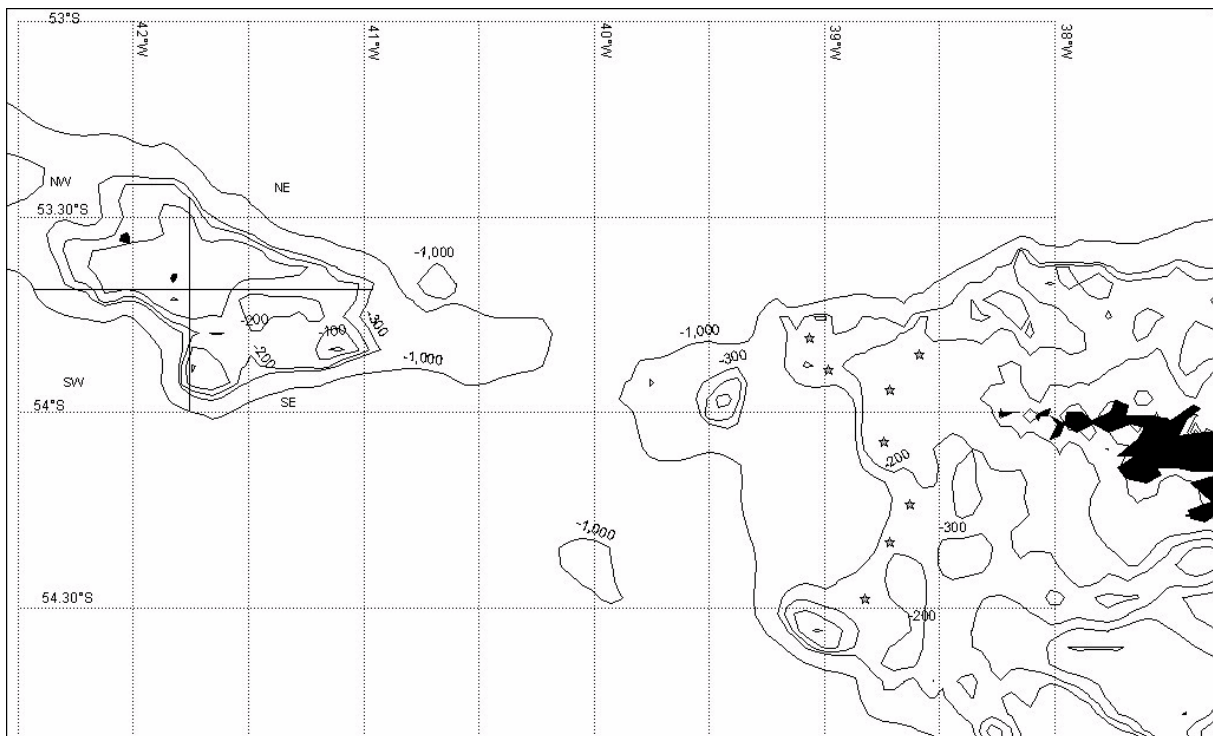


Figure 32: Distribution of 20 exploratory fishing hauls on *Champsocephalus gunnari* at Shag Rocks (12) and South Georgia (8) from 1 March to 31 May 2002.

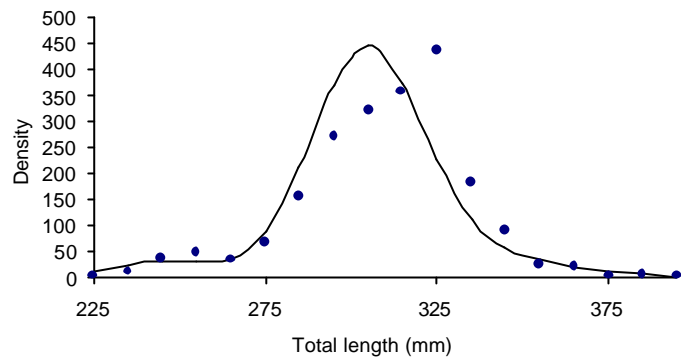


Figure 33: Observed densities at length and fitted mixtures of distributions for the Australian survey in Division 58.5.2 in May 2001.

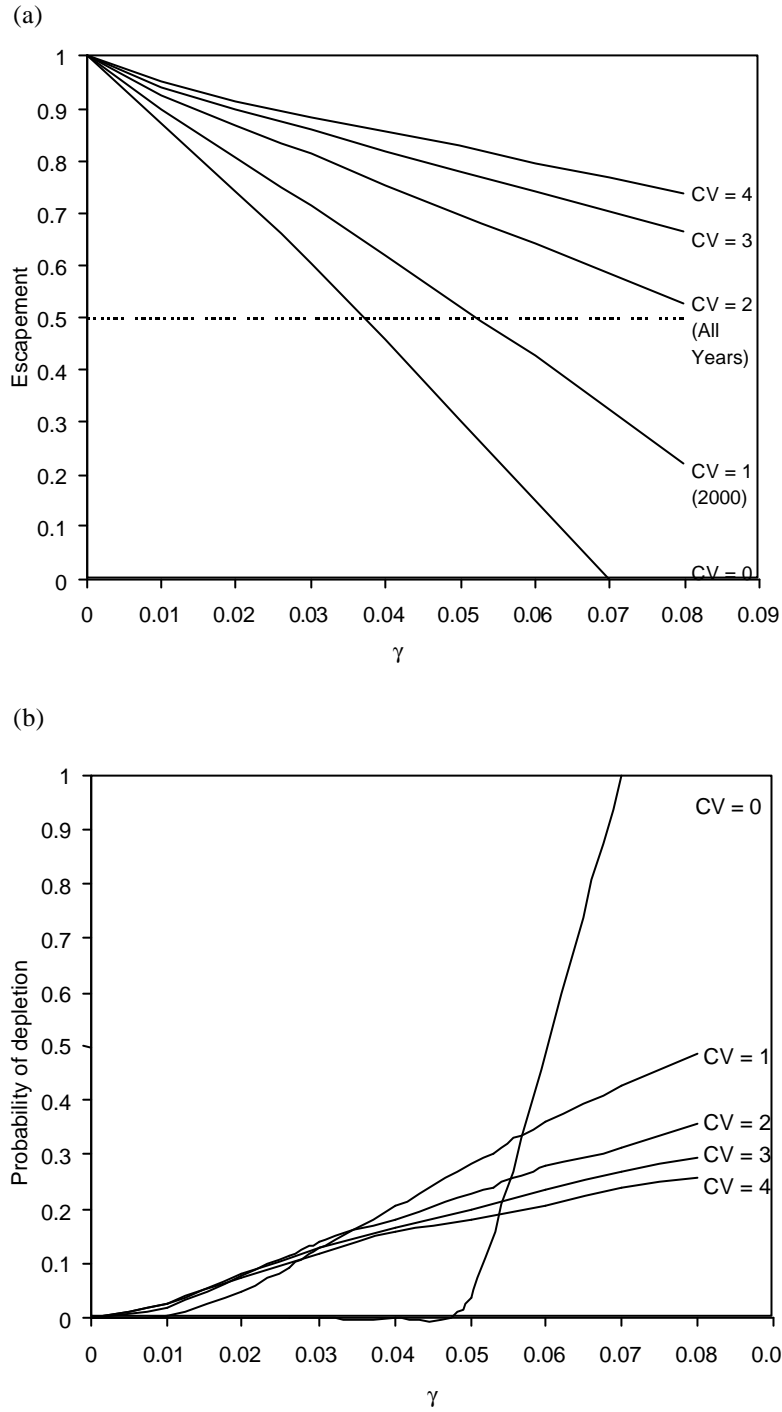


Figure 34: Response of (a) escapement and (b) depletion as a function of precautionary pre-exploitation harvest level (γ) under various levels of coefficient of variation of B_0 for skates and rays around South Georgia. Dashed line represents the level of γ under the established decision rule.

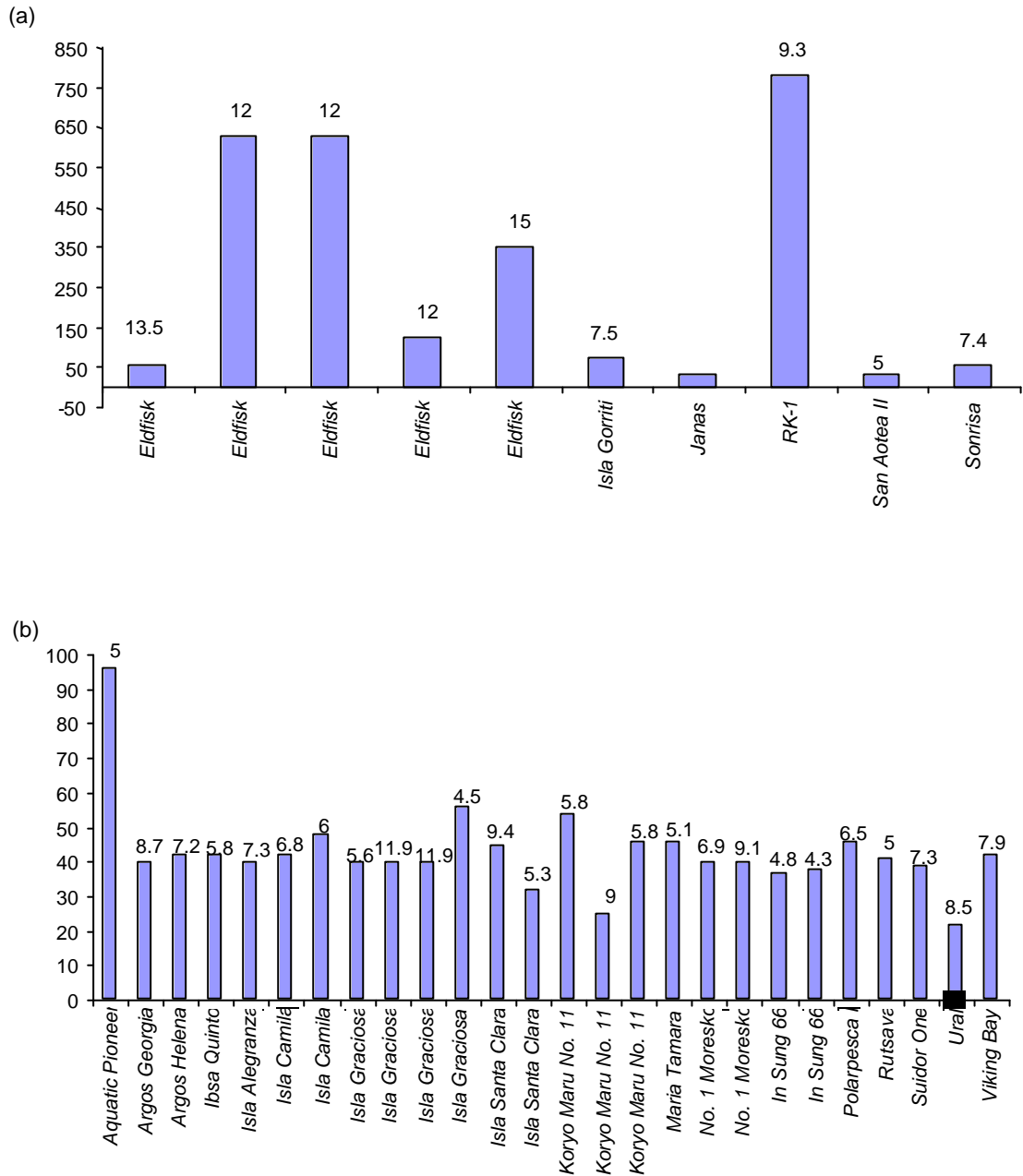


Figure 35: Longline weight spacing (y-axis in metres) and weights used (kilograms) by (a) autoline and (b) Spanish systems during the 2001 season.

**SPECIFIC TASKS IDENTIFIED BY THE SCIENTIFIC COMMITTEE
FOR THE 2001/02 INTERSESSIONAL PERIOD**

SPECIFIC TASKS IDENTIFIED BY THE SCIENTIFIC COMMITTEE FOR THE 2001/02 INTERSESSIONAL PERIOD

No.	Task	Reference to paragraphs in SC-CAMLR-XX	Deadline	Action Required	
				Secretariat	Members
1.	Fishery status and trends				
1.1	Submit catch and effort data from the krill fishery and re-examine the use of indices derived from these data.	2.3, 5.17	September	Coordinate, analyse, report	Implement
1.2	Update information on krill processing, market developments, economic analyses and any other information that may assist WG-EMM in monitoring the development of the krill fishery.	2.4	July	Coordinate, analyse, report	Implement
1.3	Provide information on the extent of catches both within and outside the Convention Area using CDS, vessel sightings and reported catch data.	2.14(i)	September	Coordinate, analyse, report	Implement
1.4	Investigate more closely the CDS records which pertain to catches from Area 51 and those other areas where reported catches have increased since the implementation of the CDS.	2.14(ii)	September	Coordinate, analyse, report	Implement
1.5	Provide further information on: the spatial and temporal distribution of krill fisheries; krill processing factors, particularly from modern processing machinery; and the economics of the krill fisheries and on the market developments that might affect the development of such fisheries.	3.8	July	Coordinate, analyse, report	Implement
1.6	Complete questionnaire on krill fishing tactics and/or provide practical suggestions as to how the questionnaire may be modified.	3.9	July	Coordinate, analyse, report	Implement
1.7	Collect data on conversion factors using the CCAMLR guidelines provided to scientific observers and skippers.	3.12	September	Coordinate, analyse, report	Implement
1.8	Evaluate conversion factors regularly throughout the season to take into account biological variability such as seasonal changes due to spawning condition, and submit data in the observer reports.	3.12	2001/02 season	Coordinate, analyse, report	Implement
1.9	Provide information on tagging studies on <i>Dissostichus</i> spp. and other species of interest.	3.14	January	Coordinate and summarise	Implement
1.10	Include information on tagging studies on <i>Dissostichus</i> spp. and other species of interest in the revision of the <i>Scientific Observers Manual</i> for the 2001/02 season.	3.14	February	Implement	Distribute

No.	Task	Reference to paragraphs in SC-CAMLR-XX	Deadline	Action Required	
				Secretariat	Members
2.	Dependent species				
2.1	SC-CAMLR endorsed the tasks identified by WG-EMM.	Annex 4, Table 1	July	Coordinate, implement	Implement
2.2	Consider new, and revisions to existing, CEMP standard methods, advise on and review new techniques for the analysis of parameters, and develop criteria to evaluate the methods used in the collection of non-CEMP parameters identified by WG-EMM as relevant to its work.	4.10	July	Coordinate	Subgroup to implement
2.3	Consider whether any further work is required on a general procedure for assessing Marine Protected Areas, and whether the values of a proposal need to be assessed with respect to the two issues identified by the Commission.	4.14	September	Coordinate	Implement
2.4	Prepare and forward a draft management plan for establishing the Terra Nova Bay ASPA in time for review by the appropriate working group(s) of the Scientific Committee in 2002.	4.17	July		Italy to submit plan
3.	IMAF				
3.1	SC-CAMLR endorsed the tasks identified by WG-IMAF, including the following tasks.	Annex 5, Appendix F	September	Coordinate, implement	Implement
3.2	Complete the submission of data requested for the review of size and trends of populations of albatross species and of <i>Macronectes</i> and <i>Procellaria</i> petrels vulnerable to interactions with longline fisheries, the foraging ranges of populations of these species adequate to assess overlap with areas used by longline fisheries, and genetic research relevant to determining the origin of birds killed in longline fisheries.	4.25	September	Coordinate	Implement
3.3	Provide relevant advice and, where possible, assist Japan to implement and monitor the success of mitigating measures, similar to those successfully used in the Convention Area, to minimise seabird by-catch during longline fishing outside CCAMLR waters.	4.58	September		Implement
3.4	Seek further information on seabird by-catch levels, mitigation measures in use 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.	4.59	September	Implement	Provide information
3.5	Support further research and development on mitigating measures, and submit reports to the next meeting of WG-IMAF.	4.61	September		Implement

No.	Task	Reference to paragraphs in SC-CAMLR-XX	Deadline	Action Required	
				Secretariat	Members
3.6	Provide help, whether in terms of financial, logistic or other assistance, in carrying out a study on the effects of the different elements of Conservation Measure 29/XIX, when applied to the Spanish longline system, in reducing seabird mortality.	4.63	2001/02 season		Implement
4.	Marine debris				
4.1	Provide details of standardised quantitative surveys from vessels of debris at sea and data to the Secretariat.	4.100	September	Coordinate, analyse, report	Implement
4.2	Collect data on marine debris according to the prescribed standard methods and submit such data to the Secretariat using the standard reporting forms.	4.101	September	Coordinate, analyse, report	Implement
4.3	Correspond intersessionally to validate in detail submitted data and encourage submission of any additional current, recent or historical data, where such data have been collected by a method consistent with the approved standard method and where data will be submitted on the standard reporting forms.	4.102	September	Implement	Implement
4.4	Prepare an annual report on marine debris.	4.99(iv), 4.103	September	Implement	
4.5	Provide data reports where these contain information that would amplify and assist the interpretation of trends and/or when they are reporting on data not yet submitted in part or in full to the CCAMLR database.	4.104	September	Coordinate, analyse, report	Implement
5.	Harvested species				
5.1	SC-CAMLR endorsed the tasks identified by WG-FSA, including the following tasks.	Annex 5, Section 10	September	Coordinate, implement	Implement
5.2	Further develop an approach to harvesting units taking into consideration: satellite information, bathymetry, the position of the Polar Front, oceanographic data and additional data on krill distribution and abundance, particularly further evidence of the existence of sub-populations of krill.	5.8, 5.9	July	Coordinate	Subgroup to implement
5.3	Review mechanisms that could be used for managing the krill fishery based on periodic reports from the fishery that would be able to ensure that overshoot of the catch limit was unlikely to occur.	5.19	September	Implement	
5.4	Continue developing and testing methods to integrate different indicators of stock status into assessments.	5.34	September		Implement
5.5	Prepare revised species identification sheets to assist observers in making accurate identification of species.	5.97(v)	December		Subgroup to implement

No.	Task	Reference to paragraphs in SC-CAMLR-XX	Deadline	Action Required	
				Secretariat	Members
5.6	Revise <i>Scientific Observers Manual</i> and the electronic observer logbook to improve the information collected on fish and invertebrate by-catch in all fisheries.	5.97(vi)	February	Implement	
5.7	Publish species identification sheets in laminated waterproof material and send to technical coordinators. Copies of the species identification sheets should be included in the <i>Scientific Observers Manual</i> .	5.99	March	Implement	Distribute
6.	Ecosystem monitoring and management				
6.1	SC-CAMLR endorsed the tasks identified by WG-EMM, including the following tasks.	Annex 4, Table 1	July	Coordinate, implement	Implement
6.2	Approach the IWC Secretariat for documents relating to the IWC Scientific Committee discussions on small-scale management units.	6.17(i)	July	Implement	
6.3	Develop analyses appropriate for fisheries data prior to the workshop on small-scale management units in order to determine what fisheries data is required for the workshop and whether the data provided in the CCAMLR database are sufficient.	6.17(ii)	July	Assist	Steering Committee to implement
7.	Management under uncertainty				
7.1	Revise the two existing fishery plans, and make available the final versions of the two plans.	7.2	April	Implement	
7.2	Prepare fishery plans for all fisheries in the Convention Area, beginning with <i>D. eleginoides</i> in Subarea 48.3 and Division 58.5.2, <i>Dissostichus</i> spp. in Subarea 88.1 and <i>C. gunnari</i> in Division 58.5.2.	7.3	September	Implement	
7.3	Continue to develop the fishery summary.	7.7	September	Implement	
8.	Data management				
8.1	Complete the development of a standard CCAMLR format for the submission of research data.	10.4	February	Implement	
9.	Cooperation with other international organisations				
9.1	Observe and participate in international meetings of relevance to the work of SC-CAMLR.	11.26	Intersessionally, as required	Coordinate	Represent CAMLR as required (nominated observers)

No.	Task	Reference to paragraphs in SC-CAMLR-XX	Deadline	Action Required	
				Secretariat	Members
10.	2001/02 intersessional period				
10.1	Support participation by experts at future meetings of WG-EMM and WG-FSA. WG-EMM had outlined a schedule of workshops for the period from 2002 to 2005 so as to assist Members in planning such expert participation. WG-FSA had also urged scientists from France and Ukraine, along with other experts, to assist with its work at future meetings.	13.7	Intersessionally, as required		Implement
11.	Other business				
11.1	Prepare and circulate summaries of the Working Group reports as they pertain to the Scientific Committee agenda, and include such references to the appropriate paragraphs in the reports.	18.3	September	Coordinate	Conveners to implement
11.2	Revise the format of the annotated agenda of the Scientific Committee so as to include references to all paragraphs in the reports of the working groups that invite comment from the Scientific Committee.	18.3	September	Implement	SC Chair to implement
11.3	Consider whether it would be desirable to assemble the synopses of working papers, pending notification and agreement of authors, and circulate these to the Scientific Committee as a background paper.	18.4	September	Coordinate	WGs to implement
11.4	Continue developing an agenda for the 2002 meeting through correspondence.	18.6	September	Coordinate	SC Chair to implement

**GLOSSARY OF ACRONYMS AND ABBREVIATIONS
USED IN CCAMLR REPORTS**

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN CCAMLR REPORTS

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)
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 <i>Dissostichus</i> 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
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
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	<i>Dissostichus</i> catch document

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 <i>Polarstern</i> Study
EPROM	Erasable Programmable Read-Only Memory
FAO	Food and Agriculture Organisation
FFA	Forum Fisheries Agency
FFO	Foraging–fishery overlap
FIBEX	First International BIOMASS Experiment
FRAM	Fine Resolution Antarctic Model
FV	Fishing vessel
GAM	Generalised Additive Model
GEBCO	General Bathymetric Chart of the Oceans
GIS	Geographic Information System
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 (I-ATTC)	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
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
IMALF	Incidental Mortality Arising from Longline Fishing
IMO	International Maritime Organisation
IOC	Intergovernmental Oceanographic Commission
IOCSOC	IOC Regional Committee for the Southern Ocean

IOFC	Indian Ocean Fisheries Commission
IOTC	Indian Ocean Tuna 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
IUCN	International Union for the Conservation of Nature and Natural Resources – the World Conservation Union
IUU	Illegal, Unregulated and Unreported
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	the International Convention for the Prevention of Pollution from Ships
MBAL	Minimum biologically acceptable limits
MFTS	Multiple-frequency method for <i>in situ</i> TS measurements
MIA	Marginal Increment Analysis
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 Organisation
NASA	National Aeronautical and Space Administration (USA)
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 transmitter terminals
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
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	South Pacific Commission
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
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 Program
UNCLOS	UN Convention on the Law of the Sea
UNIA	the 1995 UN Agreement for the Implementation of Provisions of the United Nations Convention on the Law of the Sea 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
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 Working Group on Incidental Mortality Arising from Longline Fishing
WG-Krill	CCAMLR Working Group on Krill
WMO	World Meteorological Organisation
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 <i>D. eleginoides</i>
WWD	West Wind Drift
WWW	World Wide Web
XBT	Expendable bathythermograph
Y2K	Year 2000