ANNEX 5

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 13 to 22 October 1997)

TABLE OF CONTENTS

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INTRODUCTION

1.1 The meeting of WG-FSA was held at CCAMLR Headquarters, Hobart, Australia, from 13 to 22 October 1997. The Convener, Dr W. de la Mare (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. With the addition of sub-item 3.6 'Consideration of Management Areas and Stock Boundaries' 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 Drs A. Constable (Australia), E. Balguerías (Spain), J. Croxall and I. Everson (UK), R. Holt (USA), G. Kirkwood (UK), K.-H. Kock (Germany), E. Marschoff (Argentina), D. Miller (South Africa), G. Parkes (UK), G. Watters (USA), Mr R. Williams (Australia) and the Secretariat.

REVIEW OF AVAILABLE INFORMATION

Data Requirements

Inventory and User's Guide

3.1 An inventory of CCAMLR databases (SC-CAMLR-XVI/BG/11) was developed at the request of WG-FSA-96. The inventory lists all datasets currently in use within the Secretariat. This is the first stage in developing dataset users' guides for each dataset maintained by the Secretariat. The Working Group agreed that the inventory should include the assessment summaries produced by WG-FSA, and details on the data fields within each dataset. It was noted that some users' guides already existed for some datasets maintained by other agencies, and these should be referenced. The Secretariat was requested to revise the paper and this was completed at the meeting.

3.2 A draft dataset user's guide was presented (WG-FSA-97/32), outlining a proposed general structure and format for this type of document, and an example was developed for the catch and effort data from longline fisheries (C2). Members were encouraged to provide comments and additions during the meeting. The Working Group discussed the need for a staged approach to developing users' guides. The C2 user's guide drafted by the Secretariat was comprehensive, and considerable time would be required to develop similar guides for other major fisheries and research datasets. The Working Group felt that it would be

preferable, in the short term, to develop guides covering the essential data elements of each dataset, including data fields, constraints and usage. Later, as resources allow, each dataset user guide could be developed further.

3.3 The Secretariat was encouraged to explore the development of interactive, web-based users' guides. Rules governing access to, and usage of, CCAMLR datasets should be clearly stated in the users' guides. In addition, the maintenance of a record of usage of datasets would provide useful information when the Working Group allocated priorities for further development of datasets, and analytical tools.

Database Data Entry and Validation

3.4 The Secretariat reported on its actions in response to data requirements endorsed by the Scientific Committee in 1996 (SC-CAMLR-XVI/BG/21 and related papers). The state of requests specified by WG-FSA-96 (SC-CAMLR-XV, Annex 5, paragraph 9.2) are as follows:

(i) haul-by-haul data from longline fisheries for *Dissostichus eleginoides* in Subarea 48.3 (SC-CAMLR-XV, Annex 5, Table 16) – the data problems listed were identified, and where feasible, corrected as part of data validation and improvement to the data-entry process. The single largest problem in this dataset remains: data on the end position of hauls were not submitted until 1996, when data form C2 Version 5 was introduced (SC-CAMLR-XVI/BG/18);

(ii) haul-by-haul length-frequency data for *D. eleginoides* from earlier bottom trawl surveys in Subarea 48.3 – the Secretariat corresponded with Germany and Russia, and data were submitted by Germany, and the results of the 1990 survey of the RV *Akademic Knipovich* are represented in WG-FSA-97/12;

(iii) catch data from fisheries for *D. eleginoides* in areas adjacent to the Convention Area – a request was sent to Members and the UK submitted data;

(iv) haul-by-haul, catch and age data from earlier *Champsocephalus gunnari* fisheries in Subarea 48.3 – the Secretariat corresponded with Russia, Germany and Poland, and data were submitted by Germany;

(v) a comprehensive list of bottom trawl surveys – the Secretariat compiled a list of bottom trawl surveys conducted within the Convention Area (SC-CAMLR-XVI/BG/22), covering surveys for which data have been submitted to the Secretariat, and others notified by Members. At the request of the Working Group, the Secretariat circulated a detailed listing of research and exploratory cruises (SC-CAMLR-XVI/BG/22 addendum), and Members were invited to provide annotations and corrections; and

(vi) haul-by-haul data from the Ukrainian fishery for *D. eleginoides* in Division 58.5.1 – the Secretariat was advised by Ukraine that further work would be required to prepare historical data for submission and that this could not be done due to resource limitations. Longline fishery data for the 1996/97 fishing season were submitted.

3.5 The Working Group also requested that the Secretariat review CCAMLR databases and determine which datasets are incomplete (SC-CAMLR-XV, Annex 5, paragraph 9.3). This has proved a lengthy problem to address as the Secretariat can only identify missing datasets if there is a record of those sets. Identification of other datasets require input from Members to be resolved satisfactorily. The Working Group proposed that the Secretariat provide each technical coordinator with a full inventory of data held by the Secretariat and invite Members to identify missing datasets and submitted data, as appropriate. The Working Group recommended that, in order to cover the full spectrum of datasets maintained by the Secretariat, the role of coordination through technical coordinators would need to be broadened to encompass catch and effort data and CEMP data.

3.6 The state of requests specified by WG-FSA-96 (SC-CAMLR-XV, Annex 5, paragraph 9.4) are as follows:

(i) preparation of an inventory of, and users' guides for, the CCAMLR databases – see paragraphs 3.1 to 3.3;

(ii) development and application of methods for validation of data entries into the databases – the Secretariat has begun a review of database structure and routines, and has implemented an inventory of data and submissions (see paragraphs 3.1 to 3.3);

(iii) preparation of data files for length-density analyses of *D. eleginoides* – all length-frequency data available to the Secretariat have been compiled. Further work may be required;

(iv) completion and validation of the entry of observer data for 1995/96 – Argentina have submitted remaining data and these have been processed;

(v) request information on fisheries activities by non-Members – some information was reported by Members in their activities reports and this information will be collated during the meeting; and

(vi) revision of catch and effort and biological data forms for the squid jigging fishery – the data forms and instructions were revised in consultation with Dr P. Rodhouse (UK) in December 1996. The revised fine-scale catch and effort data reporting form (C3 Version 3) and its instructions was distributed to all Members in December 1996. An advance copy of the scientific observer squid logbook forms (S1, S2 and S3) was sent to all Members and technical coordinators in December 1996, and later published in the *Scientific Observers Manual* in June 1997.

3.7 The Working Group recognised that the quantity and diversity of data requested from Members was high and likely to increase during 1997/98 and subsequent years. A list of data requirements and submission deadlines was circulated during the meeting (SC-CAMLR-XVI/BG/21 addendum). Data processing priorities should be identified so as to guide the work of the Secretariat during the intersessional periods. The Secretariat was advised that data from the most recent split-year should be afforded top priority when preparing data for analyses by WG-FSA.

3.8 UK survey data for a number of surveys conducted around the South Georgia area were re-submitted to the Secretariat at WG-FSA-96 following problems in the formatting of previous submissions within the CCAMLR database. The structure of the UK survey data was more detailed than the model for commercial (C1) data, which is used by the Secretariat for survey datasets. During 1997, the UK re-submitted the data in a format compatible with the CCAMLR commercial trawl fisheries database. These data are presently held by the Secretariat in a separate database and will be transferred to the primary database by the end of 1997. The Working Group thanked Dr Parkes and Mr C. Jones as well as the Secretariat for resolving this issue.

3.9 The Working Group recommended that the Secretariat be asked to develop a data format and procedure for handling research survey data submitted to CCAMLR, which ensures that all of the complexity of the data is preserved and the data are readily available for analysis during future meetings.

3.10 The timing of, and responsibility for, submissions of catch and effort data, biological data and observer data were also discussed. The Working Group recognised that the current schedule for submitting data may result in expensive data transmissions or delays in cases where vessels undertook prolonged fishing trips. The Working Group discussed the requirements for vessels carrying observers to report biological data and the possibility that observers collect these data as part of their own observations and submissions. The role of observers in reporting these data should be stated in the bilateral observer agreements. The Working Group agreed to review the types of data needed to monitor fisheries and conduct stock assessments, and to identify critical data and ways that would ensure their timely submission to the Secretariat. Changes in data requirements would need to take into account the responsibility of flag states for reporting data, existing conservation measures, the absence of any measures of port control and the duties of observers.

3.11 The Working Group discussed the Secretariat's request for regular reporting of vessel names during the fishing season to facilitate the reconciliation of catch and effort data and observer data. The Working Group recommended that Members advise the Secretariat of the names of vessels engaged in fishing whenever they submitted five-day, 10-day or monthly catch reports. Data forms would be modified to include this requirement.

3.12 The Working Group discussed the results of a study comparing longline fishery data submitted to CCAMLR, and those acquired by the UK (WG-FSA-97/37). Both sets of data were collected independently from the fishery from 1994 to 1996. Comparisons were made at two levels: between hauls and within hauls. Reported problems included data for multiple hauls submitted to CCAMLR as a single record, some zero catches not reported to CCAMLR, inconsistencies in the reporting of by-catch and incidental bird mortality. The number of discrepancies between the two datasets declined from 1994 to 1996. The Working Group took these findings into consideration when assessing stocks during the meeting.

Other

3.13 New calculations of seabed area by depth strata were presented (SC-CAMLR-XVI/BG/17), using a newly-released topographic dataset of Sandwell and Smith. The Secretariat was asked to compare the output of this new method with estimates of seabed area published by Kock and Harm (1995) and Everson (1990). Overall, there was reasonable

agreement between these estimates.

3.14 At South Georgia, the new dataset appears to overestimate the areas closest inshore although there was good agreement with the total area down to 500 m. The Working Group was unable to assess the quality of the areas for depths between 500 and 1 500 m at the meeting.

Fisheries Information

Catch, Effort, Length and Age Data

3.15 The Secretariat presented summaries of reported catches within the Convention Area for the 1997 split-year (Table 1). Catches for the split-year were derived from STATLANT data, if available, or estimates based on data in the fine-scale databases (SC-CAMLR-XVI/BG/1). Catches for the fishing season were obtained from five-day, 10-day or monthly catch and effort reports (CCAMLR-XVI/BG/17).

3.16 The Working Group examined annual catches in the proposed revision of the *Statistical Bulletin*, Volume 1 (SC-CAMLR-XVI/BG/19). The revision was based on the latest version of STATLANT data which included reworked Ukrainian data (WG-FSA-96/7). There were few changes between the revised and original dataset, except for catches reported by Ukraine for *C. gunnari* from 1971 to 1979. The total reported catch from 1970 to 1979 in the revised dataset was 76 774 tonnes less than the total based on that published in Volume 1. The Working Group expressed concern that the revised dataset may be incomplete. Further investigation during the meeting revealed that revised annual catches from 1979 to 1996 matched those published (SC-CAMLR-XVI/BG/19 addendum).

Dissostichus eleginoides

Commercial Catch

3.17 Catches taken under conservation measures regulating fishing for this species in various statistical areas are reported in CCAMLR-XVI/BG/17. In addition, catches have been reported by France from French EEZs. These are summarised in Table 2.

Unreported Catches

3.18 It is crucial for the purposes of stock assessment to have as complete information as possible on removals of fish from a stock. A large number of Commission circulars (COMM CIRCs 96/71, 97/4, 97/26, 97/27, 97/38, 97/40, 97/43, 97/48 and 97/50) drew attention to high levels of unregulated fishing on *D. eleginoides*, in particular, in the Indian Ocean sector (Area 58). Of the 90 vessels which were implicated as taking part in the unregulated fishery on *D. eleginoides*, 46 (51.1%) were flagged to CCAMLR Members. Forty-four longliners (49.9%) were either from non-Member states with the majority flagged to Panama and Belize or their flag state could not be identified with certainty. As in previous years (SC-CAMLR-XIV, Annex

5, paragraph 5.11; SC-CAMLR-XV, Annex 5, paragraphs 4.46 and 4.47), the Working Group considered information from various sources in order to be able to estimate the magnitude of catches in the authorised and in the unregulated fishery on *D. eleginoides* during the 1996/97 season.

3.19 Information was drawn from reports of landings in ports of Members and non-Members, reports on sightings of fishing vessels in various subareas and divisions available from COMM CIRCs and national authorities, estimated fishing capacities of these vessels, and catch and effort data from licensed vessels fishing in the same subareas and divisions for purpose of estimating of catches of sighted vessels. This information is more detailed in Appendix D.

3.20 The total reported catch of *D. eleginoides* from EEZs outside the CCAMLR Convention Area and from inside the CCAMLR Convention Area was 32 991 tonnes in the 1996/97 split-year (Table 3). In addition, the unreported catch derived from landings in ports of southern Africa and Mauritius (Appendix D, Table D.2) was estimated to be 74 000 to 82 200 tonnes (Table 3). The total catch of 107 000 to 115 000 tonnes was similar to information received by the Working Group that about 130 000 tonnes of *D. eleginoides* were available on the world market in the past 12 months.

3.21 Landings in southern African ports and Mauritius mostly, if not all, originated from catches taken in the Indian Ocean sector (Area 58). Most of this catch was apparently taken between August 1996 and April 1997 (Figure 1). Based on sightings of longliners, their known fishing capacities, and catch and effort data from the licensed fishery in this area (Appendix D, Table D.3), the Working Group made an attempt to estimate the unreported catch in each subarea and division. However, estimates for the various subareas and divisions (Appendix D, Table D.4) add up to only 38 000 to 42 800 tonnes (Table 3), i.e. approximately 50% of the landings. Some of the landings could have been from catches on banks in international waters north of the CCAMLR Convention Area. However, given the small dimensions of these seamounts and their location at the northernmost limit of the geographical range of *D. eleginoides*, it is unclear to what extent catches from such areas contributed to the landings. The Working Group was unable to reconcile the two estimates of the amount of unreported catches at the present stage.

3.22 Information from recent landings, in particular in the port of Mauritius (Appendix D, Table D.2) and sightings of vessels in Divisions 58.5.1 and 58.5.2 provided strong evidence that the unregulated fishing in the current 1997/98 season continues at a similar level to 1996/97. Until the end of September 1997, landings of 17 500 to 28 500 tonnes were reported (Table 4). Again, catch estimates using catch and effort data from vessels known to have fished in the area were much lower than the reported landings (Table 4). Information from commercial sources suggests that the unregulated fishing had been extended to the Ob and Lena Banks (Division 58.4.4), but no firm evidence was available to the Working Group.

Scientific Observer Information

3.23 Conservation Measures 101/XV, 102/XV and 112/XV required the placement of international scientific observers on board each longline vessel fishing for *D. eleginoides* in Subareas 48.3, 48.4, 48.6, 58.6, 58.7, 88.1 and 88.2, as well as Divisions 58.4.3 and 58.4.4 during the 1996/97 season. During the 1996/97 split-year, 12 vessels (16 cruises) took part in

the fisheries in Subareas 48.3, 88.1 and 88.2, and all cruises carried international scientific observers. Nine vessels undertook fishing within the South African EEZ at the Prince Edward Islands (Subareas 58.6 and 58.7) and national scientific observers were deployed on 11 out of 14 cruises in the EEZ during the 1996/97 split-year.

3.24 The UK provided catch and biological data (see Table 5) for scientific observations on board the Korean squid jigging vessel *Ihn Sung 101* which undertook two fishing trips for *M. hyadesi* in Subarea 48.3 (WG-FSA-97/10). Results of this fishery are also considered in paragraphs 3.63, 4.2 to 4.6.

3.25 The information supplied by the observers in their reports is summarised in Table 6. Note that the data in this table are for the 1996/97 split-year, and the period 1 July 1997 to 31 August 1997.

3.26 The attention of Members is drawn to a number of observer narrative reports and observer logbook data not yet submitted to the Secretariat.

Observer Logbooks

3.27 Overall, the introduction of technical coordinators has improved the coordination and submission of information by scientific observers and the submission of observer logbook data. The Working Group noted with appreciation the much-improved promptness of submission of reports of scientific observers and the major improvement in the quality and relevance of the information presented in these reports. WG-FSA requested the Scientific Committee write to the technical coordinators, and commend all the scientific observers who had submitted reports to CCAMLR, as well as thanking technical coordinators for their efforts.

3.28 This year, the main difficulties encountered with processing and validating observer logbook data were related to the timing of submissions and data formats. About 60% of the observer data collected during the fishing season of 1996/97 were submitted to the Secretariat prior to the start of WG-FSA-97, and a further 35% of the data were submitted at the start of the meeting. Delays in submitting the data were largely attributed to the late closure of longline fisheries.

3.29 The Secretariat only received copies of about 45% of the bilateral scientific observer arrangements as required under CCAMLR's Scheme of International Scientific Observation and, consequently, had difficulty tracking scientific observers and their data. Approximately 25% of the observer data were submitted in non-CCAMLR formats, and some of these did not contain all the data required under the scheme. It appears that some scientific observers were unfamiliar with the procedures and requirements for data collection, including the collection of data on incidental catches of seabirds.

Observer Reports

3.30 At its 1996 meeting, WG-FSA recommended ways of improving data recording and submission procedures (SC-CAMLR-XV, Annex 5, paragraphs 3.7 to 3.19, 7.81 and 7.82) by scientific observers.

Feedback in Reports of Scientific Observers

3.31 In reviewing the observer reports and WG-FSA-97/25, the Working Group noted a number of difficulties experienced by observers in fulfilling or reporting their tasks. The following suggestions were made in relation to the logbook forms:

(i) add an illustration of the Beaufort scale of wind force (form L4);

(ii) add more explicit descriptions of differences between sea and swell height (L4);

(iii) reduce the size of the seabird by-catch field once CCAMLR measures are being used effectively (L5);

(iv) although WG-FSA has set a target of 60 fish per line to be measured, extra space taken from fields L5(iv) and (v) for 100 data points is likely to prove useful (as discussed in WG-FSA-97/4); and

(v) the maps in the *Scientific Observers Manual* (Part IV) are difficult to read and should be printed using larger print.

3.32 The Working Group agreed that these issues could be readily resolved would enhance data recording. It tasked the Secretariat with addressing these during the intersessional period.

3.33 The Working noted other matters and comments relating to the utility and feasibility of data recording (WG-FSA-97/25):

(i) the vessel speed during setting (form L4(ii)) varies so a single datum may be misleading. Also, the line course setting varies continuously and the observer cannot record bird interactions if involved in the recording of course changes. The latter requires alternating observations between the setting point and bridge;

(ii) the visibility index field (L4(v)) needs to include space for comments on factors limiting visibility;

(iii) the bird-hook interactions (L4(vii)) are difficult to observe completely at night due to poor visibility and during the day due to high levels of activity;

(iv) hook loss (L5(ii)) is difficult to estimate independently and there needs to be more definition of what information to include so avoiding possible errors in interpretation of information; and

(v) stage classification of gonads appears very subjective; the literature supplied should relate directly to *D. eleginoides*, rather than combining information from orange roughy and icefish (Anderson, *Zambezi*, second cruise).

3.34 The Working Group agreed that a task group be formed to address such matters during the intersessional period, and appointed the Science Officer as coordinator.

Observer Duties

3.35 The Working Group noted that reports of scientific observers refer to several matters relating to time constraints, sampling priorities and difficulties in fulfilling observer duties.

(i) The recording of by-catch numbers (L5(viii)) is straight forward, but recording of weight constitutes a large task which may detract from other higher-priority activities.

(ii) General difficulties were noted with form L5(v). A number of observers noted that the need for safe working conditions sometimes prevented observations during longline setting. Similarly, it was difficult at times to communicate with vessel crews on matters of detail.

(iii) Some tasks were hindered, or prevented by, safety considerations, captain/fishing master/crew, or communication difficulties (either within vessel or respect of radio communications with home stations or local locations.

3.36 The Working Group agreed that these matters should be referred to the task group for consideration during the intersessional period. In the longer term, changes and additions should be included in a revised edition of the *Scientific Observers Manual*. Scientific observers and technical coordinators were encouraged to continue to seek feedback from other observers on their experiences in carrying out duties under the Scheme of International Scientific Observation and to consider the suggested changes to operating procedures. Such feedback and suggestions should be regularly reviewed with a view to improving the scheme's efficiency.

Additional Information in Observer Reports

3.37 The Working Group noted the information provided by scientific observers on vessel awareness of CCAMLR conservation measures (see Table 7). The crews of several vessels appeared unaware of CCAMLR conservation measures. For example:

Aquatic Pioneer, cruise 1: crew unaware of Conservation Measure 29/XV until 20 November;

Aquatic Pioneer, cruise 3: crew unaware of Conservation Measure 29/XV until 7 May;

Garoya: crew believed that day setting of longlines was not prohibited;

Garoya: crew refused to deploy the streamer line required by Conservation Measure 29/XV.

3.38 The Working Group also noted that several reports of scientific observers indicated that some vessels (e.g. *Aquatic Pioneer, Garoya*) operating in the Convention Area had plastic packaging bands on board. In addition, there was a report of an oil spill involving

Zambezi and *Garoya*, and several reports of discarding of damaged fishing gear and plastics and other packaging at sea (e.g. *Aquatic Pioneer, Koryo Maru*). There were also records of good practice, and the Working Group noted this especially in relation to the *Garoya*.

3.39 The Working Group agreed that the issues of awareness of CCAMLR conservation measures and marine pollution should be drawn to the attention of the Scientific Committee and Commission, as appropriate. The observations above indicate the need for enhanced efficiency in ensuring the crews of fishing vessels are aware of CCAMLR conservation measures and of the regulations governing waste disposal in the Convention Area.

3.40 The Working Group congratulated the many observers who were able to assist vessels in awareness of, and compliance with, CCAMLR conservation measures and Southern Ocean/Antarctic waste disposal regulations.

Research Surveys

3.41 Results from research cruises undertaken during 1996/97 were noted. Germany re-surveyed Subarea 48.1 around Elephant Island during November/December 1996, and the results and changes in biomass are reported in WG-FSA-97/27. Australia conducted a survey for *C. gunnari* in Division 58.5.2 on Shell Bank and Heard Plateau in August 1997, and the results are presented in WG-FSA-97/29. The UK conducted a repeat survey for *C. gunnari* and *D. eleginoides* in Subarea 48.3 around South Georgia in September 1997 (WG-FSA-97/39). Argentina conducted a survey for *C. gunnari* in Subarea 48.3 around South Georgia in March 1997 (WG-FSA-97/44 and 97/47). In addition, Prof. G. Duhamel advised that France had conducted a survey in Division 58.5.1 and that the resulting data were available to the Working Group. Dr Balguerías advised that the Spanish longline survey proposed for August 1997 had been postponed until November 1997.

Mesh/Hook Selectivity and Related Experiments Affecting Catchability

3.42 Two papers were considered, one reporting trawl mesh selectivity for *C. gunnari* (WG-FSA-97/29), the other reporting information of hook selectivity for *D. eleginoides* (WG-FSA-97/49).

Fish and Squid Biology and Demography

Champsocephalus gunnari

3.43 An analysis of data from South Georgia (Subarea 48.3) in WG-FSA-97/44, indicated that there had been increases in standing stock from the low level found in 1994 through to 1995 and 1996 but that, for some unexplained reason, this had not been sustained through to 1997. The distribution of size classes, analysis presented in WG-FSA-97/45, indicated that larger fish tended to be found in deeper water near to the shelf break.

3.44 Research surveys in the vicinity of Heard Island (Division 58.5.2), reported in

WG-FSA-97/29, indicated that there were important ecological differences between the fish present on the Heard plateau from those on the Shell Bank. Spawning occurs in August/September on the plateau and Gunnari Ridge whereas on the Shell Bank the fish spawn in April. The size at first spawning is about the same at both locations. Differences were detected in the parameters of the von Bertalanffy growth equation. On the plateau k = 0.41, L_{inf} = 411 mm and t_0 = 0.57, whereas on the Shell Bank k = 0.45, L_{inf} = 392 mm and t_0 = 0.17. Prof. Duhamel noted that similar differences in spawning season were also to be found between fish from the Kerguelen Shelf and Skif Bank.

3.45 Several papers included information on natural mortality rates. WG-FSA-97/5 presented a re-examination of data from the 1950s and 1960s, the period prior to large-scale commercial fishing. Following correction of an error in the paper, it was concluded that during that early period, the Heincke method, which provided the best estimates of M, 0.42 (for 1955) and 0.46 (for 1966) for this pre-exploitation period, was realistic. The same study indicated that there had been an increase in mortality rate after 1966 which may have been due to fishing prior to 1970, the first year for which CCAMLR statistics are available.

3.46 Recent studies at different localities had indicated large interannual variations in natural mortality coefficients. At South Georgia from 1995 to 1996, M was 0.49 but trebled for the year 1996 to 1997 (WG-FSA-97/44).

3.47 It was noted that, in general, fish from the Atlantic sector attain a greater size than those from the Indian Ocean sector; with such a difference it was to be expected that there would be differences between these areas in growth and mortality rates.

3.48 The sizes of fish taken in the surveys in Subarea 48.3 followed the pattern of previous surveys with few fish greater than 40 cm total length. At Shag Rocks no large fish, greater than 40 cm length, were present. Dr Kock noted that in a survey in 1975/76 around the South Orkneys (Subarea 48.2) size classes of 40 to 52 cm predominated in the stock (Kock, 1991); these size classes were absent two years later at the commencement of commercial fishing.

3.49 There was some discussion regarding whether the variability in standing stock in specific areas might be caused by *C. gunnari* migrating between regions where concentrations have been found in the past. Genetic studies had been inconclusive in determining whether different stocks existed in the Atlantic sector. There were noticeable differences in size frequency distributions, from for example, Shag Rocks and South Georgia, and also, Heard Island, Shell Bank, Kerguelen and Skif Banks, which might indicate that such groups are, for management purposes, geographically isolated.

3.50 Analysis of stomach contents of *C. gunnari* reported in WG-FSA-97/48 sampled in four surveys over the period from 1994 to 1997 in Subarea 48.3, confirmed the importance of krill in the diet of this species. In 1994, a year when krill were scarce in the region, krill were replaced in importance in the diet by the amphipod hyperiid *Themisto gaudichaudii*. In 1996 and 1997, krill were abundant and were the dominant component in the diet. The krill abundance index in 1995 was intermediate between 1994 and 1996 and this is reflected in the diet composition. Dr E. Barrera-Oro (Argentina) noted that these results provided a good link to acoustic survey data and CEMP indices for the area.

Dissostichus spp.

3.51 Around Kerguelen (Division 58.5.1), the region of greatest catch rates of *D. eleginoides* by Ukrainian longliners was on the northwestern shelf in 1995/96, whereas during the 1996/97 season the higher catch rates were obtained along the western and southwestern slope regions (WG-FSA-97/7). This change may possibly be associated with the period of strong westerly winds in 1996/97 and the incursion of warm sub-Antarctic waters to the south (WG-FSA-97/8).

3.52 A review of biological information for *D. eleginoides* was presented in WG-FSA-97/42. Spawning within the CCAMLR Convention Area takes place during the period from June to September at Crozet, Kerguelen, Shag Rocks and South Georgia, whereas on the Falkland/Malvinas shelf it is slightly earlier, from March to June. *D. eleginoides* is typical of many nototheniids in that it produces large yolky oocytes. Male fish tend to reach sexual maturity at an earlier age (7–11 years and 72–90 cm total length) than females (9–12 years and 90–100 cm). Off the coast of southern Chile maturity occurs at a larger size, 105 cm in the case of males and 117 cm for females.

3.53 WG-FSA-97/41 provided further evidence for differences between the size at sexual maturity of male and female *D. eleginoides*. Results from a commercial longliner operating during the spawning season around South Georgia indicated that L_{m50} for males was 76 cm whereas for females it was approximately 99 cm. This had meant that 76% of the female fish taken in the commercial catch were immature; 23% of the male fish in the commercial catches were immature.

3.54 Information from outside the CCAMLR region (WG-FSA-97/41), on the Argentinian slope, indicated that male *D. eleginoides* matured at a smaller size than females L_{m50} (male) = 78.3 and L_{m50} (female) = 87.1 cm; these values are much lower than those reported in WG-FSA-97/42. In discussion it was suggested that there is probably a geographical and seasonal progression in maturation with spawning in northern regions taking place in the fall and in the Antarctic zone in the latter part of the winter. Within these areas spawning appears to be prolonged with the result that the maturity ogive may depend on the time of year during which the observations are made. In addition, fish in spawning condition have been taken outside this extended season, which indicates that the spawning season may be even more extended than previously reported.

3.55 The Working Group agreed that further work was needed on this topic and noted a suggestion that spawning occurs at a low level throughout much of the year. Prof. C. Moreno (Chile) and Dr Everson agreed to investigate this matter during the intersessional period.

3.56 The current assessment models for *D. eleginoides* do not take account of sexual differences in biological parameters. In view of the differences in size at sexual maturity of males and females it was agreed that this should be undertaken as a matter of priority.

3.57 Two papers (WG-FSA-97/7 and 97/8) were tabled which provided information on the distribution and ecology of *Dissostichus mawsoni* which had been abstracted from the records of various YugNIRO research and commercial fishing. A third paper (WG-FSA-97/19), provided various other general observational notes on meteorological information and its possible relationship to *Dissostichus* distribution.

3.58 In the Indian Ocean sector, WG-FSA-97/19 indicates that *D. mawsoni* were found from 63°57' to 69°30'S and from 11°50' to 144°34'E. Juveniles of 9 to 75 cm standard length were reported from all the continental Antarctic seas as a by-catch during target fishing for *Chaenodraco wilsoni*. Juveniles less than 150 mm had been reported regularly in near-surface midwater trawls targeting krill and *Pleuragramma* in oceanic areas 3 to 4 000 m deep.

3.59 Results from an extensive series of observations of *Dissostichus* found in sperm whale (*Physeter macrocephalus*) stomachs were summarised in WG-FSA-97/19 and from trawl fishing in WG-FSA-97/20.

3.60 Both species, *D. mawsoni* and *D. eleginoides*, are found in the Atlantic sector but there did not appear to be any overlap in distribution. *D. mawsoni* were only found south of about 56°S. *D. eleginoides* were only found in the northern and western part of the sector; they were not found very far to the east of the South Georgia area. The gap between the observed limits of the two species in the Bouvet Island area is between three and four degrees of latitude and with a temperature difference of about three degrees Centigrade.

3.61 In the Indian Ocean sector, *D. mawsoni* were found close to the continent and in deep water to the north. *D. eleginoides* appeared to be restricted to the shelf and slope regions of sub-Antarctic islands and Ob and Lena Banks but rarely extended into deep oceanic water. It was also noted that generally *D. mawsoni* tends to be more pelagic than *D. eleginoides*.

3.62 *D. mawsoni* were found over much of the Pacific sector and appear to make extensive migrations as far north as the Antarctic Polar Frontal Zone. This distribution and assumed migration pattern are thought to be related to the presence of squid, its principal food.

3.63 The Working Group agreed with this general view of the distribution of the two species although it was suggested that the differences in distribution may not be quite so clearly defined as the papers indicated and that there may be some significant overlap in some regions.

Martialia hyadesi

3.64 Catches of *M. hyadesi* were reported from near-surface waters on the northern slope of South Georgia (WG-FSA-97/10) in waters of depths from 500 to 1 500 m. The mantle length of males ranged from 236 to 332 mm (mode 270 mm) and females 235 to 361 mm (mode 300 mm). Most of the males were maturing (stages IV and V) whereas most of the females were immature (stage II). The squid appeared to be feeding on krill.

Review of Biological Reference Points for Decision Criteria

3.65 The current decision rules used to assess long-term annual yields identify two criteria based on the status of the spawning stock: (i) the critical level of spawning stock relative to the pre-exploitation median level below which recruitment may be impaired; and (ii) the long-term escapement of the stock relative to the pre-exploitation median level (SC-CAMLR-XIII, paragraphs 5.18 to 5.26). These decision rules provide a practical means of implementing important elements of Article II. The exact form of the two criteria is not

solely a scientific consideration. At its 1996 meeting, WG-FSA explored the implications of varying elements of the criteria (e.g. the probability of depletion and the critical level of depletion) to *D. eleginoides* and to the fishery in Subarea 48.3 (SC-CAMLR-XV, Annex 5, paragraphs 4.75 to 4.80). This analysis was seen as a first step to providing the Scientific Committee with advice on the nature of suitable biological reference points for the stocks considered by CCAMLR. In continuing this work, the Working Group asked the Secretariat to undertake a general review of the nature and use of biological reference points in other fisheries organisations in order to be able to compare those with reference points used in CCAMLR (SC-CAMLR-XV, Annex 5, paragraph 9.5).

3.66 WG-FSA-97/35 provided an overview of reference points and their use in NAFO and FAO. The Working Group thanked the Science Officer for producing this review and agreed this was a useful foundation for identifying practices in other fisheries agencies which could be considered in the implementation of Article II. The paper described many types of reference points, which can be divided into those pertaining to a constant fishing mortality and those pertaining to critical spawning biomasses (in relation to stock-recruitment relationships). Few examples were available as to the methodologies used to identify critical reference points and none were available for helping identify critical biological reference points on the status of populations required under Article II.

3.67 The Working Group noted that the current decision rules used by CCAMLR encapsulate biological reference points that are as advanced as any currently in use in fisheries management. This is because they identify critical levels of spawning biomass and take account of uncertainties in specifying these levels as well as the inherent inability to state such levels precisely. Nonetheless, the Working Group also recognised that further work needs to be undertaken to examine the properties of these reference points in relation to fish stocks with different life history characteristics.

3.68 To date, the decision rules have been applied to krill and *D. eleginoides*. Intersessional work on *C. gunnari* (WG-FSA-97/29 and 97/38) has revealed that the decision rules may not be appropriate for this species in their current form. WG-FSA-97/29 identified substantial levels of recruitment variability for *C. gunnari* at Heard Island, which results in the probability of the population falling to below 20% of median spawning stock biomass being naturally high when fishing is absent. In the case of icefish on the Heard Plateau, the generalised yield model (GYM) predicts that, even in the absence of fishing, the probability of falling below 20% of the median unexploited spawning stock biomass is about 0.5. The current decision criterion used in formulating catch limits requires that this probability be held at 0.1. Clearly, this is not possible for this fish population, and application of this decision rule would prevent any fishing on it. This suggests that the existing form of the rule is not appropriate for such cases. WG-FSA-97/29 proposes an alternative form of the decision rule for application in such cases designed to ensure that the probability of falling below the 20% reference level is not substantially increased by the effects of fishing. In this case, the authors proposed that the probability of depletion should not be increased by more than 0.05. Combining this with the existing decision criteria leads to a composite form of the decision rule where the decision probability level (p_{dec}) is set to 0.1 when the probability of depletion with no fishing ($p_{F=0}$) is less than 0.05 and $p_{dec} = p_{F=0} + 0.05$ when $p_{F=0}$ is greater or equal to 0.05, i.e.:

$$p_{dec} = \begin{cases} 0.10 & ; p_{F=0} < 0.05 \\ \end{cases}$$

$p_{F=0} + 0.05$; *otherwise*

3.69 The Working Group agreed that such a rule has merit but its implications need to be explored further. The relationship between this rule and the overall dynamics of the stock needs to be examined, including the length of the projection over which the rule is evaluated, the magnitude of change in the probability of depletion and the real relationship between spawning stock biomass and recruitment.

3.70 WG-FSA-97/38 highlights the need to review the decision rule regarding the level of escapement. *C. gunnari* is a prey species of fur seals, which may increase consumption of icefish when krill abundance is low. For this reason, the level of escapement would be considered to be 75% of median pre-exploitation spawning biomass (compared to 50% escapement in a single-species assessment). The Working Group noted that, in evaluating long-term annual yields using the GYM, this paper explicitly factors in interannual variation in mortality of *C. gunnari* that might arise from the prey switching by fur seals when krill abundance is low. In this case, the 75% escapement rule may be able to be relaxed to 50% because escapement for predators has been accounted for in the mortality function. The implications of such a change for both predators and the prey species need to be explored further. Notably, a revision of this rule will depend on the ability to apportion natural mortality to the various sources, such as that arising from predation compared to other sources, as well as including covariation in other parameters arising from changes in M, such as growth and recruitment.

3.71 Similarly, different parts of a stock may be subject to different levels of predation. For example, at Heard Island, juvenile *D. eleginoides* may be prey of elephant seals while the larger fish escape such predation (WG-EMM-97/31). Consequently, decision rules need to be sufficiently robust to cater for variation in predator–prey interactions ontogenetically as well as spatially and temporally.

3.72 The Working Group also recognised that pre-exploitation stock levels may be unable to be estimated for some species. As a consequence, work needs to be undertaken to identify appropriate biological reference points in these cases.

3.73 The Working Group considered the appropriateness of having target levels of fishing mortality as biological reference points in the decision rules. Previous work has shown that a strategy of fishing at $F_{0.1}$ can overexploit the stock in short lived species such as *Electrona carlsbergi* (SC-CAMLR-X, Annex 6, paragraphs 7.136 to 7.140 and 7.144; SC-CAMLR-X, paragraph 4.80). WG-FSA-97/43 shows that such a strategy may lead to overexploitation in the long-lived species *D. eleginoides* as well. The Working Group agreed that target levels of F, including $F_{0.1}$, are inappropriate for implementing Article II. However, further evaluation of target fishing mortalities such as $F_{0.1}$ as a reference point in a long-term management strategy for *C. gunnari* remains to be undertaken.

Developments in Assessment Methods

Sampling Method for Longline Observations

3.74 WG-FSA-97/4 provides a methodology for sampling fish from longlines by observers in

order to obtain an unbiased random sample of fish from the whole longline. These methodologies are developed for Japanese and Spanish systems comprising series of several hundred baskets of hooks joined together to form a continuous line as well as the Norwegian system of a single continuous line. The paper outlines the statistical rationale, the methods to be followed by observers and some worked examples. In addition, an addendum provides a report of direct application of the system by an observer of a Spanish longline system.

3.75 The Working Group commended the authors for their work and encouraged them to put together a document with general instructions for observers, bearing in mind that observers may not have statistical training. This can then be circulated to technical coordinators in each country for trials and subsequent feedback as to its general application. The Working Group noted that refinements to sampling of continuous longlines may need to be developed to avoid observers having to attend the longline at all times. Nevertheless, the Working Group recognised that this work is very useful for establishing a standard methodology for sampling fish caught using longlines.

Determination of Stock Structure and Movement of *Dissostichus eleginoides*

3.76 WG-FSA-97/40 reports on progress on the determination of stock structure and movement-at-age in *D. eleginoides* through laser-based analysis of otoliths. Samples have been obtained from Macquarie Island, Kerguelen Island and South Georgia Island. Work is progressing well as a result of a well coordinated program of sampling and supply of otoliths from CCAMLR Members.

3.77 The Working Group was also informed of three other studies currently working on the stock structure of *D. eleginoides*: a DNA study being coordinated by New Zealand, a C_{14} study by Australia and a cruise being undertaken by the UK to examine stock structure of toothfish, icefish and krill. Similarly, Spain is intending to conduct a longline survey (see paragraph 6.8), the objective of which is to study the stock structure of *Dissostichus* in Subarea 48.6 and Division 58.4.4.

Developments in the Generalised Yield Model

3.78 The GYM has had two additions to its structure since last meeting. The first concerns the option of using a table of recruits in place of a lognormal recruitment function. This enables estimates of recruitment from observations of year class strength in mixture analyses to be used directly in a bootstrap function. In addition, uncertainty in these estimates can be incorporated in the model. A parametric bootstrap procedure has been added to the program so that the recruitment selected from the table of recruits is randomly modified according to a lognormal distribution with a coefficient of variation derived from the uncertainty in that recruitment estimate. This procedure is illustrated in WG-FSA-97/29.

3.79 The second enhancement of the model is the incorporation of a function allowing M to vary from year to year in a projection run. Such a function requires that the initial age structure be established sequentially from oldest to youngest ages. As a consequence, the correct formulation of the pre-exploitation median spawning biomass requires considerably more time to run than the case where M does not vary between years. Two interannual

variations in M are possible. The first is where M is randomly modified according to a lognormal distribution with a coefficient of variation derived for the estimate of M. The second case is for M to be multiplied by a specified amount, with a probability of this occurrence in any year being specified also. This case is illustrated for *C. gunnari* in WG-FSA-97/38 where M may be multiplied by 4 with a probability of this occurring in any year of 0.2.

3.80 The Working Group agreed that validation of the GYM should be given a high priority by the Secretariat in the intersessional period. The Working Group also requested that an improved user interface be developed and made available at the next meeting.

Consideration of Management Areas and Stock Boundaries

3.81 WG-FSA-97/50 proposes a change of the boundary between Subareas 58.6 and 58.7 (see Figure 2) to avoid transecting the South African EEZ around the Prince Edward Islands and to clearly separate the reporting from fishing grounds around these islands from those around Crozet Island.

3.82 The Working Group noted that, in principle, management units should have a biological justification and agreed that management advice should be based on stocks rather than statistical areas. To this end, management areas may need to be identified for individual stocks based on small scale areas, as was undertaken in the crab fishery and as has been considered in the past in distinguishing Shag Rocks from South Georgia in the myctophid fishery. This distinction is also necessary for two stocks of *C. gunnari* in the Heard Island area (WG-FSA-97/29). If this recommendation is adopted then adjustments, although likely to be minor, will need to be made to the existing database and reports for statistical subareas.

3.83 The Working Group agreed that the proposed change of the boundary between Subareas 58.6 and 58.7 be undertaken because the proposed boundary is likely to coincide with a natural boundary between stocks in the shelf area of Prince Edward Islands and stocks in the shelf area around Crozet Island.

ASSESSMENTS AND MANAGEMENT ADVICE

New and Exploratory Fisheries

New Fisheries in 1996/97

4.1 There were seven new fisheries operating in 1996/97. Summary information on these is given in Table 8, and a summary of data received by the Secretariat is given in Table 9.

New Fishery for *Martialia hyadesi* in Subarea 48.3

4.2 A total catch of 81 tonnes was reported for the Republic of Korea/UK new fishery for *M. hyadesi* in Subarea 48.3 in 1996/97 (Conservation Measure 99/XV). This was taken by a single vessel in 14 days during June/July 1997; fishing operations by this vessel for six days in January 1997 had failed to locate squid. The observer's report for the June/July operations

is given in WG-FSA-97/10. All fishery and observer data have been submitted to CCAMLR.

4.3 The failure to locate squid to the north and west of South Georgia during January is in line with the results of previous squid fishing trials and groundfish surveys, which have never revealed the presence of squid in this area during the austral summer. However, the winter operations did provide new information about the biology of *M. hyadesi* (SC-CAMLR-XVI/BG/10).

4.4 CCAMLR-XVI/21 cites an unusually good and extended season for *Illex argentinus* in the southwest Atlantic (February to June 1997) and a desire to join the *Dosidicus gigas* fishery off Peru at the end of July as the reason for the low fishing effort directed towards *M. hyadesi* this year.

4.5 A new fishery notification for *M. hyadesi* in Subarea 48.3 in 1997/98 by the UK and the Republic of Korea is given in CCAMLR-XVI/21. This is discussed in paragraphs 4.59 to 4.62.

4.6 Revised data forms for the squid jig fishery were developed in consultation with Dr P. Rodhouse (British Antarctic Survey) by the Secretariat as requested by the Working Group last year (SC-CAMLR-XV, Annex 5, paragraph 4.14) and used for recording and submitting data for this new fishery.

New Fisheries for *Dissostichus* spp.
in Subarea 48.6 and Division 58.4.4

4.7 For administrative reasons, no fishing took place in the new fisheries for *D. eleginoides* and *D. mawsoni* notified by South Africa for Subarea 48.6 and Division 58.4.4 (Conservation Measure 114/XV and 116/XV). A new fishery notification for these two fisheries for 1997/98 is discussed in paragraphs 4.27 to 4.29.

New Fisheries for *Dissostichus* spp.
in Subareas 58.6 and 58.7

4.8 A total of 2 521 tonnes of *D. eleginoides* was taken between October 1996 and 31 August 1997 in Subareas 58.6 and 58.7. This comprised 1 200 tonnes taken in the South African EEZ around Prince Edward Islands up to late January 1997 (CCAMLR-XVI/8 Rev. 1), a further 1 320 tonnes taken in the South African EEZ around Prince Edward Islands between 1 March and 31 August 1997, and around 400 kg taken outside the EEZ in Subareas 58.6 and 58.7. Approximately half the catches in the South African EEZ were taken in Subarea 58.7.

4.9 All observer data have been submitted to CCAMLR, as have STATLANT data for the fisheries up to 30 June 1997. Additional length-at-age data, CPUE by month and set and summary VMS data were made available to the Working Group during the meeting.

4.10 It was agreed that, at least in respect of the fishery within the Prince Edward Islands EEZ, the results of fishing operations reported in CCAMLR-XVI/8 Rev. 1 had established that the

fishery was commercially viable. Notifications for exploratory fisheries in Subareas 58.6 and 58.7 in 1997/98 outside EEZs are discussed in paragraphs 4.75 to 4.91.

New Fisheries for *Dissostichus* spp. in Subareas 88.1 and 88.2

4.11 CCAMLR-XVI/17 reports that, for a number of reasons, fishing operations in the new fisheries for *D. eleginoides* and *D. mawsoni* notified by New Zealand for Subareas 88.1 and 88.2 (Conservation Measure 115/XV) did not commence until May 1997. Only two sets were made, one each in Subareas 88.1 and 88.2, with a total catch of 128 kg of *D. eleginoides*. All data pertaining to these catches have been submitted to CCAMLR. The primary reason for the low fishing effort expended was that, given the late start to fishing, extensive sea-ice coverage greatly restricted fishing operations. A new fishery notification for these two fisheries for 1997/98 is discussed in paragraphs 4.30 to 4.34.

New Fishery for *Dissostichus* spp. in Division 58.4.3

4.12 New fishery notifications had been made in 1996 for Division 58.4.3 to take *D. eleginoides* and *D. mawsoni* by Australia and South Africa. In the Australian notification, the fish were to be taken by bottom trawl; in the South African notification, longlines were to be used. For 1996/97, this new fishery was covered by Conservation Measure 113/XV.

4.13 For the same administrative reasons cited earlier, no fishing was undertaken in Division 58.4.3 by South African vessels. An Australian vessel fished for four days on BANZARE Bank in March 1997, but no *Dissostichus* spp. were caught. Fishing for one day in April on Elan Bank resulted in a catch of 7 kg of *D. eleginoides* (WG-FSA-97/31). A VMS trial was successfully carried out. The low fishing effort was a result of poor weather conditions and a preference by the vessel to fish in Division 58.5.2.

New Fishery for Deepwater Species in Division 58.5.2

4.14 A new fishery for deepwater species not covered by Conservation Measures 109/XV and 110/XV had been notified by Australia in Division 58.5.2 (Conservation Measure 111/XV). No catches of the target species were made and the total catch of less than 24 tonnes consisted of known fish species taken as a by-catch in the *D. eleginoides* fishery. There is no current interest by Australia in progressing further with this fishery.

New Fisheries Notified for 1997/98

4.15 When reviewing notifications for new fisheries and for exploratory fisheries in 1997/98, the Working Group noted that in a number of cases, these fisheries had been new fisheries in 1996/97.

4.16 In two cases (South Africa: Subarea 48.6, Divisions 58.4.3 and 58.4.4 – CCAMLR-XVI/7; and Norway: Subarea 48.6 – CCAMLR-XVI/10), no fishing took place and new fishery notifications have been submitted for these for 1997/98.

4.17 In three other cases, however (Australia, Division 58.4.3; New Zealand, Subareas 88.1 and 88.2 – CCAMLR-XVI/17; UK/Republic of Korea, Subarea 48.3 – CCAMLR-XVI/21), only very small catches had been taken during 1996/97. In these cases, Members had taken different approaches to notifications for these fisheries in 1997/98; Australia submitted a notification for an exploratory fishery, while the New Zealand and UK/Republic of Korea notifications were for new fisheries. The Working Group agreed to consider these notifications under the categories nominated by the notifying Member. Where possible, however, additional advice is given in case the Scientific Committee or Commission should consider an alternative categorisation would be more appropriate.

4.18 To aid its discussions of new fishery notifications for 1997/98, the Working Group developed a check list of information required by Conservation Measure 31/X and, particularly in the case of fisheries for *Dissostichus* spp., the additional points in SC-CAMLR-XV paragraph 8.17. Summaries in tabular form were then developed for each notification and these are given below.

4.19 The Working Group observed that in some of the notifications for new and exploratory fisheries for 1997/98, it had not been specifically indicated that all the data collection and submission requirements of Conservation Measures 117/XV and 112/XV had been met. While these omissions were no doubt inadvertent, the Working Group recommended that all Members undertaking new or exploratory fisheries operations be reminded of the need to comply fully with these conservation measures.

4.20 In respect of Conservation Measure 112/XV, experience had been gained in the application of this in the South African fishery in Subareas 58.6 and 58.7. Compliance with those aspects of this conservation measure that related to fine scale rectangles was found to be feasible, but only if very good positional information was available, such as from VMS.

New Fishery for *D. eleginoides* in Division 58.4.4

4.21 Ukraine submitted a notification (CCAMLR-XVI/6) for a new fishery for *D. eleginoides* in Division 58.4.4. A summary is given in the following table.

New Fishery – Information Required	Information Supplied
Member	Ukraine
Reference	CCAMLR-XVI/6
Area	Division 58.4.4
Species	*D. eleginoides*
1997/98 notification by 28 July 1997	Yes
Catch level (tonnes) for viable fishery	Expect to catch about 500 tonnes in first year

Table (continued)

New Fishery – Information Required	Information Supplied
Fishery plan	Target fishing using Mustad longlines One fishing vessel during September 1997 to May 1998
Biological information	Research data since 1971
Effect on dependent species	Expect by-catch species to include *Bathyraja* spp., *Macrourus whitsoni* (*M. holotrachys*), *Muraenolepis marmoratus*. Catches of these species will not exceed those in Subarea 48.3 and Division 58.5.1. All CCAMLR measures will be taken to minimise incidental catches.
Information for calculation of potential yield	Biomass estimates from trawl survey (to 300 m)
Data collection plan	Haul-by-haul data as required by CCAMLR
Observer coverage	One national observer (biologist) and one CCAMLR observer
Position verification	Not mentioned
Other information/comment	Limit of 100 tonnes/fine-scale grid (Conservation Measure 112/XV) will not allow viable fishing due to bathymetry of region.

4.22 The Working Group noted that commercial catches of *D. eleginoides* have not been reported to date from this division and very little information is available to CCAMLR about the abundance and status of fish stocks in the division. It noted further, however, that CCAMLR-XVI/6 reveals the existence of data from a long series of trawl surveys conducted by Ukraine since 1971, which are apparently sufficient, *inter alia*, to allow biomass estimates for *D. eleginoides* to be calculated.

4.23 None of these data, however, have been submitted to CCAMLR, and the Working Group recommended that Ukraine be requested to submit these data as soon as possible. Had these data been available in the CCAMLR database, the Working Group believed that a thorough assessment of stock status similar to those undertaken in Subarea 48.3 and Division 58.4.2 could have been conducted and sound advice provided.

4.24 Biomass estimates of 1 500 tonnes and 3 000 tonnes for *D. eleginoides* are reported in CCAMLR-XVI/6 for the Ob and Lena Bank areas respectively. These estimates stem from surveys conducted within the 300 m isobath. The proposed catches of 500 tonnes may seem large in comparison with these biomass estimates, but such comparisons are very difficult to make, because the estimates are likely to relate only to juvenile fish at 300 m and less. It was unclear to the Working Group how catches would be restricted mainly to mature fish.

4.25 The Working Group agreed that, as suggested in CCAMLR-XVI/6, by-catches of *Bathyraja* spp., *Macrourus whitsoni* and *Muraenolepis marmoratus* were likely. It noted, however, that at shallower depths in the range proposed to be fished, it was also possible that *Lepidonotothen squamifrons* and *Notothenia rossii* may also be taken.

4.26 The Working Group noted that fishing was planned to take place throughout the summer. If this occurs, at times it will be very difficult to set longlines only at night and there may be a problem with bird by-catches (see also section 7).

New Fisheries for *Dissostichus* spp. in Subarea 48.6
and Divisions 58.4.3 and 58.4.4

4.27 South Africa submitted a notification (CCAMLR-XVI/6) for new fisheries for *Dissostichus* spp. in Subarea 48.6 and Divisions 58.4.3 and 58.4.4. A summary is given in the following table.

New Fishery – Information Required	Information Supplied
Member	South Africa
Reference	CCAMLR-XVI/7
Area	Subarea 48.6, Divisions 58.4.3 and 58.4.4
Species	*Dissostichus* spp.
1997/98 notification by 28 July 1997	Yes. Subarea 48.6 and Division 58.4.4 were new fisheries in 1996/97 (not fished).
Catch level (tonnes) for viable fishery	
Fishery plan	South African flagged longline vessels Limit of 100 tonnes/fine-scale grid (Conservation Measure 112/XV) 1 March to 31 August 1998, or earlier
Biological information	WG-FSA-96 for Subarea 48.6
Effect on dependent species	By-catch of any species other than *Dissostichus* shall not exceed 50 tonnes for each species. Jellymeat *Dissostichus* will be reported. All CCAMLR measures will be taken to minimise incidental catches.
Information for calculation of potential yield	WG-FSA-96 for Subarea 48.6
Data collection plan	Catch, effort and biological as stipulated in Conservation Measure 117/XV Five-day catch and effort reports
Observer coverage	CCAMLR observers on all trips
Position verification	VMS on all vessels
Other information/comment	Collection of environmental data

4.28 In 1996/97, there were new fisheries notified by South Africa for Subarea 48.6 and Division 58.4.4, but these were not fished. The notification for Division 58.4.4 is for a fishery in the same area as the Ukrainian notification discussed above. Australia has notified an exploratory fishery for Division 58.4.3 in 1997/98.

4.29 The South African notification addresses all the requirements of Conservation Measure 31/X and the points in SC-CAMLR-XV, paragraph 8.17.

New Fisheries for *Dissostichus* spp.
in Subareas 88.1 and 88.2

4.30 New Zealand submitted a notification (CCAMLR-XVI/17) for new fisheries for *Dissostichus* spp. in Subareas 88.1 and 88.2. A summary is given in the following table.

New fishery – Information required	Information supplied
Member	New Zealand
Reference	CCAMLR-XVI/17
Area	Subareas 88.1 and 88.2
Species	*Dissostichus* spp.
1997/98 notification by 28 July 1997	Yes. New fishery in 1996/97 (128 kg)
Catch level (tonnes) for viable fishery	Re-apply the 1980 tonnes catch limit
Fishery plan	Limit of 100 tonnes/fine-scale grid (Conservation Measure 112/XV), longline 15 February to 31 August 1998
Biological information	WG-FSA-96
Effect on dependent species	By-catch of any species other than *Dissostichus* shall not exceed 50 tonnes for each species. All CCAMLR measures will be taken to minimise incidental catches.
Information for calculation of potential yield	WG-FSA-96
Data collection plan	As required by CCAMLR
Observer coverage	CCAMLR observers on all trips
Position verification	VMS on all vessels, required to leave area on malfunction

4.31 A very small catch (128 kg) was taken in Subareas 88.1 and 88.2 in a new fishery undertaken by New Zealand in 1996/97 (see paragraph 4.11).

4.32 The New Zealand notification addresses all the requirements of Conservation Measure 31/X and the points in SC-CAMLR-XV, paragraph 8.17.

4.33 The Working Group noted that extensive tagging of *D. mawsoni* had been carried out by US scientists at McMurdo and of *D. eleginoides* by Australian scientists at Macquarie Island. It is possible that tagged fish from both sources may be taken in this new fishery.

4.34 The Working Group noted that for this fishery, no further development of the Data Collection Plan (Conservation Measure 65/XII) by the Scientific Committee would be required in the coming year, should it be considered to be an exploratory fishery (see paragraph 4.67 and Appendix E).

New Fishery for *D. eleginoides* in Subarea 48.6

4.35 Norway submitted a notification (CCAMLR-XVI/10) for a new fishery for *D. eleginoides* in Subarea 48.6. A summary is given in the following table.

New Fishery – Information Required	Information Supplied
Member	Norway
Reference	CCAMLR-XVI/10
Area	Subarea 48.6
Species	*D. eleginoides*
1997/98 notification by 28 July 1997	Yes. New fishery in 1996/97 (permits not issued for fishing).
Catch level (tonnes) for viable fishery	Maximum catch of 1 500 tonnes
Fishery plan	Mainly in waters around Bouvet Island One vessel, longline
Biological information	
Effect on dependent species	All CCAMLR measures will be taken to minimise incidental catches.
Information for calculation of potential yield	
Data collection plan	As required by CCAMLR
Observer coverage	As required by CCAMLR
Position verification	VMS

4.36 A new fishery had been notified by Norway for this subarea for 1996/97, but it was not fished.

4.37 As was the case with the notification submitted by Norway last year, the Working Group was unable to comment on the current notification, because of the lack of information provided in it. The Working Group did query the restriction of the notification to *D. eleginoides* only, since if fishing operations took place towards the southern part of Subarea 48.6, it is likely that *D. mawsoni* may also be taken.

New Fisheries for *Dissostichus* spp.
in Subareas 48.1, 48.2 and 88.3

4.38 Chile submitted a notification (CCAMLR-XVI/9) for new fisheries for *Dissostichus* spp. in Subareas 48.1, 48.2 and 88.3. The document submitted is a summary of a much longer document (in Spanish only) which provided a comprehensive review of the proposed fishery and data collection plan. This document was made available to the Working Group. A summary of the notification is given in the following table.

New Fishery – Information Required	Information Supplied

Member	Chile
Reference	CCAMLR-XVI/9
Area	Subareas 48.1*, 48.2* and 88.3 (*see current conservation measures)
Species	*Dissostichus* spp.
1997/98 notification by 28 July 1997	Yes
Catch level (tonnes) for viable fishery	Suggest a catch limit of 1 980 tonnes in each subarea
Fishery plan	Research and commercial fishing Three longline vessels Limit of 100 tonnes/fine-scale grid (Conservation Measure 112/XV) 1 January to 31 October 1998
Biological information	No
Effect on dependent species	By-catch of any species other than toothfish shall not exceed 50 tonnes for each species. All CCAMLR measures will be taken to minimise incidental catches.
Information for calculation of potential yield	As per Conservation Measure 112/XV
Data collection plan	Catch, effort and biological as stipulated in 117/XV Five-day catch and effort reports
Observer coverage	CCAMLR observers on all trips
Position verification	VMS
Other information/comment	Collection of environmental data

4.39 The Working Group noted that, for Subareas 48.1 and 48.2, there were conservation measures in force that prohibited the directed fishing for finfish, at least until such time as a survey of stock biomass has been carried out, its results have been analysed, and a decision to reopen the fishery has been made by the Commission based on the advice of the Scientific Committee (Conservation Measure 72/XII and 73/XII).

4.40 WG-FSA-97/27 reports the results of a survey conducted around Elephant Island (Subarea 48.1) in 1996 and a comparison of the results of that survey with previous surveys (see paragraph 4.136). The conclusion was reached that the fish standing stock biomass has continued to decline since closure of the area and that there is little prospect of reopening the multispecies trawl fishery around Elephant Island. Dr Kock advised the Working Group that an estimate of the biomass of juvenile *D. mawsoni* around Elephant Island from the 1996 survey was approximately 57 tonnes (calculated from a catch of 26 individuals of lengths from 18 to 65 cm).

4.41 Dr Balguerías advised that no *Dissostichus* spp. were taken during the most recent Spanish survey (1991) carried out in Subarea 48.2 at depths less than 500 m.

4.42 Reviewing the background to Conservation Measures 72/XII and 73/XII, the Working Group observed that their imposition had arisen from concerns about the status of finfish

species vulnerable to capture in trawl fisheries in relatively shallow waters. The new fishery proposal was for longlining in deeper waters using the Spanish system.

4.43 Reported by-catches by longline system in the *D. eleginoides* longline fishery in Subarea 48.3 are shown in Table 10.

4.44 The Working Group agreed that the by-catch rates in this table may be underestimated, because they are based on reported by-catches from the commercial fishery, rather than scientific observation. However, it agreed that if the Spanish system is used and longlining is restricted to depths greater than 600 m, it is unlikely that there would be any threat to the species of concern in Conservation Measures 72/XII and 73/XII.

4.45 The most likely by-catch species from the proposed longline fishery using the Spanish system are *Rajiformes* and *Macrourus* species. On the evidence from the table above, it appears that the by-catch rate of these species may also be low, but attention was again drawn to the likelihood that these estimates of by-catch rates are biased downwards.

4.46 CCAMLR-XVI/9 indicates that the intended fishing operations will comply with the by-catch provisions of Conservation Measure 112/XV. The Working Group recommended that, in addition to this, a by-catch provision similar to that in Conservation Measures 109/XV, 110/XV and 111/XV be adopted, under which vessels move to another fishing location if the by-catch in any one longline set of species other than *D. eleginoides* or *D. mawsoni* exceeds 5%, subject to the modification suggested in CCAMLR-XVI/12.

4.47 The principal concern raised by members of the Working Group regarding Subareas 48.1 and 48.2 was that the little existing information suggested that the abundance of *D. eleginoides* or *D. mawsoni* in these areas may be very low. In this context, attention was drawn to the very low abundances of juvenile *D. mawsoni* in research surveys in Subareas 48.1 and 48.2 in comparison with juvenile abundance estimates for *D. eleginoides* from surveys in Subarea 48.3. It was also noted that *D. mawsoni* may be more pelagic in its habits (WG-FSA-97/19 and 97/20), thus making it less vulnerable to capture in a bottom trawl survey.

4.48 In view of the possibility that very low catches may be achieved, the need for three vessels was queried. Prof. P. Arana (Chile) clarified that the fishing operation plan called for an initial cruise of 45 days by one vessel systematically exploring three regions within the areas. The results of this exploratory cruise will be used to prepare fishing plans for a later period using up to three vessels. If the initial exploratory cruise failed to locate sufficient fish, the later fishing operations would be abandoned.

4.49 Dr Kock observed that, as so little is known about the deepwater fish species to be found in these areas, it was very pleasing to see that an expert in taxonomy would be participating in the cruises. He offered further assistance in this area should it be needed.

4.50 The Working Group also noted that, because of the extensive sea-ice coverage in these subareas, only a restricted period of months would be available for fishing. During the summer months, there is a high risk of by-catch of giant petrels and albatrosses (see section 7). It was explained that the proposed fishing season of 1 January to 31 October allowed two potential periods of sea-ice-free fishing activities.

4.51 In relation to the proposed fishing activities in Subarea 88.3, it was noted that there was a low risk of seabird by-catch (see paragraph 7.126(xii)).

4.52 Attention was drawn to the extensive tagging of *D. mawsoni* by US scientists at McMurdo. A close watch should be kept for the presence of external tags.

New Fisheries for *D. eleginoides* in Subareas 48.1, 48.2 and 48.4

4.53 Uruguay submitted a preliminary notification by letter for new fisheries for *D. eleginoides* in Subareas 48.1, 48.2 and 48.4. No accompanying document has been submitted to CCAMLR. A summary of the information contained in the preliminary notification is given in the following table.

New Fishery – Information Required	Information Supplied
Member	Uruguay
Reference	Preliminary notification by letter (4 August 97)
Area	Subareas 48.1*, 48.2* and 48.4*. (*see current conservation measures)
Species	*D. eleginoides*
1997/98 notification by 28 July 1997	No
Catch level (tonnes) for viable fishery	-
Fishery plan	Up to six vessels?
Biological information	-
Effect on dependent species	-
Information for calculation of potential yield	WG-FSA-97
Data collection plan	-
Observer coverage	-
Position verification	-

4.54 The new fisheries proposed for Subareas 48.1 and 48.2 are for the same areas notified by Chile in CCAMLR-XVI/9. Existing conservation measures for these areas are discussed in paragraphs 4.39 to 4.44.

4.55 Insufficient information is provided in this preliminary notification for the Working Group to comment. Concern was expressed, however, that apparently up to six vessels may be involved in this fishery. This may be rather excessive, given the notification submitted by Chile for up to three vessels in these subareas and the doubts expressed by the Working Group as to the likely levels of abundance of *Dissostichus* spp. in these areas (see paragraphs 4.47 and 4.48).

4.56 Under these circumstances, if fishing does take place the Working Group recommended that consideration should be given to imposition of restrictions on the level of fishing effort, as well as existing limitations on catches in fine-scale rectangles and overall precautionary catch limits for these areas. Dr Holt noted that there was a precedent for such restrictions in the measures adopted for the crab fishery in Subarea 48.3.

4.57 The Working Group noted that Conservation Measure 101/XV sets a catch limit of 28 tonnes for *D. eleginoides* in Subarea 48.4 for 1996/97, and that catches of *D. eleginoides* (but not *D. mawsoni*) have previously been reported (see paragraph 4.115; SC-CAMLR-XV, paragraph 4.79).

4.58 The Working Group was also concerned that the preliminary notification was for *D. eleginoides* only. It is highly likely that *D. mawsoni* will also be taken.

New Fishery for *Martialia hyadesi* in Subarea 48.3

4.59 The UK and the Republic of Korea submitted a notification (CCAMLR-XVI/21) for a new fishery for *M. hyadesi* in Subarea 48.3. A summary is given in the following table.

New Fishery – Information Required	Information Supplied
Member	UK and Republic of Korea
Reference	CCAMLR-XVI/21
Area	Subarea 48.3
Species	*M. hyadesi*
1997/98 notification by 28 July 1997	No. New fishery in 1996/97 (81 tonnes)
Catch level (tonnes) for viable fishery	800 to 1 200 tonnes per vessel. Overall catch limit 2 500 tonnes. Prospects discussed in SC-CAMLR-XVI/BG/10.
Fishery plan	Joint venture UK/Republic of Korea Jig fishery
Biological information	Research and 1997 fishery data
Effect on dependent species	Limited by-catch, potential threat to squid predators
Information for calculation of potential yield	Research and WG-FSA-96
Data collection plan	As required by CCAMLR
Observer coverage	Scientific observers on all trips
Position verification	Not mentioned

4.60 As with the notification by New Zealand (CCAMLR-XVI/17), this fishery had been notified as a new fishery for 1996/97, but only a very small catch (81 tonnes) was taken (see paragraphs 4.2 to 4.5).

4.61 The UK/Republic of Korea notification addresses all the information requirements Conservation Measure 31/X. An analysis of future prospects for the fishery is given in SC-CAMLR-XVI/BG/10.

4.62 The Working Group noted that for this fishery, no further development of a Data Collection Plan (Conservation Measure 65/XII) by the Scientific Committee would be required in the coming year, should it be considered to be an exploratory fishery (see paragraph 4.67 and Appendix E).

Exploratory Fisheries Notified for 1997/98

4.63 Notifications of exploratory fisheries for 1997/98 were submitted by Australia (Division 58.4.3) and South Africa (Subareas 58.6 and 58.7), and notifications by Ukraine and Russia for Subareas 58.6 and 58.7 were also considered to be for exploratory fisheries.

4.64 As with new fishery notifications for 1997/98, the Working Group developed a check list of information required by Conservation Measure 65/XII to aid it in its discussions and summaries in tabular form were prepared for each notification.

4.65 This is the first time that the Working Group has had to provide advice on notifications for exploratory fisheries under Conservation Measure 65/XII. One of the requirements of Conservation Measure 65/XII is that the Scientific Committee shall develop a Data Collection Plan for each exploratory fishery.

4.66 Each of the notifications to be considered at this meeting are for fisheries that were new fisheries in 1996/97. Although data for these fisheries have been submitted to CCAMLR, there has not been sufficient time for the Working Group to analyse these data or to develop detailed specific Data Collection Plans.

4.67 Both the Australian and South African notifications for *Dissostichus* spp. contained comprehensive data collection plans that were quite similar. Based on these and on the UK/Republic of Korea notification for a new fishery for squid, an outline Data Collection Plan was developed by the Working Group. This is included as Appendix E. The status of scientific observers is referred to the Scientific Committee for further consideration.

4.68 The Working Group noted that in the preamble to Conservation Measure 65/XII, the Commission had agreed that exploratory fishing should not be allowed to expand faster than the acquisition of information necessary to ensure that the fishery can and will be conducted in accordance with the principles set forth in Article II. A vital element in ensuring this is the ability of the Scientific Committee to conduct stock assessments.

4.69 For *Dissostichus* spp., the assessment methods currently available to the Scientific Committee all require research survey estimates of biomasses. For longline fisheries for *Dissostichus*, the Working Group has been unable to assess the status of the stocks using data from longline fishing only. The Working Group agreed that the conducting of research surveys was an essential element of the precautionary development of exploratory fisheries. It therefore recommended that research trawl surveys be included at the very early stages of the development of new and exploratory fisheries for *Dissostichus*. In this context, the

Working Group welcomed the inclusion of plans for the early conducting of research surveys in the notifications by South Africa and Australia.

Exploratory Fishery for *Dissostichus* spp. in Division 58.4.3

4.70 Australia submitted a notification by letter for an exploratory fishery for *Dissostichus* spp. in Division 58.4.3. A summary of the information provided is given in the following table.

Exploratory Fishery – Information Required	Information Supplied
Member	Australia
Reference	Letter
Area	Division 58.4.3
Species	*Dissostichus* spp.
1997/98 notification date	Received by Secretariat on 19 September 1997 New fishery in 1996/97
Catch level (tonnes) for viable fishery	800 tonnes
Fishery plan	One vessel Trawl fishery
Biological information	Research data
Effect on dependent species	As for 1996/97 new fishery and WG-FSA-97/31
Information for calculation of potential yield	WG-FSA-96
Research plan	WG-FSA-97/31
Observer coverage	CCAMLR observers on all trips
Registration of vessel details	Yes
Position verification	VMS

4.71 As discussed in paragraphs 4.12 and 4.13, a new fishery had been notified for this division by Australia for 1996/97. Only 7 kg of *D. eleginoides* had been taken.

4.72 A detailed research and data collection plan for this fishery is given in WG-FSA-97/31. Random stratified trawl surveys are planned for both BANZARE and Elan Banks, though surveys of both banks will not necessarily be completed in the first year. When these surveys have been completed, it should be possible for the Working Group to conduct stock assessments using the methods employed currently for Subarea 48.3 and Division 58.5.2.

4.73 Mr Williams advised that past observations have shown no lethal interactions of the fishing gear and fishing activities with seabirds and marine mammals. Australian regulations require that there be no overboard discharge of offal or waste.

4.74 The Working Group noted that a new fishery proposal for a longline fishery for *Dissostichus* spp. in Division 58.4.3 was discussed in paragraphs 4.27 to 4.29.

Exploratory Fisheries for *Dissostichus* spp. in Subareas 58.6 and 58.7 outside EEZs

4.75 Notifications have been submitted for exploratory fisheries for *Dissostichus* spp. in Subareas 58.6 and 58.7 outside EEZs by South Africa (CCAMLR-XVI/8), Ukraine (CCAMLR-XVI/6) and Russia (by letter).

4.76 A summary of the information provided in the South African notification is given in the following table.

Exploratory Fishery – Information Required	Information Supplied
Member	South Africa
Reference	CCAMLR-XVI/8 Rev. 1
Area	Subareas 58.6 and 58.7, outside EEZs
Species	*Dissostichus* spp.
1997/98 notification date	Received by Secretariat on 15 July 1997
Catch level (tonnes) for viable fishery	Up to 3 200 tonnes in each subarea
Fishery plan	South African flagged longline vessels Catch rate decision rule (CCAMLR-XVI/8 Rev. 1) Year round Haul-by-haul data as required by CCAMLR
Biological information	WG-FSA-96
Effect on dependent species	By-catch of any species other than toothfish shall not exceed 50 tonnes for each species. Jellymeat *Dissostichus* will be reported. All CCAMLR measures will be taken to minimise incidental catches.
Information for calculation of potential yield	WG-FSA-96
Research plan	Experimental fishing, two-stage decision rule Research survey in each subarea within two years
Observer coverage	CCAMLR observers on all trips
Registration of vessel details	?
Position verification	VMS on all vessels
Other information/comment	Collection of environmental data

4.77 As discussed in paragraphs 4.8 to 4.10, a new fishery had been notified for these subareas by South Africa for 1996/97. A total of 2 521 tonnes of *D. eleginoides* had been taken by 31 August 1997, almost all within the EEZ around Prince Edward Islands. In addition, very large unreported catches were estimated to have been taken in these subareas.

4.78 The notification by South Africa is intended to cover longline fishing only outside the Prince Edward Islands EEZ. No notification had been submitted in respect of fishing activities within the Prince Edward Islands EEZ for 1997/98.

4.79 Detailed research, data collection and fishing plans are included in CCAMLR-XVI/8 Rev. 1. A three stage research plan involving both normal and experimental fishing is proposed, with a two-stage decision rule based on catch rates in fine-scale rectangles being used to set tiered catch levels. The research plan also envisages that a research survey will be completed in the two subareas within the first two years. This should enable the Working Group to conduct stock assessments using the methods employed currently for Subarea 48.3 and Division 58.5.2.

4.80 The decision rule proposed in the South African notification for setting tiered catch levels based on catch rates in fine-scale rectangles was similar to proposals made last year by South Africa and New Zealand. The Working Group recalled its previous discussions on fine-scale rectangle catch limits and its agreement that a uniform approach should be taken across all new and exploratory fisheries. It had consequently recommended that there should be a 100-tonne limit imposed on the catches taken in each 0.5 by 1 degree rectangle (SC-CAMLR-XV, Annex 5, paragraphs 4.22 to 4.27).

4.81 It was further observed that one of the reasons it had preferred the 100-tonne limit to the adaptive approach using a more complex decision rule was that the properties of that decision rule had not yet been elaborated. The Working Group agreed that it could consider the adaptive approach further if a paper considering further development of it were submitted for the Working Group's consideration at its next meeting.

4.82 Several members commented, however, that practical experience with application of the fine-scale rectangle catch limit had indicated that there were some problems in its application, both for trawl and longline fisheries. These occurred particularly in circumstances where there were limited fishable grounds or fishable aggregations within the area being fished, or where the overall catch limit for the area was low. In some of these cases, strict adherence to the 100-tonne limit could make the fishery unviable.

4.83 The Working Group recalled that the primary aim of this conservation measure was to ensure that fishing effort was spread around the area. In very large areas, such as Subarea 48.6, the measure should not cause problems. However, it did appear that problems could arise in smaller areas with low overall catch limits. It therefore believed that consideration might be given to some relaxation of the fine scale limit in appropriate areas.

4.84 The fishing season proposed envisaged no closed seasons other than those agreed by CCAMLR for mitigating seabird mortality or for other reasons. In this respect, CCAMLR-XVI/8 Rev. 1 comments on the likely efficacy of closed seasons for mitigating seabird mortality, for improving knowledge of *Dissostichus* dynamics year round and in relation to the need for maintaining a legitimate presence. The Working Group felt it was not appropriate for it to

discuss these points, other than to note that these subareas appear to be some of the highest risk areas for seabird mortality (paragraphs 7.126(viii) and (ix)).

4.85 Dr Miller noted that the 3 200 tonnes maximum catch limits for each area proposed in CCAMLR-XVI/8 Rev. 1 was based on extrapolation of catch rates from Subarea 48.3 and that the limits were presented for the purpose of provoking discussion. He also noted that, while the effect of the very large estimated unreported catches on the stocks in these areas was uncertain, they did demonstrate the likelihood of substantial abundances of *D. eleginoides* in the general region, possibly also including adjacent areas close to the northern boundary of CCAMLR.

4.86 When calculating estimates of precautionary catch levels using extrapolations based on seabed areas or numbers of fine-scale rectangles, the Working Group noted that it would not be excluding the areas contained within EEZs in the subareas or divisions (see paragraphs 4.94 to 4.96). Should fishing within EEZs be restricted, with the precautionary catch limits being taken only outside of EEZs, then higher removals from the stocks than intended may occur.

4.87 A summary of the information provided in the Ukrainian notification (CCAMLR-XVI/6) is given in the following table.

Exploratory Fishery – Information Required	Information Supplied
Member	Ukraine
Reference	CCAMLR-XVI/6

Table (continued)

Exploratory Fishery – Information Required	Information Supplied
Area	Subareas 58.6 and 58.7, outside EEZs
Species	*Dissostichus* spp.
1997/98 notification date	Received by Secretariat on 11 June 1997
Catch level (tonnes) for viable fishery	Expect to catch about 500 tonnes in first year
Fishery plan	Target fishing using Mustad longlines One fishing vessel from September 1997 to May 1998
Biological information	-
Effect on dependent species	Expect by-catch species to include *Bathyraja* spp, *Macrourus whitsoni* (*M. holotrachys*), *Muraenolepis marmoratus*. Catches of these species will not exceed those in Subarea 48.3 and Division 58.5.1. All CCAMLR measures will be taken to minimise incidental catches.
Information for calculation of potential yield	-
Research plan	Haul-by-haul data as required by CCAMLR
Observer coverage	One national observer (biologist) and one CCAMLR observer

Registration of vessel details	-
Position verification	-
Other information/comment	Notified as new fishery. Limit of 100 tonnes/fine-scale grid (Conservation Measure 112/XV) will not allow viable fishing due to bathymetry of region.

4.88 In the original notification, this proposal had been treated as for a new fishery, but on the advice of the Secretariat it has been treated here as for an exploratory fishery.

4.89 There was insufficient information provided to allow the Working Group to evaluate what is intended.

4.90 A summary of the information provided in the Russian letter of notification is given in the following table.

Exploratory Fishery – Information Required	Information Supplied
Member	Russia
Reference	Letter
Area	Subareas 58.6 and 58.7, outside EEZs
Species	*Dissostichus* spp.
1997/98 notification date	Received by Secretariat on 20 August 1997
Catch level (tonnes) for viable fishery	

Table (continued)

Exploratory Fishery – Information Required	Information Supplied
Fishery plan	Longline fishery Same plan as for South Africa
Biological information	WG-FSA-96
Effect on dependent species	Same plan as for South Africa
Information for calculation of potential yield	WG-FSA-96
Research plan	
Observer coverage	Same plan as for South Africa
Registration of vessel details	
Position verification	

4.91 As with the Ukrainian notification, insufficient information had been provided for the Working Group to comment on the Russian notification. Dr K. Shust (Russia) advised that all CCAMLR regulations and conservation measures will be strictly adhered to in this fishery, and as far as possible the research and data collection plans proposed by South Africa will be followed.

Calculation of Precautionary Catch Levels

4.92 Last year, the Working Group had agreed that a conservative approach to advising on precautionary catch limits for new fisheries would be to extrapolate from estimated yields for *D. eleginoides* in Subarea 48.3 and Division 58.5.2 in a manner that is discounted to take implicit account of incomplete knowledge of previously unexploited areas and/or adjusted for the relative areas of fishable seabed (SC-CAMLR-XV, Annex 5, paragraph 4.28).

4.93 In its 1996 report (SC-CAMLR-XV, Annex 5, paragraph 4.29), the Working Group presented an example calculation involving multiplying the yield estimate by 0.5. Subsequently, the Commission agreed to precautionary catch limits equal to the yield estimates multiplied by 0.45.

4.94 It was not possible last year to make an adjustment of precautionary catch limits based on proportional seabed areas, and the Secretariat was asked to undertake such calculations during the intersessional period. Estimates were tabled at this meeting in SC-CAMLR-XVI/BG/17. Also available was a computer program that allowed calculations for any range of depths required.

4.95 During the meeting, at the request of the Working Group, the Secretariat calculated, for each subarea and division, the estimated seabed areas in three depth ranges: 0 to 600 m (possibly representative of juvenile habitat), 600 to 1 800 m (longline fishing depths) and 500 to 1 500 m (trawl fishing depths).

4.96 It was noted that the estimates of seabed areas in high latitudes were more uncertain than those in lower latitudes, and it had been necessary to perform these calculations only as far as 70°S. This may result in a considerable underestimation of seabed area if there are substantial areas of shallow water in high latitudes. For this reason, the degree of underestimation may be quite large in Subareas 88.1 and 88.2 (Ross Sea), for example. Also, it is likely that seabed areas in regions with numbers of isolated seamounts are underestimated.

4.97 Dr Miller observed that the seabed area calculations also ignored the areas to the north of the northern boundary of the Convention Area. At least in the case of Subareas 58.6 and 58.7, there were undoubtedly *D. eleginoides* present to the north. It was important to recognise that conservation of *D. eleginoides* involved consideration of areas and fisheries both inside and outside the Convention Area.

4.98 Seabed areas above 600 m may provide some indication of the area of juvenile habitat, but the Working Group emphasised that interpretation of these was difficult, because of uncertainties in the extent of migratory movement of *Dissostichus* spp.

4.99 The Working Group agreed that at this meeting it would carry out calculations of precautionary catch limits that involved:

(i) proportional adjustments for areas of fishable seabed. For longline fisheries the adjustment used the relative areas of seabed between 600 and 1 800 m in Subarea 48.3 and in the area under consideration. For trawl fisheries, the depth

range used was 500 to 1 500 m;

(ii) calculations using the GYM with biological and fishery parameters set at the values most appropriate for the area under consideration. For most areas, this meant using parameters from assessments for Subarea 48.3 for longline fisheries (see Tables 20 and 33), or those for Division 58.5.2 for trawl fisheries. Information from observer reports for Subareas 58.6 and 58.7 on maturity at length (range 50–80 cm, LM_{50} = 65 cm) and selectivity (knife-edge at 55 cm) were used in calculations for those two subareas;

(iii) use of the GYM to incorporate the potential effects of the recent catch history on the long-term status of the spawning stocks in each area for which calculations were made; and

(iv) yield levels calculated in this way were then multiplied by a factor less than 1.0 to account for the uncertainty of extrapolation to previously unfished or lightly fished areas.

4.100 The Working Group noted that the catches in the 1996/97 season, including unreported catches, are unlikely to substantially affect the precautionary long-term annual yields (see paragraph 4.270 for consideration of this issue). However, these catches were substantially greater than the crude estimates of yield presented here. The Working Group agreed that sustained catches substantially above estimates of the long-term annual yield could cause the spawning stocks to collapse.

4.101 The proportional adjustments for seabed area were made by adjusting the mean recruitment in the GYM for either Subarea 48.3 or Division 58.5.2 by the relative seabed areas in the appropriate fishable depth ranges.

4.102 The Working Group noted that last year precautionary catch limit calculations for new fisheries had used average catches in Subarea 48.3 and Division 58.5.2 as an indicator of yield. This year estimates from the GYM were used. In addition to providing a more consistent estimator of yield, use of the GYM allowed use of absolute estimates of recruitment and accounting for the different recent catch histories in each area.

4.103 For Subareas 58.6 and 58.7, two separate sets of calculations were done. The first set involved calculation of seabed areas and allocation of catches according to the existing boundaries of the two subareas. These are labelled 'current' in Table 11. The second set of calculations involved use of the new boundaries for the two subareas as proposed in WG-FSA-97/50. These areas are labelled 'proposed' in Table 11.

4.104 Initially, precautionary catch limit calculations were done for the whole of the areas under consideration, regardless of the *Dissostichus* species involved. However, several members expressed concern that the available knowledge about *D. mawsoni* was much less than that for *D. eleginoides*. This implied that precautionary catch levels calculated in the manner proposed would be much more uncertain for *D. mawsoni* than for *D. eleginoides*. In these circumstances, it may be appropriate for a greater discount factor for uncertainty to be applied for *D. mawsoni*.

4.105 Accordingly, the calculations (including the proportional seabed area calculations)

were repeated separately for those parts of each subarea or division that were believed to be occupied by the two species. The discount factor used for *D. eleginoides* was 0.45, matching the factor used by the Commission for calculating precautionary catch limits for new fisheries last year. The discount factor used for *D. mawsoni* was 0.3. The Working Group emphasised that there is no scientific basis for selecting particular values for these discount factors.

4.106 The results of these calculations are shown in the Table 11.

4.107 In view of the restricted and scattered nature of information on *D. mawsoni*, the Working Group recommended that the Secretariat compile all available information on this species for presentation to the Working Group at its next meeting.

4.108 Mr Williams observed that if the proposed new fisheries were to encounter both *D. eleginoides* and *D. mawsoni*, there would be a need for observers to identify them positively. He agreed to prepare an addendum to the *Scientific Observers Manual* to cover this.

4.109 Before considering the individual precautionary catch limit calculations in detail, the Working Group discussed the strengths and limitations of the calculation procedure used. On the one hand, the Working Group agreed that the procedure used was, scientifically, the best available given the existing information. In particular, the procedure was essentially the one it had wanted to use last year, but had been unable to because of the lack of estimates of areas of fishable seabed. On the other hand, however, there were a number of intrinsic uncertainties in the procedure that meant the results must be interpreted with considerable caution.

(i) First, as was noted last year (SC-CAMLR-XV, Annex 5, paragraph 4.30), the values calculated for precautionary limits should not be taken to imply that such quantities of fish would actually be available for capture.

(ii) The calculation procedure relies explicitly on extrapolation from assessments of existing fisheries to new and exploratory fisheries in previously unfished or lightly fished areas. In particular, it makes the assumption that the recruitment rate per unit area of fishable seabed is the same across all areas. This assumption may not hold, but there was evidence from some areas (e.g. Crozet Islands) that the approach produced precautionary catch limits that were consistent with independent information of yield levels.

(iii) There is much greater uncertainty associated with the calculations for *D. mawsoni*. This is reflected in part in the greater discount factor used for uncertainty, but it must be emphasised that the factors used in the calculations are to a large extent arbitrary.

(iv) Estimates of unreported catches are also uncertain.

4.110 In reviewing the precautionary catch limits calculated for individual areas, several members reiterated their concerns (see paragraphs 4.96 and 4.97) that the fishable seabed areas listed may not for some subareas (e.g. Subareas 58.6, 58.7 and 88.2) be fully representative.

4.111 Subareas 48.1 and 48.2 are covered by existing conservation measures (72/XII and 73/XII) prohibiting the directed fishing for finfish. As discussed in paragraphs 4.42 to 4.44, the Working Group agreed that, provided longline fishing using the Spanish system is restricted to depths greater than 600 m, it was unlikely that the undertaking of new fisheries for *Dissostichus* spp. in these subareas would threaten the species that these conservation measures were designed to protect.

4.112 In a number of cases, the precautionary catch limits for either *D. eleginoides* or *D. mawsoni* calculated using the agreed procedure are zero or very low. The Working Group acknowledged that the method used to split catch limits between the two species was only approximate and based on rather imperfect knowledge of the distribution of the two species. On these grounds, and in view of the need to gain as much new information as possible, it would be quite inappropriate to insist, for example, that fishing should cease if a zero or low precautionary catch limit on one species was inadvertently exceeded.

4.113 Rather, the Working Group agreed that some flexibility was needed. This might be achieved, for example, by allowing a limited proportion of the catch limit for each *Dissostichus* species to be transferred to the other species.

4.114 With the exception of *D. eleginoides* in Subarea 48.4, and subject to the above points, the Working Group recommended that the precautionary catch limits given in Table 11 for *D. eleginoides* and *D. mawsoni* be applied for the new and exploratory fisheries in the subareas and divisions for which they were notified.

4.115 A catch limit of 28 tonnes was set for *D. eleginoides* in Subarea 48.4 during 1996/97 (Conservation Measure 101/XV). This was discussed in relation to the notification for a new fishery in Subarea 48.4 by Uruguay in paragraph 4.57. Management advice for *D. eleginoides* on a recommended catch limit in this subarea is given in paragraphs 4.233.

General Comments

4.116 The large number of notifications for new and exploratory fisheries for 1997/98, along with the need to review the results of new fisheries notified for 1996/97, meant that a large part of the time available to the Working Group was devoted to discussing this topic.

4.117 The Working Group was disappointed by the large variation in the amount of information contained in the notifications. In many cases, there was insufficient information provided for the Working Group to develop useful advice and in some cases the notifications referred to data and analyses not available to the Working Group. In other cases, there were varying interpretations as to what constituted new or exploratory fisheries (see paragraph 4.17).

4.118 In a number of cases, the notifications indicated that the data collection and/or research and fishery plans adopted would be as required by CCAMLR. It was not clear that these statements of intent would always result in practice in the requisite data being collected successfully or the plans being fully followed.

4.119 For example, the experience in the South African fisheries in Subareas 58.6 and 58.7 indicates that compliance with Conservation Measure 112/XV requires that each vessel has

very accurate positioning information. This experience has been mirrored in other new fisheries carried out by Australia and New Zealand. In each case, the method used to ensure accurate positioning information was installation of a VMS on each vessel.

Management Advice

4.120 Seven new fisheries operated in 1996/97. Information and comments on these are in paragraphs 4.1 to 4.14. Seven notifications for new fisheries in 1997/98 had been received by the Secretariat by the start of the meeting. Information and Working Group comments on these are given in paragraphs 4.15 to 4.62. In addition, four notifications had been received for exploratory fisheries in 1997/98. Information and Working Group comments on these are in paragraphs 4.63 to 4.91.

4.121 In Subareas 48.1 and 48.2, there are conservation measures in force which prohibit the directed fishing for finfish, at least until such time as a survey of stock biomass has been carried out, its results have been analysed, and a decision to reopen the fishery has been made by the Commission based on the advice of the Scientific Committee (Conservation Measures 72/XII and 73/XII). These conservation measures had been imposed as a result of concerns about the status of finfish species vulnerable to capture in trawl fisheries in relatively shallow waters.

4.122 Notifications for new fisheries in Subareas 48.1 and 48.2 have been received from both Chile (CCAMLR-XVI/9) and Uruguay (by letter). These were for longlining for *Dissostichus* spp. in deeper waters using the Spanish system.

4.123 Recent surveys around Elephant Island (Subarea 48.1) in 1996 and the results of a 1991 Spanish survey in Subarea 48.4 both suggested that the species of concern in Conservation Measures 72/XII and 73/XII continued to have low abundance. However, examination of by-catch rates for the longline fisheries in Subarea 48.3 (paragraphs 4.42 to 4.44) indicated that if the Spanish system is used and longlining is restricted to depths greater than 600 m, it is unlikely that there would be any threat to the species of concern in Conservation Measures 72/XII and 73/XII.

4.124 The Working Group was concerned, however, that the surveys in these subareas had revealed very low abundances of juvenile *D. mawsoni* (paragraphs 4.40 and 4.41). It is therefore possible that the new fisheries may catch very few fish. The Working Group was pleased to receive confirmation that the Chilean fishing operation plan called for an initial exploratory cruise of 45 days by one vessel and that the results of this cruise will be used by Chile to prepare fishing plans for a later period using up to three vessels. If the initial exploratory cruise failed to locate sufficient fish, the later fishing operations would be abandoned.

4.125 It was noted, however, that there was, in addition, a notification for a new fishery in this area by Uruguay, which involves up to six vessels. The Working Group recommended that if fishing does take place, consideration should be given to imposition of restrictions on the level of fishing effort, as well as on fine-scale rectangle and overall precautionary catch limits for these areas (paragraph 4.56).

4.126 The Chilean notification for a new fishery in Subareas 48.1 and 48.2 (CCAMLR-XVI/9) indicates that the intended fishing operations will comply with the by-catch provisions of Conservation Measure 112/XV. The Working Group recommended that, in addition to this, a by-catch provision similar to that in Conservation Measures 109/XV, 110/XV and 111/XV be

adopted, under which vessels move to another fishing location if the by-catch in any one longline set of species other than *D. eleginoides* or *D. mawsoni* exceeds 5%, subject to the modification suggested in CCAMLR-XVI/12 (paragraphs 4.43 to 4.46).

4.127 The Working Group was able this year to complete calculations of precautionary catch limits for new and exploratory fisheries in 1997/98 using methods similar to those it had wished to use last year. These methods are described in paragraph 4.99. The Working Group agreed that the procedure used was, scientifically, the best available given the existing information. However, there were still significant uncertainties that imply a need to take account of the points discussed in paragraphs 4.109 and 4.110.

4.128 Separate precautionary catch limits were calculated for *D. eleginoides* and *D. mawsoni.* The final step in the calculation involved multiplying by a factor that allowed for the uncertainty in extrapolation from known fisheries (Subarea 48.3 for longlines and Division 58.5.2 for trawl fisheries) to previously unfished or lightly fished areas. A factor of 0.45 (as used by the Commission last year) was used for *D. eleginoides* and 0.3 (making a greater allowance for uncertainty) was used for *D. mawsoni.* While it believed the factor should be less for *D. mawsoni* than for *D. eleginoides,* the Working Group emphasised that there was no scientific basis for selecting appropriate values for these factors.

4.129 The results of the calculations are shown in Table 11 by area, species and fishing gear for each of the new and exploratory fisheries notified for 1997/98.

4.130 In a number of cases, the precautionary catch limits for either *D. eleginoides* or *D. mawsoni* calculated using the agreed procedure are zero or very low. The method used to split catch limits between the two species is only approximate and it is based on imperfect knowledge of the distribution of the two species. In view of the need to gain as much new information as possible, the Working Group believed that it would be quite inappropriate to insist, for example, that fishing should cease if a zero or low precautionary catch limit on one species was inadvertently exceeded. Rather, the Working Group agreed that some flexibility was needed. This might be achieved, for example, by allowing a limited proportion of the catch limit for each *Dissostichus* species to be transferred to the other species.

4.131 With the exception of *D. eleginoides* in Subarea 48.4, and subject to the above points, the Working Group recommended that the precautionary catch limits given in Table 11 for *D. eleginoides* and *D. mawsoni* be applied for the new and exploratory fisheries in the subareas and divisions for which they were notified.

4.132 In addition to the conservation measures for Subareas 48.1 and 48.2 discussed above, a catch limit of 28 tonnes was set for *D. eleginoides* in Subarea 48.4 during 1996/97 (Conservation Measure 101/XV). This was discussed in relation to the notification for a new fishery in Subarea 48.4 by Uruguay in paragraph 4.57. Management advice for *D. eleginoides* on a recommended catch limit in this subarea is given in paragraph 4.233.

4.133 The primary aim of those aspects of Conservation Measure 112/XV that imposed a 100-tonne limit on catches of *Dissostichus* spp. in fine-scale rectangles was to ensure that fishing effort was spread around the area. In very large areas, such as Subarea 48.6, the measure should not cause problems. However, it did appear that problems could arise in smaller areas with low overall catch limits (see paragraphs 4.82 and 4.83). The Working Group therefore believed that consideration might be given to some relaxation of the fine-scale limit in appropriate areas.

4.134 Management advice stemming from consideration of seabird by-catches in new and exploratory fisheries is given in paragraphs 7.148(xxi) and (xxii).

Antarctic Peninsula (Subarea 48.1)

Notothenia rossii, Gobionotothen gibberifrons, Chaenocephalus aceratus, Chionodraco rastrospinosus, Lepidonotothen larseni, Lepidonotothen squamifrons and *Champsocephalus gunnari*

4.135 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, mackerel icefish (*C. gunnari*) and marbled notothenia (*N. rossii*) by the mid-1980s, Subarea 48.1 was closed for finfishing from the 1989/90 season onwards.

4.136 A bottom trawl survey within the 500 m isobaths was carried out by Germany in the vicinity of Elephant Island, one of the most important fishing grounds in the area, in November/December 1996 (paragraphs 3.35 and 4.40). Results from this survey (WG-FSA-97/27) provided the Working Group with the first opportunity to assess the status of most of the abundant fish stocks (*C. gunnari*, *C. aceratus*, *G. gibberifrons*, *L. squamifrons*, *C. rastrospinosus* and *L. larseni*) after the closure of the area for finfishing (Table 12). No new information could be obtained during the survey on the status of *N. rossii*.

4.137 Biomass estimates (Table 13) using CCAMLR standard methodology (de la Mare, 1994) suggested that, despite a closure of the area for finfishing, the fish standing stock biomass had declined compared to the previous survey in 1987. The causes for this decline are unclear, but are likely to be sought in natural variability. Unauthorised fishing which might have taken place after the closure of the area for fishing in 1989 could be a possible explanation for the decline in fish standing stock biomass. However, the size distribution of the most abundant species appears to have changed little.

4.138 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

4.139 There appears to be little prospect for a substantial fishery given the low biomass estimates for the 1996/97 season and some of the uncertainties associated with decline in biomass compared to 1987. The Working Group therefore recommended that Conservation Measure 72/XII should remain in force for the species considered in this section until future surveys indicate an increase in fish biomass in the subarea.

4.140 Further advice concerning the new longline fisheries for *Dissostichus* spp. in this subarea is contained in paragraphs 4.120 to 4.134.

South Orkney Islands (Subarea 48.2)

4.141 No new information was available to the Working Group on stocks in this subarea.

Management Advice

4.142 In the absence of new information on stocks in this subarea, the Working Group noted that fisheries in Subarea 48.2 should remain closed in accordance with Conservation Measure 73/XII. Advice relating to the new longline fisheries for *Dissostichus* spp. in this subarea is contained in paragraphs 4.120 to 4.134.

South Georgia (Subarea 48.3)

Dissostichus eleginoides (Subarea 48.3)

Standardisation of CPUE Indices

4.143 Following on the work conducted at its last meeting, the Working Group used generalised linear models (GLMs) to standardise CPUE data from the *D. eleginoides* fishery in Subarea 48.3. The aim of this analysis was to determine whether there are any annual trends in CPUE after controlling for the effects of any other factors/covariates that add to the variability in observed CPUE.

4.144 During the intersessional period, it was determined that the CPUE standardisations conducted at the Working Group's 1996 meeting were in error. As such, the results in Table 17 and Figures 5 and 6 of last year's report (SC-CAMLR-XV, Annex 5) are incorrect and should be disregarded.

4.145 The GLM analyses presented below do not contain the errors made at the 1996 meeting and have been updated to include revised information from previous fishing seasons (see paragraph 4.148 below) as well as new information from the 1996/97 fishing season. It should not be surprising, therefore, that the following results are quite different from those presented in last year's report. Note that the basic approach used to fit the GLMs was the same as that used last year and at the 1995 meeting of the Working Group; details of the methodology are provided in SC-CAMLR-XIV, Annex 5, Appendix G.

4.146 The GLMs were fitted to haul-by-haul data with non-zero catches submitted on form C2 over the period 1992 to 1997. Data from years prior to 1992 were not available in haul-by-haul format so they could not be used in the analyses. Numbers per hook and kilogram per hook were used as response variables, and nationality, fishing season, month, area, depth and bait type were considered as predictor variables. Fishing seasons were defined as occurring from 1 October to 30 September; this definition was consistent with the approach used last year
(SC-CAMLR-XV, Annex 5, paragraph 4.100).

4.147 Last year the Working Group considered vessel identification number as a factor in the

GLM analyses. At this year's meeting, nationality was used instead of vessel because when vessel is used as a factor the design matrix is poorly crossed, i.e. there are large gaps in the overlap between vessel ID and other factors. Using nationality rather than vessel made the GLM parameters easier to estimate.

4.148 At its 1996 meeting, the Working Group noted that there were a number of data records that were spurious or incomplete (SC-CAMLR-XV, Annex 5, paragraph 4.102). One of the worst data problems in 1996 was a lack of position information for over 1 000 hauls. During the intersessional period, the Secretariat remedied many of the problems in the C2 database and the GLMs were easier to fit this year. The Working Group thanked the Secretariat for its work on revising and updating the C2 database, but noted that there are still a number of data omissions that are catalogued in SC-CAMLR-XVI/BG/11 Rev. 1.

4.149 Nationality, fishing season, month, area and bait type contributed significant sources of variation to haul-by-haul CPUE (Table 14). Nationality was the most significant component of variability in CPUE, and the fishing season effect was the next most significant component of variability in catch rates.

4.150 The time series effects of fishing season on kilogram per hook and numbers per hook are plotted in Figure 3. These time series are adjusted for the presence of hauls with zero catches. This adjustment was made by estimating the probability of a zero catch in each fishing season and multiplying this probability by standardised CPUEs predicted from the GLMs.

4.151 The probabilities of zero catches for each fishing season are provided in Table 15. These probabilities should be viewed with some caution since there have been very few vessels to actually report zero catches. The Working Group noted that the C2 database may be biased because hauls with zero catches may not always be reported to CCAMLR. In this regard, the Working Group encouraged Members to make every possible effort to assure that zero catches are also recorded on the form C2 and reported to CCAMLR.

4.152 Adjusted, standardised catch rates increased between the 1992 and 1993 fishing seasons, but declined after 1993 (Figure 3). The decline was faster for kilogram/hook than it was for numbers/hook, indicating that the average size of fish in the catch has decreased over time. The decline of both CPUE indices slowed between the 1996 and 1997 fishing seasons. Both CPUE indices were less variable at the end of the time series than they were at the beginning of the time series.

4.153 The Working Group noted the trends in Figure 3 with concern. Standardised catch per unit effort in kilogram/hook in 1997 is at the lowest level for the period from 1992 to 1997. It is important to note that the *D. eleginoides* fishery began before the 1992 fishing season, and the Working Group cannot comment on the standardised kilogram/hook for 1997 compared to years prior to 1992. Season-specific, unstandardised catch rates (calculated as the sum of catch divided by the sum of hooks fished in a season) are not reliable indicators of trends in CPUE (Figure 3).

4.154 The predicted effects of month on kilogram and numbers per hook are illustrated in Figure 4. The GLMs predicted that kilogram/hook were highest in the period from March through July of each fishing season. This trend was not as apparent for numbers/hook, but expected numbers/hook were slightly higher in March and April.

4.155 The Working Group noted that the results in Figure 4 suggest that delaying the start of the *D. eleginoides* fishing season until 1 May of each year would not have a negative impact of catch rates.

Maturity Ogive of *D. eleginoides*

4.156 *D. eleginoides* spawns in Subarea 48.3 between June and October (WG-FSA-97/49). Other studies (see SC-CAMLR-XI, Annex 5) have shown that in this same subarea spawning occurs between June and September, with a peak in August. Fish in the Cape Horn–Diego Ramirez Island area have a similar spawning period (WG-FSA-97/42). Given the difficulties to accurately determine maturity stages in *D. eleginoides* experienced by observers in previous seasons, the Working Group used information on the proportion of various maturity stages in the stock at the peak of the spawning season in August. Further studies of maturity ogives from observer data are to be examined (see paragraph 3.55).

4.157 In previous years the fishing season finished in July (1996) or even earlier (1992 to 1995), so data on reproductive condition were only available from before the spawning season. During 1996/97 the season ended on 31 August, and at least two vessels with scientific observers operated in the subarea in that month, the *Cisne Verde* and *Argos Helena*. Data on fish maturity collected by the observers consisted of 434 fish samples for females and 398 for males. The parameters to fit the observations (maturity stage I versus stages II–V) to the logistic model used in previous meetings of the Working Group are presented in Table 16.

4.158 Results in Table 16 confirm earlier observations by the Working Group (SC-CAMLR-XI, Annex 5) that males and females have different sizes when attaining sexual maturity. It is unclear at present whether the differences are due to different growth rates or different ages when attaining sexual maturity. The Working Group recommended that more emphasis should be given to age and growth studies of this species. Length compositions superimposed on the maturity ogive (Figure 5) demonstrate that a high proportion of the males in the exploited part of the population is sexually mature, while more than 60% of the females are immature when exploited. The high proportion of immature females in the catch indicates that this species may be vulnerable to recruitment overfishing.

4.159 No age/length keys separated by sex were available. Therefore the Working Group agreed to use a maturity ogive for both sexes combined, but recommended, that in order to make progress in the assessment of the population of *D. eleginoides* separated by sex, an effort should be made to prepare such age/length keys in time for the next meeting and also to improve the studies on maturity. The Working Group recommended that Members inform the Secretariat of the location and availability of the scales and otoliths collected by scientific observers to facilitate their use for this research.

Revised Estimates of Recruitment Parameters

4.160 An error was discovered in a procedure for calculating the swept area from some of the trawl surveys used to estimate the recruitment parameters used in the GYM assessments last year (SC-CAMLR-XV, Annex 5, paragraphs 4.69 to 4.73). Revised estimates of

recruitment are given in Tables 17 to 19.

Generalised Yield Model

4.161 The assessment of the precautionary yield using the GYM was undertaken to incorporate the revised estimates of the parameters for recruitment as well as the revised maturity ogive and the catch for split-year 1996/97. The input parameters are shown in Table 20. In this case, 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 3 540 tonnes. The median escapement for this catch level was 0.51.

4.162 The GYM was used to predict the status of the spawning stock biomass and fishable biomass prior to exploitation (1988/89) and during the period of catches from 1989/90 to the 1996/97. These biomasses were monitored during the runs described above. The respective median biomasses (and 95% confidence intervals) at 1 March over each of these years is shown in Figure 6. The trend in the median biomasses predicts that the current spawning biomass is 59% of the pre-exploitation median level with the fishable biomass potentially at 54% of the pre-exploitation median level.

Trends in Size at Capture

4.163 An attempt was made to analyse trends in the size of fish caught in the South Georgia fishery since 1990. Length-frequency data submitted on Form B2 were plotted for each year between 1990 and 1997. No consistent trend was evident. The Working Group felt that length-frequency data not corrected for size of catch and size of sample measured are unlikely to be of much use. Such datasets are only available from observers' reports for the 1996 and 1997 fishing seasons, and the Working Group stressed that the continued collection and appropriate recording in the database of these data remains a high priority. Routines should be developed by the Secretariat to extract length frequencies corrected for size of catch and sample size by next year's meeting.

Comparison of GLM and GYM Results

4.164 The Working Group summarised its assessment of the *D. eleginoides* stock in Subarea 48.3 by comparing results from GLM and GYM analyses.

4.165 The trend in median biomasses from the GYM predicts that the current median spawning biomass is 59% of the pre-exploitation median level (see Figure 7). This stock is therefore above, but approaching, one of the reference points used in CCAMLR decision rules which holds that the median spawning stock should not be allowed to fall below 50% of its unexploited median level.

4.166 The Working Group noted with concern a sustained decline in standardised CPUE from the GLM between 1993 and 1997 and that standardised CPUEs have fallen more rapidly than the median fishable biomasses predicted by the GYM. This may be due to the total removals

of *D. eleginoides* in a number of years being greater than estimated. If this is so, these underestimates will result in a decline in stock size greater than that indicated by the time series of median fishable biomasses predicted from the GYM using the current input data.

4.167 The Working Group did note, however, that it is very difficult to interpret time series of CPUE data. The relationship between CPUE and stock size is unknown (and needs to be better understood), and there are many mechanisms that are not related to stock size but can still explain trends in CPUE. The Working Group discussed a number of such mechanisms but agreed that there was no information available to weigh the relative merits of the various, proposed alternatives. As such, the Working Group considered that it would still be appropriate (and more risk-averse) to view the trend of declining CPUE as an indication that stock size has declined substantially.

Management Advice

4.168 The estimate of yield from the GYM was 3 540 tonnes.

4.169 The Working Group considered that the TAC for 1997/98 should be less than the 3 540 tonnes in order to maintain a degree of caution appropriate to the uncertainty indicated by the results above.

4.170 The Working Group was unable, however, to advise on what lower TAC is appropriate. This was because there are no elements in the decision rules to reconcile conflicting indicators such as in this case, where the GYM suggests the stock is approaching a decision rule reference point, whereas the CPUE trend suggests it may already have exceeded it. A high priority task is to develop advice to deal with such situations.

Champsocephalus gunnari (Subarea 48.3)

Development of a Long-term Management Strategy

4.171 The Working Group recalled the high priority given to the development of a long-term management strategy for *C. gunnari* in Subarea 48.3 at previous meetings of the Scientific Committee (e.g. SC-CAMLR-XV, paragraph 4.75). Two papers discuss long-term approaches to the management of *C. gunnari* as well as suggesting interim measures during the development of the long-term strategies.

4.172 WG-FSA-97/38 presents the components to be considered in the long-term management of *C. gunnari* in Subarea 48.3. A management strategy in this subarea needs to take account of food chain interactions between *C. gunnari*, krill and fur seals, which have been discussed extensively at previous meetings (e.g. SC-CAMLR-XV, Annex 5, paragraphs 4.136 to 4.155). The paper proposes the use of the GYM (Constable and de la Mare, 1996) to estimate a precautionary yield, which takes into account the possibility of periodic increases in natural mortality associated with years of poor krill availability in the vicinity of South Georgia. The analysis undertaken in this paper was updated at the Working Group meeting with the following revisions:

(i) explicit use of the mortality function rather than an approximation (see paragraph 3.79);

(ii) correct evaluation of the status of the spawning stock when interannual variation in M is present;

(iii) use of the recruitment parameters estimated from VPA Run 5 in 1993 (SC-CAMLR-XII, Annex 5); and

(iv) assessment of real catches rather than an assessment of γ because the recruitment parameters were available.

4.173 The GYM analysis was rerun using the parameters listed in Table 23. In this run, the decision rule regarding the probability of depletion was binding. The results were similar to that for Heard Island (WG-FSA-97/29) where the probability of depletion with no fishing was greater than the critical probability of 0.1. When the decision rule is modified to that described in paragraph 3.68, the long-term annual yield was estimated to be 2 600 tonnes.

4.174 WG-FSA-97/38 suggested that further development of the management scheme could use information from studies on krill and predators undertaken as part of CEMP, to interpret or modify information from commercial fisheries and research surveys in an attempt to make informed predictions about future levels of M in the short term. This information could be used in association with estimates of long-term precautionary yield in a quasi-real-time management strategy. For example a precautionary catch limit could be augmented in years when there is evidence of abundant year classes in the stock and the likelihood of increased natural mortality is low. The authors recognised that this scheme would require greater quantitative knowledge of food web dynamics within the South Georgia ecosystem than presently available, but that an interim approach for setting catch limits is required.

4.175 WG-FSA-97/29 also presented assessments of precautionary catch limits developed using the GYM for Division 58.5.2 as well as a method for adjusting catch limits according to results of recent surveys. The parameters used in this assessment were all obtained from the stock at Heard Island. Recruitment was found to have substantial variability, which was not well modelled by a lognormal distribution. Consequently, the GYM assessment used a parametric bootstrap procedure to model the recruitments.

4.176 The Working Group noted the substantial probabilities of the spawning stock declining to below 20% of the unexploited median even in the absence of fishing for *C. gunnari* both in Subarea 48.3 and Division 58.5.2. Consequently the Working Group agreed that the appropriate form of decision rule to apply in such cases needs further consideration. Some further tests on the properties of this type of decision criterion are described in paragraphs 3.68 and 3.69.

4.177 The Working Group welcomed these useful contributions to the development of a long-term management strategy for *C. gunnari*. The Working Group encouraged further work on assessments of long-term annual yield in line with the development of biological reference points. For Subarea 48.3 these assessments will benefit from further analysis of survey data to examine the magnitude and frequency of previous periodic increases in M and the development of recruitment estimates from survey results rather than VPA analyses.

4.178 In addition the Working Group agreed that the following components should be evaluated for their inclusion in an integrated long-term management procedure:

(i) appropriate biological reference points for *C. gunnari* in Subarea 48.3 and Division 58.5.2;

(ii) the level of catch appropriate as a long-term precautionary yield when no recent surveys are available;

(iii) methods for adjusting catch levels based on recent survey results to take advantage of strong year classes recruiting to the fishery;

(iv) use of CEMP data and other knowledge of predator/prey interactions to predict adjustments in natural mortality, recruitment and growth parameters for use in assessments; and

(v) methods for achieving target levels of fishing mortality.

Short-term Assessment Methodology

4.179 The Working Group agreed that at present it could not recommend precautionary catch limits for *C. gunnari* on the basis of current applications of the GYM, until further studies on the properties of possible decision criteria have been considered (see paragraphs 3.68
and 3.69).

4.180 WG-FSA-97/29, for example reported that the precautionary catch limit, based on decision rules discussed in paragraph 3.68, is dominated by the periods in which the stock has naturally fallen to a low level. Consequently, the opportunity to increase catches is foregone when the stock is abundant due to the presence of one or more strong year classes. The authors suggested that this is currently the case on the plateau at Heard Island where the recent trawl survey gives a biomass estimate of about 50 000 tonnes, with two strong year classes in the spawning stock. This suggests that a form of management strategy based on recent abundance estimates would allow an increase in yield over the precautionary level. However, the development of such a strategy is a substantial task requiring further study and evaluation.

4.181 Nonetheless, WG-FSA-97/29 proposed an interim step in this direction, where catch limits are calculated which allow for higher catches in the next two seasons without any substantial risk of depleting the spawning stock. The criterion applied was to calculate the fishing mortality which would result in a probability of no more than 0.05 that the spawning stock after fishing would be less than 75% of the level which would have occurred in the absence of any fishing. This was achieved by using the bootstrap one-sided lower 95% confidence bound on the trawl survey estimate as the current stock biomass. The numbers of fish in the cohorts are calculated using the following formula:

$$\tilde{N}_a = \frac{\hat{N}_a}{\sum_i \hat{N}_i} \cdot \frac{\tilde{B}}{\overline{w}} \tag{1}$$

where $\tilde{N}_a$ is the number of fish of age *a*, given the current age structure and a population biomass at the lower 95% confidence bound B, N_a is the estimated abundance of fish aged *a* in the current population and $\overline{w}$ is the average weight of a fish in the current population. The average weight is given by:

$$\overline{w} = \frac{w_a \hat{N}_a}{\sum_i \hat{N}_i} \tag{2}$$

where w_a is the average weight of fish of age *a*, calculated from the growth curve and weight-length relationship. The fishing mortality was found numerically by solving the usual fisheries differential equations with an initial age structure derived from equation (1):

$$\begin{aligned} \frac{dN}{dt} &= -zN \\ \frac{dB}{dt} &= NaL_\infty{}^b \left(bk\left(1-\mathrm{e}^{-k(t-t_0)}\right)^{b-1} \mathrm{e}^{-k(t-t_0)} - z\left(1-\mathrm{e}^{-k(t-t_0)}\right)^b \right) \\ \frac{dC}{dt} &= FB \end{aligned} \tag{3}$$

where N is the number of fish, $z = M+F$ where M and F are the natural and fishing mortality rates respectively, B is the biomass of fish, L_∞, k and t_0 are the von Bertalanffy growth parameters, a and b are the weight – length parameters and C is the catch.

4.182 The Working Group agreed that the procedure set out in WG-FSA-97/29 was useful first step in developing assessments of *C. gunnari* based on current biomass estimates and recommended that such procedures should be further developed as a component of the long-term management strategy for this species.

General Management Advice on *C. gunnari*

4.183 The Working Group welcomed the progress made at this year's meeting on the development of an assessment methodology which could form the basis of an approach to the long-term management of *C. gunnari*. Several ways in which this approach could be developed in the future were identified (paragraph 4.178), and the Working Group recommended that these be given a high priority at the next meeting.

4.184 In the future it is expected that the strategy will enable calculation of long-term precautionary yields which may be adjusted in years when up-to-date information on the stocks is available, for example from research surveys. Given that this is a strategy under development, the Working Group recommended that surveys be undertaken during the 1997/98 season in all areas where fisheries for this species occur.

Assessment of *C. gunnari* in Subarea 48.3

Commercial Catch

4.185 There was no commercial catch of *C. gunnari* in Subarea 48.3 during the 1996/97 season, although there was a TAC of 1 300 tonnes in accordance with Conservation Measure 107/XV. There has now been no substantial reported commercial catch since March 1990.

Research Surveys

4.186 The survey conducted on board RV *Dr Eduardo Holmberg* during March and April 1997 was summarised in WG-FSA-97/47. The position of the trawl stations closely followed those sampled during previous surveys by Argentina. The proportion of young fish in the samples remained high: 95% of the fish at South Georgia and 84% of the fish at Shag Rocks were age class three and below.

4.187 A brief summary of the recent UK survey on the *Argos Galicia* was presented in WG-FSA-97/39, sampling for which had only finished around South Georgia on 29 September 1997. The Working Group congratulated Dr Everson and his team for completing the study and bringing the results to the meeting so quickly.

4.188 The survey had been undertaken in the same way as the previous UK surveys with randomly-located hauls allocated to the three depth strata, 50 to 150 m, 150 to 250 m and 250 to 500 m, in the ratio of approximately 1:2:1. All hauls were undertaken during the hours of daylight. Although it has been assumed that the fish concentrate close to the seabed during daylight, it was noted that experience at Heard Island had indicated that the fish did not disperse into the water column until about two hours after sunset and return to the seabed until about two hours after sunrise.

4.189 A summary of the results of these two surveys is provided in Table 21.

4.190 With respect to the acoustic survey by Russia using RV *Atlantida* in 1996, correspondence between Drs Everson, V. Vorobyov and K. Sushin (WG-FSA-97/11) was discussed. In his final letter, Dr Everson agreed that in the conduct of both the survey, and the results obtained from it, the most important possible sources of bias had been taken into account. The Working Group concluded that it would be useful to refer the report of the survey (WG-FSA-96/59) to acoustic experts for further consideration. If necessary, Drs Everson and
P. Gasiukov agreed that data from the *Atlantida* survey could be re-analysed and re-submitted to WG-FSA. The Working Group noted with gratitude the work done to clarify the issues raised during WG-FSA-96, and agreed that the results from this survey could be considered in future assessments of *C. gunnari*.

Other Information

4.191 WG-FSA-97/5, presenting a review of the estimation of M for *C. gunnari* in Subarea

48.3, is reviewed in paragraph 3.45.

4.192 WG-FSA-97/45 demonstrated a significant relationship between size and age of *C. gunnari* and depth, with larger, older fish being found in deeper water.

4.193 WG-FSA-97/44 examined the series of density observations derived from the four Argentinian surveys conducted in Subarea 48.3 between 1994 and 1997. Density increased significantly from 1994 to 1996 and there was no significant difference between observations in 1997 and 1996. An analysis of numbers at age indicated that variations in observed density were closely related to changes in the numbers of fish at age 1 and less. A study of relative cohort abundance over time suggested that the results of the 1994 survey were anomalously low. The age structures of the samples from the 1995, 1996 and 1997 surveys were similar. The steep decline in relative abundance of the older age classes is indicative of higher mortality of older fish, but it might also be the result of a recovery in the stock.

4.194 WG-FSA-97/48 reported on an analysis of the diet of *C. gunnari* in Subarea 48.3 (see paragraph 3.50).

Recommendations from WG-FSA-96

4.195 The Working Group recalled several recommendations made at last year's meeting with respect to the development of a long-term management approach for this fishery. These included a review of previous assessments (SC-CAMLR-XV, Annex 5, paragraph 4.137), submission of any outstanding historical commercial fisheries data and research surveys to the Secretariat (SC-CAMLR-XV, Annex 5, paragraphs 4.138 and 4.142), compilation of a comprehensive list of surveys (SC-CAMLR-XV, Annex 5, paragraph 4.124), and standardisation of trawl surveys using GLMs.

4.196 Data from research trawl surveys undertaken by the UK were re-submitted to the Secretariat during the intersessional period. At the time of the meeting, these data were being incorporated into the CCAMLR database and were at various stages of availability for analysis at the meeting. However, the Working Group noted that these data were being handled within the database using the commercial fisheries data format (C1) and that this tended to result in some loss of detailed information due to the relative complexity of the survey data (see paragraphs 3.8 and 3.9).

4.197 A comprehensive list of surveys in all subareas is provided in Table 22.

4.198 The Working Group reiterated its recommendation made at last year's meeting that a standardisation of the trawl survey time series using GLMs should be undertaken. No papers were presented and no further analysis was undertaken at this year's meeting. This was partly due to problems with the processing of survey data submitted to CCAMLR and availability of these data for analysis by Members during the intersessional period (see also paragraph 4.196).

Analyses Undertaken at this Year's Meeting

Short-term Assessment

4.199 The Working Group noted that the recent UK and Argentinian surveys reported in WG-FSA-97/39 and 97/47 respectively show that the population has recovered from recent low levels after the recruitment of two cohorts above the mean recruitment estimated from the VPA run 5 in 1993 (see Table 21). The Working Group developed an assessment using the approach described in paragraph 4.181 and WG-FSA-97/29 for Division 58.5.2. Length-density estimates of age class strength were derived from the two surveys using the maximum likelihood method (de la Mare, 1994).

4.200 Recalling discussions at last year's meeting (SC-CAMLR-XV, Annex 5, paragraph 4.139), the Working Group agreed to assess the population in Subarea 48.3 as one stock, although it was noted that, among other things, marked differences in age structure between South Georgia and Shag Rocks warranted further examination with a view to resolving the question of stock structure in the region.

4.201 The estimates of year class strength are given in Table 24.

4.202 A lower one-sided 95% confidence bound for the abundance estimate was calculated using a bootstrap procedure with the UK survey results. This was equivalent to the procedure used for Heard Island (Division 58.5.2) (WG-FSA-97/29), although in this case the result using the bootstrap procedure was very similar to that produced by the TRAWLCI program (Table 25). Because the Argentinian survey was designed for examining aspects of stock distribution, it was not used for abundance estimation (WG-FSA-97/47). The lower confidence bound from the UK survey was estimated to be 31 563 tonnes.

4.203 The number of fish in each age class for this biomass was calculated using equations (1) and (2) given above. The calculations use a von Bertalanffy growth function with parameters derived from UK surveys between 1989 and 1992 (Parkes, 1993) and a weight-length relationship derived from samples collected during the UK survey in 1997. The parameters for these functions are shown in Table 26.

4.204 The Working Group noted that the fluctuating ecosystem interactions believed to be responsible for periodic increases in the natural mortality of *C. gunnari* might also result in changes in growth. It was agreed that the sensitivity of the short-term projections to variations in growth parameters should be investigated in the future.

4.205 The numbers of fish in each age class for a biomass at the level of the lower 95% confidence bound are shown in Table 27.

4.206 The Working Group recalled previous discussions of the possible values of catchability of trawl surveys, based principally on the results of VPAs tuned to survey abundance indices (SC-CAMLR-XII, Annex 5, paragraphs 6.34 to 6.46). There were indications from these analyses that catchability could be substantially less than 1, but in view of the fact that M was constant in the VPA, which was now considered to be an unacceptable assumption, these results could not be considered reliable. In the absence of other quantitative information about catchability of the survey trawl, for the purposes of this analysis, it was assumed to be 1.

4.207 Catch limits were calculated by solving the usual fishing differential equations to find

the fishing mortality that, if fished over a projected two-year period, would result in a biomass at 75% of the level which would occur without fishing. This was calculated using two values of M, one which would apply in a 'normal' year, M = 0.42 (paragraph 3.45), and one which would be four times this value. The latter was derived from comparisons between surveys using deterministic cohort analysis, and has been suggested as being consistent with the declines observed for *C. gunnari* in Subarea 48.3 in those years when krill, a major food item for *C. gunnari*, are scarce (WG-FSA-97/38). However, the Working Group recognised that this estimate was highly uncertain and that further investigation would be necessary before such a value could be used reliably in an assessment. The value was used in the present analysis only as a means of investigating the sensitivity of the projection results to such a large increase in M.

4.208 The fishing mortality and catches in each of the two projected years are shown in Table 28.

Future Work

4.209 The Working Group recommended several areas of future work for the development of the assessment and management strategy for *C. gunnari* in Subarea 48.3, in particular:

(i) analyse all available survey data to investigate the possible magnitude and frequency of periodic increases in M at South Georgia;

(ii) examine the potential for deriving recruitment estimates directly from trawl survey results, rather than using the VPA results; and

(iii) examine the sensitivity of assessments of yield to variations in growth parameters.

Management Advice

4.210 The Working Group noted that recent surveys show that the population of *C. gunnari* in Subarea 48.3 has recovered from recent low levels (paragraph 4.199), however, given the continued uncertainty about the potential yield of *C. gunnari* in Subarea 48.3, the Working Group considered that a conservative approach to management is appropriate in the immediate future.

4.211 The Working Group noted that the yield estimated from the short-term projections undertaken at this year's meeting were based on the lower 95% confidence bound of the survey undertaken by the UK in September 1997 and that this constituted a conservative estimate of yield. Accordingly, the Working Group recommended that fishing in the 1997/98 season should be limited to a total catch of 4 520 tonnes.

4.212 Dr Marschoff noted that the abundance of fish in the older age classes estimated from the UK survey, when compared with the median biomass derived from the application of the GYM (paragraph 4.161) showed that a probability of 0.05 exists that the spawning biomass is below 0.2 of B_0.

4.213 Other members noted the difficulties, identified at this meeting, of applying the

decision rule relating to depletion of the spawning stock biomass to less than 20% of B_0 for *C. gunnari* (see paragraph 4.176).

4.214 The Working Group recalled its consideration at the 1992 meeting (SC-CAMLR-XI, Annex 5, paragraphs 6.67 to 6.74) of the proportion of by-catch of other finfish in the *C. gunnari* fishery and the implied ceiling on the catch of the target species. No new information was presented to the Working Group on the proportion of by-catch species in the commercial catch. The recommended catch limit given in paragraph 4.211 is substantially below the implied ceilings on both a bottom trawl and pelagic trawl fishery (8 800 and 9 200 tonnes respectively).

4.215 The Working Group also recalled its conclusion from previous meetings that a pelagic trawl fishery would result in a lower proportion of by-catch and would avoid the possible adverse effects of bottom trawling on the benthic community (e.g. SC-CAMLR-XII, Annex 5, paragraph 6.61). Accordingly it is recommended that the fishery in 1997/98 be undertaken by pelagic trawling only.

4.216 The fishing season set for 1996/97 by Conservation Measure 107/XV closed on 1 May 1997. The Working Group noted that this represented a one-month extension of the season applied in previous seasons and was adopted by the Commission on the understanding that it would apply for the 1996/97 season only. In accordance with earlier seasons, the Working Group recommended that the fishing season in the 1997/98 season be closed on 1 April to reduce fishing directed at spawning concentrations.

4.217 In order to provide the information required for assessment of the fishery, the Working Group recommended that reporting requirements for the commercial fishery should include the submission of haul-by-haul data in accordance with standard CCAMLR formats and that an international scientific observer be on board every vessel participating in the fishery in the 1997/98 season.

Chaenocephalus aceratus, Pseudochaenichthys georgianus, Gobionotothen gibberifrons, Notothenia rossii, Patagonotothen brevicauda guntheri, Lepidonotothen larseni and *Lepidonotothen squamifrons* (Subarea 48.3)

4.218 New biomass estimates of *Chaenocephalus aceratus, Pseudochaenichthys georgianus, Gobionotothen gibberifrons, Notothenia rossii, Patagonotothen brevicauda guntheri, Lepidonotothen larseni* and *Lepidonotothen squamifrons* were available to the Working Group from Argentinian and UK biomass surveys conducted around Shag Rocks and South Georgia (WG-FSA-97/47 and 97/39).

4.219 The surveys were conducted in March/April (Argentinian survey) and September 1997 (UK survey) according to the methodologies described in paragraph 3.41. The estimated standing stocks of each of these species on the Shag Rocks and the South Georgia shelf, (i.e. effectively the whole of Subarea 48.3), calculated from each of the surveys are shown in Table 29.

4.220 Biomass estimates from both surveys are quite similar for *N. rossii* and *G. gibberifrons* but differ in several orders of magnitude for all other species, being greater for Nototheniids (*L. squamifrons* and *P. guntheri*) in the Argentinian survey and for Channichthyds (*C. aceratus* and *P. georgianus*) in the UK survey. These differences in the

distribution of the fish are difficult to explain since they could be due to the concurrence of several factors such as the period of the cruise, the sampling design and the gear used.

4.221 Despite these differences, biomass estimates of both cruises seem to confirm a degree of stability in most of the stocks compared to results obtained in previous cruises conducted in the Subarea using a similar methodology. Only *G. gibberifrons* has experienced an apparent biomass decrease from 1994 to 1997 in the UK surveys series, which is not apparent in the Argentinian series.

4.222 The Working Group did not make any attempt to calculate precautionary catch limits from these estimates using the GYM, but given the apparently low abundances of most of these stocks and the difficulties in managing fisheries which exploit mixed-species assemblages, there seems to be little prospect for a fishery targeted on them.

Management Advice

4.223 Taking into account the considerations which arose during its deliberations, the Working Group reiterated its advice from previous years concerning these species and therefore recommended that Conservation Measures 2/III, 3/IV and 95/XIV remain in force and that Conservation Measure 100/XV be extended to the 1997/98 season.

Electrona carlsbergi (Subarea 48.3)

4.224 No new data were available.

Management Advice

4.225 The Working Group reiterated its advice from 1995 and 1996 concerning this stock (SC-CAMLR-XIV, Annex 5, paragraphs 5.116 and 5.117; SC-CAMLR-XV, Annex 5, paragraph 4.168). In the absence of any new information the Working Group recommended that Conservation Measure 103/XV be carried forward for the 1997/98 season.

Crabs (*Paralomis spinosissima* and *P. formosa*) (Subarea 48.3)

4.226 There has not been any fishing activity on these stocks since the last operations of the US fishing vessel *American Champion* conducted in January 1996 according to the Experimental Harvest Regime set up in Conservation Measure 90/XV.

4.227 Noting that this fishery does not appear to be commercially viable and that no information had been received on vessels intending to enter the fishery, the Working Group determined that it was not necessary to conduct an assessment of the crab stocks in Subarea 48.3.

Management Advice

4.228 The Working Group, recognising the great utility of the experimental harvest regime set out in Conservation Measure 90/XV in providing useful information for developing an assessment of the target species, reiterated the view expressed at its 1996 meeting that Conservation Measure 90/XV 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).

4.229 The Working Group also stated that since the crab stocks were not assessed, a conservative management scheme as contained in Conservation Measure 104/XV is still appropriate for this fishery.

Squid (*Martialia hyadesi*) (Subarea 48.3)

4.230 A notification of the intent to conduct a new fishery for the squid *M. hyadesi* in Subarea 48.3 during the 1996/97 season was lodged jointly by the Republic of Korea and the UK (SC-CAMLR-XV, Annex 5, paragraphs 4.7 and 4.188). Discussions on this fishery are contained in paragraphs 4.2 to 4.6.

South Sandwich Islands (Subarea 48.4)

4.231 Although a small fishery for *D. eleginoides* was open in this area, no catches were reported.

4.232 A proposal for a new longline fishery for *D. eleginoides* in Subarea 48.4 has been lodged by Uruguay. In considering the proposal, the Working Group noted the possibility of *D. mawsoni* also being caught (paragraph 4.58).

Management Advice

4.233 In the absence of any new information on this species, the Working Group recommended that Conservation Measure 101/XV for this stock be carried forward for the 1997/98 season. Additional advice concerning *D. mawsoni* is provided in paragraphs 4.120 to 4.134.

Bouvet Island (Subarea 48.6)

4.234 Notifications of the intention to conduct new fisheries for *D. eleginoides* in Subarea 48.6 during the 1996/97 season were lodged by Norway and South Africa (SC-CAMLR-XV, Annex 5, paragraphs 4.7 and 4.192). Details on their development are provided in paragraphs 4.7 and 4.27 to 4.29.

4.235 No information was available to make any assessment on other stocks occurring in this subarea.

Statistical Area 58

4.236 Total reported catches by species and subarea in Area 58 for the 1997 season are shown in Table 30.

Antarctic Coastal Areas (Divisions 58.4.1 and 58.4.2)

4.237 No new information was available to the Working Group to undertake any assessment on the stocks in these divisions.

BANZARE and Elan Banks (Division 58.4.3)

Dissostichus spp. (Division 58.4.3)

4.238 Notifications of the intention to conduct new fisheries for *D. eleginoides* and *D. mawsoni* in Division 58.4.3 during the 1996/97 season were respectively lodged by Australia and South Africa (SC-CAMLR-XV, Annex 5, paragraphs 4.7 and 4.195). Details on the development of these fisheries are given in paragraphs 4.27 to 4.29 and the corresponding management advice is provided in paragraphs 4.120 to 4.134.

Ob and Lena Banks (Division 58.4.4)

Dissostichus eleginoides (Division 58.4.4)

4.239 South Africa notified its intention to initiate a new fishery for *D. eleginoides* in Division 58.4.4 during the 1996/97 season (SC-CAMLR-XV, Annex 5, paragraphs 4.7 and 4.197). No fishing took place by South African vessels in this division and a new fishery notification has been received from this Member for 1997/98 (paragraph 4.16). Management advice on this new fishery is provided in paragraphs 4.120 to 4.134.

Lepidonotothen squamifrons (Division 58.4.4)

4.240 A conservation measure to allow a commercial catch of 1 150 tonnes of *L. squamifrons* to be caught over a two-year period (Conservation Measure 87/XIII) was approved and extended over three consecutive seasons at the successive requests made by Ukraine, provided a biomass survey was undertaken. Apparently no biomass surveys were carried out during the 1994/95, 1995/96 and 1996/97 seasons, and therefore no data were available to the Working Group to assess the state of this stock.

Management Advice

4.241 Conservation Measure 87/XIII, allowing a catch of 1 150 tonnes of *L. squamifrons* on the two banks provided an approved biomass survey is undertaken, was extended until the end of the 1996/97 season (Conservation Measure 105/XV). The Working Group noted that the survey proposed by Ukraine did not take place and therefore recommended that the

fishery should be closed until a biomass survey of the design approved by the Scientific Committee shows that the stock could support a sustainable fishery.

Kerguelen Islands (Division 58.5.1)

Dissostichus eleginoides (Division 58.5.1)

Standardisation of CPUE Indices

4.242 The Working Group also used a GLM to standardise an updated series of CPUE data from the trawl fishery for *D. eleginoides* in Division 58.5.1. This GLM analysis followed the approach used for *D. eleginoides* in Subarea 48.3 (paragraphs 4.143 to 4.155).

4.243 As was the case for Subarea 48.3, the results from last year's meeting of the Working Group were found to be in error for this division, and Table 22 and Figure 7 of SC-CAMLR-XV, Annex 5 are not correct.

4.244 The GLM was fitted to haul-by-haul data from the French and Ukrainian trawl fisheries operating off the western, northern, and eastern coasts of Kerguelen during the period 1990 to 1997. Kilograms per hour towed was used as the response variable, and nationality, year, month, area, and depth were considered as predictor variables. Year was defined as split-year.

4.245 Last year the Working Group considered vessel identification number as a factor in the GLM analysis. At this year's meeting, nationality was used instead of vessel.

4.246 Nationality, year, month and area contributed significant sources of variation to haul-by-haul CPUEs from the trawl fishery (Table 31). The year effect was the most significant component of variability in CPUE, and the month effect was the next most significant component of variability in catch rates.

4.247 Figure 8 illustrates the effects of year and month on standardised catch rates from the trawl fishery. The time series is adjusted for the presence of hauls with zero catches. This adjustment was made by estimating the probability of a zero catch in each fishing season and multiplying this probability by standardised CPUEs predicted from the GLMs.

4.248 The probabilities of zero catches for each fishing season are provided in Table 32. These probabilities should be viewed with some caution since very few vessels have actually reported zero catches.

4.249 Adjusted, standardised catch per unit effort has decreased over the course of the time series, and CPUEs in the 1997 split-year were the lowest on record (Figure 8, upper panel). Standardised CPUE was also less variable at the end of the time series than it was at the beginning of the time series.

4.250 The Working Group viewed the declining trend in adjusted, standardised catch rates with concern and noted that the trend in unstandardised catch rates mirrored that of standardised catch rates (Figure 8).

4.251 Although month explained a significant amount of variation in trawl CPUE (Table 31),

there was no clear pattern in standardised CPUE by month (Figure 8, lower panel).

Management Advice

4.252 The declining trend in CPUE in the trawl fishery demonstrated by the GLM analysis confirms previous studies of this stock (WG-FSA-93/15). Annual reductions of the French TAC (3 800 tonnes for the 1996 season, 3 500 tonnes for the 1997 season and 3 000 tonnes for the 1998 season) shows the concern in the management of the fishery in the French EEZ.

4.253 The French authorities have allocated a TAC for trawling for the 1997/98 season. A maximum of 3 000 tonnes applies for the whole area, including a 1 000-tonne limit in the eastern sector.

4.254 The longlining catch limit in the western sector has already been established up to the end of 1997 (October–December). A TAC of 500 tonnes applies for two vessels only. The total value for 1997/98 season in this sector will not exceed the value of the long-term sustainable yield estimated at the 1994 meeting (1 400 tonnes).

4.255 A TAC of 600 tonnes will apply for 1997/98 season for one French longliner in the eastern sector outside the area used by trawlers.

4.256 The Working Group considered that the GLM analysis of factors affecting CPUE in the trawl fishery is a useful technique to improve its assessments and recommended the continued reporting of catch and effort data on a haul-by-haul basis. In addition, efforts should continue to acquire haul-by-haul data collected on board Ukrainian longline vessels from the Ukrainian authorities, and to ensure that such data are also collected from the longliner working in the eastern sector.

4.257 Management of this fishery, in common with other subareas in the Indian Ocean sector, will be severely compromised as long as illegal catches continue.

Champsocephalus gunnari (Division 58.5.1)

4.258 As recommended by the Scientific Committee at last year's meeting (SC-CAMLR-XV, paragraph 4.96), there were no commercial catches on the shelf stock during the 1996/97 season. This was intended to allow the expected abundant new cohort born in 1994 to have a first spawning before being fished.

4.259 As requested by the Scientific Committee (SC-CAMLR-XV, paragraph 4.96), two pre-recruit biomass surveys were conducted during the summer/autumn of 1996/97 to evaluate the abundance of age 3 fish. Standardised hauls were undertaken during daylight (due to vertical migration of fish at night) at randomly allocated locations within a monostratified
(100–200 m depth) area. Two different French trawlers were used for the surveys. The first survey, during late March 1997 (35 hauls) covered a shelf area of 18 318 km^2. The second survey, early in May (29 hauls), concentrated on a smaller area of the shelf break (5 246 km^2) within the area of the first survey, which was identified as having a higher density of fish.

4.260 As expected, three-year-old fish of the cohort born in 1994 were present in nearly all the catches. They grew from 27.2 cm to 28.1 cm (mean TL) between the two surveys. However, no aggregations of fish were detected despite indications from the previous year of a strong cohort entering the fishable stock. The abundance of other age classes was low.

4.261 The standing stock estimate of icefish in the areas covered by the surveys was calculated using the TRAWLCI program (de la Mare, 1994) and the results are given in Table 25.

4.262 The difference observed in the density between the two surveys is related to the position of the area in which the second survey was carried out, i.e. close to the shelf break where the concentrations are normally reported. Even if the distribution of the cohort over the whole shelf (48 965 km^2 in the normal bathymetric range of the stock) is assumed to be homogenous, as has been observed for the previous abundant cohorts, the standing stock estimate would be about 10 500 tonnes.

4.263 The Working Group noted that the unexpectedly low biomass was as yet not explained. Several possible explanations were briefly considered, including, early migration for spawning, change in the position of the fish aggregations to other places on the shelf, increase in predation by fur seals or *Channichthys rhinoceratus*, another predatory icefish, for which a high level of catches was reported during the survey. The French authorities have indicated that they plan to continue to monitor the stock with the help of the French trawlers on the basis of an allocation of very limited catches (not more than 1–5% of the present standing stock), and the use of scientific observation or other data collection opportunities.

Management Advice

4.264 The Working Group recalled its advice from the 1995 meeting (SC-CAMLR-XIV, Annex 5, paragraphs 5.151 and 5.152) that the fishery for *C. gunnari* in Division 58.5.1 should be closed until at least the 1997/98 season when the cohort born in 1994 would have had an opportunity to spawn. The recommended pre-recruit biomass survey conducted this season has shown that the strength of this cohort (age 3) is lower than expected and no conclusive explanation for this situation is presently available.

4.265 The Working Group supported the plan of action proposed by the French Authorities as outlined in paragraph 4.263 above.

Notothenia rossii (Division 58.5.1)

4.266 No new data on the stocks of this species in the Division were made available to the Working Group.

Management Advice

4.267 The Working Group reiterated its advice from previous meetings (SC-CAMLR-XV, Annex 5, paragraph 4.223) that the fishery for *N. rossii* in Division 58.5.1 remain closed until new information demonstrating the recovery of the stock to a level that allows for its exploitation is submitted for analysis.

Lepidonotothen squamifrons (Division 58.5.1)

4.268 No data were reported to the Working Group to allow the assessment of this stock.

Management Advice

4.269 In the absence of a new assessment the Working Group recommended that the Kerguelen fishery for *L. squamifrons* should remain closed.

Heard and McDonald Islands (Division 58.5.2)

Dissostichus eleginoides (Division 58.5.2)

Impact of Illegal Catches on TAC

4.270 The 1996/97 season was the first one in which commercial fishing for *D. eleginoides* was conducted in this division. As the reported catch of 1861 tonnes was less than half the TAC of 3 800 tonnes, and no new biological data are yet available, it was not considered necessary to re-evaluate the TAC. Because of the high estimates of unreported catches from this division, however, the assessment of the precautionary yield using the GYM from 1996 was re-run to examine the effect on the long-term annual yield of the estimates of unreported catches from this division in the last fishing season. The inputs to the model are given in Table 33. Two catch levels were used in these runs, being the reported catch (1 861 tonnes) plus the lower and higher estimates of unreported catches respectively (10 200 and 18 400) (Appendix D). In both cases, the decision rule concerning the escapement of spawning stock after 35 years was binding. The future long-term annual yield at which median escapement is 0.5 was 3 720 tonnes for the lower estimate of catch and 3 700 tonnes for the upper estimate, provided that high levels of unreported catches do not continue. The respective probabilities of depletion below the 0.2 median pre-exploitation biomass over 35 years were 0.039 and 0.045.

Management Advice

4.271 In view of the large illegal catches estimated to have been taken from this Division, the Working Group recommends that the TAC should be revised to 3 700 tonnes, the yield estimated by the GYM with the higher estimate of illegal catches used as input.

4.272 This TAC should be used on the assumption that total catches are reduced to 3 700 tonnes or less in the near future. If total catches continue at levels similar to those estimated by the Working Group for the 1996/97 season, there will be a much greater affect on TAC than has been estimated at this meeting.

Champsocephalus gunnari (Division 58.5.2)

Commercial Catch

4.273 A commercial catch of 216 tonnes was taken by one vessel from Australia in Division 58.5.2 during the 1996/97 season, which was less than the precautionary TAC of 311 tonnes set by Conservation Measure 110/XV.

Research Surveys

4.274 Three research surveys were conducted around Heard Island in the years 1990, 1992 and 1993 (Williams and de la Mare, 1995). In August 1997 a further survey was carried out on Shell Bank and the Heard Plateau. The results of this paper were presented in WG-FSA-97/29. This survey covered a smaller area of the plateau than previous surveys and may therefore represent an underestimate by comparison. However, most of the area not covered in this survey had a very low biomass in the previous surveys, so the underestimate is probably not very great. Biomass estimates were calculated using both the Delta-lognormal maximum likelihood estimator (Pennington, 1983; de la Mare, 1994) and the sample means with bootstrap variance and confidence intervals. Biomass estimates are given in Table 25.

Assessment of Short-term Yield

4.275 WG-FSA-97/29 presented an assessment of the potential yield of *C. gunnari* over the next two years, using the method described in paragraph 3.68. The assessment used growth curves, maturation ogives and weight-length relationships derived from the survey data collected at Heard Island.

4.276 The assessment was carried out for the populations of *C. gunnari* in two regions:

(i) the plateau of Heard Island, including the locality known as Gunnari Ridge; and

(ii) Shell Bank, which is separated from the plateau by water of depths greater than 500 m.

4.277 The *C. gunnari* populations in these two regions have different spawning seasons, and as indicated in WG-FSA-97/29, have different age structures in the same year and appear to have differences in their growth curves. For these reasons the two populations are treated separately.

4.278 The bootstrap lower 95% confidence interval was used to estimate the initial age structure for the projection. The resulting fishing mortality was F = 0.095. This resulted in a combined catch over two years from the two abundant cohorts of 1500 tonnes. This comprises 900 tonnes in the first year and 600 tonnes in the second year.

Management Advice

4.279 The Working Group recommended a catch limit of 900 tonnes for *C. gunnari* on the plateau at Heard Island for the 1997/98 season.

4.280 The Working Group noted that the lower 95% confidence limit for the abundance estimate of *C. gunnari* on Shell Bank reported in WG-FSA-97/29 was only 592 tonnes. Accordingly, the Working Group recommended that commercial fishing on this bank should be avoided in the 1997/98 season.

4.281 The Working Group noted the value of having up-to-date surveys on which to base assessments of a species such as *C. gunnari* which has widely fluctuating abundance. The Working Group recommended that such surveys should be conducted regularly.

4.282 The Working Group further noted the conclusion presented in WG-FSA-97/29 that there appears to be no compelling requirement to protect juvenile fish from the effects of fishing at the levels proposed for precautionary catch limits. However, this has not been established for the higher catch limits from the interim procedure for estimating catch limits for abundant cohorts. For this reason, the Working Group agreed that it would be advisable to continue a procedure for limiting the proportion of small fish taken by the fishery. It recommended that a fishing vessel should move to another location when the proportion of small fish exceeds 10% of the total (provided the catch of *C. gunnari* is above a minimum threshold such as 100 kg). Small fish should be defined as those of less than 240 mm total length (paragraphs 4.312 to 4.319).

Channichthys rhinoceratus, Lepidonotothen squamifrons and Skates (*Bathyraja* spp.) (Division 58.5.2)

4.283 WG-FSA-97/30 provides an assessment on the long-term annual yield for two species, and a group of species, caught as by-catch in the commercial trawl fishery in the Heard Island area: *C. rhinoceratus*, *L. squamifrons* and skates (*Bathyraja* spp.). Two analyses were undertaken. First, the long-term annual yield for each of the stocks was estimated using the GYM developed for WG-FSA. The second analysis examined the amount of each species and group of species caught in the commercial operations, the nature of the trawl operations in which they were caught and the effectiveness of current by-catch provisions in CCAMLR to ensure the status of these stocks is not affected by these fisheries (paragraphs 4.312 to 4.319).

4.284 The assessment of yield for each stock was based on the determination of γ, as used for determining precautionary catch limits for krill and *E. carlsbergi*, where γ is the proportion of a biomass estimate that can be taken as a long-term annual yield. In the case of these three stocks, three biomass estimates were available. The decision rules used to assess the precautionary limits were those used for prey species (i.e. that median escapement of the spawning stock at the end of 20 years of exploitation should be 75% of the pre-exploitation spawning biomass and the probability of depletion below 0.2 of the median pre-exploitation spawning biomass be no greater than 10%). Where possible, biological characteristics of the stocks used as inputs for the GYM were obtained from data of research surveys conducted in the division. However, when not available these data were extracted from information contained in the literature on related species occurring in other geographical areas (sometimes in very distant waters). Consequently, the yields derived from these results are uncertain, especially for skates for which very little information is available.

4.285 The range of estimates of long-term annual yields meet the 75% escapement rule. The

precautionary catch limits for *C. rhinoceratus, L. squamifrons* and skates were 69 to 97 tonnes (average 80 tonnes), 7 to 911 tonnes (average 325 tonnes) and 50 to 210 tonnes (average 120 tonnes) respectively. The Working Group noted that the by-catch of these species in the Heard Island trawl fishery did not exceed the lowest estimates of yield for each species and therefore it does not seem to be negatively affecting their stocks. It also stated that while further work is needed to refine the estimates of long-term annual yields, especially for skates, these results could be used as a basis to set precautionary catch limits for these stocks in Division 58.5.2.

4.286 The Working Group welcomed the assessments of these stocks using the GYM and noted a number of further refinements which could be undertaken in the future.

Management Advice

4.287 The Working Group recommended that the estimates of yield using the GYM should be the basis for setting the by-catch limits for these species in Division 58.5.2 during the 1997/98 season: 69–97 tonnes for *C. rhinoceratu*s, 7–911 tonnes for *L. squamifrons* and 50–210 tonnes for skates (*Bathyraja* spp.).

Crozet Islands (Subarea 58.6)

Dissostichus eleginoides (Subarea 58.6)

Standardisation of CPUE Indices

4.288 A generalised additive model (GAM) (Hastie and Tibshirani, 1990) was used to standardise CPUE data from the joint French-Japanese longline survey conducted around Crozet Island. GAMs are similar to GLMs in that one does not need to assume that residuals are normally distributed, but GAMs are more flexible than GLMs because the former model uses nonparametric smoothing techniques to model the effects that continuous predictor variables have on the response.

4.289 Kilograms per hook was used as the response variable, and month and depth were considered as predictor variables (note that the model did not include a year effect because the data were collected during the period December 1996 through April 1997). The effect of depth was modelled with a smoothing spline. A chi-square test was used to determine whether the smoothing spline explained significantly more variation in kilogram/hook than a simple linear model. Details about fitting GAMs to data, using smoothing splines, and making inferences from chi-square tests can be found in Hastie and Tibshirani (1990).

4.290 Depth explained a significant amount of variation in kilogram/hook (Table 34). The depth effect was modelled with a smoothing spline that approximated a quadratic function, and CPUE was predicted to have a shallow, U-shaped relationship with depth (Figure 9, upper panel). The smoothing spline was significantly different from a simple linear fit ($p = 0.02$), so the Working Group considered what mechanisms might explain the U-shaped relationship.

4.291 Prof. Duhamel provided the Working Group with information on the by-catch of grenadiers captured during the toothfish survey, and the Working Group considered whether grenadiers outcompete *D. eleginoides* for hooks. A GAM was used to model grenadier CPUE as a function of depth. Grenadier CPUE was calculated as numbers per hook because

grenadiers might be seen to outcompete toothfish for hooks if the catch was measured in weight rather than numbers.

4.292 Depth explained a significant amount of variation in grenadier CPUE ($p < 0.01$), and the depth effect was modelled with a smoothing spline that had a bell-shaped curve (Figure 4, upper panel). The smoothing spline for grenadier CPUE was significantly different from a simple linear fit ($p < 0.01$).

4.293 The predicted trends in *D. eleginoides* and grenadier CPUE peaked at different depths (Figure 9, upper panel), and the Working Group agreed that there was some evidence that these two species compete for hooks around Crozet Island. Grenadiers may have the strongest effect on toothfish CPUE at depths between about 800 and 1 000 m.

4.294 Month was a statistically significant ($p = 0.1$) source of variation in the CPUE of *D. eleginoides* (Table 34). Standardised catch rates of toothfish were highest in December 1996 and declined through April 1997 (Figure 9, lower panel).

4.295 The Working Group noted that the declining trend illustrated in Figure 9 (lower panel) was different from that estimated for Subarea 48.3 (Figure 4) where CPUE was higher in March and April than in January and February. The Working Group speculated that the declining trend illustrated in Figure 9 may have resulted from the substantial unreported catches taken from Subarea 58.6 since its last meeting in October 1996 (see Table 3). In this regard, the Working Group noted that the median unexploited spawning biomass estimated from the GYM for Subarea 58.6 (according to proposed new boundaries) was 52 290 tonnes and the total estimated catch from this subarea was 23 943 tonnes (see section 4). The Working Group further noted that the total estimated catch from Subarea 58.6 was thus about 45% of the predicted median unexploited spawning biomass. The Working Group considered that such a large proportion of the estimated spawning stock biomass being taken in a single year is a very serious situation. It is even more disturbing considering that last season was the first known occasion of a significant level of exploitation, and that very little is known of the fish stock in this region.

4.296 The Working Group agreed that since the declining trend illustrated Figure 9 is likely to be a result of the substantial catches taken from Subarea 58.6, the information in this figure could not be used to assess how delaying the start of the fishing season until the beginning of May (as a means of reducing incidental mortality to seabirds) would affect the fishery.

Management Advice

4.297 The Working Group viewed with concern the estimate that 23 943 tonnes have been taken from this area (based on the proposed new boundaries of Subarea 58.6), which represents 45% of the median unexploited spawning biomass estimated from the GYM.

4.298 In the assessment of new fisheries, the Working Group determined that a precautionary catch limit for Subarea 58.6 should be 817 tonnes based on area of seabed and taking 0.45 of the calculated yield (paragraphs 4.92 to 4.115 and Table 11).

4.299 The decline in CPUE observed in the GLM analysis, together with the very high level of catches compared with estimated unexploited spawning biomass and precautionary catch

limits is cause for concern. There will be a severe effect on the stock if the high level of illegal catches continues.

4.300 Further work is urgently needed to determine the biological parameters of *D. eleginoides* in this subarea.

Crozet and Prince Edward Islands (Subareas 58.6 and 58.7)

4.301 Notification of the intention to conduct a new fishery for *D. eleginoides* in Subareas 58.6 and 58.7 during the 1996/97 season was lodged by South Africa (SC-CAMLR-XV, Annex 5, paragraphs 4.7 and 4.244). South Africa, Ukraine and Russia have expressed their intentions to continue the fishery in a exploratory phase during the 1997/98 season. Information relating to this fishery is contained in paragraphs 4.8 to 4.10 and 4.63. Management advice is provided in paragraphs 4.120 to 4.134.

4.302 No information was available on other stocks occurring in these subareas.

Prince Edward Islands (Subarea 58.7)

Dissostichus eleginoides (Subarea 58.7)

Standardisation of CPUE Indices

4.303 The Working Group used a GLM to standardise CPUE data from the longline fishery for *D. eleginoides* in Subarea 58.7 around the Prince Edward Islands. The analysis was conducted with the same techniques used to analyse haul-by-haul CPUEs from the longline and trawl fisheries in Subarea 48.3 and Division 58.5.1 respectively.

4.304 CPUEs were calculated as kg per hook, and month, vessel ID, and depth were used as predictor variables. The haul-by-haul data were provided by Dr Miller (South Africa) and covered the period from October 1996 through June 1997. Dr Miller provided data on over 1 000 hauls, but the Working Group was not able to use all of this information in the analysis because of problems joining various fields in the data set. Just over 500 hauls were used in the analysis, so the Working Group considered the results to be preliminary. The Working Group noted that it would be able to undertake a more thorough analysis of the Prince Edward Islands data at its next meeting if the haul-by-haul data are be entered into the CCAMLR database by that time.

4.305 Month and vessel ID were statistically significant ($p < 0.01$) sources of variability to kg/hook (Table 35). The effect of month is illustrated in Figure 10. The Working Group noted that there was not a clear pattern to the standardised series of CPUE by month. Dr Miller further commented that the GLM results presented in Figure 10 were similar to results separately obtained by South African scientists who were able to analyse the full dataset.

4.306 The Working Group noted that for this subarea, as in Subarea 58.6, the estimated total of reported and illegal catches is a high proportion of the median unexploited spawning

biomass estimated from the GYM (according to proposed new boundaries). For this Subarea the predicted median unexploited total biomass was 102 210 tonnes and the total estimated catch was 18 839 tonnes (Appendix D), or 18.4% of the median unexploited total biomass. The Working Group considered that the situation in Subarea 58.7 was equally serious to that in Subarea 58.6 because such a considerable proportion of the estimated spawning stock biomass has been taken in a single year. Again, it is particularly disturbing that last season was the first known occasion of a significant level of exploitation, and that very little is known of the fish stock in this region.

Management Advice

4.307 In the assessment of new fisheries, the Working Group determined that a precautionary catch limit for Subarea 58.7 should be 1 685 tonnes based on area of seabed and taking 0.45 of the calculated yield (paragraphs 4.93 to 4.115 and Table 11).

4.308 The Working Group viewed with concern the estimated catch of 18 839 tonnes taken from this area (based on the proposed new boundaries of Subarea 58.7), 87% of which was taken in the unregulated fishery. This was 17 154 tonnes greater than the estimated precautionary yield and represents 18.4% of the median unexploited spawning biomass estimated from the GYM. The high level of catches compared with estimated unexploited spawning biomass and precautionary catch limits is cause for great concern. There will be a severe effect on the stock if the high level of illegal catches continues.

4.309 Further work is urgently needed to determine the biological parameters of *D. eleginoides* in this subarea. The Working Group also recommended that a bottom trawl survey be carried out during the forthcoming season.

Pacific Ocean Sector (Area 88)

4.310 Notification of the intention to conduct a new fishery for *D. eleginoides* and *D. mawsoni* in Subareas 88.1 and 88.2 during the 1996/97 season was lodged by New Zealand (SC-CAMLR-XV, Annex 5, paragraph 4.17). Details on its development are given in paragraphs 4.11 and 4.30 to 4.34.

4.311 No information was available on other stocks occurring in this sector.

General By-catch Provisions

4.312 The Working Group considered issues associated with the by-catch of fish in this section of the report. Information on the by-catch (incidental mortality) of seabirds can be found under section 7 'Incidental Mortality Arising from Longline Fishing'.

4.313 Two papers that related to fish by-catch were presented to the Working Group: WG-FSA-97/30 and CCAMLR-XVI/12.

4.314 WG-FSA-97/30 presented results from Division 58.5.2 where *C. rhinoceratus*, *L. squamifrons* and skates (*Bathyraja* spp.) are caught as by-catch in the trawl fishery around Heard Island. In the paper, the GYM was used to estimate precautionary yields for each of

these species (parameter estimates for running the model were taken from research survey results and from the literature). Species-specific, total by-catches taken during 1997 were then compared to the lowest estimates of precautionary yield. In all three cases, the actual by-catch was less than the estimated precautionary yield.

4.315 The Working Group noted that WG-FSA-97/30 was an important step forward in dealing with by-catch species and agreed that in general it is better to evaluate levels of by-catch in relation to stock productivity. Evaluating potential yield of by-catch species is preferable to arbitrary rules that restrict the level of by-catch.

4.316 The Working Group did acknowledge, however, that there will often be instances where information is not available to estimate yield for by-catch species.

4.317 WG-FSA-97/30 also outlined a practical problem with the by-catch provisions outlined in Conservation Measures 109/XV, 110/XV, and 111/XV; the same problem was discussed in CCAMLR-XVI/12. The provisions of these three conservation measures have made it difficult for fishermen to prospect for suitable trawling grounds because the fishermen were frequently forced to leave local areas when catches of by-catch species were less than 100 kg. Both WG-FSA-97/30 and CCAMLR-XVI/12 forwarded the proposal that the by-catch provisions in the three conservation measures be modified so that vessels are not forced to move if catches of any single by-catch species are less than 100 kg in any single haul.

4.318 The Working Group agreed that the 100 kg threshold for by-catch in a single haul would probably not cause stocks of by-catch species to become overexploited but agreed that there should also be an upper limit to the number of 100 kg by-catches that could occur in a single year. Ideally, this upper limit should be determined by the potential yield of each by-catch species.

4.319 The Working Group summarised its discussions on by-catch provisions by acknowledging that a mixed strategy of dealing with by-catch is probably most appropriate for all fisheries where there are fish by-catches. The mixed strategy has two components:
(i) total removals of each by-catch species are limited by estimates of potential yield; and
(ii) haul-specific by-catch limits are set at levels that permit prospecting but are not likely to cause the potential yield from Component 1 to be exceeded. The Working Group further noted that haul-specific by-catch limits in Component 2 of the mixed strategy should be set on a case-by-case basis and acknowledged that such a strategy has already been implemented in the *C. gunnari* fishery in Subarea 48.3 (Conservation Measure 107/XV).

Resumption of Closed or Lapsed Fisheries

4.320 At its last meeting, the Working Group recommended that the Commission maintain a register of lapsed fisheries (SC-CAMLR-XV, Annex 5, paragraph 4.251). In response to this recommendation the Secretariat prepared SC-CAMLR-XIV/BG/16 Rev. 1 and presented it to the Working Group. The paper identified five types of fisheries: new, exploratory, established, closed and lapsed. The paper further noted that formal definitions only exist for new, exploratory and closed fisheries. The Working Group noted that there were some errors and omissions in the document which should be revised and presented in a Rev. 2.

4.321 The Working Group agreed that SC-CAMLR-XIV/BG/16 Rev. 1 was a useful and

important step forward in developing a framework for classifying fisheries in the CCAMLR Convention Area. The Working Group further commented that such a framework could provide the basis of a general means for guiding the Scientific Committee's and Commission's policies in reference to dealing with fisheries in the Convention Area. For instance, the Scientific Committee could direct the Working Group to conduct specific types of assessments for each type of fishery, and the Commission could adopt a standard data collection and reporting strategy for each type of fishery.

4.322 The Working Group further noted that the lack of consistent quality between the various notifications of new and exploratory fisheries received at this year's meeting (paragraph 4.17) indicated that Members applied different interpretations to the various requirements in the current conservation measures on new and exploratory fisheries (Conservation Measures 31/X and 65/XII). The Working Group agreed that a standard framework for dealing with various types of fisheries would make it easier for Members to provide the information necessary to evaluate new and exploratory fishery notifications.

4.323 As a final note on this topic, the Working Group reiterated the recommendation that information and procedures similar to those required for the initiation of a new fishery and/or for the execution of an exploratory fishery should be required during the resumption of a closed fishery (SC-CAMLR-XV, Annex 5, paragraph 4.249).

CONSIDERATIONS OF ECOSYSTEM MANAGEMENT

Interactions with WG-EMM

5.1 Dr Everson (Convener, WG-EMM) outlined those aspects of the ecosystem assessment conducted by WG-EMM at its meeting this year (Annex 4) which related directly to the work of WG-FSA.

5.2 The Working Group noted with appreciation that WG-EMM had continued to investigate the by-catch of fish in the krill fishery (Annex 4, paragraphs 6.1 to 6.4 and WG-EMM-97/72). It was also noted that this information could be used in conjunction with information on the distribution of juvenile and larval phases of fish species to determine the effect of the krill fishery on finfish populations. Therefore, in 1995 WG-FSA established a correspondence group to analyse all available material on fish by-catch in krill fisheries for the entire Convention Area.

5.3 To date, the Working Group (WG-FSA-97/46 Rev. 1) has:

(i) identified all datasets reported to CCAMLR and/or published elsewhere;
(ii) agreed on data requirements and analytical procedures;
(iii) requested authors/owners of data to submit them in a specified format;
(iv) developed a database; and
(v) processed the data received and input them into the CCAMLR database.

5.4 The Working Group noted that not all data identified and requested for inclusion in the database has been made available. It agreed that the Secretariat should once again request these data.

5.5 In addition, some deficiencies were noted in a number of datasets received. The Working Group agreed that the Secretariat should request originators of the data to correct deficiencies where possible.

5.6 However, irrespective of whether or not additional data and/or corrections of deficiencies identified in existing datasets have been received, after three months from the end of the Commission meeting (1 March 1998), a final database should be established and circulated to members of the Working Group for subsequent data analyses and review of methodology during the next intersessional period.

5.7 The Working Group noted that an analysis of data reporting stomach contents of fish specimens incidentally taken by a Japanese krill fishing vessel in January/February 1995 which was to be submitted to WG-FSA this year (Annex 4, paragraph 6.3) has not been received. The Working Group agreed that this analysis would be a valuable contribution to its work and would welcome its availability in the near future.

5.8 As demonstrated in papers submitted to previous meetings of WG-EMM and in WG-EMM-97/61, Antarctic blue-eyed shags (*Phalacrocorax bransfieldensis*) rely heavily on a range of inshore fish species. WG-EMM considered that, if a reliable method could be developed, it may be appropriate to adopt the Antarctic blue-eyed shag as a CEMP monitoring species (Annex 4, paragraph 6.82). At this year's meeting, Members of WG-EMM felt enough new information was now available to justify preparing a revised version of the draft standard method for consideration by WG-EMM and WG-FSA (Annex 4, paragraph 8.75).

5.9 The Working Group welcomed the development of this new monitoring method by Lic. R. Casaux (Argentina) and his colleagues and agreed with WG-EMM (Annex 4, paragraph 10.24) that a revised version of the draft standard method should be completed during the next intersessional period which could then be considered by both working groups.

5.10 The Working Group appreciated advice provided by WG-EMM concerning the potential impact of a fishery for squid (*M. hyadesi*) on predators (Annex 4, paragraphs 6.83 to 6.87). It noted that WG-EMM considered that there was generally insufficient information to conclude how the development of such a fishery was likely to influence predators. It appeared that most predators were taking one-year-old squid and there was little indication that they were feeding on spent squid. The most accurate information about squid consumption comes from the predator species which accounted for the smallest proportion of the estimated predation of squid in Area 48 (Annex 4, paragraph 6.83).

5.11 The Working Group thanked WG-EMM for its advice concerning the need for more information on the estimates of the natural mortality rate of squids, on variability in recruitment, on the appropriate level of squid escapement, and on the timing of the fishery (Annex 4, paragraphs 6.85 to 6.87). These concerns will be incorporated in the Working Group's advice to the Scientific Committee.

5.12 WG-EMM reviewed an analysis pertinent to the determination of the appropriate level for the median biomass of *D. eleginoides* after fishing (escapement) in the commercial fishery at Heard Island (Annex 4, paragraphs 6.88 and 6.89; WG-EMM-97/42). The analysis considered the age classes of *D. eleginoides* taken by elephant seals, based on seven otoliths from probably four *D. eleginoides* found in one of 65 sampled stomachs. The analysis indicated that the level of escapement in the age classes likely to be eaten by elephant seals was of the order of 87%, and the assessment developed by WG-FSA would not require

adjustment to account for predator requirements on this species.

5.13 The Working Group accepted this conclusion, but noted that larger samples of otoliths from elephant seal stomachs at Heard Island would be useful. Dr Croxall indicated that preliminary data from South Georgia on diet composition estimated from lipid composition of milk suggested that *D. eleginoides* could form a substantial fraction of the elephant seal diet at this site.

5.14 The Working Group was encouraged that WG-EMM compared the GYM used to determine fish stock assessments to its krill yield model and found that it provided duplicate results (Annex 4, paragraph 7.3). WG-EMM also found that the generalised model used by WG-FSA is more readily extended to incorporate new features. After the Secretariat has validated the generalised model, it will replace the existing krill yield model for future krill-related computations.

5.15 The Working Group recognised that WG-EMM's plan to conduct a synoptic survey to determine krill biomass in the 1999/2000 season (Annex 4, paragraph 8.109) could be an opportunity to collect ancillary information which might further the Working Group's goals. For example, squid might be detected and delineated in the acoustic data and net sampling protocols might be developed to allow information on larvae and juvenile fish to be obtained. The Working Group agreed that Members should develop data collection plans which could utilise this opportunity and present them to its next meeting.

5.16 The Working Group expressed interest in an approach initiated by WG-EMM's Subgroup on Statistics. They recognised that an approach for the proper treatment of anomalies in data from non-normal distributions should be developed. In addition, they noted that some observations which are 'anomalies' from a biological perspective may not be statistically significant (Annex 4, Appendix D, paragraphs 2.5 to 2.23). The detection and treatment of these values were examined by investigating a proposal for combining CEMP variables to produce a smaller number of summary indices. The Working Group agreed that this work may have application for WG-FSA's work.

5.17 It was noted that WG-EMM is developing ecosystem assessments in a standardised form (Annex 4, paragraphs 7.29 and 7.30). An illustrative example developed by WG-EMM (Annex 4, Appendix F) was based on that used to present assessment summaries by WG-FSA. The Working Group encouraged this development and hoped further collaborative work along this line would be possible.

5.18 Finally, the Working Group noted WG-EMM's advice that revised calculations of precautionary catch limits for the krill fishery in Area 48 should be deferred until additional pertinent information (such as the results of the synoptic krill survey planned for 1999/2000) becomes available (Annex 4, paragraphs 7.1 to 7.3).

Ecological Interactions

5.19 The Working Group noted that several reports of scientific observers on board vessels participating in the *D. eleginoides* longline fisheries mentioned interactions between marine mammals and fish (Table 36). In Subarea 48.3 most observers reported that sperm whales were regularly associated with longline vessels during hauling operations. Killer whales and fur seals were occasionally seen in close proximity to the longline. Most observers in

Subarea 48.3 reported potential loss of fish to whales and/or fur seals. In four cases the observers estimated the number of fish lost, ranging from 6–7 grenadiers to 44–450 toothfish.

5.20 In Subareas 58.6 and 58.7 all observers noted the regular presence of marine mammals (Table 37), principally sperm whales with occasional observations of killer whales and fur seals. Only on two occasions were observers certain that fish had been removed from the longline, involving small numbers of *D. eleginoides*. There were two reports of entanglement with sperm whale and one with a minke whale which caused the loss of substantial portions of longline (and presumably the fish caught on these lines).

5.21 The Working Group endorsed results of the workshop on predator-prey-fisheries interactions reported by Australia (WG-EMM-97/27 and 97/31). The aim of the workshop was to report on:

(i) the current state of knowledge on those predator-prey relations in the Heard Island and McDonald Islands region and at Macquarie Island which may be affected by fisheries, particularly on *D. eleginoides* and *C. gunnari*;

(ii) future research requirements, including an outline of a research plan; and

(iii) interim advice on the implications of predator-prey interactions for the development of management plans for fisheries.

The Working Group was encouraged that the work will be continued intersessionally.

5.22 The management of *C. gunnari* at South Georgia is complicated by the likelihood of substantial periodic variation in natural mortality rates which may be associated with their increased consumption by fur seals in years of poor krill availability. A scheme that would use information from studies on krill and predators undertaken as part of CEMP to interpret or modify information from commercial fisheries and research surveys leading to estimates of stock biomass was developed (WG-FSA-97/38 and paragraph 4.174). The Working Group encouraged further development of this scheme.

RESEARCH SURVEYS

Simulation Studies

6.1 The Working Group noted that WG-EMM is undertaking a simulation study on the development of model-assisted assessments of biomass from krill acoustic surveys. It was agreed to closely follow these developments since the results could be applied in biomass estimates of fish surveys.

6.2 Drs Gasiukov and Marschoff reported on an intended simulation study aimed at the quantification of the influence of spatial correlation in the estimates of the stock of *C. gunnari*, attempting to define the minimum distance between stations allowing randomisation of the design.

Recent and Proposed Surveys

Recent Surveys

6.3 A list of all surveys undertaken in CCAMLR waters was compiled by the Secretariat and is given in Table 22.

6.4 Several members conducted surveys during the last season, which are discussed in the pertinent sections of this report.

6.5 Dr. Everson informed the Working Group that during the UK survey conducted in September 1997 on board *Argos Galicia* in Subarea 48.3, a baited camera was deployed to record the presence of *D. eleginoides* in order to provide estimates of density using a methodology that is independent of fishery methods.

Proposed Surveys

6.7 During the 1997/98 season, the USA intends to conduct a bottom trawl survey in Subarea 48.1 using a stratified random survey design and stations previously utilised by Spanish and German scientists (e.g. WG-FSA-97/27). The survey will be conducted between 9 March and 8 April using the chartered Russian RV *Yuzhmorgeologiya*. It is expected that 40 to 50 hauls each lasting approximately 30 minutes will be completed.

6.8 The Spanish longline survey to be conducted in Subarea 48.6 and Division 58.4.4, according to COMM CIRC 97/42 dated 22 July 1997, will take place during the coming season and will last for about 45 days operating in these subareas and outside CCAMLR waters on Meteor Bank. The mean number of hooks per set will be about 1 500 to allow a larger number of sites to be sampled.

6.9 A French survey on *C. gunnari* in Division 58.5.1 is expected to be conducted during the 1997/98 season if agreement is obtained from owners of French trawlers operating in the fishing grounds.

6.10 A survey on mesopelagic ichthyofauna is scheduled off the Kerguelen Islands (Polar Frontal Zone – Division 58.5.1) during January/February 1998 on board *La Curieuse* (see CCAMLR-XVI/MA/4). Myctophids are the targeted species of the scientific cruise. No high levels of catches are expected. A report will be available for the next meeting of WG-FSA.

6.11 The Argentinian research vessel *Dr Eduardo L. Holmberg* will be fitted with a deepwater winch. If available on time, a bottom trawl survey will be conducted in Subareas 48.3 and 48.2. It is planned that the design of the survey will make use of the results of the simulation exercise referred to in paragraph 6.2 above.

6.12 During the 1997/98 season, Australia is planning to repeat a random stratified trawl survey for *C. gunnari* on the Heard Island plateau and Shell Bank in Division 58.5.2. The conduct of this survey will depend on a suitable opportunity during the operations of an Australian trawler, but it is hoped to carry out the survey late in the season.

INCIDENTAL MORTALITY ARISING FROM LONGLINE FISHING

7.1 Concern was expressed that only two members of the CCAMLR ad hoc Working Group on Incidental Mortality Arising from Longline Fishing (WG-IMALF) had been able to attend, as requested last year, to commence work on this topic from the start of the WG-FSA meeting. It was hoped that some members of WG-IMALF from Australia and New Zealand would be able to attend the whole meeting next year.

7.2 The Working Group approved the addition of Mr G. Benavides (Chile), Mr B. Baker (Australia) and Ms B. Dettmann (Australia) to WG-IMALF. Members were invited to review their nominees to this working group and to notify the Secretariat of any changes.

Intersessional Work

7.3 The Secretariat circulated the IMALF plan of intersessional work to members of the WG-IMALF in January 1997. WG-FSA-97/57 summarises the work requested (together with those responsible and deadlines), actions undertaken and responses received. The Science Officer was thanked for coordinating this work. It was noted that an earlier circulation of the intersessional work plan might assist scientists to undertake tasks prior to departure for Antarctic field work.

7.4 Background information on the work of IMALF was also circulated, including to the technical coordinators of scientific observer programs for them to forward to all scientific observers who had been scientific observers on board longline vessels in the Convention Area during the 1995/96 season.

7.5 The newly-revised *Scientific Observers Manual* (containing logbook forms for scientific observers on board longline vessels) was translated, published and distributed to all Members during the year.

7.6 Mr Benavides suggested that the list of bird species in Part IV, Section 5 of the manual should be updated and that the vernacular names of species in all languages of the Commission should be included. This was agreed.

7.7 During the year the Science Officer and the IMALF group were involved in extensive correspondence with non-governmental organisations, especially in the USA, on issues relating to incidental mortality of seabirds. Examples of some of this dialogue are included in WG-FSA-97/57.

7.8 The booklet *Fish the Sea Not the Sky* was widely circulated to Members, international governmental and non-governmental organisations (WG-FSA-97/57). Some publicity was sought from fishing publications and via Mustad, a company specialising in the production of longline fishing gear, in an article in *Fishing News International* (SC-CAMLR-XV/BG/23).

7.9 There was little indication that any feedback on this booklet had been provided by users. There were no comments in any of the reports of scientific observers to indicate whether the booklet was available on board vessels, whether it was used, or how useful it was. It was recommended that these questions be posed to observers via a footnote in the *Scientific Observers Manual.*

7.10 Mr Benavides indicated that Chilean observers/vessels had found the booklet useful.

He recommended that in any reprinting of this booklet the scientific names of bird species be included on the plates.

7.11 To assist in getting the messages contained in the CCAMLR booklet across to the fishing industry and fishermen, it was recommended that the Secretariat send copies to the main companies believed to be engaged in longline fishing in the Convention Area and adjacent areas. They should be requested to help ensure that copies are available on board all their vessels.

7.12 It was agreed that publicising on the worldwide web (see SC-CAMLR-XVI/BG/23) the CCAMLR booklet and CCAMLR activities and data concerning IMALF would be of considerable value.

7.13 The Science Officer had attended the second meeting of the Ecologically Related Species Working Group of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT-ERSWG) as the CCAMLR observer (SC-CAMLR-XVI/BG/13). His report noted:

(i) that the use of tori poles has become mandatory in the Australian, New Zealand and Japanese southern bluefin tuna fisheries. Data indicate that reductions in seabird by-catch of 69 to 87% have been achieved on Japanese vessels using appropriately designed and deployed tori poles and streamer lines;

(ii) that data suggest that a 70 to 96% reduction in incidental mortality of seabirds, especially albatrosses and giant petrels, is possible with night-time setting;

(iii) the recommendation from ERSWG to CCSBT to prepare plans for research priorities for mitigation measures;

(iv) that the CCAMLR proposal for a joint meeting of ERSWG and CCAMLR WG-IMALF has been referred to CCSBT; and

(v) the approval for information exchange between the two above groups – as evidenced by the provision to CCAMLR of several papers originally tabled at the ERSWG meeting (WG-FSA-97/13 to 97/17).

7.14 A request from CCSBT to CCAMLR for data on longline fishing effort in the Convention Area has been referred to WG-FSA, to provide advice to the Scientific Committee on establishing a data exchange between CCSBT and CCAMLR (SC-CAMLR-XVI/BG/13). It was noted that these data would contribute to analyses complementary to those being undertaken within CCAMLR. The Working Group recommended that the Scientific Committee agree to supply CCSBT with these data.

7.15 The Working Group welcomed the collaboration between CCSBT-ERSWG and CCAMLR and recommended that CCAMLR should request from CCSBT observer status for future meetings of ERSWG and that observers from CCSBT should continue to be invited to attend meetings of WG-FSA and/or WG-IMALF.

7.16 Last year CCAMLR requested other organisations regulating tuna fishing, especially ICCAT and IOTC, to establish groups to tackle the problem of seabird–longline fishing interactions. The report of the Coordinating Working Party on Fishery Statistics (CWP) had noted this recommendation (WG-FSA-97/51). However, there has so far been no further feedback from either of the above tuna commissions.

Research into Status of Albatrosses,
Giant Petrels and White-chinned Petrels

7.17 Before last year's meeting, CCAMLR had requested Members to provide information on their monitoring programs to assess the status and trends of breeding populations of albatrosses and petrels likely to be at risk through longline fishing in the Convention Area and adjacent regions. Reports from Australia, New Zealand and the UK had been made available last year.

7.18 A response from France had not yet been received; the Secretariat was requested to solicit a written report on relevant French programs.

7.19 It was noted that the projected Australian surveys at Heard Island (SC-CAMLR-XV, Annex 5, paragraph 7.18(iii)) had been postponed until 1998.

7.20 Further details of the New Zealand monitoring studies would be welcome (see SC-CAMLR-XV, paragraph 7.16) and should be requested intersessionally by the Secretariat.

7.21 South Africa had reported intersessionally that annual counts are made of wandering and grey-headed albatrosses at Marion Island. Recent information on sooty and light-mantled sooty albatrosses is lacking, principally because of the logistic difficulty of undertaking surveys. No data are available from Prince Edward Island so it is not known whether the population status of albatrosses and petrels there has changed since the 1970s (WG-FSA-97/57).

7.22 Dr Miller indicated that it was hoped to conduct surveys of seabird breeding populations at Prince Edward Island in the 1997 or 1998 summer.

7.23 Dr Robertson will also be conducting studies of albatross populations including satellite-tracking in collaboration with the Chilean Antarctic Institute in November 1997.

7.24 The additional information on monitoring studies was welcomed. It was requested that Members conducting such work provide CCAMLR with regular updates on their studies, particularly if population changes or trends are detected.

7.25 In response to intersessional requests for information on distribution and population size of albatrosses and petrels potentially at risk from new and exploratory longline fisheries, information had been supplied on giant petrels by SCAR (WG-FSA-97/22), on albatrosses worldwide by Dr R. Gales (Australia) (WG-FSA-97/28) and on bird communities at the Prince Edward Islands by South Africa (WG-FSA-97/23).

7.26 In addition, WG-FSA-97/59 reviews the conservation status of albatrosses, using the results of the latest taxonomic investigations – recommending the recognition of 10 new taxa at the species level – by applying the new IUCN criteria for the objective definition of threatened species. The conclusions of this review, in terms of categories of threat for albatrosses, have been reviewed by the appropriate IUCN Specialist Group and will be incorporated into the 1997 edition of the IUCN Red List.

7.27 The review indicates that of the albatross species breeding in the Convention Area, five are Threatened (at the Vulnerable level): wandering albatross (South Georgia, Prince Edward Islands, Crozet, Kerguelen, Macquarie), Salvin's albatross (Crozet), Indian yellow-nosed albatross (Prince Edward Islands, Crozet), grey-headed albatross (South Georgia,

Prince Edward Islands, Crozet, Kerguelen, Macquarie), sooty albatross (Prince Edward Islands, Crozet, Kerguelen). In addition, one species is Near-threatened: black-browed albatross (South Georgia, Prince Edward Islands, Crozet, Kerguelen, Heard/McDonald Islands, Macquarie); and one is Data Deficient: light-mantled sooty albatross (South Georgia, Prince Edward Islands, Crozet, Kerguelen, Heard/McDonald Islands, Macquarie).

7.28 Those Members of CCAMLR with responsibilities for islands where these threatened species of albatross breed (Australia, France, South Africa, UK) may need to consider whether they have special responsibilities to protect globally threatened species. Australia is already giving effect to this responsibility in respect of wandering albatrosses at Macquarie Island.

7.29 At the fifth meeting of the Conference of the Parties of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) held in Geneva, Switzerland in April 1997, the Amsterdam albatross (which occurs in the northern part of the Indian Ocean region of the Convention Area) was placed on Appendix 1; 12 other species of albatross were placed on Appendix 2. Of the latter, six species breed in the Convention Area (wandering albatross, black-browed albatross, yellow-nosed albatross, grey-headed albatross, sooty albatross, light-mantled sooty albatross). The implications of these designations for CCAMLR and CCAMLR Members may need investigation.

7.30 Mr Baker noted that the listing of all albatross species to the CMS has now opened the way to develop an agreement under Article IV of the Convention. Australia believes that an agreement under the Convention is the most accessible mechanism to achieve global coordination of albatross conservation efforts. Australia will actively endeavour to develop an agreement in cooperation with other albatross range states.

7.31 Dr Kock suggested that the Secretariat should contact the CMS Secretariat in Bonn to inform it of CCAMLR's work in relation to albatross conservation. It was agreed to recommend this action to the Scientific Committee and that a copy of the information be sent to Dr Kock, to enable him to follow this up personally.

7.32 Dr Miller suggested that it might be appropriate for CCAMLR to draw the attention of the Convention on Biological Diversity (CBD) to the interactions between albatrosses and longline fisheries as an example of harmful biological consequences caused by anthropogenic effects. The Secretariat was requested to correspond with the CBD Secretariat to establish whether the Convention's clearing house mechanism and/or the UNEP Regional Seas Program would be interested in having further information on CCAMLR's work in this field.

Reports on Incidental Mortality of Seabirds during Longline Fishing in the Convention Area

1996 Data

7.33 Last year, analysis of the 1995/96 data could not be completed due to late and incomplete arrival of data and to the submission of data in non-standardised formats. Subsequent resubmission of data from scientific observers from Argentina was received in electronic format on 27 July 1997 but did not include data on seabird mortality (WG-FSA-97/36).

7.34 Consequently, it was not possible to improve the analysis of data on seabird incidental

mortality from that presented in last year's report. Last year it was noted that extrapolating to the complete dataset based on four (of 16) sets of observer data was most unsatisfactory. Nevertheless, this still remains the best assessment possible with the available data.

7.35 Validation of data on incidental mortality from the C2 forms submitted in 1996 has resulted in a few minor changes being made to the data reported last year. These are as follows:

Antarctic III:	4, not 5, birds killed;
Vieirasa Doce:	41, not 42, birds killed;
Mar del Sur:	197, not 195, birds killed;
Frio Sur III:	48, not 49, birds killed.

This changes the overall total by only one bird; as a consequence it was not thought necessary to recalculate the complete tables from last year.

7.36 An additional set of 1996 data, submitted intersessionally by Japan, was from the *Anyo Maru No. 22* in Division 58.5.1 (Kerguelen). The C2 form records a total of 145 longline sets (696 000 hooks), between 17 February and 29 April 1996, when 246 white-chinned petrels were killed. This is a catch rate of 0.35 birds per thousand hooks.

1997 Data

Data Submission

7.37 The overall summary of data and reports from scientific observers on vessels engaged in longline fishing in the Convention Area is in Table 5.

7.38 It was recognised that the submission of data this year was a major improvement on last year and the Working Group thanked all observers and technical coordinators for contributing to this.

7.39 However, many data submissions and reports were received only on the first day of the WG-FSA meeting. A comprehensive (albeit still incomplete) set of data on incidental mortality of seabirds was not available for validation and analysis until the second week of the WG-FSA meeting. It was stressed that observer data and reports must be submitted to the Secretariat within one month of the observer returning to port. The Scientific Observer Data Analyst and the Data Entry Assistant were particularly thanked for their work before and during the meeting.

7.40 Information on data contained in scientific observer reports is summarised in Tables 38 and 39. Scientific observers were congratulated on the high standard of reports, which facilitated the extraction of this information. To assist this process in future years it was agreed to add to the *Scientific Observers Manual* a checklist of topics for which the observer should attempt to provide information (or indicate if no information/data are available) in the report. This checklist is attached as Appendix F. It was hoped that Items 4a, 4b and 5a on this checklist could be incorporated into the logbook forms at their next revision and thereby removed from the checklist.

7.41 During the meeting, priority in entering of incidental mortality data was accorded to data from Subarea 48.3. Data for all but four (of 21) cruises were entered before the end of the meeting (see Table 40) and therefore these data are used to estimate overall seabird by-catch rates.
7.42 There are, however, some discrepancies between these data and those recorded in the observer reports. High priority should be given to resolving these differences by discussion between the Scientific Observer Data Analyst and the Members and/or scientists responsible or knowledgeable about these data.

7.43 Entry of incidental mortality data from Subareas 58.6 and 58.7 was accorded a lower priority, particularly because most data were already summarised in WG-FSA-97/51 (see paragraphs 33 and 34). Only three sets of data could be entered before the end of the meeting (see Table 41). Consequently the data from the scientific observers' reports – which accord very closely with those in WG-FSA-97/51 – were used to estimate overall seabird by-catch and the species composition of this by-catch.

7.44 High priority should be given to completing data entry for the remaining cruises in Subareas 58.6 and 58.7 with a view to producing revised versions of Tables 41 to 43 as soon as possible (intersessionally) and resolving any discrepancies with appropriate Members/ scientists.

Results

Subarea 48.3

7.45 In addition to the information contained in Tables 38, 40 and 44 to 46, several reports relating to the seabird by-catch in Subarea 48.3 had been tabled.

7.46 WG-FSA-97/9 reports a study on the *Cisne Verde* of seabird by-catch associated with longline fishing around South Georgia in March to May 1997. All setting operations occurred at night; no offal was discharged during the haul. In response to last year's request by WG-FSA (SC-CAMLR-XV, Annex 5, paragraph 7.86) for research into the effectiveness of streamer lines, a randomised experiment (presence/absence of streamer lines) was carried out. With the precautions used, including appropriate weighting of the fishing line, seabird by-catch rates were very low, being 0.018 birds per thousand hooks. There was no significant difference in by-catch rates at night with or without streamer lines.

7.47 It was noted, however, that the number of sets used in the experiment was small and the result should be interpreted with caution.

7.48 WG-FSA-97/26 provides a preliminary analysis and summary of seabird by-catch data from nine cruises by four Chilean vessels between 1 March and 8 September 1997. The total seabird by-catch was 478 birds, comprising 196 black-browed albatross (41%) and 162 white-chinned petrels (34%) with small numbers of other species. The overall average seabird by-catch rate was 0.149 birds per thousand hooks compared with 0.077 in 1996 and 0.339 in 1995; none of these values was significantly different.

7.49 It was noted, however, that the above calculations on the Chilean data, based on the C2 format, assume that there was 100% observer coverage of all sets of all vessels. The logbook data submitted to the Secretariat indicate that, for some vessels, only 5–10% of the

sets may have been observed (Table 40).

7.50 It was noted that the overall contribution of white-chinned petrels to the 1997 mortality estimates in WG-FSA-97/26 could be as great as 42% if the 60 sooty albatrosses (a very rare vagrant to Subarea 48.3) were white-chinned petrels (hereafter assumed to be the case) and 52% if the 48 unidentified petrels from the first *Isla Camila* cruise were also white-chinned petrels.

7.51 Table 40 indicates that about 89% of hooks were set at night, a marked improvement in compliance with Conservation Measure 29/XV compared with previous years.

7.52 However, of the 17 cruises in Table 40, streamer lines were apparently not (or hardly) used on nine cruises and only comprehensively used on four cruises. This is a very disappointing level of compliance with an important element of Conservation Measure 29/XV.

7.53 Table 39 indicates that some vessels are still discharging offal at the set – inevitably attracting large numbers of seabirds and substantially increasing the risk of incidental mortality and reduced fishing efficiency. Tables 39 and 40 suggest that a substantial proportion of vessels are still discharging offal during the haul on the same side as the vessel on which they hauling the longline. This practice is contrary to the intention of Conservation Measure 29/XV and is certainly responsible for the high level of bird entanglement observed during the haul by many vessels (though only 5% of the 360 birds entangled were killed) (Table 47).

7.54 Most seabird catch rates in Table 40 are broadly in line with previous experience (allowing for the poor use of streamer lines but noting the improved night setting performance), being in the range 0 to 0.72 birds per thousand hooks. It is notable that catch rates on summer cruises (1 March to 31 April) are an order of magnitude higher than on winter cruises (after 1 May). Night-time rates are consistently lower than daytime ones.

7.55 A notable exception to the by-catch rates above is the first cruise of the *Isla Isabel* where 276 birds were observed caught (99 – all white-chinned petrels – from a single set) an estimated overall rate of 9.31 birds per thousand hooks. The observation data suggest that only 10% of sets were observed, so this high catch rate is based on a relatively small sample, which is extrapolated to give the large estimate of the overall numbers of birds killed on this cruise (2 453 birds – see Table 45).

7.56 This example highlights the importance of ensuring that sampling of seabird by-catch is adequate to obtain a realistic estimate of the total mortality. It was recommended that Members investigate intersessionally the optimum levels of sampling of longline hauls to ensure coverage adequate to give robust overall estimates of seabird by-catch. Until this has been properly investigated, there is no reason to change the current procedures (recommending observations of as high a proportion as possible of the hooks hauled).

7.57 The species composition of the by-catch is summarised in Table 44. The main species killed are white-chinned petrels (48%, including the so-called sooty albatrosses (see paragraph 7.50)), black-browed albatross (40%), northern and southern giant petrels (2% combined) and grey-headed albatross (2%). If the unidentified petrels are white-chinned petrels (see paragraph 7.50) then their total becomes 55%.

7.58 Data from Table 40 are used to estimate the overall by-catch of seabirds per vessel (Table 45). Using the species composition data from Table 43, this estimate is converted into

an estimate of total seabird mortality by species in Subarea 48.3 in the 1996/97 fishing season in Table 46.

7.59 Some concern was expressed that the method of analysis might not take account of biases due to disproportionate numbers of sets being in the periods of high or low seabird by-catch (e.g. summer or winter).

7.60 In response, it was noted that, provided the distribution of observer effort matches that of fishing effort, this should not be a problem. However, it was agreed that it might be useful to investigate this intersessionally. Members were also encouraged to propose other methods of analysis of the seabird by-catch data from scientific observers. Until such new proposals had been thoroughly investigated it was recommended that the existing approach be retained.

Division 58.5.1

7.61 No logbook data on seabird by-catch in this area have yet been received by the Secretariat.

7.62 WG-FSA-97/6 reports seabird by-catch for two Ukrainian longline vessels fishing in the Kerguelen Islands area between October 1996 and March 1997. The *N. Reshetnyak* made 540 sets (1 286 000 hooks) and caught 65 white-chinned petrels, an overall by-catch rate 0.051 birds per thousand hooks. The *Pantikapey* made 503 sets (1 201 500 hooks) and caught 39 white-chinned petrels, 1 black-browed albatross and 1 sooty albatross, an overall by-catch of 0.034 birds per thousand hooks.

7.63 From October to December, longlines were set both during the day and at night. The *N. Reshetnyak* caught 53 white-chinned petrels between 0400 and 2000 h. The *Pantikapey* caught 34 white-chinned petrels and both albatrosses between 0400 and 2000 h and 5 white-chinned petrels between 2000 and 0400 h. The peak by-catch was in November. After January, longlines were set only at night; only 12 white-chinned petrels were caught (all by *N. Reshetnyak*).

7.64 The Working Group noted that this was a good example of a change in fishing practice, to comply with Conservation Measure 29/XV, producing a considerable reduction in seabird by-catch and increase in fishing efficiency.

Subareas 58.6 and 58.7

7.65 In addition to the information contained in Tables 39 and 41 to 43, several reports relating to the seabird by-catch in Subareas 58.6 and 58.7 had been tabled.

7.66 WG-FSA-97/51 reports and summarises seabird by-catch data from 12 cruises of longline fishing vessels around the Prince Edward Islands. The cruises include *Alida Glacial* and *American Champion* (no observers on board and data not used in analysis), *Mr B* and *Aliza Glacial* (no observer reports yet received by CCAMLR). This paper does not include the last cruises of the *Aquatic Pioneer, Sudurhavid* and *Zambezi*. However, these cruises contributed only a total by-catch of two birds (both northern giant petrels).

7.67 The observer data included in WG-FSA-97/51 gave a total of 923 birds killed at an overall rate of 0.289 birds per thousand hooks. However, catch rates varied greatly both seasonally and between vessels and cruises. Thus the January to February cruise of the *Aquatic Pioneer* killed 417 birds (45% of all birds and 60% of all white-chinned petrels) at a by-catch rate of 1.468 birds per thousand hooks. For cruises only in winter (*Sudurhavid, Aquatic Pioneer* in May/June) the by-catch rate is 0.009 compared with a the summer rate (all other cruises) of 0.363 birds per thousand hooks, a 40-fold difference.

The main species caught were white-chinned petrels (73%), grey-headed and yellow-nosed albatrosses (23% combined) and giant petrels (4%). Catches of white-chinned petrels and albatrosses both peaked in February; few albatrosses or white-chinned petrels were caught after April.

About 55% of hooks were set during the day. Excluding white-chinned petrels, catch rates during the night were 0.012 birds per thousand hooks, an order of magnitude less than for daytime catches (0.138 birds per thousand hooks). On the January to February *Aquatic Pioneer* cruise, more white-chinned petrels were caught at night than during the day (0.231 and 0.190 birds per thousand hooks respectively). On the other cruises, however, white-chinned petrel by-catch during the day was higher than at night (0.131 and 0.043 birds per thousand hooks respectively).

7.68 The Working Group noted that further analysis of by-catch rates of white-chinned petrels in relation to phase of moon might prove illuminating, particularly by analogy with other studies of seabird by-catch in *Dissostichus* and tuna fisheries (see paragraph 7.113)

7.69 WG-FSA-97/51 also investigates by-catch rates as a function of distance from breeding site. Catch rates of seabirds were greater closer to the Prince Edward Islands. For all species except white-chinned petrel, six times as many birds were caught within 100 km of the islands as between 100 and 200 km (0.087 and 0.015 birds per thousand hooks respectively); however, the former zone was where most fishing effort occurred. In contrast, white-chinned petrels were present at similar catch rates within 100 km and between 100 and 200 km of the islands.

7.70 In response to a question, Dr Miller indicated that white-chinned petrel by-catch and fishing effort in relation to distance from the Prince Edward Islands could be compared by using haul-by-haul data. This analysis was encouraged by the Working Group.

7.71 WG-FSA-97/51 noted that not all vessels deployed streamer lines while setting gear and observers did not always report whether streamer lines were in use or not for particular sets. Therefore only for one vessel (*Garoya*) were there sufficient data to examine the effects of streamer lines. The use of streamer lines on the *Garoya* reduced by-catch by 41% during daytime sets and by 61% during night sets.

7.72 Estimates of the overall seabird by-catch in Subareas 58.6/58.7 in 1997, in both regulated and unregulated fisheries, were provided in WG-FSA-97/51. The authors estimated a total fishing effort 20 to 40 million hooks, equivalent to a total by-catch of 5 000 to 10 000 birds. Assuming a similar species composition of bird by-catch in both types of fishery, this represents 4 000 to 8 000 white-chinned petrels, 1 000 to 2 000 grey-headed albatrosses, 300 to 600 yellow-nosed albatrosses, 150 to 300 southern giant petrels and 100 to 200 northern giant petrels. As most birds caught were breeding adults this represents 8 to 16% of white-chinned petrel, 4 to 8% of grey-headed albatross and 2 to 4% of yellow-nosed

albatross breeding populations at the Prince Edward Islands. The authors noted that these rates are unsustainable for the populations concerned.

7.73 The summarised observer data (together with the information in WG-FSA-97/51) indicate that setting only took place during the night on 45% of occasions. This represents a serious departure from compliance with Conservation Measure 29/XV.

7.74 Streamer lines of some description, perhaps one-half fairly similar to that specified by CCAMLR, were used on most vessels, though often not in all or part of earlier cruises, apparently because of misunderstandings concerning permit conditions.

7.75 On only one cruise was offal discharged at the set. However, while hauling the longline, about half the vessels discharged offal on the same side, undoubtedly contributing to the numerous entanglements of live birds recorded in observer reports (Table 39). These reports recorded entanglements of 21 black-browed albatrosses, 9 unspecified albatrosses, 13 giant petrels, 1 white-chinned petrel, 9 unspecified petrels and 1 gentoo penguin, with reference to a variety of other species (yellow-nosed albatross, macaroni and rockhopper penguins) also being entangled. Only 1 black-browed albatross, 1 giant petrel and 8 white-chinned petrels were recorded as killed during hauls.

7.76 The actual by-catch rates have already essentially been discussed in paragraphs 7.62 and 7.63. The main points to re-emphasise are the high rate for the January/February cruise of the *Aquatic Pioneer*, the much higher rates before 1 May compared with afterwards, the much lower catch rates at night compared to day and the substantial reduction in by-catch on sets when streamer lines were set, whether at day or night.

7.77 The data on species composition of the by-catch (Table 42) are very similar to those reported in WG-FSA-97/51 with white-chinned petrel (63%; 73% if combined with unidentified petrels), grey-headed albatross (15%), giant petrels (4%) and yellow-nosed albatross (1%) the main species involved. All albatrosses were caught during the day; white-chinned petrel by-catch was fairly evenly divided between day and night.

7.78 Because observer coverage was 100% on virtually all cruises it is straightforward to estimate the total seabird mortality by species for the subareas during the 1996/97 year (Table 43). This results in an estimated overall total of 879 seabirds killed, including 202 albatrosses (23%), 34 giant petrels (4%) and 551 white-chinned petrels (63%) (638 (73%) if unidentified petrels are included.

7.79 Prof. Duhamel reported on results from an experimental longline fishing cruise by the *Anyo Maru 22* within the Crozet Islands EEZ in Subarea 58.6 between December 1996 and April 1997. In 219 sets (865 260 hooks), all at night, all with 100% observation and all but one with CCAMLR streamer lines, only 27 seabirds (26 white-chinned petrels, 1 grey-headed albatross) were caught, a catch rate of 0.031 birds per thousand hooks (Table 39).

General

7.80 The catch rates recorded by observers are likely to underestimate the true seabird by-catch for at least two reasons. First, a proportion of birds caught during setting would not be recovered at the haul. In some tuna longline fisheries this difference has been estimated at

27% (WG-IMALF-94/6). The only value available to CCAMLR from this year's data is 11%, representing the failure to recover nine grey-headed albatrosses observed killed at one set on the *Garoya* (see Boix, observer report).

7.81 Second, especially where automatic baiting machines are in use, a proportion of hooks set are not baited and therefore are not 'available' to catch birds. In Subarea 48.3, because the Spanish method of longlining is prevalent, this would result in a less than 1% difference in overall seabird by-catch rates. In Subareas 58.6 and 58.7, however, where autoliners are used extensively, baiting efficiency was in the range 60 to 85%, depending on vessel (Table 39) and therefore the seabird by-catch rate would be underestimated by 15 to 40% for the vessels concerned.

7.82 The Working Group noted that extensive information was now available on the relationship between the presence and by-catch of seabirds in relation to time of year. The overall relationship between seabird by-catch and fishing effort in relation to data is shown for Subarea 48.3 in Figure 11 and for Subareas 58.6 and 58.7 in Figure 12. Typical data on abundance of albatrosses in the vicinity of longline vessels in relation to date for Subareas 48.3 and 58.6 and 58.7 are shown in Figures 13 and 14.

7.83 All of these data, and many comments and observer reports, testify to the scarcity of albatrosses (except wandering albatross) and white-chinned petrels after late April. Recalling the discussion last year (SC-CAMLR-XV, Annex 5, paragraph 7.71) on the merits of delaying the start of the longline fishing season for *D. eleginoides* until 1 May, the catch rates of seabirds in March/April and May to August were calculated (Table 48). These data indicate the major difference (of more than two and one orders of magnitude respectively) between night and day by-catch rates in the two periods.

7.84 The Working Group recommended delaying the start of the longline fishing season in the Convention Area until 1 May in order to achieve a significant reduction in incidental mortality of seabirds.

Estimated Seabird By-catch in Unregulated Fisheries

7.85 At the meeting, WG-FSA requested members of WG-IMALF to estimate the levels of seabird by-catch that might be associated with the unregulated longline fisheries in the Convention Area in 1996/97.

7.86 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, information from the regulated fishery and estimates of total catch from the unregulated fishery have been used (Appendix D).

Seabird By-catch

7.87 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 higher than in the regulated fishery. However, it should be noted that the worst case catch rate used is 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.

Unregulated Effort

7.88 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.

Subarea 48.3

7.89 Appendix D identified no catch from unregulated fishing in this subarea this year, so no estimate of unregulated seabird by-catch is necessary.

Subareas 58.6 and 58.7

7.90 For this fishery, the year has been divided into two seasons, a summer season (September–April) and a winter season (May–August), corresponding to the periods with substantially different bird by-catch rates. Two sources of fish catch rates are available. The first is from the 'French survey' in Subarea 58.6 as used in the GLM and includes data from December 1996 to April 1997. The other is from South African data in SC-CAMLR-XVI/BG/28 and provides estimates from October 1996 to June 1997 inclusive (i.e. including two months of data for the winter period). The seabird catch rates used have been taken from Table 38 and Table 1 of WG-FSA-97/51. The results are shown in Table 49.

Divisions 58.5.1 and 58.5.2

7.91 For the fishery in these areas there is no breakdown available of the estimated distribution of the unregulated catch against time and very few data on seabird by-catch rates from the regulated fishery. If we assume that the fishery in these areas follows an identical pattern to those in Subareas 58.6 and 58.7 then, on the basis of the estimated unregulated

catch of 9 200 to 14 000 tonnes (Appendix D, Table D.4), and using the data from SC-CAMLR-XVI/BG/28, the seabird by-catch totals would be as follows.

Unregulated Catch	Total Numbers of Seabirds in By-catch	
	Mean	Maximum
9 200 tonnes	8 006	19 727
14 200 tonnes	12 359	30 448

7.92 It was emphasised that the values in paragraph 7.91 are very rough estimates (with potentially large errors). A more thorough analysis should be conducted, including attempts to estimate error and confidence bounds. The present estimate should only be taken as indicative of the potential levels of seabird mortality prevailing in the area due to unregulated fishing and should be treated with caution.

General

7.93 The Working Group noted that the estimate of by-catch in unregulated fisheries around the Prince Edward Islands is, at a conservative view, more than double the estimate made in WG-FSA-97/51. This is probably because CCAMLR has been able to make more accurate estimates of the catch rates in the unregulated *D. eleginoides* fishery.

7.94 The total estimated by-catch of seabirds in the unregulated fishery is at least one order of magnitude greater than that estimated for the regulated fishery in the same areas.

7.95 The Working Group noted that, as already indicated in WG-FSA-97/51, these by-catch rates for albatrosses and petrels are totally unsustainable for the populations concerned.

7.96 These levels of seabird by-catch – including of several globally threatened species – were viewed with the greatest concern by the Working Group. It recommended that these concerns should form the basis of the strongest representation to the Members of CCAMLR and other countries responsible for the unregulated fishing.

7.97 Dr Miller indicated that, in his view, the maintenance of a regulated fishery in Subareas 58.6 and 58.7 offered a good way of minimising the activities and impact of unregulated fisheries. In response to a question, he indicated that there was good evidence of fewer observations of unregulated vessels in the Prince Edward Island EEZ when the regulated fishery was operating, than outside these times. He also indicated that other advantages of maintaining the regulated fishery included obtaining the best information on fished stocks and in obtaining data on by-catch levels of seabirds.

7.98 It was agreed that further discussion on this topic, at least under this agenda item, was probably inappropriate for WG-FSA, and would be more appropriately dealt with by the Scientific Committee and ultimately by the Commission.

Reports on Incidental Mortality of Seabirds during

Longline Fishing from Outside the Convention Area

7.99 In recognition of potential importance of incidental mortality outside the Convention Area of seabirds breeding within the area, CCAMLR has a standing request to Members for such information. The Working Group welcomed the data supplied below by the UK, South Africa and Australia.

7.100 WG-FSA-97/21 reports that during longline fishing (involving some 300 000 hooks set) by three vessels around the Falklands/Malvinas between August 1996 and May 1997, 103 cases of incidental mortality were observed. Two records relate to seals, one unidentified, one a southern elephant seal. Of the 101 seabirds, 93 (90%) were black-browed albatross, 4 (5%) white-chinned petrel, 2 (2%) Cape petrel and one each southern giant petrel and unidentified albatross. The overall rate of incidental mortality of seabirds was 0.34 birds per thousand hooks (maximum for any set 6.96 birds per thousand hooks). If the single set when 87 birds were caught (because of lack of appropriate mitigating measures) is excluded, the average catch rate was 0.05 birds per thousand hooks.

7.101 Previously unpublished data (many tabled at CCAMLR in WG-FSA-95/21) on seabird mortality associated with the experimental longline fishery for hake off South Africa have now been published (WG-FSA-97/55). The longlines observed were set at night between October and December 1994 and caught only white-chinned petrels (a species whose breeding distribution is virtually confined to the Convention Area). The overall catch rate was 0.44 birds per thousand hooks. The fishery was estimated to kill 8 000 ± 6 400 white-chinned petrels annually.

7.102 Dr Miller indicated that a decision would be made by the end of 1997 concerning the continuation of the South African experimental longline fishery for hake. This decision would address such matters as the level of fishing effort to be deployed, as well as consideration of mitigating measures to reduce incidental mortality consistent with new national fisheries regulations currently under negotiation.

7.103 Data provided by Australia, via CCSBT-ERSWG, in WG-FSA-97/13 updates WG-FSA-96/63 by providing information on:

(i) 113 sets (20 493 hooks) by eight vessels fishing for southern bluefin tuna in the Cairns area, Queensland, from May to August 1996, where no seabird by-catch was observed; and

(ii) five sets (9 082 hooks) by one vessel off the east coast of Tasmania, where no seabird by-catch was observed.

7.104 WG-FSA-97/14 provides data on seabird by-catch from 1995 cruises in the Real Time Monitoring Program conducted by the parties to the CCSBT in order to provide data for assessments of southern bluefin tuna. The complete set of relevant data for 1995 is set out in Table 50 (vessels 4 to 8 being supplementary to data summarised in WG-FSA-96/62; see SC-CAMLR-XV, Annex 5, paragraph 7.6). The high catch rate (1.52 birds per thousand hooks) in the absence of mitigating measures (tori poles/streamer lines) is evident.

7.105 WG-FSA-97/15 provides data on the seabird by-catch from Japanese tuna longline vessels in the Australian fishing zone between April 1995 and March 1997. For 1995 (3 599

sets with 11.373 million hooks) catch rates averaged 0.10 birds per thousand hooks (range 0.00–0.20) giving an estimated total of 1 085 birds caught. For 1996 (2 058 sets with 6.348 million hooks) catch rates averaged 0.30 birds per thousand hooks (range 0.00–1.65) giving an estimated total of 1 503 birds. The species identity of the birds caught is under investigation.

7.106 Dr Holt enquired about the reasons for the apparent increase in seabird by-catch in the 1996 season. Dr Tuck replied that the high value for 1996 was principally due to a single cruise in the southeast Indian Ocean, in winter, when 30 birds were observed caught from nine of
12 observed sets.

7.107 WG-FSA-97/17 provides a 1997 update (see WG-FSA-96/65 and SC-CAMLR-XV, Annex 5, paragraph 7.59 for a comprehensive review) of trends in tuna longline fisheries in the Southern Ocean and implications for seabird by-catch. The paper concludes that:

(i) there has been a marked reduction in Japanese longline effort in the Southern Ocean in recent years. The effort in 1995 is about 52% of the 1986 level. There have also been major contractions and shifts in the spatial extent of the Japanese fishery;

(ii) there has been a seasonal contraction in Japanese fishing effort to the second and third quarters (May–September). In 1994, 91% of the effort occurred in these two quarters;

(iii) the size of the Japanese longline fishery in relationship to other longline tuna fisheries (primarily Taiwanese) has been declining markedly, both in absolute and relative terms. Japanese effort in 1994 constituted less than 33% of the estimated tuna longline effort below 30°S; and

(iv) reported effort by Taiwanese vessels fishing south of 30°S has increased rapidly and markedly since 1990. The reliability of the reported effort needs to be assessed as the current levels of effort, if accurate, would be expected to result in substantial incidental takes of seabirds. However, there is no direct information on seabird by-catch rates for this fleet.

7.108 The paper also notes that in addition to the Japanese and Taiwanese longline fisheries, there are a number of other tuna longline fleets/fisheries in the southern oceans. These include:

(i) Korean longline vessels (traditionally targeting albacore);

(ii) Australian domestic vessels (traditionally targeting yellowfin tuna but recently expanding to include southern bluefin tuna, bigeye and swordfish);

(iii) New Zealand domestic vessels;

(iv) Spanish longline vessels (targeting swordfish);

(v) domestic longline fleets in South America (e.g. Brazil and Uruguay); and

(vi) Taiwanese and Japanese joint ventures with various South American countries.

For most of these fleets/fisheries, there is little readily accessible and reliable information on either fishing effort or seabird by-catch rates. Total by-catch from all of these sources, however, could be significant and by-catch from some sources may be important for specific populations of seabirds.

7.109 WG-FSA-97/17 concluded that, given the magnitude of the reported effort by Taiwanese vessels in the Southern Ocean in recent years, any assessment of the current and future impact of tuna longlining on seabird populations will need to account for the incidental takes by these vessels. Also, the by-catch from the other tuna longline fleets listed above will be important to take into account in any assessment, particularly since a number of these are expanding, because of the high catch rates that have been reported in some of them and because of the potential proximity to foraging areas of breeding seabirds. Improved information on fishing effort and direct observations on by-catch rates are needed from all of these fisheries.

7.110 WG-FSA-97/16 reports GLM analysis of the effects of environmental factors and the use of mitigating measures on the by-catch rate of seabirds by Japanese longline vessels fishing for tuna in the Australian region between April 1992 and March 1995. The variables included were year, time of capture (night, day), moon phase (full, new), area (southeast Australia, Tasmania, South Australia, southeast Indian Ocean), season (winter (April–September), summer (October–March)), wind, cloud, sea (all high, medium, low), use of tori pole during setting (yes, no), condition of bait (not, partly or well thawed), use of bait thrower during setting (yes, no). The overall dataset comprised 2 291 sets, involving 3.257 million hooks (32.5% set at night) and a by-catch of 577 birds (78% albatrosses) at an average rate of 0.18 birds per thousand hooks. The results from the GLM indicate that the environmental factors which most affect seabird catch rates are time of day (day/night sets), area fished and season fished. Of less importance but still significant is an interaction between time of day and moon phase. Effects which were not significant are year, moon phase alone, area/season interactions, wind, cloud, sea conditions and individual vessels. The strong interaction between day and moon phase would be expected if light levels were a primary factor affecting by-catch rates. The probability of capture of a bird is substantially greater in summer than in winter. Catch rates were highest in southern Australia and lowest in the southeast Indian Ocean (though data were fewest for this area). The lowest catch rate of seabirds is produced by a new moon at night, with higher catches at night during full moon and highest of all during the day, whether the moon is full or not. For hooks set at night there was a reduction of 91% in by-catch compared to hooks set during the day; during new moon the night by-catch was 98% less than the daytime rate. There were insufficient sets made without tori poles to investigate their effectiveness.

7.111 Overall, the most important factor affecting by-catch rates of seabirds in southern Australian waters is whether the longline is set during the night or day. If the prime objective of the fishing fleet was to avoid catching birds, then only setting lines at night would be the most effective strategy of the mitigation measures examined. However, maximising the value of the fish catches within operational and management constraints is most likely the highest priority for the vessels. From observer data, the average time to complete a set in winter at 43°S is 5 hours and 15 minutes. Therefore, with six hours of darkness at this time, it is possible to complete setting entirely at night in any stratum within the Australian region

without adversely constraining the amount of time available for setting the longline.

7.112 The data on catch rates of southern bluefin tuna suggests that there is little difference between sets commenced at night, early in the morning or later in the day during winter. In summer there are indications that the catch rate decreased for sets which commence between 0300 and 0500 h local time (nautical twilight at 0300 h), and then increased until 0700 h. There were insufficient data to assess catch rates on sets wholly at night.

7.113 The Working Group noted that, although these results on seabird by-catch relate to a pelagic longline fishery for tuna in waters to the north of the Convention Area, it is probably not unrealistic to expect the results to have more general application. Indeed, these results are not dissimilar to those obtained by Moreno et al. (1996), who showed that distance from land, lunar phase, use of streamer lines and hook size were important sources of variation in seabird by-catch rates. It is not clear the extent to which diel variation in catch rates of tuna might be relevant to catch rates of *Dissostichus* spp.

7.114 Dr Kock enquired whether the data from *Dissostichus* spp. longline fisheries submitted to CCAMLR would enable similar analyses to be undertaken. In response it was indicated that at present there were probably insufficient data for a comprehensive analysis. However, in theory, the data from CCAMLR observers should include all appropriate information on environmental and biological variables. The greatest difficulty was likely to be whether records of the use of streamer had been made systematically on a per set basis (see paragraph 7.71). Scientific observers were encouraged to ensure that such records were always made in future.

7.115 It was recollected that New Zealand scientists had attempted to conduct similar analyses of data from longline fisheries in their area. The Working Group encouraged the submission to it of reports of the results of this analysis.

7.116 The Working Group thanked CCSBT-ERSWG for encouraging the preparation of these important papers and for allowing them to be tabled at WG-FSA.

7.117 In WG-FSA-97/52 the year-round foraging movements of shy albatrosses breeding at two sites off Tasmania were determined by satellite telemetry in order to assess potential levels of interaction with longline fisheries for tuna. It was concluded that the recent contraction of the Japanese southern bluefin tuna longline fishery to the south and east coasts of Tasmania has resulted in extensive overlap with adult shy albatrosses from Pedra Branca, but appears to pose a minimal threat to adult birds from Albatross Island. Coupled with the concomitant increase in the Australian domestic tuna longline fishing industry, adult shy albatrosses from southern Tasmania (Pedra Branca and the Mewstone) are vulnerable to incidental capture throughout their annual cycle.

Assessment of Incidental Mortality in Relation to New and Exploratory Fisheries

7.118 Last year, amongst the concerns raised relating to the numerous proposals for new fisheries and the potential rapid and widespread development of exploratory fisheries, was the potential for substantial increases in seabird incidental mortality.

7.119 The need was noted for data to provide advice on known and potential interactions with seabirds, relating to the:

(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.

7.120 Relevant information was solicited from Members intersessionally. At this meeting, in addition to basic general reference material on the breeding and at-sea distribution of Southern Ocean seabirds, more specific information was available on breeding, distribution and population sizes of albatrosses and petrels in WG-FSA-97/22, 97/23, 97/28 and on at-sea distribution from satellite-tracking studies in WG-FSA-97/8 and 97/56. The species particularly at risk were assumed to be all species of albatross, both species of giant petrel and *Procellaria* petrels (in the Convention Area white-chinned petrel, *P. aequinoctialis* and, in some areas, grey petrel, *P. cinerea*).

7.121 The estimates of site-specific breeding populations and of total world breeding populations are principally derived from WG-FSA-97/22 and 97/28, together with data summarised in Croxall et al. (1984) and Marchant and Higgins (1990).

7.122 In the assessments that follow, known potential for interaction was based exclusively on the known ranges of breeding birds determined by recent satellite-tracking studies. These are, therefore, minimum estimates of the home range of breeding populations. Within the Convention Area there have been no recent satellite-tracking studies of giant petrels. The only such data for white-chinned petrels are currently unpublished; there are no data for grey petrels.

Inferred potential for interaction is based on:

(i) ranges for breeding populations analogous to those determined by satellite-tracking at other breeding sites; and

(ii) at-sea distributions derived from seabird at-sea sightings during the breeding season as published in distribution atlases.

7.123 To assess distributions outside the breeding season, Tickell (1993) was used for albatrosses and Marchant and Higgins (1990) for giant petrels, white-chinned petrel and grey petrel. For the areas under review (see paragraph 7.124 below), the distributions are as follows:

wandering albatross	all, but only northern part of Subareas 88.1, 88.2, 88.3
royal albatross	Subareas 58.5, 58.7; northeastern part of Subarea 48.1; western part of Subarea 48.2
black-browed albatross	all, but only northeast part of Subareas 48.6, 88.1; rare in Division 58.4.4 and southern part of Subarea 88.3; virtually absent in Subarea 88.2

grey-headed albatross	all, but only northern part of Subarea 48.6; rare Subarea 88.2
yellow-nosed albatross	Subareas 58.5, 58.7
shy albatross	Division 58.4.3, Subarea 58.6
sooty albatross	Division 58.4.4, Subareas 58.6, 58.7
light-mantled sooty albatross	all, but only northern part of Subarea 88.2
Amsterdam albatross	no data
Antipodean albatross	no data
southern giant petrel	all
northern giant petrel	all, but only northern half of Subareas 48.1, 48.2, 48.6, 88.1, 88.2, 88.3
white-chinned petrel	all, but only northeast half of Subareas 88.1, 88.2; only extreme north of Subareas 48.1, 48.2, 48.6, 88.3
grey petrel	all except Subareas 48.1, 48.2, 48.4; but only northern part of Subareas 48.6, 88.1, 88.2, 88.3

7.124 Assessments were made against a five-point scale of potential risk of interaction between seabirds, especially albatrosses, and longline fisheries. The five levels are: low; average-to-low; average; average-to-high; high.

7.125 The advice section is based purely on consideration of reducing seabird by-catch by vessels operating under CCAMLR regulations.

7.126 The areas considered were those where proposals for new and exploratory fisheries were received by CCAMLR in 1996 and 1997: viz

Subarea 48.1	(Chile, Uruguay)
Subarea 48.2	(Chile, Uruguay)
Subarea 48.4	(Uruguay)
Subarea 48.6	(Norway, South Africa)
Subarea 58.6	(South Africa, Ukraine, Russia)
Subarea 58.7	(South Africa, Ukraine, Russia)
Division 58.4.3	(Australia, South Africa)
Division 58.4.4	(South Africa, Ukraine)
Division 58.5.2	(Australia)
Subarea 88.1	(New Zealand)
Subarea 88.2	(New Zealand)
Subarea 88.3	(Chile)

(i) Subarea 48.1:

Breeding species in area: southern giant petrel (c. 7 000 pairs; 20% world population)

Breeding species known to visit area: wandering albatross, grey-headed albatross from South Georgia

Breeding species inferred to visit area: black-browed albatross from South Georgia, Chile, Falklands/Malvinas; grey-headed albatross from Chile; southern giant petrel from Chile, Argentina, Falklands/Malvinas; white-chinned petrel from South Georgia.

Assessment: potential interactions with substantial fraction of southern giant petrel population and a small proportion of populations of three albatross species (two threatened, one near-threatened), most notably grey-headed albatross from both of its two main breeding sites, and white-chinned petrel.

Advice: average risk; prohibit longline fishing during the breeding season of black-browed and grey-headed albatrosses, southern giant petrel and white-chinned petrel (i.e. September–April); maintain all elements of Conservation Measure 29/XV.

(ii) Subarea 48.2:

Breeding species in area: southern giant petrel (c. 9 000 pairs; 26% world population).

Breeding species known to visit area: grey-headed albatross, black-browed albatross from South Georgia.

Breeding species inferred to visit area: white-chinned petrel from South Georgia.

Assessment: potential interactions with an important fraction of the southern giant petrel population and a small proportion of the population of two albatross species (one threatened, one near-threatened) and white-chinned petrel.

Advice: average-to-low risk; avoid longline fishing during the breeding season of southern giant petrel (October–March); maintain all elements of Conservation Measure 29/XV.

(iii) Subarea 48.4:

Breeding species in area: southern giant petrel (c. 800 pairs; 2% world population).

Breeding species known to visit area: none.

Breeding species inferred to visit area: wandering albatross, black-browed albatross, light-mantled sooty albatross, northern giant petrel, white-chinned

petrel from South Georgia (see Ashford et al., 1994).

Assessment: little known/visited area so potential interactions probably underestimated. Nevertheless area, and especially shelf and shelf-slope, is small.

Advice: low risk (see also Ashford et al., 1994); avoid longline fishing during the breeding season of southern giant petrel (October–March); maintain all elements of Conservation Measure 29/XV.

(iv) Subarea 48.6:

Breeding species in area: southern giant petrel (until c. 1981).

Breeding species known to visit area: none.

Breeding species inferred to visit area: wandering albatross, light-mantled sooty albatross from Prince Edward Islands.

Assessment: relatively poorly-known area in terms of visiting species. Its very large area, however, suggests interaction potential is probably underestimated.

Advice: low risk; no obvious need for restriction of longline fishing season; applying Conservation Measure 29/XV would be sensible as a precautionary measure until better data are available.

(v) Division 58.4.3:

Breeding species in area: none.

Breeding species known to visit area: wandering albatross from Crozet Islands.

Breeding species inferred to visit area: black-browed albatross, light-mantled sooty albatross, southern giant petrel from Heard/Macdonald Islands; grey-headed albatross, black-browed albatross, light-mantled sooty albatross, northern giant petrel, white-chinned petrel, grey petrel from Kerguelen; white-chinned petrel, grey petrel from Crozet Islands.

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 (perhaps average-to-high) risk; prohibit longline fishing during the breeding season of albatrosses, giant petrels and white-chinned petrels (September–April); maintain all elements of Conservation Measure 29/XV.

(vi) Division 58.4.4:

Breeding species in area: none.

Breeding species known to visit area: wandering albatross, light-mantled sooty albatross from Crozet.

Breeding species inferred to visit area: grey-headed albatross, yellow-nosed albatross, southern giant petrel, white-chinned petrel, grey petrel from Crozet; wandering albatross, grey-headed albatross, yellow-nosed albatross, light-mantled sooty albatross, southern giant petrel, white-chinned petrel, grey petrel from Prince Edward Islands.

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 (perhaps average-to-high) risk; prohibit longline fishing during the main breeding season albatrosses and petrels (September–April); maintain all elements of Conservation Measure 29/XV.

(vii) Division 58.5.2:

Breeding species in area: black-browed albatross (750 pairs; 0.1% world population), light-mantled sooty albatross (c. 350 pairs; 1.5% world population), southern giant petrel (2 350 pairs; 7% world population) at Heard/McDonald Islands.

Breeding species known to visit area: wandering albatrosses from Crozet; black-browed albatrosses from Kerguelen; Amsterdam albatross from Amsterdam Island.

Breeding species inferred to visit area: all species breeding at Heard/McDonald Islands; wandering albatross, grey-headed albatross, yellow-nosed albatross, sooty albatross, light-mantled sooty albatross, northern giant petrel, white-chinned petrel from Kerguelen; yellow-nosed albatross from Amsterdam Island.

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 Island.

Advice: average-to-high risk; prohibit longline fishing within the breeding season of the main albatross and petrel species (September–April). Ensure strict compliance with Conservation Measure 29/XV.

It was noted that longline fishing is currently prohibited within the EEZ around Heard/McDonald Islands.

(viii) Subarea 58.6:

Breeding species in area: wandering albatross (1 730 pairs; 20% world population), grey-headed albatross (5 950 pairs; 6% world population), black-browed albatross (1 000 pairs; 0.1% world population), Salvin's albatross (4 pairs), Indian yellow-nosed albatross (4 500 pairs; 12% world population), sooty albatross (1 200 pairs; 8% world population), light-mantled sooty albatross (2 200 pairs; 10% world population), southern giant petrel (1 000 pairs; 3% world population), northern giant petrel (1 300 pairs; 13% world population), white-chinned petrel (100 000+ pairs; world's second most important site), grey petrel (thousands of pairs) at Crozet Islands.

Breeding species known to visit area: wandering albatross, sooty albatross, light-mantled sooty albatross from Crozet Islands.

Breeding species inferred to visit area: in addition to all the Crozet Islands breeding species, wandering albatross from Prince Edward Islands and Kerguelen; black-browed, yellow-nosed, sooty, light-mantled sooty albatrosses, northern giant petrel, southern giant petrel, white-chinned petrel, grey petrel from the Prince Edward Islands; grey-headed albatross, white-chinned petrel, grey petrel from Kerguelen.

Assessment: known (see paragraphs 7.65 to 7.79) 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 petrels and 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. September–April); ensure strict compliance with Conservation Measure 29/XV.

(ix) Subarea 58.7:

Breeding species in area: wandering albatross (3 070 pairs, 36% world population – most important site), grey-headed albatross (7 720 pairs; 8% world population), yellow-nosed albatross (7 000 pairs; 19% world population), sooty albatross (2 750 pairs; 18% world population), light-mantled sooty albatross (240 pairs; 1% world population), southern giant petrel (1 750 pairs; 5% world population), northern giant petrel (500 pairs; 5% world population), white-chinned petrel (10 000+ pairs), grey petrel (thousands of pairs) at Prince Edward Islands.

Breeding species known to visit area: wandering albatrosses from Crozet

Islands.

Breeding species inferred to visit area: all species breeding at the Prince Edward Islands; grey-headed albatross, black-browed albatross, yellow-nosed albatross, southern giant petrel, northern giant petrel, white-chinned petrel, grey petrel from Crozet Islands.

Assessment: known (see paragraphs 7.65 to 7.79) 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.
Advice: high risk; prohibit longline fishing during the main albatross and petrel breeding season (September–April); ensure strict compliance with Conservation Measure 29/XV.

(x) Subarea 88.1:

Breeding species in area: none.

Breeding species known to visit area: Antipodean albatross from Antipodes Island, light-mantled sooty albatross from Macquarie Island.

Breeding species inferred to visit area: light-mantled sooty albatross from Auckland, Campbell and Antipodes Islands; grey-headed albatross from Campbell Island; wandering albatross from Macquarie Island.

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.

Advice: average risk; longline fishing season limits of uncertain advantage; the provisions of Conservation Measure 29/XV should be strictly adhered to.

It was noted that New Zealand had undertaken some longline fishing in this subarea in 1997, using a vessel with an underwater setting system (see paragraphs 7.143 to 7.146).

(xi) Subarea 88.2:

Breeding species in area: none.

Breeding species known to visit area: none.

Breeding species inferred to visit area: none.

Assessment: few relevant data but unlikely that many at-risk albatross and petrel species forage extensively in this area.

Advice: low risk; restrictions on timing of longline fishery probably inappropriate. Conservation Measure 29/XV should be applied as a precautionary measure, at least until better data have been acquired.

(xii) Subarea 88.3:

Breeding species in area: none.

Breeding species known to visit area: grey-headed albatross from South Georgia.

Breeding species inferred to visit area: grey-headed albatross from Chile.

Assessment: few relevant data from most of this large area. In the regions closer to the Antarctic Peninsula/South America there is considerable potential for interactions with albatrosses.

Advice: low risk; restrictions on timing of longline fishery probably inappropriate. Apply Conservation Measure 29/XV, at least until further data on seabird-fishery interactions are available.

7.127 For the purpose of comparison, similar assessments for the two areas with established longline fisheries for *D. eleginoides*, viz Subarea 48.3 (South Georgia) and Division 58.5.1 (Kerguelen) are presented below.

(i) Subarea 48.3:

Breeding species in area: wandering albatross (2 178 pairs; 26% world population – second most important site), grey-headed albatross (54 200 pairs; 59% world population), black-browed albatross (96 252 pairs; 14% world population – second most important site), light-mantled sooty albatross (c. 6 250 pairs; 29% world population – most important site), southern giant petrel (5 000 pairs; 15% world population), northern giant petrel (3 000 pairs; 28% world population – most important site), white-chinned petrel (c. 2 million pairs; perhaps 80% of world population) at South Georgia.

Breeding species known to visit area: wandering albatross, grey-headed albatross, black-browed albatross, light-mantled sooty albatross, white-chinned petrel from South Georgia.

Breeding species inferred to visit area: the remaining South Georgia breeding species.

Assessment: known interactions with four species of albatross (two threatened, one near-threatened), both species of giant petrel and white-chinned petrel,

South Georgia being the world's most important breeding site for four of these.

Advice: high risk; prohibit longline fishing during the main albatross and petrel breeding season (i.e. September–April); ensure strict compliance with Conservation Measure 29/XV.

(ii) Division 58.5.1:

Breeding species in area: wandering albatross (1 455 pairs; 17% world population), grey-headed albatross (7 900 pairs; 9% world population), black-browed albatross (3 115 pairs; 0.5% world population), yellow-nosed albatross (50 pairs; 0.1% world population), sooty albatross (c. 5 pairs), light-mantled sooty albatross (c. 4 000 pairs; 19% world population), northern giant petrel (1 800 pairs; 17% world population), white-chinned petrel (100 000+ pairs – second most important site), grey petrel (5 000–10 000 pairs) at Kerguelen.

Breeding species known to visit area: wandering albatross from Crozet Islands, black-browed albatross from Kerguelen, Amsterdam albatross from Amsterdam Island.

Breeding species inferred to visit area: all the remaining species breeding at Kerguelen; most, if not all, species breeding at Heard/McDonald Islands; many species breeding at Crozet Islands.

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. September–April); ensure strict compliance with Conservation Measure 29/XV.

7.128 It was re-emphasised that the advice presented relating to fishing season and to the application of Conservation Measure 29/XV was solely based on reducing by-catch of seabirds by vessels operating within the CCAMLR regulations. This advice did not, therefore, take into account other potential considerations, such as fishing operational considerations or measures to combat unregulated fishing.

7.129 Dr Miller noted that other mechanisms for protecting seabirds from longline by-catch should also be considered, such as no-fishing zones around breeding islands, following the example of the French EEZ around the Crozet Islands.

7.130 Dr Miller also noted that significant incidental mortality of seabirds breeding in the Convention Area is likely to be occurring in areas immediately to the north of the Convention Area, especially adjacent to Subareas 48.3 and 48.6, Division 58.5.1, and Subareas 58.6, 58.7 and 88.1. It was agreed that CCAMLR should urge those responsible for regulating longline

fishing in these areas to adopt the provisions of Conservation Measure 29/XV and to consider restricting fishing to the time of year outside the main breeding season of albatross and petrels (September–April).

7.131 The Working Group advised the Scientific Committee that consideration of other elements relating to the management of new and exploratory fisheries is to be found in paragraphs 4.1 to 4.134. The Working Group had insufficient time to attempt to reconcile the management advice from these two sources.

Research into, and Experience with, Mitigating Measures

Tori Poles/Streamer Lines

7.132 Many reports of scientific observers in 1997 indicate difficulties in the use of streamer lines. These problems include:

(i) refusal of captain/fishing master to allow their deployment;

(ii) lack of materials to construct (or repair) appropriate streamer lines (especially line too short, no swivels);

(iii) entanglement of streamer line(s) with fishing line (especially with vessels using the Spanish double-line system);

(iv) loss of streamer lines in bad weather; and

(v) streamer lines ineffective when longline is set at an angle to the wind.

7.133 Many of the difficulties experienced probably resulted from the inappropriate construction and deployment of the streamer line. Most of these kinds of problems were discussed in detail in WG-FSA-95/58 which was the basis for much of the advice provided in the CCAMLR booklet *Fish the Sea Not the Sky*. The Working Group noted that it is essential that all scientific observers on longline vessels be familiar with the appropriate construction and deployment of streamer lines and associated mitigating measures. Members should also take all possible steps to ensure that fishing companies and especially fishing captains and masters are also fully familiar with the contents of this guide.

7.134 There was increasing evidence that streamer lines, if properly constructed and deployed and used in conjunction with other appropriate mitigating measures, provided significant reductions in seabird by-catch (e.g. paragraphs 7.71 and 7.78). Accordingly, the Working Group agreed that it was now a lower priority to test new or modified types of streamer line than to ensure that the existing design is deployed correctly.

7.135 In future, proposals to investigate the efficacy of existing or new types of streamer line should be accompanied by detailed research plans and submitted to the Working Group for comment in advance of the proposed field study. It may be appropriate to review footnote 6 of Conservation Measure 29/XV in the light of this advice.

Acoustic Scarers

7.136 Several scientific observers reported the use of sound cannons (e.g. Boix on *Garoya*) or other ad hoc sound scaring devices (e.g. Heinecken on *Koryo Maru No. 11*) especially during hauling operations. All reports indicated that albatrosses were either unaffected, or only briefly discouraged, by these devices but that they were much more effective in scaring giant and white-chinned petrels.

Bait

7.137 In response to the intersessional request from the Secretariat, Dr G. Robertson (Australia) reported (WG-FSA-97/57) that in June 1997 the Australian Antarctic Division conducted at-sea experiments on the sink rates of bait used in the Japanese longline tuna fishery off Tasmania. Factors tested were sea condition (two types), bait type (two types), bait thaw status (two types) and distance (lateral) bait was deployed from the ship propeller (three types). The experimental variable was sink rate. Among other things the experiment seeks to determine the optimal distance from the ship bait should be deployed to maximise sink rate (and hence where the bird scaring streamer line should be situated), whether it is necessary to thaw bait completely and whether or not bait thaw status is overridden by sea condition. Further experimental work will be conducted by the Division in a *Dissostichus* spp. longline fishery in December 1997. Results will be made available when time permits analysis of the data.

7.138 WG-FSA-97/24 describes recent experiences in the North Sea using artificial baits (based on waste fish and offal mixture). The advantages of these baits are deemed to include:

(i) higher percentage of hooks baited (because the cylindrical bait sausage passes perfectly through the baiting machine);

(ii) better selectivity in respect of target fish species; and

(iii) bait structure being excellent for long soak times.

7.139 Artificial bait had been supplied by Mustad to an autoliner targeting *D. eleginoides* (WG-FSA-97/57). The Secretariat was requested to contact Mustad to obtain further details.

7.140 The Working Group encouraged Members to carry out studies comparing the performance of artificial and natural baits especially in relation to their attractiveness to seabirds.

Weights

7.141 Many reports of scientific observers indicated or suggested that the fishing line carried insufficient weight to sink at an appropriate speed; therefore it was exposed to bait loss from seabirds (and the seabirds to incidental mortality) for much longer than necessary or desirable. In some cases observers reported that adding extra weights rectified the matter. It is vital that longlines carry enough weight to sink as quickly as possible, therefore avoiding

bait loss and seabird by-catch and enhancing fishing efficiency.

Underwater Setting

7.142 Information on the Mustad underwater setting tube for longlines is contained in WG-FSA-97/24 (see also SC-CAMLR-XV, Annex 5, paragraph 7.24). A study of the performance of this device in relation to seabird by-catch is to be undertaken in the North Sea by a collaboration between the Norwegian Ornithological Society and the Royal Society for the Protection of Birds (UK) in October 1997. Results will be made available to CCAMLR in due course.

7.143 Two papers had been submitted on the developments in New Zealand of underwater setting devices designed to be suitable for use on domestic pelagic longline vessels (see SC-CAMLR-XV, Annex 5, paragraph 7.23). WG-FSA-97/53 gives details of trials of U-tube devices, the back-facing one of which successfully flushed baits to the required 3 m depth. Further study is deemed necessary to test the device under commercial operating conditions and to assess its effectiveness in avoiding by-catch of seabirds.

7.144 WG-FSA-97/54 reports trials of a towed depth-set paravane and of a capsule transporting the baited snood. Retrieval of the paravane and its associated endless cable proved too difficult and development was discontinued. Sea trials of the transporting capsule provided 100% successful bait release. The trials suggested various modifications which would further improve performance.

7.145 The Working Group thanked New Zealand for providing this information and for its initiative in commissioning this work. Further development of the two devices would seem highly worthwhile, in conjunction with observations to determine their efficacy in avoiding seabird by-catch and their performance under commercial operating conditions.

7.146 It was understood that the *Lord Auckland* (longline fishing in Subareas 88.1 and 88.2) and one Argentinian vessel had used underwater setting devices in the 1997 fishing season. No reports on experiences with these devices had yet been received. The Working Group strongly encouraged Members to supply appropriate information to CCAMLR as soon as possible.

Implications for Conservation Measure 29/XV

7.147 No submission had been received to indicate a need to revise any element of Conservation Measure 29/XV this year. However, it was felt that the footnote concerning the appropriate amount and spacing of weights might usefully be re-examined, in view of the problems experienced (see paragraph 7.137). Footnote 6 (concerning testing streamer lines) may also need reviewing (see paragraph 7.135).

Advice to the Scientific Committee

7.148 The Scientific Committee was requested to note the following recommendations/advice.

General

(i) Suggested revisions to the *Scientific Observers Manual* (paragraphs 7.6 and 7.9).

(ii) Circulation of the booklet *Fish the Sea Not the Sky* (paragraph 7.11), publicising its existence (paragraph 7.12) and the request for feedback from scientific observers on its availability and utility (paragraph 7.9).

(iii) Continuation of collaboration with CCSBT-ERSWG (paragraph 7.15) and the agreement to the request of CCSBT for access to data on longline fishing effort (paragraph 7.14).

(iv) Request for information on monitoring programs for seabirds particularly at risk from longline fishing from France (paragraph 7.18), further information from New Zealand (paragraph 7.20) and for regular updates on their studies from all Members (paragraph 7.24).

(v) Addition to CMS Appendices 1 and 2 of one and 12 species of albatross respectively, and the forthcoming classification on the IUCN Red List as Threatened, Near-threatened and Data Deficient of five, one and one species of albatross respectively, together with potential future obligations on and opportunities for Members of CCAMLR with range state responsibilities for these taxa (paragraphs 7.26 to 7.30).

(vi) Contact with Secretariats of CMS and CBD (paragraphs 7.31 and 7.32).

Data on Incidental Mortality of Seabirds during Longline Fishing in the Convention Area

(vii) Intersessional improvement to the analysis and conclusions from the 1996 data had been impossible because few additional relevant data had been submitted (paragraphs 7.33 to 7.36).

(viii) Substantial improvements in the quality and quantity of data submitted for 1997 and in the quality of the reports of scientific observers (paragraphs 7.38 and 7.40).

(ix) Late submission of data still causing major problems for analysis prior to and during WG-FSA (paragraphs 7.39, 7.41 to 7.43) and implications for intersessional work (paragraph 7.44).

(x) Results from 1997 data from Subarea 48.3 (paragraphs 7.45 to 7.58) indicate:

(a) in respect of compliance with Conservation Measure 29/XV:

- much improvement in night-time settings;
- poor compliance with requirement to use streamer lines;
- poor compliance with requirement on location of discharge of offal during haul;

(b) rates of seabird by-catch for most cruises/vessels are broadly similar to last year, but a few cruises gave higher values;

(c) some of this seabird mortality undoubtedly reflects lack of compliance with Conservation Measure 29/XV; other elements are less easy to explain; overall the result is a higher estimated total mortality of seabirds this year (5 755) than last year (1 618); and

(d) the species involved are principally black-browed albatross (40%; mainly caught during the day and twilight) and white-chinned petrel (48%; caught both during the day and at night), the latter when use of streamer lines was minimal throughout the fishery.

(xi) Results from Division 58.5.1 (paragraphs 7.62 to 7.64) indicate seabird by-catch rate was substantially reduced once night-time setting was implemented.

(xii) Results from Subareas 58.6 (outside the waters adjacent to the Crozet Islands) and 58.7 (paragraphs 7.65 to 7.71):

(a) in respect of compliance with Conservation Measure 29/XV indicate:

- low levels (45%) of setting at night;
- much less than comprehensive use of streamer lines;
- about half the vessels discharging offal on the same side as the haul;

(b) rates of seabird by-catch average 0.289 birds per thousand hooks, probably largely reflecting the lack of compliance with Conservation Measure 29/XV;

(c) catch rates:

- at night, were an order of magnitude less than during the day (0.012 and 0.138 birds per thousand hooks respectively);

- in October to April, were 40-fold greater than in May to June (0.363 and 0.009 birds per thousand hooks respectively);

- of species other than white-chinned petrel, within 100 km of the Prince Edward Islands were six times greater than between 100 and 200 km;

(d) species mainly affected are white-chinned petrels (73%) and grey-headed/yellow-nosed albatrosses (23%) – the two albatrosses both threatened species;

(e) total estimated seabird mortality was at least 879 birds.

(xiii) Requirements for intersessional work relating to the data from scientific observers on longline vessels (paragraphs 7.42, 7.44, 7.56 and 7.60).

(xiv) By-catch rates of seabirds estimated by the Working Group are underestimates due to birds killed at the set being unrecorded at the haul and because the proportion of baited hooks set on autoline vessels is substantially less than the total hooks set (paragraphs 7.80 and 7.81).

(xv) Delay the start of the longline fishing season in the Convention Area until 1 May in order to achieve significant reduction in seabird by-catch (paragraphs 7.83 and 7.84).

(xvi) The level of seabird by-catch in the unregulated fishery for *D. eleginoides* in the Convention Area is probably at least an order of magnitude greater than that of the regulated fishery (paragraphs 7.85 to 7.94). Its impact on white-chinned petrels and albatrosses is entirely unsustainable for the populations concerned – principally those at breeding sites in the Indian Ocean (Prince Edward Islands, Crozet, Kerguelen, Heard/McDonald Islands) (paragraph 7.95). The strongest possible action by the Commission is recommended (paragraph 7.96).

Incidental Mortality of Seabirds Outside the Convention Area

(xvii) Information concerning the nature and extent of longline fishing for various fish species in the Southern Ocean, including areas adjacent to the Convention Area (paragraphs 7.107 to 7.109).

(xviii) Information on seabird by-catch outside the Convention Area, indicating that in some areas there is substantial mortality of some seabird species breeding within the Convention Area (paragraphs 7.99 to 7.117).

(xix) Results of analyses of data on seabird by-catch in longline fishing for southern bluefin tuna in relation to environmental variables and the use of mitigating measures, which are of relevance to CCAMLR (paragraph 7.110).

(xx) Encourage New Zealand to report to CCAMLR results of similar analyses (paragraph 7.115).

Incidental Mortality of Seabirds in Relation
to New and Exploratory Fisheries

(xxi) Advice on measures to minimise by-catch of seabirds in areas proposed for new and exploratory fishing (paragraph 7.126, noting also the comments in paragraphs 7.128, 7.129 and 7.131).

(xxii) The Commission should urge those responsible for regulating longline fishing in the areas immediately to the north of the Convention Area adjacent to Subareas 48.3 and 48.6, Division 58.5.1 and Subareas 58.6, 58.7 and 88.1 to adopt the provisions of Conservation Measure 29/XV and to consider restricting the fishing season (paragraph 7.130).

Research into, and Experience with, Mitigating Measures

(xxiii) Difficulties experienced by CCAMLR scientific observers in the use of streamer lines and recommendations that all scientific observers be fully familiar with the construction and deployment of streamer lines and other mitigating measures (paragraphs 7.132 and 7.133).

(xxiv) Efficacy of streamer lines (when correctly deployed), need for any future proposals to investigate streamer line performance to be based on research plans submitted beforehand to WG-FSA and possible need to review footnote 6 of Conservation Measure 29/XV (paragraphs 7.134, 7.135 and 7.147).

(xxv) Request Members to undertake studies of the performance of natural and artificial baits in relation to their attractiveness to seabirds (paragraph 7.140) and for Members using such baits to report information to CCAMLR (paragraph 7.139).

(xxvi) Importance of correct weighting of longlines (paragraph 7.141) and possible need to review footnote 3 of Conservation Measure 29/XV (paragraph 7.147).

(xxvii) Encourage New Zealand and Norway to undertake further work on the development of their devices for underwater setting of longlines (paragraphs 7.142 to 7.145) and for Members to report on their experiences in using these devices in the 1997 fishing season (paragraph 7.146).

OTHER INCIDENTAL MORTALITY

8.1 The reports of scientific observers (see Table 36) noted that three fur seals became entangled and drowned during the August cruise of the *Ercilla* in Subarea 48.3. Three other fur seals were entangled but were able to free themselves.

8.2 In Subareas 58.6 and 58.7, two sperm whales and one minke whale became entangled in longlines, but broke free (see paragraph 5.20 and Table 37).

FUTURE WORK

9.1 The Working Group identified a number of tasks which should be carried out by WG-FSA participants and the Secretariat. These tasks are summarised below. References are given to paragraphs in the report which contain details of these tasks.

9.2 The following tasks were identified for the Secretariat in general data management:

(i) include in the inventory of CCAMLR databases the assessment summaries produced by WG-FSA, and details on the data fields within each dataset

(paragraph 3.1);

(ii) develop guides covering essential data elements of each dataset, including data fields, constraints and usage (paragraph 3.2);

(iii) explore the development of interactive, web-based user's guides (paragraph 3.3);

(iv) develop a data format and procedure for handling research survey data submitted to CCAMLR (paragraphs 3.8 and 10.13);

(v) compare the output of new calculations of seabed area by depth strata with published estimates (paragraph 3.13);

(vi) develop electronic forms and formats for the submission of data, reports and meeting documents (paragraph 10.11);

(vii) consolidate and validate methodology and datasets used by WG-FSA (paragraph 10.14);

(viii) prepare tables summarising the trips conducted by scientific observers, information from their reports (paragraph 10.8);

(ix) maintain observers logbook datasets (paragraph 10.8); and

(x) prepare and circulate by 1 March 1998 a database on fish by-catch in krill fisheries for analysis by members of the ad hoc group (paragraph 5.6).

9.3 The following tasks were identified for the work of the Secretariat in stock assessment analyses and modelling:

(i) arrange for data for WG-FSA analyses from the previous split-year to be prepared as a matter of priority (paragraphs 3.7 and 10.13) – Coordinator Dr Constable;

(ii) validate GYM and prepare documentation for the next meeting of WG-FSA (paragraph 3.80);

(iii) calculate an adjustment of precautionary catch limits for *D. eleginoides* based on proportional seabed areas (paragraph 4.94);

(iv) compile all available fisheries and biological information on *D. mawsoni* (paragraph 4.107);

(v) finalise the update of C2 database for *D. eleginoides* fisheries (paragraph 4.148);

(vi) prepare for next meeting age/length keys and register of holdings of the scales and otoliths of *D. eleginoides* collected by scientific observers (paragraph 4.159) - Coordinator Dr Williams;

(vii) develop routines to extract length frequencies for *D. eleginoides* corrected for size of catch and sample size (paragraph 4.163);

(viii) continue to acquire haul-by-haul data from *D. eleginoides* fishery by Ukraine in Division 58.5.1 (paragraph 4.256);

(ix) accomplish entry of haul-by-haul data for *D. eleginoides* fishery by South Africa in Subareas 58.6 and 58.7 (paragraph 4.304);

9.4 The following tasks were identified in the work of the Secretariat on the assessment of incidental mortality of seabirds and marine mammals in longline fisheries:

(i) insert a footnote in the Longline Observation Logbook on evaluation of the use of the book *Fish the Sea Not the Sky* on board longline vessels (paragraph 7.9);

(ii) send copies of the book to fishing companies believed to be engaged in longline fishing in the Convention Area and adjacent areas (paragraph 7.11);

(iii) contact the Secretariat of the CMS, with the assistance of Dr Kock, and inform it of CCAMLR work on albatross conservation (paragraphs 7.29 and 7.31);

(iv) draw attention of the Convention on Biological Diversity to the interactions between albatrosses and longline fisheries (paragraph 7.32);

(v) encourage the adoption of provisions of Conservation Measure 29/XV for regulating fisheries in areas adjacent to the CCAMLR Convention Area (paragraph 7.130);

(vi) identify discrepancies between observers logbooks and reports (paragraph 7.42);

(vii) complete data entry for remaining cruises in Subareas 58.6 and 58.7 (paragraph 7.44); and

(viii) add to the *Scientific Observers Manual* a list of topics for which the observer should attempt to provide information (paragraph 7.40).

9.5 The Working Group requested the Secretariat to correspond with appropriate scientists and authorities in Member countries and request them to do the following:

General:

(i) supply data from existing surveys of *D. eleginoides* in Division 58.4.4 (paragraph 4.23) – Ukraine;

(ii) submit papers and carry out simulations on an adaptive fishery management based on fine-scale rectangles catch limits (paragraph 4.81);

(iii) extend current technical coordination by Members in the provision scientific observers data to encompass catch and effort data and CEMP data (paragraph 3.5);

(iv) include names of vessels in five-day, 10-day and monthly catch reports (paragraph 3.11);

(v) review data needed to monitor fisheries and conduct stock assessment, and to identify critical data and ways that would ensure their timely submission to the Secretariat (paragraph 3.10);

(vi) prepare for the *Scientific Observers Manual* an identification guide for *Dissostichus* spp. (paragraph 4.106) – Mr Williams;

(vii) prepare general instructions for observers on sampling the fish from longlines (paragraph 3.75) – Dr J. Ashford and Prof. G. Duhamel (authors of WG-FSA-97/4); and

(viii) consider conducting bottom trawl surveys of *D. eleginoides* in Subareas 58.6 and 58.7 (in order to determine biological parameters) (paragraphs 4.300 and 4.309).

Stock assessment analyses and modelling:

(i) undertake standardisation of the trawl survey time series using GLMs (paragraph 4.198);

(ii) analyse all available survey data for *C. gunnari* to investigate the possible magnitude and frequency of periodic increases of M at South Georgia (paragraph 4.209(i));

(iii) examine the potential for deriving *C. gunnari* recruitment estimates directly from trawl survey results (paragraph 4.209(ii));

(iv) examine the sensitivity of assessments of yield variations in growth parameters for *C. gunnari* (paragraph 4.209(iii)); and

(v) investigate a possibility that spawning of *D. eleginoides* occurs at a low level throughout much of the year and that the maturity ogive may depend on the time of year during which observations are made (paragraph 3.55) – Prof. Moreno and Dr Everson.

Incidental mortality of seabirds in longline fisheries:

(i) provide to the Secretariat reports on national research programs into status of albatrosses, giant petrels and white-chinned petrels (paragraphs 7.18 and 7.20) – France and New Zealand;

(ii) provide to the Secretariat regular updates on population status of albatrosses and petrels (paragraph 7.24);

(iii) provide to WG-FSA results of GLM analysis of seabird interactions with longline fisheries (paragraph 7.115) – New Zealand;

(iv) provide information on the use of underwater longline setting devices in fisheries conditions (paragraph 7.116);

(v) investigate intersessionally the optimum levels of sampling of longline hauls to ensure coverage adequate to give robust overall estimates of seabirds by-catch (paragraph 7.56);

(vi) investigate intersessionally if the distribution of observer effort matches that of fishing effort (paragraphs 7.59 and 7.60); and

(vii) undertake studies of the performance of natural and artificial bait in relation to their attractiveness to seabirds and report to CCAMLR (paragraphs 7.139 and 7.140).

9.6 As was the practice in the past, a plan of work on the incidental mortality of marine animals in fisheries (discussed under Agenda Item 7) will be considered during CCAMLR-XVI by members of the IMALF Coordinating Group. The Secretariat will report on the work of the coordinating group to the next meeting of WG-FSA.

9.7 The Working Group also identified the following tasks in the Secretariat's general support to WG-FSA meetings:

(i) continue the practice of delivering meeting documents, on request, to participant's hotels prior to the start of the meeting (paragraph 10.5);

(ii) consider the provision of adequate resources to improve the scientific content of the library (paragraph 10.6); and

(iii) apply strategic planning and consultations with key participants of the Group in order to facilitate intersessional work (paragraph 10.10).

OTHER BUSINESS

10.1 The Working Group discussed the circulation of meeting documents and CCAMLR reports, the level of support required from the Secretariat prior to, and during, WG-FSA, and other issues related to the organisation of the meeting. The discussion was held with reference to a similar discussion held during WG-EMM-97.

Meeting Documents and CCAMLR Publications

10.2 The Working Group agreed that the rules pertaining to the submission and circulation for meeting documents should be strictly enforced, and endorsed the relevant points discussed during WG-EMM. Members were reminded that documents submitted to the Secretariat one month in advance of the meeting are circulated to all Members. Papers submitted by 0900 h of the first day of the meeting should be accompanied by 40 copies, and would be circulated to participants at the meeting. Ideally, Members should submit their papers at the earliest opportunity so as to allow participants adequate time to consider papers and issues for discussion, and alleviate the workload of the Secretariat in preparing for the Commission

meetings. It was noted that papers submitted as little as one week in advance of the meeting may still be copied prior to WG-FSA, and were likely to be included in the bundles of papers.

10.3 WG-FSA supported WG-EMM's suggestion that Members and the Secretariat should be encouraged to move towards electronic submission and circulation of papers. This was seen as a logical step, and one which would eventually reduced the amount of paper used in producing the documents, and the volume of papers carried by Members to and from the meetings. Papers could be submitted electronically via email, or through the proposed CCAMLR web site. Alternatively, the Working Group discussed the possibility of circulating document abstracts prior to the meeting, and producing limited reference copies of complete papers, and agreed that this option would also reduce the volume of meeting papers copied by the Secretariat.

10.4 The Working Group noted that the current CCAMLR document distribution publication policy had resulted in a restricted circulation of CCAMLR reports and publications, with many of participants at WG-FSA no longer receiving copies of the Scientific Committee reports, and other relevant documents. The Working Group recommended that the Scientific Committee recommend to the Commission to review the current distribution policy to ensure that all participants at Working Group meetings receive, as a minimum, copies of the Working Group and Scientific Committee reports.

Secretariat Support

10.5 WG-FSA recognised that it operated under fewer constraints than WG-EMM. In particular, WG-FSA had fewer participants (about 30 participants) and enjoyed the Secretariat's home advantage with known equipment and regular facilities. WG-FSA encouraged the Secretariat to continue its practice of delivering meeting documents, on request, to participants' hotels prior to the start of the meeting. This was found to be useful, and the Secretariat was requested to extend this service to more participants, as requested.

10.6 The Working group found that the library resources in the Secretariat provided inadequate support to Members during the analyses of WG-FSA, and staff during the intersessional periods. The Working Group recommended that adequate resources be provided to improve the scientific contents of the library, particularly in the fields of stock assessment, ecosystem management and taxonomy.

Preparation of Data and Information Prior to WG-FSA

10.7 WG-FSA identified a number of tasks undertaken during the meeting which are becoming routine, and may now be undertaken by the Secretariat in the period leading up to meetings.

10.8 The Working Group spent a considerable time reading observer reports, and abstracting information. Following the format prepared this year, the Working Group recommended that the Secretariat prepare, if possible, tables summarising the trips conducted by scientific observers, and information in their reports, prior to future meetings. In addition, dataset inventories, of the type proposed in SC-CAMLR-XVI/BG/11 Rev. 1 be maintained for the

observer logbook datasets. However, this year, the Working Group recognised that over 50% of the observer reports and logbooks had been submitted to the Secretariat during the first half of October, and that these could not have been summarised by the Secretariat prior to the meeting. Many of these reports were hand-delivered by Members. Some reports would have required translation.

10.9 The Working Group agreed that much of the initial preparation for new and exploratory fisheries assessments could now be performed by the Secretariat. For example, seabed areas for given depth intervals could be calculated using the program developed by the Secretariat (SC-CAMLR-XVI/BG/17).

10.10 The Working Group identified a number of tasks which had been requested during previous meetings and had not been entirely completed. It was recognised that some requests may not have been sufficiently clearly specified, and the Working Group suggested that key individuals be identified to facilitate inter-sessional work to be undertaken by the Secretariat and participants. The Working Group encouraged the development of a consultative process, and open communication between participants and the Secretariat so that ambiguities and problems can be easily and efficiently resolved. Dr Kock encouraged the Secretariat to take a more active role in strategic planning.

10.11 As part of this strategic planning, the Working Group encouraged the Secretariat to develop electronic forms and formats for the submission of data, reports and meeting documents. The Working Group agreed that clear specifications are required for each type of submission, and that these should be developed and provided by the Secretariat. This standard approach would ensure that submissions are made in the correct format, and using CCAMLR codes. The Secretariat should also consider developing simple stand-alone programs for data entry, primarily for use in the field, and providing Members with databases shells (e.g. SC-CAMLR-XVI/BG/21).

10.12 The Working Group reviewed the priorities for processing fisheries, research and observer data. It was agreed that the highest priority for processing and validating fishery and observer data should be given to data acquired during the previous split-year (to 30 June). Because of the importance of survey data in the assessments, these should be processed and validated on submission so that the latest results are available to WG-FSA. Finally, and as resources permit, data for the current fishing season should be processed and validated. These data are not considered essential to the analyses, and could be processed during the intersessional period following WG-FSA.

10.13 Recent problems with the submission of the UK survey data highlighted the need for the Secretariat to transfer survey data currently held in the catch and effort database (C1) to a purpose built research survey database. The Working Group agreed that the Secretariat should address this issue during the intersessional period. More generally, the Working Group recommended that the Secretariat review datasets, and develop databases for future needs. The Secretariat should work closely with Members involved in developing databases and data collection systems so as to avoid duplication. The Working Group agreed that a small data steering group should be formed under the coordination of Dr Constable.

10.14 The Working Group also encouraged the Secretariat to consolidate and validate the methodology and datasets used by WG-FSA. Some of this supporting analytical software should be packaged as a WG-FSA toolbox available in electronic format, preferably on the

proposed CCAMLR web site.

Tasks During WG-FSA

10.15 WG-FSA identified a number of tasks and issues which should be addressed by the Secretariat during its meetings. As identified at WG-EMM, there was a need for a better system for circulating meeting papers (e.g. electronic submission and dissemination), and for keeping participants informed of progress during the meeting. It was suggested that the Secretariat should continue to maintain a whiteboard with up-to-date information on the state of rapporteur reports and other meeting papers. The possibility of using a numbering system for papers, and different coloured paper to distinguish the types of papers, was discussed. It was concluded that, at the very least, all working papers, reports and revisions prepared and distributed by subgroups should be clearly labelled with the name of the rapporteur, and the date and time of circulation.

Other Issues

10.16 WG-FSA recognised that some of its instructions to the Secretariat should be more thoroughly documented. It was agreed that some methods used during the meeting have evolved to a relatively final stage, and that these should be better documented.

10.17 The Working Group agreed that the appointment of a chief rapporteur should facilitate the compilation of the WG-FSA report in the future. In addition, the appointment of subgroup coordinators could be made in advance of the meeting so as to more clearly identify tasks and analyses likely to be undertaken by the Working Group.

10.18 The Working Group noted that it had proposed a number of analyses and data compilations which would require substantive use of the Secretariat's data management resources. Such requirements are likely to have budgetary implications.

10.19 The Working Group appreciated the work done by the Secretariat within the resources available, and was grateful for the Secretariat's work in support of WG-FSA. The Working Group thanked the Secretariat for the progress made, and agreed to assist the Secretariat in resolving problems identified above.

ADOPTION OF THE REPORT

11.1 The report of the meeting was adopted.

CLOSE OF THE MEETING

12.1 The Convener thanked all participants for their hard work during a busy meeting and expressed his appreciation to the conveners of the subgroups and to the rapporteurs for their

considerable efforts.

12.2 On behalf of the Working Group, Dr Parkes thanked the Convener for conducting a successful meeting.

12.3 The Convener then closed the meeting.

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Table 1: Reported catches (tonnes) by species and area for the split-year 1996/97 (1 July to 30 June). Source: STATLANT data.

Species	Subarea/Division										
	48.1	48.2	48.3	58.4.3	58.5.1	58.5.2	58.6	58.7	88.1	88.2	All Areas
A. rostrata			<1			<1					
C. gunnari					<1	216					216
C. rhinoceratus					4	1					5
D. eleginoides			2 389	<1	4 681	837	333[a]	2 386[a]	<1	<1	10 626
E. superba	51 286	98	31 124								82 508
L. nasus						2					2
L. squamifrons						4					4
Lithodidae			<1								
Macrourus spp.			15			<1					15
M. hyadesi			28								28
Myctophidae spp.						<1					
N. rossii					<1	<1					
Osteichthyes spp.						1					1
P. spinosissima			0								
Rajiformes spp.			29			3					32
Total	51 286	98	33 585		4 685	1 064	333	2 386			93 437

[a] From Annex D

Table 2: Catches of *D. eleginoides* from various statistical areas reported to the end of the 1996/97 fishing season on 31/8/97.

Conservation Measure	Subarea/ Division	Location	Method	Catch Limit (tonnes)	Reported Catch (tonnes)
109/XV	58.5.2	Heard Island	Trawl	3 800	1 861
102/XV	48.3	South Georgia	Longline	5 000	3 924
116/XV	58.6, 58.7	Prince Edward and Crozet Is	Longline	4 400[a]	2 096[b] 333[c]
	58.5.1	Kerguelen	Trawl		3 676
	58.5.1	Kerguelen	Longline		1 007
113/XV	58.4.3		Trawl	1 980	0.007
115/XV	88.1		Longline	1 980	0.114
115/XV	88.2		Longline	1 980	0.014

[a] Catch limit 2 200 tonnes for each of Statistical Areas 58.6 and 58.7
[b] Catch reported for South African EEZ around Prince Edward Islands
[c] Catch from joint French–Japanese experimental fishery in the French EEZ around Crozet Islands

Table 3: Estimates of unreported catches (in tonnes) of *D. eleginoides* in the 1996/97 split-year.

Reported Total Catch in EEZs outside CCAMLR Area	Reported Total Catch in CCAMLR Area	Estimated Unreported Catch in CCAMLR Area from Landings	Estimated Unreported Catch in CCAMLR Subareas/Divisions from Catch/Effort Data
22 365	10 626[1]	74 000 – 82 200	38 000 – 42 800

[1] Includes catches in EEZs inside CCAMLR waters

Table 4: Estimates of unreported catches (in tonnes) of *D. eleginoides* from 1 July to 30 September 1997.

Reported Total Catch in EEZs outside CCAMLR Area	Reported Total Catch in CCAMLR Area	Estimated Unreported Catch in CCAMLR Area from Landings	Estimated Unreported Catch in CCAMLR Subareas/Divisions from Catch/Effort Data
2 048[3]	3 735[1]	17 580 – 28 580	5 500 – 8 900[2]

[1] Includes catches in EEZs inside CCAMLR waters
[2] Divisions 58.5.1 (2 500 tonnes) and 58.5.2 (3 000 to 6 400 tonnes) only
[3] Argentinian EEZ only

Table 5: Data from observer reports from longline fishing vessels.

Vessel	Type	Date	Sets	Hooks				Fish Lost	Fish By-catch	Fish Speci-mens	CPUE	Length (L)	L/Wt	Sex		Catch Depth	Soak T/Catch	Pro-duct	Conv. Fact.	Fish Con-dition
				Set	Bait	Obs	Lost							Ratio	Mat / L					
Subareas 58.6 and 58.7:																				
American Champion	A	8–9/96	263	845.2	-	-	N	N	N	Y	Y	Y	Y	Y	Y N	N	N	Y	N	Y
Aquatic Pioneer	A	11–12/96	101	288.7	82.5 (238.2)	(100)	Y	Y	Y	Y	Y	Y	Y	Y	Y Y	Y	Y	Y	Y	N
Aquatic Pioneer	A	1–2/97	82	287.0	82.5 (236.8)	(100)	Y	Y	Y	Y	Y	Y	Y	Y	Y Y	Y	Y	Y	Y	N
Aquatic Pioneer	A	4–6/97	109	389.1	82.5 (321.0)	(100)	N	N	Y	N	Y	Y	N	N	N N	N	N	Y	N	N
Aquatic Pioneer	A	7-8/97	54	207.5	60 (124.5)	47	Y	Y	Y	Y	Y	Y	Y	Y	Y Y	Y	N	Y	Y	Y
Garoya	S-1	4/97	62	251.6	67.5 (169.8)	(100)	Y	N	N	Y	Y	Y	Y	Y	Y Y	Y	N	Y	N	N
Koryo Maru 11	S-2	11/96–1/97	48	248.2	100	(100)	N	N	Y	Y	N	N	N	N	N N	N	N	N	N	N
Koryo Maru 11	S-2	1–3/97	51	297.8	(100)	(100)	Y	N	Y	Y	Y	N	N	N	N N	Y	Y	Y	N	N
Sudurhavid	S-1	5–6/97	66	247.1	100	(100)	Y	N	Y	Y	Y	N	N	N	N N	Y	Y	Y	N	N
Sudurhavid	S-1	7/97	20	74.0	100	(100)	Y	N	Y	Y	Y	N	N	N	N N	Y	Y	Y	N	N
Zambezi	A	3–5/97	190	699.0	85 (594.1)	(100)	N	N	Y	Y	N	Y	Y	Y	Y Y	N	N	N	N	N
Zambezi	A	7–8/97	80	356.0	73 (259.9)	(100)	N	N	N	Y	N	Y	Y	Y	Y Y	N	N	Y	Y	N

Table 5 (continued)

Vessel	Type	Date	Sets	Hooks				Fish Lost	Fish By-catch	Fish Speci-mens	CPUE	Length (L)	L/Wt	Sex		Catch Depth	Soak T/Catch	Pro-duct	Conv. Fact.	Fish Con-dition
				Set	Bait	Obs	Lost							Ratio	Mat / L					
Division 58.5.1:																				
Anyo Maru 22	S-1	12/96–4/97	219	865.3		(100)														
Subarea 48.3:																				
Cisne Verde	S-2	3–5/97	61	654.4	100	20														
Koryo Maru 11	S-2	4–7/97	92	854.0	99 (845.5)	(100)	N	N	N	Y	N	Y	Y	N	Y Y	Y	N	N	N	N
Elqui	S-2	5-7/97	51	695	199	96	N	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N
Elqui	S-2	7-8/97	40	457	100	71	N	N	Y	Y	Y	N	N	N	N	Y	N	Y	Y	N
Ercilla	S-2	4-5/97	44	512	100	60	N	Y	Y	N	Y	Y	N	N	N	N	N	Y	Y	N
Ercilla	S-2	5-7/97	51	695	100	96	N	N	Y	N	Y	Y	N	N	N	N	N	Y	Y	N
Ercilla	S-2	8-8/97	50	244	100	62	Y	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	N
Ibsa Quinto	S-2	4-8/97	167	1184	100	60	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N
Isla Camila	S-2	3-4/97	45	365	100	18	N	N	N	Y	Y	N	N	N	N	N	N	Y	Y	N
Isla Camila	S-2	4-6/97	44	489	100	18	N	N	N	Y	Y	N	N	N	N	N	N	Y	Y	N
Isla Camila	S-2	7-8/97	44	489	100	18	N	N	N	N	Y	N	N	N	N	N	N	Y	Y	N
Isla Isabel	S-2	3-4/97	35	275	100	10	Y	N	Y	Y	Y	Y	N	N	N	Y	N	Y	Y	N
Isla Isabel	S-2	4-6/97	51	527	100	53	N	N	N	Y	Y	N	N	N	N	N	N	Y	Y	N
Isla Isabel	S-2	6-8/97	45	431	100	45	Y	N	Y	Y	Y	N	N	N	N	N	N	Y	Y	N

Table 6: Summary of scientific observer data and reports received by the Secretariat as of 18/10/97.

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report / Date Submitted	Data Reported
UK	*Argos Helena*	LLS Auto	Quintero Spain	48.3 *D. eleginoides*	1/3 – 11/8/97	Observer logbook 8/10/97	Cruise, vessel, catch and IMALF details
Chile	*Cisne Verde*	LLS Spanish	Ashford UK	48.3 *D. eleginoides*	24/3 – 24/5/97	Observer logbook 15/7/97, cruise report 14/10/97	Cruise, vessel, catch and IMALF details
Chile	*Cisne Verde*	LLS Spanish	Ovejero Spain	48.3 *D. eleginoides*	22/6 – 29/8/97	Observer logbook 2/10/97	Cruise, vessel, catch and IMALF details
Chile	*Elqui*	LLS Spanish	del Rio Spain	48.3 *D. eleginoides*	18/3 – 10/5/97	Observer logbook 29/7/97	Cruise, vessel, catch and IMALF details
Chile	*Elqui*	LLS Spanish	Raggio Argentina	48.3 *D. eleginoides*	20/5 – 21/7/97	Observer logbook and cruise report 11/10/97	Cruise, vessel, catch and IMALF details
Chile	*Elqui*	LLS Spanish	Almeyda Argentina	48.3 *D. eleginoides*	24/7 – 7/9/97	Electronic submission 3/10/97 Observer logbook and report 11/10/97	Cruise, vessel, catch and IMALF details
Chile	*Ercilla*	LLS Spanish	Treves Argentina	48.3 *D. eleginoides*	9/4 – 17/7/97	Electronic submission 3/10/97 Observer logbooks (2) and report 11/10/97	Cruise, vessel, catch and IMALF details
Chile	*Ercilla*	LLS Spanish	Marchetti Argentina	48.3 *D. eleginoides*	1/8 – 8/9/97	Electronic submission 3/10/97 Observer logbook and report 11/10/97	Cruise, vessel, catch and IMALF details
Spain	*Ibsa Quinto*	LLS Spanish	Alvarado Chile	48.3 *D. eleginoides*	17/4 – 31/8/97	Observer logbook and cruise report 13/10/97	Cruise, vessel, catch and IMALF details
Korea	*In Sung 66*	LLS Auto	Kozlov Russia	48.3 *D. eleginoides*	7/4 – 31/8/97	Observer logbook and cruise report 17/10/97	Cruise, vessel, catch and IMALF details
Korea	*In Sung 101*	Squid Jigger	Harding UK	48.3 *M. hyadesi*	1/1 – 6/1/97	Observer logbook and cruise report 17/2/97	Cruise, vessel, catch and biological details
Korea	*In Sung 101*	Squid Jigger	Harding UK	48.3 *M. hyadesi*	24/6 – 14/7/97	Observer Logbook and cruise report 23/9/97	Cruise, vessel, catch and biological details
Chile	*Isla Camila*	LLS Spanish	Sinconegui Argentina	48.3 *D. eleginoides*	20/2 – 12/6/97	Electronic submission 3/10/97 Observer logbooks (2) and report 11/10/97	Cruise, vessel, catch and IMALF details

Table 6 (continued)

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report / Date Submitted	Data Reported
Chile	*Isla Camila*	LLS Spanish	Giangualano Argentina	48.3 *D. eleginoides*	29/6 – 23/8/97	Electronic submission 3/10/97 Observer logbook and report 11/10/97	Cruise, vessel, catch and IMALF details
Chile	*Isla Isabel*	LLS Spanish	Remaggi Argentina	48.3 *D. eleginoides*	1/3 – 9/4/97	Electronic submission 3/10/97 Observer logbook and report 11/10/97	Cruise, vessel, catch and IMALF details
Chile	*Isla Isabel*	LLS Spanish	Brachetta Argentina	48.3 *D. eleginoides*	18/4 – 16/6/97	Electronic submission 3/10/97 Observer logbook and report 11/10/97	Cruise, vessel, catch and IMALF details
Chile	*Isla Isabel*	LLS Spanish	Caballero Argentina	48.3 *D. eleginoides*	4/7 – 18/8/97	Electronic submission 3/10/97 Observer logbook and report 11/10/97	Cruise, vessel, catch and IMALF details
UK	*Jacqueline*	LLS Auto	Gyllen Chile	48.3 *D. eleginoides*	18/4 – 29/5/97	Observer logbook 13/10/97	Cruise, vessel, catch and IMALF details
UK	*Jacqueline*	LLS Auto	Gyllen Chile	48.3 *D. eleginoides*	5/7 – 31/8/97	Observer logbook 13/10/97	Cruise, vessel, catch and IMALF details
Japan	*Koryo Maru 11*	LLS Auto	Keith South Africa	48.3 *D. eleginoides*	30/3 – 11/8/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
Spain	*Pescarosa Primero*	LLS Spanish	Arata Chile	48.3 *D. eleginoides*	2/5 – 11/9/97	Observer logbook 13/10/97	Cruise, vessel, catch and IMALF details
Australia	*Austral Leader*	Trawler	Williams Australia	58.5.2 *D. eleginoides*	6/3 – 7/5/97	Observer logbook 27/6/97	Cruise, vessel, catch and biological details
Australia	*Austral Leader*	Trawler	Saunders New Zealand	58.5.2 *D. eleginoides*	20/5 – 7/6/97	Observer logbook 23/7/97	Cruise, vessel, catch and biological details
Australia	*Austral Leader*	Trawler	Tucker Australia	58.5.2 *D. eleginoides*	10/7 – 2/9/97	Observer logbook 2/10/97	Cruise, vessel, catch and biological details
New Zealand	*Pakura*	Trawler	Brady New Zealand	58.5.2 *D. eleginoides*	5/4 – 18/5/97	Observer logbook 17/6/97	Cruise, vessel, catch and biological details
Argentina	*Alida Glacial*	LLS	No Observer	58.7 *D. eleginoides*	21/10 – 27/12	Logbook 15/10/97	Cruise, vessel, catch and IMALF details

Table 6 (continued)

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report / Date Submitted	Data Reported
Argentina	*Aliza Glacial*	LLS	Stoffberg South Africa	58.7 *D. eleginoides*	7/12/96 – 7/1/97	Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
USA	*American Champion*	LLS	Koen South Africa	58.7 *D. eleginoides*	14/8 – 28/9/96	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
USA	*American Champion*	LLS	No Observer	58.7 *D. eleginoides*	24/10 – 21/11/96	Logbook 15/10/97	Cruise, vessel, catch and IMALF details
South Africa	*Aquatic Pioneer*	LLS	Purves South Africa	58.7 *D. eleginoides*	31/10 – 10/12/96	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
South Africa	*Aquatic Pioneer*	LLS	Purves South Africa	58.7 *D. eleginoides*	8/1 – 1/3/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
South Africa	*Aquatic Pioneer*	LLS	Wanless South Africa	58.7 *D. eleginoides*	20/4 – 18/6/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
South Africa	*Aquatic Pioneer*	LLS	Williams South Africa	58.7 *D. eleginoides*	1/7 – 29/8/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
Namibia	*Garoya*	LLS	Boix ~~Spain~~[1]	58.7 *D. eleginoides*	5/4 – 10/5/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
Japan	*Koryo Maru 11*	LLS	Enticott South Africa	58.7 *D. eleginoides*	10/11/96 – 5/1/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
Japan	*Koryo Maru 11*	LLS	Heinecken South Africa	58.7 *D. eleginoides*	17/1 – 22/3/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
USA	*Mr B*	LLS	Le Roux South Africa	58.7 *D. eleginoides*	22/10 – 28/11/96	Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
USA	*Mr B*	LLS	Stoffberg South Africa	58.7 *D. eleginoides*	29/1 – 14/2/97	Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
Namibia	*Sudurhavid*	LLS	Heinecken South Africa	58.7 *D. eleginoides*	15/5 – 16/6/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details

[1] South Africa – see SC-CAMLR-XVI, paragraph 3.8

Table 6 (continued)

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Period of Observation	Report / Date Submitted	Data Reported
Namibia	*Sudurhavid*	LLS	Heinecken South Africa	58.7 *D. eleginoides*	4/7 – 24/7/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
Namibia	*Zambezi*	LLS	Stoffberg South Africa	58.7 *D. eleginoides*	19/3 – 16/5/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
South Africa	*Zambezi*	LLS	Anderson South Africa	58.7 *D. eleginoides*	25/7 – 29/8/97	Cruise report 9/10/97 Observer logbook 15/10/97	Cruise, vessel, catch and IMALF details
New Zealand	*Lord Auckland*	LLS Auto	Tucker Australia	88.1, 88.2 *D. eleginoides*	9/5 - 2/6/97	Observer logbook 24/6/97	Cruise, vessel, catch and IMALF details

Table 7: Information on packaging bands and marine debris from scientific observer reports from longline vessels fishing in Subareas 48.3, 58.6 and 58.7.

Vessel	Observer	Type	Date	Band	Oil	Debris	
						Gear	Garbage
Subarea 48.3:							
Elqui	Raggio, Argentina	S-2	5–7/97	Y		Y	Y
Elqui	Almeyda, Argentina	S-2	7–8/97	Y		Y	Y
Ercilla	Treves, Argentina	S-2	4–5/97				
Ercilla	Treves, Argentina	S-2	6–7/97				
Ercilla	Marchetti, Argentina	S-2	8/97	Y			Y
Ibsa Quinto	Alvarado, Chile	S-2	4–8/97	Y		Y	Y
Isla Camila	Sinconegui, Argentina	S-2	3–4/97	Y			
Isla Camila	Sinconegui, Argentina	S-2	4–6/97				
Isla Camila	Giangualano, Argentina	S-2	7–8/97				
Isla Isabel	Giangualano, Argentina	S-2	3–4/97	Y		Y	Y
Isla Isabel	Brachetta, Argentina	S-2	4–6/97				
Isla Isabel	Caballero, Argentina	S-2	6–8/97	Y		Y	Y
Cisne Verde	Ashford, UK	S-2	3–5/97				
Koryo Maru 11	Keith, South Africa	S-2	4–7/97				
Subareas 58.6, 58.7:							
American Champion	Koen, South Africa	A	8–9/96				
Aquatic Pioneer	Purves, South Africa	A	11–12/96				
Aquatic Pioneer	Purves, South Africa	A	1–2/97				
Aquatic Pioneer	Wanless, South Africa	A	4–6/97	Y		Y	Y
Aquatic Pioneer	Williams, South Africa	A	7-8/97				
Garoya	Boix, ~~Spain~~[1]	S-1	4/97	Y	Y		
Sudurhavid	Heinecken, South Africa	S-1	5–6/97				
Sudurhavid	Heinecken, South Africa	S-1	7/97				
Koryo Maru 11	Enticott, South Africa	S-2	11/96–1/97	Y		Y	
Koryo Maru 11	Heinecken, South Africa	S-2	1–3/97				
Zambezi	Stoffberg, South Africa	A	3–5/97				
Zambezi	Anderson, South Africa	A	7–8/97				

[1] South Africa – see SC-CAMLR-XVI, paragraph 3.8

Type A = Autoliner; S-1 = Spanish single line; S-2 = Spanish double line

Date Months only

Band Information available (Y = yes) on packaging bands (Conservation Measure 63/XV)

Oil Oil spillage observed (Y = yes)

Debris Information available (Y = yes) on marine pollution/waste disposal: Gear = disposal of fishing gear; Garbage = disposal of plastic, cardboard or other non-offal waste

Table 8: New fisheries in 1996/97.

Conservation Measure	Target Species	Subarea/ Division	Catch Limit (tonnes)	Season	Reported Catch (tonnes)	Closure Date 1997
99/XV	*M. hyadesi*	48.3	2 500	2 Nov 1996 – 7 Nov 1997	81	7 Nov
114/XV	*D. eleginoides* *D. mawsoni*	48.6	1 980	1 March – 31 Aug 1997	0	31 Aug
116/XV	*D. eleginoides* *D. mawsoni*	58.4.4	1 980	1 March – 31 Aug 1997	0	31 Aug
116/XV	*D. eleginoides* *D. mawsoni*	58.6, 58.7	2 200 in each	30 Oct 1996 – 31 Aug 1997	2 521	31 Aug
115/XV	*D. eleginoides* *D. mawsoni*	88.1, 88.2	1 980 in each	15 Feb – 31 Aug 1997	0.128	31 Aug
113/XV	*D. eleginoides* *D. mawsoni*	58.4.3	1 980	2 Nov 1996[a] or 1 Mar 1997[b] – 31 Aug 1997	0.007	31 Aug
111/XV	Deepwater species	58.5.2	50[c]	2 Nov 1996 – 31 Aug 1997	0	31 Aug

[a] For trawling
[b] For longlining
[c] For each species not covered by Conservation Measures 109/XV and 110/XV

Table 9: Summary of data submitted for new fisheries in 1996/97.
T – five-day or 10-day catch and effort reports, C – catch and effort data, B – biological data, S – STATLANT data (to 30 June 1997), R – report, L – logbook.

Target Species	Member	Subarea/ Division	Fishery Data	Observer Data	Other Data
M. hyadesi	Rep. of Korea	48.3	T, C, B	R, L	
D. eleginoides *D. mawsoni*	South Africa	48.6	Not fished		
D. eleginoides *D. mawsoni*	South Africa	58.4.4	Not fished		
D. eleginoides *D. mawsoni*	South Africa	58.6, 58.7	S T[1],C[1],B[1]	R, L	Length at age; CPUE by month and set; summary VMS data
D. eleginoides *D. mawsoni*	New Zealand	88.1, 88.2	T, C, B	L	VMS trial
D. eleginoides *D. mawsoni*	Australia South Africa	58.4.3	T, C, B	L	VMS trial
Deepwater species	Australia	58.5.2	not fished		VMS trial

[1] Outside EEZ

Table 10: Reported by-catch of crabs, rays and fish in the longline fishery for *D. eleginoides* in Subarea 48.3. Catches are expressed as percentage of the reported annual catch, by weight, for *D. eleginoides*. Source: fine-scale catch and effort data (C2) for Spanish-style longlines (split-years 1995–98), autoliners (1995–96), and not specified (1990–96).

By-catch Taxon	Catch (%)		
	Spanish	Autoliner	Not Specified
Crabs:			
Paralomis spinosissima	<0.04		
Lithodidae	≤0.06	<0.01	<0.02
Rays:			
Rajiformes spp.	0.53 – 2.95	0.67 – 2.80	0.03 – 2.60
Raja georgiana	<0.01		
Fish:			
Macrourus spp.	0.25 – 0.98	0.94 – 4.00	≤0.84
Antimora rostrata	≤0.07		
Unknown / mixed spp.	<0.05	≤3.01	<0.01
Lepidonotothen squamifrons			<0.01
Muraenolepis microps			<0.01

Table 11: Precautionary catch limits for new and exploratory fisheries for *Dissostichus* spp. during 1997/98.

Target Species	Area		Reported Catch (tonnes) to 31 August 1997	Estimated Total Catch (tonnes) including Unreported	1996/97 Catch Limit (tonnes)	Seabed Area (km^2)		GY Unadjusted Catch Limit (tonnes) for Total Area	GY Unadjusted Catch Limit (tonnes) for Species	Precautionary Catch Limit (tonnes)	
						<600 m <500[d] m	600–1800 m 500–1500[d] m			0.45*GY	0.30*GY
Longline:											
D. eleginoides	48.3	(600–1800 m)	3 924	3 924	5 000	45 110	67 506				
D. eleginoides	48.1	north of 65°S				156 505	73 107	4 262	3 960	1 782	
D. mawsoni	48.1	south of 65°S				130 206	5 569		302		91
D. eleginoides	48.2	north of 60°S				198	16 847	4 013	912	410	
D. mawsoni	48.2	south of 60°S				35 465	57 308		3 101		930
D. eleginoides	48.4	north of 57°S	0	0	28	816	7 356	1 293	397	179	
D. mawsoni	48.4	south of 57°S				2 940	16 587		896		269
D. eleginoides	48.6	north of 65°S	0	0	1 980[b]	1 288	34 879	3 953	1 887	849	
D. mawsoni	48.6	65-70°S				32 963	38 205		2 066		620
D. eleginoides	58.4.3	north of 60°S				352	107 795	5 928	5 833	2 625	
D. mawsoni	58.4.3	south of 60°S				0	1 753		95		28
D. eleginoides	58.4.4	north of 60°S	0	?[c]	1 980[b]	8 783	22 848	1 234	1 234	555	
D. mawsoni	58.4.4	south of 60°S				0	0		0		0
D. eleginoides	58.6	current	2 521[a]	19 233	2 200[b]	19 933	69 158	4 648	4 648	2 092	
D. eleginoides	58.7	current		14 129	2 200[b]	1 988	15 618	996	996	448	
D. eleginoides	58.6	proposed		12 822		17 677	28 691	1 885	1 885	848	
D. eleginoides	58.7	proposed		18 839		4 244	56 085	3 745	3 745	1 685	
D. eleginoides	88.1	north of 65°S	0.114	0.114	1 980[b]	21	13 277	4 455	719	323	
D. mawsoni	88.1	65–70°S				57 087	69 045		3 736		1 121
D. eleginoides	88.2	north of 65°S	0.014	0.014	1 980[b]	17	1 012	178	55	25	
D. mawsoni	88.2	65–70°S				3	2 276		123		37
D. eleginoides	88.3	north of 65°S				0	20	1 454	1	0	
D. mawsoni	88.3	65–70°S				76 729	26 867		1 453		436
Trawl:											
D. eleginoides	58.5.2	(500–1500 m)	1 861	10 437	3 800	48 186	91 771				
D. eleginoides	58.4.3	north of 60°S	0.007	0.007	1 980[b]	107	49 550	2 047	2 047	921	
D. mawsoni	58.4.3	south of 60°S				0	0		0		0

[a] Subareas 58.6 and 58.7 combined

[b] *Dissostichus* spp.

[c] Evidence of substantial fishing (see Appendix D, Table D.3)

[d] Trawl fisheries

Table 12: Biomass estimates of several fish stocks obtained in a German research cruise conducted in Subarea 48.1 during the 1996/97 season (WG-FSA-97/27).

Species	Biomass (tonnes)	Confidence Intervals (tonnes)
Champsocephalus gunnari	606	37 – 1 268
Chaenocephalus aceratus	2 124	1 169 – 13 015
Chionodraco rastrospinosus	282	135 – 856
Gobionotothen gibberifrons	5 157	2 679 – 212 193
Lepidonotothen squamifrons	312	65 – 5 564
Lepidonotothen larseni	182	131 – 269

Table 13: Biomass estimates (in tonnes) and their upper and lower 95% confidence intervals of finfish in the vicinity of Elephant Island in 1987 and 1996.

Species	1987		1996	
	Mean	CI	Mean	CI
Champsocephalus gunnari	2 059	929 – 8 406	606	374 – 1 268
Notothenia rossii	630	223 – 3 414	32	16 – 48
Gobionotothen gibberifrons	21 309	10 982 – 45 679	5 157	2 679 – 212 193
Chaenocephalus aceratus	5 530	3 234 – 12 251	2 124	1 169 – 13 015
Chionodraco rastrospinosus	475	285 – 985	282	135 – 856
Lepidonotothen larseni	533	317 – 944	182	131 – 269
Lepidonotothen squamifrons	139	48 – 809	312	65 – 5 564

Table 14: Analysis of deviance tables for GLMs fitted to time series of CPUE data for *D. eleginoides* from Subarea 48.3.

Effect	df	Deviance	Residual df	Residual Deviance	p
kg/hook					
NULL			4 160	2 087.70	
+ season	5	144.24	4 155	1 943.46	<0.01
+ month	9	64.50	4 146	1 878.96	<0.01
+ area	4	35.22	4 142	1 843.74	<0.01
+ nationality	8	277.11	4 134	1 566.63	<0.01
+ bait	4	30.88	4 130	1 535.75	<0.01
numbers/hook					
NULL			3 987	1 737.24	
+ season	5	121.93	3 982	1 615.31	<0.01
+ month	9	29.03	3 973	1 586.28	<0.01
+ area	4	31.09	3 969	1 555.20	<0.01
+ nationality	8	173.36	3 961	1 381.84	<0.01
+ bait	4	35.37	3 957	1 346.47	<0.01

Table 15: Percentage of longline hauls with zero catches for *D. eleginoides* from Subarea 48.3.

Season Ending 30 September	Number of Vessels	Mean % Hauls with Catch = 0
1992	3	8.42
1993	3	9.41
1994	2	3.12
1995	7	5.21
1996	2	3.20
1997	5	3.63

Table 16: Maturity ogive for *D. eleginoides* in Subarea 48.3 during August 1997.

Sex	am	bm	$L_{50\%}$
Males	-14.724876	0.194428	75.73
Females	-12.800288	0.1159154	110.43
Both*	-6.3819180	0.0686313	92.99

* Used in the assessment

Table 17: Estimated abundance at age (millions of fish) from a series of trawl surveys carried out at South Georgia.

Survey	N_3	Standard Error (N_3)	N_4	Standard Error (N_4)	N_5	Standard Error (N_5)
Argentina 1996	4.993	1.649	1.150	0.223	0.751	0.293
Argentina 1995 South Georgia	-	-	1.212	0.599	2.118	0.627
Argentina 1995 Shag Rocks	2.384	1.644	3.360	1.163	1.092	0.726
Total	2.384	1.644	4.572	1.308	3.210	0.959
UK 1994 depth 1	0.157	0.101	0.109	0.057	0.121	0.093
UK 1994 depth 2	0.764	0.537	0.678	0.153	-	-
UK 1994 depth 3	0.267	0.140	0.357	0.135	0.404	0.175
Total	1.188	0.778	1.144	0.345	0.526	0.268
UK 1992 depth 1	1.300	0.427	-	-	-	-
UK 1992 depth 2	5.523	1.970	0.092	0.512	0.115	0.129
UK 1992 depth 3	2.401	0.594	0.474	0.408	0.341	0.239
Total	9.225	2.102	0.567	0.655	0.457	0.271
UK 1991 depth 1	0.142	0.064	0.026	0.026	0.058	0.034
UK 1991 depth 2	0.056	0.037	0.026	0.013	0.057	0.029
UK 1991 depth 3	0.029	-	0.132	0.072	0.698	0.519
Total	0.229	0.073	0.185	0.076	0.813	0.521
UK 1990 depth 1	1.446	1.436	6.617	6.065	4.216	3.777
UK 1990 depth 2	0.058	0.035	0.081	0.063	0.165	0.103
UK 1990 depth 3	0.011	-	0.009	-	0.040	0.030
Total	1.515	1.437	6.707	6.065	4.422	3.779
US/Poland 1988	0.299	0.096	0.285	0.144	0.078	0.024
US/Poland 1986	1.000	0.288	1.051	0.805	0.045	0.026
USSR 1986	-	-	0.523	0.296	2.323	1.016

Table 18: Recruitment to the stock of *D. eleginoides* in Subarea 48.3 as numbers of fish by year class at age class 4, estimated from trawl surveys at South Georgia.

Cohort	Number of Fish at Age 4 (millions)
1993	4.255
1992	1.591
1991	2.155
1990	2.455
1989	4.239
1988	0.381
1987	0.671
1986	3.831
1985	2.722
1984	0.285
1983	0.315
1982	0.822
1981	1.389

Table 19: Parameters for the lognormal recruitment function.

Parameter	Value
Mean number of recruits at age 4	1 932 000
Standard deviation	2 187 000
Lognormal mean	14.243
Lognormal standard error	0.188
Lognormal standard deviation	0.679

Table 20: Parameters input to the GYM for evaluation of precautionary yield of *D. eleginoides* in Subarea 48.3.

Category	Parameter	*D. eleginoides*
Age composition	Recruitment age in simulation	4
	Number of age classes	35
	Plus class present – years in plus class in initial age structure	21
Resolution	Number of increments per year	360
Natural mortality	Mean annual M	0.16
Fishing mortality	Length of fish when 50% of individuals of that size are recruited to fishery (l_{r50})	70 cm
	Length range over which recruitment occurs (l_r)	65–75 cm
	Reasonable upper bound for annual fishing mortality	5
	Tolerance (error) for determining fishing mortality in each year	1E-05
von Bertalanffy growth	Time 0	0
	$L_{\square}$	170.8 cm
	K	0.088
Weight-length ($W = aL^b$)	a	2.5E-05
	b	2.8
Spawning biomass	Maturity ogive by length (m_m) - Lm_{50}	93 cm
	Range over which maturity occurs	78–108 cm
	Date when spawning begins	1 August
	Number of increments in spawning season	1 (knife edge)
Recruitment	Mean of $\log_e$ (Recruits)	14.219
	Standard error of the mean of $\log_e$ (Recruits)	0.194
	Standard deviation of $\log_e$ (Recruits)	0.698
Simulation characteristics	Number of runs in simulation for each catch	1 001
	Years to project stock to remove effects of initial age structure	1
	Vector of real catches for projecting over known catch period (tonnes)	8 501, 4 206, 7 309, 5 589, 6 605, 6 171, 4 362, 2 619
	Number of years to project stock following known catch period	35
	Seed for random numbers	-24189
Decision rules	Reference point for assessment of long-term annual yield	$0.2.SB_0 median$

Table 21: Relative biomass estimates for *C. gunnari* in Subarea 48.3 from surveys undertaken by Argentina and the UK during the 1996/97 season.

Depth Stratum	Argentinian Survey		UK Survey (MVUE)		Lower CI	Upper CI
	Hauls	Mean	Hauls	Mean		
Shag Rocks:						
1	5	11 953	5	1 267	524	8 262
2	4	74 831	5	6 736	3 410	24 950
3	0	–	2	44.2	13.3	820
Total	9	86 784	12	8 047		
South Georgia:						
1	15	14 356	8	3 627	588	209 873
2	15	20 535	24	21 531	11 585	56 052
3	11	887	12	36 547	5 587	163 903
Total	41	35 777	44	61 705		
Overall Total	50	122 561	56	69 753	32 119	164 973

Table 22: List of bottom trawl surveys in the CCAMLR Convention Area compiled from information held by the Secretariat. ANI – *C. gunnari,* MZZ – Osteichthyes spp., NOX – Nototheniidae, TOP – *D. eleginoides.*

Year	Nationality	Area	Vessel	Survey Dates	Species	Sampling Design	Data Submitted
1997	Argentina	48.3	*Dr Eduardo L. Holmberg*	21/3 – 2//4/97	MZZ	Clustered survey	Yes
	Australia	58.5.2	*Austral Leader*	20/8 – 8/9/97	ANI	Random survey	No
	Spain	48.6, 58.4.4	*Ibsa Quinto*	20/9 – 20/10/97	TOP	Systematic, distribution and biology	Postponed
	UK	48.3	*Argos Galicia*	9/97	MZZ	Random survey	Yes
1996	Argentina	48.3	*Dr Eduardo L. Holmberg*	20/3 – 9/4/96	MZZ	Clustered survey	No
	Germany	48.1	*Polarstern*	14/11 – 30/12/96	MZZ	Random survey (37 tows)	Yes
	Russia	48.2, 48.3	*Atlantida*	3 – 4/96	MZZ		Yes
	USA	88.1	*Nathaniel B. Palmer*	5/12/96 – 5/1/97	NOX		No
	USA	48.1	*Polar Duke*	3/7 – 29/8/96	MZZ		No
1995	Argentina	48.2, 48.3	*Dr Eduardo L. Holmberg*	10 – 25/2/95	MZZ	Clustered survey	Yes
1994	Argentina	48.2, 48.3	*Dr Eduardo L. Holmberg*	12/2 – 23/3/94	MZZ	Clustered survey	Yes
	UK	48.3	*Cordella*	4/1 – 8/2/94	MZZ	Random survey	Yes
1993	Australia	58.5.2	*Aurora Australis*	2/9 – 24/9/93		Random survey	Yes
1992	Australia	58.5.2	*Aurora Australis*	23/1 – 12/2/92	MZZ	Random survey	Yes
	UK	48.3	*Falklands Protector*	5 – 14/1/92	MZZ	Random survey	Yes
1991	Spain	48.2	*Naroch*	19/1 – 10/2/91	MZZ	Random survey	Yes
	UK	48.3	*Falklands Protector*	22/1 – 11/2/91	MZZ	Random survey	Yes
	USSR	48.3	*Atlantida*	1/4 – 27/5/91	MZZ	Random survey	Yes
1990	Australia	58.5.2	*Aurora Australis*	23/5 – 21/6/90	MZZ	Random survey	Yes
	UK	48.3	*Hill Cove*	1/1 – 26/1/90	MZZ	Random survey	Yes
	USSR	48.3	*Pioner*	7/90	MZZ		Yes
	USSR	48.3	*Akademik Knipovich*	1/90 – 3/90	ANI		
	USSR	48.3	*Anchar*	4/90 – 6/90	MZZ	Distribution and biology	Yes
	USSR	58.4.2	*Professor Mesyatsev & Fiolent?*	21/1 – 1/4/90	MZZ	Distribution and biology	Yes
1989	Poland	48.3	Unknown	11/8 – 11/8/88	MZZ	Exploratory fishing?	Yes
	Poland/UK	48.1, 48.2, 48.3	*Professor Siedlecki*	1/1 – 14/2/89	MZZ	Random survey	Yes
	USSR	58.4.2	*Professor Mesyatsev*	1/2 – 21/3/89	MZZ		Yes
1988	Brazil	48.1	*Prof. W. Besnard*	11/1 – 11/1/88	MZZ	Histology	Yes
	Poland	48.1	Unknown	1 – 11/2/88	MZZ	Exploratory fishing?	Yes
	USSR	48.3	*Pioner Latvii*	12/88 – 1/89	MZZ	Biology	Yes
	USSR	48.3	*Evrika*	3 – 4/88	MZZ		Yes
1987	Brazil	48.1	*Prof. W. Besnard*	21/2 – 21/2/87	MZZ	Histology	Yes
	Germany	48.1	*Polarstern*	21/10 – 11/12/87	MZZ	Random survey (40 tows)	Yes
	Spain	48.1	*Pescapuerta Cuarto*	16/1 – 5/2/87	MZZ	Random survey	Yes
	GDR	48.3	Unknown		MZZ	Random survey	Yes
	Poland	48.3	Unknown	21/12/87 – 1/1/88	MZZ	Exploratory fishing?	Yes

Table 22 continued

Year	Nationality	Area	Vessel	Survey Dates	Species	Sampling Design	Data Submitted
1987	USSR	48.3	Unknown	1/8 – 21/9/87	ANI	Exploratory fishing?	Yes
	USSR	48.3	Unknown	21/7/87	NOG	Exploratory fishing?	Yes
	USSR	48.3	*Gizhiga*	7 – 8/87	MZZ		Yes
	USSR	48.3	*Gizhiga*	7 – 11/87	MZZ		Yes
	USSR/Australia	58.5.2	*Professor Mesyatsev*	10 – 27/5/87	MZZ	Biology	Yes
	USSR/Australia	58.5.2	*Professor Mesyatsev*	24/7 – 2/8/87	MZZ	Biology	Yes
	USA/Poland	48.3	*Professor Siedlecki*	11/12/87 – 1/1/88	MZZ	Random survey	Yes
1986	FRG	48.1	*Polarstern*	5 – 6/86	MZZ	Random survey (36 tows)	Yes
	Spain	48.2	*Pescapuerta Cuarto*	29/12/86 – 14/1/87	MZZ	Random survey	Yes
	Spain	48.4	*Pescapuerta Cuarto*	23 – 26/12/86	MZZ	Random survey	Yes
	Spain	48.3	*Pescapuerta Cuarto*	21/11 – 20/12/86	MZZ	Random survey	Yes
	USSR	48.3	*Gizhiga*	5 – 11/86	MZZ	Random survey	Yes
	USSR	58.4.2	Unknown	11/3 – 21/3/86	WIC	Exploratory fishing?	Yes
	USSR	58.4.2	Unknown	1/1/86	MZZ		Yes
	USA/Poland	48.3	*Professor Siedlecki*	21/11 – 11/12/86	MZZ	Random survey	Yes
1985	FRG	48.1, 48.2, 48.3	*Walter Herwig*	2/85	MZZ	Random survey (37 tows)	Yes
	USSR	48.3	*Gizhiga*	7 – 8/85	MZZ		Yes
	USSR	58.4.2	Unknown	1/1 – 1/4/85	MZZ		Yes
1984	USSR	48.3	*Gizhiga*	27/1 – 30/4/84	MZZ		Yes
1983	FRG	48.1	*Polarstern*	11/83	MZZ	Random survey (12 tows)	Yes
1981	FRG	48.1	*Walter Herwig*	3/81	MZZ	Random survey (13 tows)	Yes
1978	FRG	48.1, 48.2, 48.3	*Julius Fock*	1 – 3/78	MZZ	Non-random survey (20 tows)	Yes
1977	FRG	48.1, 48.2, 48.3	*Walter Herwig*	11/77, 1/78	MZZ	Random survey (7 tows)	Yes
1976	FRG	48.3	*Walter Herwig*		MZZ	Random survey	Yes
	FRG	48.1, 48.2, 48.3	*Weser*	1 – 2/76	MZZ	Non-random survey (18 tows)	Yes
1974	USSR	48.3	*Atlant*	12/74	MZZ		Yes
	USSR	48.3	*Salekhardt*	2 – 3/74	MZZ		Yes

Table 23: Parameters input to the GYM for evaluation of precautionary yield of *C. gunnari* in Subarea 48.3.

Category	Parameter	*C. gunnari*
Age composition	Recruitment age in simulation	1
	Number of age classes	6
	Plus class present – years in plus class in initial age structure	3
Resolution	Number of increments per year	360
Natural mortality	Mean annual *M*	0.42–0.55
	Interannual variability in *M*	0.2 probability of increase in M by 4
Fishing mortality	Length of fish when 50% of individuals of that size are recruited to fishery (l_{r50})	15–22 cm
	Length range over which recruitment occurs (l_r)	5 cm
	Fishing season	15 November – 31 March
	Reasonable upper bound for annual fishing mortality	5
	Tolerance (error) for determining fishing mortality in each year	1E-05
von Bertalanffy growth	Time 0	0
	$L_{\square}$	45.5 cm
	K	0.332
Weight-length ($W = aL^b$)	*a*	1.8E-06
	b	3.36
Spawning biomass	Maturity ogive by length (m_m) - Lm_{50}	21–28 cm
	Range over which maturity occurs	10 cm
	Spawning season	1 March – 30 April
Recruitment	Mean of $\log_e$ (Recruits)	20.1042
	Standard error of the mean of $\log_e$ (Recruits)	0.2397
	Standard deviation of $\log_e$ (Recruits)	0.8970
Evaluation of Gamma	Date of biomass survey	1 September
	CV of biomass survey estimate	0.3
	Coverage of survey	1.0
Simulation characteristics	Number of runs in simulation for each catch	1001
	Years to project stock to remove effects of initial age structure	1
	Vector of real catches for projecting over known catch period (tonnes)	
	Number of years to project stock following known catch period	10
	Seed for random numbers	Start (-24189) Not reset each time
Decision rules	Reference point for assessment of long-term annual yield	0.2.SB_0*median*

Table 24: Estimated year class strength from the Argentine and UK surveys showing the proportion of the population in each age class by number.

Age Class	Survey		Average	Proportion
	Argentina	UK		
	Number of fish (millions)			
2	776	562	669	0.426
3	936	503	720	0.458
4	18	243	131	0.083
5	40	63	52	0.033
6	2	9	5	0.003

Table 25: Abundance estimates and confidence intervals for *C. gunnari* from the 1997 Heard Island survey.

Stratum	Delta Lognormal Maximum Likelihood				Sample Statistics with Bootstrap			
	Abundance (tonnes)	Std. Error	95% Confidence Interval		Abundance (tonnes)	Std. Error	95% Confidence Interval	
			Lower	Upper			Lower	Upper
Shell 1	253.3	201.9	38.7	14 527.2	177.4	97.3	13.7	381.9
Shell 2	4 190.0	2 822.8	1 000.3	77 998.0	4 353.3	2 983.2	407.8	10 365.5
Plateau	110 825.0	91 849.1	14 420.5	$7.9^{*}10^{6}$	49 050.0	30 426.7	7 194.3	112 745.5
Gunnari R.	840.0	598.9	182.0	19 344.8	611.7	324.7	124.2	1 278.9
Shell 1+2					4 531.7	2 769.2	591.8	10 624.0
Gunn+Plat					49 661.7	28 946.1	7 810.9	113.2
Total	116 109.3	91 894.7	18 963.0	$7.9^{*}10^{6}$	54 193.4	29 071.7	11 765.6	118 235.2

Table 26: Parameters for von Bertalanffy growth curve and weight – length relation used for *C. gunnari* assessment in Subarea 48.3. The parameters *a* and *b* apply to a weight – length relationship $w = al^{b}$, where length *l* is measured in mm, the resultant weight *w* is given in kg.

Parameter	Value
von Bertalanffy t_0	0. (yrs)
von Bertalanffy k	0.332
von Bertalanffy L_{∞}	455.0 (mm)
Weight – length a	6.172×10^{-10}
Weight – length b	3.388

Table 27: Calculated numbers of fish in each age class for a biomass at the lower 95% confidence bound.

Age Class	Number of Fish (millions)
2	119.4
3	128.4
4	23.3
5	9.2
6	0.9

Table 28: Fishing mortality and catches for a two year projection of the *C. gunnari* stock in Subarea 48.3, assuming that the current biomass is at the lower 95% confidence bound of the UK survey carried out in September 1997. Two levels of natural mortality are used in the calculations.

Natural Mortality	Relative Change in Abundance without Fishing	Target Change in Abundance with Fishing	Fishing Mortality	Catch for the 1997/98 Season (tonnes)	Catch for the 1998/99 Season (tonnes)
0.42	1.088	0.816	0.145	4520	4140
1.68	0.090	0.068	0.144	2575	695

Table 29: Biomass estimates (in tonnes) of several fish stocks obtained from Argentinian and UK research cruises conducted in Subarea 48.3 during the 1996/97 season.

	Argentina			UK		
	South Georgia	Shag Rocks	Total	South Georgia	Shag Rocks	Total
N. rossii	10 074	0	10 074	12 398	0	12 398
G. gibberifrons	2 059	48	2 107	2 466	45	2 511
L. squamifrons	0	21 758	21 758	747	412	1 159
L. larseni	186	0	186	-	-	-
P. guntheri	0	23 907	23 907	0	4 244	4 244
C. aceratus	1 970	0	1 970	13 159	3	13 162
P. georgianus	1 921	0	1 921	8 315	0	8 315

Table 30: Total reported catches by species and subarea in Statistical Area 58. Species are designated by abbreviations as follows: ANI (*Champsocephalus gunnari*), LIC (*Channichthys rhinoceratus*), TOP (*Dissostichus eleginoides*), NOR (*Notothenia rossii*), NOS (*Lepidonotothen squamifrons*), ANS (*Pleuragramma antarcticum*), MZZ (Unknown), SRX (Rajiformes spp.), WIC (*Chaenodraco wilsoni*).

Split-	ANI		LIC	WIC	TOP				NOR			NOS			ANS		MZZ			SRX
Year	58	58.5	58.5	58.4	58	58.4	58.5	58.6	58	58.4	58.5	58	58.4	58.5	58	58.4	58	58.4	58.5	58.5.1
1971	10231				xx				63636			24545					679			
1972	53857				xx				104588			52912					8195			
1973	6512				xx				20361			2368					3444			
1974	7392				xx				20906			19977					1759			
1975	47784				xx				10248			10198					575			
1976	10424				xx			6	6061			12200					548			
1977	10450				xx			-	97			308					11			
1978	72643	250	82		196	-	2	370	46155			31582	6023	98	234		261			
1979				101	3	-	-	-				1307	2096				1218			
1980		1631	8	14		56	138	-			1742		3035	11308				239		
1981		1122	2			16	40	-		217	7924		4865	6239				375	21	
1982		16083				83	121	-		237	9812		1594	4038		50		364	7	
1983		25852				4	128	14			1829		733	1832		229		4	17	1
1984		7127				1	145	-		50	744		1175	3794					611[1]	17
1985		8253		279		8	6677	-		34	1707		570	7394		966		11	7	4
1986		17137		757		8	459	-		-	801		11283	2464		692				3
1987		2625		1099		34	3144	-		2	482		1963	1641		28		22		
1988		159		1816		4	554	491		-	21		5002	41		66				

Split-	ANI		WIC	TOP			NOR	NOS		ANS	
Year	58.5.1	58.5.2	58.4.2	58.4.4	58.5.1	58.6	58.5.1	58.4.4	58.5.1	58.4.2	58.4.4
1989	23628	-	306	35	1630	21	245	4016	1553	30	17
1990	226	-	339	5	1062	-	155	1463	1262	-	-
1991	13283[2]	-	-	-	1944	-	287	1000	98	-	-
1992	44	3	-	-	7492[3]	13	-	-	4	-	-
1993	-	-	-	-	2722	-	2	-	-	-	-
1994	12	3	-	-	5083	56	-	-	-	-	-
1995	3936	-			5534	114					
1996	5	-	-	-	4911	3			15		
1997	-	215	-	-	4681	333	-	-	-	-	-

[1] Mainly Rajiformes spp.

[2] There are some discrepancies between the French statistics for the Soviet fishery under licence in Division 58.5.1 (12 644 tonnes) and the STATLANT A data provided by the USSR (13 268 tonnes). It may be explained by the inclusion of 826 tonnes of by-catch (mainly Rajiformes) in this total.

[3] 1 589 tonnes - France; 5 903 tonnes - Ukraine, of which 705 tonnes were caught by longline.

NB: Before 1979/80 catches reported in Statistical Area 58 mainly concern Division 58.5.1 (Kerguelen subarea). Catch reporting was not divided into Divisions 58.5.1 and 58.5.2 until the 1989 season.

Table 31: Analysis of deviance table for GLM fitted to time series of CPUE data (tonnes/hour) for *D. eleginoides* from Division 58.5.1.

Effect	df	Deviance	Residual df	Residual Deviance	p
NULL			5 445	4 699.29	
+ year	7	249.69	5 438	4 449.60	<0.01
+ month	11	215.34	5 427	4 234.26	<0.01
+ area	2	64.68	5 425	4 169.58	<0.01
+ nationality	1	10.19	5 424	4 159.39	0.01

Table 32: Percentage of trawl hauls with zero catches for *D. eleginoides* from Division 58.5.1.

Year	Number of Vessels	Mean % Hauls with Catch = 0
1990		
1991		
1992		
1993		
1994	2	0.47
1995	2	1.81
1996	3	3.00
1997	2	0.84

Table 33: Parameters input to the GYM for evaluation of precautionary yield of *D. eleginoides* in Division 58.5.2.

Category	Parameter	*D. eleginoides*
Age composition	Recruitment age in simulation	4
	Number of age classes	35
	Plus class present — years in plus class in initial age structure	21
Resolution	Number of increments per year	360
Natural mortality	Mean annual M	0.12–0.20
Fishing mortality	Age selectivity function: Age (Selectivity)	0. (0.) , 3. (0.), 3.5 (0.07), 4.5 (0.311), 5.5 (0.699), 6.5 (1.0), 7.5 (1.038), 8.5 (0.849), 9.5 (0.579), 10.5 (0.341), 11.5 (0.179), 12.5 (0.085), 13.5 (0.037), 14.5 (0.015), 15. (0.)
	Reasonable upper bound for annual fishing mortality	5
	Tolerance (error) for determining fishing mortality in each year	1E-05
von Bertalanffy Growth	Time 0	0
	L_∞	170.8 cm
	K	0.088
Weight-length ($W = aL^b$)	a	2.5E-05
	b	2.8
Spawning biomass	Maturity-at-age function: age (proportion mature)	0. (0.), 1.39 (0.0002), 2.32 (0.0009), 3.10 (0.0027), 4.13 (0.0096), 4.82 (0.0213), 5.76 (0.0564), 6.56 (0.117), 7.67 (0.270), 8.45 (0.418), 9.49 (0.617), 10.70 (0.792), 11.59 (0.871), 12.58 (0.924), 14.07 (0.964), 16.08 (0.985), 18.90 (0.995), 21.48 (1.0)
	Date when spawning begins	1 July
	Number of increments in spawning season	1 (knife edge)
Recruitment	Mean of $\log_e$ (Recruits)	14.585
	Standard error of the mean of $\log_e$ (Recruits)	0.159
	Standard deviation of $\log_e$ (Recruits)	0.422
Simulation characteristics	Number of runs in simulation for each catch	1001
	Years to project stock to remove effects of initial age structure	1
	Vector of real catches for projecting over known catch period (tonnes)	Run 1: 12061 Run 2: 20261
	Number of years to project stock following known catch period	35
	Seed for random numbers	-24189
Decision rules	Reference point for assessment of long-term annual yield	$0.2.SB_0 median$

Table 34: Analysis of deviance table for GAM fitted to haul-by-haul CPUE data (kg/hook) for *D. eleginoides* from Subarea 58.6 (Crozet Island).

Effect	df	Deviance	Residual df	Residual Deviance	p
NULL			219	93.46	
+ month	4	8.84	215	84.62	0.07
+ depth	2	8.83	213	75.79	0.01

Table 35: Analysis of deviance table for GLM fitted to haul-by-haul CPUE data (kg/hook) for *D. eleginoides* from Subarea 58.7 (Prince Edward Islands).

Effect	df	Deviance	Residual df	Residual Deviance	p
NULL			530	425.56	
+ month	8	144.02	522	281.54	<0.01
+ depth	8	76.12	514	205.41	<0.01

Table 36: Data on marine mammal incidental mortality from scientific observer reports from longline vessels fishing in Subarea 48.3.

Vessel	Observer	Type	Date	Mammals			
				K	E	O	F
Cisne Verde	Ashford, UK	S-2	3–5/97	0	0	Y	Y
Elqui	Raggio, Argentina	S-2	5–7/97	0	-	-	Y
Elqui	Almeyda, Argentina	S-2	7–8/97	0	0	Y	Y
Ercilla	Treves, Argentina	S-2	4–5/97	0	0	Y	TOP (450)
Ercilla	Treves, Argentina	S-2	6–7/97	0	0	Y	-
Ercilla	Marchetti, Argentina	S-2	8/97	SXX (3)	SXX (3)	Y	Y
Ibsa Quinto	Alvarado, Chile	S-2	4–8/97	0	0	Y	Y
Isla Camila	Sinconegui, Argentina	S-2	3–4/97	0	0	Y	Y
Isla Camila	Sinconegui, Argentina	S-2	4–6/97	0	0	N	Y
Isla Camila	Giangualano, Argentina	S-2	7–8/97	0	0	Y	TOP (44) GRV (6)
Isla Isabel	Giangualano, Argentina	S-2	3–4/97	0	0	Y	Y
Isla Isbel	Brachetta, Argentina	S-2	4–6/97	0	0	Y	TOP (47) GRV (7)
Isla Isabel	Caballero, Argentina	S-2	6–8/97	0	0	Y	TOP (10)
Koryo Maru 11	Keith, South Africa	S-2	4–7/97	0	0	Y	Y

Type A = Autoliner; S-1 = Spanish single line; S-2 = Spanish double line

Date Months only

Mammals K = killed; E = entangled; O = observations of frequency of occurrence of marine mammals
(Y = yes; N = no); F = fish loss observed (species, number estimated) or: Y = yes; N = no; - = no information)

Table 37: Data on marine mammal incidental mortality from scientific observer reports from longline vessels fishing in Subareas 58.6 and 58.7.

Vessel	Observer	Type	Date	Mammals			
				K	E	O	F
American Champion	Koen, South Africa	A	8–9/96	-	-	-	-
Aquatic Pioneer	Purves, South Africa	A	11–12/96	0	SPW(1)	Y	N
Aquatic Pioneer	Purves, South Africa	A	1–2/97	0	SPW(1)	Y	N
Aquatic Pioneer	Wanless, South Africa	A	4–6/97	0	0	Y	Y
Aquatic Pioneer	Williams, South Africa	A	7-8/97	0	0	Y	N
Garoya	Boix, ~~Spain~~[1]	S-1	4/97	0	0	Y	N
Sudurhavid	Heinecken, South Africa	S-1	5–6/97	0	MIW(1)	Y	N
Sudurhavid	Heinecken, South Africa	S-1	7/97	0	0	Y	N
Koryo Maru 11	Enticott, South Africa	S-2	11/96–1/97	-	-	-	-
Koryo Maru 11	Heinecken, South Africa	S-2	1–3/97	-	-	-	-
Zambezi	Stoffberg, South Africa	A	3–5/97	0	0	Y	-
Zambezi	Anderson, South Africa	A	7–8/97	0	0	Y	Y

[1] South Africa – see SC-CAMLR-XVI, paragraph 3.8

Type A = Autoliner; S-1 = Spanish single line; S-2 = Spanish double line

Date Months only

Mammals K = killed; E = entangled; O = observations of frequency of occurrence of marine mammals
(Y = yes; N = no); F = fish loss observed (species, number estimated) or: Y = yes; N = no; - = no information)

Table 38: Data on seabird incidental mortality from scientific observer reports from longline vessels fishing in Subarea 48.3.

Vessels	Observer	Type	Date	Sets			Hooks			Bait	Streamer			Offal		Seabirds Killed				Birds at Set	Birds Ent.	Birds Band
				[No]	D	N	[Set]	[Bait]	[Obs]		Type	Time	Success	When	Where	Alb	GP	Pet	Total			
Cisne Verde	Ashford UK	S-2	3–5/97	61			654.4	100	20	T	C	DN	H	H	S	2	0	9	12	Y	Y(24)	
Elqui	Raggio Argentina	S-2	5–7/97	(51)	0	100	(695)	100	(96)	(T)	-	No	-	S,H	S	0	0	0	0	N	Y(7)	Y(2)
Elqui	Almeyda Argentina	S-2	7–8/97	40	-	-	457	100	71	(T)	N	3%	-	S,H	S	0	0	0	0	Y		
Ercilla	Treves Argentina	S-2	4–5/97	44	10	90	512	100	60	(T)	C	D	-	-	-	34	3	0	38	Y	Y	
Ercilla	Treves Argentina	S-2	6–7/97	36	4	96	335	100	45	(T)	C	D	H	-	-	0	0	0	0	Y	Y	
Ercilla	Marchetti Argentina	S-2	8/97	50	20	80	244	100	62	(T)	-	No	-	-	-	0	0	0	0	Y	Y(8)	
Ibsa Quinto	Alvarado Chile	S-2	4–8/97	(167)	10	(90)	1184	(100)	60	-	C	N	-	-	O	33	8	0	41	Y	Y(1)	Y(1)
Isla Camila	Sinconegui Argentina	S-2	3–4/97	45	-	-	365	100	18	(T)	N	-	-	H	S	2	0	51	53	N		
Isla Camila	Sinconegui Argentina	S-2	4–6/97	44	-	-	489	100	18	(T)	N	-	-	-	-	4	0	6	10	N	Y(10)	
Isla Camila	Giangualano Argentina	S-2	7–8/97	53	-	-	460	100	9	(T)	-	No	-	H	S	0	0	0	0	Y		
Isla Isabel	Giangualano Argentina	S-2	3–4/97	35	3	97	275	100	10	T	C	N	-	H	S	126	6	148	280	Y	Y(23)	Y(3)
Isla Isabel	Brachetta Argentina	S-2	4–6/97	51	0	100	527	100	53	(T)	C	N	H	(H)	O	4	-	-	-	Y		
Isla Isabel	Caballero Argentina	S-2	6–8/97	45	0	100	431	100	45	T	C	N	H	(H)	O	0	0	0	0	Y		
Koryo Maru 11	Keith, Sth Africa	S-2	4–7/97	92			854.0	99 (845.5)	(100)	-	C	-	-	H	S	1	0	8	9	-	Y(9)	

[ ] = data entered by Secretariat
( ) = estimated data

Type	A = Autoliner; S-1 = Spanish single line; S-2 = Spanish double line
Date	Months only
Sets	D = daylight %; N = night %
Hooks	Set = thousands of hooks Bait = % baited Obs = % observed; values in parenthesis inferred
Bait	T = thawed; (T) = inferred thawed
Streamer	Type: C = CCAMLR design; ±C = similar to CCAMLR design; N = non-CCAMLR design; No = not used Time = proportion (%) of sets for which streamer line used, or whether streamer line used at night (N), day (D), day and moonlit nights (D+). Success: Observer opinion of success of using streamer line: H = high; M = medium; L = low
Offal	When: H = haul; S = set Where: O = opposite side to haul; S = same side as haul
Seabirds killed	Alb = albatrosses; GP = giant petrels; Pet = petrels (note that Other and Unidentified are not totalled separately)
Catch rate	Birds per thousand hooks
Birds band	Banded birds recovered and details recorded (Y = yes, number in parenthesis)
Birds at set	Data recorded on abundance of seabirds around the vessel during the set (Y = yes; N = no)
Birds ent.	Data on species and/or number of birds entangled during hauling (Y = yes, number in parenthesis; N = no)
-	No information

Table 39: Data on seabird incidental mortality from scientific observer reports from longline vessels fishing in Subareas 58.6 and 58.7.

Vessel	Observer	Type	Date	Sets				Hooks			Bait	Streamer			Offal		Seabirds Killed				Catch Rate		Birds	Birds	Birds
				No.	D	T	N	Set	Bait	Obs		Type	Time	Value	When	Where	Alb	GP	Pet	Total	All	Baited	at Set	Ent.	Band
American Champion	Koen, Sth Africa	A	8–9/96	263				845.2	-	-	-	-	-	-	-	-	0	0	0	0	0	-	Y	Y(1)	
Anyo Maru 22	-	S-1	12/96–4/97	219			100	865.3		(100)	-	C	DN	-	H	O	1	0	26	27	0.031	-	-	Y(1)	-
Aquatic Pioneer	Purves, Sth Africa	A	11–12/96	101	78*		22*	288.7	82.5 (238.2)	(100)	-	±C	most	M	-	-	25	4	108	138	0.478	0.579	N	Y	Y(1)
Aquatic Pioneer	Purves, Sth Africa	A	1–2/97	82	33*		67*	287.0	82.5 (236.8)	(100)	-	±C	D,N	M	H	-	3	8	403	415	1.446	1.753	N	Y	
Aquatic Pioneer	Wanless, Sth Africa	A	4–6/97	109	15 20*		85 80*	389.1	82.5 (321.0)	(100)	T	±C	23%	-	S,H	-	5	0	0	5	0.012	0.016	N	-	
Aquatic Pioneer	Williams, Sth Africa	A	7-8/97	54	17	13	70	207.5	60 (124.5)	47	-	±C	D	M	H	O	0	1	0	1	0.010	0.016	Y	N	
Garoya	Boix, ~~Spain~~[1]	S-1	4/97	62	50*		50*	251.6	67.5 (169.8)	(100)	T	C	part	M	H	O	67	10	4	82	0.326	0.483	Y	N	
Koryo Maru 11	Heinecken, Sth Africa	S-2	11/96–1/97	48	64 47*		36 53*	248.2	100	(100)	T	C	DN	H	H	O	15	7	22	44	0.177	0.177	N	N	
Koryo Maru 11	Heinecken, Sth Africa	S-2	1–3/97	51	72 94*	8	20 6*	297.8	(100)	(100)	T	C	DN	-	H	O,S	50	0	83	133	0.447	0.447	Y	Y(18)	
Sudur-havid	Enticott, Sth Africa	S-1	5–6/97	66	41*		59*	247.1	100	(100)	T	±C	D+	-	H	S	0	4	0	5	0.020	0.020	N	N	
Sudur-havid	Heinecken, Sth Africa	S-1	7/97	20	-		-	74.0	100	(100)	T	±C	D+	-	H	S	0	1	0	1	0.014	0.014	N	N	
Zambezi	Stoffberg, Sth Africa	A	3–5/97	190	48*		52*	699.0	85 (594.1)	(100)	-	N	part	-	H	O	38	2	15	55	0.079	0.093	N	Y(1+)	
Zambezi	Anderson, Sth Africa	A	7–8/97	80	1		99	356.0	73 (259.9)	(100)	-	C	49%	-	-	-	0	0	0	0	0	0	N	N	

[1] South Africa – see SC-CAMLR-XVI, paragraph 3.8

Type	A = Autoliner; S-1 = Spanish single line; S-2 = Spanish double line
Date	Months only
Sets	D = daylight %; T = twilight (dawn, dusk) %; N = night %; * = % of hooks set (as opposed to % of sets)
Hooks	Set = thousands of hooks Bait = % baited, with estimated number of hooks in parenthesis Obs = % observed; values in parenthesis inferred
Bait	T = thawed; (T) = inferred thawed
Streamer	Type: C = CCAMLR design; ±C = similar to CCAMLR design; N = non-CCAMLR design; No = not used
	Time = proportion (%) of sets for which streamer line used, or whether streamer line used at night (N), day (D), day and moonlit nights (D+).
	Success: Observer opinion of success of using streamer line: H = high; M = medium; L = low
Offal	When: H = haul; S = set Where: O = opposite side to haul; S = same side as haul
Seabirds killed	Alb = albatrosses; GP = giant petrels; Pet = petrels (note that Other and Unidentified are not totalled separately)
Catch rate	Birds per thousand hooks
Birds band	Banded birds recovered and details recorded (Y = yes, number in parenthesis)
Birds at set	Data recorded on abundance of seabirds around the vessel during the set (Y = yes; N = no)
Birds ent.	Data on species and/or number of birds entangled during hauling (Y = yes, number in parenthesis; N = no)
-	No information

Table 40: Summarised incidental mortality data of seabirds in longline fisheries for *D. eleginoides* in Subareas 48.3 and 88.1/88.2 during the 1996/97 season. Sp – Spanish method, Auto – Mustad autoliner, N – night-time setting, D – daytime setting (including nautical dawn and dusk), O – opposite side to hauling, S – same side as hauling, * – data obtained from observer cruise report. Shaded areas indicate extrapolated values.

Vessel	Dates of Fishing	Method	Streamer Line in Use (%)		Offal Discharge at Haul	Sets Deployed				Number of Hooks (1 000s)					Hooks Baited (%)	Number of Birds Caught			Observed Catch Rates of Dead Birds (birds/1 000 hooks)		
										Observed			Set Total	Percent Observed		Dead		Total			
			N	D		N	D	Total	%N	N	D	Total				N	D		N	D	Total
Subarea 88.1/88.2:																					
Lord Auckland	16–19/5/97	Auto	100	100	S	1	1	2	50	1.58	1.58	3.176	3.176	100	85	0	0		0	0	0
Subarea 48.3:																					
Argos Helena	2/3–11/8/97	Sp	0	0	S	150	15	165	91	284.0	45.4	329.4	1 392.9	23	95	128	62	190	0.45	1.37	0.58
Cisne Verde	24/3–23/5/97	Sp	66	60	S	56	5	61	92	119.6	13.3	132.9	654.4	20	100	10	2	12	0.08	0.15	0.09
Cisne Verde	22/6–29/8/97	Sp	2	0	S	93	6	99	94	417.3	29.4	446.7	951.9	46	100	0	0	0	0	0	0
Elqui	18/3–9/5/97	Sp	0	0	S	49	0	49	100	302.8	0	302.8	690	43	100	94	0	94	0.31	0	0.31
*Elqui**	20/5–21/7/97	Sp							89				695.4						0.18	0.93	0.23
Elqui	29/7–31/8/97	Sp	0	33	S	37	3	40	93	297.5	28.6	326.1	456.9	71	100	0	0	0	0	0	0
Ercilla	16/4–28/5/97	Sp	0	0	S	40	4	44	91	308.2	2.8	311.0	512.3	60	100	14	10	24	0.05	3.64	0.07
Ercilla	8/6–10/7/97	Sp	0	0	S	35	1	36	97	144.0	8.0	152.0	335.0	45	100	0	0	0	0	0	0
Ercilla	8/8–31/8/97	Sp	0	0	S	39	11	50	78	121.3	31.1	152.4	243.7	62	100	0	0	0	0	0	0
*Ibsa Quinto**	17/4–31/8/97	Sp							89			710.5	1 184.0	60		41		41	0.18	0.93	0.23
*Ihn Sung 66**	7/4–31/8/97	Auto				87	84	171	51			366.1	1 694.3	22					0.18	0.93	0.23
Isla Camila	5/3–7/4/97	Sp	98	0	S	41	4	45	91	64.0	4.5	68.5	364.7	18	100	43	6	49	0.67	1.32	0.72
Isla Camila	20/4–6/6/97	Sp	87	0	S	44	0	44	100	88.5	0	88.5	489.3	18	100	10	0	10	0.11	0	0.11
Isla Camila	4/7–18/8/97	Sp	2	0	S	53	0	53	100	44.3	0	44.3	459.8	9	100	0	0	0	0	0	0
Isla Isabel	13/3–9/4/97	Sp	67	100	S	30	5	35	86	24.6	5.0	29.6	274.6	11	100	175	101	276	7.11	20.14	9.31
Isla Isabel	23/4–10/6/97	Sp	100	100	S	50	1	51	98	276.0	6.9	282.9	527.3	53	100	4	0	4	0.01	0	0.01
Isla Isabel	24/6–10/8/97	Sp	100	100	S	44	1	45	98	194.2	2.5	196.7	431.0	45	100	0	0	0	0	0	0
Jacqueline	16/4–29/5/97	Auto	0	0	S	32	12	44	73	14.1	5.4	19.5	380.9	5	100	1	9	10	0.07	1.65	0.51
Jacqueline	5/7–31/8/97	Auto	0	0	S	69	21	90	77	31.3	10	41.3	683.0	6	100	0	6	6	0	0.60	0.15
*Koryo Maru 11**	30/3–11/8/97	Auto	100	0	S	92	0	92	100	854	0	854	854	100	99	9	0	9	0.01	0.01	0.02
*Pescarosa Primero**	2/5–11/9/97	Sp							89				277.6						0.18	0.93	0.23
Total									89			4855	13 553.0					725			

Table 41: Summarised incidental mortality data of seabirds in longline fisheries for *D. eleginoides* in Subareas 58.6 and 58.7 during the 1996/97 season. Sp – Spanish method, Auto – Mustad autoliner, N – night-time setting, D – daytime setting (including nautical dawn and dusk), O – opposite side to hauling, S – same side as hauling.

Vessel	Dates of Fishing	Method	Streamer Line in Use (%)		Offal Discharge at Haul	Sets Deployed				Number of Hooks (1 000s)					Hooks Baited (%)	Number of Birds Caught			Observed Catch Rates of Dead Birds (birds/1 000 hooks)		
										Observed			Set Total	Percent Observed		Dead		Total			
			N	D		N	D	Total	%N	N	D	Total				N	D		N	D	Total
Alida Glacial	21/10–27/12/96	Auto																			
Aliza Glacial	7/12/96–7/1/97	Auto																			
American Champion	14/8–28/9/96	Auto																			
American Champion	24/10–21/11/96	Auto																			
Aquatic Pioneer	31/10–10/12/96																				
Aquatic Pioneer	13/1–22/2/97	Auto	100	100	S	61	21	82	74	214	73	287	287	100		337	78	415	1.57	1.07	1.45
Aquatic Pioneer	26/4–11/697	Auto	9	71	S	88	21	109	81	313	75.5	388.5	388.5	100	80	0	4	4	0	0.05	0.01
Aquatic Pioneer	22/7–22/8/97	Auto	8	63	S	38	16	54	70	63.6	26.9	90.5	205.5	44	60	0	1	1	0	0.04	0.01
Garoya	5/4–10/5	Sp																			
Koryo Maru 11	10/11/96–5/1/97	Sp																			
Koryo Maru 11	17/1–22/3/97	Sp																			
Mr B	22/10–28/11/96	Auto																			
Mr B	29/1–14/2/97	Auto																			
Sudurhavid	15/5–16/6/97	Sp																			
Sudurhavid	4/7–24/7/97	Sp																			
Zambezi	19/3–16/5/97	Auto																			
Zambezi	25/6–29/9/97	Auto																			

Table 42: Summary of the species composition of birds killed in longline fisheries in Subarea 58.7 during the 1996/97 season. N – night setting, D – daylight setting (including nautical dawn and dusk), DIX – wandering albatross, DIM – black-browed albatross, DIC – grey-headed albatross, YNA – yellow-nosed albatross, PHE – light-mantled sooty albatross, ALZ – albatross unidentified, MAI – southern giant petrel, MAH – northern giant petrel, PRO – white-chinned petrel, PCI – grey petrel, PTZ – petrels unidentified, SKZ – skuas, UNK – unknown, * – data derived from scientific observer cruise reports.

Vessel	Dates of Fishing	Number of Birds Killed, by Group						Composition by Species												
		Petrels		Albatross		Total		DIX	DIM	DIC	YNA	PHE	ALZ	MAI	MAH	PRO	PCI	PTZ	SKZ	UNK
		N	D	N	D	N	D													
*American Champion**	24/10–21/11/96	1		0		1								1						
*Aquatic Pioneer**	31/10–10/12/96	112		25		137			2	15	8			3	1	108			1	
Aquatic Pioneer	13/1–22/2/97	336	75	0	3	336	78			2		1		6	2	403				1
Aquatic Pioneer	26/4–11/6/97	0	0	0	4	0	4			4										
Aquatic Pioneer	22/7–22/8/97	0	1	0	0	0	1							1						
*Garoya**	5/4–10/5/97	15		67		82		1		66				3	7	4	1			
Koryo Maru 11	10/11/96–5/1/97	29		15		44				11	4			7		22				
Koryo Maru 11	17/1–22/3/97	83		50		133							50					83		
*Sudurhavid**	15/5–16/6/97	4		0		4												4		1
*Sudurhavid**	4/7–24/7/97	1		0		1								1						
*Zambezi**	19/3–16/5/97	17		38		55			2	36				2		14	1			
Total (%)		674		202		876		1(0.1)	4(0.5)	134(15)	12(1)	1(0.1)	50(6)	24(3)	10(1)	551(63)	2(0.2)	87(10)	1(0.1)	2(0.2)

Table 43: Total seabird mortality by species for Subarea 58.7 during the 1996/97 fishing season.

Species	Total	Species	Total
Wandering albatross	1	Northern giant petrel	10
Black-browed albatross	4	White-chinned petrel	551
Grey-headed albatross	134	Grey petrel	2
Yellow-nosed albatross	12	Petrels unidentified	87
Light-mantled sooty albatross	1	Skuas	1
Albatross unidentified	50	Unidentified	2
Southern giant petrel	24		
		Total	879

Table 44: Summary of the species composition of birds killed in longline fisheries in Subarea 48.3 and adjacent areas during the 1996/97 season. N – night setting, D – daylight setting (including nautical dawn and dusk), DIX – wandering albatross, DIM – black-browed albatross, DIC – grey-headed albatross, PHE – light-mantled sooty albatross, MAI – southern giant petrel, MAH – northern giant petrel, PRO – white-chinned petrel, PTZ – petrels unidentified, UNK – unknown, * – data obtained from scientific observer cruise reports.

Vessel	Dates of Fishing	Number of Birds Killed by Group						Composition by Species								
		Petrels		Albatross		Total		DIX	DIM	DIC	PHE	MAI	MAH	PRO	PTZ	UNK
		N	D	N	D	N	D									
Argos Helena	2/3–11/8/97	114	3	14	59	128	62	2	68	3		3		114		
Cisne Verde	24/3–23/5/97	7	2	2	0	9	2		2					9		1
Elqui	18/3–9/5/97	60	0	34	0	94	0		31	1	2			60[1]		
Ercilla	16/4–25/5/97	0	3	14	7	14	10		21			3				
*Ibsa Quinto**	17/4–31/8/97	8		33		41			33					8		
Isla Camila	5/3–7/4/97	42	6	1	0	43	6		1						48	
Isla Camila	20/4–6/6/97	6	0	4	0	10	0		4					4	2	
Isla Isabel	13/3–9/4/97	120	30	55	71	175	101	1[2]	122	3			6	144		
Isla Isabel	23/4–10/6/97	0	0	4	0	4	0		3	1						
Jacqueline	16/4–29/5/97	0	0	1	9	1	9		3	7						
Jacqueline	5/7–31/8/97	0	5	0	1	0	6		1			5				
*Koryo Maru 11**	30/3–31/8/97	8	0	1	0	9	0		1					8		
Total (%)		414		310		724		3(0.4)	290(40)	15(2)	2(0.3)	11(1)	6(0.8)	347(48)	50(7)	1(0.1)

[1] These birds were originally identified as sooty albatross (see paragraph 7.50)

[2] This bird was originally identified as a royal albatross (see paragraph 7.50)

Table 45: Total estimated seabird mortality per vessel for Subarea 48.3 during the 1996/97 fishing season.

Vessel	Hooks Set (1 000s)	Night Sets (%)	Estimated Number of Birds Caught Dead		
			Night	Day	Total
Argos Helena	1 392.9	91.0	580.39	171.74	742.14
Cisne Verde	654.4	92.0	48.16	7.85	56.02
Cisne Verde	951.9	94.0	0	0	0
Elqui	690.0	100.0	213.9	0	213.9
Elqui	695.4	89.0	109.27	70.93	180.21
Elqui	456.9	93.0	0	0	0
Ercilla	512.3	91.0	20.98	167.83	188.81
Ercilla	335.0	97.0	0	0	0
Ercilla	243.7	78.0	0	0	0
Ibsa Quinto	1 184.0	89.0	186.05	121.12	307.17
In Sung 66	1 694.3	51.0	152.56	772.09	924.66
Isla Camila	364.7	91.0	222.36	43.33	265.68
Isla Camila	489.3	100.0	53.82	0	53.82
Isla Camila	459.8	100.0	0	0	0
Isla Isabel	274.6	86.0	1 679.07	774.26	2 453.33
Isla Isabel	527.3	98.0	5.17	0	5.17
Isla Isabel	431.0	98.0	0	0	0
Jacqueline	380.9	73.0	19.46	169.69	189.15
Jacqueline	683.0	77.0	0	94.25	94.25
Koryo Maru 11	854.0	100.0	8.54	0	8.54
Pescarosa Primero	277.6	89.0	43.62	28.4	72.02
Total	13 553.0		3 333.36	2 421.51	5 754.87

Table 46: Total estimated seabird mortality, by species, for Subarea 48.3 during the 1996/97 fishing season.

Species	Dead			Percent
	Night	Day	Total	
Wandering albatross	13.9	10.2	24.1	0.4
Black-browed albatross	1 348.2	979.4	2 327.6	40.4
Grey-headed albatross	69.7	50.7	120.4	2.1
Light-mantled sooty albatross	9.3	6.8	16.1	0.3
Southern giant petrel	51.1	37.2	88.3	1.5
Northern giant petrel	27.9	20.3	48.2	0.8
White-chinned petrel	1 576.0	1 144.9	2 720.9	47.3
Petrels unidentified	232.5	168.9	401.3	7.0
Unidentified	4.6	3.4	8.0	0.1
Total	3 333	2 422	5 755	100

Table 47: Total number of seabirds caught alive in Subarea 48.3 during the 1996/97 fishing season. N – night-time setting, D – daytime setting (including nautical dawn and dusk), * – data obtained from observer cruise reports.

Vessel	Number of Birds Caught Alive		
	N	D	Total
Argos Helena	80	9	89
Cisne Verde	18	6	24
Cisne Verde	1	1	2
Elqui	121	0	121
Elqui	6	0	6
*Elqui**	7		7
Ercilla	40	0	40
Ercilla	3	0	3
Ercilla	8	0	8
*Ibsa Quinto**	0		0
*In Sung 66**			
Isla Camila	2	2	4
Isla Camila	9	0	9
Isla Camila	0	0	0
Isla Isabel	23	0	23
Isla Isabel	10	0	10
Isla Isabel	1	0	1
Jacqueline	3	0	3
Jacqueline	1	0	1
*Koryo Maru 11**	9	0	9
*Pescarosa Primero**			
Total			360

Table 48: Seabird mortality catch rates for Subarea 48.3 during the 1996/97 fishing season.

Season	Seabird Catch Rates (birds/1 000 hooks)		
	Night	Day	Total
March – April	0.66	4.85	0.87
May – August	0.003	0.084	0.0083

Table 49: Estimate of seabird by-catch in the unregulated *Dissostichus* fishery in Subareas 58.6 and 58.7 in 1996/97.

Data Source for *Dissostichus* Catch Rate	Unregulated Catch (tonnes)		*Dissostichus* Catch Rate (kg/1 000 hooks)		Unregulated Effort (1 000 hooks)		Seabird By-catch Rate (birds/1 000 hooks)				Estimated Total Unregulated Seabird By-catch			
	Summer*	Winter*	Summer	Winter	Summer	Winter	Summer		Winter		Summer		Winter	
							Mean	Max	Mean	Max	Mean	Max	Mean	Max
GLM	28120.4	2679.6	380.8	-	73845.6	-	0.363	1.446	-	-	26806	106780	-	-
SC-CAMLR-XVI/BG/28	28120.4	2679.6	615.7	330	45672.2	8120.0	0.363	1.446	0.009	0.02	16572	66042	73	162

* Annex D, Table D.3 estimates total catch at 30 800 tonnes. It has been divided into summer and winter according to the table in SC-CAMLR-XVI/BG/28.

Table 50: Summary of observed seabird by-catch and by-catch rates for Real Time Monitoring Program observer cruise in 1995 for which seabird by-catch data are currently available. Identification of seabirds as albatrosses or petrels was made by the observers at the time of recovery.

Vessel	Cruise	Area of Operation	No. of Sets	Start Date	Finish Date	Pole Length (m)	Line Length (m)	Streamers	No. of Seabirds	No. of Albatross	No. of Petrels	Unknown	Obs. Hooks (1 000s)	Seabirds per 1 000 Hooks
1	1	S Atlantic	24	15/6/95	20/7/95	3.5	110	bait straps	16	10	5	0	43.6	0.37
	2 (total)	SE Indian	42	23/7/95	22/9/95				27	27	0	0	88.8	0.30
	2 (first 8 sets)					4	100	none	21	21	0	0	13.8	1.52
	2 (last 34 sets)					10	150	bait straps	6	6	0	0	75.0	0.08
	3	SE Indian	20	22/9/95	18/10/95	8.5	144	3–4 m	0	0	0	0	50.3	0.00
2	1	Sth Africa	28	16/6/95	24/7/95				14	8	2	4	77.9	0.18
3	1	SE Indian	69	21/8/95	16/10/95	8.9	48–70	6–10 m	45	42	0	3	114.8	0.39
4	1	Sth Africa	37	15/5/95	22/6/95				24	19	4	1	100.9	0.24
5	1	Tasman Sea	31	15/5/95	20/6/95				1	1	0	0	65.8	0.02
6	1	Tasman Sea	32	15/5/95	16/6/95				1	1	0	0	95.9	0.01
7	1	Sth Africa	42	13/5/95	24/6/95				106	89	17	0	101.4	1.05
8	1	Sth Africa	67	7/5/95	20/7/95				20	11	9	0	137.2	0.15

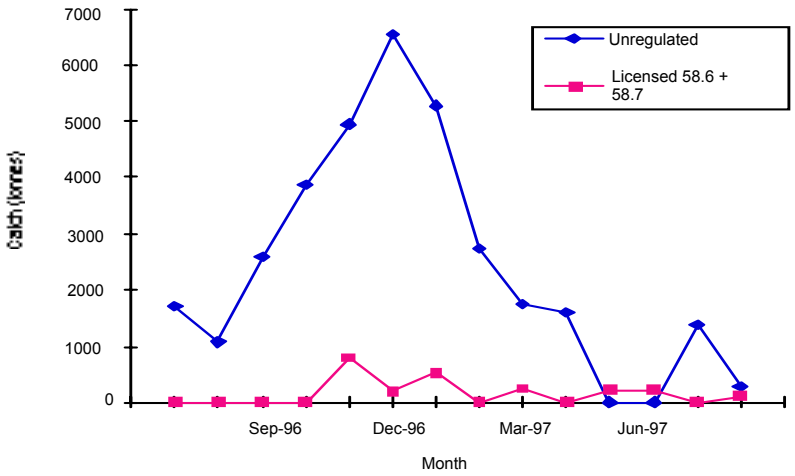

Figure 1: Catches estimated from landings in southern African ports from the unregulated fishery and catches from the licensed fishery in the South African EEZ in Subareas 58.6 and 58.7 by month from July 1996 to August 1997.

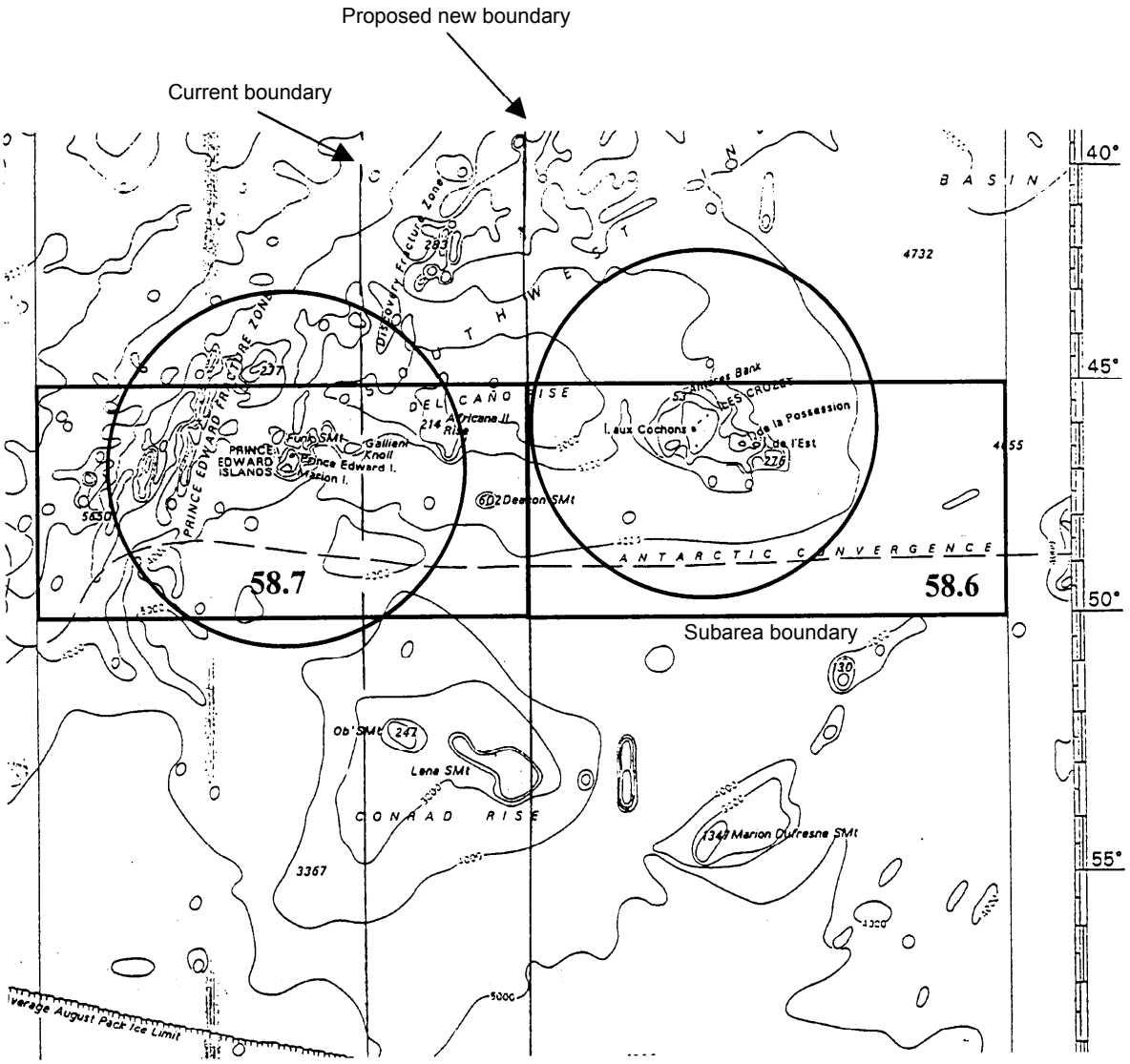

Figure 2: Proposed change of boundary between Subareas 58.6 and 58.7.

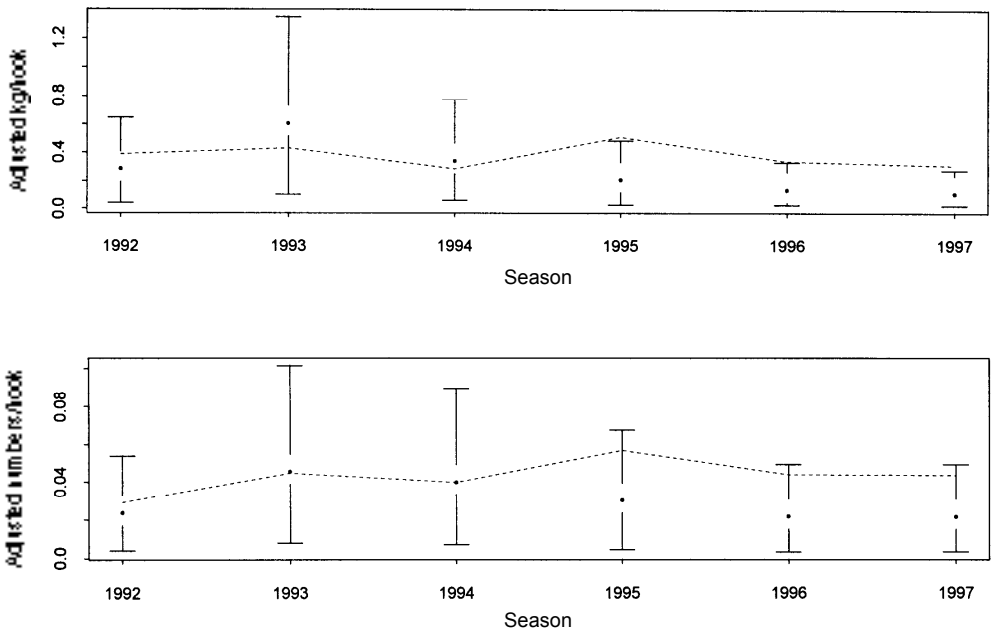

Figure 3: Time series of predicted fishing season effects on kilogram and numbers per hook of *D. eleginoides* from Subarea 48.3. The dashed lines are unstandardised catch rates; the whisker plots are standardised catch rates. All catch rates are adjusted for the presence of zero catches.

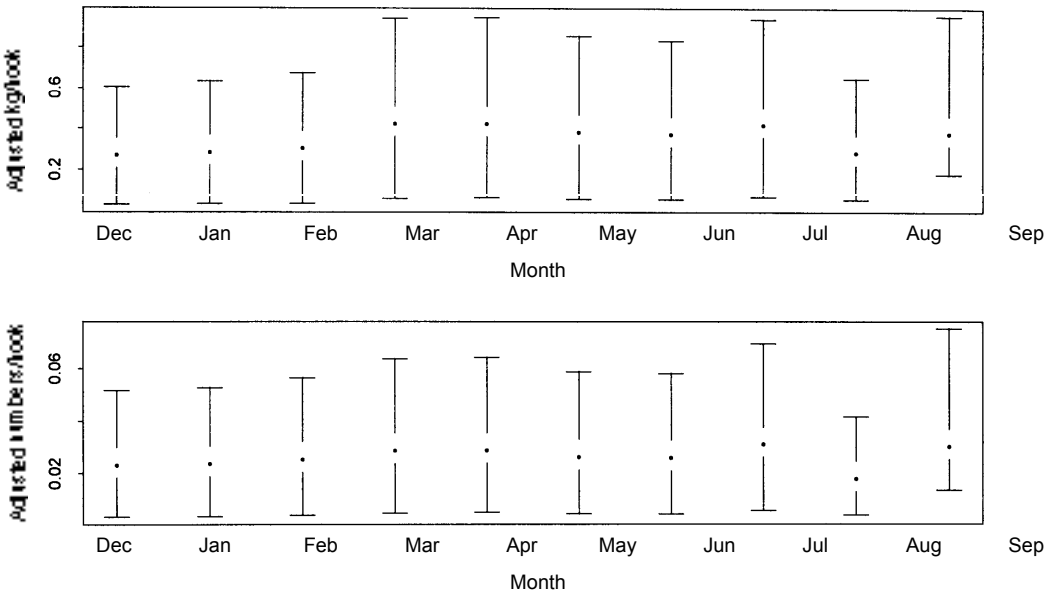

Figure 4: Predicted month effects on kilogram and numbers per hook of *D. eleginoides* in Subarea 48.3. The plots are standardised to the 1992 fishing season. Standardised catch rates for other fishing seasons would show the same monthly trends but would be scaled differently.

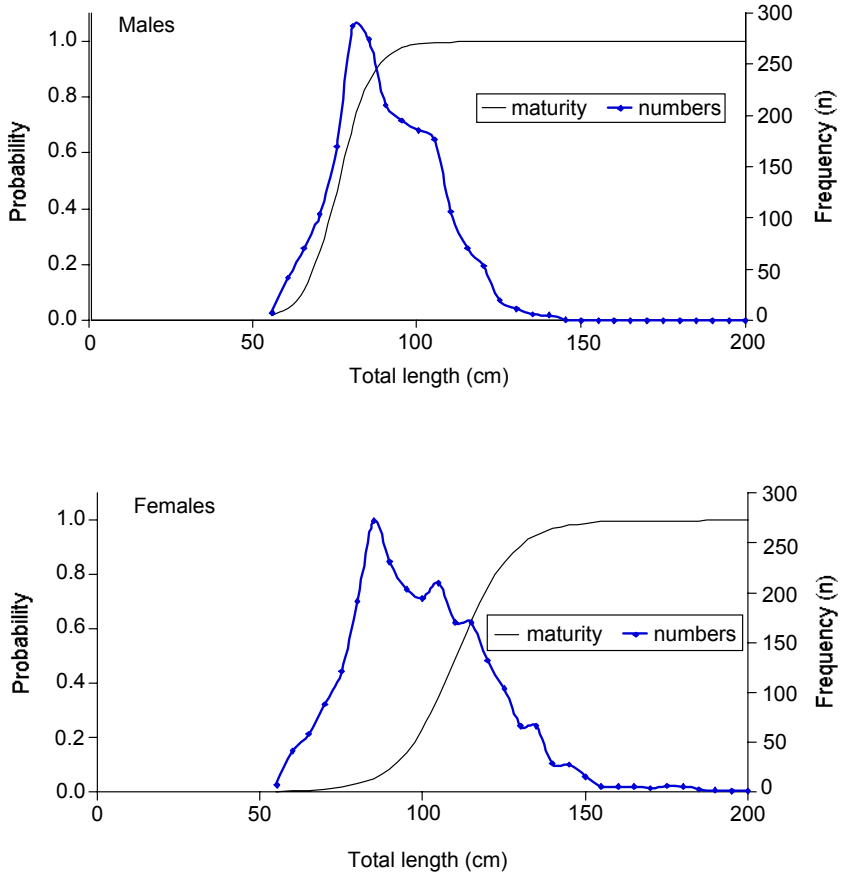

Figure 5: Size composition of the *D. eleginoides* catches in Subarea 48.3 during 1997 and the maturity ogive for males and females from August, the peak month of reproduction.

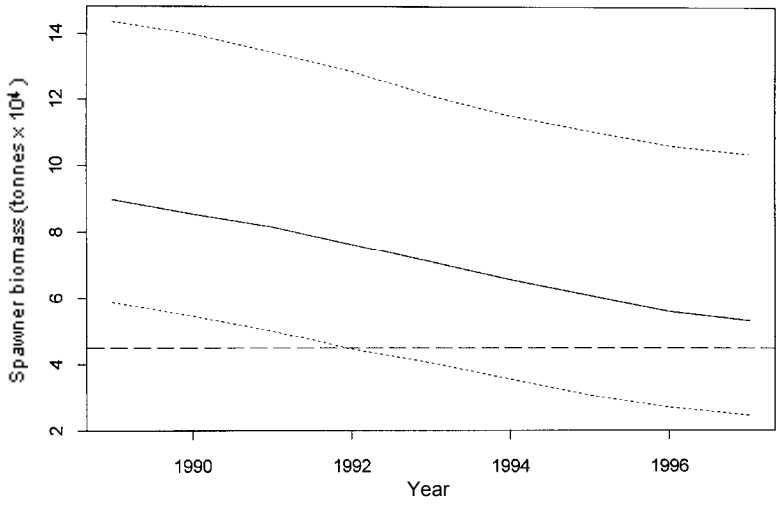

Figure 6: Annual trend in median spawning stock biomass predicted by the GYM. The dashed horizontal line drawn across the graph at approximately 4.5 x 10^4 tonnes is the level of spawning stock biomass that is equal to one half of the median unexploited spawning stock biomass.

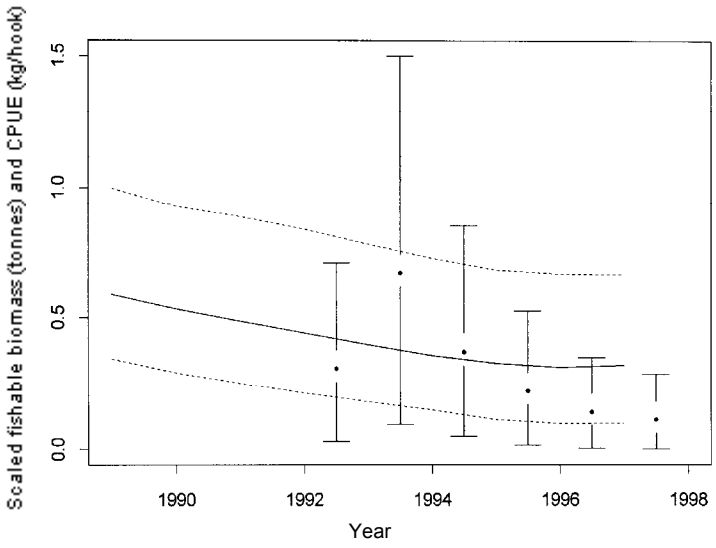

Figure 7: Predicted annual trends in median fishable biomass (solid line with 95% confidence bounds plotted as dashed lines) and standardised kg/hook (whisker plots) of *D. eleginoides* in Subarea 48.3. The two time series are scaled so that the areas under curves defined by median fishable biomass and expected standardised CPUE (solid dots) are appoximately equal. Median fishable biomasses are plotted on March 1 of each year, and standardised catch rates are plotted on September 30 of each year.

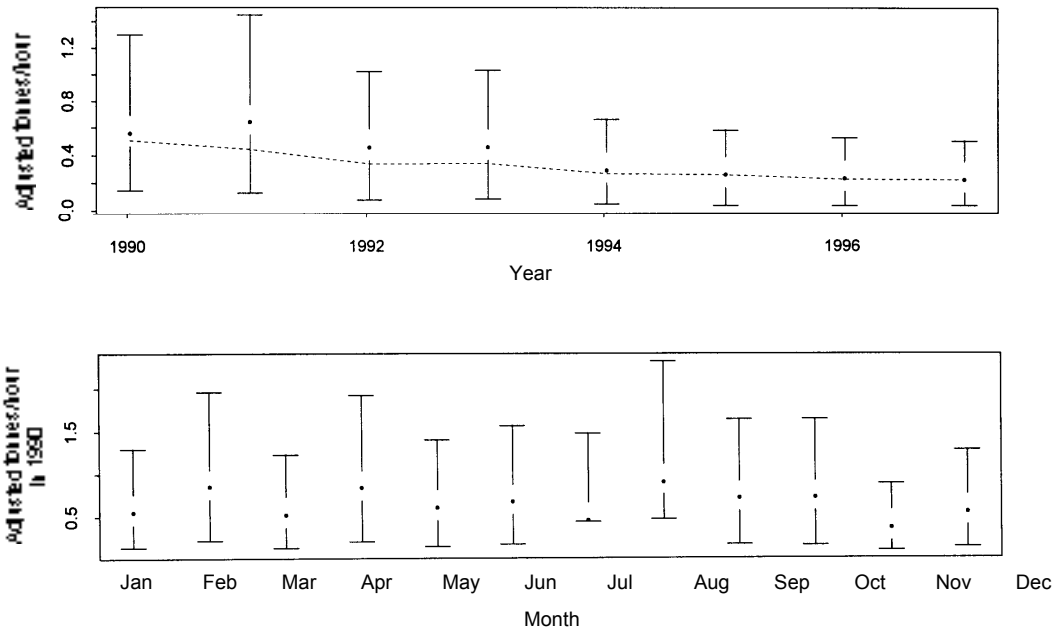

Figure 8: Predicted year (upper panel) and month (lower panel) effects on kg/hour of *D. eleginoides* from Division 58.5.1. The dashed line is the trend of unstandardised catch rates; the whisker plots are standardised catch rates. All catch rates in the upper panel are adjusted for the presence of zero catches.

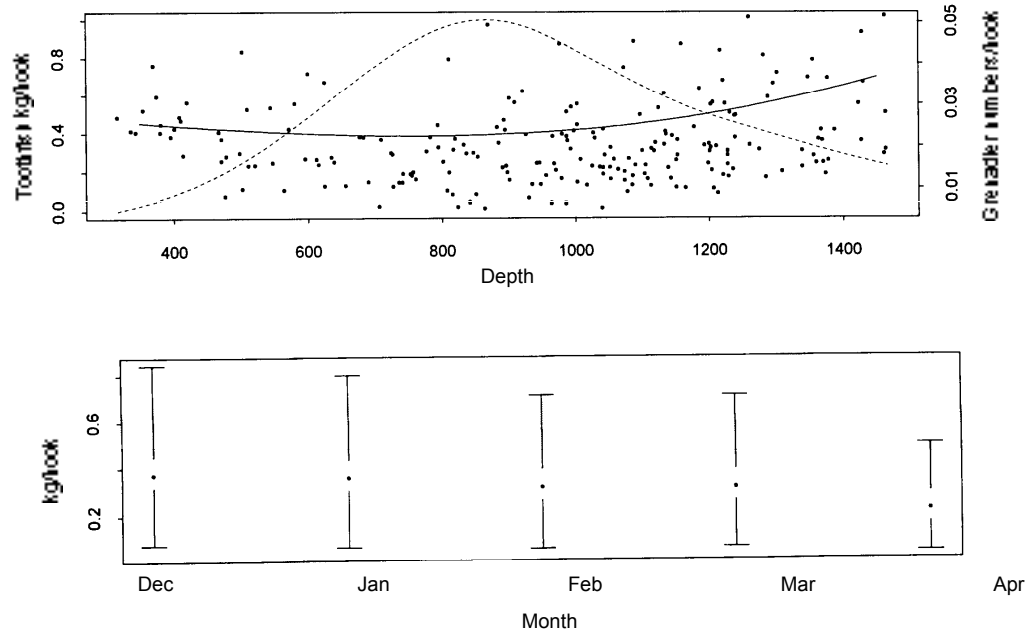

Figure 9: Depth (upper panel) and month (lower panel) effects on kg/hook of *D. eleginoides* from Subarea 58.6 (Crozet Island). In the upper panel, the data points are observed catch rates of *D. eleginoides* (kg/hook); the solid line is the predicted CPUE of *D. eleginoides* from the GAM described in Table 34; and the dashed line is the predicted CPUE of grenadiers (numbers/hook) from the GAM described in paragraphs 4.291 and 4.292.

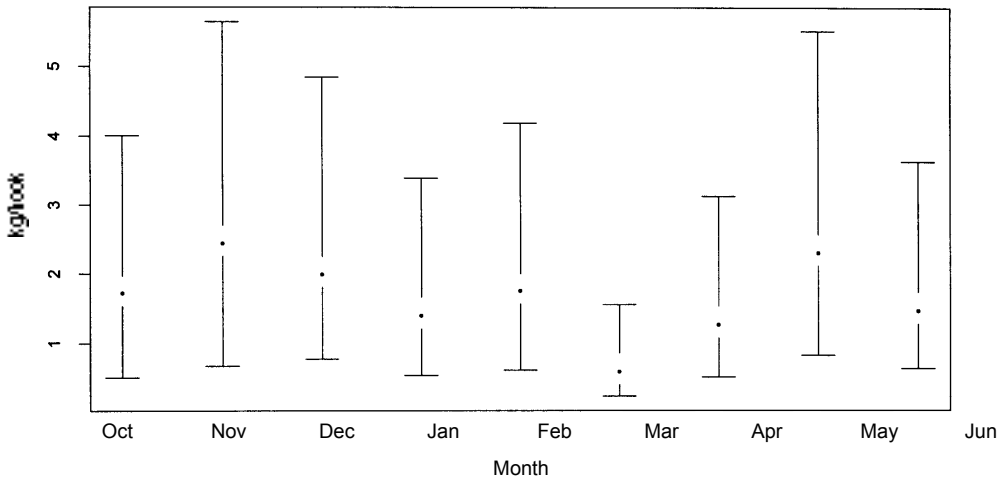

Figure 10: Effect of month on standardised CPUE of *D. eleginoides* from Subarea 58.7 (Prince Edward Islands).

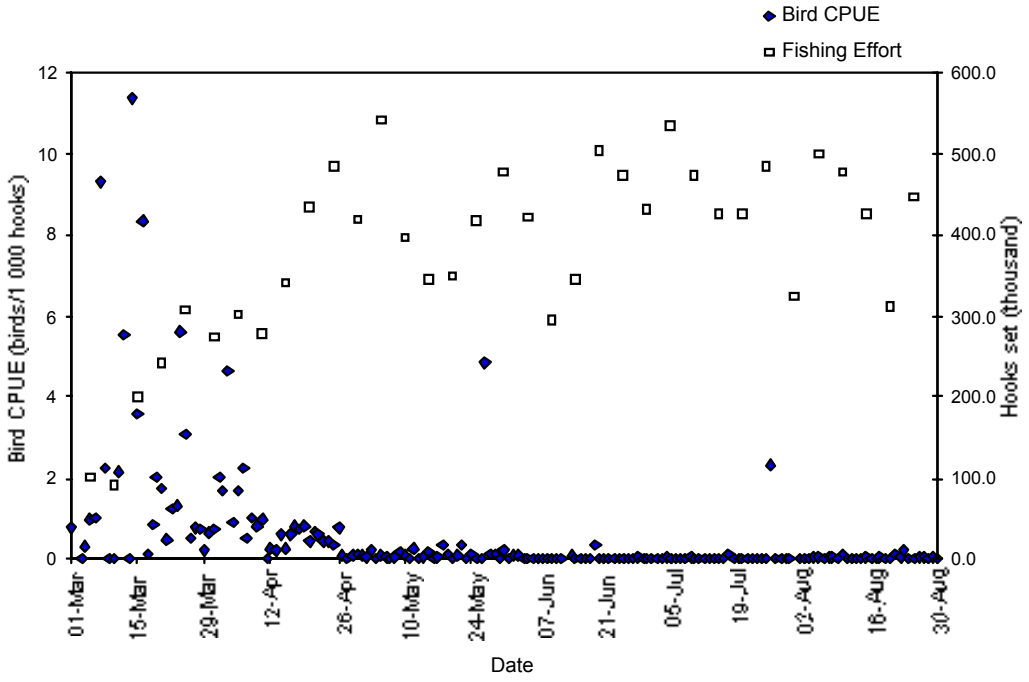

Figure 11: Daily catch-per-unit-effort values for seabird by-catch and fishing effort (hooks set) for Subarea 48.3 during the 1996/97 fishing season.

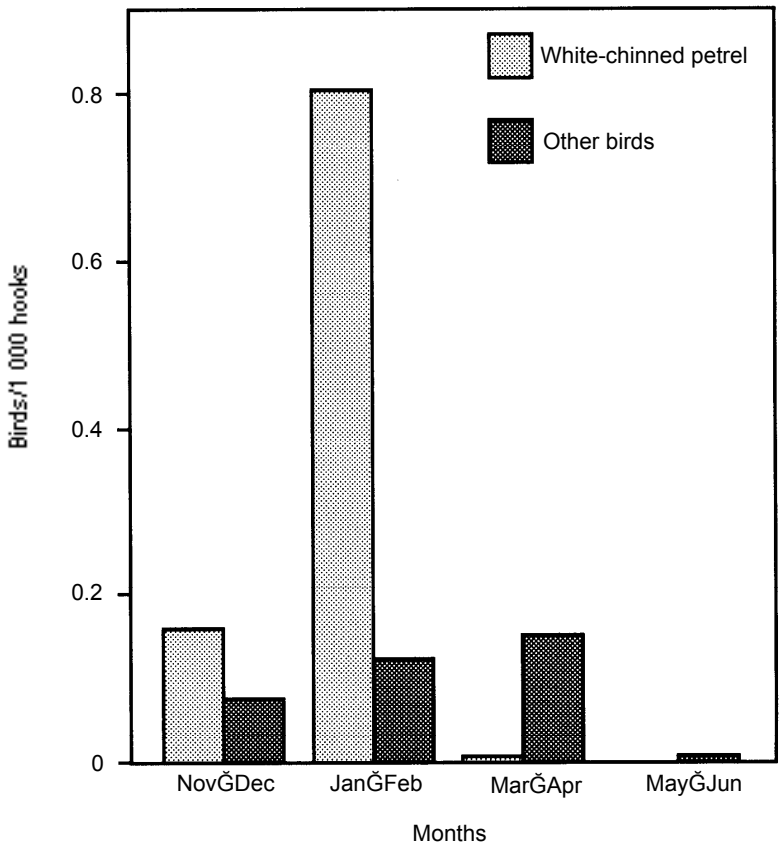

Figure 12: Seasonal differences in seabird by-catch mortality in the longline fishery for *D. eleginoides* at the Prince Edward Islands, from October 1996 to June 1997. Almost all 'other birds' are grey-headed albatrosses, yellow-nosed albatrosses and giant petrels (from WG-FSA-97/51).

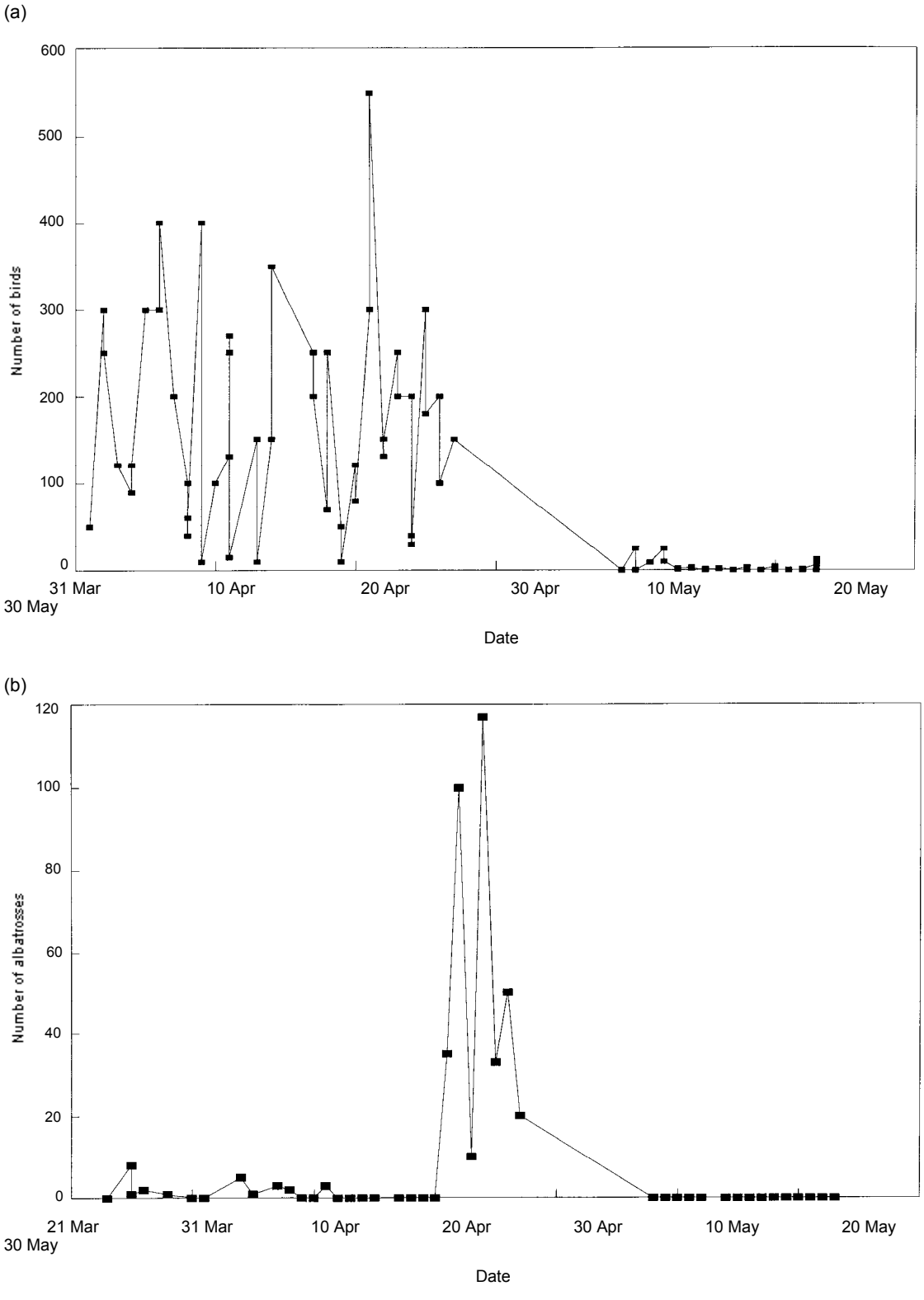

Figure 13: Daily abundance of seabirds in relation to date: (a) black-browed albatross at night; (b) all albatrosses during longline setting (from WG-FSA-97/9).

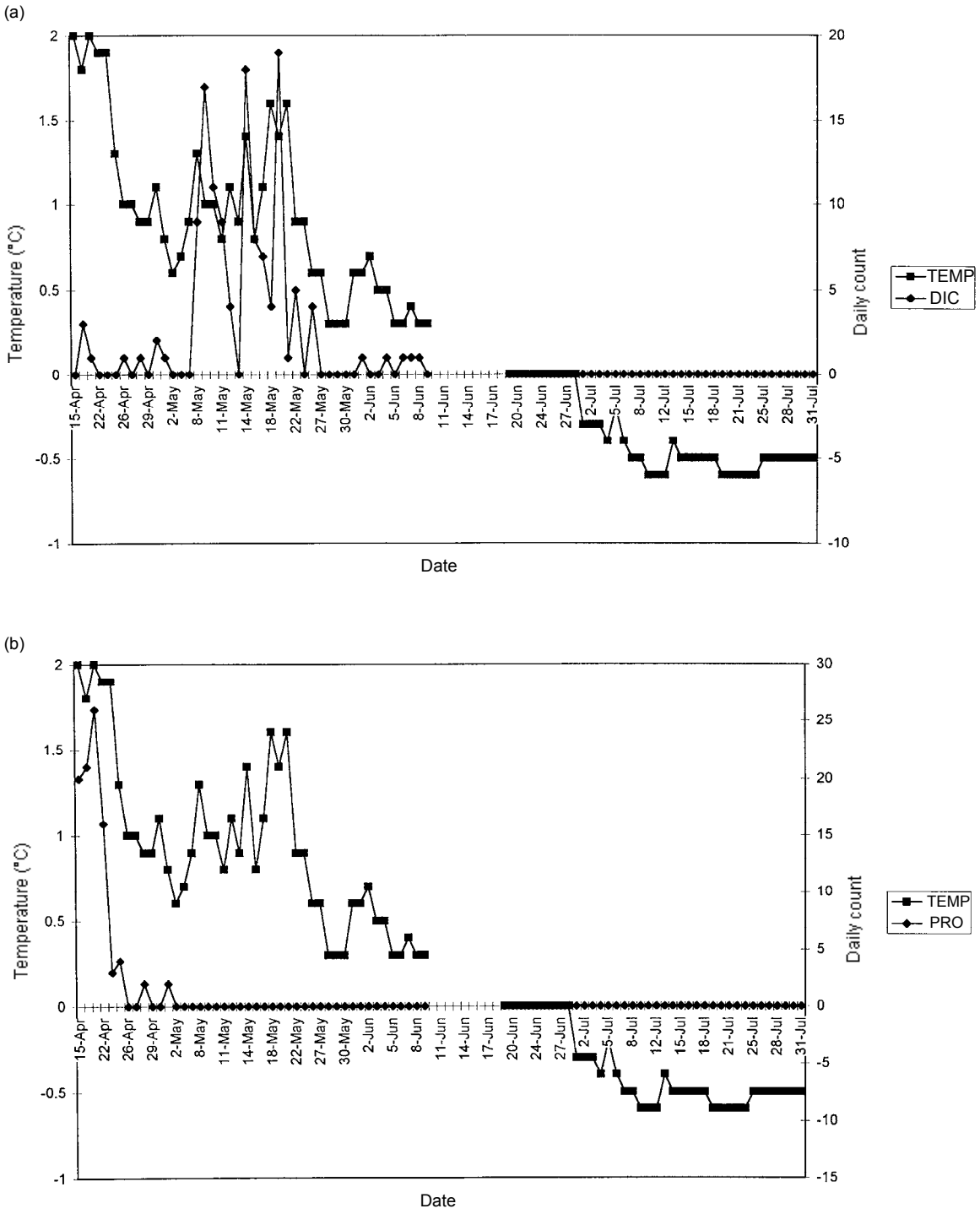

Figure 14: Daily abundance of seabirds in relation to date and sea-surface temperature: (a) grey-headed albatross (DIC); (b) white-chinned petrel (PRO) from Keith, D., scientific observer report, *Koryo Maru No. 11*, April to July 1997.