SC-CAMLR-XVIII

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

REPORT OF THE EIGHTEENTH MEETING OF THE SCIENTIFIC COMMITTEE

HOBART, AUSTRALIA
25 – 29 OCTOBER, 1999

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Chairman of the Scientific Committee
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Abstract

This document presents the adopted report of the Eighteenth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, from 25 to 29 October 1999. 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 EIGHTEENTH MEETING OF THE SCIENTIFIC COMMITTEE

(Hobart, Australia, 25 to 29 October 1999)

OPENING OF THE MEETING

1.1 The Scientific Committee for the Conservation of Antarctic Marine Living Resources met under the Chairmanship of Dr D. Miller (South Africa) from 25 to 29 October 1999 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, 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 Chairman welcomed to the meeting observers from Denmark in respect of the Faroe Islands, ASOC, SCAR, IUCN and IWC, 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 R. Holt (USA), Fishery Status and Trends and Crab Resources;
- Dr P. Penhale (USA), Species Monitored in the CCAMLR Ecosystem Monitoring Program;
- Mr B. Baker (Australia) and Mr J. Cooper (IUCN), Assessment of Incidental Mortality;
- Mr B. Watkins (South Africa), Marine Mammal and Bird Populations;
- Dr S. Nicol (Australia), Krill Resources;
- Dr G. Parkes (UK) and Mr R. Williams (Australia), Fish Resources;
- Ms I. Lutchman (UK), Squid Resources;
- Dr A. Constable (Australia), Ecosystem Monitoring and Management, and New and Exploratory Fisheries;
- Dr I. Everson (UK), Management under Conditions of Uncertainty about Stock Size and Sustainable Yield, and New and Exploratory Fisheries;
- Prof. B. Fernholm (Sweden), Cooperation with Other Organisations; and
- Dr D. Ramm and Ms N. Slicer (Secretariat), all other matters.

Adoption of Agenda

1.6 The Provisional Agenda had been circulated prior to the meeting and was adopted without change (Annex 3).

Report of the Chairman

Intersessional Meetings

1.7 Three CCAMLR meetings were held during the 1998/99 intersessional period:

(i) the planning meeting for the CCAMLR 2000 Krill Synoptic Survey of Area 48 (Cambridge, UK, 8 to 12 March 1999);

(ii) the meeting of WG-EMM (Santa Cruz de Tenerife, Spain, 19 to 29 July 1999); and

(iii) the meeting of WG-FSA, including ad hoc WG-IMALF (Hobart, Australia, 11 to 21 October 1999).

1.8 On behalf of the Scientific Committee, the Chairman 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.

Intersessional Activities of CCAMLR Members

1.9 Fisheries conducted in the Convention Area during the 1998/99 season targeted *Champsocephalus gunnari* (267 tonnes), *Dissostichus* spp. (13 119 tonnes), *Euphausia superba* (103 318 tonnes) and crabs (4 tonnes), and these included some new and exploratory fisheries (see section 2 and CCAMLR-XVIII/BG/9). Scientific observers conducted 41 trips aboard fishing vessels, and provided complete coverage of longlining and trawling for finfish and potting for crabs (see section 3 and SC-CAMLR-XVIII/BG/11). 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.

1.10 In 1998/99, representatives of the Scientific Committee had attended various international meetings, including IOTC, CEP, IWC, GOSEAC, CWP-18, ICES and the Second International Krill Symposium which CCAMLR had co-sponsored (see section 11).

1.11 The Scientific Committee learnt, with great sadness, of the passing of Martin White of the British Antarctic Survey, UK. Martin was a distinguished Antarctic fish biologist, and had been an active and highly respected member of the CCAMLR community. He died on 3 July 1999, after a short battle with cancer.

FISHERY STATUS AND TRENDS

Krill

2.1 Reported catches of krill (*E. superba*) are shown in Tables 1 and 2. A total of 103 318 tonnes was caught during the 1998/99 split-year. The catch was taken by Argentina, Japan, Republic of Korea, Poland and Ukraine.

2.2 The Scientific Committee noted the following plans for krill fishing during the 1999/2000 season: Japan, Poland and the Republic of Korea reported that their krill fishing activities would be similar to those in the 1998/99 season (i.e. about 60 000 tonnes, 20 000 tonnes and 2 000 tonnes respectively). Uruguay reported that it had one vessel that began fishing in August 1999 and expects to continue during the next season. Germany and the USA stated that they expect to have one and two vessels respectively, fishing during the next season. Argentina reported that it had one vessel that fished during the 1998/99 season, but unfortunately it sank, although there was no loss of life. Argentina acknowledged that the owner company expects to replace the vessel and fish during the next season. Russia indicated that if a Russian company is allowed to fish for *C. gunnari* during the coming season, it may switch to the krill fishery when the finfish fishery is closed. Ukraine indicated that it will send two to three vessels to fish for krill in 1999/2000 and that about 30 000 to 40 000 tonnes will be taken. Finally, the Scientific Committee noted that WG-EMM (Annex 4, paragraph 2.9) received information from the CCAMLR Secretariat that Canada was evaluating a proposal to fish for krill, that Panama had indicated it would not fish for krill and that no response to its inquiry was received from China.

2.3 The Scientific Committee noted that trends in CPUE, reported in tonnes per hour or tonnes per day for Subareas 48.1, 48.2 and 48.3 over recent years, were close to their long-term mean values.

2.4 The Scientific Committee welcomed an analysis, provided by Japanese scientists, of haul-by-haul CPUE reported as catch per tow and catch per minute, and the size distribution of krill caught by the Japanese fleet in the 1997/98 season (WG-EMM-99/48). Submission of data from other nations' fisheries was encouraged as was analysis of the data.

2.5 The Scientific Committee noted that WG-EMM discussed types of conversion factors (CFs) used to estimate the total catch of krill. The Japanese fleet has traditionally used a factor of 10 to raise the weight of fishmeal to the estimated fresh weight of the catch. A factor of 10 was also used to raise the weight of peeled krill to the estimated fresh weight of the catch. A factor of 1 was used to estimate fresh weight from the weight of frozen krill. Other Members were encouraged to collect detailed data on fresh and processed weights and submit the information to the Secretariat.

2.6 Japan confirmed that key market features regarding their krill fishery reported last year (SC-CAMLR-XVII, paragraph 2.5) still applied in 1999. That is, krill was harvested mostly as feed for the aquaculture industry and bait in recreational fisheries; a small proportion was for human consumption.

2.7 Last year the Scientific Committee requested information from the krill fishery on past and current market prices for krill products (SC-CAMLR-XVII, paragraphs 2.5 and 2.6). This information is needed for the economic analysis of the fishery and development of management strategies which are compatible with the fishery's stage of development (SC-CAMLR-XVII, Annex 4, paragraph 2.9). This need was reiterated this year.

2.8 The Scientific Committee noted WG-EMM's concern at the extent of the winter fishery for krill in the ice-free areas off South Georgia (Annex 4, paragraph 2.11). It was noted that this may place localised pressure on krill populations and therefore, management strategies should be reviewed in light of year-round fishing. The Scientific Committee agreed that Members involved in krill fisheries should provide general information on krill prices and a breakdown of catches by product type.

Fish

2.9 Catches reported from the Convention Area during the 1998/99 split-year are presented in SC-CAMLR-XVIII/BG/1 Rev. 1 (Tables 3 and 4). The major catches of finfish include: 4 567 tonnes in Subarea 48.3, 5 399 tonnes in Division 58.5.1, 5 531 tonnes in Division 58.5.2 and 1 938 tonnes in Subarea 58.6.

2.10 The total catch reported in the longline fishery for *Dissostichus eleginoides* in Subarea 48.3 exceeded the catch limit by 152 tonnes (4%). The Scientific Committee agreed that monitoring of catch levels by the Secretariat as the catch limit was approached had been in accordance with the agreed protocol, and the small excess was the result of high catch rates during the final 10 days of the fishing season.

2.11 Information concerning illegal, unregulated and unreported (IUU) fishing levels and status is presented in section 5.

2.12 Several Members made notification of their intentions to conduct new and exploratory fishing activities for several species in several subareas and divisions. These are taken up in section 9.

2.13 In addition, the UK submitted a notification of research vessel activity when the total catch is expected to be >50 tonnes (WG-FSA-99/41). This involved experimental fishing for *D. eleginoides* using pots. There had been considerable debate at the WG-FSA meeting on whether this notification should be considered as one for a research vessel activity with a total catch exceeding 50 tonnes, or as a new or exploratory fishery. This notification was taken up in section 6.

Crabs

2.14 The Scientific Committee noted that the UK fished for crabs using pots in Subarea 48.3 during September 1999. Approximately 4 tonnes were reported caught in 14 days of fishing (see also paragraph 5.125). The UK indicated they will continue their fishery during the next season. The USA also indicated that they expect to have one vessel fishing for crabs during the next season.

2.15 The management advice concerning crab stocks in Subarea 48.3 is provided in paragraphs 5.128 to 5.130.

Squid

2.16 There was no fishery for squid in the Convention Area in the 1998/99 season and no additional data on squid have been reported to the Secretariat. Management advice is provided in paragraph 5.133.

CCAMLR SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

Scientific Observation Conducted in the 1998/99 Fishing Season

3.1 International and national scientific observers provided 100% coverage of fishing operations of vessels targeting *Dissostichus* spp. or *C. gunnari* in the Convention Area during the 1998/99 season. Reports and logbook data were submitted from 32 cruises aboard longliners in Subareas 48.3, 58.6, 58.7 and 88.1, eight cruises aboard trawlers in Subarea 48.3 and Divisions 58.4.1, 58.4.3 and 58.5.2, and one cruise aboard a vessel potting for crab in Subarea 48.3. CCAMLR scientific observers had been deployed by six Members: Argentina, Australia, Chile, South Africa, UK and Uruguay. In addition, information collected by national observers aboard Japanese krill trawlers is routinely reported to WG-EMM. The Scientific Committee encouraged other Members with national observers on krill vessels to submit data to WG-EMM.

3.2 The Scientific Committee noted the continued improvement in both the quantity and quality of data and reports submitted by scientific observers in finfish fisheries. The Scientific Committee also noted that some of these advances had been achieved at high costs to the observers in terms of their on-board workload. All scientific observers were thanked for their great efforts over the past year, as well as in previous years.

3.3 Most of the logbooks and reports were submitted within six weeks of each observer's return to port. This year's closure of the longline fishery in Subarea 48.3 on 17 July had allowed the Secretariat to process the data and prepare preliminary analyses in good time for the meeting of WG-FSA. The Scientific Committee noted with appreciation that the logbook and report from Mr M. Purves (South Africa), scientific observer aboard a vessel fishing for crab until 23 September 1999, had been prepared and submitted to the Secretariat by the start of the meeting of WG-FSA.

3.4 The Scientific Committee advised technical coordinators that observer logbook data should be submitted as soon as available, and may be submitted in advance of the observer narrative report.

3.5 As requested at its last meeting (SC-CAMLR-XVII, paragraph 3.4), the Scientific Committee noted that electronic data forms (eforms) are now available for reporting observer data on finfish and crabs. These observer eforms, as well as eforms for most other types of fishery data, have been developed by the Secretariat in Microsoft Excel. Approximately 30% of the data submitted in 1999 were submitted electronically using eforms. In addition, a prototype Microsoft Access database had also been developed as an alternative for submitting observer data; this database had been available since mid-1999, but was yet to be evaluated.

3.6 The Scientific Committee noted with concern that there is still a paucity of information on the operation of krill fisheries and the associated by-catch in the fishery. Such information which is urgently needed for the work of WG-EMM could only be obtained by observers on krill fishing vessels. The following is a summary of the data types currently in CCAMLR's *Scientific Observers Manual* (Section I, Part 2, paragraph 4):

(i) observations on fishing activities;
(ii) haul-by-haul data on catch and effort;
(iii) representative length-frequency distributions;
(iv) representative distribution of sex and maturity stages;
(v) observations on feeding intensity;
(vi) observations on by-catch of juvenile finfish; and
(vii) observations on incidental mortality of predators (seabirds and seals).

3.7 The Scientific Committee agreed that it would be desirable to extend this list to include data on the conversion factors which are used to convert the weight of various krill products to an estimated total fresh weight (Annex 4, paragraphs 2.8 and 2.14).

3.8 Information on the decision processes used by fishing companies and vessel masters to formulate fishing operation strategies was also needed (Annex 4, paragraph 2.16). Such information on fishing strategies could be acquired by developing standard survey questionnaires based on the list of activities identified in the CCAMLR-sponsored study undertaken by Butterworth (1988). Members were encouraged to undertake this task and provide comments for consideration at the next meeting of WG-EMM.

3.9 The Scientific Committee encouraged the deployment of national or international observers on krill fishing vessels to collect and submit information in accordance with the CCAMLR Scheme of International Scientific Observation.

3.10 The Scientific Committee agreed that high priority should be given to deploying scientific observers (either international or national) aboard commercial krill vessels during the

CCAMLR 2000 Krill Synoptic Survey of Area 48 (hereinafter referred to as the CCAMLR-2000 Survey) during January and February 2000. The information provided would be important to the interpretation of survey results in relation to fishing operations taking place at the same time as the survey and over various spatial scales.

3.11 It was agreed that during the CCAMLR-2000 Survey, particular emphasis should also be given to obtaining observer data on the demographics of krill from commercial catches. Scientific observers were requested to sample 200 krill collected from one commercial haul per day; individual animals should be measured, and sex as well as stage of maturity determined. Samples could either be measured aboard, or preserved in formalin for later measurements. As a last resort, samples could be frozen. Should the sampling regime be too onerous, the Scientific Committee directed observers to collect fewer samples, but still concentrate on the 200-individual sample requirement.

3.12 Along with the deployment of scientific observers aboard vessels with experience in krill fisheries, Members were especially encouraged to place observers aboard vessels which have recently entered these fisheries, or which were about to begin fishing for krill for the first time. Information from vessels which have recently entered the fishery should provide useful insights into the development of fishing operations and the evolution of fishing strategies. The Scientific Committee recognised that deployment of observers may be limited by availability of accommodation aboard some krill fishing vessels.

Future Developments

3.13 In considering future developments in CCAMLR's Scheme of International Scientific Observation, the Scientific Committee agreed that it was essential to consider the conditions under which the observers operate compared with the scientific merit of the information they collect. In this regard, it was recognised that not all requests for data may be feasible.

3.14 A number of developments of the scheme have been proposed by the working groups and technical coordinators, and the Scientific Committee agreed that the following should be carried out during the forthcoming intersessional period:

(i) The Secretariat should update the observers' table of nautical dawn and dusk to include the times for areas south of 72°S in Subarea 88.1, and the tables should be made as simple as possible (Annex 5, paragraph 3.68).

(ii) The Secretariat should amend scientific observation logbook forms for krill fisheries in order to include records of information on conversion rates for krill products and urge Members to submit this information to the Secretariat (Annex 4, paragraph 12.2).

(iii) The Secretariat and Members should develop standard survey questionnaires to collect information on krill fishing strategies (Annex 4, paragraph 12.2).

(iv) WG-FSA and the Secretariat should investigate sampling strategies for measuring fish, and identify implications for assessments (Annex 5, paragraph 9.11).

(v) The Secretariat should address tasks identified by ad hoc WG-IMALF (Annex 5, paragraphs 9.14 and 9.15).

3.15 In addition, the Scientific Committee endorsed WG-IMALF's recommendation (Annex 5, paragraph 3.63) that observers weigh 30 longline weights at random. However, the Scientific Committee recommended that this procedure be conducted while the vessel is alongside the wharf, and preferably during a routine inspection by the Flag State (e.g. under Conservation Measure 119/XVII).

3.16 The Scientific Committee stressed that the responsibility for compliance with the requirements of Conservation Measure 29/XVI resides with the Flag State. Flag States should be encouraged to ensure that their vessels are fully equipped to comply with these requirements prior to their departure from port.

3.17 The Scientific Committee agreed that the collection of information on the disposal of garbage and the loss of fishing gear at sea should be added to the list of tasks of scientific observers. Specific forms should be developed by the Secretariat for recording and reporting such information (Annex 5, paragraphs 3.52 to 3.54).

3.18 The Scientific Committee discussed the need for a species identification guide for finfish which could be used by observers in the field. As a first step, the Scientific Committee agreed that taxonomic keys for species of finfish commonly encountered in the longline fishery should be extracted from Gon and Heemstra (1990), and distributed to scientific observers to facilitate the acquisition of data on by-catch at the level of species. This task should be undertaken by the Secretariat in collaboration with the technical coordinators, and the experience of such a guide by observers should be reviewed by WG-FSA and the Scientific Committee at next year's meeting.

Advice to the Commission

3.19 The Scientific Committee drew the attention of the Commission to the continued improvements in both the quantity and quality of data and reports submitted by the scientific observers in finfish fisheries, some of which had been achieved at a high cost to observers in terms of their on-board workload.

3.20 The Scientific Committee also drew the attention of the Commission to the information which has been collected by national observers aboard Japanese krill trawlers, and which is routinely reported to WG-EMM. However, the Commission should note that there remains a paucity of information on the operation of krill fisheries. This would be rectified by the deployment of more scientific observers and the routine submission of their data to CCAMLR. The Scientific Committee had outlined a protocol for the collection of data by scientific observers. The Commission may wish to encourage Members to develop bilateral agreements and deploy international scientific observers in krill fisheries when practicable.

3.21 The Scientific Committee reiterated its advice that, wherever possible, two scientific observers should be used on longline vessels, one expert in fish work, the other experienced with seabirds. In such cases, the Scientific Committee recommended that the data collection responsibilities of each observer should be clearly defined prior to the cruise, preferably in bilateral agreements.

3.22 The Scientific Committee noted the value of factual sightings by scientific observers of vessels engaged in IUU fishing (Annex 5, paragraph 9.13). This task had been endorsed by the Commission (CCAMLR-XVII, paragraph 8.16) on the proviso that the independence and integrity of scientific observers were not compromised, and that this activity be confined to gathering data in support of the Scientific Committee. The Scientific Committee requested that scientific observers continue reporting data on sightings in their reports.

3.23 The Scientific Committee recommended to the Commission that SCOI may wish to undertake its own review of the observer reports to make sure that the information supplied is fully understood. Information of direct relevance to SCOI is mostly contained in the section 'observed fishing vessel activity' of the observer reports.

3.24 The Scientific Committee wished to remind the Commission that a vessel's compliance with conservation measures, and the submission of catch and effort reports and fine-scale data arising from the vessel's activities, remained the responsibility of the Flag State.

DEPENDENT SPECIES

Species Monitored under the CCAMLR Ecosystem Monitoring Program (CEMP)

Report of WG-EMM

4.1 Dr Everson introduced the report of WG-EMM by noting that Dr Ramm (Data Manager) had submitted a summary report of trends and anomalies of CEMP indices (WG-EMM-99/8). Dr Ramm and his staff were thanked for the amount and quality of the work.

4.2 An ad hoc group of WG-EMM reviewed the CEMP indices for possible errors. The group reported that out of several thousand entries, only about 34 contained possible errors, a very small proportion.

4.3 The Secretariat was requested to resolve the status of all the currently remaining queries concerning specific data entries.

4.4 The Scientific Committee endorsed the recommendations of WG-EMM regarding CEMP data and indices:

(i) Updated CEMP indices should be posted on the CCAMLR website each year prior to WG-EMM and copies sent to attendees and data holders by email. Two hard copies of the data should be brought to each meeting by the Secretariat for reference.

(ii) Data tables consisting of small, inactive summaries should be archived after consultation with the respective data holders regarding the status of these data. A table summarising archived data should be included as an appendix to the report. This would reduce the bulk of the CEMP indices report by about 23 tables.

(iii) Data should be submitted electronically in standard Excel formats to be developed by the Secretariat after consultation with current data holders.

(iv) The report of anomalies and trends should be presented in two ways: all variables by each site and all sites within subareas by each variable (where the variables are represented at every site).

(v) Each data holder should submit maps of sites and colonies where CEMP data are collected. These will be archived by the Secretariat.

4.5 A number of studies on the distribution and population dynamics of dependent species were reported.

(i) A census of seabirds breeding on Marion Island (WG-EMM-99/6) reported that in general, species with large foraging ranges increased whereas species foraging nearer to Marion Island showed decreases in numbers.

(ii) Sightings of large whales from three independent sighting databases showed that the areas where whales were sighted with the greatest frequency corresponded with traditional whaling areas, indicating that areas used by whales had not changed over time (WG-EMM-99/34).

(iii) Antarctic fur seal pup production at Cape Shirreff, Livingston Island, showed a 10% increase in 1998/99 from values in 1997/98. This followed a 14% decrease between 1996/97 and 1997/98, which was attributed to the El Niño Southern Ocean (ENSO) event (WG-EMM-99/16).

4.6 A promising technique for estimating Antarctic fur seal field metabolic rates, important for energetics calculations in prey consumption models, was described in WG-EMM-99/36. The technique, which is based on variations in heart rate, offers an attractive alternative to the doubly labelled water technique.

Proposals for Extension of CEMP Activities

Consideration of Existing and New Draft CEMP Methods

4.7 A discussion was held on issues related to existing CEMP methods and on proposals for new methods.

4.8 The current CEMP Standard Method C1a recommends a sample size of 40 animals to detect interannual differences in the foraging trip duration of lactating female Antarctic fur seals at Cape Shirreff. Analyses presented in WG-EMM-99/45 indicate that a smaller sample size (25 to 40 animals) was sufficient.

4.9 It was agreed that the advice on reduced sample size for Method C1a should be incorporated into the next revision of the standard methods.

4.10 It was noted that CEMP Standard Method A8a (meal mass of Adélie penguins) required clarification to emphasise the importance of determining the breeding status of sampled birds (WG-EMM-99/46). The Secretariat was requested to flag in the database potential problems arising from analyses of this parameter.

4.11 WG-EMM-99/12 presented new standard methods for indices of environmental parameters which have potential direct effect on predators. Methods and data collection forms were presented for three indices: F1 (sea-ice extent viewed from a CEMP site), F3 (local weather at a CEMP site) and F4 (snow cover at a CEMP site). These are to be considered for adoption at the next meeting of WG-EMM.

4.12 The Secretariat was tasked with requesting Members undertaking CEMP work at shore-based stations what meteorological data they collected on site or had ready access to from nearby stations.

4.13 The fatty acid signature analysis method was put forward as a potentially useful method for the characterisation of the diet of predators (WG-EMM-99/44).

4.14 The Working Group noted that the discriminant function method to determine the sex of krill, based on simple length and width measurements of the removed carapace (WG-EMM-99/31), was a useful development with potential for application to other taxa.

4.15 Progress was reported on the development of a standard method for the sampling of the diet of Antarctic fur seals (WG-EMM-97/5).

4.16 It was recommended that future consideration of the detailed aspects of submissions regarding methods be considered in a subgroup, either intersessionally and/or during the WG-EMM meeting, prior to a report being presented to the Working Group for discussion in plenary.

Proposals for CEMP Sites

4.17 No new CEMP sites were proposed for consideration by WG-EMM.

4.18 It was noted that all structures have been removed from Seal Island, the former site of US CEMP research. The Working Group regretted that the site had been closed but was pleased that the site had been cleared.

4.19 The Scientific Committee considered Conservation Measure 82/XIII, which affords protection to the Cape Shirreff CEMP site. It noted that the measure became effective 1 May 1995.

4.20 The Scientific Committee considered Conservation Measure 18/XIII which states that each management plan shall be reviewed every five years to determine whether it requires revision and whether continued protection is necessary. This task was referred to the Subgroup on Designation and Protection of CEMP Sites for guidance.

4.21 The subgroup cited the importance of the long-term CEMP research being conducted at Cape Shirreff by Chile and the USA and recommended continued protection. A review of the management plan (Conservation Measure 18/XIII, Annex B – Cape Shirreff) showed that there are minor technical aspects of the plan that require revision.

4.22 The subgroup referred the Scientific Committee to Conservation Measure 62/XI, which affords protection to the Seal Islands CEMP site. It was noted that the management plan (Conservation Measure 82/XIII, Annex B – Seal Islands) also requires minor technical revision, due to the removal of all structures at the site.

4.23 The Chairman noted the importance of avoiding a gap in protection to the Cape Shirreff CEMP site, while acknowledging the need for minor technical revisions to the management plan. The Chairman suggested that a way forward would be to recommend to the Commission an extension of site protection for five years. The Scientific Committee agreed with this recommendation.

4.24 The Chairman referred the review and revision of the technical aspects of the management plans for both CEMP sites to the Subgroup on Designation and Protection of CEMP Sites, which would work intersessionally to prepare revised plans for consideration during the next WG-EMM meeting. Additionally, due to concern about the quality of maps for CEMP sites, the subgroup was tasked with working intersessionally with the Secretariat to address this matter.

4.25 Dr K. Sullivan (New Zealand) introduced CCAMLR-XVIII/24 which presents a management plan for a proposed Specially Protected Area (SPA) which includes the Balleny Islands and a surrounding marine area. He requested that the Scientific Committee comment on the merits of protection for this area both in principle and with regard to the specific proposal, which had been revised since the initial submission of the draft plan in June 1999 at the CEP meeting at ATCM-XXIII.

4.26 The Chairman of the Scientific Committee noted that WG-EMM had discussed an earlier draft of the Balleny Island SPA Management Plan (WG-EMM-99/21) at its July 1999 meeting. The Working Group had decided to circulate this paper to its Subgroup on Designation and Protection of CEMP Sites and noted that approval was beyond WG-EMM's remit at this year's meeting (paragraph 11.33(iii)). It was also recommended that clearer information and a scientific rationale for zone limits be provided, along with improved maps.

4.27 The Chairman further noted that this paper was submitted to the Commission and would most likely be referred to the Scientific Committee for comment. According to Annex V, Article 6(2) of the Protocol for Environmental Protection, the draft management plans that include a 'marine area' need to be submitted to CCAMLR for approval.

4.28 The Scientific Committee commented that, in principle, the concept of a marine protected area and ecological preserve could have scientific merit, if properly assessed, but that it was premature to comment specifically on the proposal for the Balleny Islands. It was recommended that the details of the proposal be directed to the Subgroup on Designation and Protection of CEMP Sites.

4.29 The Scientific Committee noted that the Subgroup on Designation and Protection of CEMP Sites should consider further development of a methodology for the assessment of proposals for marine protected areas put forward by the ATCM. It was further recommended that the subgroup be expanded to include additional expertise in the area of fisheries.

4.30 As a matter of clarification, the Chairman asked Dr E. Fanta (Brazil) to comment on the current status of the review of the management plan in the ATCM system. She stated that the plan had been reviewed at the July 1999 GOSEAC meeting (SC-CAMLR-XVIII/BG/27) and then noted that some of the changes recommended by GOSEAC had been incorporated into the plan submitted as CCAMLR-XVIII/24 (paragraph 11.33).

4.31 The Chairman cautioned that it was important for the most current version of the management plan to be provided to those charged by CCAMLR to review the plan.

4.32 Prof. C. Moreno (Chile) called attention to the first report of anti-*Brucella* antibodies in fur and Weddell seals from Cape Shirreff, Livingston Island (SC-CAMLR-XVIII/BG/18). It was noted that protected areas are not impermeable to the possibility of disease.

Data Requirements

4.33 Dr Everson noted the importance of continuing the data collection process. He called attention to the SCAR Working Group on Bird Biology workshop held in Montana, USA, during May 1999. This report will be submitted to the upcoming SCAR meeting to be held in July 2000 in Japan.

4.34 Since this report will contain the best information on the status and trends of Antarctic seabird populations, the Scientific Committee requested that the report be provided in advance of the 2000 meeting of WG-EMM.

4.35 Mr Cooper, Chairman of the SCAR-BBS, agreed that the report would be provided in advance of WG-EMM.

4.36 Prof. D. Torres (Chile) informed the Scientific Committee that the SCAR-GSS would be producing a report on the status of seals for the 2000 meeting of SCAR. Prof. Torres noted the importance of having this report made available to the 2000 WG-EMM meeting. Dr Miller agreed to write a letter to the group's convener, Dr J. Bengtson (USA), asking that the report be made available prior to WG-EMM.

4.37 Dr Everson noted the importance of the collaboration between CCAMLR and the IWC in the upcoming CCAMLR-2000 Survey. The participation of IWC observers in cruises will provide data beneficial to both CCAMLR and the IWC.

4.38 Dr Everson reported that Dr P. Hammond (IWC) clarified the status of whale survey data to be collected by IWC observers participating in the CCAMLR-2000 Survey. The data would be freely available for analyses to be presented to its scientific committee but would still be subject to the CCAMLR data rules for publication.

4.39 Dr Holt noted that the US APIS Program would conduct an ice-seal survey as part of its overall ecosystem research cruise in January 2000. The results of this survey would have relevance to CCAMLR, which is a joint sponsor of the program.

4.40 The Scientific Committee agreed with the following tasks for work on CEMP sites and existing and new standard methods:

Secretariat tasks:

(i) Resolve the status of all inquiries listed in Table 1 of the WG-EMM report (Annex 4).

(ii) Flag in the database potential problems of interpretation arising from analysis of parameters of Method A8a.

(iii) Request Members undertaking CEMP work at shore-based stations to advise on the type of meteorological data they collect on site or had ready access to from nearby stations.

Working Group activities:

Subgroup on Designation and Protection of CEMP Sites –

(iv) Review and revise the technical aspects of the management plans for both the Cape Shirreff and the Seal Islands CEMP sites.

(v) In cooperation with the Secretariat, upgrade the quality of maps for CEMP sites.

(vi) Review the details of the management plan of the Balleny Island SPA.

(vii) Consider further development of a methodology for the assessment of proposals for marine protected areas put forward by the ATCM.

Subgroup on Standard Methods –

(viii) Prepare advice on reduced sample size for Method C1a which should be incorporated into the next revision of the *CCAMLR Standard Methods.*

(ix) Consider drafts of Methods F1 and F4 for adoption at the next meeting of WG-EMM.

Advice to the Commission

4.41 The Scientific Committee reviewed the management plan of the Cape Shirreff CEMP site (Conservation Measure 62/XI), as per the procedures for affording protection to CEMP sites (Conservation Measure 18/XIII, Annex B – Cape Shirreff). The Scientific Committee, noting the importance of the long-term CEMP research being conducted by Chile and the USA, recommended that the Commission extend protection to the Cape Shirreff CEMP site for an additional five years.

Assessment of Incidental Mortality

Incidental Mortality Arising from Longline Fishing

4.42 The Scientific Committee noted the recommendations and advice provided by ad hoc WG-IMALF (Annex 5, paragraphs 7.171 to 7.180).

4.43 The Scientific Committee welcomed the publication of the book *Identification of Seabirds of the Southern Ocean. A Guide for Scientific Observers aboard Fishing Vessels* published by CCAMLR and the National Museum of New Zealand in 1999, and noted WG-IMALF's comments for any possible future revisions (Annex 5, paragraph 7.5). Dr A. Baker (New Zealand) promoted the guide as the best available and highlighted its importance in assisting CCAMLR to gather more accurate data on incidental mortality of seabirds. He also indicated that good use could be made of the guide by observers working in areas outside the Convention Area.

4.44 The Scientific Committee noted the comprehensive response to its request for information on research programs into the population status and foraging ecology of seabird species at risk from longline fishing in the Convention Area (Annex 5, paragraph 7.7). It endorsed WG-IMALF's interim advice along with the need for intersessional investigation and refinement of information to determine more accurately the potential utility to CCAMLR of data from such research programs (Annex 5, paragraphs 7.9 to 7.18).

4.45 Also the Scientific Committee recognised the need for ongoing investigation of the sampling effort required to estimate accurately seabird by-catch rates (Annex 5, paragraph 7.33).

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

4.46 The intersessional revision of 1998 data by WG-IMALF showed that:

(i) seabird by-catch totals and rates for Subareas 58.6 and 58.7 (Annex 5, Tables 46 to 48) were 63 and 39% of the 1997 values respectively (Annex 5, paragraph 7.21); and

(ii) the time of year (very few birds caught after April) and use of streamer lines were important in reducing seabird by-catch as shown by observer data from 1997 and 1998. However, the effects of most other factors (including line weighting) could not be fully analysed using the existing data (Annex 5, paragraphs 7.22 to 7.25).

4.47 The Scientific Committee noted that further improvements to, and assessments of, mitigation measures will require carefully designed field experiments as not much more is likely to be learnt from continuing analysis of observer data (Annex 5, paragraph 7.28).

4.48 Timely submissions by Members resulted in detailed analysis of 1999 data (Annex 5, paragraph 7.30) which showed that:

(i) Subarea 48.3: seabird by-catch (210 birds) was reduced by 65% and the by-catch rate (0.01 birds/thousand hooks) by 67%, compared with 1998. However, there was scope for further reductions through improved offal discharge, daytime setting and line weighting (Annex 5, paragraphs 7.36 to 7.38).

(ii) Division 58.5.1: no data were received but at least 151 birds were killed. France was requested to submit data to future meetings (Annex 5, paragraphs 7.39 and 7.40).

(iii) Subareas 58.6 and 58.7: seabird by-catch (156 birds) was reduced by 70% and the by-catch rate (0.03 birds/thousand hooks) by 85%, compared with 1998 (Annex 5, paragraphs 7.41 to 7.44). The largest reductions in by-catch were achieved by a change in the fishing area and by the use of underwater setting. WG-IMALF recommended that fishing within 200 km of the Prince Edward

Islands should be prohibited from January to March (Annex 5, paragraphs 7.41 to 7.46). In response, Mr Watkins drew the Scientific Committee's attention to the fact that South Africa had prohibited longlining close to the islands year round, had improved compliance with Conservation Measure 29/XVI and was vigorously investigating underwater setting of lines. All these factors had resulted in a marked reduction of bird by-catch during the past year.

(iv) Subarea 88.1: no seabird by-catch was observed (Annex 5, paragraph 7.34).

4.49 The Scientific Committee noted that seabird by-catch and by-catch rate in the regulated fishery over the past three years had been reduced by 96.4 and 95.7% respectively in Subarea 48.3 and by 81.3 and 94.2% respectively in Subareas 58.6 and 58.7 from 1997 to 1999. This had been achieved by a combination of improved compliance with Conservation Measure 29/XVI and by delaying the start of fishing towards the end of the breeding season of most albatross and petrel species (Annex 5, paragraph 7.47).

Compliance with Conservation Measure 29/XVI

4.50 The Scientific Committee noted that overall, levels of compliance with elements of Conservation Measure 29/XVI have steadily improved, particularly with respect to night setting and offal discharge. However, compliance with line weighting and overall use of streamer lines is still far from satisfactory. Two autoline vessels operating in Subarea 88.1 complied with all aspects of Conservation Measure 29/XVI (subject to the variation to allow daytime setting granted under Conservation Measure 169/XVII). For the remainder of the vessels, either insufficient data were provided to assess full compliance or not all elements of the conservation measure were complied with (Annex 5, paragraph 7.48 and Table 16).

4.51 The average weights (kg) per metre of mainline for all vessels in 1997, 1998 and 1999 were 0.111 (5 kg at 45 m), 0.133 (6 kg at 45 m) and 0.159 (7 kg at 44 m) respectively. This indicates a substantial increase in the overall weight added to lines in 1998/99, but is still well below the level (6 kg at 20 m) specified by Conservation Measure 29/XVI (Annex 5, paragraph 7.49). One vessel complied with the line-weighting regime for the Spanish longline system (6 kg every 20 m) on two of three cruises. Another vessel used a line-weighting regime close to this requirement (5 kg every 20 m) on two of five cruises.

4.52 The Scientific Committee recommended that further experiments to determine minimum effective line-weighting regimes for both Spanish and autoline systems should be undertaken as a matter of urgency (Annex 5, paragraphs 7.167 and 7.180(vi)). In the meantime, it recommended that the line-weighting regime in Conservation Measure 29/XVI be adhered to.

4.53 In Subareas 58.6, 58.7 and 88.1, there was 100% compliance with the requirement either to hold offal on board during the haul, or to discharge on the opposite side of the vessel to hauling. In Subarea 48.3, 71% of the vessels discharged offal on the opposite side to hauling, compared with only 31% in 1998 (Annex 5, paragraph 7.50). In Subarea 88.1, vessels achieved compliance through having a fish meal plant operating to process offal.

4.54 Night setting was achieved for 80% of sets in Subarea 48.3 and 84% in Subareas 58.6 and 58.7. Excluding daytime sets made during mitigation-measure experiments by the *Argos Helena* in Subarea 48.3 and *Eldfisk* in Subareas 58.6 and 58.7, night-setting values are 86 and 98% respectively, compared with 90 and 93% for 1998 (Annex 5, paragraph 7.51).

4.55 Both vessels fishing in Subarea 88.1 deployed streamer lines that complied with Conservation Measure 29/XVI. No vessels fishing in Subareas 48.3, 58.6 and 58.7 used streamer lines that met all aspects of the CCAMLR design. The length of streamer lines was the element with lowest compliance and only 10% of vessels in Subareas 58.6 and 58.7 and 26%

in Subarea 48.3 had lines that were at least 150 m long. Compliance with attachment height and number and spacing of streamers is generally close to 100% (Annex 5, paragraph 7.52, Tables 16 and 17).

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

4.56 The Scientific Committee noted that the 1997 seabird by-catch rates from the regulated fishery, rather than the much lower 1999 values, had been used to characterise the performance of unregulated vessels in 1999 in respect of incidental mortality of seabirds (Annex 5, paragraphs 7.57 to 7.62).

4.57 The estimates of potential seabird by-catch by area for 1999 (Annex 5, paragraphs 7.64 to 7.68, Tables 55 and 56) were:

Subarea 48.3	3 230–4 360 to 11 700–15 800 seabirds
Subareas 58.6 and 58.7	12 070–16 140 to 23 800–32 100 seabirds
Divisions 58.5.1 and 58.5.2	110–155 to 3 725–5 050 seabirds
Division 58.4.4	3 015–4 030 to 5 030–7 130 seabirds.

4.58 The overall estimated totals for the whole Convention Area (Annex 5, paragraph 7.69 and Table 56) indicated a potential seabird by-catch in the unregulated fishery of 18 000–25 000 (lower level) to 44 000–59 000 birds (higher level) in 1998/99. This compares with totals of 17 000–27 000 (lower level) to 66 000–107 000 (higher level) in 1996/97 and 43 000–54 000 (lower level) to 76 000–101 000 (higher level) in 1997/98. However, any suggestion of a decrease in 1998/99 should be viewed with caution, given the uncertainties and assumptions involved in the calculations.

4.59 The species composition of the estimated potential seabird by-catch (Annex 5, Table 57) indicates a potential by-catch of 21 000 to 46 500 albatrosses, 3 600 to 7 200 giant petrels and 57 000 to 138 000 white-chinned petrels in the unregulated fishery in Convention Area over the last three years.

4.60 The Scientific Committee agreed that such levels of mortality are unsustainable for the populations of albatrosses, giant petrels and white-chinned petrels breeding in the Convention Area (Annex 5, paragraph 7.73).

4.61 As last year (SC-CAMLR-XVII, paragraph 4.50), the Scientific Committee therefore recommended that the Commission take the most stringent measures possible to combat IUU fishing in the Convention Area.

4.62 Dr Baker expressed extreme concern at the continuing massive mortalities of seabirds during IUU longline fishing. He also expressed disappointment that not all CCAMLR-licensed vessels were adhering to CCAMLR conservation measures, and suggested that Flag States needed to be much stricter in their control of such vessels and their parent companies.

Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries

4.63 The Scientific Committee noted the levels of the incidental mortality of seabirds in new and exploratory longline fisheries during the 1998/99 season. In Subarea 88.1 (New Zealand), no seabirds were caught (Annex 5, paragraph 7.31), and in Subareas 58.6 and 58.7 (South Africa) low levels of seabird by-catch were experienced (Annex 5, paragraphs 7.29 to 7.51).

4.64 In this and past years, WG-IMALF has undertaken comprehensive assessments of incidental seabird mortality for most subareas and divisions. Full assessments of the risk of seabird by-catch have been compiled for all statistical subdivisions of the Convention Area (except Subarea 48.5) (SC-CAMLR-XVIII/BG/23; Annex 5, paragraph 7.84 and Table 58).

4.65 The Scientific Committee noted there are a number of potential conflicts between proposed fishing seasons and closed seasons to protect breeding seabirds from longline fishing contained in the new and exploratory fisheries notifications for 1999/2000. These were:

(i) minor for Divisions 58.4.3 (European Community), 58.4.4 (Chile, European Community, South Africa and Uruguay), Subarea 58.6 (Chile, European Community, South Africa) and Subarea 58.7 (South Africa);

(ii) substantial for Divisions 58.4.3 (France), 58.4.4 (France), 58.5.1 (France), Subarea 58.6 (France) and Subarea 58.7 (France); and

(iii) uncertain for Division 58.5.1 (Chile).

4.66 The Scientific Committee endorsed WG-FSA's advice (Annex 5, paragraph 7.90) that the New Zealand proposal to continue variation to Conservation Measure 29/XVI in 1999/2000 within Subarea 88.1 (Annex 5, paragraphs 7.85 to 7.93) be accepted by the Commission.

4.67 With the exception of the variation agreed for Subarea 88.1, the Scientific Committee agreed that Conservation Measure 29/XVI should be retained for all longline fisheries in all parts of the Convention Area. With respect to new and exploratory fishery in 1999/2000, the Scientific Committee also recommended that the Commission adopt seasonal fishing closures for various subareas and divisions in line with those proposed by WG-IMALF (SC-CAMLR-XVIII/BG/23; Annex 5, paragraph 7.84 and Table 58).

Incidental Mortality of Seabirds during Longline Fishing outside the Convention Area

4.68 Information on seabird by-catch outside the Convention Area continues to indicate substantial by-catch of species and populations breeding within the Convention Area (Annex 5, paragraphs 7.97 to 7.100).

4.69 It was noted that no data were received from Members, especially for regions adjacent to the Convention Area, such as New Zealand, South Africa, southern South America and the Falkland/Malvinas Islands. The Scientific Committee considered that this situation was regrettable and Members were requested to conduct analyses of any existing datasets and provide information to next year's meeting of WG-IMALF (Annex 5, paragraphs 7.102 and 7.103).

Effectiveness of Mitigation Measures

4.70 The continued evaluation of methods to mitigate seabird by-catch in longline fisheries was welcomed by the Scientific Committee.

4.71 Offal discharge: Some vessels were still discharging offal on the same side of the vessel as hauling of the longline. This practice is in contravention of Conservation Measure 29/XVI. Vessels were encouraged to undertake waste-pipe reconfiguration using information from the *Koryo Maru 11* (Annex 5, paragraph 7.110).

4.72 Line weighting: Experiments into line-weighting regimes using the Spanish longline-system vessels in Subarea 48.3 in February (Annex 5, paragraphs 7.111 to 7.115) and autoline vessels in Subarea 88.1 in January and February (Annex 5, paragraph 7.116), showed reductions in bird by-catch rates from 3.98 birds/thousand hooks to <1 bird/thousand hooks (in Subarea 48.3) and zero by-catch (in Subarea 88.1). These results have potentially important implications for longline fishing practices in the Convention Area (paragraph 4.76).

4.73 Underwater setting: The experiment using a Mustad underwater setting funnel in Subareas 58.6 and 58.7 between August 1998 and June 1999 showed that seabird by-catch (0.002 birds/thousand hooks) was significantly less with the funnel's use than without it (0.017 birds/thousand hooks) (Annex 5, paragraph 7.122). Further use and development of this system was strongly encouraged (Annex 5, paragraph 7.124).

4.74 The Scientific Committee requested technical coordinators of national scientific observation programs to provide relevant information on operational issues and fishing strategy procedures that may influence the successful use of mitigation measures, especially line-weighting regimes, for next year's meeting of WG-IMALF (Annex 5, paragraphs 7.126 and 7.127).

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

4.75 Initiatives to reduce seabird by-catch in longline fisheries by FAO, CMS, Australia and New Zealand (Annex 5, paragraphs 7.128 to 7.149) were supported by the Scientific Committee. The following initiatives were also noted and Members were urged to support them where appropriate:

(i) adoption by FAO of its IPOA–Seabirds in 1999 along with requests for FAO member states to produce NPOAs and report on them to FAO in 2001. The Scientific Committee encouraged longlining Members to develop their own NPOA–Seabirds and to report on progress next year (paragraph 11.4; Annex 5, paragraphs 7.129 to 7.131);

(ii) an initiative by the Valdivia Group to assist conservation of southern hemisphere albatrosses (Annex 5, paragraph 7.133);

(iii) progress with implementation of the Australian Threat Abatement Plan (Annex 5, paragraphs 7.137 to 7.140); and

(iv) the intention of New Zealand to host an International Fishers Forum in 2000 to develop improved mitigation measures. Members and fishers were encouraged to participate in this important initiative (Annex 5, paragraphs 7.144 to 7.149).

Approaches to Eliminating Seabird By-catch in Longline Fisheries in the Convention Area

4.76 The Scientific Committee welcomed and endorsed the review of policies and practices by WG-IMALF, involving seabird and fish research, fishing gear development, education and legislation which it believed was essential to furthering the work of WG-IMALF (Annex 5, paragraphs 7.150 to 7.170). The attention of the Commission was drawn to the following:

(i) Within the Convention Area, IUU longline fishing now poses the principal survival threat for most, if not all, the species and populations of at-risk seabirds (Annex 5, paragraph 7.156).

(ii) The impact of IUU fishing on seabirds could be reduced by increasing the benefit to fishers of using vessels or fishing practices which were configured and/or operated in ways to reduce the probability of seabird by-catch (e.g. underwater setting, integrated weighted autolines) (Annex 5, paragraph 7.157).

(iii) Relaxation of current fishing season restrictions can only be recommended when there is full compliance with all elements of Conservation Measure 29/XVI (Annex 5, paragraph 7.160).

(iv) Vessels able to demonstrate that they have consistently (i.e. in every cruise) achieved full compliance with all elements of Conservation Measure 29/XVI in a fishing season should, in the following year, be allowed to fish at any time of year (Annex 5, paragraphs 7.163 to 7.166). In this respect:

(a) continuing compliance would need to be monitored on the basis of all available data, including scientific observer reports;

(b) appropriate line-weighting regimes for autoline vessels still require determination;

(c) there should be in-port inspection of vessels prior to departure in order to ensure that they are capable of complying fully with Conservation Measure 29/XVI and have all necessary fishing and related gear on board (see also paragraph 3.16); and

(d) longline fishing should cease if a significant level of bird by-catch occurs (cf. the Scientific Committee recommendation in SC-CAMLR-XVII, Annex 5, paragraphs 4.67 and 4.68, with respect to the New Zealand proposal for fishing in Subarea 48.1 in 1998/99). Advice on appropriate levels of seabird by-catch, on an area-specific basis, should be provided by WG-IMALF.

4.77 Given that full compliance with Conservation Measure 29/XVI remains elusive, the Scientific Committee agreed that it was premature to advise adoption of the above approach at the present time (Annex 5, paragraph 7.164).

4.78 The Scientific Committee noted the need for continued experiments to define the optimum (minimum) line-weighting regime that will eliminate (or reduce to a very low level) seabird by-catch for both autoliners and vessels using the Spanish system. As an incentive to attract the cooperation of fishers and fishery managers, the Scientific Committee recommended that such experiments should be conducted in accordance with a strictly specified experimental design under Conservation Measure 64/XII (Annex 5, paragraphs 7.167 and 7.169).

Incidental Mortality in Trawl Fisheries

4.79 The Scientific Committee noted WG-IMALF's conclusions on incidental mortality due to trawl fisheries (Annex 5, paragraphs 8.2 to 8.6).

4.80 The Scientific Committee noted that although WG-IMALF had identified measures to minimise seabird by-catch in trawl fisheries, such fisheries may exert other effects on seabird populations and that these required further research (Annex 5, paragraph 8.7).

4.81 The Scientific Committee agreed that vessels conducting trawling operations in the Convention Area should have demonstrated their capacity to retain waste products from fishing and should organise the location and intensity of deck lighting to minimise the possibility of bird strikes. The latter would require directing lights inboard and downward onto the deck.

Marine Debris

4.82 The UK undertook surveys of entanglements of Antarctic fur seals at Bird Island, South Georgia (SC-CAMLR-XVIII/BG/5) as in previous years. The numbers (13) of entangled seals in winter represented an 86% increase on the 1997 figure. Only two animals were entangled with polypropylene straps, the second lowest level since records started. Twenty-four seals were observed entangled in summer, 84% higher than the previous year. The proportion of animals showing severe injuries (30%) was in contrast to 1997/98 when none was noted. Overall, occurrence of entanglement was down 80 to 90% of early 1990 levels. Polypropylene strap incidences have decreased slightly (35%) since their prohibition by CCAMLR in 1994, but severity of entanglement has increased. Sustained monitoring and continuing publicity aimed at preventing the disposal of debris at sea remains necessary.

4.83 In 1998/99 the UK undertook the third systematic annual survey of entanglements of Antarctic fur seals at Signy Island, South Orkney Islands (SC-CAMLR-XVIII/BG/6). Ten seals were sighted with neck collars, all juvenile males. The number of sightings increased by 66% since the previous season but was 17% lower than for 1996/97. Severe or very severe injuries were noted in 70% of the animals. The continued presence of packaging bands and synthetic line is of concern.

4.84 For the sixth year, the UK recorded man-made debris associated with seabirds at Bird Island, South Georgia (SC-CAMLR-XVIII/BG/7). An unprecedented quantity of lines originating from fishing vessels was recorded in association with wandering albatrosses. Quantities of fishing gear remained within the levels of previous years for most other species. Plastic debris remained within the levels of previous years for most species. Birds soiled with paint, tar and oil were noted.

4.85 Marine debris and fishing gear associated with seabirds at Marion Island was reported in SC-CAMLR-XVIII/BG/14. Most (52%) of the 306 items originated from the fishing industry. The most common items were rope nooses (79) and fishing hooks (28). Wandering albatrosses took the highest proportion of fishing gear, followed by southern giant petrels. Standardised searches revealed a slight decrease in debris associated with albatross nests since 1997/98, but levels were still much higher than in 1996/97.

4.86 Prof. Torres reported on the presence of transparent packaging bands, observed for the first time at Cape Shirreff in 1998/99.

4.87 The Scientific Committee took note of reports of marine debris surveys by several nations (CCAMLR-XVIII/BG/6, BG/7, BG/14, BG/18, BG/20, BG/22, BG/39, BG/40 as well as SC-CAMLR-XVIII/BG/10) that would be considered by the Commission.

4.88 It was noted that the increased summer totals of marine debris at South Georgia, at a time when no licensed fishing occurs, is a cause for concern (CCAMLR-XVIII/BG/12).

4.89 Dr Baker noted that in addition to CCAMLR-XVIII/BG/20, the two longline vessels which operated in Subarea 88.1 in 1998/99 each returned three tonnes of non-biodegradable waste to New Zealand at the end of their exploratory fishing.

4.90 Prof. Torres reported on the risk of disease from syringes and other medical waste and of containers with unidentified contents found washed up at Cape Shirreff in 1998/99 (CCAMLR-XVIII/BG/39).

Marine Mammal and Bird Populations

4.91 At its Sixth Meeting, the Scientific Committee agreed to periodically review the status of all marine mammals and bird populations in the Antarctic (SC-CAMLR-VI, paragraphs 8.6 and 8.7). The purpose of such a review would be to identify those species whose populations have experienced or are currently experiencing a significant change in abundance. SCAR-GSS, SCAR-BBS and the IWC were requested in 1995 to provide appropriate information on such populations (SC-CAMLR-XIV, paragraph 3.70).

4.92 The Scientific Committee has agreed that it will review the status of marine mammal and bird populations every five years (SC-CAMLR-VI, paragraph 8.7). The next review is planned for the year 2000.

4.93 It was noted that both SCAR-GSS and SCAR-BBS were currently involved in producing population assessments for pack-ice seals and seabirds respectively. In this regard, Dr Holt indicated that the APIS census planned for January and February 2000 is a one-off survey (paragraph 4.39). Dr Everson also noted that data gathered from whale observations during the CCAMLR-2000 Survey could provide population information on whales (paragraph 4.37).

4.94 The Scientific Committee encouraged SCAR-BBS and SCAR-GSS to provide their assessments in good time for the results to be reviewed by WG-EMM at its meeting in late July 2000. It was agreed that Mr Cooper and Prof. Torres should convey this request to the respective SCAR groups. It was also recognised that both these groups will meet in advance of WG-EMM's next meeting (paragraphs 4.35 and 4.36). Consequently, the Scientific Committee indicated its appreciation to Mr Cooper for his undertaking to provide a late draft version of the seabird population assessments as soon as this was available.

HARVESTED SPECIES

Krill

Report of WG-EMM

Distribution and Standing Stock

5.1 The Scientific Committee noted that results of various local krill surveys in Subareas 48.1 and 48.3 had been reported to WG-EMM (Annex 4, paragraphs 3.1 to 3.8).

Estimates of Global Krill Abundance

5.2 The Scientific Committee noted that new estimates of the global krill biomass had been presented to WG-EMM (Annex 4, paragraphs 3.9 to 3.14). These estimates were based on the distribution of krill and recent stratified acoustic density measurements, and ranged from 62 to 137 million tonnes. This range is lower than earlier estimates using a variety of methodologies and is considerably lower than the figure of 500 million tonnes which is often quoted as the global krill biomass.

5.3 Possible reasons for these differences include: underestimation of the range of krill, underestimates of krill density by acoustics and overestimate of krill demand by predators. The Scientific Committee noted that research into these areas had already improved knowledge in the field of krill acoustics and into the krill requirements of predators, but encouraged further research to determine which of these factors contributes most to the uncertainties in krill biomass and production estimates (Annex 4, paragraph 3.10).

CCAMLR 2000 Krill Synoptic Survey of Area 48

5.4 The Scientific Committee agreed with WG-EMM that the key results of the CCAMLR-2000 Survey will be an estimate of krill biomass (B_0) that will be used in the krill yield model (KYM) to set a precautionary catch limit in Area 48.

5.5 These results of the CCAMLR-2000 Survey could be viewed in the context of the results of the other, smaller, acoustic surveys that have been carried out in the South Atlantic. Consequently, it may be apparent whether the survey has been conducted in an anomalous year.

5.6 The Scientific Committee agreed that an urgent task was the development of mechanisms for the subdivision of this catch limit into smaller management areas to prevent the fishery from concentrating its effort in a relatively small area at one time. This subdivision may have to include temporal as well as spatial elements because of the seasonal movements of the fishery and because of its focus on the South Georgia area in winter.

Regional, Vertical and Seasonal Distribution of Krill

5.7 The Scientific Committee noted WG-EMM's discussion on studies concerning regional, vertical and seasonal distribution of krill (Annex 4, paragraphs 3.15 to 3.19) and population structure, recruitment, growth and production (Annex 4, paragraphs 3.20 to 3.22), and agreed that these were topics requiring further research.

Indices of Abundance Distribution and Recruitment

5.8 WG-EMM had discussed indices of krill abundance distribution and recruitment (Annex 4, paragraphs 3.23 to 3.41). The Scientific Committee encouraged further research on potential errors involved in sampling krill populations, including the non-random structure of krill aggregations, potential flux into and out of the sampling areas and the provision of independent estimates of mortality (Annex 4, paragraph 3.40).

5.9 The Scientific Committee recognised the need for long time series of data on krill population parameters from the Indian and Pacific Ocean sectors of the Antarctic to improve general understanding of krill population dynamics (Annex 4, paragraph 3.41).

Future Work

5.10 It was noted that a time series of krill surveys in the area north of the South Shetland Islands in 1999/2000 (in conjunction with the CCAMLR-2000 Survey) was planned by Japan, USA and Republic of Korea (Annex 4, paragraphs 3.42 and 3.43) and the results of this survey will complement those of the CCAMLR-2000 Survey.

Data Requirements

5.11 The Secretariat had been requested to approach Peru for details of recent surveys in the Bransfield Strait (Annex 4, paragraph 3.43).

5.12 WG-EMM had highlighted the need for data from the commercial fishery during the 1999/2000 season (Annex 4, paragraph 2.15). The Scientific Committee endorsed the priorities for data collection by scientific observers on krill fishing vessels operating during the CCAMLR-2000 Survey which are set out in section 3.

Advice to the Commission

5.13 The purpose of the CCAMLR-2000 Survey is to provide an estimate of biomass (B_0) that will be used in the KYM to set a precautionary catch limit for krill in Area 48.

5.14 The setting of a new precautionary catch limit is merely the beginning of the process of developing a management procedure for krill in the South Atlantic. This procedure will need to include a consideration of the subdivision of the catch limit into smaller management units. The size of these management units and the trigger level at which the catch limit would be subdivided need to be determined by WG-EMM at its next meeting.

Fish Resources

Review of Available Information

Data Inventory and Developments in the CCAMLR Database

5.15 The majority of the data from the 1998/99 split-year (1 July 1998 to 30 June 1999) and the 1998/99 fishing season (various periods) were available to WG-FSA. STATLANT data were summarised in SC-CAMLR-XVIII/BG/1. Some STATLANT data remain to be submitted. For assessments at WG-FSA-99, missing data were temporarily constructed from catch and effort and fine-scale data. Catch and effort data reports for the 1998/99 fishing season were summarised in CCAMLR-XVIII/BG/9. Dr S. Kawaguchi (Japan) reported that fine-scale data for the krill fishery in Area 48, referred to in paragraph 3.5 of WG-FSA's report (Annex 5), have now been submitted.

5.16 The Scientific Committee welcomed developments in the CCAMLR research survey database during 1999, and looked forward to further developments in 2000. The Scientific Committee endorsed the comments of WG-FSA regarding submission of research survey data for inclusion in this database.

5.17 Appendix B of SC-CAMLR-XVIII/BG/1 summarised data on the trade of *D. eleginoides* in 1998 and 1999, which had been reported to the Secretariat by Australia, Chile, USA and FAO. These data quantify imports and exports of *Dissostichus* products such as frozen fillets and headed, gutted and tailed (HAT) fish.

Data Entry and Validation

5.18 All the available fishery, observer and survey data from the 1998/99 split-year and from the 1998/99 fishing season had been entered into the CCAMLR database and validated. As in previous years, some datasets were submitted only a short time before the meeting and were processed during the meeting. Annex 5, paragraph 3.14 listed fine-scale data which were overdue at the start of the WG-FSA meeting. The Scientific Committee noted that these data had either now been received or were expected to be received very soon, but requested the Commission to remind Members of the importance of timely submission of data to facilitate the activities of WG-FSA.

5.19 The Scientific Committee noted the problems identified in the database from validation of fine-scale data and endorsed the comments of WG-FSA regarding resolution of these problems.

5.20 The Scientific Committee welcomed developments in the use of electronic data forms for reporting STATLANT data, catch and effort reports, fine-scale data (catch, effort and biological) and observer data, as well as the creation of a prototype Microsoft Access database for use by observers.

Estimates of Seabed Area

5.21 The Scientific Committee noted the revised estimates of seabed areas within the 500 m isobath of the South Orkney Islands presented to WG-FSA. The revision of seabed areas requested at WG-FSA-98 had not been undertaken in 1999 due to a delay in the release of a new dataset, at a spatial resolution of 1 x 1 minute, from Sandwell and Smith.

Catch, Effort, Length and Age Data Reported to CCAMLR

5.22 Table 2 of WG-FSA's report (Annex 5) summarised catches reported from the Convention Area during the 1998/99 split-year (1 July 1998 to 30 June 1999). Table 3 summarised fisheries carried out under conservation measures in force during the 1998/99 fishing year (5 November 1998 to 30 November 1999). The main fisheries in this case were:

(i) trawl fishery for *C. gunnari* in Subarea 48.3; catch limit 4 840 tonnes, reported catch 265 tonnes;

(ii) trawl fishery for *C. gunnari* in Division 58.5.2; catch limit 1 160 tonnes, reported catch 2 tonnes;

(iii) trawl fishery for *D. eleginoides* in Division 58.5.2; catch limit 3 690 tonnes, reported catch 3 480 tonnes;

(iv) longline fishery for *D. eleginoides* in Subarea 48.3; catch limit 3 500 tonnes, reported catch 3 652 tonnes;

(v) exploratory longline fishery for *Dissostichus* spp. in Subarea 88.1; catch limit 271 tonnes north of 65°S, 2 010 tonnes south of 65°S, reported catch 0 tonnes north of 65°S, 298 tonnes south of 65°S;

(vi) pot fishery for crabs in Subarea 48.3; catch limit 1 600 tonnes, reported catch 4 tonnes; and

(vii) other fisheries allowable as new or exploratory fisheries in the 1998/99 season were either not carried out or caught less than 1 tonne of the target species.

5.23 The Scientific Committee noted an overshoot of the catch limit in the longline fishery for *D. eleginoides* in Subarea 48.3 amounting to 152 tonnes (4%), which resulted from high catch rates during the final 10 days of the fishing season. The issue of conversion factors is discussed in more detail in paragraphs 5.41 to 5.51.

Estimates of *Dissostichus* spp. Catches from Illegal, Unregulated and Unreported Fishing

5.24 The Scientific Committee noted the deliberations of WG-FSA regarding IUU catches of *Dissostichus* spp. in the Convention Area, set out in Annex 5, paragraphs 3.29 to 3.44. Information for the 1998/99 season was compiled intersessionally by a small task group and further reviewed during the WG-FSA meeting.

Catches by Members and Acceding States in the Convention Area and EEZs

5.25 Reported catches of *Dissostichus* spp. by Members and Acceding States, from inside the Convention Area and EEZs outside the Convention Area, along with estimated unreported catches by Members and Acceding States from inside the Convention Area, are presented in Table 5. The total estimated catch by Members and Acceding States for all areas was similar in the 1998/99 split-year (41 201 tonnes) to that in 1997/98 (42 508 tonnes). The total reported catch from EEZs outside the Convention Area and from within the Convention Area during the 1998/99 split-year (37 165 tonnes) was more than during the 1997/98 split-year (27 908 tonnes). The estimates of total unreported catches during the 1998/99 split-year (4 080 tonnes) was much less than during the 1997/98 split-year (14 600 tonnes).

5.26 The Scientific Committee noted that estimates of unreported catches by Members and Acceding States (Table 5) were only available for Argentina and Chile, and that these numbers should be treated with caution because they are derived from crude estimates of potential catch and effort in the Indian Ocean. It was noted that the caution is in regard to the possible upper level of the estimates rather than the lower level. The real level of IUU catch is likely to be greater than that estimated by WG-FSA, but it is uncertain how much higher.

IUU Landings by all Countries

5.27 WG-FSA had estimated landings of IUU-caught *D. eleginoides* by all countries (CCAMLR Members and non-Members) in Cape Town/Durban (South Africa), Walvis Bay (Namibia), Port Louis (Mauritius) and Montevideo (Uruguay) for the 1997/98 and 1998/99 split-years and the period July to September 1999 (Annex 5, Table 5). The total green-weight landings for the 1998/99 split-year were estimated as 16 636 tonnes. The Scientific Committee noted that this was a decrease compared to the previous split-year (26 829 tonnes), but that WG-FSA had been unable to determine the reasons for this decline. Mauritius remains the primary site for the landing of IUU-caught fish.

IUU Effort and Catches in the Convention Area for the 1998/99 Split-year

5.28 WG-FSA used the approach adopted at its 1998 meeting (SC-CAMLR-XVII, Annex 5, paragraph 3.24) to estimate the magnitude of IUU fishing effort and catches in various subareas and divisions of the Convention Area during the 1998/99 split-year. The results of this analysis are presented in Tables 6 and 7 of WG-FSA's report (Annex 5). The estimated total catch for all subareas and divisions in the Convention Area in the 1998/99 split-year was 24 211 tonnes, comprising 17 588 tonnes of reported catch and 6 653 of estimated unreported catch (Annex 5, Table 7). The total estimated landings of catches in Walvis Bay and Mauritius (16 425 tonnes) in 1998/99 accounted for some 86% of the estimated 18 983 tonnes total catch in the Indian Ocean.

Estimated Trade in *Dissostichus* spp. in the 1998/99 Split-year

5.29 Trade statistics for *D. eleginoides* in 1998/99 were received from FAO, Japan, USA, Chile and Australia. These figures were presented in Annex 5, Tables 9 to 11. Product imports into Japan and the USA totalled an estimated equivalent of 44 796 tonnes of whole *D. eleginoides* during the 1998 calendar year, with Chile, Argentina, Mauritius, France and Australia being the major sources of supply. In the first half of 1999, imports into Japan and the USA totalled 23 207 tonnes equivalent whole weight, with China emerging as a more important source. The equivalent estimate of imports in the 1997 calendar year was 69 978 tonnes (SC-CAMLR-XVII, Annex 5, Table 9).

5.30 Although there was a decrease in the volume of imports into Japan and the USA, the Scientific Committee noted that the price of headed and gutted product on the US market has nearly trebled since July 1998 (Annex 5, Figure 1). The increasing trend has continued despite obvious fluctuations in supply, and will increase the incentive for IUU fishing.

5.31 The Scientific Committee reiterated its warning of previous years that trade statistics should be treated with caution since the export sources of product are not necessarily responsible for the catching of fish. In this context, the emergence of China as an export source was noted and the fact that China could contribute to increased fishing effort in the future.

Overall Estimates of IUU Catch

5.32 Table 12 of WG-FSA's report (Annex 5) provides overall estimates of the catch from IUU fishing operations. The total estimate for the 1998/99 split-year was 10 733 tonnes. This compares to 33 583 tonnes in the 1997/98 split-year and 38 000 to 42 800 tonnes in 1996/97. Although the estimates of IUU catches have decreased, the Scientific Committee noted WG-FSA's concern that the difficulties in estimating IUU catches have increased. For example, information received by WG-FSA indicates that the transhipment of catches at sea is increasing and that as much as 6 000 tonnes of fish may have been moved in this way during 1998/99. The information available for 1998/99 is therefore more uncertain than that for 1997/98. The Scientific Committee agreed that estimates of IUU catches of *Dissostichus* spp. are only minimum estimates and that the values for 1998/99 should be compared with previous years only with caution.

5.33 There is, however, some indication that the potential number of vessels involved in IUU fishing has decreased. Information presented to WG-FSA in the report of the intersessional subgroup on IUU fisheries indicated that four vessels engaged in IUU fishing in Area 58 had been arrested and were no longer taking part in IUU fisheries. Prof. Moreno noted that although the problem of IUU fishing continues and is very serious, there have been some positive developments. In particular, Chile has implemented new measures (e.g. requirement for VMS on all fishing vessels and revision of the national authorisation for fishing) which has resulted in the reduction of the Chilean fleet authorised to conduct longlining operations from 36 to nine vessels.

5.34 The Scientific Committee also noted that whilst the overall picture of IUU fishing is bleak, the problem is not uniformly distributed throughout the Convention Area. As in the past, most IUU fishing for *Dissostichus* spp. during 1998/99 occurred in the Indian Ocean sector (Area 58). Concern was expressed over the emergence of Division 58.4.4 (Ob and Lena Banks) as a focus of IUU fishing, particularly in view of the remoteness of this region and the high degree of uncertainty regarding real levels of effort occurring there. In other areas, estimates of IUU catches are lower and there is more information on likely levels of effort by IUU vessels.

Use of IUU Catch Estimates in Stock Assessments and Implications for Management

5.35 Estimates of IUU catches for Subareas 48.3, 58.6 and 58.7, and Divisions 58.5.1, 58.5.2 and 58.4.4 were used to calculate estimates of total removals for the 1998/99 fishing season, for use in updated assessments using the GYM (Annex 5, Table 8). As in past years, WG-FSA took into account unreported catches of *D. eleginoides* in its assessment of yields on the assumption that IUU catches can be brought under control.

5.36 The Scientific Committee again stressed that continued illegal fishing holds serious implications for the long-term yield and that total catches, in some areas at least, may seriously compromise the status of the spawning stock in the shorter term. For example, there are indications that catches of *D. eleginoides* in the South African EEZ around the Prince Edward Islands (Subareas 58.6 and 58.7) have fallen to about 10% of their initial levels and biomass estimates around the Crozet Islands have declined to between 25 and 30% of their original levels. Dr Constable further pointed out that assessments of stock status and future projections using the GYM as done in the past, do not presently include a stock–recruitment relationship. Thus the possible direct effects of large reductions in spawning biomass on future recruitment are not taken into account.

5.37 The Scientific Committee recalled that there are lessons to be learned in this respect from former fisheries for *Notothenia rossii* in the Convention Area. More than 20 years after the end of large-scale commercial fishing for this species in Subareas 48.1 and 48.3, there is little sign of recovery to former levels of biomass. The impact on these stocks, although it resulted from fishing prior to the establishment of CCAMLR, is therefore at a level which is contrary to the requirements of Article II.3(c).

5.38 Based on monitoring studies on inshore demersal fish carried out over a 16-year period in the lower South Shetland Islands area (Subarea 48.1) (Annex 5, paragraph 3.135), Dr E. Barrera-Oro (Argentina) established a parallel between the decline in the abundance of *N. rossii*, and that of *Gobionotothen gibberifrons* which was also caught in the commercial fishery in the late 1970s. He noted that although *G. gibberifrons* is still the dominant offshore fish species of the area, it has virtually disappeared from the catches taken from inshore waters, in conjunction with the decline of *N. rossii*.

Research Surveys

5.39 Several research cruises to study harvested stocks were conducted in the Convention Area during the 1998/99 season, and these are detailed in Annex 5, paragraphs 3.78 to 3.81. These included trawl surveys by Australia in Divisions 58.4.1, 58.4.3 and 58.5.2, and by the USA in Subarea 48.2. Longline-weighting trials were conducted by the UK in Subarea 48.3. Other research surveys notified for 1998/99 and summarised in CCAMLR-XVIII/BG/9 had either been postponed or were not aimed to acquire data in support of the assessment of fish stocks.

5.40 Surveys proposed for the 1999/2000 season are described in Annex 5, paragraphs 6.6 to 6.12. These include survey activities by Australia in Division 58.5.2; UK, Russia, and Argentina in Subarea 48.3; New Zealand in Subarea 88.1 and the USA in Subarea 48.1.

Conversion Factors

5.41 As last year, scientific observers' reports included independent estimates of CFs used to convert measurements of processed weights to estimates of whole weight of catches. 1998/99 was the first year that observers had made consistent observations of CFs using a standard protocol established at last year's meeting. The results are presented in Table 18 of WG-FSA's report (Annex 5).

5.42 The Scientific Committee noted that differences between the CFs calculated by observers and those used by the fishing vessels to report their catches suggest that there might be errors in reported catches. Table 19 of WG-FSA's report presents mean CFs from observers and vessels.

5.43 The Scientific Committee noted with concern that catches from some fisheries, particularly in Subarea 48.3, may be underestimated because inappropriate CFs are being used by most vessels when reporting their catches. Observer-derived CFs were 15% higher than CFs used by vessels in Subarea 48.3, 7% higher in Subarea 58.7 and 3% higher in Division 58.5.2 (Annex 5, Table 19). Consequently, catches reported for the past three seasons in Subarea 48.3, calculated using the vessels' CFs, are lower than those that would result from using the observers' CFs by 351, 399 and 545 tonnes respectively.

5.44 The Scientific Committee noted that these calculations make the assumption that the observers' estimates of CFs are correct and those used by the vessels are incorrect. The large differences observed in Subarea 48.3 might still result from differences between products considered by vessel skippers and those considered by scientific observers. It is not always clear from observer reports whether CFs have been calculated using different product forms and how the factors relate to standard product cuts such as illustrated in the *Scientific Observers Manual*.

5.45 There are two issues to be considered in relation to inconsistencies in CFs:

(i) the within-season reporting of catches required to implement catch limits and establish fishery closure dates; and

(ii) WG-FSA requires accurate estimates of total removals of fish in order to undertake its assessments.

5.46 With respect to the latter point, it is possible for WG-FSA to make adjustments after the season based on the best estimates of CFs. However, with respect to within-season reporting, some action is needed to ensure that appropriate CFs are used in the calculation of total catches to be reported to the Commission.

5.47 The Scientific Committee stressed the need to avoid the potential for catches to routinely exceed catch limits. The possible use of a standard CF throughout the fishery was discussed, but it was noted that CFs vary between vessels and also depend on the size of fish being processed. WG-FSA's report had noted the possibility that the exploitation patterns in the longline fishery in Subarea 48.3 may be changing, hence it would be problematic to adopt a single factor in a particular year.

5.48 An alternative approach is to directly record the whole weight of whole fish in the catch. This would avoid the use of CFs in the estimation of total weight of catches. The Scientific Committee recognised that direct weighing of catch was probably not a practical option in the short term, but should be kept under consideration for the future.

5.49 The Scientific Committee agreed that observers should continue to use the current protocol for determining CFs set out in the *Scientific Observers Manual*, and that the fish being sampled should be subject to exactly the same processing methods as used during commercial processing of the catch.

5.50 Prof. Moreno noted that CFs used by commercial vessels are often based on historical records and that there are no specific instructions to masters on how CFs should be measured and updated from year to year. The Scientific Committee recommended that the procedure set out in the *Scientific Observers Manual* be adopted as a standard method for measuring CFs, not only by observers, but also by vessel masters. The protocol could be circulated to Members in the form of a Commission circular and passed on to vessel masters by Flag States, or possibly set out in a technical conservation measure in a similar way to the regulation on mesh size measurement (Conservation Measure 4/V). The Scientific Committee encouraged vessel masters and observers to cooperate in the establishment of CFs to avoid duplication of work and possible inconsistencies in results.

5.51 CFs estimated at the start of each fishing trip using the standard procedure should then be used in the calculation of total catches to be reported to the Commission during the season.

Fish Biology, Demography and Ecology

5.52 The Scientific Committee welcomed a number of important contributions on *D. eleginoides* and *D. mawsoni* which had been presented to WG-FSA (Annex 5, paragraphs 3.94 to 3.112). These included information on age determination and genetic techniques to separate stocks and to identify fish products to species level.

5.53 A considerable amount of new information was presented on the biology of *C. gunnari* (Annex 5, paragraphs 3.113 to 3.129). This includes length-to-mass relationships and size distributions for the Atlantic sector, diurnal migrations, standing stock, reproduction, feeding, condition factor and parasites.

Developments in Assessment Methods

5.54 The Scientific Committee noted the deliberations of WG-FSA regarding development of assessment methods (Annex 5, paragraphs 3.139 to 3.145). Intersessional activities included a workshop held at the Renewable Resources Assessment Group, Imperial College, UK, in March 1999 to further develop the mixture analyses for estimating recruitments at South Georgia and to examine ways of integrating CPUE analyses and the yield assessments of the GYM.

5.55 Dr P. Gasiukov (Russia) had presented a paper to WG-FSA (WG-FSA-99/60) reporting on the implementation of an approach for processing outputs from the GYM when CPUE or some other index of abundance is available. This approach results in a subset of possible projections being used in the final assessment of long-term annual yield according to the CCAMLR decision rules.

5.56 The Scientific Committee welcomed this development, particularly as it had been indicated last year as an area of priority research. The Scientific Committee noted the discussion by WG-FSA of another approach to the same problem, which is to use a Sampling/Importance Resampling (SIR) algorithm (McAllister et al., 1994). This approach avoids the problem of rejecting large numbers of projections, by assigning probabilities to individual projections according to the compatibility of the observed CPUE with projected abundances.

5.57 Recalling comments from previous years on the need for information required to develop direct estimates of recruitment for areas subject to new and exploratory fisheries (SC-CAMLR-XVII, paragraph 7.6), the Scientific Committee noted that apart from a recent survey by Australia at Heard Island and BANZARE Bank, no new information had become available. The Scientific Committee expressed great concern at the continuing lack of information on stocks of *Dissostichus* spp. subject to applications for new and exploratory fisheries, especially given that many of these stocks appear to have been targeted already by IUU vessels. It was agreed that in the absence of research voyages into these areas, there is a need for longliners entering these fisheries to contribute to some form of research program to help develop assessments of stock status and long-term yield. This is discussed further in section 9.

Assessments and Management Advice

Assessed Fisheries

Methods Applied to the Assessment of *D. eleginoides*

5.58 The assessment of *D. eleginoides* undertaken by WG-FSA again focused on three main analyses:

(i) standardisation of CPUE data using GLMs;
(ii) analysis of catch-weighted length frequencies; and
(iii) determination of long-term annual yields using the GYM.

5.59 Analysis of the CPUE data was only undertaken for Subarea 48.3 where new data were available for the latter part of the 1997/98 season and the whole of the 1998/99 season. The basic approach used to fit the GLMs was the same as that used last year (SC-CAMLR-XIV, Annex 5, Appendix G). However, changes were made to the CPUE data transformation and the particular type of GLM analysis used, in order to improve the distribution of residuals (Annex 5, paragraph 4.105).

5.60 Catch-weighted length frequencies were generated using a database application developed by the Secretariat during the intersessional period (WG-FSA-99/15). This analysis also focused on Subarea 48.3.

5.61 Long-term annual yields were reassessed for Subarea 48.3 and Division 58.5.2, based on revised input parameters for the GYM. Revised inputs included new growth parameters, a new exploitation pattern for longlines, a range of natural mortality (M) rather than a single value and new estimates of recruitment. Details of the assessment methods are found in paragraphs 4.104 to 4.135 of Annex 5 for Subarea 48.3, and in paragraphs 4.151 to 4.156 for Division 58.5.2.

5.62 Considerable time was spent during the WG-FSA meeting on refining inputs into the GYM. It was therefore not possible at this year's meeting to examine the use of depletion-based methods and methods for combining the GYM with abundance indices such as CPUE (see paragraph 5.55). The Scientific Committee recommended that further examination of the use of these methods should be undertaken at next year's meeting.

5.63 The Scientific Committee endorsed the methods used by WG-FSA for the assessment of *D. eleginoides* this year, and noted the common approaches being used to assess the longline fishery in Subarea 48.3 and the trawl fishery in Division 58.5.2. In both these areas, fisheries for *D. eleginoides* have been undertaken for several years and time series of recruitments are available, based on the results of fisheries-independent trawl surveys.

D. eleginoides at South Georgia (Subarea 48.3)

Standardisation of CPUE

5.64 Details of the analysis of CPUE are provided in Annex 5, paragraphs 4.104 to 4.114. The Scientific Committee endorsed the CPUE analysis undertaken by WG-FSA this year, including the following modifications:

(i) the use of a square root transformation for the CPUE data; and
(ii) the use of a robust form of GLM.

5.65 These modifications resulted in a more satisfactory distribution of residuals, but little change in the pattern of standardised CPUE up to the 1997/98 season.

5.66 The Scientific Committee noted that the adjusted, standardised catch rates decreased between the 1993/94 and 1997/98 seasons, but increased in the 1998/99 season (Annex 5, paragraph 4.109). This was consistent with expectations based on estimates of recruitment from fishery-independent surveys (Annex 5, paragraph 4.141).

Distribution of Fishing and Size at Capture

5.67 The Scientific Committee noted the investigation by WG-FSA of recent changes in the distribution of fishing by depth in Subarea 48.3 and the possible effect on the exploitation pattern (Annex 5, paragraphs 4.110 to 4.112). It appears that the longline fishery is starting to concentrate more in shallower water where the fish are generally smaller. The Scientific Committee recommended that this development be reviewed again at next year's meeting.

Determination of Long-term Annual Yield using the GYM

5.68 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. In particular, the Scientific Committee noted and endorsed the following revisions of input data and parameters for Subarea 48.3:

(i) Revised growth parameters were estimated, based on length–age data from readings of scales taken from the commercial longline fishery in the period February to May 1991, and otoliths collected during the UK survey around South Georgia in January and February 1991. A priority task for next year should be to re-estimate the growth parameters based on new information of length at age from material collected as part of the CCAMLR Scheme of International Scientific Observation.

(ii) A range of estimates of M (0.13–0.2 yr^{-1}), equivalent to the range 2 k to 3 k, rather than a single value was used.

(iii) A revised selectivity pattern was developed, based on the assumption that fish in excess of 79 cm in length are likely to be fully selected by the fishery. In conjunction with the apparent shift towards the catching of smaller fish in shallower water in some parts of Subarea 48.3 (paragraph 5.67), the Scientific Committee recommended that next year's meeting of WG-FSA undertake a more detailed analysis of the effect of changing selectivity on long-term annual yield.

(iv) A comprehensive review of the recruitment time series was undertaken based on bottom trawl surveys undertaken in Subarea 48.3 between 1987/88 and 1996/97.

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

5.69 The estimate of yield from the GYM was 5 310 tonnes. This was higher than the result obtained at last year's meeting (3 550 tonnes) for two main reasons:

(i) the increase in the estimate of mean recruitment; and
(ii) the revision of the selectivity pattern to include all fish >79 cm.

5.70 The Scientific Committee welcomed the considerable progress made at this year's meeting of WG-FSA in refining the data inputs into the GYM.

5.71 According to the analysis of available data for the most recent season, the standardised CPUE has increased since the 1997/98 season. This may be partially explained by the recruitment to the fishery of the strong 1989 year class (age 4 in 1992/93 – Annex 5, Table 38).

5.72 The Scientific Committee agreed that the estimate of yield from the GYM analysis undertaken by WG-FSA should be used to set the catch limit for the 1999/2000 season. Other management measures for *D. eleginoides* in Subarea 48.3 in the 1999/2000 season should remain as for the 1998/99 season.

5.73 The Scientific Committee noted the small overshoot of the catch limit in the 1998/99 season, resulting from higher than average CPUE at the end of the season (Annex 5, paragraph 3.25) and the occurrence of some illegal fishing in Subarea 48.3 (Annex 5, paragraph 3.33). However, it was noted that these additional catches were taken into account by WG-FSA in the calculation of long-term yield using the GYM, and that therefore it would not be necessary for the amount of this additional catch to be subtracted from the catch limit set for the 1999/2000 season.

5.74 Dr E. Marschoff (Argentina) noted that the analysis of CPUE discussed in paragraphs 5.55 and 5.56 produced an estimate of yield which was lower than the 3 550 tonnes agreed by the Commission last year. Dr Marschoff indicated that the catch in 1999/2000 should be less than 5 310 tonnes in order to maintain a degree of caution appropriate to the uncertainty indicated by the results of this analysis.

5.75 Other Members noted that, whilst this analysis was a useful contribution to the development of procedures for the refinement of the outputs of the GYM, the results did not include CPUE and catch data available at this year's meeting of WG-FSA, and used input data and parameters for the GYM from last year's meeting which have since been revised. These results could therefore not be used to infer the outcome of such a procedure in this year's analysis.

5.76 The Scientific Committee noted that any catch of *D. eleginoides* taken as part of research fishing in Subarea 48.3 should contribute towards the catch limit.

5.77 The Scientific Committee recommended the development of methods to integrate different indicators of stock status into assessments.

D. eleginoides at South Sandwich Islands (Subarea 48.4)

5.78 Despite a catch limit of 28 tonnes for *D. eleginoides*, no fishing in this subarea was reported to the Commission during the 1998/99 season. No new information was made available to WG-FSA on which to base an update of the assessment.

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

5.79 The Scientific Committee noted that there had been no longline fishing reported in this subarea since the 1992/93 season, but that the existing catch limit was a precautionary harvest level which was based on the results of an exploratory fishing trip (SC-CAMLR-XII, Annex 5, paragraphs 6.1 to 6.4). The Scientific Committee recommended that 28 tonnes be adopted as an appropriate catch limit for a precautionary harvest strategy for *D. eleginoides* and *D. mawsoni* in Subarea 48.4 and that WG-FSA consider what would be an appropriate precautionary harvest strategy and data collection plan at its next meeting (section 7).

D. eleginoides at Kerguelen Islands (Division 58.5.1)

5.80 The total catch in the longline fishery in Division 58.5.1 during the 1998/99 season was 5 402 tonnes. The Scientific Committee noted that the recent catch was less than the long-term annual yield derived from assessments last year. France has reported all catch and effort data to the Commission, but no new assessments were undertaken this year.

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

5.81 The French authorities will allow trawling and longlining in their EEZ within this division in the 1999/2000 season (1 September 1999 to 31 August 2000). The French authorities have advised that there will be no increase in total catch of *D. eleginoides* over that taken last season, and that catch for the trawl fishery will be reduced.

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

5.82 The catch limit of *D. eleginoides* in Division 58.5.2 for the 1998/99 season was 3 690 tonnes for the period 7 November 1998 to the end of the Commission meeting in 1999 (Conservation Measure 158/XVII). The catch reported for this division at the time of the WG-FSA meeting was 3 480 tonnes.

Determination of Long-term Annual Yields using the GYM

5.83 The analysis of long-term annual yield was updated with the recent catches taken from Division 58.5.2. With the exception of natural mortality, revised data and parameters have all been estimated directly for Heard Island fish, in contrast to previous years when estimates from South Georgia have been used.

5.84 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. In particular, the Scientific Committee noted and endorsed the following revisions of input data and parameters for Division 58.5.2:

(i) Estimates of von Bertalanffy growth parameters were revised by WG-FSA at this year's meeting. A difficulty with estimating the parameters for Heard Island is that the samples comprise mostly small fish. In the absence of other information on L_∞, WG-FSA agreed to use the L_∞ estimated for South Georgia (194.6 cm).

(ii) A range of M was used rather than a single value. The range adopted was 0.0828 to 0.1242 yr^{-1}.

(iii) A new series of recruitments was used based on a new mixture analysis presented in WG-FSA-99/68.

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

5.85 The estimate of yield from the GYM was 3 585 tonnes. This is similar to the previous estimates of yield despite the application of many new parameters derived from the Heard Island region. The combined effects of slower growth rates, lower mortality and revised fishing selectivity have been balanced by observations of very strong recruitments in recent years.

5.86 The Scientific Committee recommended that the catch limit for Division 58.5.2 in the 1999/2000 season should be revised to 3 585 tonnes. Other management measures for *D. eleginoides* in Division 58.5.2 in the 1999/2000 season should be similar to the 1998/99 season.

C. gunnari at South Georgia (Subarea 48.3)

5.87 One Russian vessel took part in the commercial fishery for *C. gunnari* around South Georgia (Subarea 48.3) during the 1998/99 season which was open from the end of the Commission meeting in November 1998 until 1 April 1999. The catch limit was 4 840 tonnes. The total reported catch was 265 tonnes, taken in 23 days between 16 February and 10 March 1999. The Scientific Committee noted that 86% of this catch was taken in the four days between 28 February and 3 March on the northwestern slope of South Georgia, where *C. gunnari* formed dense concentrations which were feeding on krill.

Assessment at this Year's Meeting

5.88 The Scientific Committee noted WG-FSA's discussions regarding variability in M between years in relation to the availability of krill and predation by fur seals, and the need to consider appropriate decision rules for application of the GYM to assessing precautionary yield for this fishery (e.g. SC-CAMLR-XVI, paragraphs 4.171 to 4.178).

5.89 An assessment of *C. gunnari* in Subarea 48.3 was made using the same short-term annual yield method adopted during the 1997 meeting. This method is also used for this species in Division 58.5.2. The resulting fishing mortality for 1999/2000 and 2000/2001 was 0.14. This resulted in a combined catch over two years of 6 810 tonnes, comprising 4 036 tonnes in the first year (1 December 1999 to 30 November 2000) and 2 774 tonnes in the second year (1 December 2000 to 30 November 2001). The 2000/2001 catch level will be subject to revision if a new survey is conducted in 1999/2000.

5.90 The Scientific Committee noted that it was now two years since the time of the last survey and there is a large degree of uncertainty in the current state of the stock. The yields estimated from the short-term projections were based on the lower 95% confidence bound of the 1997 UK trawl survey and most participants considered that this constituted a conservative estimate of yield.

5.91 Dr Marschoff noted that given the time lapsed since the last survey and events in the past causing high mortality which have yet to be explained, this assessment might be invalid and a survey was needed before setting any catch limit. He stated that his view is reinforced by the failure of the fishery in the last two seasons. In the 1997/98 season, the explanation offered was that the master of the fishing vessel did not have experience in the fishery, while this year the fishing company's headquarters had abruptly decided to move the ship (after a week of low catch rates) to the squid fishery.

5.92 Dr K. Shust (Russia) pointed out that the decision to move the *Zakhar Sorokin* away from Subarea 48.3 was unrelated to the conditions in the *C. gunnari* fishery. The vessel achieved catches of 2 to 5 tonnes shortly before leaving Subarea 48.3 to fish elsewhere for squid.

5.93 In relation to the probability of events of high mortality in the stock of *C. gunnari*, Dr Marschoff indicated that these events have been associated with years of low krill availability (WG-FSA-99/50). WG-EMM has indicated that 1998/99 has been a year of low krill abundance in Subarea 48.3 while the 1999/2000 season is expected to continue the trend of low-abundance years (Annex 4, paragraphs 3.1 to 3.3).

5.94 Dr Shust noted that a report of the fishing cruise of the *Zakhar Sorokin* presented at the meeting of WG-FSA reported that the *C. gunnari* caught by the vessel were feeding on krill as their main prey item. The fish found in the largest concentration to the northwest of South Georgia were in an area of high krill concentration and had stomachs full of krill (Annex 5, paragraphs 4.163 and 5.12).

5.95 The Scientific Committee welcomed the news that three new scientific surveys on *C. gunnari* in Subarea 48.3 by the UK, Russia and Argentina were planned for the 1999/2000 season. The results of these surveys should be available for the next meeting to update the assessment (paragraph 5.40).

Protection of Young Fish and Spawning Aggregations

5.96 The Scientific Committee noted the discussion in the report of WG-FSA regarding the merits of various approaches to protection of young fish and spawning aggregations, including the closure of coastal spawning grounds and the establishment of refuge areas for young fish (Annex 5, paragraphs 4.174 to 4.184).

5.97 The Scientific Committee agreed that the present closed season from 1 April to the end of the Commission meeting was not necessary for the protection of spawning and that a closed season of 1 March to 31 May would be more appropriate. It was also agreed that the priority for the protection of spawning was to apply this closed season to areas where spawning is known to take place.

5.98 There was considerable discussion in the Scientific Committee regarding the extent of the area to which the closure should apply. The debate centred on whether there was sufficient information on the location of spawning aggregations to identify a subsection of Subarea 48.3 to which the closure should apply, or whether the closure should apply to the whole subarea.

5.99 Information regarding the location of spawning was discussed by WG-FSA (Annex 5, paragraph 4.177). Existing information indicates that peak spawning of *C. gunnari* at South Georgia occurs in the fjords and coastal areas between March and May (Annex 5, Figure 27).

5.100 Some Members felt that the information available on the location of spawning concentrations indicated that it was not necessary to close the whole subarea to protect spawning. The required level of protection could be achieved by creating a refuge area covering the coastal areas of South Georgia, out to a set distance from the island. This would allow spawning to take place in the fjords all around the island of South Georgia without disturbance from the commercial fishery. There is precedent for such an approach within the conservation measures of the Commission. Conservation Measure 1/III, in force from 1984 to 1989, closed to fishing the waters within 12 n miles of South Georgia.

5.101 Other Members of the Scientific Committee felt that knowledge on spawning of *C. gunnari* at South Georgia and around Shag Rocks is still too limited to justify that only certain areas of the shelf, such as waters immediate to the coast, be closed to fishing during the spawning season. A survey conducted in late March 1978 found aggregations of *C. gunnari* immediately prior to spawning in Cumberland West Bay, Fortuna Bay and Royal Bay. Males start their migration to the spawning grounds earlier than females (Kock, 1981, 1989). Other areas were not investigated. It is thus still unknown to what extent the species spawns in other fjords along the east coast of the island, at the more exposed west coast and around Shag Rocks. A survey of these coastal areas in March and April is urgently needed to further identify spawning grounds and to better understand spawning activities of *C. gunnari* at South Georgia. The Scientific Committee also noted that information from the commercial fishery could provide useful insights into spawning seasons, migrations and aggregations.

5.102 Both options were forwarded to the Commission for consideration.

5.103 Since there will be nine months to take any catch limit that the Commission wishes to establish, Dr Marschoff questioned whether a restriction to the protection of spawning should occur, given the paucity of the information available on the geographical distribution of the spawning grounds.

5.104 Dr Parkes pointed out that the protection of spawning concentrations and the setting of catch limits are separate management issues. Measures to protect spawning are associated with the life cycle of the fish and therefore tend to perpetuate from year to year. Catch limits change more frequently according to the status of the stock.

5.105 The Scientific Committee also noted the discussion by WG-FSA regarding the application of closed areas to the protection of young fish and the analysis of length data from bottom trawl surveys around South Georgia. The Scientific Committee recommended that a more detailed analysis be undertaken to provide advice on the possible benefits of the use of refuges for protecting young fish as part of the management procedure for *C. gunnari*. The Scientific Committee agreed that this issue was relevant for all areas where there are fisheries for *C. gunnari* and should be a priority task for the intersessional subgroup of WG-FSA working on the assessment of this species.

5.106 The Scientific Committee endorsed the decision of WG-FSA to again postpone the Workshop on the Development of a Long-term Management Strategy for *C. gunnari* as first recommended in 1997. The requirement for the types of analyses listed in the provisional terms of reference for this workshop remain high, but WG-FSA's intersessional subgroup on *C. gunnari* fisheries and WG-EMM participants will aim to make progress on these issues along the lines of paragraph 9.10 of Annex 5. The requirement for a dedicated workshop should be considered again at next year's meeting.

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

5.107 Most Members agreed that the total catch limit for *C. gunnari* in Subarea 48.3 should be revised to 4 036 tonnes for the period 1 December 1999 to 30 November 2000. The catch limit for the 2000/2001 season of 2 774 tonnes will be subject to revision if one or more surveys are conducted in 1999/2000.

5.108 Dr Marschoff noted that the low catch in this fishery indicates that the stock remains at a low level and that a survey is needed before setting any catch limit.

5.109 The Scientific Committee agreed that in order to protect spawning concentrations, there should be a closed season in the fishery for *C. gunnari* in Subarea 48.3 between 1 March and 31 May.

5.110 The Scientific Committee noted that WG-FSA had agreed that the closed season should apply to the areas where spawning is known to take place, but was not in a position at this stage to provide unequivocal advice on the extent of the area within Subarea 48.3 which needed to be protected. The Scientific Committee offered two alternatives for consideration by the Commission. The first alternative is to close certain areas of the shelf for fishing from 1 March to 31 May 2000. This is detailed in paragraph 5.100. The other alternative is to close the whole of Subarea 48.3 for the same period. This option is further detailed in paragraph 5.101.

5.111 Other management measures for *C. gunnari* in Subarea 48.3 set for the 1998/99 season should remain in force.

C. gunnari at Kerguelen Islands (Division 58.5.1)

5.112 No commercial fishing for *C. gunnari* took place in this division during the 1998/99 season. A survey during the 1998/99 season indicated that the current biomass on the traditional northeastern fishing ground is very low. The French authorities have indicated that a resumption of fishing is not being contemplated at this time but that the survey will be repeated in the 1999/2000 season.

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

5.113 The Scientific Committee is looking forward to seeing the full analysis of the results of the survey conducted in 1998/99 and welcomed the reported intention to undertake a survey in 1999/2000.

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

5.114 The catch in the commercial fishery for *C. gunnari* in Division 58.5.2 during the 1998/99 fishing season up to the time of the current meeting was 2 tonnes. This was a result of the fishing vessels concentrating on the *D. eleginoides* fishery. The only aggregations of *C. gunnari* detected were of young fish. No survey for *C. gunnari* was undertaken in 1998/99.

5.115 An assessment of *C. gunnari* in the Heard Island Plateau area was made using the same short-term annual yield method adopted during the 1997 meeting and used for this species in Subarea 48.3. The results of a trawl survey conducted in 1998 were used as input to this assessment. The resulting fishing mortality for 1999/2000 and 2000/2001 was 0.139. This resulted in a combined catch over two years of 1 518 tonnes, comprising 916 tonnes in the first year and 603 tonnes in the second year.

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

5.116 The Scientific Committee agreed that the management of the fishery for *C. gunnari* on the Heard Island Plateau part of Division 58.5.2 during the 1999/2000 season should be similar to that in force last season, as detailed in Conservation Measure 159/XVII.

5.117 The total catch limit should be revised to 916 tonnes in accordance with this year's short-term yield calculations. The fishery on Shell Bank should be closed, as last year.

Other Fisheries

Antarctic Peninsula (Subarea 48.1)

5.118 Finfish stocks in the Antarctic Peninsula region (Subarea 48.1) have been exploited from 1978/79 to 1988/89, with most of the commercial harvesting taking place in the first two years of the fishery. Given the substantial decline in biomass of the target species in the fishery, *C. gunnari* and *N. rossii*, by the mid-1980s, Subarea 48.1 was closed for finfishing from the 1989/90 season onwards.

5.119 New data pertaining to the biological characteristics of Antarctic fish stocks taken in a random stratified bottom trawl survey around Elephant Island and the lower South Shetland Islands during 1998/99 were presented to WG-FSA. However, this new information was not sufficient to undertake any assessment on the stocks in this subarea (Annex 5, paragraphs 4.199 to 4.201).

Management Advice

5.120 There appears to be little prospect for a substantial fishery given the low biomass estimates for the 1997/98 season (SC-CAMLR-XVII, paragraph 5.107) and the absence of sufficient new information. WG-FSA therefore recommended that Conservation Measure 72/XVII should remain in force.

South Orkney Islands (Subarea 48.2)

5.121 A random stratified bottom trawl survey within the 500 m isobath was carried out by the US AMLR Program around the South Orkney Islands in 1999 and the biomass of eight species of finfish were estimated. Biomass levels for only two species increased in 1999 over the 1991 survey, and there was an apparent decrease in biomass for all other species in 1999, particularly *C. gunnari*. The upper 95% confidence limit of the 1999 biomass level of *C. gunnari* is roughly at 4% of pre-exploitation levels around the South Orkney Islands (Annex 5, paragraphs 4.203 to 4.210). Given the current low abundance of *C. gunnari* and the other species, no attempt was made to calculate precautionary catch limits using the GYM.

Management Advice

5.122 There appears to be little prospect for a substantial fishery given the low biomass estimates for the 1998/99 season. The Scientific Committee therefore recommended that Conservation Measure 73/XVII should remain in force until future surveys indicate an increase in fish biomass in the subarea.

Pacific Ocean Sector (Subarea 88.3)

5.123 No fishing occurred in Subarea 88.3 during the 1998/99 season and no Member has notified their intention to conduct fishing operations in this area during the 1999/2000 season.

Management Advice

5.124 In view of the low catch rates encountered by a feasibility study during the 1997/98 season, the Scientific Committee recommended that fishing for *Dissostichus* spp. should be prohibited in the 1999/2000 season.

Crab Resources

5.125 The Scientific Committee noted a UK report that between 7 and 20 September 1999, a single vessel had caught 30 512 individuals of *Paralomis formosa* and 4 602 of *P. spinosissima* (Annex 5, paragraphs 4.215 to 4.219). This catch comprised 7 184 and 1 900 kg respectively by weight of the two species. However, the percentages of retained crabs were very small (14 and 9%). This resulted in only 4 129 individuals and 1 861 kg of *P. formosa* and 402 individuals and 317 kg of *P. spinosissima* being retained. Concern was expressed regarding the large proportion of undersized crabs and the uncertainty regarding the survival of discards.

5.126 The problem of discards was recognised by the 1993 CCAMLR Workshop on the Long-Term Management of the Antarctic Crab Fishery (SC-CAMLR-XII, Annex 5, Appendix E, paragraphs 4.7 and 6.10) and the Scientific Committee accepted the workshop's advice that long-term studies should be conducted on discard mortality from the crab fishery.

5.127 The UK and the USA indicated that one vessel from each country expects to participate in the crab fishery during the 1999/2000 season.

Management Advice for Crabs (*Paralomis* spp.)

5.128 The Scientific Committee recognised the great utility of the experimental harvest regime set out in Conservation Measure 150/XVII and recommended that the measure should remain in force. However, if new vessels were to enter the fishery, the Commission might wish to revise Phase 2 in the light of the comments made in paragraph 4.183 of the 1996 report (SC-CAMLR-XV, Annex 5).

5.129 The Scientific Committee agreed that, since no need had been identified at this time requiring vessels to conduct activities under Phase 2, then this requirement could be eliminated from Conservation Measure 150/XVII.

5.130 The Scientific Committee also agreed that since crab stocks have not been fully assessed, the conservative management scheme contained in Conservation Measure 151/XVII is still appropriate for this fishery.

Squid Resources

Squid (*Martialia hyadesi*) in Subarea 48.3 (South Georgia)

5.131 No new information on this species was presented to WG-FSA at this year's meeting. The scientific basis on which the current conservation measure was based has not changed.

5.132 In addition, there was no notification of intention to conduct a fishery for the 1999/2000 season.

Management Advice

5.133 The Scientific Committee recommended that the existing management regime, as set out in Conservation Measure 165/XVII, be maintained for the 1999/2000 fishing season.

ECOSYSTEM MONITORING AND MANAGEMENT

6.1 The fifth meeting of WG-EMM was held at the Instituto Español de Oceanografía, Santa Cruz de Tenerife, Spain, from 19 to 29 July 1999, the second time a SC-CAMLR working group had met at the institute. The Scientific Committee thanked the hosts of the meeting, Mr L. López Abellán and Dr E. Balguerías, for an efficient and friendly meeting, and the convener, Dr Everson, for chairing the meeting.

Environmental Variables

6.2 The Scientific Committee endorsed the recommendation of WG-EMM (Annex 4, paragraph 5.9) that monitoring of the key environmental variables identified in the CEMP standard methods should continue.

6.3 Recent research results presented to WG-EMM indicate that increased UV-B in Antarctica may have the potential to adversely affect krill and other key populations (Annex 4, paragraphs 5.6, 5.7 and 5.10). The Scientific Committee noted that effects such as these warrant further directed research (detailed in Annex 4, paragraph 5.10) to identify how such effects may affect the overall productivity of krill populations and the ecosystem as a whole.

6.4 The Scientific Committee noted how the long-term study of the US AMLR Program had indicated the presence of an oceanic front to the northwest of Livingston Island and King George Island which was known to vary in its location by approximately 10 to 20 km. The Scientific Committee encouraged Dr Holt to provide more information to WG-EMM at its next meeting (Annex 4, paragraphs 5.2 and 12.3).

Ecosystem Analysis

6.5 The Scientific Committee noted further progress in the development of multivariate analyses of CEMP indices (Annex 4, paragraphs 6.1 to 6.7). It welcomed the direction that WG-EMM was taking in working towards identifying how composite standardised indices (CSIs) might be used in a management context. In particular, the Scientific Committee endorsed the following important questions for future work (Annex 4, paragraphs 6.5 and 6.6):

(i) How to formulate reference points for decision rules that incorporate CSIs or other information on predators?

(ii) How to select parameters to derive indices and interpret these indices in relation to demography and abundance of indexed species and the identification of ecologically important values and trends (SC-CAMLR-XVII, Annex 4, paragraph 8.17 and endorsed by SC-CAMLR-XVII, paragraph 6.17)?

(iii) What functional relationships can be developed relating CSIs to krill abundance (such as the one described in WG-EMM-99/40)?

(iv) How can CSIs be used for identifying a critical level of krill abundance (reference points) for use in estimating precautionary yields or for adjusting catch limits in the short term?

(v) How sensitive are CSIs to changes in key environmental or other parameters compared to krill abundance?

(vi) What developments are required to facilitate the use of CSIs in feedback management processes or for evaluating the success of conservation measures?

(vii) What analytical and assessment methods are required to test the utility of CSIs as a basis for management decisions?

6.6 The Scientific Committee agreed that this program of work should help identify how data arising from CEMP might be used in predictive models to assess the possible impacts of krill harvesting as well as how these monitoring activities may be used in providing feedbacks to help with adjusting catch controls.

6.7 Some progress had been made with archiving the KYM in the past year (Annex 4, paragraph 6.8). The Scientific Committee endorsed the continued archiving of this model and asked the Secretariat, in consultation with Dr Constable, to continue preparing documentation on the model.

6.8 Methods for estimating the overlap between fisheries and predator foraging areas have been under consideration for several years and some progress had been made during the intersessional period (Annex 4, paragraphs 6.9 and 6.10). The Scientific Committee endorsed the recommendation of WG-EMM for further work on these models as detailed in Annex 4, paragraph 6.11. The Scientific Committee encouraged Members to involve statistical experts to assist the Secretariat with the development of indices (Annex 4, paragraph 6.12).

Krill-centred Interactions

6.9 The Scientific Committee noted the work on the diet of krill predators (Annex 4, paragraphs 6.16 to 6.21), the effect of diet on individual predators (Annex 4, paragraphs 6.22 to 6.24), the effect of diet on predator populations (Annex 4, paragraphs 6.25 to 6.28), the distribution of predators relative to krill (Annex 4, paragraphs 6.29 to 6.33) and the overlap in foraging of predators with fisheries (Annex 4, paragraphs 6.34 and 6.35). In particular, revised estimates of krill consumption for Adélie, chinstrap and gentoo penguins and female Antarctic fur seals in the South Shetland Islands cannot be met from the current estimates of krill density (Annex 4, paragraphs 6.20 and 6.21). Part of this problem may arise from uncertainty in the demographic parameters used in the KYM. This problem is common for other areas where krill consumption appears to far exceed the estimate of krill biomass (Annex 4, paragraphs 3.9 and 3.10).

Ecological Processes and Interactions

6.10 WG-EMM reported on a number of studies examining interactions of the ecosystem with the environment (Annex 4, paragraphs 6.36 to 6.39). The Scientific Committee noted the need to develop appropriate ecosystem models for underpinning management decisions in CCAMLR and work to reduce uncertainties in these ecosystem models was encouraged. It was also noted that the international workshop ‘Large-scale Variability in the Southern Ocean – Patterns, Mechanisms and Impacts’ provided some directions for study in this area (paragraph 11.29).

6.11 The Scientific Committee noted that considerable progress has been made in refining acoustic estimates of krill abundance. It agreed that attention needs to be given to refining estimates of predator abundance in order to improve the estimates of the demand for krill by predators.

Fish- and Squid-based Interactions

6.12 The Scientific Committee noted the discussions concerning squid-based interactions (Annex 4, paragraphs 6.40 to 6.42).

Ecosystem Assessment

6.13 An ecosystem assessment involves two components:

(i) an analysis of the status of key biotic components of the ecosystem; and
(ii) a prediction of the likely consequences of alternative management action (SC-CAMLR-XIV, Annex 4, paragraphs 2.13 to 2.21).

6.14 The Scientific Committee noted the progress in developing assessment methods since 1995 (Annex 4, paragraphs 7.1 to 7.13). It was noted that almost all initiatives so far had been associated with krill-centred systems and that assessments of ecosystem interactions involving fish and squid may be considered in the near future. In this regard, the Scientific Committee noted that it would be useful to consider whether, and in what form, action is necessary to improve assessments of these interactions.

6.15 The Scientific Committee also noted that there was a need to complement existing management advice for catch limits at large scales with advice on management at local scales (Annex 4, paragraph 7.11).

6.16 The Scientific Committee endorsed the request by WG-EMM to have the Secretariat review the items listed under the agenda item on future work at and after 1995 to provide some indication of the current status of the various tasks (Annex 4, paragraph 7.12). It noted that the assistance of Members will be important for this work.

Estimates of Potential Yield

6.17 In 1997 WG-EMM had recommended that revision of estimates of potential yield of krill should be postponed until the results of the CCAMLR-2000 Survey became available. The Scientific Committee endorsed this recommendation, noting that such estimates are expected next year and that advice will also be provided on a subdivision of the area-wide precautionary catch limit. This subdivision is considered necessary in order to ensure the interaction between fisheries and krill predators remains at appropriate levels.

Precautionary Catch limits

6.18 Precautionary catch limits for krill are currently enacted in Conservation Measures 32/X (Area 48), 45/XIV (Division 58.4.2) and 106/XV (Division 58.4.1). The Scientific Committee recommended that these conservation measures should remain in force as they stand, until the results of the CCAMLR-2000 Survey are available.

6.19 The survey will include revised estimates of stock biomass which will contribute to the revision of precautionary catch limits at least for Area 48. It was understood that unless relevant new data with which to revise γ are developed intersessionally, the only changes to the KYM will be the new estimates of stock biomass in Area 48 (Annex 4, paragraphs 7.16 and 8.50).

Assessment of the Status of the Ecosystem

6.20 An extensive review of the status of the ecosystem in Area 48 was undertaken last year, particularly arising from the results of the Workshop on Area 48 (SC-CAMLR-XVII, Annex 4, Appendix D). Also, it is expected that a report on the status of bird populations will be available from SCAR to WG-EMM next year. Consequently, WG-EMM provided an assessment of the status of the ecosystem only for 1999. These assessments are summarised for Area 48 (Annex 4, paragraphs 7.21 to 7.25), Division 58.4.2 (Annex 4, paragraph 7.26), Subareas 58.7 (Annex 4, paragraph 7.27) and 88.1 (Annex 4, paragraph 7.28).

6.21 The Scientific Committee endorsed the approach to these assessments to be taken by WG-EMM next year in which the following areas will be evaluated:

(i) status and trends of resources;
(ii) status and trends of dependent species;
(iii) status and trends of environmental variables;
(iv) status and trends of fisheries; and
(v) interactions between environment, resources, dependent species and fisheries.

6.22 The Scientific Committee agreed that fishery-derived data should be included in this topic and Members were asked to consider intersessionally which indices might be relevant and to prepare suggestions and/or data on these to facilitate discussion at the next meeting of WG-EMM.

6.23 The Scientific Committee noted the opportunities being developed in WG-EMM for using composite standardised indices for detecting trends in the ecosystem (Annex 4, paragraphs 7.31 to 7.38). It was noted that the krill fishery is considered to be at a low level but may expand in the near future. Consequently further elaboration of how to incorporate predator information in a management framework is required quickly in order that the effects of krill fishing on predators can be appropriately monitored. This might be achieved through a consultancy, but not in the immediate future (Annex 4, paragraph 7.39).

6.24 The Scientific Committee endorsed the development and testing of models which offer the ability to ensure precautionary management approaches that are robust and effective (Annex 4, paragraphs 7.40 to 7.42).

Considerations with respect to Precautionary Approaches

6.25 The Scientific Committee noted the considerations with respect to precautionary approaches (Annex 4, paragraphs 7.43 to 7.45).

6.26 The Scientific Committee noted that a succinct summary of the key components of the GYM is given in Annex 4, paragraphs 7.47 and 7.48. The Scientific Committee agreed that the potential for incorporating age-structured krill mortality into the GYM should be investigated by Prof. I. Boyd (UK), Dr Constable and Prof. D. Butterworth (South Africa) (Annex 4, paragraph 7.49). Other considerations of the KYM and GYM are given in Annex 4, paragraphs 7.46 to 7.54. In addition, existing work and new proposals on estimating krill yield based on estimation of krill consumption by dependent species would be considered by Prof. Boyd, and Drs Everson, Constable and Nicol (Annex 4, paragraphs 7.51 and 7.52).

6.27 The Scientific Committee noted the issues associated with ecosystem variability (Annex 4, paragraphs 7.55 to 7.62), including:

(i) the problems involved in scaling up (extrapolating) to larger scales using data collected at smaller scales;

(ii) the allocation of catch limits at scales smaller than statistical areas (i.e. how limits estimated at or for large areas are divided for application to smaller areas); and

(iii) avoidance of localised effects of krill fishing, especially in relation to potential adverse effects on dependent species.

6.28 It was concluded that much useful information might accrue from a dialogue with fishers.

6.29 In order to establish a feedback management regime, as intended by the Commission, it is essential to have good information about the way in which the fishery might develop (Annex 4, paragraphs 7.63 to 7.73). Of particular interest is the use of scientific observers on krill fishing vessels. The Scientific Committee recommended that this is a matter of general importance. It endorses the request of WG-EMM for these to be operational during the CCAMLR-2000 Survey either through the CCAMLR scheme or by bilateral arrangements because such information would be useful for comparing the fishing activities with the observed distribution from the survey (Annex 4, paragraphs 7.72 and 7.73).

6.30 The Scientific Committee noted that the IUCN global review of threatened species was discussed by WG-EMM (Annex 4, paragraphs 7.74 to 7.78). It noted that the Commission may need to take action on some species to afford protection to them under Article II.3(c). The Secretariat was requested to contact IUCN in order to obtain details on the criteria used and the process applied in the preparation for publication in 2000 of the new list of globally threatened species. The Scientific Committee asked Mr Cooper, representative from IUCN, to convey to the SCAR-BBS that WG-EMM would like the report on the status and trends of Antarctic seabirds arising from the Montana, USA, meeting in 1999 to be made available to the 2000 meeting of WG-EMM if at all possible. This will facilitate the assessment of the ecosystem as well as providing important data for use in estimating consumption of krill by predators.

The Ecosystem Approach as Applied in other Parts of the World

6.31 The Scientific Committee noted the discussion of WG-EMM concerning similar ecosystem management initiatives elsewhere in the world (Annex 4, paragraphs 9.1 to 9.9) and that there is value in examining the experiences of other groups that may have encountered similar management problems to those faced by CCAMLR. Such approaches and meetings include the South African BENEFIT Programme (Annex 4, paragraphs 9.2 and 9.3) and the recent SCOR/ICES Symposium on the Ecosystem Effects of Fishing in Montpellier, France, during March 1999.

6.32 At the latter meeting, CCAMLR was represented by Dr Constable, whose presentation was well received at the meeting and the subsequent paper presented to the ScientificCommittee in SC-CAMLR-XVIII/BG/26 (Annex 4, paragraphs 9.4 to 9.7). From that meeting, it was clear that the work of CCAMLR is well ahead of other management organisations in terms of developing a precautionary approach to the ecosystem management of fisheries. The Scientific Committee considered that some aspects of the work of CCAMLR, especially in the areas of by-catch of elasmobranchs or the effects of trawling on the seabed, may merit greater attention in future. The results of the Montpellier meeting would help to provide guidance about operational objectives and definitions for ecosystem management. Some of these results, particularly in relation to the definitions of the precautionary approach to fisheries management, had been developed at the Lysekil, Sweden, meeting in 1995 (SC-CAMLR-XIV, Annex 5, paragraphs 10.1 to 10.8).

6.33 Mr A. Dommasnes (Norway) indicated to the Scientific Committee that multispecies models have been developed for the Barents Sea and the waters around Iceland, using the long history of data and research programs from these fisheries. Norway is also planning to include marine mammals and plankton in these models. The Scientific Committee welcomed this input and encouraged further input to CCAMLR regarding these models. It was noted that these models are far more detailed than is possible for Antarctica. It was recognised that ecosystem models for the Southern Ocean need to concentrate at this stage on the important linkages of dependent species to the target species of fisheries, as well as taking account of uncertainty in knowledge of these systems.

6.34 The Scientific Committee noted the discussion of WG-EMM on the proposal of Mr R. Shotton at last year’s meeting (SC-CAMLR-XVII, paragraph 6.20) regarding a FAO initiative to host a meeting on the ecosystem approach to management. The Scientific Committee welcomed this initiative and recommended that if CCAMLR is to participate, then it should take a lead in developing the terms of reference of such a meeting and that it should ensure that it is strongly represented. The Chairman of the Scientific Committee agreed to correspond with FAO with regard to this request.

CCAMLR-2000 Survey

6.35 The plans for this survey are very well advanced following a meeting in March 1999 in Cambridge, UK, and subsequent correspondence leading to further refinement of the procedures during the WG-EMM meeting in Tenerife, Spain. The details of the plans can be found in Annex 4, paragraphs 8.1 to 8.36.

6.36 The Scientific Committee welcomed the participation of the USA, UK, and Japan in the survey in January and February 2000. It also welcomed the announcement by Russia of their participation in the survey and their contribution for covering the large area in Subarea 48.4 (SC-CAMLR-XVIII/BG/22).

6.37 The objective of the survey is to provide an estimate of B_0 for calculating a precautionary yield. Accordingly, a two-week workshop meeting is planned for May–June 2000 to be held in La Jolla, USA. Plans for this are set out in Annex 4, paragraphs 8.37 to 8.39.

6.38 The Scientific Committee agreed that key papers arising from the survey might be published in *CCAMLR Science* in 2001.

6.39 The Scientific Committee agreed the terms of reference for the workshop should be:

(i) estimate B_0 for Area 48;
(ii) identify and parameterise survey measurement and sampling variance; and
(iii) report the results of (i) and (ii) to WG-EMM-2000.

6.40 The Scientific Committee agreed that in estimating potential yield it was recognised that a number of processes should be undertaken (Annex 4, paragraph 8.50):

(i) estimate B_0 for Area 48;
(ii) update γ to incorporate the variance estimate of the B_0 survey;
(iii) estimate sustainable potential yield; and
(iv) derive the precautionary catch limit for Area 48 and subdivide this precautionary catch limit for smaller management areas as appropriate.

6.41 The Scientific Committee endorsed the approach of WG-EMM for subdividing the estimate of yield for Area 48 into smaller areas. This will be done by subdividing the precautionary catch limit (see Annex 4, paragraph 8.52) by prorating the overall yield by the proportion of the CCAMLR-2000 Survey in each statistical subarea (estimated from the lengths of survey tracks associated with the large-scale component of the survey) (Annex 4, paragraph 8.61). Other options that may be developed in future by individual members are considered in Annex 4, paragraphs 8.55 to 8.62.

6.42 The Scientific Committee agreed that the Data Manager should participate in the workshop and that the datasets should be archived at the Secretariat. One of the key roles of the Data Manager at the workshop is to begin the process of archiving data. The Scientific Committee also agreed that a member of the Secretariat should accompany the Data Manager in order that a high-quality report can be produced in time for WG-EMM that year.

6.43 The Scientific Committee noted that WG-EMM will consider at its next meeting how the data from regional krill surveys can be used in conjunction with the CCAMLR-2000 Survey.

6.44 The Scientific Committee thanked Drs J. Watkins (UK), R. Hewitt (USA) and M. Naganobu (Japan) for their leadership and organisation of the survey.

6.45 The Scientific Committee also thanked the IWC for its contribution in the planning and future conduct of the survey and noted that this collaboration is similar to the SOWER workshop. This is described in Annex 4, paragraphs 8.69 to 8.74. The Scientific Committee noted that the collaboration will need to continue beyond the survey and that there may be an opportunity for a joint IWC–CCAMLR workshop to examine the relationships between the cetacean dataset and the synoptic survey dataset to be obtained from the CCAMLR-2000 Survey.

Convenership of WG-EMM

6.46 The Scientific Committee thanked Dr Everson for steering WG-EMM for its first five years. It recognised his significant contribution for laying solid foundations for the integration of WG-Krill and WG-CEMP. The Scientific Committee also thanked Dr Everson for his extensive involvement through the history of CCAMLR.

6.47 The Scientific Committee thanked Dr Hewitt for agreeing to become the next convener of WG-EMM, taking it into the next millennium.

MANAGEMENT UNDER CONDITIONS OF UNCERTAINTY ABOUT STOCK SIZE AND SUSTAINABLE YIELD

7.1 Over the past few years the Commission had sought the advice of the Scientific Committee on matters related to management under uncertainty. At its 1998 meeting the Commission had requested the Chairman of the Scientific Committee to set up a task group during the intersessional period to explore the scientific issues associated with developing a regulatory framework for fisheries management. This task group had considered these issues and prepared a report which had been tabled and had previously been considered by WG-FSA (SC-CAMLR-XVIII/BG/25). Before considering this paper, the Scientific Committee discussed specific points raised by the Commission last year (CCAMLR-XVII, section 10).

Management of *Dissostichus* spp. Stocks and in particular taking account of Uncertainties in Stock Structure and Recruitment

7.2 The Scientific Committee noted that new information available on growth and natural mortality had been tabled at WG-FSA. Whilst accepting that this had resulted in major advances, the Scientific Committee felt that there was still considerable scope for improving these estimates. In particular, it was noted that the values of natural mortality coefficients had been obtained by using basic models due to the paucity of age-density data from unexploited populations (Annex 5, paragraphs 3.100 to 3.104).

7.3 It was noted that further information on mortality might arise from analysis of tagging experiments. Such studies were being undertaken by Australia at Heard, McDonald and Macquarie Islands in addition to those planned by the UK using *D. eleginoides* from the toothfish experimental pot fishery (CCAMLR-XVIII/BG/38). Dr Holt agreed to provide information on the US long-term study on *D. mawsoni* at McMurdo Sound in the Ross Sea. The Scientific Committee looked forward to receiving reports on these activities.

Methods for Monitoring Spawning Stocks of *D. eleginoides*

7.4 Spawning activity of *D. eleginoides* is thought to occur from June to August in deep water on, or close to, the continental slope. Arising from this, the Scientific Committee agreed that it was very difficult in a number of subareas to monitor spawning aggregations using conventional trawl surveys.

7.5 The tagging studies mentioned above might provide some information on migration of this species to and from spawning and feeding grounds.

Methods for Assessment of Catch Limits in Mixed-gear Fisheries

7.6 WG-FSA had considered the problems associated with setting catch limits which satisfy CCAMLR's decision rules in determining an appropriate combined catch for trawl and longline fisheries within the same assessment area. WG-FSA noted that no formal mechanism for indicating the sustainability of combined catches is available at this stage. As an interim measure, the following formula was proposed for partitioning the long-term yield between a trawl and a longline fishery:

$$\text{Trawl catch} = (1\text{-}p_{longline}) \times Y_{trawl}$$

where $p_{longline}$ is the proportion to be taken of longline annual yield, and Y_{trawl} is the long-term annual yield for a trawl fishery.

Requirements for a General By-catch Conservation Measure

7.7 The Scientific Committee reiterated the need to assess the levels of by-catch in all fisheries in all areas. WG-FSA had noted that in longline fisheries for *Dissostichus* spp. the by-catch is dominated by Rajidae and Macrouridae (Annex 5, paragraph 4.73). It was noted that in those fisheries rajids are frequently discarded and not reported in the by-catch records.

7.8 Based on new information, WG-FSA agreed that for macrourids a maximum by-catch rate of 18% by mass of the *Dissostichus* spp. catch per fine-scale rectangle would be appropriate as a basis for setting general by-catch levels for new and exploratory fisheries. For Rajidae, the Scientific Committee agreed that the same by-catch provisions as had been proposed last year, namely 10 to 15% by mass, should be applied (Annex 5, paragraph 4.84).

7.9 In applying the above by-catch provisions, the Scientific Committee advised that it would be appropriate for vessels to move from a fishing location when the by-catch proportions had been exceeded. It recommended that the minimum distance a vessel should move should be 5 n miles from the fishing location (in the case of longlines, the fishing location would be set as the centre point between the longline setting location and the longline hauling location). The Scientific Committee also recognised that there should be a lower-level trigger below which it would not be necessary to require movement from a fishing location once the by-catch proportion had been exceeded. It was recommended that a total catch of 100 kg would be appropriate as such a trigger level.

7.10 The Scientific Committee noted that there remains a pressing need for reliable catch, effort and biological information for by-catch species. Furthermore it was noted that it was essential that data collection requirements, commensurate with those for target species, should be specified in conservation measures for new and exploratory fisheries.

Scientific Basis of a Regulatory Framework

7.11 The Chairman of the Scientific Committee introduced SC-CAMLR-XVIII/BG/25. This had been developed by a small ad hoc task group during the intersessional period. Brief discussion had taken place at WG-FSA (Annex 5, paragraphs 4.227 to 4.229). These topics were also discussed as the Scientific Committee considered new and exploratory fisheries.

7.12 It was noted that the development of a unified regulatory framework by the Scientific Committee and Commission is an iterative process which may take some time to complete. The Scientific Committee considered the subject under the following three broad headings: steps in the development of a fishery, procedures to guide the development of a fishery and the designation of the status of the different levels of the fishery.

7.13 The Scientific Committee considered this topic in the light of the requirements of Conservation Measures 31/X and 65/XII and the specific conservation measures for individual fisheries. It was noted that the requirements of Conservation Measure 65/XII (exploratory fisheries) were more exacting than those for Conservation Measure 31/X (new fisheries). The Scientific Committee considered that the initial requirements for information should be broadly based, and that as the fishery develops and it becomes clear what information is required for making assessments, the list could be relaxed.

Steps in the Development of a Fishery

7.14 It was agreed that the first and most important step would be to define the entry-level requirements for undeveloped fisheries, irrespective of whether they might currently be classified as 'new' or 'exploratory'. This would involve a notification procedure which contains a clear statement of the harvest strategy. This should provide available information on the targeted and by-catch species within the proposed fishery locality.

7.15 Alongside the notification procedure, research and data collection plans need to be developed as well as precautionary harvest strategies at scales of individual vessels and areas. These components would be used to formulate a management procedure under which the fishery is permitted to develop.

7.16 A variety of categories have been considered in the past to describe the different fisheries. These include the following categories: undeveloped, developing, established, lapsed and closed. The progress from one stage of fishery development to the next was viewed as a continuum with characteristics tailored to each fishery. The aim of the process would be to streamline the process of annual review in the face of a continuing increased workload being placed on assessment groups.

7.17 In considering lapsed fisheries, the Scientific Committee took as an example Conservation Measure 156/XVII which refers to *D. eleginoides* in Subarea 48.4. The precautionary catch limit was originally set following a study in the area in the 1992/93 season, but subsequently no commercial fishing has been reported. As such, the Scientific Committee had some information, the validity of which was deteriorating with time. Even so, the catch limit of 28 tonnes was seen as sufficiently precautionary as not to warrant annual review and might remain indefinitely. Such an approach might be extended to other areas in the future.

7.18 The currency of assessments was also considered with respect to situations where, in a locality where fishing had lapsed, it was likely to be resumed. The period of currency in this context would be equivalent to the average longevity of the target species in its natural state. An example of this was the proposed new fishery in Division 58.4.2, where information from the previous fishery over a decade ago would provide little insight into the current status of the stocks.

Procedure to Guide the Development of the Fishery

7.19 In developing management advice over the years, the Scientific Committee had developed a variety of procedures to determine the status of individual stocks and provide estimates of yield. Catch limits were set using conventional targets at the time. These included target levels of fishing mortality such as $F_{0.1}$. Subsequent work by WG-FSA showed that these target levels were inappropriate for CCAMLR. As a consequence, new decision rules were formulated leading to the development of the KYM and later the GYM.

7.20 This procedure had been developed for the krill fishery through the work of WG-EMM and expanded to *Dissostichus* spp. (SC-CAMLR-XVII, paragraph 5.134) and *C. gunnari* (Annex 5, paragraph 9.10) through the work of WG-FSA. Arising from this, the Scientific

Committee noted that assessments on *D. eleginoides* and *C. gunnari*, both in Division 58.5.2 and Subarea 48.3, provided good examples of such a process.

Future Work and Management Advice

7.21 The Scientific Committee was pleased to note the progress that had been made, but recognised that there was much which still needed to be done. Priorities were seen as:

(i) refining the fishery development framework from SC-CAMLR-XVIII/BG/25;

(ii) identifying data requirements from both commercial operations and research surveys;

(iii) developing robust procedures for assessment; and

(iv) addressing issues of determining the status of individual fisheries.

7.22 The Scientific Committee agreed that these activities should be addressed by the ad hoc task group in time for a draft document to be considered by WG-EMM and WG-FSA, and their comments should be considered at SC-CAMLR-XIX in 2000.

7.23 In view of the high level of IUU fishing in many parts of the Convention Area, the Scientific Committee noted that it was unrealistic to regard fisheries for *Dissostichus* spp. as new. It was therefore recommended that the advance notification scheme set out in Conservation Measure 65/XII be applied to all notifications of new and exploratory fisheries for *Dissostichus* spp.

SCIENTIFIC RESEARCH EXEMPTIONS

8.1 The Scientific Committee noted the following notifications under Conservation Measure 64/XII of scientific research surveys planned for the 1999/2000 intersessional period (see CCAMLR-XVIII/BG/9, Table 5; Annex 5, paragraphs 6.6 to 6.12):

- Argentina (*Dr Eduardo L. Holmberg*) in Subarea 48.3 (various Antarctic fish);
- Australia (to be announced) in Division 58.5.2 (*C. gunnari* and *D. eleginoides*);
- France (*La Curieuse*) in Division 58.5.1 (studies on mesopelagic fish);
- Japan (*Kaiyo Maru*) in Area 48 (CCAMLR-2000 Survey and related work);
- Russia (*Atlantida*) in Area 48 (CCAMLR-2000 Survey, *C. gunnari* and other species);
- UK (*Argos Atlanta*) in Subarea 48.3 (experimental pot fishery for *D. eleginoides*);
- UK (*James Clark Ross*) in Area 48 (CCAMLR-2000 Survey and related work on krill, *C. gunnari* and other species);
- UK (*Argos Galicia*) in Subarea 48.3 (*C. gunnari* and *D. eleginoides*);
- USA (*Yuzhmorgeologiya*) in Area 48 (CCAMLR-2000 Survey and related work); and

- USA (*Laurence M. Gould* and *Nathaniel B. Palmer*) in Subareas 48.1, 88.1 and 88.2 (various studies on krill, fish, plankton, benthic communities, larval fish and pack-ice seals).

8.2 In addition, New Zealand planned to tag and release *D. mawsoni* and skates in Subarea 88.1 as part of its research plan for the exploratory longline fishery for *D. mawsoni*.

8.3 With the exception of the experimental pot fishing for *D. eleginoides* planned by the UK in Subarea 48.3, the total catch of finfish and krill in each of the surveys notified for 1999/2000 was expected to be less than 50 tonnes.

8.4 The Scientific Committee noted that the UK expected to catch 400 to 600 tonnes of *D. eleginoides* during the planned experimental pot fishing; details of the experimental design were submitted in CCAMLR-XVIII/BG/38 and had been considered by WG-FSA (Annex 5, paragraph 6.7). The Scientific Committee agreed that the catch of *D. eleginoides* taken in pots would be deducted from the catch limit for that species in Subarea 48.3 in the 1999/2000 season in accordance with the provisions of Conservation Measure 64/XII.

8.5 The Scientific Committee also noted that experimental pot fishing for *D. eleginoides* may result in significant levels of by-catch, particularly crabs, and that this should also be taken into consideration when monitoring the catch limit for crabs in this subarea. Similarly, any *D. eleginoides* taken in the pot fishery for crabs should be taken into consideration when monitoring the catch limit for *D. eleginoides* in this subarea.

NEW AND EXPLORATORY FISHERIES

9.1 Three conservation measures on new fisheries were in force during 1998/99, but only in respect of one of these (Conservation Measure 162/XVII) was fishing carried out. Seven conservation measures relating to exploratory fisheries were in force during 1998/99, but only in respect of four of these (Conservation Measures 151/XVII, 166/XVII, 167/XVII and 169/XVII) was fishing carried out.

9.2 For those new and exploratory fisheries where fishing occurred in 1998/99, in all but one case, the numbers of days fished and the catches reported were very small. The exception was the exploratory fishery for *Dissostichus* spp. in Subarea 88.1, conducted under Conservation Measure 169/XVI, where two vessels fished for a total of 76 days in 38 fine-scale rectangles taking 298 tonnes of *D. mawsoni*.

9.3 The Scientific Committee noted that all data for each active new or exploratory fishery in 1998/99 required under Conservation Measure 65/XII had been submitted to the Secretariat by the due date. A summary of background information is given in Annex 5. Table 21 (Annex 5) indicates that in all but a few cases, either no fishing, or at most a very small amount of fishing, had actually been carried out for the new or exploratory fisheries that had been notified. WG-FSA had noted that increasing amounts of time had been spent each year developing advice on precautionary limits for such fisheries. Particular concern was expressed that WG-FSA had received virtually no new information on *Dissostichus* spp. stocks in a number of subareas and divisions. This was in spite of the fact that new or exploratory fisheries had been notified for these areas, in some cases over the previous four fishing seasons. The concern is further heightened by the fact that substantial amounts of IUU fishing are believed to have occurred in these areas.

9.4 Before discussing the individual notifications, especially in relation to fisheries for *Dissostichus* spp., WG-FSA had noted that the distinction between new and exploratory fisheries was somewhat blurred. In view of this similarity between new and exploratory fisheries, the notifications under the two categories had been discussed together.

9.5 The following notifications had been received at the Secretariat by 28 July 1999, the due date for their consideration during the current year:

- new longline fishery for *D. eleginoides* in Subarea 48.6 and Division 58.4.4, notified by South Africa (CCAMLR-XVIII/9);
- new trawl fishery in Division 58.4.2, notified by Australia (CCAMLR-XVIII/11);
- new longline fishery in Division 58.4.4 outside the South African EEZ, notified by Uruguay (CCAMLR-XVIII/14);
- exploratory trawl fishery in Divisions 58.4.3 and 58.4.1, notified by Australia (CCAMLR-XVIII/12);
- exploratory longline fishery for *Dissostichus* spp. for Subareas 58.6, 88.1 and 88.2, and Divisions 58.4.4 and 58.5.1 outside the EEZs of South Africa and France, notified by Chile (CCAMLR-XVIII/13);
- exploratory longline fishery for *Dissostichus* spp. in Subarea 88.1, notified by New Zealand (CCAMLR-XVIII/10); and
- exploratory longline fishery for *D. eleginoides* in Subarea 58.6 outside the EEZs of South Africa and France, notified by South Africa (CCAMLR-XVIII/8).

9.6 In addition, the existence of one notification had been made known to the Secretariat by the due date although the full submission had not arrived until later. This was the new and exploratory longline fisheries for *D. eleginoides* in Subareas 58.6 and 58.7 and Divisions 58.4.3, 58.4.4, 58.5.1 and 58.5.2 outside the EEZs of South Africa, Australia and France, that was notified by France (CCAMLR-XVIII/20).

9.7 The European Community had submitted a notification (CCAMLR-XVIII/21) on behalf of Portugal for new and exploratory fishing for *Dissostichus* spp. in Subareas 48.6, 58.6, 88.1, 88.2 and Divisions 58.4.3 and 58.4.4 outside the Australian, French and South African EEZs. This had only been received by the Secretariat on 1 October 1999 (Annex 5, paragraphs 4.20 to 4.23).

9.8 The UK had submitted a notification of research vessel activity when the total catch is expected to be >50 tonnes (WG-FSA-99/41). Since this related to a study using a new method in an existing fishery, the Scientific Committee considered this under Agenda Item 8, Scientific Research Exemption.

9.9 The Scientific Committee noted that Conservation Measures 31/X (new fisheries) and 65/XII (exploratory fisheries) clearly specify the type of information that should be provided as part of the notification. Apart from the proposed new fishery in Division 58.4.2 and the proposed exploratory trawl fisheries in Divisions 58.4.1 and 58.4.3, the information provided in the notifications submitted for 1999/2000 was seriously deficient in terms of the requirements set out in paragraph 3 of Conservation Measure 31/X and paragraph 2 of Conservation Measure 65/XII. The Scientific Committee noted that this had seriously jeopardised the ability of WG-FSA to provide advice on the likely consequences to the target and by-catch species, should the notified fisheries commence.

Calculation of Precautionary Catch Levels

9.10 WG-FSA used the same procedure for the calculation of precautionary catch levels as it had used at its 1998 meeting (SC-CAMLR-XVII, Annex 5, paragraph 9.37) and compared the results with a refined version that had been developed at the meeting. The refinement involved the use of an adjustment based on relative areas of seabed which may be classified as recruitment areas.

9.11 A further refinement was to adjust the mean recruitment further by scaling it by the relative levels of CPUE recorded for different areas compared to CPUE in Subarea 48.3. This was thought to reduce the level of uncertainty associated with the estimates. In the absence of CPUE data for areas notified for new or exploratory fisheries, the assessments were undertaken using the relative CPUE from adjacent areas. This meant using CPUE data from Subarea 88.1 for Subarea 88.2, and CPUE data from Division 58.4.4 for Division 58.4.3.

9.12 For assessments for the trawl fishery in Division 58.4.2 and the fisheries proposed for Divisions 58.4.1 and 58.4.3, WG-FSA had prorated the estimated recruitment from that observed at Heard and McDonald Islands.

9.13 WG-FSA drew the attention of the Scientific Committee to the results of a trawl survey on BANZARE Bank in Divisions 58.4.1 and 58.4.3 in which only very low abundances of *Dissostichus* spp. had been found.

9.14 New biological information, detailed in Annex 5, paragraphs 4.41 to 4.55, was available for a few localities and was incorporated into the assessments. The results of the GYM projections are set out in Annex 5, Table 27.

9.15 In reviewing the results of the GYM calculations, WG-FSA had agreed that in a number of cases the calculated yield levels were far in excess of any possible precautionary catch levels appropriate for those subareas or divisions. WG-FSA had noted that the calculations had used agreed methods incorporating assumptions that it had believed to be the most appropriate given the available information. The instances of clearly inappropriate calculated yields were therefore taken to indicate that the methods and assumptions themselves must be flawed. Having spent a significant amount of time on the analyses and checking the results, WG-FSA decided that it could not recommend precautionary catch levels using the calculated yields in Annex 5, Table 27 for new and exploratory fisheries.

9.16 The procedure had originally been developed by WG-FSA in an attempt to investigate the possible effects of IUU catches. WG-FSA agreed that it was no longer appropriate to use these methods for estimating precautionary yield levels for new and exploratory fisheries for *Dissostichus* spp.

9.17 WG-FSA had agreed that the only methods that were likely to result in reliable estimates of precautionary catch levels were those that were based on estimates of recruitment to the fishery obtained for the actual area subject to notification of a new or exploratory fishery. If such recruitment estimates were available, together with estimates of seabed area over which the recruits are found and catch rate data for any fishing carried out in the area, the assessments based on them would be similar in nature to those carried out in Subarea 48.3 and Division 58.5.2.

9.18 WG-FSA had stressed the importance of full compliance with Conservation Measure 65/XII, which explicitly requires submission of data in accordance with a data collection plan developed by the Scientific Committee for that area and the submission of a research and fisheries operation plan by the Member making the notification. It was agreed that submission of a research plan considered acceptable by the Scientific Committee should be a prerequisite to the commencement of any future new or exploratory fishery (paragraph 7.23).

9.19 Due to its other assessment tasks, WG-FSA did not have sufficient time to develop a generic science plan for new and exploratory fisheries, but had provided outline requirements in Annex 5, paragraphs 4.67 to 4.71. In this context, it had repeated its recommendation of last year that research surveys to estimate biomass should be included in the very early stages of the development of new and exploratory fisheries for *Dissostichus* spp. (SC-CAMLR-XVII, Annex 5, paragraph 4.76).

9.20 The Scientific Committee considered how to incorporate this research activity into the development plans for new and exploratory fisheries. It was accepted that two approaches were needed:

(i) research surveys to estimate standing stock and recruitment; and
(ii) a sampling design to be implemented during commercial fishing operations.

9.21 The requirements of research surveys have been considered in detail in the past and the Scientific Committee accepted that further comment was unnecessary at this stage.

9.22 There was considerable discussion about suitable sampling designs and how they might be implemented during commercial fishing. The Scientific Committee took as an example the recent prospecting survey by Chile to Subareas 48.1, 48.2 and 88.3 (SC-CAMLR-XVI, paragraphs 9.31 to 9.37). Two considerations were paramount:

(i) a desire to obtain objective data from normal commercial operations; and
(ii) a need to obtain information over as large an area as possible.

9.23 In discussing the matter the following key points arose:

(i) the research and fishing plan should be an integral part of the notification;

(ii) the plans should be reviewed annually;

(iii) the reasons behind the plan should be made clear to commercial operators;

(iv) the plan should not be so complex as to jeopardise efficient commercial fishing operations; and

(v) the sampling design should take full account of all by-catch species.

9.24 The Scientific Committee considered it a high priority to develop these ideas further and Dr Constable agreed to convene an informal group to consider the matter. The group was also requested to consider precautionary catch limits for the current season. The discussions of the subgroup are reflected below.

Fisheries-based Research Plan

9.25 The Scientific Committee noted the advice of WG-FSA that new and exploratory fisheries should be accompanied by research activities (Annex 5, paragraphs 4.62 to 4.71). In the past, this has been recommended to be in the form of fisheries-independent surveys of recruitment of young *Dissostichus* spp. The Scientific Committee agreed that fishing vessels undertaking new or exploratory fisheries are likely to be the only vessels able to undertake research in some of the proposed areas until large surveys can be coordinated amongst several institutions. Surveys of *Dissostichus* spp. have been undertaken in the past as part of the early stages in some fisheries, e.g. longline fishing for *D. eleginoides* in Subarea 48.4, crab fishing in Subarea 48.3, and trawl fishing in Division 58.4.3. These surveys required sampling across the wider area of interest in order to provide, at least, estimates of the average density in the area.

9.26 Research plans should be submitted for each area for which a new or exploratory fishery is intended. The Scientific Committee agreed that research plans were necessary for the new and exploratory fisheries proposed this year. This is because few data are available for undertaking assessments in the areas for which fishing has been proposed. Assessments are urgently required to identify the appropriate catch levels for these developing fisheries. The Scientific Committee agreed that the proposal suggested by WG-FSA (Annex 5, paragraphs 4.67 to 4.71) provides a suitable basis for developing such a plan. It has been proposed that, for the coming year, fishing vessels undertake research activities during the period they are prospecting in the new or exploratory fishing grounds.

9.27 The components of the fisheries-based research activity proposed for this year include:

(i) the identification of small-scale research units (SSRUs) for assessing the relative density of *Dissostichus* spp. using CPUE;

(ii) measures to ensure:

(a) sufficient shots are undertaken in each area to provide the statistical power for detecting differences in *Dissostichus* spp. density that will influence management advice on catch limits in each area;

(b) the effort is distributed over the whole area in order to ensure the CPUE is most likely to reflect the average density of fish in the SSRU; and

(c) minimum characteristics of each haul needed for maintaining a minimum standard sampling methodology.

9.28 The Scientific Committee noted that the research activity would be desirable in successive years in order to provide all of the information necessary to characterise the distribution of the stocks in the different statistical and biological units.

9.29 The Scientific Committee recommended to extend to all areas for new and exploratory fisheries the delineation of SSRUs provided by WG-FSA for Subareas 58.6 and 58.7 and Division 58.4.4 (Annex 5, paragraph 4.68).

9.30 In specifying research areas, the Scientific Committee recognised that terminology concerning areas is becoming confusing. The following definitions are given:

Subarea	A CCAMLR statistical subarea for which catches are reported. Catches are not reported for subareas when these are divided into divisions.
Division	Some subareas have been divided into divisions. Such divisions are CCAMLR statistical divisions for which catches are reported.
Fine-scale rectangles	These are areas defined in conservation measures for catch reporting and, in some measures, to limit the level of catch in localised areas, thereby reducing the potential for localised depletion. Such rectangles are defined as 0.5° latitude by 1° longitude (approximately 30 x 30 n miles).
SSRUs	These are newly defined this year for the purposes of a fishery-based research plan for new and exploratory fisheries such that the area is equivalent to a survey stratum and that research hauls be placed, preferably at random, throughout the unit. Such units are much greater in size than fine-scale rectangles but smaller than statistical subareas or divisions. They are in the order of 100 to 300 n miles in their dimensions.

9.31 The details of each SSRU are given in Table 6 and shown in Figure 1.

9.32 The Scientific Committee considered that the research proposal for a new trawl fishery in Division 58.4.2 was appropriate for that fishery (CCAMLR-XVIII/11). This proposal requires some flexibility in the placement of the research operation, but the approach is consistent with the dimensions of the SSRUs described above.

9.33 The Scientific Committee recognised that a common sampling methodology is required for all research units to ensure a common distribution and density of samples in the different fishing grounds, including the application of these requirements to both longline and trawl fisheries. As a result, it should be possible to obtain a coherent set of data that will enable analyses of the distribution and some aspects of the dynamics of these stocks.

9.34 The Scientific Committee discussed whether to determine the data requirements for individual SSRUs as a whole or whether requirements should be applied to each vessel when in the area. The Scientific Committee agreed that each vessel should have a minimum requirement per research unit and that such a minimum requirement should facilitate the detection of broad differences between areas irrespective of the number of vessels undertaking the fisheries-based research.

9.35 The Scientific Committee used the analysis of WG-FSA (Annex 5, paragraph 4.69, Figure 3 and Table 29) to determine the number of hauls required per research unit. This analysis was based on the 1992 haul-by-haul data from Subarea 48.3, the earliest year when haul-by-haul data were available. The Scientific Committee noted that small differences will be difficult to detect in the early stages of this plan. It agreed that 20 research hauls per research unit will be needed by each vessel operating in the unit. This will enable comparisons of the relative densities between units and with Subarea 48.3. This level of sampling should be able to detect differences between areas which are greater than 20%. The Scientific Committee noted that little progress would be made in the assessment of relative abundance and other aspects of the biology and ecology of *Dissostichus* spp. in these units if there were less than 20 research hauls undertaken in a research unit.

9.36 For the 1999/2000 season, the Scientific Committee considered that all research hauls should be separated from each other by a minimum of 10 n miles. Such a separation should be measured from haul centres. This should ensure that the research hauls provide a wide coverage across the research unit and enable the best opportunity for estimating the average CPUE across the unit. In order to standardise the hauls, the Scientific Committee agreed that a haul should comprise at least 3 500 hooks at a station and that the soak time (time from the end of the set to the beginning of the haul) should be no less than six hours.

9.37 The Scientific Committee agreed that all vessels in new and exploratory fisheries must have scientific observers present, subject to the requirements of the Commission, during these activities and that all the information specified in the *Scientific Observers Manual* should be collected during the research hauls, as well as during the commercial activities in these research units. The Scientific Committee also agreed that the following information should be collected:

(i) effort: in the case of longlines this will include the positions and depths of the beginning and end points of every line set in a haul, total number of hooks in the haul and the soak time from the end of the set to the beginning of hauling. In the case of trawling, it will include the location and depth of the beginning and end points in the haul, the length of the tow (including deviations from a straight line) and the characteristics of the net;

(ii) catch: estimate of the total green weight and number of all fish species in the catch. For longlines, green weight should be estimated from individually weighing all fish in the research catch. In trawl fisheries, catch weights up to about 1 tonne should be measured by weighing directly a number of bins of fish and prorating by the total number of bins. For catches over 1 tonne, estimates by the master or from factory production records should be used;

(iii) bait: the type of bait used on longlines;

(iv) conditions: the sea and cloud conditions during deployment;

(v) biological information: all fish in a haul up to 100 fish to be measured and biological characteristics to be obtained in accordance with the *Scientific Observers Manual* (in particular length, weight, sex and maturity). Otoliths and scales should be sampled in a way that ensures representative sampling from all lengths of fish in the catch. A method for randomly sampling the fish should be applied when only a subsample of fish from the catch is taken for these measurements; and

(vi) by-catch: all by-catch should be recorded (number and mass by species), including estimates of by-catch released or lost prior to landing.

9.38 The Scientific Committee agreed that this research plan could be undertaken during commercial activities, such that research hauls could be interspersed with commercial hauls. This agreement was based on the understanding that haul-by-haul data from observers would be made available from all commercial and research hauls in these fisheries to CCAMLR. Also, the Scientific Committee noted that a haul would only qualify as a research haul if it satisfies all the criteria described above concerning the haul characteristics, distance from other research hauls and the amount of biological information available from the haul.

9.39 The Scientific Committee agreed that results from the research plan are a prerequisite for beginning assessments of the status of stocks in areas of new and exploratory fisheries. The Scientific Committee agreed that the research plan should be a necessary component of activities by vessels undertaking new or exploratory fisheries in the SSRUs. The Scientific Committee noted that the simplest application of the research plan would be to have it undertaken in a SSRU prior to beginning commercial prospecting in that unit. It also noted that some prospecting may reveal that few *Dissostichus* spp. are available in some research units. In such cases, the research plan may be unnecessary in determining that insufficient fish are present to support a fishery.

9.40 The Scientific Committee agreed that an alternative approach may be to enable some prospecting prior to requiring the research plan to be undertaken. In this case, the Scientific Committee agreed that prospecting to the level of 10 tonnes of *Dissostichus* spp. catch or 10 hauls in a SSRU, whichever is triggered first, could be an appropriate limit to initial prospecting prior to requiring the research plan to be undertaken in that unit. If a vessel wished to continue prospecting in the research unit, then it should be required to undertake the research plan prior to leaving the area. This is important to ensure that the data from all shots are comparable without being confounded by time.

9.41 If a vessel leaves a research area and subsequently returns, catch or hauls achieved in previous periods still contribute to triggering the research plan. The research plan would need to be completed in accordance with paragraph 9.40.

9.42 The Scientific Committee agreed that no exemptions from conservation measures need to be applied to this research plan. Thus, the Scientific Committee agreed that Conservation Measure 29/XVI should be complied with and that any catch of the research hauls should be counted toward catch limits. It was noted that some of the SSRUs overlap with EEZs. In these areas, the undertaking of the research operation will require the cooperation of the relevant authorities.

9.43 The Scientific Committee considered that the research plan described here is the first step to developing a fisheries-based research plan that will assist with assessments in the future. Currently, there are few research programs planned for the coming fishing season that can be used in assessments next year. The Scientific Committee agreed that the plan will need to be reviewed next year in order to ensure that fisheries-based research can continue to be used in the assessment process.

Catch Limits

9.44 Four main options for establishing precautionary catch levels were considered by the Scientific Committee:

(i) use this year's assessments by WG-FSA as a guide to setting precautionary catch levels, particularly for *D. eleginoides* (Table 7);

(ii) recommend that the catch levels adopted by the Commission last year should remain until more information is available (Table 7);

(iii) identify a maximum catch for each statistical area that would enable the conduct of the fisheries-based research plan in the SSRUs in that area; or

(iv) recommend zero catches until fisheries-independent research is undertaken to provide sufficient data for an assessment.

9.45 The Scientific Committee noted that the lower catch levels provided in the assessments of yield by WG-FSA this year do not raise concern. In contrast, the greater catch levels do raise concern, particularly for areas with continental shelves and for Division 58.4.3 where a trawl survey on BANZARE Bank in that area did not find many *Dissostichus* spp. (Annex 5, Table 27). The Scientific Committee also noted that the catch levels in the respective areas for new and exploratory fisheries need to be precautionary until sufficient information is available to provide an assessment. This is consistent with the intent of the conservation measures on new and exploratory fisheries. If catches are too great in the early stages of a fishery, then the status of the stock may be jeopardised if the stock is only small, and the long-term sustainability of the fishery will be diminished.

9.46 Given the uncertainty, the Scientific Committee considered that the assessments from last year may be a better starting point. However, these were based on many of the same assumptions as this year's assessments. The Scientific Committee noted that the discount factors applied in the past (0.45 for *D. eleginoides* and 0.3 for *D. mawsoni*) may not have been appropriate for all areas. CPUE estimates for some of the new and exploratory fisheries areas are lower than these levels (Annex 5, Table 27).

9.47 The Scientific Committee noted that the longline fishery for *Dissostichus* spp. in Subarea 48.4 began with a fixed low level of catch that enabled prospecting and research, allowed the vessel to try to recover costs, but recognised the potential low abundance of *Dissostichus* spp. in that area. This was used as the basis for the third option. The Scientific Committee agreed that a maximum catch per statistical area would be better than a catch limit per vessel because of the potential for a large number of vessels to undertake prospecting in the same areas, notably Division 58.4.4. Alternatively, the Commission may wish to restrict the number of vessels entering areas of new and exploratory fisheries.

9.48 In addition, the Scientific Committee noted that it may be possible to introduce a minimum CPUE rate that needs to be achieved in order to enable continued prospecting in a small-scale or fine-scale area. Such a scheme was applied in Subarea 48.4 during the initial development of the longline fishery described above. The Scientific Committee agreed that such a measure could help protect local stocks if the catch levels set for an area are too high.

9.49 The Scientific Committee noted that spreading of effort using fine-scale area limitations is going to be a very important component of measures for new and exploratory fisheries this year. The Scientific Committee agreed that the fine-scale rectangle limitation of 100 tonnes should remain as a means of protecting local stocks from depletion in new and exploratory fisheries.

9.50 The Scientific Committee considered that new fisheries proposed for Divisions 58.5.1 and 58.5.2 outside of the EEZs were unlikely to be viable as a result of the very small amount of fishable grounds in those areas (Annex 5, Table 27).

9.51 The Scientific Committee examined the proposal for the trawl fishery for Division 58.4.2. It agreed that the proposed catch limits of 500 tonnes per species were a concern. However, for the coming year and given the information presented in the proposal, the Scientific Committee could not provide additional advice on alternative values. This level of catch per species was considered acceptable for the coming season for the following main reasons:

(i) the area to be explored is very large (over 1 000 n miles of coastline);

(ii) midwater trawling will protect the rich and diverse benthic communities and allow significant refuge for the target species;

(iii) a total catch limit of 1 500 tonnes means not all nominated species will have catch levels of 500 tonnes; and

(iv) previous annual catches of some of the species of similar or greater magnitude have not appeared to have any deleterious effect on the stocks.

9.52 The Scientific Committee agreed that, in order to spread fishing effort for *D. mawsoni* in the proposed trawl fishery, the catch of this species be subdivided between three smaller units of Division 58.4.2 according to 10° longitude sections identified for the longline fisheries above and that the catch of this species should be restricted to 150 tonnes in each unit.

Future Work

9.53 The Scientific Committee requested that WG-FSA undertake the following tasks at its next meeting:

(i) review the efficacy of the fisheries-based research plans, including an examination of the relationships between data from the commercial operations and the outcomes of the research operations to ensure the integrity of research data obtained in this way;

(ii) assess and compare the relative densities of *Dissostichus* spp. between areas and compare with Subarea 48.3;

(iii) compare biological characteristics of these stocks between areas;

(iv) provide advice on catch levels for 2000/2001; and

(v) revise, as required, the fishery-based research plan.

9.54 The Scientific Committee requested that data arising from the fishery-based research activities be submitted at least one month prior to the meeting of WG-FSA. It also requested that the convener of WG-FSA liaise with Members to begin analyses of these data prior to the meeting of the working group, perhaps in the subgroup on assessments.

9.55 The Scientific Committee considered that it will be important for WG-FSA to give due consideration in 2000 to the results arising from this fishery in Division 58.4.2 and the research to be undertaken in the course of the fishery in order to determine appropriate catch levels in the future. The Scientific Committee recommended that the Secretariat contact Ukraine to request that they submit data from their historical fisheries in Division 58.4.2. These data should be made available to CCAMLR in the near future to better understand the dynamics of fish stocks in the area.

DATA MANAGEMENT

10.1 Dr Ramm presented a report on the work undertaken by the Secretariat's Data Management group in the 1998/99 intersessional period (SC-CAMLR-XVIII/BG/8). This group includes Mr E. Appleyard (Scientific Observer Data Analyst), Mrs L. Millar (part-time Data Entry Assistant), Ms N. Slicer (part-time Data Management Assistant) and Mr N. Williams (Computer Systems Officer).

10.2 The amount of data processed by the Secretariat has continued to increase, and a third of all data held in the CCAMLR databases had been processed over the past three years. Approximately 16% of all records submitted to date had been processed in 1999. In spite of increasing efficiencies in data management, the increased amount of data places ever-increasing demands on the Secretariat's resources.

10.3 CCAMLR data processed in 1999 included catch and effort reports, fine-scale fishery data, observer data, STATLANT data, research survey data and CEMP data (see also Annex 4, paragraphs 4.1 to 4.4; Annex 5, paragraphs 3.1 to 3.16). In addition, the Data Management group processed and analysed data on bathymetry and seabed areas, sea-ice extent and sea-surface temperatures.

10.4 Electronic data forms (eforms) were now available for reporting STATLANT data, catch and effort reports, fine-scale data (catch, effort and biological) and observer data (see WG-FSA-99/8 and 99/10). The eforms were developed in Microsoft Excel. A prototype Microsoft Access database had also been developed for the observer data, and is yet to be trialled in the field.

10.5 In addition to this work, the Data Management group had also undertaken the following major tasks in 1998/99:

(i) produced Volume 11 of the *Statistical Bulletin* (1989–1998);

(ii) revised and updated the procedure for generating CEMP indices, and the layout of the annual report to WG-EMM;

(iii) further developed estimates of the fishery–krill–predator overlap;

(iv) further developed draft standard methods for recording sea-ice cover viewed from a CEMP site (Index F1), local weather at a CEMP site (Index F3) and snow cover at a CEMP site (Index F4);

(v) revised estimates of seabed areas within the fishable depth range of *Dissostichus* spp. in the Convention Area, and estimated seabed areas for *D. eleginoides* in adjacent waters;

(vi) developed a new research survey database and begun transferring data to this new system;

(vii) further developed a routine for deriving catch-weighted length frequencies for *Dissostichus* spp. and *C. gunnari* caught in commercial fisheries within the Convention Area; and

(viii) revised the *Fishery Data Manual*.

10.6 Major work is detailed in meeting papers presented to the Scientific Committee or its working groups. Dr Ramm also participated in the Eighteenth Session of the Coordinating Working Party on Fisheries Statistics (CWP-18) (paragraphs 11.17 to 11.20).

10.7 Dr Ramm advised that the data processing load was likely to be greater in 2000 than in 1999, due to the possible submission of observer data from krill fisheries. The archiving of core datasets from the CCAMLR-2000 Survey would also require new work including the modification of the existing data system and the expansion of data storage facilities.

CCAMLR Website

10.8 At the end of 1998, after the prototype CCAMLR website had been tested and discussed at CCAMLR-XVII, the task of further developing and maintaining the website was transferred to the administration area of the Secretariat. Work on the website in 1999 has continued under the supervision of the Administration and Finance Officer. New developments can be viewed at http://www.ccamlr.org and are summarised in CCAMLR-XVIII/BG/17. The Data Management group has continued to assist where appropriate.

10.9 The Scientific Committee reviewed progress, and endorsed the recommendations of WG-EMM (Annex 4, paragraphs 10.1 to 10.12 and 12.7) and WG-FSA (Annex 5, paragraphs 10.1 to 10.6). With regard to STATLANT data, the Scientific Committee confirmed that data published in the *Statistical Bulletin* should be placed on the website as a downloadable file in pdf format, or equivalent.

10.10 The Scientific Committee briefly discussed the need for establishing a CCAMLR Geographic Information System (GIS) in support of its analyses, and for enhancing the presentation of information on the website. The Scientific Committee agreed that there was a growing need for this type of software, and that a GIS would provide a detailed spatial analysis of the data which will be acquired during the CCAMLR-2000 Survey. The Scientific Committee would welcome any contribution in the development of such methodology to assist in the analyses of CCAMLR-2000 Survey data.

COOPERATION WITH OTHER ORGANISATIONS

Reports of Observers from International Organisations

SCAR

11.1 The Scientific Committee noted with pleasure the presence of an observer from SCAR at this meeting, and believed that it would facilitate collaboration between SCAR and CCAMLR.

11.2 The SCAR Observer, Dr Fanta, explained that SCAR will not meet this year and that the next meeting will be in Tokyo, Japan, in July 2000. A number of SCAR subsidiary groups have, however, met and are reported on in paragraphs 11.33 to 11.35.

ASOC

11.3 The ASOC Observer made the following statement:

> 'It appears to ASOC that this committee is making increasingly fewer of its decisions based on the precautionary approach. Instead it appears to be relying on political accommodation among its Members. It is also disturbing that this committee knows less this year about the status of fish species under its jurisdiction and is divided on how to fill these serious data gaps.
>
> Member governments proposing new and exploratory fisheries are disregarding IMALF's recommended conservation measures in favour of greater commercial gain.
>
> ASOC calls on this committee to advise the Commission to take the following steps to regain control of these fisheries:
>
> - enact a moratorium on the current legal fishery and all new and exploratory fisheries for *D. eleginoides* using as a scientific rationale that the spawning season of *D. eleginoides* happens to coincide with the best time to avoid seabird mortality;
>
> - develop agreed-upon penalties to enhance compliance with these conservation measures (including all by-catch measures);
>
> - call on Member governments to support new research surveys;
>
> - embrace the environmental impact assessment provisions of the Antarctic Environmental Protocol to the Antarctic Treaty; and
>
> - embrace the Appendix II listing proposal for *D. eleginoides* at CITES as the most effective mechanism to apply a rigorous catch documentation scheme on non-CCAMLR parties fishing for the species. If the scheme is not rigorous, an absolute prohibition on trade is the only option.
>
> ASOC urges this committee to be faithful to its obligations under Article II and to base all conservation and management advice to the Commission on the precautionary approach.'

IUCN

11.4 IUCN considered the most serious conservation issue currently facing the Southern Ocean is IUU fishing for *Dissostichus* spp. and its attendant unsustainable bird mortality. To address this problem, the closed season for longline fisheries should be extended to 30 April, after most seabird breeding in the Convention Area is completed. IUCN supported efforts by CCAMLR to introduce a catch documentation scheme for *Dissostichus* spp. IUCN wished to recommend to CCAMLR Members that undertake longline fishing in the Southern Ocean that they adopt FAO IPOA–Seabirds. Further, IUCN recommended that CCAMLR investigates the role that Marine Protected Areas can play in conserving the resources of the Southern Ocean.

IWC

11.5 The IWC Observer, Dr K.-H. Kock (Germany), reported that the last few years have seen a development in the IWC towards more openness and collaboration. This is clearly demonstrated with respect to cooperation during the CCAMLR-2000 Survey, where the IWC will place whale observers on the vessels.

FAO, SCOR, IOC, FFA, ICCAT, IOFC, SPC, CCSBT, I-ATTC and UNEP

11.6 No observers from FAO, SCOR, IOC, FFA, ICCAT, IOFC, SPC, CCSBT, I-ATTC and UNEP were present at the meeting.

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

CEP

11.7 The Scientific Committee noted the report of the CCAMLR Observer, the Scientific Committee Chairman, to the Second Meeting of CEP, Lima, Peru, from 24 to 28 May 1999 (CCAMLR-XVIII/BG/23). He drew attention to a lack of knowledge of the work of CCAMLR within CEP and had proposed a reciprocal arrangement whereby a representative of CEP would attend SC-CAMLR meetings as an observer.

11.8 CEP had considered the report by its State of the Antarctic Environment Report (SAER) intersessional contact group. The Scientific Committee asked its working groups, WG-EMM and WG-FSA, to consider what relevant information they may be able to provide for SAER so that this information may be forwarded to CEP.

11.9 The SCAR Observer, Dr Fanta, drew attention to the report (SC-CAMLR-XVIII/BG/27, p. 6) indicating that GOSEAC has identified key variables for which data should be assembled for SAER.

1998 ICES Symposium

11.10 The Scientific Committee noted the report of the CCAMLR Observer, the Scientific Committee Chairman, to the 1998 ICES Symposium (SC-CAMLR-XVIII/BG/2) which indicated that ICES is addressing similar problems to CCAMLR.

11.11 An interesting conclusion of the symposium was the idea of establishing a library of case studies of fisheries where management had failed as a tool to learning from past mistakes. Within the Convention Area, that could include the *N. rossii* fishery, although extensive fishing had taken place over a decade before the CCAMLR Convention came into force.

11.12 It was noted that the papers from the symposium were of general interest to CCAMLR and should be included in the CCAMLR library when available. Since the symposium proceedings were being published by his home institute, the Scientific Committee Chairman undertook to provide a copy to the Secretariat.

IWC

11.13 A report on the 51st Meeting of the IWC, held in Grenada, West Indies, from 3 to 15 May 1999, was presented to the Scientific Committee by the IWC Observer, Dr Kock. Collaboration between the IWC and CCAMLR is now well established. Two workshops were held in Aberdeen and Cambridge, UK, in March 1999 in preparation for the CCAMLR-2000 Survey in January and February 2000, and the presence of whale observers on board all CCAMLR vessels. In addition, the IWC is sending a vessel to conduct whale observations in close collaboration with CCAMLR vessels.

11.14 Further close collaboration is planned following the meeting of WG-EMM in Tenerife, Spain, in July 1999, and in the months prior to the commencement of the krill survey. All the scientists to act as whale observers on CCAMLR vessels during the krill survey had been nominated by September 1999. Further collaboration of the two organisations is envisaged for 2001 when a workshop is planned to take place with attendance of scientists from both organisations. This workshop would analyse whale observations in relation to oceanographic, krill and other data in order to better understand meso- and small-scale movements of whales in relation to oceanic features, shelf contours and prey abundance.

COFI

11.15 The Scientific Committee noted the report of the CCAMLR Observer, Mr Cooper, to the 23rd Session of FAO COFI (SC-CAMLR-XVIII/BG/4).

11.16 COFI had unanimously adopted its IPOA–Seabirds. The report can be found on the FAO website. The Scientific Committee recommended that the plan be adopted by Member nations and that national reports be produced.

CWP

11.17 The Scientific Committee noted the report of the CCAMLR Observer, Dr Ramm, to the Eighteenth Session of CWP (SC-CAMLR-XVIII/BG/9).

11.18 The Data Manager noted that the meeting had been very useful in bringing colleagues together and he noted, in particular, interaction with the IWC Data Manager.

11.19 FAO is reported to be producing new data-entry lists for sharks and also formatted identification sheets for its website for 20 important shark species.

11.20 Dr Miller indicated that this interaction among organisations holding fisheries data is likely to be the beginning of a process of increased collaboration.

International Conference on Integrated Fisheries Monitoring

11.21 The Scientific Committee noted the report of the CCAMLR Observer, the Chairman of the Scientific Committee, to the International Conference on Integrated Fisheries Monitoring (SC-CAMLR-XVIII/BG/15).

11.22 The conference had noted that the increasing deployment of on-board observers (whether for scientific or compliance purposes) has considerable potential to improve the quality of fisheries data and even change the behaviour of fishing vessels.

Second International Symposium on Krill

11.23 The Scientific Committee noted the report of the CCAMLR Observer, Dr Nicol, to the Second International Symposium on Krill (SC-CAMLR-XVIII/BG/18).

11.24 The Second International Symposium on Krill, which was partially funded by CCAMLR, was held from 23 to 27 August 1999 at the University of California, Santa Cruz, USA (SC-CAMLR-XVIII/BG/18). Some 77 talks and posters included studies on distribution, oceanography, biochemistry, physiology, demography, genetics, parasitology, modelling effects of UV-B, behaviour, swarming, development, feeding and acoustics. The major emphasis was on Antarctic krill and on other species of actual or proposed commercial potential (*Euphausia pacifica* and *Meganyctiphanes norvegica*). A highlight of the symposium was the participation of a large number of young investigators whose presence was facilitated by the funding provided by CCAMLR and other sponsors. The proceedings of the meeting are to be published as rapidly as possible in the *Canadian Journal of Fisheries and Aquatic Sciences*. The local host committee, in particular the convener Prof. M. Mangel (USA), are to be congratulated for providing a relaxed and friendly atmosphere which encouraged intense discussion and lively debate.

11.25 The Scientific Committee joined in thanking the local organisation, particularly Prof. Mangel, for arranging this fruitful meeting.

ICES Annual Science Conference

11.26 The Scientific Committee noted the report of the CCAMLR Observer, Dr B. Sjöstrand (Sweden), to the ICES Annual Science Conference.

11.27 The report was presented by Prof. Fernholm who noted that ICES is working, among other things, on developing sustainability criteria, the language of fisheries science and management, and ecosystem management – all subjects of considerable relevance to CCAMLR.

IOTC

11.28 The Scientific Committee noted the Observer's report (CCAMLR-XVIII/BG/32).

International Workshop on Interannual Variability in the Southern Ocean

11.29 The Scientific Committee looked forward to receiving a report from the international workshop 'Large-scale Variability in the Southern Ocean – Patterns, Mechanisms and Impacts' held at the British Antarctic Survey, UK, in August 1999.

FAO Fisheries Global Information System

11.30 The Scientific Committee noted the report of the Data Manager concerning correspondence about FAO Fisheries Global Information System (FIGIS).

11.31 FIGIS intends to collect, put together and publish global fisheries statistics and has asked CCAMLR if it can supply data for that purpose.

11.32 The Scientific Committee advised that it would be suitable to submit the information contained in the *Statistical Bulletin* to FAO for the FIGIS project. Such information is already in the public domain.

GOSEAC

11.33 The Scientific Committee noted the report of the CCAMLR Observer, Dr Fanta, to SCAR-GOSEAC (SC-CAMLR-XVIII/BG/27). The main points of interest to CCAMLR were:

(i) The revised terms of reference of the group include some areas that are of common interest to CCAMLR, such as: environmental education and training, protected areas, requirements on environmental management and conservation, environmental criteria relating to research activities and associated logistical support, environmental assessment and conservation.

(ii) Agenda items of particular interest to CCAMLR were:

  (a) criteria for the evaluation of the levels of harm caused to the environment by human activities should include the threshold concept and a scaling of impacts could be developed in the future. An exchange of information related to the program on marine debris and the establishment of regulatory conservation measures by CCAMLR, and the standardisation of monitoring methods by GOSEAC could be achieved;

  (b) scientific definitions of dependent and associated ecosystems were elaborated taking into account CCAMLR's ecosystem approach;

  (c) environmental damage caused by human activities and the levels of acceptable damage, as well as containment, mitigation, clean up and restoration were considered. These concepts relate to the entanglement and mortality of marine mammals and birds in artefacts released from fishing vessels into the environment; and

  (d) the Treaty requested that SCAR, in consultation with CCAMLR and other organisations, should review the list of Specially Protected Species (SPS) listed in Appendix A to the Environmental Protocol. This requires the action of different subcommittees and groups of specialists, and the Working Group on Biology, and will be considered at the next SCAR meeting.

(iii) The content and scientific justification of the draft management plan for SPA No. 4, Balleny Islands, Northern Ross Sea, Antarctica, proposed by New Zealand (CCAMLR-XVIII/24) was reviewed by GOSEAC. The following considerations were made:

  (a) the scientific justification should be given for the protection of the marine area;

  (b) the feeding grounds of birds and seals should be shown on the map;

  (c) a more detailed map for each one of the islands is required for the establishment of the protected sites;

  (d) the bathymetric contour lines should be included in the marine area to be protected;

(e) routes for ship traffic should be included;

(f) the marine area should be reduced to a smaller size;

(g) considering the varied aspects of the area, and activities within the area, it was suggested that it could be presented as a Multiple Use Area and contain some Protected Areas; and

(h) it was recommended that the plan should have an explanatory introduction directed to CCAMLR and that it should be presented in time for discussions by WG-EMM.

(iv) A list of standard techniques for environmental monitoring, based on the results of the SCAR/IUCN Workshop on Antarctic Environmental Monitoring will be published at the beginning of 2000. This will be followed by studies on the production of biological environmental monitoring standard methods to be undertaken in conjunction with CCAMLR.

(v) CCAMLR issues were reported to GOSEAC and great concern was expressed about the high amount of illegal and unreported catches of *D. eleginoides*, and the danger of a serious depletion of the fish population and of threatened birds that are accidentally caught in longline fisheries.

(vi) The next meeting of GOSEAC will be in 2000. The venue and dates are not yet known.

SCAR Subcommittee on Evolutionary Biology of Antarctic Organisms

11.34 The Scientific Committee noted the report of the CCAMLR Observer, Dr Fanta, to the SCAR Subcommittee on Evolutionary Biology of Antarctic Organisms (SC-CAMLR-XVIII/BG/29). The main points of interest to CCAMLR were:

(i) A Workshop on Evolutionary Biology of Antarctic Organisms was held in Curitiba, Brazil, from 12 to 15 May 1999.

(ii) The meeting received 20 invited speakers on evolution, gene flow, biodiversity and adaptation, and the present status and trends in evolutionary biology of Antarctic organisms were discussed.

(iii) At the subsequent meeting of the subcommittee, the criteria to be used in the development of an integrated multinational, multidisciplinary research program within SCAR were established.

(iv) Close collaboration with CCAMLR is planned, when some areas of common interest will be developed. The integrative plan of research into gene flow and molecular genetics will provide useful information on the definition of stocks. It can also identify the origin of birds that are killed by longline fishing.

(v) Biodiversity issues might be considered by CCAMLR in developing its ecosystem approach to management.

(vi) The group will meet again from 24 to 27 March 2000 in Kent, UK, to finalise the proposal of the plan (EVOLANTA) to be presented to the SCAR Working Group on Biology meeting.

SCAR-BBS and SCAR-GSS

11.35 The Scientific Committee noted that activities of these groups had been discussed in paragraphs 4.33 to 4.36, 4.93 and 4.94.

Future Cooperation

11.36 The Scientific Committee noted that WG-EMM considered a number of international meetings which were of relevance to its work:

(i) CMS, 10 to 16 November 1999, Cape Town, South Africa – Mr Cooper.

(ii) Fisheries Western Australia in Cooperation with FAO – Use of Property Rights in Fisheries Management, 15 to 17 November 1999, Fremantle, Western Australia – no nomination.

(iii) Second Session IOTC, 7 to 10 December 1999, Japan – no nomination.

(iv) Scientific Committee on International Geosphere–Biosphere Program, 20 to 24 February 2000, Mexico – no nomination.

(v) CITES, 10 to 20 April 2000, Gigiri, Kenya – an observer will be sought.

(vi) 52nd Meeting of the IWC Scientific Committee, Adelaide, Australia, June 2000 – Dr Kock.

(vii) Second International Conference on Albatrosses and Petrels, 8 to 12 May 2000, Hawaii, USA – Mr Cooper.

(viii) CEP, to be held during the ATCM-XXIV, May 2000 – Chairman of the Scientific Committee.

(ix) Convention on Biological Diversity, Fifth Meeting of the Parties, 15 to 26 May 2000, Nairobi, Kenya – no nomination.

(x) Joint Global Ocean Flux Study (SCOR), 9 to 13 July 2000, Brest – Prof. M. Fukuchi (Japan).

(xi) The Fisheries Society of the British Isles, Annual International Symposium – Biology of Polar Fish, 24 to 28 July 2000, Cambridge, UK – Dr Everson.

(xii) ICES Symposium on 100 Years of Science under ICES, 1 to 3 August 2000, Helsinki, Finland – Dr Sjöstrand.

(xiii) Fourth International Penguin Conference, 4 to 8 September 2000, La Serena, Chile – Prof. J. Valencia (Chile).

(xiv) International Fisheries Forum, date to be determined, Auckland, New Zealand – Ms J. Molloy (New Zealand).

(xv) ICES Annual Science Conference, 25 September to 4 October 2000, Bruges, Belgium – Mr W. Vanhee (Belgium).

(xvi) XXVI SCAR, July 2000, Tokyo, Japan – an observer will be sought (Japan).

(xvii) SCAR Working Group on Biology, 10 to 14 July 2000, Tokyo, Japan – Dr Fanta.

(xviii) SCAR-GOSEAC, venue and date to be decided – Dr Fanta.

(xix) SCAR Subcommittee on Evolutionary Biology of Antarctic Organisms, 24 to 27 March 2000, Kent, UK – Dr Fanta.

(xx) SCAR-GSS, July 2000, Tokyo, Japan – Prof. Torres.

PUBLICATIONS

12.1 The sixth edition of *CCAMLR Science* was published just prior to CCAMLR-XVIII. The Scientific Committee extended its sincere thanks to Dr E. Sabourenkov (Editor) and his production team for their efforts in the publication of this volume.

12.2 Following last year's request by the Scientific Committee, the Secretariat has applied to the Institute for Scientific Information (ISI) to include *CCAMLR Science* in its publication *Current Contents* and in the *Science Citation Index*. The institute recently advised that the evaluation will be completed following the issue of the sixth volume of the journal.

12.3 The Scientific Committee considered CCAMLR-XVIII/7 and discussed the future of *CCAMLR Science* beyond the end of its second three-year term. The journal had achieved a high technical standard and had grown greatly in stature. The Scientific Committee agreed that *CCAMLR Science* was a showcase for the scientific work in support of CCAMLR and strongly recommended that its publication be continued.

12.4 The following documents were also published during 1999:

(i) *CCAMLR Scientific Abstracts*;
(ii) *Statistical Bulletin*, Volume 11 (1989–1998); and
(iii) Revisions of the *Scientific Observers Manual*, *CCAMLR Inspectors Manual* and *CEMP Standard Methods*.

12.5 The Scientific Committee noted that the *Fishery Data Manual* had been revised and edited, and prepared for publication (Annex 5, paragraph 10.13). However, it agreed to delay the translation and publication of the manual until next year, pending developments in the data requirements for new and exploratory fisheries.

12.6 The Scientific Committee welcomed the publication of the book *Identification of Seabirds of the Southern Ocean. A Guide for Scientific Observers aboard Fishing Vessels* published by CCAMLR and the National Museum of New Zealand in 1999. The Scientific Committee endorsed the comments offered by WG-IMALF to help in any future revision (Annex 5, paragraph 7.5).

12.7 The Scientific Committee discussed the status of the book *Understanding CCAMLR's Approach to Management*. A scientific editing committee had been appointed to oversee final editing and production of the book (see SC-CAMLR-XVII, paragraph 12.12). The Scientific Committee was pleased to note that final editing was nearing completion, and that the document would be placed on the CCAMLR website in early 2000. The Scientific Committee thanked Dr Kock for his contribution to this worthwhile project, and his dedicated efforts in nurturing its early development.

12.8 In addition, a professional editor had been contracted to produce a synopsis of the book (see SC-CAMLR-XVII, paragraph 12.12). Dr Miller had reviewed a draft in August, and substantive comments had been provided to the editor. A revised draft would soon be submitted to the editing committee. The synopsis, with colour illustrations, is expected to be published in early 2000.

12.9 The Scientific Committee discussed the possibility of the Secretariat translating non-CCAMLR documents of significant value to the work of Members. It was agreed that future requests for such translation would be evaluated in three steps, as follows:

(i) the document should be evaluated by the relevant working group;

(ii) the document, together with the working group's recommendation for translation, should then be evaluated by the Editorial Board of *CCAMLR Science*; and

(iii) the Board's recommendation, together with advice where appropriate, on translation, publication format and costing, would be considered by the Scientific Committee.

12.10 A key consideration in such evaluation would be to assess if the documents' contents are important in terms of their potential contribution and value to CCAMLR's work. This requirement is similar to one of the key criteria being applied in the acceptance of manuscripts for publication in *CCAMLR Science*.

12.11 However, the Scientific Committee agreed to consider WG-FSA's request to translate the headings, figures and table captions from the book *Fishes and Fish Resources of the Antarctic* by Dr Shust (Annex 5, paragraph 10.9). The Scientific Committee emphasised that decision in this regard should not set a precedent.

12.12 The Scientific Committee agreed to the request of WG-FSA, and tasked the Secretariat with the translation of the headings, figures and table captions. Once translated, the Scientific Committee requested that the Editorial Board provide advice on further translation of this book. Once formulated, the Scientific Committee requested that the Secretariat circulate the Editorial Board's advice to Members. The advice of the Board and Members' views would be considered at SC-CAMLR-XIX.

12.13 The Scientific Committee agreed that its Chairman should contact SCAR and explore the possibility of SCAR sponsoring the completion of a CD-ROM-based bibliography of Antarctic fish. This request had been forwarded by WG-FSA, and the total cost of such a production was estimated at around A$8 000 (Annex 5, paragraph 10.10).

SCIENTIFIC COMMITTEE ACTIVITIES DURING THE 1999/2000 INTERSESSIONAL PERIOD

13.1 The following Scientific Committee activities are planned for the 1999/2000 intersessional period:

(i) CCAMLR-2000 Survey (January–February 2000);
(ii) B_0 Workshop (two-week period, May–June 2000);
(iii) meeting of WG-EMM (17 to 28 July 2000); and
(iv) meeting of WG-FSA (9 to 19 October 2000).

13.2 The Scientific Committee thanked Prof. L. Guglielmo (Italy) for his kind offer to host the sixth meeting of WG-EMM in Taormina, Sicily, in July 2000. The Scientific Committee recalled that Italy had very successfully hosted the first meeting of WG-EMM in 1995.

13.3 The Scientific Committee again decided to postpone the Workshop on the Development of a Long-term Management Strategy for *C. gunnari* until a time after 2000 (paragraph 5.106).

13.4 The Scientific Committee briefly reviewed the procedure developed by the Chairman and conveners of working groups to allocate and track intersessional tasks. Activities during the 1998/99 intersessional period were listed in SC-CAMLR-XVII, Annex 6. It was agreed that this procedure had been successful, and was used by the Secretariat, the working groups and Members in planning intersessional work.

13.5 The Secretariat's intersessional work in 1998/99 in support of the working groups had been reported at the latter's respective meetings (WG-EMM-99/10, WG-FSA-99/8). The working groups had reviewed this work, and noted that most of the tasks in the past intersessional period had been completed; tasks which remained incomplete were generally pending input by Members or international organisations.

13.6 Major activities scheduled in the 1999/2000 intersessional period are listed in Annex 6.

13.7 The Scientific Committee assessed a proposal by SCAF to alternate meetings of WG-EMM between host countries and the Secretariat's Headquarters in Hobart. The proposal aimed to reduce the costs associated with the Secretariat's travel to the meetings of WG-EMM.

13.8 While the Scientific Committee recognised that some savings could be made by holding the meeting of WG-EMM in Hobart every second year, it was not clear how great such savings would be, given that costs would be incurred in hosting the meetings at the Headquarters. In addition, the Scientific Committee believed that this proposal would incur significant 'costs' in the long term. The Scientific Committee also recognised that some countries incurred high costs in sending delegations to Hobart, due to its remoteness, and that such costs may prohibit return visits within a single year.

13.9 The Scientific Committee indicated that it had further reservations concerning SCAF's proposal for the following reasons. The key consideration for hosting the meetings of WG-EMM in Member countries was to encourage young scientists (with little or no support for international travel) and national organisations to participate more broadly in, and contribute to, CCAMLR research activities. Participation by young scientists was an essential element in the recruitment of expertise and the development of innovative methodologies to manage the Antarctic marine living resources. Limiting the ability of young scientists to attend meetings would result in a critical loss of expertise over the long term, and jeopardise the work of the Scientific Committee and its working groups.

13.10 The Scientific Committee noted that the work of its working groups is already suffering from reduced participation at meetings held in recent years. For example, this year's Convener of WG-FSA had sought the assistance of colleagues in encouraging more experts in assessment modelling and statistics to participate in the activities of WG-FSA, to spread the increasing load of this aspect of the working group's work (Annex 5, paragraph 12.3). The Scientific Committee echoed this need, and encouraged Members to send more researchers, including young scientists, to future meetings of CCAMLR.

13.11 In addition, Dr Miller agreed to contact national representatives of the Scientific Committee, and seek their active support to recruit new scientists to meetings.

BUDGET FOR 2000 AND FORECAST BUDGET FOR 2001

14.1 The budget of the Scientific Committee for 2000 and the forecast budget for 2001, as agreed by the Scientific Committee, is summarised in Table 8. The following points were discussed.

14.2 The Scientific Committee agreed that the Workshop on the Development of a Long-term Management Strategy for *C. gunnari*, first proposed for 1997 (SC-CAMLR-XVI, paragraphs 5.58 to 5.65), should once again be deferred (paragraph 13.3). Funding would not be required in 2000, but may be considered in the 2001 budget.

14.3 The Scientific Committee agreed that the Data Manager should participate in the B_0 Workshop to be held in La Jolla, USA, over a two-week period in May–June 2000 (Annex 4, paragraphs 8.37 and 8.66). In addition, it was agreed that the Secretariat should provide secretarial support to the workshop.

14.4 The Scientific Committee advised on the following possible expenditures under the Commission's budget for 2000:

(i) participation by the Chairman in the proposed 2000 meeting of CEP;

(ii) additional data processing arising from the likely submissions of observer data from krill fisheries (section 10); and

(iii) development of web-based news groups in support of the work of the Scientific Committee and its working groups (section 10).

14.5 The Scientific Committee also advised on the following possible expenditures under the Commission's forecast budget for 2001:

(i) expansion of data systems to archive core datasets collected during the CCAMLR-2000 Survey (section 10);

(ii) translation and publication of the *Fishery Data Manual* (section 12); and

(iii) translation and publication of the supplementary issue of *CCAMLR Science* reporting findings of the CCAMLR-2000 Survey (paragraph 6.38).

ADVICE TO SCOI AND SCAF

15.1 The Scientific Committee's advice to SCOI and SCAF is detailed in sections 3, 14 and 18.

ELECTION OF VICE-CHAIRPERSONS OF THE SCIENTIFIC COMMITTEE

16.1 Drs Siegel and Shust nominated and seconded Drs Fanta and Nicol as vice-chairpersons of Scientific Committee. No further nominations were received, and Drs Fanta and Nicol were unanimously elected to these positions for 2000 and 2001. The Scientific Committee congratulated Drs Fanta and Nicol on their appointments.

16.2 The Scientific Committee thanked Drs Siegel and Shust for serving as vice-chairpersons in 1998 and 1999.

NEXT MEETING

17.1 The next meeting of the Scientific Committee would be held in the current venue from 23 to 27 October 2000.

OTHER BUSINESS

Members' Reporting Obligations

18.1 The Scientific Committee reviewed the annual reporting obligations of Members, as outlined in CCAMLR-XVIII/6. The Scientific Committee reaffirmed the need for Members to report information of direct relevance to the work of the Scientific Committee and its working groups. This included:

(i) information related to the implementation of conservation measures;
(ii) changes in fishing operations and harvest strategies;
(iii) notification of research surveys made under Conservation Measure 64/XII; and
(iv) research relevant to CEMP, but not directly reported under that program (e.g. research conducted under the auspices of SCAR).

18.2 The Scientific Committee agreed that notifications of surveys which do not include sampling by fishing gear were not required. The Scientific Committee believed that such information would continue to be disseminated through existing dialogue and networks.

18.3 The Scientific Committee endorsed all suggested improvements listed in Table 1 of CCAMLR-XVIII/6 on the condition that the electronic dissemination of this information would be phased in over the next few years, and that information vital to the work of its working groups be also circulated in hard copy. This vital information would include notification of surveys where the total catch of finfish was expected to exceed 50 tonnes.

18.4 Japan's question regarding the types of VMS information to be disseminated on the secure pages of the CCAMLR website was referred to SCOI.

General

18.5 The Scientific Committee noted with pleasure the development of Ukraine's research program in support of CEMP, and looked forward to further information in Ukraine's next report on Member's activities, and the submission of CEMP data.

ADOPTION OF THE REPORT

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

CLOSE OF THE MEETING

20.1 On behalf of the Scientific Committee, Dr Kock thanked the chairman, Dr Miller, for his expertise and hard work in guiding the discussions of the past week, and bringing the meeting to a successful close. Significant advances had been made this year, and Dr Miller's efforts had been greatly appreciated.

20.2 In closing the meeting, Dr Miller thanked the rapporteurs for synthesising the extensive discussions, and bringing together the issues which the Scientific Committee had addressed at the meeting. Dr Miller also thanked staff at the Secretariat who had been closely involved in the meeting, including the translators who had worked long hours to ensure that most sections of the report had been available in all four languages at adoption. Dr Miller also acknowledged the interpreters for their great effort, and all participants for their dedication and hard work during the meeting.

20.3 The meeting was closed.

Table 1: Total reported krill catch (in tonnes) in the 1997/98 and 1998/99 split-years by area and country.

Nationality	1997/98				1998/99			
	Subarea				Subarea			
	48.1	48.2	48.3	Total	48.1	48.2	48.3	Total
Argentina								6 524
Japan	34 430	6 673	22 130	63 233	26 106	35 810	9 402	71 318
Rep. of Korea	890		733	1 623			1 228	1 228
Poland	13 883	0	1 429	15 312	8 150	6 891	3 513	18 554
Ukraine				0		5 694		5 694
UK	634			634				0
Total	49 837	6 673	24 292	80 802	34 256	48 395	14 143	103 318

Table 2: National reported krill catches (in tonnes) since the 1990/91 split-year based on STATLANT returns.

Nationality	Split-year[1]								
	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
Argentina									6 524
Chile	3 679	6 065	3 261	3 834					
Germany									
Japan	67 582	74 325	59 272	62 322	60 303	60 546	58 798	63 233	71 318[3]
Latvia				71					
Rep. of Korea	1 210	519						1 618	1 228
Panama					141	495			
Poland	9 571	8 607	15 909	7 915	9 384	20 610	19 156	15 312	18 554
USSR[2]	275 495								
Russia		151 725	4 249	965					
South Africa				2					
Ukraine		61 719	6 083	8 852	48 884	20 056	4 246		5 694
UK							308	634	
Total	357 537	302 960	88 774	83 961	118 712	101 707	82 508	80 802	103 318

1 The Antarctic split-year begins on 1 July and ends on 30 June.
2 Although the formal date for the dissolution of the USSR was 1 January 1992, for comparative purposes statistics are compiled here for Russia and Ukraine separately for the complete split-year, i.e. 1 July 1991 to 30 June 1992.
3 STATLANT data submitted by Japan on 21 October 1999.

Table 3: Total reported finfish catch (in tonnes) in the 1997/98 and 1998/99 split-years by area and country.

Nationality	Subarea/Division											
	48.1	48.2	48.3	58.4.1	58.4.3	58.5.1	58.5.2	58.6	58.7	88.1	88.3	Total
1997/98												
Australia							2 495					2 495
Chile	1	<1	1 490								<1	1 491
France						3 775		104				3 879
Japan			76									76
Rep. of Korea			176									177
New Zealand										54		54
Russia												0
South Africa			507					89	598			1 194
Spain			196									199
Ukraine						997						997
UK			589									595
Uruguay			261									262
Total	1	<1	3 306	0	0	4 772	2 495	193	598	54	<1	11 419
1998/99												
Argentina			9									9
Australia				<1	<1		5 548					5 548
Chile			1 666									1 666
France						4 639		1 615				6 254
Japan												0
Rep. of Korea			259									259
New Zealand										309		309
Russia			270									270
South Africa			451					323	227			1 001
Spain			153									153
Ukraine						760						760
UK			1 244									1 244
USA		13										13
Uruguay			520									520
Total	0	13	4 567	<1	<1	5 399	5 531	1 938	227	309	0	18 006

Table 4: National reported finfish catches (in tonnes) since the 1990/91 split-year based on STATLANT returns.

Nationality	Split-year[1]								
	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
Argentina				9	867	107			9
Australia		4		2			1 057	2 495	5 548
Bulgaria		114	220	70	177				
Chile		2 917	2 125	150	1 894	3 092	1 275	1 489	1 666
France	1 576	1 589	826	4 211	4 173	3 673	3 674	3 879	6 254
Japan						263	334	76	
Rep. of Korea				143	420	381	452	177	259
New Zealand								54	309
Poland	41								
Russia		48 589	281	265	11	102			270
Spain	35						291	199	153
South Africa							2 096	1 194	1 001
Ukraine		11 265	2 346	942	5 473	1 003	1 007	997	760
UK	9	10		6			403	595	1 244
USA						184			13
USSR[2]	97 240								
Uruguay								262	520
Total	98 901	64 488	5 798	5 798	13 015	8 805	10 562	11 419	18 006

[1] and [2] Refer to footnotes in Table 2.

Table 5: Reported catches (in tonnes) of *D. eleginoides* and *D. mawsoni* by Members and Acceding States in EEZs and in the CCAMLR Convention Area, and estimates of unreported catches from the CCAMLR Convention Area by Members and Acceding States in the 1998/99 split-year. Catches for the 1997/98 split-year are given in parentheses. The information in this table may be incomplete.

Member/ Acceding State	Outside CCAMLR Area Catch in EEZs		CCAMLR Area Reported Catch		CCAMLR Area Estimates of Unreported Catches by Members		Estimated Total Catch All Areas	
Chile	9 172[1]	(8 692)	1 668	(1 479)[4]	3 280	(5 640)[8]	14 120	(15 811)
Argentina	8 297	(5 651)	10	(0)	800	(5 760)[9]	9 107	(11 411)
France	0	(0)	6 260	(3 032)	0	(0)	6 260	(3 832)
Australia	100	(575)[2]	5 451	(2 418)	0	(0)	5 551	(2 993)
South Africa	79	(0)	948	(1 149)[5]	0	(1 200)[10]	957	(2 349)
UK	>1 416	(1 624)[3]	1 238	(590)	0	(0)	2 654	(2 214)
Uruguay	1 059	(?)	517	(262)[4]	0	(800)[11]	1 576	(1 062)
Ukraine	0	(0)	760	(997)[6]	0	(0)	760	(997)
Spain	0	(0)	154	(196)[4]	0	(0)	154	(196)
Rep. of Korea	0	(0)	255	(170)[4]	0	(0)	255	(170)
Peru	0	(156)	0	(0)	0	(0)	0	(156)
Japan	0	(0)	0	(76)[4]	0	(0)	0	(76)
New Zealand	<1	(0)	296	(41)[7]	0	(0)	323	(41)
USA	0	(0)	<1	(0)	0	(0)	<1	(0)
All countries	20 124	(16 698)	17 558	(11 210)	4 080	(13 400)	41 718	(41 308)

1 1998 calendar year
2 From Macquarie Island
3 From Falkland/Malvinas Islands
4 From Subarea 48.3
5 From South African EEZ in Subareas 58.6 and 58.7 and from Subarea 48.3
6 From French EEZ in Division 58.5.1
7 From Subarea 88.1; catch consisted mostly of *D. mawsoni*
8 Based on the following estimates: three vessels observed in Division 58.5.1, five vessels observed in Walvis Bay and Mauritius, assumed that eight vessels were fishing at some time during the season taking into account that some of these vessels were also involved in the regulated fishery in Subarea 48.3 for part of the year, effort – 940 days fishing, mean daily catch rate – 6 tonnes.
9 Based on the following estimates: four vessels observed or arrested in Division 58.5.1, three vessels landing catches in Walvis Bay, assumed that seven vessels were fishing at some time during the season, effort – 960 days fishing, mean daily catch rate – 6 tonnes.
10 Based on the following estimates: one vessel sighted in Division 58.5.1, probably fishing for the whole season, effort – 200 days fishing, mean daily catch rate – 6 tonnes.
11 Based on the following estimates: one vessel landing catch in Walvis Bay, assumed the vessel was fishing for part of the season when not involved in the regulated fishery in Subarea 48.3, effort – 133 days fishing, mean daily catch rate – 6 tonnes.

NB: An additional unreported catch of 1 200 tonnes was attributed to Portugal (European Community) in the 1997/98 split-year based on two vessels sighted in Division 58.5.1 fishing for part of the season (see SC-CAMLR-XVII, Annex 5, Table 3).

Table 6: The coordinates of eight fishing grounds in Subareas 58.6, 58.7 and Division 58.4.4 (Figure 1).

Grid	Subarea/ Division	Grid Coordinates				Length (n miles)		Seabed Area (km^2) 0–2 000 m
		Top Left Latitude	Top Left Longitude	Bottom Right Latitude	Bottom Right Longitude	Top	Side	
1	58.7	45 S	37 E	48 S	40 E	130	180	33 921
2	58.6	45 S	40 E	48 S	44 E	170	180	33 918
3	58.6	45 S	44 E	48 S	48 E	170	180	39 213
4	58.6	45 S	48 E	48 S	51 E	130	180	25 367
5	58.6	45 S	51 E	48 S	54 E	130	180	13 232
6	58.4.4	51 S	40 E	54 S	42 E	80	180	4 031
7	58.4.4	51 S	42 E	54 S	46 E	150	180	14 180
8	58.4.4	51 S	46 E	54 S	50 E	150	180	7 749
9	58.4.3	55 S	60 E	62 S	73.5 E	460	420	
10	58.4.3	55 S	73.5 E	62 S	80 E	230	420	
11	58.4.1	55 S	80 E	64 S	89 E	320	860	
12	88.1	60 S	150 E	65 S	170 W	1 200	300	
13	88.1	65 S	150 E	72 S	180	760	420	
14	88.1	65 S	180	72 S	170 W	250	420	
15	88.1	72 S	171 E	84 S	180	170	730	
16	88.1	72 S	180	84.5 S	170 W	190	750	

Subarea 88.2 is divided into six 10° longitudinal sections and one 5° longitudinal section.
Subarea 48.6 is divided into one section north of 60°S and five 10° longitudinal sections south of 60°S.

Table 7: Details for new and exploratory longline fisheries in 1999/2000. E – *Dissostichus eleginoides*, M – *Dissostichus mawsoni*.

Subarea / Division	Species	Member	Proposed No. of Vessels	1998 Estimates of Yield with Discount Factor (SC-CAMLR-XVII, Table 8)		1999 Estimates of Yield Prorated by Recruitment Grounds and Observed CPUE when Available			No. of Small-scale Research Units in Area	Seabed Area of Fishing Grounds (km^2)	Average Area per Small-scale Research Unit	Approx. No. of Fine-scale Rectangles per Research Unit
				Total Area	Outside EEZ	CPUE	Yield Estimate (not discounted) Total Area	Yield Estimate (not discounted) Outside EEZ				
48.6	E	South Africa	4	707					1	28 070	28 070	9.6
		EC	1									
58.4.1		Australia (trawl)	1									
58.4.3	E	France (longline)	4	2 438	2 361	not estimated following survey results			2	93 791	46 896	32.2
		EC (longline)	1									
		Australia (trawl)	1	886	886							
58.4.4	E	South Africa	4	572		0.36	746		3	22 743	7 581	7.8
		Uruguay	2									
		France	4									
		EC	1									
		Chile	3									
58.6	E	France	4	3 993	1 555	0.3	1 410	549	4	71 295	17 824	24.4
		EC	1									
		Chile	3									
		South Africa	4									
58.7	E	France	4	688	27	0.37	184	7	1	12 655	12 655	4.3
88.1	E	EC	1	271		0.2	0		1	10 838	10 838	3.7
		Chile	3									
		NZ	3									
48.6	M	South Africa	4	495		0.04	1 028		5	56 146	11 229	19.3
		EC	1									
88.1	M	EC	1	2 010		0.2	11 690		4	236 391	59 098	81.1
		Chile	3									
		NZ	3									
88.2	M	Chile	3			0.2	72		6.5	30 986	4 767	10.6
		EC	1									

Table 8: Scientific Committee Budget for 2000 and Forecast for 2001.

1999			2000		2001 Forecast	
		WG-FSA meeting:				
16 700		Preparation and Secretariat support	16 800		17 300	
26 800		Report completion and translation	27 000		27 800	
	43 500			43 800		45 100
	0	Workshop on *C. gunnari*		0		0
		WG-EMM meeting:				
19 900		Preparation and Secretariat support	20 100		20 700	
24 900		Report completion and translation	25 100		25 900	
	44 800			45 200		46 600
	4 500	Support of International Krill Symposium		0		0
	5 000	Support of SCAR Bird Assessment		0		0
		Travel for Scientific Committee Program:				
	42 700	WG-EMM meeting (freight, flights and subsistence)		42 300		43 600
		Workshop on Area 48:				
0		Data Manager travel	3 900		4 000	
0		Secretarial support	3 900		4 000	
8 200		Report costs	10 000		10 300	
	8 200			17 800		17 800
	1 100	Contingency		1 100		1 100
A$	149 800	Total	A$	150 200	A$	154 200

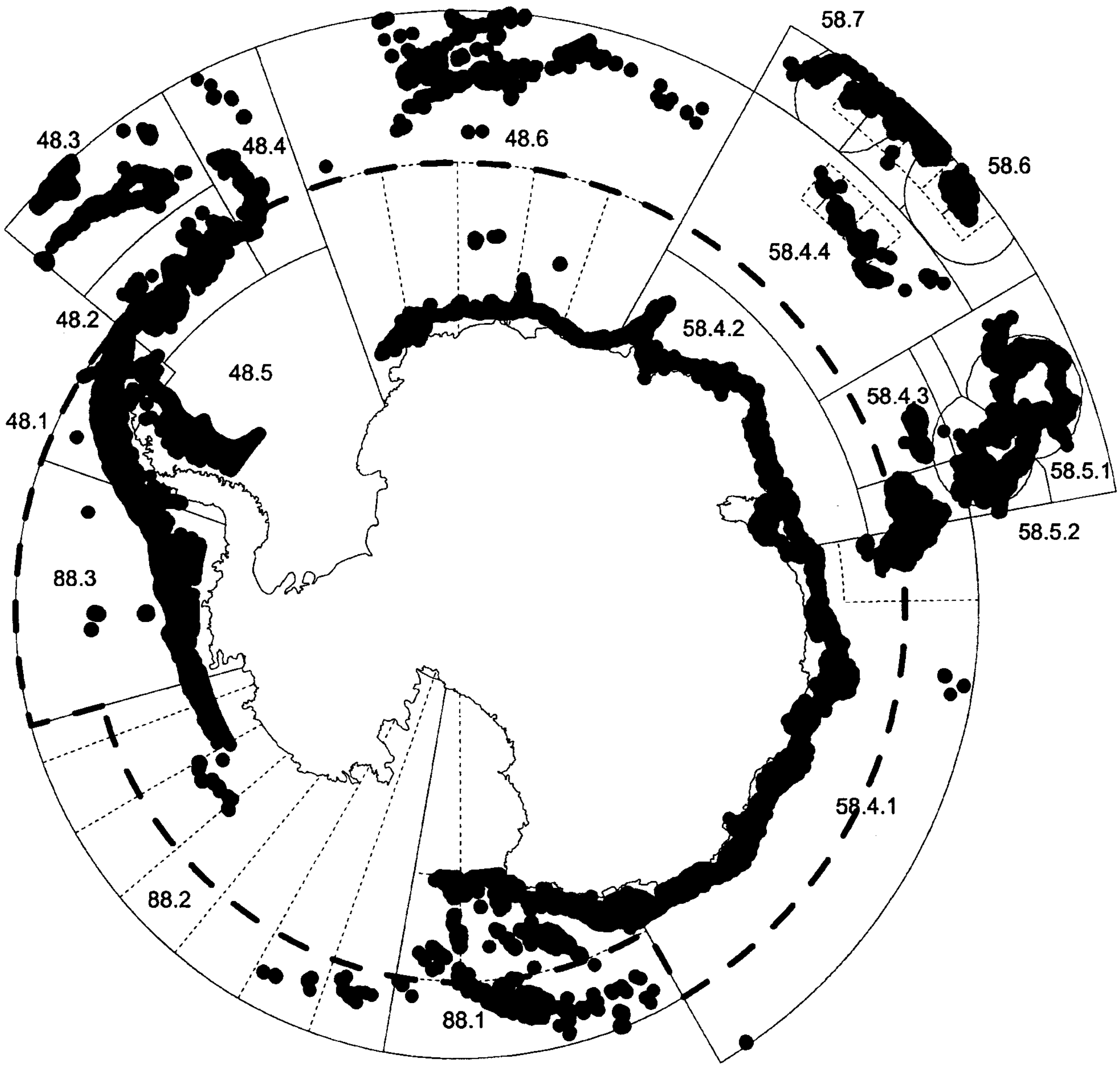

Figure 1: SSRUs for new and exploratory fisheries. The boundaries of these units are listed in Table 6. EEZ boundaries for Australia, France and South Africa are marked in order to address notifications for new and exploratory fisheries in waters adjacent to these zones. Dashed line – delineation between *Dissostichus eleginoides* and *Dissostichus mawsoni*; shaded patches – seabed areas between 500 and 1 800 m.

ANNEX 1

LIST OF PARTICIPANTS

LIST OF PARTICIPANTS

CHAIRMAN

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Department of Environment Affairs
Cape Town

ARGENTINA

Representative:	Dr. Enrique Marschoff Instituto Antártico Argentino Buenos Aires
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Alternate Representatives:	Dr Anthony Press Australian Antarctic Division Environment Australia Tasmania
	Dr Stephen Nicol Australian Antarctic Division Environment Australia Tasmania
	Mr Richard Williams Australian Antarctic Division Environment Australia Tasmania
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Ms Dorothea Huber
Australian Fisheries Management Authority
Canberra

Mr Michael Bliss
Legal Branch
Department of Foreign Affairs and Trade
Canberra

Mr Max Kitchell
Representative of Australian and State
and Territory Governments
Hobart

Mr David Moser
Australian Antarctic Division
Environment Australia
Tasmania

Mr Martin Exel
Representative of Australian Fishing Industry
Kailis and France Group
Western Australia

Mr Ian Hay
Australian Antarctic Division
Environment Australia
Canberra

Mr Alistair Graham
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Mr Geoff Rohan
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Adviser:	Mr Frank Arnauts Counsellor Royal Belgian Embassy Canberra

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Representative:	Dr Edith Fanta UFPR - Depto. Biología Celular Curitiba
Alternate Representative:	Dr André Chiaradia Secretariat of Biodiversity and Forestry Ministry of Environment
Adviser:	Mr Francisco Osvaldo Barbosa DPA Ministério da Agricultura e do Abastecimento Brasília

CHILE

Representative:	Prof. Carlos Moreno Instituto Antártico Chileno Universidad Austral de Chile Valdivia
Alternate Representative:	Prof. Daniel Torres Instituto Antártico Chileno Santiago
Adviser:	Sra. Valeria Carvajal Subsecretaría de Pesca Ministerio de Economía Valparaíso

EUROPEAN COMMUNITY

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ANNEX 2

LIST OF DOCUMENTS

LIST OF DOCUMENTS

SC-CAMLR-XVIII/1	Provisional Agenda for the Eighteenth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
SC-CAMLR-XVIII/2	Provisional Annotated Agenda for the Eighteenth Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources
SC-CAMLR-XVIII/3	Report of the Working Group on Ecosystem Monitoring and Management (Santa Cruz de Tenerife, Spain, 19 to 29 July 1999)
SC-CAMLR-XVIII/4	Report of the Working Group on Fish Stock Assessment (Hobart, Australia, 11 to 21 October 1999)

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SC-CAMLR-XVIII/BG/1 Rev. 2	Catches in the Convention Area 1998/99 and related data Secretariat
SC-CAMLR-XVIII/BG/2	Report of the CCAMLR Observer at the 1998 ICES Symposium CCAMLR Observer (D.G.M. Miller, Chairman of the Scientific Committee)
SC-CAMLR-XVIII/BG/3	Observer's report from the 51st Meeting of the Scientific Committee of the International Whaling Commission Grenada, 3–15 May 1999 CCAMLR Observer (K.-H. Kock, Germany)
SC-CAMLR-XVIII/BG/4	Attendance at the 23rd Session of the Committee on Fisheries of the Food and Agriculture Organisation of the United Nations Rome, Italy, 15–19 February 1999 CCAMLR Observer (J. Cooper, South Africa)
SC-CAMLR-XVIII/BG/5	Entanglement of Antarctic fur seals *Arctocephalus gazella* in man-made debris at Bird Island, South Georgia during the 1998 winter and 1998/99 pup-rearing season Delegation of the United Kingdom
SC-CAMLR-XVIII/BG/6	Entanglement of Antarctic fur seals *Arctocephalus gazella* in man-made debris at Signy Island, South Orkney Islands, 1998/99 Delegation of the United Kingdom
SC-CAMLR-XVIII/BG/7	Anthropogenic feather soiling, marine debris and fishing gear associated with seabirds at Bird Island, South Georgia, 1998/99 Delegation of the United Kingdom
SC-CAMLR-XVIII/BG/8	Data management: report on activities during 1998/99 Secretariat
SC-CAMLR-XVIII/BG/9	Report on the 18th session of the Coordinating Working Party on Fisheries Statistics (CWP–18) Secretariat

SC-CAMLR-XVIII/BG/10	Monitoring results of marine debris at King Sejong Station, Antarctica, during 1997–1999 Delegation of the Republic of Korea
SC-CAMLR-XVIII/BG/11	Summary of scientific observations on longline fisheries conducted in the 1998/99 season in accordance with the Scheme of International Scientific Observation and national observation programs Secretariat
SC-CAMLR-XVIII/BG/12	Calendar of meetings of relevance to the Scientific Committee – 1999/2000 Secretariat
SC-CAMLR-XVIII/BG/13	Report of the World Conservation Union (IUCN) to the XVIIIth meeting of the Convention on the Conservation of Antarctic Marine Living Resources IUCN Observer (J. Cooper, South Africa)
SC-CAMLR-XVIII/BG/14	Marine debris and fishing gear associated with seabirds at sub-Antarctic Marion Island – 1998/99 Delegation of South Africa
SC-CAMLR-XVIII/BG/15	Report on the international conference on integrated fisheries monitoring Sydney, Australia, 1–5 February 1999 CCAMLR Observer (Chairman of the Scientific Committee)
SC-CAMLR-XVIII/BG/16	International fishers forum: solving the incidental capture of seabirds Delegation of New Zealand
SC-CAMLR-XVIII/BG/17	First record of anti-*Brucella* antibodies in *Arctocephalusgazella* and *Leptonychotes weddellii* from Cape Shirreff, Livingston Island, Antarctica Delegation of Chile (available in Spanish and English)
SC-CAMLR-XVIII/BG/18	Report on the Second International Symposium on Krill Observer (S. Nicol, Australia)
SC-CAMLR-XVIII/BG/19	FAO's fisheries global information system Secretariat
SC-CAMLR-XVIII/BG/20	On cooperation with UNEP (copies of correspondence) Secretariat
SC-CAMLR-XVIII/BG/21	Extracts from the Report of the Planning Meeting for the 1999/2000 IWC/SOWER Cruise, Tokyo, Japan, 27–30 September 1999 Secretariat
SC-CAMLR-XVIII/BG/22	Progress report on the plans for the Russian contribution for the CCAMLR Synoptic Survey Delegations of Russia and the United Kingdom

SC-CAMLR-XVIII/BG/23	IMALF assessment of new and exploratory fisheries by statistical area (Working Group on Fish Stock Assessment)
SC-CAMLR-XVIII/BG/24	Fishery information for WG-FSA-99 Secretariat (This document was presented to the meeting of WG-FSA as WG-FSA-99/9)
SC-CAMLR-XVIII/BG/25	Report of the ad hoc task group to consider a regulatory framework for CCAMLR fisheries
SC-CAMLR-XVIII/BG/26	Managing fisheries to conserve the Antarctic marine ecosystem: practical implementation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) Paper presented to ICES/SCOR Symposium on 'Ecosystem Effects of Fishing', 15–19 March 1999 Montpellier, France
SC-CAMLR-XVIII/BG/27	Report on activities of SCAR's Group of Specialists on Environmental Affairs and Conservation E. Fanta, Brazil, GOSEAC Liaison Officer
SC-CAMLR-XVIII/BG/28	Research proposal for the Third International Coordination's activities near the South Shetland Islands during the 1999/2000 austral summer period Delegation of the Republic of Korea
SC-CAMLR-XVIII/BG/29	Report on the activities of the SCAR Subcommittee on Evolutionary Biology of Antarctic Organisms CCAMLR Observer (E. Fanta, Brazil)
SC-CAMLR-XVIII/BG/30	The ICES annual science conference CCAMLR Observer (B. Sjöstrand, Sweden)

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CCAMLR-XVIII/1	Provisional Agenda for the Eighteenth Meeting of the Commission for the Conservation of Antarctic Marine Living Resources
CCAMLR-XVIII/2	Provisional Annotated Agenda for the Eighteenth Meeting of the Commission for the Conservation of Antarctic Marine Living Resources
CCAMLR-XVIII/3	Examination of the audited financial statements for 1998 Executive Secretary
CCAMLR-XVIII/4	Review of the 1999 budget, draft 2000 budget and forecast budget for 2001 Executive Secretary
CCAMLR-XVIII/5	Vacant
CCAMLR-XVIII/6	Review of Members' annual reporting obligations Secretariat

CCAMLR-XVIII/7	Publication of *CCAMLR Science* Secretariat
CCAMLR-XVIII/8	Notification of South Africa's intention to initiate an exploratory fishery Delegation of South Africa
CCAMLR-XVIII/9	Notification of South Africa's intention to initiate new/exploratory fisheries Delegation of South Africa
CCAMLR-XVIII/10	Notification of New Zealand's intention to continue an exploratory fishery Delegation of New Zealand
CCAMLR-XVIII/11	Notification of Australia's intention to initiate a new fishery Delegation of Australia
CCAMLR-XVIII/12	Notification of Australia's intention to initiate an exploratory fishery Delegation of Australia
CCAMLR-XVIII/13	Proposal by Chile for an exploratory fishery of *Dissostichus* spp. (*D. eleginoides* and *D. mawsoni*) in the CCAMLR Convention Area Delegation of Chile
CCAMLR-XVIII/14	Notification of Uruguay's intention to initiate a new fishery Delegation of Uruguay
CCAMLR-XVIII/15	Timing of payment of Members' contributions Executive Secretary
CCAMLR-XVIII/16	Review of formula for calculating Members' contributions Executive Secretary
CCAMLR-XVIII/17	Proposal to revise investment policy Executive Secretary
CCAMLR-XVIII/18	UN review of CCAMLR salaried positions Delegation of the USA
CCAMLR-XVIII/19	Review of working arrangements for the Standing Committee on Observation and Inspection (SCOI) Secretariat
CCAMLR-XVIII/20	Notification of France's intention to initiate new and exploratory fisheries Delegation of France
CCAMLR-XVIII/21	Notification of an exploratory fishery Delegation of the European Community
CCAMLR-XVIII/22	Catch Documentation Scheme Delegations of Australia, European Community and USA

CCAMLR-XVIII/23	Intersessional invitations to key meetings of international organisations – clarification of existing procedures Secretariat
CCAMLR-XVIII/24	Proposed specially protected area – Balleny Islands, Antarctica Delegation of New Zealand
CCAMLR-XVIII/25	Report of the Standing Committee on Observation and Inspection (SCOI)
CCAMLR-XVIII/26	Report of the Standing Committee on Administration and Finance (SCAF)

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CCAMLR-XVIII/BG/1 Rev. 1	List of documents
CCAMLR-XVIII/BG/2	List of participants
CCAMLR-XVIII/BG/3	Report on the meeting of FAO and non-FAO regional fisheries bodies or arrangements CCAMLR Observer (Italy)
CCAMLR-XVIII/BG/4	Report on the Twenty-Third Session of the Committee on Fisheries (COFI) Executive Secretary
CCAMLR-XVIII/BG/5	Report of the CCAMLR Observer to ATCM XXIII Executive Secretary
CCAMLR-XVIII/BG/6	Beach debris survey – Main Bay, Bird Island, South Georgia, 1997/98 Delegation of the United Kingdom
CCAMLR-XVIII/BG/7	Beach debris survey Signy Island, South Orkney Islands, 1998/99 Delegation of the United Kingdom
CCAMLR-XVIII/BG/8	Late payment of contributions – the necessity for tighter regulations Executive Secretary
CCAMLR-XVIII/BG/9	Implementation of conservation measures in 1998/99 Secretariat
CCAMLR-XVIII/BG/10	Summary of current conservation measures and resolutions – 1998/99 Secretariat
CCAMLR-XVIII/BG/11	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 South Africa
CCAMLR-XVIII/BG/12	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 United Kingdom

CCAMLR-XVIII/BG/13	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 Poland
CCAMLR-XVIII/BG/14	CCAMLR activities on monitoring marine debris in the Convention Area Secretariat
CCAMLR-XVIII/BG/15	Implementation of the System of Inspection and other CCAMLR enforcement provisions in the 1998/99 season Secretariat
CCAMLR-XVIII/BG/16	Calendar of meetings of relevance to the Commission – 1999/2000 Secretariat
CCAMLR-XVIII/BG/17	Development of the CCAMLR Website Secretariat
CCAMLR-XVIII/BG/18	Relevamiento de desechos marinos 1998/99 Delegación de Uruguay
CCAMLR-XVIII/BG/19	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 Ukraine
CCAMLR-XVIII/BG/20	New Zealand report on lost fishing gear, marine debris and the assessment and avoidance of incidental mortality in Statistical Subarea 88.1 in the 1998/99 season Delegation of New Zealand
CCAMLR-XVIII/BG/21	Withdrawn
CCAMLR-XVIII/BG/22	Beach litter accumulation at sub-Antarctic Marion Island – 1998/99 Delegation of South Africa
CCAMLR-XVIII/BG/23	Report of the Second Meeting of the Committee for Environmental Protection Lima, Peru, 24–28 May 1999 CCAMLR Observer (Chairman of the Scientific Committee)
CCAMLR-XVIII/BG/24	International conference, monitoring, control and surveillance on fishing activities Santiago, Chile, 25–27 January 2000 Secretariat
CCAMLR-XVIII/BG/25	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 Japan
CCAMLR-XVIII/BG/26	On the exchange of information with FAO on CCAMLR activities Executive Secretary

CCAMLR-XVIII/BG/27	Implementación de las medidas de conservación de la CCRVMA en Chile Delegación de Chile
CCAMLR-XVIII/BG/28	Report of the CCAMLR Observer at the XXIIIrd Antarctic Treaty Consultative Meeting Executive Secretary
CCAMLR-XVIII/BG/29	Information on trade in *Dissostichus* spp. Delegation of Australia
CCAMLR-XVIII/BG/30	US plans for fishing for crab in Subarea 48.3 in accordance with Conservation Measures 150/XVII and 151/XVII Delegation of the USA
CCAMLR-XVIII/BG/31	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 Australia
CCAMLR-XVIII/BG/32	Report from CCAMLR observers at Indian Ocean Tuna Commission Scientific Committee and Commission Meetings CCAMLR Observer (Australia)
CCAMLR-XVIII/BG/33	Implementation by the United States of Conservation Measure 148/XVII, automated satellite-linked vessel monitoring systems (VMS) Delegation of the USA
CCAMLR-XVIII/BG/34	Report to CCAMLR of the observer to the Second Workshop on Antarctic Protected Areas CCAMLR Observer (J. Valencia, Chile)
CCAMLR-XVIII/BG/35	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 USA
CCAMLR-XVIII/BG/36	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 Republic of Korea
CCAMLR-XVIII/BG/37	Summary of measures taken to combat illegal, unregulated and unreported fishing in the Convention Area for the year to 30 June 1999 Delegation of Australia
CCAMLR-XVIII/BG/38	Notification of research vessel activity in the Convention Area Delegation of the United Kingdom (This document was presented to the meeting of WG-FSA as WG-FSA-99/41)
CCAMLR-XVIII/BG/39	Synthesis of marine debris survey at Cape Shirreff, Livingston Island, during the Antarctic season 1998/99 Delegation of Chile
CCAMLR-XVIII/BG/40	Report on assessment and avoidance of incidental mortality in the Convention Area 1998/99 Brazil

CCAMLR-XVIII/BG/41	Report of the Antarctic and Southern Ocean Coalition (ASOC) to the XVIIIth Meeting of the Convention on the Conservation of Antarctic Marine Living Resources Submitted by ASOC
CCAMLR-XVIII/BG/42	Ad hoc Workshop of the APEC Fisheries Working Group on Fisheries Management Delegation of Japan
CCAMLR-XVIII/BG/43	The report of the CCSBT5 and 5(2) as the Observer from CCAMLR CCAMLR Observer (Japan)
CCAMLR-XVIII/BG/44	Observer's report from the 51st Meeting of the International Whaling Commission CCAMLR Observer (Prof. B. Fernholm, Sweden)
CCAMLR-XVIII/BG/45	List of vessels of CCAMLR Members intending to harvest marine living resources in the Convention Area during the year beginning 1 July 1999 Secretariat
CCAMLR-XVIII/BG/46	Report of the SCAR Observer to CCAMLR Observer (E. Fanta, Brazil)
CCAMLR-XVIII/BG/47	Première Conférence des Directeurs des Services des Pêches des pays et territoires membres de la Communauté du Pacifique Observateur de la CCAMLR (France)
CCAMLR-XVIII/BG/48	The Catch Documentation Scheme under WTO rules Submitted by IUCN
CCAMLR-XVIII/BG/49	Informe de la undécima reunión extraordinaria de la Comisión Internaciónal para la Conservación del Atún Atlántico Delegación de Communidad Europea
CCAMLR-XVIII/BG/50 Rev. 1	Consideration of the implementation of the objective of the Convention Delegation of Chile
CCAMLR-XVIII/BG/51	Policy to enhance cooperation between CCAMLR and non-Contracting Parties Delegation of Australia
CCAMLR-XVIII/BG/52	Policy to enhance cooperation between CCAMLR and non-Contracting Parties Delegation of the European Community

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CCAMLR-XVIII/MA/1	Report of Member's activities in the Convention Area 1998/99 South Africa
CCAMLR-XVIII/MA/2	Report of Member's activities in the Convention Area 1998/99 Poland

CCAMLR-XVIII/MA/3	Report of Member's activities in the Convention Area 1998/99 New Zealand
CCAMLR-XVIII/MA/4	Report of Member's activities in the Convention Area 1998/99 Ukraine
CCAMLR-XVIII/MA/5	Report of Member's activities in the Convention Area 1998/99 Norway
CCAMLR-XVIII/MA/6	Report of Member's activities in the Convention Area 1998/99 Chile
CCAMLR-XVIII/MA/7	Report of Member's activities in the Convention Area 1998/99 Uruguay
CCAMLR-XVIII/MA/8	Report of Member's activities in the Convention Area 1998/99 Russia
CCAMLR-XVIII/MA/9	Report of Member's activities in the Convention Area 1998/99 France (available in French only)
CCAMLR-XVIII/MA/10	Report of Member's activities in the Convention Area 1998/99 Germany
CCAMLR-XVIII/MA/11	Report of Member's activities in the Convention Area 1998/99 United Kingdom
CCAMLR-XVIII/MA/12	Report of Member's activities in the Convention Area 1998/99 Japan
CCAMLR-XVIII/MA/13	Report of Member's activities in the Convention Area 1998/99 Australia
CCAMLR-XVIII/MA/14	Report of Member's activities in the Convention Area 1998/99 Italy
CCAMLR-XVIII/MA/15	Report of Member's activities in the Convention Area 1998/99 USA
CCAMLR-XVIII/MA/16	Report of Member's activities in the Convention Area 1998/99 Argentina (available in Spanish only)
CCAMLR-XVIII/MA/17	Report of Member's activities in the Convention Area 1998/99 Republic of Korea
CCAMLR-XVIII/MA/18	Report of Member's activities in the Convention Area 1998/99 Brazil
CCAMLR-XVIII/MA/19	Report of Member's activities in the Convention Area 1998/99 Spain (available in Spanish only)

AGENDA OF THE EIGHTEENTH MEETING OF THE SCIENTIFIC COMMITTEE

AGENDA OF THE EIGHTEENTH MEETING
OF THE SCIENTIFIC COMMITTEE

1. Opening of the Meeting

   (i) Adoption of the Agenda
   (ii) Report of the Chairman
   (iii) Preliminary Consideration of Scientific Committee Budget

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 1998/99 Fishing Season
   (ii) Advice to the Commission

4. Dependent Species

   (i) Species Monitored under the CCAMLR Ecosystem Monitoring Program (CEMP)
      (a) Report of 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) Report of WG-EMM
      (b) Data Requirements
      (c) Advice to the Commission

   (ii) Fish Resources
      (a) Report of WG-FSA
      (b) Data Requirements
      (c) Advice to the Commission

   (iii) Crab Resources
      (a) Report of WG-FSA
      (b) Data Requirements

(c) Advice to the Commission

(iv) Squid Resources
  (a) Report of WG-FSA
  (b) Advice to the Commission

6. Ecosystem Monitoring and Management

   (i) Report of 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 1998/99 Season
   (ii) Exploratory Fisheries in the 1998/99 Season
   (iii) Proposals for New and Exploratory Fisheries for the 1999/2000 Season

10. CCAMLR Data Management

11. Cooperation with Other Organisations

   (i) Reports of Observers from International Organisations
   (ii) Reports of SC-CAMLR Representatives at Meetings of Other International Organisations
   (iii) Future Cooperation

12. Publications

13. Scientific Committee Activities during the 1999/2000 Intersessional Period

14. Budget for 2000 and Forecast Budget for 2001

15. Advice to SCOI and SCAF

16. Election of Vice-Chairmen of the Scientific Committee

17. Next Meeting

18. Other Business

   (i) Members' Reporting Obligations

19. Adoption of the Report of the Eighteenth Meeting of the Scientific Committee

20. Close of the Meeting.

ANNEX 4

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT

(Santa Cruz de Tenerife, Spain, 19 to 29 July 1999)

CONTENTS

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT
(Santa Cruz de Tenerife, Spain, 19 to 29 July 1999)

INTRODUCTION

Opening of the Meeting

1.1 The fifth meeting of WG-EMM was held at the Instituto Español de Oceanografía, Santa Cruz de Tenerife, Spain, from 19 to 29 July 1999.

1.2 The Assistant Director of the Instituto Español de Oceanografía, Dr E. López Jamar, opened the meeting and welcomed participants to the institute. In his opening remarks, Dr López Jamar outlined Spain's long-standing commitment to research in support of CCAMLR, and emphasised the importance of the Working Group's work in advising on the management of Antarctic marine living resources. Dr López Jamar thanked Dr E. Balguerías, Mr L. López Abellán and other staff at the institute for the local organisation of the meeting.

1.3 On behalf of the Working Group, the Convener, Dr I. Everson, thanked Dr López Jamar and the local organisers for hosting the meeting in Santa Cruz. He noted that some of the participants had attended the meeting of WG-CEMP held in the institute in 1991. He looked forward to a similarly productive meeting.

Adoption of the Agenda and Organisation of the Meeting

1.4 The Provisional Agenda was introduced and discussed. Two items were added to the agenda:

Item 6.4 'Environmental Interactions with Harvested and Dependent Species'; and

Item 10 'CCAMLR Website'.

With these changes, the agenda was adopted (Appendix A).

1.5 During the course of the meeting it became clear that some papers, although relevant to agenda items, did not fit well into the subitems. Accordingly, some modifications were made to the structure within agenda items as the meeting progressed.

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

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

FISHERIES INFORMATION

Catches: Status and Trends

2.1 The distribution of catches from krill fisheries in the CCAMLR Convention Area during the split-year 1997/98 (July 1997 to June 1998) was presented in WG-EMM-99/9. A total of 80 178 tonnes of krill had been reported as fine-scale data, which represented 99% of the catches reported in the STATLANT data. Fishing took place in Subareas 48.1 (49 388 tonnes or 62% of the total catch), 48.2 (6 672 tonnes, 8%) and 48.3 (24 043 tonnes, 30%). In addition, catches totalling 75 tonnes of krill had been reported from waters adjacent to the Convention Area in Division 41.3.2 (Southern Patagonia). Fleets had fished for krill near the South Shetland Islands (Subarea 48.1) in all months except July to September 1997, and near South Georgia (Subarea 48.3) from July to September 1997 and May to June 1998. Vessels had also operated in the vicinity of the South Orkney Islands from December 1997 to March 1998 and May 1998. Catches exceeding 3 000 tonnes of krill per fine-scale rectangle and 10-day reporting period were reported off South Georgia for July 1997.

2.2 The Working Group discussed trends in catch per unit of effort (CPUE). CPUE has been reported in tonnes per hour (CEMP Index H1a) and tonnes per day (CEMP Index H1b) in WG-EMM-99/8. CPUE reported in Subareas 48.1, 48.2 and 48.3 over recent years were close to their long-term mean values, and no anomaly had been detected in any of the time series in 1997/98.

2.3 Haul-by-haul CPUE, estimated as catch per tow and catch per minute, and the size distribution of krill caught by the Japanese fleet in the 1997/98 season, were reported in WG-EMM-99/48 using data collected by fishing crews. Four Japanese trawlers targeted krill near the South Shetland Islands and Antarctic Peninsula from mid-December to mid-May. The fleet then divided, with two vessels continuing to fish near the South Shetland Islands, and two vessels fishing to the northeast of South Georgia from May until late June. CPUE, in catch per tow, ranged from 5 to 24 tonnes per tow, and increased as the season progressed. Measured in terms of catch per minute, CPUE showed marked variation between vessels, especially from late April to late June; differences in this measure of CPUE may be attributed to differences in the density and extent of krill aggregations. In addition, krill were distributed over a narrow size range on grounds near the Antarctic Peninsula and at South Georgia, with modal lengths of 50 mm and 37 to 39 mm respectively. Krill were found to be distributed over a wider size range near the South Orkney Islands where modal length varied over time.

2.4 The Working Group noted that only haul-by-haul CPUE was likely to be of use in answering key questions regarding krill population processes and in understanding the fishery, but that this was only available from the Japanese fishery. Submission of data from other nation’s fisheries was encouraged, as was the analysis of these data.

2.5 Visual and radar observations on the number of icebergs encountered by a Japanese trawler searching for krill in Subarea 48.1 in early May 1999 was presented in WG-EMM-99/54. Observations were made up to 24 n miles on either side of vessel, and indicated high densities of icebergs (>60–100 icebergs within 6 n miles of the vessel) along the inshore sector of the area surveyed, from Anvers Island northwards to Elephant Island. The high number of icebergs encountered by the Japanese trawler had prevented fishing and the vessel had moved to the South Orkney Islands. In contrast, Dr Trivelpiece reported that few icebergs had been sighted off Cape Shirreff during February 1999.

2.6 Information on the occurrence of icebergs was welcomed by the Working Group, and the potential effects of high densities of icebergs on the fishing operation and CPUE were briefly discussed. The Working Group agreed that a number of factors may influence trends in CPUE, including search time, fishing strategies, icebergs and trends in the krill market. These factors would need to be incorporated into any future analysis of CPUE aiming to understand trends in abundance of krill and fishing effort. The Working Group welcomed the analysis of CPUE on a vessel-by-vessel basis as reported in WG-EMM-99/48.

2.7 The krill catches for the 1998/99 season and reported to date to the Secretariat indicated that five Member countries had fished for krill in Area 48: Argentina (4 427 tonnes); Japan (55 879 tonnes); Republic of Korea (1 231 tonnes); Poland (16 285 tonnes) and Ukraine (5 694 tonnes). The Working Group noted that data for the past season were incomplete because the reports for June 1999 were not due until the end of July 1999. The Working Group was advised that Japanese vessels had caught approximately 15 000 tonnes of krill in June. The catch taken in June by the Japanese fleet represented approximately 15% of the total annual catch, and raised the annual catch taken by Japan to 71 022 tonnes. With this addition, the total catch within the Convention Area in 1998/99 would be at least 98 658 tonnes. No fishing was reported from Areas 58 and 88. In adjacent waters, Poland had reported a catch of 254 tonnes of krill in Subarea 47.4 (southeast Atlantic); no catch was reported from Division 41.3.2.

2.8 The Working Group discussed the types of conversion factors used to estimate the total catch of krill. The Japanese fleet has traditionally used a factor of 10 to raise the weight of fishmeal to the estimated fresh weight of the catch (i.e. fresh weight = 10 · fishmeal weight). A factor of 10 was also used to raise the weight of peeled krill to the estimated fresh weight of the catch. A factor of 1 was used to estimate fresh weight from the weight of frozen krill. The Working Group agreed that conversion factors used in the krill fishery should be documented, and that the approach used by WG-FSA to quantify conversion factors in the *Dissostichus* spp. fisheries was applicable to the krill fisheries. Members were encouraged to collect detailed data on fresh and processed weights, and submit this information to the Secretariat.

2.9 Members were asked about their plans to fish for krill during the split-year 1999/2000. The USA advised that two vessels were now licensed to fish for krill, and fishing was expected to start in August 1999 in Subareas 48.1, 48.2 and 48.3. Japan advised that it planned to continue fishing at the same level of about 50 000 to 70 000 tonnes of krill taken by four trawlers operating in Subareas 48.1, 48.2 and 48.3. Germany may issue a licence to one vessel, and fishing may begin in January 2000. India had no immediate plans to fish for krill. Australia had received several enquiries, but no licences had been issued. In the UK, one company had expressed interest in krill fishing but no licences had been issued. The Secretariat had received notice from Ukraine that two vessels would continue fishing in 1999/2000 at a level similar to that of the past season. The Secretariat was also aware of initial discussions in Chile for fishing using a non-Member flagged vessel; no further information was available. The Secretariat had sought information from Canada, China and Panama: Canada was evaluating a proposal; no response had been received from China; and Panama advised that it would not fish for krill in 1999/2000. Information at hand in the Secretariat at the time of adoption indicated that Poland had extended the licences of five vessels to the 1999/2000 season.

Harvesting Strategies

2.10 Last year the Working Group discussed the need for information on past and current market prices for krill. This information would provide further insight into the fishery, and is essential for the economic analysis of this fishery and development of management strategies (SC-CAMLR-XVII, Annex 4, paragraph 2.9). Some participants and the Secretariat had attempted to locate market information and prices via the Internet; no information had been found so far on market prices. The Working Group agreed that Members involved in krill fisheries should provide general information on krill prices and a breakdown of catches by product type. This information is essential to understand underlying market trends and to determine how reactive fishing operations were to market forces.

2.11 Japan confirmed that the key market features reported last year (SC-CAMLR-XVII, paragraph 2.5) had applied in 1999. That is, krill was harvested mostly as feed for the aquaculture industry and bait in recreational fisheries; a small proportion of the catches was also processed as food for human consumption. Also, Japanese trawlers had extended their fishing season to autumn and winter so as to avoid catching early-season green krill (low value), increase their catch of white krill (high value), and increase the length of the period when krill can be supplied to markets. The Working Group was concerned that the development of the winter fishery for krill in ice-free areas off South Georgia may place localised pressure on krill populations; management strategies should be reviewed in the light of year-round fishing.

2.12 Dr Nicol advised the Working Group that potential new markets for pharmaceutical products may only require small quantities of harvested krill as a base for enzyme production.

Observer Scheme

2.13 The Working Group noted that considerable data had been acquired by Japan in the past using national observers. In addition, in 1998/99 some observer data had been collected by Argentina and were to be submitted to the Secretariat, and the USA had considered deploying scientific observers aboard krill vessels. Despite these efforts, the Working Group noted that there remained a paucity of information on the operation of krill fisheries and by-catch. In particular, the Working Group recommended that observers be deployed regularly on krill vessels to collect and report data assigned high priority in CCAMLR's *Scientific Observers Manual* (section 1, part 2, paragraph 4). These are:

(i) observations on fishing activities;
(ii) gathering of haul-by-haul data on catch and effort;
(iii) representative length-frequency distributions;
(iv) representative distribution of sex and maturity stages;
(v) observations on feeding intensity;
(vi) observations on by-catch of juvenile finfish; and
(vii) observations on incidental mortality of predators (seabirds and seals).

2.14 In addition, the Working Group agreed that it may be desirable for observers to collect data on conversion factors used to convert the weight of various krill products to fresh weight. The availability of information on conversion factors is essential to ensuring that catches reported to CCAMLR have been reported in a consistent manner (see paragraph 2.8).

2.15 Members agreed that it is of high priority to have observers aboard commercial krill vessels during the execution of the CCAMLR 2000 Krill Synoptic Survey of Area 48 in January–February 2000 (hereafter referred to as 'the CCAMLR-2000 Survey'). Information provided by observers is likely to be important to the interpretation of survey results in relation to fishing operations taking place at the same time as the survey over various spatial scales.

2.16 In addition, the Working Group suggested that, as a matter of priority, information delineating the decision processes used by vessel masters to formulate fishing operation strategies was needed. For example, does the master formulate fishing strategy based on acoustic traces, catch parameters (green krill, krill size etc.) or other factors? The use of 'echolisteners' which provide scientific-quality output from echosounders on commercial vessels was considered an important component to provide information pertaining to fishing operations during the CCAMLR-2000 Survey.

2.17 It would be useful to develop standard survey questionnaires based on the list of activities identified by Butterworth (1988) to collect fishing strategy information.

HARVESTED SPECIES

Distribution and Standing Stock

Local Surveys

3.1 An acoustic krill biomass survey was conducted off the western end of South Georgia in 1986 using a radiating transect design specifically to examine the relationship between krill biomass and krill predators (WG-EMM-99/17). The data had been analysed in three depth strata: offshore (<2 000 m), slope and shelf. Krill biomass was highest on the slope (44.58 gm^{-2}), intermediate on the shelf (27.79 gm^{-2}) and lowest offshore (21.69 gm^{-2}), emphasising the importance of the shelf/slope area for krill.

3.2 Off South Georgia in 1998/99, biomass of krill in the two regularly sampled survey areas was low (11.1 gm^{-2} in the western box and 12.0 gm^{-2} in the eastern box) relative to other years in the BAS Core Programme (WG-EMM-99/20). The krill in both survey areas were large, with a mean size of 50.7 mm in the east and 52.9 mm in the west.

3.3 Based on recent trends, low krill densities are predicted in the South Georgia area in 1999/2000, unless there has been a major influx of krill into the area in the intervening period (WG-EMM-99/20).

3.4 Two small-scale acoustic surveys in the vicinity of the South Shetland Islands were conducted in 1998 (WG-EMM-99/55). In January 1998 a survey to the south of the South Shetlands yielded a biomass of 21.15 gm^{-2} in an area of 982 n $miles^2$. This biomass estimate was derived only from acoustic data collected between depths of 20 to 75–125 m because of noise problems outside that depth range. In December 1998 a larger (5 363 n $miles^2$) survey to the north of the South Shetlands yielded a mean krill biomass of 319.8 gm^{-2} with most of the krill (>75%) being found in layers between 115 and 320 m.

3.5 The reported high level of mean density in the December 1998 survey compared to other surveys in the region could have been a result of other species being included in the acoustic results. There was also some uncertainty over the target strength (TS) used to arrive at the biomass estimate. New calculations carried out during the Working Group meeting using the definition of krill TS at 120 kHz indicated a krill density of 151 gm^{-2} to the north of the South Shetland Islands.

3.6 The 1998/99 US AMLR surveys off the Elephant Island area reported the second lowest acoustically estimated density of krill (23 gm^{-2}) in the seven-year series (WG-EMM-99/47). This low density was also reflected in the net haul surveys. Krill in this area were concentrated in the shelf/slope area.

3.7 Krill in the area were dominated by larger size classes that had been actively spawning since mid- to late December, which contrasts to recent years when spawning has been reduced in intensity and occurred later in the season. The low biomass detected in the Elephant Island area in 1998/99 agrees with predictions, and even lower biomass levels are predicted for the 1999/2000 season.

3.8 Dr Constable suggested that changes in recruitment in this area, and other areas, could be related to changes in the rate at which krill are advected through the area. In this context, no direct measurements of changes in the rate of advection have been made, but changes in the value of M (see later sections) may indicate that the rate of advection is not constant.

Global Krill Abundance

3.9 Estimates of global krill abundance were presented, based on an estimate of the distributional range of krill from historical data and using modern estimates of acoustically estimated krill density from areas around the Antarctic (WG-EMM-99/22). The global krill biomass estimates ranged from 62 to 137 million tonnes which is low compared to earlier estimates based on a variety of methodologies.

3.10 Possible reasons for the difference between these and previous estimates include: underestimation of the range of krill, underestimates of krill density by acoustics and the overestimate of krill demand by predators. Further research is necessary to determine which of these factors contribute most to the uncertainties in krill biomass estimation.

3.11 Dr V. Sushin (Russia) noted that in a number of areas for which surveys gave low densities of krill, commercial fleets had high values of CPUE for seasons corresponding with surveys, for example in Subarea 48.2 (WG-EMM-99/8). He believes that this discrepancy has apparently resulted from areas of surveys and their duration being too small.

3.12 Although krill density figures can be varied and the results of the calculations would change, it was agreed that it would require unrealistic estimates of density throughout the distributional range to raise the estimates to levels approaching the figure of 500 million tonnes, which is often quoted as the global krill biomass (WG-EMM-99/22).

3.13 The calculations highlighted the need for research into krill distribution and abundance in large unsurveyed areas such as Subareas 48.6, 88.1 and 88.2 which had the potential to significantly alter the global figure. There is interest by New Zealand and Australia in surveying Subarea 88.1 – this initiative was encouraged by the Working Group.

3.14 Using the calculations in WG-EMM-99/22 it is evident that the CCAMLR-2000 Survey may result in a biomass estimate that could yield a large precautionary limit. The Working Group agreed that the development of mechanisms to subdivide the precautionary catch limit into smaller management areas could assume high priority since the fishery could concentrate all its effort within a relatively restricted area at one time.

Regional, Vertical and Seasonal Distribution of Krill

3.15 Discussion of the papers presented on krill distribution highlighted the need for further studies into the availability of krill in the surface layer which is likely to be of prime importance to predators yet which may be underestimated in acoustic surveys.

3.16 The Working Group agreed that acoustic surveys were the best method available to provide an estimate of krill biomass and that the planned CCAMLR-2000 Survey has been designed to minimise bias due to vertical migration by surveying only during the day.

3.17 It was recognised that studies into the distribution and abundance of krill in the surface layers have been carried out using techniques such as sideways or upward-looking echosounders and echosounders mounted in small boats. The Working Group encouraged the submission of reports on the results of such studies and the conduct of further studies of this nature. The issue of the relationship between krill density estimates derived from nets and from acoustics was also a topic highlighted for urgent study.

3.18 The relationship between the seasonal patterns of the fishery and the distribution of krill is important given that the fishery appears to be concentrating on Subarea 48.3 in winter. Little information, which could be used in developing strategies for managing the fishery in winter, is currently available on the winter distribution of krill and the foraging behaviour of krill predators in ice-covered or ice-free areas.

3.19 The Working Group noted that at least two studies on the winter distribution of krill and krill predators were planned; one at South Georgia in 2003 and the SO-GLOBEC study off the Antarctic Peninsula in 2001 (Marguerite Bay).

Population Structure, Recruitment, Growth and Production

3.20 The Working Group recognised that information on the mean sizes and length ranges of krill from various regions were available from a number of sources: RMT nets (WG-EMM-99/17 and 99/20), IKMT nets (WG-EMM-99/47), bongo nets (WG-EMM-99/55), commercial nets (WG-EMM-99/48) and predator diet samples (WG-EMM-99/37). The Working Group also recognised that regional comparisons between these different types of samples could be useful for the examination of krill population structure (see also BIOMASS, 1991), bearing in mind the limitations and biases particular to each type of sampling method.

3.21 The Working Group suggested that the development of general methodologies for the analysis and presentation of information on krill population structure, such as size ranges or length-density information from time-series studies, would be extremely useful to facilitate comparisons between areas. It was recognised that the formulation of data handling protocols from the CCAMLR-2000 Survey may go some way towards such standardisation.

3.22 The CCAMLR-2000 Survey and the continuing local-scale surveys in the same season may also provide an opportunity for the examination of the different scales of krill distribution and abundance, and how these relate to krill predator foraging behaviour. Consideration should be given to how the data from the regional surveys can be used in conjunction with the CCAMLR-2000 Survey.

Indices of Abundance, Distribution and Recruitment

3.23 A conceptual model of krill abundance and population structure, developed from krill lengths from predator diet samples at South Georgia from 1991 to 1997, allowed predictions to be made for the 1998 season (WG-EMM-99/37). It correctly predicted a serial change in krill population structure, low krill biomass and low predator reproductive performance.

3.24 The biomass of krill around South Georgia changed markedly during the 1997/98 season, being lowest in October and highest in January–February. The sizes of krill observed in fur seal and macaroni penguin diets also changed, reflecting an influx of krill from outside the area. Because of changes in the length-frequency composition over the season, the proportional index of recruitment could vary by two orders of magnitude between December and March.

3.25 The successful prediction by this conceptual model indicates that predator diet samples can reflect local processes in the krill population which may be under the influence of larger scale environmental processes.

3.26 The Working Group agreed that analyses of mean lengths of krill in the diet of predators need to take account of potential differences in the foraging area of different predator species and the size of krill eaten by each predator species. Examples of this were provided in WG-EMM-96/9 (Reid et al., 1996) and WS-Area48-98/15 (Reid et al., 1999). The Working Group indicated that it would be valuable to analyse the krill length-frequency data in WG-EMM-99/37 at the level of the individual seal. This will be the closest approximation to the length-density analyses comparing sizes of krill in trawl surveys and would be extremely useful for future comparisons. These analyses may help to distinguish between changes in krill abundance and changes in krill recruitment as assessed from analysis of predator diet samples.

3.27 A new per capita recruitment (PCR) model was developed to obviate some of the perceived ambiguities involved in using either proportional or absolute recruitment methods (WG-EMM-99/50; SC-CAMLR-XVII, Annex 4, paragraphs 9.6 to 9.12). The PCR is a proxy for recruits per spawner expressed as a function of R1 (the proportion of age-1 krill in the population).

3.28 The PCR model is based on four assumptions: post-recruit mortality does not vary over age or between years; 100% of age-1 animals spawn; a representative sample of the population is available; and the proportion of age-1 animals in the sample can be determined unambiguously.

3.29 A simple population model was constructed to test the sensitivity of the PCR to a relaxation of its underlying assumptions and to examine which of the input parameters it was most sensitive to. The PCR was found to be unbiased relative to recruits per spawner when mortality is constant over all age classes and all years, and when all age-1 animals spawn.

3.30 The results indicated that with age-specific declines in mortality and reducing proportion of age-1 spawners, the PCR is biased low. Introducing year-to-year random variability in both mortality and the proportion of age-1 spawners resulted in a broadening of the distribution, but did not appear to introduce additional bias. The PCR will underestimate recruits per spawner if reasonable assumptions are made regarding the variability of mortality and the proportion of age-1 spawners.

3.31 The Working Group recommended that simulation trials be conducted to examine whether correlation exists between recruits per spawner and the PCR described in WG-EMM-99/50.

3.32 The PCR is based on an approach that uses a minimum number of assumptions. In particular, the assumption that the spawners and recruits are found in the same general area. For example, in the Elephant Island area this assumption may hold true because year classes are observed to move through the population. This suggests that either the population in this area is stationary or that the population is representative of a larger area.

3.33 The Working Group noted that the CCAMLR-2000 Survey may determine whether the population sampled in the fine-scale surveys off the Elephant Island area is actually representative of a larger area. Additionally, fisheries data may be useful for obtaining information on wider areas than the smaller scale scientific surveys.

3.34 The Working Group agreed that the key use of such models is to provide information on the productivity of krill populations and that there were at least two linked processes involved in recruitment: spawning of adults and survival of larvae through year 1.

3.35 Producing an index of productivity in krill populations that is sensitive to factors that are known to be of importance and which is sensitive to factors such as local fisheries, was seen to be the ultimate aim of this process. However, caution was expressed concerning attempts to construct stock-recruitment relationships for krill as this approach had failed in many other fisheries where it had been applied.

3.36 Two models were put forward which correct for the proportion of age-1 krill in the krill density model proposed last year (SC-CAMLR-XVII, Annex 4, paragraphs 4.25 to 4.37), and both suggest that if reasonable mortality values are used (0.8 to 1.0), the potential proportional recruitment is larger than values actually observed (WG-EMM-99/51).

3.37 Although the two models were able to correct the uncertainties in the age-1 krill in the krill density model, they were unable to account for the variation in krill density in the Antarctic Peninsula area after the 1994/95 season. This suggests that the variation in krill density after the 1994/95 season may not be explained solely by recruitment and mortality.

3.38 Current estimates of mean recruitment rates suggest that the krill population is unsustainable as the recruitment rates are too low to maintain the estimated mortality rate. Two methods were put forward to tackle this problem (WG-EMM-99/56). In the first method mortality rates were estimated using bulk density estimates and linear regression methods. The second method used an age-structured population model.

3.39 Both models provided an instantaneous mortality rate of 0.6 (~43% per annum) for the first year class but this was poorly constrained between 0.3 and 1.0 (26–63% per annum) and long-term trajectories of density estimated by the models gave poor fits to the observed data. For the second year class the models produced higher mortality estimates, between 0.8 and 1.0 (59–63% per annum), and better fits to the observed density changes.

3.40 The exercise raised questions about the manner in which the recruitment data, particularly that for the first age group, could be interpreted. Mortality, density and recruitment are critically linked and estimates of these values should be internally consistent. It was suggested that changes in mortality rather than changes in recruitment could be responsible for the observed changes in density, and that changes in the rate of advection could affect estimates of all population variables. The Working Group encouraged further research on potential errors involved in sampling the krill population, including the non-random population structure of krill aggregations, flux into and out of the sampling areas, and the provision of independent estimates of mortality.

3.41 The Working Group reiterated the need for time-series data on krill demographic parameters from the Indian and Pacific sectors of the Antarctic to improve general understanding of krill population dynamics.

Future Work

3.42 Plans for surveys by Japan in the South Atlantic using the *Kaiyo Maru* in 1999/2000, include the CCAMLR-2000 Survey, an oceanographic survey and an investigation of krill flux through the krill fishing grounds (WG-EMM-99/49). This latter survey will be carried out by sampling close-spaced stations around the krill fishing grounds in the South Shetlands. A series of repeated surveys will also be carried out during December and January, with Korean and US surveys in other time periods as well.

3.43 A time series of surveys by Japan, USA and Republic of Korea between December 1999 and February 2000 was also noted. Some Peruvian scientists recently expressed their intention to join this coordination work. Peru’s involvement is being considered by its National Commission of Antarctic Affairs. The Working Group also recalled that there had been earlier surveys by Peru in the Bransfield Strait and the Secretariat was requested to approach Peru for some details of the results of these surveys for next year’s meeting.

DEPENDENT SPECIES

CEMP Indices

4.1 Dr Ramm submitted a summary report of trends and anomalies of CEMP indices (WG-EMM-99/8) supplemented by an appendix containing the complete datasets in the CEMP database.

4.2 The Working Group thanked Dr Ramm and his staff for this thorough report.

4.3 A number of queries were raised concerning specific data entries particularly relating to questionable dates and out-of-range values. A discussion followed on how to ensure quality control of the data. The Secretariat should review data after submission and flag 'out-of-range' values or dates and contact data holders as appropriate. Prof. Boyd proposed that data holders be required to confirm on each submission that the data were collected according to the standard method. It was reiterated that the data holders indicate the nature of and reason for, any departure from the standard method.

4.4 An ad hoc group was formed to review CEMP indices for possible errors in data and to make recommendations to the Secretariat on quality control of the data. The group assessed the indices and out of several thousand entries identified only about 34 with possible errors that needed to be checked with data holders (Table 1). Of these, however, only a few concerned the validity of the data entry, the rest likely involved transcription errors. It was noted that the number of potential errors detected was a very small percentage of the entire database.

4.5 The group made the following recommendations:

(i) updated CEMP indices should be posted on the CCAMLR website each year prior to WG-EMM and copies sent to attendees and data holders by email. Two hard copies of the data should be brought to each meeting by the Secretariat for reference;

(ii) data tables consisting of small, inactive summaries be archived after consultation with the respective data holders regarding the status of these data. A table summarising archived data should be included as an appendix to the report. This would reduce the bulk of the CEMP indices report by about 23 tables;

(iii) data should be submitted electronically in standard Excel formats to be developed by the Secretariat after consultation with current data holders;

(iv) the report of anomalies and trends should be presented in two ways: all variables by each site and all sites within subareas by each variable (where the variables are represented at every site); and

(v) each data holder should submit maps of sites and colonies where CEMP data are collected. These will be archived by the Secretariat.

4.6 Dr Trivelpiece advised the Working Group that the SCAR Working Group on Bird Biology held a workshop in Montana, USA, in May 1999 to review the status and population trends among Antarctic seabirds. The workshop participants analysed long-term datasets for several species of interest to WG-EMM. Models were used to statistically investigate trends in populations. The results of this workshop, including details of the methodologies used, will be available to WG-EMM at its next meeting. WG-EMM therefore agreed that substantive discussion of changes in status and trends of CEMP species be deferred until next year.

4.7 Inspection of the land-based predator indices for 1998/99 revealed that no major changes had occurred in predator performance indices in the Antarctic Peninsula (Scotia Sea regions) since the analyses conducted during the Workshop on Area 48 (WG-EMM-98/16).

4.8 Subareas 48.1, 48.2 and 48.3 showed coherence in predator indices. Penguin population estimates were stable or increasing throughout the region relative to 1997/98. Reproductive success, foraging trip duration and chick fledging weights were all average to good. This re-affirmed the findings of the Workshop on Area 48, that land-based predator indices in summer are generally coherent across Subareas 48.1, 48.2 and 48.3.

4.9 WG-EMM-99/25 examined foraging location data, trip duration, chick meal size, chick growth rates and reproductive success to determine the reasons for poor breeding success of

Adélie penguins at Béchervaise Island (Division 58.4.2) in 1998/99. It compared data for nine years, from 1990 to 1998. In 1998/99 adults spent more time at sea and males foraged greater distances (feeding at the shelf break with greater frequency than in 'good' years). Meal masses returned to chicks were considered normal, but adults made fewer trips to sea. The pattern in 1998/99, in part, was associated with late clearing of shore-fast ice from the area, but not entirely, as tidal cracks allowed access to local foraging grounds which appeared to be depleted in necessary food resources. The physical conditions causing late breakout of fast-ice may also have caused redistribution of prey resources.

4.10 Prof. Croxall remarked that a similarly poor year was reported for this site in 1994/95. In that year, poor reproductive success for Adélies at Béchervaise was apparently a localised event as colonies 100 km east and west had normal breeding seasons. No data were available for the other colonies in the region for 1998/99 to determine if the event was local or of a more regional nature.

4.11 WG-EMM-99/60 presented data from Edmonson Point (Subarea 88.1) on Adélie penguins for the 1994/95 to 1998/99 seasons. The 1998/99 season was characterised as normal. Few data were presented for 1997/98, but of the remaining four years, 1995/96 stood out as a year of poor reproductive success. No estimates of variance were presented, but there appeared to be no differences in foraging trip duration between 1994/95 and 1995/96. There were, however, apparent differences in diet (less krill in the diet in 1995/96 than in 1994/95) and meal masses were smaller. Data for foraging locations were not presented, but it was stated that birds foraged nearer the coastline in 1995/96 than in 1994/95 and 1998/99.

Studies on Distribution and Population Dynamics

4.12 WG-EMM-99/6 reported on 13 species of seabirds breeding on Marion Island. Censuses were conducted in varying years for different species to compare with censuses conducted in the early 1980s. Six species (northern giant petrel, grey-headed and wandering albatross, Salvin's prion, blue and great-winged petrels) and possibly king penguins all showed increases in numbers of breeding animals. The southern giant petrel population was stable, while gentoo and rockhopper penguins, the Crozet shag, and possibly macaroni penguins, all decreased in numbers. In general, species with large foraging ranges increased whereas species foraging nearer to Marion Island showed decreases in numbers.

4.13 The Working Group noted that many of the species described in this paper were not CEMP species but that consideration of these trends will be discussed next year. There was a concern expressed by the members of the Working Group that techniques used in the censuses were not adequately described.

4.14 The Working Group noted that the discussion of trends in Antarctic seabird populations, including non-CEMP species, will be possible at next year's meeting when the SCAR Working Group on Bird Biology will present its report (see paragraph 4.6). This consideration will include examination of the trends in seabird populations and the significance and potential causes of those trends.

4.15 WG-EMM-99/34 reported sightings of large whales from three independent sighting databases: a cruise of the *Abel-J* in 1997 from the Falkland/Malvinas Islands to South Georgia (Subarea 48.3), shore-based sightings from Bird Island (Subarea 48.3) between 1979 and 1998, and mariner sightings between 1992 and 1997. Southern right whales were the most common whale sighted. Two right whales from the South Georgia area were identified to have been observed at Peninsula Valdez. Blue and fin whales were less abundant. Areas where whales were sighted with the greatest frequency corresponded with traditional whaling areas, indicating that areas used by whales had not changed over time.

4.16 WG-EMM-99/16 reported an apparent 11% increase in pup production in 1998/99 at Cape Shirreff, Livingston Island. Pup production at the San Telmo Islands was estimated as researchers were unable to census there. Overall production for the SSSI (Cape Shirreff and San Telmo combined) appeared to be 10% greater in 1998/99 than in 1997/98. Pup production, however, appeared to be down the year before by 14%. The 1998/99 increase returned pup production to approximately the 1996/97 level.

4.17 The Working Group noted that limited access to the San Telmo Islands makes the estimation of overall population trends difficult. In addition, uncertainties in the estimates of the counts need to be presented. If the population at this SSSI continues to expand, a mark-recapture program may help facilitate improved estimates of demographic parameters.

Future Studies

4.18 WG-EMM-99/36 estimated field metabolic rates of Antarctic fur seals from variations in heart rate and reported results comparable to metabolic rates obtained from doubly labelled water studies. Heart rate exhibited a high degree of variability within and between animals. However, most of the variability was explained by the morphology of the animals. Estimates of metabolic rates suggested that there were no differences in the costs of being at sea or ashore and that the costs of being at sea were lower than previously estimated. A main advantage to this method is that it is not as restrictive as the doubly labelled water technique in the duration that metabolic rates can be measured over. The technique offers some promise in future studies of field metabolic rates in dependent species which are important for energetics calculation in prey consumption models.

ENVIRONMENT

Consideration of Studies on Key Environmental Variables

5.1 A number of papers were tabled which contained information on the environment. It was agreed that those papers which emphasised environmental interactions with harvested and dependent species (WG-EMM-99/15, 99/16 and 99/35) should be considered under relevant subitems of Agenda Item 6.

5.2 WG-EMM-99/47 provided a summary of field activities by the US AMLR Program in the 1998/99 season. It was noted that a long-term objective of this program was to describe functional relationships between krill, their predators and key environmental variables. Dr Hewitt noted that results from the program over the past 11 years had indicated the presence of an oceanic front to the northwest of Livingston Island and King George Island (Amos and Lavender, 1992) which was known to vary in its location by approximately 10 to 20 km. The Working Group encouraged the US AMLR Program to table a paper on the oceanographic environment in the AMLR area at its next meeting.

5.3 Following submissions in previous years (WG-EMM-97/69 and 98/31), WG-EMM-99/53 sets out preliminary work targeted at estimating the extent (area and number) of polynyas. Such work is in response to WG-EMM's request to standardise the investigation of polynya dynamics with a view to understanding better the influence of polynyas on biological productivity in winter and spring (SC-CAMLR-XVII, Annex 4, paragraphs 6.8 and 12.7). Further development of this work was encouraged.

5.4 WG-EMM-99/54 presented the distribution of icebergs detected by a fishing vessel during the course of fishing activities in Subarea 48.1 in May 1999. The implications of this paper are described in paragraphs 2.5 and 2.6.

5.5 WG-EMM-99/52 contained an assessment of large-scale environmental information that influences the variability of krill density and recruitment. Significant positive correlations were shown between krill recruitment in the Antarctic Peninsula region and the strength of westerly winds from 1982 to 1998. Years with strong westerlies during summer resulted in high krill recruitment in 1987/88, 1990/91 and 1994/95, while the years of weak westerlies resulted in low krill recruitment in 1982/83, 1988/89, 1992/93 and 1996/97. The strength of westerlies was significantly related to the recruitment of both one- and two-year-old krill. In addition, the strength of westerlies showed a strong correlation with chlorophyll-*a* and sea-ice cover at a lag period of one year.

5.6 A second result highlighted by WG-EMM-99/52 was a negative correlation between krill density in the vicinity of the Antarctic Peninsula and the extent of stratospheric ozone depletion between 1977 and 1997. The authors of WG-EMM-99/52 had suggested four hypotheses to explain the possible effects of ozone depletion on krill density (see also discussion in paragraph 5.10):

(i) UV-B has an adverse effect on phytoplankton, potentially reducing the krill stock size;

(ii) UV-B has an adverse direct effect on krill larvae, potentially affecting krill stock size;

(iii) ozone depletion in the stratosphere leads to atmospheric change, which potentially impacts certain oceanic phenomena that may affect krill habitat and krill stock size; and

(iv) spurious correlation exists owing to unknown causality.

5.7 WG-EMM-99/24 contained two published papers on the susceptibility of krill to ultraviolet radiation and on the susceptibility of krill DNA to damage by UV-B. It was agreed that these results offered important developments on a crucial topic, particularly in light of the discussion outlined in the previous paragraph. Future directed research on the potential impacts of ultraviolet radiation on krill was encouraged.

Indices of Key Environmental Variables

5.8 WG-EMM-99/8 (Figures 18 to 20) presented the index deviates for sea-ice cover, proportion of the year free of ice, sea-ice <100 km from CEMP sites and sea-surface temperature in various areas. The Working Group noted that while it was relatively simple to identify anomalous years from such presentations, the elaboration of trends was rather more difficult and required careful interpretation.

Future Work

5.9 The Working Group agreed that monitoring of the key environmental variables identified in the CEMP standard methods should continue.

5.10 It was also emphasised that directed research to understand the potential effects of ultraviolet radiation on key Antarctic biota should be encouraged. Ancillary to such research, modelling of key processes should be encouraged in order to develop a strategic appreciation of the potential effects of increased ultraviolet radiation on CEMP species in general and on krill in particular. Such modelling should serve to identify key parameters to be measured, define the likely extent of the effects of increased ultraviolet radiation on the important demographic properties (especially mortality) of key biota, and develop hypotheses to be tested.

ECOSYSTEM ANALYSIS

Analytical Procedures and Combinations of Indices

Multivariate Analysis of CEMP Indices

6.1 Last year the Working Group considered further work on the development of Composite Standardised Indices (CSIs) (SC-CAMLR-XVII, Annex 4, paragraphs 7.1 to 7.4), which provide a means of combining the many predator indices determined in CEMP into a single index. It requested that differences in approaches to estimating the covariance matrix underpinning the CSI be discussed intersessionally and presented at this meeting.

6.2 Dr Constable outlined the differences in the approaches presented last year and how these related to the original paper of Dr W. de la Mare (WG-EMM-STATS-97/7). The original formulation of the CSI in WG-EMM-STATS-97/7 intended that the covariance matrix be determined from pairwise correlations from all available pairwise combinations of the indices in the time series. This was the method used in WS-Area48-98/6. WG-EMM-98/45 presented a sensitivity analysis based on covariance matrices determined from pairwise correlations over the time series in years when all indices in the CSI were represented (i.e. a complete dataset where there were no missing values, and where the covariance matrix is identical to the correlation matrix). This was the same method used by the WG-EMM Subgroup on Statistics in 1997 (SC-CAMLR-XVI, Annex 4, Appendix D, paragraphs 2.7 to 2.18) in its initial appraisal of the method. A comparison of the robustness of these two different methods has been undertaken by Dr Constable but the results were not ready for presentation to this meeting.

6.3 An extension of this method for estimating CSIs was presented in WG-EMM-99/40. This extension was developed to provide a means of smoothing the covariance matrix when data were missing. This paper also outlined a possible method for determining confidence intervals around CSIs and a procedure for examining the relative influence of different predator indices to the trends indicated by the CSI. The paper used a single simulated dataset derived from a cyclical function as well as the Bird Island dataset used in previous workings of this method. This simulated dataset was then used to illustrate how well the new formulation may perform compared to the formulation presented in WG-EMM-98/45 given various combinations of numbers of missing values and numbers of vectors with missing values. In the specific case presented, the new formulation appeared more robust to missing data. Following this, the Bird Island dataset was re-analysed using the modified version of the CSI. This produced similar trends in predator performance to the original formulation discussed by the Subgroup on Statistics in 1997 and to other work describing changes in predator parameters in relation to known changes in krill abundance. The paper concluded by describing a possible positive non-linear correlation between the modified CSI and estimates of krill density in the region.

6.4 Dr Constable noted that the modifications to the CSI offered a potential enhancement of the method of combining indices. This modification, as with any other development, needs to be examined for its robustness in providing a high probability of correctly indicating the actual trends in the parameters of interest. To this end, Dr Constable also suggested that the performance of the modified CSI under various scenarios of missing values will need to be evaluated for scenarios when the different parameter vectors have varying degrees of relationship to a single function, such as the cyclical function, and for cases when some vectors are influenced by other functions. Examples of these tests are given in WG-EMM-98/45. This latter point is important because the later analyses in WG-EMM-99/40 indicate that some parameters in the Bird Island dataset may be influenced to varying degrees by other factors.

6.5 The Working Group thanked Prof. Boyd for his work in this area and agreed that further development would be welcomed. The Working Group reiterated the need to identify how CSIs can be used in a management context (SC-CAMLR-XVII, paragraph 6.5). The Working Group also noted that further development is required on how to formulate reference points for decision rules that incorporate CSIs or other information on predators.

6.6 The Working Group recalled its discussion on ecosystem assessments last year (SC-CAMLR-XVII, Annex 4, paragraphs 8.17 and 8.18), some of which related back to the early discussions of the Working Group in 1995. Most of the points raised in those paragraphs were regarded as remaining important to the development and use of CSIs. In addition, the Working Group raised the following questions for further consideration:

(i) What functional relationships can be developed relating CSIs to krill abundance (such as the one described in WG-EMM-99/40)?

(ii) How can CSIs be used for identifying a critical level of krill abundance (reference points) for use in estimating precautionary yields or for adjusting catch limits in the short term?

(iii) How sensitive are CSIs to changes in key environmental or other parameters compared to krill abundance?

(iv) What developments are required to facilitate the use of CSIs in feedback management processes or for evaluating the success of conservation measures?

(v) What analytical and assessment methods are required to test the utility of CSIs as a basis for management decisions?

6.7 The Working Group recognised that these questions need to be addressed as soon as possible.

Use of GYM for Krill Stock Assessments

6.8 Dr Ramm reported on progress to archive the krill yield model (SC-CAMLR-XVII, Annex 4, paragraphs 7.9 to 7.11). He has compiled all information available in the Secretariat and is ready to fully document the use of the model. Dr Constable agreed to assist in this documentation. Others involved in the development and application of the krill yield model will be approached to assist in this work during the intersessional period.

Other Approaches

6.9 Methods for estimating the overlap between fisheries and predator foraging areas have been considered since 1992 (see WG-EMM-99/11 for background; see also SC-CAMLR-XV, Annex 4, Appendix H, paragraphs 36 to 43 and SC-CAMLR-XVI, Annex 4, Appendix D, paragraphs 3.1 to 3.15). WG-EMM-99/11 presented a summary of how four different indices aimed at examining predator–fishery overlap compare for Adélie, gentoo, chinstrap and macaroni penguins in part of Subarea 48.1 since the early 1980s. The four indices are:

(i) catch in the Critical Period Distance (CPD) (where the CPD is up to 100 km from predator colonies);

(ii) Agnew–Phegan index (a measure of consumption of krill by predators compared to biomass of krill taken by fisheries in the same area);

(iii) Realised Potential Overlap (RPO) (modified Agnew–Phegan index to account for potential overlap); and

(iv) Schroeder Index (a measure of the relative proportions taken by predators and fishing in the foraging areas).

6.10 WG-EMM-99/11 also included revision to the Agnew–Phegan model and some refinements to the RPO index and to the fine-scale distribution of catches. The Agnew–Phegan and Schroeder indices were compared at nine levels of spatio-temporal resolution and using normal, exponential and uniform foraging distributions. The type of foraging distribution and level of spatio-temporal resolution produced only small differences in the values of both the Agnew–Phegan and Schroeder indices. However, it was noted that a more realistic distribution of foraging, for central place foragers such as penguins, was likely to be described by an inverse exponential function. The CPD and Agnew–Phegan indices produced similar temporal trends. The other two indices were similar to each other but differed in their trend from the former two indices. The RPO and Schroeder indices indicated a substantial increase in the level of overlap from 1995 to 1998. The catch in the CPD and the Agnew–Phegan indices were stable over this period. The analysis in WG-EMM-99/11 also showed that increasing the resolution of the model (especially spatially) results in lower values of overlap indices.

6.11 The Working Group thanked the Secretariat for presenting this work and agreed that further work was necessary to:

(i) determine overlap between predator foraging and fishing at times other than the summer breeding period, particularly in winter as this is when many krill fishing activities are becoming concentrated;

(ii) include more of the available empirical data on predator foraging areas;

(iii) extend the use of these indices to cover all areas where the krill fishery operates, particularly in Subareas 48.2 and 48.3;

(iv) improve the definition of what is required of the index and undertake additional work to develop the application of appropriate indices in this regard;

(v) estimate the confidence intervals for these indices; and

(vi) identify how these indices may be used in a management context.

6.12 The Working Group recalled the request of the Scientific Committee last year (SC-CAMLR-XVII, paragraph 6.11) to involve statistical experts in the development of these indices and encouraged Members to assist the Secretariat in this work.

6.13 Last year the Working Group considered other methods for assessing the status of ecosystems (SC-CAMLR-XVII, Annex 4, paragraph 8.19) including the use of Ecopath and Ecosim simulation software. The Secretariat reported on correspondence with Prof. T. Pitcher (University of British Columbia, Canada) who had approached CCAMLR for collaboration in developing an Ecosim model on the Antarctic marine ecosystem (WG-EMM-99/10). The Working Group endorsed the response of the Secretariat and the Chair of the Scientific Committee to Prof. Pitcher, which indicated that a full proposal would need to be submitted to the Scientific Committee before determining how such a request could be supported.

Krill-centred Interactions

6.14 The Working Group considered the format of this item and agreed that there were two components to the following discussion. The first component is to develop analyses that assist the Commission in understanding how krill predators may be influenced by krill at individual and population levels. In this context it was considered important to understand the importance of krill in predator diets and the degree to which predators are associated with krill and overlap in their foraging activities with the activities of krill fisheries.

6.15 The second component considered important is how krill and their predators fit into the ecosystem. To this end, the influence of environmental factors on krill and its predators is important. Also, interpretation of changes in the ecosystem may be facilitated by understanding the ecological processes, other than predation of krill, that may influence krill predators.

Diet of Krill Predators

6.16 WG-EMM-99/19 described the diet of gentoo penguins at Laurie Island, South Orkney Islands, in three autumn periods. The results indicated that, by mass, crustaceans were the most important in 1993 (krill was the dominant species) while benthic fish were most important in 1995 and 1996. The Working Group noted that at some sites gentoo penguins have a strong propensity to switch diet in seasons of reduced krill availability.

6.17 WG-EMM-99/28 detailed how time depth recorders with light sensors can be used to indicate the turbidity of water in which seals are diving by correlating light intensity with water depth. It showed that such information may provide indications of when the seals are diving in krill swarms. Prof. Boyd informed the Working Group that this paper is the first product of a project to deploy instruments on diving animals to record the characteristics of the physical environment.

6.18 WG-EMM-99/37 presented changes in length-frequency distribution of krill in the diet of fur seals and macaroni penguins at South Georgia. Years of increased mean lengths of krill in the diet of Antarctic fur seals, when adult krill dominate the population, follow periods of recruitment failure. This is discussed in more detail in paragraphs 3.23 to 3.25. The Working Group noted that such techniques may be useful in monitoring changes in the size structure and composition of both local and regional krill populations.

6.19 WG-EMM-99/44 examined the use of fatty acids in providing broad indications of seasonal and annual dietary shifts in seals as well as differences in diet between seals at South Georgia. The study showed that the diet of Antarctic fur seals was likely to be different from Elephant seals, the former consuming predominantly krill and krill-eating fish while the latter consumed fish-eating fish and squid.

6.20 WG-EMM-99/57 provided updated estimates of krill consumption by Adélie, chinstrap and gentoo penguins and female Antarctic fur seals in the South Shetland Islands. Total consumption of krill by all land-based predators on the South Shetland Islands was estimated at 8.3×10^5 tonnes. Sensitivity analyses showed that estimates of total prey consumption could be improved by better estimates of population size of predators, foraging ranges, prey consumption and the annual energy requirements of these species.

6.21 The Working Group welcomed these revised estimates of krill consumption, noting that the total consumption is 1.5 times higher than estimates currently used. It noted that the current estimates of krill density and demographic parameters do not provide sufficient krill for predators. Part of this problem may be uncertainty in the parameters used in the models as described in WG-EMM-99/57. These questions need to be addressed in the not too distant future.

Effect of Diet on Individual Predators

6.22 Foraging trip duration and time spent ashore by lactating female Antarctic fur seals at South Georgia are discussed in WG-EMM-99/32 and 99/35. The results indicated that, in times of low food supply over the last eight years when krill surveys have been undertaken, lactating female seals would increase both their foraging trip duration and time spent ashore. During long foraging trips, the feeding intensity would diminish. In high food years, these seals fed predominantly on krill during shorter foraging trips. In low food years, these seals still fed predominantly on krill but with more fish and squid in the diet.

6.23 The Working Group welcomed the development of an optimal foraging model for fur seals (WG-EMM-99/32). It encourages further development of functional feeding relationships and, in particular, models that endeavour to relate foraging areas of predators with the patchiness of prey at different scales.

6.24 WG-EMM-99/59 reported on a preliminary study examining the capacity of Adélie penguins and south polar skuas in the vicinity of Edmonson Point, Ross Sea to recover from oxidative stress. It was found that Adélie penguins recovered much more quickly than skuas, probably because of the need to sustain greater levels of diving activity. The Working Group noted that this type of research may be useful to assess stress in animals in the future. The Working Group looked forward to seeing results of comparisons with other penguins in the future.

Effect of Diet on Predator Populations

6.25 Trends in breeding success of Adélie penguins at the CEMP study site on Béchervaise Island, near Mawson in eastern Antarctica are reported in WG-EMM-99/25. The size of the colony has been stable since the start of the research program in 1990 and during most of these years the breeding success has been high, ranging from 0.7 to 1.1 chicks crèched per breeding pair for all but three seasons. In the 1994/95 season all chicks died of starvation. In the 1995/96 season only 0.35 chicks were crèched per nest and in the 1998/99 season 0.43 chicks were crèched per nest. Evidence is presented that increased foraging trip duration, as a result of poor food availability in foraging areas near the colony, contributed to lower growth rates, later fledging and higher mortality of chicks. Male foraging behaviour was different to female foraging behaviour, which was relatively normal. For males, more time was spent in feeding grounds further away than usual. This time away reduced the overall amount of food to chicks, even though the amount of food per trip was similar to good foraging years.

6.26 The Working Group noted that this was the second time that poor breeding success has occurred at this site. Dr Nicol informed the Working Group that current and future research aims to determine if there are differences in reproductive success between birds in the Mawson area with birds in other areas, such as near Casey and further east towards the Ross Sea.

6.27 Dr Nicol reported that Australia is planning to start regular sampling of krill off the coast of Béchervaise Island in a manner similar to the UK and USA programs around South Georgia and South Shetland Islands respectively.

6.28 The Working Group encouraged the continued monitoring of this site and suggested additional analyses for presentation at future meetings, such as the comparison of foraging trip duration between birds and an evaluation of different methods for summarising and analysing trip duration.

Distribution of Predators relative to Krill

6.29 WG-EMM-99/27 documented commercial operations of a Russian trawler targeting mackerel icefish (*Champsocephalus gunnari*) in the South Georgia and Shag Rocks areas in late February to March 1999. It presented observations consistent with surveys from approximately 10 years ago that aggregations of older *C. gunnari* are found in areas to the northwest of South Georgia where krill are typically found in high densities.

6.30 The Working Group noted that the locations of catches on aggregations in the northeast were consistent with one of the areas routinely surveyed for krill abundance by the UK in their annual fine-scale surveys around South Georgia.

6.31 WG-EMM-99/30 presented a positive relationship between whale sightings (numbers of whales per transect) and acoustic estimates of krill density on transects in the fine-scale krill survey at South Georgia in January to February 1998. This was consistent with the hypothesis that krill predators are associated with patches of high krill density. However, whale observations were not well correlated to krill abundance at fine-scale resolutions, indicating that whales are likely to be related to krill densities according to the distribution of swarms and other large-scale features rather than the density of krill *per se*. The paper also reports that most whales were observed to the east of South Georgia, which is consistent with previous reports on the locations of whales in the region.

6.32 Dr Nicol indicated that such studies are rare and that continued work on relating the distribution of whales to different characteristics of krill aggregations would be useful. A similar study from eastern Antarctica will soon be published.

6.33 The Working Group noted that the scale of association between predators and prey could well be modelled according to some optimal foraging model, which associates the scale of searching capacity (mobility) and the frequency of occurrence of prey. For ecosystem analyses generally, the development of predictive foraging models (e.g. those developed in WG-EMM-99/32) that endeavour to link the range of foraging areas with environmental parameters and prey distribution would be useful to the Working Group. This is because they may help predictions on how foraging areas may change between seasons and years, thereby improving our capacity to predict potential overlap with the krill fishery.

Overlap in Foraging of Predators with Fisheries

6.34 The overlap between predators and fisheries was examined in WG-EMM-99/11 and 99/57. The former paper has been discussed elsewhere (paragraphs 6.10 and 6.11). WG-EMM-99/57 was presented by authors not previously associated with CCAMLR activities. They used three different indices to assess potential overlap between foraging penguins and fisheries at the South Shetland Islands. They found, in contrast to Ichii et al. (1996) for the same area, that the overlap in foraging between penguins and the krill fishery was likely to be significant.

6.35 The Working Group noted that issues surrounding estimates of consumption of krill by predators as well as the methodologies used to estimate overlap had been discussed earlier (paragraphs 6.10, 6.20 and 6.21). The Working Group agreed that the use of the Schaeffer Ratio and the Evans Ratio as indices of overlap may be worth examining for their potential in the routine examination of overlap by the Working Group.

Ecological Processes and Interactions

6.36 WG-EMM-99/52 and 99/24 described the effects of environmental variables on krill populations. These are discussed in paragraphs 5.5 to 5.7.

6.37 WG-EMM-99/58 provided a review of the potential sensitivity of the marine ecosystem at the Antarctic Peninsula to global climate change. The authors discussed a number of models about the linkages between marine biota and the changes in the physical environment likely to ensue with a changing climate. In particular, the authors presented a conceptual model detailing how Adélie and chinstrap penguin populations may change as a result of these long-term changes to the environment.

6.38 The Working Group agreed that this paper provided an interesting and useful overview. However, some concerns were expressed in relation to the parts of the paper dealing with ice–prey–predator interactions in the light of previous Working Group discussions of this topic. Firstly, as the paper itself indicated, the models made no attempt to distinguish between changes in populations of dependent species directly caused by environmental change and those mediated by interactions with prey. Secondly, the conceptual model proposed that conditions of moderate ice cover are optimal for Adélie penguins and thereby responsible for decreases in populations at Anvers Island (ice cover and habitat quality decreasing) and increases in the Ross Sea (ice cover reducing and habitat quality increasing). This model may be insufficiently explicit generally and particularly so in respect of taking account of area-specific differences in population trends within Subareas 48.1 and 48.2, and in reflecting many current ideas on relationships between ice cover, krill spawning and survival, and prey availability to penguins.

6.39 The Working Group reiterated the need to develop appropriate ecosystem models for underpinning management decisions in CCAMLR. To that end, work to reduce uncertainties in these ecosystem models was encouraged. The Working Group also encouraged members who were attending the UK Workshop on Interannual Variability in the Physical Environment to pursue questions of relevance to CCAMLR and the development of these models. It noted that the Scientific Committee will be receiving a report from Drs J. Priddle and E. Murphy (UK) at its next meeting.

Fish and Squid-centred Interactions

6.40 WG-EMM-99/13 described the squid diet of southern elephant seals based on stomach lavage samples from 25 animals at King George Island, South Shetland Islands. It showed that the squid *Psychroteuthis glacialis* was the most common species in the samples obtained. However, the Working Group recognised the limitations with this type of study of diet in elephant seals. Stomach lavage samples may contain substantial biases. In comparison, WG-EMM-99/44 examined diet using fatty acid signatures in elephant seal milk, which is likely to provide a broader view of diet than stomach lavage. This showed that elephant seals did not feed on krill and that their most probable diet was fish or squid. There are limited reliable data concerning elephant seal diets.

6.41 WG-EMM-99/15 described a relationship between sea-surface temperatures in the southwest Atlantic and the activities of the vessels fishing for squid, *Illex argentinus*. The paper suggested that the southern area of the Falkland/Malvinas Current has been cooling in recent years and the eastern margin of the current fluctuated. The range of this species of squid varied with the movement of the boundary. This might have implications for Area 48 generally.

6.42 Dr Trathan informed the Working Group of a recent analysis of squid catches and sea-surface temperatures in the Falkland/Malvinas squid fishery that showed an inverse relationship between temperature in the area of spawning and catches in the following year.

ECOSYSTEM ASSESSMENT

7.1 The Working Group recollected the definition, from the first meeting of the Working Group in 1995 (SC-CAMLR-XIV, Annex 4, paragraph 2.13), of an ecosystem assessment:

(i) an analysis of the status of key biotic components of the ecosystem; and

(ii) a prediction of the likely consequences of alternative management actions on the future status of these components;

and noted the elaboration of the elements of this in SC-CAMLR-XIV, Annex 4, paragraphs 2.13 to 2.21. It noted that a conceptual framework of relevant components and interactions had been prepared (SC-CAMLR-XIV, Annex 4, Figure 1) in order to indicate the nature of the data and models that might be involved in comprehensive assessments.

7.2 Both at the 1995 meeting and subsequently, attempts were made to identify the nature and content of existing research, and to develop new initiatives as feasible, relevant to characterising or modelling the main interactions which might contribute to assessments.

7.3 Over recent years there has been considerable progress on a number of key initiatives. In many respects there are also now clearer ideas on the constraints imposed on assessments by limitations of data availability.

7.4 Encouraging progress has been made on characterising some of the main components essential to CCAMLR ecosystem assessment models, for example in improving the methods for estimating krill biomass and for combining indices of reproductive performance of dependent species. Areas of slower progress, however, have been in developing (or improving) indices of krill demography and indices of key environmental variables and processes at appropriate scales.

7.5 Although many substantial contributions have been made towards understanding interactions between components (or elements thereof), attempts to integrate these into models of potential relevance to generating management advice have essentially been confined to the topics of krill yield and functional relationships between krill and dependent species.

7.6 The krill yield model, despite limitations imposed by the difficulty of accurately characterising the mortality and recruitment variables, has allowed precautionary catch limits to be developed at a large (statistical area) scale. However, there still may be problems in applying this approach at smaller scales, including those of potentially greatest relevance to interactions between fisheries, dependent species and krill.

7.7 The relationships between prey availability and population dynamics of dependent species has been extensively explored using the best available data for the best-studied dependent species (Adélie penguin, black-browed albatross, Antarctic fur seal). Although some promising insights have been obtained, limitations in the data still preclude sufficiently accurate characterisation of the shape and dynamics of the functional relationships to develop clear advice on the magnitude of changes in prey availability that would produce specific changes in the population dynamics of dependent species.

7.8 Various conceptual models of potential interactions between environmental variables (e.g. sea-ice distribution and extent), krill reproduction and recruitment, and population changes in dependent species have been produced but quantification and testing of these are still at early stages.

7.9 It was recognised that almost all initiatives so far have focused on ecosystem interactions involving krill with little attention given to those involving fish and squid.

7.10 The Working Group noted that the Scientific Committee might wish to consider whether and in what form, action is necessary to improve assessment of ecosystem interactions involving fish and squid.

7.11 There was also a need to complement existing management advice for catch limits at large scales with advice on management at local scales.

7.12 Many tasks and initiatives have been developed as part of the Working Group’s program over the last four years (SC-CAMLR-XIV, Annex 4, paragraph 8.2; SC-CAMLR-XV, Annex 4, paragraphs 7.58 and 7.59; WG-EMM-99/10). The current status of some of these is not always clear, particularly in respect of some of the earlier tasks. The Secretariat was requested to review the items listed under the agenda item on future work at and after the 1995 meeting and to provide some indication of the current status of these tasks. It was recognised that, in many cases, members of the Working Group would need to assist the Secretariat with this task.

7.13 The Working Group felt that it might also be appropriate to review the utility of some of the work (see paragraph 7.12) undertaken by WG-EMM in the context of the likelihood of developing timely management advice. It was agreed that this would best be carried out, if deemed appropriate, once the review of potential approaches to management involving precautionary principles (see paragraphs 7.43 to 7.62) had been completed.

Estimates of Potential Yield

7.14 In 1997 the Working Group recommended that revised estimates of potential yield of krill (and their use in calculations of precautionary catch limits) should be postponed until the results of the CCAMLR-2000 Survey became available (SC-CAMLR-XVI, Annex 4, paragraph 7.2). The Working Group reaffirmed this decision, noting that the survey was scheduled to take place in the forthcoming (1999/2000) season.

7.15 The Working Group recognised that advice needs to be given on a subdivision of the area-wide precautionary catch limit in order to identify the means by which the interaction between fisheries and predators remains at appropriate levels.

Precautionary Catch Limits

7.16 Precautionary catch limits for krill are currently enacted in Conservation Measures 32/X for Area 48, 45/XIV for Division 58.4.2 and 106/XV for Division 58.4.1. The Working Group recommended to the Scientific Committee that these conservation measures should remain in force as they stand, until the results of the CCAMLR-2000 Survey are available. The survey results will include revised estimates of stock biomass which will contribute to the revision of precautionary catch limits at least for Area 48. It was understood that unless relevant new data with which to revise γ are developed intersessionally, the only changes to the krill yield model will be the new estimates of stock biomass in Area 48.

Assessment of the Status of the Ecosystem

7.17 In developing its assessment of the status of the ecosystem at the present meeting, the Working Group relied primarily on the summaries of CEMP indices prepared by the Secretariat (WG-EMM-99/8) and on tabled papers presenting analyses of these and related data. As these latter papers were discussed extensively under earlier agenda items, only summaries of relevant conclusions are presented here.

7.18 It was noted that the presentation in WG-EMM-99/8 of the analysis of CEMP data was considerably enhanced since the 1998 compilation. The Secretariat and Data Manager were thanked for this and also for undertaking the substantial task of preparing this document so efficiently. The timely submission of data from Members is essential to this process and it was gratifying to note that almost all data for 1999 had been submitted for nearly all variables measured at all sites currently active.

7.19 The new format for summarising indices and anomalies was commended. However, it was noted that some additional consideration would need to be given to the presentation of the overall summary data in Figure 1 of WG-EMM-99/8 to take account of relationships between the number of variables monitored and the number of anomalies detected. Further work on identifying ecologically important values (EIVs) was still required, so the identification of anomalies throughout the figures in WG-EMM-99/8 should be regarded as very preliminary at this stage.

7.20 Given these considerations and that:

(i) an extensive review of these and related data had been presented to, and undertaken by, the Working Group in 1998 (particularly in the report of the Workshop on Area 48); and

(ii) detailed consideration of trends in populations of dependent species had been deferred until the WG-EMM meeting in 2000 when the SCAR report on status and trends of seabird populations would be available;

the Working Group agreed that the assessment this year should essentially be confined to observations relating to events in the current year (1999).

Area 48

7.21 In Subarea 48.1 the annual AMLR acoustic survey in the Elephant Island area produced an estimate of krill biomass that was the second lowest in the seven-year series. Krill were of older age classes and actively (and extensively) spawning early in the season. For this reason PCR is expected to be high in 2000, in contrast to the situation in the three preceding years. The low krill biomass in 1999 is consistent with predictions made last year (Brierley et al., 1999a) and enhances confidence in the prediction that values will be lower still in 2000.

7.22 Population sizes and breeding performance of penguins in Subarea 48.1 were indicative of an average year.

7.23 At South Georgia (Subarea 48.3) estimates of krill biomass from the annual survey were towards the lower end of values recorded in the last 20 years, albeit above the threshold (Brierley et al., 1999b) currently used to characterise years of abnormally low krill density. Krill were of large size and the absence of juveniles suggests that 2000 will also be a year of low krill density, consistent with predictions by Brierley et al. (1999a).

7.24 Krill-dependent penguins, albatrosses and fur seals at South Georgia showed population sizes and breeding performances characteristic of an average year.

7.25 The apparent paradox that, although krill biomass levels were relatively low in both Subareas 48.1 and 48.3 the performance of dependent species in these subareas was not worse than average, might be explained by some combination of:

(i) whereas krill abundance was relatively low in absolute terms, its availability was still adequate to sustain dependent species;

(ii) the krill available being large, providing predators with energy-dense prey and thereby enhancing their foraging efficiency;

(iii) functional relationships between prey availability and predator performance being unlikely to be linear;

(iv) lack of spatio-temporal congruence between krill surveys and foraging areas of dependent species from CEMP monitoring sites; and

(v) estimates of krill abundance from local surveys not fully representing krill availability to dependent species throughout their breeding season at relevant CEMP sites.

Division 58.4.2

7.26 At Béchervaise Island breeding success of Adélie penguins was significantly reduced compared to previous years (though nearly comparable to the year of breeding failure in 1995) and the duration and location of foraging supported suggestions that this was caused by reduced availability of krill. In 1994/95 the phenomenon was believed to be of local scale only but no data from adjacent areas were available for 1999.

Subarea 58.7

7.27 At Marion Island breeding population counts of gentoo and macaroni penguins indicated a normal year; breeding success for both species was the highest yet recorded in the five-year time series.

Subarea 88.1

7.28 Data from 1999 studies at Edmonson Point (WG-EMM-99/60) indicated that breeding population size and reproductive performance were typical of those over the last five years.

Consideration of Information relevant to Ecosystem Assessment

7.29 Under this agenda item the Working Group felt that next year it might be useful to include consideration of information under five subitems, viz:

(i) status and trends of resources;
(ii) status and trends of dependent species;
(iii) status and trends of environmental variables;
(iv) status and trends of fisheries; and
(v) interactions between environment, resources, dependent species and fisheries.

Wherever possible, it would also be helpful to consider predictions based on the analysis of status, trends and interactions.

7.30 Although formal consideration of fishery-derived data has not previously been undertaken under this agenda item, the Working Group last year requested that fishery-dependent indices related to krill availability, such as CPUE, should be incorporated into these assessments (SC-CAMLR-XVII, Annex 4, paragraph 8.4). However, it was felt that some other indicators, including those relating to the economics of the fishery, might also be relevant (see also paragraphs 2.10, 7.66 and 7.67). Members were asked to consider intersessionally which indices might be relevant and to prepare suggestions and/or data on these to facilitate a detailed discussion at next year's meeting. It was noted that the recent review by

Nicol and Endo (1999) might be a useful source of relevant ideas, as might various papers to be published in the forthcoming proceedings of the 1995 Vancouver symposium (Pitcher and Chuenpagdee, 1995).

Use of CEMP Indices to provide Management Advice

7.31 The development of CSIs provides new opportunities for examining time-series data in the context of detecting trends, changes, patterns and relationships that may be relevant to the formulation of management advice (SC-CAMLR-XVI, Annex 4, paragraphs 6.6 to 6.8).

7.32 WG-EMM-99/40 provided recent examples relevant to two potential approaches. One approach (illustrated by reference to WG-EMM-99/40, Figure 3b) relates to the potential use of EIVs, defined by different probability levels, to provide information on trends or changes in frequency of such events (especially of years when low krill availability had clear negative effects on dependent species).

7.33 The other approach (illustrated by reference to WG-EMM-99/40, Figure 5a) involves relating the CSI to krill abundance. WG-EMM-99/40 noted that this has the potential of defining reference points and/or management targets for the system; purely illustrative examples of this could be keeping the CSI above zero or krill biomass above 20 gm^{-2} for the system.

7.34 Further development of these indices and relationships is required before they can be implemented fully. These indices could be related to krill abundance and used to adjust fishery catch levels in feedback management procedures. The development of such procedures will assist in ensuring that ecosystem values are protected from the effects of fishing in an expanding krill fishery.

7.35 The Working Group encouraged further development of these approaches, particularly in relation to feedback management procedures and reference points. It noted the importance of developing CSIs which would reflect system variability at other times of year (e.g. winter) and at longer temporal (and probably spatial) scales, for instance involving demographic variables, including population size.

7.36 Other areas of important future work could usefully include:

(i) investigation of the sensitivity of CSIs to the inclusion/exclusion of specific variables;

(ii) consequences for CSIs of incorporating variables with statistically significant trends across time (especially relevant to population size); and

(iii) refinement of the identification of EIVs and investigation of relationships between statistically and ecologically significant anomalies.

7.37 Dr Trivelpiece noted that predator variables and CSIs showed much greater interannual variation at South Georgia than at the South Shetland Islands, despite apparently similar magnitudes of fluctuation in krill abundance in the two areas. The basis for such area-specific effects needs investigation, particularly in respect of the size of predator populations in relation to both krill abundance and krill availability (including consideration of flux/replenishment rates).

7.38 The Working Group stressed the importance of comparing CSIs and estimates of krill abundance at equivalent spatio-temporal scales. Prof. Boyd indicated that this was indeed the case with the data used in WG-EMM-99/40.

7.39 The krill fishery is considered to be at a low level but may expand in the near future. Consequently, further elaboration of how to incorporate predator information in a management framework is required quickly in order that the effects of krill fishing on predators can be appropriately monitored. The Working Group noted that one option for achieving this work in the near future may be to arrange a consultancy with appropriate experts in this field. The Working Group agreed that such an option is not required at this stage but that it may be worth considering at the next meeting if insufficient work is undertaken in the interim.

Use of Models to provide Management Advice

7.40 The identification of potential cycles in abundance of krill in Area 48 (e.g. Brierley et al., 1999a; WG-EMM-99/37) might create an opportunity for adjustment of precautionary catch levels in respect of appropriate predictions of future patterns of abundance. A not dissimilar approach is already undertaken by WG-FSA in respect of using survey data for *C. gunnari* to set catch limits for the following two years. Such a procedure could also derive from the approaches discussed in paragraph 7.32.

7.41 The methods for adjusting catch limits in the short term need to be evaluated using the approaches developed by Butterworth, de la Mare and others in the late 1980s and synthesised at the joint WG-Krill and WG-CEMP meeting in Viña del Mar, Chile, in 1992 (SC-CAMLR-XI, Annex 8). The Working Group encouraged the further exploration, development and testing of models which offer the ability to ensure precautionary management approaches which are robust and effective.

7.42 Such work, however, is likely to be very time consuming and will need to be complemented in the interim by other approaches for developing effective feedback management, especially at local scales.

Considerations with respect to Precautionary Approaches

7.43 In considering precautionary approaches to management, Dr Miller drew attention to the Commission's expressed views on the relationship between management decisions and the nature and quality of scientific evidence and advice (CCAMLR-IX, paragraphs 7.6 and 7.7) and its view on the precautionary approach, specifically in relationship to the krill fishery (CCAMLR-X, paragraph 6.13).

7.44 In the first case the Commission noted that management decisions may be required when the Scientific Committee has been unable to formulate advice, even on the basis of the 'best scientific evidence available'. The Commission 'endorsed the principle that in the absence of essential data, very conservative catch limits should be set' (CCAMLR-IX, paragraph 7.7).

7.45 In the second case the Commission 'endorsed the advice of the Scientific Committee that reactive management … is not a viable long-term strategy for the krill fishery. Some form of feedback management … is preferred as a long-term strategy. In the interim, a precautionary approach is desirable and in particular a precautionary limit on annual catches should be considered' (CCAMLR-X, paragraph 6.13).

Uncertainty

7.46 Dr Constable gave a brief introduction to the krill yield model which had been developed specifically to take account of uncertainty with respect to decision rules for management.

7.47 The krill yield model is a simulation model that is used to find the proportion of a biomass estimate for setting precautionary catch limits. This proportion is known as γ and is chosen on the basis of the CCAMLR decision rules for precautionary catch limits, which are explained in SC-CAMLR-XIII, Annex 5, paragraph 4.98 and summarised in SC-CAMLR-XIV, Annex 4, paragraph 4.55. The model underpinning the simulations is an age-structured population model relying on functions of recruitment, natural mortality, growth and fishing mortality. The simulations generate many stock trajectories within the bounds of uncertainties associated with the four functions as well as uncertainties in the estimates of biomass. In the latter case, uncertainty as to whether the biomass is higher or lower than the pre-exploitation median is incorporated in the simulation. For a specific value of γ, the probability of the stock becoming depleted to a specified level is determined using these simulations. Similarly, the expected change in the median biomass in the long term is also determined. γ is reduced in cases when the stock is likely naturally to fall to levels lower than the level of critical depletion defined by the decision rule. Specific models of the different population functions, as well as the relationship of the biomass estimate to the pre-exploitation median, can be included in the simulations using the Generalised Yield Model (GYM).

7.48 The krill yield model as developed by 1995 had particular potential difficulty in dealing with estimating precautionary catch limits at smaller scales (SC-CAMLR-XIV, Annex 4, paragraph 7.40). The development of the GYM allows more flexibility in the input functions, such as recruitment and mortality. These functions can be specially written and incorporated within the general structure of the population model. Consequently, it may be possible to incorporate simple models of advection by adjusting the mortality function based on recent research that quantifies these parameters. In addition, there is the prospect of tuning estimates of B_0 using time-series data.

7.49 It was recognised that in the formulation of the GYM there were still significant opportunities for improving the model, particularly in sensitive areas such as the estimation of recruitment and mortality. It was agreed to re-investigate the potential for incorporating age-structured mortality based on approaches developed by WG-EMM between 1994 and 1996 (see SC-CAMLR-XIV, Annex 4, paragraphs 5.114 to 5.118). Prof. Boyd and Dr Constable agreed to correspond with Prof. D. Butterworth (South Africa) and to coordinate any further work, including the conduct of any simulations, as necessary or appropriate.

7.50 Applying the GYM to krill is only one of the management approaches that are being, or need to be, developed by the Working Group to contribute to the management objectives of the Commission. It does, however, have the advantage of taking explicit account of uncertainty and relating this to clearly defined decision rules.

7.51 Various other potential models were considered in paragraphs 7.31 to 7.41. In addition, the Working Group has tried to develop models based on estimation of krill consumption by dependent species, on the basis that surplus biomass, after meeting the requirements of dependent species, could be made available for harvesting. These initiatives were based on models suggested by Drs Everson and de la Mare in 1995 (SC-CAMLR-XIV, Annex 4, paragraphs 7.61 to 7.80 and Appendix H); a subgroup was established in 1995 to further develop this work.

7.52 The Working Group recommended that further consideration be given to this initiative, especially in collaboration with similar work being undertaken by Drs Constable and Nicol. A review of existing work and explicit proposals for new work should be solicited intersessionally; Prof. Boyd and Dr Everson, the coordinators of the original subgroup, would liaise with Dr Constable to achieve this.

7.53 It was re-emphasised that many of these models were complementary to the approach of the krill yield model/GYM but that significant progress on them would be unlikely to yield prospects of complementary management advice in the near future. There was still a need to identify mechanisms for providing proactive management advice, in timely fashion, in particular to deal with the scales at which fisheries, dependent species and krill overlapped.

7.54 Dr Miller introduced the topic of what levels of confidence should be considered in the formulation and testing of hypotheses relating to management advice and the concurrent assessment of risk. It was agreed that this was a complex topic, that levels of confidence should be attached to results wherever possible and that decisions on appropriate levels of confidence for decision rules and management advice would relate to the nature of the questions being asked and the potential consequences of error. A particular consideration would always be the application of the precautionary principle in respect of the risk of taking no management action when some action is required.

Ecosystem Variability

7.55 Various aspects of this topic, especially relating to predicting patterns of variability, were discussed in previous sections. One topic not so far explicitly addressed relates to the nature of temporal and spatial variability in the distribution of krill and dependent species and of the interactions between both of these with the krill fisheries.

7.56 Three key issues (themselves interlinked) were identified:

(i) the problems involved in scaling up (extrapolating) to larger scales using data collected at smaller scales;

(ii) the allocation of catch limits at scales smaller than statistical areas (i.e. how limits estimated at or for large areas are divided for application to smaller areas); and

(iii) avoidance of localised effects of krill fishing, especially in relation to potential adverse effects on dependent species.

7.57 This last issue has been a major topic of discussion for much of the last decade but although important reviews of potential management approaches (e.g. Watters and Hewitt, 1992) had been produced and various indices for measuring overlap developed (paragraph 6.9), little effective progress in translating these into precautionary management advice had been made.

7.58 Until approaches based on catch limits are developed to the point where management advice at all appropriate spatio-temporal scales can be produced, evaluated and implemented, other complementary approaches may be needed.

7.59 In this respect the Scientific Committee had recently (SC-CAMLR-XVII, paragraph 6.12) recommended further development of models involving fishery–predator–krill interrelationships (especially developing from models of Mangel and Switzer, 1998) and functional relationships (e.g. Butterworth and Thomson, 1995).

7.60 In addition, the Scientific Committee had recommended the continued investigation of the consequences of various types of conservation measure associated with precautionary approaches to management in local areas such as those described in paragraph 7.56(iii) (SC-CAMLR-XVII, paragraph 6.12). Potential measures to be considered would presumably include closed seasons and closed areas. Effective evaluation of these would require exploring with fishers and fishery managers the manner in which fishing practice could be modified in local areas important to predators (see SC-CAMLR-XII, paragraphs 6.65 to 6.69; CCAMLR-X, paragraphs 8.39 to 8.45).

7.61 As a precautionary approach it would be particularly important to identify potential changes to fishing areas and seasons that would impose no additional burden on fishing operations but which would yield clearly perceived conservation benefit for dependent species.

7.62 The Working Group agreed that this whole topic was a priority area for future work and for closer dialogue with Members involved in relevant fishing activities. The Working Group would monitor developments at both practical and theoretical levels in order to determine when it might be appropriate to undertake an in-depth evaluation and analysis of the nature, merits and feasibilities of the various potential approaches to providing interim advice on precautionary management at local scales.

Fishery Development Potential

7.63 The Commission desires to develop and maintain feedback management arrangements, including application of precautionary principles and proactive, rather than reactive, management. This includes the development of ways of preventing uncontrolled expansion and/or development of fisheries.

7.64 In the case of finfish fisheries, WG-FSA and the Scientific Committee have assisted the Commission in developing a suite of conservation measures governing the conduct of new and developing fisheries.

7.65 For krill, however, the conservation measures currently in force generally do not have measures to reduce risks of effects of fishing at the scale most critical to predator feeding. There are currently no mechanisms for preventing uncontrolled development of fishing at these scales, whether in terms of increased catches, or changes in intensity, whether by season or area.

7.66 Three approaches were identified which might assist in developing appropriate measures:

(i) consideration of the various potential changes in fishing practice which might need regulation and for which reference points might be developed in order to trigger appropriate management action;

(ii) acquisition and analysis of various economic indicators relating to the krill fishery and its products (e.g. trend analysis of product costs); and

(iii) better understanding of certain aspects of current krill fishing operations.

7.67 In relation to paragraph 7.66(i) and (ii), members were asked to provide any relevant information and/or ideas so that a more detailed discussion might take place at the next WG-EMM meeting (see also paragraph 7.30).

7.68 In respect of paragraph 7.66(iii), it was suggested that it might be timely to acquire some of the more important data (e.g. on fishing effort and search time) via scientific observers on krill fishing vessels.

7.69 Dr R. Holt (USA) recollected that Japan had provided considerable relevant data over many years and that a bilateral scientific observer arrangement between the USA and Japan had been particularly valuable in acquiring important insights. Nevertheless, the Working Group recognised that it had still proved difficult to obtain certain potentially sensitive information, including topics relating to fishing pattern and effort.

7.70 The Working Group reiterated its appreciation of the contributions by Japan and stressed that it hoped – and needed – to acquire data on fishing operations from all Members engaged in krill fishing. Particular opportunities were recognised in respect of Members newly participating in krill fishing.

7.71 The Working Group recommended to the Scientific Committee that the use of scientific observers on krill fishing vessels be encouraged and implemented as a matter of general importance.

7.72 The Working Group reiterated the considerable additional value from scientific observers collecting data on fishing operations at the same time as the CCAMLR-2000 Survey was being carried out (paragraph 2.15).

7.73 In view of the short time available before the start of the CCAMLR-2000 Survey, however, the Working Group encouraged Members to make appropriate bilateral arrangements as soon as possible. This would be facilitated by the ability to access the WG-EMM report rapidly via the CCAMLR website.

Globally Threatened Species

7.74 Prof. Croxall indicated that the next IUCN global review of threatened species would be published in about October 2000. In addition to being the most rigorous application yet of the new (1994) criteria (decision rules) for identifying and classifying threatened species, it is likely to be the first time that species (except for the wandering albatross) whose main populations lie within the Convention Area are included.

7.75 Several species are likely to be classified as globally threatened on the basis of criteria that include reference to substantial known or probable population decreases. Some of these species have demographies whereby these decreases are unlikely to be redressed over one or more decades.

7.76 Given that the CCAMLR Convention makes explicit reference to potential action in respect of changes which are unlikely to be reversible over 20 to 30 years (Article II, paragraph 3), the Commission may need to consider actions to improve (or avoid further jeopardy to) the conservation status of such species.

7.77 Members expressed interest in the details of the IUCN criteria and of the process leading to the publication of the new list. The Secretariat agreed to investigate this and notify Members as to how such information could be obtained.

7.78 It was noted that such information should also be relayed to WG-FSA, given that some Antarctic fish species might be candidates for globally threatened status under the new criteria.

Global Change

7.79 Discussion focused on the need to differentiate between the effects of fishing and the effects of environmental change on relevant resources, dependent species and interactions between them. The detection, evaluation and understanding of existing and potential environmental change is a complex but important topic, relating both to systematic change and to periodic fluctuations. In both cases it may be necessary to assess the potential effects of environmental change on marine system production and to revise or re-evaluate management approaches and measures.

7.80 The Working Group had discussed earlier three papers (WG-EMM-99/24, 99/52 and 99/58) that illustrate potential mechanisms by which environmental change could exert significant influence on the population dynamics of krill and dependent species (see paragraphs 5.5 to 5.7, 6.37 and 6.38).

7.81 The Working Group encouraged further research on methods that would help distinguish the effects of fishing from the effects of environmental change given the large degree of uncertainties in both these areas.

Concluding Remarks

7.82 No precautionary catch measures for krill have yet been agreed at anything other than the largest scales. Limited progress has been made in agreeing on precautionary approaches for management in respect of the spatio-temporal scales of greatest importance to regulating interactions between krill, dependent species and fisheries.

7.83 Using the approaches of the krill yield model (and other models as appropriate) to provide advice on precautionary catch limits, at least at the smaller scales, is an urgent priority.

7.84 Complementary approaches, involving all types of precautionary management measures potentially appropriate to the scales indicated in paragraph 7.82, need priority attention. These measures should be designed to help deliver precautionary management conferring potential benefits on krill stocks and on dependent species without undue restriction on the performance of krill fisheries.

METHODS AND PROGRAMS INVOLVING STUDIES ON HARVESTED AND DEPENDENT SPECIES AND THE ENVIRONMENT

Area 48 Synoptic Krill Survey (CCAMLR-2000 Survey)

Survey Design

8.1 The report of the CCAMLR Synoptic Survey Planning Meeting held at the British Antarctic Survey, Cambridge, UK, from 8 to 12 March 1999, is presented in WG-EMM-99/7 (attached to this report as Appendix D). The report provides detailed information on the following aspects of the survey:

(i) proposed survey design, including contingencies to cover losses due to bad weather;

(ii) principal participating nations plus those that have expressed an interest in the survey;

(iii) the development of primary protocols to cover acoustic, net and CTD sampling;

(iv) the development of secondary protocols to cover the collection of other multinational datasets; and

(v) implications for data analysis and archiving.

The Working Group endorsed the work of the planning meeting and the conclusions reached in Appendix D.

8.2 WG-EMM-99/39 (attached to this report as Appendix E) presented details of the rationale and procedures undertaken subsequent to the planning meeting to produce the final randomised, stratified transects and provisional sampling stations for the three principal participating nations. Figures within the paper provide details of the cruise tracks in relation to locations of the major fronts, commercial fishery and subarea boundaries and also the provisional locations of the net sampling stations.

8.3 The Working Group joined the Chairman of the Scientific Committee in thanking all those involved in the detailed and thorough planning of the CCAMLR-2000 Survey. In particular, a debt of gratitude was placed on record for the efforts of the principal scientists on the three vessels involved in the survey (Drs Hewitt, M. Naganobu (Japan) and Watkins), the producers of the survey plan (Drs Trathan, Watkins and Mr A. Murray (UK)) and Dr Watkins for convening the CCAMLR Synoptic Survey Planning Meeting in March 1999. It was recognised that the enthusiasm, dedication and hard work of such key participants had served to develop an excellent survey plan.

8.4 WG-EMM-99/43 presented details of a proposal by Russia to undertake a survey in Subarea 48.4 as an integral part of the CCAMLR-2000 Survey. It was reported that there is very little survey data available for this subarea, but commercial catches have been taken around the South Sandwich Islands in a number of years. Russia therefore proposed that a stratified survey of Subarea 48.4, based on the design principles outlined in WG-EMM-99/39, would be carried out in conjunction with a survey of the mesoscale stratum in Subarea 48.2.

8.5 The Working Group noted that a protocol for including any surveys in addition to those undertaken by the principal participating nations had been put forward at the planning meeting. It had been agreed that any such additional surveys should be replicates of the principal survey tracks and a suggested order for these replicates was provided in WG-EMM-99/39 (Appendix E) and posted on the CCAMLR-2000 Survey website.

8.6 Despite the above recommendation, the Working Group agreed that the Russian proposal would result in an enhanced survey of krill in Area 48 for the following reasons. Firstly, because commercial krill fishing had taken place in Subarea 48.4 and secondly, because this subarea could be considered as a direct extension of Subareas 48.2 and 48.3, so was likely to contain the same krill population. The Working Group therefore agreed that the Russian proposal be accepted, subject to the following conditions:

(i) Drs Trathan and Watkins and Mr Murray will produce a survey design to provide broad-area coverage in Subarea 48.4 and mesoscale coverage along the northeastern side of the South Sandwich Islands in a similar fashion to existing survey designs for Subareas 48.1, 48.2 and 48.3;

(ii) the mesoscale survey planned for the shelf area north of the South Orkney Islands be an exact replicate of the existing survey trackline for ship number 2;

(iii) acoustic sampling should be conducted with a Simrad EK500 echosounder operating at three frequencies (38, 120 and 200 kHz) and that data be collected using the SonarData EchoLog software;

(iv) ping-by-ping acoustic data shall be made available to the data analysis workshop to be held in May–June 2000 (paragraph 8.37). In addition, it would be preferable for one or more of the persons responsible for collecting the data to attend;

(v) net sampling for krill and other micro-nekton shall be accomplished with an RMT8 net and, if possible, zooplankton shall be sampled simultaneously with an RMT1 net;

(vi) all general protocols for core measurements (acoustic, net sampling, CTD protocols shown on the CCAMLR-2000 Survey website) should be followed; and

(vii) a progress report detailing the survey plan development and compliance with the above protocols should be submitted to the 1999 meeting of the Scientific Committee.

Sampling Protocols

Acoustic

8.7 In relation to the CCAMLR-2000 Survey, the data requirements of three TS estimation methods were considered: (i) the Greene et al. (1990) linear TS versus length relationship adopted by SC-CAMLR-X (GTS) (WG-Krill-90/29); (ii) the multiple-frequency method for *in situ* TS measurements (MFTS) (WG-EMM-99/38); and (iii) the distorted wave Born approximation model (DWBA) (WG-EMM-99/41). The GTS requires knowledge of krill lengths. The MFTS requires split-beam TS measurements at multiple frequencies and sufficiently dispersed krill to allow individual krill to be acoustically resolved. Application of the DWBA requires characterisation of krill densities, sound speeds, sizes, shapes, and orientations (or broadband measurements from which to infer orientation distributions) (WG-EMM-99/42). All three methods require a krill weight-to-length relationship for converting numerical abundance to density units (gm^{-3}). Although the DWBA explicitly accounts for the many variables primarily influencing acoustic backscattering from krill, their distributions are not easily characterised. Therefore the relatively minimal data requirements of the GTS and MFTS make them currently the most tractable methods for scaling the echo integration results of the CCAMLR-2000 Survey.

8.8 The MFTS improves the rejection of unresolvable and constructively interfering target multiples by combining synchronised signals from two or more adjacent split-beam transducers of different frequencies which are not integer multiples of each other. In WG-EMM-99/38 the method itself was improved by: (i) optimising the accuracy and precision of the angular and range measurements of the individual frequency detections; (ii) more precisely determining the relative three-dimensional locations (x, y, and z) and angular orientations (pan and tilt) of the transducers and thus the positional transformation; and (iii) increasing the range resolution of one or more of the frequencies. Tank tests indicated that such careful application of the MFTS method can reject all multiple targets while allowing 90% of the resolvable single targets to be measured.

8.9 Customised EK500 Control Processor EPROMs (firmware V5.3) have been created to allow 1.0 ms pulse durations at 200 kHz, equivalent to prescribed durations at both 38 and 120 kHz. Programmed and authorised by Mr Solli of Simrad, Norway, these EPROMs were duplicated by Mr Soule (South Africa) and distributed to Japan, UK and USA. Pending confirmation that RV *Atlantida* is outfitted with an EK500 configured to operate at 38, 120 and 200 kHz, an additional EPROM will be created and provided by Dr D. Demer (USA) to AtlantNIRO, Kaliningrad, Russia.

8.10 The Acoustic Protocols prescribe the usage of transducer beamwidths as characterised on the manufacturer's specification sheets and adjusted for the mean sound speed of Area 48 (see paragraph 8.11). Dr Demer will provide a conversion table for beam width versus sound speed which will be posted on the CCAMLR-2000 Survey website as Appendix D of the Acoustic Protocols.

8.11 The Acoustic Protocols prescribe the common usage of a mean sound-speed profile and mean absorption coefficients at 38, 120 and 200 kHz which are representative of Area 48 (Acoustic Protocols, Appendix E). To derive these mean values, Drs A. Brierley (UK) and Demer have been asked to gather, summarise and convert representative temperature and salinity versus depth data (0–500 m) from past surveys of the area. With this strategy, errors in the estimate of krill biomass resulting from estimates of the time-varying gain function can be most easily quantified and/or corrected after the survey.

8.12 Calibration spheres of 38.1 mm tungsten carbide with spark eroded holes and monofilament tethers, all manufactured with high precision from a single manufacturing lot, will be distributed by Dr Demer. Navigational and mooring information pertaining to the calibration sites at both Stromness Bay, South Georgia and Admiralty Bay, King George Island, will be provided by Drs Watkins and Hewitt. Local arrangements at South Georgia are to be organised by Dr Watkins.

8.13 Inter-ship comparisons of the acoustic system performance are to be conducted after both the initial and final standard sphere calibrations. The two short acoustic transects, located in the vicinity of Stromness Bay, South Georgia and Admiralty Bay, King George Island, will be defined by Drs Watkins and Hewitt and detailed in Appendix F of the Acoustic Protocols. The details of the shallow-water transect will include start and stop locations, ship speed and local navigational information.

8.14 Members have agreed to report any anticipated exceptions to the recommended and/or prescribed Acoustic Protocols to Dr Watkins who will tabulate them in Appendix G.

8.15 On completion of bench and field testing of the Acoustic Protocols by Drs Brierley, Demer and T. Pauly (Australia), the parameter lists for the survey (Acoustic Protocols, Appendix A), calibrations (Acoustic Protocols, Appendix B), and noise measurements (Acoustic Protocols, Appendix C) will be written to CD and copies will be distributed by Dr Demer. It was recognised that current testing of the parameters may identify the need to modify one or more of the parameters and any modifications would be reflected in the Acoustic Protocols on the website.

8.16 WG-EMM-99/18 highlighted the relationship of ambient noise perceived by the echosounder versus frequency, ship speed and ship type. Not mentioned are the appreciable effects of transducer deployment configuration (e.g. hull-mounting: flush, blister or retractable keel; or towed-body) and beam width.

8.17 It was agreed that the current prescription for characterising system noise in the Acoustic Protocols was sufficiently comprehensive. Measurements of ambient noise at each frequency are to be made at the conclusion of each day’s acoustic survey effort under survey course and speed. Characterisation of system noise versus all vessel speeds was considered unnecessary, as appreciably slower speeds are impractical for completion of the current survey design in the allotted timeframe.

8.18 Concern was raised over the plan to perform daily data backup to writeable CDs concurrent with continuous data logging. To avoid any potential problems with such a data backup procedure, it was decided that the daily data backup would be conducted on workstation No. 2 and that data logging to workstation No. 2 would be temporarily halted during the backup procedures. Then, immediately upon completion of the backup procedures, logging on workstation No. 2 would be restarted and the data file(s) recorded during the backup procedure would be copied from workstation No. 1 to workstation No. 2.

Krill and Zooplankton

8.19 The Working Group discussed the net sampling protocols established during the CCAMLR Synoptic Survey Planning Meeting which had been made available on the CCAMLR-2000 Survey website for Members’ consideration. The two objectives of the net sampling program were reiterated:

(i) to validate acoustic targets and obtain length-frequency data for TS estimation by target net hauls; and

(ii) to describe krill demography, large-scale distribution of size classes and regional recruitment indices from random double-oblique net hauls.

8.20 The Working Group re-examined the proposal for the use of different types of gear during the survey. It welcomed the effort that has been undertaken to equip every vessel participating in the survey with RMT8+1 nets and agreed that only this type of net shall be used as standard gear for target and random hauls. Alternative gear such as IKMT nets of a similar size to the RMT8 shall only be used when the RMT system is lost or damaged to a degree that no spare parts are available to effect repair. To date it has not been possible to clarify which net system will be used on the Russian survey vessel because the proposal (WG-EMM-99/43) does not specify the equipment precisely.

8.21 Some additional comments have to be included in the subsampling and preservation sections of the net sampling protocol, however, these are of minor explanatory nature and will not change the agreed substance of the protocol. These changes will be carried out by Drs Watkins and Siegel and included in the text on the website.

8.22 The protocols for random oblique and target hauls were reviewed. It was confirmed that random oblique tows shall be carried out during night time, while target hauls will be restricted to daytime. However, in contrast to the proposal put forward at the planning meeting in March, it was agreed that ships that do not have an opening and closing net shall carry out only day and night-time random oblique tows whereas those vessels that have an opening/closing net shall carry out random night tows and target daytime tows.

8.23 The Working Group noted the necessity to develop standardised data reporting formats to allow a minimum data collection by all participants. Dr Siegel will develop the required zooplankton and krill data sheets and send them to participating Members so that comments and changes can be made prior to the Scientific Committee meeting in October.

8.24 Participants in the survey were reminded that in case of delays during the CCAMLR-2000 Survey due to equipment failure or bad weather, the instructions that are clearly set out in WG-EMM-99/39 (page 7) should be followed.

Birds, Pinnipeds and Whales

8.25 The Working Group recognised the importance of the collaboration between CCAMLR and IWC, and agreed that priority be given to the collection of consistent marine mammal observations across participating vessels. Consistent methodology, and selection of observers, for cetacean observations will be coordinated by the IWC. IWC observers will collect data on all marine mammals.

8.26 The Working Group recommended that all bird observations should be made using one of the two primary methods available (i.e. vector correction or snapshot), and noted that these quantitative methods are to be used in preference to the BIOMASS protocol. It was recognised that the choice of methods would depend on the number and experience of the observers on each vessel.

8.27 The current situation with regard to proposed levels of participation was outlined.

> USA – six places consisting of six marine mammal observers with seabird observations to be conducted on an ad hoc basis.
>
> UK – six places consisting of four marine mammal observers and two dedicated seabird observers.
>
> Japan – three places consisting of two marine mammal observers (provisional) and one dedicated seabird observer.

8.28 IWC data collection methods dictate the need for a minimum of two dedicated observers on a vessel, as determined by the SOWER 2000 workshop and confirmed at the IWC Scientific Committee meeting in May 1999. Therefore, if only one place was available on any vessel, that place will not be taken up.

8.29 The IWC would welcome the opportunity to place a minimum of two observers on both the Japanese and Russian vessels. However, financial support for this has yet to be finalised and, if funding is limited, it may be more effective to concentrate IWC effort on just some of the four survey vessels now participating.

8.30 WG-EMM-99/33 presented a proposal to coordinate diet sampling of Antarctic fur seals at shore sites in Subareas 48.1, 48.2 and 48.3 to coincide with the areas of intensive sampling within the CCAMLR-2000 Survey. The aim of this diet study is to assess the level of concordance between krill sampled from predator diets and scientific nets at different locations, and to compare within-season trends in the local krill population with the regional population structure resulting from the CCAMLR-2000 Survey.

8.31 In recognising the importance of this study in relation to the CCAMLR-2000 Survey, the Working Group noted that data would also be available from diet samples from penguins across a similar range of sites.

Organisation of the CCAMLR-2000 Survey

8.32 Cruise leaders for Japan, UK and USA, along with other interested parties, met to discuss organisational details regarding the conduct of the CCAMLR-2000 Survey. Topics for discussion included timetables, invited participants and exchange of personnel between ships, coordination of the survey during its conduct, data analysis workshops, consideration of additional survey effort in the South Shetland Islands between December 1999 and March 2000, and publication of results.

8.33 With regard to timetables, it was noted that ship schedules currently published on the CCAMLR-2000 Survey website for the US survey vessel and in WG-EMM-99/43 for the Russian survey vessel, were subject to slight change pending ongoing developments in each country. It was noted however, that the current schedules call for both survey vessels to be conducting the mesoscale survey north of the South Orkney Islands at approximately the same time. It was also noted that the schedule for the Japanese survey vessel, currently posted on the website, needs to be updated to reflect current plans, and that the schedule for the UK survey vessel is set but may vary by one to two days in response to unexpected external factors.

8.34 It was re-emphasised that all planning and reporting times are expressed in GMT. Dr Watkins demonstrated the use of a spreadsheet listing transect waypoints and sampling stations for three of the survey vessels. Such a spreadsheet can be used to track progress and project actions that may be required to assure complete survey coverage. The spreadsheet may also be used to adjust schedules for changes in start dates, weather contingencies and other unexpected events. The spreadsheet was enthusiastically received by the cruise leaders and Dr Watkins was asked to distribute an updated version, including schedules for the Russian survey vessel.

8.35 With regard to invited participants and exchange of personnel between survey ships, it was recognised that such exchanges would add considerably to the value of the survey as well as ensure that similar methods were employed in the data collection activities conducted aboard all of the survey vessels. Several possible participants and exchange opportunities were identified and tentative arrangements made. It was recommended that cruise leaders continue to actively pursue such opportunities.

8.36 With regard to coordination of the survey during its conduct, it was agreed that daily contact be maintained between the survey vessels. As a minimum, an evening radio schedule will be maintained by all participating ships; ancillary forms of communication include voice, facsimile and email via INMARSAT satellite links. It was agreed that vessel telephone numbers and email addresses would be exchanged between cruise leaders. It was further agreed that Dr Watkins would continue to act as survey coordinator during the conduct of the cruise, and that daily position reports would be forwarded to him so that he could track overall progress and recommend adjustments to each cruise leader if necessary.

8.37 The Working Group recommended that a two-week data analysis workshop be held in La Jolla, USA, sometime during May–June 2000 with the intention of estimating B_0 and its variance for Area 48 (hereafter referred to as the B_0 Workshop). The Working Group also recommended that all core datasets to be considered at this workshop be submitted to Dr Hewitt in electronic format no later than one month prior to the workshop so that they can be posted on a data server and linked to the CCAMLR-2000 Survey website with secure access. In this manner, all contributors will have access to the common datasets for the purposes of validation and cross-checking prior to the workshop. It was also recommended that ancillary datasets, which may assist in the interpretation of the core datasets, be submitted in summary form ahead of the workshop.

8.38 It was recognised that the B_0 Workshop will likely be the first of several workshops and collaborations making use of various datasets collected during the survey. It was again re-affirmed that the analysis of core datasets (acoustics, krill demographic samples and CTD data) shall be conducted in a cooperative and collaborative fashion.

8.39 With regard to additional surveys to be conducted along the mesoscale transects in the area north of the South Shetland Islands as part of the Subgroup on International Coordination (see paragraphs 3.42 and 3.43), it was agreed to treat these data as ancillary information rather than replicates as will be the case with the conduct of mesoscale survey transects north of the South Orkney Islands by the Russian and US survey vessels.

8.40 With regard to publishing various papers describing the survey plans and results, the Working Group recommended that consideration be given to a special issue of *CCAMLR Science* in 2001. This consideration should not preclude, however, the option of publishing a limited number of papers in the regular issue of *CCAMLR Science* or any other venue deemed appropriate by the survey participants.

Analytical Methods

8.41 The following analytical procedures were considered to be the key steps in the production of an estimate of B_0 from acoustic data:

(i) apportionment of volume backscattering strength (S_v) to that from krill ($S_{v\ krill}$) and all other biological scatterers;

(ii) conversion of $S_{v\ krill}$ to volumetric biomass density of krill;

(iii) summation of biomass density over the survey area; and

(iv) estimation of uncertainty.

8.42 It was further recognised that some analytical work could be conducted in advance of the B_0 Workshop. Such analyses would serve to refine the methods employed to accomplish the above procedures and could greatly contribute to the efficiency and productivity of the workshop.

8.43 With regard to the apportionment of volume backscattering strength it was recognised that at least two methods were available. Both methods take advantage of frequency-specific acoustic signatures of krill. The first method uses data collected at 38 and 120 kHz (Madureira et al., 1993) and the second method uses data collected at all three frequencies (Demer et al., 1999). Analytical work that could be accomplished in advance of the workshop includes the specific definition of multifrequency classifications, the definition of cell sizes (in both horizontal and vertical dimensions) over which volume backscattering data is to be averaged, and the development of software scripts required to accomplish this task for large datasets.

8.44 With regard to converting volume backscattering strength to volumetric krill biomass density, it was recognised that at least two methods were available. The first method uses a distribution of krill body lengths to estimate a distribution of target strengths which is then divided into volume backscattering strength in order to estimate density (Greene et al., 1991; Hewitt and Demer, 1993). The second method employs direct *in situ* measurements of volume backscattering strength (Demer et al., 1999). Both methods assume a krill length–weight relationship. Analytical work that could be accomplished in advance of the workshop includes the definition of strata over which to aggregate krill length frequencies or *in situ* TS measurements, specification of the appropriate krill length–weight relationship(s), and the development of software scripts required to accomplish this task for large datasets.

8.45 With regard to the summation of biomass density over the survey area it was recognised that at least two methods were available. The first method exploits the stratified random design of the survey (Jolly and Hampton, 1990) and the second employs geostatistical methods which are not dependent on randomisation of survey effort with respect to the population, but which exploit the spatial structure apparent in its dispersion (Foote, 1993; Petitgas, 1993). Analytical work that could be completed in advance of the workshop includes the development of spreadsheets, analytical tools and software scripts required to accomplish this task.

8.46 With regard to the estimation of uncertainty, it was recognised that both sampling (Jolly and Hampton, 1990) and measurement (Demer, 1995) errors should be included in the estimate of variance associated with B_0. Analytical work that could be accomplished in advance of the workshop includes definition of the major components of this variance, elaboration of methods for estimating their magnitude and techniques for combining these components.

8.47 In addition, it will be crucial for the participants to develop, formalise and submit appropriate analytical procedures in good time to ensure that the necessary computer routines are available during the workshop.

8.48 The Working Group agreed that in respect of advancing consideration of subareal divisions of the krill potential yield, the workshop should provide estimates of the total area surveyed as well as the proportions of that area which fall within specific statistical subareas (transect length in large-scale component of the survey in each statistical subarea (see paragraph 8.61)).

8.49 It was further agreed that all data to be considered at the workshop be submitted to Dr Hewitt in electronic form at least one month ahead of the workshop.

Interpretation of Results with respect to Estimation of Potential Yield

8.50 The Working Group agreed that there were a number of distinct processes that should be undertaken to obtain the estimate of potential yield:

(i) estimate B_0 for Area 48 (see paragraphs 8.41 to 8.49);

(ii) update γ to incorporate the variance estimate of the B_0 survey;

(iii) estimate sustainable potential yield (calculated from γ x B_0); and

(iv) derive the precautionary catch limit for Area 48 and subdivide this precautionary catch limit for smaller management areas as appropriate**.**

8.51 With respect to (ii) above, the Working Group recognised that it would be desirable to re-estimate γ with more realistic characterisation of possible variations in mortality and recruitment.

8.52 The Working Group discussed the relative merits of subdividing the estimate of B_0 versus subdividing the precautionary catch limit. The Working Group agreed that at present the most practicable way forward would be to subdivide the precautionary catch limit. However, in the future other options may be considered (see paragraph 8.63).

8.53 The Working Group examined methods for subdividing the estimated yield for Area 48 into smaller areas. It recalled that principles of such a subdivision had been discussed since the time of developing the first precautionary catch limit for krill in Area 48 (see SC-CAMLR-X, paragraphs 3.76 to 3.82; SC-CAMLR-XI, paragraph 2.72; SC-CAMLR-XI, Annex 4, paragraphs 4.86 to 4.88 and 6.6 to 6.10). These can be summarised as:

(i) to avoid localised depletion of krill (SC-CAMLR-X, paragraph 3.76); and

(ii) to reduce the potential impact of localised fishing within restricted predator ranges (SC-CAMLR-X, paragraph 3.80).

8.54 WG-Krill originally devised a method for partitioning the Area 48 precautionary catch limit (SC-CAMLR-XI, Annex 4, paragraph 6.9 and Table 5). However, WG-EMM recognised that these calculations were based on a survey that did not cover the whole of Area 48 and that fishing activities have changed since that time.

8.55 The Working Group examined various interim methods for subdividing the catch limits, and evaluated them in terms of their inherent biases and/or the uncertainties in data inputs or assumptions. The options for subdividing the yield estimate for Area 48 into yields per subarea included:

(i) dividing by the number of subareas to give equal catches between subareas;

(ii) prorating by the area of each statistical subarea;

(iii) prorating by the proportion of the CCAMLR-2000 Survey in each statistical subarea where the proportions are estimated from the lengths of survey tracks associated with the large-scale component of the survey;

(iv) prorating by the area of locations of importance in each statistical subarea where such locations may be defined as:

(a) mesoscale strata of expected high densities of krill;
(b) krill distribution;
(c) shelf area;
(d) water mass;
(e) foraging area; and

(v) prorating by the levels of historical fishing in the respective subareas.

8.56 The Working Group agreed that methods (i) and (ii) are likely to be biased because they do not relate to the proportions of areas where krill are available. Similarly, method (v) is not suitable because fishing locations and times have been changing in recent years. Method (iii) appears to be a tractable option this year as it directly relates the subdivision of yield to the areas in which krill were observed. This method may be slightly biased because of different levels of sampling in some of the strata in areas of known krill concentrations.

8.57 The Working Group discussed the different options for characterising local areas of importance to krill in method (iv). It considered that the stratification of areas by water masses or by predator foraging areas may be suitable in the future, but decided that work was required to develop the frameworks necessary for such subdivisions. For example, subdivisions by predator foraging areas would require assessment of these areas combined with an evaluation of predator consumption in these areas. Thus, the Working Group decided that neither of these approaches would be considered as high priority this year.

8.58 In considering the other three components of method (iv), the Working Group agreed that shelf area is incorporated into the definitions of mesoscale strata. In addition, shelf area would not give sufficient weight to Subarea 48.4. The Working Group agreed that both (iv)(a) and (iv)(b) could be determined in part from the results of the CCAMLR-2000 Survey or they could be determined from historical data.

8.59 For example, krill distribution in each area could be estimated from the boundaries of the CCAMLR-2000 Survey in which, say, 80% of krill biomass was found. These areas would then be used in the calculations of the subdivision. A problem with this approach is that such distributions may vary between years. Alternatively, historical data from the *Discovery* investigations would be used in place of such calculations as described in WG-EMM-99/22.

8.60 In the case of mesoscale strata, this approach may be problematic because no such strata have been defined for Subarea 48.4, the strata defined in Subareas 48.1, 48.2 and 48.3 have been defined subjectively at this stage and the abundance of krill is known to be low in Subarea 48.4.

8.61 The Working Group agreed to develop method (iii) and method (iv)(b) further for the workshop and for calculations of an interim subdivision at its next meeting. The Working Group requested that the relative proportions of track length in the large-scale survey be estimated at the workshop for each statistical subarea. Using method (iii), the Working Group noted that the subdivision of yield between Subareas 48.1, 48.2 and 48.3 (based on approximations from the current survey plan) would be approximately 28%, 31% and 41% respectively. If the method (iv)(b) is used as in WG-EMM-99/22, then the respective division of yield would be 37%, 15% and 48%. This is calculated from the spatial area of krill distribution in each of the subareas detailed in the *Discovery* reports.

8.62 The Working Group emphasised that these calculations were of an interim nature, but necessary to provide some guidance on how precautionary measures may be taken at smaller scales than the current management unit of whole statistical areas. It recommended that further work be undertaken to identify management units that relate directly to the ecology of krill and its predators, as well as examining other approaches to take account of the needs of predators.

8.63 The Working Group discussed a number of points to consider in the elaboration of measures in future to subdivide yield in Area 48, including:

(i) estimating B_0 in each location of importance (paragraph 8.55(iv));

(ii) the influence of flux on estimating yield in local areas based on either the krill yield model using a local estimate of B_0 or predator demand models; and

(iii) local variations in mortality, recruitment and growth.

8.64 The Working Group encouraged Members to develop such alternative methods and looked forward to reviewing presentations of the methods, how they address assumptions and how they will improve on the methods proposed to be used in the coming year.

8.65 The Working Group agreed that there is sufficient information on functional relationships between predators and krill abundances, as well as patterns in krill recruitment that would enable a re-examination of the reference points used in the current yield decision rule. The Working Group encouraged Members to consider the current reference points of the krill yield model.

Data Management and Archive Implications

8.66 The Working Group agreed that it was vital the CCAMLR Data Manager should attend the B_0 Workshop. In addition, given the expected high workload at the workshop, the Working Group considered that secretarial support from the Secretariat should also be provided.

8.67 The Working Group also agreed that the datasets arising from the CCAMLR-2000 Survey will be a very important resource and that long-term archive storage of these data should be undertaken by the CCAMLR Secretariat.

8.68 Each ship will store all acoustic data on CD-ROMs and copies should be provided to the Secretariat. Copies of the other core program datasets should also be held in the appropriate format by the Secretariat. The Working Group agreed that cruise leaders and the Data Manager will further refine the specification of these formats prior to the survey.

8.69 The Working Group discussed the status of data collected by IWC observers participating in the CCAMLR-2000 Survey and access by IWC to these data and to all other data collected during the survey.

8.70 Dr P. Hammond (IWC) indicated that data collected by IWC observers would not be governed by IWC rules for data availability because they would result from what were effectively platforms of opportunity. However, because the cetacean data would be collected by IWC observers, the IWC anticipated that these data would be freely available for analyses to be presented to its Scientific Committee.

8.71 The rules for access and use of CCAMLR data state, in essence, that such data may be used freely in the preparation of materials for CCAMLR working groups (and workshops), but that the publication of such data requires the authorisation of the data originator(s).

8.72 In the circumstances of the CCAMLR-2000 Survey, therefore, it was understood that all data collected during the survey would be freely available to IWC, for the purpose of submission of analyses in documents to be presented to its Scientific Committee. Publication of any data or results of these analyses, however, even if by IWC scientists and based on the cetacean data alone, would still be subject to the CCAMLR rules and therefore would require the permission of the appropriate authorities in respect of the scientists and vessel or vessels participating in the survey.

8.73 The analysis of data on interactions between environment, krill and marine mammals, which are of particular interest to both IWC and CCAMLR, will be planned and undertaken in appropriate collaborative fashion, with issues relating to publication being resolved on a case-by-case basis, but still within the rules for the use of CCAMLR data.

8.74 Dr Hammond indicated that the IWC would be willing to undertake responsibility for validating and archiving marine mammal data collected during the CCAMLR-2000 Survey, and to make such data available to the collaborative workshops undertaking interactive analyses. The Working Group welcomed this offer and agreed that this was a very important contribution.

Shore-based Studies

Consideration of Comments on Existing CEMP Methods

8.75 In WG-EMM-99/45 power analysis and bootstrap functions were used to estimate the sample size required to detect interannual differences in the foraging trip duration of lactating female Antarctic fur seals at Cape Shirreff. The current CEMP standard method (C1a) suggests a sample size of 40 animals. The results of this analysis indicate that at Cape Shirreff, significant differences between years can be detected with a smaller sample size and suggest that the CEMP method be amended to 25–40 animals.

8.76 Prof. Boyd expressed concern over the assumption of normality required for the power analysis. However, he believed that the non-linearity of the response of foraging trip duration to environmental variability increased the likelihood of detection of anomalous years.

8.77 It was agreed that the advice on reduced sample size for Method C1a should be incorporated into the next revision of the standard methods.

8.78 It was noted that the data on foraging trip duration that were involved in the original analysis to estimate appropriate sample size (WG-CEMP-89/6) were not held in the CEMP database. The Data Manager was requested to liaise with Dr Holt to determine the status and availability of these data.

8.79 Two papers presented the effects of different sampling protocols on the analysis of predator diets. In WG-EMM-99/29 the effects of sampling interval were examined by comparison of diet samples from gentoo penguin and Antarctic fur seals at South Georgia collected on three occasions over a 14-day period with an equivalent number of samples collected on a single sampling occasion. No differences were found in either the mass of samples or the characteristics of krill using either protocol.

8.80 Prof. Croxall commented that this study addressed the concerns raised by Marschoff and González (1989) and the results indicated that the current CEMP method for diet determination appears robust with respect to the sampling protocol recommended in the standard methods.

8.81 WG-EMM-99/46 presented a comparison of the meal masses of Adélie penguins at Anvers Island and Admiralty Bay. Mean meal mass at Admiralty Bay, where samples were only collected from breeding birds, was significantly higher than at Anvers Island where the breeding status of birds was not confirmed. This was attributed to the inclusion of non-breeding birds at Anvers Island that were not feeding chicks and were therefore carrying a reduced food load.

8.82 The Working Group agreed that:

(i) the CEMP Standard Method A8a requires clarification to emphasise the importance of determining the breeding status of sampled birds; and

(ii) the conclusions of WG-EMM-99/46, in respect of highlighting potential problems of interpretation arising from analysis of data of this CEMP parameter, both within and between sites, be flagged in the database.

Consideration of New Draft Methods

8.83 WG-EMM-99/12 presented new standard methods for indices of environmental parameters which have potential direct effect on predators. Methods and data collection forms were presented for three indices: F1 (sea-ice extent viewed from a CEMP site), F3 (local weather at a CEMP site) and F4 (snow cover at a CEMP site).

8.84 The absence of responses to requests from the Secretariat for intersessional comment on the further development of these standard methods was regretted.

8.85 The Working Group agreed that the text and data submission formats for Methods F1 and F4 seemed appropriate, but should be remitted to the Working Group's Subgroup on Methods for final consideration. The Working Group would expect to be able to adopt these standard methods in full at its next meeting.

8.86 For Method F3, the Working Group felt that it was not appropriate or necessary for Members to submit synoptic weather data to the CCAMLR database. In circumstances when unusual meteorological events had, in the opinion of the data holders, significantly influenced the data being submitted under CEMP protocols, this should be indicated at the time of submission and clearly flagged in the database.

8.87 The Secretariat would ask Members undertaking CEMP work at shore-based stations what meteorological data they collected on site or had ready access to from nearby stations.

Other Information relating to Shore-based Methods

8.88 WG-EMM-99/44 (discussed also in paragraph 6.19) described a method (fatty acid signature analysis) that could be useful in the characterisation of the diet of predators, particularly species difficult to sample in more conventional ways. An application of this method could be to classify such predators according to the general characteristics of their diet, i.e. krill-based predators, fish-based predators, squid-based predators and predators that have mixed diets.

8.89 The importance of diet determination in southern elephant seals was recognised, especially with respect to the contribution to the precautionary catch limit of squid, which is based to a large extent on estimates of predator demand. The Working Group encouraged the further use and development of this method, which members noted had applicability to a wide range of species.

8.90 WG-EMM-99/31 presented a discriminant function to determine the sex of krill based on simple length and width measurements of the removed carapace. Determination of the sex also allowed more accurate sex-specific regression models to be used to estimate total length of krill found in prey samples from predators.

8.91 This was considered a useful development and application of similar techniques to other taxa, particularly e.g. *Euphausia crystallorophias*, was encouraged.

8.92 WG-EMM-99/33 (see paragraphs 8.25 to 8.31) contained important developments relevant to the proposal of a standard method for the sampling of the diet of Antarctic fur seals (WG-EMM-97/5).

8.93 Prof. Croxall suggested that in future the detailed aspects of submissions relating to methods be considered in a subgroup, intersessionally by the Subgroup on Methods and/or by a subgroup at the Working Group meeting, and that a report be presented to the Working Group for discussion in plenary.

Consideration of CEMP Sites

8.94 No new CEMP sites have been proposed for consideration by the Working Group.

8.95 There was some concern expressed about the quality of the maps showing the location of monitored colonies of dependent species at CEMP sites, which had been provided for inclusion in the CEMP database. The CEMP Subgroup on Designation and Protection of CEMP Sites will work with the Secretariat intersessionally to address this matter.

8.96 Dr Holt reported that all structures have been removed from Seal Island and the site is now cleared. The Working Group was sorry that this CEMP site had to be closed, but noted with pleasure that the site had been cleared.

8.97 Dr Wilson introduced WG-EMM-99/21 and pointed out that an earlier draft of this management plan for the Balleny Islands' Specially Protected Area (SPA) had been submitted to the Committee on Environmental Protection at the recent XXIII ATCM in Lima, Peru. Under Annex V to the Protocol on Environmental Protection to the Antarctic Treaty, the ATCM is required to obtain CCAMLR's approval prior to establishing a protected area with a marine component. Although Annex V is not yet in force, New Zealand has tabled the Balleny SPA reserve proposal at WG-EMM for information, for discussion, and hopefully to have endorsement in principle of the concept of the proposed Balleny Island SPA as an ecological preserve.

8.98 The Working Group recognised that CCAMLR would have to deal with marine reserve proposals when Annex V to the Protocol on Environmental Protection to the Antarctic Treaty comes into force. The Working Group will circulate WG-EMM-99/21 to its Subgroup on the Designation and Protection of CEMP Sites for comment and as part of its work on the development of a methodology for the assessment of proposals for marine protected areas put forward by the ATCM within the Protocol for Environmental Protection.

8.99 The Working Group discussed New Zealand's Balleny Islands SPA plan, but noted that approval was beyond the remit of the Working Group. Drs Miller and Wilson noted that the key objective of the proposal was to preserve the integrity of the natural terrestrial and marine ecosystems in the Ross Sea at and around a site of outstanding biodiversity.

8.100 The Working Group felt that much clearer information and reasons on a scientific basis will be needed for the selection of a 500 m limit to the offshore restricted zone around Sabrina and Chinstrap Islands and for a 200 n mile limit for the marine reserve as a whole.

8.101 The Working Group also noted that the presentation of the maps and of the information contained therein would not meet the standards which CCAMLR currently applies to maps of CEMP sites.

8.102 Dr Wilson indicated that this version of the proposal is purely for information and discussion and that in later versions maps would be prepared to the standards required by CCAMLR and the ATCM.

8.103 The Working Group drew these comments to the attention of the Scientific Committee. Prof. Croxall noted that consideration of this proposal might be assisted by information on other marine protected areas, especially those adjacent to the Convention Area, including recent proposals by Australia for Macquarie Island.

THE ECOSYSTEM APPROACH AS APPLIED IN OTHER PARTS OF THE WORLD

9.1 The Working Group considered that it was important to take account of work with similar marine ecosystem management initiatives elsewhere in the world. There is value in examining the experiences of other groups that may have encountered similar management problems to those faced by CCAMLR. Two of the tabled papers were relevant to this issue.

9.2 WG-EMM-99/5 presented an executive summary of a scientific plan of the South African BENEFIT Program which focuses on the Benguela Current ecosystem. Fisheries in this region are in a depressed state partly as a result of mismanagement. The program objectives are to:

(i) develop the scientific capacity of marine fisheries science in the countries bordering the Benguela ecosystem;

(ii) develop a framework plan that would improve knowledge and understanding of the Benguela ecosystem; and

(iii) provide the enhanced science capability necessary for the optimal and sustainable utilisation of living resources in the Benguela ecosystem. The BENEFIT Program has been developed as a 10-year program in two phases, the first of which runs from 1997 to 2000.

9.3 Although the BENEFIT Program does not have an explicit ecosystem management component, it is an example of a large regional program that is likely to develop methods and expertise that would be of interest to CCAMLR. It was also noted that the BENEFIT Program complements a new regulatory convention which is proposed for fisheries management in the southeast Atlantic region and which contains many of the ecosystem-based sentiments of Article II of CCAMLR.

9.4 WG-EMM-99/26 reported on a SCOR/ICES symposium, held in Montpellier, France, during March 1999, on the ecosystem effects of fishing. The symposium aimed to:

(i) provide a global synthesis of the impacts of fishing on marine ecosystems;
(ii) report new methods for quantifying impacts at the ecosystem level; and
(iii) discuss how nature conservation objectives can be integrated in future fisheries management.

Discussion of the ecosystem perspective to management highlighted the general applicability of the principles in Article II of CCAMLR. Apart from those of CCAMLR, there are only a few examples of management procedures that included ecosystem monitoring. It was clear that the work of CCAMLR is well ahead of other management organisations in terms of developing a precautionary approach to the ecosystem management of fisheries.

9.5 The Working Group thanked Dr Constable for presenting the CCAMLR view of ecosystem-based fisheries management at the Montpellier meeting. Dr Constable noted that, while many of the participants at the meeting were ready to accept the principles of ecosystem management of fisheries, there were conceptual difficulties with the implementation of this approach which CCAMLR had begun to overcome through the development of the krill yield model and CEMP. Nevertheless, a difficulty that was identified by the meeting, and which is also likely to be a problem for CCAMLR, is development of an ability to adapt management tactics rapidly to changing circumstances.

9.6 The Montpellier meeting also identified several areas of marine conservation that have hitherto not featured strongly in the conservation strategies adopted by CCAMLR. These included the conservation of habitats and biodiversity. In this context, the Working Group considered that some aspects of the work of CCAMLR, especially in the areas of by-catch of elasmobranchs or the effects of trawling on the seabed, may merit greater attention in future by the Scientific Committee.

9.7 The Working Group also considered that the results of the Montpellier meeting would help to provide guidance about operational objectives and definitions for ecosystem management. Some of these, particularly in relation to the definitions of the precautionary approach to fisheries management, had been discussed and developed previously at a technical consultation meeting held by the Government of Sweden in conjunction with FAO at Lysekil, Sweden, in June 1995. The Working Group's attention was drawn to the report on that meeting given in SC-CAMLR-XIV, Annex 5, paragraphs 10.1 to 10.8.

9.8 The Working Group considered paragraph 6.20 of SC-CAMLR-XVII in which Mr R. Shotton (FAO) offered the cooperation and support of FAO to hold an international meeting on the ecosystem approach to management. The Working Group encouraged this initiative and recommended to the Scientific Committee that if CCAMLR is to participate then it should take a lead in developing the terms of reference of such a meeting and that it should ensure that it is strongly represented. The rationale for a strong CCAMLR involvement derives from the likelihood that CCAMLR can learn from experiences elsewhere, but also because there is a need to interest more experts within other management systems in contributing to the CCAMLR approach.

9.9 Dr S. Kim (Republic of Korea) informed the Working Group of a forthcoming PICES workshop on Pacific euphausiids and herring to be held in Vladivostok, Russia, during 8 and 9 October 1999. The objectives of this workshop will be to analyse the population dynamics of these species in relation to ecosystem variability.

CCAMLR WEBSITE

10.1 Dr Ramm advised on recent developments with the English sections of the CCAMLR website (http://www.ccamlr.org), and work underway for the implementation of the French, Russian and Spanish sections.

10.2 The Working Group reviewed this progress and discussed the usefulness of the website in support of its work. It noted that information on 'hit rates' and usage of the website was not yet available. The Secretariat had intended to monitor hit rates so as to quantify usage and fine-tune the structure of the website. However, the limited budget available to develop the website has precluded the implementation of this feature.

10.3 Participants who had accessed the CCAMLR website had generally found this site extremely useful, well presented and easy to use. The Working Group had appreciated the time and effort spent by the Secretariat in developing the website. The Working Group reviewed the advice it had provided last year (SC-CAMLR-XVII, Annex 4, paragraphs 13.14 to 13.16), considered new needs, and looked forward to future developments of the website.

10.4 Options for submitting meeting papers and documents destined for use on the website were re-examined. The Working Group agreed that papers and other material should be submitted, where possible, in Microsoft compatible formats to facilitate transfer to the website. Text and tables should be submitted in Word format (*.doc), figures in Excel (*.xls) or JPEG (*.jpg) formats, maps and photographs in JPEG (*.jpg) format. Graphics should be submitted in separate files (i.e. not embedded in text). Where necessary, large files may be zipped using WinZip (*.zip).

10.5 The Working Group noted that only a small number of the papers presented at the meeting had been submitted electronically and in time for loading onto the website. If all documents for circulation prior to the meeting had been submitted electronically, then the current system whereby photocopied documents are airmailed to participants prior to meetings could have been replaced by an email notification advising participants that documents were available on the website. This practice would lead to savings in paper and postage costs which may then be re-allocated to further development of the website. The Working Group encouraged participants to submit all documents electronically. However, it was recognised that the paperless distribution of meeting documents should be phased in, and that any document submitted by the deadline as a hard copy would still need to be copied and distributed via airmail.

10.6 The Working Group agreed that its request to scan meeting documents and place these on the website (SC-CAMLR-XVII, Annex 4, paragraph 13.14) was problematic and no longer practical. Documents scanned as images are usually large in size, leading to long download times. Documents scanned using character recognition software required additional proof reading to ensure that all characters were correctly assigned. The request to circulate meeting documents on CD-ROM prior to the meeting (SC-CAMLR-XVII, Annex 4, paragraph 13.15) was also agreed to be inappropriate for this purpose.

10.7 The Working Group agreed that information on papers and documents held in the CCAMLR bibliography, and related to the work of the Working Group, should be placed on the website. This would supplement the *CCAMLR Scientific Abstracts* which are now available via the website. The Working Group agreed that this part of the bibliography, containing information on authors, years, subjects and abstracts, should be loaded as a text file on an open-access section of the website; authors, years and titles of meeting papers were already in the public domain. Importantly, access to the content of the papers must continue to be governed by CCAMLR's policy on meeting papers.

10.8 The Working Group reiterated the usefulness of loading onto a password-protected webpage a collection of maps relating to CEMP sites and colonies. Potential uses of a web-based GIS were briefly considered, however the Working Group agreed that the low-cost alternative of scanning maps and displaying these in JPEG format would satisfy its needs in the near future.

10.9 The Working Group also considered making the STATLANT data available via the website; these data are public domain and published each year in the *StatisticalBulletin*. It was recommended that these data should be placed on an open-access section of the website. However, the Working Group's use of STATLANT data was limited, and it sought advice from WG-FSA and the Scientific Committee on the format used to present these data on the website. At this stage, the Working Group felt that these data may be best released as simple tables summarising main features published in the *StatisticalBulletin*. The use of a web-based query interface may be desirable in the long term. The Working Group supported Dr Ramm's proposal that STATLANT data provided on the website should be physically isolated from the primary databases held by the Secretariat so as to maintain the highest level of protection to the databases and data confidentiality.

10.10 During the course of the meeting, the Working Group considered three other features which should be included on the website:

(i) the CEMP Data Report, as presented in the appendix of WG-EMM-99/8, should be placed on a password-protected webpage and updated prior to each meeting;

(ii) an advance copy of the meeting report should be placed on a password-protected webpage immediately following each meeting, and remain accessible until the published version of the report is released under the publications section of the website; and

(iii) a link to the website of the CCAMLR-2000 Survey should be established as soon as possible.

Some participants also expressed interest in the development of electronic correspondence groups.

10.11 The Working Group was aware that development of the CCAMLR website was constrained by the human and financial resources available for this work. Importantly, the initial development of the website was proceeding in parallel with the established work procedures and methods of communication in use by the Secretariat. By necessity, the website would need to be evaluated and endorsed by all Members before it could replace some of the existing communication via paper copies and facsimile. Therefore the cost of developing the website could not be offset at present by savings in other operational areas. However, the Working Group recommended that cost-saving features of the website, such as the paperless distribution of documents in advance of meetings, should be introduced as soon as the procedures are operational.

10.12 The Working Group recognised that certain features it had discussed in relation to the website, such as a comprehensive assessment of hit rates and web-based software to support database queries and GIS, would require specific budget allocations if these were to be implemented in the foreseeable future.

ADVICE TO THE SCIENTIFIC COMMITTEE

Management Advice

Assessment

11.1 The Working Group reaffirmed its advice given in 1997 that revised estimates of potential yield of krill should be postponed until results of the CCAMLR-2000 Survey became available (paragraph 7.14). The Working Group agreed that the current conservation measures which establish precautionary catch limits for krill should remain in force as they stand (paragraph 7.16).

11.2 The Working Group reiterated the need for advice to be given on precautionary management measures for krill fisheries at spatio-temporal scales of greatest importance to regulating interactions between krill, dependent species and fisheries (paragraphs 7.15, 7.62 and 7.82 to 7.84). For example, some fisheries may be concentrating around South Georgia, particularly in winter (paragraph 2.11), whereas others are still concentrated around the South Shetland Islands especially during summer (paragraph 2.1). To that end, the Working Group considered methods for subdividing the estimate of yield that will arise out of the CCAMLR-2000 Survey and recommended two methodologies to be considered next year (paragraph 8.61) in the interim while developing more formal methodologies (paragraphs 8.62 and 8.63).

11.3 Preparation for the CCAMLR-2000 Survey is in its final stages with the addition of a fourth vessel from Russia. The Working Group has identified a considerable number of tasks as part of the ongoing planning process and tasks to be carried out after the survey. These tasks will be carried out, as appropriate, by the survey coordinator, the cruise leaders, the nominated experts and the Secretariat.

11.4 The Working Group recommended that a workshop to estimate krill biomass in Area 48 be held in May–June 2000 (paragraphs 8.37, 8.38 and 8.41 to 8.49). The workshop would require support of the Secretariat and, in particular, participation of the Data Manager. The Working Group recommended that the Secretariat archive a copy of the data from the survey. The Working Group also considered that a special issue of *CCAMLR Science* may be an appropriate place to publish the results of the survey. All of these activities have financial implications.

11.5 The Working Group requested that the Scientific Committee endorse the steps for providing an estimate of yield for Area 48 and for calculating an interim subdivision of this yield into statistical subareas at its meeting next year. These are detailed in paragraphs 8.50 and 8.61.

Fishing Activities

11.6 The Working Group recommended that scientific observers on board krill fishing vessels should be used to collect information as described in the *Scientific Observers Manual* and further amended by the Working Group (paragraphs 2.8, 2.13, 2.14, 7.30, 7.66(iii), 7.68 and 7.71).

11.7 The Working Group recommended that more information be obtained on fishing operation strategies for its assessments (paragraph 2.10).

11.8 The Working Group recommended that a special effort be made to place observers on board krill fishing vessels which will conduct fishing within Area 48 at the same time as the CCAMLR-2000 Survey (paragraphs 2.15 and 7.73) and that the use of echo-listener data loggers on echosounders may be useful in this regard (paragraph 2.16).

11.9 The Working Group also recommended the collection and submission of data to the Secretariat on krill products, conversion rates used in the krill fishery, a breakdown of krill catches by product type and general information on krill prices (paragraphs 2.8, 2.10 and 7.66(ii)).

11.10 The Working Group requested that consideration be given to identifying potential changes to fishing areas and seasons that would impose no additional burden on fishing operations, but which would yield conservation benefit for dependent species (paragraphs 7.60 and 7.61).

11.11 The Working Group noted that there are currently no mechanisms for preventing uncontrolled development of krill fishing at scales most critical to predator foraging and recommended that a procedure be developed to ensure measures can be taken to safeguard predators as the krill fishery expands (paragraphs 7.63 to 7.66).

Other

11.12 The Working Group recommended that greater attention be given to research into by-catch of elasmobranchs and the effect of trawling on the seabed (paragraph 9.6).

11.13 At its next meeting the Working Group expected to have further information on the IUCN global review of threatened species to be published in 2000, which would include species whose main populations lie within the Convention Area. The Working Group advised that the Commission may need to consider actions to improve the conservation status of such species (paragraph 7.76).

11.14 The Working Group noted that the Scientific Committee might wish to consider whether, and in what form, action is necessary to improve assessment of ecosystem interactions involving fish and squid (paragraph 7.10).

11.15 The Working Group drew the attention of the Scientific Committee to issues related to proposals for marine protected areas that may arise from Annex V to the Protocol on Environmental Protection to the Antarctic Treaty when the Annex comes into force (paragraphs 8.97 to 8.103).

11.16 The Working Group recommended the continued collaboration with IWC, and in particular, observing marine mammals during the CCAMLR-2000 Survey (paragraph 8.28), developing access rules for data collected by IWC observers during the survey (paragraph 8.69) and the proposal by IWC to undertake validation and archiving of marine mammal observations during the survey (paragraph 8.74).

11.17 The Working Group identified a number of tasks for the 1999/2000 intersessional period and research priorities for future work which had been identified at the meeting. These are summarised below under Item 12 'Future Work' (paragraphs 12.1 to 12.6).

11.18 The Working Group recommended that its next meeting be held in 2000 at approximately the same time as WG-EMM/99. The Working Group welcomed an offer from Italy for the meeting to be held in Sicily and noted that a formal invitation would be submitted to CCAMLR-XVIII.

11.19 The Working Group recommended that the Scientific Committee consider Dr Hewitt as the new Convener of WG-EMM (paragraph 15.3).

FUTURE WORK

12.1 The Working Group identified a number of tasks to be carried out by WG-EMM participants and the Secretariat during the 1999/2000 intersessional period. The tasks are summarised below. References are given to paragraphs in the report which contain these tasks.

12.2 The following tasks were identified in the work on harvested and dependent species:

Secretariat tasks:

(i) Amend scientific observation logbook forms for krill fisheries in order to include records of information on conversion rates for krill products and urge Members to submit this information (paragraphs 2.7, 2.14 and 7.66).

(ii) In cooperation with Members, develop standard survey questionnaires to collect information on krill fishing strategies (paragraph 2.17).

(iii) In cooperation with Members, continue work on the estimation of the overlap between fisheries and predator foraging areas (paragraphs 6.11, 6.12 and 6.35).

(iv) Request Peru to submit to the next meeting of WG-EMM results of their krill surveys conducted in Subarea 48.1 (paragraph 3.43).

(v) Contact IUCN in order to obtain details on the criteria used and the process applied in the preparation for publication in 2000 of a new list of globally threatened species; relay this information to WG-FSA (paragraphs 7.77 and 7.78).

(vi) Prepare documentation on the use of krill yield model in cooperation with Dr Constable (paragraph 6.8).

Working Group activities:

(vii) Submit fine-scale CPUE data and their analysis for national krill fisheries in addition to data already submitted by Japan – Members (paragraph 2.4).

(viii) Re-investigate the potential for incorporating age-structured krill mortality into the GYM – Prof. Boyd, Dr Constable and Prof. Butterworth (paragraph 7.49).

(ix) Review existing work and new proposals on potential krill yield models based on estimation of krill consumption by dependent species – Prof. Boyd and Drs Everson, Constable and Nicol (paragraphs 7.51 and 7.52).

(x) Provide any information and/or ideas relevant to the development of ways of preventing uncontrolled expansion and/or development of krill fisheries (paragraphs 7.66 and 7.67).

12.3 The following tasks were identified in the work on environmental variables:

Working Group activities:

(i) Table a paper on the oceanographic environment in the South Shetland Islands area at the next meeting of WG-EMM – Dr Holt (paragraph 5.2).

12.4 The following tasks were identified in the work on ecosystem analysis and assessment:

Secretariat tasks:

(i) Implement recommendations of the Working Group on handling CEMP data (paragraphs 4.3 and 4.5).

(ii) Review, in cooperation with members of WG-EMM, the status of tasks and initiatives undertaken by the Working Group since its meeting in 1995 (paragraph 7.12).

(iii) To the extent that new data are available from Members or statistical experts, continue to develop indices and models of overlap between predator foraging and fishing (paragraphs 6.11, 6.12, 6.33 and 6.35).

Working Group activities:

(iv) Consider which indices derived from fishery-related data might be relevant to ecosystem assessment (paragraph 7.30).

12.5 The following tasks were identified in the work on CEMP sites, existing and new standard methods:

Secretariat tasks:

(i) Resolve the status of all queries listed in Table 1 (paragraph 4.4).

(ii) Flag, in the database, potential problems of interpretation arising from analysis of parameters of the Method A8a (paragraph 8.82).

(iii) Request Members undertaking CEMP work at shore-based stations to specify what meteorological data they collect on site or had ready access to from nearby stations (paragraph 8.87).

Working Group activities:

Subgroup on Designation and Protection of CEMP Sites –

(iv) In cooperation with the Secretariat, upgrade the quality of maps for CEMP sites (paragraph 8.95).

(v) Consider the draft management plan prepared by New Zealand for the Balleny Islands SPA (WG-EMM-99/21) (paragraph 8.98).

Subgroup on Standard Methods –

(vi) Prepare advice on reduced sample size for Method C1a which should be incorporated into the next revision of the CCAMLR standard methods (paragraph 8.77).

(vii) Consider drafts of Methods F1 and F4 for their adoption at the next meeting of WG-EMM (paragraph 8.85).

12.6 The following tasks were identified in the work on the CCAMLR-2000 Survey:

Secretariat tasks:

(i) Archive data submitted to the Secretariat from the CCAMLR-2000 Survey (paragraph 8.67).

Working Group activities:

(ii) Investigate how the data from regional krill surveys can be used in conjunction with the CCAMLR-2000 Survey (paragraph 3.22).

(iii) A considerable number of tasks have been identified as part of the ongoing planning process for the CCAMLR-2000 Survey. These tasks, detailed in paragraphs 8.1 to 8.40, will be carried out as appropriate by the survey coordinator, cruise leaders, nominated experts and the Data Manager.

(iv) Tasks to be carried out after the CCAMLR-2000 Survey, but prior to the B_0 Workshop in May–June 2000, are outlined in paragraphs 8.41 to 8.49 and will be carried out as appropriate by the survey coordinator, cruise leaders, nominated experts and the Data Manager.

12.7 The following tasks were identified in the work on the CCAMLR website:

Secretariat tasks:

(i) Place the report of WG-EMM on the website as soon as possible after the end of the meeting (paragraph 7.73).

(ii) The following features should be added to the CCAMLR website as password-protected pages:

(a) the CEMP Data Report (paragraph 10.10);
(b) a collection of maps showing CEMP sites and colonies (paragraph 10.8);
(c) an advance copy of the meeting reports (paragraph 10.10); and
(d) a link to the website of the CCAMLR-2000 Survey (paragraph 10.10).

(iii) The following features should be added as open-access pages:

(a) text file containing information (authors, dates, titles and abstracts) on papers and documents held in the CCAMLR bibliography, and related to the work of the Working Group (paragraph 10.7); and

(b) text files summarising STATLANT data (paragraph 10.9).

(iv) Wherever possible, the current system whereby photocopied documents are airmailed to participants prior to meetings should be replaced by an email notification advising participants that documents are available on the website (paragraph 10.5).

Working Group activities:

(v) Members to submit via email all documents intended for circulation prior to meetings and other information for use on the web, using formats specified in paragraph 10.4.

12.8 In addition, the Working Group identified a number of research priorities for future work. These research priorities are summarised below. References are given to paragraphs in the report which identify research requirements.

Development of precautionary management measures for krill fisheries:

(i) Further exploration, development and testing of models of precautionary management approaches to krill fisheries (paragraph 7.41).

(ii) Development of precautionary management measures, including interim measures, which are potentially appropriate to spatio-temporal scales of greatest importance for regulating interactions between krill, dependent species and fisheries (paragraphs 3.14, 7.15, 7.55 to 7.62 and 7.82 to 7.84).

(iii) Development of proactive and feedback management approaches to krill fisheries, especially at local scales (paragraphs 7.40, 7.42 and 7.53).

(iv) Consider a variety of factors which may influence trends in krill CPUE (paragraph 2.6).

(v) Investigate consequences of various types of conservation measures associated with precautionary approaches to management in local areas (paragraphs 7.60 and 7.61).

(vi) Investigate alternative methods for subdividing krill yield in Area 48 into smaller management units (paragraph 8.64).

(vii) Consider the current biological reference points of the krill yield model (paragraph 8.65).

Research on harvested and dependent species, and environment:

(viii) Research into krill distribution and abundance in large unsurveyed areas such as Subareas 48.6, 88.1 and 88.2 (paragraph 3.13).

(ix) Collect time-series data on krill demographic parameters from the Indian and Pacific sectors of the Antarctic (paragraph 3.41).

(x) Conduct simulation trials to examine whether correlation exists between krill recruits per spawner and per capita as described in WG-EMM-99/50 (paragraph 3.31).

(xi) Conduct regional comparisons of data on the mean sizes and length ranges of krill obtained using different types of sampling techniques (paragraph 3.20).

(xii) Study the relationship between krill density estimates derived from net and acoustic sampling (paragraph 3.17).

(xiii) Determine factors responsible for differences between estimates of global krill abundance based on historical data and on recent acoustics surveys (paragraph 3.10).

(xiv) Study the availability and distribution of krill in the surface layer, in particular, using techniques as side-looking and up-looking echosounders and echosounders mounted in small boats (paragraphs 3.15 and 3.17).

(xv) Investigation of errors involved in sampling the krill population, flux into and out of the sampling areas and the provision of independent estimates of krill mortality (paragraph 3.40).

(xvi) Development of general methodologies for the analysis and presentation of information on krill population structure (paragraph 3.21).

(xvii) Estimation of krill consumption by predators, including analysis of mean length of krill in their diets, and effect of diet on individual predators and predator populations (paragraphs 3.26, 6.21, 6.24 and 6.28).

(xviii) Continued work on relating the distribution of whales to different characteristics of krill aggregations (paragraph 6.32).

(xix) Directed research on, and modelling of the potential impacts of, ultraviolet radiation on krill (paragraphs 5.7 and 5.10).

(xx) Further development of methods of determining diets in elephant seals and other species of seals (paragraph 8.89).

(xxi) Further work on discriminant functions to determine the sex of euphausiids based on simple length and width measurements of the removed carapace (paragraph 8.90).

Research on ecosystem assessment and modelling:

(xxii) Further work on identifying EIVs for CEMP (paragraph 7.19).

(xxiii) Development of combined standardised indices (paragraphs 6.6, 6.7 and 7.31 to 7.36).

(xxiv) Development of ecosystem models underpinning management decisions in CCAMLR (paragraphs 6.39 and 7.49 to 7.52).

(xxv) Development of methods to distinguish the effects of fishing from the effects of environmental changes (paragraph 7.81).

OTHER BUSINESS

13.1 The Working Group noted with great pleasure the imminent Second International Krill Symposium being held at the University of California, Santa Cruz, USA, from 23 to 27 August 1999 (WG-EMM-99/23), of which CCAMLR is a co-sponsor.

13.2 Over 40 papers and 29 posters will be presented, including 32 presentations on Antarctic krill. A number of papers submitted to the symposium will be published as a supplement to the *Canadian Journal of Fisheries and Aquatic Sciences.*

ADOPTION OF THE REPORT

14.1 The report of the fifth meeting of WG-EMM was adopted.

CLOSE OF THE MEETING

15.1 In closing the meeting, the Convener, Dr Everson, on behalf of the Working Group, thanked the Director of the institute, Dr Balguerías, Mr López Abellán and other staff for hosting the meeting and for providing excellent facilities. This had greatly contributed to the smooth running of the meeting. Dr Everson also thanked Mrs L. Bleathman, Mrs R. Marazas and Drs Ramm and Sabourenkov of the Secretariat for their dedicated efforts, and other staff back in Hobart for their work in support of the Working Group, such as the compilation of the CEMP indices.

15.2 Dr Everson had indicated earlier that this meeting of the Working Group was to be his last as Convener. He recalled the difficult task which had been undertaken at the first meeting of this Working Group in Siena, Italy, in 1995 when the work of WG-Krill and WG-CEMP had been brought together. A new agenda had been developed and this had provided a successful framework for future meetings and the work of WG-EMM. The outcome of this work is evident today with new developments in ecosystem assessments and the forthcoming CCAMLR-2000 Survey. Dr Everson thanked all participants for their enthusiasm in conducting this work, and he felt confident that this collaborative spirit would continue under the stewardship of the new Convener.

15.3 Dr Siegel, Vice-Chair of the Scientific Committee, advised that informal discussions during the meeting had identified a candidate to replace Dr Everson. The Working Group recommended that the Scientific Committee consider Dr Hewitt as the new Convener of WG-EMM.

15.4 Prof. Croxall, on behalf of the Working Group, thanked Dr Everson for his outstanding leadership during the first five meetings of the Working Group. Prof. Croxall joined with Dr Miller who, earlier in the meeting and on behalf of participants and the Scientific Committee, had thanked Dr Everson for convening yet another successful meeting. Dr Everson's leadership had greatly advanced CCAMLR's work in ecosystem monitoring and management. The Working Group joined in expressing their appreciation and looked forward to Dr Everson's continued participation in the work of WG-EMM.

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Table 1: List of actions with respect to the CEMP data and the calculation of indices.

Responsibility	Table	Split-year(s)	Task	Comment
Argentina	1.05, mixed	1989	Check date of first period	
	3.08	1995	Check dates	
	9.07*	All years	Check data (total <100%)	
Australia	1.07, all	1993	Check procedure	
	4.05	All years	Why do data differ from those reported in WG-EMM-99/25?	
		1996 onwards	Are data available (see Table 1.07)?	
	7.08	1995	Check dates	
	8.08	1996	Check data	
	9.09*	1999	Check data (total <100%)	
Italy	3.16	1996	Check dates	
	5.10	All years	Why do data differ from those reported in WG-EMM-99/60?	
	9.10*	1999	Check data (total <100%)	
Japan	3.13	1991, 1996	Check dates	
New Zealand	3.17	1993	Check dates	
South Africa	3.04	1995	Check date of last period	
	3.27	All years	Why do data differ from those reported in WG-EMM-99/6?	
	7.04	1995, 1999	Check data (sd, se)	
		1997, 1998	Check dates	
	7.16	Most years	Check dates	
		1997, 1999	Check data (sd, se)	
	8.04	1996, 1997, 1999	Check data	
	9.04*	1999	Check data (total <100%)	
UK	1.01, female	1996, 1999	Check dates	
	1.01, male	1996	Check dates	
	1.08, mixed	1998–1999	Check data	
	3.21	1999	Check data	
	5.06	1996	Are data available?	
	5.12	1993	Check number of colonies for A6	
		1999	Are data available?	
	5.15	All years	Check number of nests and chicks	
	7.03	1996	Check data (sd, se)	
	8.02	1999	Check data (mean)	
	9.02*	1998, 1999	Check data (total <100%)	
	9.18*	1999	Check data (total <100%)	
	14.03	Most years	Provide dates	
USA	3.05	Most years	Check date of last period (>24 November)	
	6.03	Most years	Check data	
	7.12	1997	Check dates	
	14.01	1999	Check data	Corrected dates
	14.02	1987, 1989	Check data because some data are reported in WG-CEMP-89/6	
Secretariat	1.08, all	1998	Add missing value (reason b)	
	1.08, mixed	1998–1999	Check data	
	3.05	1999	Add missing value (reason b)	
	3.10	1996	Check date of first period	
	3.21	1998	Add missing value (reason b)	

Table 1 (continued)

Responsibility	Table	Split-year(s)	Task	Comment
Secretariat (continued)	3.25	Most years	Check calculation	
		1998	Add missing value (reason b)	
	3.26	1981	Add missing value (reason a)	
	5.06	1998	Add missing value (reason b)	
	5.09	1996	Check number of colonies for A6	
	5.12	1998	Add missing value (reason b)	
	5.15	All years	Check number of nests and chicks	
	7.03	1999	Check date for last period	
	8.05	1996	Check date last period	
	8.17	1999	Add missing value (reason a)	
	14, all		Transform deviate by (-1)	
	15.01	1994, 1995	Flag last date as early	
	General		Use summary provided by researchers in absence of CEMP data	
	General		Develop flag for data which do not Conform with CEMP standard methods	
	General		Flag time series collected using >1 procedure	
	General		Filter data, in consultation with researchers, to exclude short time series and discontinued research	

* Will also affect calculation of Index A8c

APPENDIX A

AGENDA

Working Group on Ecosystem Monitoring and Management
(Santa Cruz de Tenerife, Spain, 19 to 29 July 1999)

1. Introduction

    1.1 Opening of the Meeting
    1.2 Organisation of the Meeting and Adoption of the Agenda

2. Fisheries Information

    2.1 Catches: Status and Trends
    2.2 Harvesting Strategies
    2.3 Observer Scheme
    2.4 Other Information

3. Harvested Species

    3.1 Distribution and Standing Stock
    3.2 Population Structure, Recruitment, Growth and Production
    3.3 Indices of Abundance, Distribution and Recruitment
    3.4 Future Work

4. Dependent Species

    4.1 CEMP Indices
    4.2 Studies on Distribution and Population Dynamics
    4.3 Future Work

5. Environment

    5.1 Consideration of Studies on Key Environmental Variables
    5.2 Indices of Key Environmental Variables
    5.3 Future Work

6. Ecosystem Analysis

    6.1 Analytical Procedures and Combination of Indices
        (i) Multivariate Analysis of CEMP Indices
        (ii) Use of GYM for Krill Stock Assessments
        (iii) Other Approaches
    6.2 Krill-centred Interactions
    6.3 Fish and Squid-centred Interactions
    6.4 Environmental Interactions with Harvested and Dependent Species

7. Ecosystem Assessment

    7.1 Estimates of Potential Yield
    7.2 Assessment of the Status of the Ecosystem
        (i) Current Trends by Areas and Species
        (ii) Presentation of Assessments in Summary Form
    7.3 Consideration of Possible Management Measures
    7.4 Further Approaches to Ecosystem Assessment

8. Methods and Programs involving Studies on Harvested and Dependent Species and the Environment

   8.1 Area 48 Synoptic Krill Survey
      (i) Survey Design
      (ii) Sampling Protocols
         (a) Acoustic
         (b) Krill and Zooplankton
         (c) Oceanographic
         (d) Birds, Pinnipeds and Whales
         (e) New CEMP Methods for At-sea Studies
      (iii) Organisation of Synoptic Survey
      (iv) Analytical Methods
      (v) Interpretation of Results with respect to Estimation of Potential Yield
      (vi) Data Management and Archive Implications
   8.2 Shore-based Studies
      (i) Consideration of Comments on Existing CEMP Methods
      (ii) Consideration of New Draft Methods
   8.3 Consideration of CEMP Sites

9. The Ecosystem Approach as Applied in Other Parts of the World

10. CCAMLR Website

11. Advice to the Scientific Committee

12. Future Work

13. Other Business

14. Adoption of the Report

15. Close of the Meeting.

APPENDIX B

LIST OF PARTICIPANTS

Working Group on Ecosystem Monitoring and Management
(Santa Cruz de Tenerife, Spain, 19 to 29 July 1999)

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APPENDIX C

LIST OF DOCUMENTS

Working Group on Ecosystem Monitoring and Management
(Santa Cruz de Tenerife, Spain, 19 to 29 July 1999)

WG-EMM-99/1	Provisional Agenda and Provisional Annotated Agenda for the 1999 Meeting of the Working Group on Ecosystem Monitoring and Management (WG-EMM)
WG-EMM-99/2	List of participants
WG-EMM-99/3	List of documents
WG-EMM-99/4	Withdrawn
WG-EMM-99/5	BENEFIT – Benguela Environment Fisheries Interaction and Training: Science Plan Delegation of South Africa
WG-EMM-99/6	Population size and trends of some seabirds at Marion Island R.J.M. Crawford, O.A.W. Huyser, D.C. Nel, J. Cooper, J. Hurford and M. Greyling (South Africa)
WG-EMM-99/7	Report of the CCAMLR Synoptic Survey Planning Meeting (British Antarctic Survey, UK, 8 to 12 March 1999)
WG-EMM-99/8	CEMP indices 1999: analysis of anomalies and trends Secretariat
WG-EMM-99/9	Fine-scale data from the krill fisheries in 1997/98 Secretariat
WG-EMM-99/10	Secretariat work in support of WG-EMM Secretariat
WG-EMM-99/11	Estimation of the fishery–krill–predator overlap Secretariat
WG-EMM-99/12	Draft standard methods for environmental indices F1, F3 and F4 Secretariat
WG-EMM-99/13	Cephalopod diet of the southern elephant seal (*Mirounga leonina*) at King George Island, South Shetland Islands G.A. Daneri, A.R. Carlini (Argentina) and P.G.K. Rodhouse (United Kingdom) (*Antarctic Science*, submitted)
WG-EMM-99/14	SCAR Bird Biology Subcommittee ad hoc Working Group on Seabirds at-sea Methodology – Synopsis of Workshop Activities and Recommendations SCAR Bird Biology Subcommittee

WG-EMM-99/15	Effects of the Antarctic Circumpolar Current on fishing for squid (*Illex Argentinus*) in the Atlantic sector of the Southern Ocean G.P. Vanyushin and T.B. Barkanova (Russia)
WG-EMM-99/16	Trends of Antarctic fur seal population at SSSI No. 32, Livingston Island, South Shetlands, Antarctica R. Hucke-Gaete, D. Torres, A. Aguayo, J. Acevedo and V. Vallejos (Chile)
WG-EMM-99/17	Estimation of krill biomass from an acoustic survey carried out in 1986, during a study of predator–prey interactions around the western end of South Georgia C. Goss and S. Grant (United Kingdom)
WG-EMM-99/18	Underwater noises produced by research vessels (some comments on acoustic sampling protocol for the Area 48 synoptic survey S. Kasatkina (Russia)
WG-EMM-99/19	Interannual variation in the autumn diet of the gentoo penguin *Pygoscelis papua* at Laurie Island, Antarctica N. Coria, M. Libertelli, R. Casaux and C. Darrieu (Argentina)
WG-EMM-99/20	Acoustic estimates of krill density at South Georgia, December/January 1998/99 A.S. Brierley and C. Goss (United Kingdom)
WG-EMM-99/21	Draft management plan for Specially Protected Area (SPA) No. 4: Balleny Islands northern Ross Sea, Antarctica New Zealand
WG-EMM-99/22	Estimates of global krill abundance based on recent acoustic density measurements and their implications for the calculation of precautionary catch limits and the designation of management areas S. Nicol, A. Constable and T. Pauly (Australia)
WG-EMM-99/23	The Second International Krill Symposium S. Nicol (Australia) and M. Mangel (USA)
WG-EMM-99/24	Potential effects of UV-B on krill – experimental and genetic studies S. Newman, S. Jarman, S. Nicol, D. Ritz, H. Marchant, N. Elliot and A. McMinn (Australia) (*Polar Biol.*, 22: 50–55, 1992)
WG-EMM-99/25	Poor breeding success of the Adélie penguin at Béchervaise Island in the 1998/99 season L. Irvine, J.R. Clarke and K.R. Kerry (Australia)
WG-EMM-99/26	Report on the SCOR/ICES Symposium on the Ecosystem Effects of Fishing, March 1999 A. Constable (Australia)

WG-EMM-99/27	Correlation between krill and *Champsocephalusgunnari* stocks in the South Georgia Area 48.3 K.V. Shust, V.L. Senioukov, P.N. Kochkin and N.A. Petrukhina (Russia)
WG-EMM-99/28	Light levels experienced by foraging Antarctic fur seals, *Arctocephalus gazella* D.J. McCafferty, I.L. Boyd and T.R. Walker (United Kingdom)
WG-EMM-99/29	Influence of sampling protocol on diet determination of gentoo penguins, *Pygoscelis papua* and Antarctic fur seals, *Arctocephalus gazella* S.D. Berrow, R.I. Taylor and A. Murray (United Kingdom) (*Polar Biol.,* in press)
WG-EMM-99/30	Relationships between the distribution of whales and Antarctic krill *Euphausia superba* at South Georgia K. Reid, A.S. Brierley (United Kingdom) and G.A. Nevitt (USA) (*J. Cetacean Res. Management*, in press)
WG-EMM-99/31	Determining the sex of Antarctic krill *Euphausiasuperba* using carapace measurements K. Reid and J. Measures (United Kingdom) (*Polar Biol.*, 19: 145–147, 1998)
WG-EMM-99/32	Foraging and provisioning in Antarctic fur seals: interannual variability in time-energy budgets I.L. Boyd (United Kingdom) (*Behav. Ecol.*, 10 (2): 198–208)
WG-EMM-99/33	A proposal for large scale sampling of krill in the diet of predators across Area 48 to coincide with the CCAMLR synoptic survey K. Reid (United Kingdom)
WG-EMM-99/34	Relative abundance of large whales around South Georgia M.J. Moore (USA), S.D. Berrow (UK), B.A. Jensen (USA), P. Carr (UK), R. Sears (Canada) and V.J. Rowntree, R. Payne and P.K. Hamilton (USA) (*Marine Mammal Science,* in press)
WG-EMM-99/35	Foraging response of Antarctic fur seals to changes in the marine environment D.J. McCafferty, I.L. Boyd, T.R. Walker and R.I. Taylor (United Kingdom) (*Mar. Ecol. Prog. Ser.*, 166: 285–99, 1998)
WG-EMM-99/36	Heart rate and behaviour of fur seals: implications for measurement of field energetics I.L. Boyd, R.M. Bevan, A.J. Woakes and P.J. Butler (United Kingdom) (*Am. J. Physiol.*, 276 (*Heart Circ. Physiol.*, 45): H844–H857, 1999)

WG-EMM-99/37	Predicting changes in the Antarctic krill *Euphausia superba* population at South Georgia K. Reid, K.E. Barlow, J.P. Croxall and R.I. Taylor (United Kingdom) (*Marine Biology*, in press)
WG-EMM-99/38	Improvements to the multiple-frequency method for *in situ* target strength measurements D.A. Demer (USA) and M.A. Soule (South Africa)
WG-EMM-99/39	The CCAMLR 2000 Krill Synoptic Survey: a description of the rationale and design
WG-EMM-99/40	Combining data vectors from CEMP indices I.L. Boyd and A.W.A. Murray (United Kingdom)
WG-EMM-99/41	Effect of orientation on broadband acoustic scattering of Antarctic krill *Euphausia superba*: implications for inverting zooplankton spectral acoustic signatures for angle of orientation L.V. Martin Traykovski (USA), R.L. O'Driscoll (New Zealand) and D.E. McGehee (USA) (*J. Acoust. Soc. Am.*, 104 (4), 1998)
WG-EMM-99/42	Effects of orientation on acoustic scattering from Antarctic krill at 120 kHz D.E. McGehee (USA), R.L. O'Driscoll (New Zealand) and L.V. Martin Traykovski (USA) (*Deep-Sea Research*, II, 45: 1273–1294, 1998)
WG-EMM-99/43	Supplement to the krill synoptic survey design in Area 48 (with participation of a Russian scientific research vessel) V.A. Sushin, S.M. Kasatkina and F.F. Litvinov (Russia)
WG-EMM-99/44	Fatty acid signature analysis from the milk of Antarctic fur seals and southern elephant seals from South Georgia: implications for diet determination D.J. Brown, I.L. Boyd, G.C. Cripps and P.J. Butler (United Kingdom) (*Mar. Ecol. Prog. Ser.*, for submission)
WG-EMM-99/45	An examination of variance and sample size for female Antarctic fur seal trip durations M.E. Goebel (USA)
WG-EMM-99/46	The effect of different methodologies used in penguin diet studies at three US AMLR predator research sites: Admiralty Bay, Palmer Station and Cape Shirreff W. Trivelpiece, S. Trivelpiece (USA) and K. Salwicka (Poland)
WG-EMM-99/47	AMLR 1998/99 Field Season Report: objectives, accomplishments and tentative conclusions US Delegation

WG-EMM-99/48	CPUEs and body length of Antarctic krill density during the 1997/98 season in Area 48 S. Kawaguchi (Japan)
WG-EMM-99/49	Plan for the eighth Antarctic survey by the RV *Kaiyo Maru*, Japan, in 1999/2000 M. Naganobu, S. Kawaguchi, T. Kameda, Y. Takao and N. Iguchi (Japan)
WG-EMM-99/50	An index of per capita recruitment R. Hewitt (USA)
WG-EMM-99/51	An idea to incorporate potential recruitments in the krill density model S. Kawaguchi and M. Naganobu (Japan)
WG-EMM-99/52	Relationship between Antarctic krill (*Euphausia superba*) variability and westerly fluctuations and ozone depletion in the Antarctic Peninsula area M. Naganobu, K. Kutsuwada, Y. Sasai and T. Taguchi (Japan) and V. Siegel (Germany) (*Journal of Geophysical Research*, in press)
WG-EMM-99/53	Note: time series of polynyas extent in the Antarctic ocean K. Segawa and M. Naganobu (Japan)
WG-EMM-99/54	Observations on a large number of icebergs in the krill fishing ground (Subarea 48.1) in May 1999 Japan Deep Sea Trawlers Association
WG-EMM-99/55	Distribution and abundance of Antarctic krill (*Euphausia superba*) around the South Shetland Islands, Antarctic Ocean D. Kang, D. Hwang and S. Kim (Republic of Korea)
WG-EMM-99/56	Modelling the dynamics of krill populations in the Antarctic Peninsula region E.J. Murphy (United Kingdom), A. Constable (Australia) and D. Agnew (United Kingdom)
WG-EMM-99/57	Penguins, fur seals, and fishing: prey requirements and potential competition in the South Shetland Islands, Antarctica D.A. Croll and B.R. Tershy (USA) (*Polar Biol.*, 19: 365–74, 1998)
WG-EMM-99/58	Marine ecosystem sensitivity to climate change R.C. Smith, D. Ainley, K. Baker, E. Domack, S. Emslie, B. Fraser, J. Kennett, A. Leventer, E. Mosley-Thompson, S. Stammerjohn and M. Vernet (*BioScience*, 49 (5))
WG-EMM-99/59	Susceptibility to oxidative stress in different species of Antarctic birds: preliminary results S. Corsolini, F. Regoli, S. Olmastroni, M. Nigro and S. Focardi (Italy)

WG-EMM-99/60	Breeding biology of Adélie penguin (*Pygoscelis adeliae*) at Edmonson Point CEMP site (Ross Sea, Antarctica): report of the first five years S. Olmastroni, S. Corsolini, F. Pezzo, S. Focardi (Italy) and K. Kerry (Australia)

Other Documents

SC-CAMLR-XVIII/BG/3	Observer's report from the 51st Meeting of the Scientific Committee of the International Whaling Commission, Grenada, 3–15 May 1999 CCAMLR Observer (K.-H. Kock, Germany)

APPENDIX D

CCAMLR SYNOPTIC SURVEY PLANNING MEETING
(Cambridge, UK, 8 to 12 March 1999)

CCAMLR SYNOPTIC SURVEY PLANNING MEETING
(Cambridge, UK, 8 to 12 March 1999)

A planning meeting for the CCAMLR-sponsored multinational, multi-ship, near-synoptic acoustic survey for krill biomass in Area 48 to be conducted in January 2000 (hereafter referred to as CCAMLR-2000) was convened by Dr J. Watkins (UK) and held at the British Antarctic Survey (BAS), Cambridge, UK, from 8 to 12 March 1999. The List of Participants is included in this report as Attachment A, the Agenda as Attachment B and a List of Actions resulting from the meeting as Attachment C.

2. Ms S. Hedley, representing the IWC, expressed her gratitude for the opportunity to explain the IWC's broad objectives with regard to the study of cetaceans and their habitat, and to present the IWC request to participate in CCAMLR-2000. She also expressed the hope for fruitful collaboration between IWC and CCAMLR scientists as well as a closer relationship between the two organisations.

SURVEY DESIGN

3. The group reaffirmed that the principal participants conducting the survey will be Japan, UK and USA. The time period of the survey would be early January to mid-February with specific start and stop dates dictated by the necessities of national programs. Each country would contribute 30 days of ship time for the conduct of CCAMLR-2000. Specific ship schedules are listed under Itinerary[1].

4. Dr S. Kim (Republic of Korea) noted that the CCAMLR Subgroup on International Coordination intends to encourage several countries who plan to have field programs in the vicinity of the South Shetland Islands during the austral summer of 1999/2000 to repeat the CCAMLR-2000 transects in this area. The close-spaced CCAMLR-2000 transects on the north side of the South Shetland Islands are likely to be surveyed four times (one by the Republic of Korea in late-December, one by Japan in late-December, one by the CCAMLR-2000 survey vessel in late January–early February, and one by the USA in late February–early March).

5. It was understood that Brazil, Russia and Ukraine are also interested in participating, but that each of these countries is not in a position to make firm commitments at this time to CCAMLR-2000. It was further reported that Ukraine will be conducting field work in the vicinity of the South Orkney Islands during the 1999/2000 austral summer and that their ship will be equipped with an echosounder other than a Simrad EK500; that Russia may have a research vessel available during the survey period and that it will be equipped with a Simrad EK500 echosounder; and that Brazil has a research vessel equipped with an EK500, but that the availability of this ship during the survey period is less certain. Accordingly, it was decided that the Ukrainians would be encouraged to conduct an acoustic survey with a calibrated system in the vicinity of the South Orkney Islands and that this information could be used to complement the planned survey coverage and as an aid in the interpretation of survey results. It was also decided that if Russia were able to participate they would be encouraged to conduct a replicate of one of the three planned survey tracklines with a calibrated EK500 system.

6. It was recognised that the extent of sea-ice may affect the degree to which the southward extent of planned transect lines may be conducted. It was agreed, therefore, to examine recent trends in the annual extent of sea-ice and if a reasonable probability existed that the planned transect lines could not be completed, then the survey design would be adjusted so as to achieve a more efficient use of time.

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[1] Underlined words refer to links to the CCAMLR-2000 website.

7. During a discussion of the survey design it was noted that the proposed transects run along meridians were not parallel, converging as they approach the pole. Considerable discussion ensued weighing the advantages of design simplicity against the disadvantages of over-sampling the higher latitudes relative to the lower ones (transect spacing at the highest latitudes would be approximately 65% of the transect spacing at the lowest latitudes). Ultimately, it was decided to use transects that were parallel on the earth's surface. In order to orient these transects as closely as possible along the prevailing topographic gradient the area was divided into two grids. The first grid includes Subareas 48.2 and 48.3 and was aligned N–S along the 40°W meridian. The second was aligned along a bearing of 330° at 50°W in order to take account of the topography in Subarea 48.1. These grids were used to describe the nominal survey design, which would yield the maximum survey coverage using the available ship time. A randomisation scheme will now be applied to all possible parallel transects on this grid to achieve the final survey design. Every third transect will then be assigned to each ship and cruise tracks will be laid out. Each transect will have a unique number. In addition, the nominal noon and midnight stations will be laid out for each transect and be assigned a unique number. Mr A. Murray (UK) agreed to undertake these tasks with the understanding that his work is critical to the success of CCAMLR-2000 and should be thoroughly checked.

8. Weather contingencies were discussed and it was agreed that the following guidelines would be adopted by each cruise leader in the event that weather and/or equipment failure caused introduced delays such that the survey could not be completed within the allotted time. Noon and midnight stations will be placed along each transect (the actual time of the station will vary according to the net-sampling rules laid out in paragraph 10 below and adjustment for local apparent time). The cruise leader on each survey vessel will check progress against the expected time at the station and make adjustments if necessary according to the following hierarchical scheme:

(i) lengthen daytime acoustic survey operations by beginning and ending acoustic transects at the local apparent time of civil twilight; else

(ii) increase vessel speed without sacrificing quality of acoustic data (see Acoustic Sampling Protocol for guidance); else

(iii) delete daytime net sampling and CTD cast.

In addition, the cruise leader will check progress against the expected time at the approximate mid-point of each major transect (seven for each ship) and make adjustments if necessary according to the following hierarchical scheme:

(i) break survey work on current line and redirect the survey vessel toward the beginning of the next transect; else

(ii) break survey work on current line and redirect the survey vessel toward the most adjacent point on the next transect; else

(iii) delete an entire transect according to a randomly determined transect ranking order (see Random).

PRIMARY PROTOCOLS

9. During a discussion of acoustic sampling protocols it was reaffirmed that acoustic data should be collected at all times. The costs of data storage were considered to be relatively cheap when compared to the cost of missing data collection that may prove useful for future analysis. This principle pertains to time periods while calibrating, to noisy conditions during rough seas,

to station times, and to transits between sampling transects. The directive, in essence, is to turn on the echosounder and record data from the time the ship leaves the pier to the time it returns again. It was also noted that additional specifications regarding the characterisation of noise and operational guidelines as to its acceptable level should be developed; that guidelines should be developed for simultaneous use of echosounders and ADCPs; that lists of instrument settings for calibration and underway data collection should be developed and distributed among survey participants; and that during calibration only TS gain and Sv gain be adjusted while keeping axis offset angles (in the case of split-beam transducers) set to zero and the beam angles set to the manufacturer's description, adjusted for sound speed, for the specific transducer. In light of the fact that the acoustic data are critical to the success of CCAMLR-2000, it was also emphasised that data should be recorded redundantly and equipment spares should be aboard each ship. These and other issues are to be addressed in an updated Acoustic Sampling Protocol.

10. During a discussion of net sampling protocols it was noted that some directed net sampling effort would be necessary to reduce the uncertainty associated with the delineation of krill in the acoustic data record. This sampling would be directed at a variety of 'acoustic morphs', some presumed to be krill and some presumed not to be krill, and, as such, would not be appropriate for the primary purpose of the net sampling as stated at the 1998 WG-EMM meeting; that is, the description of krill population demography. Nonetheless, it was noted by the group that the primary purpose of CCAMLR-2000 is to provide an estimate of B_0 from an acoustic survey and some directed sampling is necessary to achieve this end. Discussion further ensued as to whether the net sampling effort should be increased by reducing the number and/or length of acoustic transects or whether the currently planned net sampling effort (one tow at midnight and another at midday) should be reallocated with some tows used for directed sampling and others as standard oblique tows at predetermined locations. Again, the primary purpose of CCAMLR-2000 was invoked as a rationale for reallocating net sampling effort rather than reducing acoustic sampling effort. The following fishing strategy was adopted:

(i) At local apparent midnight, conduct a standard oblique tow in conjunction with a CTD cast.

(ii) From the time of local apparent sunrise to local apparent noon, conduct a directed tow if an acoustic morph of interest was detected and a reasonable chance of sampling it existed.

(iii) If a directed tow was conducted between local apparent sunrise and three hours before local apparent noon, delay the CTD cast until local apparent noon.

(iv) If a directed tow was conducted after three hours before local apparent noon, conduct the CTD cast at the same locale.

(v) If no suitable acoustic morphs were detected by local apparent noon, conduct a standard oblique tow in conjunction with a CTD cast.

Additional issues were raised during discussion of the net sampling protocol including the desire to standardise nets among all participants, the treatment of 'other zooplankton', and the use of additional nets for sampling smaller zooplankton. These issues were addressed in the revised Net Sampling Protocols. It was noted that Japan does not currently have access to an RMT8 net and that this may be addressed by inviting the participation of an outside expert who has an RMT8 net, on the Japanese survey vessel.

11. During a discussion of the CTD protocols, it was noted that both the general flow pattern across the Scotia Sea as well as the position of fronts were important determinates of the dispersion of krill and that describing these should be the objectives of the oceanographic sampling protocol. It was further noted that CTD sampling to the depth of a particular

oceanographic feature (e.g. a vertical boundary of the CDW) may be more rational than sampling to an arbitrary depth of 1 000 m. This could be considered a plane of no motion for geostrophic calculations as it relates to the structuring of krill habitat. Discussion ensued as to whether this would add to the time required to conduct the CTD casts, but without a detailed analysis of climatic atlases this question could not be readily answered. It was also noted that the UK intends to collect ADCP measurements to approximately 400 m depth with hull-mounted transducers and that Japan intends to collect LADCP measurements over the full extent of the CTD cast; only the USA does not expect to make ADCP measurements. These measurements of absolute currents may be used to interpret CTD data. It was therefore decided that the current protocol (CTD casts to 1 000 m depth (or to the bottom if shallower)) should stand pending investigation of the climatological depth of UCDW. It was further noted that the position of fronts along the transects could be more accurately described with the use of towed and/or expendable sensors. Issues relating to CTD measurements are addressed in the revised CTD Protocols.

Secondary Sampling

12. Ms Hedley presented an overview of the IWC's objectives, sampling methods, and personnel requirements for its participation in CCAMLR-2000. Discussion ensued as to the value of relative versus absolute estimates of cetacean abundance. The IWC's short-term objective with regard to CCAMLR-2000 is to relate the spatial distribution of baleen whales to krill and other environmental covariates; in this regard relative abundance may be adequate. There is some debate, however, within the IWC scientific community on this point. On the other hand, the IWC's long-range objective is to evaluate the impact of baleen whale consumption on the krill resource (presumably this is of direct interest to CCAMLR as well); in this regard absolute estimates of whale abundance are more appropriate. For CCAMLR-2000 the IWC would like to achieve 100% coverage of all transects using the double-platform method which will generate absolute estimates of whale abundance. This would require two teams of four observers (eight berths) on each survey vessel. Tradeoffs between transect coverage and the proportion of the survey that could be conducted using the double-platform method were described if fewer berths were available. It was noted that firm commitments needed to be passed by the CCAMLR-2000 coordinator to Dr G. Donovan at IWC in time for the annual meeting in May. The final protocols for pelagic krill predator observations may differ between ships and will be determined in consultation with the IWC and published on the CCAMLR-2000 website.

13. The extraordinary opportunity offered by CCAMLR-2000 to sample zooplankton across the Scotia Sea was discussed. Sampling may be accomplished without jeopardising the primary sampling operations by adding a set of 1 m^2 333 micron mesh nets to the RMT8 sampler which will be used to sample krill and other micronekton. Specific protocols were not developed except to note the value to all participants of a common zooplankton database, which could be accessed via the CCAMLR-2000 website. Phytoplankton sampling was also discussed and it was determined that all three survey vessels will have fluorometers mounted on their flow-through systems as well as CTD instrument packages and will also make chlorophyll extractions from water samples. Additional measurements will vary among vessels and it was agreed that observation protocols would be posted on the website as they are developed. It was further noted that water samples could be preserved in a Lugol's solution for subsequent analysis, but that the shelf life of such samples was only two years.

14. Underway observation systems will be maintained by all three survey vessels. Measurements will include wind speed and direction, air pressure, humidity, photosynthetically available radiation, sea-surface temperature, salinity, turbidity and fluorescence. In addition, Japan will collect continuous measurements of particle volumes (as a proxy for zooplankton) and dissolved oxygen. The UK will also tow an undulating oceanographic recorder which will contain an optical plankton recorder and make additional measurements of photosynthetically

available radiance, fluorescence, turbidity, salinity and temperature. It was noted that it would be advisable to standardise averaging intervals among the three vessels. Japan has an ADCP that could be operated continuously, however, current plans call for it to be secured during underway operations and an LADCP used instead in conjunction with CTD casts. The UK will operate an underway ADCP, but the USA has no current plans to do so.

15. The potential value of satellite imagery was discussed and it was agreed that Dr Watkins would investigate the various products that would be appropriate complements to CCAMLR-2000. In this regard it may be necessary to request SeaWiFS ground stations at Palmer and/or Rothera to archive specific imagery.

DATA COLLECTION AND ARCHIVING

16. With regard to the conduct of acoustic transects, it was agreed that after the completion of station observations each survey vessel would relocate to the closest point along the intended transect before proceeding to the next station.

17. The utility of maintaining an underway log was emphasised. Such a log would contain notes regarding the start and end times of acoustic transects, comments on weather conditions and sea state as they affect the acoustic records, unusual features noted in the acoustic data, and any other details that may be of use when interpreting the acoustic data after the survey is finished. Similar notes obtained in conjunction with net sampling and CTD operations would clearly be useful as well. Discussion ensued regarding routine logs and the various numbering systems for activities and stations employed by different national programs. It was agreed that, as a minimum, the start and end times and positions of all operations should be recorded in an electronic format such that a list could be made up and queried for all activities conducted at a given set of stations or, alternatively, all locations where a given set of activities was conducted.

18. With regard to computer problems associated with the year 2000 (Y2K), all vessel cruise leaders were encouraged to check the GPS receivers on their ships that will be in use during CCAMLR-2000. These receivers will be the primary source for time stamping the acoustic date set and must be compatible with the millennium change. It is highly desirable that all data collections on a survey vessel are referenced to the same time standard and thus redundant Y2K compliant GPS receivers are critical. Vessel coordinators were also encouraged to check with Simrad and SonarData for assurances that their equipment and software has been tested for Y2K compliance.

DATA ANALYSIS

19. The group reaffirmed and strongly endorsed the decisions made at the last planning session for CCAMLR-2000 held during the WG-EMM meeting in 1998 at Kochi, India, that (i) the collection of acoustic data, micronekton samples from RMT8 nets, and CTD profiles would form the core datasets, and that (ii) the analyses and interpretation of these core datasets and the reporting of results would be conducted in a collaborative fashion. The core datasets refer to those collected according to the survey design described in paragraph 7.

20. It was agreed that because an estimate of B_0 derived from the acoustic data is expected to be tabled at the meeting of WG-EMM in July 2000, a data workshop should be held sometime during May–June 2000. It was tentatively agreed that the workshop would be held over a one- to two-week period in La Jolla, USA, where computational facilities and other logistic support are readily available. It was emphasised that results from the directed net sampling for identification of acoustic morphs, the oblique net sampling for the determination of krill demographic structure and the oceanographic sampling would be of value in interpreting the

acoustic records. As such, it will be highly desirable to include these elements in the workshop. It was also recognised that summary statistics from the regional surveys conducted at South Georgia and the South Shetland Islands would be valuable in the interpretation of the results.

21. With regard to analysis of the acoustic data it was noted that two of the most important tasks will be target strength estimation and the apportionment of backscattered energy to krill and other scatterers of lesser interest. It is anticipated that several methods of accomplishing these tasks will be applied to the dataset and results compared as part of the final report to WG-EMM. Accordingly, it was suggested that working papers on various techniques to estimate TS and to delineate taxa in the acoustic dataset be invited for the upcoming meeting of WG-EMM in July 1999, that time be requested at that meeting for survey participants to discuss these methods and to select the most promising methods, and that individual scientists be commissioned to develop the computer code required to implement the selected methods on a production basis. This code could then be brought to the workshop and applied to the datasets at hand with the potential of saving a substantial amount of time that would otherwise be spent at the workshop accomplishing these preliminary tasks. The group agreed to this idea in principle.

22. It was also emphasised that the May–June 2000 workshop would be only the first of many workshops and collaborative analyses that may be expected in the aftermath of CCAMLR-2000.

OTHER ISSUES

23. Dr Watkins reported to the group that Drs D. Miller (South Africa) and V. Siegel (Germany) had expressed interest in participating in CCAMLR-2000. It was agreed that their participation was very desirable and that recommendations as to how to best deploy additional experts should be made after all expressions of interest are received and a better idea of how they could contribute is in hand. Exchange of personnel between ships was also discussed and it was decided that such agreements would be first explored between national programs and ultimately coordinated by the CCAMLR-2000 coordinator (Dr Watkins). Dr M. Naganobu (Japan) noted that Japan would not be able to send any personnel to other ships but would welcome experts in the field of acoustics and net sampling, particularly if the latter were able to bring an RMT8 net.

24. The importance of maintaining liaison with other institutions and groups conducting field programs in this sector of the Southern Ocean was recognised. In particular, it was recognised that substantial benefits could accrue by making these groups aware of the developing plans for CCAMLR-2000 and inviting their comments and suggestions. It was recognised that there could be several collaborative opportunities of which we are currently unaware and that individual scientists should actively engage colleagues outside the CCAMLR community regarding planned operations and the existence of the website. In particular, the group agreed that the coordinators for SO-GLOBEC (Drs Kim and E. Hofmann (USA)) should be contacted.

25. Dr Naganobu presented a plan to conduct a series of deep CTD casts across the Drake Passage (following the standard WOCE transect) with the intention of describing the flow field. The group recognised the potential value of such a set of observations and enthusiastically endorsed the plan.

LIST OF PARTICIPANTS

CCAMLR Synoptic Survey Planning Meeting
(Cambridge, UK, 8 to 12 March 1999)

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ATTACHMENT B

AGENDA
CCAMLR Synoptic Survey Planning Meeting
(Cambridge, UK, 8 to 12 March 1999)

1. Introduction
   1.1 Welcome
   1.2 Meeting arrangements
2. Adoption of agenda

3. Survey design
   3.1 Timing (time available, start times)
   3.2 Assessment of survey coverage in relation to physical and biological variables
   3.3 Randomisation of surveys (explanation of techniques)
   3.4 Boundaries and sampling intensity of second stratum
   3.5 Intercalibration
   3.6 Integration of national regional surveys
   3.7 Contingency plans (bad weather etc.)
   3.8 Additional survey tracks for new participants
4. Primary protocols
   4.1 Acoustics including calibration
   4.2 Net sampling for population structure and target strength
   4.3 CTDs and station ADCP
5. Opportunities for secondary sampling
   5.1 Predator observations (IWC collaboration)
   5.2 Larval krill/zooplankton/macrozooplankton
   5.3 Krill feeding, growth
   5.4 Physical environment – towed undulator
   5.5 Others
6. Secondary protocols
   6.1 Predator observations
   6.2 Sea-surface samples
   6.3 Underway ADCP
   6.4 Chlorophyll, nutrient, dissolved oxygen measurements
   6.5 Others
7. Data entry, maintenance and archive requirements for cruise

8. Data analysis
   8.1 Timetable
   8.2 Workshop
   8.3 Methods
   8.4 Publication strategy
9. International experts
   9.1 Allocation of additional experts
   9.2 Intership exchanges
   9.3 Collaboration with other programs

10. Preparation of report
    10.1 Report of meeting to WG-EMM
    10.2 Preparation of protocols
    10.3 Dissemination on website
11. Additional discussion groups
    11.1 Beyond the EK500 (acousticians)
    11.2 RMT8 and associated equipment.

ATTACHMENT C

LIST OF ACTIONS RESULTING FROM CCAMLR SYNOPTIC SURVEY PLANNING MEETING
(Cambridge, UK, 8 to 12 March 1999)

Task	Reference	Responsible
Update ship schedules	paragraph 3	Dr Watkins
Inform Russia, Ukraine and Brazil of latest plans	paragraph 5	Dr Watkins
Examine recent trends in sea-ice extent	paragraph 6	Dr Hewitt
Finalise survey design • determine exact transect alignment • randomise transects • produce final survey plot • check calculations • produce station plots • produce grid of day length for different dates and latitude/longitude	paragraph 7	Drs Murray, Trathan and Watkins
Develop acoustic protocols further • noise measurement protocols • guidelines for concurrent operation of ADCP and EK500	paragraph 9	Drs Demer, Brierley and Pauly
Develop net sampling protocols further	paragraph 10	Drs Watkins, Siegel and Kawaguchi
Develop CTD protocols further • explore climatological depth of UCDW	paragraph 11	Drs Amos, Naganobu and Trathan
Inform IWC of berths available on each ship	paragraph 12	Dr Watkins
Produce guidelines for zooplankton sampling	paragraph 13	Drs Watkins, Siegel and Kawaguchi
Produce guidelines for surface monitoring	paragraph 14	Drs Priddle, Watkins and others
Investigate availability of satellite imagery	paragraph 15	Drs Watkins and Trathan
Contact SO-GLOBEC coordinators	paragraph 24	Dr Watkins

APPENDIX E

CCAMLR 2000 KRILL SYNOPTIC SURVEY: A DESCRIPTION OF THE RATIONALE AND DESIGN

THE CCAMLR 2000 KRILL SYNOPTIC SURVEY: A DESCRIPTION OF THE RATIONALE AND DESIGN

PREAMBLE

The aim of this document is to describe the rationale behind the CCAMLR 2000 Krill Synoptic Survey of Area 48 (hereafter referred to as CCAMLR-2000), and to document in one place the details underlying the survey design. Such a document will be necessary in the future, particularly during the analysis and interpretation of the survey results. Furthermore, detailed descriptions of survey design are relatively rare in the published literature, therefore this document provides an opportunity for CCAMLR to establish a lead in this topic.

2. At present the CCAMLR-2000 survey design and data protocols have not received final ratification by either WG-EMM or the Scientific Committee. Therefore the status of this document should be seen as provisional; it is inevitable that it will evolve following future discussions. This document draws heavily from previous planning documents and meetings, and work carried out at the CCAMLR Synoptic Survey Planning Meeting held in Cambridge, UK, from 8 to 12 March 1999. The planning meeting report is contained in Appendix D.

INTRODUCTION

3. Antarctic krill (*Euphausiasuperba*), are considered to be one of the key species in the Antarctic marine food web, being prey to a wide variety of dependent species. In addition to consumption by natural predators, krill are also harvested commercially. Commercial exploitation of krill is managed under the direction of CCAMLR and is regulated in accordance with a sustainable ecosystem rationale. Such management principles are still developing, however, they require fundamental knowledge about the abundance and distribution of krill.

4. The CCAMLR methodology for the management of krill relies heavily on results derived from the CCAMLR generalised yield model (Constable and de la Mare, 1996) and the krill yield model (Butterworth et al., 1991, 1994). This model is used to estimate the long-term annual yield of krill in Area 48 and the precautionary catch limit for the fishery (Conservation Measure 32/X; SC-CAMLR-X). To run the krill yield model, a number of parameters are required, including an estimate of the pre-exploitation biomass of krill (B_0) together with an estimate of the associated variance. The current estimate of B_0 used in the model is derived from the FIBEX synoptic survey which took place from January to March 1981.

5. Over recent years it has been increasingly recognised by the CCAMLR community that a more up-to-date estimate of krill biomass is required for B_0 (SC-CAMLR-XII paragraphs 2.38 to 2.43). For example, in 1996 the Scientific Committee recognised the urgent need for a synoptic survey in Area 48 and noted that management advice for Area 48 could not be updated until such a survey had been conducted (SC-CAMLR-XV, paragraph 4.28). Since then, plans to carry out a CCAMLR krill synoptic survey have progressed steadily (SC-CAMLR-XVI, paragraphs 5.13 to 5.19) and there is now a firm commitment to carry out a survey in the summer of 2000 (between January and February). The primary objective of this survey will be to improve the CCAMLR estimate of B_0 (SC-CAMLR-XII, paragraphs 2.39 and 2.41 to 2.47); additional survey objectives have been formulated, but these are considered secondary to the estimate of B_0.

6. The synoptic survey is a community project that will concentrate effort in Subareas 48.1, 48.2 and 48.3. The survey will involve the participation of three (or more) research vessels from different CCAMLR nations. The composition of the scientific parties

aboard these vessels will also be multinational and will include relevant experts from outside the CCAMLR community. The planning effort for this multi-ship survey is considerable and complex, therefore it is crucial that all stages of the process are documented. Thus, the primary purpose of this paper is to describe in detail the procedures used to design the synoptic survey.

SAMPLING STRATEGY

7. The synoptic survey design was a culmination of numerous decisions. These are reported in a number of separate working documents and reports, and are reproduced here in order to provide a single ready source. The major design strategy decisions were:

(i) whether pre-planned transects positions or adaptive transects positions should be used;

(ii) whether transect separation should be regular and systematic or random;

(iii) whether the design should be stratified or unstratified; and

(iv) the definition of survey limits.

Pre-planned or Adaptive Transect Positions

8. An adaptive survey design would generally offer an increased understanding of the structure of the ecosystem, and improve the CV of the biomass estimate. However, the advantages of a more detailed description of the distribution of krill within high-density areas may be out-weighed by the increased complexity in terms of survey design, execution and subsequent analysis. In the light of these concerns, a more conservative approach of utilising a pre-planned survey has been adopted as the preferred approach. Such an approach had been widely used in the past (for instance FIBEX–BIOMASS, 1980) and is statistically robust and defensible.

Systematic or Random Transect Positions

9. The main objective of the survey is to improve the estimate of B_0 used in the krill yield model. Although an improved estimate could be based on a wide variety of survey designs, the chosen survey design must be statistically defensible. Modern methods of statistical analysis are continually evolving and are providing new opportunities for improved analysis. However, at present no overall consensus exists with regard to some of the model-based geostatistical methodologies. In the future, an agreed methodology using model-based methods may become available, but until that time the CCAMLR community has agreed that a randomised design coupled to a design-based analysis should produce the most statistically defensible result (CCAMLR, 1998a; 1998b Appendix 1; see also conclusions from Miller, 1994).

10. To achieve this the survey will follow a design based on randomised parallel transects. The advantage of using such a design will be that it will be possible to use classical design-based statistical methods (Jolly and Hampton, 1990) without precluding model-based geostatistical methods (e.g. Petitgas, 1993; Murray, 1996) during the survey analysis. In contrast, the use of regular systematic transects would preclude the use of classical design-based statistical methods.

Stratified or Unstratified Design

11. There is still considerable uncertainty within the CCAMLR community regarding the relative abundance of krill in the open ocean compared to that over the continental shelf areas around the Antarctic Peninsula and the islands in Area 48. Although the distribution is complex (illustrated by a variety of datasets and published papers, e.g. Ichii et al., 1998; Sushin and Shulgovsky, 1998), it is important that the B_0 estimate is based on a survey that samples all areas where biomass is important. The FIBEX survey was based on the premise that the majority of krill biomass was close to, or over, shelf areas. However, if krill are also distributed in similar quantities in the open ocean, a design that gives a uniform density of sampling across the whole region should be used. In contrast, if krill are concentrated in particular predictable areas, an appropriate stratified sample design is likely to produce a lower overall CV. Though appropriate stratification may improve the overall CV, it will not change the expected estimate of mean biomass.

12. In view of the debate over the relative importance of shelf and oceanic areas, a compromise survey design was considered appropriate. Thus, the design will allocate extra effort to areas of expected krill concentration.

Definition of Survey Boundaries

13. Given the complexity of the marine ecosystem (cf. Ichii et al., 1998; Sushin and Shulgovsky, 1998), natural limits to the survey area are difficult to define. In establishing appropriate boundaries a variety of factors have to be considered. These include the known historical distribution of krill, the oceanographic structure within the region, the distribution of the commercial fishery, and the distribution of the summer pack-ice. However, these ecological boundaries do not necessarily equate to the artificial limits of the subareas that define the management boundaries.

14. As estimates of krill biomass may be required for strata that have been defined using either ecological or management-based criteria (for example, the Scotia Sea cf. Subarea 48.1), survey boundaries must be based on a compromise between ecological and management boundaries.

OUTLINE OF SELECTED SURVEY DESIGN

15. Considering the factors outlined in the previous section (sampling strategy) the following survey design has been agreed. The ships will undertake a series of randomised transects located within two large-scale strata that cover the Scotia Sea and the area to the north of the Antarctic Peninsula. The first of these strata will cover much of Subareas 48.2 and 48.3, whereas the second will cover most of Subarea 48.1. In order to lie orthogonal to the main axis of the regional bathymetry, the two strata will be oriented in different directions. Within these large-scale strata, three regions are known to have a high abundance of krill and to be of importance to commercial fishing fleets. In these areas additional mesoscale transects will be steamed in order to reduce the CV of the biomass estimate. The first of the mesoscale strata will be to the north of South Georgia, the second will be to the north of the South Orkney Islands, and the third will be to the north of the South Shetland Islands. In the mesoscale strata, the transects will be double the transect density of the large-scale strata. The boundaries of the mesoscale strata will be coincident with the boundaries of selected large-scale sampling units in order to ensure that the survey area is uniformly covered by primary sampling units (transects) for the purposes of randomisation. Details of these cruise tracks are shown in Figures 1, 2 and 3.

METHOD OF RANDOMISATION

16. Within each stratum, transects are randomised. The basic requirement for a truly randomised parallel-transect survey is that all potential transect lines in the survey area should have an equal probability of being sampled. However, one problem arising from a simple randomisation procedure is that there is a possibility of transects being very close together; this can result in an inefficient use of available effort. To overcome this we have used a two-stage randomisation process (see also Brierley et al., 1997). First, the survey area was divided into a series of parallel zones of equal width separated by alternating parallel inter-zones of the same width. A survey transect was then randomly placed within each of the zones. The inter-zones contain no transects and act to keep the transects a minimum distance apart. To comply with the requirement that any transect has an equal probability of being chosen, the location of the entire survey grid was then moved by a random distance equal to, or less than, the inter-zone width. Thus, using the two-stage process, all sampling units have equal probability of being chosen; this gives the necessary condition for the validity of the design-based estimators.

IMPLEMENTATION OF SURVEY DESIGN

17. The computer software package used to carry out the survey design was Arc/Info Version 7.1.1 (ESRI). The final design was checked in Arc/Info and then validated using a separate software package (Proj4). The survey design was undertaken in five strata:

(i) the Scotia Sea large-scale stratum (SS);
(ii) the Antarctic Peninsula large-scale stratum (AP);
(iii) the South Georgia Island mesoscale stratum (SGI);
(iv) the South Orkney Islands mesoscale stratum (SOI); and
(v) the South Shetland Islands mesoscale stratum (SSI).

18. The implementation of the two-stage randomisation process was carried out in seven steps:

(i) generate a regular 25 x 25 km base grid extending beyond the limits of the survey area;

(ii) for each stratum, identify the sampling zones and inter-zones on the appropriate base grid;

(iii) for each transect, identify the random shift within each sampling zone;

(iv) for each stratum, identify the random grid shift for the sampling zones and inter-zones;

(v) for each transect, identify the northern and southern limits of sampling;

(vi) for each transect, identify waypoints at 25 km spacing; and

(vii) for each transect, project the waypoints into geographic coordinates.

Generate Regular 25 x 25 km Base Grids

19. Two regular 25 x 25 km grids that extended beyond the limits of the anticipated survey area were generated, one for the Scotia Sea and one for the Antarctic Peninsula. Each grid was oriented orthogonal to the general axis of the regional bathymetry. Thus, the base grid for the Scotia Sea was designed to lie parallel to the 40°W meridian, whereas the grid for the Antarctic Peninsula was designed to lie at 330° to the 50°W meridian; this second grid was therefore located parallel to the line between 65°00.0'S, 50°00.0'W and 60°00.0'S, 55°46.4'W. The limits of the regular base grids are shown in Table 1.

20. The two base grids were generated using a Lambert Conformal Conic Projection with standard parallels placed approximately 25% from the top and bottom of the anticipated survey areas; with these parallels, scale errors should be approximately 1%. The parameters used for the generation of the grids are shown in Table 2.

Identify the Survey Sampling Zones and Inter-zones

21. Following the criteria outlined above, transect sampling zones were generated on the two base grids. The zones were located at equal distances across the anticipated survey area and were separated by inter-zones of the same width. The parameters for setting up the sampling zones are shown in Table 3.

Identify the Random Transect Positions within the Sampling Zones

22. In order to assign random transect positions, each sampling zone was subdivided into 125 potential positions, giving a sampling resolution of 0.5 km for the large-scale transects and 0.25 km for the mesoscale transects. Within each sampling zone the actual transect position was determined by randomly selecting one of the potential transect positions. The random shift for each transect within each sampling zone is shown in Table 4.

Identify the Random Grid Shift

23. The second level of survey randomisation was carried out by subdividing the grid shift inter-zone into 125 potential grid positions, giving a sampling resolution of 0.5 km. The grid shift was chosen by picking one of these potential grid positions at random. The same grid shift was used for both base grids. This provided the second level of randomisation for both the large-scale transects and the mesoscale transects and ensured that even sampling probability was maintained. The random shifts for the grids are shown in Table 4.

Identify the Northern and Southern Limits for Each Transect

24. After randomly assigning transect positions on the X-axis of the base grid, Y-axis coordinates for the northern and southern end points of each transect were determined by extending the transects to the limits of the survey strata. The southern transect limits were identified with reference to nearby coastlines and the anticipated northern extent of the summer pack-ice, while the northern limits were identified with reference to the boundaries of Subareas 48.1, 48.2 and 48.3, the existence of krill in Area 41, and the frontal structure of the Antarctic Circumpolar Current (see Figures 4, 5 and 6).

Identify Waypoints along each Transect

25. As survey transects are parallel and do not follow meridians, transect orientation continually changes. Therefore to aid navigation during the survey, waypoints were created at regular intervals along each transect. These waypoints were generated from north to south at 25 km spacing.

Project the Transects into Geographic Coordinates

26. The transect waypoints on the base grid were projected from the Lambert Conformal Conic Projection to geographic coordinates using the parameters shown in Table 5.

IMPLICATIONS FOR THE ANALYSIS OF SURVEY STRATA

27. The different orientations of the large-scale grids lead to an overlap of some primary sampling units and a change to the sampling probability to the east of the Antarctic Peninsula. Therefore when estimating B_0 for the southwest Atlantic, it is important that an *a priori* selection of sampling units is made in the region of overlap. Thus, it is recommended that data collected south of 59° on transect 10 should be omitted to avoid problems in data analysis.

28. When preparing an estimate of B_0 for the FAO subareas, other parts of the transects outside the FAO areas will need to be omitted. For these estimates there is no ambiguity about which transect sections to discard.

ALLOCATION OF SURVEY EFFORT TO PARTICIPATING VESSELS

29. Three Member nations within the CCAMLR community have arranged to support the synoptic survey with approximately 30 days each of ship time. These nations are Japan, UK and USA. Other nations may be able to contribute effort, but at the moment they are not in a position to confirm their commitment.

30. The transects within the Scotia Sea (SS) and Antarctic Peninsula (AP) large-scale strata were allocated to the three vessels as follows:

Ship 1 (UK): transects SS-1, SS-4, SS-7, SS-10, AP-13, AP-16 and AP-19;
Ship 2 (USA): transects SS-2, SS-5, SS-8, AP-11, AP-14 and AP-17; and
Ship 3 (Japan): transects SS-3, SS-6, SS-9, AP-12, AP-15 and AP-18.

31. The transects within the mesoscale strata were allocated as follows:

Ship 2 (USA): transects SGI-1, SGI-2, SGI-3 and SGI-4;
Ship 2 (USA): transects SOI-1, SOI-2, SOI-3 and SOI-4; and
Ship 3 (Japan): transects SSI-1, SSI-2, SSI-3, SSI-4, SSI-5, SSI-6, SSI-7 and SSI-8.

32. The UK vessel (Ship 1) was not allocated any mesoscale sampling effort as it has a larger commitment to contribute effort at the large scale.

ADDITIONAL SURVEY EFFORT

33. The synoptic survey design allows for three survey vessels operating within a restricted period of time. However, it is possible that additional survey effort from other CCAMLR Member nations will become available in the future. If this occurs, plans will be required to efficiently utilise the additional effort without compromising the validity of the basic survey design. For example, adding additional transects interleaved between existing transects would result in uneven sampling probabilities, which would be unacceptable. However, two feasible options are available, these are:

(i) to replicate one (or more) of the mesoscale survey areas; and
(ii) to replicate one (or more) of the large-scale survey areas.

34. Choosing between these options depends on the amount of additional effort that becomes available. If a limited amount of effort was to become available (for example five or six days), it would be most useful if it was used to replicate one of the mesoscale strata. Conversely, if a longer period was available (for example 11 to 15 days), it would be most useful if it was used to replicate one of the large-scale strata.

35. It is likely that logistic constraints will dictate which strata will be sampled. However if time were unconstrained, additional effort would be used most efficiently if it were used to repeat the complete itinerary of one (or more) vessel. Following a random selection, the vessel itinerary to repeat should be that of Ship 1, followed by that of Ship 2, and then that of Ship 3.

REDUCTION OF SURVEY EFFORT DUE TO LOST TIME

36. In the southwest Atlantic it is highly likely that some survey time will be lost due to bad weather; contingency plans for lost time are therefore absolutely necessary. The following guidelines are provided in the event that weather and/or equipment failure causes serious delays. It is suggested that each vessel should check progress against the expected time at each station and make adjustments if necessary according to the following hierarchical scheme:

- increase vessel speed without sacrificing quality of acoustic data; or
- delete daytime net sampling and CTD casts.

37. In addition, a check should be made against the expected time at the approximate mid-point of each major transect (six or seven for each ship) and adjustments made according to the following hierarchical scheme:

- curtail the current transect and recommence surveying at the start of the next; else

- curtail the current transect and recommence surveying at the most adjacent point on the next; or

- omit an entire transect according to the randomly determined ranking given in Table 6.

DETERMINATION OF STATION POSITIONS ON TRANSECTS

38. In addition to undertaking a series of acoustic transects, it was agreed that each ship should undertake a series of net hauls to collect krill and zooplankton, and a series of CTD casts to characterise water masses. The initial plans were based on the following assumptions:

- that acoustic transects would be run during daylight so that acoustic biomass estimates would not be biased by night-time migrations of krill to the surface (where they would not be sampled by echosounders);

- that 18 hours per day would be spent conducting acoustic transects; and

- that the remaining six hours per day would be used to sample two stations. One station would be sampled around local midnight, the other around local midday. At each station a CTD cast to 1 000 m and a net haul between 0 m and 200 m would be undertaken.

39. The major implication of such a sampling regime is that station positions are not fixed locations but rather will depend on the start time of each ship, the time and duration of the dark period and the actual progress the ship makes along each transect.

40. The provisional position of the stations has been determined in a series of stages:

(i) determine the approximate dates when each ship will steam each transect;

(ii) calculate the times of local dawn and dusk for the given dates for set positions on each transect; and

(iii) establish the station positions and the cruise plan based on the calculated steaming times.

41. To facilitate cruise planning we have used a PC-based spreadsheet to calculate steaming times around the survey grid. It is hoped that this spreadsheet can be made available to all cruise leaders to help monitor expected progress around the survey transects.

Provisional Start Date for each Vessel

42. Provisional sampling positions have been calculated assuming that the first transect to be steamed by each ship will be started at the times shown in Table 7.

Times of Dawn and Dusk for each Vessel on each Transect

43. The times of civil twilight (where the sun is more than 6° below the horizon) are shown for each vessel respectively in Tables 8, 9 and 10. Selected positions for each transect are shown in order to provide an estimate of local conditions at different latitudes and longitudes. These set positions were selected at the northern and southern extremity of each transect and close to the middle of each transect. Three positions were considered adequate for initial planning purposes as it was recognised that station times would vary according to weather and equipment failures. The final station positions will need to be recalculated by each cruise leader as each cruise progresses.

44. Inspection of the twilight times for each position on each transect reveals that many parts of the survey are in areas where the sun is more than 6° below the horizon for between 4 and 6 hours. This means that the nominal 3 hours allocated for a night-time station is unrealistic. Several compromises will therefore be required to ensure that the survey transects can be covered in the time available. These compromises are:

- transecting starts at local civil dawn and extends until local civil twilight;
- only 2 hours are allowed for the daytime net and CTD; and
- the ships steam at 10.5 knots along transects and at 12 knots between transects.

45. If these conditions cannot be met, then the survey will take longer than originally anticipated, or the transects will have to be shortened according to the hierarchy discussed in the sampling protocols. Assuming that the compromise conditions will be met, provisional station positions have been calculated.

Provisional Station Sampling Positions

46. Based on the available transecting time between local civil dawn and local civil twilight, station positions were calculated. The provisional positions for each of the ships are shown in Tables 11, 12 and 13.

REGIONAL SUPPORT AND CONTEXT FOR THE SYNOPTIC SURVEY

47. The results derived from CCAMLR-2000 will allow a new estimate of B_0 to be produced. However, the magnitude of this new estimate is likely to differ from that of the existing B_0 estimate derived from the FIBEX results (Trathan et al., 1992). If the difference between these two values is marked, considerable debate is likely to ensue and subsequent synoptic surveys may be required. Given the financial and logistic complexity of multi-ship operations, such future surveys cannot be relied upon.

48. However, CCAMLR-2000 should be seen in the context of smaller-scale regional surveys that have been undertaken previously or which may be undertaken in the future. Of particular importance will be those smaller-scale surveys that are undertaken close to the time of the synoptic survey; especially those surveys that form part of long-term time series (such as the US AMLR survey (USA), the BAS Core Programme (UK) and the cruises fostered by the CCAMLR Subgroup on International Coordination). If these regular regional surveys can be linked to the large-scale synoptic survey in time and space, it may be possible to interpret temporal variations observed in the regional surveys, with respect to the larger area. If this proves feasible, it may then become possible to use smaller-scale regional surveys to monitor long-term trends in krill biomass. At present, prior to CCAMLR-2000, any relationship between the regional surveys and the biomass across Area 48 remains undefined.

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Table 1: Limits of the 25 x 25 km base grids used as the foundation for the survey design.

Stratum	Grid		Limit			
	Origin	Rotation	Northern	Southern	Eastern	Western
Scotia Sea	62°S, 40°W	0°	49°S	62°S	23°W	56°W
Antarctic Peninsula	65°S, 50°W	330°	52°S	68°S	40°W	79°W

Table 2: Parameters used for the Lambert Conformal Conic Projections.

Stratum	Spheroid	Units	Standard Parallel 1	Standard Parallel 2	Central Meridian	Origin of Projection	X,Y Shift
Scotia Sea	WGS84	Metres	54°30’S	59°30’S	40°W	62°W	0, 0
Antarctic Peninsula	WGS84	Metres	59°30’S	64°30’S	50°W	65°W	0, 0

Table 3: Parameters used for determining the transect sampling zones.

Stratum	Start Position on Base Grid* (grid column)	Width of Grid Shift Inter-zone (km)	Number of Transects	Width of Transect Sampling Zone (km)	Width of Transect Sampling Inter-zone (km)
Scotia Sea	11	62.50	10	62.50	62.50
Antarctic Peninsula	15	62.50	9	62.50	62.50
South Georgia	21	62.50	4	31.25	31.25
South Orkney Islands	41	62.50	4	31.25	31.25
South Shetland Islands	25	62.50	8	31.25	31.25

* The position with row = 1, column = 1 is at the northeast corner of the grid.

Table 4: Random offsets for transects within the sampling zones and for the grid shift.

Stratum	Random Shift within Transect Sampling Zones (km)										Random Shift for Grid (km)
	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	
Scotia Sea*	3.00	36.00	43.50	44.50	13.50	0.50	50.00	29.00	41.50	6.50	17.50
Antarctic Peninsula*	40.00	38.50	16.00	37.00	44.50	1.50	57.00	13.00	2.00		17.50
South Georgia+	29.25	0.75	6.50	9.25							17.50
South Orkney Islands+	7.75	18.25	18.50	19.25							17.50
South Shetland Islands+	20.50	5.00	20.25	20.75	11.00	26.75	4.25	29.25			17.50

* Randomisation was carried out with potential transect sampling units separated by 0.50 km.
\+ Randomisation was carried out with potential transect sampling units separated by 0.25 km.

Table 5: Parameters used for the Geographic Projection.

Stratum	Spheroid	Units	X,Y Shift
Scotia Sea	WGS84	Decimal degrees	0, 0
Antarctic Peninsula	WGS84	Decimal degrees	0, 0

Table 6: Priority for omitting transects following periods of lost time; if a transect has already been surveyed, then the next highest priority transect should be omitted.

Vessel	Priority for Omission

	1	2	3	4	5	6	7	8
Ship 1 (large scale)	SS-7	AP-13	SS-10	AP-16	SS-1	SS-4	AP-19	
Ship 2 (large scale)	SS-5	SS-8	AP-14	AP-11	SS-2	AP-17		
Ship 3 (large scale)	AP-12	SS-3	SS-6	SS-9	AP-15	AP-18		
Ship 2 (mesoscale)	SGI-4	SGI-2	SGI-3	SGI-1				
Ship 2 (mesoscale)	SOI-2	SOI-4	SOI-1	SOI-3				
Ship 3 (mesoscale)	SSI-7	SSI-5	SSI-8	SSI-6	SSI-2	SSI-1	SSI-4	SSI-3

Table 7: Start times for each vessel.

Vessel ID	Nation	Start Date and Time
Ship 1	UK	20 Jan 2000 14:00
Ship 2	USA	14 Jan 2000 06:00
Ship 3	Japan	14 Jan 2000 11:00

Table 8: Times of civil dawn and civil dusk for each transect undertaken by Ship 1. Times are GMT.

Transect	Position	Longitude	Latitude	Date	Civil Dawn	Civil Dusk
SS01	North	-31.22	-51.89	20/01/00	05:40	22:52
SS01	Middle	-30.13	-56.56	22/01/00	04:58	23:24
SS01	South	-28.80	-61.00	24/01/00	04:08	00:06
SS04	North	-37.27	-51.98	24/01/00	06:05	23:16
SS04	Middle	-36.93	-56.69	26/01/00	05:35	23:43
SS04	South	-36.49	-61.40	27/01/00	04:46	00:32
SS07	North	-42.79	-51.98	28/01/00	06:36	23:31
SS07	Middle	-43.16	-56.91	30/01/00	06:10	00:03
SS07	South	-43.62	-61.62	31/01/00	05:29	00:48
SS10	North	-48.89	-57.99	01/02/00	06:30	00:29
SS10	Middle	-49.54	-60.44	02/02/00	06:14	00:50
SS10	South	-50.22	-62.66	03/02/00	05:55	01:15
AP13	North	-56.25	-59.68	04/02/00	06:55	01:04
AP13	Middle	-54.45	-61.49	04/02/00	06:30	01:14
AP13	South	-52.47	-63.25	05/02/00	06:05	01:23
AP16	North	-62.93	-60.00	06/02/00	07:26	01:27
AP16	Middle	-61.52	-61.90	06/02/00	07:02	01:39
AP16	South	-60.03	-63.67	07/02/00	06:40	01:50
AP19	North	-69.94	-60.00	08/02/00	08:01	01:48
AP19	Middle	-68.38	-63.05	09/02/00	07:30	02:07
AP19	South	-66.47	-66.06	10/02/00	06:47	02:35

Table 9: Times of civil dawn and civil dusk for each transect undertaken by Ship 2. Times are GMT.

Transect	Position	Longitude	Latitude	Date	Civil Dawn	Civil Dusk
SS02	North	-33.53	-51.82	16/01/00	05:35	23:11
SS02	Middle	-32.73	-56.15	18/01/00	05:02	23:46
SS02	South	-31.69	-61.20	19/01/00	03:54	00:40
SS05	North	-38.63	-52.01	20/01/00	06:02	23:27
SS05	Middle	-38.46	-56.72	21/01/00	05:28	00:03
SS05	South	-38.24	-61.43	23/01/00	04:35	00:55
SS08	North	-44.59	-54.62	24/01/00	06:17	00:04
SS08	Middle	-45.15	-58.87	25/01/00	05:45	00:41
SS08	South	-45.81	-62.89	27/01/00	04:59	01:34
AP11	North	-52.74	-58.73	30/01/00	06:33	00:56
AP11	Middle	-51.25	-60.11	30/01/00	06:13	01:04
AP11	South	-50.08	-61.11	31/01/00	06:12	00:56
AP14	North	-58.81	-60.01	31/01/00	06:48	01:30
AP14	Middle	-57.53	-61.45	01/02/00	06:31	01:37
AP14	South	-56.13	-62.88	01/02/00	06:06	01:51
AP17	North	-66.33	-60.01	02/02/00	07:25	01:53
AP17	Middle	-64.98	-62.16	03/02/00	07:01	02:08
AP17	South	-63.53	-64.17	04/02/00	06:31	02:25
SGI01	South	-34.89	-54.78	15/01/00	05:16	23:40
SGI04	North	-37.60	-53.11	14/01/00	05:38	23:39
SOI01	South	-42.75	-60.74	28/01/00	05:24	00:44
SOI04	North	-46.22	-59.73	29/01/00	05:53	00:43

Table 10: Times of civil dawn and civil dusk for each transect undertaken by Ship 3. Times are GMT.

Transect	Position	Longitude	Latitude	Date	Civil Dawn	Civil Dusk
SS03	North	-35.45	-51.92	14/01/00	05:38	23:22
SS03	Middle	-34.88	-56.62	15/01/00	04:58	23:57
SS03	South	-34.14	-61.32	17/01/00	03:52	01:01
SS06	North	-40.26	-52.01	18/01/00	06:05	23:37
SS06	Middle	-40.29	-56.73	19/01/00	05:29	00:14
SS06	South	-40.34	-61.44	21/01/00	04:34	01:11
SS09	North	-46.75	-54.74	22/01/00	06:20	00:17
SS09	Middle	-47.52	-58.76	23/01/00	05:49	00:55
SS09	South	-48.48	-62.77	24/01/00	04:55	01:57
AP12	North	-54.65	-59.24	25/01/00	06:19	01:23
AP12	Middle	-52.34	-61.43	25/01/00	05:41	01:43
AP12	South	-50.12	-63.25	26/01/00	05:03	02:04
AP15	North	-61.36	-60.01	27/01/00	06:44	01:53
AP15	Middle	-60.03	-61.68	27/01/00	06:16	02:10
AP15	South	-58.43	-63.46	28/01/00	05:44	02:30
AP18	North	-67.84	-60.00	29/01/00	07:17	02:12
AP18	Middle	-66.33	-62.60	30/01/00	06:42	02:36
AP18	South	-64.63	-65.06	31/01/00	05:51	03:13
SSI01	North	-55.55	-60.50	01/02/00	06:34	01:19
SSI08	South	-62.61	-62.88	05/02/00	06:51	01:59

Table 11: Provisional positions for net and CTD sampling stations for Ship 1. Times are GMT.

Station	Station ID	Transect	Longitude	Latitude	Date and Time
1	SS0101	SS01	-30.8837	-53.4453	20 Jan 23:32
2	SS0102	SS01	-30.5734	-54.7801	21 Jan 13:33
3	SS0103	SS01	-30.2413	-56.1149	21 Jan 23:12
4	SS0104	SS01	-29.8852	-57.4489	22 Jan 12:33
5	SS0105	SS01	-29.4357	-59.0032	22 Jan 23:29
6	SS0106	SS01	-28.9448	-60.5540	23 Jan 13:08
7	SS0401	SS04	-36.5109	-61.1745	24 Jan 13:29
8	SS0402	SS04	-36.6692	-59.6071	25 Jan 00:24
9	SS0403	SS04	-36.8137	-58.0372	25 Jan 14:11
10	SS0404	SS04	-36.9280	-56.6905	25 Jan 23:51
11	SS0405	SS04	-37.0344	-55.3436	26 Jan 13:23
12	SS0406	SS04	-37.1495	-53.7729	27 Jan 02:36
13	SS0407	SS04	-37.2114	-52.8761	27 Jan 14:09
14	SS0701	SS07	-42.8095	-52.2023	28 Jan 15:26
15	SS0702	SS07	-42.8866	-53.3227	28 Jan 23:49
16	SS0703	SS07	-42.9849	-54.6685	29 Jan 14:25
17	SS0704	SS07	-43.0900	-56.0152	30 Jan 00:04
18	SS0705	SS07	-43.2029	-57.3620	30 Jan 14:04
19	SS0706	SS07	-43.3242	-58.7083	30 Jan 23:43
20	SS0707	SS07	-43.4780	-60.2772	31 Jan 14:13
21	SS0708	SS07	-43.6216	-61.6195	31 Jan 23:51
22	SS1001	SS10	-49.8668	-61.5496	02 Feb 00:22
23	SS1002	SS10	-49.4155	-59.9966	02 Feb 14:19
24	SS1003	SS10	-49.0601	-58.6623	02 Feb 23:58
25	AP1301	AP13	-53.5832	-62.2921	05 Feb 00:53
26	AP1302	AP13	-55.0723	-60.8894	05 Feb 14:50
27	AP1601	AP16	-62.0074	-61.2721	07 Feb 00:54
28	AP1602	AP16	-60.8325	-62.7437	07 Feb 15:25
29	AP1603	AP16	-60.0261	-63.6703	07 Feb 23:05
30	AP1901	AP19	-66.7579	-65.6520	09 Feb 00:47
31	AP1902	AP19	-67.8720	-63.9227	09 Feb 15:20
32	AP1903	AP19	-68.6227	-62.6191	10 Feb 01:00
33	AP1904	AP19	-69.4196	-61.0931	10 Feb 15:26
34	AP1905	AP19	-69.9429	-60.0005	10 Feb 23:48

Table 12: Provisional positions for net and CTD sampling stations for Ship 2. Times are GMT.

Station	Station ID	Transect	Longitude	Latitude	Date and Time
1	SGI0301	SGI03	-36.5551	-53.9814	14 Jan 19:17
2	SGI0201	SGI02	-35.5553	-53.6031	15 Jan 04:46
3	SGI0101	SGI01	-35.0060	-53.8866	15 Jan 17:07
4	SGI0102	SGI01	-34.8924	-54.7824	16 Jan 03:35
5	SS0201	SS02	-33.4295	-52.4934	16 Jan 22:40
6	SS0202	SS02	-33.1729	-54.0565	17 Jan 13:50
7	SS0203	SS02	-32.9365	-55.3972	17 Jan 23:29
8	SS0204	SS02	-32.6393	-56.9614	18 Jan 13:58
9	SS0205	SS02	-32.3639	-58.3014	18 Jan 23:38
10	SS0206	SS02	-32.0155	-59.8625	19 Jan 13:03
11	SS0207	SS02	-31.6907	-61.1978	19 Jan 22:42
12	SS0501	SS05	-38.3117	-60.0865	21 Jan 01:15
13	SS0502	SS05	-38.3860	-58.5159	21 Jan 14:20
14	SS0503	SS05	-38.4446	-57.1683	22 Jan 00:00
15	SS0504	SS05	-38.5079	-55.5957	22 Jan 14:11
16	SS0505	SS05	-38.5581	-54.2482	22 Jan 23:51
17	SS0506	SS05	-38.6051	-52.9019	23 Jan 13:32
18	SS0801	SS08	-44.6999	-55.5132	24 Jan 23:41
19	SS0802	SS08	-44.8985	-57.0823	25 Jan 14:36
20	SS0803	SS08	-45.0826	-58.4267	26 Jan 00:16
21	SS0804	SS08	-45.3157	-59.9933	26 Jan 14:23
22	SS0805	SS08	-45.4587	-60.8873	27 Jan 00:11
23	SS0806	SS08	-45.7690	-62.6711	27 Jan 14:36
24	SOI0201	SOI02	-44.0864	-60.7096	28 Jan 20:02
25	SOI0301	SOI03	-45.0948	-59.7768	29 Jan 01:18
26	SOI0401	SOI04	-46.2158	-59.7299	29 Jan 19:29
27	SOI0402	SOI04	-46.3817	-60.6231	29 Jan 23:57
28	AP1101	AP11	-50.3436	-60.8879	30 Jan 15:40
29	AP1102	AP11	-51.6909	-59.7185	31 Jan 00:22
30	AP1103	AP11	-52.7420	-58.7345	31 Jan 11:23
31	AP1401	AP14	-58.8057	-60.0060	01 Feb 05:59
32	AP1402	AP14	-57.7186	-61.2427	01 Feb 14:41
33	AP1403	AP14	-56.3368	-62.6736	02 Feb 00:30
34	AP1701	AP17	-63.6028	-64.0762	03 Feb 00:08
35	AP1702	AP17	-65.1266	-61.9409	03 Feb 15:28
36	AP1703	AP17	-65.9425	-60.6521	04 Feb 00:10

Table 13: Provisional positions for net and CTD sampling stations for Ship 3. Times are GMT.

Station	Station ID	Transect	Longitude	Latitude	Date and Time
1	SS0301	SS03	-35.3969	-52.3671	14 Jan 13:46
2	SS0302	SS03	-35.2440	-53.7099	14 Jan 23:25
3	SS0303	SS03	-35.0806	-55.0539	15 Jan 12:52
4	SS0304	SS03	-34.8753	-56.6226	15 Jan 23:49
5	SS0305	SS03	-34.6521	-58.1907	16 Jan 13:46
6	SS0306	SS03	-34.4086	-59.7572	17 Jan 00:42
7	SS0307	SS03	-34.1419	-61.3207	17 Jan 13:11
8	SS0601	SS06	-40.3234	-60.0965	18 Jan 13:35
9	SS0602	SS06	-40.3091	-58.5255	19 Jan 00:31
10	SS0603	SS06	-40.2961	-56.9529	19 Jan 14:00
11	SS0604	SS06	-40.2858	-55.6046	19 Jan 23:40
12	SS0605	SS06	-40.2746	-54.0323	20 Jan 14:08
13	SS0606	SS06	-40.2657	-52.6859	20 Jan 23:47
14	SS0901	SS09	-46.9069	-55.6322	22 Jan 14:32
15	SS0902	SS09	-47.1562	-56.9734	23 Jan 00:12
16	SS0903	SS09	-47.4706	-58.5370	23 Jan 14:33
17	SS0904	SS09	-47.7629	-59.8754	24 Jan 00:12
18	SS0905	SS09	-48.1900	-61.6558	24 Jan 14:45
19	AP1201	AP12	-50.1248	-63.2510	25 Jan 03:32
20	AP1202	AP12	-51.6568	-62.0233	25 Jan 14:34
21	AP1203	AP12	-53.0033	-60.8403	26 Jan 00:13
22	AP1204	AP12	-54.6487	-59.2442	26 Jan 14:39
23	AP1501	AP15	-60.7156	-60.8449	27 Jan 15:03
24	AP1502	AP15	-59.6764	-62.0971	28 Jan 00:42
25	AP1801	AP18	-65.6257	-63.6743	29 Jan 15:18
26	AP1802	AP18	-66.4672	-62.3828	30 Jan 00:57
27	AP1803	AP18	-67.4827	-60.6532	30 Jan 15:20
28	SSI0201	SSI02	-56.3241	-60.6831	01 Feb 20:11
29	SSI0301	SSI03	-56.8563	-61.7915	02 Feb 08:51
30	SSI0401	SSI04	-57.9514	-62.0227	02 Feb 21:52
31	SSI0501	SSI05	-59.6069	-61.3797	03 Feb 09:54
32	SSI0601	SSI06	-60.9750	-61.6381	03 Feb 23:36
33	SSI0701	SSI07	-61.0057	-62.6053	04 Feb 11:25
34	SSI0801	SSI08	-62.6133	-62.8770	05 Feb 01:31
35	SSI0802	SSI08	-63.2521	-62.0290	05 Feb 12:59

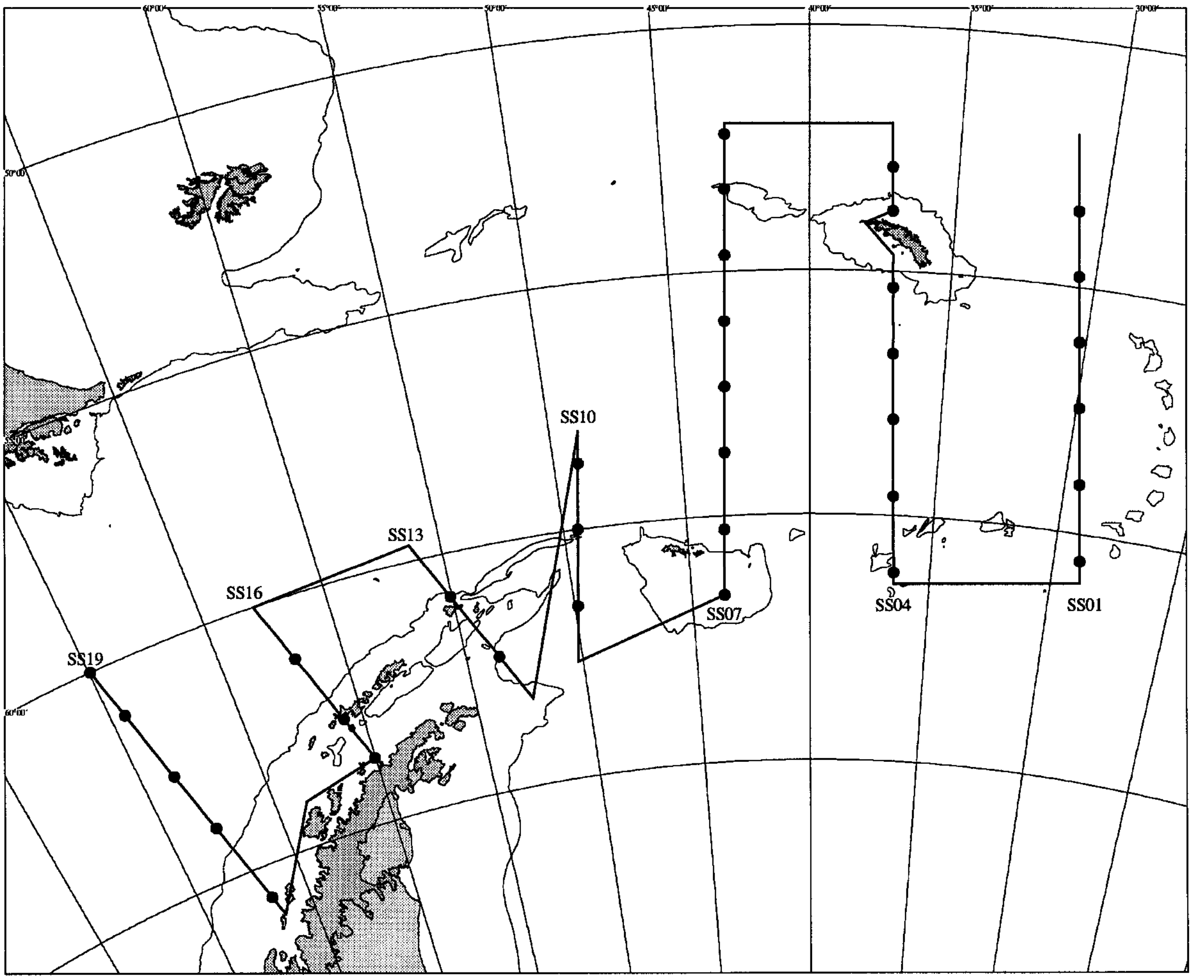

Figure 1: CCAMLR-2000 cruise track for Ship 1 (UK vessel).

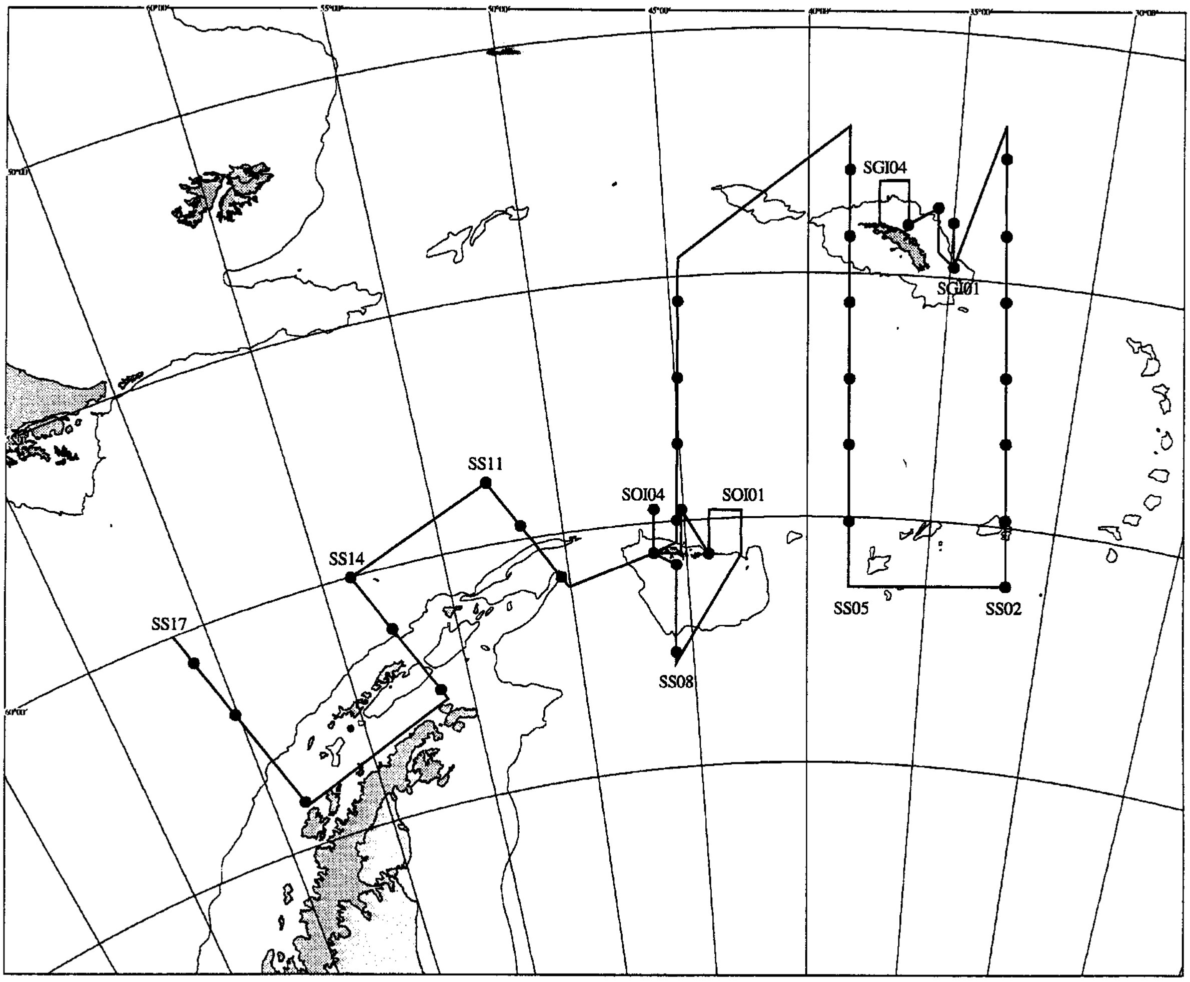

Figure 2: CCAMLR-2000 cruise track for Ship 2 (USA vessel).

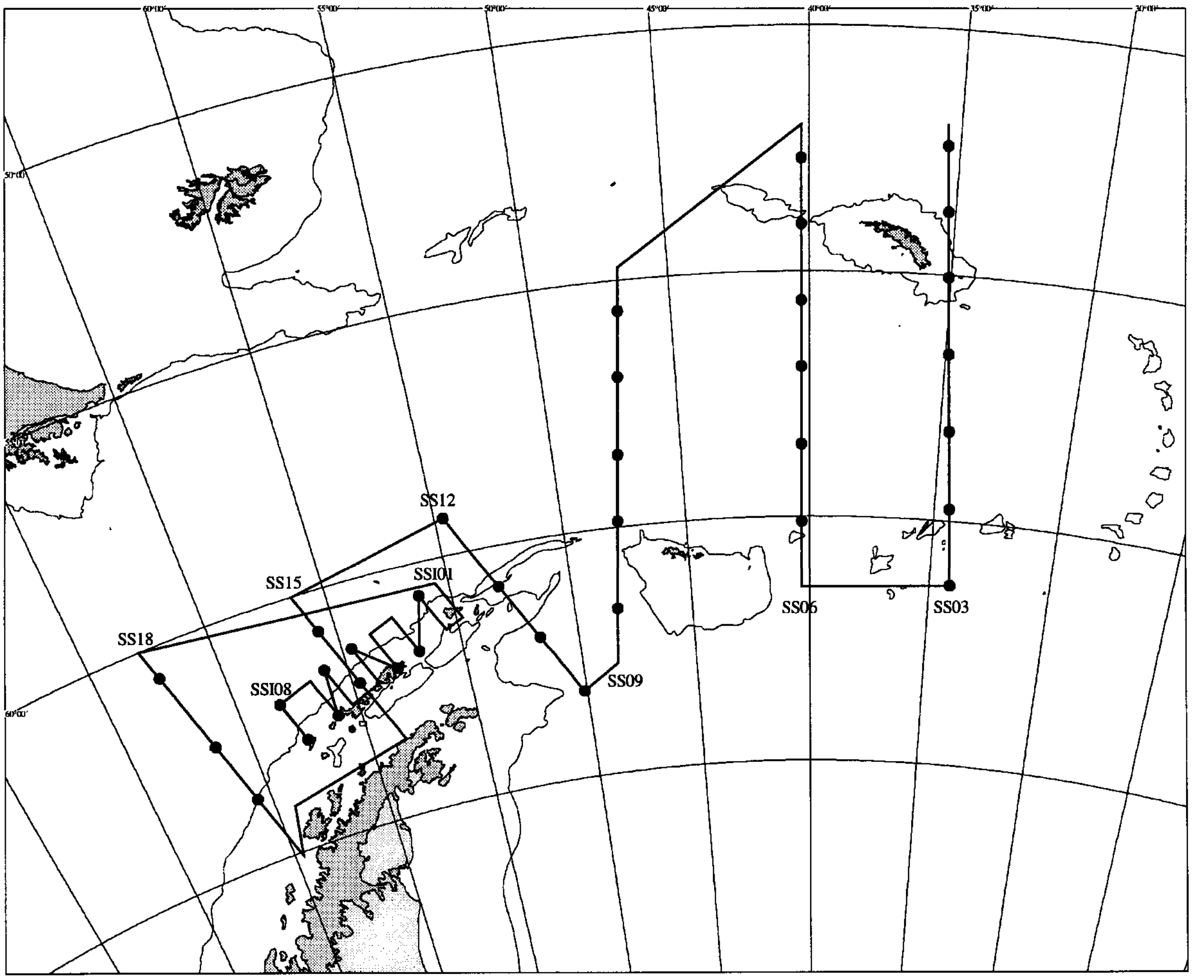

Figure 3: CCAMLR-2000 cruise track for Ship 3 (Japanese vessel).

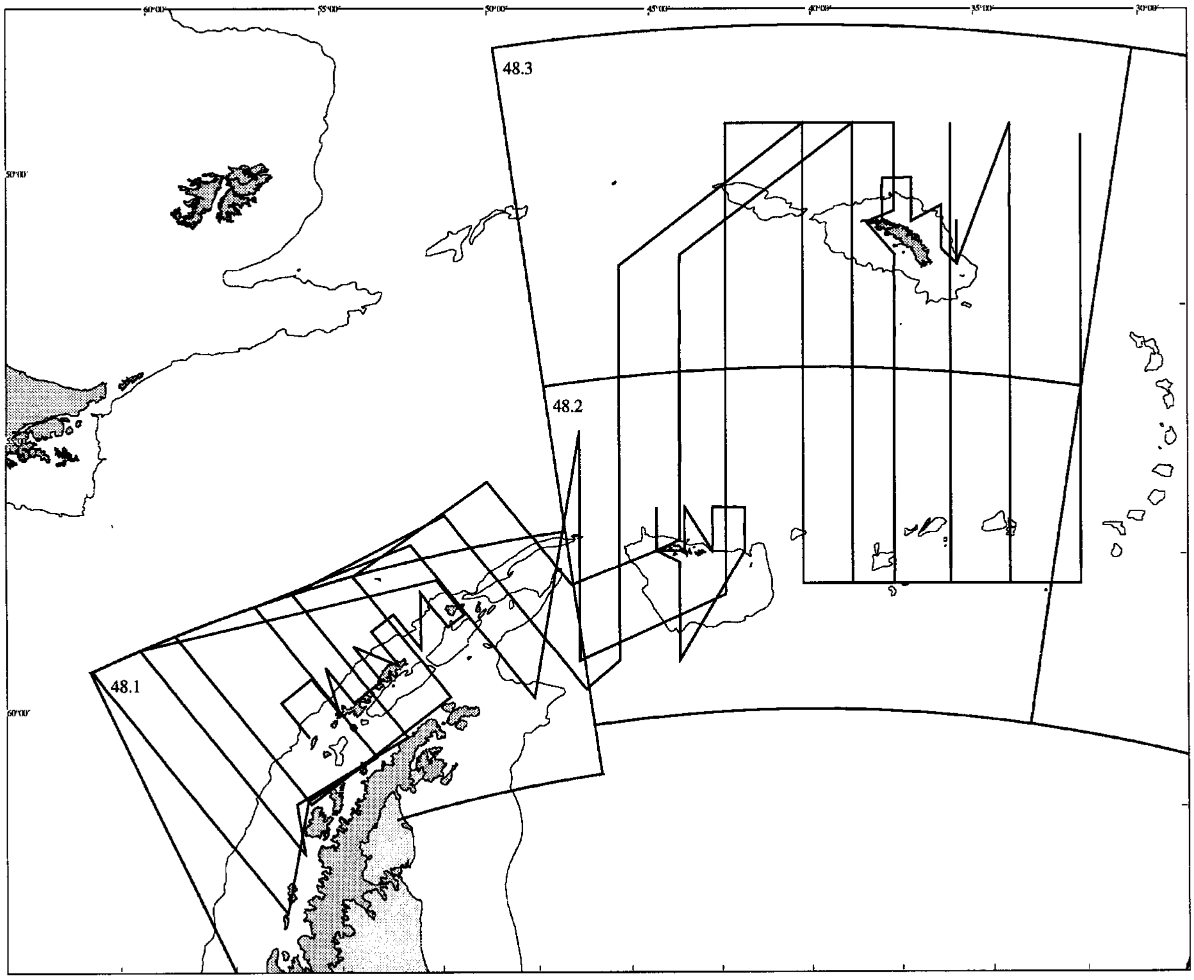

Figure 4: CCAMLR-2000 cruise tracks with the boundaries shown for Subareas 48.1, 48.2 and 48.3.

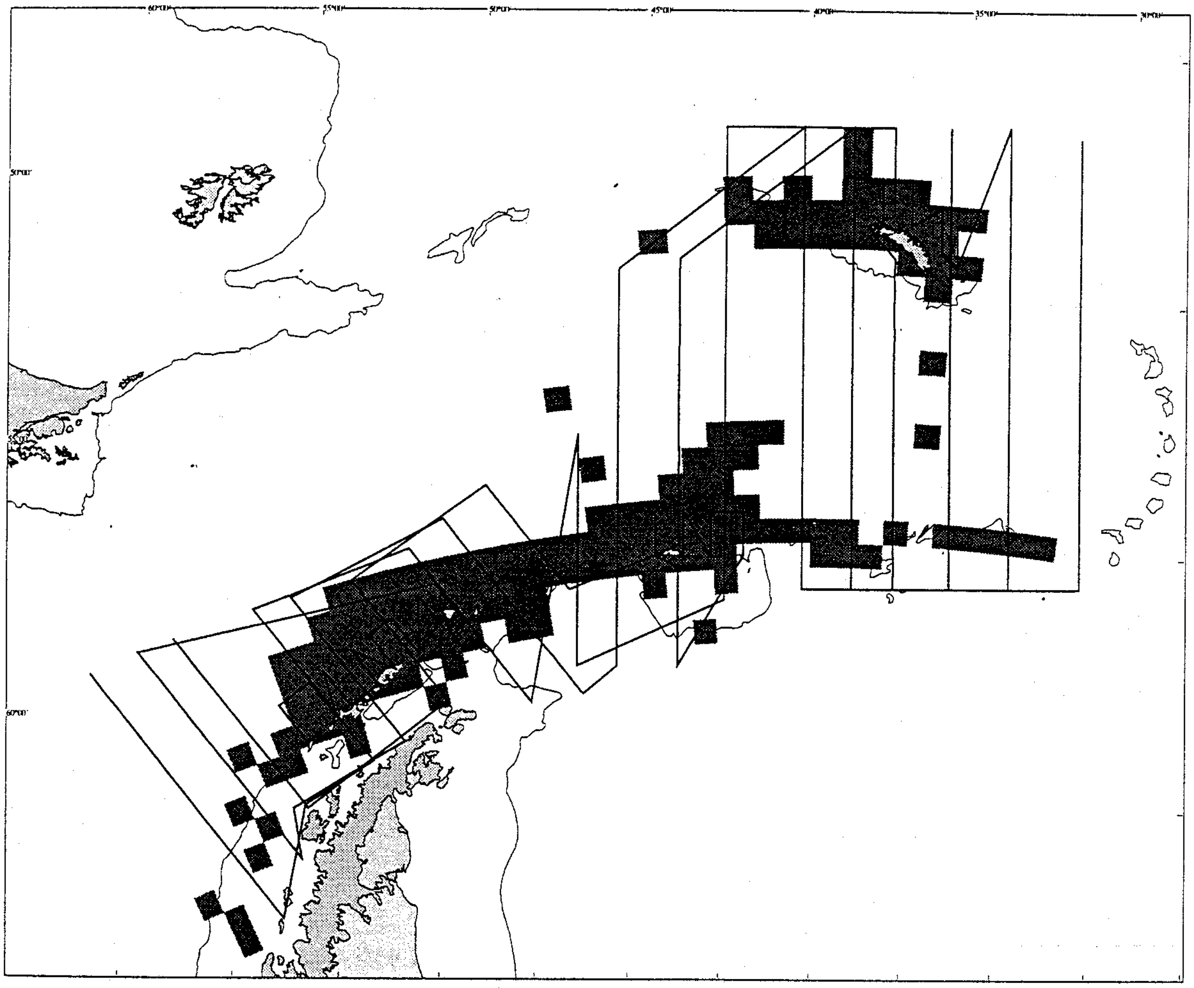

Figure 5: CCAMLR-2000 cruise tracks with positions where krill catches have been reported during the period 1986 to 1992 (CCAMLR, 1997).

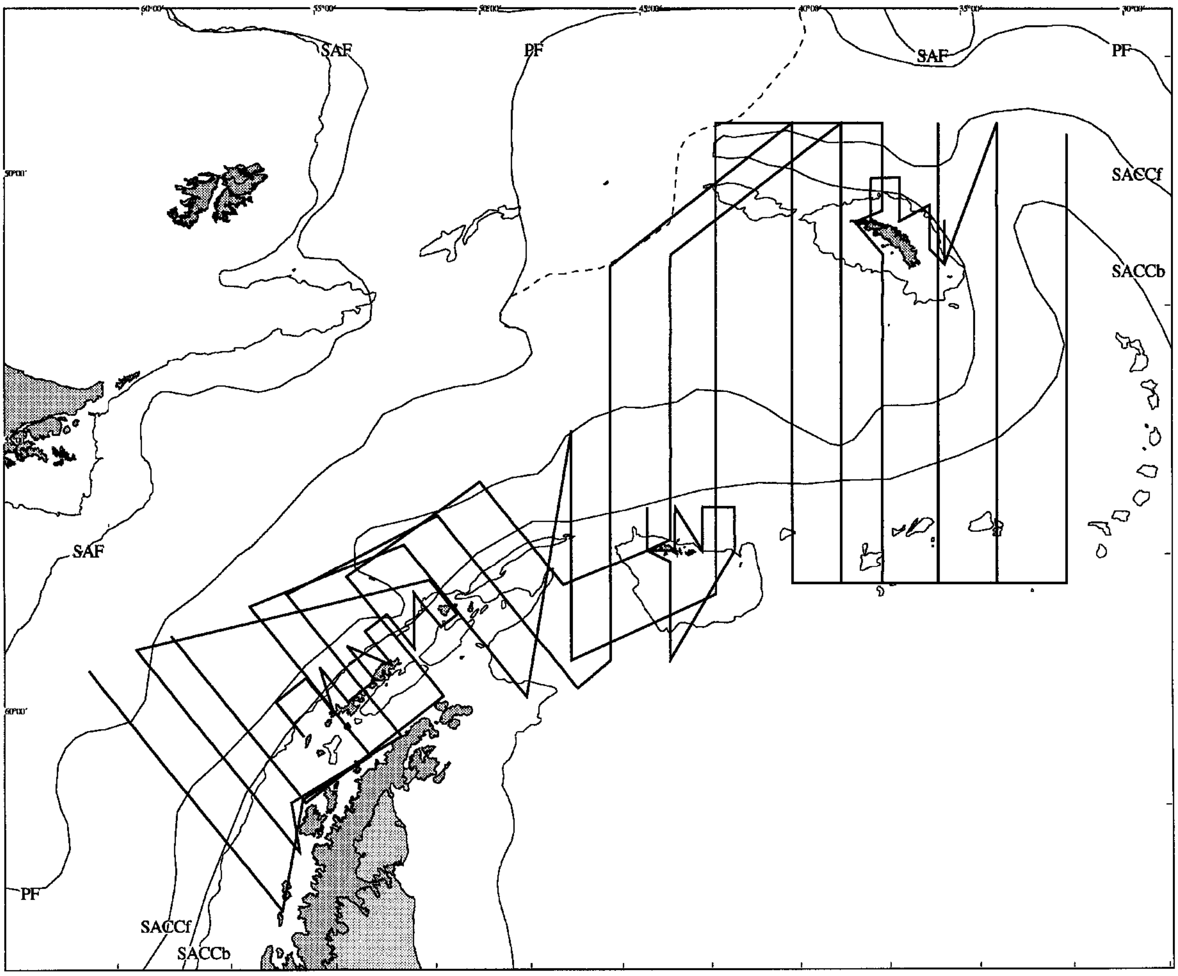

Figure 6: CCAMLR-2000 cruise tracks with climatic positions of the major fronts in the Antarctic Circumpolar Current. SAF – Sub-Antarctic Front; PF – Polar Front; SACCf – Southern ACC Front; SACCb – Southern ACC boundary. Positions of fronts after Orsi et al. (1995), with the Polar Front modified after Trathan et al. (1997).

ANNEX 5

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 11 to 21 October 1999)

CONTENTS

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT
(Hobart, Australia, 11 to 21 October 1999)

INTRODUCTION

1.1 The meeting of WG-FSA was held at CCAMLR Headquarters, Hobart, Australia, from 11 to 21 October 1999. 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 and introduced the Provisional Agenda which had been circulated prior to the meeting. Following discussions, it was agreed that:

(i) Subitem 3.3 'Status of Fisheries and Assessments' should be moved to Item 4 and be incorporated in a new Subitem 4.5 'Regulatory Framework for Fisheries Development'; and

(ii) a new Subitem 7.9 'Strategic and Policy Issues' should be added.

With these changes the Agenda was adopted.

2.2 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.

2.3 The report was prepared by Mr B. Baker (Australia), Dr E. Balguerías (Spain) Dr E. Barrera-Oro (Argentina), Mr N. Brothers (Australia), Dr A. Constable (Australia), Prof. J. Croxall (UK), Dr I. Everson (UK), Dr R. Gales (Australia), Dr R. Holt (USA), Mr C. Jones (USA), Dr G. Kirkwood (UK), Dr K.-H. Kock (Germany), Dr E. Marschoff (Argentina), Dr D. Miller (Chairman, Scientific Committee), Ms J. Molloy (New Zealand), Ms N. Montgomery (Australia), Dr G. Parkes (UK), Dr G. Robertson (Australia) and the Secretariat.

REVIEW OF AVAILABLE INFORMATION

Data Requirements Endorsed by the Commission in 1998

Data Inventory and Developments in the CCAMLR Database

3.1 A report on the present state of the CCAMLR databases was presented by Dr D. Ramm (Data Manager).

3.2 The majority of the data from the 1998/99 split-year (1 July 1998 to 30 June 1999) and the 1998/99 fishing season (various periods) had been submitted and were available to WG-FSA.

3.3 With the exception of data from Argentina, Japan, Russia and Spain, all STATLANT data for the 1998/99 split-year had been submitted; data from Spain were submitted on

20 October 1999. Where STATLANT data were not yet available, data were temporarily constructed from catch and effort and fine-scale data. STATLANT data were summarised in SC-CAMLR-XVIII/BG/1.

3.4 With the exception of reports arising from trawling for *Champsocephalus gunnari* in Subarea 48.3, all catch and effort reports for the 1998/99 fishing season had been submitted. Data from the catch and effort reports were summarised in CCAMLR-XVIII/BG/9.

3.5 All fine-scale data from finfish fishing in the 1998/99 fishing season had been submitted, with the exception of data from three longliners targeting *Dissostichus eleginoides* in Subareas 48.3 and 48.6 (CCAMLR-XVIII/BG/9 and paragraphs 3.13 to 3.16). Fine-scale data from the krill fishery in Area 48, and the crab fishery in Subarea 48.3 in 1998/99 had not yet been submitted.

3.6 Observer data and reports on longline fishing and trawling in the 1998/99 season had been submitted. These data were summarised in WG-FSA-99/10, 99/11 and 99/12. The observer data and a report on the crab fishery in Subarea 48.3 were submitted at the meeting.

3.7 The CCAMLR research survey database underwent a major transformation in 1999, with further work to be completed during 2000. Data from trawl surveys, which had been maintained previously in the same database as the commercial trawl data, were being transferred to a new dedicated database (WG-FSA-99/14). The structure of this new database was presented and discussed at WG-FSA-98, then further developed. Data from six surveys (Argentina 1994, 1995, 1996, 1997; UK 1997; USA 1999) were available in the new format at the start of the meeting, and the transfer of other survey data was well under way.

3.8 At the four previous meetings, Dr P. Gasiukov (Russia) had found some apparent errors with the survey database. These problems had prevented him from undertaking analyses on the South Georgia trawl surveys. Arising from this, he and Dr Everson had agreed to try to resolve these difficulties during the intersessional period (SC-CAMLR-XVII, Annex 5, paragraph 3.6). Most of the difficulties that Dr Gasiukov had experienced with the UK survey database had been resolved. At the meeting it became clear that one problem remained, the specification of water depth for the 1991 UK survey. Due to an oversight, the water depths from that survey had been reported in metres when the actual measurement was made in fathoms; the appropriate transformation had not been made. The correct depths had been provided in the original tabled paper WG-FSA-91/14. Dr Everson apologised for this oversight and hoped that, with this correction, there would be no further problems. He requested that the Data Manager liaise with him whilst the remaining UK trawl survey data are loaded into the database.

3.9 Participants at WG-FSA were encouraged to update and/or correct the information listed in WG-FSA-99/14 and provide additional survey data. WG-FSA also requested that other information relevant to the surveys, such as the maturity scales reported in WG-FSA-99/55, be submitted to the Secretariat so that this may be appended to the database for reference.

3.10 The Working Group noted the greater complexity of the data resulting from research surveys compared to commercial fisheries data, and the consequent difficulties in interpretation by researchers other than the originators of the data. Those involved in submitting research data to the Secretariat were encouraged to include supplementary information on sampling protocols. Summary information to allow validation of the data should also be provided.

3.11 Data on the trade of *D. eleginoides* in 1998 and 1999 were reported to the Secretariat by Australia, Chile, USA and FAO. These data quantified imports and exports of *Dissostichus* products such as frozen fillets and headed, gutted and tailed (HAT) fish. Processed weights were converted to whole weights using the conversion factors (CFs) used by WG-FSA in 1998: a factor of 2.2 was used to convert fillet weight to whole weight; and a factor of 1.7 was used to convert HAT weight to whole weight. Available trade data were summarised in Appendix B of SC-CAMLR-XVIII/BG/1.

3.12 Some data on landings were submitted to the Secretariat during 1999. These data were circulated to Members and provided to WG-FSA's subgroup on illegal, unregulated and unreported (IUU) fishing in WG-FSA-99/51.

Data Entry and Validation

3.13 Available data from the 1998/99 split-year (STATLANT data) have been entered. In addition, data from the 1998/99 fishing season have been entered with the exception of the observer logbook data from the crab fishery in Subarea 48.3 which were submitted at the meeting. Available STATLANT data and catch and effort reports have been validated, and validation was under way for the remaining data from the 1998/99 fishing season.

3.14 The following fine-scale data were overdue at the start of the meeting:

(i) from the UK – *Argos Helena* longlining in Subarea 48.3 from 15 April to 17 July 1999 (preliminary data were submitted prior to WG-FSA, and processed during WG-FSA; the complete dataset was submitted on 18 October 1999);

(ii) from the Republic of Korea – *No. 1 Moresko* longlining in Subarea 48.3 from 15 April to 17 July 1999 (preliminary data were submitted prior to WG-FSA, and processed during WG-FSA; the complete dataset arrived by mail on 19 October 1999); and

(iii) from South Africa – *Koryo Maru 11* longlining in Subareas 48.3 and 48.6 from 15 April to 5 August 1999 and *Northern Pride* longlining in Subarea 48.3 from 1 April to 22 August 1998.

3.15 Validation of fine-scale data had identified a number of instances where it was suspected that processed weights, rather than whole weights, had been reported in the longline fisheries for *Dissostichus* spp. Currently all catches in the fine-scale data must be recorded as whole weights, and all factors used to convert processed weights to whole weights must be included in the submitted data. Two types of errors were suspected: (i) both the retained and discarded weights of *Dissostichus* spp. were reported as processed weights (e.g. HAT and offal); and (ii) the retained weight of *Dissostichus* spp. was reported as whole weight, but the discarded weight included offal.

3.16 The suspected errors were detected through reconstruction of catches using reported CFs and data from the catch and effort reports. The percentages of suspect records in the C2 dataset, by area, year, month and country, were listed in WG-FSA-99/9. Most of these suspected problems occurred in data submitted by the UK and advice had been sought from the UK. Further discussion during the meeting confirmed the use of processed weights, and WG-FSA recommended that the UK submit corrections to the Secretariat as a matter of urgency. The Secretariat would also contact other Members who had submitted data with suspected problems (see WG-FSA-99/9, Table A1) to seek confirmation, and corrections, where appropriate.

Other

3.17 Electronic data forms (eforms) were now available for reporting STATLANT data, catch and effort reports, fine-scale data (catch, effort and biological) and observer data (see WG-FSA-99/8 and 99/10). The eforms were developed in Microsoft Excel, and available from the Secretariat via email; access via the CCAMLR website will be provided in 2000. Approximately 30% of the fishery data submitted in 1999 were submitted on the Excel eforms.

In addition, a prototype Microsoft Access database had also been developed for the observer data as requested last year (SC-CAMLR-XVII, Annex 5, paragraph 3.64). This database had been available in 1999, but was yet to be evaluated.

3.18 Estimates of seabed areas within the fishable depth range and the geographic ranges of *Dissostichus* spp., both within and outside the Convention Area, were reported in WG-FSA-99/13. These estimates included those calculated at WG-FSA-98 for a number of ‘small-scale’ management units, and new estimates for areas north of the Convention Area to the northern limits of the geographic range of *D. eleginoides*. The release of a new dataset from Sandwell and Smith, at a spatial resolution of 1 x 1 minute, had been delayed and consequently the planned revision of seabed areas requested at WG-FSA-98 (SC-CAMLR-XVII, Annex 5, paragraph 3.12) had not been possible in 1999.

3.19 Revised estimates of seabed areas within the 500 m isobath of the South Orkney Islands were presented in WG-FSA-99/33. The estimates were derived from depth soundings and satellite altimetry data held in 16 datasets, including data from surveys conducted by the USA, Germany, Spain and the UK.

3.20 WG-FSA reviewed the available bathymetry data and differences in estimates reported in papers tabled over the past few years. The Sandwell and Smith dataset currently used by the Secretariat was known to have some limitations, including the absence of data south of 72°S due to the presence of permanent sea-ice. Mr G. Patchell (New Zealand) also identified large discrepancies between this dataset and the ETOPO5 data in Area 88. Despite these limitations, the Sandwell and Smith dataset did provide a consistent approach to the estimation of seabed areas within the Convention Area, especially in areas subject to notifications for new and exploratory fisheries where little shipboard data had been collected.

3.21 WG-FSA reaffirmed its conclusion from last year (SC-CAMLR-XVII, Annex 5, paragraph 3.11) that seabed areas within fishing depth ranges estimated from the Sandwell and Smith dataset were adequate for the purpose of estimating the amount of potentially suitable substrate available to *D. eleginoides* and *D. mawsoni* in regions where little information was available. The Working Group also continued to encourage Members to collect detailed bathymetry data, and to submit these to the Secretariat so as to develop a high resolution bathymetry dataset which could be used to further biological knowledge about key species (SC-CAMLR-XVII, Annex 5, paragraph 3.12). Detailed data could also be used to ground truth composite datasets such as Sandwell and Smith in areas where surveys had been conducted. Bathymetry data available within the Working Group are listed in Table 1.

3.22 Other data and information available to WG-FSA included (WG-FSA-99/9):

(i) notifications for new and exploratory fisheries in 1999/2000;
(ii) monitoring the longline fishery for *D. eleginoides* in Subarea 48.3 in 1998/99;
(iii) a brief history of new and exploratory fisheries;
(iv) data requirements for CCAMLR fisheries in 1997/98 and 1998/99; and
(v) catch-weighted length frequencies for *D. eleginoides* in Subarea 48.3.

Fisheries Information

Catch, Effort, Length and Age Data Reported to CCAMLR

3.23 Catches reported from the Convention Area during the 1998/99 split-year (1 July 1998 to 30 June 1999) are summarised in Table 2. These catches included those taken within South Africa’s EEZ in Subareas 58.6 and 58.7, France’s EEZ in Subarea 58.6 and Division 58.5.1, and Australia’s EEZ in Division 58.5.2.

3.24 Fisheries carried out under the conservation measures in force during the fishing season of 1998/99 were reported in CCAMLR-XVIII/BG/9. Reported catches from all fisheries are summarised in Table 3.

3.25 WG-FSA briefly examined the monitoring of the longline fishery for *D. eleginoides* in Subarea 48.3 in 1998/99 (WG-FSA-99/9). The total catch reported in this fishery had exceeded the catch limit (3 500 tonnes) by 152 tonnes (4%). The Working Group concluded that the monitoring by the Secretariat had been in accordance with the agreed protocol, and that the small overshoot was the result of high catch rates during the final 10 days of the fishing season. WG-FSA also noted that 66% (56 reports) of all catch and effort reports had been submitted after their respective deadlines.

3.26 Length-frequency data have continued to be submitted during 1999. Most of the data were collected by scientific observers and reported in their logbooks and reports. Some length-frequency data were submitted on the fine-scale biological data form.

3.27 At the request of WG-FSA in 1998, the Secretariat had further developed the routine for deriving catch-weighted length frequencies for *Dissostichus* spp. and *C. gunnari* caught in commercial fisheries within the Convention Area (WG-FSA-99/15). Catch-weighted length frequencies were derived from four CCAMLR datasets: (i) length-frequency data collected by scientific observers; (ii) length-frequency data submitted by Flag States; (iii) fine-scale catch data submitted by Flag States; and (iv) STATLANT data submitted by Flag States.

3.28 Catch-weighted length frequencies were held in a new database, and were available to WG-FSA in a format which allowed graphical presentation and standardisation of data to examine trends over time. As an example, catch-weighted length frequencies for *D. eleginoides* taken by longline in Subarea 48.3 were reported in WG-FSA-99/9.

Estimates of *Dissostichus* spp. Catches from Illegal, Unregulated and Unreported Fishing

3.29 The Working Group has reviewed IUU catches of *Dissostichus* spp. in the Convention Area over the past two years (SC-CAMLR-XVI, Annex 5, paragraphs 3.18 to 3.22 and Appendix D; SC-CAMLR-XVII, Annex 5, paragraphs 3.20 to 3.41). Information for the 1998/99 season was compiled by a small task group convened by Prof. G. Duhamel (France) and presented as WG-FSA-99/51.

3.30 Reported catches of both *D. eleginoides* and *D. mawsoni*, along with estimates of unreported catches by Members and Acceding States, are presented in Table 4. Catches for the 1997/98 split-year are shown in parentheses. Information on catches in EEZs outside the Convention Area are available for most countries except Peru. Estimates of unreported catches were available for Argentina and Chile, but since these catches are derived from crude estimates of potential catch and effort in the Indian Ocean (see paragraph 3.31 below), they should be treated with caution.

3.31 Estimated landings of IUU-caught *D. eleginoides* by CCAMLR Members and non-Members alike in Cape Town/Durban (South Africa), Walvis Bay (Namibia), Port Louis (Mauritius) and Montevideo (Uruguay) are presented in Table 5 for the past three years. This information was provided by authorities in the countries concerned as well as by commercial sources. While it can be seen that landings have decreased in 1998/99 compared with the previous two years, the reasons for this decline are unclear and cannot be attributed to any obvious cause. Mauritius remains the primary site for the landing of IUU-caught fish.

3.32 Following the approach adopted at its 1998 meeting (SC-CAMLR-XVII, Annex 5, paragraph 3.24), the Working Group estimated the magnitude of IUU fishing effort and catches in various subareas and divisions during the 1998/99 split-year (Table 6).

3.33 In respect of catch estimates for Subarea 48.3, the Working Group noted that there had been a report of up to three IUU vessels from Argentina fishing in the area. Catches taken by these vessels could therefore potentially raise the total catch for Subarea 48.3 in 1998/99 by some 1 920 tonnes. However, the Working Group recognised that three CCAMLR inspections had been carried out by the UK in Subarea 48.3 during the 1998/99 fishing season and that no sightings of IUU vessels have been reported by the UK. While the presence of buoys with fishing lines attached may indicate that some IUU fishing has taken place in Subarea 48.3, this is probably relatively minimal, amounting to no more than about 300 to 400 tonnes in 1998/99. Consequently, the range of potential IUU catches in Subarea 48.3 during 1998/99 may have been between 300 and 1 920 tonnes and the Working Group was unable to narrow the range any further.

3.34 From Table 7 it can be seen that in most areas IUU catches account for between 30 and 100% of the estimated total catch. The total estimated landings of catches in Walvis Bay and Mauritius in 1998/99 (16 425 tonnes) accounted for some 86% of the estimated 18 983 tonnes total catch in the Indian Ocean. They were also similar to the estimated total reported catch by Members and Acceding States (17 041 tonnes) in the Convention Area in 1998/99, but in contrast to previous years (e.g. SC-CAMLR-XVII, Annex 5, paragraph 3.25) somewhat in excess of the range of estimated unreported catches (10 733 to 12 653 tonnes) (see Tables 4 and 6).

Estimated Unreported Catches of *D. eleginoides* for the Generalised Yield Model

3.35 As last year, estimates of total catches were obtained in order to update current assessments of *D. eleginoides* in Subareas 48.3, 58.6 and 58.7 as well as Divisions 58.5.1, 58.5.2 and 58.4.4. These catches were apportioned into reported catches and unreported catches from the Convention Area for the period November 1998 to September 1999 (Table 8).

Estimated Trade in *D. eleginoides* and *D. mawsoni* for 1998/99

3.36 Trade statistics for *D. eleginoides* in 1998/99 were received from FAO, Japan, USA, Chile and Australia (Tables 9 to 11). As last year, no market information was available for smaller markets. It can be seen that some 32 178 tonnes of *D. eleginoides* were imported into Japan and the USA during 1998/99, with Chile, Argentina, Mauritius and China being the major sources of supply. This can be compared with a total estimated import of 69 978 tonnes in the 1997 calendar year and 33 825 tonnes in the first half of 1998 (SC-CAMLR-XVII, Annex 5, Tables 9 and 10).

3.37 From a plot of the price and import quantity of *D. eleginoides* in the US market (Figure 1), it can be seen that the price of product has been steadily increasing since July 1998. The trend has continued despite obvious fluctuations in supply as shown by variable import quantities.

3.38 As noted for 1997 and 1998 (SC-CAMLR-XVII, Annex 5, paragraph 3.33), the estimated total *Dissostichus* spp. catch in 1998/99 (41 201 tonnes) was slightly in excess of the total trade (32 178 tonnes) by the USA and Japan.

3.39 As last year, the Working Group noted that trade statistics should be treated with caution since the export sources of product are not necessarily responsible for the catching of fish. In this context, the emergence of China as an export source and the fact that China could contribute to increased fishing effort in the future were noted. Other anomalies between estimated catches and trade figures may be attributable to inter-market transfers of product and stockpiling.

Working Group Commentary on Estimated Total Removals of, and IUU Fishing for, *Dissostichus* spp.

3.40 In both 1997 and 1998, WG-FSA took into account unreported catches of *D. eleginoides* in its assessment of stock yields and on the assumption that IUU catches can be brought under control (SC-CAMLR-XVI, paragraphs 2.13, 5.100, 5.108 to 5.111, 5.130 and 5.138; SC-CAMLR-XVII, paragraphs 5.85 and 5.89).

3.41 Estimated total catches for *Dissostichus* spp. over the past three split-years are given in Table 12. In keeping with similar results in 1997 and 1998, most IUU fishing for *Dissostichus* spp. during 1998/99 occurred in the Indian Ocean (Area 58) with the major focus being on Subarea 58.6 (Crozet) and Division 58.5.1 (Kerguelen) (Table 7). The emergence of Division 58.4.4 as an area of IUU fishing is noteworthy.

3.42 The Working Group reiterated its concern that the information on which its review of IUU fishing has been based over the past three years has considerable uncertainties attached to it. In the Indian Ocean, coverage of IUU activities is patchy in Subareas 58.6 and 58.7 (Prince Edward and Crozet Islands) as well as Divisions 58.5.1 (Kerguelen Islands) and 58.5.2 (Heard and McDonald Islands), and is almost absent for Division 58.4.4 (Ob and Lena Banks). This makes it difficult to directly quantify the impacts of IUU operations on the stocks concerned, despite indications that catches of *D. eleginoides* in the South African EEZ around the Prince Edward Islands have fallen to about 10% of their initial levels and biomass estimates around the Crozet Islands have declined to between 25 and 30% of their original levels.

3.43 Taking such considerations into account, the Working Group agreed that estimates of IUU catches of *Dissostichus* spp. are only minimum estimates at best and that 1998/99 values should be compared with previous years only with caution. Furthermore, information provided in WG-FSA-99/51 indicates that the transhipment of catches at sea is on the increase and that as much as 6 000 tonnes of fish may have been moved during 1998/99 in this way. Such developments only serve to raise further the uncertainty associated with estimates of total *Dissostichus* spp. removals.

3.44 Although IUU catches appear to be lower than last year, the Working Group stressed that the difficulties in estimating IUU catches have increased. The available information for 1998/99 is therefore, if anything, more uncertain than for 1997/98 and hence the Working Group reiterated the views set out in paragraphs 3.39 to 3.41 of last year's report (SC-CAMLR-XVII, Annex 5).

Catch and Effort Data for *D. eleginoides* in Waters adjacent to the Convention Area

3.45 Catches taken in fisheries operating outside the Convention Area and reported to national fisheries agencies were summarised in SC-CAMLR-XVIII/BG/1. Catches were reported by Argentina, Australia, Chile, New Zealand, South Africa, Uruguay and the UK. Data were also available from FAO. Annual catches of *D. eleginoides* taken outside the Convention Area, and reported to FAO, peaked at 36 884 tonnes in 1995 (calendar year), then decreased to 24 030 tonnes in 1996 and 18 359 tonnes in 1997. Data submitted by Members indicated that the annual catch in 1998 was approximately 23 000 tonnes.

Scientific Observer Information

3.46 The available information collected by scientific observers was summarised in WG-FSA-99/12. International and national scientific observers provided 100% coverage of fishing operations of vessels targeting *Dissostichus* spp. or *C. gunnari* in the Convention Area during 1998/99, and reports and logbook data were submitted from 32 cruises aboard longliners and eight cruises aboard trawlers. These cruises covered longlining in Subareas 48.3, 58.6, 58.7 and 88.1, and trawling in Subarea 48.3 and Divisions 58.4.1, 58.4.3 and 58.5.2. Additionally, information from an exploratory cruise with pots for crabs carried out in Subarea 48.3 was provided by the scientific observer on board. Observers have been deployed by six Members: Argentina (1) in Subarea 48.3; Australia (7) in Divisions 58.4.1, 58.4.3 and 58.5.2; Chile (2) in Subarea 48.3; South Africa (12) in Subareas 48.3, 58.6, 58.7 and 88.1, and in Divisions 58.4.1, 58.4.3 and 58.5.2; UK (18) in Subareas 48.3 and 58.7; and Uruguay (1) in Subarea 48.3.

3.47 The Working Group noted the high quality of logbooks and the remarkable improvement of the reports submitted in 1999. Also, problems in previous years related to delays in the arrival of some logbooks and reports at the Secretariat have been solved satisfactorily. Most of the logbooks and reports have been submitted within six weeks of the observer's return to port. This has permitted the Secretariat to enter the corresponding data into the database, begin validation (paragraph 3.13) and to prepare preliminary analyses in time for the meeting of WG-FSA.

3.48 At last year's meeting the Secretariat was tasked with the development of a stand-alone database containing the essential elements of the CCAMLR observer database, to be used on laptop computers commonly carried by scientific observers (SC-CAMLR-XVII, Annex 5, paragraphs 3.62 to 3.64). The requested database should include the observer data forms and instructions, CCAMLR codes and basic validation routines.

3.49 These electronic forms were prepared in spreadsheet format (Excel 97) and distributed among scientific observers who have had the opportunity of testing them during the 1998/99 field season (paragraph 3.17). As a result, three complete electronic observer logbooks were submitted, two from Chilean observers and one from an Argentinian observer. This has greatly facilitated the input of data into the CCAMLR general database. However, the Working Group has noted that further refinements were needed, especially relating to the development of basic validation routines.

3.50 The Working Group reviewed the contents of Tables 1 to 3 in WG-FSA-99/12 (Tables 13 to 15 in this report). These tables were found to contain important information on the types of data available. An evaluation of the vessels' compliance with Conservation Measure 29/XVI and other measures in force related to the incidental mortality arising from longline fishing, is given in paragraphs 7.48 to 7.54 and Table 16.

3.51 All the observers' reports contain very detailed information on the vessels' characteristics, the cruise itinerary, the gear and the fishing operations, the meteorological conditions and on the biological observations carried out on fish (see summary in Table 13). Information on the work conducted in relation to the seabird incidental mortality and the marine mammal observations is also fairly comprehensive. However, in general the reports lack sufficient description on the offal discharge practices, on the details of streamer lines and on mitigation measures used to avoid marine mammal interactions with the fishing gear.

3.52 Work on biological sampling of fish has been undertaken according to the current research priorities identified by the Scientific Committee for conducting scientific observations on commercial fishing vessels. The collection of biological samples has been extended significantly to the scales of *Dissostichus* spp., and the collection of new samples and data. The continuation of specific experiments (i.e. stomach contents, tissues for genetic studies, tagging) has been reported by several observers. Also, a good response has been noted for sampling directed to the estimation of independent CFs following the standard methodology established at last year's meeting of WG-FSA (SC-CAMLR-XVII, Annex 5, Appendix D) and endorsed by the Scientific Committee (SC-CAMLR-XVII, paragraph 3.6).

3.53 Currently scientific observers are not required to collect information on the disposal of garbage and the loss of fishing gear at sea. However, in accordance with actions agreed by the Commission on monitoring marine debris, this information is being collected by Members from their flag vessels and submitted to the Commission in Members' activities reports. A small number of observers also collected and reported this information in 1998/99 (Table 14). Several vessels were reported as returning all non-biodegradable garbage to their home ports. One vessel had plastic bands aboard, although it has not been reported to have dumped them at sea. The loss of portions of fishing gear such as hooks, floaters, doors, bobbins and other, seems to be rather frequent. Also one vessel was reported to have lost a complete longline. Only one report of an incidental oil spillage was reported.

3.54 The Working Group felt that the collection of this information by scientific observers is required taking into account a lack of precise information by vessels on the disposal of garbage and the loss of fishing gear at sea. This information would be useful for the Scientific Committee in preparing its advice to the Commission on the matter. The Working Group recommended that the collection of the abovementioned information be added to the list of tasks of scientific observers and specific forms be developed by the Secretariat for its recording and reporting.

3.55 Reports of interactions of marine mammals with fishing gear have been increasing over the years. They are mostly restricted to longlines involving Odontoceti such as killer whales and sperm whales and Otariidae such as fur seals, although there is an increasing number of records of other species (e.g. leopard seals, elephant seals) in the proximity of longlines. Also, several fur seals have been reported to interact with trawls during fishing operations. One Antarctic fur seal was recovered dead in a trawl (*Southern Champion*, Division 58.5.2) and one undetermined dolphin was reported to have been hooked but released itself (*Isla Sofía*, Subarea 48.3) (Table 15). France reported that killer whales predated heavily on *D. eleginoides* caught on longlines during fishing at the Crozet Islands in 1998/99 (CCAMLR-XVIII/MA/9).

3.56 Detailed information on streamer lines is rather scarce in the observer reports, but has been adequately recorded in the corresponding logbook forms. From them, it has been established that only one vessel complied in full with the streamer-line specifications (Table 17), and only one vessel using the Spanish longline system applied the recommended line-weighting regime of 6 kg/20 m (Figure 30). Further details and discussion are provided in paragraphs 7.49 to 7.52.

3.57 Last year it was observed that some vessels were still unaware of CCAMLR regulations and measures to prevent incidental mortality of seabirds. The Working Group therefore decided that in addition to the distribution of the booklet *Fish the Sea Not the Sky* to CCAMLR Members and directly to fishing companies, sufficient copies (including in languages appropriate for vessels being observed) had to be provided to technical coordinators for passing them on, via scientific observers, to crews of observed vessels (SC-CAMLR-XVII, Annex 5, paragraph 3.78). The Secretariat acted as requested, but despite these efforts some of the observers have commented on the lack of awareness of fishing crews of CCAMLR conservation measures and on the availability and utility of the abovementioned booklet.

3.58 At last year's meeting, comments of scientific observers on the *Scientific Observers Manual* and, in particular, on its data collection logbooks, were reviewed and a number of recommendations were made on their improvement (SC-CAMLR-XVII, Annex 5, paragraph 3.48). The revised sections of the manual were prepared by the Secretariat and circulated in January 1999.

3.59 During 1998/99 the task group on the *Scientific Observers Manual,* comprising technical coordinators of national observation programs, has continued its work. Only a limited number of comments were received from technical coordinators by the time of the WG-FSA meeting.

Therefore, the Working Group reviewed the reports submitted by scientific observers in 1998/99 and made a number of recommendations which are described in the following paragraphs.

3.60 Direct comments by scientific observers on the *Scientific Observers Manual* are rare, but some information can be extracted indirectly from their reports. Most of the reported problems are similar to previous years. The Working Group reviewed these comments and other matters raised by meeting participants and requested the Secretariat to modify the related forms as appropriate, in time for being tested during the next fishing season.

3.61 The need for observers to accurately record the weights used on longlines and the weight spacings is increasing as the potential of this mitigation measure for both autoliners and vessels using the Spanish system gains recognition.

3.62 Form L2(i) and the accompanying instructions in the manual could be changed slightly to increase the reliability of the data observers' record. It is recommended that a diagram of both the Spanish system and the autoline system are included in this section with boxes for observers to fill in relevant line dimensions, weighting regimes and weighting methods.

3.63 A related issue that requires refinement is the method of determining the mass of weights and the distance between weights. To address this, it is recommended that observers weigh 30 weights at random and provide this information in a new form which could be included in Form L2(i).

3.64 Instructions on these new requirements would be needed for the manual.

3.65 Conservation Measure 29/XVI requires vessels to discharge offal on the opposite side to hauling, if discharge of offal during hauling is unavoidable. The logbook form allows observers to record whether offal is discharged on the same or opposite side to hauling but does not allow a record of whether offal is discharged during hauling. The Working Group recommended that a new data field be added that records whether offal was never, occasionally, or always discharged during hauling, to allow more accurate analysis of compliance with Conservation Measure 29/XVI.

3.66 Form L4(vi): Preferably, at least two counts/set and minimum number of each seabird species should be recorded.

3.67 Form L4(vii): It is virtually impossible to determine if bait is taken and/or birds hooked when large numbers of birds are present. The time column is irrelevant unless recording continually 10-minute observations/set or the whole set. This part of the table could possibly be reduced to:

Species Code	Distance Astern	Method of Foraging

Other details (e.g. birds observed hooked, interactions, unusual foraging etc.) could be recorded in the comments section.

3.68 The nautical dawn/dusk table should be updated/improved, including south of 72°S in Subarea 88.1.

3.69 The outline of information to be included in scientific observer summaries to CCAMLR (reports), under '4: Summary of Fishing Operations' should include garbage and plastic disposal, snoods, hooks in discards, bands, oil/fuel discharge.

3.70 Following a recommendation of WG-FSA in 1998, the Secretariat changed instructions related to the form L3 'Daily Work Schedule of Observers' by adding a note that this form should be completed at the discretion of observers for a limited number of days during the cruise. However, there are still some comments of scientific observers on this particular form. Therefore, WG-FSA asked technical coordinators to make sure that the amendment is drawn to the attention of scientific observers.

3.71 Many observers felt that it was difficult to accurately record seabird and marine mammal abundance as well as seabird activity at night or when visibility was poor (form L4 ‘Daily Setting Observation’). The Working Group noted that changes have been introduced in this form during the intersessional period, according to its recommendations at last year’s meeting (SC-CAMLR-XVII, Annex 5, paragraph 3.53), to reflect the fact that there is no need to complete this form in full when visibility is low or at night, but that the form should remain in use for research trips. Even at night, however, information on the presence, and, if possible, relative abundance of seabirds was required. WG-FSA requested technical coordinators to draw the attention of scientific observers to these changes.

3.72 Another frequent problem mentioned by observers is the difficulty of assessing the gonadal maturity stages in *D. eleginoides*. It was suggested that the *Scientific Observers Manual* should include visual guidance (drawings/photographs) of the stages (i.e. similar to that of krill). The Working Group discussed this question and concluded that more studies and feedback from observers were needed in order to make an accurate macroscopical description of the different maturity stages. It requested that a questionnaire be prepared and distributed among a number of experienced observers to gather the necessary material and information.

3.73 Many observers expressed their inability to comply with the longline random-sampling design originally proposed by the Working Group. Also the alternative methodology established at last year’s meeting (SC-CAMLR-XVII, Annex 5, paragraph 3.66) has proved impractical, especially for those observers working on board vessels with limited space availability at their factories. The Working Group stated that some analyses should be undertaken intersessionally to evaluate the quality of the collected data and their potential effect on the stock assessments. It was agreed that, in the meantime, some flexibility would be required with the established systems as fishing operations are not identical on all vessels.

3.74 WG-IMALF also noted apparent inconsistencies between data in observers’ reports (and papers derived therefrom, e.g. WG-FSA-98/60 and 99/42 Rev. 1) and in the summaries prepared by the Secretariat, in respect of estimates of the amount of setting in daytime. It is important to resolve these discrepancies and to ensure that everyone is calculating this in identical fashion.

3.75 The need for a comprehensive and easy to interpret key for identification of the most common fish species caught in the longline fishery, similar to that recently prepared for the seabirds of the Southern Ocean, was stressed by several observers.

3.76 The Working Group re-emphasised the earlier advice of WG-FSA and the Scientific Committee that, wherever possible, two scientific observers should be used, one expert in fish work, the other experienced with seabirds. When only one scientific observer could be used, there would need to be some clear instructions on work priorities and/or how to subsample within and between the main fish and seabird tasks. In this respect, the Working Group discussed the existing work tasks and although it recognised that many of these tasks were performed in some areas, further improvement in data and material collection is needed.

3.77 The Working Group thanked all scientific observers involved in monitoring fisheries in 1998/99 for the great deal of very good work which they have done under difficult conditions. The data and reports have contributed substantially to the analyses of the Working Group.

Research Survey Data

3.78 Longline weighting trials were conducted by the UK in Subarea 48.3 in February 1999 (WG-FSA-99/5). Fine-scale catch and effort data and data collected by the scientific observer were available to the Working Group.

3.79 Australia conducted a random stratified survey in Division 58.5.2 in March and April 1999 which provided new data on density and abundance of *D. eleginoides*, as well as fishing selectivity and stock structure, age and growth, maturity and recruitment (WG-FSA-99/68). A second survey, based on a grid design, was conducted on BANZARE Bank. This survey was a requirement of the exploratory fishery for *D. eleginoides* in Divisions 58.4.1 and 58.4.3 in 1998/99. Only two individuals of *D. eleginoides* were caught. However, the survey provided new information on abundance of *Macrourus carinatus* (WG-FSA-99/69).

3.80 The USA conducted a random stratified survey in Subarea 48.2 in March 1999, and new findings on the biology of demersal fish stocks in the southern Scotia Arc were reported (WG-FSA-99/16). This included new information on the species assemblage, length composition, length–weight relationships, sexual dimorphism, sexual maturity and gonadosomatic indices. Estimates of biomass for eight species were reported in WG-FSA-99/32, including trends since 1985. Revised estimates of seabed areas in waters off the South Orkney Islands were also available (WG-FSA-99/33).

3.81 Other research surveys notified for 1999 (CCAMLR-XVIII/BG/9) had either been postponed or were not aimed to acquire data in support of fish stock assessments.

Mesh/Hook Selectivity and related Experiments affecting Catchability

3.82 Dr Everson reminded WG-FSA of the continued need to collect data on mesh and hook selectivity, and to determine catchability. The need for such research had been recognised as early as 1906 (WG-FSA-99/66); no new data were presented to WG-FSA this year.

Conversion Factors

3.83 At last year's meeting of WG-FSA, it was noted that existing differences between the 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 and Table 13).

3.84 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 1998/99 season (SC-CAMLR-XVII, paragraph 3.6).

3.85 The 1998/99 season was the first year that observers had made consistent observations of CFs using a standard protocol. At this meeting, the information on CFs from observer reports was collated by the Secretariat. Table 18 presents a summary of available data.

3.86 Data from individual fish were analysed using a nested ANOVA design to provide estimates of the variance components in the CF of fish headed, gutted and tailed arising from vessels (0.0147), cruises (0.00653), hauls (0.00529) and individual fish (0.01973). Equivalent estimates of CF in headed and gutted fish was not possible since this product was obtained on only one of the cruises where individual fish were sampled.

3.87 Mean CFs were 1.672 (s^2 = 0.000112) for headed and gutted fish and 1.6565 (s^2 = 0.000097) for headed, gutted and tailed. There were no significant differences in CFs between male and female. Similarly, there were no significant differences in CFs between headed and gutted product and headed, gutted and tailed product.

3.88 Observers on several other cruises also provided valuable information on CFs from aggregated samples of fish which were compared with the CFs used by the vessel reports (Table 19).

3.89 These observations confirm the views expressed by WG-FSA in 1998 (SC-CAMLR-XVII, Annex 5, Table 13) that catches from some fisheries, particularly in Subarea 48.3, are being underestimated because inappropriate CFs are being used by most vessels when reporting their catches.

3.90 The large differences observed in Subarea 48.3 might also result from differences in the products considered by vessel skippers as opposed to scientific observers. For example, collars and cheeks may be included in the CFs used by vessels, but not used when determining total catch. Furthermore, the CFs determined by observers may or may not include collars and cheeks with the added complication that collars and cheeks undergo secondary processing in some vessels. It is not always clear from observer reports whether CFs have been calculated using different product forms and how the factors relate to standard product cuts such as illustrated in the *Scientific Observers Manual*.

3.91 The Working Group agreed that observers should continue to use the current format for determining CFs set out in the *Scientific Observer Manual*. However, the fish being sampled should be subject to the same processing methods as used during commercial processing of the catch. It was recognised that the strict application of the scientific observer guidelines for determining CFs may result in a reduction of the number of individual fish sampled. The Working Group urged theoretical studies to be undertaken in an effort to derive better estimates of the sampling precision of procedures to be applied in CF estimation.

3.92 The Working Group recognised the potential difficulties inherent in inconsistent CFs and the implications of this problem for the calculation of real catch levels. For example, catches reported for the past three seasons in Subarea 48.3 are calculated using the observer-derived CFs in Table 20.

3.93 The Working Group recommended that the Scientific Committee consider steps to ensure that appropriate CFs are used when reporting catches to CCAMLR. The possibility of directly recording the green weight of all catches should be considered in this regard.

Fish and Squid Biology/Demography/Ecology

Dissostichus eleginoides and *D. mawsoni*

Identification to Species Level of Fish Products

3.94 The Working Group noted that there had been reports of *Dissostichus* spp. being landed under other species' names. Such activities would contribute to the unaccounted illegal catch. WG-FSA-99/46 indicated that protein fingerprints can be readily obtained from fillet samples by isoelectric focusing on the muscle proteins. This process cannot be undertaken in the field, but could be undertaken in a few hours, or at most a day, in a basic laboratory ashore.

3.95 It was noted that CSIRO (Australia) had recently published a book (Yearsley et al., 1999) which contained information on the description of the appearance of fillets and the protein fingerprint for *D. eleginoides* as well as other fish species.

Stock Separation

3.96 Two papers were concerned with stock separation. WG-FSA-99/48 gave a brief summary of electrophoretic analysis of water-soluble muscle protein which indicated that there was no genetic difference between fish caught within the Argentine–Uruguayan zone in comparison with other locations of the southwest Atlantic.

3.97 An analysis of preliminary results with allozyme markers reported in WG-FSA-99/46 indicated that there was evidence for population subdivision among Pacific and Indian Ocean samples at three out of 11 loci in muscle tissue, although the population subdivision is not consistent among loci.

3.98 It was noted that samples of *D. eleginoides* had been provided to Dr P. Rodhouse (UK) as part of a 'geneflow' study. Also, the Working Group recalled that last year an additional approach had been described which was based on otolith microchemistry (WG-FSA-98/40). No further progress was reported on either of these studies.

3.99 The Working Group encouraged further work on these topics and recommended that experimental designs incorporate double-blind and inter-laboratory tests.

Age Determination

3.100 Analyses of 730 otoliths from *D. mawsoni* were reported in WG-FSA-99/43. This was a much more extensive analysis than had been possible previously. The estimates of von Bertalanffy parameters with 95% confidence limits from *D. mawsoni* caught on longlines in Subarea 88.1 were as follows:

Male L_∞ = 171.2 (162.5–180.0); k = 0.098 (0.084–0.113) and t_0 = 0.06 (-0.54–0.66)
Female L_∞ = 189.5 (179.5–199.5); k = 0.086 (0.073–0.098) and t_0 = 0.01 (-0.60–0.62).

The Working Group agreed that these should be used for current analyses.

3.101 A description was given in WG-FSA-99/43 of a study using otoliths from *D. eleginoides* for age determination. The material came from several months during the period from 1995 to 1999 and had come from three localities. All the otoliths were read by at least two of a total of four readers and their estimates compared. The results from three of the readers were in good agreement. The fourth reader gave results that were consistently higher by a constant amount relative to the other three.

3.102 The reasons for this difference are described in WG-FSA-99/56 and were suggested to be due to the criteria used to identify the first few annuli as had been described in WG-FSA-98/52. After about age 4 the annuli appear regular, a transition that is not thought to be related to the onset of sexual maturity. In WG-FSA-99/56 it is also noted that there are difficulties in determining whether the edge of the otolith was opaque or hyaline. These studies highlight the difficulties that are present in estimating the age of *Dissostichus* spp.

3.103 The estimates of von Bertalanffy growth parameters for *D. eleginoides* presented in WG-FSA-99/43 were somewhat different to earlier studies with L_∞ for males being 134.3 cm and females 158.7 cm.

3.104 Additional results on biological and population parameters for *D. eleginoides* were presented in WG-FSA-99/68. The samples for this study were obtained from a trawl survey in April 1999 and by observers on commercial trawlers operating around Heard Island (Division 58.5.2) since 1997. There were significant differences in the age composition from the sampling methods. Selectivity by longlines is known to be significant and result in catches within a narrow size range. Trawls are thought to undersample fish larger than about 1 m in length. Neither method catches large numbers of fish greater than about 130 cm. Thus the larger and older fish are poorly represented in the samples which could lead to an underestimation of L_∞.

3.105 Various alternative analytical procedures were discussed and it was concluded that different approaches were needed depending on whether a population age composition, or age composition of the commercial catches or an age–length key was the aim of the particular study. Age composition of the commercial catches can be obtained by direct sampling but sampling for the other two objectives needs to take account of the various biases.

3.106 Pending the availability of further information, it was decided that for the time being it was probably best to fix L_∞ at some arbitrary realistic value and estimate k from the data appropriate to the stock in question. The value of t_0 appears to be close to zero for all the sets of available parameter values.

3.107 It was agreed that the effects of this approach on results from the GYM and other procedures should be examined carefully.

3.108 The Working Group welcomed the collaboration between workers in trying to standardise methodology. Such a process had been very successful in the 1980s for age determination studies on other Antarctic fish species.

3.109 Analysis of length-density data from the Heard Island area presented in WG-FSA-99/68 indicated that the fish were not randomly distributed over the Heard Island shelf, but migrated between different zones. Small fish, 30 to 40 cm long, were present in the shallow part of the shelf plateau while the commercial catches in restricted parts of the upper slope zone were of fish 50 to 75 cm length. Larger fish appeared to be present in deeper waters.

3.110 A sexual maturity/length function from the samples described in WG-FSA-99/68 indicated that L_{m50} for these fish is around 970 mm, close to the values for other localities, but using the von Bertalanffy growth parameters from the study indicated that this size is reached only when the fish are about 15.5 years old. The Working Group agreed that the age at L_{m50} should be revised in the light of reconsideration of the von Bertalanffy growth parameters already mentioned.

3.111 It was noted that there was some confusion over the descriptions of the maturity stages used to describe the reproductive cycle of *Dissostichus* spp. The problem appears to be greatest for *D. mawsoni* in the Ross Sea area because that fishery is restricted to about two months during the summer, a period several months away from the assumed spawning season as noted in last year's report (SC-CAMLR-XVII, Annex 5, paragraph 3.122). In the absence of further information, it was agreed that the L_{m50} value of 100 cm (range 95–105 cm) agreed at last year's meeting should continue to be used. In the Atlantic sector, where the fishery is currently restricted to the winter months, the ripening of the gonads prior to spawning is more easily recognisable. It was agreed that development of good descriptions, including photographs of the various stages and based on samples from as much of the season as possible, should be undertaken as part of the Scheme of International Scientific Observation.

3.112 The Working Group considered the depth range over which it would be most appropriate to integrate the recruitment estimates. Taking into account survey results from different regions it was agreed that the depth range from 0 to 500 m should be used.

Champsocephalus gunnari

Length to Mass Relationship

3.113 The following general relationships using several seasons' data from South Georgia (Subarea 48.3) were given in WG-FSA-99/50:

Total mass = 0.001285 $L_t^{3.46}$
Gutted mass = 0.001136 $L_t^{3.46}$.

These relationships had been used to calculate condition indices, presented in the same paper.

3.114 In addition, the following relationships were given in WG-FSA-99/16:

Lower South Shetlands:	total mass = 0.0006 $L_t^{3.7045}$
Elephant Island:	total mass = 0.0008 $L_t^{3.581}$
South Orkneys:	total mass = 0.0017 $L_t^{3.421}$.

Size Distribution

3.115 The length distributions from two localities (Elephant Island and lower South Shetlands shelf) in Subarea 48.1 were given in WG-FSA-99/16. These indicated that different modes were present at the different localities. At Elephant Island, modes were at 24 and 35 cm, whereas on the lower South Shetlands shelf they were at 27 and 33 cm. There was a greater difference when compared with the South Orkneys at the same period where the modal values were at 23 and 43 cm, with the larger size being by far the dominant group.

3.116 The size distribution from a series of 85 hauls in Subarea 48.3 using a commercial midwater trawl in February and March 1999 described in WG-FSA-99/57, gave a length range from 13 to 46 cm with peaks at 16–17, 24–25 and 30 cm corresponding to 1+, 2+ and 3+ age classes respectively. It was suggested that the large numbers of 1+ fish at some localities probably indicated a strong recruiting year class.

Diurnal Migrations

3.117 In WG-FSA-99/64 it is noted that fry (9–10 cm) undertook a diurnal vertical migration, ascending into the water column before dawn and returning to the seabed before sunset. Juveniles and adults were present in the water column at night where catches were approximately three times those obtained by day.

3.118 WG-FSA-99/65 contained an analysis of data on the distribution of *C. gunnari* around South Georgia over a 20-year period. The annual cycle of the fish is divided into three periods: feeding (October to March), spawning (April to June) and wintering (July to September). During the feeding period, immature and large fish were present on the northern part of the South Georgia and Shag Rocks shelves. Juvenile fish at this time tended to be concentrated on the southern shelf. As the fish develop, they appear to migrate northwards through the eastern and western parts of the shelf while the bulk of small fish migrate northeastwards along the eastern part of the shelf. Most immature fish are found in the eastern shelf area.

3.119 Pre-spawning migrations are directed eastwards from the northeast part of the shelf towards the coastal zone. Off the western part of the north coast the fish migrate west and south to spawn in coastal areas on the south side of the island. Post-spawning migrations occur in the opposite directions. The fish overwinter at depths of 200 to 250 m at some distance from the coast mainly on the north side of the island.

Standing Stock

3.120 In WG-FSA-99/63 an explanation was sought for some very large reductions in standing stock between successive seasons. These reductions were coincident with seasons of low krill abundance. It is suggested that the reduction in standing stock is due to predation by fur seals which at that time were unable to obtain sufficient krill, their favoured food item.

3.121 Dr Gasiukov noted that the increase in standing stock from 1988/89 to 1989/90 was of equal interest and suggested that, even though the 95% confidence limits for the surveys overlapped, the increase could also in part be due to immigration. It was agreed that this might be investigated further in developing models of the South Georgia ecosystem. Dr Constable had noted some similar changes in *C. gunnari* at Heard Island.

Reproduction

3.122 Over the period of the *C. gunnari* fishery a number of different descriptions of maturity stages have been used by workers from different laboratories. These descriptions have much commonality but divide the annual gonad cycle into different numbers of stages. WG-FSA-99/55 described the different systems used and provided an indication of the degree of compatibility. It was agreed that Members inform the Secretariat of any errors in the descriptions. The Secretariat was requested to find out which series should be applied to each of the datasets in the CCAMLR database.

3.123 Estimates of gonadosomatic indices in March of the 1997/98 and 1998/99 seasons were presented in WG-FSA-99/16. These were 15.0 (range 9.74–22.27) for females in the South Shetlands (Subarea 48.1) and 6.52 (range 0.93–11.29) for females and 2.29 (range 0.28–6.45) for males from the South Orkneys (Subarea 48.2). The length at sexual maturity and length at first spawning appear to be reached one year later than at South Georgia (Subarea 48.3). During the period from 16 February to 10 March 1999 the majority of fish were at or close to maturity stage III. Gonad maturation appeared to be more advanced in Subareas 48.1 and 48.2 than had been reported at Shag Rocks or the South Georgia shelf as reported in WG-FSA-99/57.

3.124 Information from commercial fishing around South Georgia presented in WG-FSA-99/65 indicated that most fish would be coming into spawning condition during April.

3.125 Data from research cruises and commercial fishing were analysed to provide within-season indications of the gonad maturation process and the results presented in WG-FSA-99/54. In most seasons nearly all sexually mature fish were coming into spawning condition by April. However, the timescale of the maturation process appears to vary greatly from season to season and this is attributed to feeding conditions during the preceding winter. The analysis demonstrates that, even though in November the maturation may be several months behind a ‘normal’ schedule, the process is sufficiently plastic for fish to come into spawning condition in April.

3.126 WG-FSA-99/52 reviewed the development of conservation measures for *C. gunnari* around South Georgia and questioned the need for an extended closure of the fishery to protect juvenile and spawning fish. The paper was seen as a useful compilation of the sequence of events leading to each change in the conservation measures. The Working Group discussed the implications of the paper further under Agenda Item 4.

Feeding

3.127 Data from commercial fishing during February and March 1999 reported in WG-FSA-99/57 indicated that the fish were feeding predominantly on krill. These were present in 88% of the stomachs examined. The second most important prey item was the amphipod *Themisto gaudichaudii* which was present in 16.2% of stomachs examined. The mean index of stomach fullness was 1.72.

Condition

3.128 Results from an analysis of condition indices were reported in WG-FSA-99/50. The condition index is the ratio of the measured total mass to the expected total mass. The index is thought to be related to the amount of food available and, on the South Georgia shelf, is closely correlated to the density of krill observed from acoustic surveys. The paper presented results from an analysis of data from commercial fishing and research trawl surveys around South Georgia (Subarea 48.3) between 1972 and 1997. Periods of low condition index are linked to indicators of poor krill seasons identified during CEMP. Short-term changes in condition, of the order of a month, were found to occur. It was agreed that condition indices and variability in reproductive status should be discussed further with respect to interactions with WG-EMM.

Parasites

3.129 During commercial fishing for *C. gunnari* in March 1999 in Subarea 48.3, a large sample of fish was examined for ectoparasites. These results are reported in WG-FSA-99/58. Of the 3 000 fish examined, 24.4% were infested by the copepod *Eubrachiellantarctica* and 18.5% with the leech *Trulliobdella capitis*. It was noted that studies such as that reported in the paper might provide useful information on the degree of mixing between fish from different localities and the proposal by the authors to consider further work on the topic was welcomed.

Rajidae

3.130 At its meeting in 1998 the Working Group had identified a need for more information on elasmobranch by-catch and specifically on rays (SC-CAMLR-XVII, Annex 5, paragraphs 9.1 and 9.2). Three papers relevant to the topic were tabled.

3.131 A report on the fish species caught during exploratory longline fishing in Subarea 88.1 was presented in WG-FSA-99/44. Three species, *Raja georgiana*, *Bathyraja eatonii* and *Bathyraja* spp. nov. were reported from catches and specimens registered in the National Fish Collection at the Museum of New Zealand.

3.132 Information on rays as by-catch can be found in WG-FSA-99/40 and 99/45, and in paragraph 4.90.

Comparative and Absolute Estimates of Standing Stock

3.133 Standing stock estimates for eight species of fish encountered in bottom trawl surveys which had been undertaken in 1985, 1991 and 1999 in Subarea 48.2 were compared and the results presented in WG-FSA-99/32. Although there is substantial variability in point estimates, biomass levels of most of the species appear to be unchanged or may have declined slightly since 1991. The exceptions were in the stock of *C. gunnari*, which is currently extremely low in spite of there being no commercial fishing on this species for a number of years, and *Lepidonotothen squamifrons* and *Notothenia rossii* where there appears to be a signal of recovery. It is noted that the overall levels of biomass indicate very little potential for commercial exploitation.

3.134 Studies on *Notothenia coriiceps* at Potter Cove, presented in WG-FSA-99/24, indicated that the sampling program, which had been concentrated within a small area, had caused a decrease in mean size of fish in the population. This study is part of a monitoring program on fish species of commercial/potential commercial interest in the inshore waters of the lower South Shetland Islands area.

3.135 Monitoring of *N. rossii, Gobionotothen gibberifrons* and *N. coriiceps* mainly over a much larger area of Potter Cove over a period of nine years, presented in WG-FSA-99/30, indicated that relative to *N. coriiceps*, the other two species are still at low levels. This decline was thought to be due to commercial fishing in the region in the late 1970s. In spite of this it is reported that there are some signs of a recovery in recruitment of *N. rossii* in the last two years.

3.136 The information in WG-FSA-99/30 was compared with that from a larger scale trawl survey in the South Shetlands area in WG-FSA-99/31 (see also paragraph 4.201). It is hoped that future surveys will allow a more detailed comparison to be made so that the more frequent sampling that is possible at Potter Cove and other inshore sites of the lower South Shetland Islands area can be viewed in a wider context.

3.137 In considering these papers, the Working Group was concerned that even 20 years after the end of large-scale commercial fishing on *N. rossii*, it was still showing so little sign of significant recovery. Whilst accepting that the CCAMLR Convention had not been agreed at the time during which this fishing activity was taking place, the Working Group noted that the impact was such as to be contrary to the requirements of Article II.3(c).

3.138 Comparisons were drawn between the level of reported fishing on *N. rossii* with the total level of fishing on *D. eleginoides* from reported and IUU catches and the biological similarity of the two species. Serious concern was expressed that the levels of fishing thought to have taken place on *D. eleginoides* were similar to those which had taken place on *N. rossii* and which might lead to the imminent collapse of the stock. With *N. rossii* as the only comparison, it was felt that if such a collapse did take place, any recovery would almost certainly last for longer than the timescale specified in Article II.3(c).

Developments in Assessment Methods

3.139 WG-FSA-99/71 provided an outline of intersessional activities on the development of assessment methods for use at WG-FSA. A small workshop was held at the Renewable Resource Assessment Group (UK) to further develop the mixture analyses for estimating recruitments at South Georgia and to examine ways of integrating the CPUE analyses and the yield assessments of the GYM. Other research has made progress on developing methods for determining the age of *Dissostichus* spp. in the UK, New Zealand and Australia.

3.140 Apart from a recent survey at Heard Island and BANZARE Bank, no new information has become available to assist with estimating recent recruitment levels in the Convention Area as requested for assisting in the assessments of new and exploratory fisheries. The Working Group expressed great concern at the continuing lack of information on stocks of *Dissostichus* spp. subject to applications for new and exploratory fisheries, especially given that many of these stocks appear to have been targeted already by IUU fishers. Importantly, the Working Group noted that, in the absence of research voyages into these areas, longliners entering these fisheries need to contribute to some form of research program to help develop assessments of stock status and long-term yield.

3.141 Dr Gasiukov presented WG-FSA-99/60 in which a method is described for enhancing the application of the GYM when CPUE or some other index of abundance is available. The method uses estimates of uncertainty in the CPUE time series combined with the relationship between catch and fishing mortality in the period of known catches during the projections to ascertain whether individual projections in the simulations are plausible, given the apparent trends in CPUE in reality. The paper details the methodology required to process outputs from the GYM. This approach results in a subset of possible projections being used in the final assessment of long-term annual yield according to the CCAMLR decision rules. In the example developed in the paper based on the CPUE and GYM assessments for *D. eleginoides* at South Georgia, 10 000 projections were used to obtain a sample (approximately 10% of plausible projections) to include in the assessment. A smaller sample may be possible but 1 000 projections are likely to be too few in this procedure. The paper indicates that the current catch levels may be higher than would result from the application of this new approach (2 500 tonnes compared with 3 500 tonnes).

3.142 The Working Group noted that the results of this paper were based on last year's assessment results. The workplan for assessing yield in *D. eleginoides* at this meeting was to involve a review and, where necessary, revision of the input parameters to the GYM as well as updating the CPUE time series with the recent fishing activities. Consequently, the Working Group noted that the results of the paper provided an example of the workings of the proposed procedure but that they could not be used to infer the outcomes of such a procedure in this year's analysis.

3.143 The Working Group welcomed these developments, particularly as this had been an area of priority indicated last year. It noted that analyses that utilise and refine the outputs of the GYM will be very helpful in progressing the assessments of the Working Group.

3.144 Dr Kirkwood indicated that another approach to the same problem is to use a SIR (Sampling/Importance Resampling) Algorithm (see McAllister et al., 1994) to help tune the GYM to CPUE trajectories. This would assign probabilities to individual projections according to how compatible the observed CPUE was with those projected abundances. This would avoid the problems of rejecting large numbers of projections before an assessment could be undertaken.

3.145 The Working Group recommended that these types of analyses be developed over the intersessional period in order that some post-hoc analyses of the outputs of the GYM can be undertaken next year.

ASSESSMENTS AND MANAGEMENT ADVICE

New and Exploratory Fisheries

New and Exploratory Fisheries in 1998/99

4.1 Three conservation measures relating to new fisheries were in force during 1998/99, but only in respect of one of these was fishing carried out (Conservation Measure 162/XVII). Seven conservation measures relating to exploratory fisheries were in force during 1998/99, but only in respect of four of these was fishing carried out (Conservation Measures 151/XVII, 166/XVII, 167/XVII, 169/XVII).

4.2 For those new and exploratory fisheries where fishing occurred in 1998/99, in all but one case, the numbers of days fished and the catches reported were very small. The exception was the exploratory fishery for *Dissostichus* spp. in Subarea 88.1 conducted under Conservation Measure 169/XVII, where two vessels fished for a total of 76 days in 38 grids, taking 298 tonnes of *D. mawsoni*.

4.3 The Working Group noted that for each active new or exploratory fishery in 1998/99, all data required under Conservation Measure 65/XII were submitted by the due date.

4.4 A summary of the history of new and exploratory fisheries that have been notified since 1992/93 is given in Table 21, and a summary of the data requirements for CCAMLR fisheries in 1998/99, as defined in conservation measures, is given in Table 22.

4.5 Reviewing the information in Table 21, the Working Group noted that in all but a few cases, either no fishing or at most a very small amount of fishing had actually been carried out for the new or exploratory fisheries that had been notified. The Working Group further noted that increasing amounts of time are spent each year developing advice on precautionary catch limits for such fisheries. Particular concern was expressed that the Working Group has essentially no new information on *Dissostichus* spp. stocks in a number of subareas and divisions, despite new or exploratory fisheries having been notified for these areas, in some cases for up to four seasons in a row. The concern is further heightened by the fact that substantial amounts of IUU fishing are believed to have occurred in these areas.

4.6 The exploratory fishery for *D. mawsoni* in Subarea 88.1 provided an exception to this general pattern in 1998/99. The Working Group welcomed the new information on age and growth in WG-FSA-99/43. These data were used when calculating precautionary catch levels for Subarea 88.1 (see paragraph 4.55).

New and Exploratory Fisheries Notified for 1999/2000

4.7 A summary of new and exploratory fisheries notifications for 1999/2000 is given in Table 23.

4.8 Before discussing the individual notifications, several members noted that, especially in relation to fisheries for *Dissostichus* spp., the distinction between new and exploratory fisheries was somewhat blurred. This is particularly true for new or exploratory fisheries notified for areas that have been subjected to extensive amounts of IUU fishing.

4.9 One issue raised was that, since the closing date for notifications of new and exploratory fisheries occurs before the end of the fishing season, it is difficult to know whether an existing new fishery notified for the current season should be classified as a new or exploratory fishery in the next season. This can cause problems, since currently the two types of fisheries have different requirements for data collection.

4.10 The Working Group agreed that these classifications needed further consideration. This is taken up under Agenda Item 4.5 (paragraphs 4.227 to 4.229).

4.11 In view of the similarity between new and exploratory fisheries, the Working Group agreed to discuss the notifications together. The research vessel activity involving trap fishing for *D. eleginoides* in Subarea 48.3 notified by the UK was also considered to have similar characteristics to an exploratory fishery, and it was also discussed along with the new and exploratory fisheries notifications.

4.12 The Working Group noted that the USA had submitted a notification (CCAMLR-XVIII/BG/30) of plans to fish for crab in Subarea 48.3 in accordance with Conservation Measures 150/XVII and 151/XVII; FV *Pro Surveyor* intends to catch 1 600 tonnes of crabs, and approximately 60 tonnes of finfish as by-catch.

New Trawl Fishery for *Chaenodraco wilsoni*, *Lepidonotothen kempi*, *Trematomus eulepidotus*, *Pleuragramma antarcticum* and *Dissostichus* spp. in Division 58.4.2

4.13 Australia submitted a notification (CCAMLR-XVIII/11) for a new fishery for *Chaenodraco wilsoni*, *Lepidonotothen kempi*, *Trematomus eulepidotus*, *Pleuragramma antarcticum,* and *Dissostichus* spp. in Division 58.4.2. A summary is given in the following table.

Information required	Information supplied
Type of fishery	New
Member	Australia
Reference	CCAMLR-XVIII/11
Area	Division 58.4.2
Relevant conservation measures	31/X
Species	*C. wilsoni, L. kempi, T. eulepidotus, P. antarcticum, Dissostichus* spp.
1999/2000 notification by 28 July 1999	Yes
Catch level (tonnes) for a viable fishery	Overall catch of 1 500 tonnes.
Fishery plan	Mostly pelagic trawl; demersal trawl prohibited in depths of <550 m except in designated ‘open’ strips for research purposes. Fishing operations will comply with Conservation Measures 2/III and 30/X.
Biological information	Provided in CCAMLR-XVIII/11.
Effect on dependent species	Provided in CCAMLR-XVIII/11.
Information for calculation of yield	
Data collection plan	In accordance with Conservation Measures 51/XII, 121/XVI and 122/XVI.
Observer coverage	One international and one other scientific observer on each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

New Longline Fisheries for *D. eleginoides* in Subarea 48.6 and Division 58.4.4 outside the South African EEZ

4.14 South Africa submitted a notification (CCAMLR-XVIII/9) for new fisheries for *D. eleginoides* in Subarea 48.6 and Division 58.4.4 outside the South African EEZ. A summary is given in the following table.

Information required	Information supplied
Type of fishery	New
Member	South Africa

Table (continued)

Information required	Information supplied
Reference	CCAMLR-XVIII/9
Area	Subarea 48.6 and Division 58.4.4 outside the South African EEZ
Relevant conservation measures	31/X, 161/XVII, 162/XVII and 164/XVII
Species	*Dissostichus* spp.
1999/2000 notification by 28 July 1999	Yes
Catch level (tonnes) for a viable fishery	To be determined based on 100 tonnes/fine-scale rectangle.
Fishery plan	Longlines; set grid catch limit for target species at 100 tonnes/ fine-scale rectangle; confine fishery to South African-flagged vessels; fishing seasons as defined in Conservation Measures 162/XVII and 164/XVII; vessels to comply with Conservation Measures 29/XVI, 31/X, 51/XII, 63/XV, 65/XII, 121/XVI, 122/XVI, 161/XVII, 162/XVII and 164/XVII.
Biological information	In accordance with Conservation Measures 121/XVI and 122/XVI.
Effect on dependent species	
Information for calculation of yield	
Data collection plan	As defined in Conservation Measures 51/XII, 121/XVI, 122/XVI and Annex 161/A of 161/XVII.
Observer coverage	International scientific observer on each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

4.15 Dr Miller noted that the South African notification for new fisheries in Subarea 48.6 and Division 58.4.4 submitted last year contained a description of a 'sliding scale' for biological sampling (SC-CAMLR-XVII, Annex 5, paragraph 4.20). This was not instituted last year. He advised that this year it was intended that the feasibility of this form of sampling would be examined, but it has not been made a formal part of the notification.

New Longline Fishery for *Dissostichus* spp. in Division 58.4.4 outside the South African EEZ

4.16 Uruguay submitted a notification (CCAMLR-XVIII/14) for a new fishery for *Dissostichus* spp. in Division 58.4.4 outside the South African EEZ. A summary is given in the following table.

Information required	Information supplied
Type of fishery	New
Member	Uruguay
Reference	CCAMLR-XVIII/14

Table (continued)

Information required	Information supplied
Area	Division 58.4.4 outside the South African EEZ
Relevant conservation measures	31/X, 161/XVII and 164/XVII
Species	*Dissostichus* spp.
1999/2000 notification by 28 July 1999	Yes*
Catch level (tonnes) for a viable fishery	Proposed total catch limit of 580 tonnes as outlined in Conservation Measure 138/XVI (current total catch limit 572 tonnes – Conservation Measure 164/XVII).
Fishery plan	Maximum of two longliners.
Biological information	
Effect on dependent species	
Information for calculation of yield	
Data collection plan	In accordance with conservation measures.
Observer coverage	One international and one national scientific observer on board each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

* Notification dated 26 July 1999, received 31 July 1999.

New and Exploratory Longline Fisheries for *Dissostichus eleginoides* in Subareas 58.6 and 58.7 and Divisions 58.4.3, 58.4.4, 58.5.1 and 58.5.2 outside the EEZs of South Africa, Australia and France

4.17 France submitted a notification (CCAMLR-XVIII/20) for new and exploratory fisheries for *D. eleginoides* in Subareas 58.6 and 58.7 and Divisions 58.4.3, 58.4.4, 58.5.1 and 58.5.2 outside the EEZs of South Africa, Australia and France. A summary is given in the following table.

Information required	Information supplied
Type of fishery	New and exploratory
Member	France
Reference	CCAMLR-XVIII/20
Area	Subareas 58.6 and 58.7 and Divisions 58.4.3, 58.4.4, 58.5.1 and 58.5.2 outside the EEZs of South Africa, Australia and France.
Relevant conservation measures	31/X, 65/XII, 160/XVII, 161/XVII, 163/XVII, 164/XVII and 168/XVII

Table (continued)

Information required	Information supplied
Species	*D. eleginoides*
1999/2000 notification by 28 July 1999	Yes*
Catch level (tonnes) for a viable fishery	Total of 2 500 tonnes for all vessels in all regions.
Fishery plan	Four longliners; fishing depth 500–2 000 m; minimum length of fish retained 60 cm.
Biological information	
Effect on dependent species	
Information for calculation of yield	
Data collection plan	Data in accordance with Conservation Measures 51/XII, 121/XVI and 122/XVI.
Observer coverage	One national observer, and eventually one international scientific observer on each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

* A preliminary notification was submitted on 25 July 1999, CCAMLR-XVIII/20 was submitted on 17 September 1999.

4.18 The Working Group noted that, while the original notification was submitted on time, full details were not available until considerably later.

4.19 The Working Group also noted that the distribution of fishing effort amongst fine-scale rectangles within an area will presumably be covered by Conservation Measure 161/XVII. However, no information was given on the planned distribution of effort or catches amongst subareas and divisions in this notification. Since this notification covers subareas and divisions subject to other notifications of new or exploratory fisheries, provision of management advice in relation to precautionary catch levels for those areas may be made more difficult.

New and Exploratory Fisheries for *Dissostichus* spp. in Subareas 48.6, 58.6, 88.1 and 88.2, and Divisions 58.4.3 and 58.4.4 outside the Australian, French and South African EEZs

4.20 The European Community submitted a notification (CCAMLR-XVIII/21) on behalf of Portugal for new and exploratory fisheries for *Dissostichus* spp. in Subareas 48.6, 58.6, 88.1 and 88.2, and Divisions 58.4.3 and 58.4.4 outside the Australian, French and South African EEZs. A summary is given in the following table.

Information required	Information supplied
Type of fishery	New and exploratory[1]
Member	European Community (Portugal)
Reference	CCAMLR-XVIII/21

Table (continued)

Information required	Information supplied
Area	Subareas 48.6, 58.6, 88.1 and 88.2 and Divisions 58.4.3 and 58.4.4 outside Australian French and South African EEZs, and Division 58.5.1[2].
Relevant conservation measures	31/X, 65/XII, 162/XVII, 163/XVII, 164/XVII, 168/XVII and 169/XVII
Species	*Dissostichus* spp.
1999/2000 notification by 28 July 1999	Received 1 October 1999.
Catch level (tonnes) for a viable fishery	900 tonnes
Fishery plan	One longliner; fishing depth 500–2 500 m.
Biological information	
Effect on dependent species	By-catch of *Macrourus* spp. and *Bathyraja* spp.
Information for calculation of yield	
Data collection plan	In accordance with conservation measures.
Observer coverage	International scientific observer on board.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

1 This notification also covers longlining in Subarea 48.3 (550 tonnes of *D. eleginoides*)
2 Not stated whether inside or outside French EEZ

4.21 The Working Group noted that this proposal had been submitted very late.

4.22 It also noted that this is the first time that a proposal had been received on behalf of a non-Contracting Flag State. In this context, it agreed that submission of information on previous fishing activities within the Convention Area by Portuguese-flagged vessels, if any, would be welcomed.

4.23 The notification also included longlining in Subarea 48.3. The Working Group agreed that this could not be considered a new or exploratory fishery. Rather, any longline fishing in Subarea 48.3 should be subject to the catch limit and any related conservation measures adopted for that subarea.

Exploratory Trawl Fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.3

4.24 Australia submitted a notification (CCAMLR-XVIII/12) for an exploratory fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.3. A summary is given in the following table.

Information required	Information supplied
Type of fishery	Exploratory
Member	Australia

Table (continued)

Information required	Information supplied
Reference	CCAMLR-XVIII/12
Area	Divisions 58.4.1 and 58.4.3
Relevant Conservation Measures	65/XII, 166/XVII and 167/XVII
Species	*Dissostichus* spp.
1999/2000 notification by 28 July 1999	Yes
Catch level (tonnes) for a viable fishery	Similar to 1998/99 catch limit in 58.4.3; possibly around 150 tonnes in Division 58.4.1.
Fishery plan	Two Australian-flagged trawlers.
Biological information	Provided in CCAMLR-XVIII/12.
Effect on dependent species	Escapement from the trawl fishery in Division 58.5.2 >85%.
Information for calculation of yield	See CCAMLR-XVIII/12.
Data collection plan	Random stratified trawl survey and data in accordance with Conservation Measures 51/XII, 121/XVI and 122/XVI.
Observer coverage	International scientific observer on each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

Exploratory Longline Fisheries for *Dissostichus* spp. in Subareas 58.6, 88.1 and 88.2, and Divisions 58.4.4 and 58.5.1 outside the EEZs of South Africa and France

4.25 Chile submitted a notification (CCAMLR-XVIII/8) for exploratory fisheries for *Dissostichus* spp. in Subareas 58.6, 88.1 and 88.2, and Divisions 58.4.4 and 58.5.1 outside the EEZs of South Africa and France. A summary is given in the following table.

Information required	Information supplied
Type of fishery	Exploratory
Member	Chile
Reference	CCAMLR-XVIII/13
Area	Subareas 58.6, 88.1 and 88.2 (outside South African and French EEZs), Divisions 58.4.4 (outside South African EEZ) and 58.5.1 (outside French EEZ).
Relevant conservation measures	65/XII, 139/XVI, 161/XVII, 164/XVII, 168/XVII and 169/XVII
Species	*D. eleginoides, D. mawsoni*
1999/2000 notification by 28 July 1999	Yes

Table (continued)

Information required	Information supplied
Catch level (tonnes) for a viable fishery	To be determined based on 100 tonnes/fine-scale rectangle.
Fishery plan	Bottom longlines; maximum of three vessels; catch limits of 100 tonnes in each fine-scale rectangle.
Biological information	
Effect on dependent species	
Information for calculation of yield	
Data collection plan	In accordance with Conservation Measures 51/XII, 121/XVI and 122/XVI.
Observer coverage	International scientific observer on each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

Exploratory Longline Fishery for *Dissostichus* spp. in Subarea 88.1

4.26 New Zealand submitted a notification (CCAMLR-XVIII/10) for an exploratory fishery for *Dissostichus* spp. in Subarea 88.1. A summary is given in the following table.

Information required	Information supplied
Type of fishery	Exploratory
Member	New Zealand
Reference	CCAMLR-XVIII/10
Area	Subarea 88.1
Relevant conservation measures	65/XII, 161/XVII and 169/XVII
Species	*D. eleginoides, D. mawsoni*
1999/2000 notification by 28 July 1999	Yes
Catch level (tonnes) for a viable fishery	As determined by CCAMLR.
Fishery plan	Longliners; fishing season from 1 December 1999 to 31 August 2000; New Zealand-flagged vessels only.
Biological information	
Effect on dependent species	New by-catch provisions proposed.
Information for calculation of yield	
Data collection plan	Line-weighting experiment (see paper) and data in accordance with Conservation Measures 51/XII, 121/XVI and 122/XVI.

Table (continued)

Information required	Information supplied
Observer coverage	International scientific observer and New Zealand Ministry of Fisheries scientific observer on each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

Exploratory Longline Fishery for *D. eleginoides* in Subarea 58.6 outside the EEZs of South Africa and France

4.27 South Africa submitted a notification (CCAMLR-XVIII/8) for an exploratory fishery for *D. eleginoides* in Subarea 58.6 outside the EEZs of South Africa and France. A summary is given in the following table.

Information required	Information supplied
Type of fishery	Exploratory
Member	South Africa
Reference	CCAMLR-XVIII/8
Area	Subarea 58.6 (outside South African and French EEZs)
Relevant conservation measures	65/XII, 161/XVII and 168/XVII
Species	*D. eleginoides*
1999/2000 notification by 28 July 1999	Yes
Catch level (tonnes) for a viable fishery	
Fishery plan	South African-flagged vessels; fishing season to be determined by CCAMLR, but note that the existence of a closed season may serve to encourage high levels of unregulated fishing which in turn may exert substantive impact on seabirds.
Biological information	
Effect on dependent species	
Information for calculation of yield	
Data collection plan	Trawl survey in Subarea 58.6 and data in accordance with Conservation Measures 51/XII, 121/XVI, 122/XVI and Annex 161/A of 161/XVII.
Observer coverage	International scientific observer on each vessel.
Position verification	VMS in accordance with Conservation Measure 148/XVII.

Experimental Trap Fishing for *D. eleginoides* in Subarea 48.3

4.28 The UK submitted a notification (WG-FSA-99/41) of research vessel activity for which the total catch is expected to be >50 tonnes. This involved experimental fishing for *D. eleginoides* using pots. A summary is given in the following table.

Member	Gear	Target Species	Subarea and Time
UK[1]	Trap	*Dissostichus eleginoides*	48.3, January–July 2000

[1] Estimated total catch of target species is 400 to 600 tonnes

4.29 There was considerable discussion on whether this notification should be considered as one for research vessel activity with a total catch exceeding 50 tonnes, or as a new or exploratory fishery, and also on the size of the anticipated catch in relation to the catch needed to determine the rate of incidental mortality.

4.30 Dr Parkes explained that in Subarea 48.3 there already exists a well-established longline fishery for *D. eleginoides*, but that the longline fishing gear is subject to a significant bird by-catch problem. Experience from a similar pot fishery for *D. eleginoides* within the Uruguayan EEZ suggested that pots can take *D. eleginoides* successfully and that there is no associated bird mortality, but the fishing method has not been tried for *D. eleginoides* in Subarea 48.3.

4.31 The aim of the fishing trials proposed is to test the commercial viability of an alternative method of catching *D. eleginoides* that has a high potential to avoid or eliminate incidental mortality of seabirds. It is intended that the experiment will start in mid-January and to continue until mid-July. Pots will be set both during the day and at night. The expected catch is based on typical Uruguayan catch rates of 2 to 3 tonnes per day. All catches would be counted as part of the catch limit set for Subarea 48.3.

Working Group Comments on New and Exploratory Fisheries

4.32 The Working Group noted that the conservation measures on new (31/X) and exploratory (65/XII) fisheries clearly specify the type of information to be provided and then considered by the Scientific Committee in the formulation of its advice to the Commission. Apart from the proposed new fishery in Division 58.5.2 and the proposed exploratory trawl fishery in Divisions 58.4.3 and 58.4.1, the information provided in the notifications submitted for 1999/2000 was deficient in terms of the requirements set out in paragraphs 3 and 2 respectively of the conservation measures concerned. The Scientific Committee's attention was drawn to this situation which WG-FSA agreed had serious implications for its ability to fully advise the Scientific Committee on the likely consequences of the notified fisheries entering into force as well as their subsequent management and ability to provide essential scientific information.

Calculation of Precautionary Catch Levels

4.33 The Working Group agreed to continue to use the same general approach it adopted at its last meeting and calculated precautionary catch limits for new and exploratory fisheries by extrapolating from estimated long-term yields for *D. eleginoides* in Subarea 48.3 and Division 58.5.2. This involved two types of calculation. Firstly, yields estimated for Subarea 48.3 or Division 58.5.2 were extrapolated to other areas using the GYM, making adjustments for the relative seabed areas and for the estimated relative densities. Following this, the extrapolated yields were discounted to take implicit account of incomplete knowledge of previously unexploited or lightly exploited areas.

4.34 While the general approach adopted was similar to last year, there were two key changes. Firstly, two alternative approaches were used to adjust for relative seabed areas. The first of these approaches was identical to that used last year, where the adjustment was based on relative areas of fishable seabed. The second approach involved adjustment based on relative areas of seabed which may be classified as recruitment areas.

4.35 The Working Group agreed that, as the proportional adjustment was actually applied to mean recruitment in each area under consideration, in principle the second approach may be more scientifically justifiable than the first, however it agreed to review the two sets of estimated seabed areas before reaching any final conclusion on this.

4.36 Secondly, the mean recruitment that had been adjusted proportionally by seabed area was multiplied by a further factor, equal to the estimated relative density on the fishing grounds of the area under consideration for new or exploratory longline fisheries, compared with that in South Georgia. This factor was calculated as the ratio of the average longline CPUE (kg/hook) available for the area under consideration to the average longline CPUE (kg/hook) for Subarea 48.3 in the 1991/92 season, the first season when haul-by-haul CPUE data were available for Subarea 48.3.

4.37 The aim of this second adjustment was to take explicit account of observed relative densities in Subarea 48.3 and the various subareas and divisions under consideration for new or exploratory fisheries. In calculating the adjustment factor in this way, the Working Group recognised that effectively it was treating CPUE data for a well-established commercial fishery as being directly comparable with CPUE data for fishing areas that were not well known or explored. It is possible that this may lead to an underestimate of the appropriate adjustment factor, but the Working Group agreed that, if this occurred, the resulting precautionary catch limit would also be underestimated. Any disadvantages this approach entailed were felt by the Working Group to be far outweighed by the advantages of taking account of relative densities on the fishing grounds.

4.38 In the absence of CPUE data for an area notified for a new or exploratory fishery, the assessments were undertaken using the relative CPUE from adjacent areas. This meant using CPUE data from Subarea 88.1 for Subarea 88.2, and CPUE data from Division 58.4.4 for Division 58.4.3.

4.39 The Working Group noted that in assessments for the trawl fishery in Division 58.4.2, the estimated recruitment should be prorated from that observed at Heard and Macquarie Islands. A survey conducted in Division 58.4.3 found only very low abundances of *Dissostichus* spp. There is a need for the Scientific Committee to consider how this information could be used in the assessment of appropriate catch levels for this division.

4.40 The calculations using the GYM involved three main components:

(i) Estimates of mean recruitment in each area under consideration were obtained by proportional adjustments for either fishable or recruitment seabed areas. For longline fisheries, the adjustments based on fishable seabed areas used the relative areas of seabed between 600 and 1 800 m in Subarea 48.3 and in the areas under consideration. For trawl fisheries, the depth range used was 500 to 1 500 m. For adjustments based on recruitment seabed areas, the relative areas of seabed used were between 0 and 500 m in Subarea 48.3 and in the areas under consideration.

(ii) Other biological and fishery parameters were set equal to the values most appropriate for the area under consideration. Where reliable estimates of biological parameters were available for the area under consideration, these were used. For other areas, available parameter estimates from the same ocean sector were used, except the Indian Ocean sector parameters were used for areas in the Pacific Ocean sector. When calculating precautionary catch limits in those areas where *D. mawsoni* would be the predominant target species, available estimates of biological parameters for that species were used.

(iii) The recent catch history for each area under consideration was updated to include the most recent information on regulated (Tables 2 and 3) and IUU (Tables 7 and 8) catches.

4.41 For *D. mawsoni*, new data on age and growth were provided in WG-FSA-99/43. These data were used to estimate a von Bertalanffy growth curve for combined sexes. Parameter estimates were L_∞ = 182.89 cm, k = 0.089 yr^{-1} and t_0 = -0.015 yr. For *D. eleginoides*, growth parameters estimated using data from Subarea 48.3 were used (paragraph 4.116). It was noted that *D. mawsoni* appears to grow faster and reach a lower maximum length than *D. eleginoides*.

4.42 For *D. eleginoides*, the Working Group agreed to use the same range of M values estimated for Subarea 48.3 (0.13–0.2 yr^{-1}, see paragraph 4.120). For *D. mawsoni*, the Working Group agreed to use a range of M values from twice to two and a half times the estimated k for that species. That resulted in a range of M of 0.18 to 0.22 yr^{-1}.

4.43 For *D. mawsoni*, the size at maturity was assumed to be 100 cm TL with a range of 95 to 105 cm. The length–weight relationship calculated from 1998 and 1999 data combined (WG-FSA-98/43) was $W = 6 \times 10^{-6} L^{3.1509}$.

4.44 Estimated seabed areas are shown in Table 24. The seabed areas cover depths between 500–600, 600–1 500 and 1 500–1 800 m, and within the fishable depth ranges for trawling (500–1 500 m) and longlining (600–1 800 m) in Subareas 48.1, 48.6, 58.6, 58.7, 88.1 and 88.2, and Divisions 58.4.1, 58.4.2, 58.4.3, 58.4.4, 58.5.1 and 58.5.2. The methods used for the estimations are outlined in WG-FSA-98/6 and 98/50. For all regions except Subarea 88.1, the Sandwell and Smith bathymetric data were used. In Subarea 88.1, WG-FSA-98/50 used additional data sources to account for the areas in the Ross Sea excluded from the Sandwell and Smith database. More detailed data are available for calculating the seabed area between 0 and 500 m in Subarea 48.3 than in other areas, but these are not used, in order to provide consistency between areas.

4.45 In calculating seabed areas, all regions of permanent ice have been omitted, including the Ross Sea ice shelf in Subarea 88.1 and the Amery ice shelf in Division 58.4.2. No data are available from the Sandwell and Smith database for seabed areas south of 72°S in Subarea 88.2. The southeastern side of the Ross Sea in this subarea is sometimes free of fast-ice during summer.

4.46 The Working Group noted that, as was done last year, the adult habitat on the Maurice Ewing Bank was included in the calculations of fishable seabed area in Subarea 48.3. No new information was available to the Working Group on the effects on estimates of precautionary yield for new and exploratory fisheries of removing Maurice Ewing Bank from seabed area calculations (SC-CAMLR-XVII, Annex 5, paragraph 4.64).

4.47 Similarly, the Delcano Rise was included in the calculation of fishable seabed area for Subarea 58.6 this year, although, as recognised last year, this is another area where adult *D. eleginoides* are captured on banks that are not immediately adjacent to juvenile habitat (the shelf around Crozet Islands). No new information was available to the Working Group on whether adult fish on the Delcano Rise contribute to recruitment of juvenile fish around Crozet Islands (SC-CAMLR-XVII, Annex 5, paragraph 4.64).

4.48 Average catch rates by species in kg/hook, weighted by the number of hooks set in each region, are given in Table 25 by subarea and division, along with the proportions these averages represent of the 1991/92 weighted average catch rate in Subarea 48.3.

4.49 For Division 58.5.1, CPUE data were available from 1995/96 to 1998/99, but the first season had a very low catch rate (0.06 kg/hook) with a very large number of hooks set, and only the second two years were used to calculate weighted average catch rates. In Subarea 58.6, CPUE data were available from 1996/97 to 1998/99, but only the first two seasons were used in calculating weighted average catch rates, as a high average catch rate occurred (0.78 kg/hook) in the most recent season. Results from a Spanish longline research cruise in Subarea 48.6 and Division 58.4.4 (Ob and Lena Banks) in 1997 (WG-FSA-98/48) provided the only source of CPUE information for these areas.

4.50 The input parameters for the GYM for areas where there are notifications for new and exploratory fisheries are given in Table 26.

4.51 The precautionary catch limit calculations were done separately for those parts of each subarea or division that were believed to be occupied by *D. mawsoni* and *D. eleginoides.* As already indicated, different growth parameters were used for each species.

4.52 The Working Group recalled that last year it had identified a number of intrinsic uncertainties in the calculation of precautionary yields. On the basis of these, the Commission had decided to apply further discount factors to the estimated precautionary yields. These were 0.45 for *D. eleginoides* fisheries and 0.3 for *D. mawsoni* fisheries.

4.53 This year, when calculating precautionary yield levels for areas notified for new or exploratory longline fisheries, the mean recruitment levels have been scaled by the estimated stock densities in the area under consideration relative to those in Subarea 48.3, as measured by CPUE ratios. The Working Group agreed that, by adopting this approach, some of the additional uncertainties involved in extrapolating recruitment have been taken into account and there may not be a need to apply the same discount factor as last year for longline fisheries.

4.54 For trawl fisheries, however, it has not yet been possible to use a correction factor for relative densities, so the Working Group agreed that a discount factor of 0.45 should continue to be applied for both *Dissostichus* species. It noted that there remained no scientific basis for selecting a particular value for this discount factor.

4.55 The Working Group also noted that this year it had substantial new information on biological parameters for *D. mawsoni* based on data collected during exploratory fishing in Subarea 88.1. At least for that area, it may no longer be necessary to apply as low a discount factor for uncertainty for *D. mawsoni* as was done last year. The Working Group agreed, however, that the available information about *D. mawsoni* was still considerably less than for *D. eleginoides.*

4.56 The results of the projections using the GYM are given in Table 27.

4.57 In calculating these projections, given the shortness of time available, some approximations were made. The actual assessments conducted using the GYM were only undertaken for a single run within each of the different sets of fishery models. A fishery model is defined by the combination of:

(i) the biological parameters (taken either from South Georgia or Heard Island for *D. eleginoides* depending on the ocean in which the proposed fishery was to be undertaken, and from the Ross Sea for *D. mawsoni*);

(ii) the recruitment variability derived from the recruitment function applied to the model (taken from South Georgia for proposed fisheries using longlining, including *D. mawsoni*, and for which CPUE was available from the proposed fishing area, or from Heard Island for Indian Ocean fisheries in which no CPUE adjustment could be applied); and

(iii) the fishing selectivity function, which differed between trawl and longline fisheries.

4.58 The resulting yield from a model run can be scaled to a different mean level of recruitment by determining the long-term annual yield per mean recruit from the model run and multiplying this by the new mean level of recruitment, which has been scaled by seabed area and, in some areas, relative levels of CPUE. The Working Group agreed that this approach was appropriate under the circumstances because the differences between approximations and some GYM trials to test the method were very small.

4.59 When reviewing the results of the GYM calculations, all members of the Working Group agreed that in a number of cases, the calculated yield levels were far in excess of any possible precautionary catch levels appropriate for those subareas or divisions. This occurred particularly in regions with substantial areas of continental shelf, but this feature was not restricted to those cases alone. The Working Group noted that the calculations had used agreed methods incorporating assumptions that it had believed to be the most appropriate it could make given the available information. The instances of clearly inappropriate calculated yields were therefore taken by the Working Group to signal that the methods and assumptions themselves must be flawed. Consequently, the Working Group was unable to use the calculated yields in Table 27 as a basis for recommending precautionary catch levels.

4.60 In attempting to identify the most likely reason for the failure of the methods for calculating precautionary yields, the Working Group agreed that almost certainly the problems lay in the extrapolations of recruitment to areas where no direct estimates of recruitment were available.

4.61 Over the last three years, considerable time and effort have been expended in developing and extending these methods based on extrapolated recruitment estimates, which were introduced originally in an attempt to investigate the possible effects of IUU catches. The Working Group agreed that it was no longer appropriate to attempt to use these methods for estimating precautionary yield levels for new or exploratory fisheries for *Dissostichus* spp.

4.62 The Working Group further agreed that the only methods that were likely to be able to result in reliable estimates of precautionary catch levels were those that were based on estimates of recruitment to the fishery obtained for the actual area subject to notification of a new or exploratory fishery. If such recruitment estimates were available, together with catch rate data for any fishing carried out in the area, the assessments based on them would then be similar in nature to those carried out in Subarea 48.3 and Division 58.5.2.

4.63 Well-designed scientific research surveys of the area under consideration were agreed by the Working Group to be the best sources of estimates of recruitment for that area. The Working Group recalled that it had recommended last year that research surveys to estimate biomass should be included in the very early stages of the development of new and exploratory fisheries for *Dissostichus* spp. (SC-CAMLR-XVII, Annex 5, paragraph 4.76).

4.64 Under the current circumstances, the urgency of this recommendation is even greater than it was before. In this context, the Working Group recognised that some subareas and divisions are rather large, and it may therefore be difficult for a single institution to undertake such a survey. However, as shown by the forthcoming CCAMLR 2000 Krill Synoptic Survey of Area 48, surveys of large areas are possible with collaboration between several institutions.

4.65 Other potential sources of data for an area are the new or exploratory fisheries notified for that area. Conservation Measure 65/XII, covering exploratory fisheries, explicitly requires compliance with a Data Collection Plan developed by the Scientific Committee for that area and the submission of a Research and Fisheries Operation Plan by the Member making the notification. The Working Group noted that these requirements have in practice only very rarely been complied with in the notifications.

4.66 Given the Working Group's current inability to provide advice on precautionary catch levels for new or exploratory fisheries in the absence of data pertaining to the area concerned, the Working Group agreed that submission of a research plan considered acceptable by the Scientific Committee should be a prerequisite to the commencement of any new or exploratory fishery.

4.67 One important issue when conducting assessments of an area is identifying variations in density of *Dissostichus* spp. across the area. Data that would allow this to be addressed could be collected as part of exploratory fishing programs, however this would require sufficient hauls to be made in each potential fishing ground in order for differences in densities to be detected statistically.

4.68 The Working Group identified eight fishing grounds in Subareas 58.6 and 58.7 and Division 58.4.4 (Figure 2). These grounds are of a similar size to the grounds investigated for differences in CPUE around South Georgia. The coordinates of these areas are given in Table 28. The Working Group agreed that these grounds could form the basis of a research plan for new and exploratory longline fisheries. The research would involve each vessel undertaking a minimum number of longline sets in those squares in which exploration was to be undertaken.

4.69 The number of sets appropriate for this research activity was examined by using the CPUE data from Subarea 48.3. The analysis of haul-by-haul data for the *D. eleginoides* fishery in that subarea suggests that the square root of the CPUE (kg/hooks) is approximately normally distributed. In 1991/92 (the first season for which haul-by-haul data are available), the mean of this variable for the Shag Rocks fishing ground was 0.56 and the standard deviation was 0.19. The average number of hooks deployed per set in this ground was approximately 4 400. This information was used in a statistical power analysis to estimate the sample sizes of hauls needed to detect different proportional differences in densities between two areas using a two-sided 5% test with power 0.8. These sample sizes are shown in Table 29 and Figure 3.

4.70 In discussing the analysis, the Working Group agreed that, as part of a research plan for a new or exploratory fishery, a requirement to undertake a minimum number of longline sets in each small area fished had considerable merit, and that the results presented could form an appropriate basis for determining that minimum number.

4.71 It will also be necessary to specify the minimum number of hooks per set, the minimum length of longlines, and the minimum distance between sets. The Working Group agreed that there was insufficient time at this meeting to resolve issues concerning line deployment, and that this matter should be examined further at the next meeting.

4.72 Finally, the notification for a new trawl fishery in Division 58.4.2 by Australia (CCAMLR-XVIII/11) involved the taking of a number of fish species other than *Dissostichus* spp. The Working Group noted that there was no information available on the biology or abundance of these species in this division, and that it had been unable to undertake any assessments. It therefore had no sound basis to advise on the likely effects of the proposed levels of catch of these species. Dr Miller noted, however, that when yields had been assessed of these species in other areas, these have often been less than 200 tonnes.

4.73 As last year, the Working Group agreed that it was necessary for measures to be taken to restrict the by-catch levels in new or exploratory fisheries. For fisheries for *Dissostichus* spp., the key by-catch species are Rajidae and Macrouridae. Based on new information available this year (see paragraph 4.91), the Working Group agreed that a maximum by-catch rate of 18%, by weight, per fine-scale rectangle would be appropriate as a basis for setting general by-catch levels for new and exploratory fisheries at this stage. While new information was also available on rajid by-catches, the Working Group agreed that the same by-catch provisions as recommended last year should be applied. The Working Group reiterated that it is important to assess the by-catch levels appropriate for fisheries in all areas (paragraph 4.98).

4.74 The Working Group agreed that there remains an urgent need for detailed catch, effort and biological data to be collected on all by-catch species and, in this regard, agreed that conservation measures specifying by-catch limitations on new and exploratory fisheries should specify data collection requirements for by-catch species that are commensurate with data collection requirements for the target species.

4.75 The Working Group noted that setting catch limits for trawl and longline fisheries in the same assessment area may cause problems in determining an appropriate combined catch that satisfies the CCAMLR decision rules. While the Working Group is developing methods of incorporating different fisheries into the GYM, no formal mechanism for indicating the sustainability of combined catches is available at this stage. It recalled its discussion last year (SC-CAMLR-XVII, Annex 5, paragraph 4.75) where some indication is given to what might be a maximum catch in a mixed fishery. The Working Group considered that a better way to determine the total catch is by the formula:

Trawl catch = (1 - proportion to be taken of longline long-term annual yield) x trawl long-term annual yield.

Management Advice

4.76 Three conservation measures relating to new fisheries were in force during 1998/99, but only in respect of one of these was fishing carried out. Seven conservation measures relating to exploratory fisheries were in force during 1998/99, but only in respect of four of these was fishing carried out. Information about new and exploratory fisheries during 1998/99 is contained in paragraphs 4.1 to 4.6.

4.77 The Secretariat received nine notifications for new fisheries in 1999/2000 (Table 23). All notifications for the 1999/2000 season were for fisheries on *Dissostichus* spp., except that the notification from Australia for a new trawl fishery in Division 58.4.2 also includes a number of other fish species. Information and Working Group comments on new and exploratory fisheries for 1999/2000 are in paragraphs 4.7 to 4.75.

4.78 As a result of apparent failures of assumptions in the methods used (see paragraphs 4.59 to 4.61), the Working Group was unable this year to provide advice on precautionary catch levels for new and exploratory fisheries notified for 1999/2000.

4.79 The Working Group further advised that it believed it is no longer appropriate to attempt to use these or similar methods based on extrapolated recruitment. The only methods that the Working Group believed likely to be able to result in reliable estimates of precautionary catch levels are those that are based on estimates of recruitment obtained for the actual area subject to notification of a new or exploratory fishery.

4.80 The Working Group therefore repeated its recommendation of last year that research surveys to estimate biomass should be included in the very early stages of the development of new and exploratory fisheries for *Dissostichus* spp. (SC-CAMLR-XVII, Annex 5, paragraph 4.76).

4.81 The Working Group stressed the importance of full compliance with the requirements of Conservation Measure 65/XII, which explicitly requires submission of data in accordance with a Data Collection Plan developed by the Scientific Committee for that area and the submission of a Research and Fisheries Operation Plan by the Member making the notification. Submission of a research plan considered acceptable by the Scientific Committee should be a prerequisite to the commencement of any future new or exploratory fishery. Such research plans should include a minimum number of sets or hauls per small area as advised by the Scientific Committee (paragraphs 4.67 to 4.72).

4.82 The Working Group also noted that in nearly every instance, notifications of new or exploratory fisheries for 1999/2000 were deficient in the provision of information as required in Conservation Measures 31/X and 65/XII (paragraph 4.32).

4.83 The Working Group was unable to advise on the likely effects of the levels of catch of species other than *Dissostichus*, proposed in the notification for a new trawl fishery in Division 58.4.2 by Australia (CCAMLR-XVIII/11).

4.84 The Working Group agreed that a maximum by-catch rate of 18% per fine-scale rectangle should be imposed for by-catches of macrourids in new and exploratory fisheries. For rajid by-catches, the Working Group agreed that the same by-catch provisions as recommended last year should be applied (10 to 15%).

4.85 There remains an urgent need for detailed catch, effort and biological data to be collected on all by-catch species. Conservation measures specifying by-catch limitations on new and exploratory fisheries should specify data collection requirements for by-catch species that are commensurate with data collection requirements for the target species.

4.86 Management advice stemming from consideration of seabird by-catches in new and exploratory fisheries is given in paragraph 7.176.

4.87 The Working Group recognised that further development of alternative advice may be possible, and the attention of the Scientific Committee was drawn to this.

By-catch

4.88 At last year's meeting, WG-FSA reviewed the need to study elasmobranch by-catch in the light of discussions initiated at CCAMLR-XVI between Mr R. Shotton (FAO Observer) and Drs Miller and Ramm. The Working Group recognised the long-term need to document and assess, in general, by-catch in fisheries within the Convention Area, and to collect information which would allow the assessment of stocks of species caught as by-catch (SC-CAMLR-XVII, Annex 5, paragraphs 9.1 and 9.2). Several steps were envisaged:

(i) Quantify the data available in the CCAMLR database and the national archives of Members.

(ii) Identify the needs for additional data and develop strategies for collecting such data.

(iii) Analyse data on by-catch and, in particular, assess the stocks of species dominant within the by-catch.

4.89 Following up on these recommendations, three papers on the particular topic of by-catch were submitted for the consideration of the Working Group at this year's meeting: WG-FSA-99/40, 99/45 and 99/69.

4.90 WG-FSA-99/40 analysed data collected by UK scientific observers on vessels fishing *D. eleginoides* in Subarea 48.3. The overall average catch rate of rays was

0.7 individuals/thousand hooks, compared with 34.7 individuals/thousand hooks for *D. eleginoides* and 2.2 individuals/thousand hooks for macrourid species. GLM analyses demonstrated that there are significant differences between the catch rates of rays for different vessels, areas and depths in Subarea 48.3. Some vessels, fishing on the northern shelf edge at both Shag Rocks and South Georgia, achieved catch rates of over 1 ray/thousand hooks, and 20 to 30 rays/thousand *D. eleginoides*. The two species most frequently found were *R. georgiana* and *Bathyraja murrayi*. Additionally, *B. meridionalis*, *B. griseocauda* and *R. taaf* were also recorded by scientific observers, although confirmation of the identification of the two latter species was not possible and should be considered provisional. Catches were made in depths of 500 to 1 500 m and although most rays are released, they may sometimes retain hooks in their mouths. The level of mortality from this practice is unknown, but the authors intend to further investigate this question in future works.

4.91 An assessment of yield and status of the by-catch species *M. carinatus* on BANZARE Bank (Division 58.4.3/58.4.1) is given in WG-FSA-99/69. The authors estimated the long-term precautionary yield of this species using the GYM and results from the trawl survey on BANZARE Bank in 1999. Length and weight data were taken from a trawl survey conducted at Macquarie Island in 1999. Where parameters were not available for *M. carinatus*, estimates were obtained from the literature for similar species elsewhere in the world. The long-term annual yield calculated for the species was 550 tonnes, based on a critical value (γ) of 0.033 found using the CCAMLR decision rules. Applying the critical value of γ to the mean density observed in the survey results gave a catch rate of 5.81 kg/km^2 which corresponds to a precautionary yield of 17.9 tonnes per fine-scale rectangle. Such a yield represents 18% of the total catch allowed for *D. eleginoides* in fine-scale areas in new and exploratory fisheries. The authors suggested that this catch rate may be useful in setting general by-catch rules for *M. carinatus*.

4.92 WG-FSA-99/45 presented a research program aimed to assess the impact of the exploratory fishery for *Dissostichus* spp. proposed by New Zealand in Subarea 88.1 during the 1999/2000 season (CCAMLR-XVIII/10) on species of the family Rajidae. Information and biological material collected by scientific observers in the 1998/99 and 1999/2000 fishing seasons would be used to address the following objectives:

(i) determine the species of family Rajidae present in the study area;
(ii) estimate the catch rate of various skates;
(iii) determine the age and growth rate of various Rajidae species; and
(iv) assess the feasibility of live release of skates as a method for reducing the impact of incidental catch.

4.93 The amount of by-catch reported from longline fisheries targeting *Dissostichus* spp. during the 1998/99 season was estimated at the time of the meeting of the Working Group from data reported in the five-day catch and effort reports, scientific observer data and the haul-by-haul data. Reconstruction of by-catch using the observer data proved to be difficult because the proportion of the catch from which by-catch was recorded was usually not defined. In addition, by-catch was not always reported by weight, thus some numbers had to be converted to weights using a mean weight for each species. Nevertheless, results shown in Table 30 indicate that by-catch estimates from different reporting sources are quite similar for Subareas 58.6 and 58.7 (combined for the Prince Edward Island EEZ), and Subarea 88.1, the average values being 59.7 and 65.9 tonnes respectively. In contrast, values in Subarea 48.3 ranged from 27.4 tonnes in the catch and effort reports to 85.1 tonnes in the observer data.

4.94 The species composition of by-catch reported in the haul-by-haul data from longline fisheries in the 1998/99 season is summarised in Table 31. Estimates show that the total recorded by-catch accounted for 2%, 14%, 13% and 18% of the total catch in Subareas 48.3, 58.6, 58.7 and 88.1 respectively. By-catch comprised a total of 21 identified species belonging to nine families of Chondrichthyes, Osteichthyes and crustaceans. The dominant by-catch families, by weight, in Subarea 48.3 were Macrouridae (0.93% of total catch) and Rajidae

(0.76%). Macrouridae also dominated the by-catch in Subareas 58.6 (10.4%) and 58.7 (11.7%). In Subarea 88.1, Rajidae was the most abundant family (11.0%), followed by Macrouridae (6.2%).

4.95 The Working Group acknowledged the submission of the above-described papers and the results of the preliminary analyses conducted at the time of the meeting. It recognised the potential severity of the by-catch problem on the management of the stocks of the species involved and identified a number of difficulties that needed to be solved to adequately assess it.

4.96 The most important problem is obtaining reliable catch figures by species, which also implies the proper identification of the species that are caught. The Working Group noted that several conservation measures currently in force (51/XII, 61/XII, 121/XVI and 122/XVI) require the reporting of catches and length composition measurements of by-catch species and requested the Scientific Committee to draw the attention of Members, as appropriate, to the need to comply with these requirements. However, the Working Group recognised that additional information on survival rates of the different by-catch species would also be necessary to evaluate the full impact of fishing on these species.

4.97 The precise identification of by-catch species seems to be rather complicated with the available identification keys, specially in longline fisheries where most of the unwanted species are released before taking them on board (paragraph 3.75). In this respect, Dr Kock reiterated the offer for assistance with the development of suitable taxonomic keys for elasmobranchs made by Dr V. Siegel (Germany) at the last meeting of WG-FSA (SC-CAMLR-XVII, Annex 5, paragraph 9.3). The Working Group accepted this offer and looked forward to the new keys.

4.98 The Working Group felt that the quality and the quantity of the by-catch information available to the meeting do not allow any further progress in this matter, or with the request from last year's Scientific Committee to work towards general by-catch provisions for assessed fisheries. Therefore, the Working Group tasked a small group, comprising Drs D. Agnew (UK) and B. Prenski (Argentina), to work intersessionally according to the steps outlined in paragraph 4.88 and report its findings for consideration at next year's meeting of WG-FSA.

Assessed Fisheries

Dissostichus eleginoides

4.99 Methods for assessing *D. eleginoides* were established by WG-FSA in 1995 (SC-CAMLR-XIV, Annex 5, including Appendix E). Since that time, the Working Group has focused on determining whether there are any trends in CPUE and assessing long-term annual yields using the GYM. These were the primary components of the work this year.

4.100 Analysis of CPUE data was only undertaken for Subarea 48.3 where new data were available. The details and extensions of the analysis are discussed under that subarea.

4.101 Assessments of long-term annual yield were reviewed for Subarea 48.3 and Division 58.5.2. An important component of the work this year was to reassess the input parameters to the GYM, including the addition of new estimates of parameters for Division 58.5.2. The methods for estimating the parameters were those used in the Workshop on Methods for the Assessment of *Dissostichus eleginoides* (WS-MAD) held in 1995 (SC-CAMLR-XIV, Annex 5, Appendix E).

4.102 Part of this work included standardising the parameters to a specific start date in the year, specified as the time of recruitment. This is a refinement to scale data from different surveys and samples of fish taken at different times of the year. This is illustrated in Figure 4.

Lengths at age of younger fish can appear different between samples as a result of when the samples were taken. If most are taken at approximately the same time, then the bias is not a problem. Much of the sampling, however, is spread over the year. Thus, the sample time since the nominal start date of the year is factored into the analysis (see WG-FSA-99/68). Similarly, estimates of recruitment are adjusted to the nominal start date according to when the survey was undertaken. This is part of the procedure of projecting the cohorts identified in the mixture analyses to transform the numbers at age to numbers of fish at age four.

South Georgia (Subarea 48.3)

4.103 The catch limit of *D. eleginoides* in Subarea 48.3 for the 1998/99 season was 3 500 tonnes (Conservation Measure 124/XVI) for the period 1 April to 31 August 1999. A total of 15 vessels from Chile, South Africa, UK and Uruguay fished during the season. The fishery was closed on 17 July 1999, with a total reported catch of 3 652 tonnes (CCAMLR-XVIII/BG/1).

Standardisation of CPUE

4.104 GLM analyses were conducted using haul-by-haul catch and effort data for Subarea 48.3 submitted on C2 forms for the 1991/92 to 1998/99 fishing seasons. As agreed by the Working Group last year, only CPUE data for the winter months (March to August inclusive) were used in the analyses. CPUEs in numbers/hook and kg/hook were used as response variables, and nationality, winter season, month, area (east South Georgia, northwest South Georgia, south South Georgia, west Shag Rocks and Shag Rocks; see Figure 2), depth and bait type were considered as predictor variables. GLM analyses were conducted on positive CPUE data only, with an adjustment for zero catches being made afterwards.

4.105 The basic approach used to fit the GLMs was the same as that used last year. Details of the methodology are provided in SC-CAMLR-XIV, Annex 5, Appendix G. However, changes were made in the CPUE data transformation used and the particular type of GLM analysis used. These changes were made because the distribution of residuals produced by the GLM model fitted last year was found to have unsatisfactory features (see Figure 6 for a QQ-plot of residuals from the model fitted to CPUE in kg/hook). This year, a square-root transformation was used and a robust form of GLM analysis was carried out. For the analysis of CPUE in kg/hook, the model used was GLM(cpue ~ season + month + area + nationality + bait + poly(depth, 2), family = robust(quasi(link))), while for CPUE in numbers/hook, the model used was GLM(cpue ~ season + month + area + nationality + bait + poly(depth, 4), family = robust(quasi(link))). This resulted in a much more satisfactory distribution of residuals (see Figure 7 for the fit to CPUE in kg/hook).

4.106 Nationality, winter season, month, area, depth and bait type were each found to be highly statistically significant sources of variation to haul-by-haul CPUE, both in kg/hook and numbers/hook. These predictors were also highly significant in the Working Group's previous analyses.

4.107 The standardised time series of winter season CPUEs in kg/hook is plotted in Figure 8 and given in Table 32. The standardisation is with respect to Chilean vessels fishing in east South Georgia during March at 1 152 m using mackerel bait. This time series has also been adjusted for the presence of hauls with zero catches. As was done last year, the adjustment was made by estimating the proportions of non-zero catches in each fishing season and multiplying the standardised CPUEs predicted from the GLMs by these proportions. The proportions of non-zero catches are given in Table 33.

4.108 The time series of standardised winter season CPUEs in numbers/hook is plotted in Figure 9 and given in Table 34. The same standardisation as used for the CPUEs in kg/hook was used, and the time series has also been adjusted for the presence of hauls with zero catches.

4.109 Adjusted, standardised catch rates decreased between the 1993/94 and 1997/98 seasons, but they increased again in the 1998/99 season. However, the extent of the increase in standardised CPUE in the most recent season was quite different for the kg/hook and numbers/hook analyses. There was only a small increase in standardised CPUE in kg/hook, but a substantial increase in CPUE in numbers/hook. There was also a substantially greater difference between the nominal and standardised CPUEs in 1998/99 than in previous seasons.

4.110 Possible reasons for these features were examined by considering distributions of depths fished in Subarea 48.3 by season and area. These indicated clearly that in the last two seasons, but especially in 1998/99, there had been a considerable increase in the numbers of longlines being set at shallow depths (300 to 700 m), particularly to the north of Shag Rocks. Histograms of depths fished by season are shown in Figure 10, and by area around South Georgia for the 1997/98 and 1998/99 seasons in Figures 11 and 12. When these distributions are grouped by different levels of CPUE (in weight or numbers), it is clear that the shallow-depth fishing contributed substantially to the overall nominal CPUEs both in weight and numbers (see Figures 13 and 14).

4.111 The Working Group next examined mean weights of fish taken in the winter seasons, calculated as simple averages of mean weights per haul, with no catch weighting. For Subarea 48.3 as a whole, there was a small decline in mean weight for the most recent two seasons (Figure 15). The decline in mean weight in the last two seasons was much more obvious at Shag Rocks (Figure 16), and when this was further examined by depth zone at Shag Rocks (Figure 17), for the middle two depth zones there is a noticeable decline in mean weight in the most recent season. It is believed that these features largely explain the difference between nominal and standardised CPUE in the most recent season.

4.112 The Working Group finally examined the (full-season) catch-weighted length frequencies by season and area (Figures 18 to 20). These indicate that in the last two seasons the modal length around South Georgia was lower than in previous seasons. Around Shag Rocks, there was a notable decline in modal length in the last two seasons and also a notable reduction in the spread of the length-frequency distributions. Unexpectedly, the length frequencies for depths above and below 900 m at Shag Rocks were very similar.

4.113 During discussion of these results, it was emphasised that, since depth was included as an explanatory variable in the analyses, the standardisation process should have taken full account of the most recent changes in depth distribution of fishing. It was noted, however, that the models fitted did not include a term for possible interaction between season and depth. It is unclear whether the data would support robust estimation of season–depth interactions given the current form of model used, especially that for CPUE in numbers/hook where depth is modelled as a fourth degree polynomial. One possibility that should be examined next year would be to treat depth as a factor with a small number of levels, in which case it ought to be possible to take account of possible season–depth interactions.

4.114 It was also noted that it had been necessary in the analyses to treat vessels flying the same national flag as replicates. This would imply that, if national fleets had increased in efficiency over time, for example with more efficient vessels joining the fleet to replace less efficient vessels, then this would not be accounted for in the analyses. However, no evidence was available to suggest that this had actually happened to any major extent.

Determination of Long-term Annual Yields using the GYM

4.115 The analysis of long-term annual yield was updated with the recent catches taken from Subarea 48.3 and a revision of the recruitment function, growth parameters and natural mortality.

Growth, Mortality and Fishing Selectivity

4.116 Estimates of the von Bertalanffy parameters were obtained from a reanalysis of length-at-age data used in 1995. This year, L_∞, k and t_0 were estimated by combining the lengths at age from two sources. The first source was lengths at age read from otoliths collected in the UK survey around South Georgia in January and February 1991. The second source was an age–length key compiled by Aguayo (1992) from readings of scales taken from the commercial longline fishery during February to May 1991. The parameters were estimated using a weighted non-linear regression in Mathcad 7.0. The results are presented in Figure 21. The estimated parameters were L_∞ = 194.6 cm, k = 0.066.yr^{-1} and t_0 = -0.56 years. These parameters do not substantially alter the estimates of length at age in younger fish arising from the previous estimates. The main difference is the estimate of L_∞. This increased size from 170.8 cm is consistent with the upper size range of fish observed in the longline fishery (the maximum observed in the database is 240.5 cm). The growth curve was adjusted to the beginning of the projection year by altering t_0.

4.117 The Working Group recalled the deliberations of WS-MAD in 1995 noting that scale readings may provide underestimates of age (SC-CAMLR-XIV, Annex 5, Appendix E, paragraphs 2.4 to 2.17). Similarly, underestimates of age from otoliths may arise due to a delay in laying the first ring (e.g. WG-FSA-99/68). It noted the continued work in developing methodologies to determine the age of fish using otoliths (see paragraphs 3.100 to 3.102). The Working Group considered that work to refine and validate age determination methods, including the validation of annual formation of rings in otoliths, is a high priority for future assessments. The Working Group agreed that a priority task for next year should be to re-estimate the growth parameters based on new information on length at age.

4.118 The Working Group examined the relationship between the weighted length-frequency distribution for all longline fishing in Subarea 48.3 from 1992 to the present (Figure 22). This distribution was consistent with selection of fish into the fishery occurring greater than 55 cm with full selection greater than 79 cm. Total mortality (Z = M + F) was estimated from these data using the Beverton and Holt method, giving Z = 0.255. The shape of the curve is different to those reported in 1995 (SC-CAMLR-XIV, Annex 5, Figure 6 and SC-CAMLR-XIV, Annex 5, Appendix E, Figure 5). The current weighted age frequency shows the average representation of different length classes in the fishery, taking into account variation in recruitment. The Working Group agreed that the fish were likely to be fully selected for lengths greater than 79 cm.

4.119 The Working Group noted that the selectivity of fish was likely to be changing such that smaller fish were contributing more to the catches than in the past. If this is the case, then the resulting long-term annual yield will need to be reduced. The Working Group considered that a more detailed analysis of the selectivity pattern needs to be undertaken next year in order to incorporate a changing selection pattern into the GYM. Work to accommodate this in the GYM also needs to be given high priority.

4.120 The estimate of M, the natural mortality rate, used last year was 0.16 yr^{-1}. The Working Group noted that this was not incompatible with an estimate of Z (total mortality rate) derived from the pooled 1991/92 to 1998/99 catch-weighted length frequency (0.255 yr^{-1}), but it believed it appropriate to use a range of estimates of M, rather than a single value. Noting that the value 0.16 yr^{-1} is approximately 2.5 times the estimate of k, the Working Group agreed to use a range of values of M equivalent to the range 2k to 3k (i.e. 0.13–0.2 yr^{-1}).

Recruitment

4.121 At past meetings (1995 and 1997), the Working Group had analysed length-frequency data from trawl surveys expressed in terms of density (numbers per km^2) using the CMIX program (de la Mare, 1994) (termed 'length-density'), (SC-CAMLR-XIV, Annex 5, paragraphs 5.44 to 5.49) in order to generate estimates of recruitment to the population of *D. eleginoides* in Subarea 48.3. At last year's meeting, an attempt was made to incorporate data from trawl surveys in 1997 by Argentina and the UK into the recruitment function. Due to problems reconciling the data from these surveys with available data on growth, it was not possible to incorporate those data at that meeting.

4.122 Intersessionally, the WG-FSA subgroup on assessment methods had considered the problem of reconciling survey data with growth models. At this year's meeting, the Working Group decided to undertake a reanalysis of as much of the survey length-density data as possible, in conjunction with the development of new growth parameters (paragraph 4.116).

4.123 In the past, there have been problems with the extraction of length-density distributions from research survey data held in the CCAMLR database (SC-CAMLR-XVII, Annex 5, paragraph 105). Progress made at last year's meeting, and intersessionally by the subgroup on assessment methods, meant that it was possible to perform a routine data extraction from survey data held in the CCAMLR database, some of which were available in the new research survey format and others in the C1 commercial trawl format. Nevertheless, some difficulties were experienced with extracting the data from the C1 format and the Working Group again recommended that all available survey data be transferred into the new research data format as soon as possible (see paragraphs 3.7 to 3.10).

4.124 Length-density distributions were extracted from a total of 12 trawl surveys in Subarea 48.3 (Table 35). However, data from only 11 surveys were used in the final analyses.

4.125 Analysis of the survey data showed that in some cases, whilst catches of *D. eleginoides* were recorded, very few fish had been measured. In the case of the *Anchar* survey in 1990, the total catch was 3.7 tonnes, but only 210 fish had been measured throughout the survey. A large proportion of the catch (2.7 tonnes) was taken at two stations where only 34 fish were measured in total. The Working Group considered that due to the small sample sizes relative to the size of the catch, the length-density estimates might not provide a good representation of the size distribution of young fish in that year, particularly in view of the extent of the extrapolation required. It was therefore decided to omit this survey from the analysis.

4.126 There were also several cases in the other surveys where catches of *D. eleginoides* were recorded, but no fish were measured. Because length densities measure absolute numbers of fish in a given area, the Working Group agreed that even though length distributions for these catches were not available, it was necessary to include these fish in the analysis, in order that the estimates of recruitment would reflect the total abundance of fish in the survey catches. To achieve this, an average length distribution derived from other stations in the same stratum was applied to the catches where no fish were measured. The Working Group noted that for the surveys in Table 35 the number of cases and the catch of fish at stations where this occurred was generally low. However, in the case of the *Hill Cove* survey in 1990, there was a single station where the catch of *D. eleginoides* was 0.91 tonnes, but only six fish were measured. Nevertheless, a total of 715 fish were measured at other stations in the same stratum during the rest of the survey. The Working Group therefore agreed to apply the average length distribution of these samples to the catch at this station.

4.127 Following the procedure used at the 1995 meeting, the densities of fish in age classes 3, 4 and 5 for each survey were estimated by fitting a mixture of normal distributions directly to the length-density distributions. Length densities for separate strata were pooled according to the method described in WG-FSA-96/38 and paragraphs 4.67 and 4.68 of WG-FSA-96 (SC-CAMLR-XV, Annex 5). For *k* strata, the density data from each haul are rescaled by the composite sampling fraction:

$$D_{i,j} = d_{i,j} \frac{A_i}{\sum_k A_k} \frac{\sum_k n_k}{n_i}$$

where $D_{i,j}$ is the rescaled density at length for haul *I* in stratum *j*, $d_{i,j}$ is the original density-at-length estimate for that haul, and A_i and n_i are the area and number of hauls in stratum *I* respectively.

4.128 The area under each fitted distribution component is assumed to estimate the density of the corresponding age class. The assignment of nominal ages to mixtures assumed a birthday of 1 December. The results of the fitting process are illustrated in Table 36 and Figure 23. The graphs in Figure 23 illustrate the observed length densities, the fitted mixtures and the upper and lower confidence intervals of the observations. In all cases, the positions of the modes of the fitted mixtures were consistent with the growth rate expected from the new value of k estimated for Subarea 48.3 (paragraph 4.116). Differences between sums of observed expected densities were generally low and the fits to the data were considered to be good. The only survey for which the fit to the data was poor was the UK survey in January 1991. Although fish of lengths over the full range considered in the analysis (250–750 mm) were present, fish of more than 400 mm were rare in the catches. The majority of the catch was between 280 and 400 mm, considered to represent mainly two-year-olds. Although the fit was poor, and two-year-olds were not used in the estimation of recruitment, the mode observed was consistent with the strong mode of three-year-olds in the survey the following year.

4.129 The Working Group noted some consistency in the patterns of age modes moving through the population sampled by the survey, but also noted that in some cases, apparently strong year classes in one year did not appear in the samples the following year. For example, the Working Group noted that the strong 1989 year class discussed in paragraph 4.128 was not detected as five-year-olds in the 1993/94 surveys. Also, the age-3 and age-4 fish observed in the UK survey in January 1990 were detected only in low numbers in the survey the following year. Attempts to fit mixtures to lengths above 470 mm in the 1991 survey data were unsuccessful. As a result, there were no direct density estimates for age classes 3, 4 and 5 in 1990/91. Nevertheless, the Working Group considered that overall the results of the analysis of length densities were a reasonable basis for estimating recruit over the period of the analysis. Future work in this area could include a more detailed examination of modes moving through the population, and surveys to detect the two-year-old age class.

4.130 Fitted age-class densities were rescaled to observed densities by multiplying them by the ratio of observed to expected sums of densities. Multiplying the rescaled age-class densities by the area surveyed and assuming a catchability coefficient of 1.0 leads to an absolute abundance estimate for each age class in the analysis for each survey. The area surveyed was assumed to be as presented in Everson and Campbell (1990). This gives a total seabed area for 50 to 500 m of 40 993.3 km^2. Resulting estimates of numbers of recruits are given in Table 37.

4.131 In accordance with the methodology used in previous years, the number of recruits was standardised to age 4 by correcting the three- and five-year-old numbers for the effects of natural mortality (assumed to be 0.165). In some cases, the same cohort is represented as a different year class in different surveys, and the same cohort is represented in two surveys in the same year. In these cases, the number of recruits was estimated from the weighted average of the $\log_e$ recruit numbers from the different surveys.

4.132 The resulting estimates of recruits at age 4 for the years in the analysis are given in Table 38.

4.133 As in the past, the recruitment estimates were used to estimate a lognormal recruitment function for use in stock projections using the GYM. The Working Group noted that the length-density analysis produced no estimate of the abundance of 4-year-olds in 1992 for several reasons:

(i) the failure to fit mixtures to ages 3, 4 and 5 fish in the 1990/91 survey;
(ii) the failure to fit mixtures to ages 4 and 5 in the 1991/92 survey; and
(iii) the lack of a survey in the 1992/93 season.

4.134 The Working Group considered that although technically this excluded 1992 from the estimation of the recruitment function, evidence from the surveys in 1990/91 and 1991/92 suggested that the number of four-year-olds in 1991/92 was low. In the absence of additional information, for the purposes of estimating a recruitment function for input into the GYM, the Working Group decided to assume a number of four-year-olds in 1991/92 equal to the lowest estimated level over the period of the analysis. This was equal to 0.701 million individuals (the figure for 1996).

4.135 The parameters for the resulting recruitment function are given in Table 39. The Working Group again noted that this procedure assumes no trend in recruitment over the time period of the estimated recruitments.

Assessment

4.136 The input parameters for the GYM are shown in Table 39, giving the updated parameters as derived above. As in previous years, the decision rule concerning the probability of depletion was binding. The yield at which there is a probability of 0.1 of falling below 0.2 of the median pre-exploitation spawning biomass level over 35 years was 5 310 tonnes. The median escapement for this level of catch was 0.574.

4.137 The estimated long-term annual yield is greater than previous years because of the increased mean recruitment combined with the change in the selectivity function.

4.138 An analysis presented to the meeting used the standardised CPUE time series up to the 1997/98 season combined with the GYM, and indicated that the effect of the CPUE data was to reduce the estimate of yield. This was consistent with the advice in last year's report (SC-CAMLR-XVII, Annex 5, paragraph 4.117). The standardised CPUE in the 1998/99 season increased (paragraph 4.109), but the Working Group did not have sufficient time to update this assessment to ascertain the effects of the most recent data on the analysis (paragraph 3.141 and WG-FSA-99/60).

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

4.139 The estimate of yield from the GYM was 5 310 tonnes. This was higher than the result obtained at last year's meeting (3 550 tonnes), for two main reasons:

(i) the increase in the estimate of mean recruitment; and
(ii) the revision of the selectivity pattern to include all fish >79 cm.

4.140 The Working Group welcomed the considerable progress made at this year's meeting in refining the data inputs into the GYM, particularly with respect to the estimates of recruitment from survey data and estimates of growth parameters.

4.141 According to the analysis of available data for the most recent season, the standardised CPUE has increased since the 1997/98 season. This may be partially explained by the recruitment to the fishery of the strong 1989 year class (which was aged 4 in 1992/93 – Table 38), which was indicated by trawl surveys in 1990/91 and 1991/92, although this year class was not detected by trawl surveys in 1993/94.

4.142 The Working Group agreed that the catch limit for the 1999/2000 season should be 5 310 tonnes, as indicated by the analysis using the GYM. Other management measures for *D. eleginoides* in Subarea 48.3 in the 1999/2000 season should be similar to the 1998/99 season.

4.143 Dr Marschoff indicated that the catch should be less than 5 310 tonnes in order to maintain a degree of caution appropriate to the uncertainty indicated by the results of the CPUE analysis shown above (paragraph 4.138).

4.144 Any catch of *D. eleginoides* taken as part of research fishing in Subarea 48.3 should contribute towards this catch limit.

4.145 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.

South Sandwich Islands (Subarea 48.4)

4.146 Despite a catch limit of 28 tonnes for *D. eleginoides* (Conservation Measure 156/XVII), no fishing in this subarea was reported to the Commission during the 1998/99 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)

4.147 The Working Group recommended that Conservation Measure 156/XVII be carried forward for the 1999/2000 season. As last year, it was also recommended that the situation in this subarea be reviewed at next year's meeting with a view to considering the period of validity of the existing assessment.

Kerguelen Islands (Division 58.5.1)

4.148 The total catch in the longline fishery in Division 58.5.1 during the 1998/99 season was 5 402 tonnes. The Working Group noted that the recent catch was less than the long-term annual yield derived from assessments last year. No new information was available to the Working Group. No assessments were undertaken this year.

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

4.149 The French authorities will allow trawling and longlining in their EEZ within this division in the 1999/2000 season (1 September 1999 to 31 August 2000). The French authorities have advised that there will be no increase in total catch of *D. eleginoides* over that taken last season, and that the catch for the trawl fishery will be reduced.

Heard and McDonald Islands (Division 58.5.2)

4.150 The catch limit of *D. eleginoides* in Division 58.5.2 for the 1998/99 season was 3 690 tonnes (Conservation Measure 131/XVI) for the period 8 November 1997 to the end of the Commission meeting in 1999. The catch reported for this division was 3 480 tonnes.

Determination of Long-term Annual Yields using the GYM

4.151 The analysis of long-term annual yield was updated with the recent catches taken from Division 58.5.2 and revised parameters for recruitment, growth, maturity, fishing selectivity and natural mortality. Until this meeting, the Working Group had used biological parameters estimated for *D. eleginoides* at South Georgia Island. WG-FSA-99/68 provided estimates of these parameters, except for mortality, for *D. eleginoides* at Heard Island (paragraph 3.79).

4.152 The maturity and fishing selectivity parameters used in the assessment were taken directly from WG-FSA-99/68, but the age-based functions were revised according to the growth parameters estimated during the meeting.

4.153 Estimates of the von Bertalanffy growth parameters in WG-FSA-99/68 were revised following the revision of these parameters for South Georgia. A difficulty with estimating the parameters for Heard Island is that the samples comprise mostly small fish (paragraphs 3.109 and 3.110). In the absence of other information on L_∞, the Working Group agreed to use the L_∞ estimated for South Georgia (194.6 cm). K and t_0 were estimated by non-linear regression. Ages of fish were adjusted to account for different dates of capture, which can affect the estimates of k (see WG-FSA-99/68). The final growth model was estimated as at 1 November and is shown in Figure 24. The estimates of parameters were k = 0.0414 yr^{-1} and t_0 = -1.80 years. The Working Group noted that the size of t_0 may indicate that the age of fish is being underestimated. The Working Group requested that further work be undertaken to clarify the growth model for this area (see also discussion in paragraphs 4.116 to 4.120).

4.154 This analysis has shown that the lengths at age of fish in the Heard Island region are much smaller than at South Georgia. Thus, it can no longer be assumed that the growth rates in these two areas are the same.

4.155 Natural mortality, M, was revised following the method of approximation accepted for South Georgia this year (paragraph 4.120). This yielded a range of M of 0.0828 to 0.1242 yr^{-1}.

4.156 The parameters for the lognormal recruitment function presented in WG-FSA-99/68 were revised to take account of different values for natural mortality. The mean lengths of the different cohorts estimated from the 1999 survey at Heard Island and from two previous surveys (1990 and 1993) analysed in 1996, were checked against the estimates of length at age from the new growth parameters. These lengths were consistent with the new estimates. Thus, no new mixture analyses were considered necessary at this meeting. The cohorts were combined using the revised mean M of 0.1035 yr^{-1}. The resultant time series of recruitments at Heard Island are given in Table 40 and the parameters for deriving the lognormal function are given in Table 39.

Assessment

4.157 The input parameters for the GYM are shown in Table 39, giving the updated parameters as derived above. As in previous years, the decision rule concerning the probability of depletion was binding. The yield at which there is a probability of 0.1 of falling below 0.2 of the median pre-exploitation spawning biomass level over 35 years was 3 585 tonnes. The median escapement for this level of catch was 0.547.

4.158 This long-term annual yield is similar to the previous estimates of yield despite the application of many new parameters derived from the Heard Island region. The combined effects of slower growth rates, lower mortality and revised fishing selectivity have been balanced by observations of very strong recruitments in recent years.

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

4.159 The Working Group recommended that the catch limit for Division 58.5.2 in the 1999/2000 season be revised to 3 585 tonnes, representing the annual yield estimate from the GYM.

4.160 The analysis resulting in this recommendation assumed that total removals of fish in 1999/2000 and future seasons are 3 585 tonnes.

Champsocephalus gunnari

South Georgia (Subarea 48.3)

4.161 The commercial fishery for *C. gunnari* around South Georgia (Subarea 48.3) was open from the end of the Commission meeting in November 1998 until 1 April 1999. The catch limit agreed by the Commission for this period was 4 840 tonnes (Conservation Measure 153/XVII). 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, data reporting on a haul-by-haul basis, and the presence of a CCAMLR scientific observer on every vessel.

4.162 WG-FSA-99/57 provides a summary of the commercial fishing on *C. gunnari* in Subarea 48.3 during the 1998/99 season. Only one vessel, the Russian-registered stern trawler *Zakhar Sorokin*, took part in this fishery. The vessel fished for 23 days between 16 February and 10 March 1999. The catch of *C. gunnari* was 265 tonnes. Total catch of other species, including *Chaenocephalus aceratus*, *Pseudochaenichthys georgianus*, *Patagonotothen guntheri* and *Gymnoscopelus nicholsi* was 9.2 tonnes (Table 41).

4.163 In the four days between 28 February and 3 March 1999, 86% of the catch of *C. gunnari* was taken on the northwestern slope of South Georgia, where *C. gunnari* formed dense concentrations which were feeding on krill.

4.164 The vessel carried an observer, designated by the UK in accordance with the CCAMLR Scheme of International Scientific Observation, and an observer report was submitted to the Secretariat.

Past Assessment

4.165 The catch limit for the 1998/99 season was derived from a short-term cohort projection first performed at the 1997 meeting of WG-FSA (SC-CAMLR-XVI, Annex 5, paragraphs 4.179 to 4.182). This was based on a lower 95% confidence bound of the biomass estimate from the UK trawl survey in September 1997, calculated using a bootstrap procedure during the 1997 meeting (SC-CAMLR-XVI, Annex 5, paragraphs 4.199 to 4.208). The projection estimated catch limits for a period of two years. At last year's meeting, in view of the extremely low commercial catch in 1997/98, the projection was repeated, estimating catch limits of 4 840 tonnes in the 1998/99 season and 3 650 tonnes for 1999/2000.

Assessment at this Year's Meeting

4.166 The Working Group recalled its discussions from previous years regarding variability in M between years in relation to the availability of krill and predation by fur seals, and the need to consider appropriate decision rules for application of the GYM to assessing precautionary yield for this fishery (e.g. SC-CAMLR-XVI, paragraphs 4.171 to 4.178).

4.167 There was no new information available to the Working Group on the properties of possible decision criteria for applications of the GYM to fisheries for *C. gunnari*. The Working Group therefore agreed to repeat the short-term projection method performed at last year's meeting, incorporating the reported catch from the fishery, which was well below the catch limit.

4.168 The data inputs for the short-term assessment are provided in Table 42. The following changes were made compared to the projection performed at last year's meeting:

(i) there were 426 days of known catch (5 tonnes) from the UK survey in September 1997 to the meeting in 1998 (assumed to be 1 November);

(ii) 395 days of known catch (265 tonnes) were added from the 1 November 1998 to 30 November 1999 to take the stock to the end of the 1999 CCAMLR fishing year; and

(iii) the age when selection begins to the fishery was adjusted from 2.5 years to 1.5 years (selection then ramps to the age of full selection, which was set to 3 years).

4.169 The purpose of the change in the selectivity pattern was to take account of the observed commercial catch at age from the 1999 season, obtained from the length distribution of the catches and the most recent length-at-age key (WG-FSA-95/37) (Figures 25 and 26), which indicated that age-2 fish were at least partially recruited to the fishery.

4.170 The resulting fishing mortality for the forthcoming two years was 0.14. This resulted in a combined catch over two years of 6 810 tonnes, comprising 4 036 tonnes in the first year (1 December 1999 to 30 November 2000) and 2 774 tonnes in the second year (1 December 2000 to 30 November 2001).

4.171 The Working Group noted that it was now two years since the time of the last survey and that there is a large degree of uncertainty in the current state of the stock. The yields estimated from the short-term projections were based on the lower 95% confidence bound of the 1997 UK trawl survey and most participants considered that this constituted a conservative estimate of yield. It was also noted that the commercial vessel operating in the 1999 season had found a large concentration of fish and fished on it for four days before leaving the area to fish elsewhere for squid.

4.172 Dr Marschoff noted that given the time lapsed since the last survey and the events of yet to be explained high mortality experienced by this stock, this assessment might be invalid and a survey was needed before setting any catch limit. The Working Group noted that this view is supported by the failure of the commercial fishery for two consecutive seasons.

4.173 The Working Group welcomed the news that a new survey was planned for the 1999/2000 season (see section 6) and that the results of this survey should be available for the next meeting to update the assessment.

Protection of Young Fish and Spawning Aggregations

4.174 WG-FSA-99/52 reviewed and discussed the need to protect young fish and spawning aggregations in the *C. gunnari* fishery in Subarea 48.3. Measures put in place to date by the Commission include closed areas (Conservation Measure 1/III – no longer in force), mesh size regulations (Conservation Measure 19/IX), closed seasons (set annually), and, most recently, avoidance of catches of small fish (Conservation Measure 153/XVII, paragraph 4). A strategy for the future protection of young fish and spawning aggregations of *C. gunnari* in Subarea 48.3 was proposed, which included continuation of the mesh size and minimum fish size provisions to protect young fish, and adoption of a modified closed season and closed area for the protection of spawning.

4.175 The Working Group discussed the merits of various approaches to protection of young fish and spawning aggregations, including the closure of coastal spawning grounds and the establishment of refuge areas for young fish.

4.176 It was noted that, whilst spawning aggregations may need to be protected due to the possibility that fishing on such aggregations could disrupt spawning activity, there was no clear necessity at this stage to afford protection to non-spawning aggregations of adult fish (e.g. fish aggregating for the purposes of feeding) over and above the setting of catch limits.

4.177 Existing information indicates that peak spawning of *C. gunnari* at South Georgia occurs in the fjords and coastal areas from March to May, but may start in February and extend to June. Recent evidence from surveys indicates that interannual variation in spawning time may be dependant on the condition of the fish, related to krill availability (Everson et al., 1996, 1997). WG-FSA-99/65 provided evidence of spawning being concentrated in waters adjacent to the shore in April and May, as indicated by the predominance of fish in maturity stage V (spent) and a drop in CPUE on the shelf.

4.178 The Working Group agreed that the present closed season, from 1 April to the end of the Commission meeting, was not necessary for the protection of spawning and that a closed season of 1 March to 31 May would be more appropriate. It was also agreed that the priority for the protection of spawning was to apply this closed season to areas where spawning is known to take place (see Figure 27 – redrawn from WG-FSA-99/65).

4.179 The Working Group also considered the application of closed areas for the protection of young fish. Length data from seven bottom trawl surveys in the late 1980s and 1990s were analysed to examine the relationship between size of fish and depth, and size of fish and distance from shore. The surveys used were those for which data were available at this meeting in the new CCAMLR research survey database (Table 43).

4.180 The results of this analysis indicated that there was no clear relationship between size of fish and distance from shore, but as shown in previous analyses (e.g. Kock, 1991; WG-FSA-97/45), smaller fish tend to be found in shallower water. Figure 28 illustrates the relationship between the cumulative fraction of the survey catch at lengths below and above 24 cm (the size limit used in Conservation Measure 153/XVII which is approximately equal to the size at maturity). This shows that at depths from approximately 110 to 180 m there is a consistent difference of about 0.4 between the cumulative fraction of the catch made up of fish less than 24 cm and the cumulative fraction of the catch made up of fish above 24 cm.

4.181 The Working Group noted that at this year's meeting it had been possible to analyse data from only a subset of the surveys undertaken in the area and that these were all conducted in summer. Information from WG-FSA-99/65 and other previous studies indicate that young fish are distributed widely over the shelf and may be present in different parts of the shelf at different times of the year.

4.182 It was also noted that the analysis had been conducted using length data from surveys which used bottom trawls with small mesh. The fishery uses semi-pelagic trawls with a mesh size limit and a requirement to move if the catch of young fish exceeds a certain threshold (Conservation Measure 153/XVII). The exploitation pattern of the commercial fishery is therefore likely to be different to that suggested by the survey results. This is illustrated by the low proportion of fish of less than 24 cm in the commercial catches in the 1998/99 season (Figure 28).

4.183 The Working Group recommended that a more detailed analysis of the distribution of young fish from surveys and the exploitation pattern of the fishery operating under existing measures to protect young fish is required, in order to provide advice on the possible benefits of the use of refuges for protecting young fish as part of the management procedure for *C. gunnari*. The Working Group agreed that this issue was relevant for all areas where there are fisheries for *C. gunnari* and should be a priority task for the intersessional subgroup working on the assessment of this species.

4.184 In this respect, the Working Group discussed the need to undertake a workshop on the development of a long-term management strategy for *C. gunnari*, as first recommended in 1997 (SC-CAMLR-XVI, paragraphs 5.58 to 5.65). The Working Group agreed that the requirement for the types of analyses listed in the provisional terms of reference for this workshop remained high. However, the Working Group recommended that the intersessional subgroup on *C. gunnari* fisheries should aim to make progress on these issues and the issue of the requirement for a dedicated workshop should be considered at next year's meeting.

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

4.185 The Working Group agreed that the management measures for *C. gunnari* in Subarea 48.3 should be similar to those of 1998/99 with the following revisions:

(i) In order to protect spawning concentrations, the closed season should be revised from 1 April–30 November to 1 March–31 May.

(ii) The closure should apply to the areas where spawning is known to take place (paragraph 4.177).

4.186 Most participants agreed that the total catch limit should be revised to 4 036 tonnes for the period 1 December 1999 to 30 November 2000.

4.187 Dr Marschoff noted that the low catch in this fishery indicated that the stock remains at a low level and that a survey is needed before setting any catch limit.

Kerguelen Islands (Division 58.5.1)

4.188 No commercial fishing for *C. gunnari* took place in this division during the 1998/99 season.

4.189 The Working Group recalled that the brief survey conducted in February 1998 indicated that the previous strong cohort (4+ years old) had almost disappeared, but that a new year 1+ cohort (~170 mm long fish) was present in 1997/98. At last year's meeting, it was reported that France intended to conduct a full survey on *C. gunnari* during 1998/99 to assess the abundance of this new cohort using the same method as in the 1997 survey. According to information provided to the Working Group, the survey proved disappointing, with practically zero biomass detected 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. The late timing of the survey is apparently not sufficient to explain the low biomass. During associated scientific programs, *C. gunnari* were reportedly observed being preyed upon by Antarctic fur seals.

4.190 The French authorities have indicated that a resumption of fishing is not being contemplated at this time.

4.191 The survey will be repeated in the 1999/2000 season.

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

4.192 The Working Group looked forward to seeing the full analysis of the results of the survey conducted in 1998/99 and welcomed the reported intention to undertake a survey in 1999/2000.

Heard and McDonald Islands (Division 58.5.2)

Commercial Catch

4.193 The commercial fishery for *C. gunnari* around Heard Island (Division 58.5.2) was open from the end of the Commission meeting in November 1998 to 31 November 1999. The catch limit agreed by the Commission for this period was 1 160 tonnes to be taken on the Heard Island Plateau area only (Conservation Measure 159/XVII). 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 157/XVII).

4.194 The commercial catch in the 1998/99 fishing season was 2 tonnes. This was a result of the fishing vessels concentrating on the *D. eleginoides* fishery. The only aggregations of *C. gunnari* detected were of young fish.

4.195 No survey specifically for *C. gunnari* was undertaken in 1998/99. The design of a survey undertaken to assess the distribution and abundance of *D. eleginoides* was not suitable for the assessment of *C. gunnari*.

Assessment at this Meeting

4.196 During the meeting, an assessment of *C. gunnari* in the Heard Island Plateau area was made using the same short-term annual yield method adopted during the 1997 meeting (SC-CAMLR-XVI, Annex 5, paragraph 4.181), and used for this species in Subarea 48.3. Results of a survey conducted in 1998 were used as input. Estimates of yield for Shell Bank were not made because of the very low abundance of this population. Data inputs for the short-term projection are provided in Table 42.

4.197 The resulting fishing mortality for 1999/2000 and 2000/2001 was 0.139. This resulted in a combined catch over two years of 1 518 tonnes, comprising 916 tonnes in the first year and 603 tonnes in the second year.

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

4.198 The Working Group agreed that the management of the fishery for *C. gunnari* on the Heard Island Plateau part of Division 58.5.2 during the 1999/2000 season should be similar to that in force last season, as detailed in Conservation Measure 159/XVII. The total catch limit should be revised to 916 tonnes in accordance with this year's short-term yield calculations. The fishery on Shell Bank should remain closed.

Other Fisheries

Antarctic Peninsula (Subarea 48.1)

Notothenia rossii, Gobionotothen gibberifrons, Chaenocephalus aceratus, Chionodraco rastrospinosus, Lepidonotothen larseni, Lepidonotothen squamifrons and *Champsocephalus gunnari*

4.199 Finfish stocks in the Antarctic Peninsula region (Subarea 48.1) have been exploited from 1978/79 to 1988/89 with most of the commercial harvesting taking place in the first two years of the fishery. Given the substantial decline in biomass of the target species in the fishery, *C. gunnari* and *N. rossii*, by the mid-1980s, Subarea 48.1 was closed for finfishing from the 1989/90 season onwards (SC-CAMLR-XVII, Annex 5, paragraph 4.179).

4.200 New data pertaining to the biological characteristics (species composition, species assemblages, length composition, length–weight relationships, length at sexual maturity and length at first spawning, gonadosomatic indices and oocyte diameter) of Antarctic fish stocks, taken by random stratified bottom trawl around Elephant Island and the lower South Shetland Islands during 1998, were presented (WG-FSA-99/16). However, the new information available to the Working Group was not sufficient to undertake any assessment on the stocks in this subarea.

4.201 Data from an offshore scientific trawl survey of bottom fish sampling within the 50 to 500 m isobath of the lower South Shetland Islands during 1998 were combined with inshore data taken at Potter Cove during 1998 (WG-FSA-99/31). Combined length–weight relationships for *N. coriiceps* and *N. rossii* were constructed. Further data covering additional years is needed from the offshore area.

Management Advice

4.202 There appears to be little prospect for a substantial fishery given the low biomass estimates for the 1997/98 season and the absence of sufficient new information. The Working Group therefore recommended that Conservation Measure 72/XVII should remain in force.

South Orkney Islands (Subarea 48.2)

4.203 Surface areas of seabed within the 500 m isobath were presented (WG-FSA-99/33) for the South Orkney Islands. Revised estimates were based on several integrated datasets and incorporated seafloor slope. The updated estimates for the area within the 50 to 500 m area were approximately 20% larger than previous estimates. The Working Group agreed that this new dataset should be used for subsequent biomass estimates.

4.204 A random stratified bottom trawl survey within the 500 m isobath was carried out by the US AMLR Program around the South Orkney Islands in 1999. Information from the survey on the biology of several species (WG-FSA-99/16) and standing stock biomass (WG-FSA-99/32) was reported.

4.205 New data pertaining to the biological characteristics (species composition, species assemblages, length composition, length–weight relationships, length at sexual maturity and length at first spawning, gonadosomatic indices and oocyte diameter) of Antarctic fish stocks, taken by random stratified bottom trawl around the South Orkney Islands during 1999, were presented (WG-FSA-99/16).

4.206 Estimates of standing stock biomass for eight species of finfish are presented in Table 44. Computations were based on updated estimates of seabed area (WG-FSA-99/33).

4.207 Comparable biomass estimates for the trawl surveys conducted by Germany in 1985 and Spain in 1991 are also presented in Table 44. The 1985 and 1991 survey data were reanalysed using updated seabed and analyses methods.

4.208 On a species basis, there may have been some substantial shifts in levels of biomass from the three surveys (WG-FSA-99/32). For all species except *Lepidonotothen larseni* biomass levels have increased in the 1991 and 1999 surveys over the 1985 survey. However, biomass levels for only two species increased in 1999 over the 1991 survey, and there was an apparent decrease in biomass for all other species in 1999, particularly *C. gunnari*. If the 1999 biomass level of *C. gunnari* is accurate, even the upper 95% confidence limit is roughly at 4% of pre–exploitation levels (Kock et al., 1985) around the South Orkney Islands.

4.209 One species that may have increased is *N. rossii*. There is no indication that, historically, a large standing stock existed in the South Orkney Islands relative to *C. gunnari* and *G. gibberifrons*. This species has only been a by-catch species with substantial catches being made only in 1979/80 and 1983/84 (1 722 tonnes and 714 tonnes respectively). Current biomass levels of *N. rossii* are still small relative to other species.

4.210 Given the current low abundance of *C. gunnari* and the other species and the difficulties which CCAMLR had experienced previously in managing fisheries which exploit mixed-species assemblages, the Working Group did not attempt to calculate precautionary catch limits using the GYM during the meeting.

Management Advice

4.211 There appears to be little prospect for a substantial fishery given the low biomass estimates for the 1998/99 season and some of the uncertainties associated with the decline in biomass compared to 1985. The Working Group therefore recommended that Conservation Measure 73/XVII should remain in force until future surveys indicate an increase in fish biomass in the subarea.

South Georgia (Subarea 48.3)

Squid (*Martialia hyadesi*)

4.212 No notification of the intention to conduct an exploratory fishery for the squid *M. hyadesi* in Subarea 48.3 under Conservation Measure 165/XVII was received for the 1998/99 season; therefore no fishing was carried out. No new information was presented to the Working Group at this year’s meeting.

4.213 The scientific basis on which the current conservation measure was based has not changed. WG-FSA, WG-EMM and the Scientific Committee had detailed discussions on the subject of a squid fishery in 1997 (SC-CAMLR-XVI, Annex 5, paragraphs 4.2 to 4.6; SC-CAMLR-XVI, Annex 4, paragraphs 6.83 to 6.87; and SC-CAMLR-XVI, paragraphs 9.15 to 9.18). The catch limit is considered to be precautionary since it is only 1% of a conservative estimate of annual predator consumption (SC-CAMLR-XV, paragraph 8.3).

Management Advice

4.214 The Working Group recommended that a conservative management scheme as contained in Conservation Measure 165/XVII is still appropriate for this fishery.

Crabs (*Paralomis spinosissima* and *P. formosa*)

4.215 Between 7 and 20 September 1999, the UK vessel *Argos Helena* fished for *Paralomis* spp. in Subarea 48.3[1]. During the 14-day period, the vessel made 24 sets which included 1 323 pots for a total number of 20 283 pot hours. The vessel expended 7 192, 3 170, 5 047 and 4 874 pot hours in fishing blocks A, B, C, and D respectively (defined by Conservation Measure 150/XVII).

4.216 During all sets, the vessel caught 30 512 individuals of *P. formosa* and 4 602 individuals of *P. spinosissima*. This represented 7 184 and 1 900 kg respectively by weight of the two species. However, the percentages of retained crabs were very small (14 and 9%). Therefore only 4 129 individuals and 1 861 kg of *P. formosa* and 402 individuals and 317 kg of *P. spinosissima* were retained.

4.217 Concern was expressed regarding the degree of discard mortality. This was also a concern discussed by the 1993 CCAMLR Workshop on the Long-term Management of the Antarctic Crab Fishery (SC-CAMLR-XII, Annex 5, Appendix E, paragraphs 4.7 and 6.10). The workshop members agreed that discard mortality may not be evident until some months

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1 Report of South African-designated CCAMLR observer (Mr M. Purves) on board the British-registered longliner *Argos Helena* in Subarea 48.3, 31 August to 23 September 1999.

after the catching incident because damage may result in an inability to moult rather than immediate death, and consequently discard mortality studies should be of long duration. No data exist at present to investigate these effects.

4.218 During the 14-day fishery, 334 fish (1 189 kg) of seven species of finfish were also caught. The majority (49% by numbers and 95% by weight) of the by-catch was *D. eleginoides*.

4.219 The Working Group noted the intention of the UK to continue its crab fishery next season and the notification that a US company had requested a permit to begin crab fishing next season.

Management Advice

4.220 The Working Group, recognising the great utility of the experimental harvest regime set out in Conservation Measure 150/XVII in providing useful information for developing an assessment of the target species, reiterated the view expressed at its 1996 meeting that Conservation Measure 150/XVII should remain in force, but that, if new vessels were to enter the fishery, the Commission might wish to revise Phase 2 in the light of the comments made in paragraph 4.183 of the 1996 report (SC-CAMLR-XV, Annex 5).

4.221 The Working Group agreed that, at this time, no need was identified to require vessels to conduct activities under Phase 2 and this requirement could be eliminated from Conservation Measure 150/XVII.

4.222 The Working Group also stated that since the crab stocks were not assessed, a conservative management scheme as contained in Conservation Measure 151/XVII is still appropriate for this fishery.

Antarctic Coastal Area of Divisions 58.4.1 and 58.4.2

4.223 Notification of the intention to conduct a new trawl fishery for various fish species in Division 58.4.2 during the 1999/2000 season was provided by Australia (CCAMLR-XVIII/11). Details on the development of the fishery are given in paragraph 4.13.

Pacific Ocean Sector (Area 88) – Subareas 88.1 and 88.2

4.224 Notifications of the intention to conduct exploratory fisheries for various species of fish in Subareas 88.1 and 88.2 during the 1999/2000 season were lodged by the European Community (Portugal) and Chile, and in Subarea 88.1 by New Zealand (summarised in WG-FSA-99/9). Details on the development of the fishery in Subareas 88.1 and 88.2 are given in paragraphs 4.20 to 4.23, 4.25 and 4.26.

Pacific Ocean Sector (Area 88) – Subarea 88.3

4.225 No fishing occurred in Subarea 88.3 during the 1998/99 season and no Member has notified their intention to conduct exploratory fishing operations in this area during the 1999/2000 season.

Management Advice

4.226 In view of the low catch rates encountered by a feasibility study during the 1997/98 season, the Working Group recommended that fishing for *Dissostichus* spp. should be prohibited as defined in Conservation Measure 149/XVII.

Regulatory Framework

4.227 WG-FSA-99/67 entitled 'Working paper on Scientific Issues related to a Unified Regulatory Framework for CCAMLR based on Stages of Fishery Development' was presented to the Working Group. This paper had been prepared by an intersessional working group in response to a request from the Commission (CCAMLR-XVII, paragraph 10.7).

4.228 The paper was briefly introduced. It contained six major elements. These were:

(i) scientific information required in order to provide scientific advice;

(ii) the circumstances under which a fishery should be considered as 'established';

(iii) information requirements for an established fishery;

(iv) information from fisheries that are changing from one stage of development to another;

(v) scientific requirements of the research and data collection plan of a developing fishery; and

(vi) consistency of the regulatory framework with current CCAMLR fishery classifications.

Data collection, assessment and decision processes were partly illustrated by figures.

4.229 WG-FSA discussed several aspects of this topic in depth, and referred a number of items to the task group. The results of the task group discussions will be presented to the Scientific Committee.

CONSIDERATION OF ECOSYSTEM MANAGEMENT

Interaction with WG-EMM

By-catch of Young Fish in the Krill Fishery

5.1 No new information was provided on by-catch of juvenile fish in the krill fishery, even though it had been considered an important topic for further study (SC-CAMLR-XVII, paragraph 6.24). The Working Group felt that the topic was still one of potential concern and encouraged Members to undertake studies on the topic.

5.2 Dr Marschoff informed the meeting that during the 1998/99 season, Argentina had placed an observer on a krill fishing vessel. Although the observer was able to obtain a considerable amount of data, in the absence of a standardised reporting format it had not been possible to submit the data to the Secretariat. The Working Group welcomed the collection of these data and hoped that they would be available in the near future. The Scientific Committee's attention was drawn to the fact that a reporting format for observers on krill fishing vessels would greatly facilitate this process.

Interaction between Marine Mammals and Fishing Operations

5.3 During its meeting in 1998, the Working Group had noted that marine mammals, specifically killer and sperm whales, had been taking *D. eleginoides* from longlines (SC-CAMLR-XVII, Annex 5, paragraphs 5.18 to 5.22). Further reports from CCAMLR observers, summarised in WG-FSA-99/12 and anecdotal reports, were received at this meeting.

5.4 It was thought that although the interaction may at times be a major problem locally, the overall reduction in landings of fish was not thought to be causing a major problem for assessment purposes. It was also noted that the number of species involved in taking *D. eleginoides* from longlines had increased. From the observer reports it was noted that although during the 1998/99 season many longliners had operated with experimental mechanisms to help avoidance of interactions with marine mammals, these devices had produced little or no effect for their aim. The Working Group was unable to provide any further guidance on the subject of reducing the interaction.

Information arising from WG-EMM

5.5 Dr Everson drew the attention of the meeting to points made in the report of WG-EMM. Consideration of precautionary approaches was set out in Annex 4, paragraphs 7.43 to 7.45.

5.6 WG-EMM noted key issues regarding the scales at which observations had been made, and which needed to be taken into account in considering ecosystem variability. Key points are summarised in Annex 4, paragraph 7.56. It was noted that the way in which values were scaled or extrapolated to larger or different areas had implications when the Working Group was considering new and exploratory fisheries. Of particular importance was the consideration of stock structure and spawning locations. In taking this into account, it was agreed that it is necessary to consider the consequences for individual assessments.

5.7 WG-EMM had noted that there were likely to be some benefits from a closer interaction with commercial fishing operations, so that in any proposed revisions to conservation measures account could be taken of the additional burden on fishing operations which might arise. Although sympathetic to the idea, the Working Group had no specific suggestions to offer.

5.8 WG-EMM had noted that the next IUCN global review of threatened species would be published in October 2000 and that some Antarctic fish species might be candidates for globally threatened status under the new criteria (Annex 4, paragraphs 7.74 to 7.77). In this context it was noted that the Secretariat had agreed to investigate this and notify Members of the outcome.

5.9 Two points arising from the SCOR/ICES symposium held during March 1999 in Montpellier, France, reported in WG-EMM-99/26 were noted. Firstly, there was concern at the level of elasmobranch by-catch in commercial fisheries (this is considered further in paragraphs 4.88 to 4.98). The second point relates to the effects of trawling on the seabed.

Ecological Interactions

5.10 WG-FSA-99/30 and 99/31 reported that the information on the decline in abundance of *G. gibberifrons* and *N. rossii* in inshore waters of the lower South Shetland Islands observed in trammel net catches, had been supported by data on the diet of the Antarctic shag (*Phalacrocorax bransfieldensis*). Recent information obtained at Cierva Point on the Danco Coast, Antarctic Peninsula, indicated that in that region *G. gibberifrons* constitutes one of the main prey of the Antarctic shag. This likely reflects high availability of this fish species in a site which is far away from the main historical commercial fishing grounds of the South Shetland Islands (Elephant Island and north of Livingston/King George Island) and the tip of the Antarctic Peninsula (Joinville Island).

5.11 Predator–prey interactions between *C. gunnari* and krill in the South Georgia region (Subarea 48.3) were described in WG-FSA-99/65 and WG-EMM-99/27. The former paper noted that feeding aggregations were found from October to November through to the summer on the northeastern and eastern parts of the shelf. During the summer months the fish aggregate and actively feed on krill. During this period, the fish undergo an extensive vertical feeding migration. It was noted that when krill is available over the shelf the fish concentrations are stable, but when krill is absent the fish disperse. When krill is absent the fish tend to be distributed throughout the water column over most of the 24-hour period.

5.12 Additional information was provided from observations from a commercial vessel working around South Georgia (WG-EMM-99/27) which indicated that the largest concentrations of *C. gunnari* were present to the northwest of the island in an area of high krill concentration. In that area the fish had stomachs full of krill.

5.13 WG-FSA-99/50 and 99/54 were tabled in response to SC-CAMLR-XVII, Annex 4, paragraph 7.32. The former paper indicated that there was a good correlation between condition indices from research surveys and krill density estimated from independent acoustic surveys during the same month. In addition, the condition indices were seen to vary through the season indicating that krill availability was unlikely to be constant throughout the period. WG-FSA/99-54 presented results which indicated that the gonad maturation cycle is subject to considerable variability in its timing, although in most years the majority of fish appear to come into spawning condition. It was suggested that the commencement of the maturation cycle is dependent on food availability late in the winter.

5.14 WG-FSA-99/63 examined possible reasons for observed reductions in icefish density between seasons. It was suggested that this was due to increased natural mortality due to predation by fur seals. This hypothesis had already been considered by the Working Group with respect to the development of a management plan as described in Agnew et al. (1998) and Parkes (1993).

RESEARCH SURVEYS

Simulation Studies

6.1 There were no new developments in survey design methods undertaken during 1998/99. WG-FSA-99/33 examined the effects of revised seabed areas within the 500 m isobath of the South Orkney Islands in Subarea 48.2 on estimates of standing stock biomass of nine species of finfish using the TRAWLCI model. The increase in total seabed area of 20% (1 424 n miles^2) resulted in an increase of 5 to 30% for eight species and a decrease of 20% for one species. Changes in confidence limits of biomass were affected by the degree of uneven spatial distribution within strata, coupled with the change in seabed area.

Recent and Proposed Surveys

Recent Surveys

6.2 Three recent cruises were undertaken in the Convention Area in 1998/99 covering Subareas 48.2, 48.3 and Division 58.5.2. Studies were undertaken by the USA, Russia and Australia respectively.

6.3 The Australian survey (WG-FSA-99/68) was conducted around the Heard Island Plateau, Division 58.5.2, from 27 March to 21 April 1999 on board the FV *Southern Champion*. The bottom trawl survey targeted *D. eleginoides*.

6.4 Russian scientists undertook research activities on board the trawler *Zakhar Sorokin* in Subarea 48.3 while it was engaged in commercial trawling from 16 February to 10 March 1999 (WG-FSA-99/57). A large pelagic trawl was used for the study and targeted *C. gunnari*.

6.5 The US AMLR Program conducted a bottom trawl survey of finfish around the South Orkney Islands in Subarea 48.2. Trawling operations were conducted from 9 to 25 March 1999 aboard the RV *Yuzhmorgeologiya* (WG-FSA-99/16 and 99/32). The USA also collected limited samples of fish aboard the RV *Lawrence M. Gould* in Subarea 48.1 from 22 March to 30 June 1999.

Proposed Surveys

6.6 Australia plans a *C. gunnari* and *D. eleginoides* pre-recruitment survey for the 1999/2000 season. This survey will probably occur during April and May 2000 on the Heard Island Plateau and Shell Bank areas (Division 58.5.2). The aim of this survey is to estimate the biomass and recruitment of *C. gunnari* and *D. eleginoides*. These estimates will be used for stock assessments at the next meeting of WG-FSA.

6.7 The UK plans to carry out a study on the feasibility of using pots to catch *D. eleginoides* in Subarea 48.3 (WG-FSA-99/41) from January to July 2000 aboard the FV *Argos Atlanta*. This study was notified in accordance with Conservation Measure 64/XII.

6.8 The UK also plans to conduct a bottom trawl survey in Subarea 48.3 during January and February 2000.

6.9 Russia plans to conduct a random-design bottom trawl survey in Subarea 48.3 during February 2000, targeting *C. gunnari* and other species.

6.10 Argentina plans to conduct a bottom trawl survey aboard the RV *Dr Eduardo E. Holmberg* in Subarea 48.3 during March and April 2000, targeting mixed species of fish.

6.11 New Zealand intends to conduct a tagging program in Subarea 88.1. The program will be conducted during January and February 2000 targeting skates and *D. mawsoni*.

6.12 The USA intends to collect limited fish specimens from Subarea 48.1 in October and December 1999 and February, March and May 2000. The Working Group requested that catch data be made available by any programs working within the Convention Area, even those that only sample small numbers of fish.

INCIDENTAL MORTALITY ARISING FROM LONGLINE FISHING

IMALF Intersessional Activities

7.1 The Secretariat reported on the intersessional activities of ad hoc WG-IMALF (WG-FSA-99/7). The IMALF group worked in accordance with the plan of intersessional activities developed immediately after the completion of CCAMLR-XVII (November 1998) by the Secretariat in consultation with Prof. Croxall (Convener), Mr Baker (Deputy Convener) and other members of ad hoc WG-IMALF. As in previous years, the intersessional work of the IMALF group was coordinated by the Secretariat's Science Officer.

7.2 The report of intersessional activities of ad hoc WG-IMALF contained records of all activities planned and their results. It was considered item by item to evaluate outcomes and to decide which tasks were complete, which needed continuing or repeating, and which were in essence annual standing requests. Major items of future work would be considered later under that agenda item (paragraphs 9.14 and 9.15). The remaining tasks which needed intersessional work would appear in the plan of intersessional activities for 1999/2000 (Appendix D).

7.3 The Working Group noted the extensive work accomplished intersessionally by ad hoc WG-IMALF, details of which were presented in a number of WG-FSA papers. The Working Group thanked the Science Officer for his work on the coordination of IMALF activities. 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 1998/99 fishing season.

7.4 The membership of ad hoc WG-IMALF was reviewed. The need for continuing membership of Ms K. Maguire (Australia), Dr M. Imber (New Zealand) and Ms J. Dalziell (New Zealand) was questioned. Mr T. Reid (Australia) was recommended as an additional member. The Science Officer and Convener would take up these suggestions with the members involved. WG-FSA noted that some CCAMLR Member countries which are involved in longline fishing and/or seabird research in the Convention Area (e.g. Norway, Ukraine, Uruguay and USA) are not represented in ad hoc WG-IMALF. Members were asked to review their representation in ad hoc WG-IMALF intersessionally and to facilitate attendance of as many of their members as possible at the meeting. In respect of the latter, attendance by representatives from France would be particularly appreciated.

7.5 The Working Group welcomed the appearance of the book *Identification of Seabirds of the Southern Ocean. A Guide for Scientific Observers aboard Fishing Vessels* by D. Onley and S. Bartle, published by CCAMLR and the National Museum of New Zealand in 1999. This book is intended as a guide for use by fisheries observers when aboard fishing vessels south of 40°S. The main purpose is to identify any birds that come on deck (live or dead) rather than to identify birds in flight. The Working Group offered some comments to help in any future revision.

(i) For effective use (e.g. on deck) it would be helpful for the pages to lie flat when open (e.g. using ring binding), and for the plates to be waterproof.

(ii) In the appropriate section of the book observers should be requested to supply any relevant information on why they thought birds were caught on particular sets/hauls.

(iii) The taxonomy and nomenclatures of albatrosses, particularly in the wandering albatross group, is inconsistent with the most recent comprehensive treatment (Robertson and Gales, 1998). This will create unnecessary confusion. It was noted that the Oversight Committee had suggested that authors adhere to the nomenclature, especially vernacular, used by Robertson and Gales (1998).

(iv) Since bills were being used predominantly for identifying species, it would have been helpful if all species were shown on one page so that observers could look them up quickly, once they had become familiar with the different species.

(v) Not all very young black-browed albatrosses have a pale eye, rendering *Diomedea melanophrys* and *Diomedea impavida* very difficult to distinguish at this age (and, in Australia at least, a large proportion of the birds are of this age).

(vi) Most photographs of the spectacled petrel show bills to have pale tips.

(vii) The book does not illustrate any species of penguin, despite at least gentoo and king penguins being caught by longliners with some regularity. On the other hand, southern fulmars and Antarctic petrels are shown, despite not having been caught by fishing vessels.

(viii) Because there is an expectation that the birds will be identified in the hand, measurements may be invaluable in deciding the identity of some birds. However, in this book the measurements given seem to only be a small subsample of those already published, and only a few measurements are given.

(ix) The section on breeding, populations, distribution and behaviour may be of somewhat restricted generality. Comments to improve this were provided to the authors a year ago, but only one has been incorporated in the text. Examples of misleading text are the statements that shy albatrosses are sometimes caught by southern bluefin tuna longliners and by trawl gear south and east of New Zealand (it is the species most commonly caught by domestic southern bluefin tuna longliners in southeast Australia), and that short-tailed shearwaters sometimes feed around trawlers and are caught by drift nets in the North Pacific (they are very common around, and sometimes caught by, longliners around Australia).

7.6 With respect to comments in paragraph 7.5(iii), the Secretariat advised that the species nomenclature used in the guide is same as used in the *CCAMLR Scientific Observers Manual*. The preface to the guide states that it was written taking into account, in particular, the requirements of the CCAMLR Scheme of International Scientific Observation. The list of seabird species appended to the guide also contains references to their CCAMLR codes. Therefore, any future changes to the guide will require similar changes to the *CCAMLR Scientific Observers Manual*.

Research into Status of Seabirds at Risk

7.7 In response to the request for information on current national research programs into the status of seabird species vulnerable to fisheries interactions (albatrosses, giant petrels, *Procellaria* petrels) (SC-CAMLR-XVII, Annex 5, paragraph 7.8), summary papers had been presented by Australia (WG-FSA-99/61), France (WG-FSA-99/27), New Zealand (WG-FSA-99/49), South Africa (WG-FSA-99/34) and the UK (WG-FSA-99/17).

7.8 The Working Group was unaware of any relevant current research additional to that reported in the above papers, given that WG-FSA-99/61 and 99/17 included collaborative projects involving Chile.

7.9 The information in the above papers was further summarised in Table 45. This indicates regions and sites at which research on populations and foraging ecology is currently in progress and also those regions/sites of importance for target species at which no current research is being undertaken. While it is encouraging that significant research programs have been initiated during the 1990s for a range of species at a number of sites, notable deficiencies remain. Some of these are indicated in paragraphs 7.10 to 7.15.

7.10 The populations of many regions (e.g. Falkland/Malvinas Islands, South Georgia, Crozet Islands) comprise sub-populations at numerous geographically distinct sites or islands; demographic monitoring and foraging range information is usually derived from studies at only one island/site. Recent studies of a number of species indicate that birds from different islands within a region may segregate at sea. This may result in differential interactions with fishing activities and so be reflected in differing population trends. Where possible, multisite studies within breeding regions are preferable.

7.11 Within the *Diomedea* albatrosses, researchers have indicated current research on both population monitoring and foraging ecology for all species at most sites. However, the adequacy of many of these programs for confident assessments of population trends and foraging distributions is not always clear from the available information. Summaries provided elsewhere (Gales, 1998; Croxall, 1998) indicate that some of the demographic programs have limited time series data and so may be of limited use at present. Many of the foraging range/ecology studies are limited to information from only a few adult birds at restricted times during the breeding season; results cannot necessarily be extended to other seasons or age groups.

7.12 For the *Thalassarche* albatrosses, the extent and utility of information is similarly restricted; for some important populations there are still no research or monitoring programs in place. Priority populations for targeted research and/or monitoring would include grey-headed albatrosses and Indian yellow-nosed albatrosses in the western Indian Ocean sector, as well as foraging ecology studies for both Salvin's and white-capped albatrosses. Notable also is the absence of recent population assessments for the critically endangered Chatham Island albatross.

7.13 Even less information is available for the two species of *Phoebetria* albatrosses. The need for population monitoring and foraging ecology studies at western Indian Ocean sites for both species, as well as for South Georgia and New Zealand populations of light-mantled albatrosses, remains a priority.

7.14 Both species of giant petrels are impacted by longline fishing, yet information on population trends remains inadequate for most populations. Recent satellite-tracking studies of giant petrels at South Georgia (WG-FSA-99/38 and 99/39) showed both species and sex-specific foraging segregation, these results highlighting the need for similar studies at other important breeding sites.

7.15 For white-chinned and grey petrels, population assessments remain inadequate. Population trends are unknown for all sites across the range of both species. Recent satellite-tracking studies of white-chinned petrels (WG-FSA-99/20 and 99/47), the commonest species in the by-catch of longliners in many sectors, show their extended foraging ranges overlap with longline fisheries from Antarctic to sub-tropical waters. Information on population trends and foraging distribution of both species at all important sites is urgently required.

7.16 Assessments of the genetic profiles of albatrosses from various sites are currently being undertaken in laboratories of a number of countries including Australia, New Zealand, South Africa, UK and the USA. The application of these results in determination of the provenance of birds killed in longline fisheries will assist in identifying the populations most at risk. To accelerate this process, cooperation and coordination in the dissemination of the population specific profiles is essential. Members were requested to table information on the current status of these research programs for next year's meeting of WG-FSA.

7.17 In order to determine more accurately the status and potential utility to CCAMLR of the research programs summarised in Table 45, further investigation and refinement of information is required. Dr Gales undertook to coordinate this intersessionally.

7.18 Members were requested to update the information summarised in Table 45 by means of appropriate reports to future meetings of the Working Group.

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

1998 Data

7.19 Last year, for Subareas 58.6 and 58.7, four of the observer logbooks were incomplete. An attempt was made intersessionally to get the missing information required to calculate the seabird catch rates and numbers of hooks observed; however, this information was not collected and could not be calculated from the available data. Table 46 summarises all available information on seabird catch rates and the numbers of birds observed for these areas. This updates the relevant parts of SC-CAMLR-XVII, Annex 5, Table 35 and necessitates recalculation of estimates of overall seabird by-catch and of the species composition of the catch.

7.20 The revised observed species composition for birds killed in the longline fishery for Subareas 58.6 and 58.7 during the 1997/98 season is given in Table 47. White-chinned petrels (91%) were the most common of all birds killed; no incidental mortality of albatrosses was recorded.

7.21 The estimated total incidental catch of seabirds for each vessel (Table 48) was calculated using the catch rate (birds/thousand hooks) for each vessel multiplied by the total number of hooks set by that vessel during the fishing season. For the four vessels where catch rates could not be calculated, the overall catch rate was used. The overall catch rate was calculated from the total number of hooks observed and the total observed seabird mortality. The catch rates for Subareas 58.6 and 58.7 was 0.15 and 0.54 birds/thousand hooks for night and day setting respectively (Table 46) and 0.19 birds/thousand hooks overall. The night rate was about 31% of the level of the previous season (0.49 birds/thousand hooks); however, the day rate was similar to that of the previous season (0.58 birds/thousand hooks). The estimated total of 528 birds killed was 63% of the 1997 total (834 birds); the overall catch rate in 1998 was 39% of that in 1997.

7.22 WG-FSA-99/28 used data collected by CCAMLR international scientific observers in 1997 and 1998 to examine potential relationships between seabird incidental mortality rates on longline vessels fishing for *D. eleginoides* and the nature and use of mitigating measures, as well as with environmental variables such as time of day, time of year.

7.23 Out of the 3 283 longline sets analysed, only 311 caught birds (9.4%). Data conformed most closely to a Delta distribution (many zero values and lognormal distribution of non-zero values) and were analysed using two GLMs, a binomial model for presence/absence of seabird catches and a Gamma model for the magnitude of non-zero catches. Sparsity of data precluded analysis of seabirds at a taxon level more detailed than albatrosses and petrels combined. Other analytical difficulties, particularly in using GLMs, related to the large number of potentially important factors, the lack of overlap between factors and the fact that fishing has purposely avoided making catches of seabirds. There were, for instance, only three records in the entire dataset where none of the mitigation measures has been used.

7.24 The only factors consistently significant were time of year (very few birds caught after April) and use of streamer lines, but the effects of most other factors could not be fully analysed with the present data. Even vessels using streamer lines and setting at night were found to catch albatrosses occasionally (Figure 29), although in all such cases the line weightings used were less than those specified by Conservation Measure 29/XVI.

7.25 Vessel-specific effects were not considered in this analysis. The shortening of the season between 1997 and 1998 significantly reduced the data available, such that only two vessels fished in March and April in both years, and both changed a number of their operating parameters in this time.

7.26 The Working Group concurred with the conclusion in WG-FSA-99/28 that given the difficulties of analysing this dataset, especially the problem of very low numbers of sets not using mitigation measures and sets catching birds, experimental approaches to identifying effective mitigation measures may be preferable to post hoc analysis of observer data.

7.27 It was noted, however, that the data distributions used in the models may not be entirely realistic. In particular, there is a need to cater for the assumption that with mitigation measures in use there is an expectation that the more likely by-catch may still be zero birds. Newly available analytical software may assist in improving the analysis described in WG-FSA-99/28, and it was recommended that this be investigated intersessionally.

7.28 In general, however, it was recognised that analysis of the existing observer data is unlikely to provide clear-cut answers with respect to the efficacy of mitigation measures. As observed seabird by-catch rates decrease, this will be increasingly true. Further improvements to, and assessments of, mitigation measures will need testing using carefully designed experiments.

1999 Data

7.29 A total of 32 cruises was conducted within the Convention Area during the 1998/99 season, with scientific observers (international and national) aboard all vessels. Twenty-one cruises were undertaken in Subarea 48.3 by 12 vessels, nine cruises were undertaken in Subareas 58.6 and 58.7 by three vessels and two cruises were undertaken by two vessels in Subarea 88.1. A detailed list of the observations conducted and the type of data submitted to the Secretariat is contained in Table 49.

7.30 The timeliness of logbook and cruise report submissions to the Secretariat greatly improved this season, with all of the logbooks being received before the start of the meeting. The quality of the logbooks submitted this year has been much improved on previous years. All of the logbooks have been submitted using the CCAMLR logbook forms, although some forms were outdated and lacked some information (e.g. numbers of hooks observed). Positive feedback was received from the observers, through their technical coordinators, on the use of the electronic observers logbook. Submission of data using this method should be encouraged.

7.31 The Working Group expressed concern that the proportion of hooks being observed to provide overall estimates of seabird mortality was still rather low (WG-FSA-99/18 and 99/26). A desirable level of observation would be about 40 to 50% (SC-CAMLR-XVII, Annex 5, paragraphs 3.60 and 7.124 to 7.130); levels below 20% may introduce potentially serious errors into estimates.

7.32 Average values (percentages with ranges in parenthesis) over the last three years, for Subareas 48.3 and 58.6/58.7 have been as follows:

1997: 48.3 – 34 (5–100); 58.6/58.7 – 60 (15–100);
1998: 48.3 – 24 (1–57); 58.6/58.7 – 43 (14–100); and
1999: 48.3 – 25 (10–91); 58.6/58.7 – 34 (13–62).

7.33 The Working Group agreed that the level of sampling effort required to estimate seabird mortality should be investigated using existing data and simulation models. This work, which should be undertaken by WG-IMALF in the intersessional period, should consider the resolution and accuracy of estimates of seabird by-catch rates under various levels of observed by-catch rates.

7.34 The seabird catch rates for Subareas 48.3, 58.6, 58.7 and 88.1 were calculated from the combined numbers of hooks observed and the total seabird mortality observed (Table 50). No incidental mortality was observed for Subarea 88.1. The estimated total catch of seabirds by vessel was calculated using the vessel's catch rate multiplied by the total number of hooks set. For those vessels where data for calculating catch rates were unavailable, the overall catch rate for that area was used.

7.35 The data compiled and analyses undertaken by the Secretariat with respect to Subarea 48.3 included the results from the line-weighting experiment by the *Argos Helena* (WG-FSA-99/5). It was agreed that it was inappropriate to include these data in the estimation of by-catch and calculation of by-catch rates. However, there was insufficient time at the meeting to undertake the necessary recalculations in respect of Tables 16 and 50 to 52. Therefore it was agreed to highlight (and footnote as appropriate) these data in the above tables and to ensure that data from such experiments were excluded from the main calculations in future.

Subarea 48.3

7.36 For Subarea 48.3, the total catch rate of birds killed during daytime setting periods (0.08 birds/thousand hooks) was higher than that for night setting (0.01 birds/thousand hooks). However, this includes 88 birds killed in daytime during the line-weighting experiment on the *Argos Helena* (WG-FSA-99/5). If these data are excluded, the overall daytime catch rate would be 0.03 birds/thousand hooks and the combined overall value 0.01 birds/thousand hooks. The total estimated seabird mortality in Subarea 48.3 for 1999 was 306 birds (Table 51), a 48% decrease on the previous season, or 210 birds (a 65% decrease) if the *Argos Helena* line-weighting experiment is excluded.

7.37 The most commonly observed species killed in Subarea 48.3 (Table 52) was black-browed albatross, comprising 66% of the total seabird mortality, followed by white-chinned petrel (27%) and grey-headed albatross (3%). If *Argos Helena* data are excluded, the values are: black-browed albatross 81%, white-chinned petrel 7%, grey-headed albatross 5%.

7.38 The Working Group commended the continued reduction in the number of seabirds killed in this subarea and the maintenance of the previous year's very low by-catch rate. It noted, however, that further reductions could be achieved by:

(i) reconfigurations of offal discharge arrangements on the three vessels still discharging on the same side as the haul;

(ii) eliminating daytime setting; and

(iii) using line-weighting regimes that comply with Conservation Measure 29/XVI.

Division 58.5.1

7.39 CCAMLR-XVIII/BG/19 reported that during 1 481 longline sets by two Ukrainian vessels, 151 seabirds were killed, comprising 149 white-chinned petrels, 1 black-browed albatross and 1 light-mantled albatross.

7.40 The Working Group regretted that the full data from this fishery – and similar data from fishing within the French EEZ in Subarea 58.6 – had not been submitted to the Secretariat for analysis and evaluation at the meeting. It urged France to submit data in timely fashion to future meetings.

Subareas 58.6 and 58.7

7.41 For Subareas 58.6 and 58.7, no incidental mortality was observed during daylight setting (12% of total); the catch rate for night setting was 0.05 birds/thousand hooks. An estimated total of 156 birds were killed (Table 53), 30% of the value in 1998.

7.42 In Subareas 58.6 and 58.7, white-chinned petrels were the most common observed species killed, comprising 67% of the total seabird mortality (Table 52), followed by giant petrel (17%), gentoo penguin (8%) and grey petrel (6%).

7.43 Further analysis of the seabird by-catch in the longline fishery around the Prince Edward Islands (Subarea 58.7) in the 1998/99 season was provided in WG-FSA-99/42 Rev. 1. The 11 sanctioned fishing trips contributed a fishing effort of 5.1 million hooks, 19% more than the number of hooks set in 1997/98. Only 79 seabirds (15% of the total killed in 1997/98) were observed killed. Average seabird by-catch rate by sanctioned vessels was 0.016 birds/thousand hooks, compared with 0.289 in 1996/97 and 0.117 in 1997/98. Comparisons between years for the same vessel, using the same gear design and at the same time of year, show marked decreases in seabird by-catch rate during 1998/99.

7.44 Five bird species were reported killed: white-chinned petrels predominated (79%), followed by giant petrels *Macronectes* spp. (13%) and grey petrels (6%). The last is a concern as only one grey petrel had been killed prior to this year. Birds were caught on only 3.1% of lines set (n = 1 187). Bird by-catch was primarily linked to daytime sets, with most birds caught in the late afternoon or shortly after dusk. Use of an underwater setting device (a Mustad funnel) significantly reduced bird by-catch to very low levels (0.002 birds/thousand hooks), but it was not tested during the period when seabird by-catch typically peaks (mid- to late summer). An average of 4.5 live birds were caught per 100 hauls; although these were released alive, the higher catch rate of Spanish double-line gear is cause for concern.

7.45 WG-FSA-99/42 Rev. 1 suggested that the substantial reduction in seabird by-catch rates reported for 1998/99 was due to:

(i) continued application of mitigation measures (use of streamer lines, setting lines at night or in conjunction with an underwater setting device);

(ii) increasing experience by both crews and observers;

(iii) switch in fishing to waters more distant from the Prince Edward Islands; and

(iv) reduction in the amount of offal released from vessels.

The change in fishing area may have been especially important during the high-risk late summer period; it was recommended that fishing within 200 km of the islands from January to March should be prohibited.

7.46 The Working Group commended the efforts of South Africa in achieving continued improvement in the performance of the fishery within its EEZ in terms of reduction of seabird by-catch. It noted, however, that:

(i) there was evidence that a proportion of seabird by-catch went unobserved, at least on some vessels;

(ii) the biggest reductions in by-catch were achieved by the change in fishing area and by the use of underwater setting; and

(iii) further reduction would likely be achieved by elimination of daytime setting and by line-weighting regimes that complied with Conservation Measure 29/XVI.

It endorsed the recommendation that fishing within 200 km of the Prince Edward Islands should be prohibited from January to March inclusive.

General

7.47 The Working Group noted that over the last three years, comparing 1999 with 1997 (Table 54), seabird by-catch and by-catch rate in the regulated fishery have been reduced by 96.4% and 95.7% respectively in Subarea 48.3 and by 81.3% and 94.2% respectively in Subareas 58.6 and 58.7. This has been achieved by a combination of improved used of mitigating measures in compliance with Conservation Measure 29/XVI and by delaying the start of fishing until after the end of the breeding season of most albatross and petrel species.

Compliance with Conservation Measure 29/XVI

7.48 This section summarises information on the extent of compliance with the main elements of Conservation Measure 29/XVI in 1998/99. Table 16 provides a comparison between 1996/97, 1997/98 and 1998/99, together with an indication of the proportion of logbooks that provided data on each of the elements of Conservation Measure 29/XVI (see also WG-FSA-99/12). Based on available data, in 1998 two autoline vessels (*San Aotea II* and *Janus*), operating in Subarea 88.1, complied with all aspects of Conservation Measure 29/XVI, subject to the variation to allow daytime setting granted under Conservation Measure 169/XVII (see paragraph 7.85). For the remainder of the vessels, either insufficient data were provided to assess full compliance or not all elements of the conservation measure were complied with.

7.49 Line weighting: Data for each vessel and cruise are shown separately for Spanish system and autoline vessels in Figures 30 and 31. This year one vessel (*Illa de Rua*) complied with the line-weighting regime that applies to vessels using the Spanish system (6 kg every 20 m) on two of three cruises. One other vessel (*Koryo Maru 11*) used a line-weighting regime very close to the requirement (5 kg every 20 m) on two of five cruises. Overall (i.e. for all areas combined), the median weight and distance between weights for each of the last three years (1996/97, 1997/98 and 1998/99) for all vessels using the Spanish system was 5 kg at 45 m, 6 kg at 45 m and 7 kg at 44 m respectively. The average weight (kg) per metre of mainline for the three years was 0.111, 0.133 and 0.150 respectively. This indicates a substantial increase in overall weight added to lines in 1998/99, but is still well below the level specified by Conservation Measure 29/XVI.

7.50 Offal discharge: In Subareas 58.6, 58.7 and 88.1 there was 100% compliance with the requirement either to hold offal on board during the haul, or to discharge on the opposite side of the vessel to hauling. In Subarea 48.3, 71% of the vessels discharged offal on the opposite side to hauling. This was a substantial improvement on 1998 when only 31% of vessels complied in this regard. In Subarea 88.1 vessels achieved compliance through having a fish meal plant operating to process offal.

7.51 Night setting: Night setting was successfully completed for 80% of sets in Subarea 48.3 and 84% in Subareas 58.6 and 58.7. If the daytime sets made during mitigation measure experimentation by the *Argos Helena* in Subarea 48.3 and *Eldfisk* in Subareas 58.6 and 58.7 are removed, the percentage of night sets for the two subareas would be 86% and 98% respectively, compared with values for 1998 of 90% and 93% respectively.

7.52 Streamer lines: Vessel and cruise-specific data are summarised in Tables 16 and 17. Both vessels fishing in Subarea 88.1 used streamer lines that complied with Conservation Measure 29/XVI. However, no vessels fishing in Subareas 48.3, 58.6 and 58.7 used streamer lines that met all aspects of the CCAMLR design. The length of streamer lines was the element with lowest compliance; only 10% of vessels in Subareas 58.6 and 58.7 and 26% in Subarea 48.3 had lines that were at least 150 m long. This situation has not improved over the last three seasons. Adequate streamer line length is very important because it is a crucial element in the amount of protection afforded by the streamer line. Compliance with attachment height is generally good, showing consistent improvement for vessels fishing in Subarea 48.3. The number and spacing of streamers is generally close to 100% (Table 17). Thirteen observers (compared to eight last year) noted that spare streamer line material was on board. However, two observers (none last year) indicated that spare material was absent.

7.53 Thawed bait: As with the previous two years, reporting on compliance with use of thawed bait was incomplete. It appears from the logbooks that at least one vessel (*Ibsa Quinto*) used frozen bait on more than one set.

7.54 Overall, levels of compliance with elements Conservation Measure 29/XVI are steadily improving, particularly with respect to night setting and offal discharge. Compliance with line weighting and overall use of streamer lines is still far from satisfactory.

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

7.55 The Working Group estimated the levels of seabird by-catch that might be associated with the unregulated longline fisheries in the Convention Area in 1998/99.

7.56 An estimate of total seabird by-catch for any fishery requires information on seabird by-catch rates from a sample of the particular fishery and an estimate of the total number of hooks deployed by the fishery. For unregulated fisheries, information is not available either for seabird catch rate or for total hooks set. To estimate these parameters, catch rates of seabirds and *Dissostichus* spp. from the regulated fishery and estimates of total fish catches from the unregulated fishery are required.

Unregulated Seabird By-catch

7.57 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 are under 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.

7.58 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 last year. The assessment this year, therefore, followed the identical procedure to that used last year (SC-CAMLR-XVII, Annex 5, paragraphs 7.75 to 7.81) except that assessments this year also needed to be made for Subarea 48.3 and Division 58.4.4.

7.59 No seabird by-catch data are available for Division 58.4.4. The IMALF risk assessment for this division is level 3 (average) compared with level 5 (high) for Subareas 58.6 and 58.7, which lie immediately to the north. Seabird by-catch rates for Division 58.4.4 were therefore set at 60% of those pertaining to Subareas 58.6 and 58.7.

Unregulated Effort

7.60 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.

7.61 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.

7.62 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

7.63 The results of these estimations are shown in Tables 55 and 56.

7.64 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 3 200 to 4 300 birds in summer (and 30 to 60 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 11 500 to 15 400 birds in summer (and 200 to 400 in winter).

7.65 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 12 000 to 16 000 birds in summer (and 70 to 140 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 23 500 to 31 500 birds in summer (and 300 to 600 in winter).

7.66 It should be noted that Subarea 58.7, mainly due to low levels of fishing and catch rates of fish, makes rather little contribution to this year's total.

7.67 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 100 to 130 birds in summer (and 10 to 25 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 3 650 to 4 900 birds in summer (and 75 to 150 in winter).

7.68 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 3 000 to 4 000 birds in summer (and 15 to 30 in winter) to a potentially higher level (based on the maximum by-catch rate of regulated vessels) of 5 000 to 7 000 birds in summer (and 30 to 130 in winter).

7.69 The overall estimated totals for the whole Convention Area (Table 56) indicate a potential seabird by-catch in the unregulated fishery of 18 000 to 25 000 (lower level) to 44 000 to 59 000 birds (higher level) in 1998/99.

7.70 This compares with totals of 17 000–27 000 (lower level) to 66 000–107 000 (higher level) in 1996/97 and 43 000–54 000 (lower level) to 76 000–101 000 (higher level) in 1997/98. Any suggestion of a decrease in 1998/99 should be viewed with caution, given the uncertainties and assumptions involved in these calculations.

7.71 The composition of the estimated potential seabird by-catch based on data from 1997 is set out in Table 57. This indicates a potential by-catch of 21 000 to 46 500 albatrosses, 3 600 to 7 200 giant petrels and 57 000 to 138 000 white-chinned petrels in the unregulated fishery in the Convention Area over the last three years.

7.72 As in the last two years, it was emphasised that the values in Tables 55 to 57 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.

7.73 Nevertheless, even taking this into account, the Working Group endorsed its conclusion of last year that such levels of mortality are entirely unsustainable for the populations of albatrosses and giant and white-chinned petrels breeding in the Convention Area.

Summary Conclusion

7.74 IMALF 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 three years, an estimated 170 000 to 250 000 seabirds have been killed by these vessels. Of these, 21 000 to 46 500 were albatrosses, including individuals of four species listed as globally threatened (vulnerable) using the IUCN threat classification criteria. These and several other albatross and petrel species are facing potential extinction as a result of longline fishing. The Working Group urgently requests the Commission to take action to prevent further seabird mortality by unregulated vessels in the forthcoming fishing season.

Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries

Assessments of Risk in CCAMLR Subareas and Divisions

7.75 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 (SC-CAMLR-XVI, Annex 5, paragraph 7.118; SC-CAMLR-XVII, Annex 5, paragraph 7.98).

7.76 In order to address these concerns, the Working Group prepared 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.

7.77 The assessments made in 1997 and 1998 for new and exploratory fisheries proposed in those years are set out in SC-CAMLR-XVI, Annex 5, paragraph 7.126 and SC-CAMLR-XVII, Annex 5, paragraph 7.116. Similar assessments of two areas with established longline fisheries (Subarea 48.3 and Division 58.5.1) were undertaken in 1997 (SC-CAMLR-XVI, Annex 5, paragraph 7.127).

7.78 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/XVI. 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.

7.79 This year new data on breeding distribution and population sizes of albatrosses and petrels were provided in WG-FSA-99/59, and on at-sea distribution from satellite-tracking studies in WG-FSA-99/19, 99/20, 99/21, 99/25, 99/36, 99/38, 99/39 and 99/47.

7.80 The areas for which proposals for new and exploratory fisheries were received by CCAMLR in 1999 were:

Subarea 48.6	(South Africa, European Community)
Division 58.4.1	(Australia – trawl)
Division 58.4.2	(Australia – trawl)
Division 58.4.3	(Australia – trawl, France, European Community)
Division 58.4.4	(Chile, South Africa, Uruguay, France, European Community)
Division 58.5.1	(Chile, France)
Division 58.5.2	(France)
Subarea 58.6	(Chile, France, South Africa, European Community)
Subarea 58.7	(France)
Subarea 88.1	(Chile, European Community, New Zealand)
Subarea 88.2	(Chile, European Community).

7.81 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 7.76 and adopted in previous years. Two areas, Division 58.4.2 and Subarea 88.2 were fully assessed for the first time. Full details of these two new assessments are provided in paragraph 7.84, together with summaries for the other areas.

7.82 The full texts of all assessments were combined into a background document for use by the Scientific Committee and Commission (SC-CAMLR-XVIII/BG/23). It was agreed that this document should in future be tabled annually for the Scientific Committee.

7.83 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 fisheries in 1999 is set out in Table 58. The assessment conclusion, advice and full comments on the proposals are set out below.

7.84 (i) Subarea 48.6:

Assessment: moderately well-known area in terms of visiting species. Its very large area, however, suggests interaction potential is probably underestimated. The northern part of the area (north of c. 55°S) contains extensive potential fishing grounds and is also the area in which most seabirds potentially at risk occur.

Advice: 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/XVI as a seabird by-catch precautionary measure.

It was noted that South Africa (CCAMLR-XVIII/9) and the European Community (CCAMLR-XVIII/21) propose to fish from 1 March to 31 August north of 60°S and from 15 February to 15 October south of 60°S and to comply fully with all elements of Conservation Measure 29/XVI. This does not conflict with the above advice.

(ii) Division 58.4.1:

Assessment: although no breeding populations are within the area, this is a potentially important foraging area for five albatross species (two threatened, one near-threatened), southern giant petrel, northern giant petrel, white-chinned petrel and short-tailed shearwater from important breeding areas for the species concerned.

Advice: average risk; prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (September–April); apply all elements of Conservation Measure 29/XVI.

It was noted that Australia (CCAMLR-XVIII/12) is proposing a trawl fishery in this area, and that longline fishing is not currently proposed.

It was also noted that 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.

(iii) Division 58.4.2 (new assessment)

Breeding species in this area: southern giant petrel.

Breeding species known to visit this area: wandering albatross, light-mantled albatross and white-chinned petrel from Crozet Islands.

Breeding species inferred to visit this area: black-browed albatross, light-mantled albatross, grey-headed albatross, northern giant petrel, white-chinned petrel and grey petrel.

Other species: short-tailed shearwater, sooty shearwater.

Assessment: this is an important foraging area for four albatross species (two threatened), southern giant petrel and white-chinned petrel.

Advice: average-to-low risk; prohibit longline fishing during the breeding season of giant petrels (October to April); maintain all elements of Conservation Measure 29/XVI.

It was noted that Australia (CCAMLR-XVIII/11) is proposing a trawl fishery in this area, and that longline fishing is not currently proposed.

(iv) Division 58.4.3:

Assessment: although no breeding populations are within the area, this is a potentially important foraging area for four albatross species (two threatened, one near-threatened), southern giant petrel and white-chinned petrel from important breeding areas for the species concerned.

Advice: average risk; prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (1 September to 30 April); maintain all elements of Conservation Measure 29/XVI.

It was noted that:

(a) France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season and to comply fully with all elements of Conservation Measure 29/XVI. This fishing season substantially conflicts with the IMALF advice;

(b) the European Community (CCAMLR-XVIII/21) intends to fish from 15 April to 31 August and to comply fully with all elements of Conservation Measure 29/XVI. This will overlap the recommended season closure by two weeks; and

(c) the proposal by Australia (CCAMLR-XVIII/12) is for a trawl fishery.

(v) Division 58.4.4:

Assessment: although no breeding populations are within the area, this is a potentially important foraging area for four albatross species (three threatened, one near-threatened), southern giant petrel, white-chinned petrel and grey petrel from very important breeding areas for the species concerned.

Advice: average risk; prohibit longline fishing during the main breeding season of albatrosses and petrels (1 September to 30 April); maintain all elements of Conservation Measure 29/XVI.

It was noted that:

(a) France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season and to comply fully with all elements of Conservation Measure 29/XVI. This fishing season substantially conflicts with the IMALF advice;

(b) Chile (CCAMLR-XVIII/13), South Africa (CCAMLR-XVIII/9), Uruguay (CCAMLR-XVIII/14) and the European Community (CCAMLR-XVIII/21) propose to fish from 15 April to 31 August. This will overlap the recommended season closure by two weeks; and

(c) Chile (CCAMLR-XVIII/13) states its intent to comply with streamer-line requirements under Conservation Measure 29/XVI, but makes no specific reference to the other provisions of this conservation measure. However, it is understood that Chile intends to conform fully with all elements of Conservation Measure 29/XVI. South Africa, Uruguay and the European Community intend to comply fully with all elements of Conservation Measure 29/XVI.

(vi) Division 58.5.1:

Assessment: important foraging area for six albatross species (four threatened, one near-threatened), southern giant petrel, white-chinned petrel and grey petrel, for several of which Kerguelen is a very important breeding site. Most albatross and petrel species breeding at Heard and McDonald Islands will also forage in this area, as will birds of many of the species breeding at Crozet.

Advice: high risk; prohibit longline fishing during the main albatross and petrel breeding season (i.e. 1 September to 30 April); ensure strict compliance with Conservation Measure 29/XVI.

It was noted that:

(a) France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season and to comply fully with all elements of Conservation Measure 29/XVI. This fishing season substantially conflicts with the IMALF advice;

(b) Chile (CCAMLR-XVIII/13) states that it would comply with conservation measures that were in force concerning fishing seasons in relevant subareas and divisions. However, there was no fishing season conservation measure for Division 58.5.1 in force in 1998/99. Given the high-risk category of the division, it is recommended that the fishing season be restricted to 1 May to 31 August; and

(c) Chile (CCAMLR-XVIII/13) states its intent to comply with streamer-line requirements under Conservation Measure 29/XVI, but makes no specific reference to the other provisions of this conservation measure. However, it is understood that Chile intends to conform fully with all elements of Conservation Measure 29/XVI.

(vii) Division 58.5.2:

Assessment: important foraging area for six albatross species (four threatened, one near-threatened and including one of the only two albatross species which are critically endangered – Amsterdam albatross) and for both species of giant petrel and white-chinned petrels from globally important breeding sites at Kerguelen, Heard and Amsterdam Islands.

Advice: average-to-high risk; prohibit longline fishing within the breeding season of the main albatross and petrel species (September to April). Ensure strict compliance with Conservation Measure 29/XVI.

It was noted that:

(a) France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season and to comply fully with all elements of Conservation Measure 29/XVI. This fishing season substantially conflicts with the IMALF advice; and

(b) longline fishing is currently prohibited within the EEZ around Heard and McDonald Islands.

(viii) Subarea 58.6:

Assessment: known and potential interactions with seven species of albatross (five threatened, one near-threatened), for many of which Crozet is one of the most important world breeding sites, as it is for giant, white-chinned and grey petrels. Also substantial potential for fishery interactions with albatrosses and petrels from the Prince Edward Islands and albatrosses from a variety of other breeding sites in their non-breeding season. Even outside the French EEZ (within which commercial longline fishing is presently prohibited), this is one of the highest risk areas in the Southern Ocean.

Advice: high risk; prohibit longline fishing during the main albatross and petrel breeding season (i.e. 1 September to 30 April); ensure strict compliance with Conservation Measure 29/XVI.

It was noted that:

(a) France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season and to comply fully with all elements of Conservation Measure 29/XVI. This fishing season substantially conflicts with the IMALF advice;

(b) South Africa (CCAMLR-XVIII/8), Chile (CCAMLR-XVIII/13) and the European Community (CCAMLR-XVIII/21) propose to fish from 15 April to 31 August. This will overlap the recommended season closure by two weeks; and

(c) Chile (CCAMLR-XVIII/13) states its intent to comply with streamer-line requirements under Conservation Measure 29/XVI, but makes no specific reference to the other provisions of this conservation measure. However, it is understood that Chile intends to conform fully with all elements of Conservation Measure 29/XVI. South Africa and the European Community intend to comply full with all elements of Conservation Measure 29/XVI.

(ix) Subarea 58.7:

Assessment: known and potential interactions with five species of albatross (four threatened), for most of which the Prince Edward Islands is one of the most important world breeding sites, as it is for giant petrels. Also substantial potential for fishery interactions with albatrosses and petrels from the Crozet Islands and albatrosses from various other breeding sites in their non-breeding season. This small area is one of the highest risk areas in the Southern Ocean. It should be noted that within South Africa's EEZ, commercial longline fishing is currently permitted all year.

Advice: high risk; prohibit longline fishing during the main albatross and petrel breeding season (1 September to 30 April); ensure strict compliance with Conservation Measure 29/XVI.

It was noted that France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season and to comply fully with all elements of Conservation Measure 29/XVI. This fishing season substantially conflicts with the IMALF advice.

(x) Subarea 88.1:

Assessment: the northern part of this area lies within the foraging range of three albatross species (two threatened) and is probably used by other albatrosses and petrels to a greater extent than the limited available data indicate. The southern part of this subarea has potentially fewer seabirds at risk.

Advice: average risk overall. Average risk in northern sector (*D. eleginoides* fishery), average to low risk in southern sector (*D. mawsoni* fishery); longline fishing season limits of uncertain advantage; the provisions of Conservation Measure 29/XVI should be strictly adhered to.

It was noted that:

(a) Chile (CCAMLR-XVIII/13), the European Community (CCAMLR-XVIII/21) and New Zealand (CCAMLR-XVIII/10) propose to fish from 15 December to 31 August;

(b) Chile (CCAMLR-XVIII/13) states its intent to comply with streamer-line requirements under Conservation Measure 29/XVI, but makes no specific reference to the other provisions of this conservation measure. However, it is understood that Chile intends to conform fully with all elements of Conservation Measure 29/XVI. The European Community intends to comply fully with all elements of Conservation Measure 29/XVI; and

(c) New Zealand (CCAMLR-XVIII/10) proposes a continuation of the variation to Conservation Measure 29/XVI as provided for by Conservation Measure 169/XVII, to allow line-weighting experiments to continue south of 65°S in Subarea 88.1 (see paragraphs 7.85 to 7.91 for further discussion).

(xi) Subarea 88.2 (new assessment):

Breeding species in this area: none.

Breeding species known to visit this area: light-mantled albatross from Macquarie Island.

Breeding species inferred to visit this area: light-mantled albatross from Auckland, Campbell and Antipodes Islands; Antipodean albatross from Antipodes Island; grey-headed albatross and Campbell albatross from Campbell Island; wandering albatross, black-browed albatross and grey-headed albatross from Macquarie Island, grey petrel and white-chinned petrel from New Zealand populations.

Other species: sooty shearwater.

Assessment: although there are few observational data from this area, the northern part of this area lies within the suspected foraging range of six albatross species (four threatened) and is probably used by other albatrosses and petrels to a greater extent than the limited available data indicate. The southern part of this subarea has potentially fewer seabirds at risk.

Advice: low risk. No obvious need for restriction of longline fishing season; apply Conservation Measure 29/XVI as a seabird by-catch precautionary measure.

It is noted that:

(a) the European Community (CCAMLR-XVIII/21) states that it will comply with Conservation Measure 29/XVI, including only setting gear at night; and

(b) Chile (CCAMLR-XVIII/13) states its intent to comply with streamer-line requirements under Conservation Measure 29/XVI, but makes no specific reference to the other provisions of this conservation measure. However, it is understood that Chile intends to conform fully with all elements of Conservation Measure 29/XVI.

New Zealand Proposal in respect of Subarea 88.1

7.85 The Working Group noted New Zealand's request for a continuation of the variation to Conservation Measure 29/XVI, as provided for last year by Conservation Measure 169/XVII, to allow line-weighting experiments to continue south of 65°S in Subarea 88.1 (CCAMLR-XVIII/10). Conservation Measure 169/XVII allowed vessels to set lines during the daytime south of 65°S in Subarea 88.1 if vessels weighted their lines and achieved a minimum sink rate of 0.3 m/s for all parts of the longline. This variation was sought because during austral summer (December to March) there are no periods of darkness at these latitudes.

7.86 In 1998 the Working Group noted that line weighting has the best potential as an alternative mitigation measure, and noted the need to urgently gain information on longline sink rates and seabird interactions for both autoliners and vessels using the Spanish system. The Working Group also noted in 1998 that while manual addition and removal of weights will probably be the best means of achieving the target sink rates in the short term, more efficient and safer ways of weighting longlines need to be developed.

7.87 New Zealand reported that no seabird mortalities were recorded either during the experimental line-weighting program or when fishing north of 65°S and complying in full with Conservation Measure 29/XVI. Time–depth recorders were used to monitor sink rate and the minimum sink rate of 0.3 m/s was consistently achieved.

7.88 The Working Group supported the variation in 1998 on the grounds that this would assist in the development of line weighting for all areas of CCAMLR. In considering New Zealand's request to continue line sink rate experimentation, the Working Group noted that the southern part of Subarea 88.1 was assessed as average to low risk for seabirds. This limits the usefulness of extrapolation of the results of the line-weighting experiment to other higher risk areas.

7.89 However, continuation of the experiment will build on last year's data. It should also provide the opportunity to experiment with ways to integrate weighting into the mainline.

7.90 The Working Group therefore supported the New Zealand proposal to continue the variation to Conservation Measure 29/XVI and encouraged New Zealand to investigate ways of more safely and efficiently weighting longlines. The Working Group suggested that a condition might be attached to this variation requiring vessels to determine what weighting regime would be required to achieve an integrated weighting system.

7.91 The Working Group also requested that New Zealand report to the next meeting of WG-FSA on the nature and effectiveness of its line-weighting regimes for minimising seabird mortality within the New Zealand EEZ during the 1998/99 and 1999/2000 seasons.

7.92 CCAMLR-XVIII/10 indicated that New Zealand vessels operating within Subarea 88.1 in 1999/2000, where possible, will be required to operate fishmeal plants for processing offal and by-catch. If a vessel experiences operational problems with their meal plant, they will retain offal and by-catch on board for disposal in port on their return to New Zealand. This provision will apply to the whole of Subarea 88.1.

7.93 The Working Group noted that this constituted an excellent example of good operational practice and encouraged widespread emulation of this practice.

New and Exploratory Fisheries Operational in 1998/99

7.94 Table 59 provides information on the performance of new and exploratory fisheries undertaken in 1998/99. It was noted that little or no fishing was carried out in Subarea 48.6 and Divisions 58.4.1, 58.4.3 and 58.4.4.

7.95 Comprehensive reports on seabird interactions with longline fishing in Subareas 58.6, 58.7 and 88.1 have been provided by South Africa and New Zealand (WG-FSA-99/42 and 99/35). Information contained in these reports was used in assessments of new and exploratory fisheries in 1999/2000, where relevant. The seabird by-catch data and the effectiveness of mitigation measures employed in these new and exploratory fisheries are discussed in paragraphs 7.29 to 7.54 and 7.116.

Incidental Mortality of Seabirds during Longline Fishing outside the Convention Area

7.96 WG-FSA-99/18 reviewed seabird by-catch in the Australian Fishing Zone (AFZ) over the decade to 1997. Most of the birds killed in the tuna longline fishery were albatrosses. Analyses of the trends of seabird catch rates in the AFZ by Japanese longliners over 10 years show an apparent fall from the 1988 by-catch figure of 0.4 birds/thousand hooks to levels of between 0.1 to 0.2 birds/thousand hooks. Based on current fishing levels, these recent rates equate to between 1 000 and 3 500 birds being killed each year. Although the initial fall in the by-catch rate was achieved rapidly, the rate has plateaued or risen slightly since, indicating that there may have been changes to fishing practices or equipment which are detrimental to efforts to minimise seabird by-catch and/or adoption of mitigation methods has been slow. The paper emphasises that large amounts of data are necessary to gain clear insights into the suite of species impacted by a fishery, and the effect of different fishing gear, environmental variables, and the mitigation measures employed.

7.97 WG-FSA-99/73 reported on seabird interactions with longline fisheries in the AFZ in 1998. There was no fishing in 1998 by Japanese longline fishing vessels. Fishing in the AFZ by domestic pelagic longliners is logically treated as two fleets: a heterogenous local-style fleet and a homogenous Japanese-style fleet. The increase in local-style pelagic effort during the 1990s was sustained this year, with over 9 million hooks being set, a 22% rise over the number of hooks set during 1997. Of these, 13 700 (0.1%) were observed. Over 770 000 hooks, of which c. 50 000 (6.5%) were observed, were set in the AFZ by Australian-owned Japanese-style vessels. This number has been fairly constant throughout the 1990s.

7.98 In the local-style pelagic fishery, all observations were made around Tasmania in summer, most observed hooks were set at night, and the observed by-catch rate was 0.58 birds/thousand hooks. Shy albatrosses were the most commonly caught species of seabird. By-catch rates were influenced by moon phase. The importance of measures additional to bird lines (such as weights) was emphasised.

7.99 The observed by-catch rate in the Australian-owned Japanese-style fishery was 0.4 birds/thousand hooks. Most observed hooks were set during the day. The species caught were mainly black-browed and wandering albatrosses. Bird lines were found to reduce the observed by-catch rate, but only if they were of good quality. Thawed bait and fewer birds around the vessel were observed to result in lower by-catch rates.

7.100 Measured by-catch rates of birds by both parts of the fleet are high (in the order of 0.4 to 0.6 birds/thousand hooks during 1998), and this suggests that both of these fleets continue to catch a substantial number of seabirds in the AFZ. Because of the small percentage of hooks observed, estimates of the total numbers of seabirds caught would be premature. Approximately 43 000 hooks were observed set by domestic demersal longline fishing vessels. No birds were observed to be caught by these hooks.

7.101 New data on foraging ranges outside the Convention Area of seabird species breeding within the Convention Area are provided for:

(i) white-chinned petrel in WG-FSA-99/20 and 99/47, showing substantial overlap with longline fisheries in coastal South America and with southern bluefin tuna fisheries in the Indian Ocean;

(ii) northern and southern giant petrels in WG-FSA-99/38 and 99/39, showing substantial overlap with longline fisheries in coastal South America; and

(iii) grey-headed albatross in WG-FSA-99/25, showing substantial overlap with southern bluefin tuna fisheries in the Indian Ocean.

7.102 The Working Group regretted the absence of other data from Members on incidental mortality of seabirds, especially for regions adjacent to the Convention Area, such as New Zealand, South Africa, southern South America and the Falkland/Malvinas Islands.

7.103 Members were reminded that such information is likely to include data on incidental mortality of seabirds which breed in the Convention Area and were requested to provide relevant data for next year’s meeting.

Research into and Experience with Mitigating Measures

7.104 The FAO review of incidental catch of seabirds by longline fisheries, including a review of, and technical guideline for, mitigation (WG-FSA-99/23), is to be published shortly. This is an authoritative source reference, the main conclusions of which have been taken forward into the FAO International Plan of Action on the Reduction of Incidental Catch of Seabirds in Longline Fishing (FAO IPOA–Seabirds) (WG-FSA-99/6, Appendix 1).

7.105 WG-FSA-99/26 reviewed factors affecting the number and the mortality of seabirds attending longliners and trawlers fishing in the Kerguelen area during 1994 and 1997, based on on-board observations by dedicated observers. The total numbers of seabirds attending vessels varied mainly according to the year, cloud cover and presence of offal from longliners. The dumping of offal increased the numbers of birds attending the vessel. The activity of the vessels also affected the numbers attending, birds being more abundant during line setting and during trawl hauling. The white-chinned petrel was the most abundant ship-following seabird, followed by black-browed albatross and giant and cape petrels. The number of white-chinned petrels, black-browed and grey-headed albatrosses attending fishing vessels increased through the season, whereas the converse was true for giant and cape petrels.

7.106 Four species of birds were caught by fishing gear (mainly by longliners), the order of frequency being white-chinned petrels, black-browed, grey-headed and wandering albatrosses. Taking into account the number of birds from each species attending longliners and known to be potential by-catch, white-chinned petrel and grey-headed albatross were caught in much greater proportion than the number of potential by-catch present, whereas black-browed albatrosses were caught in lower proportions. Giant petrels were abundant around longliners, but not observed caught.

7.107 WG-FSA-99/26 reported that, for longline vessels, most birds were killed when the lines were set during the day or at other times when the deployment of the streamer lines was incorrect, at an overall rate of 0.47 birds/thousand hooks. Only one albatross was caught when the lines were set during the night. White-chinned petrels represented 92% of all birds killed by longliners. The number of birds caught varied significantly between months and between years. The type of bait used also affected the catch rate. The catch rate was related to the number of birds attending the longliner only for black-browed albatrosses. Most birds killed by trawlers were caught by the netsonde cable. Night setting is the most efficient method to reduce mortality of albatrosses. Additional methods need developing to reduce the mortality of species active at night, especially the white-chinned petrel, whose populations in the Indian Ocean are threatened by longline fisheries.

7.108 Observer effects on reported by-catch rates were evident from experiences reported in WG-FSA-99/26. For one vessel, the by-catch rate recorded while the observer was undertaking other fishery monitoring tasks was five times lower (0.05 birds/thousand hooks) than that recorded during dedicated observations of the line haul (0.25 birds/thousand hooks). These observations reinforce the need for caution when interpreting by-catch rate data, as comparisons between vessels and studies may be affected by differences in the quality of the reported data.

7.109 The Working Group reviewed new information relating to methods for mitigating seabird by-catch in longline fisheries, with special emphasis on those aspects and topics covered by Conservation Measure 29/XVI.

Offal Discharge

7.110 The Working Group commended the fact that available reports on vessels operating in the longline fisheries in Subareas 58.6 and 58.7 in 1998 (Table 50) indicate that all vessels discharge offal on the opposite side to the haul, as specified in Conservation Measure 29/XVI. The advantages of this, in respect of reducing seabird by-catch, were clearly indicated from last year's data (SC-CAMLR-XVII, Annex 5, paragraph 7.140) In Subarea 48.3, however, three vessels (*Isla Sofía*, *Isla Camila* and *Jacqueline*) are still operating with offal discharge on the same side as the haul, in contravention of the conservation measure. The fact that, unlike last year, high seabird by-catch rates are not associated with these vessels, probably reflects that they were fishing at a time when very few birds were available to be caught. The Working Group noted that the engineer's diagram of the waste-pipe reconfiguration of the *Koryo Maru 11* had been provided to the Secretariat, as requested last year (SC-CAMLR-XVII, Annex 5, paragraph 7.144). It was hoped that the vessels above could use this as a basis for reconfiguration.

Line Weighting

7.111 Three papers provided new insights on mitigation. WG-FSA-99/5 reported the results of line-weighting experiments on the *Argos Helena* in Subarea 48.3 in February 1999. Many commercial vessels using the Spanish longline system attach weights every 40 m, rather than the 20 m interval specified in Conservation Measure 29/XVI. The experiment was therefore designed to examine the effect on seabird mortality of increasing line weighting from 4.25 kg at 40 m intervals to 8.5 kg (double) and 12.75 kg (treble) at 40 m intervals. Doubling the weight reduced the bird mortality from 3.98 birds/thousand hooks to <1/thousand hooks. There was no significant reduction in mortality with a line weighting of 12.75 kg per 40 m, compared to 8.5 kg per 40 m.

7.112 WG-FSA-99/5 noted that bird catch rates with twice and three times the normal weighting regime were similar to those found during daytime setting around South Georgia in the 1998 winter fishery. Many more birds are present around South Georgia in the February period than in winter. The fact that such low catch rates are achievable, even when fishing during the day at a time of year when certain species, especially black-browed albatrosses, are most vulnerable, suggests that it may be possible to develop a viable year-round fishing regime with an acceptably low threat to seabirds through the use of effective line weighting.

7.113 The Working Group was surprised that with line weightings of 8.5 kg at 40 m intervals, which should equate to sink rates of about 1 m/s (WG-FSA-95/58) (cf. Conservation Measure 29/XVI which specifies 6 kg at 20 m, giving a sink rate of about 0.9 m/s), the line still did not sink sufficiently fast to avoid catching any birds.

7.114 An important observation in WG-FSA-99/5 was that the distance of 40 m between the weights meant that the fishing line could loop up to the surface, increasing the danger of birds being caught on hooks. The effect of buoyancy of birds already caught on the line was particularly important in this regard. Observations from the stern indicated that this was still a problem even with the use of three times the normal weight, and emphasised the importance of the 20 m interval specified in Conservation Measure 29/XVI. WG-FSA-99/5 also reported on the effect of environmental conditions and seabird behaviour on the vulnerability of seabirds to hooking and the effectiveness of mitigation methods. Strong winds in particular reduced the effectiveness of the streamer line by blowing it away from the fishing line. The use of multiple streamer lines under these circumstances was suggested as a possible solution to this problem.

7.115 The Working Group recognised that this experiment was a useful contribution to the understanding of the importance of line weighting in the mitigation of seabird mortality, and the practicalities of increasing line weighting above that currently in general use in the fishery. It also provided a helpful example of the use of GLMs in the analysis of data on factors affecting seabird mortality. Further experimentation on longline-weighting regimes with the Spanish method is necessary before advice on the refinement of the relevant part of Conservation Measure 29/XVI can be provided.

7.116 WG-FSA-99/35 reported the results of line-weighting trials on autoline vessels in Subarea 88.1. For two vessels, 5 kg weights every 60 m sank longlines at 0.36 m/s (setting at 4.5 to 5 knots) and 5 kg weights at 65 m sank lines at 0.4 m/s (setting at 5.5 to 6 knots). Setting speed has a substantial effect on line sink rate. No seabirds were observed caught in Subarea 88.1 with these weighting regimes and sink rates. Although the numbers of seabirds around the vessel were high at times, few were of species known to be vulnerable to capture on longlines. WG-FSA-99/37 provides similar information as WG-FSA-99/35 in poster form but also notes that weights at larger spacings (5 kg every 400 m) have no effect on sink rate.

7.117 WG-FSA-99/62 reported the results of meetings with Norwegian autoline gear makers Mustad and Fiskevegn. Conclusions were that marine, autoline and rope engineers have much to offer in efforts to reduce seabird deaths in autoline longline fishing globally and have been under-utilised in efforts thus far. It was also concluded Mustad and Fiskevegn are unlikely to respond to requests to modify autoline gear (e.g. make heavier magazine carriers to support heavier ropes) and rope composition (to increase specific gravities) until client demand makes it economically viable to do so. An increase in client demand is most likely to come with the imposition of fishing licence conditions which require faster sinking longlines.

7.118 The Working Group noted that four of five autoline vessels fishing in the Convention Area in 1998/99 used weights on their longlines. In addition, the spacings between weights on autoline vessels have varied over the last three years, from median values of 4 kg at 200 m (average 0.014 kg/m) in 1997, to 9 kg at 640 m (average 0.015 kg/m) in 1998, to 5 kg at 100 m (average 0.022 kg/m) in 1999.

Line Setter

7.119 No response from Mustad was received to the Secretariat's request for further information (SC-CAMLR-XVII, Annex 5, paragraph 7.155).

Streamer Line

7.120 No new specific or experimental information on design or use had been received this year. Several reports had testified to reduction in seabird by-catch achieved using streamer lines, the importance of constructing and using them correctly (e.g. WG-FSA-99/26) and to certain circumstances in which they were of reduced effectiveness (e.g. WG-FSA-99/5), together with suggestions to help rectify this.

Underwater Setting

7.121 WG-FSA-99/5 referred to potential tests of the effectiveness of an underwater setting tube on the Spanish system vessel *Argos Helena*. The trial was aborted due to poor tube design.

7.122 In Subareas 58.6 and 58.7, the autoliner *Eldfisk* used a Mustad underwater setting funnel, designed to set line at 2 m depth (WG-FSA-99/42 Rev. 1). It set 487 longlines (1.4 million hooks) during three cruises. Of these, 203 sets (41.0% of hooks) used the Mustad funnel (11.6% of total fishing effort). Fifteen birds were killed (13 white-chinned and 2 grey petrels); only one (a white-chinned petrel) was caught on a set made using the funnel. Seabird by-catch using the funnel (0.002 birds/thousand hooks) was markedly less than when not using the funnel (0.017), and the difference is significant despite the small sample size ($X^2 = 5.95$, df = 1, $P < 0.05$). This underestimates the efficacy of the funnel, because it does not take into account the much greater proportion of hooks set during the day using the funnel (97.0%) compared with night sets (11.1%). Given the known higher by-catch rate during day sets, the null model of an equal likelihood of mortalities occurring with and without the funnel is conservative. The sample size of night sets using the funnel was too small to be compared with night sets not using the funnel, but the only bird killed while using the funnel was caught during the day.

7.123 The line jumped out of the funnel during 22 of 203 sets (11%). With increasing experience this happened less frequently (16%, 13%, 3% on successive trips). This did not result in any birds being caught in this study, but could be a problem during day sets in areas/times with a high risk of seabird by-catch. There is also a problem with increased rates of bait loss as a result of the use of the funnel. This needs to be addressed by the funnel manufacturer.

7.124 The Working Group commended the work, and strongly encouraged further use and development of this system.

General

7.125 Consideration needs to be given to the use of coloured fishing gear as a possible aid to reducing seabird by-catch. It is possible that proper use of appropriate mitigation measures might result in reduction in the by-catch of albatrosses to acceptable levels, but that catch rates of white-chinned petrels will remain unacceptably high due to the reduced effectiveness of night setting with this species. One approach with this species might be to dye, either dark blue or black, hook lines, snood lines, hooks and bait in an attempt to make gear less visible to white-chinned petrels foraging, whether in daylight or in darkness.

7.126 Members expressed a desire to achieve better feedback from the fishing industry on operational issues and fishing strategy procedures that may influence the successful use of mitigation measures. Of particular concern was to learn more from the industry about practical implications of the line-weighting regimes promoted in Conservation Measure 29/XVI and similar regimes being suggested for autoliners.

7.127 Members, especially technical coordinators of national scientific observation programs, were requested to provide relevant information in advance of next year's meeting of WG-FSA.

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

7.128 WG-FSA-99/6 reviewed most of the current international initiatives relating to the elimination of seabird by-catch in longline fisheries. In addition to summarising progress on issues discussed in paragraphs 7.132 to 7.140, it noted that:

(i) the United Nations adopted a resolution at its 53rd Session (in 1998) noting its concern with loss of seabirds and urging states to reduce fishery by-catches;

(ii) workshops addressing seabird by-catch issues in longline fisheries are planned to be held in 2000:

  (a) in Canada under the auspices of the Circumpolar Seabird Working Group of the Intergovernmental Committee on Conservation of Arctic Flora and Fauna;

  (b) in Hawaii, USA, in May as part of the Second International Conference on Albatrosses and Petrels;

  (c) in South Africa, with support from the Global Environmental Facility and BirdLife South Africa; and

(iii) the BirdLife International Seabird Conservation Programme, working through national partnership in 80 countries, intends to commence a global campaign addressing seabird by-catch issues, including persuading and facilitating the major longlining nations to prepare effective plans of action under the FAO IPOA (see paragraphs 7.129 to 7.131).

FAO International Plan of Action on the Reduction of Incidental Catch of Seabirds in Longline Fisheries (IPOA–Seabirds)

7.129 SC-CAMLR-XVIII/BG/14 reported that at the 23rd session of the FAO Committee on Fisheries (COFI; Rome, 15 to 19 February 1999) the IPOA–Seabirds was adopted and forwarded to the FAO Council, which endorsed it in June 1999.

7.130 Members of COFI are requested to report to its next meeting (in 2001) their progress in relation to IPOA–Seabirds in conducting assessments followed by adopting National Plans of Action (NPOAs) if warranted.

7.131 The Working Group recognised the importance of prompt preparation of detailed NPOA–Seabirds by relevant Member States, especially those with most experience in longline fisheries and seabird by-catch issues. It encouraged all Members of the Commission involved in longline fishing, especially those operating within the Convention Area, to develop appropriate NPOAs and to report on progress to the next meeting of ad hoc WG-IMALF.

Convention on Migratory Species

7.132 The Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) provides a framework for countries to work together towards the conservation of migratory species throughout their range. At the 5th Conference of Parties to the Convention, held in 1997, all southern hemisphere species of albatrosses were listed on either Appendix I or II of the CMS. Listing on Appendix II obliges range states to endeavour to conclude regional agreements that facilitate cooperative conservation and management actions.

7.133 Since this listing, the Group of Temperate Southern Hemisphere Countries on the Environment (known as the Valdivia Group) have been endeavouring to develop an agreement in cooperation with other southern hemisphere albatross range states. Members of the Valdivia Group are Argentina, Australia, Brazil, Chile, New Zealand, South Africa and Uruguay. An ad hoc Valdivia Working Group on Albatrosses was formed to progress development of a regional agreement. In June 1999, Australia hosted the inaugural meeting of the working group which was attended by all member countries of the Valdivia Group. The group identified key elements for a framework of regional cooperation on the conservation of all southern hemisphere albatross species.

7.134 This meeting also agreed to explore the preparation of a program promoting exchange of experts, technicians and personnel responsible for developing and implementing different techniques for mitigating fishing impacts on albatross species. It was recognised that a number of organisations, such as CCAMLR and FAO, had recommended conservation measures pertinent to albatross conservation and Member countries agreed to exchange information regarding their implementation of CCAMLR and other measures.

7.135 The Working Group commended these approaches and encouraged the Valdivia Group to progress their initiatives and to contribute fully to other relevant undertakings, especially with respect to the FAO IPOA–Seabirds and to planned seabird by-catch workshops (paragraphs 7.144 to 7.149).

7.136 The Working Group was informed (WG-FSA-99/6) that South Africa is nominating seven members of the genera *Macronectes* and *Procellaria* (including the white-chinned petrel) to Appendix II of the Bonn Convention; this will be considered at the 6th Conference of Parties in November 1999.

Australian Threat Abatement Plan

7.137 The objective of the Australian Threat Abatement Plan, officially released on 2 August 1998, is to reduce seabird by-catch in all fishing areas, seasons and fisheries to below 0.05 birds/thousand hooks, based on current fishing levels. This represents a reduction of up to 90% of seabird by-catch within the AFZ, and should be achievable within the five-year life of the plan. The ultimate aim of the threat abatement process is to achieve a zero by-catch of seabirds, especially threatened albatross and petrel species, in longline fisheries.

7.138 WG-FSA-99/53 reported on implementation of first-year actions. Critical actions under this plan include: regulation of fishing practices, implementation of an observer program to identify seabird by-catch rates throughout the AFZ, testing and refinement of underwater setting devices, further experimentation of line-weighting regimes, development of seabird collection kits, and development of a communication program to enhance industry understanding and adoption of new regulations and other measures contained in the plan.

7.139 A working group has been established to identify indicative 'best-practice' mitigation measures that may be appropriate in the sub-Antarctic fisheries, should demersal longlining be considered in the future in these areas.

7.140 A video has been produced, providing information on the correct use of mitigating measures to reduce seabird by-catch in pelagic tuna fisheries.

Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

7.141 No information was available this year to the Working Group from this Commission or from its Ecologically Related Species Working Group (ERSWG). It was understood that the ERSWG had not met in 1999.

Indian Ocean Tuna Commission (IOTC)

7.142 SC-CAMLR-XVIII/BG/32 indicated that the inaugural meeting of the IOTC Scientific Committee acknowledged the importance of considering non-target, associated and dependent species (NTADs) in research and management measures. However, specific seabird mitigation measures were not considered.

7.143 The Working Group encouraged the IOTC to review the nature and extent of seabird by-catch in tuna longline fisheries within its area of jurisdiction and to require vessels to adopt appropriate mitigating measures.

International Fishers Forum

7.144 The Working Group noted New Zealand's intention to host an international forum for fishers, focused on solving the incidental capture of seabirds in demersal and pelagic longline fisheries, during the fourth quarter of 2000 (SC-CAMLR-XVIII/BG/16).

7.145 The forum will be an opportunity for fishers, gear technologists and researchers to meet, and hear first hand about mitigation measures used in longline fisheries around the world, and to learn about new measures currently under development.

7.146 The Working Group agreed that this exchange of information and ideas would result in a more coordinated response to this issue and hopefully accelerate progress in solving the problem. In addition, countries participating would be in a more informed position to prepare their NPOAs in relation to the FAO IPOA–Seabirds initiative (paragraphs 7.129 to 7.131; SC-CAMLR-XVIII/BG/4).

7.147 A second objective for the forum will be the use of modelling tools to predict the impact of fisheries on seabird species. Seabird modelling experts will report on projects undertaken to date and will address questions posed by the workshop participants.

7.148 Dr Robertson indicated that he had been holding discussions relating to the need for a focused workshop on seabird mortality in the autoline fishery. He felt this might advantageously be associated with the International Fishers Forum. The autoline workshop will attempt to bring together marine architects, autoline gear makers and rope manufacturers with the objective of encouraging engineers from these disciplines to manufacture longline vessels configured to deploy longlines that do not catch birds. A second objective will be to derive engineering modifications to existing vessels that would, through structural change, facilitate the deployment of fast-sinking longlines.

7.149 The Working Group supported the International Fishers Forum and associated autoline workshop, and encouraged Member countries longlining in the Convention Area to participate.

Strategic and Policy Issues

Regulated Fishing

7.150 The Working Group noted the Commission's endorsement of the strategic advice of the Scientific Committee concerning policies and practices believed essential to addressing and resolving the issue of seabird by-catch in longline fisheries (CCAMLR-XVII, paragraph 6.31), specifically that:

(i) sustained development of underwater setting offers the most likely medium- to long-term solution to the problem;

(ii) work to develop line-weighting regimes to ensure sink rates that will preclude seabirds accessing bait offers the best short-term solution, as well as the likelihood of permitting exemption from several other mitigating measures currently in use in the Convention Area; and

(iii) in the meantime, improved compliance with the existing suite of mitigation measures in Conservation Measure 29/XVI is essential.

7.151 The Working Group noted with appreciation the increased efforts, especially by New Zealand and South Africa, to use and develop underwater setting. It also commended the recent work, especially by Australia, New Zealand and the UK, directed at improving knowledge of appropriate line-weighting regimes. The results of work to date reinforce the view, suggested last year, that appropriate line weighting could lead to a relaxation of certain elements of existing conservation measures regulating longline fishing in the Convention Area.

7.152 The Working Group regretted, however, that compliance with Conservation Measure 29/XVI, especially in the critical area of line weighting, had not improved greatly since last year. In effect, no vessel engaged in longline fishing (using the Spanish method) in the Convention Area had operated in compliance with Conservation Measure 29/XVI in the 1998/99 fishing season. Only two vessels (and only on four of eight cruises) had complied with the line-weighting specifications of Conservation Measure 29/XVI.

7.153 The Working Group recollected the instruction of the Commission last year (CCAMLR-XVII, paragraph 6.24) that vessels discharging offal during the haul on the same side as the line hauling site should not be allowed to fish in the Convention Area.

7.154 The Working Group wished to extend this principle to recommend that vessels which had proven unable or unwilling to comply with all the provisions of Conservation Measure 29/XVI should not be allowed to fish in the Convention Area.

IUU Fishing

7.155 The Working Group noted the endorsement by the Scientific Committee (SC-CAMLR-XVII, paragraphs 4.49 and 4.50) and Commission (CCAMLR-XVII, paragraph 6.22) of its advice and concerns last year (SC-CAMLR-XVII, Annex 5, paragraphs 7.93 to 7.95) that levels of IUU fishing are generating levels of seabird by-catch about two orders of magnitude greater than in the regulated fishery and unsustainable for the albatross, giant petrel and white-chinned petrel populations concerned. It noted that the Commission viewed this with the greatest concern and was proposing a wide range of measures to address the problem of unregulated and illegal fishing (CCAMLR-XVII, paragraphs 5.16 to 5.69).

7.156 The Working Group reiterated its view that, within the Convention Area, IUU longline fishing now poses the principal survival threat for most, if not all, the species and populations of at-risk seabirds.

7.157 The Working Group recognised the difficulty of simultaneously trying to enhance the effectiveness of the regulated fishery and to diminish the attractiveness of the IUU fishery. It noted the impact of IUU fishing on seabirds could be reduced by increasing the benefit to fishers of using vessels or fishing practices which were configured and/or operated in ways to reduce the probability of seabird by-catch (e.g. underwater setting, integrated weighted autolines).

7.158 It also recollected the views expressed by some Members in previous years (e.g. CCAMLR-XVII, paragraph 9.10; SC-CAMLR-XVII, paragraphs 4.45 and 9.25) that:

(i) extending the regulated fishing season could achieve a reduction in levels of IUU fishing; and

(ii) the current closed season (September to April inclusive) may be promoting IUU fishing at the time of year when risk of seabird by-catch is greatest (i.e. during the breeding season of albatrosses and petrels).

7.159 However, other members felt that there was insufficient information on the operations of IUU fishing to have any confidence that extending the fishing season for regulated vessels would reduce the impact of IUU fishing.

Mitigating Measures and Fishing Seasons

7.160 The Working Group agreed that relaxation of current fishing season restrictions could only be recommended when there is compliance with all the main elements of Conservation Measure 29/XVI.

7.161 The key mitigation measures (excluding underwater setting) relevant to permitting year-round fishing by regulated vessels are, in approximate order of priority:

(i) appropriate line-weighting regime;
(ii) night-time setting;
(iii) correct use of streamer lines; and
(iv) minimisation of problems associated with offal discharge.

7.162 Compliance with night setting is currently about 80%. Offal discharge practice has steadily improved in recent years. Use of streamer lines, as specified by Conservation Measure 29/XVI, needs considerable improvement. Compliance with line weighting, potentially the most crucial element of Conservation Measure 29/XVI, is still very inadequate.

7.163 Ad hoc WG-IMALF proposed that vessels able to demonstrate that they have consistently (i.e. in every cruise) achieved full compliance with each element of Conservation Measure 29/XVI in the 1999/2000 fishing season should, in the following year, be allowed to fish at any time of year. Such compliance would be carefully verified, particularly with respect to line-weighting requirements, by WG-IMALF and WG-FSA, on the basis of all available data and the report of the scientific observer. WG-IMALF noted that an appropriate line-weighting regime for autoline vessels will need to be determined. From the results reported in WG-FSA-99/35 it is recommended that this should not be less than the achievement of a minimum sink rate of at least 0.3 m/s on every set, with a goal of achieving a sink rate of 0.4 m/s.

7.164 The Working Group endorsed this approach in principle. It felt, however, that it might be premature to advise adoption of this procedure at the present meeting.

7.165 The Working Group also recognised the existing risk that vessels, having complied consistently and fully with all elements of Conservation Measure 29/XVI in one year, could relax their compliance while fishing year round in the next year. This could lead to high levels of seabird by-catch during the austral summer.

7.166 To minimise this risk, the Working Group proposed that:

(i) to the extent feasible, there should be in-port inspections of vessels in order to ensure that they are configured, and have all fishing and related gear necessary, to be able to comply in full with Conservation Measure 29/XVI; and

(ii) longline fishing should cease if a significant level of bird by-catch occurs (cf. the Scientific Committee recommendation, in SC-CAMLR-XVII, paragraphs 4.67 and 4.68, with respect to the New Zealand proposal for fishing in Subarea 48.1 in 1998/99). Advice on appropriate levels of seabird by-catch, on an area-specific basis would be provided by WG-IMALF to WG-FSA.

7.167 An essential complement to the recommendations in paragraphs 7.162 and 7.163 is rapid further progress in defining the optimum (minimum) line-weighting regime that will eliminate (or reduce to a very low level) seabird by-catch for both autoliners and vessels using the Spanish system. Doing this will require dedicated experiments.

7.168 The Working Group recommended that such experiments be strongly encouraged. As an incentive to attract the cooperation of fishers and fishery managers, such experiments, which should be conducted in accordance with a strictly specified experimental design, could be undertaken under CCAMLR Conservation Measure 64/XII, being eligible for an appropriate catch level (i.e. more than 50 tonnes) under the CCAMLR research exemption provisions. Any such experiments will need to be conducted before the commercial fishery has exhausted the catch limit and would require notification at least six months in advance of the starting date of the research.

7.169 An appropriate experimental design could be rapidly devised by WG-IMALF in consultation with WG-FSA, in particular taking account of the design and experience reported in WG-FSA-99/5. For the Spanish system, the main research priorities are to quantify, for different seabird species, the area in which baits are available to seabirds and for this to be expressed in terms of longline sink rates and line-weighting regimes, together with data relating to other factors that affect longline sink rate and bird behaviour, such as wind strength and direction and setting speed. The main measures of effectiveness would be bird mortality and rates of bird attacks on bait. Cruises of up to three weeks duration and considerable flexibility in fishing to allow for experimental manipulations, would be required. Cruises would take place at times of high bird numbers, with appropriate limits on bird by-catch, so that the effectiveness of line-weighting regimes can be properly tested.

7.170 For the autoline system, in addition to the research requirements outlined for the Spanish system, a method of incorporating weighting into the fishing line is a high priority. This would eliminate safety risks, increase ease of use and, with appropriate sink rates, achieve compliance with CCAMLR conservation measures.

Advice to the Scientific Committee

7.171 The Scientific Committee was requested to note the following recommendations/advice.

7.172 General:

(i) The Working Group welcomed the appearance of the book *Identification of Seabirds of the Southern Ocean. A Guide for Scientific Observers aboard Fishing Vessels* published by CCAMLR and the National Museum of New Zealand in 1999; some comments are offered to help in any future revision (paragraph 7.5).

(ii) There had been a comprehensive response to the request for information on research programs into the population status and foraging ecology of seabird species at risk from longline fishing in the Convention Area (paragraph 7.7). Interim advice on important gaps was provided; intersessional investigation and refinement of information is required to determine more accurately the potential utility to CCAMLR of data from these research programs (paragraphs 7.9 to 7.18).

(iii) The sampling effort required to estimate accurately seabird by-catch rates is to be investigated intersessionally (paragraph 7.33).

7.173 Data on incidental mortality of seabirds during regulated longline fishing in the Convention Area:

1998:

(i) Revision of data and results for Subareas 58.6 and 58.7 (Tables 46 to 48) gave new by-catch totals and rates that were 63% and 39% of the 1997 values (paragraph 7.21).

(ii) Results of intersessional analysis of all scientific observer data from 1997 and 1998 confirmed the importance of time of year (very few birds caught after April) and use of streamer lines in reducing seabird by-catch but the effects of most other factors (including line weighting) could not be fully analysed with the existing data (paragraphs 7.22 to 7.25).

(iii) The Working Group concluded that further improvements to, and assessments of, mitigation measures will need testing using carefully designed experiments (rather than continuing analysis of general scientific observer data) (paragraph 7.28).

1999:

(iv) Timely data submissions ensured excellent availability of data for scrutinising at the meeting (paragraph 7.30).

(v) For Subarea 48.3, the seabird by-catch (210 birds) was reduced by 65% and the by-catch rate (0.01 birds/thousand hooks) by 67%, compared with 1998. However, there was scope for further reductions through improving offal discharge, daytime setting and line weighting (paragraphs 7.36 to 7.38).

(vi) For Division 58.5.1, no data were received, but at least 151 seabirds were killed. France was asked to submit data in timely fashion to future meetings (paragraphs 7.39 and 7.40).

(vii) For Subareas 58.6 and 58.7, seabird by-catch (156 birds) was reduced by 70% and by-catch rates (0.03 birds/thousand hooks) by 85%, compared with 1998 (paragraphs 7.41 to 7.44). The biggest reductions in by-catch were achieved by the change in fishing area and by the use of underwater setting. The Working Group recommended that fishing within 200 km of the Prince Edward Islands should be prohibited from January to March inclusive (paragraphs 7.45 and 7.46).

(viii) For Subarea 88.1, there was no seabird by-catch (paragraph 7.34).

General:

(ix) In comparing seabird by-catch and by-catch rate in the regulated fishery over the last three years (Table 54), these have been reduced by 96.4% and 95.7% respectively in Subarea 48.3, and by 81.3% and 94.2% respectively in Subareas 58.6 and 58.7 from 1997 to 1999. This has been achieved by a combination of improved used of mitigating measures in compliance with Conservation Measure 29/XVI and by delaying the start of fishing until after the end of the breeding season of most albatross and petrel species (paragraph 7.47).

7.174 Compliance with Conservation Measure 29/XVI:

(i) Overall, levels of compliance with elements of Conservation Measure 29/XVI are steadily improving, particularly with respect to night setting and offal discharge. Compliance with line weighting and overall use of streamer lines is still far from satisfactory. Two autoline vessels, operating in Subarea 88.1, complied with all aspects of Conservation Measure 29/XVI (subject to the variation to allow daytime setting granted under Conservation Measure 169/XVII). For the remainder of the vessels, either insufficient data were provided to assess full compliance or not all elements of the conservation measure were complied with (paragraph 7.48 and Table 16).

(ii) Line weighting: one vessel complied with the line-weighting regime that applies to vessels using the Spanish system (6 kg every 20 m) on two of three cruises; one other vessel used a line-weighting regime very close to the requirement (5 kg every 20 m) on two of five cruises. The average weight (kg) per metre of mainline for 1997, 1998 and 1999 was 0.102 (5 kg at 45 m), 0.096 (6 kg at 45 m) and 0.142 (7 kg at 44 m) respectively. This indicates a substantial increase in overall weight added to lines in 1998/99, but still well below the level specified by Conservation Measure 29/XVI (paragraph 7.49).

(iii) Offal discharge: in Subareas 58.6, 58.7 and 88.1 there was 100% compliance with the requirement either to hold offal on board during the haul, or to discharge on the opposite side of the vessel to hauling. In Subarea 48.3, 71% of the vessels discharged offal on the opposite side to hauling, compared with only 31% in 1998. In Subarea 88.1, vessels achieved compliance through having a fish meal plant operating to process offal (paragraph 7.50).

(iv) Night setting: night setting was successfully completed for 80% of sets in Subarea 48.3 and 84% in Subareas 58.6 and 58.7. Excluding daytime sets made during mitigation measure experimentation by the *Argos Helena* in Subarea 48.3 and *Eldfisk* in Subareas 58.6 and 58.7, values are 86% and 98% respectively, compared with 90% and 93% for 1998 (paragraph 7.51).

(v) Streamer lines: both vessels fishing in Subarea 88.1 used streamer lines that complied with Conservation Measure 29/XVI. No vessels fishing in Subareas 48.3, 58.6 and 58.7 used streamer lines that met all aspects of the CCAMLR design. The length of streamer lines was the element with lowest compliance; only 10% of vessels in Subareas 58.6 and 58.7 and 26% in Subarea 48.3 had lines that were at least 150 m long. Compliance with attachment height and number and spacing of streamers is generally close to 100% (paragraph 7.52, Tables 16 and 17).

7.175 Assessment of incidental mortality of seabirds during unregulated longline fishing in the Convention Area:

(i) The estimates of potential seabird by-catch by area for 1999 (paragraphs 7.64 to 7.68, Tables 55 and 56) were:

Subarea 48.3:	3 230–4 360 to 11 700–15 800 seabirds;
Subareas 58.6 and 58.7:	12 070–16 140 to 23 800–32 100 seabirds;
Divisions 58.5.1 and 58.5.2:	110–155 to 3 725–5 050 seabirds; and
Division 58.4.4:	3 015–4 030 to 5 030–7 130 seabirds.

(ii) The overall estimated totals for the whole Convention Area (paragraph 7.69 and Table 56) indicate a potential seabird by-catch in the unregulated fishery of 18 000–25 000 (lower level) to 44 000–59 000 birds (higher level) in 1998/99. This compares with totals of 17 000–27 000 (lower level) to 66 000–107 000 (higher level) in 1996/97 and 43 000–54 000 (lower level) to 76 000–101 000 (higher level) in 1997/98. Any suggestion of a decrease in 1998/99 should be viewed with caution, given the uncertainties and assumptions involved in these calculations.

(iii) The species composition of the estimated potential seabird by-catch (Table 57) indicates a potential by-catch of 21 000 to 46 500 albatrosses, 3 600 to 7 200 giant petrels and 57 000 to 138 000 white-chinned petrels in the unregulated fishery in Convention Area over the last three years.

(iv) The Working Group endorsed its conclusion of last year that such levels of mortality are entirely unsustainable for the populations of albatrosses, giant petrels and white-chinned petrels breeding in the Convention Area (paragraph 7.73).

(v) The Scientific Committee was asked to recommend that the Commission take the most stringent measures possible to combat unregulated fishing in the Convention Area.

7.176 Incidental mortality of seabirds in relation to new and exploratory fisheries:

(i) Of those new and exploratory fisheries approved for 1998 which were operational in 1998/99, that in Subarea 88.1 (New Zealand) caught no seabirds (paragraph 7.34). Those in Subareas 58.6 and 58.7 (South Africa) had low levels of seabird by-catch and are reviewed in detail in paragraphs 7.41 to 7.47.

(ii) The full texts of assessments of risk of by-catch of seabirds in all statistical subdivisions of the Convention Area (except Subarea 48.5) were compiled into a background document for the use of the Scientific Committee and Commission (paragraph 7.82; SC-CAMLR-XVIII/BG/23).

(iii) All proposals this year for new and exploratory fisheries were reassessed in terms of risk of by-catch of species and groups of seabirds at risk (paragraph 7.84 and Table 58). In respect of this year's proposals, potential conflict between proposed fishing seasons and advice on seasons closed to fishing to protect seabirds was:

(a) minor for Divisions 58.4.3 (European Community), 58.4.4 (Chile, European Community, South Africa and Uruguay), Subareas 58.6 (Chile, European Community, South Africa) and 58.7 (South Africa);

(b) substantial for Divisions 58.4.3 (France), 58.4.4 (France), 58.5.1 (France), Subareas 58.6 (France) and 58.7 (France); and

(c) uncertain for Division 58.5.1 (Chile).

(iv) Detailed advice was provided in respect of the New Zealand request for a continuation of the variation from Conservation Measure 29/XVI for exploratory fishing in Subarea 88.1 (paragraphs 7.85 to 7.93). Otherwise it was recommended that Conservation Measure 29/XVI should be retained for longline fisheries in all parts of the Convention Area.

7.177 Incidental mortality of seabirds during longline fishing outside the Convention Area:

(i) Information on seabird by-catch outside the Convention Area, submitted by Australia, continues to indicate that substantial by-catch occurs of species and populations breeding within the Convention Area (paragraphs 7.96 to 7.100).

(ii) The Working Group received no data from other Members, especially for regions adjacent to the Convention Area, such as New Zealand, South Africa, southern South America and the Falkland/Malvinas Islands; appropriate Members were requested to provide relevant data for next year's meeting (paragraphs 7.102 and 7.103).

7.178 Research into, and experience with, mitigating measures:

(i) Offal discharge: vessels still operating with offal discharge on the same side as the haul, in contravention of the Conservation Measure 29/XVI, should undertake waste-pipe reconfiguration using information from the *Koryo Maru 11* (paragraph 7.110).

(ii) Line weighting: experiments into line-weighting regimes using the Spanish system vessels in Subarea 48.3 in February (paragraphs 7.111 to 7.115) and autoline vessels in Subarea 88.1 in January and February (paragraph 7.116) showed reductions in bird by-catch rates from 3.98 birds/thousand hooks to <1 bird/thousand hooks (in Subarea 48.3) and zero by-catch (in Subarea 88.1). These results have potentially important implications for longline fishing practices in the Convention Area.

(iii) The experiment using a Mustad underwater setting funnel in Subareas 58.6 and 58.7 between August 1998 and June 1999, showed that seabird by-catch using the funnel (0.002 birds/thousand hooks) was significantly less than when not using the funnel (0.017 birds/thousand hooks) (paragraph 7.122). Further use and development of this system was strongly encouraged (paragraph 7.124).

(iv) Technical coordinators of national scientific observation programs were requested to provide relevant information on operational issues and fishing strategy procedures that may influence the successful use of mitigation measures, especially line-weighting regimes, for next year's meeting of WG-FSA (paragraphs 7.126 and 7.127).

7.179 International and national initiatives:

(i) Initiatives relating to reducing seabird by-catch in longline fisheries by FAO, CMS, Australia and New Zealand (paragraphs 7.128 to 7.149).

(ii) Adoption by FAO of its IPOA–Seabirds in 1999 and its request for FAO member States to produce NPOAs and report on them to FAO in 2001. Longlining Members of the Commission are encouraged to develop their own NPOA–Seabirds and to report on progress (paragraphs 7.129 to 7.131).

(iii) An initiative by the Valdivia Group to assist conservation of southern hemisphere albatrosses (paragraph 7.133).

(iv) Progress with implementation of the Australian Threat Abatement Plan (paragraphs 7.137 to 7.140).

(v) The intention of New Zealand to host an International Fishers Forum in 2000 to improve the development of mitigation measures and encouragement to Members to participate (paragraphs 7.144 to 7.149).

7.180 Strategic and policy issues:

(i) The recommendation that vessels which had proven unable or unwilling to comply with all the provisions of Conservation Measure 29/XVI should not be allowed to fish in the Convention Area (paragraphs 7.152 to 7.154).

(ii) Within the Convention Area, IUU longline fishing now poses the principal survival threat for most, if not all, the species and populations of at-risk seabirds (paragraph 7.156).

(iii) The impact of IUU fishing on seabirds could be reduced by increasing the benefit to fishers of using vessels or fishing practices which were configured and/or operated in ways to reduce the probability of seabird by-catch (e.g. underwater setting, integrated weighted autolines) (paragraph 7.157).

(iv) Relaxation of current fishing season restrictions could only be recommended when there is compliance with all the main elements of Conservation Measure 29/XVI (paragraph 7.160).

(v) Vessels able to demonstrate that they have consistently (i.e. in every cruise) achieved full compliance with each element of Conservation Measure 29/XVI in a fishing season should, in the following year, be allowed to fish at any time of year (paragraphs 7.163 to 7.166). In respect of this:

(a) compliance would need careful verification, particularly with respect to line weighting, by ad hoc WG-IMALF and WG-FSA, on the basis of all available data and the report of the scientific observer;

(b) appropriate line-weighting regimes for autoline vessels need determining.

(c) to the extent feasible, there should be in-port inspections of vessels in order to ensure that they are configured, and have all fishing and related gear necessary, to be able to comply in full with Conservation Measure 29/XVI; and

(d) longline fishing should cease if a significant level of bird by-catch occurs (cf. the Scientific Committee recommendation in SC-CAMLR-XVII, paragraphs 4.67 and 4.68, with respect to the New Zealand proposal for fishing in Subarea 48.1 in 1998/99). Advice on appropriate levels of seabird by-catch, on an area-specific basis, would be provided by ad hoc WG-IMALF to WG-FSA.

Given these considerations, the Working Group felt that it might be premature to advise adoption of this procedure at the present meeting (paragraph 7.164).

(vi) The need for rapid further progress in conducting experiments to define the optimum (minimum) line-weighting regime that will eliminate (or reduce to a very low level) seabird by-catch for both autoliners and vessels using the Spanish system. As an incentive to attract the cooperation of fishers and fishery managers, such experiments, which should be conducted in accordance with a strictly specified experimental design, could be undertaken under CCAMLR Conservation Measure 64/XII (paragraphs 7.167 and 7.168).

OTHER INCIDENTAL MORTALITY

Longline Vessels – Marine Mammals

8.1 Interactions between longline vessels and marine mammals appear to be increasingly reported by scientific observers (paragraph 3.55 and Table 15). However, no deaths of marine mammals were reported. A dolphin (species undetermined) was hooked in Subarea 48.3 but released itself. Sperm whales were temporarily entangled on two occasions in longlines in Subareas 58.6 and 58.7 (Table 15).

Trawl Fishing

8.2 In Subarea 48.2 Japanese krill fishery vessels killed two seals (species unreported but most likely to be Antarctic fur seals); a third seal was released alive.

8.3 In Subarea 48.3 the observer on the Russian trawler *Zakhar Sorokin*, fishing for *C. gunnari*, reported that a total of six seabirds (four black-browed albatrosses and two white-chinned petrels (actually reported as sooty albatross)), were killed by the warps of the net during hauling; and one white-chinned petrel was released in poor condition.

8.4 CCAMLR-XVIII/BG/31 reported that, during fishing in Division 58.5.2, the *Southern Champion* reported three white-chinned petrels killed after entanglement in trawl nets. One cape petrel was found dead on deck, probably striking the warp; one Antarctic fur seal was recovered from the codend of a trawl. On the *AustralLeader*, one cape petrel was found dead on deck, near the trawl doors.

8.5 Information provided in WG-FSA-99/26 and 99/72 emphasised the importance of minimising seabird interactions with relevant trawl operation. Procedures causing fewer interactions or bird mortalities occurred with vessels operating according to the following procedures:

(i) no netsonde cable;
(ii) no discharge of waste products; and
(iii) low levels of lighting.

8.6 The following requirements, largely derived from operations described in WG-FSA-99/72, are considered appropriate for all trawl fishery operations in the Convention Area. All vessels should have demonstrated capacity to:

(i) retain waste products from fishing;

(ii) operate without the need for plastic packaging bands in fishing operations (this is already prescribed in Conservation Measure 63/XV); and

(iii) maintain lighting levels and locations so as to give minimum outwardly-directed illumination.

8.7 However, the Working Group noted that, although such measures may minimise seabird by-catch, there are other aspects of the activities of trawl fisheries that may have adverse effects on seabirds (e.g. alteration of nest attendance patterns, provisioning rate etc.) that need further research.

8.8 Vessels conducting trawl fishing operations in the Convention Area should have a demonstrated capacity to retain waste products from fishing and to organise the location and power of lights so as to minimise the risk of bird strikes.

FUTURE WORK

9.1 The Working Group reviewed the activities of subgroups which had worked during the intersessional period, and provided information to the meeting. WG-FSA agreed that the tasks assigned to the subgroups had generally far exceeded the time available to each subgroup. However, each subgroup had produced valuable work and information which had contributed to the assessments and review of information available at the meeting. WG-FSA agreed that the activities of each group should be extended during the 1999/2000 intersessional period. Where possible, each subgroup would focus on a small number of key tasks, achievable within the intersessional period. 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.

Intersessional Work of Subgroups

9.2 WG-FSA identified major tasks for the 1999/2000 intersessional period, and assigned these to seven subgroups:

(i) A subgroup to compile catch and effort data from regulated and IUU fishing activities, coordinated by Mr B. Watkins (South Africa) and assisted by Mr S. Fitch (Australia), Dr Prenski and Prof. Duhamel.

(ii) A subgroup to review observer reports and information, coordinated by Dr Balguerías with assistance from Dr Barrera-Oro and an IMALF member.

(iii) An assessment group coordinated by Dr Constable and assisted by Drs Agnew, Gasiukov, Kirkwood and Parkes. This subgroup was asked to focus on further developments of the GYM, including the incorporation of multiple selection functions and the development of post-processing capabilities (paragraph 3.145). The subgroup was also asked to address some of the key management issues regarding *C. gunnari* (paragraph 9.8).

(iv) A subgroup to review, and where necessary, assess the biology and demography of species considered by the Working Group, coordinated by Dr Everson and assisted by Dr Prenski, Prof. C. Moreno (Chile), and Drs J. Ashford (UK), P. Horn (New Zealand) and J. Kalish (Australia). WG-FSA recognised that this subgroup had expertise in ageing fish and had established a mechanism for reading otoliths from *D. eleginoides* (e.g. WG-FSA-99/43 and 99/68). The subgroup was asked to finalise a method for ageing *D. eleginoides* using otoliths and to provide advice on how best to advance the analysis of otoliths collected by scientific observers. Advice on otolith collection strategies was also sought.

(v) A subgroup to compile data necessary for ad hoc WG-IMALF activities;

(vi) A subgroup to review the tasks of scientific observers, coordinated by Mr Watkins with the assistance of Mr Williams. The subgroup was asked to:

(a) review the tasks of scientific observers;
(b) determine the relevance of data collected;
(c) address priorities for data collection and activities; and
(d) coordinate data requests with requests from WG-EMM and ad hoc WG-IMALF.

(vii) A subgroup to document the extent of by-catch in CCAMLR fisheries, coordinated by Dr Agnew with the assistance of Dr Prenski (paragraph 4.98). Tasks would include:

(a) quantifying the data available in the CCAMLR database and the national archives of Members;

(b) identifying the needs for additional data and develop strategies for collecting such data;

(c) analysing data on by-catch; and

(d) investigating options for general by-catch provision for assessed fisheries.

9.3 The work of last year's subgroup tasked with the review of new and exploratory fisheries activities and notifications had been undertaken by the Secretariat, and the Working Group requested that this be repeated for the next meeting (paragraph 9.8).

9.4 The Working Group proposed that the Secretariat investigate the feasibility of establishing news groups via the website to assist with the coordination of this work.

Other Intersessional Work

9.5 The Working Group agreed that a summary of the issues discussed, assumptions made and problems encountered during this meeting should be circulated to all participants prior to the next meeting. This summary would provide a focused starting point for future assessments. The Working Group tasked the Convener, subgroup coordinators and the Secretariat with the preparation of such a summary soon after this meeting. This summary should be included in the Secretariat's paper 'Data and Resources Available to WG-FSA-2000' which will be distributed one to two months prior to the next meeting.

9.6 The Working Group identified a number of other tasks which should be carried out by participants and the Secretariat during the intersessional period. These tasks are summarised below. References are given to paragraphs in the report which contain details of these tasks.

9.7 The following tasks were identified as part of developing the CCAMLR database:

Secretariat:

(i) Finalise the transfer of survey data to the new database, and validate data extraction routines (paragraph 3.7).

(ii) Link descriptions of maturity scales to research survey datasets (paragraph 3.122).

(iii) Process all available fishery and observer data from the split-year prior to the meeting (ongoing).

(iv) Process, where possible, all available fishery and observer data from the current fishing season prior to the meeting (ongoing).

(v) Publish seabed areas (by subarea and division, and by fishable depth ranges of *Dissostichus* spp.) in the *Statistical Bulletin* (paragraphs 10.7 and 10.8).

(vi) Publish the *Fishery Data Manual* (paragraph 10.13).

Members:

(vii) Submit overdue fishery data (paragraph 3.14).

(viii) Submit corrected C2 data (the UK and others as requested by the Secretariat, paragraph 3.16).

(ix) Submit detailed bathymetry data (paragraphs 3.21 and 10.8).

(x) Inform the Secretariat of any errors in the descriptions of maturity scales (paragraph 3.122).

(xi) Submit data on catches of target species taken outside the Convention Area by next meeting (ongoing).

(xii) Submit observer logbook data and reports within the deadlines set by the Commission (ongoing).

(xiii) Submit recent survey data and support documentation to the Secretariat so that these data could be used in future analyses of the Working Group – note that survey data need to be submitted in a format, and using data codes, compatible with those in use in the CCAMLR database (ongoing).

9.8 The following tasks were identified as part of the work in stock assessment analyses and modelling:

Secretariat:

(i) Maintain an up-to-date suite of software so as to fully document and operate validation procedures and models (ongoing).

(ii) Review notifications for new and exploratory fisheries.

(iii) Update estimates of seabed areas in relation to notifications of new and exploratory fisheries (ongoing).

Members:

(iv) Collect information on mesh/hook selectivity for *Dissostichus* spp. (paragraph 3.82).

9.9 The Working Group reaffirmed the urgent need to examine the short-term implications of the current management strategies for *C. gunnari*, and to develop long-term management strategies. A workshop to investigate options for long-term management had been planned for 1999 and subsequently postponed (SC-CAMLR-XVII, Annex 5, paragraph 9.10). The Working Group agreed that the need for such a workshop remained high, although its timing could not be established at this stage. In the interim, some management issues were referred to the assessment subgroup for advancement during the intersessional period.

9.10 In addition, the Working Group encouraged participants to undertake as a matter of urgency, the necessary analyses required under the major biological components of the terms of reference. These were:

(i) to review the fisheries on *C. gunnari* in various subareas and divisions, including trends in catches and changes in stock composition in terms of length and age;

(ii) to review information on the biology and demography of the species, including age, growth, reproduction and diet;

(iii) to review information on stock identity, structure and movements, including distribution, movements, segregation by age and stock separation;

(iv) to review estimates of absolute and relative abundance and year-class strength;

(v) to review the historical assessment methods, including short- and long-term methods and highlight their shortcomings; and

(vi) to evaluate interactions of *C. gunnari* with other components of the ecosystem, including krill and fur seals, to investigate past fluctuations in natural mortality and explore the potential to predict changes in M.

9.11 The following tasks were identified as part of the revision of data collection and procedures for scientific observers:

Secretariat:

(i) Investigate sampling strategies for measuring fish, and identify implications for assessments (paragraph 9.2(iii)).

(ii) Extend the table of nautical twilight times (paragraph 3.68).

9.12 The data collection priorities of scientific observers were further discussed, and WG-FSA agreed, as an interim measure for 2000, that technical coordinators ask scientific observers to concentrate on one of three major fish data collection activities during each trip: the collection of otoliths (especially from large fish), or the collection of by-catch data, or the collection of biological data. This, however, should not imply that any of the three data collection activities should be completely ignored on any one cruise.

9.13 WG-FSA also confirmed that factual sightings by scientific observers of vessels engaged in IUU fishing were valuable in identifying fishing areas. This task had been endorsed by the Commission (CCAMLR-XVII, paragraph 8.16) on the proviso that the independence and integrity of scientific observers were not compromised, and that this activity be confined to gathering data in support of the Scientific Committee. The Working Group recommended that scientific observers should continue reporting data on sightings in their reports.

IMALF Intersessional Work

9.14 The tasks listed below were identified as part of the work on the assessment of incidental mortality of seabirds and marine mammals arising from fishing operations. The list comprises those tasks which are not standing requests or repetition or continuation of items which appeared in the 1999 plan of intersessional work. The latter items will be so identified in the 2000 work plan, which is attached as Appendix D. The following tasks were identified:

Secretariat:

(i) Intersessional analysis of scientific observer data in order to evaluate the resolution and accuracy of estimates of seabird by-catch rates in relation to observed by-catch rates (paragraph 7.33).

(ii) Document exact procedure for converting observer data on seabird by-catch into estimates of overall by-catch and by-catch rates for vessels and subareas (e.g. in relation to Tables 46 to 54).

(iii) Coordinate responses from technical coordinators on feedback requested from the industry on operational issues (paragraphs 7.126 and 7.127).

(iv) Circulate observer reports to one representative of each country participating in WG-IMALF.

Members:

(v) Assist interpretation of research programs into the population status and foraging ecology of albatross, giant petrel and *Procellaria* petrels (paragraphs 7.17 and 7.18).

(vi) Provide information on current status of research programs on population genetic profiles of albatrosses (paragraph 7.16).

(vii) Further use and development of underwater setting systems (paragraph 7.124).

(viii) Data on incidental mortality of seabirds for regions adjacent to the Convention Area, especially from Argentina, Chile, France, New Zealand, South Africa and the UK (paragraph 7.102).

(ix) Acquisition of any outstanding data from EEZs to ensure comprehensive assessments can be undertaken (paragraph 7.40).

(x) Report on efficacy of mitigating measures in use in longline fisheries in New Zealand in 1998/99 and 1999/2000 (paragraph 7.91).

(xi) Participation in workshops addressing issues relating to seabird by-catch in longline fisheries (paragraphs 7.128 and 7.144 to 7.149).

(xii) Implementation of actions under the Australian Threat Abatement Plan (paragraphs 7.137 to 7.140).

(xiii) Reports on progress towards development of NPOAs in relation to FAO IPOA–Seabirds (paragraph 7.131).

9.15 The following tasks should be carried out intersessionally in cooperation with technical coordinators:

(i) review the comments of scientific observers, revise logbook forms and instructions, publish and distribute updates by February 2000;

(ii) urge vessel owners and captains to provide as much protection as possible for observers against adverse weather conditions (SC-CAMLR-XVII, Annex 5, paragraph 3.61); and

(iii) encourage technical coordinators and scientific observers in promoting awareness of the details of CCAMLR conservation measures in force (SC-CAMLR-XVII, Annex 5, paragraph 3.77).

OTHER BUSINESS

Website

10.1 Dr Ramm reported on recent developments and usage of the CCAMLR website. This had been the second year that meeting papers submitted electronically had been available via a secure webpage, and a growing number of participants had accessed material through the Internet. Approximately 20% of all papers submitted to the meeting had been sentelectronically and loaded on the website.

10.2 Documents submitted in paper format were not suitable for placing on the website because these would need to be either scanned as images or as text using character recognition software. Documents scanned as images usually result in large files, leading to long download times via the Internet. Documents scanned using character recognition software would require additional proofreading to ensure that all characters were correctly assigned. WG-FSA encouraged all participants to submit papers electronically to future meetings.

10.3 Participants who had used the website had found the facility extremely useful. They encouraged the Secretariat to continue development of the website, and other participants to make use of this new tool. Dr Miller emphasised the need to quantify hit rates so as to objectively evaluate the usage of the website. This information would also provide guidance in further development of the website.

10.4 Dr Everson reported on the recommendations of WG-EMM concerning the website (Annex 4, paragraphs 10.1 to 10.12). WG-EMM had identified several tasks for the Secretariat during 1999/2000 (Annex 4, paragraph 12.7), including:

(i) placing advance copies of meeting reports on a secure webpage;

(ii) providing public access to a text file containing information (authors, dates, titles and abstracts) on papers and documents held in the CCAMLR bibliography, and related to the work of WG-EMM; and

(iii) providing public access to text files summarising STATLANT data reported in the *Statistical Bulletin*.

10.5 In addition, WG-EMM had encouraged its members to submit via email, all documents intended for circulation prior to meetings and other information for use on the web, using formats specified in Annex 4, paragraph 10.4.

10.6 WG-FSA explored the possibility of loading all meeting documents on the server used by the Working Group during the meeting, so that these may be accessed by participants using their laptop computers. The Secretariat was encouraged to investigate this option.

Seabed Areas

10.7 WG-FSA discussed the central role of seabed area estimates in its work on new and exploratory fisheries, and a proposal to publish summary information on seabed areas in the *Statistical Bulletin*. This proposal would ensure that key information was readily available, and updated as new data were acquired and analyses refined.

10.8 The Working Group recommended that a summary of seabed areas, by subarea and division, and by fishable depth ranges of *Dissostichus* spp., be published annually in the *Statistical Bulletin*. In addition, disaggregated data used in these estimations should be submitted to the CCAMLR database so that these data may be available to future assessments.

Fishes and Fish Resources of the Antarctic

10.9 The need to translate a newly published book by Dr K. Shust (Russia) on *Fishes and Fish Resources of the Antarctic* was reviewed by a subgroup during the meeting. The book was written in Russian, with an English summary. The subgroup, led by Dr Kock, concluded that it would be useful to translate from Russian to English the headings, figure and table captions, and the references to Russian publications; Dr Kock estimated that this task would require about two days of one of the Secretariat's Russian translators. Dr Miller stressed the need to establish criteria for evaluating such requests, and to determine which material should be translated. The Working Group referred this matter to the Scientific Committee.

Bibliography on Antarctic Fish

10.10 Dr Kock advised that he had received a number of requests to update and distribute a bibliography on Antarctic fish which he had compiled over many years. However, due to other work commitments, he had been unable to complete this task, and sought support from the Working Group to secure funding for an assistant to complete the task. Dr Kock estimated that approximately A$8 000 would be required to update the bibliography, transfer the information to CD-ROM, and distribute. WG-FSA agreed that this type of information would be generally useful to publish. However, most members of WG-FSA already had access to such material. The Working Group referred this matter to the Scientific Committee; financial support may be sought from SCAR.

Biology of Polar Fish

10.11 Dr Everson reminded the Working Group of the forthcoming international symposium on the 'Biology of Polar Fish'. This symposium is being hosted by the Fisheries Society of the British Isles and will be held in Cambridge, UK, from 24 to 28 July 2000.

CCAMLR Science

10.12 Following last year's request by the Scientific Committee, the Secretariat has applied to the Institute for Scientific Information (ISI) to include *CCAMLR Science* in its publication *Current Contents* and in the *Science Citation Index*. An application was forwarded to ISI in February. The institute recently advised that the evaluation will be completed following the issue of the sixth volume of the journal.

Fishery Data Manual

10.13 WG-FSA reviewed the draft *Fishery Data Manual* (WG-FSA-99/8), and recommended that it be published as a loose-leaf publication in the four languages of the Commission, as recommended last year (SC-CAMLR-XVII, Annex 5, paragraphs 9.4 to 9.6).

Martin White

10.14 The Working Group learnt, with great sadness, of the passing of Martin White of the British Antarctic Survey, UK. Martin was a distinguished Antarctic fish biologist, and had been an active and highly respected member of the CCAMLR community. He died on 3 July 1999, after a short battle with cancer.

ADOPTION OF REPORT

11.1 The report of the meeting was adopted.

CLOSE OF THE MEETING

12.1 Dr Miller, on behalf on the Working Group, thanked Mr Williams for his excellent work in convening the meeting. He had done an excellent task in his first year as Convener, and had skilfully steered the group through difficult assessments and lengthy discussions. The Working Group had also greatly appreciated the long hours that participants had worked during the meeting, and in particular thanked Dr Constable, Ms E. van Wijk (Australia) and Drs Parkes, Kirkwood and Marschoff. The Working Group also thanked all the staff at the Secretariat for their high level of support at the meeting.

12.2 The Working Group reflected on the length of the meeting and the amount of work which it had faced over the past 11 days. Several options for facilitating an earlier start to substantive work at future meetings were discussed. Ideas proposed to shorten the lead-up period at the start of the next meeting included:

(i) reducing the amount of new material distributed during the first day of the meeting by encouraging participants to submit their papers electronically at least one to two weeks in advance of the meeting;

(ii) providing a summary of key events during the last meeting to all participants one to two months in advance of the meeting (paragraph 9.5); and

(iii) encouraging participants to meet for an informal 'ice-breaker' on the Sunday evening prior to the start of the meeting.

12.3 Mr Williams agreed to investigate such options for the meeting in 2000. In addition, he expressed concern at the growing amount of work associated with the assessments, and the increasing burden carried by a small number of participants. He sought assistance of colleagues in encouraging more experts in assessments modelling and statistics to participate in the activities of WG-FSA, therefore spreading the load of this aspect of the Working Group's work.

12.4 In closing the meeting, the Convener thanked the Working Group for their excellent work. He also thanked the rapporteurs for their efforts, and especially Drs Kirkwood, Constable and Parkes for working under extreme pressure in the final days of the meeting.

12.5 The meeting was closed.

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Table 1: Summary of available bathymetry data.

Region	Data Available
Southwest Atlantic	
48.1	Kock (1986), Kock and Harm (1995), GEBCO, GEODAS, Sandwell and Smith
48.2	GEBCO, GEODAS (see WG-FSA-99/33), Sandwell and Smith
48.3	Everson (1987), Everson and Campbell (1990), GEBCO, GEODAS, Sandwell and Smith
48.4	GEBCO, GEODAS, Sandwell and Smith
48.5[2]	GEBCO, GEODAS, Sandwell and Smith
48.6	GEBCO, GEODAS, Sandwell and Smith[1]
Western Indian	
58.4.2	GEBCO, GEODAS, Sandwell and Smith[1]
58.4.3	GEBCO, GEODAS, Sandwell and Smith[1]
58.4.4	GEBCO, GEODAS, Sandwell and Smith[1]
58.5.1	GEBCO, GEODAS, Sandwell and Smith[1]
58.5.2	GEBCO, GEODAS, Sandwell and Smith[1]
58.6	GEBCO, GEODAS, Sandwell and Smith[1]
58.7	GEBCO, GEODAS, Sandwell and Smith[1]
Eastern Indian	
58.4.1	GEBCO, GEODAS, Sandwell and Smith[1]
Southwest Pacific	
88.1[2]	GEBCO, GEODAS, Sandwell and Smith[1], ETOPO5[1] (see WG-FSA-98/50)
88.2[2]	GEBCO, GEODAS, Sandwell and Smith[1]
Southeast Pacific	
88.3	GEBCO, GEODAS, Sandwell and Smith

[1] Dataset used to estimate seabed areas reported in Table 24
[2] Extends south of 72°S

Table 2: Catches (tonnes) by species and area reported from the split-year 1998/99 (1 July 1998 to 30 June 1999). Source: STATLANT data.

Species Names	Area/Subarea/Division											All Areas
	48	48.1	48.2	48.3	58.4.1	58.4.3	58.5.1	58.5.2	58.6	5.87	88.1	
Raja georgiana											11	11
Antimora rostrata				<1	<1	<1			3	3	<1	6
Bathyraja eatonii											1	1
Bathyraja spp.											1	1
Chaenocephalus aceratus			1	<1								1
Chaenodraco wilsoni			<1									<1
Champsocephalus gunnari			1	265				73				339
Channichthyidae			<1								<1	<1
Channichthys rhinoceratus							1	2				3
Chionodraco rastrospinosus			1									1
Dissostichus eleginoides				4 291		<1	5 402	5 451	1 912	205	1	17 262
Dissostichus mawsoni			<1								296	296
Elasmobranchii				<1					1			1
Euphausia superba	76 341	8 150	12 585	4 741								101 817
Lepidonotothen squamifrons			5					10				15
Lithodes murrayi				<1					<1			<1
Lithodes spp.				<1								<1
Lithodidae				<1								<1
Macrourus carinatus											20	20
Macrourus spp.				12	<1	<1	1	1	24	21	1	61
Macrourus whitsoni											1	1
Medusae								2				2
Muraenolepis microps											4	4
Muraenolepis spp.											1	1
Myctophidae			<1	5								5
Gobionotothen gibberifrons			5									5
Notothenia neglecta			<1									<1
Notothenia rossii			<1				1	<1				2
Nototheniidae				<1				3			<1	3
Osteichthyes spp.			<1					<1				<1
Paralomis aculeata				<1								<1
Patagonotothen brevicauda				3								3
Porifera								<1				<1
Pseudochaenichthys georgianus			3	<1								3
Raja spp.											6	6
Rajiformes spp.			<1	15			6	4	1	<1		26
Somniosus pacificus								1				1
Trematomus spp.			<1									<1
Total	76 341	8 150	12 602	9 333	<1	<1	5 410	5 548	1 942	230	342	119 898

Table 3: Catches (tonnes) by species, area and gear reported for the 1998/99 fishing season (i.e. the period between the end of the Commission meeting in 1998 and the time of the WG-FSA meeting in 1999, except for krill fisheries).

Conservation Measure	Subarea/ Division	Location	Fishing Method	Catch Limit (tonnes)	Reported Catch (tonnes)
Euphausia superba:					
32/X	48		Trawl	1 500 000	101 820
45/XIV	58.4.2		Trawl	450 000	0
106/XV	58.4.1		Trawl	775 000	0
Dissostichus spp.:					
Established fisheries:					
154/XVII	48.3	South Georgia	Longline	3 500	3 652
156/XVII	48.4	South Sandwich Is	Longline	28	0
158/XVII	58.5.2	Heard Island	Trawl	3 690	3 480
–	58.5.1	Kerguelen EEZ	Trawl		3 042
–	58.5.1	Kerguelen EEZ	Longline		1 194
–	58.6	Crozet EEZ	Trawl		52
–	58.6	Crozet EEZ	Longline		1 019
–	58.6	Prince Edward Is EEZ	Longline		201
–	58.7	Prince Edward Is EEZ	Longline		180
Exploratory fisheries:					
166/XVII	58.4.1	West of 90°E	Trawl	261	<1
		East of 90°E		0	0
167/XVII	58.4.3		Trawl	625	<1
168/XVII	58.6	Outside EEZs	Longline	1 555	0
New fisheries:					
162/XVII	48.6	North of 60°S	Longline	707	0*
		South of 60°S	Longline	495	0
163/XVII	58.4.3	North of 60°S	Longline	700	0
		South of 60°S	Longline	0	0
164/XVII	58.4.4	North of 60°S (outside EEZ)	Longline	572	0
		South of 60°S	Longline	0	0
169/XVII	88.1	North of 65°S	Longline	271	0
		South of 65°S	Longline	2 010	298
Champsocephalus gunnari:					
153/XVII	48.3	South Georgia	Trawl	4 840	265
159/XVII	58.5.2	Heard Island	Trawl	1 160	2
Electrona carlsbergi:					
155/XVII	48.3	South Georgia	Trawl	109 000	0
Martialia hyadesi:					
165/XVII	48.3	South Georgia	Jig	2 500	0
Crab:					
151/XVII	48.3	South Georgia	Pot	1 600	4

* One South African vessel fished for three days.

Table 4: Reported catches (in tonnes) of *D. eleginoides* and *D. mawsoni* by Members and Acceding States in EEZs and in the CCAMLR Convention Area, and estimates of unreported catches from the CCAMLR Convention Area by Members and Acceding States in the 1998/99 split-year. Catches for the 1997/98 split-year are given in parentheses. The information in this table may be incomplete.

Member/ Acceding State	Outside CCAMLR Area Catch in EEZs		CCAMLR Area Reported Catch		CCAMLR Area Estimates of Unreported Catches by Members		Estimated Total Catch All Areas	
Chile	9 172[1]	(8 692)	1 668	(1 479)[4]	3 280	(5 640)[8]	14 120	(15 811)
Argentina	8 297	(5 651)	10	(0)	800	(5 760)[9]	9 107	(11 411)
France	0	(0)	6 260	(3 032)	0	(0)	6 260	(3 832)
Australia	100	(575)[2]	5 451	(2 418)	0	(0)	5 551	(2 993)
South Africa	79	(0)	948	(1 149)[5]	0	(1 200)[10]	957	(2 349)
UK	>1 416	(1 624)[3]	1 238	(590)	0	(0)	2 654	(2 214)
Uruguay	1 059	(?)	517	(262)[4]	0	(800)[11]	1 576	(1 062)
Ukraine	0	(0)	760	(997)[6]	0	(0)	760	(997)
Spain	0	(0)	154	(196)[4]	0	(0)	154	(196)
Rep. of Korea	0	(0)	255	(170)[4]	0	(0)	255	(170)
Peru	0	(156)	0	(0)	0	(0)	0	(156)
Japan	0	(0)	0	(76)[4]	0	(0)	0	(76)
New Zealand	<1	(0)	296	(41)[7]	0	(0)	323	(41)
USA	0	(0)	<1	(0)	0	(0)	<1	(0)
All countries	20 124	(16 698)	17 558	(11 210)	4 080	(13 400)	41 718	(41 308)

1 1998 calendar year
2 From Macquarie Island
3 From Falkland/Malvinas Islands
4 From Subarea 48.3
5 From South African EEZ in Subareas 58.6 and 58.7 and from Subarea 48.3
6 From French EEZ in Division 58.5.1
7 From Subarea 88.1; catch consisted mostly of *D. mawsoni*
8 Based on the following estimates: three vessels observed in Division 58.5.1, five vessels observed in Walvis Bay and Mauritius, assumed that eight vessels were fishing at some time during the season taking into account that some of these vessels were also involved in the regulated fishery in Subarea 48.3 for part of the year, effort – 940 days fishing, mean daily catch rate – 6 tonnes.
9 Based on the following estimates: four vessels observed or arrested in Division 58.5.1, three vessels landing catches in Walvis Bay, assumed that seven vessels were fishing at some time during the season, effort – 960 days fishing, mean daily catch rate – 6 tonnes.
10 Based on the following estimates: one vessel sighted in Division 58.5.1, probably fishing for the whole season, effort – 200 days fishing, mean daily catch rate – 6 tonnes.
11 Based on the following estimates: one vessel landing catch in Walvis Bay, assumed the vessel was fishing for part of the season when not involved in the regulated fishery in Subarea 48.3, effort – 133 days fishing, mean daily catch rate – 6 tonnes.

NB: An additional unreported catch of 1 200 tonnes was attributed to Portugal (European Community) in the 1997/98 split-year based on two vessels sighted in Division 58.5.1 fishing for part of the season (see SC-CAMLR-XVII, Annex 5, Table 3).

Table 5: Estimated landings (in tonnes) of IUU-caught *D. eleginoides* in southern African ports, Mauritius and Montevideo in the 1997/98 split-year, the 1998/99 split-year and the beginning of the 1999/2000 split-year. Values in parentheses indicate the number of recorded landings. Total green weight landings for 1998/99 are estimated as 16 636 tonnes.

Port	Product Weight 1997/98	Estimated Green Weight 1997/98	Product Weight Jul–Sep 1998	Estimated Green Weight Jul–Sep 1998	Product Weight 1998	Estimated Green Weight 1998	Product Weight 1998/99	Estimated Green Weight 1998/99	Product Weight Jul–Sep 1999	Estimated Green Weight Jul–Sep 1999
Walvis Bay	3 222[1]	5 477[1]	422[1]	717[1]	268[1,5] (2)	469[1,5] (2)	2 571[1,5] (19)	4 502	260[1,5] (1)?	455[1,5]
Cape Town/Durban	780[2]	1 326[1]	85[2]	150[1]			30 (1)	53	21[1,5] (1)	37[1,5]
Mauritius	11 780[3]	20 026[1]	4 320[3]	7 344[1]	1 286[1,5] (3)	2 251[1,5] (3)	6 813[1,5] (36)	11 923	146[1,5] (?)	256[1,5]
Montevideo							90 (1)	158		

1 Catches/landings conversion factor of product to green weight: 1.7.
2 Information from Australian commercial sources. Catches mostly from Kerguelen Plateau.
3 Information from Japanese Seafood Daily Newspaper, September 1997.
4 Minimum estimate from known landings.
5 Landings in Cape Town include catches from unregulated fishing up to the end of the 1996/97 split-year. Landings thereafter were from the licensed fishery only.
6 From data in WG-FSA-99/51.

Table 6: Estimated effort, mean catch rates/day and total catches by subarea/division in the unregulated fishery on *D. eleginoides* in the 1998/99 split-year. Estimates for the 1997/98 split-year are given in parentheses. The total estimated unreported catch for 1998/99 is 6 653 tonnes (or 8 573 tonnes[1]). The reported catch for 1998/99 is given in Table 4. The estimated total catch for 1998/99 is 23 914 tonnes (or 25 834 tonnes[1]).

Area/ Subarea/ Division	Estimated Start of Unregulated Fishery	No. of Vessels Sighted in Unregulated Fishery[1]	No. of Surveillance Vessels	Estimated No. of Vessels Fishing	No. of Days Fishing per Fishing Trip	Estimated Effort in Days Fishing (1)	Mean Catch Rate per Day[4] (tonnes) (2)	Estimated Unreported Catch (1) x (2)	Estimated Total Catch
48.6	No info								
48.3	1991	1[2] (0)		1[4] (0)				300–400[4]	4 931 (3 258)
58.7	Apr/May 1996	1 (8)	6 (5)	2 (10)	40[3]	100 (370)	1.4	140	345 (1 501)
58.6	Apr/May 1996	4 (6)	4 (3)	6 (30–35)[5]	40	920 (504)	1.9	1 748	3 660 (1 940)
58.5.1	Dec 1996	11 (26)	6 (6)	15 (35–40)[5]	40	310 (2 365)	2.0	620	6 022 (16 566)
58.5.2	Feb/Mar 1997	2 (3)	2 (2)	4 (30)[5]	40	80 (1 400)	2.0	160	5 611 (9 418)
58.4.4	Sep 1996	2 (0)	0	7 (2)	40	1 230 (180)	1.5	1 845	1 845 (900)
58		3 (40–50)		5	40	1 000	1.5	1 500	1 500

1 The additional reported three vessels would increase the unreported catch by 1 920 tonnes. However, other reports indicate a total IUU catch for 1998/99 in Subarea 48.3 of the order of 300 to 400 tonnes (see paragraph 3.33).
2 Double sightings in one zone not counted
3 Data from licensed operations.
4 Report of additional three vessels in 1998/99 in this subarea.
5 Estimated number of vessels not in areas throughout period, but moving between areas.

Table 7: Estimated total catch (in tonnes) by subarea/division of *D. eleginoides* and *D. mawsoni* in the CCAMLR Convention Area for the 1998/99 split-year. Estimates for the 1997/98 split-year are in parentheses.

Subarea/ Division	Estimated Total Catch		Reported Catch 1998/99		Estimated Unreported Catch		Unreported Catch in % of the Estimated Total Catch
48.1	(<1)		0	(<1)	probably low		
48.2	(<1)		0	(<1)	probably low		
48.3	4 931[1]	(3 258)	4 291	(3 258)	300–400[1]		13 or 65[1]
58.4.4	1 845	(900)	0	(0)	1 845	(900)	100
58.5.1	6 022	(16 566)	5 402	(4 741)	620	(11 825)	10
58.5.2	5 611	(9 418)	5 451	(2 418)	160	(7 000)	3
58.6	3 660	(1 940)	1 912	(175)	1 748	(1 765)	48
58.7	345	(1 501)	205	(576)	140	(925)	40
88.1	297	(41)	297	(41)	probably low		
88.3	(<1)		0	(<1)	probably low		
All subareas	24 211[2]	(33 625)	17 558	(11 210)	6 653[1]	(22 415)	27 or 38[1] or 69[3]

1 Not included is estimate of additional 1 920 tonnes of catch from three vessels reported in Subarea 48.3.
2 Includes 1 500 tonnes of unreported catch for Area 58 as a whole.
3 Proportion based on total landings in various ports (see Table 5).

Table 8: Estimates of total catches of *D. eleginoides* and *D. mawsoni* in various subareas and divisions from November 1998 to September 1999.

Subarea/Division	Convention Area Reported Catch[1]	Estimated Unreported Catch[2]	Estimated Total Catch
48.3	3 652	648[3]	4 300
58.4.4	0	1 845	1 845
58.5.1	4 236	698	4 934
58.5.2	3 480	148	3 628
58.6	1 272	1 715	2 987
58.7	180	150	330
88.1	298	0	298

1 From Table 3
2 Assumes no IUU catches between 1 July and 1 September 1999.
3 Calculation made during the meeting, but information on IUU fishing indicated 300–400 tonnes (Table 7, pargraph 3.33).

Table 9: Imports of whole *Dissostichus eleginoides* (tonnes) in Japan and the USA in 1998 (January–December) and 1999 (Japan: January–July; USA: January–June). Trade data for Japan were supplied by FAO. Whole weights were estimated by the Secretariat using a factor of 2.2 to convert fillet weight to whole weight.

Source	1998 (January–December)				1999 (January–June/July)			
	Japan	USA	Total	% of Total	Japan	USA	Total	% of Total
Argentina	1 820	3 984	5 805	14	696	1 909	2 605	11
Australia	1 781	457	2 237	5	1 459	268	1 727	7
Belize	892	403	1 294	3	99		99	<1
British Virgin Islands		2	2	<1		3	3	<1
Bulgaria	58		58	<1	78		78	<1
Canada	22	44	65	<1		1	1	<1
Cayman Islands		27	27	<1				0
Chile	18 539	1 936	20 475	48	9 274	990	10 265	44
China	656		656	2	2 095	324	2 419	10
Falkland/Malvinas	281	45	325	1	78	35	113	<1
France	2 477	57	2 534	6	1 816	385	2 202	9
Gambia	87		87	<1				0
Guinea-Bissau		31	31	<1				0
Guyana		4	4	<1				0
Hong Kong				0		36	36	<1
India		5	5	<1		10	10	<1
Indonesia				0		127	127	1
Maldives		41	41	<1				0
Mauritania	8		8	<1				0
Mauritius	3 066	537	3 603	8	714	251	965	4
Namibia	470	451	920	2	19		19	<1
Netherlands	6		6	<1				0
New Zealand	4		4	<1	16	129	145	1
Norway	269		269	1	71		71	<1
Panama	504	201	705	2	27	121	148	1
Republic of Korea	40		40	<1	205		205	1
Reunion Island	631		631	1	661		661	3
Seychelles		65	65	<1				0
Singapore					12		12	<1
South Africa	1 204	221	1 426	3	89	120	209	1
Spain	129		129	<1	180		180	1
St Helena	207		207	<1	24		24	<1
Thailand		43	43	<1		32	32	<1
United Kingdom	72	12	83	<1	32		32	<1
Uruguay	641	305	946	2	123	655	778	3
USA	21		21	<1	23		23	<1
Vanuatu	44		44	<1	20		20	<1
Total	33 929	8 867	42 796		17 811	5 396	23 207	

Table 10: Exports of *Dissostichus eleginoides* (tonnes) from Australia from 1 July 1998 to 30 June 1999. Data were supplied by Australia. Whole weights were estimated by the Secretariat using a factor of 2.2 to convert fillet weight to whole weight, and a factor of 1.7 to convert headed, gutted and tailed (HAT) weight to whole weight; 'heads' were not included.

Destination	Exports (tonnes)	
	Product	Whole Fish[1]
Contracting Parties to CCAMLR		
Japan	3 370	4 990
USA	227	336
Republic of Korea	58	85
Non-Contracting Parties to CCAMLR		
China	494	511
Others[2]	315	325
Total	4 463	6 247

Product Breakdown	Weight (tonnes)	
	Product	Whole Fish
HAT	1 906	3 239
Fillets	691	1 521
Heads	407	0
Whole fish	651	651
All products	3 654	5 411
HAT	448	761
Fillets	3	6
Heads	289	0
Whole fish	69	69
All products	809	836

1 Pro-rata based on the product breakdown in the shaded box and the amount of product exported.
2 Taiwan, Thailand, Singapore and Hong Kong

Table 11: Exports of *Dissostichus eleginoides* (tonnes) from Chile from January to July 1999. Data were supplied by FAO. It was not known whether the weights referred to processed or whole fish; no conversion factor was applied.

Product	Export (tonnes)
Frozen fish	5 002
Fresh fish on ice	1 521
Smoked fish	6
Total	6 529

Table 12: Estimated and reported catches of *Dissostichus* spp. by regulated and IUU operations.

Year	Regulated Catch Estimated	Reported IUU Catch	Estimated IUU Catch	Outside CCAMLR	Total Reported	Total
1996/97	12 897	10 626	38 000–42 800	22 365	45 888	73 262–78 062
1997/98	11 210	14 600	33 583	16 698	42 508	61 491
1998/99	17 558	?	10 733	20 124	37 165	41 201

Table 13: Summary of information contained in the observer cruise reports for the 1998/99 fishing season. Nationality: AUS – Australia, CHL – Chile, ESP – Spain, GBR – United Kingdom, KOR – Republic of Korea, NZL – New Zealand, RUS – Russia, URY – Uruguay, ZAF – South Africa; Fishing method: A – autoliner, Sp – Spanish, OTM – midwater trawl, OTB – bottom trawl, Pot – crab pots; Information on: LF – length frequency, CF – conversion factor; Y – yes, N – no, - unknown.

Vessel Name (Nationality)	Dates of Trip	Fishing Method	IMALF Data	Mammal Interactions	Debris Information	Information on					Samples		Observer Manual Comments
						By-catch	LF	Weight	Maturity	CF	Otoliths	Scales	
Subarea 48.3													
Argos Helena (GBR)	10/4–30/7/99	Sp	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N
Argos Helena (GBR)	31/8–23/9/99	Pot	Y	Y	N	Y	Y	N	Y	Y	-	-	Y
Ibsa Quinto (ESP)	10/4–4/6/99	Sp	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Ibsa Quinto (ESP)	8/6–21/7/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Illa de Rua (URY)	8/4–28/6/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Illa de Rua (URY)	1/7–17/7/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Isla Camila (CHL)	11/4–22/6/99	Sp	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Isla Camila (CHL)	15/6–18/7/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
Isla Gorriti (URY)	8/5–12/6/99	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Isla Gorriti (URY)	12/6–17/7/99	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Isla Sofía (CHL)	31/3–31/6/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Isla Sofía (CHL)	28/6–22/7/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N
Jacqueline (GBR)	11/4–21/7/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
Koryo Maru 11 (ZAF)	10/4–27/6/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Koryo Maru 11 (ZAF)	30/6–4/8/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Lyn (GBR)	9/4–14/6/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Lyn (GBR)	17/6–20/7/99	Sp	Y	Y	N	Y	Y	N	Y	Y	N	N	Y
Magallanes III (GBR)	14/5–21/8/99	Sp	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	N
No. 1 Moresko (KOR)	11/4–22/7/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N
Tierra del Fuego (CHL)	11/4–23/6/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	N	N	N
Tierra del Fuego (CHL)	17/6–25/7/99	Sp	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
Zakhar Sorokin (RUS)	13/2–13/3/99	OTM	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Subareas 58.6 and 58.7													
Arctic Fox (ZAF)	21/9–14/11/98	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Arctic Fox (ZAF)	24/11/98–11/1/99	A	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N
Arctic Fox (ZAF)	31/3–29/5/99	A	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N
Arctic Fox (ZAF)	8/6–23/7/99	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N

continued

Table 13 continued

Vessel Name (Nationality)	Dates of Trip	Fishing Method	IMALF Data	Mammal Interactions	Debris Information	Information on By-catch	LF	Weight	Maturity	CF	Samples Otoliths	Scales	Observer Manual Comments
Eldfisk (ZAF)	2/10–1/11/98	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Eldfisk (ZAF)	1/5–23/6/99	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Koryo Maru 11 (ZAF)	3/11–28/12/98	Sp	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Koryo Maru 11 (ZAF)	5/1–5/2/99	Sp	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Koryo Maru 11 (ZAF)	6/2–24/3/99	Sp	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Subarea 88.1													
Janas (NZL)	23/12/98–5/3/99	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
San Aotea II (NZL)	22/12/98–3/3/99	A	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Division 58.5.2													
Austral Leader (AUS)	20/8–24/9/98	OTB	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y
Southern Champion (AUS)	27/9-11/11/98	OTB	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y
Southern Champion (AUS)	19/11/98–6/1/99	OTB	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	N
Southern Champion (AUS)	13/1–3/3/99	OTB	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	N
Southern Champion (AUS)	10/3–29/4/99	OTB	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Southern Champion (AUS)	8/5–14/7/99	OTB	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	N
Divisions 58.5.2, 58.4.3, and 58.4.1													
Austral Leader (AUS)	14/3–13/5/99	OTB	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	N

Table 14: Disposal of wastes and oil reported by observers. Nationality: AUS – Australia, CHL – Chile, ESP – Spain, GBR – United Kingdom, KOR – Republic of Korea, NZL – New Zealand, RUS – Russia, URY – Uruguay, ZAF – South Africa; Fishing method: A – autoliner, Sp – Spanish, OTM – midwater trawl, OTB – bottom trawl, Pot – crab pots; Y – disposed of over board; N – waste retained or burnt at sea; - no information.

Vessel Name (Nationality)	Dates of Trip	Fishing Method	Bands (Bait etc.)	Oil	Gear Debris	Garbage (Galley, Other)	Hooks in Discards
Subarea 48.3							
Argos Helena (GBR)	10/4–30/7/99	Sp	-	-	Y	Y	-
Argos Helena (GBR)	31/8–23/9/99	Pot	-	-	-	-	-
Ibsa Quinto (ESP)	10/4–4/6/99	Sp	-	-	Y	Y	Y
Ibsa Quinto (ESP)	8/6–21/7/99	Sp	-	-	-	-	-
Illa de Rua (URY)	8/4–28/6/99	Sp	-	-	-	-	-
Illa de Rua (URY)	1/7–17/7/99	Sp	-	-	-	-	-
Isla Camila (CHL)	11/4–22/6/99	Sp	-	-	-	-	Y
Isla Camila (CHL)	15/6–18/7/99	Sp	-	-	-	-	-
Isla Gorriti (URY)	8/5–12/6/99	A	-	-	-	-	-
Isla Gorriti (URY)	12/6–17/7/99	A	-	-	-	Y	-
Isla Sofía (CHL)	31/3–31/6/99	Sp	-	-	-	-	-
Isla Sofía (CHL)	28/6–22/7/99	Sp	-	-	-	-	-
Jacqueline (GBR)	11/4–21/7/99	Sp	-	-	-	-	-
Koryo Maru 11 (ZAF)	10/4–27/6/99	Sp	-	-	-	-	-
Koryo Maru 11 (ZAF)	30/6–4/8/99	Sp	-	-	-	-	-
Lyn (GBR)	9/4–14/6/99	Sp	-	-	-	-	-
Lyn (GBR)	17/6–20/7/99	Sp	N	-	Y	-	-
Magallanes III (GBR)	14/5–21/8/99	Sp	-	-	-	Y	-
No. 1 Moresko (KOR)	11/4–22/7/99	Sp	-	-	-	-	-
Tierra del Fuego (CHL)	17/6–25/7/99	Sp	-	-	-	-	-
Tierra del Fuego (CHL)	11/4–23/6/99	Sp	-	-	-	-	-
Zakhar Sorokin (RUS)	13/2–13/3/99	OTM	N	-		N	
Subareas 58.6 and 58.7							
Arctic Fox (ZAF)	21/9–14/11/99	A	-	-	-	Y	-
Arctic Fox (ZAF)	24/11–1/1/99	A	-	-	-	N	-
Arctic Fox (ZAF)	31/3–29/5/99	A	-	-	-	-	-
Arctic Fox (ZAF)	8/6–23/7/99	A	N	N	N	N	-
Eldfisk (ZAF)	2/10–1/11/98	A	-	-	-	-	Y
Eldfisk (ZAF)	1/5–23/6/99	A	-	-	Y	-	-
Koryo Maru 11 (ZAF)	3/11–28/12/98	Sp	N	-	N	Y	-
Koryo Maru 11 (ZAF)	5/1–5/2/99	Sp	N	-	N	Y	-
Koryo Maru 11 (ZAF)	6/2–24/3/99	Sp	-	-	N	N	-
Subarea 88.1							
Janas (NZL)	23/12/98–5/3/99	A	N	-	-	N	-
San Aotea II (NZL)	22/12/98–3/3/99	A	N	N	N	N	-
Division 58.5.2							
Austral Leader (AUS)	20/8–24/9/98	OTB	N	N	N	N	
Southern Champion (AUS)	27/9–11/11/98	OTB	N	N	N	N	
Southern Champion (AUS)	19/11/98–6/1/99	OTB	N	N	N	N	
Southern Champion (AUS)	13/1–3/3/99	OTB	N	N	N	N	
Southern Champion (AUS)	10/3–29/4/99	OTB	-	-	-	Y	
Southern Champion (AUS)	8/5–14/7/99	OTB	N	N	N	N	
Divisions 58.4.1, 58.4.3 and 58.5.2							
Austral Leader (AUS)	14/3–13/5/99	OTB	N	N	N	N	

Table 15: Marine mammal incidental mortality and interactions with fishing operations reported by observers. Nationality: AUS – Australia, CHL – Chile, ESP – Spain, GBR – United Kingdom, KOR – Republic of Korea, NZL – New Zealand, RUS – Russia, URY – Uruguay, ZAF – South Africa; Y – yes, N – No, DLP – dolphin, KIW – killer whale, SEA – Antarctic fur seal, SPW – sperm whale.

Vessel Name (Nationality)	Dates of Trip	Observation Reported	Mammal Killed	(Species) Entangled	Fish Loss Observed (Species)
Subarea 48.3					
Argos Helena (GBR)	10/4–30/7/99	Y	N	N	Y (KIW, SEA, SPW)
Argos Helena (GBR)	31/8–23/9/99	Y	N	N	N
Ibsa Quinto (ESP)	10/4–4/6/99	Y	N	N	Y (KIW)
Ibsa Quinto (ESP)	8/6–21/7/99	Y	N	N	Y (SEA, SPW)
Illa de Rua (URY)	8/4–28/6/99	Y	N	N	N
Illa de Rua (URY)	1/7–17/7/99	Y	N	N	Y (SPW)
Isla Camila (CHL)	11/4–22/6/99	Y	N	N	Y (KIW, SPW)
Isla Camila (CHL)	15/6–18/7/99	Y	N	N	Y (SEA, SPW)
Isla Gorriti (URY)	8/5–12/6/99	Y	N	N	N
Isla Gorriti (URY)	12/6–17/7/99	Y	N	N	Y (KIW)
Isla Sofía (CHL)	31/3–31/6/99	Y	N	Y (DLP)	Y (KIW, SEA)
Isla Sofía (CHL)	28/6–22/7/99	Y	N	N	N
Jacqueline (GBR)	11/4–21/7/99	Y	N	N	Y (KIW, SEA)
Koryo Maru 11 (ZAF)	10/4–27/6/99	Y	N	N	Y (KIW, SEA)
Koryo Maru 11 (ZAF)	30/6–4/8/99	Y	N	N	N
Lyn (GBR)	9/4–14/6/99	Y	N	N	Y (KIW)
Lyn (GBR)	17/6–20/7/99	Y	N	N	Y (KIW)
Magallanes III (CHL)	14/5–21/8/99	Y	N	N	Y (SPW, SEA)
No. 1 Moresko (KOR)	11/4–22/7/99	Y	N	N	Y (KIW, SPW)
Tierra del Fuego (CHL)	11/4–23/6/99	Y	N	N	Y (KIW, SEA)
Tierra del Fuego (CHL)	17/6–25/7/99	Y	N	N	Y (SEA, SPW, KIW)
Zakhar Sorokin (RUS)	13/2–13/3/99	Y	N	N	N
Subarea 58.6 and 58.7					
Arctic Fox (ZAF)	21/9–14/11/98	Y	N	N	Y (SPW, KIW)
Arctic Fox (ZAF)	24/11/98–1/1/99	Y	N	N	Y (KIW, SPW)
Arctic Fox (ZAF)	31/3–29/5/99	Y	N	Y (SPW)	Y (KIW, SPW)
Arctic Fox (ZAF)	8/6–23/7/99	Y	N	N	Y (KIW, SPW)
Eldfisk (ZAF)	2/10–1/11/98	Y	N	Y (SPW)	N
Eldfisk (ZAF)	1/5–23/6/99	Y	-	N	KIW SPW
Koryo Maru 11 (ZAF)	3/11–28/12/98	Y	N	N	N
Koryo Maru 11 (ZAF)	5/1–5/2/99	Y	N	N	N
Koryo Maru 11 (ZAF)	6/2–24/3/99	Y	N	N	Y
Subarea 88.1					
Janas (NZL)	23/12/98–5/3/99	Y	N	N	N
San Aotea II (NZL)	22/12/98–3/3/99	Y	N	N	N
Division 58.5.2					
Austral Leader (AUS)	20/8–24/9/98	Y	N	N	N
Southern Champion (AUS)	27/9–11/11/98	Y	Y (SEA)	Y	Y (SEA)
Southern Champion (AUS)	19/11/98–6/1/99	Y	N	N	N
Southern Champion (AUS)	13/1–3/3/99	Y	N	N	N
Southern Champion (AUS)	10/3–29/4/99	Y	N	N	N
Southern Champion (AUS)	8/5–14/7/99	Y	N	N	Y (SEA)
Divisions 58.4.1, 58.4.3 and 58.5.2					
Austral Leader (AUS)	14/3–13/5/99	Y	N	N	N

Table 16: Summary of compliance with Conservation Measure 29/XVI, based on data from scientific observers, for 1996/97, 1997/98 and 1998/99. Values in parentheses are % of observer records that were complete.

Subarea/ Time	Line Weighting (Spanish System Only)			Night Setting	Offal Discharge	Streamer Line Compliance (%)					Total Catch Rate (Birds/1 000 Hooks)	
	Compliance %	Median Weight (kg)	Median Spacing (m)	(% Night)	(%) Opposite Haul	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]
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
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

1 Includes daytime setting – and associated seabird by-catch – as part of line-weighting experiments on *Argos Helena* (WG-FSA-99/5).
2 Includes some daytime setting in conjunction with use of an underwater-setting funnel on *Eldfisk* (WG-FSA-99/42).
3 Conservation Measure 169/XVII allowed New Zealand vessels to undertake daytime setting south of 65°S in Subarea 88.1 to conduct a line-weighting experiment.

Table 17: Compliance with streamer line minimum specifications, as reported by scientific observers, in accordance with the specifications of Conservation Measure 29/XVI. Nationality: CHL – Chile, ESP – Spain, GBR – United Kingdom, KOR – Republic of Korea, NZL – New Zealand, URY – Uruguay, ZAF – South Africa; Fishing method: A – autoliner, Sp – Spanish system; Y – yes, N – no, - no information.

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									
Argos Helena (GBR)	10/4–30/7/99	Sp	N	Y (4.5)	N (120)	Y (35)	Y (2)	-	-
Ibsa Quinto (ESP)	10/4–4/6/99	Sp	N	Y (5)	Y (150)	N (4)	Y (5)	-	-
Ibsa Quinto (ESP)	8/6–21/7/99	Sp	Y	Y (5)	Y (150)	-	Y (1)	-	N
Illa de Rua (URY)	8/4–28/6/99	Sp	N	Y (4.8)	N (100)	Y (5)	Y (5)	-	Y
Illa de Rua (URY)	1/7–17/7/99	Sp	N	N (4)	N (125)	Y (8)	Y (5)	-	Y
Isla Camila (CHL)	11/4–22/6/99	Sp	N	Y (7)	N (60)	Y (25)	Y (2)	-	-
Isla Camila (CHL)	15/6–18/7/99	Sp	N	N (3)	Y (150)	Y (5)	Y (5)	-	-
Isla Gorriti (URY)	8/5–12/6/99	A	N	N (3)	Y (155)	Y (6)	Y (5)	-	Y
Isla Gorriti (URY)	12/6–18/7/99	A	N	Y (4.5)	N (35)	Y (5)	-	Y (5)	-
Isla Sofía (CHL)	31/3–25/6/99	Sp	N	Y (5.5)	N (85)	Y (19)	Y (4.5)	-	-
Isla Sofía (CHL)	28/6–22/7/99	Sp	N	Y (6.4)	N (78.5)	Y (21)	Y (3.3)	Y (3)	-
Jacqueline (GBR)	11/4–21/7/99	Sp	N	Y (5.5)	N (75)	Y (30)	Y (2)	N (0.5)	-
Koryo Maru 11 (ZAF)	10/4–27/6/99	Sp	Y	Y (4.5)	Y (150)	-	Y (5)	-	Y
Koryo Maru 11 (ZAF)	30/6–4/8/99	Sp	N	Y (5)	N (120)	Y (5)	Y (5)	-	-
Lyn (GBR)	9/4–14/6/99	Sp	N	Y (4.5)	N (80)	Y (26)	N (6)	Y (6)	Y
Lyn (GBR)	17/6–20/7/99	Sp	N	Y (4.5)	N (80)	Y (25)	Y (2.3)	-	N
Magallanes III (CHL)	14/5–21/8/99	Sp	N	Y (5)	N (25)	Y (5)	Y (4)	-	-
No. 1 Moresko (KOR)	11/4–22/7/99	Sp	N	Y (6)	N (51)	N (4)	Y (25)	-	Y
Tierra del Fuego (CHL)	11/4–23/6/99	Sp	N	Y (7.5)	N (45)	-	-	-	-
Tierra del Fuego (CHL)	17/6–25/7/99	Sp	N	N (3)	N (75)	Y (11)	Y (1.8)	-	-
Subareas 58.6 and 58.7									
Arctic Fox (ZAF)	21/9–14/11/98	A	Y	Y (12)	Y (150)	-	-	-	-
Arctic Fox (ZAF)	24/11/98–1/1/99	A	N	Y (4.5)	N (125)	Y (10)	Y (2.5)	-	-
Arctic Fox (ZAF)	31/3–29/5/99	A	N	Y (4.5)	N (125)	Y (10)	Y (2.5)	Y (3.5)	Y
Arctic Fox (ZAF)	8/6–23/7/99	A	N	Y (4.5)	N (100)	Y (7)	Y (5)	-	-
Eldfisk (ZAF)	2/10–1/11/98	A	N	-	N (120)	Y (7)	Y (4)	-	Y
Eldfisk (ZAF)	1/5–23/6/99	A	N	Y (5.5)	N (100)	Y (8)	Y (5)	-	Y

continued

Table 17 continued

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)	
Koryo Maru 11 (ZAF)	3/11–28/12/98	Sp	N	Y (4.5)	N (45)	Y (10)	Y (3)	-	Y
Koryo Maru 11 (ZAF)	5/1–5/2/99	Sp	N	Y (4.5)	N (45)	Y (10)	Y (3)	-	Y
Koryo Maru 11 (ZAF)	6/2–24/3/99	Sp	N	Y (8)	N (100)	Y (12)	Y (3)	N (0.2)	Y
Subarea 88.1									
Janas (NZL)	23/12/98–5/3/99	A	Y	Y (8)	Y (200)	Y (5)	Y (1.8)	-	Y
San Aotea II (NZL)	22/12/98–3/3/99	A	Y	Y (5)	Y (200)	Y (10)	Y (5)	-	-

Table 18: Summary of data on conversion factors collected by observers in the 1998/99 season.

Area/Subarea/ Division	No. of Vessels	No. of Cruises	No. of Hauls	No. of Fish in Sample Unit	No. of Sample Units
48.3	14	19	587	1	1 785
48.3*	1	1	56	1	205
48.3	2	2	19	2–5	19
48.3	2	2	5	6–15	5
48.3	3	3	14	16–29	14
48.3	2	2	21	>30	21
58.5.1	1	1	1	70	1
58.5.2	2	5	7	?	7
58.7	3	6	7	?	7
88	2	2	2	?	2

* All fish were headed, gutted and tailed with the exception of some fish in Subarea 48.3 which were headed and gutted.

Table 19: Comparisons of conversion factors determined by observers and used by vessels in reporting their catches in the 1998/99 season.

Area/Subarea/ Division	Difference (%)	Observer			Vessel		
		Mean	SD	n	Mean	SD	n
48.3	15	1.658	0.163	22	1.441	0.062	21
58.5.2	3	1.79	0.058	8	1.737	0.004	4
58.7	7	1.718	0.144	7	1.6	-	9
88	0	1.73	0.07	2	1.73*	0.07	2

* Figures determined by observers.

Table 20: Possible extent of under-reporting in Subarea 48.3.

Season	Total Catches Reported (tonnes)	Revised Catch Using Correction Factors
1996/97	3 812	4 163*
1997/98	3 328	3 727*
1998/99	3 652	4 197

* Factors taken from Table 13 of SC-CAMLR-XVII, Annex 5.

Table 21: History of new and exploratory fisheries within the Convention Area. Information was derived from STATLANT data, fine-scale data and/or catch and effort reports submitted by 29 September 1999. CM: Conservation Measure.

Area	Season	Type	CM	Catch Limit (tonnes)	Vessels	Vessel Days	Grids Fished	Reported Catch (tonnes)		Country
48.1	Longline fishery for *Dissostichus* spp. in Subarea 48.1									
	1997/98	New	134/XVI	1 957	1	14	12	1*	survey	Chile
	** pre-fishery survey – catch rate <0.1kg/hook – fishery not opened*									
48.2	Longline fishery for *Dissostichus* spp. in Subarea 48.2									
	1997/98	New	135/XVI	1 401	1	4	2	<1*		Chile
	** pre-fishery survey – catch rate < 0.1kg/hook – fishery not opened*									
48.3	Pot fishery for crab (Lithodidae) in Subarea 48.3									
	1992/93	Exploratory	60/XI	1 600				0	no fishing	
	1993/94	Exploratory	74/XII	1 600				0	no fishing	
	1994/95	Exploratory	79/XIII	1 600	1	60*	?	137		USA
	1995/96	Exploratory	91/XIV	1 600	1	90*	?	497		USA
	1996/97	Exploratory	104/XV	1 600				0	no fishing	
	1997/98	Exploratory	126/XVI	1 600				0	no fishing	
	1998/99	Exploratory	151/XVII	1 600	1	13	?	4		UK
	** assuming 10 vessel days per 10-day reporting period (SC-CAMLR-XV, Annex 5, Table 19)*									
48.3	Jig fishery for *Martialia hyadesi* in Subarea 48.3									
	1995/96	Survey			1	7	?	52		Republic of Korea
	1996/97	New	99/XV	2 500	1	19	2	81		Republic of Korea*, UK
	1997/98	Exploratory	145/XVI	2 500				0	no fishing	Republic of Korea, UK
	1998/99	Exploratory	165/XVII	2 500				0	no fishing	
	** fished*									
48.6	Longline fishery for *Dissostichus* spp. in Subarea 48.6									
	1996/97	New	114/XV	1 980				0	no fishing	South Africa
	1997/98	New	136/XVI	1 536				0	no fishing	Norway, South Africa
	1998/99	New	162/XVII	1 202	1	3	1	0		South Africa
58.4.1	Trawl fishery for *Dissostichus* spp. in Division 58.4.1									
	1998/99	Exploratory	166/XVII	261	1	7	5	<1		Australia

continued

Table 21 continued

Area	Season	Type	CM	Catch Limit (tonnes)	Vessels	Vessel Days	Grids Fished	Reported Catch (tonnes)		Country
58.4.3	Trawl fishery for *Dissostichus* spp. in Division 58.4.3									
	1995/96	New	88/XIV	200				0	no fishing	Australia
	1996/97	New	113/XV	1 980*	1	5	5	<1		Australia, South Africa**
	1997/98	Exploratory	144/XVI	963				0	no fishing	Australia
	1998/99	Exploratory	167/XVII	625	1	15	10	<1		Australia
	** combined catch limit for trawl and longline fisheries ** did not fish*									
58.4.3	Longline fishery for *Dissostichus* spp. in Division 58.4.3									
	1996/97	New	113/XV	1 980*				0	no fishing	Australia, South Africa
	1997/98	New	137/XVI	1 782				0	no fishing	South Africa
	1998/99	New	163/XVII	700				0	no fishing	France
	** combined catch limit for trawl and longline fisheries*									
58.4.4	Longline fishery for *Dissostichus eleginoides* in Division 58.4.4									
	1997/98	New	138/XVI	580				0	no fishing	South Africa, Ukraine
	1998/99	New	164/XVII	572				0	no fishing	France, South Africa, Spain, Uruguay
58.5.2	Trawl fishery for deep-water species in Division 58.5.2									
	1995/96	New	89/XIV	50*	2**	?	?	<1		Australia
	1996/97	New	111/XV	50*				0	no fishing	Australia
	** per species ** fishing operation combined with target fishery for Dissostichus*									
58.6	Longline fishery for *Dissostichus eleginoides* in Subarea 58.6 (except for waters adjacent to Crozet Islands and the Prince Edward Islands)									
	1996/97	New	116/XV	2 200				0	no fishing	South Africa
	1997/98	Exploratory	141/XVI	658	1	1	1	1		South Africa*, Russia, Ukraine
	1998/99	Exploratory	168/XVII	1 555				0	no fishing	South Africa, France
	** fished*									
58.7	Longline fishery for *Dissostichus eleginoides* in Subarea 58.7 (except for waters adjacent to the Prince Edward Islands)									
	1996/97	New	116/XV	2 200				0	no fishing	South Africa
	1997/98	Exploratory	142/XVI	312	1	2	2	<1		South Africa*, Russia, Ukraine
	1998/99	Ban on fishing	160/XVII	0				0	no fishing	
	** fished*									

continued

Table 21 continued

Area	Season	Type	CM	Catch Limit (tonnes)	Vessels	Vessel Days	Grids Fished	Reported Catch (tonnes)		Country
88.1	Longline fishery for *Dissostichus* spp. in Subarea 88.1									
	1996/97	New	115/XV	1 980	1	2	1	<1		New Zealand
	1997/98	Exploratory	143/XVI	1 510	1	29	27	39		New Zealand
	1998/99	Exploratory	169/XVII	2 281	2	76	38	298		New Zealand
88.2	Longline fishery for *Dissostichus* spp. in Subarea 88.2									
	1996/97	New	115/XV	1 980	1	1	1	<1		New Zealand
	1997/98	New	139/XVI	63				0	no fishing	New Zealand
88.3	Longline fishery for *Dissostichus* spp. in Subarea 88.3									
	1997/98	New	140/XVI	455	1	12	10	<1		Chile

Table 22: Data requirements for CCAMLR fisheries in 1998/99, as defined by conservation measures. TAC – catch and effort report, C – fine-scale catch and effort data, B – fine-scale biological data, Obs – observer logbooks and reports. Note: In addition, Member countries must submit STATLANT data for each split-year, including separate recordings of effort data for finfish and krill operations (e.g. CCAMLR-IV, paragraph 45b(ii); CCAMLR-XII, paragraph 4.18).

Fishery	Status	Gear	Target Species	Area	Types of Data			
					TAC	C	B	Obs
153/XVII		Trawl	*Champsocephalus gunnari*	48.3	51/XII	122/XVI*	121/XVI	153/XVII
159/XVII		Trawl	*Champsocephalus gunnari*	58.5.2	159/XVII	159/XVII	159/XVII	159/XVII
154/XVII		Longline	*Dissostichus eleginoides*	48.3	51/XII	122/XVI*	121/XVI	154/XVII
168/XVII	Exploratory	Longline	*Dissostichus eleginoides*	58.6	51/XII	122/XVI	121/XVI	161/XVII*
158/XVII		Trawl	*Dissostichus eleginoides*	58.5.2	158/XVII	158/XVII	158/XVII	158/XVII
164/XVII	New	Longline	*Dissostichus eleginoides*	58.4.4	51/XII	122/XVI	121/XVI	161/XVII*
156/XVII		Longline	*Dissostichus* spp.	48.4	51/XII	122/XVI*	121/XVI	156/XVII
162/XVII	New	Longline	*Dissostichus* spp.	48.6	51/XII	122/XVI	121/XVI	161/XVII*
166/XVII	Exploratory	Trawl	*Dissostichus* spp.	58.4.1	51/XII		121/XVI	167/XVII*
163/XVII	New	Longline	*Dissostichus* spp.	58.4.3	51/XII	122/XVI	121/XVI	161/XVII*
167/XVII	Exploratory	Trawl	*Dissostichus* spp.	58.4.3	51/XII		121/XVI	167/XVII*
169/XVII	Exploratory	Longline	*Dissostichus* spp.	88.1	51/XII	122/XVI	121/XVI	161/XVII*
155/XVII		Trawl	*Electrona carlsbergi*	48.3	40/X	122/XVI	121/XVI	
32/X		Trawl	*Euphausia superba*	48	32/X	32/X		
106/XV		Trawl	*Euphausia superba*	58.4.1	106/XV	106/XV		
45/XIV		Trawl	*Euphausia superba*	58.4.2	45/XIV	45/XIV		
165/XVII	Exploratory	Jig	*Martialia hyadesi*	48.3	61/XII	165/XVII		165/XVII
150/XVII	Exploratory	Pot	Crab	48.3	61/XII	151/XVII (Annex)	151/XVII (Annex)	150/XVII

* Reported on a haul-by-haul basis.

Table 23: Summary of notifications of new and exploratory fisheries in 1999/2000.

Member	Type of fishery[1]	Gear	Target Species	Subarea or Division[2]
Australia	New	Trawl	*Dissostichus* spp., *Chaenodraco wilsoni*, *Lepidonotothen kempi*, *Trematomus eulepidotus*, *Pleuragramma antarcticum*	58.4.2
Australia	Exploratory	Trawl	*Dissostichus* spp.	58.4.1 and 58.4.3
Chile	Exploratory	Longline	*Dissostichus* spp.	58.4.4, 58.5.1, 58.6, 88.1 and 88.2
France	New and exploratory	Longline	*Dissostichus* spp.	58.4.3, 58.4.4, 58.5.1, 58.5.2, 58.6 and 58.7
New Zealand	Exploratory	Longline	*Dissostichus* spp.	88.1
South Africa	New	Longline	*Dissostichus* spp.	48.6 and 58.4.4
South Africa	Exploratory	Longline	*Dissostichus eleginoides*	58.6
Uruguay	New	Longline	*Dissostichus* spp.	58.4.4
European Community (Portugal)	New and exploratory	Longline	*Dissostichus eleginoides*	48.6, 58.4.3, 58.4.4, 58.5.1, 58.6, 88.1 and 88.2

1 Some fisheries may be considered as exploratory if new fisheries are conducted in 1998/1999.
2 Outside Australian, South African and/or French EEZs.

Table 24: Seabed areas between 500 and 1 800 m and within the fishable depth ranges for trawling (500–1 500 m) and longlining (600–1 800 m) in Subareas 48.3, 48.6, 58.6, 58.7, 88.1, 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3, 58.4.4, 58.5.1 and 58.5.2. See WG-FSA-98/6 and 98/50 for the methodologies. Excludes regions of permanent ice, including the Ross Sea ice shelf in Subarea 88.1 and Amery ice shelf in Division 58.4.2.

Area/ Subarea/ Division	Region	Fishery Proposed	Species	Seabed Areas (km^2)					
				Depth Range (m)				Fishing Depth Range (m)	
				0–500	500–600	600–1500	1500–1800	500–1500	600–1800
48.3[1]	Maurice Ewing Bank (North of 52.3°S)	Y	*D. eleginoides*	*	0	12 739	21 869	12 739	34 608
	South Georgia	Y	*D. eleginoides*	*	2 415	21 320	10 705	23 735	32 025
	Total			42 400	2 415	34 059	32 574	36 474	66 633
48.6	North of 60°S	Y	*D. eleginoides*	*	244	10 452	17 618	10 696	28 070
	South (60°S–72°S)	Y	*D. mawsoni*	*	6 974	36 868	19 278	43 842	56 146
	Total (to 72°S)			133 861	7 218	47 320	36 896	54 538	84 216
58.4.1	BANZARE Bank	Y	*D. eleginoides*	0	0	14 401	40 766	14 401	55 167
	Outside BANZARE Bank		*D. eleginoides*	0	43 524	198 567	77 410	242 091	275 977
	Total			0	43 524	212 968	118 176	256 492	331 144
58.4.2	62°S–72°S	Y	*D. mawsoni*	210 355	29 839	99 220	22 037	129 059	121 257
58.4.3	Inside EEZ	Y	*D. eleginoides*	101	0	0	3 053	0	3 053
	Outside EEZ			0	203	48 694	45 097	48 897	93 791
	Total			101	203	48 694	48 150	48 897	96 844
58.4.4	Total		*D. eleginoides*	7 499	1 721	15 587	7 156	17 308	22 743
58.5.1	Inside EEZ	Y	*D. eleginoides*	*	31 382	85 523	32 551	116 905	118 074
	Outside EEZ	Y	*D. eleginoides*	*	34	2 938	3 416	2 972	6 354
	Total			117 768	31 416	88 461	35 967	119 877	124 428
58.5.2	Inside EEZ (AUS)	Y	*D. eleginoides*	46 627	10 960	81 827	28 196	92 787	110 023
	Outside EEZ (AUS)	Y	*D. eleginoides*	0	14	629	454	643	1 083
	Total			46 627	10 974	82 456	28 650	93 430	111 106

continued

Table 24 continued

Area/ Subarea/ Division	Region	Fishery Proposed	Species	Seabed Areas (km²)					
				Depth Range (m)				Fishing Depth Range (m)	
				0–500	500–600	600–1500	1500–1800	500–1500	600–1800
58.6	Delcano Rise outside EEZ (SA)	Y	*D. eleginoides*	*	169	8 450	19 313	8 619	27 763
	Delcano Rise inside EEZ (SA)	Y	*D. eleginoides*	*	245	8 065	17 355	8 310	25 420
	Crozet Islands outside EEZ (FRA)	Y	*D. eleginoides*	*	0	0	0	0	0
	Crozet Islands inside EEZ (FRA)	Y	*D. eleginoides*	*	1 550	13 041	5 071	14 591	18 112
	Total			18 148	1 964	29 556	41 739	31 520	71 295
58.7	Outside EEZ	Y	*D. eleginoides*	*	0	76	427	3 741	6 445
	Inside EEZ	Y	*D. eleginoides*	*	273	6 547	5 605	3 155	6 210
	Total			1 650	273	6 623	6 032	6 896	12 655
88.1	North of 65°S	Y	*D. eleginoides*	0	0	3168	7 670	3 168	10 838
	65°S–80°S	Y	*D. mawsoni*	202 022	114 973	197 114	39 277	312 087	236 391
	Total			202 022	114 973	200 282	46 947	315 255	247 229
88.2	North of 65°S	Y	*D. eleginoides*	0	26	299	0	325	299
	65°S–72°S[2]	Y	*D. mawsoni*	1 246	1 794	19 544	11 442	21 338	30 986
	Total			1 246	1 820	19 843	11 442	21 663	31 285

[1] Everson and Campbell depth estimates for Subarea 48.3 not utilised in this assessment.
[2] Does not include seabed areas south of 72°S which are not covered by the Sandwell–Smith database.
* Not calculated.

Table 25: Catch rates (kg/hook) by species, weighted by the number of hooks set in each region, by subarea and division, and the proportions these represent of the 1991/92 catch rate in Subarea 48.3.

Area	Years	Hooks	Species	Catch (kg)	CPUE (kg/hook)	Proportion of Subarea 48.3
48.3	1992	6 075 371	*D. eleginoides*	3 799 551	0.50	1.00
48.6	1997	12 350	*D. eleginoides*	494	0.04	0.09
58.5.1	1997	1 281 600	*D. eleginoides*	449 518		
	1998	3 348 317	*D. eleginoides*	1 117 152		
					0.33	0.66
58.6	1997	430 780	*D. eleginoides*	206 352		
	1998	1 595 430	*D. eleginoides*	623 459		
					0.30	0.60
58.7	1997	3 762 390	*D. eleginoides*	1 869 233		
	1998	2 946 651	*D. eleginoides*	639 513		
					0.37	0.74
88.1	1998	241 000	*D. mawsoni*	40 971		
	1999	1 400 824	*D. mawsoni*	296 236		
					0.20	0.39
58.4.4	1997	38 550	*D. eleginoides*	13 879	0.36	0.72

Table 26: Parameters input to the GYM for evaluation of long-term annual yield of exploratory fisheries for *D. eleginoides* and *D. mawsoni*. Requirements for GYM assessments are discussed in the text and the combinations of parameters (biological, recruitment, CPUE, seabed area) are given in Table 27. Parameters given here are for assessments of *D. eleginoides* requiring the adaptation for a longline fishery of biological parameters and recruitments from Division 58.5.2, and for assessments of *D. mawsoni* for exploratory longline fisheries and exploratory trawl fisheries. In the latter two cases, recruitments have been pro-rated by the fishable seabed area and the recruitment area respectively. Assessments requiring biological parameters and recruitments directly estimated from Subarea 48.3 longline fisheries and Division 58.5.2 trawl fisheries are given in Table 39.

Category	Parameter	*D. eleginoides* Division 58.5.2 Longline (outside EEZ)	*D. mawsoni* Subarea 88.1 Longline Total Fishing Area	*D. mawsoni* Division 58.4.2 Trawl Recruitment Area
Age structure	Recruitment age	4	4	4
	Plus class accumulation	35	35	35
	Oldest age in initial structure	55	55	55
Recruitment	Mean $\log_e$(recruits)	14.9285	15.888	16.435
	SE of mean $\log_e$(recruits)	0.2593	0.2528	0.259
	SD $\log_e$(recruits)	0.935	0.8385	0.935
Natural mortality	Mean annual M	0.0828–0.1242	0.18–0.22	0.18–0.22
von Bertalanffy growth	Time 0	-1.7969	-0.015	-0.015
	L_∞	1 946.0	182.9	182.9
	k	0.04136	0.089	0.089
Weight at age	Weight–length parameter – A	2.59E-09	0.000006	0.000006
	Weight–length parameter – B	3.2064	3.1509	3.1509

continued

Table 26 continued

Category	Parameter	*D. eleginoides* Division 58.5.2 Longline (outside EEZ)	*D. mawsoni* Subarea 88.1 Longline Total Fishing Area	*D. mawsoni* Division 58.4.2 Trawl Recruitment Area
Maturity	L_{m50}		100.0	100.0
	Range: 0 to full maturity		10.0	10.0
	Maturity at age	0(0), 4.6(0), 5.4(0.005), 6.2(0.009), 7.1(0.025), 8.0(0.048), 9.0(0.066), 10.0(0.129), 11.0(0.150), 12.1(0.202), 13.2(0.296), 14.4(0.389), 15.6(0.677), 16.9(0.8), 18.3(0.909), 19.8(0.923), 23.0(1.0)		
Spawning season		01/07	01/08	01/08
Simulation characteristics	Number of runs in simulation	1 001	1 001	1 001
	Depletion level	0.2	0.2	0.2
	Seed for random number generator	-24 189	-24 189	-24 189
Characteristics of a trial	Years to remove initial age structure	1	1	1
	Observations to use in median SB_0	1 001	1 001	1 001
	Year prior to projection	1998	1997	1997
	Reference start date in year	01/11	01/12	01/12
	Increments in year	180	180	180
	Vector of known catches		0.039e6 0.298e6	
	Years to project stock in simulation	35	35	35
	Reasonable upper bound for annual F	5.0	5.0	5.0
	Tolerance for finding F in each year	0.000001	0.000001	0.000001
Fishing mortality	Length, 50% recruited	67.0	0.0	0.0
	Range over which recruitment occurs	24.0	0.0	0.0
	Fishing selectivity with age	0(1)	0(0), 5.27(0), 5.28(1), 16.27(1), 16.28(0)	0(0), 5(0.4), 6(0.7), 7.5(0.88), 8(0.9), 8.5(0.8), 10(0.3), 12(0.01), 16(0.005), 30(0)

Table 27: Assessment of long-term annual yields for new and exploratory fisheries for *D. eleginoides* and *D. mawsoni*. Approximate estimates are given in italics. Estimates in bold are derived from projections using the GYM. See text for details about how the approximate estimates were derived. Input parameters for the GYM are contained in Table 39 for respective longline and trawl fisheries from Subarea 48.3 and Division 58.5.2. Mean $\log_e$(recruits) were determined by adjusting the mean recruitment for South Georgia or Heard Island by the relative size of seabed area and, for longline fisheries that had CPUE estimates, the relative magnitude of CPUE compared to South Georgia. In the latter case, recruitments from South Georgia were applied. For other fisheries in the Indian Ocean, recruitments from Heard Island were applied. The origin of biological parameters is given. T – trawl, L – longline, E – *D. eleginoides*, M – *D. mawsoni*.

Subarea/ Division	Fishing Method	Species	Origin of Biological Parameters	Recruitment Area[1]	Fishing Area[2]	Catch History (tonnes) 1996, 1997, 1998, 1999	Mean Longline CPUE	Mean $\log_e$(recruits)			Yield Estimate (tonnes)		
								Seabed Only	Seabed and CPUE		Seabed Only	Seabed and CPUE	
								Fishing Ground	Recruitment Ground	Fishing Ground	Fishing Ground	Recruitment Ground	Fishing Ground
48.6	L	E	48.3		28070		0.04		12.147	11.23153	*2237*	**453**	**179**
48.6	L	M	88.1	133861	56146		0.04		12.84026	11.92479	*5142*	*1028*	*411*
58.4.1	T	E	58.5.2	0	14401			15.93837			*27870*		
58.4.2	T	M	88.1	210355	129059				16.4351	15.25155		**30394**	*9306*
58.4.3	L	E	58.5.2	0	93791			14.964			*7124*		
58.4.3	T	E	58.5.2	0	48897			14.28099			*94624*		
58.4.4	L	E	58.5.2	7499	22743	0, 0, 0, 1845	0.36		12.56088	13.21831		**746**	**1525**
58.5.1[3]	L	E	58.5.2		6354			15.17774			*482*		
58.5.2[3]	L	E	58.5.2	0	1083			14.92849			*80*		
58.6	L	E	58.5.2	18148	71295	9531, 19233, 2726, 2987	0.3	14.68939	13.26235	14.17856	*5878*	**1410**	**3526**
58.7	L	E	58.5.2	1650	12655	6137, 6951, 1611, 330	0.37	12.96061	11.07428	12.65951	*2250*	*184*	**900**
88.1	L	M	88.1	205022	236391	0, 0, 39, 298	0.2	15.88805	15.28144	14.97176	**21570**	**11690**	**8639**
88.1	L	E	58.5.2	0	10838		0.2	12.80562		11.88933	*1042*	*0*	*417*
88.2	L	M	88.1	1246	30986		0.2		10.17826	12.93981		*72*	*1135*
Reference details													
58.5.2	T	E	58.5.2	46627	93430			14.929	14.929	14.929	**3585**		
58.5.2	L	E			111106								
48.3	L	E	48.3	42400	66633		0.5	14.622	14.622	14.622	**5310**		

[1] 0 to 500 m
[2] 500 to 1 500 m depth in the trawl fishery and 600 to 1 800 m in the longline fishery
[3] Outside EEZ

Table 28: The coordinates of eight fishing grounds in Subareas 58.6, 58.7 and Division 58.4.4 (Figure 2).

Grid	Grid Coordinates				Length (n miles)		Seabed Area (km^2)
	Top Left Latitude	Top Left Longitude	Bottom Right Latitude	Bottom Right Longitude	Top	Side	0–2 000 m
1	-45	37	-48	40	130	180	33 921
2	-45	40	-48	44	170	180	33 918
3	-45	44	-48	48	170	180	39 213
4	-45	48	-48	51	130	180	25 367
5	-45	51	-48	54	130	180	13 232
6	-51	40	-54	42	80	180	4 031
7	-51	42	-54	46	150	180	14 180
8	-51	46	-54	50	150	180	7 749

Table 29: Estimation of sample sizes required to detect a proportional difference in sqrt(CPUE.kg) using a two-sided 5% test with power 0.8

Proportional Difference	Sample Size
0.05	362
0.07	161
0.10	91
0.15	41
0.20	23
0.25	15
0.30	11
0.35	8
0.40	6
0.45	5
0.50	54

Table 30: By-catch reported from longline fisheries targeting *Dissostichus* spp. during the 1998/99 season. TAC: catch and effort reports; OBS: observer data; C2: haul-by-haul longline data.

Subarea	By-catch (tonnes)		
	TAC	OBS	C2
48.3	27.4	85.1	41.1
Prince Edward Island EEZ (58.6 and 58.7)	62.0	57.3	no data
88.1	65.8	66.9	65.0

Table 31: Overall species composition of by-catch reported in the haul-by-haul data from longline fisheries in the 1998/99 season. The relative abundance of each taxon is expressed as the percentage by weight of the total catch.

Family	Species	% in Catch 48.3	58.6	58.7	88.1	Total
Lamnidae	*Lamna nasus*	0.01				0.01
Total Lamnidae		**0.01**				**0.01**
Rajidae	*Raja georgiana*	0.05			3.36	0.48
	Bathyraja eatonii	<0.01	0.02		0.29	0.04
	Bathyraja irrasa	<0.01				<0.01
	Bathyraja murrayi	0.02	1.46	0.13	<0.01	0.13
	Bathyraja spp.	<0.01			0.94	0.13
	Raja spp.			0.01	6.37	0.84
	Rajidae nei	0.69	0.13	0.16	<0.01	0.54
Total Rajidae		**0.76**	**1.60**	**0.30**	**10.96**	**2.16**
Other *Chondrichthyes*	Chondrichthyes nei	<0.01	0.63	0.11	<0.01	0.05
Total Other Chondrichthyes		**<0.01**	**0.63**	**0.11**	**<0.01**	**0.05**
Channichthyidae	*Pseudochaenichthys georgianus*	<0.01				<0.01
	Channichthyidae nei	<0.01			0.05	0.01
Total Channichthyidae		**<0.01**			**0.05**	**0.01**
Macrouridae	*Macrourus berglax*	<0.01				<0.01
	Macrourus carinatus	<0.01			5.54	0.74
	Macrourus holotrachys	0.03				0.02
	Macrourus spp.	0.89	4.87	10.20	0.28	1.38
	Macrourus whitsoni	<0.01	5.53	1.46	0.35	0.52
Total Macrouridae		**0.93**	**10.39**	**11.66**	**6.17**	**2.66**
Moridae	*Antimora rostrata*	0.07	1.55	0.99	0.01	0.20
Total Moridae		**0.07**	**1.55**	**0.99**	**0.01**	**0.20**
Muraenolepididae	*Muraenolepis microps*	<0.01			1.18	0.16
	Muraenolepis orangiensis				0.01	<0.01
	Muraenolepis spp.	<0.01	0.02	<0.01		<0.01
Total Muraenolepididae		**<0.01**	**0.02**	**<0.01**	**1.19**	**0.16**
Nototheniidae	*Notothenia kempi*	0.03				0.02
	Notothenia neglecta	<0.01				<0.01
	Notothenia squamifrons	<0.01				<0.01
	Nototheniops larseni			<0.01		<0.01
	Pagothenia hansoni				<0.01	<0.01
	Patagonotothen brevicauda	0.01				0.01
	Trematomus spp.		0.01	<0.01		<0.01
	Nototheniidae	0.01			0.01	0.01
Total Nototheniidae		**0.04**	**0.01**	**0.01**	**0.02**	**0.04**
Other Osteichthyes	Osteichthyes nei	0.01	<0.01	0.02	<0.01	0.01
Total Other Osteichthyes		**0.01**	**0.00**	**0.02**	**<0.01**	**0.01**
Lithodidae	*Lithodes murrayi*	0.02	0.03	0.01		0.01
	Paralithodes spp.		0.05	0.10		0.01
	Paralomis aculeata	0.04				0.03
	Lithodidae	0.01	<0.01		<0.01	0.01
Total Lithodidae		**0.07**	**0.09**	**0.12**	**<0.01**	**0.06**
Total Chondrichthyes		0.77	2.23	0.41	10.96	2.22
Total Ostheichthyes		1.05	11.97	12.67	7.44	3.07
Total Crustaceans		0.07	0.09	0.12	<0.01	0.06
Total		**1.89**	**14.29**	**13.19**	**18.39**	**5.36**

Table 32: Standardised series of CPUEs in kg/hook.

Season	Std. CPUE	SE
1991/92	0.441	0.034
1993/94	0.548	0.038
1994/95	0.541	0.022
1995/96	0.334	0.016
1996/97	0.267	0.015
1997/98	0.255	0.015
1998/99	0.271	0.015

Table 33: Proportions of non-zero catches by season.

Season	Proportion
1991/92	0.96
1993/94	0.94
1994/95	0.99
1995/96	0.98
1996/97	0.98
1997/98	0.98
1998/99	0.99

Table 34: Standardised series of CPUEs in numbers/hook.

Season	Std. CPUE	SE
1991/92	0.043	0.0044
1993/94	0.058	0.0052
1994/95	0.072	0.0032
1995/96	0.044	0.0022
1996/97	0.038	0.0023
1997/98	0.039	0.0023
1998/99	0.051	0.0025

Table 35: Trawl surveys from which length-density distributions were generated at this meeting.

Split-year	Survey	Vessel	Timing
1986/87	US/Polish	*Profesor Siedlecki*	November/December 1986
1987/88	US/Polish	*Profesor Siedlecki*	December 1987–January 1988
1989/90	UK	*Hill Cove*	January 1990
	USSR	*Anchar*	April–June 1990
1990/91	UK	*Falklands Protector*	January 1991
1991/92	UK	*Falklands Protector*	January 1992
1993/94	UK	*Cordella*	January–February 1994
	Argentina	*Dr Eduardo L. Holmberg*	February–March 1994
1994/95	Argentina	*Dr Eduardo L. Holmberg*	February–March 1995
1995/96	Argentina	*Dr Eduardo L. Holmberg*	March–April 1996
1996/97	Argentina	*Dr Eduardo L. Holmberg*	March–April 1997
1996/97	UK	*Argos Galicia*	September 1997

Table 36: Estimates of mean length (mm) and total density (numbers per km^2) for mixtures of normal distributions fitted to survey length-density distributions from surveys over the period 1986/87 to 1996/97 (assuming a split-year of 1 December to 30 November).

Survey	Nominal Age >>>	3	4	5	Sum of Observed Densities	Sum of Expected Densities
1987 US/Polish survey Nov–Dec 1986	mean length (mm)	380.27	465.945		49.7674	47.2886
	SD	19.4485	31.5855			
	total density (numbers per km^2)	20.4784	26.9235			
	SE	7.08769	4.42636			
1988 US/Polish survey Dec 1987–Jan 1988	mean length (mm)		467.821	560	21.3409	22.0951
	SD		41.3527	34.0006		
	total density (numbers per km^2)		14.4966	8.66871		
	SE		11.2833	12.5805		
1990 UK survey Jan 90	mean length (mm)	414.192	483.01	581.52	468.472	473.282
	SD	15.9212	22.693	34.9999		
	total density (numbers per km^2)	165.111	195.885	85.0901		
	SE	116.813	105.115	42.0315		
1991 UK survey Jan 91	mean length (mm)				578.823	199.007
	SD					
	total density (numbers per km^2)					
	SE					
1992 UK survey Jan 92	mean length (mm)	406.782			287.62	281.167
	SD	23.9804				
	total density (numbers per km^2)	281.373				
	SE	174.354				
1994 UK survey Jan–Feb 1994	mean length (mm)	444.837	521.726		122.462	125.88
	SD	13.9903	25.6162			
	total density (numbers per km^2)	36.2709	89.8471			
	SE	20.0802	32.6139			
1994 Argentine survey Feb–March 1994	mean length (mm)	469.404	529.3		48.029	49.578
	SD	1.73907	33.6715			
	total density (numbers per km^2)	2.61879	47.3539			
	SE	2.65314	9.32859			

continued

Table 36 continued

Survey	Nominal Age >>>	3	4	5	Sum of Observed Densities	Sum of Expected Densities
1995 Argentine survey Feb–March 1995	mean length (mm)	409.814	497.163	580	60.5409	65.5784
	SD	10.8096	29.858	39.3591		
	total density (numbers per km^2)	8.25306	21.9359	35.7098		
	SE	5.16069	9.22319	8.83209		
1996 Argentine survey March–April 1996	mean length (mm)	424.455	524.006	602.158	167.895	167.867
	SD	19	19	19		
	total density (numbers per km^2)	114.138	18.0444	22.2229		
	SE	39.7255	5.33346	6.7232		
1997 Argentine survey March–April 1997	mean length (mm)	426.46	500.479	573.708	122.912	124.561
	SD	19	19	19		
	total density (numbers per km^2)	26.3148	46.2928	16.3421		
	SE	8.31875	13.4333	6.77879		
1997 UK survey Sep 97	mean length (mm)	457.893	542.762	627.077	100.425	111.622
	SD	24.7427	29.9999	20.0001		
	total density (numbers per km^2)	52.9244	45.7511	13.6754		
	SE	32.2021	33.2331	16.6639		

Table 37: Estimated abundance at age (millions of fish) from a series of trawl surveys carried out at South Georgia.

Survey	Age 3		Age 4		Age 5	
	Numbers	SE	Numbers	SE	Numbers	SE
1987 US/Polish survey	0.883	0.306	1.162	0.191		
1988 US/Polishsurvey			0.574	0.447	0.343	0.498
1990 UK survey	6.700	4.740	7.948	4.265	3.453	1.705
1991 UK survey						
1992 UK survey	11.799	7.311				
1994 UK survey	1.446	0.801	3.583	1.301		
1994 Argentine survey	0.104	0.105	1.881	0.370		
1995 Argentine survey	0.312	0.195	0.830	0.349	1.351	0.334
1996 Argentine survey	4.680	1.629	0.740	0.219	0.911	0.276
1997 Argentine survey	1.064	0.336	1.873	0.543	0.661	0.274
1997 UK survey	1.952	1.188	1.687	1.226	0.504	0.615

Table 38: Recruitment to the stock of *D. eleginoides* in the Subarea 48.3 as numbers of fish at age 4, estimated from trawl surveys at South Georgia.

Split-year of Survey (1 December–30 November)	Weighted Mean Recruitments (age 4 in millions)
1986/87	1.146
1987/88	0.722
1988/89	4.106
1989/90	8.055
1990/91	5.786
1991/92	no estimate
1992/93	10.19
1993/94	2.061
1994/95	0.961
1995/96	0.701
1996/97	2.649
1997/98	1.119

Table 39: Input parameters for generalised yield model to assess the long-term annual yield of *D. eleginoides* taken by longline in Subarea 48.3 and trawl in Division 58.5.2.

Category	Parameter	Subarea 48.3 Longlining	Division 58.5.2 Trawling
Age structure	Recruitment age	4	4
	Plus class accumulation	35	35
	Oldest age in initial structure	55	55
Recruitment	Mean $\log_e$(recruits)	14.622	14.929
	SE of mean $\log_e$(recruits)	0.242	0.259
	SD $\log_e$(recruits)	0.839	0.935
Natural mortality	Mean annual M	0.132–0.198	0.0828–0.1242
von Bertalanffy growth	Time 0	-0.21	-1.7969
	L_∞	194.6	1946.0
	k	0.066	0.04136
Weight at age	Weight-length parameter – A	0.000025	2.59E-09
	Weight-length parameter – B	2.8	3.2064
Maturity	L_{m50}	93.0	
	Range: 0 to full maturity	78–108	
	Maturity at age		0(0), 4.6(0), 5.4(0.005), 6.2(0.009), 7.1(0.025), 8.0(0.048), 9.0(0.066), 10.0(0.129), 11.0(0.150), 12.1(0.202), 13.2(0.296), 14.4(0.389), 15.6(0.677), 16.9(0.8), 18.3(0.909), 19.8(0.923), 23.0(1.0)
	Length, 50% are mature		
	Range over which maturity occurs	30.0	
Spawning season		1 Aug–1 Aug	1 Jul–1 July
Simulation characteristics	Number of runs in simulation	1001	1001
	Depletion level	0.2	0.2
	Seed for random number generator	-24189	-24189
Characteristics of a trial	Years to remove initial age structure	1	1
	Observations to use in median SB_0	1001	1001
	Year prior to projection	1988	1996
	Reference start date in year	01/12	01/11
	Increments in year	180	180
	Vector of known catches	8.501e6 4.206e6 7.309e6 5.589e6 6.605e6 6.171e6 4.362e6 2.619e6 3.201e6 4.3e6	18.96e6 3.913e6 3.628e6
	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

continued

Table 39 continued

Category	Parameter	Subarea 48.3 Longlining	Division 58.5.2 Trawling
Fishing mortality	Length, 50% recruited	67.0 cm	
	Range over which recruitment occurs	55–79 cm	
	Fishing selectivity with age		0(0.), 3(0), 3.92(0.016), 4.88(0.207), 5.54(0.473), 5.88(0.512), 6.57(0.708), 7.29(0.886), 7.65(0.909), 8.02(0.745), 8.40(0.691), 8.78(0.642), 9.56(0.485), 9.96(0.325), 10.37(0.222), 11.2(0.099), 11.63(0.066), 12.07(0.049), 12.51(0.033), 13.43(0.014), 14.87(0.011), 16.40(0.008), 21.04(0.005), 25.21(0.002), 31.0(0.0)

Table 40: Recruitment to the stock of *D. eleginoides* in Division 58.5.2 as numbers of fish at age 4, estimated from three trawl surveys at Heard Island.

Split-year of Survey (1 November–31 October)	Weighted Mean Recruitments (age 4 in millions)
1987/88	1.550
1988/89	1.590
1989/90	3.649
1990/91	1.956
1991/92	1.793
1992/93	4.575
1993/94	2.435
1994/95	2.944
1995/96	5.674
1996/97	9.548
1997/98	21.557
1998/99	3.440
1999/2000	0.551

Table 41: Total catch (tonnes) by species of FV *Zakhar Sorokin* in Subarea 48.3 from 16 February to 10 March 1999.

Species	Catch (tonnes)	% of Total Catch
Champsocephalus gunnari	264.921	96.65
Chaenocephalus aceratus	0.153	0.05
Pseudochaenichthys georgianus	0.056	0.02
Patagonotothen guntheri	3.679	1.35
Myctophidae including *Gymnoscopelus nicholsi* (4.989 tonnes)	5.248	1.92
Other	0.035	0.01
Total	274.092	100

Table 42: Parameters input to the short-term yield calculations for *C. gunnari* in Subarea 48.3 and Division 58.5.2.

Category	Parameter	Subarea 48.3	Division 58.5.2
Survey	Date (days since birthday)	29 September 1997 (29)	1 June 1998 (213)
	Biomass – lower one-sided 95% confidence bound	31 563 tonnes	10 462 tonnes
Age structure	Estimated numbers at age	2 $1.194\ 10^{8}$	2 $4.882\ 10^{5}$
		3 $1.284\ 10^{8}$	3 $2.532\ 10^{7}$
		4 $2.332\ 10^{7}$	4 $2.880\ 10^{7}$
		5 $9.192\ 10^{6}$	5 $6.561\ 10^{5}$
		6 $9.369\ 10^{5}$	
Natural mortality	Mean annual M	0.42	0.4
Fishing mortality	Age when fully recruited to fishery	3.0	3.0
	Age when selection to fishery begins (ramps linearly to full selection)	1.5	1.5
von Bertalanffy growth	Birthday	01 September	01 September
	Time 0	0	0.234
	L_∞	455.0 mm	411.0 mm
	K	0.332	0.410
Weight–length ($W = aL^b$)	a (kg)	$6.172\ 10^{-10}$	$2.629\ 10^{-10}$
	b	3.388	3.515
Projection	Days of known catch since survey (until 1 November in current year)	426 + 395	152 + 395
	Catch since survey	5 tonnes + 265 tonnes	100 tonnes + 2 tonnes

Table 43: Trawl surveys used to generate length-density distributions analysed at this meeting.

Split-year	Survey	Vessel	Timing
1986/87	US/Polish	*Profesor Siedlecki*	November–December 1986
1991/92	UK	*Falklands Protector*	January 1992
1993/94	UK	*Cordella*	January–February 1994
	Argentina	*Dr Eduardo L. Holmberg*	February–March 1994
1994/95	Argentina	*Dr Eduardo L. Holmberg*	February–March 1995
1995/96	Argentina	*Dr Eduardo L. Holmberg*	March–April 1996
1996/97	Argentina	*Dr Eduardo L. Holmberg*	March–April 1997

Table 44: Estimates of biomass (tonnes) and 95% confidence intervals (using method of de la Mare) by stratum for the South Orkney Islands (Subarea 48.2) for the three surveys examined (WG-FSA-99/32).

Species	Strata	Biomass (tonnes)		
		1985	1991	1999
C. aceratus	50–150 m	108 (56–156)	928 (201–15606)	1859 (887–7594)
	150–250 m	1119 (491–5313)	4014 (2423–8155)	5962 (2994–17599)
	250–500 m	3949 (2004–11510)	11089 (6707–21490)	2610 (1344–7012)
	Total	5175 (2997–12203)	16031 (10897–31093)	10431 (6628–22220)
C. gunnari	50–150 m	326 (96–7643)	74 (29–343)	501 (320–1002)
	150–250 m	273 (129–1073)	2415 (1040–8526)	1249 (757–2591)
	250–500 m	4225 (1764–18647)	21132 (10087–58918)	1267 (551–4280)
	Total	4824 (2297–18318)	23621 (12274–61450)	3016 (2027–6073)
C. rastrospinosus	50–150 m	12 (3–40)	10 (4–34)	153 (73–623)
	150–250 m	386 (179–1599)	605 (367–1191)	399 (282–640)
	250–500 m	4586 (1890–20846)	14795 (8751–29750)	12881 (7373–29114)
	Total	4983 (2254–15640)	15410 (9353–30368)	13434 (7921–28796)
G. gibberifrons	50–150 m	458 (237–675)	2089 (640–15999)	6248 (2304–49329)
	150–250 m	2865 (1396–10585)	4141 (2741–7241)	10173 (5960–22700)
	250–500 m	15642 (7702–50121)	47252 (22042–134375)	22479 (12840–50640)
	Total	18965 (10637–53483)	53483 (27924–140646)	38900 (26091–82780)
L. larseni	50–150 m	4 (2–9)	3 (1–17)	45 (14–474)
	150–250 m	141 (42–1635)	40 (21–96)	91 (47–249)
	250–500 m	301 (151–909)	412 (215–1005)	151 (105–241)
	Total	446 (239–1945)	455 (255–1049)	288 (205–718)
L. squamifrons	150–250 m	215 (11–489534)	57 (17–448)	875 (160–22497)
	250–500 m	5858 (1308–93944)	14099 (5373–56560)	50059 (14345–372432)
	Total	6073 (1444–495401)	14156 (5429–56617)	50934 (15129–373309)
N. rossii	50–150 m		2 (0–308)	58 (14–532)
	150–250 m	22 (4–57)	27 (13–59)	61 (25–126)
	250–500 m	140 (60–268)	384 (128–2257)	3160 (675–61159)
	Total	163 (77–293)	412 (155–1719)	3278 (790–60672)
P. georgianus	50–150 m	25 (na)	2 (na)	167 (48–1425)
	150–250 m	156 (50–1054)	349 (159–1121)	6504 (2350–35071)
	250–500 m	4557 (1173–55578)	18498 (8975–50461)	2057 (910–6836)
	Total	4739 (1319–42432)	18847 (9316–50810)	8728 (4138–36461)

Table 45: Summary of seabirds at risk from longline fisheries in the Convention Area indicating the populations where population monitoring (PM) and foraging ecology (FE) studies are currently being undertaken (information extracted from documents cited in paragraph 7.7; also Gales, 1998; Marchant and Higgins, 1990).

Species	Species Status[1]	Study Location	Annual Pairs	Year Commenced	Objectives PM	Objectives FE
Wandering albatross *Diomedea exulans*	Vulnerable	South Georgia	2 178	1972	√	√
		Crozet	1 734	1960	√	√
		Kerguelen	1 455	1973	√	√
		Macquarie	10	1994	√	
				1998		√
		Marion	1 794	1979	√	√
		Prince Edward	1 277			
Gibson's albatross *Diomedea gibsoni*	Vulnerable	Auckland	65	1991	√	√
		Adams	5 762			
Antipodean albatross *Diomedea antipodensis*	Vulnerable	Antipodes	5 148	1994	√	√
Amsterdam albatross *Diomedea amsterdamensis*	Critically Endangered	Amsterdam	13	1983	√	√
Southern royal albatross *Diomedea epomophora*	Vulnerable	Campbell	7 800	1995	√	√
Northern royal albatross *Diomedea sanfordi*	Endangered	Chatham	5 200	1990s	√	√
		Taiaroa	18	1950s	√	√
				1993		√
Grey-headed albatross *Thalassarche chrysostoma*	Vulnerable	South Georgia	54 218	1976	√	√
		Diego Ramirez	10 000	1999	√	√
		Macquarie	84	1994	√	
				1999		√
		Campbell	6 400	1995	√	√
		Marion	6 217	1984	√	√
		Prince Edward	1 500			
		Kerguelen	7 900			
Black-browed albatross *Thalassarche melanophris*	Near Threatened	South Georgia	96 252	1976	√	√
		Falklands/Malvinas	550 000	1990	√	
				1998		√
		Diego Ramirez	32 000	1999	√	√
		Kerguelen	3 115	1978	√	√
		Macquarie	38	1994	√	
				1999		√
		Antipodes	100	1995	√	
		Heard, McDonald	750			
		Crozet	980			
Campbell albatross *Thalassarche impavida*	Vulnerable	Campbell	26 000	1995	√	√
Indian yellow-nosed albatross *Thalassarche carteri*	Vulnerable	Amsterdam	25 000	1978	√	√
		Prince Edward	7 000			
		Crozet	4 430			

continued

Table 45 continued

Species	Species Status[1]	Study Location	Annual Pairs	Year Commenced	Objectives PM	Objectives FE
Buller's albatross *Thalassarche bulleri*	Vulnerable	Snares	8 460	1992	√	√
		Solander	4 000–5 000	1992	√	√
Chatham albatross *Thalassarche eremita*	Critically Endangered	Chatham	4 000	1998		√
Salvin's albatross *Thalassarche salvini*	Vulnerable	Bounty	76 000	1998	√	
		Snares	650			
White-capped albatross *Thalassarche steadi*	Vulnerable	Antipodes	75	1995	√	
		Disappointment	72 000			
		Adams	100			
		Auckland	3 000			
Light-mantled albatross *Phoebetria palpebrata*	Data deficient	Macquarie	1 100	1993	√	
				1998		√
		Crozet	2 151	1970	√	√
		South Georgia	6 500			
		Marion	201			
		Kerguelen	3 000–5 000			
		Heard, McDonald	500-700			
		Auckland	5 000			
		Campbell	>1 500			
		Antipodes	<1 000			
Sooty albatross *Phoebetria fusca*	Vulnerable	Crozet	2 298	1970	√	√
		Amsterdam	300-400	1992	√	√
		Tristan da Cunha	2 750			
		Gough	5 000–10 000			
		Prince Edward	700			
		Marion	2 055			
Southern giant petrel *Macronectes giganteus*	(Vulnerable)	South Georgia	5 000	1980	√	
				1998		√
		Macquarie	2 300	1994	√	
		Crozet	1 017	1979	√	
		Marion		1984	√	√
		Adélie Land	9–11	1952	√	
		South Sandwich	800			
		Gough				
		Prince Edward	3 000			
		Kerguelen	3–5			
		Heard	2 350			
		South Orkney	8 755			
		South Shetland	7 185			
		Enderby Land	no estimate			
		Frazier	250			
		Antarctic Peninsula	1 125			
		Falklands/Malvinas	5 000			
Northern giant petrel *Macronectes halli*	(Near Threatened)	South Georgia	3 000	1980	√	
			1 280	1998		√
		Macquarie	1 313	1994	√	
		Crozet		1979	√	
		Marion	500	1984	√	√
		Prince Edward				

continued

Table 45 continued

Species	Species Status[1]	Study Location	Annual Pairs	Year Commenced	Objectives	
					PM	FE
Northern giant petrel continued		Kerguelen	1 450–1 800			
		Auckland	no estimate			
		Campbell	230+			
		Antipodes	320			
		Chatham	no estimate			
White-chinned petrel *Procellaria aequinoctialis*	(Vulnerable)	South Georgia	2 000 000	1995–98	√	√
		Crozet	10 000s	1970	√	√
		Prince Edward	10 000s	1996	√	√
		Falklands/Malvinas	1 000–5 000			
		Kerguelen	100 000s			
		Auckland, Campbell, Antipodes	10 000–50 000			
Grey petrel *Procellaria cinerea*	(Vulnerable)	Gough	100 000s			
		Tristan da Cunha	1 000s			
		Prince Edward	1 000s			
		Crozet	1 000s			
		Kerguelen	1 000s			
		Campbell	10 000s			
		Antipodes	10 000s			

1 As classified using IUCN criteria for threatened species (see Croxall and Gales, 1998).

Table 46: Incidental mortality of seabirds in the longline fisheries for *D eleginoides* in Subareas 58.6 and 58.7 during the 1997/98 season. Fishing method: A – autoliner, Sp – Spanish; Offal discharge at haul: O – opposite side to hauling, S – same side as hauling; D – day setting (including nautical dawn and dusk); N – night setting.

Vessel Name	Dates of Fishing	Fishing Method	Sets Deployed				No. of Hooks (1 000s)			Hooks Baited (%)	No. of Birds Observed						Observed Seabird Mortality (Birds/1 000 hooks)			Streamer Line in Use (%)		Offal Discharge at Haul (Position)
											Dead		Alive		Total							
			N	D	Total	%N	Ob-served	Set	% Ob-served		N	D	N	D	N	D	N	D	Total	N	D	
Aquatic Pioneer	15/1/97–9/1/98	A	105	0	105	100	129.8	296.2	43	80	1	0	0	0	1	0	0.01	0	0.01	72		-
Aquatic Pioneer	1/2–12/3/98	A	76	0	76	100	-	315.8	-	81	8	0	1	0	9	0	-	-	-	90		O
Aquatic Pioneer	1/4–14/598	A	95	0	95	100	-	341.6	-	78	1	0	0	0	1	0	-	-	-	100		O
Aquatic Pioneer	23/6–26/7/98	A	151	6	157	96	-	348.6	-	68	0	2	0	0	0	2	-	-	-	98	83	O
Eldfisk	3/3–17/4/98	A	240	0	240	100	164	884	18	85	8	0	1	0	9	0	0.05	0	0.05	85		O
Eldfisk	9/1–12/2/98	A	164	0	164	100	136.1	496.1	27	82	18	0	0	0	18	0	0.13	0	0.13	0		O
Eldfisk	19/8–14/9/98	A	69	69	138	50	58.2	395.2	14	63	0	0	0	0	0	0	0	0	0	100	98	O
*Koryo Maru 11**	19/11/97–15/1/98	Sp	-	-	101	-	451.7	533	84	100	27		27		54		-	-	0.06	-	-	S
Koryo Maru 11	3/2–10/3/98	Sp	57	13	70	81	434.1	434.1	100	100	104	55	11	2	115	57	0.29	0.68	0.37	0	0	O
Koryo Maru 11	28/7–31/8/98	Sp	48	0	48	100	40.4	269.4	15	100	1	0	3	0	4	0	0.02	0	0.02	100		O
Total						92%		4 314.0									0.15	0.54	0.19			

* Data obtained from observer cruise report (logbook data incomplete).

Table 47: Species composition of birds killed in longline fisheries in Subareas 58.6 and 58.7 during the 1997/98 season. D – daylight setting (including nautical dawn and dusk), N – night setting; MAH – northern giant petrel, MAI – southern giant petrel, PRO – white-chinned petrel, PTZ – unidentified petrels.

<table>
<tr><th rowspan="3">Vessel Name</th><th rowspan="3">Dates of Fishing</th><th colspan="8">No. Birds Killed by Group</th><th colspan="4" rowspan="2">Species Composition (%)</th></tr>
<tr><th colspan="2">Albatross</th><th colspan="3">Petrels/ Fulmars</th><th colspan="3">Total</th></tr>
<tr><th>N</th><th>D</th><th>N</th><th></th><th>D</th><th>N</th><th></th><th>D</th><th>MAI</th><th>PRO</th><th>MAH</th><th>PTZ</th></tr>
<tr><td>Aquatic Pioneer</td><td>15/1/97–9/1/98</td><td>0</td><td>0</td><td>1</td><td></td><td>0</td><td>1</td><td></td><td>0</td><td></td><td></td><td>1</td><td></td></tr>
<tr><td>Aquatic Pioneer</td><td>1/2–12/3/98</td><td>0</td><td>0</td><td>8</td><td></td><td>0</td><td>8</td><td></td><td>0</td><td></td><td>8</td><td></td><td></td></tr>
<tr><td>Aquatic Pioneer</td><td>1/4–14/5/98</td><td>0</td><td>0</td><td>1</td><td></td><td>0</td><td>1</td><td></td><td>0</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>Aquatic Pioneer</td><td>23/6–26/7/98</td><td>0</td><td>0</td><td>0</td><td></td><td>2</td><td>0</td><td></td><td>2</td><td>2</td><td></td><td></td><td></td></tr>
<tr><td>Eldfisk</td><td>9/1–12/2/98</td><td>0</td><td>0</td><td>18</td><td></td><td>0</td><td>18</td><td></td><td>0</td><td></td><td>18</td><td></td><td></td></tr>
<tr><td>Eldfisk</td><td>3/3–17/4/98</td><td>0</td><td>0</td><td>8</td><td></td><td>0</td><td>8</td><td></td><td>0</td><td></td><td>8</td><td></td><td></td></tr>
<tr><td>Eldfisk</td><td>19/8–14/9/98</td><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>0</td><td></td><td>0</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Koryo Maru 11</td><td>3/2–10/3/98</td><td>0</td><td>0</td><td>104</td><td></td><td>55</td><td>104</td><td></td><td>55</td><td></td><td>142</td><td></td><td>17</td></tr>
<tr><td>Koryo Maru 11*</td><td>19/11/97–15/1/98</td><td>0</td><td>0</td><td></td><td>27</td><td></td><td></td><td>27</td><td></td><td></td><td>27</td><td></td><td></td></tr>
<tr><td>Koryo Maru 11</td><td>28/7–31/8/98</td><td>0</td><td>0</td><td>1</td><td></td><td>0</td><td>1</td><td></td><td>0</td><td></td><td></td><td></td><td>1</td></tr>
<tr><td>Total %</td><td></td><td>0</td><td>0</td><td>141</td><td>27</td><td>57</td><td>141</td><td>27</td><td>57</td><td>2 (1)</td><td>204 (91)</td><td>1 (<1)</td><td>18 (8)</td></tr>
</table>

* Data obtained from observer cruise report (logbook data incomplete).

Table 48: Estimated seabird mortality by vessel for Subareas 58.6 and 58.7 during the 1997/98 season.

Vessel Name	Hooks Observed (1 000s)	Hooks Set (1 000s)	% Night Sets	Estimated Seabird Mortality during Line Setting		
				Night	Day	Total
Aquatic Pioneer	129.8	296.2	100	3	0	3
*Aquatic Pioneer**		315.8	100	47	0	47
*Aquatic Pioneer**		341.6	100	51	0	51
*Aquatic Pioneer**		348.6	96	50	8	58
Eldfisk	58.2	395.2	50	0	0	0
Eldfisk	136.1	496.1	100	64	0	64
Eldfisk	164.0	884.0	100	44	0	44
Koryo Maru 11	40.4	269.4	100	5	0	5
Koryo Maru 11	434.1	434.1	81	102	56	158
Koryo Maru 11	451.7	533.0	92	73	23	97
Total	1 414.3	4 314.0	92	441	87	528

* Estimates are based on the total observed catch rates.

Table 49: Summary of observations on fisheries conducted in the 1998/99 season by designated CCAMLR scientific observers.

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report / Date Submitted	Data Reported
Chile	*Isla Camila*	LLS Spanish	P. Boyle Great Britain	48.3 *D. eleginoides*	15/6–18/7/99	Scientific Observer Logbook 31/8/99 Cruise Report 13/9/99	Cruise, vessel, and IMALF details
Chile	*Isla Camila*	LLS Spanish	N. Mynard Great Britain	48.3 *D. eleginoides*	11/4–22/6/99	Scientific Observer Logbook 3/8/99 Cruise Report 3/8/99	Cruise, vessel, and IMALF details
Chile	*Isla Sofía*	LLS Spanish	D. Owen Great Britain	48.3 *D. eleginoides*	28/6–22/7/99	Scientific Observer Logbook 30/8/99 Cruise Report 2/9/99	Cruise, vessel, and IMALF details
Chile	*Isla Sofía*	LLS Spanish	M. Murphy Great Britain	48.3 *D. eleginoides*	31/3–25/6/99	Scientific Observer Logbook 3/8/99 Cruise Report 3/8/99	Cruise, vessel, and IMALF details
Chile	*Magallanes III*	LLS Spanish	H. Brachetta Argentina	48.3 *D. eleginoides*	14/5–21/8/99	Scientific Observer Logbook 17/9/99 Cruise Report 11/10/99	Cruise, vessel, and IMALF details
Chile	*Tierra del Fuego*	LLS Spanish	J. Taylor Great Britain	48.3 *D. eleginoides*	17/6–25/7/99	Scientific Observer Logbook 30/8/99 Cruise Report 2/9/99	Cruise, vessel, and IMALF details
Chile	*Tierra del Fuego*	LLS Spanish	N. Ansell Great Britain	48.3 *D. eleginoides*	11/4–23/6/99	Scientific Observer Logbook 10/8/99 Cruise Report 17/8/99	Cruise, vessel, and IMALF details
Great Britain	*Argos Helena*	LLS Spanish	A. Black Great Britain	48.3 *D. eleginoides*	2/1–16/2/99	Scientific Observer Logbook 31/3/99 Cruise report submitted as FSA paper	Cruise, vessel, and IMALF details
Great Britain	*Argos Helena*	LLS Spanish	Y. Marin Uruguay	48.3 *D. eleginoides*	10/4–30/7/99	Scientific Observer Logbook 1/9/99 Cruise Report 25/8/99	Cruise report, limited IMALF
Great Britain	*Jacqueline*	LLS Spanish	M. Purves South Africa	48.3 *D. eleginoides*	11/4–21/7/99	Scientific Observer Logbook 30/8/99 Cruise Report 6/9/99	Cruise, vessel, and IMALF details
Great Britain	*Lyn*	LLS Spanish	C. Cardenas Chile	48.3 *D. eleginoides*	17/6–20/7/99	Scientific Observer Logbook 30/8/99 Cruise Report 6/9/99	Cruise, vessel, and IMALF details
Great Britain	*Lyn*	LLS Spanish	P. Casas-Cordero Chile	48.3 *D. eleginoides*	9/4–14/6/99	Scientific Observer Logbook 30/8/99 Cruise Report 6/9/99	Cruise, vessel, and IMALF details
New Zealand	*Janas*	LLS Auto	F. Stoffberg South Africa	88.1 *Dissostichus* spp.	23/12/98–5/3/99	Scientific Observer Logbook 14/4/99 Cruise Report 26/3/99	Cruise, vessel, and IMALF details
New Zealand	*San Aotea II*	LLS Auto	B. Watkins South Africa	88.1 *Dissostichus* spp.	22/12/98–3/3/99	Scientific Observer Logbook 14/4/99 Cruise Report 21/5/99	Cruise, vessel, and IMALF details

continued

Table 49 continued

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report / Date Submitted	Data Reported
Republic of Korea	*No. 1 Moresko*	LLS Spanish	A. Williams Great Britain	48.3 *D. eleginoides*	11/4–22/7/99	Scientific Observer Logbook 30/8/99 Cruise Report 2/9/99	Cruise, vessel, and IMALF details
South Africa	*Koryo Maru 11*	LLS Auto	G. Fulton Great Britain	48.3 *D. eleginoides*	10/4–27/6/99	Scientific Observer Logbook 10/8/99 Cruise Report 13/9/99	Cruise, vessel, and IMALF details
South Africa	*Koryo Maru 11*	LLS Auto	D. Byrom Great Britain	48.3 *D. eleginoides*	30/6–4/8/99	Scientific Observer Logbook 30/8/99 Cruise Report 2/9/99	Cruise, vessel, and IMALF details
Panama	*Eldfisk*	LLS Auto	Watkins/Wium South Africa	58.6 , 58.7 *D. eleginoides*	2/10–1/11/98	Scientific Observer Logbook 21/4/99 Cruise Report 16/3/99	Cruise, vessel, and IMALF details
South Africa	*Arctic Fox*	LLS Auto	B. Fairhead South Africa	58.6, 58.7 *D. eleginoides*	24/11/98–11/1/99	Scientific Observer Logbook 21/4/99 Cruise Report 28/1/99	Cruise, vessel, and IMALF details
South Africa	*Eldfisk*	LLS Auto	Watkins/Pienaar South Africa	58.6, 58.7 *D. eleginoides*	1/5–23/6/99	Scientific Observer Logbook 23/7/99 Cruise Report 23/7/99	Cruise, vessel, and IMALF details
South Africa	*Koryo Maru 11*	LLS Auto	J. Wium South Africa	58.6, 58.7 *D. eleginoides*	6/2–24/3/99	Scientific Observer Logbook 21/5/99 Cruise Report 23/7/99	Cruise, vessel, and IMALF details
South Africa	*Arctic Fox*	LLS Auto	H. Crous South Africa	58.6, 58.7 *D. eleginoides*	8/6–23/7/99	Scientific Observer Logbook 6/9/99 Cruise Report 6/9/99	Cruise, vessel, and IMALF details
South Africa	*Arctic Fox*	LLS Auto	F. Stoffberg South Africa	58.7 *D. eleginoides*	21/9–14/11/98	Scientific Observer Logbook 21/4/99 Cruise Report 11/10/99	Cruise, vessel, and IMALF details
South Africa	*Arctic Fox*	LLS Auto	B. Fairhead South Africa	58.7 *D. eleginoides*	31/3–29/5/99	Scientific Observer Logbook 23/7/99 Cruise Report 23/7/99	Cruise, vessel, and IMALF details
South Africa	*Koryo Maru 11*	LLS Auto	M. Davies South Africa	58.7 *D. eleginoides*	5/1–5/2/99	Scientific Observer Logbook 21/5/99 Cruise Report 22/2/99	Cruise, vessel, and IMALF details
South Africa	*Koryo Maru 11*	LLS Auto	M. Davies Great Britain	58.7 *D. eleginoides*	3/11–28/12/98	Scientific Observer Logbook 21/4/99 Cruise Report 22/2/99	Cruise, vessel, and IMALF details
Spain	*Ibsa Quinto*	LLS Spanish	M. Endicott Great Britain	48.3 *D. eleginoides*	8/6–21/7/99	Scientific Observer Logbook 30/8/99 Cruise Report 2/9/99	Cruise, vessel, and IMALF details
Spain	*Ibsa Quinto*	LLS Spanish	L. Fearnehough Great Britain	48.3 *D. eleginoides*	10/4–4/6/99	Scientific Observer Logbook 9/7/99 Cruise Report 9/7/99	Cruise, vessel, and IMALF details
Uruguay	*Illa de Rua*	LLS Spanish	P. Ghey Great Britain	48.3 *D. eleginoides*	8/4–28/6/99	Scientific Observer Logbook 10/8/99 Cruise Report 20/8/99	Cruise, vessel, and IMALF details

Table 49 continued

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report / Date Submitted	Data Reported
Uruguay	*Illa de Rua*	LLS Spanish	P . Wright Great Britain	48.3 *D. eleginoides*	1/7–17/7/99	Scientific Observer Logbook 30/8/99 Cruise Report 2/9/99	Cruise, vessel, and IMALF details
Uruguay	*Isla Gorriti*	LLS Auto	P. Boyle Great Britain	48.3 *D. eleginoides*	8/5–12/6/99	Scientific Observer Logbook 31/8/99 Cruise Report 13/9/99	Cruise, vessel, and IMALF details
Uruguay	*Illa de Rua*	LLS Auto	G. Bruce Great Britain	48.3 *D. eleginoides*	12/6–17/7/99	Scientific Observer Logbook 31/8/99 Cruise Report 13/9/99	Cruise, vessel, and IMALF details
Russia	*Zakhar Sorokin*	Trawl	A. King Great Britain	48.3 *C. gunnari*	13/2–13/3/99	Scientific Observer Logbook 24/4/99 Cruise Report 24/4/99	Cruise, vessel, and IMALF details
Australia	*Austral Leader*	Trawl	J. Hunter Australia	58.5.2 *D. eleginoides* *C. gunnari*	20/8–24/9/98	Scientific Observer Logbook 13/11/98 Cruise Report 25/3/99	Cruise, vessel, and IMALF details
Australia	*Southern Champion*	Trawl	M. Scott Australia	58.5.2 *D. eleginoides* *C. gunnari*	27/9–11/11/98	Scientific Observer Logbook 18/12/98 Cruise Report 24/3/99	Cruise, vessel, and IMALF details
Australia	*Southern Champion*	Trawl	M. Tucker Australia	58.5.2 *D. eleginoides* *C. gunnari*	19/11/98–6/1/99	Scientific Observer Logbook 22/2/99 Cruise Report 25/3/99	Cruise, vessel, and IMALF details
Australia	*Southern Champion*	Trawl	J. Parkinson Australia	58.5.2 *D. eleginoides* *C. gunnari*	13/1–3/3/99	Scientific Observer Logbook 27/4/99 Cruise Report 15/4/99	Cruise, vessel, and IMALF details
Australia	*Southern Champion*	Trawl	I. Brown Australia	58.5.2 *D. eleginoides* *C. gunnari*	10/3–29/4/99	Scientific Observer Logbook 19/5/99 Cruise Report 23/8/99	Cruise, vessel, and IMALF details
Australia	*Austral Leader*	Trawl	C. Heinecken South Africa	58.4.1, 58.4.3, 58.5.2 *D. eleginoides*	14/3–13/5/99	Scientific Observer Logbook 1/6/99 Cruise Report 23/7/99	Cruise, vessel, and IMALF details
Australia	*Southern Champion*	Trawl	H. Sturmann Australia	58.5.2 *D. eleginoides* *C. gunnari*	8/5–14/7/99	Scientific Observer Logbook 19/7/99 Cruise Report 23/8/99	Cruise, vessel, and IMALF details
Great Britain	*Argos Helena*	Pot	M. Purves South Africa	48.4 *Paralomis* spp.	31/8–23/9/99	Scientific Observer Logbook 11/10/99 Cruise Report 11/10/99	Cruise, vessel, and IMALF details

Table 50: Incidental mortality of seabirds in the longline fisheries for *D. eleginoides* in Subareas 48.3, 58.6, 58.7 and 88.1 during the 1998/99 season. Sp – Spanish method, Auto – autoliner, N – night-time setting, D – daytime setting (including nautical dawn and dusk), O – opposite side to hauling, S – same side as hauling, * – the average seabird catch rate was used due to lack of observed hooks. The highlighted row indicates data from the UK line-weighting experiment.

Vessel Name	Dates of Fishing	Fishing Method	Sets Deployed				No. of Hooks (1 000s)			Hooks Baited (%)	No. of Birds Caught						Observed Seabird Mortality (Birds/1 000 hooks)			Streamer Line in Use (%)		Offal Discharge at Haul
											Dead		Alive		Total							
			N	D	Total	%N	Ob-served	Set	% Ob-served		N	D	N	D	N	D	N	D	Total	N	D	
Subarea 48.3																						
Argos Helena	1/2–16/2/99	Sp	0	24	24	0	81.6	89.1	91	100		88		11		99	0	1.08	1.08		91	O
Argos Helena	16/4–29/5/99	Sp	173	1	174	99	191	1259	15	100	1	0	13	0	14	0	0.005	0	0.005	83	0	O
Ibsa Quinto	13/7–3/9/98	Sp	29	0	29	100	50.9	249.1	20	100	0	0	1	0	1	0	0	0	0	100		O
Ibsa Quinto	15/4–28/5/99	Sp	38	0	38	100	131.8	339.0	38	100	5	0	8	0	13	0	0.04	0	0.04	89		O
Illa de Rua	15/4–21/6/99	Sp	114	6	120	95	207.5	1102.8	18	100	52	2	11	0	16	2	0.03	0.22	0.03	99	100	O
Illa de Rua	6/7–17/7/99	Sp	18	0	18	100	39.6	176.3	22	100	0	0	0	0	0	0	0	0	0	77		S
Isla Camila	18/4–11/6/99	Sp	88	8	96	91	433.6	749.8	57	100	30	0	16	1	46	1	0.08	0	0.07	77	87	S
Isla Camila	17/6–17/7/99	Sp	41	7	48	85	67.5	451.2	14	100	1	0	2	0	3	0	0.02	0	0.01	100	100	S
Isla Gorriti	17/5–10/6/99	Auto	39	12	51	76	48.5	463.0	10	88	0	0	0	0	0	0	0	0	0	97	100	O
Isla Gorriti	13/6–17/7/99	Auto	42	28	70	60	236.7	643.2	36	90	0	0	2	2	2	2	0	0	0	0	17	O
Isla Sofía	15/4–20/6/99	Sp	86	17	103	83	117.0	772.6	15	92	6	0	2	0	8	0	0.06	0	0.05	100	100	S
Isla Sofía	2/7–16/7/99	Sp	26	4	30	86	47.4	245.0	19	100	0	0	0	0	0	0	0	0	0	84	75	S
Jacqueline	15/4–17/7/99	Sp	77	2	79	97	354.5	971.5	36	100	1	0	30	0	31	0	0.003	0	0.003	94	100	S
Koryo Maru 11	22/4–21/6/99	Sp	57	3	60	95	134.0	761.0	17	100	0	0	0	0	0	0	0	0	0	100	100	O
Koryo Maru 11	6/7–17/7/99	Sp	10	0	10	100	26.1	145.2	18	100	0	0	0	0	0	0	0	0	0	100		O
Lyn	15/4–7/6/99	Sp	74	13	87	85	101.9	795.5	12	100	1	4	0	1	1	5	0.01	0.19	0.04	100	100	O
Lyn	27/6–15/7/99	Sp	30	4	34	88	66.0	277.0	23	100	0	0	0	1	0	1	0	0	0	0	0	O
Magallanes III	23/5–14/7/99	Sp	53	26	79	67	275.3	736.8	37	100	0	1	1	5	1	6	0	0.01	0.004	100	100	O
No. 1 Moresko	15/4–16/7/99	Sp	85	45	130	65	360.7	1074.4	33	100	0	0	2	1	2	1	0	0	0	84	91	O
*Tierra del Fuego**	15/4–11/6/99	Sp	102	6	108	94		732.0		100	20	0	7	2	9	2	0.01	0.08	0.07	97	100	O
Tierra del Fuego	19/6–17/7/99	Sp	73	15	88	82	104.8	354.5	29	100	0	0	1	0	1	0	0	0	0	87	86	O
Total						83	3076.4	12388	25								0.01	0.08	0.07			
Subarea 58.6, 58.7																						
Arctic Fox	27/9–6/11/98	Auto	128	3	131	97	390.4	914.4	42	87	14	0	0	0	14	0	0.04	0	0.04	0	0	O
Arctic Fox	30/11/98–4/1/99	Auto	82	1	83	98	159.5	479.7	33	84	1	0	0	0	1	0	0.01	0	0.01	100	100	O
Arctic Fox	6/4–22/5/99	Auto	122	4	126	96	190.7	726.2	26	83	3	0	0	0	3	0	0.02	0	0.02	99	100	O
Arctic Fox	14/6–15/7/99	Auto	131	7	138	94	259.3	415.1	62	82	5	0	1	0	6	0	0.02	0	0.02	95	100	O
Eldfisk	7/10–6/11/98	Auto	76	86	162	46	67.4	500.0	13	82	7	0	0	0	7	0	0.19	0	0.10	100	100	O
Eldfisk	7/5–8/6/99	Auto	128	54	182	70	102.8	507.3	20	83	2	0	0	0	2	0	0.03	0	0.02	100	100	O
Koryo Maru 11	8/11–20/12/98	Sp	50	0	50	100	166.4	383.5	43	100	15		5		20		0.09	0	0.09	98		O
Koryo Maru 11	10/1–31/1/99	Sp	38	4	42	90	105.0	194.3	54	100	0	0	3		3	1	0	0	0	100	100	O
Koryo Maru 11	10/2–17/3/99	Sp	64	0	64	100	73.3	367.4	19	100	1		5		6		0.01	0	0.01	100		O
Total						88	1514.8	4487.9	34								0.05	0	0.03			

continued

Table 50 continued

Vessel Name	Dates of Fishing	Fishing Method	Sets deployed				No. of Hooks (1 000s)			Hooks Baited (%)	No. of Birds Caught						Observed Seabird Mortality (Birds/1 000 hooks)			Streamer Line in Use (%)		Offal Discharge at Haul
											Dead		Alive		Total							
			N	D	Total	%N	Ob-served	Set	% Ob-served		N	D	N	D	N	D	N	D	Total	N	D	
Subarea 88.1																						
Janus	6/1–26/2/99	Auto	2	126	128	1	234.9	725.3	32	80	0	0	0	0	0	0	0	0	0	100	95	S
San Aotea II	30/12/98–22/2/99	Auto	0	126	126	0	205.8	687.0	29	83	0	0	0	0	0	0	0	0	0	100		S
Total						0.5	440.7	1412.3	31								0	0	0			

Table 51: Estimated seabird mortality by vessel for Subarea 48.3 during the 1998/99 season. The highlighted row indicates data from the UK line-weighting experiment.

Vessel Name	Hooks Observed (1 000s)	Hooks Set (1 000s)	% Night Sets	Estimated Number of Birds Caught Dead		
				Night	Day	Total
Argos Helena	81.6	89.1	0	0	96	96
Argos Helena	191	1 259	15	6	0	6
Ibsa Quinto	50.9	249.1	100	0	0	0
Ibsa Quinto	131.8	339	100	14	0	14
Illa de Rua	39.6	176.3	100	0	0	0
Illa de Rua	207.5	1 102.8	95	31	12	43
Isla Camila	67.5	451.2	85	8	0	8
Isla Camila	433.6	749.8	91	55	0	55
Isla Gorriti	48.5	463	76	0	0	0
Isla Gorriti	236.7	643.2	60	0	0	0
Isla Sofía	47.4	245	86	0	0	0
Isla Sofía	117	772.6	83	38	0	38
Jacqueline	354.5	971.5	97	3	0	3
Koryo Maru 11	26.1	145.2	100	0	0	0
Koryo Maru 11	134	761	95	0	0	0
Lyn	66	277	88	0	0	0
Lyn	101.9	795.5	85	7	23	30
Magallanes III	275.3	736.8	67	0	2	2
No. 1 Moresko	360.7	1 074.4	65	0	0	0
Tierra del Fuego	104.8	354.5	82	0	0	0
*Tierra del Fuego**		732	94	7	4	11
Total	3 076.4	12 388	79	169	137	306

* Estimates are based on the total observed catch rates.

Table 52: Species composition of birds killed in longline fisheries in Subareas 48.3, 58.6 and 58.7 during the 1998/99 season. N – night setting, D – daylight setting (including nautical dawn and dusk), DIM – black-browed albatross, DIC – grey-headed albatross, MAI – southern giant petrel, PCI – grey petrel, PRO – white-chinned petrel, DAC – cape petrel, OCO – Wilson's storm petrel, PYP – Gentoo penguin, ( ) – % composition. The highlighted row indicates data from the UK line-weighting experiment.

Vessel Name	Dates of Fishing	No. Birds Killed by Group						Species Composition (%)							
		Albatross		Petrels/Fulmars		Total									
		N	D	N	D	N	D	DIM	DIC	MAI	PRO	OCO	DAC	PYP	PCI
Subarea 48.3															
Argos Helena	1/2–16/2/99	0	51	0	37	0	88	50 (57)	1 (1)	1 (1)	36 (41)				
Argos Helena	16/4–29/5/99	1	0	0	0	1	0	1 (100)							
Ibsa Quinto	13/7–3/9/98	0	0	0	0	0	0								
Ibsa Quinto	15/4–28/5/99	2	0	3	0	5	0	2 (40)			2 (40)			1 (20)	
Illa de Rua	15/4–21/6/99	3	2	2	0	5	2	3 (43)	2 (29)		1 (14)	1 (14)			
Illa de Rua	6/7–17/7/99	0	0	0	0	0	0								
Isla Camila	18/4–11/6/99	30	0	0	0	30	0	3 (100)							
Isla Camila	17/6–17/7/99	0	0	1	0	1	0						1 (100)		
Isla Gorriti	17/5–10/6/99	0	0	0	0	0	0								
Isla Gorriti	13/6–17/7/99	0	0	0	0	0	0								
Isla Sofía	15/4–20/6/99	6	0	0	0	6	0	6 (100)							
Isla Sofía	2/7–16/7/99	0	0	0	0	0	0								
Jacqueline	15/4–17/7/99	0	0	1	0	1	0				1 (100)				
Koryo Maru 11	22/4–21/6/99	0	0	0	0	0	0								
Koryo Maru 11	6/7–17/7/99	0	0	0	0	0	0								
Lyn	15/4–7/6/99	1	3	1	0	2	3	4 (80)		1 (20)					
Lyn	27/6–15/7/99	0	0	0	0	0	0								
Magallanes III	23/5–14/7/99	0	1	0	0	0	1		1 (100)						
No. 1 Moresko	15/4–16/7/99	0	0	0	0	0	0								
Tierra del Fuego	15/4–11/6/99	2	0	0	0	2	0	2 (100)							
Tierra del Fuego	19/6–17/7/99	0	0	0	0	0	0								
Total %								98 (66)	4 (3)	2 (1)	40 (27)	1 (1)	1 (1)	1 (1)	
Subareas 58.6, 58.7															
Arctic Fox	27/9–6/11/98	0	0	14	0	14	0			6 (43)	8 (57)				
Arctic Fox	6/4–22/5/99	0	0	3	0	3	0			1 (33)	1 (33)				1 (33)
Arctic Fox	14/6–15/7/99	1	0	4	0	5	0		1 (20)					4 (80)	
Arctic Fox	30/1198–4/1/99	0	0	1	0	1	0			1 (100)					
Eldfisk	7/10–6/11/98	0	0	7	0	7	0				7 (100)				
Eldfisk	7/5–8/6/99	0	0	2	0	2	0								2 (100)
Koryo Maru 11	8/11–20/12/98	0	0	15	0	15	0				15 (100)				
Koryo Maru 11	10/1–31/1/99	0	0	0	0	0	0								
Koryo Maru 11	10/2–17/3/99	0	0	1	0	1	0				1 (100)				
Total %									1 (2)	8 (17)	32 (67)			4 (8)	3 (6)

Table 53: Estimated seabird mortality by vessel for Subareas 58.6 and 58.7 during the 1998/99 season.

Vessel Name	Hooks Observed (1 000s)	Hooks Set (1 000s)	% Night Sets	Estimated Number of Birds Caught Dead		
				Night	Day	Total
Arctic Fox	159.5	479.7	98	5	0	5
Arctic Fox	190.7	726.2	96	14	0	14
Arctic Fox	259.3	415.1	94	8	0	8
Arctic Fox	390.4	914.4	97	35	0	35
Eldfisk	67.4	500.0	46	44	0	44
Eldfisk	102.8	507.3	70	11	0	11
Koryo Maru 11	73.3	367.4	100	5	0	5
Koryo Maru 11	105.0	194.3	90	0	0	0
Koryo Maru 11	166.4	383.5	100	35	0	35
Total	1 514.8	4 487.9	87.89	156	0	156

Table 54: Total estimated seabird by-catch and by-catch rate (birds/1 000 hooks) in longline fisheries in Subareas 48.3, 58.6 and 58.7, 1997 to 1999.

Subarea	Year		
	1997	1998	1999
48.3			
Estimated by-catch	5 755	640	210*
By-catch rate	0.23	0.03	0.01*
58.6, 58.7			
Estimated by-catch	834	528	156
By-catch rate	0.52	0.19	0.03

* Excluding *Argos Helena* line-weighting experiment cruise.

Table 55: 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 1998/99. S – summer, W – winter.

Subarea/ Division	Total Unregulated Catch (tonnes)	Split S:W		Unregulated Catch (tonnes)		*Dissostichus* spp. Regulated By-catch Rate (kg/hooks)	Unregulated Effort (1 000 hooks)		Seabird By-catch Rate (birds/1 000 hooks)				Estimated Total Unregulated Seabird By-catch			
									Mean		Max		Mean		Max	
		S	W	S	W		S	W	S	W	S	W	S	W	S	W
48.3	640	80	20	512	128	0.31	1 652	413	2.608	0.07	9.31	0.51	4 307	29	15 377	211
	640	70	30	448	192	0.31	1 445	619	2.608	0.07	9.31	0.51	3 769	43	13 454	316
	640	60	40	384	256	0.31	1 239	826	2.608	0.07	9.31	0.51	3 231	58	11 532	421
58.6	1 728	80	20	1 382	346	0.09	15 360	3 840	1.049	0.017	1.88	0.07	16 113	65	28 877	269
	1 728	70	30	1 210	518	0.09	13 440	5 760	1.049	0.017	1.88	0.07	14 099	98	25 267	403
	1 728	60	40	1 037	691	0.09	11 520	7 680	1.049	0.017	1.88	0.07	12 084	131	21 658	538
58.7	140	80	20	112	28	0.10	1 120	280	0.049	0.017	1.88	0.07	55	5	2 106	20
	140	70	30	98	42	0.10	980	420	0.049	0.017	1.88	0.07	48	7	1 842	29
	140	60	40	84	56	0.10	840	560	0.049	0.017	1.88	0.07	41	10	1 579	39
58.4.4	1 845	80	20	1 476	369	0.24	6 150	1 538	0.629	0.01	1.128	0.042	3 868	15	6 937	65
	1 845	70	30	1 292	554	0.24	5 381	2 306	0.629	0.01	1.128	0.042	3 385	23	6 070	97
	1 845	60	40	1 107	738	0.24	4 613	3 075	0.629	0.01	1.128	0.042	2 901	31	5 203	129
58.5.1	620	80	20	496	124	0.24	2 067	517	0.049	0.017	1.88	0.07	101	9	3 885	36
	620	70	30	434	186	0.24	1 808	775	0.049	0.017	1.88	0.07	89	13	3 400	54
	620	60	40	372	248	0.24	1 550	1 033	0.049	0.017	1.88	0.07	76	18	2 914	72
58.5.2	160	80	20	128	32	0.24	533	133	0.049	0.017	1.88	0.07	26	2	1 003	9
	160	70	30	112	48	0.24	467	200	0.049	0.017	1.88	0.07	23	3	877	14
	160	60	40	96	64	0.24	400	267	0.049	0.017	1.88	0.07	20	5	752	19

Table 56: Estimates of potential seabird by-catch in unregulated longline fishing in the Convention Area in 1998/99.

Subarea/ Division	Potential By-catch Level	Summer	Winter	Total[1]
48.3	Lower	3 200–4 300	30–60	3 200–4 400
	Higher	11 500–15 400	210–420	11 700–15 800
58.6	Lower	12 100–16100	65–130	12 200–16 200
	Higher	21 650–28 900	270–540	21 900–29 400
58.7	Lower	40–55	5–10	50–60
	Higher	1 600–2 100	20–40	1 600–2 100
58.4.4	Lower	2 900–3 900	15–30	2 900–3 900
	Higher	5 200–6 900	65–130	5 300–7 000
58.5.1	Lower	80–100	10–20	100
	Higher	2 900–3 900	40–70	2 900–4 000
58.5.2	Lower	20–30	2–5	20–30
	Higher	750–1 000	10–20	800–1 000
Total	Lower	18 300–24 500*	100–300[1]	18 000–25 000[2]
	Higher	43 600–58 200*	600–1 200[1]	44 000–59 000[2]

[1] Rounded to nearest hundred birds
[2] Rounded to nearest thousand birds

Table 57: Composition of estimated potential by-catch in unregulated longline fisheries in the Convention Area from 1997 to 1999.

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 48.3[3]				
1996/97	-	-	-	-
1997/98	-	-	-	-
1998/99	3 000–4 000	1 505	70	1 680
	12 000–16 000	6 020	280	6 720
Subareas 58.6, 58.7[4]				
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	12 000–16 000	3 080	560	8 820
	23 500–31 500	6 050	1 100	17 325
Divisions 58.5.1, 58.5.2[4]				
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	c. 100	c. 22	c. 4	c. 63
	4 000–5 000	990	180	2 835
Division 58.4.4[4]				
1996/97	-			
1997/98	-			
1998/99	3 000–4 000	770	140	2 205
	5 000–7 000	1 320	240	3 780
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	18 000–24 000	5 377	774	12 768
	44 000–59 000	8 892	1 800	30 660
Overall Total	78 000–105 000	21 107	3 634	56 813
	186 000–265 000	47 392	7 342	140 910

1 Rounded to nearest thousand birds.
2 Based on averages for lower (above) and higher (below) level values.
3 Based on 43% albatrosses, 2% giant petrels, 48% white-chinned petrels (7% unidentified petrels) (see SC-CAMLR-XVI, Annex 5, Table 44).
4 Based on 22% albatrosses, 4% giant petrels, 6% white-chinned petrels (10% unidentified petrels) (see SC-CAMLR-XVI, Annex 5, Table 42).

Table 58: Summary of IMALF risk level and assessment in relation to proposed new and exploratory fisheries in 1999/2000.

Subarea/ Division	Risk Level	IMALF Risk Assessment	Reference	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/XVI as a seabird by-catch precautionary measure.	SC-CAMLR-XVII, Annex 5, 7.116(i)	• South Africa (CCAMLR-XVIII/9) and the European Community (CCAMLR-XVIII/21) propose to fish from 1 March to 31 August north of 30°S; and from 15 February to 15 October south of 30°S, complying with Conservation Measure 29/XVI. • This does not conflict with the IMALF advice. • Conservation Measure 162/XVII applied in 1998/99.
58.4.1	3	Average risk. Prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (1 September to 30 April). Maintain all elements of Conservation Measure 29/XVI.	SC-CAMLR-XVII, Annex 5, 7.116(ii)	• Australia (CCAMLR-XVIII/12) is proposing a trawl fishery in this area; longlining is not currently proposed.
58.4.2	2	Average-to-low risk. Prohibit longline fishing during the breeding season of giant petrels (1 October to 31 March). Maintain all elements of Conservation Measure 29/XVI.	7.84(iii)	• Australia (CCAMLR-XVIII/11) is proposing a trawl fishery in this area; longlining is not currently proposed.
58.4.3	3	Average risk. Prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (1 September to 30 April). Maintain all elements of Conservation Measure 29/XVI.	SC-CAMLR-XVII, Annex 5, 7.116(iii)	• France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season, complying with Conservation Measure 29/XVI. This season substantially conflicts with the IMALF advice. • The European Community (CCAMLR-XVIII/21) intends to fish between 15 April to 31 August, complying with Conservation Measure 29/XVI. This season will overlap the recommended season closure by two weeks. • Conservation Measure 163/XVII applied in 1998/99.

continued

Table 58 continued

Subarea/ Division	Risk Level	IMALF Risk Assessment	Reference	Notes
58.4.4	3	Average risk. Prohibit longline fishing during the main breeding season of albatrosses and petrels (1 September to 30 April) Maintain all elements of Conservation Measure 29/XVI.	SC-CAMLR-XVII, Annex 5, 7.116(iv)	• France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season, complying with Conservation Measure 29/XVI. This season substantially conflicts with the IMALF advice. • Chile (CCAMLR-XVIII/13), South Africa (CCAMLR-XVIII/9), Uruguay (CCAMLR-XVIII/14) and the European Community (CCAMLR-XVIII/21) propose to fish from 15 April to 31 August, complying with Conservation Measure 29/XVI. This season will overlap the recommended season closure by two weeks. • Conservation Measure 164/XVII applied in 1998/99.
58.5.1	5	High risk. Prohibit longline fishing during the main albatross and petrel breeding season (i.e. 1 September to 30 April). Ensure strict compliance with Conservation Measure 29/XVI.	SC-CAMLR-XVII, Annex 5, 7.116(v)	• France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season, complying with Conservation Measure 29/XVI. This season substantially conflicts with the IMALF advice. • Chile (CCAMLR-XVIII/13) stated that it would comply with conservation measures that were in force concerning fishing seasons in relevant subareas and divisions. • I t is understood that Chile intends to comply fully with Conservation Measure 29/XVI. • No conservation measures applied to this area in 1998/99.
58.5.2	4	Average-to-high risk. Prohibit longline fishing within the breeding season of the main albatross and petrel species (1 September to 30 April). Ensure strict compliance with Conservation Measure 29/XVI.	SC-CAMLR-XVII, Annex 5, 7.116(vi)	• France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/00 season, complying with Conservation Measure 29/XVI. This season substantially conflicts with the IMALF advice. • Longline fishing is currently prohibited within the EEZ around Heard/McDonald Islands. • No conservation measures applied to this area in 1998/99.

continued

Table 58 continued

Subarea/ Division	Risk Level	IMALF Risk Assessment	Reference	Notes
58.6	5	High risk. Prohibit longline fishing during the main albatross and petrel breeding season (i.e. 1 September to 30 April). Ensure strict compliance with Conservation Measure 29/XVI.	SC-CAMLR-XVII, Annex 5, 7.116(vii)	• France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season, complying with Conservation Measure 29/XVI. This season substantially conflicts with the IMALF advice. • South Africa (CCAMLR-XVIII/8), Chile (CCAMLR-XVIII/13) and the European Community (CCAMLR-XVIII/21) propose to fish from 15 April to 31 August, complying with Conservation Measure 29/XVI. This season will overlap the recommended season closure by two weeks. • Conservation Measure 168/XVII applied in 1998/99.
58.7	5	High risk. Prohibit longline fishing during the main albatross and petrel breeding season (i.e. 1 September to 30 April). Ensure strict compliance with Conservation Measure 29/XVI.	SC-CAMLR-XVII, Annex 5, 7.116(viii)	• France (CCAMLR-XVIII/20) proposes to fish the whole of the 1999/2000 season, complying with Conservation Measure 29/XVI. This season substantially conflicts with the IMALF advice. • Conservation Measure 160/XVII applied in 1998/99.
88.1	3	Average risk overall. Average risk in northern sector (*D. eleginoides* fishery), average to low risk in southern sector (*D. mawsoni* fishery). Longline fishing season limits of uncertain advantage; the provisions of Conservation Measure 29/XVI should be strictly adhered to.	SC-CAMLR-XVII, Annex 5, 7.116(ix)	• Chile (CCAMLR-XVIII/13), the European Community (CCAMLR-XVIII/21) and New Zealand (CCAMLR-XVIII/10) propose to fish from 15 December to 31 August. • This does not conflict with the IMALF advice. • Chile and the European Community intend to comply fully with Conservation Measure 29/XVI. • New Zealand (CCAMLR-XVIII/10) proposes a continuation of the variation to Conservation Measure 29/XVI as provided for by Conservation Measure 169/XVII, to allow line-weighting experiments to continue south of 65°S in Subarea 88.1 (see paragraphs 7.85 to 7.91 for further discussion). • Conservation Measure 169/XVII applied in 1998/99.

continued

Table 58 continued

Subarea/ Division	Risk Level	IMALF Risk Assessment	Reference	Notes
88.2	1	Low risk. No obvious need for restriction of longline fishing season. Apply Conservation Measure 29/XVI as a seabird by-catch precautionary measure.	7.84(xi)	• The European Community (CCAMLR-XVIII/21) will comply with Conservation Measure 29/XVI, including only setting gear at night. • It is understood that Chile intends to comply fully with Conservation Measure 29/XVI. • No conservation measures applied to this area in 1998/99.

Table 59: Results from new and exploratory longline fisheries proposed in 1998/99.

Subarea/Division	Country	Catch (tonnes)	Report on Seabird By-catch
48.6	South Africa	0	
58.4.3	France	No fishing	
58.4.4	South Africa Spain Uruguay France	No fishing No fishing No fishing No fishing	
58.6	South Africa	201 in EEZ	WG-FSA-99/42
58.7	South Africa	180 in EEZ	WG-FSA-99/42
88.1	New Zealand	298	WG-FSA-99/35

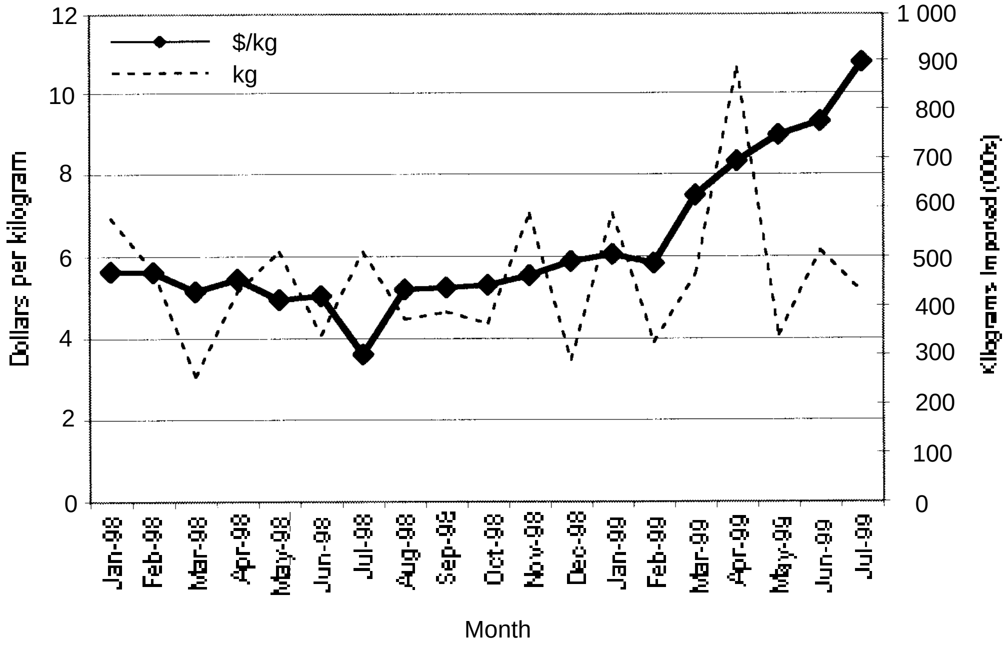


Figure 1: Import quantity and price of *Dissostichus* spp. into the US market, from January 1998 to July 1999. Dollars are US$.

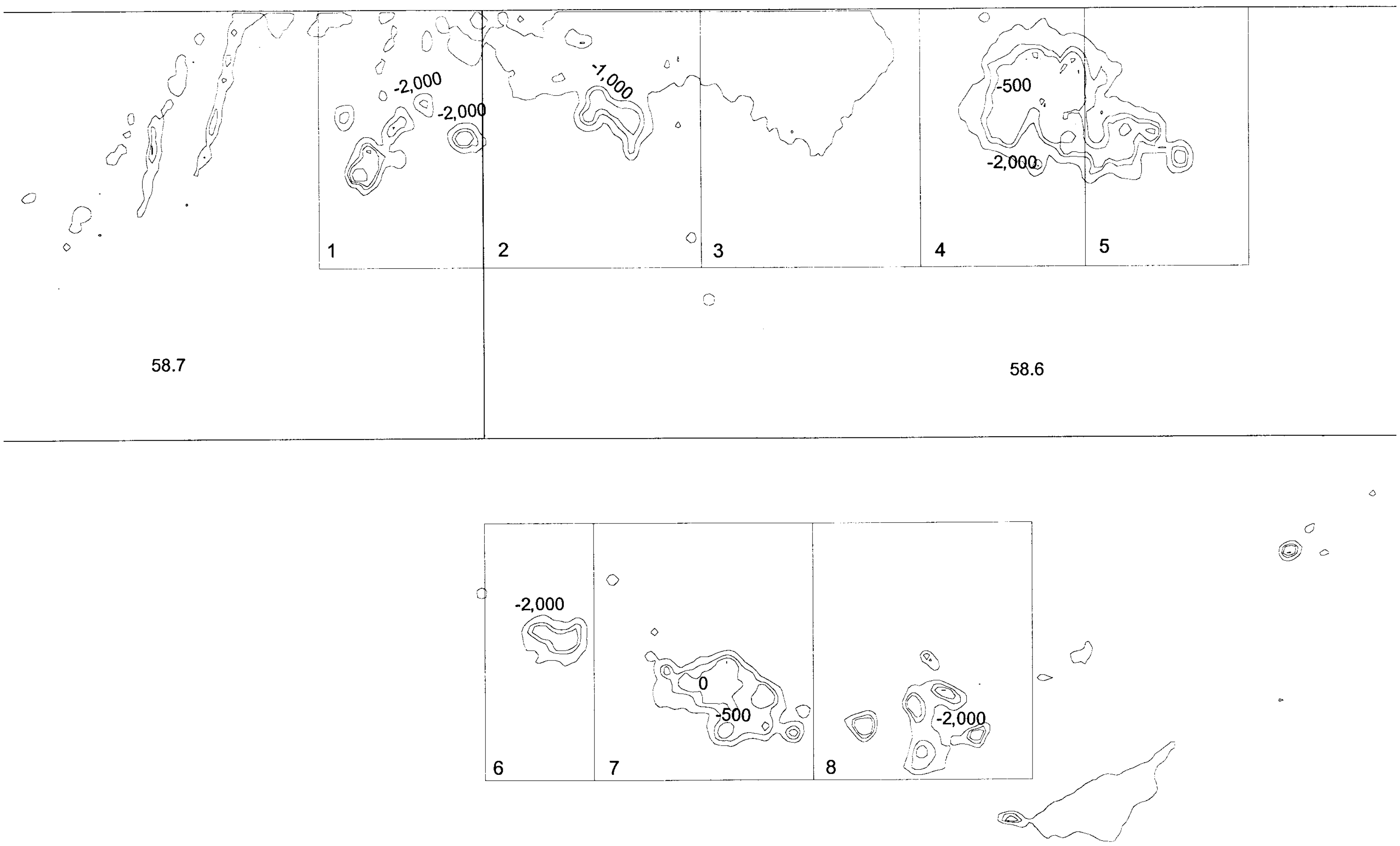


Figure 2: Outline of an experimental design for acquiring spatial information in new and exploratory fisheries in Subareas 58.6 and 58.7 and Division 58.4.4.

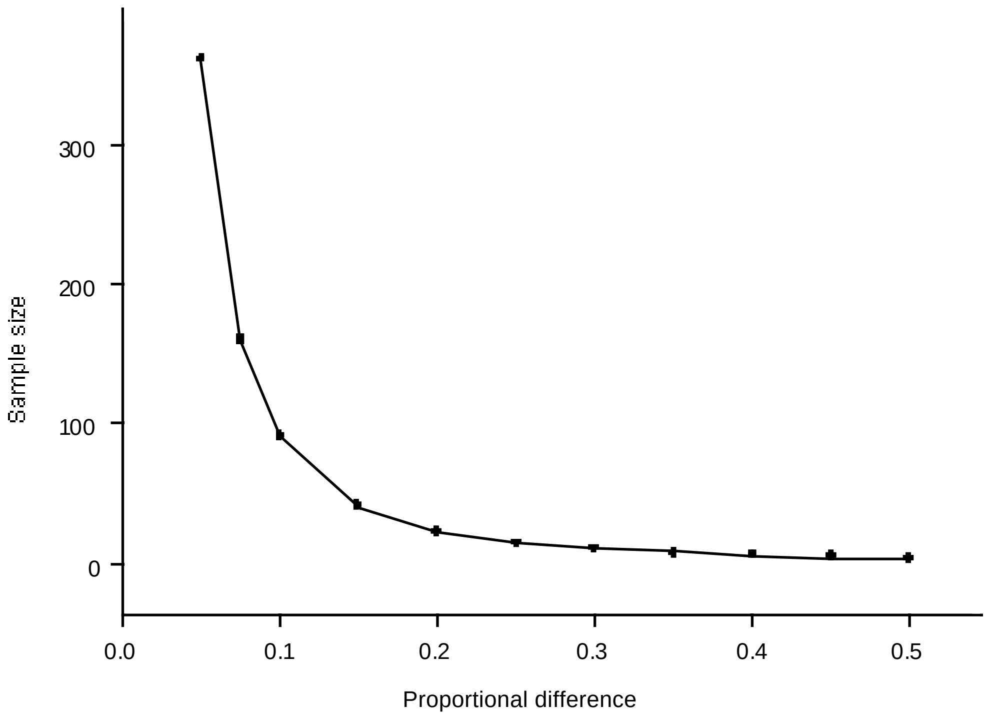


Figure 3: Sample sizes to detect a proportional difference in sqrt(CPUE/kg) with a two-sided 5% test and power 0.8.

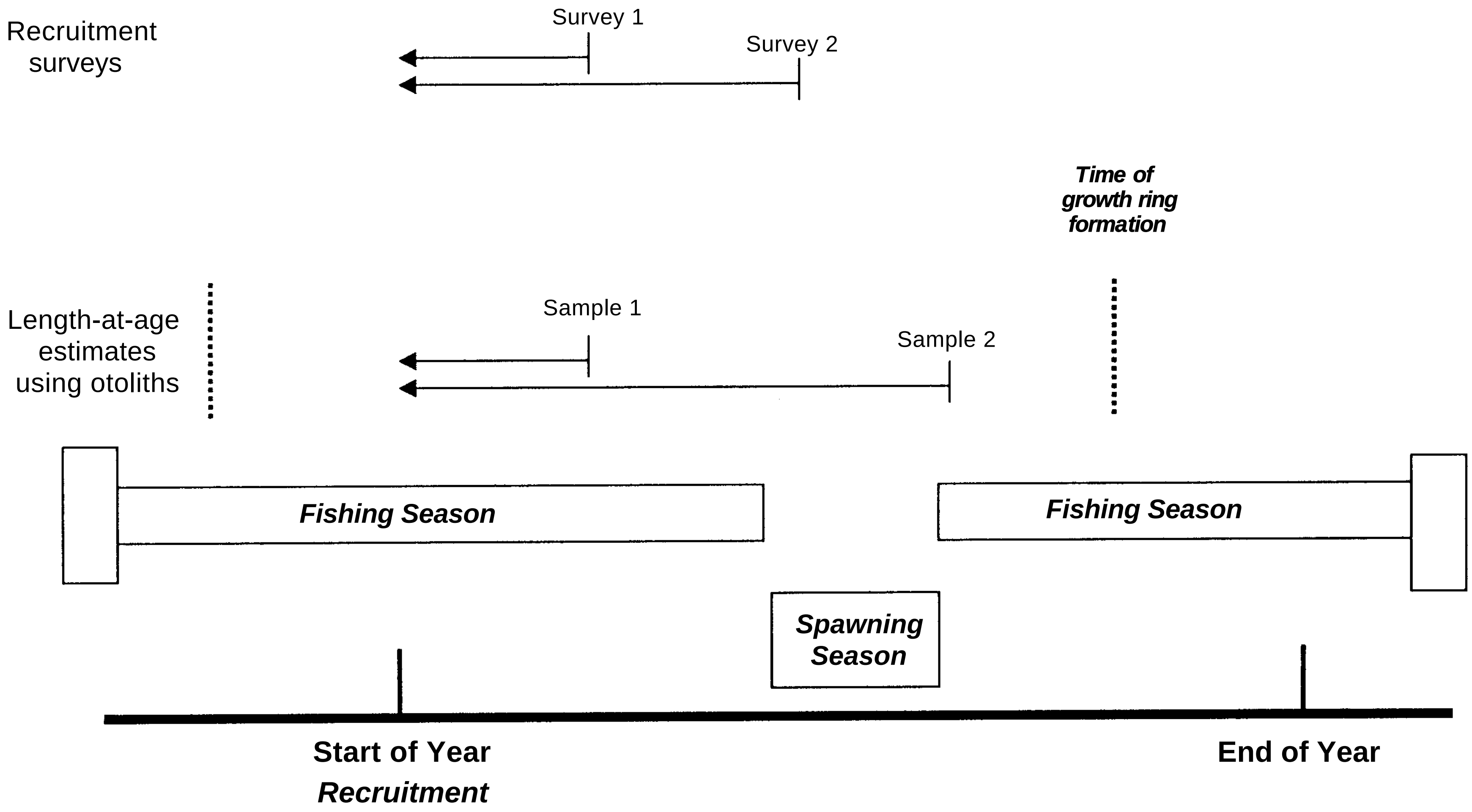


Figure 4: Schematic diagram to show the relationships between data collected to estimate growth and recruitment and the starting point in the projections using the GYM. The 'start of year' is the time, when new recruits enter the simulated population. Example timings of the spawning season and fishing season are shown.

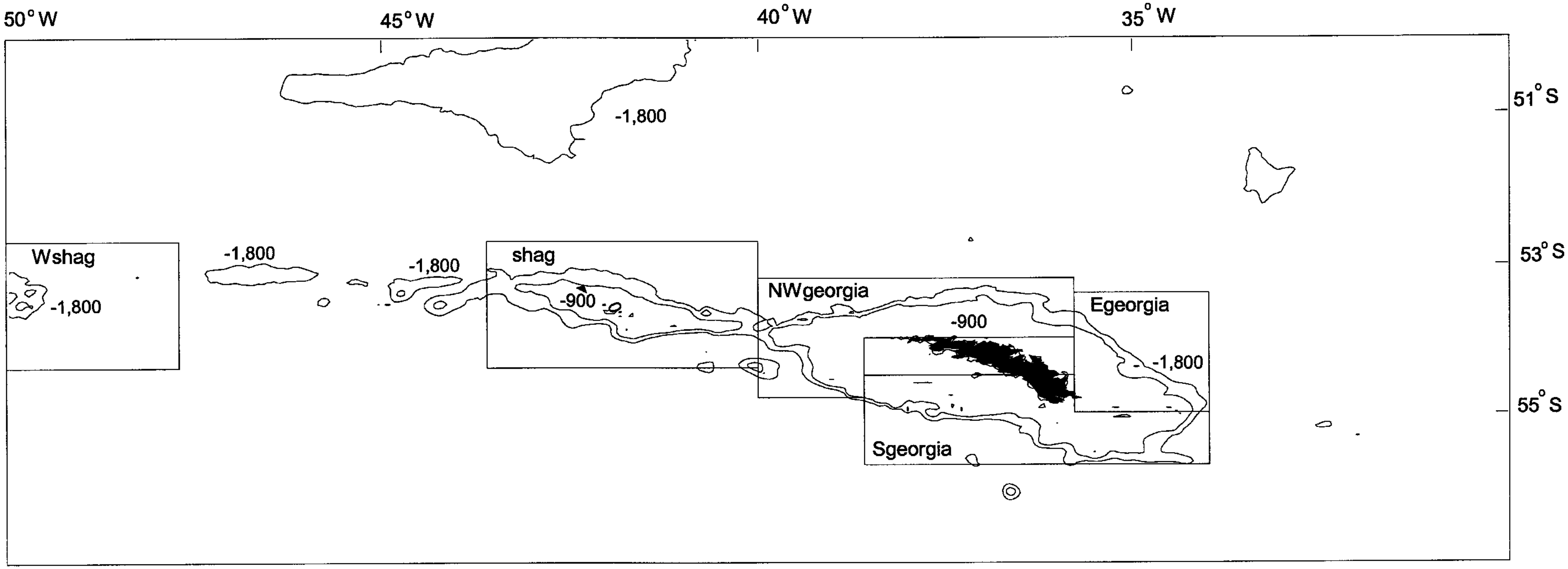


Figure 5: Fishing grounds in Subarea 48.3 used in the CPUE analysis for *D. eleginoides*. The 900 m and 1 800 m depth contour lines are indicated. shag – Shag Rocks, georgia – South Georgia.

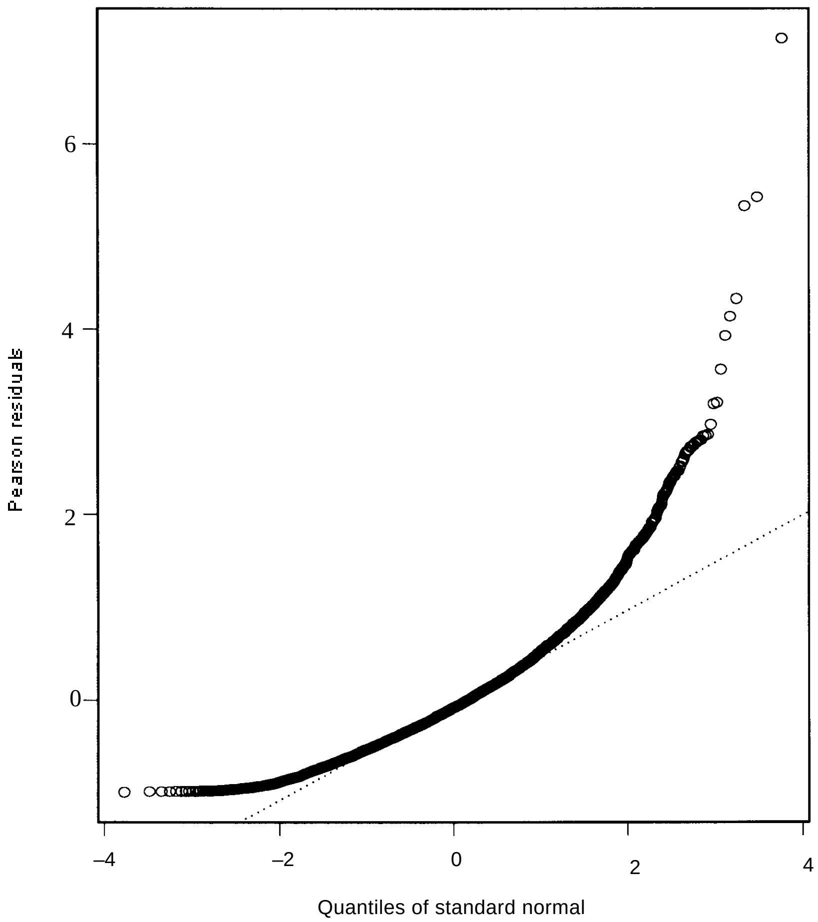


Figure 6: QQ plot of standardised residuals for the GLM fitted to CPUEs in kg/hook using the Gamma distribution family with a log link.

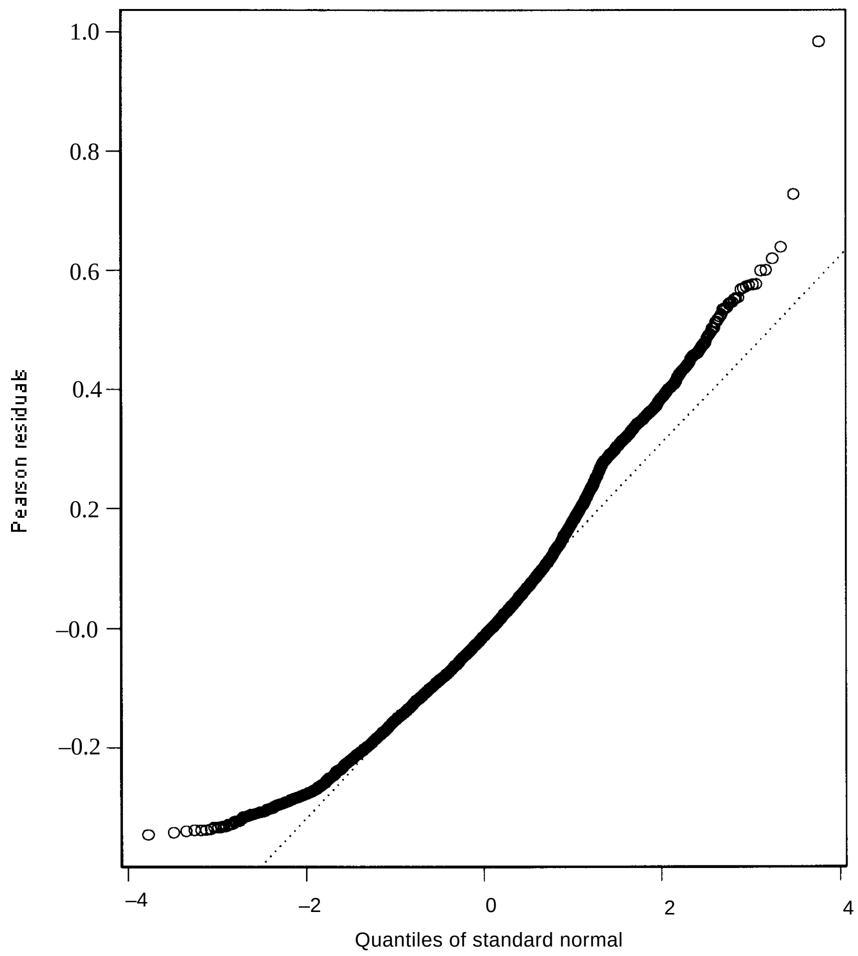


Figure 7: QQ plot of standardised residuals for the GLM fitted to CPUEs in kg/hook using a robust GLM with the quasi distribution family with a sqrt link.

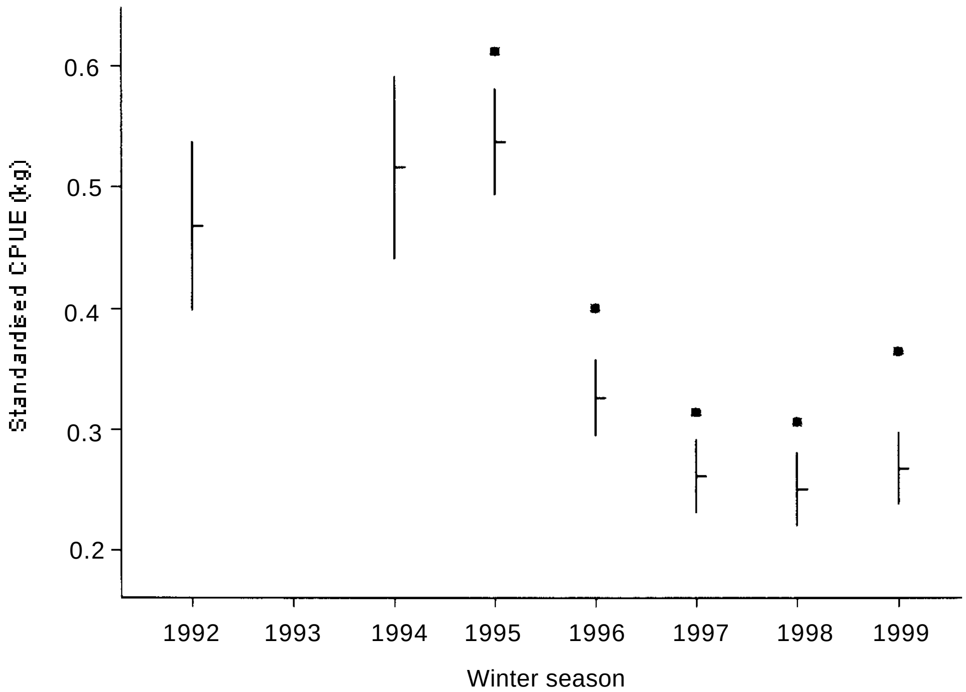


Figure 8: Standardised and nominal winter season CPUEs in kg/hook for Subarea 48.3.

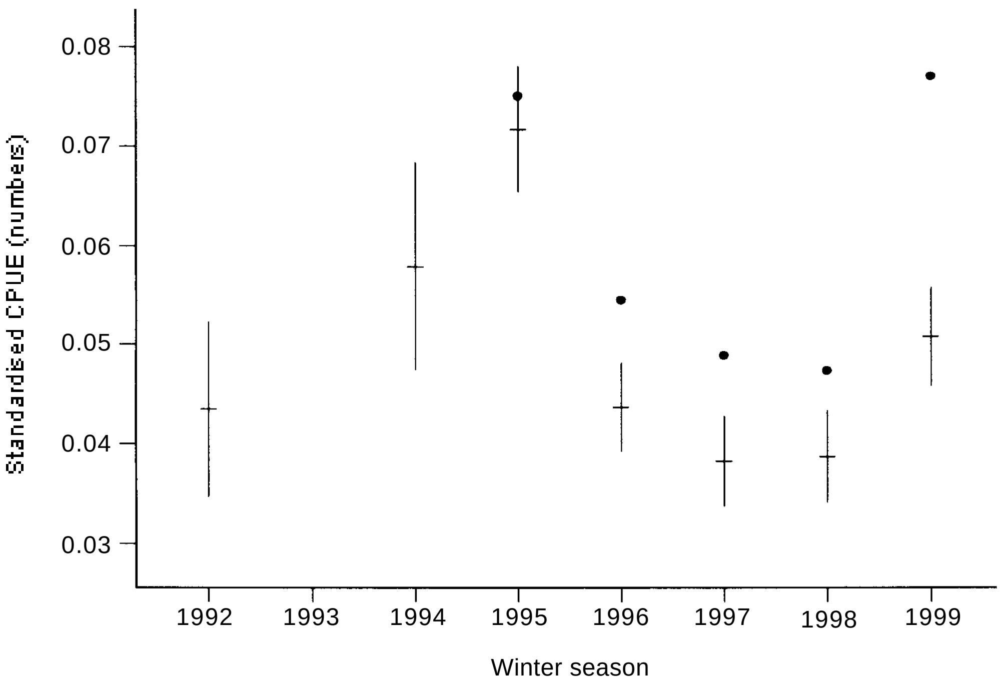


Figure 9: Standardised and nominal winter season CPUEs in numbers/hook for Subarea 48.3.

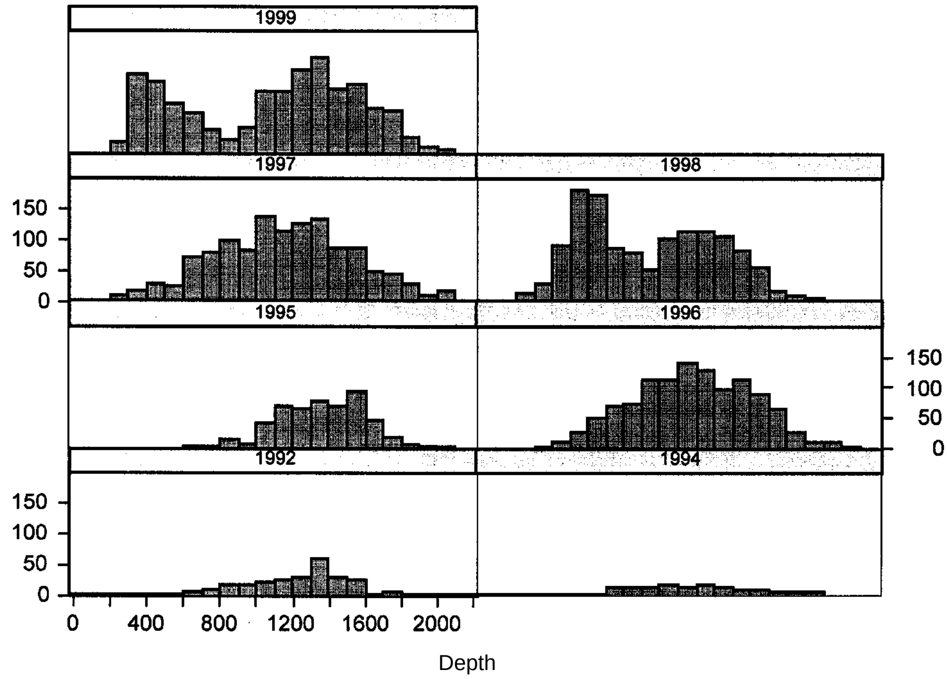


Figure 10: Histograms of depths fished during the winter seasons in Subarea 48.3.

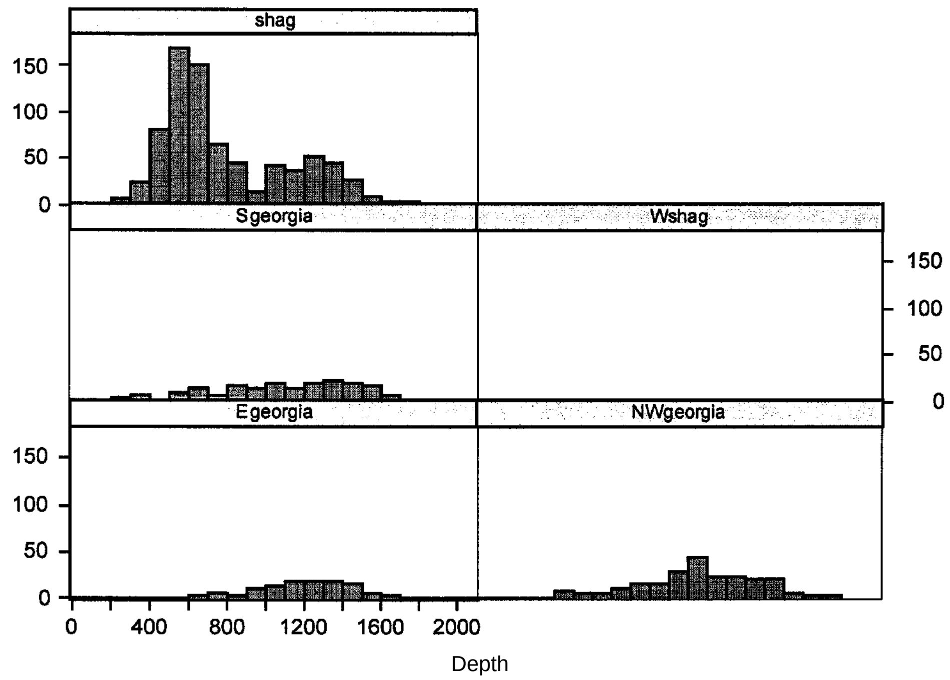


Figure 11: Histograms of depths fished during the winter 1997/98 season by area in Subarea 48.3.

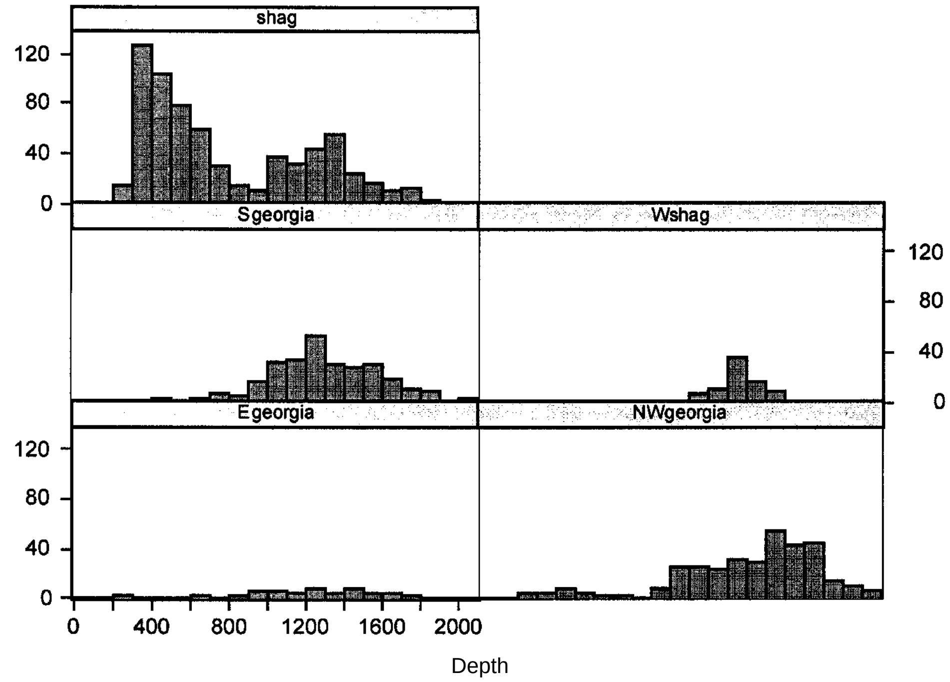


Figure 12: Histograms of depths fished during the winter 1998/99 season by area in Subarea 48.3.

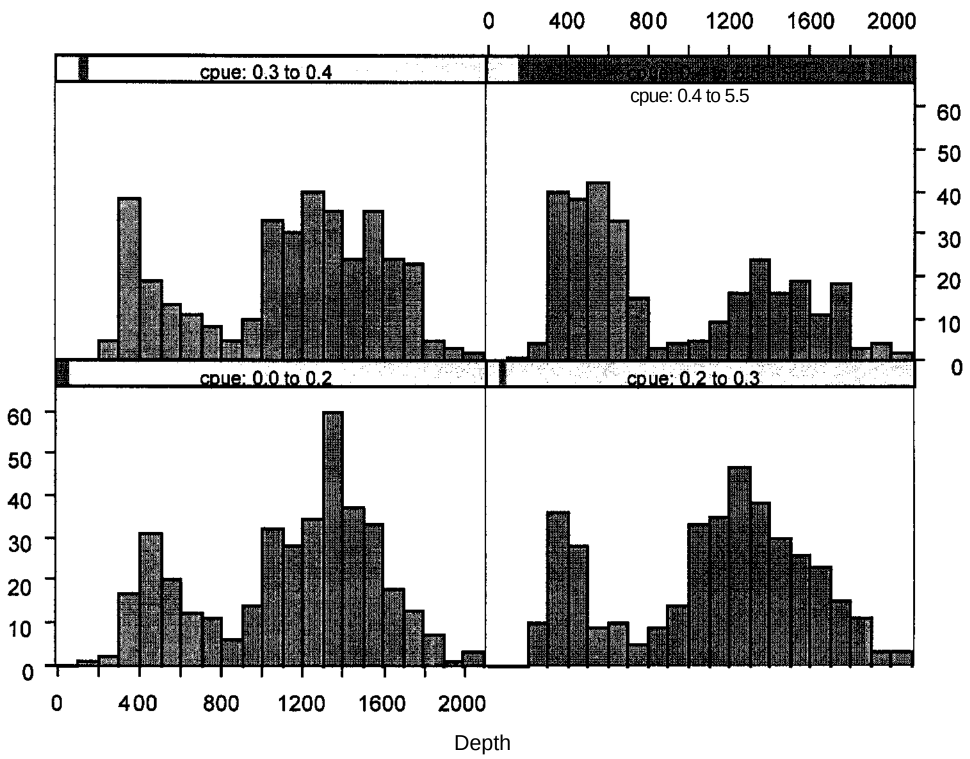


Figure 13: Histograms of depths fished during the winter 1998/99 season in Subarea 48.3 for different levels of CPUE in kg/hook.

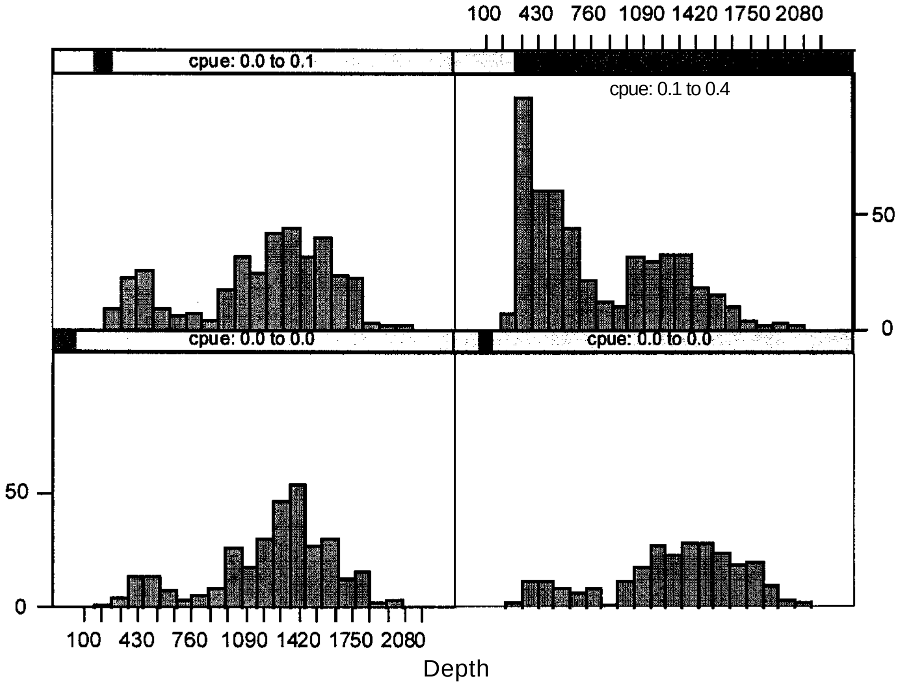


Figure 14: Histograms of depths fished during the winter 1998/99 season in Subarea 48.3 for different levels of CPUE in numbers/hook.

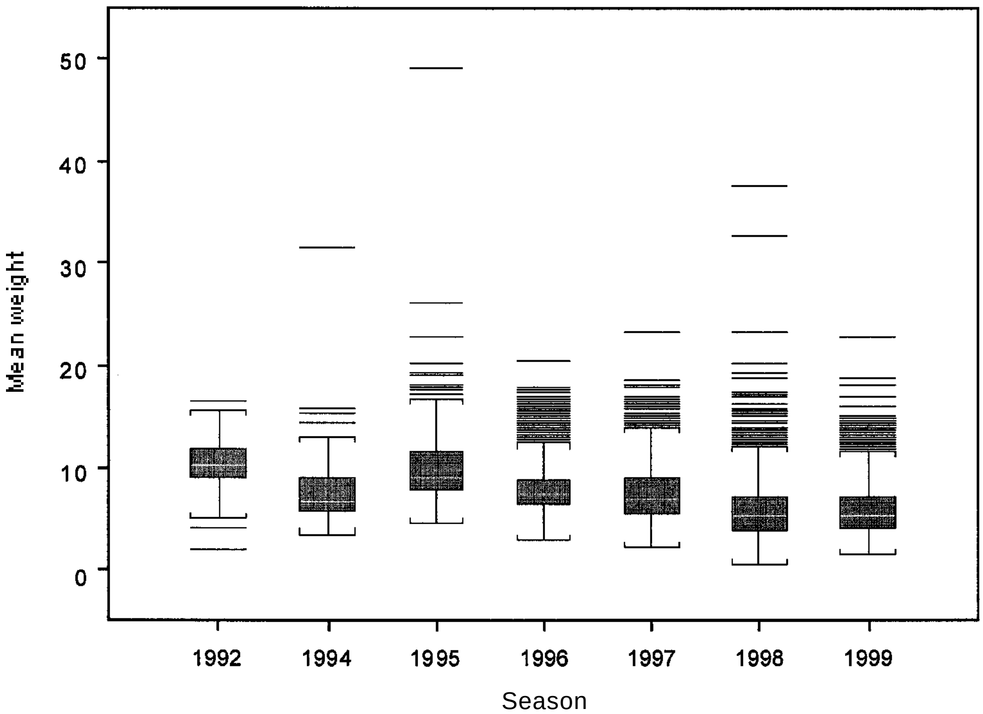


Figure 15: Mean weights of fish taken during the winter seasons in Subarea 48.3.

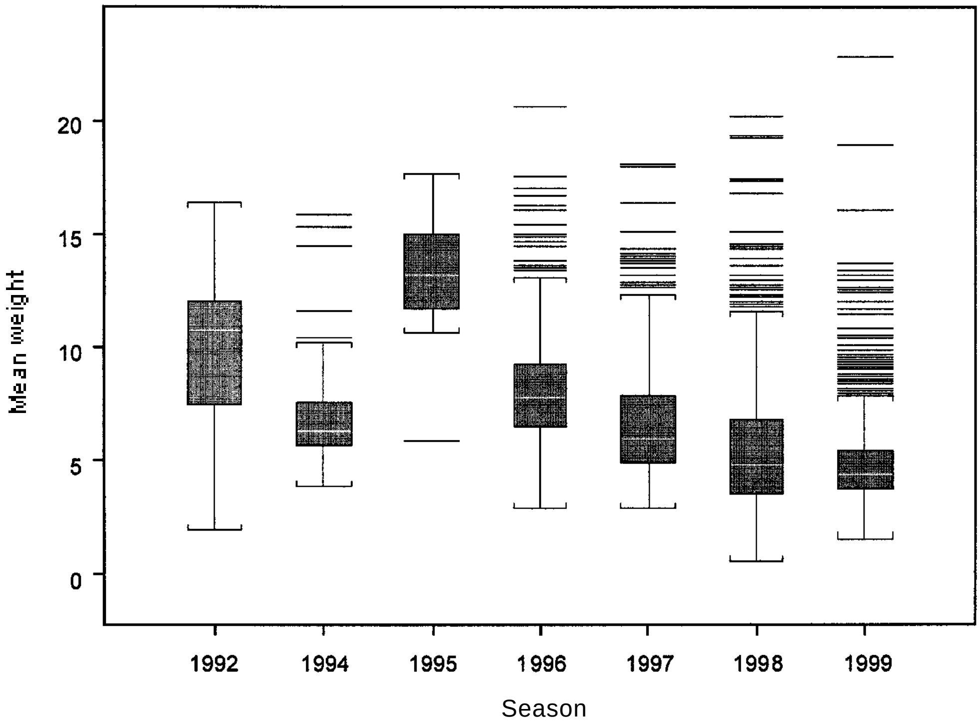


Figure 16: Mean weights of fish taken during the winter seasons at Shag Rocks.

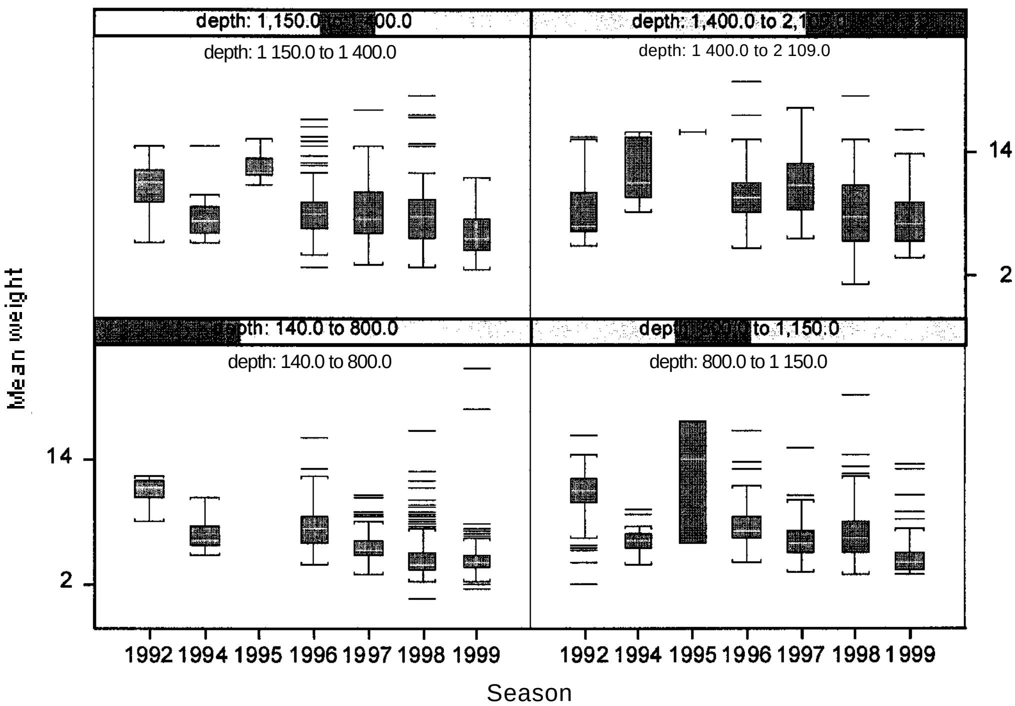


Figure 17: Mean weights of fish taken during the winter seasons at Shag Rocks by depth.

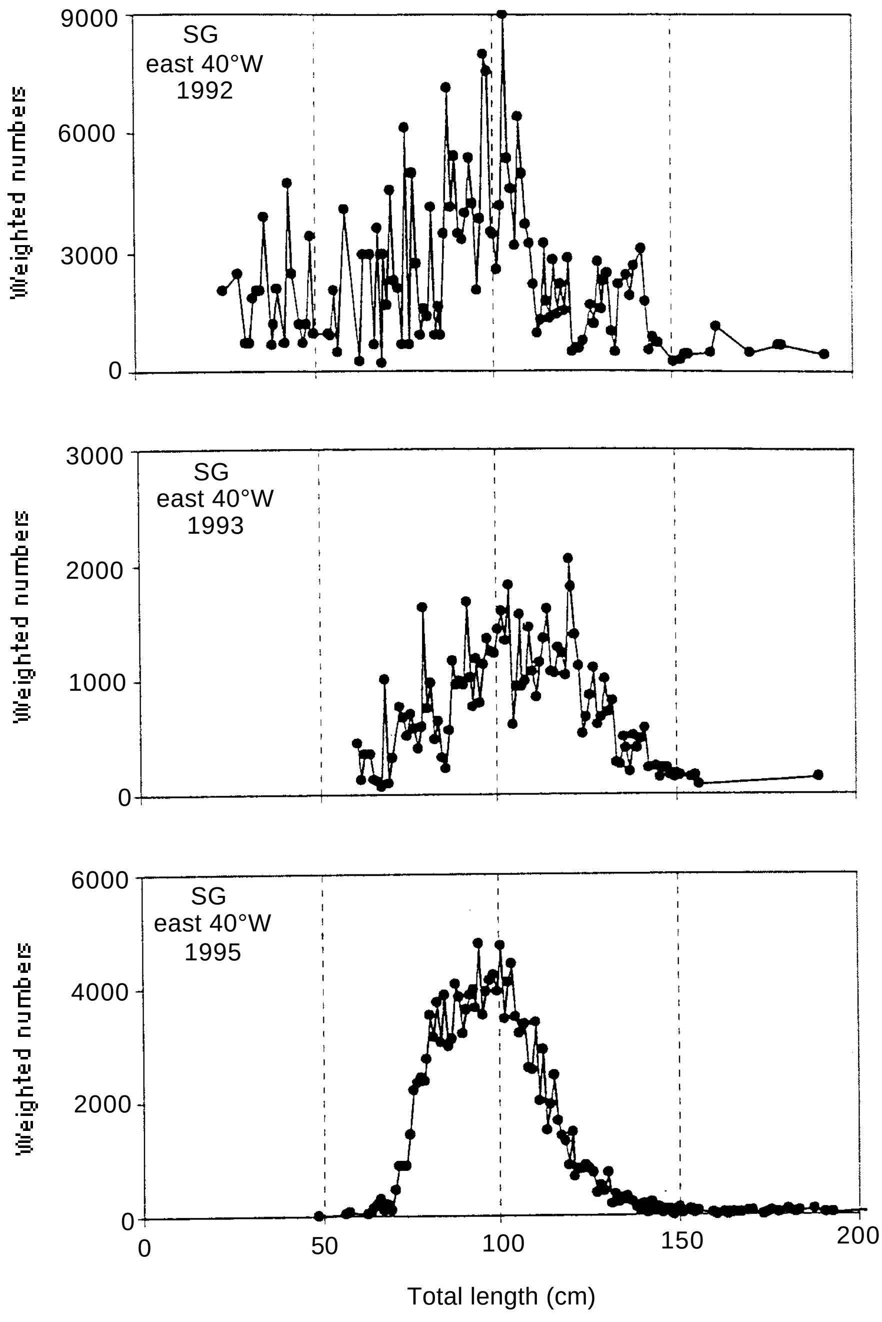


Figure 18: Catch-weighted length frequencies by season for fish taken around South Georgia.

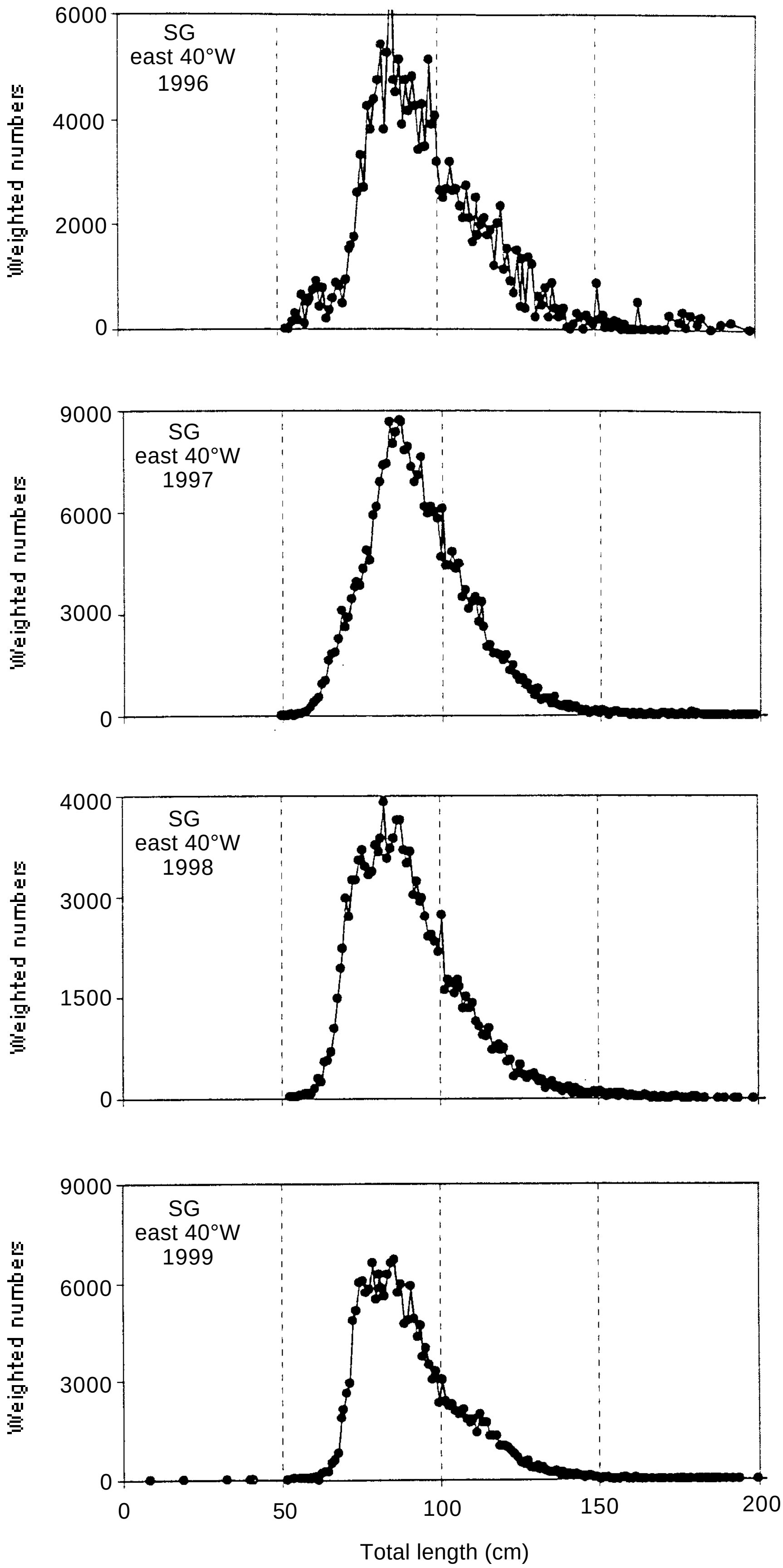


Figure 18 (continued)

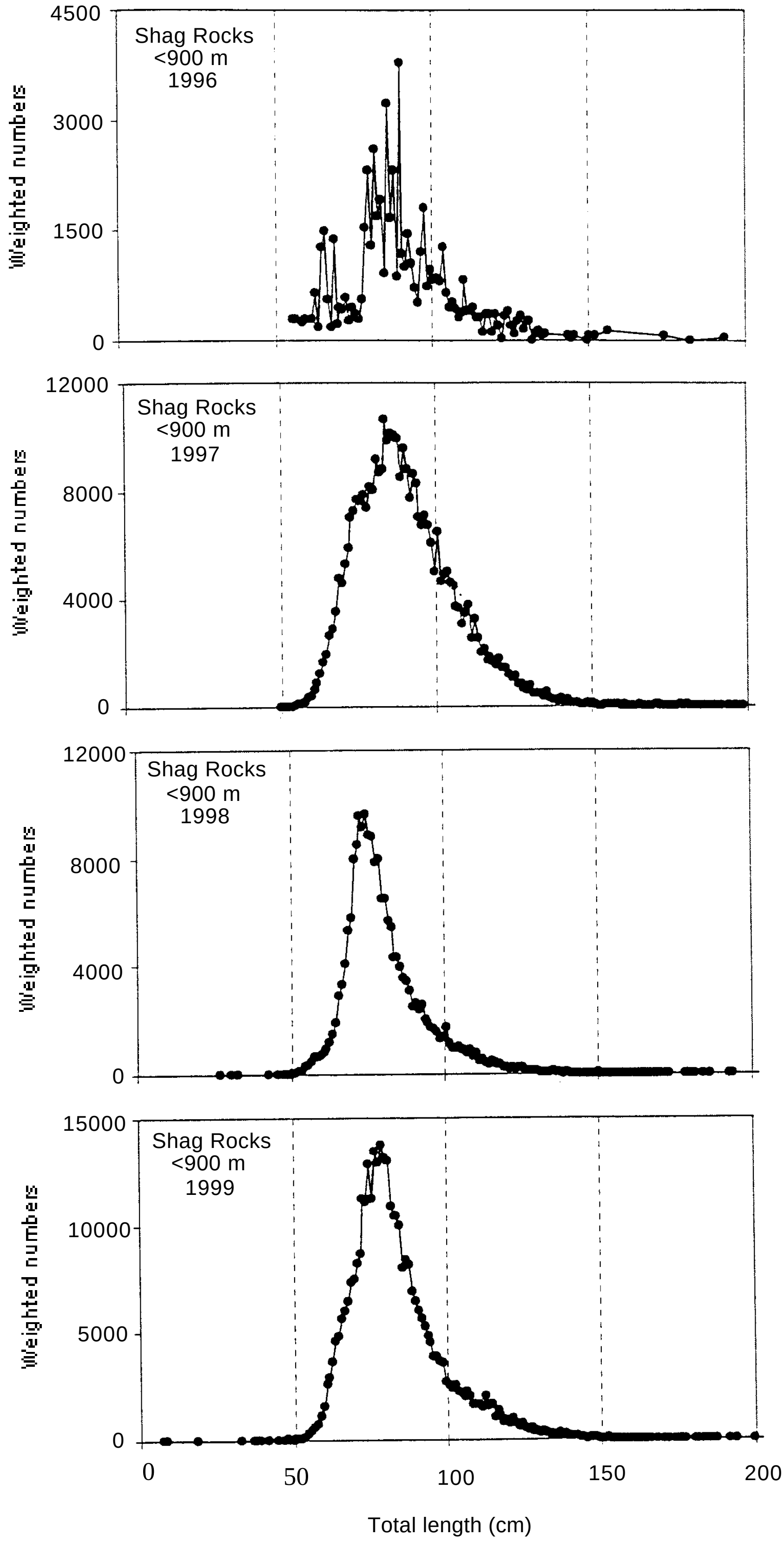


Figure 19: Catch-weighted length frequencies by season for fish taken around Shag Rocks at depths less than 900 m.

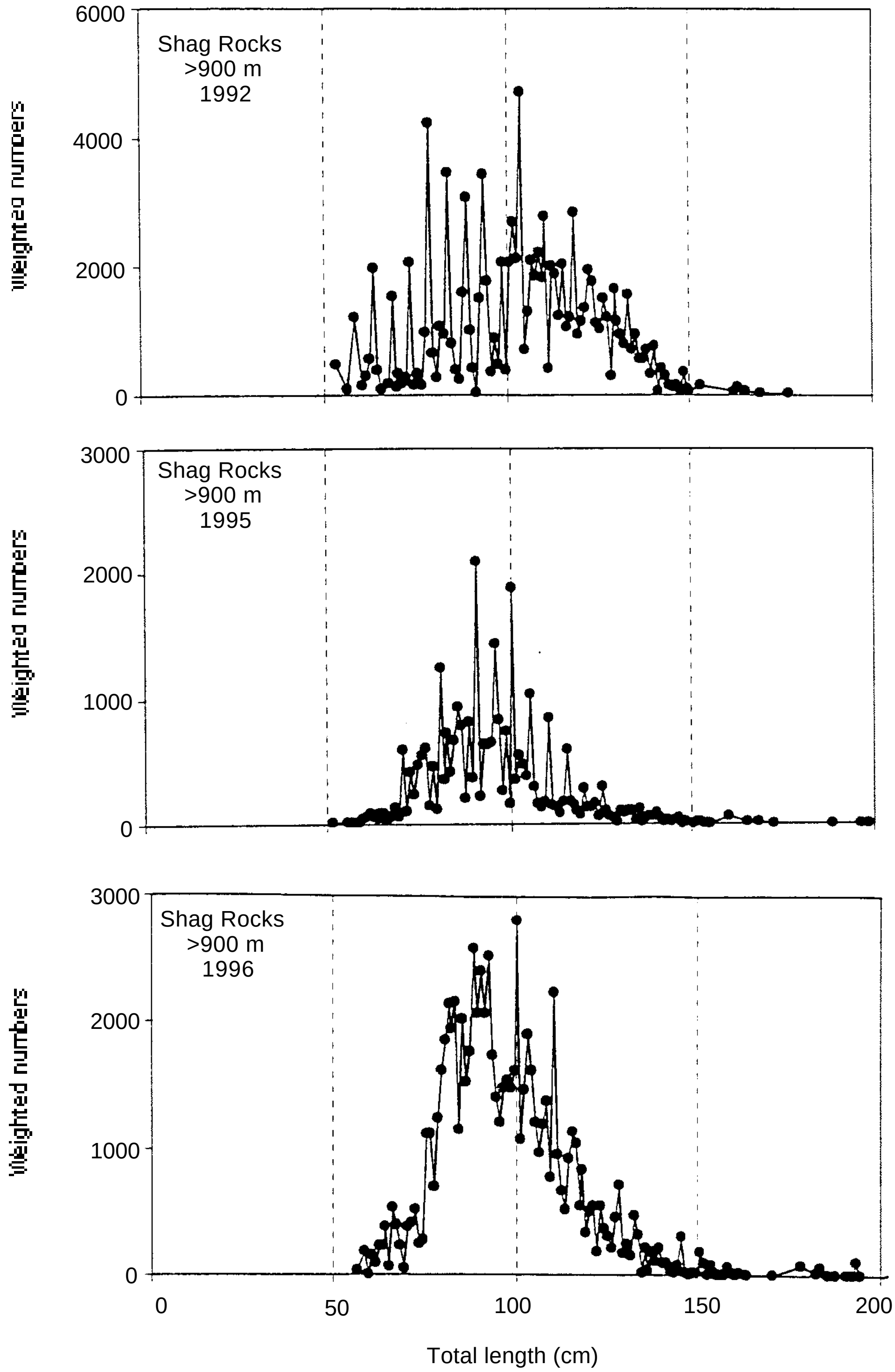


Figure 20: Catch-weighted length frequencies by season for fish taken aorund Shag Rocks at depths greater than 900 m.

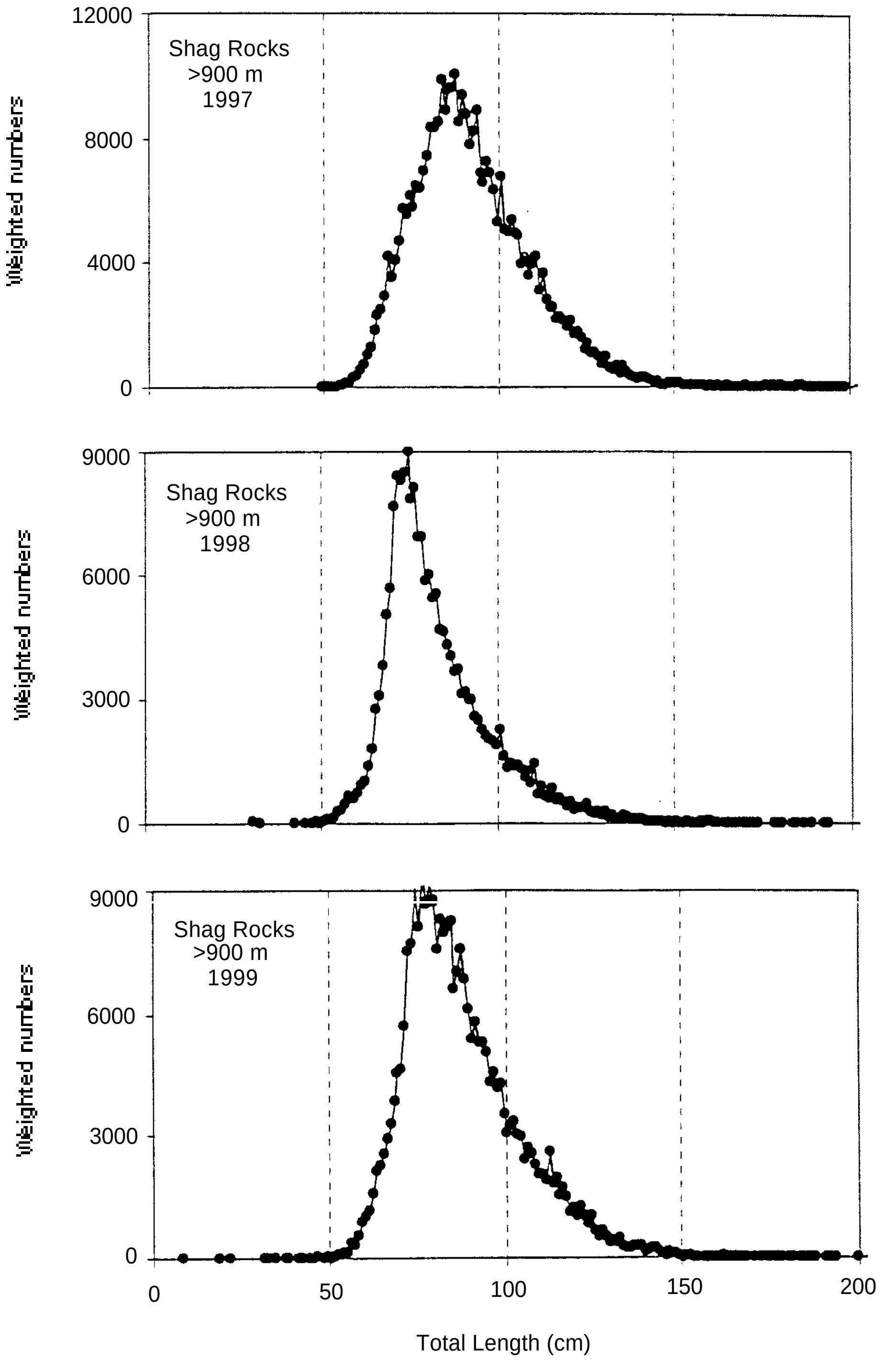


Figure 20 (continued)

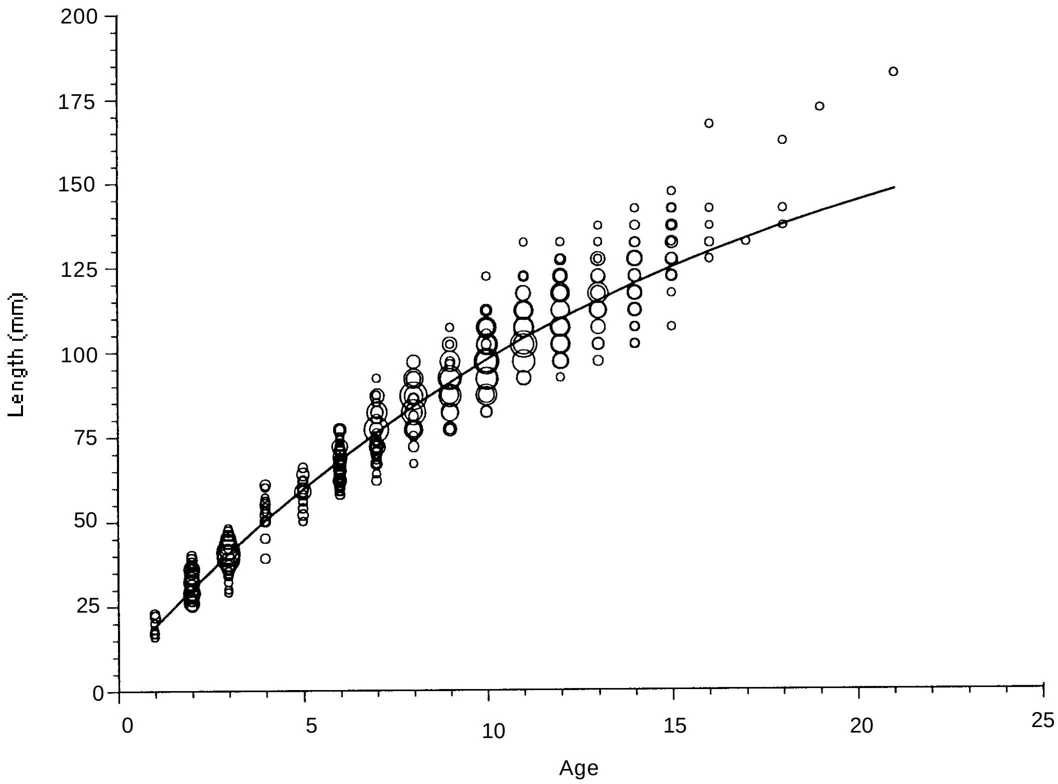


Figure 21: Lengths at age for *D. eleginoides* in Subarea 48.3 taken during 1991 from a UK trawl survey in January and February and as age–length keys from the Chilean fishery from February to May. The fitted curve is for the estimated parameters – L_∞ = 194.6 cm, k = 0.066.yr^{-1} and t_0 = -0.56 years.

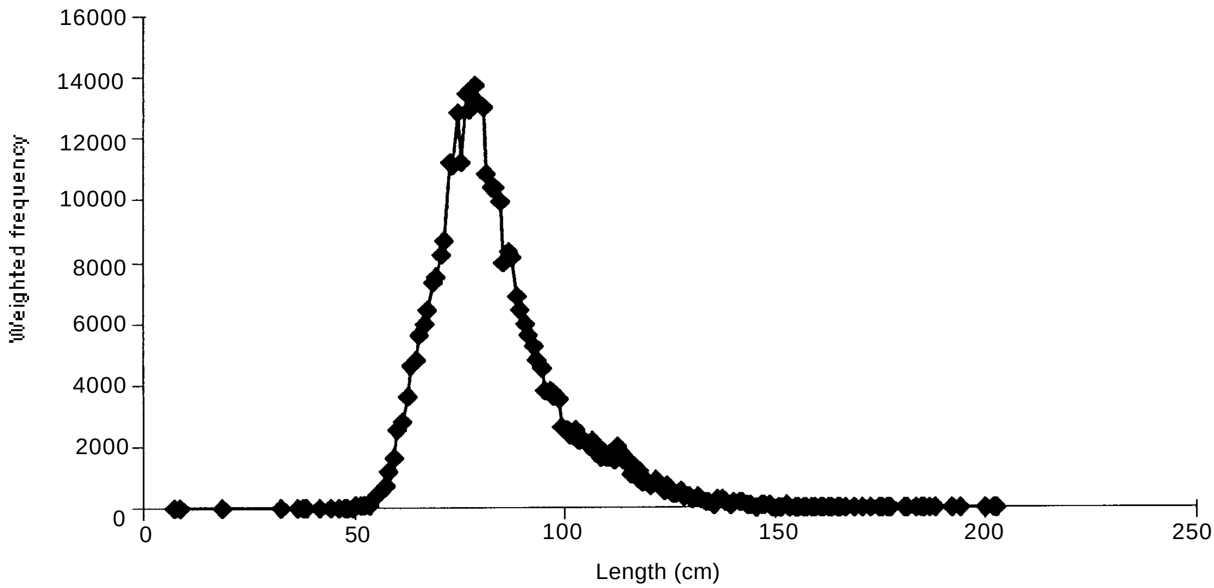
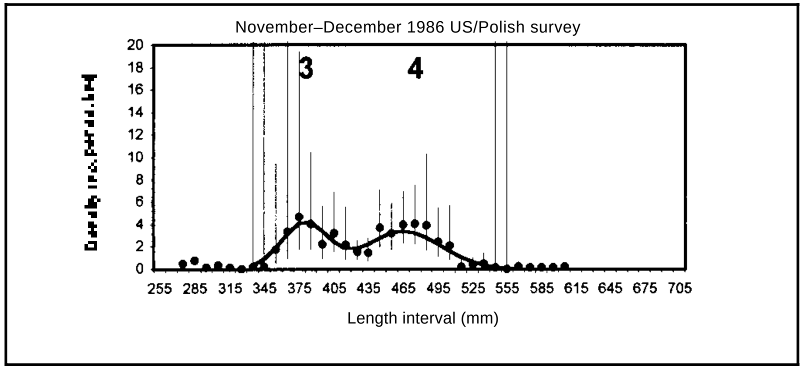


Figure 22: Weighted length frequencies of *D. eleginoides* from the commercial longline fishery in Subarea 48.3 from 1992 to the present.

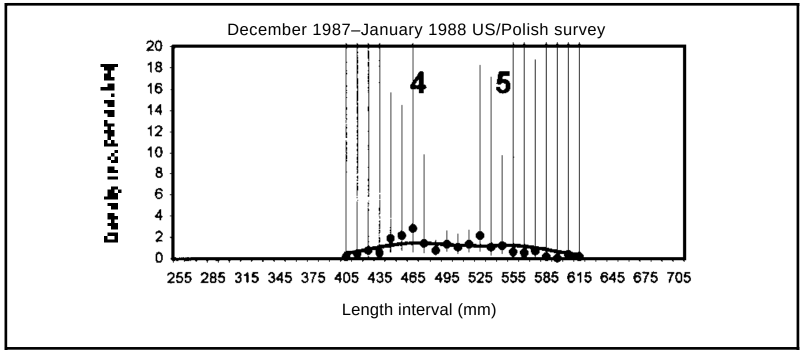
UK/US/Polish Survey Series

Argentine Survey Series

1986/87



1987/88



1988/89

No surveys

1989/90

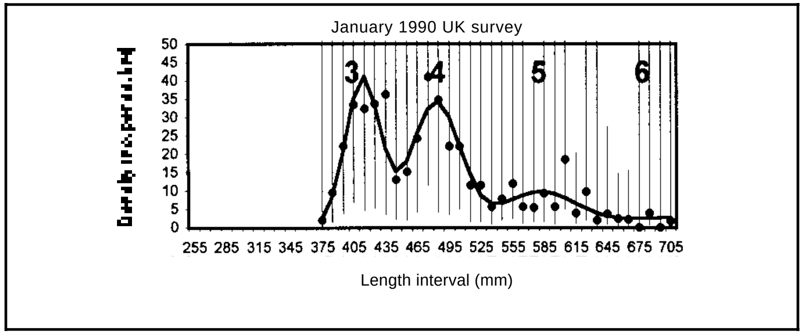
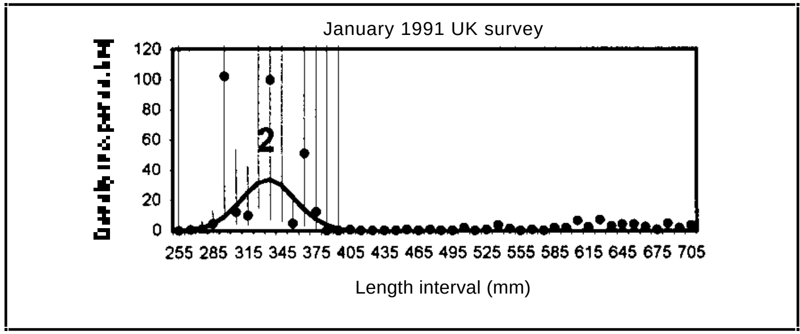


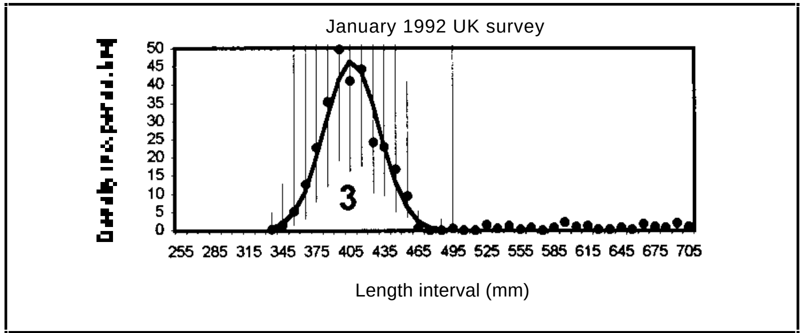
Figure 23: Plots of observed and expected length-density data produced using the CMIX program. Vertical bars represent upper and lower confidence intervals on observed density at length. Numbers superimposed on the plots indicate nominal ages assigned to each mixture.

	UK/US/Polish Survey Series	Argentine Survey Series

1990/91



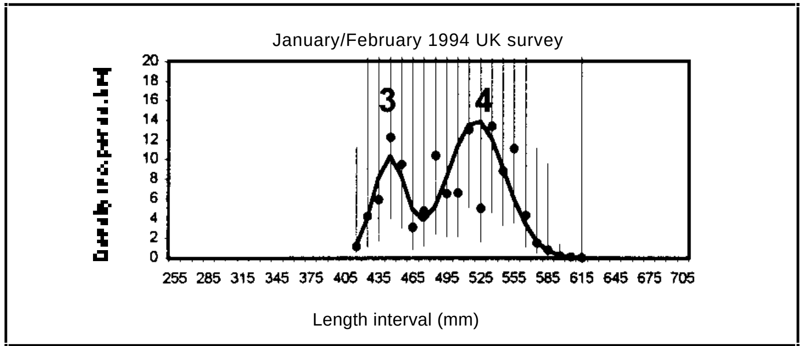
1991/92



1992/93

No surveys

1993/94



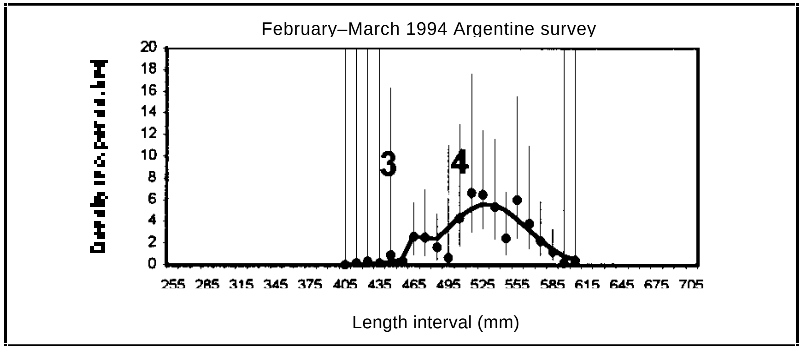
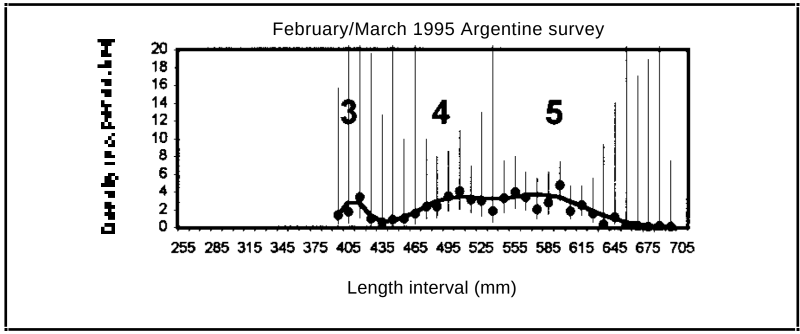


Figure 23 continued

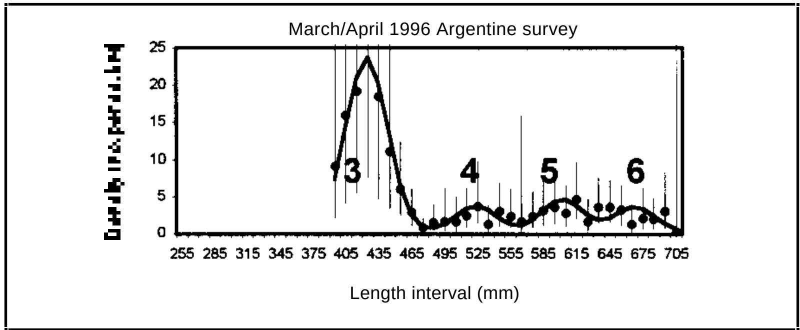
UK/US/Polish Survey Series

Argentine Survey Series

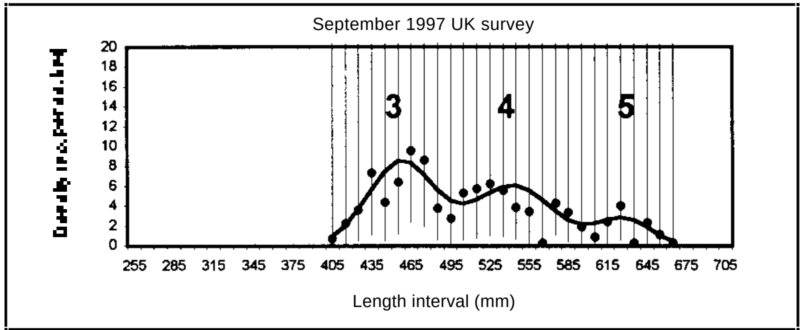
1994/95



1995/96



1996/97



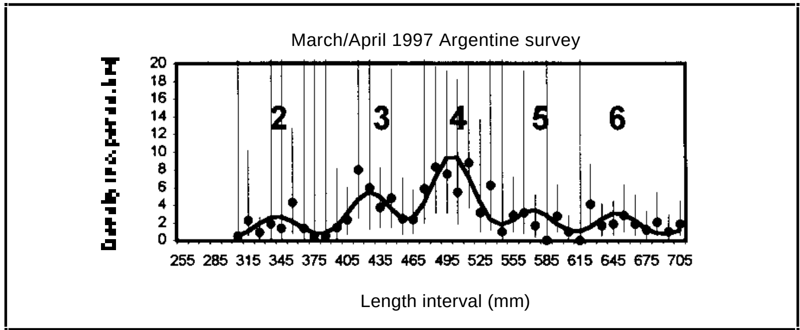


Figure 23 continued

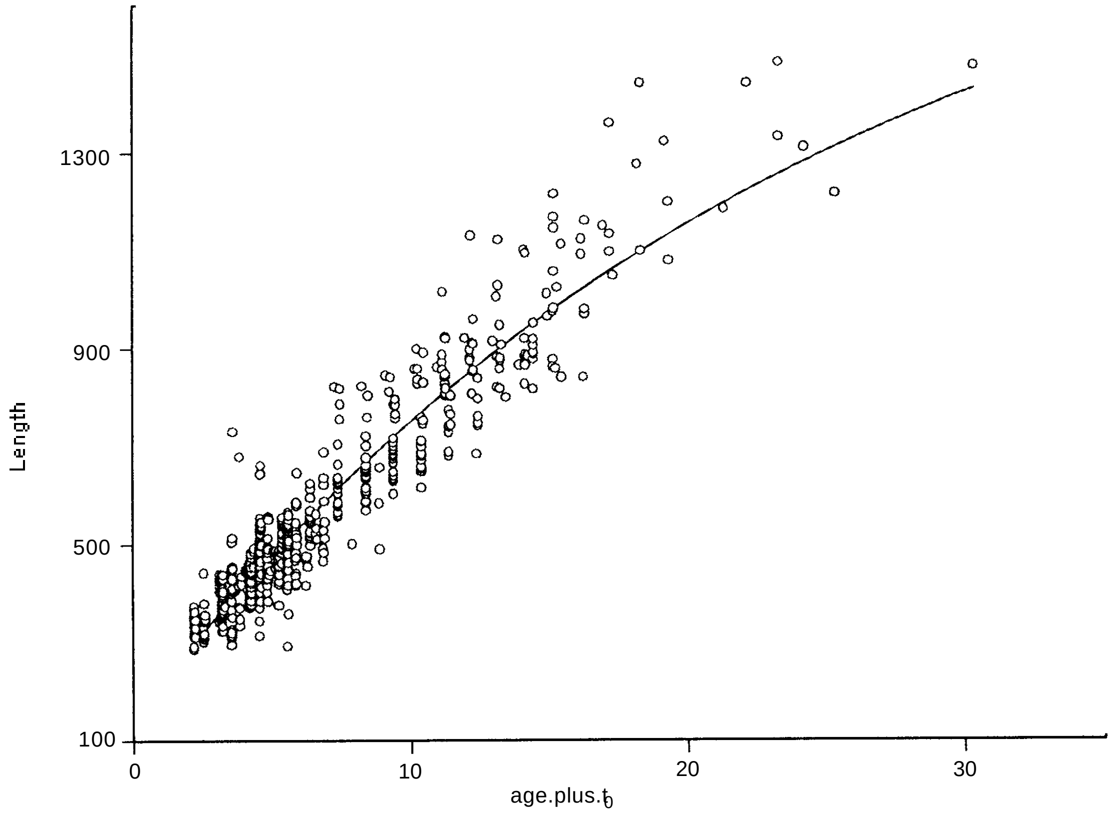


Figure 24: Lengths at age for *D. eleginoides* in Division 58.5.2 taken during trawl surveys in 1990 and 1993 and in the commercial fishery since 1997. The fitted curve is for the estimated parameters – L_∞ = 194.6 cm, k = 0.0414.yr^{-1} and t_0 = -1.80 years.

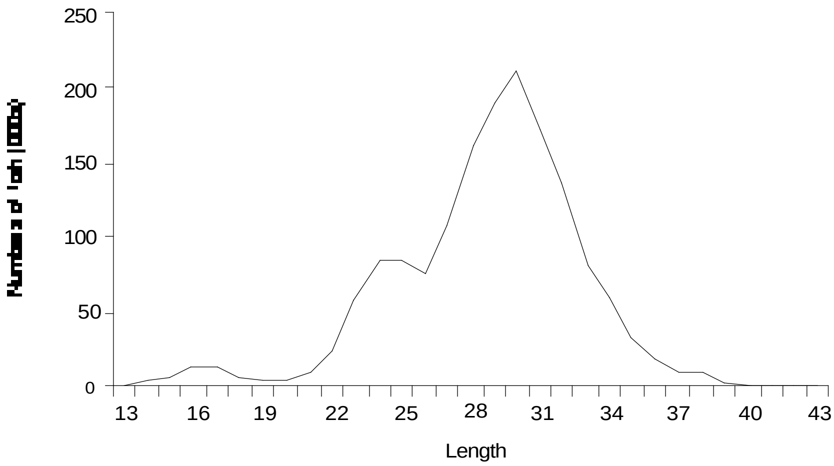


Figure 25: Weighted length frequency of *C. gunnari* during the 1998/99 season in Subarea 48.3.

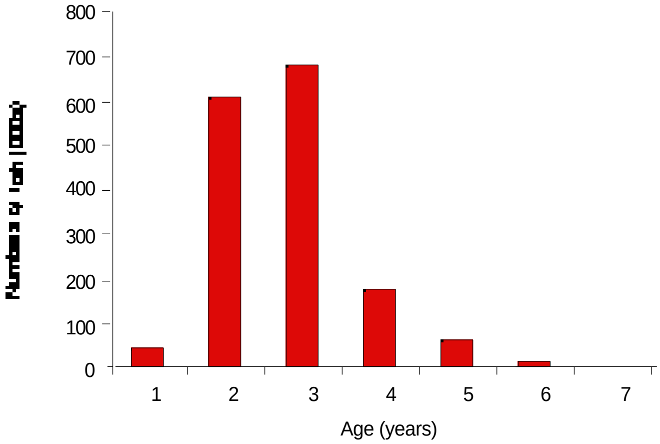


Figure 26: Catch at age of *C. gunnari* during the 1998/99 season in Subarea 48.3.

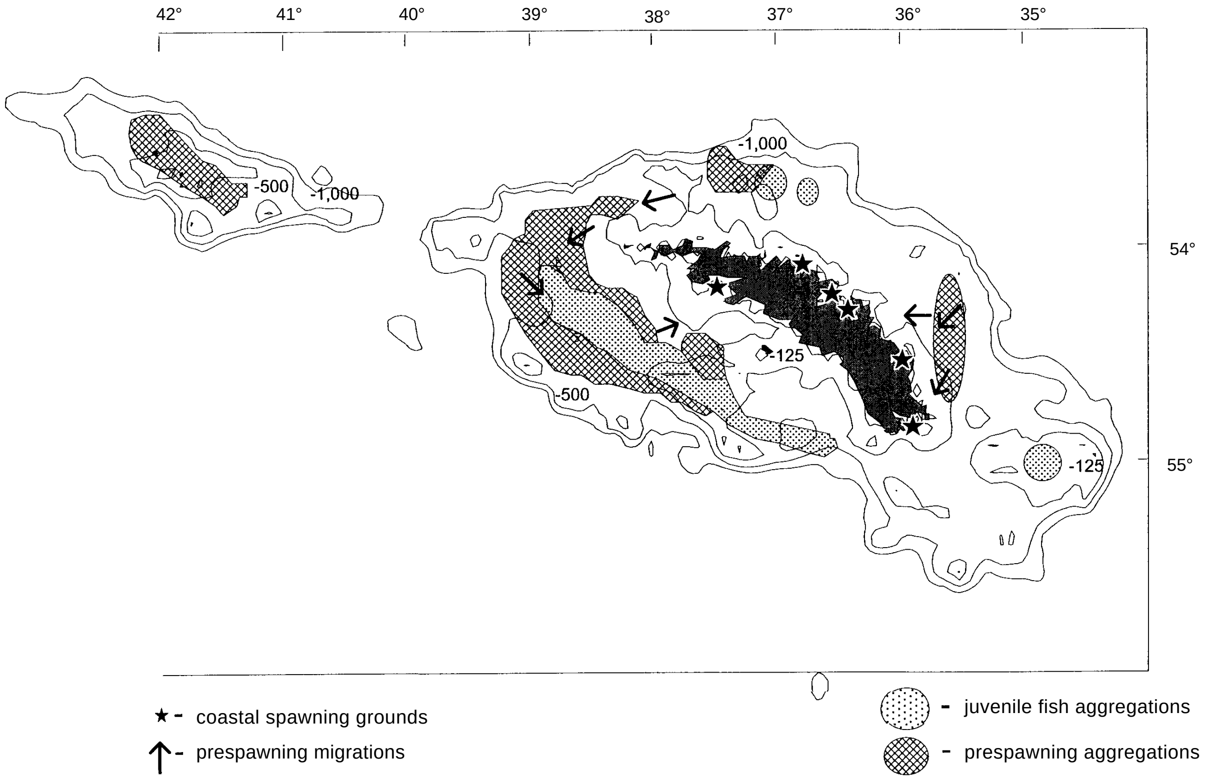


Figure 27: Spawning grounds, main aggregation of juvenile icefish and prespawning migrations.

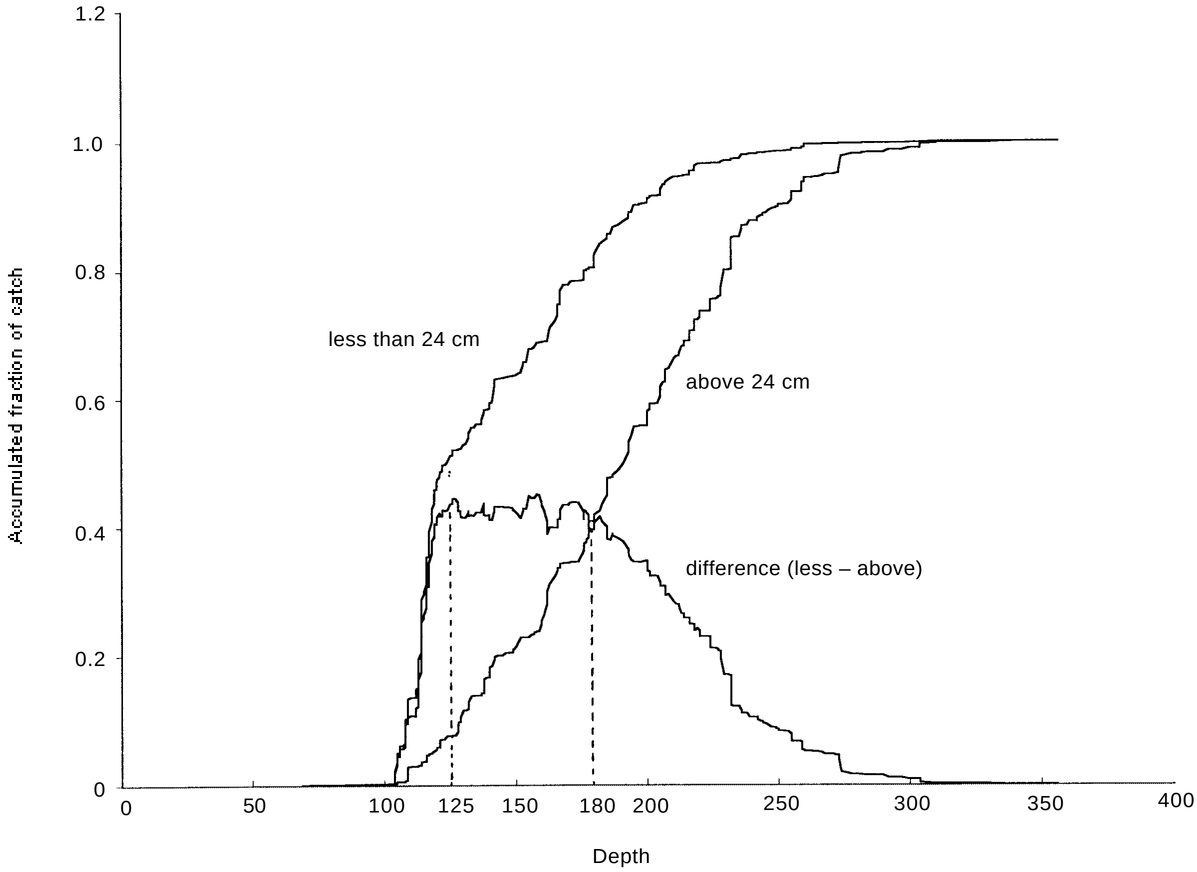


Figure 28: Relationship between the cumulative fraction of the survey of *C. gunnari* at lengths below and above 24 cm in Subarea 48.3.

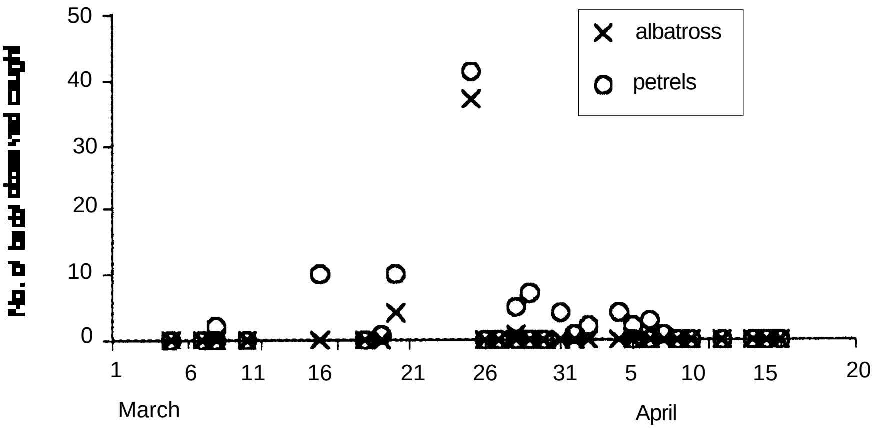


Figure 29: Catches of seabirds in March and April 1997 on longline sets where streamer lines were used, offal was not discharged and setting was at night with no moon. Line weighting was 0.1 to 0.19 kg/m (greater line weightings were not available in 1997).

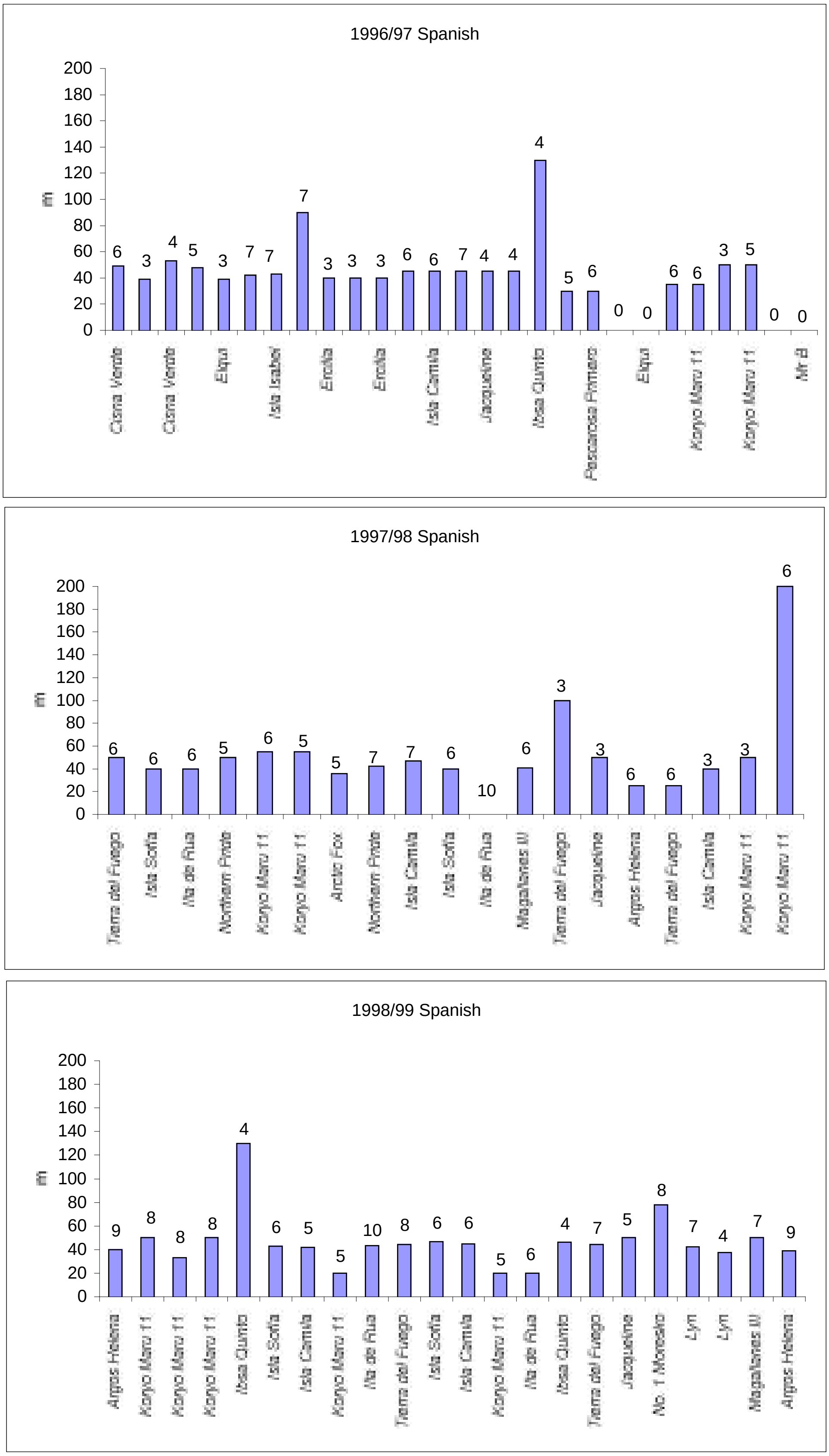


Figure 30: Mass of weights (kg) and weight spacings (m) used by vessels using the Spanish method in 1996/97, 1997/98 and 1998/99.

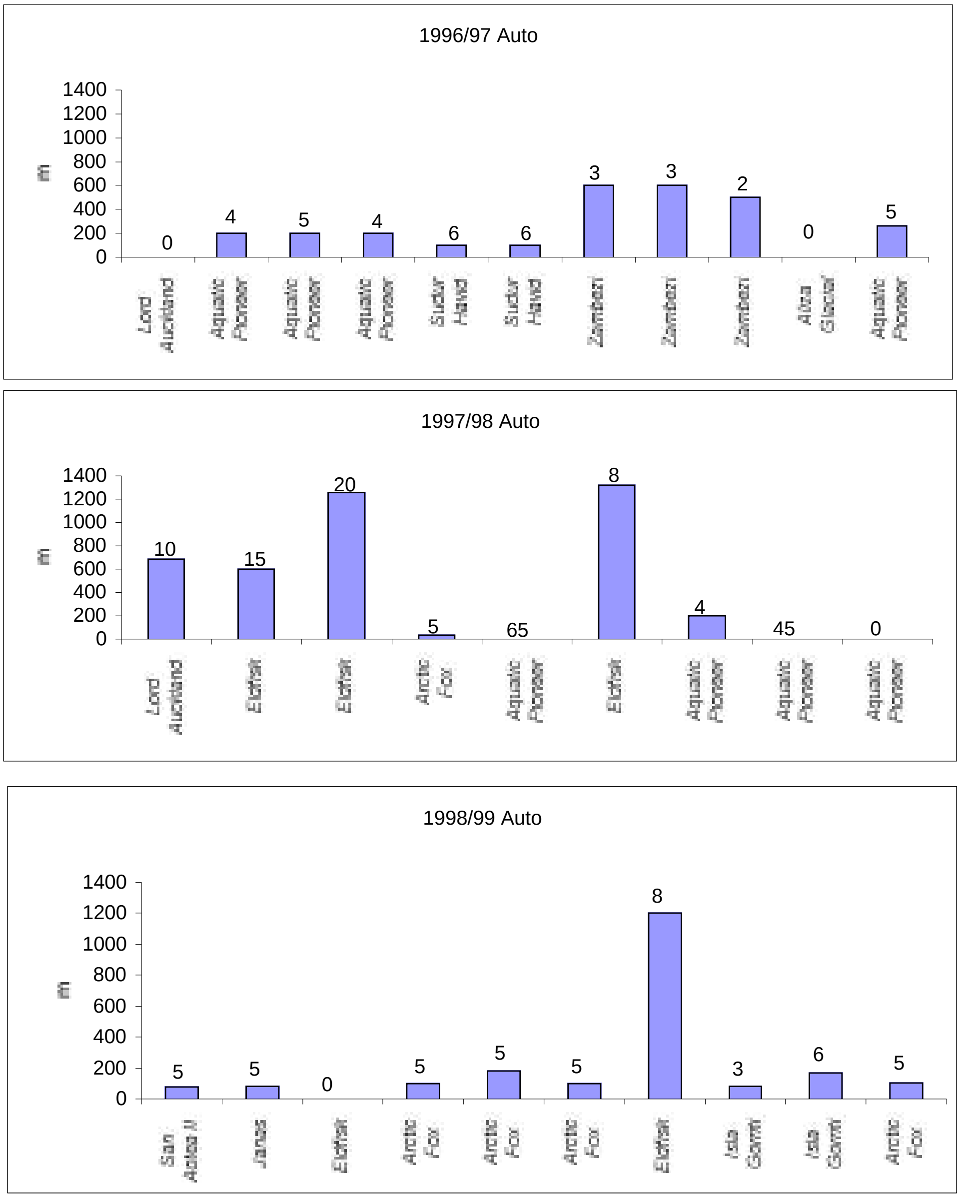


Figure 31: Mass of weights (kg) and weight spacings (m) used by autoline vessels in 1996/97, 1997/98 and 1998/99.

APPENDIX A

AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 11 to 21 October 1999)

1. Opening of the Meeting

2. Organisation of the Meeting and Adoption of the Agenda

3. Review of Available Information

    3.1 Data Requirements Endorsed by the Commission in 1998
        3.1.1 Data Inventory and Developments in the CCAMLR Database
        3.1.2 Database Data Entry and Validation
        3.1.3 Other

    3.2 Fisheries Information
        3.2.1 Catch, Effort, Length and Age Data Reported to CCAMLR
        3.2.2 Estimates of Catch and Effort from Illegal, Unregulated and Unreported (IUU) Fishing (Subgroup report)
        3.2.3 Catch and Effort Data for Toothfish Fisheries in Waters Adjacent to the Convention Area
        3.2.4 Scientific Observer Information (Subgroup report)
        3.2.5 Research Surveys
        3.2.6 Mesh/Hook Selectivity and Related Experiments Affecting Catchability
        3.2.7 Conversion Factors

    3.3 Fish and Squid Biology/Demography/Ecology (Subgroup report)

    3.4 Developments in Assessment Methods (Subgroup report)

4. Assessments and Management Advice

    4.1 New and Exploratory Fisheries
        4.1.1 New Fisheries in 1998/99
        4.1.2 Exploratory Fisheries in 1998/99
        4.1.3 New Fisheries Notified for 1999/2000 (Subgroup report)
        4.1.4 Exploratory Fisheries Notified for 1999/2000 (Subgroup report)
        4.1.5 Progress Towards Assessments in Exploratory Fisheries
        4.1.6 By-catch
        4.1.7 Apportioning Catch Limits

    4.2 Assessed Fisheries
        4.2.1 *Dissostichus eleginoides* South Georgia (Subarea 48.3)
        4.2.2 *Dissostichus eleginoides* Kerguelen Islands (Division 58.5.1)
        4.2.3 *Dissostichus eleginoides* Heard Island (Division 58.5.2)
        4.2.4 *Champsocephalus gunnari* South Georgia (Subarea 48.3)
        4.2.5 *Champsocephalus gunnari* Heard Island (Division 58.5.2)

    4.3 Other Fisheries
        4.3.1 Other Finfish Fisheries
        4.3.2 Crabs
        4.3.3 Squid

4.4 General By-Catch Provisions
4.5 Regulatory Framework for Fisheries Development

5. Considerations of Ecosystem Management

5.1 Interactions with WG-EMM
5.2 Ecological Interactions (e.g. multi-species, benthos, etc.)

6. Research Surveys

6.1 Simulation Studies
6.2 Recent and Proposed Surveys

7. Incidental Mortality Arising from Longline Fishing

7.1 Intersessional Work
7.2 Research into the Status of Seabirds
7.3 Incidental Mortality of Seabirds during Regulated Longline Fishing in the Convention Area
7.3.1 1998 Data
7.3.2 1999 Data
7.3.3 Compliance with Conservation Measure 29/XVI

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

7.5 Incidental Mortality of Seabirds in relation to New and Exploratory Fisheries
7.5.1 Assessments of Risk in CCAMLR Subareas and Divisions
7.5.2 New and Exploratory Fisheries Operational in 1998/99
7.5.3 New and Exploratory Fisheries Proposed for 1999/2000

7.6 Incidental Mortality of Seabirds during Longline Fishing Outside the Convention Area

7.7 Research into and Experience with Mitigating Measures

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

7.9 Strategic and Policy Issues

7.10 Advice to the Scientific Committee

8. Other Incidental Mortality

9. Future Work

9.1 Data Requirements
9.2 Software and Analyses to be Prepared or Developed Prior to the Next Meeting

10. Other Business

11. Adoption of Report

12. Close of Meeting.

APPENDIX B

LIST OF PARTICIPANTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 11 to 21 October 1999)

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APPENDIX C

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 11 to 21 October 1999)

WG-FSA-99/1	Provisional Agenda and Annotation to the Provisional Agenda for the 1999 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-99/2	List of participants
WG-FSA-99/3	List of documents
WG-FSA-99/4	Data and resources available to WG-FSA-99 Secretariat
WG-FSA-99/5	Results of experimental trials of bird by-catch reduction methods conducted by the UK-registered longliner *Argos Helena* in Statistical Subarea 48.3 D.J. Agnew, A. Black, J.P. Croxall and G. Parkes (United Kingdom)
WG-FSA-99/6	Off the hook? Initiatives to reduce seabird by-catch in longline fisheries J. Cooper (South Africa), J.P. Croxall (United Kingdom) and K.S. Rivera (USA)
WG-FSA-99/7	Secretariat work in support of WG-FSA Secretariat
WG-FSA-99/8	Fishery Data Manual – draft English version Secretariat
WG-FSA-99/9	Fishery information for WG-FSA-99 Secretariat
WG-FSA-99/10	Summary of observations aboard longline vessels operating in the Convention Area Secretariat
WG-FSA-99/11	Summary of observations aboard trawl vessels operating in the Convention Area during the 1998/99 season Secretariat
WG-FSA-99/12	Summary of observations on compliance with Conservation Measures 29/XVI and 63/XV Secretariat
WG-FSA-99/13	Estimates of seabed areas within the range of distribution of *Dissostichus* spp. Secretariat

WG-FSA-99/14	Research survey data Secretariat
WG-FSA-99/15	Catch-weighted length frequencies from commercial data Secretariat
WG-FSA-99/16	Biological characteristics of Antarctic fish stocks in the Southern Scotia Arc region K.-H. Kock (Germany), C. Jones (USA) and S. Wilhelms (Germany)
WG-FSA-99/17 Rev. 1	United Kingdom research underway on Southern Ocean seabirds vulnerable to fisheries interactions J.P. Croxall (United Kingdom)
WG-FSA-99/18	Seabird mortality on longlines in Australian waters: a case study of progress and policy R. Gales, N. Brothers, T. Reid, D. Pemberton and G.B. Baker (Australia) (In: Adams, N.J. and R.H. Slotow (Eds). *Proc. 22 Int. Ornithol. Congr*., Durban: 648–675)
WG-FSA-99/19	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*, in press)
WG-FSA-99/20	Foraging location and range of white-chinned petrels *Procellaria aequinoctialis* breeding in the South Atlantic S.D. Berrow, A.G. Wood and P.A. Prince (United Kingdom) (*Journal of Avian Biology*, in press)
WG-FSA-99/21	Areas and scales of interactions between albatrosses and the marine environment: species, populations and sexes P.A. Prince (United Kingdom), H. Weimerskirch (France), A.G. Wood and J.P. Croxall (United Kingdom) (In: Adams, N.J. and R.H. Slotow (Eds). *Proc. 22 Int. Ornithol. Congr*., Durban: 2001–2020. Johannesburg: BirdLife South Africa)
WG-FSA-99/22	Withdrawn
WG-FSA-99/23	The incidental catch of seabirds by longline fisheries: worldwide review and technical guidelines for mitigation FAO Fisheries Circular No. 937 Submitted by FAO
WG-FSA-99/24	Effect of a shore-based sampling program on *Notothenia coriiceps* populations R. Casaux and E. Barrera-Oro (Argentina)
WG-FSA-99/25	Foraging ecology of grey-headed mollymawks at Marion Island in relation to longline fishing activity D.C. Nel, J.L. Nel, P.G. Ryan, N.T.W. Klages (South Africa), R.P. Wilson (Germany) and G. Robertson (Australia)

WG-FSA-99/26	Factors affecting the number and mortality of seabirds attending trawlers and longliners in the Kerguelen area H. Weimerskirch, D. Capdeville and G. Duhamel (France)
WG-FSA-99/27	French research underway on Southern Ocean seabirds vulnerable to fisheries interactions H. Weimerskirch (France)
WG-FSA-99/28	Preliminary analysis of seabird by-catch using CCAMLR observer data D.J. Agnew and J.P. Croxall (United Kingdom)
WG-FSA-99/29	Vacant
WG-FSA-99/30	Increase in relative abundance of fjord *Notothenia rossii* in Potter Cover, South Shetland Islands, after the decrease associated with commercial fishing in the area E.R. Barrera-Oro, E.R. Marschoff and R.J. Casaux (Argentina)
WG-FSA-99/31	Notes on the availability of three important finfish species in offshore waters of the lower South Shetland Islands (Subarea 48.1) C.D. Jones (USA), E.R. Barrera-Oro, E.R. Marschoff and R.J. Casaux (Argentina)
WG-FSA-99/32	Changes in biomass of eight species of finfish around the South Orkney Islands (Subarea 48.2) from three bottom trawl surveys C.D. Jones (USA), K.-H. Kock (Germany) and E. Balguerías (Spain)
WG-FSA-99/33	Revised estimates of seabed areas within the 500 m isobath of the South Orkney Islands (Subarea 48.2) and consequences for standing stock biomass estimates of nine species of finfish C.D. Jones (USA)
WG-FSA-99/34	Research underway on South African seabirds vulnerable to fisheries interactions Delegation of South Africa
WG-FSA-99/35	Avoidance of incidental mortality of seabirds and the implementation of Conservation Measure 169/XVII in Statistical Subarea 88.1 in the 1998/99 season J. Molloy and N. Smith (New Zealand)
WG-FSA-99/36	Risk assessment of wandering albatrosses *Diomedea exulans*, breeding on Marion Island, to by-catch within CCAMLR statistical areas D.C. Nel, J. Cooper (South Africa) and G. Robertson (Australia)
WG-FSA-99/37	Longline sink rates on bottom autoline vessels N. Smith (New Zealand)

WG-FSA-99/38	Sexual dimorphism and sexual segregation in foraging strategies of northern giant petrels *Macronectes halli* during incubation J. González-Solís, J.P. Croxall and A.G. Wood (United Kingdom)
WG-FSA-99/39	Foraging partitioning between giant petrels *Macronectes* spp. and its relationship with breeding population changes at Bird Island, South Georgia J. González-Solís, J.P. Croxall and A.G. Wood (United Kingdom)
WG-FSA-99/40	Rajid by-catch in the longline fishery for toothfish in Subarea 48.3 D.J. Agnew, J. Taylor and I. Everson (United Kingdom)
WG-FSA-99/41	Notification of research vessel activity in the Convention Area Delegation of the United Kingdom
WG-FSA-99/42 Rev. 1	Seabird by-catch in the Patagonian toothfish longline fishery at the Prince Edward Islands: 1998–1999 P.G. Ryan and B.P. Watkins (South Africa)
WG-FSA-99/43	Age and growth of Patagonian toothfish (*Dissostichus eleginoides*) and Antarctic toothfish (*D. mawsoni*) in waters from the New Zealand Exclusive Economic Zone to CCAMLR Subarea 88.1 P.L. Horn (New Zealand)
WG-FSA-99/44	Fishes collected during the 1998/99 exploratory fishery by New Zealand in CCAMLR Subarea 88.1 and registered in the national fish collection at the Museum of New Zealand Te Papa Tongarewa A. Stewart (New Zealand)
WG-FSA-99/45	Assessing the impact of the proposed exploratory fishery for *Dissostichus* spp. in CCAMLR Subarea 88.1 in the 1999/2000 season on the family Rajidae N. Smith (New Zealand)
WG-FSA-99/46	Genetic studies on toothfish (*Dissostichus eleginoides* and *Dissostichus mawsoni)*: progress report for CCAMLR P. Smith (New Zealand)
WG-FSA-99/47	Satellite tracking of white-chinned petrels and comparison with other Procellariiformes A. Catard and H. Weimerskirch (France)
WG-FSA-99/48	Utilización de la tecnica de isoelectroenfoque en la identificación de ejemplares de merluza negra *Dissostichus eleginoides* (Smitt 1898) en el Atlantico sudoccidental A. Pereira, H. Nion, Y. Marín y O. Pin (Uruguay)
WG-FSA-99/49	Research underway on New Zealand seabirds vulnerable to fisheries interactions J. Molloy (New Zealand)

WG-FSA-99/50	Variations in condition indices of mackerel icefish at South Georgia from 1972 to 1997 I. Everson (United Kingdom) and K.-H. Kock (Germany)
WG-FSA-99/51	Undeclared catches of *Dissostichus eleginoides* (compilation of available data) – report of the subgroup on IUU fisheries Prepared by G. Duhamel, S. Fitch, M. Purves and B. Watkins
WG-FSA-99/52	Protection of young fish and spawning aggregations in the fishery for *Champsocephalus gunnari* in Subarea 48.3 (South Georgia): a discussion G. Parkes (United Kingdom)
WG-FSA-99/53	Progress in Australian initiatives for the conservation of albatrosses G.B. Baker, N. Montgomery and A. McNee (Australia)
WG-FSA-99/54	Inter-annual variation in spawning status of mackerel icefish I. Everson (United Kingdom) and K.-H. Kock (Germany)
WG-FSA-99/55 Rev. 1	A comparison of the maturity stages used to estimate the reproductive status of mackerel icefish *Champsocephalus gunnari* I. Everson, J. Ellison (United Kingdom) and K.-H. Kock (Germany)
WG-FSA-99/56	An inter-laboratory comparison of ages estimated for *Dissostichus eleginoides* using otoliths J. Ashford (United Kingdom) and P. Horn (New Zealand)
WG-FSA-99/57	Fishing cruise of the Russian trawler *Zakhar Sorokin* to the Antarctic (Subarea 48.3) from 16 February to 10 March 1999 V.L. Senioukov and P.N. Kochkin (Russia)
WG-FSA-99/58	On observations of ectoparasites of icefish *Champsocephalus gunnari* in Subarea 48.3 in March 1999 V.L. Senioukov (Russia)
WG-FSA-99/59	Relative abundance of seabirds at sea within CCAMLR statistical areas E.J. Woehler (Australia), E.J. Appleyard (Secretariat) and D.J. Watts (Australia)
WG-FSA-99/60	Using additional information for generalised yield model P.S. Gasiukov (Russia)
WG-FSA-99/61	Australian research underway on seabirds vulnerable to fisheries interactions G.B. Baker (Australia)
WG-FSA-99/62	Report on meetings with Norwegian gear manufacturers Mustad and Fiskevegn G. Robertson (Australia)

WG-FSA-99/63	Variation in standing stock of the mackerel icefish *Champsocephalus gunnari* at South Georgia I. Everson, G. Parkes (United Kingdom), K.-H. Kock (Germany) and I. Boyd (United Kingdom) *Journal of Applied Ecology* (1999), 36: 591–603
WG-FSA-99/64	On the problem of diurnal migrations of some fish species on the South Georgia shelf (Subarea 48.3) I.A. Trunov, J.A. Frolkina and M.P. Konstantinova (Russia)
WG-FSA-99/65	Distribution and some biological features of icefish (*Champsocephalusgunnari*) at different life cycle stages in the South Georgia subarea Zh.A. Frolkina (Russia)
WG-FSA-99/66	Extract from Natural History of British Fishes I. Everson (United Kingdom)
WG-FSA-99/67	Working paper on scientific issues related to a unified regulatory framework for CCAMLR based on stages of fishery development Ad Hoc Task Group on the Development of a Unified Regulatory Framework for CCAMLR Draft
WG-FSA-99/68	Revision of biological and population parameters for *Dissostichus eleginoides* on the Heard Island Plateau (Division 58.5.2) based on a comprehensive survey of fishing grounds and recruitment areas in the region A.J. Constable, R. Williams, T. Lamb and E. van Wijk (Australia)
WG-FSA-99/69	Assessment of yield and status of *Macrourus carinatus* on BANZARE Bank in the southern Indian Ocean: implications for managing by-catch in CCAMLR fisheries E.M. van Wijk, A.J. Constable, R. Williams and T. Lamb (Australia)
WG-FSA-99/70	Preliminary evaluation of global aggregate long-term annual yield for Patagonian toothfish, *Dissostichus eleginoides* A.J. Constable, L.S. Meyer and R. Williams (Australia)
WG-FSA-99/71	1999 Report of the WG-FSA Subgroup on Approaches to Assessments A. Constable (Australia), G. Parkes, D. Agnew, G. Kirkwood (United Kingdom), R. Williams (Australia) and D. Ramm (Secretariat)
WG-FSA-99/72	Seabird, seal and fishing vessel interactions in the Heard and MacDonald Islands and Macquarie Island Patagonian toothfish trawl fishery G. Robertson and B. Wienecke (Australia)

WG-FSA-99/73	Seabird interactions with longline fishing in the AFZ: 1998 seabird mortality estimates and 1988–1998 trends N. Brothers, R. Gales and T. Reid (Australia) *Wildlife Report 99/x*, Parks and Wildlife Service, Tasmania
WG-FSA-99/74	Problems with estimation of size at maturity of *Dissostichus mawsoni* in Subarea 88.1 G. Patchell (New Zealand)

Other Documents

WG-EMM-99/27	Correlation between krill and *Champsocephalus gunnari* stocks in the South Georgia Area 48.3 K.V. Shust, V.L. Senioukov, P.N. Kochkin and N.A. Petrukhina (Russia)
CCAMLR-XVIII/8	Notification of South Africa's intention to initiate an exploratory fishery Delegation of South Africa
CCAMLR-XVIII/9	Notification of South Africa's intention to initiate new/exploratory fisheries Delegation of South Africa
CCAMLR-XVIII/10	Notification of New Zealand's intention to continue an exploratory fishery Delegation of New Zealand
CCAMLR-XVIII/11	Notification of Australia's intention to initiate a new fishery Delegation of Australia
CCAMLR-XVIII/12	Notification of Australia's intention to initiate an exploratory fishery Delegation of Australia
CCAMLR-XVIII/13	Notification of Chile's intention to initiate exploratory fisheries Delegation of Chile
CCAMLR-XVIII/14	Notification of Uruguay's intention to initiate a new fishery Delegation of Uruguay
CCAMLR-XVIII/20	Notification of France's intention to initiate new and exploratory fisheries Delegation of France
CCAMLR-XVIII/21	Notification of an exploratory fishery Delegation of the European Community
CCAMLR-XVIII/BG/9	Implementation of conservation measures in 1998/99 Secretariat
CCAMLR-XVIII/BG/30	US plans for fishing for crab in Subarea 48.3 in accordance with Conservation Measures 150/XVII and 151/XVII Delegation of the USA

CCAMLR-XVIII/BG/32	Report from CCAMLR observers at Indian Ocean Tuna Commission Scientific Committee and Commission Meetings CCAMLR Observer (Australia)
SC-CAMLR-XVIII/BG/1	Catches in the Convention Area in 1998/99 and related data Secretariat
SC-CAMLR-XVIII/BG/4	Attendance at the 23rd Session of the Committee on Fisheries of the Food and Agriculture Organisation of the United Nations Rome, Italy, 15–19 February 1999 CCAMLR Observer (J. Cooper, South Africa)
SC-CAMLR-XVIII/BG/16	International fishers forum: solving the incidental capture of seabirds Delegation of New Zealand
SC-CAMLR-XVIII/BG/19	FAO's fisheries global information system Secretariat

APPENDIX D

INTERSESSIONAL WORK PLAN FOR AD HOC WG-IMALF

INTERSESSIONAL WORK PLAN FOR AD HOC WG-IMALF

The Secretariat will coordinate the intersessional work of the IMALF group. An interim review of work will be conducted in June 2000 and advised to ad hoc WG-IMALF at the time of WG-EMM (July 2000). The outcome of the intersessional work will be reviewed in August/September 2000 and reported to WG-FSA in October 2000.

* Tasks carried forward from 1998 (SC-CAMLR-XVII, Annex 5)

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance	Start/ Completion Deadlines	Action
1.	**Planning and coordination of work:**				
1.1	Circulation of CCAMLR-XVIII reports on IMALF matters.			1 Dec 1999	Circulate all relevant sections of CCAMLR-XVIII to IMALF group members and technical coordinators, and (via them) to scientific observers.
1.2	Circulation of papers submitted to WG-FSA on IMALF matters.			1 Dec 1999	Circulate the list of papers submitted to WG-FSA on IMALF matters and advise that copies of papers may be provided on request. Circulate the papers requested.
1.3	Acknowledgement of work of technical coordinators and scientific observers.			1 Dec 1999	Commend technical coordinators and all observers for their effort in the 1998/99 fishing season.
1.4	Circulation of observer reports (seabird interactions) within WG-IMALF.	9.14(iv)		As available	Copy observer reports to one member of each country participating in WG-IMALF.
1.5	Membership of WG-IMALF.	7.4	Members	Nov 1999/ as required	Update membership during the year as required. Request appropriate Members to nominate their technical coordinators to IMALF and send them to the WG-FSA meeting.
1.6	Education and training of fishing companies and fishermen on issues of incidental mortality of seabirds.	*3.79	Members	Dec 1999/ Aug 2000	Urge Members to improve education and training of fishers on issues of incidental mortality of seabirds via technical coordinator; report to IMALF-2000.
1.7	Protection for observers on board against adverse weather conditions.	*9.19(ii)	Technical Coordinators	Jan 2000	Request technical coordinators to ask vessel owners and captains to provide as much protection as possible for observers against adverse weather conditions.

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance	Start/ Completion Deadlines	Action
1.8	Awareness of CCAMLR conservation measures in force.	*9.19(iii)	Technical Coordinators	Dec 1999/ Aug 2000	Request feedback information from technical coordinators.
1.9	Submission of scientific observers' data from the 1999/2000 fisheries.		Technical Coordinators	Dec 1999/ as required	Liaise with technical coordinators, as necessary, on data submission for the 1999/2000 season.
2.	**Members' research and development activities:**				
2.1	Update information on national research programs into status of seabirds at risk.	7.18	Members	As available	Members report, as appropriate, to IMALF-2000.
2.2	Assist interpretation of research programs in 2.1 with respect to WG-FSA/CCAMLR objectives.	7.17	Members	Nov 1999/ Oct 2000	Dr Gales to coordinate and report to IMALF-2000.
2.3	Acquire reports on research on genetic profiles of albatrosses.	7.16	Members		Request IMALF members in Australia, France, New Zealand, South Africa, UK to assist in provision of information. Need to get response from USA.
2.4	Analysis of seabird interactions with longline fisheries.		New Zealand	Nov 1999	Request New Zealand report when work is completed.
2.5	Information on the use of underwater longline setting devices in fisheries conditions.	7.124	Members	Nov 1999/ Sep 2000	Request information on underwater setting development from Australia, New Zealand, Norway, South Africa; collate responses for IMALF-2000.
2.6	Updates on the work on seabird capture rates in relation to artificial bait, snood line and mainline colour; bait depth and sink rates.	*9.18(xi)	Members	Nov 1999/ Sep 2000	Standing item, request reports of work, collate responses for IMALF-2000.
2.7	National research into optimum configuration of line-weighting regimes and equipment.	*9.18(x)	Members	Nov 1999/ Sep 2000	Request Members to report on research undertaken; collate responses for IMALF-2000.
2.8	Development of automated methods for adding and removing weights to and from the line.	*7.150, 7.151	Technical Coordinators	Nov 1999/ Sep 2000	Request technical coordinators to interact and collaborate on the matter with fishing companies; review the situation at IMALF-2000.
2.9	Video recording of line-hauling operations.	*9.18(xiii)	Members	Nov 1999/ Sep 2000	Request reports, collate responses for IMALF-2000.
2.10	Information on the performance of natural and artificial bait in relation to their attractiveness to seabirds.			As required	Request reports from companies/groups involved in testing artificial bait.

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance	Start/ Completion Deadlines	Action
2.11	Information on line-setting devices for autoline vessels.	*9.18(ii), 7.154, 7.155		As required	Request information from 'Fiskevegn' (Norway).
2.12	Risk assessment of seabird by-catch in the Convention Area.		Members	Nov 1999/ Aug 2000	Further work as appropriate.
2.13	Feedback from the fishery industry on issues affecting use of mitigation measures.	7.126, 7.127	Members	Nov 1999/ Sep 2000	Request technical coordinator to facilitate this.
2.14	Line-weighting experiments on autoliners.	7.91	New Zealand	Sep 2000	Report to IMALF-2000.
3.	**Information from outside the Convention Area:**				
3.1	Information on longline fishing effort in the Southern Ocean to the north of Convention waters.	*7.121, 7.136	Members, non-Contracting Parties, international organisations	By Sep 2000	Request information intersessionally from those Members known to be licensing fishing in areas adjacent to CCAMLR (e.g. Argentina, Australia, Chile, France, New Zealand, South Africa and UK [in respect of Falkland/Malvinas Islands]); review situation at IMALF-2000.
3.2	Information on incidental mortality outside the Convention Area of seabirds breeding within the area.	7.102, 7.103	Members	By Sep 2000	Repeat request to all IMALF members, especially to those mentioned under item 3.1 above.
3.3	Implementation of provisions of Conservation Measure 29/XVI in fisheries adjacent to the CCAMLR Convention Area.		Members, non-Contracting Parties, international organisations	Nov 1999/ as required	Request information on use/implementation of provisions of Conservation Measure 29/XVI, review responses at IMALF-2000.
3.4	Reports on effectiveness of use of mitigating measures outside the Convention Area.	7.91	Members	Nov 1999/ Sep 2000	Especially New Zealand, in respect of autoliners in its EEZ.
4.	***Scientific Observers Manual*:**				
4.1	Intersessional work of the task group on scientific observation forms and guidelines.	*9.18(xii), 9.19(i)	Task Group	Nov 1999/ Sep 2000	Coordinate work of the task group to address matters relating to: the utility and feasibility of data recording, time constraints and difficulties in fulfilling observer duties; and amendments to and revisions of the *Scientific Observers Manual.*

	Task/Topic	Paragraphs of WG-FSA Report	Members' Assistance	Start/ Completion Deadlines	Action
4.2	Consultation with IMALF members on issues of relevance to the work of technical coordinator.		Members/ Task Group	Nov 1999/ as required	Consult on any issue of relevance to observation of seabirds as required, submit comments received to the task group for consideration.
4.3	Publication and circulation of updates to the *Scientific Observers Manual.*	*3.48	Task Group	January 2000	Update the manual as recommended by WG-FSA, circulate replacement pages.
5.	**Cooperation with international organisations:**				
5.1	Participation at the 2000 meeting of CCSBT ERSWG; invite CCSBT to attend WG-FSA.		CCSBT Secretariat	Jan–Feb 2000/ Jul 2000	Standing request.
5.2	Cooperation with the Secretariat of the Convention on CMS on CCAMLR work on albatross conservation.		CMS Secretariat, South Africa	Dec 2000	Request report on CMS COP-6, November 1999, Cape Town, from Mr J. Cooper.
5.3	Cooperation with ICCAT and IOTC on specific issues regarding incidental mortality of seabirds.		CCAMLR observers	Nov 1999	Remind observers of desired feedback on IMALF matters.
5.4	Develop National Plan of Action in respect of FAO (IPOA-Seabirds).	7.131	Members	Nov 1999	Provide report on progress to IMALF for information and consideration.
6.	**Data acquisition and analysis:**				
6.1	Comprehensive analyses of data from the 1998/99 fisheries.		Members	Dec 1999/ Aug 2000	Undertake analyses of data (including the relationship between vessels, daytime and night-time setting, time of year and seabird by-catch), prepare report and circulate it prior to IMALF-2000 for comments.
6.2	Preliminary analyses of data from 1999/2000 fisheries.			Sep–Oct 2000	Standing request: summarise current year data at a level adequate to undertake a preliminary assessment at IMALF-2000.
6.3	Acquisition of EEZ data.	7.40	France	Nov 1999/ Sep 2000	Discuss with French scientists how basic observer data, consistent with CCAMLR logbook data, can be acquired.
6.4	Analysis of Subareas 58.6 and 58.7 EEZ data.		South Africa	Nov 1999/ Sep 2000	Request South Africa to undertake analysis and report to IMALF-2000.

APPENDIX E

1999 ASSESSMENT SUMMARIES

Assessment Summary: *Dissostichus eleginoides*, Subarea 48.3

Source of Information: This report

Year:	1994	1995	1996	1997	1998	1999	Max[2]	Min[2]
Recommended TAC		-	4000	5000	3540	5310		
Agreed TAC	1300	2800	4000	5000	3300			
Landings	604	6171[4]	3871[5]	3924[6]	3328			
Survey Biomass		14923[*a]					2012[*b]	
		4831[+a]					67259[+b]	
Surveyed by	UK[a] Arg[b]							
Stock Biomass[3]								
Recruitment (age...)								
Mean F (.....)[1]								

Weights in tonnes
1 ... weighted mean over ages (...)
2 Over period 1982 to 1992
3 Estimated from cohort projections
4 Estimated by WS-MAD from various sources
5 For the period 1 March to 24 July 1996
6 For the period 1 March to 31 August 1997

* Shag Rocks
\+ South Georgia

Conservation Measures in Force: 154/XVII

Catches:

Data and Assessment:

Fishing Mortality:

Recruitment: Revised recruitments.

State of Stock:

Forecast for 1999/2000:

Assessment Summary: *Dissostichus eleginoides*, Division 58.5.1

Source of Information: This report

Year:	1994	1995	1996	1997	1998	1999	Max[2]	Min[2]	Mean[2]
Recommended TAC									
Agreed TAC									
Landings	5083	5534	4869	4683	4742		7492	121	
Landings[4]	5772	5588	5709	12180	16560				
Survey Biomass									
Surveyed by									
Sp. Stock Biomass[3]									
Recruitment (age...)									
Mean F (.....)[1]									

Weights in tonnes, recruits in ....
1 ... weighted mean over ages (...)
2 Over period 1982 to 1994
3 From VPA using (..........)
4 Including unreported catches

Conservation Measures in Force: None. Recommendation not to exceed 1 400 tonnes in western fishing grounds (CCAMLR-XII, paragraph 4.21).

Catches:

Data and Assessment: No assessment.

Fishing Mortality:

Recruitment:

State of Stock:

Forecast for 1999/2000:

Assessment Summary: *Dissostichus eleginoides*, Division 58.5.2

Source of Information: This report

Year:	1994	1995	1996	1997	1998	1999	Max[2]	Min[2]	Mean[2]
Recommended TAC	297	297	297	3800	3700	3690			
Agreed TAC			297	3800	3700				
Landings	0	0	0	1861[4]	3264[5]				
Landings[6]				18960	7200				
Survey Biomass	11880					Survey			
Surveyed by						Mar–Apr 1999			
Sp. Stock Biomass[3]						Recruit-			
Recruitment (age...)						ments			
Mean F (.....)[1]						estimated			

Weights in tonnes, recruits in ....

1 ... weighted mean over ages (...)
2 Over period 1982 to 1992
3 From VPA using (..........)
4 For fishing season ending 31 August 1997
5 Up to time of WG-FSA meeting in 1998
6 Including unreported catches

Conservation Measures in Force: 158/XVII

Catches:

Data and Assessment: New biology and recruitment parameters and fishing/exploitation pattern.

Fishing Mortality:

Recruitment: New estimates of mean recruitment.

State of Stock:

Forecast for 1999/2000: Yield of 3 585 tonnes.

Assessment Summary: *Champsocephalus gunnari*, Subarea 48.3

Source of Information: This report

Year:	1994	1995	1996	1997	1998	1999	Max[2]	Min[2]
Recommended TAC	0			4520	4840	4036		
Agreed TAC		1000	1300	4520	4840			
Landings	13	10	0	5	265			
Survey Biomass	16088[+a] 4870[*a] 2012[+b] 67259[*b]			122561[a] 69753[b]				
Surveyed by	UK[a] Arg[b]			Arg[a] UK[b]				
Stock Biomass[3]								
Recruitment (age 1)								
Mean F (.....)[1]								

Weights in '000 tonnes

[1] ... weighted mean over ages (...)
[2] Over period 1982 to 1992
[3] From VPA (2+)

[*] Shag Rocks
[+] South Georgia

Conservation Measures in Force: 19/IX and 153/XVII

Catches: 265 tonnes by one vessel in February–March 1999.

Data and Assessment: Short-term yield calculation based on UK survey in September 1997.

Fishing Mortality: 0.14 if the catch limit is taken.

Recruitment: Unknown

State of Stock:

Forecast for 1999/2000: Catch limit forecast is 4 036 tonnes, survey planned.

Assessment Summary: *Champsocephalus gunnari*, Division 58.5.1

Source of Information: This report

Year:	1994	1995	1996	1997	1998	1999	Max[2]	Min[2]	Mean[2]
Recommended TAC					0	0			
Agreed TAC									
Landings (Kerguelen)	12	3936		<1	0		25852	0	
Landings (Combined)									
Survey Biomass				3890[a] 1837[b]		(very low)			
Surveyed by				France					
Sp. Stock Biomass[3]									
Recruitment (age...)									
Mean F (.....)[1]									

Weights in tonnes, recruits in ....
[1] ... weighted mean over ages (...)
[2] Over period 1982 to 1994
[3] From VPA using (..........)

[a] Survey 1: 18 318 km^2
[b] Survey 2: 5 246 km^2

Conservation Measures in Force: CCAMLR: None. Recommendation that the fishery be closed until at least the 1997/98 season, and any fishing in that season to be preceded by a pre-recruit biomass survey in the 1996/97 season (SC-CAMLR-XIV, Annex 5, paragraph 5.152).

- French minimum legal size: 25 cm.

Catches: Zero in 1998/99.

Data and Assessment: None

Fishing Mortality: None

Recruitment: Unknown. Survey in 1998/99 found very few fish.

State of Stock: See above.

Forecast for 1999/2000: No commercial catch, survey planned.

Assessment Summary: *Champsocephalus gunnari*, Division 58.5.2

Source of Information: This report

Year:	1994	1995	1996	1997	1998	1999	Max[2]	Min[2]	Mean[2]
Recommended TAC	311			900	1160	916			
Agreed TAC	311	311		900					
Landings	0		216	115	2				
Survey Biomass	31701		7194–112745		9460–26446				
Surveyed by			Australia[4]		Australia[5]				
Sp. Stock Biomass[3]									
Recruitment (age...)									
Mean F (.....)[1]									

Weights in tonnes, recruits in ....
1 ... weighted mean over ages (...)
2 Over period 1982 to 1992
3 From VPA using (..........)
4 August 1997
5 June 1998

Conservation Measures in Force: 159/XVII

Catches: Very small in 1998/99.

Data and Assessment: Short-term yield calculation based on survey in April 1998.

Fishing Mortality: 0.14 if the catch limit is taken.

Recruitment:

State of Stock:

Forecast for 1999/2000: Catch limit forecast is 916 tonnes, survey planned.

ANNEX 6

SECRETARIAT TASKS IN SUPPORT OF THE SCIENTIFIC COMMITTEE FOR THE 1999/2000 INTERSESSIONAL PERIOD

SECRETARIAT TASKS IN SUPPORT OF THE SCIENTIFIC COMMITTEE FOR THE 1999/2000 INTERSESSIONAL PERIOD

The following is a list of tasks of the Secretariat for the 1999/2000 intersessional period endorsed by the Scientific Committee (SC-CAMLR-XVIII, paragraph 13.6). The lists of tasks agreed by WG-EMM and WG-FSA (including ad hoc WG-IMALF) are given in Annex 4 (paragraphs 12.1 to 12.8) and Annex 5 (paragraphs 9.1 to 9.15) to SC-CAMLR-XVIII respectively.

	Task	Reference to paragraphs in SC-CAMLR-XVIII	Collaborators	Deadline
	Fisheries Status and Trends			
1.	Request Members to provide information from the krill fishery on past and current market prices for krill products and the breakdown of catches by product type.	2.7, 2.8		February
2.	Request Members to collect and submit detailed data on fresh and processed weights of krill catches.	2.5		February
3.	Process information received and submit it for consideration at meetings of the Scientific Committee and its working groups.		SC-Chair, Conveners of WGs	One month before each meeting
	Scheme of International Scientific Observation			
4.	Remind Members that high priority be given to observation on board krill fishing vessels, including the period of CCAMLR-2000 Survey.	3.10, 3.12	Members	December
5.	Prepare a species identification guide for scientific observers in order to facilitate the collection of data on by-catch species in longline fisheries.	3.18	Technical Coordinators	April
6.	Implement decisions of Scientific Committee, WG-EMM and WG-FSA relating to the implementation of the scheme and the revision of the *Scientific Observers Manual.*	3.7, 3.11, 3.14, 3.15 and 3.17 (see also list of tasks agreed by WG-EMM and WG-FSA)	Technical Coordinators	One month before each meeting
	Dependent Species			
7.	Resolve all current queries concerning specific data entries in the CEMP database.	4.3	Members	June
8.	Collect information from Members on the type of and access to meteorological data collected at CEMP sites.	4.12	Members	June
9.	Implement decisions of WG-EMM and WG-FSA relating to dependent species.	See list of tasks agreed by WG-EMM and WG-FSA		One month before the meeting

	Task	Reference to paragraphs in SC-CAMLR-XVIII	Collaborators	Deadline
	Harvested Species			
10.	Request Ukraine to submit data from their historical fisheries in Division 58.4.2.	9.55	Ukraine	February
11.	Implement decisions of WG-EMM and WG-FSA relating to harvested species.	See list of tasks agreed by WG-EMM and WG-FSA		One month before each meeting
	Management under Conditions of Uncertainty about Stock Size and Sustainable Yield			
12.	Assist, as required, in the development of a unified regulatory framework for CCAMLR fisheries for consideration by WG-EMM and FSA and later by the Scientific Committee.	7.21	Ad hoc task group, SC Chair	June, September
	New and Exploratory Fisheries			
13.	Remind Members that the advance notification scheme set out in Conservation Measure 65/XII will be applied to all notifications of new and exploratory fisheries.	7.23	Members	May
14.	Remind Members of the requirement to submit fisheries-based research plans as approved by the Scientific Committee.	9.25 to 9.43	Members	
15.	Implement decisions of WG-FSA in respect to the submission and consideration of notifications.	See list of tasks agreed by WG-FSA	Members	May
16.	Request Members to submit data from the fishery-based research activities at least one month prior to WG-FSA.	9.54	Members	August
17.	Participate, as required, in the analysis of data from the fishery-based research activities submitted at least one month prior to WG-FSA.	9.54	Conveners of WG-FSA and its subgroups	August–September
	Development of the CCAMLR Website			
18.	Implement decisions of the Scientific Committee on website improvements in order to implement changes in reporting by Members of information of direct relevance to the work of the Scientific Committee and its working groups.	18.3	Members	Intersessionally
19.	Implement decisions of WG-EMM and WG-FSA on the development and maintenance of the site.	See list of tasks agreed by WG-EMM and WG-FSA	Members	Intersessionally
	Publications			
20.	Publish Volume 7 of *CCAMLR Science*.	12.7	Editorial Board	November

	Task	Reference to paragraphs in SC-CAMLR-XVIII	Collaborators	Deadline
21.	Publication and dissemination of the book *Understanding CCAMLR's Approach to Management.*	12.7, 12.8	SC Chair	November
22.	Submit for consideration by the Editorial Board the translated headings, figures and table captions from the book *Fish and Fish Resources* by Dr K. Shust (Russia).	12.11	Editorial Board	October
23.	Arrange for meetings of the Editorial Board and selection of papers for publication in the 2001 edition of *CCAMLR Science* (Volume 8).		Editorial Board	
	Cooperation with Other International Organisations			
24.	Provide support and prepare the required background information to observers nominated by the Scientific Committee for meetings of other international organisations.	11.36	Nominated observers	One month before each meeting
25.	Arrange intersessional work of the WG-EMM Subgroup on Designation and Protection of CEMP Sites, in particular with respect to the methodologies of assessing ATCM proposals for marine protected areas.	4.26 to 4.29	Convener of the subgroup	January–July, October
26.	Explore the possibility of SCAR sponsoring the completion of a CD-ROM-based bibliography of Antarctic fish.	12.13	SC Chair	February–March
27.	Implement decisions of WG-EMM and WG-FSA (including ad hoc WG-IMALF) on cooperation with other international organisations.	See lists of tasks agreed by WG-EMM and WG-FSA plans	Conveners of WGs and their subgroups	Intersessionally
28.	Request a report from SCAR-GSS on the status of populations of seals in the Convention Area for consideration by the Scientific Committee.	4.36	SC Chair	January
	WG-EMM			
29.	Arrange and support the intersessional work of WG-EMM subgroups on CEMP-related tasks.	4.40	Conveners of WG-EMM and its subgroups	January–July
30.	Implement tasks assigned to the Secretariat by WG-EMM as listed in its plan of intersessional activities.	See list of tasks agreed by WG-EMM	Convener of WG-EMM	One month before the meeting
31.	Arrange for the provision of necessary materials, analysis of data and support to the meeting of WG-EMM.	See list of tasks agreed by WG-EMM	Convener of WG-EMM	One month before the meeting
32.	Remind Members of research priorities identified by WG-EMM.	See list of tasks agreed by WG-EMM	Convener of WG-EMM, Members	February

	Task	Reference to paragraphs in SC-CAMLR-XVIII	Collaborators	Deadline
	WG-FSA			
33.	Arrange for the provision of necessary materials, analysis of data and support to the meeting of WG-FSA, including the meeting of ad hoc WG-IMALF.	See list of tasks agreed by WG-FSA	Conveners of WG-FSA and ad hoc WG-IMALF	One month before the meeting
34.	Implement tasks assigned to the Secretariat by WG-FSA as listed in its plan of intersessional activities.	See list of tasks agreed by WG-FSA	Convener of WG-FSA	One month before the meeting
35.	Remind Members of research priorities identified by WG-FSA.	See list of tasks agreed by WG-FSA	Convener of WG-FSA, Members	February
	Ad hoc WG-IMALF			
36.	Implement tasks assigned to the Secretariat by the ad hoc WG-IMALF as listed in its plan of intersessional activities.	See list of tasks agreed by WG-FSA (also IMALF tasks in Annex 5, Appendix D of this report)	Convener and participants of ad hoc WG-IMALF, Technical Coordinators	One month before the meeting

ANNEX 7

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)
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
ASPA	Antarctic Specially Protected Area
ASOC	Antarctic and Southern Ocean Coalition
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)
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
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)
CPD	Critical period–distance
CPUE	Catch per unit effort
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)
DPOI	Drake Passage Oscillation Index
DWBA	Distorted wave Born approximation model
EASIZ	Ecology of the Antarctic Sea-Ice Zone
EEZ	Exclusive Economic Zone
EIV	Ecologically important value
ENSO	El Niño Southern Oscillation
EPOS	European *Polarstern* Study
EPROM	Erasable Programmable Read-Only Memory
FAO	Food and Agriculture 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
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 *in situ* TS measurements
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
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
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
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
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

UCDW	Upper Circumpolar Deep Water
UN	United Nations
UNCED	UN Conference on Enviroment 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
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 *D. eleginoides*
WWD	West Wind Drift
WWW	World Wide Web
XBT	Expendable bathythermograph
Y2K	Year 2000