

**REPORT OF THE WORKING GROUP
ON FISH STOCK ASSESSMENT**

(Hobart, Australia, 7 to 16 October 1996)

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REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 7 to 16 October 1996)

INTRODUCTION

1.1 The meeting of WG-FSA was held at CCAMLR Headquarters, Hobart, Australia, from 7 to 16 October 1996. 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. The following additions were made:

- Subitem 3.2(e) 'Unreported Catches'; and
- Subitem 4.13 'Reopening Fisheries'.

With these additions 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), J. Croxall and I. Everson (UK), Prof. G. Duhamel (France), Drs S. Hanchet (New Zealand), R. Holt (USA), G. Kirkwood (UK), Lic. E. Marschoff (Argentina), Drs D. Miller (South Africa), G. Parkes (UK), G. Watters (USA) and the Secretariat.

REVIEW OF AVAILABLE INFORMATION

Data Requirements Endorsed by the Commission in 1995

3.1 It had been the experience of the Working Group that responses to general data requests had been poor. In an attempt to improve this situation the Working Group had, at its 1995 meeting, set out a specific list of data requirements (SC-CAMLR-XIV, Annex 5, paragraph 11.2) which had then

been endorsed by the Scientific Committee and Commission. The Secretariat had been asked to pursue these requests with appropriate scientists or other authorities.

3.2 The responses to these requests had been good, with information being provided on most topics. In view of this, the Working Group agreed to use the same approach in presenting this year's data requirements (see paragraphs 9.2 and 9.3).

Fisheries Information

Catch, Effort, Length and Age Data

3.3 A summary of catch data from the 1996 split-year had been prepared by the Secretariat from the STATLANT B database (SC-CAMLR-XV/BG/1 Rev. 1). In some cases STATLANT B data had not been received by the Secretariat. In these cases total catches had been estimated based on data in the fine-scale database, or else, if those data were unavailable, from five-day catch reports.

3.4 Information on the levels of reported catches is set out in Table 1.

Table 1: Summary of reported catches of finfish and crabs by species and subarea/division.

Species Name	Subarea/Division			Total
	48.3	58.5.1	58.6	
<i>Champscephalus gunnari</i>		5		5
<i>Channichthys rhinoceratus</i>		1		1
<i>Dissostichus eleginoides</i>	3821*	4915	3	8739
<i>Lepidonotothen squamifrons</i>		15		15
<i>Macrourus</i> spp.	26			26
<i>Paralomis spinosissima</i>	497			497
<i>Rajiformes</i> spp.	40			40
Total	4384	4936	3	9323

* This figure took into account an additional 704 tonnes from Chilean five-day catch reports.

3.5 In response to requests included in SC-CAMLR-XIV, Annex 5, paragraph 11.2, Ukraine had provided clarification of data previously submitted by the former Soviet Union. The revised datasets have now been incorporated into the database.

3.6 Members were encouraged to check their own data held in the Commission's databases and provide revisions if any discrepancies are detected. In the past, when some revisions have been provided, there have been problems in determining precisely how the data tables should be changed. This is particularly important where information is provided indicating how data originally submitted

for a subarea should be divided between divisions, or else where a general species category has been used and the revision provides a species breakdown. The Secretariat requested that if such revisions are made in future they should contain sufficient information to identify unequivocally the data entries that are being changed. The best way of achieving this would be to provide complete tables for all the categories and years in question. Further discussion on future work on improving the database is given in paragraphs 9.2 to 9.4.

Scientific Observer Information

Observer Programs undertaken in 1995/96

3.7 Conservation Measure 93/XIV required the placement of international scientific observers on board each longline vessel fishing for *D. eleginoides* in Subarea 48.3 in the 1995/96 season. A total of 16 vessels took part in this fishery and all carried observers. All data were submitted to the Secretariat. Details of data submission are given in paragraphs 7.26 to 7.31. Results of observation programs are discussed in paragraphs 7.32 to 7.54.

3.8 The UK reported observations conducted on board the Korean squid jigging vessel *Ihn Sung 101*, which undertook a research fishery for the squid *Martialia hyadesi* at South Georgia in June 1996 (WG-FSA-96/21). Results of this survey are considered in paragraphs 4.10 and 4.14.

3.9 A preliminary report was received from a South African observer on board the longline vessel *American Champion* (USA) fishing on the high seas close to the CCAMLR Convention Area (see paragraph 7.50).

Design of Data Forms for Observers

3.10 Following the request of last year's meeting of WG-FSA (SC-CAMLR-XIV, Annex 5, paragraph 11.8), the Secretariat has drafted forms for the Scientific Observer Logbook for recording observations in trawl fisheries (WG-FSA-96/51). The Working Group discussed these forms in detail and several changes were proposed and agreed (WG-FSA-96/51 Rev. 1).

3.11 The Working Group considered it appropriate to examine only finfish observation forms, and suggested that krill forms should be referred for consideration by krill specialists participating in WG-EMM.

3.12 Comments from observers have been received regarding the design of the existing Scientific Observer Logbook for longline fisheries. These comments have been considered by WG-FSA and the forms have been modified accordingly (WG-FSA-96/51 Rev. 1).

3.13 The Secretariat will distribute revised longline and trawl fishery observation forms for information at the forthcoming Scientific Committee meeting so they may be available to Members for use in the forthcoming season.

Observer Operational Procedures and Data Processing

3.14 Experience gained by the Secretariat in processing longline fishery Scientific Observer Logbooks and cruise reports has led to a number of recommendations which would allow significant improvements in both data quality and timeliness of submission in future.

3.15 At present, in some cases the Secretariat is unaware of the number of observers operating in the Convention Area until the data are received. Significant problems with interpretation of data supplied by observers could be easily rectified by directing specific questions to the observer (preferably through technical coordinators nominated by Member countries).

3.16 The following recommendations regarding general Scientific Observer Logbook design and operational procedures were made:

- (i) in future, the *Scientific Observers Manual* should include all instructions and procedures detailed in the current Scientific Observer Logbook. Loose-leaf master copies of the most recent version of data collection forms should be included in the *Scientific Observers Manual*, and photocopies of these forms should be made by Members and used as required. Depending on observer priorities for a particular fishery or vessel, logbooks can be compiled to include the required set of forms. Any new forms which may be suggested by the Scientific Committee for new types of fishery or fishing gear would be distributed to Members as an update to the *Scientific Observers Manual*;
- (ii) examples of completed daily observer data recording forms are to be included in the *Scientific Observers Manual*;
- (iii) to reduce erroneous entry of data due to misinterpretation of instructions (evidenced already in some data received), priority should be given to publication of the *Scientific*

Observers Manual in all four languages of the Commission, to be distributed accordingly;

- (iv) version numbers should be clearly visible on all loose-leaf pages of the *Scientific Observers Manual*, and a complete list of current versions of all sections should be provided by the Secretariat with any future updates;
- (v) each Member providing observers should nominate a technical coordinator (advising the Secretariat of the name, address, fax, phone and e-mail if available) who will be responsible for: (a) the receipt and distribution of observer instructions and data forms; (b) notifying the Secretariat, preferably by fax or e-mail, of observer departures from port to the Convention Area and also on return to port; (c) ensuring timely submission of data to the Secretariat by observers; and (d) answering or relaying questions from the Secretariat regarding data supplied by observers;
- (vi) to allow more timely processing and provision of data by the Secretariat, Scientific Observer Logbooks and cruise reports should be submitted no later than one month after the end of the observed cruise; and
- (vii) some observer data has been received in formats other than that provided by CCAMLR. Although this data is valuable, and an effort will be made to process such data as has already been received, it will not be possible to continue to process this data indefinitely. It is recognised that longline fishery logbooks may not have been available in time for some observers during 1995/96, and that trawl fishery observer data recording forms may take a short time to reach observers after initial publication and distribution.

3.17 Comments were also received from one longline fishery observer that there was insufficient time to complete all the tasks indicated in the longline fishery logbook when only a single observer was present. WG-FSA recognised that the data collection procedure has been designed for either one or two observers, and that not all tasks may be completed in detail by a single observer, depending on circumstances. With this in mind, the Working Group suggested priorities for major data collection tasks. A single observer must complete tasks nominated as high and medium priority, and should complete those given low priority as far as possible. The Working Group also noted that all currently required tasks have been successfully completed by some observers operating alone.

3.18 The following suggested priority list for observers working on board commercial longline vessels (Table 2) is designed to be kept under constant review, and is able to be changed depending on the current needs of the Scientific Committee. Should research priorities change, updated priority

lists will be made available for inclusion into the regular updates of the *Scientific Observers Manual*.

Table 2: Suggested priorities for CCAMLR scientific observers on board longline fishing vessels.

Priority	Form	Description
High	L5 (vi)	As many length measurements of fish as possible per haul, not exceeding 60.
High	L5 (vii)	Fish sex and maturity information.
High	L5 (v)	Monitoring the incidental mortality of seabirds. Collecting and recording of bird band information.
High	L2 (ii)	Description of streamer lines used.
High	L4 (iv)	Information on whether the streamer line was used during every longline set.
Medium	L5 (viii)	Estimation of commercial and by-catch species in numbers and weight, per number of hooks observed for each set.
Medium	L5 (viii)	Recording fish discards (both target and by-catch species) per number of hooks observed for each set.
Medium		Evaluation of the efficiency of mitigation measures.
Medium	L5 (vii)	Collection of fish scales and otoliths for age determination.
Medium	L4 (iv)	Monitoring the location and time of offal discharge.
Low	L5 (v)	Retaining (whole or head and leg) samples of birds for age and species identification.
Low	L5 (iv)	The estimation of the number of fish per haul damaged during interaction with marine mammals.
Low	L5 (ii)	Estimation of the number of hooks lost.

3.19 The Working Group recognised that improving the quality of scientific observation (including the production of reports and logbooks) would require the development of a scheme for training observers – such as those run by a variety of countries in relation to their domestic fisheries. A first step in this direction might be to undertake comprehensive briefing and training of the technical coordinators when they are nominated.

Research Surveys

3.20 A survey to monitor the status of *Champscephalus gunnari* in Subarea 48.3 was reported in WG-FSA-96/27.

3.21 The report of a research survey using a Korean squid jigger in Subarea 48.3 to investigate the distribution of *M. hyadesi* is given in WG-FSA-96/21. The Working Group noted that the catch data from this research survey have not yet been submitted to the CCAMLR database.

Mesh/Hook Selectivity and Related Experiments Affecting Catchability

3.22 No papers were tabled describing studies on these topics. Even so, the Working Group still considers information on these topics important for refining assessments. Estimates of hook and trawl selectivity were derived during the meeting for use in assessments (see paragraph 4.234).

Unreported Catches

3.23 At its 1995 meeting the Working Group had noted that the reported catch for *D. eleginoides* probably represented only about 40% of the total removals from the fishery. Since the total removals is an essential component of any assessment, this level of uncertainty had been viewed with considerable concern.

3.24 Members were aware of significant unreported fishing taking place within, and close to, the Convention Area during the 1996 season. For example, it was suggested that around 25 vessels had been longlining for *D. eleginoides* in the southwest Indian Ocean close to Subareas 58.6 and 58.7 and that catches of around 10 000 to 20 000 tonnes may have been taken from waters within or adjacent to the Convention Area were possible. It was noted that some of this unreported fishing was thought to have been undertaken by vessels sailing under the flags of CCAMLR Member States.

3.25 Concern was also expressed that fishing companies were alleged to be operating under 'flags of convenience' in order to conceal their activities and intentions. The Executive Secretary noted that the procedure necessary to frequently reflag a vessel was time-consuming and costly and consequently the frequent changes alluded to in the popular press were probably unrealistic.

3.26 The Working Group viewed the information in paragraph 3.24 with considerable concern, noting that without information on total removals the quality of the assessments was being seriously prejudiced.

Fish and Crab Biology/Demography/Ecology

Dissostichus eleginoides

3.27 A tagging study associated with the commercial trawl fishery at Macquarie Island was reported in WG-FSA-96/39. The results demonstrated that, with care, tagging with Texas Instruments

Radio Identification System (TIRIS) transponder internal tags and T-bar external tags was effective. The results had been used to estimate standing stock in the region.

3.28 A sequential population analysis (SPA) based on catch-at-age data from Subarea 48.3 between 1992 and 1996 was described in SC-CAMLR-XV/BG/14. The results are similar to those derived by the Working Group in 1995. This paper was considered further under Agenda Item 4 (see paragraphs 4.60 to 4.63).

3.29 Studies on the diet of *D. eleginoides* were described in WG-FSA-96/16 (Division 58.5.1), 96/29 (Subarea 48.3) and 96/43 (comparing data from Subarea 48.3 with information from the Argentinian continental shelf). All these studies highlight the importance of fish at all localities and krill in Subarea 48.3 in the diet of this species.

3.30 The analysis in WG-FSA-96/44 of the sex ratio of fish in Chilean longline catches from Subarea 48.3 indicated that there had been significant changes throughout the fishing season which may have been associated with migrations around the time of spawning.

3.31 A study during the period October 1995 to March 1996 in Division 58.5.1 indicated a relationship between catch rate in longline operations and barometric pressure (WG-FSA-96/48).

3.32 Several papers reported developments in the estimations obtained and in validation of methods for age determination. A comparison of age readings using otoliths and scales in WG-FSA-96/42 indicated that otoliths frequently appeared totally opaque, making it impossible to read them, whereas scale images were consistently clear. A method of estimating fish growth parameters using the estimated age and the radius of the otolith was described in WG-FSA-96/53. This method has been successfully tested, using data for the mackerel *Scomber japonicus*.

3.33 Several participants noted that estimations obtained from age determination methods were reasonably satisfactory for fish up to around age 20 years, but that otoliths and scales from older fish were frequently difficult to read. It was also noted that there were significant differences in the growth rates of male and female fish.

3.34 A progress report on studies of annulus formation, micro-increments and also the use of laser ablation inductively coupled mass spectrometry was provided in WG-FSA-96/55. The Principal Investigator, Dr J. Ashford (Old Dominion University, USA, and British Antarctic Survey), had submitted the research plan to several WG-FSA participants for comments and they met, as an ad hoc group, during the course of the meeting.

3.35 The research proposal was seen as being well organised and highly relevant to the needs of the Working Group. Samples of otoliths had already been provided and further samples were offered during the meeting. Further financial support was currently being sought for the project.

3.36 Dr R. Williams (Australia) noted that evidence was emerging that *D. eleginoides* had a lifespan of over 50 years. A project to test this, using carbon isotope analysis of otoliths, was already in progress, and it was noted that further material from large (>150 cm length) fish was urgently required. Participants agreed to check sample collections to see if such material might be available.

3.37 Dr Everson reported on an investigation using parasite load as an indicator of stock separation and noted that requests for material had been made of several participants.

3.38 The Working Group welcomed these developments and encouraged further collaboration and cooperation in support of these studies.

Champscephalus gunnari

3.39 An acoustic survey carried out during January 1996 by Russia (WG-FSA-96/59) indicated that there were concentrations of *C. gunnari* all around South Georgia.

3.40 Biological information arising from the Argentinian survey around South Georgia in March/April 1996 is given in WG-FSA-96/27. The size composition of the catches indicated few 1-year-old fish which it was thought may have been due to a greater proportion being present close to the bottom rather than an indication of recent poor recruitment. Compared to previous years there was an increase in the numbers of fish in older age classes, although few fish older than four years were present. The results indicate that there has been an increase in standing stock on the South Georgia shelf compared to previous years.

3.41 Diet and feeding activity of *C. gunnari*, investigated during the Argentinian survey around South Georgia, were described in WG-FSA-96/28. Krill appeared to be the dominant food item in the stomachs of fish from all localities around the island. The samples were unusual in that a high proportion of stomachs were empty in spite of the high availability of krill. Since the sampling scheme was the same as had been employed in previous seasons, it was considered that the cause was unlikely to be fish vomiting stomach contents on capture. The survey was undertaken during the spawning season and consequently there may be some link between feeding and reproduction, although no correlation was found between stomach fullness and maturity stage.

3.42 Analysis of data from a series of surveys, described in WG-EMM-96/43, showed a strong correlation between the condition index and CEMP indices associated with krill availability. This study and that described in paragraph 3.41 above demonstrate the importance of krill in the ecology of this species and highlight the need to take into account in any future management plan, extrinsic factors contributing to interannual variability.

3.43 An analysis of research catch rates at the same station on three annual surveys (WG-FSA-96/30) indicated that there was a positive correlation in density between stations up to eight miles apart. It was noted that such correlations need to be taken into account in designing surveys.

3.44 A series of six pelagic surveys conducted during the years 1984 to 1990 to assess one-year-old fish in the South Georgia and Shag Rocks region was reported in WG-FSA-96/58 and 96/60.

3.45 Dr P. Gasiukov (Russia) explained that the same random stratified design as used on demersal fish surveys was used, with sampling restricted to waters of depths of 70 to 500 m. All vessels were equipped with the same midwater trawl gear. Sampling was carried out by day and night at three depth layers: near surface, midwater and 5 to 15 m from the seabed. Towing speed was 3 to 3.5 knots and hauls and sampling were undertaken for 10 minutes from each layer. Between 81 and 141 hauls were made during each survey and the depth was monitored acoustically. A total of 27 species of fish and invertebrates from 11 families were found during these surveys.

3.46 Dr Gasiukov submitted a copy of the data from these surveys to the CCAMLR database. The Working Group welcomed the provision of these data, noting that they should contribute to studies on the ecology of the species.

3.47 During the surveys additional sampling was undertaken to investigate the vertical migration of *C. gunnari* by sampling at six-hour intervals over two 24-hour periods at 50, 75, 125, 150 m and close to the seabed. The results from these studies indicated that juvenile fish were near the seabed at night but migrated upwards during the pre-dawn period.

3.48 In comparing the distribution of juvenile fish with that of the commercial krill fishery, WG-FSA-96/60 concluded that the main concentrations of *C. gunnari* were away from the krill aggregations.

3.49 WG-FSA-96/24 provides a comprehensive review of the biology and ecology of *C. gunnari* throughout its distribution range. The review is of direct relevance to future assessments and the development of a long-term management plan. Further discussion is given in paragraphs 4.136 and 4.137.

Other Fish

3.50 WG-FSA-96/14 describes a new record of the shark *Squalus acanthias* reported from Kerguelen waters during a recent ichthyofaunal survey in Division 58.5.1.

3.51 Results of deepwater trawling on the southern part of the Kerguelen ridge (WG-FSA-96/13) indicated low concentrations of fish. These included *Macrourus whitsoni* and *D. eleginoides*.

Crabs (*Paralomis* spp.)

3.52 WG-FSA-96/15 describes information on *P. aculeata* taken as by-catch in the *Lepidonotothen squamifrons* fishery on the Ob Bank (Division 58.4.4).

3.53 Results from experimental fishing at South Georgia during the 1994/95 and 1995/96 seasons were described in WG-FSA-96/34. These results, along with those in WG-FSA-96/35 regarding size at maturity, were considered in detail under Agenda Item 4 (paragraphs 4.173 to 4.178).

3.54 During the course of these studies, a number of crabs had been tagged with T-bar tags in order to estimate local movement; although these tags are likely to have been cast during moulting it is possible that they may persist and appear in trawl survey catches.

3.55 The prevalence of parasites (*Briarosaccus callosus*) and hyperparasites (cryptoniscid isopods) on *P. spinosissima* from three habitats around South Georgia is described in WG-FSA-96/33. Host size, followed by habitat and local density were the major factors explaining parasite prevalence, whereas habitat was the only variable that explained a significant amount of the variation in hyperparasite prevalence.

Squid

3.56 Biological information on *M. hyadesi* caught during a research jigging cruise in Subarea 48.3 was presented in WG-FSA-96/21. The squid were caught in an area where echotraces at 400–500 m had been noted. Female squid predominated in the catches. The mantle lengths of male squid ranged from 220 to 350 mm (mode – 300 mm) and females 212 to 370 mm (modes – 290 and 320 mm).

3.57 An assessment of *M. hyadesi*, based on predator food consumption rates, was presented in WG-FSA-96/20 and was discussed fully under Agenda Item 4 (paragraphs 4.10 to 4.13).

3.58 Prespawning concentrations of the squid *Moroteuthis ingens* were reported from the Ob Bank as by-catch during target fishing for *L. squamifrons* in WG-FSA-96/15. It was noted that this species has a high ammonia content and is consequently unlikely to be of commercial interest.

Developments in Assessments Methods

3.59 Four papers presenting methods for assessing fish stocks were presented to WG-FSA. Two papers addressed assessment of the abundance of *D. eleginoides* (WG-FSA-96/39 and SC-CAMLR-XV/BG/14), one paper examined the estimation of an appropriate size limit for *P. formosa* (WG-FSA-96/35) and the fourth introduced refinements to the generalised yield model (WG-FSA-96/46).

3.60 WG-FSA-96/39 describes a successful method for tagging *D. eleginoides* in the Australian trawl fishery at Macquarie Island. This method was developed in conjunction with a localised trawling operation during the summer of 1995/96. Fish were double-tagged with TIRIS 23 mm transponders and a numbered yellow T-bar tag. A total of 490 fish were tagged, with 43 fish being recaptured during two fishing trips (at least another six fish were recovered but unreported during the first trip). Preliminary estimates of abundance of *D. eleginoides* around Macquarie Island (3 658 tonnes) were possible from this data. The paper presents the analysis required for estimating the abundance of fish from these data and discusses the potential biases associated with these calculations.

3.61 The Working Group noted the success of this tagging program, commenting on the ease with which electronic tags can be recovered during commercial operations; electronic tags can be detected with a TIRIS electronic reader as the fish pass along the processing line. The Working Group noted that this work demonstrates clearly that *D. eleginoides* can be tagged successfully and that these methods could be employed to assess stock abundance, migration patterns over small and large spatial scales, growth of individual fish and, in conjunction with tetracycline marking, validation of annual marks in otoliths. In addition, this study, undertaken on a small spatial scale, shows that the fish are mobile and that depletion experiments may not work because of large numbers of fish moving through an area.

3.62 The Working Group agreed that more tag-release studies were needed. In particular, the Working Group noted that tagging of fish from trawl surveys would be a useful addition to tagging fish taken on longliners as trawled fish were less likely to be fatally injured during fishing operations.

3.63 SC-CAMLR-XV/BG/14 develops a method for assessing the status of *D. eleginoides* in Subarea 48.3 using SPA based on catch-at-age data. The Working Group noted the new developments outlined in this paper and considered it in more detail during the assessment of *D. eleginoides* (see paragraphs 4.60 to 4.63).

3.64 WG-FSA-96/35 uses a weighted smoothing spline method to estimate size at maturity of male *P. formosa*. The Working Group considered this method in detail in its deliberations in the assessment of crab stocks and the appropriateness of current size limits in this fishery (see paragraphs 4.177 and 4.178).

3.65 Refinements to the generalised yield model were presented in WG-FSA-96/46. This paper describes the options available for undertaking projections with the model in its current form. The Working Group noted the improvements to the model and, in particular, noted the changes in the examination of the effects of fishing on the stock in relation to the decision rules used by the Commission (see SC-CAMLR-XIV, Annex 5, Appendix F for the formulation of the model used at WG-FSA-95).

3.66 Two main refinements will have affected the results from the model since 1995. The first refinement was to make consistent the calculation of spawning stock biomass at Time 0 and the spawning biomass in any year of the projection. In the 1995 version, the spawning stock biomass at Time 0 was estimated at the beginning of the year while in other years of the projection the spawning biomass is estimated at a specified time other than the beginning of the year. Consequently, the spawning biomass appeared larger at Time 0 than at other times in the projection, leading to a slight overestimate in the probability of depletion, and a slight underestimate in the status of the spawning stock (see Table 3).

3.67 The second refinement improves the assessment of the status of the stock at the end of a projection and the degree to which the stock was depleted during the projection. The aim of these two aspects of the assessment is to examine the status of the stock relative to the median spawning biomass at Time 0 (SB_0 median). The method used in 1995 was to test the two criteria by accumulating all values of spawning biomass at Time 0 from all projections, determining the median of these values and using this for the comparisons. However, this procedure does not allow comparisons of stock status within a projection given the basic biological parameters for the projection. In the current form of the model, the main variation in spawning biomass from year to

year within a single projection is caused by variation in recruitment. Variation in the stock trajectory between projections can be caused by varying underlying biological parameters such as mean recruitment, the magnitude of variability in recruitment, natural mortality, maturity and fishing selectivity. These underlying parameters are varied because of uncertainty in their magnitude, not because of natural interannual variability. The effects of fishing on a stock need to be determined for a given set of biological parameters. Interannual variability of each of these parameters, e.g. variability in recruitment, needs to be defined separately. Thus, the $SB_0median$ needs to be determined in a way that accounts only for interannual variability; $SB_0median$ needs to be determined at the beginning of each run once the underlying biological parameters have been set. This modification has been incorporated into the model so that the assessment of the status of the spawning stock at the end of a specified period is made using the median ratio (from all runs) of the spawning biomass at the end of a run compared to the $SB_0median$ calculated at the beginning of the run. In a similar way, the level of depletion occurring during the run is calculated as the ratio of the lowest spawning biomass during the run compared to the $SB_0median$ for that run. The probability of depletion is then the proportion of runs for which this ratio falls below the critical level (e.g. 0.2).

3.68 Table 3 shows the effect of this refinement on the assessments of the effects of fishing on a stock using the parameters for the assessment of *D. eleginoides* in 1995. The original formulation was more conservative than the current formulation. Thus, catch levels determined to satisfy the two decision rules in 1995 using the original formulation of $SB_0median$ are likely to increase with the application of the new method of determining the $SB_0median$ for each run.

Table 3: Results of assessments of the status of *D. eleginoides* in Subarea 48.3 using the generalised yield model from 1995 and with two new refinements for 1996. Parameters are the same as for WG-FSA-95 and the results are for the effects of a long-term annual yield of 4 000 tonnes.

Program Structure	Probability of Depletion below $0.2 \cdot SB_0median$	Median Status of the Stock at the End of a Projection Relative to $SB_0median$
1995	0.100	0.74
Revised timing of assessment of spawning stock at Time 0	0.093	0.81
Revised method for estimating $SB_0median$	0.020	0.78

3.69 The Working Group noted that attempts to have the program validated by the Secretariat were disrupted by the resignation of the Data Manager. Validation will not be possible until a new Data Manager has been appointed and, even then, may not be completed in time for the meeting of the Working Group in 1997. The Working Group agreed that independent validation of the program should be undertaken once the refinements specified at this meeting have been incorporated

(see paragraph 9.5). The Working Group also agreed that, in the interim, the model could be used for assessments.

ASSESSMENTS AND MANAGEMENT ADVICE

Definition of Fishing Grounds

4.1 As a matter of priority, the Commission has requested WG-FSA's advice on the current definitions of 'fishing grounds' given in various conservation measures (CCAMLR-XIV, paragraph 8.5).

4.2 Conservation Measures 78/XIV, 89/XIV and 96/XIV require that vessels move to another 'fishing location' at least 5 n miles distant for a period of not less than five days when the level of by-catch species exceeds 5% of the overall catch taken in one location. By contrast, Conservation Measures 94/XIV and 98/XIV are aimed at ensuring representative length samples from single 'fishing grounds' which are defined as single fine-scale rectangles (0.5° latitude by 1.0° longitude).

4.3 WG-FSA agreed that the term 'fishing ground' is confusing and should be avoided unless accompanied by a specific geographical definition.

4.4 The Working Group considered that the development and revision of measures to reduce by-catch should take account of the specific details of a given by-catch problem and fishery. From time to time, the Working Group has provided specific advice on measures to limit by-catches, and will continue to provide and review such advice as part of future assessments. The Working Group agreed that the formulation used in current conservation measures may cause practical problems in that a single haul containing few fish may still contain the 5% by-catch, thus triggering the requirement to relocate the fishing activities.

New Fisheries

4.5 Conservation Measure 31/X ensures that the Commission is notified of new fisheries in the Convention Area in advance of their commencement. Such notification is necessary for the accrual of adequate information from the very beginning of a fishery so as to evaluate its potential yield and impacts on target stocks or species dependent on them.

4.6 After a year, any new fishery is then defined as an 'exploratory fishery' under Conservation Measure 65/XII. Its expansion is then not allowed to proceed faster than the acquisition of

information necessary to ensure that the fishery can and will be conducted in accordance with the principles of Article II. To ensure that adequate information is made available to the Scientific Committee during the period when a fishery is classified as exploratory, Conservation Measure 65/XII also requires the annual development/review of a Data Collection Plan and a Research and Fishery Operations Plan for the fishery concerned.

4.7 In 1996/97 the Commission received five notifications of intent to initiate new fisheries under Conservation Measure 31/X. These are summarised in Table 4.

Table 4: Summary of notifications of intent to initiate new fisheries under Conservation Measure 31/X in 1996/97.

Member	Fishery	Area	Document No.
Republic of Korea/UK	Squid	Subarea 48.3	CCAMLR-XV/7
Australia	<i>D. eleginoides</i> , <i>D. mawsoni</i> , other species	Division 58.4.3	CCAMLR-XV/9
	Miscellaneous species	Division 58.5.2	
New Zealand	<i>D. eleginoides</i>	Subareas 88.1, 88.2	CCAMLR-XV/8 (Rev. 1)
Norway	<i>D. eleginoides</i>	Subarea 48.6	CCAMLR-XV/10 (Rev. 1)
South Africa	<i>D. eleginoides</i>	Subareas 48.6, 58.6, 58.7 Divisions 58.4.3, 58.4.4	CCAMLR-XV/11

4.8 The joint Republic of Korea/UK notification (CCAMLR-XV/7) is aimed at squid while the other four proposals are for finfish fisheries (three for longlines and one for bottom trawls).

4.9 All of the above notifications were considered in light of the provisions of Conservation Measure 31/X. While acknowledging that relevant information for most of the fisheries being proposed is limited, WG-FSA noted that in most cases the notifications mentioned above provided sufficient information on which to base advice.

4.10 The Republic of Korea/UK notification (CCAMLR-XV/7) and ancillary information (WG-FSA-96/20 and 96/21) concerns a proposed new fishery for *M. hyadesi* in Subarea 48.3. Based upon the review of a previous experimental fishery and research investigations, this joint venture aims to allow two vessels to harvest up to 2 500 tonnes of *M. hyadesi*.

4.11 The Working Group noted that the proposed squid catch level of 2 500 tonnes was likely to be conservative since it represents only a small fraction (approximately 1%) of the estimate of annual predator consumption of *M. hyadesi* in the Scotia Sea (approximately 245 000 tonnes). In addition, *M. hyadesi* is taken as a by-catch in the Illex fishery in areas adjacent to Subarea 48.3. In one year (1986) this by-catch reached 26 000 tonnes.

4.12 If such a fishery develops, WG-FSA-96/20 suggested that the timing of the fishery with respect to the requirements of dependent species should be reviewed. It is suggested in the paper that the fishery should be designed to minimise effects on dependent species by confining the fishing season to the period from June to August when the chick-rearing season of the most sensitive predator (grey-headed albatross) has ended and before recruitment of the next squid year class.

4.13 Given that there is a lack of data upon which to base an objective assessment of the status of *M. hyadesi* stocks in Subarea 48.3, WG-FSA agreed that the Republic of Korea/UK notification has attempted to follow a precautionary approach upon which the initiation of this new fishery may be based.

4.14 The Working Group noted that WG-FSA-96/21 recommended specific data to be collected during the development of the proposed squid fishery. It requested the Secretariat to compare these data elements with those of CCAMLR's standard fine-scale catch and effort data form for a squid jig fishery (Form C3 Version 1) to ensure that critical data are collected. Revised data forms should be developed as soon as possible in consultation with Dr P. Rodhouse (British Antarctic Survey).

4.15 The Norwegian notification for Subarea 48.6 (CCAMLR-XV/10 Rev. 1) provided no information on proposed catch levels of finfish, on the biology of proposed harvested species, on the effects on dependent/associated species or on comparisons with similar or other fisheries.

4.16 The Australian proposal (CCAMLR-XV/9) was similar to that submitted last year (CCAMLR-XIV, paragraph 6.1) for a bottom trawl fishery in Division 58.5.2. It is planned to take up to 50 tonnes per species (other than *C. gunnari* and *D. eleginoides* which are subject to TACs under Conservation Measure 78/XIV) and to conduct a bottom trawl fishery in Division 58.4.3 with a catch limit of 200 tonnes for *D. eleginoides* and *D. mawsoni* together.

4.17 The New Zealand notification (CCAMLR-XV/8 Rev. 1) is for a longline fishery for *D. eleginoides* in Subareas 88.1 and 88.2. The notification includes a plan which aims to set out a data collection and fishery operation protocol. It proposes setting precautionary catch limits of 2 500 tonnes per statistical area with subareal limits between 200 and 1 500 tonnes being distributed by rectangles of 0.25° latitude by 0.25° longitude on the basis of catch rates established during limited periods of fishing. Such catch rates could also be used to terminate fishing in specific rectangles and to provide criteria to be applied to the resumption of fishing.

4.18 The South African notification (CCAMLR-XV/11) was similar to that of New Zealand and applies to a longline fishery for *D. eleginoides* in a number of areas in the Indian Ocean which have

never been fished (e.g. Subareas 48.6 and 58.7) or where South Africa has not fished (Divisions 58.4.3 and 58.4.4). The attached management plan sets out a data collection and fishery operation protocol. It proposes setting precautionary catch limits by statistical area (a limit of 3 200 tonnes per area was chosen, based on historic catches from Subarea 48.3) with subareal limits between 200 and 800 tonnes being distributed by rectangles of 0.5° latitude by 1.0° longitude depending on the catch rates established during specific periods of fishing. Declines in catch rates are used to terminate fishing in the fine-scale rectangles and to provide criteria to be applied in the subsequent resumption of fishing in such rectangles.

4.19 WG-FSA noted that a number of general principles (particularly in respect of finfish) were common to the above notifications. Most of the notifications included some form of precautionary approach which limited catch and/or fishing effort. In the case of finfish, the general lack of knowledge concerning the distributional separation of *D. eleginoides* and *D. mawsoni* necessitates that, for the time being, these two species be considered together (i.e. catch limits should apply to both species combined). Finally, the need for regular scientific review of fisheries development was recognised.

4.20 Taking account of these generalities, the Working Group agreed that for the new fisheries for *D. eleginoides*:

- (i) CCAMLR should adopt a common and integrated approach to areas likely to be developed by new fisheries;
- (ii) as part of such an integrated approach, the application of Conservation Measure 31/X should anticipate the requirements of Conservation Measure 65/XII by setting up scientifically-based data collection and fishery/research operation plans. This will facilitate the acquisition of data necessary to manage the development of new fisheries in accordance with CCAMLR's precautionary approach;
- (iii) precautionary catch limits should be developed for statistical areas using available information (e.g. based on catches from similar fisheries elsewhere and/or on areas likely to be suitable for fishing). Limits for smaller areas (e.g. rectangles of 0.5° latitude by 1.0° longitude) should also be developed. These will serve to distribute catch and fishing effort while augmenting the collection of relevant information over a wide geographic area in a way that should reduce the risk of localised over-fishing;
- (iv) the collection of crucial fisheries and biological information requires the deployment of scientific observers; and

- (v) objective verification of positional information is essential, particularly if fine-scale rectangles are applied (see paragraphs 4.25 and 4.26 below) or if the fishery should follow stock across the Convention Area's boundaries (as appears to be the case for *D. eleginoides* in Subarea 58.7 and on the banks adjacent to Subarea 48.3).

4.21 The Working Group agreed that the generalities set out in paragraph 4.20 above could be applied to other new fisheries to a greater or lesser degree. Future investigation of their wider applicability should therefore be undertaken as a matter of priority so as to facilitate the development of a coordinated management approach to new and developing fisheries in line with the principles of the precautionary approach set out by WG-FSA in 1995 (SC-CAMLR-XIV, Annex 5, paragraphs 10.2 to 10.8).

4.22 In the specific case of the proposed new fisheries for *Dissostichus* spp. in the Australian, New Zealand, Norwegian and South African notifications, WG-FSA agreed that the adoption of precautionary catch limits in small areas could be based on historic longline catches by fine-scale rectangle in Subarea 48.3 (average – 330 tonnes for the period 1990 to 1996, range – 1 to 2 390 tonnes) and Division 58.5.1 (average – 71 tonnes for 1996, range – 1 to 264 tonnes). This gives an overall average for the two areas of about 200 tonnes.

4.23 Accepting that the purpose of fine-scale areal limits is to provide some scope for a spread of fishing effort as well as minimising the risk of localised overfishing, the Working Group agreed that a fine-scale areal catch limit in the order of 100 tonnes would meet these criteria. A 100-tonne limit would also have the advantage of being conservative.

4.24 The Working Group drew the attention of the Scientific Committee and the Commission to two important considerations inherent in the setting of fine-scale areal limits.

4.25 The first is that the administration of such limits requires that catch data and positional information should be collected and reported in as close to real time as possible. For practical purposes the former could be based on the five-day catch and effort reporting system already in place for the *D. eleginoides* fishery in Subarea 48.3, while the latter would be best achieved by some form of automated vessel monitoring system, especially if more than one vessel is fishing in a particular fine-scale area. The added advantage of having such systems to monitor the passage of fishing vessels across the Convention's boundaries has already been highlighted (paragraph 4.20).

4.26 The second important consideration is the definition of small areas. An appropriate area would be a fine-scale rectangle defined by 0.5° latitude by 1.0° longitude. The identification of each

rectangle is by the latitude of its northernmost boundary and the longitude of the boundary closest to 0°. The northern boundary must be a whole or half degree of latitude and the longitude of the boundary must be a whole degree.

4.27 The Working Group strongly emphasised that the application of the approach outlined in paragraph 4.20 should be conditional on the collection of detailed catch and effort data from both longline and trawl fisheries. Such data will not only provide information on catch rates but also on how such rates may affect fishing activity (e.g. when vessels leave or remain in a specific fishing locality). They may also be useful for assessment and management purposes (e.g. in the derivation of standardised catch rates).

4.28 The Working Group agreed that a conservative approach would be to apply calculated yields from assessments of *D. eleginoides* in Subarea 48.3 and Division 58.5.2 in a manner which is discounted to take implicit account of incomplete knowledge of previously unexploited areas and/or adjusted for the relative area of fishable seabed as a proportion of total seabed available within the statistical area. The former approach is directly analogous to that adopted for krill during the early formulation of management measures for that fishery.

4.29 For example, the calculated mean of the yields of *D. eleginoides* in Subarea 48.3 (5 000 tonnes) and Division 58.5.2 (3 800 tonnes) for 1996 is 4 400 tonnes. A 50% adjustment would then set a precautionary catch limit of 2 200 tonnes to be applied to previously unfished statistical areas for the 1996/97 season.

4.30 WG-FSA emphasised that the precautionary catch limit given in paragraph 4.29 is provided as an example of how such limits could be derived for previously unfished areas. It warned that the given limit does not imply that such quantities of fish would be available for each new statistical area, or that it represents an accurate assessment of potential yield in areas subject to new fisheries.

4.31 Adjustment of areal precautionary limits based on proportionate seabed area is not possible at this time as this procedure depends on calculations of seabed area for specific depth ranges in previously unfished areas being compared with fished areas. The Secretariat was requested to undertake such calculations during the forthcoming intersessional period.

4.32 WG-FSA agreed that all relevant conservation measures and data collection and submission requirements pertinent to the prosecution of *D. eleginoides* fisheries should apply to any new fishery for *Dissostichus* spp. as a matter of course. The Working Group emphasised that the provisions of Conservation Measure 29/XIV must be rigorously applied in order to minimise incidental mortality

associated with longline fishing. The application of all conservation measures should be regularly reviewed (see 4.33 below).

4.33 Finally, WG-FSA recognised that it would not be possible during the initial phase of any new fishery to collect sufficient data to allow for the determination of stock status on the basis of fisheries-dependent methods alone. At this stage the practical application of such methods is unclear (e.g. little is known about the viability of many of the new fisheries being proposed or their precise location). This requires that fisheries-dependent data collection procedures must be as comprehensive as possible during the 'new' phase and, assuming that the fishery continues, must also be carried over to the 'exploratory' phase as defined by Conservation Measure 65/XII. WG-FSA must also strive as a matter of urgency to set priorities for future data collection and assessment procedures. The development of such procedures should include the identification of essential data (both fisheries-dependent and independent) to be collected, the design and deployment of research effort and the application of catch (or effort) limits on fisheries during their exploratory phases.

4.34 The coding and validation of data being submitted to CCAMLR from the rapidly expanding fishery for *Dissostichus* spp. will add substantially to the already considerable workload of the Secretariat. The Working Group noted that processing the data in time for the next meeting of WG-FSA would have additional financial implications.

Antarctic Peninsula (Subarea 48.1)

4.35 No new information was available to the Working Group on stocks in this subarea. WG-FSA noted that a bottom trawl survey of Subarea 48.1 will be carried out by the German RV *Polarstern* in November and December 1996 (see paragraph 6.12).

Management Advice

4.36 In the absence of new information on stocks in this subarea, the Working Group noted that fisheries in Subarea 48.1 will remain closed in accordance with Conservation Measure 72/XII.

South Orkney Islands (Subarea 48.2)

Champscephalus gunnari (Subarea 48.2)

4.37 Taking into account the long period of time that the fishery in this region has been closed Dr Gasiukov proposed a similar approach to that adopted for *C. gunnari* in Subarea 48.3 for the 1995/96 season in Conservation Measure 97/XIV. He recommended an experimental fishery for *C. gunnari* be permitted in this region. He proposed a precautionary TAC of 1 500 tonnes based on the approximate midpoint of the range of minimum (392 tonnes) and maximum (3 010 tonnes) MSY calculated for this stock by WG-FSA in 1991 (SC-CAMLR-X, Annex 6, paragraphs 7.214 to 7.217). This proposal depends on an approved research bottom trawl survey being carried out prior to the experimental fishery, and an international scientific observer being on board each fishing vessel.

4.38 Dr Gasiukov considered that a fishery could provide valuable information on the size and age distribution of commercial stocks in the area, spatial distribution of the fish, and commercial CPUE data which could be compared with CPUE data obtained before the fishery was closed.

4.39 The Working Group noted that Conservation Measure 73/XII requires a survey to be carried out, its results reported to and analysed by WG-FSA, and a decision made by the Commission based on the advice of the Scientific Committee before the fishery is reopened. This situation is not analogous to the situation in Subarea 48.3.

Management Advice

4.40 In the absence of new information on stocks in this subarea, the Working Group noted that fisheries in Subarea 48.2 remain closed in accordance with Conservation Measure 73/XII.

South Georgia (Subarea 48.3)

Dissostichus eleginoides (Subarea 48.3)

Catch and Effort Data

4.41 The total reported catch of *D. eleginoides* in Subarea 48.3 during the 1995/96 season was 3 871 tonnes (five-day catch reports). The longline season opened on 1 March 1996 and was closed on 24 July 1996. The catch was taken entirely by longline vessels, including six from Chile, two

from Argentina, one from the Republic of Korea, one from Russia and one from the USA. There was no vessel from Bulgaria fishing this year. The catches by month are shown in Table 5.

Table 5: Catches by month from Subarea 48.3 reported to CCAMLR during the 1995/96 split-year. Haul-by-haul catches reported between 1 September and 30 November 1996 represent by-catches in the fishery for Antarctic crab.

Month	Total Catch of <i>D. eleginoides</i> (tonnes) ¹	Total catch of <i>D. eleginoides</i> (tonnes) ²	Catches of <i>D. eleginoides</i> Reported by Argentina on Statlant Forms ³	Catches used in the Yield Model
July	3			3
August				
September	5		224 ⁴	229
October	3		435 ⁴	438
November	1		167 ⁴	168
December				
January				
February				
March	1066	1145		1145
April	796	949		949
May	742	789		789
June	501	641		641
July (1996/97)		346		
Total	3117 ⁵	3871		4362

¹ Compiled from haul-by-haul catch reports (SC-CAMLR-XV/BG/1)

² Compiled from five-day catch reports (COMM CIRC 96/56)

³ WG-FSA-96/37

⁴ Argentina reported during SC-CAMLR-XV that these catches were erroneously reported for Area 48 and in fact related to areas adjacent to Convention waters.

⁵ This figure includes only 2 360 tonnes from the Chilean catch, which from the five-day catch reports totals 3 064 tonnes.

4.42 As in previous years, longline fishing effort was concentrated on the 1 000-metre contour around both South Georgia and Shag Rocks. The distribution of longline fishing effort in Subarea 48.3 over the last three seasons is shown in Figures 1(a) 1993/94, (b) 1994/95 and (c) 1995/96. There was a notable increase in the proportion of fishing effort applied on the slope around Shag Rocks in 1995/96 compared with previous years. The area to the west of Shag Rocks, fished extensively in 1994/95, was fished substantially less in 1995/96.

4.43 The Working Group noted that the map of locations of longline sets in 1994/95 provided in the 1995 report (SC-CAMLR XIV, Annex 5, Figure 1) was incorrect. This was in fact the map for 1993/94 (see Figure 1).

4.44 No information was available to the Working Group on locations of catches on banks adjacent to Subarea 48.3 (North and Rhine Banks) in 1995/96.

4.45 Catches of *D. eleginoides* from areas of the southwest Atlantic outside the Convention Area were presented in the report of last year's meeting. New data have been submitted to the Secretariat for Area 41 by Argentina, in which the total reported catch in 1995 was 10 177 tonnes. This was an increase compared to 1994, when the reported catch was 4 814 tonnes, but was in line with historical catches, which peaked at 15 461 tonnes in 1992. No new data had been submitted for Area 87 since last year's meeting.

4.46 The Working Group considered information on the possible magnitude of unreported catches of *D. eleginoides* in Subarea 48.3 during the 1995/96 season. Information provided to the Secretariat by the Chilean authorities during the intersessional period indicated that there were no unreported catches by Chilean vessels in Subarea 48.3 during 1995/96. However, there was information regarding the presence of a fishing vessel in Subarea 48.3 outside the fishing season. During the intersessional period the Secretariat circulated information from the UK on two inspection reports regarding the Argentinian longliner *Estela*, which was present in Subarea 48.3 in December 1995 and January 1996, prior to the start of the 1995/96 season on 1 March 1996 (COMM CIRC 96/9, 15 February 1996).

4.47 The best estimates of real catches of *D. eleginoides* since 1990 are shown in Table 6. The Working Group noted that the TACs set by the Commission in recent years have been set for a period between the end of one Commission meeting and the start of the next, whereas the catch data are normally presented on a split-year basis (July to June). This has led to some difficulties in the past in matching up catch data and corresponding TACs in tables presented in the report. In order to avoid confusion, catch data are presented in Table 6 both by season and by split-year.

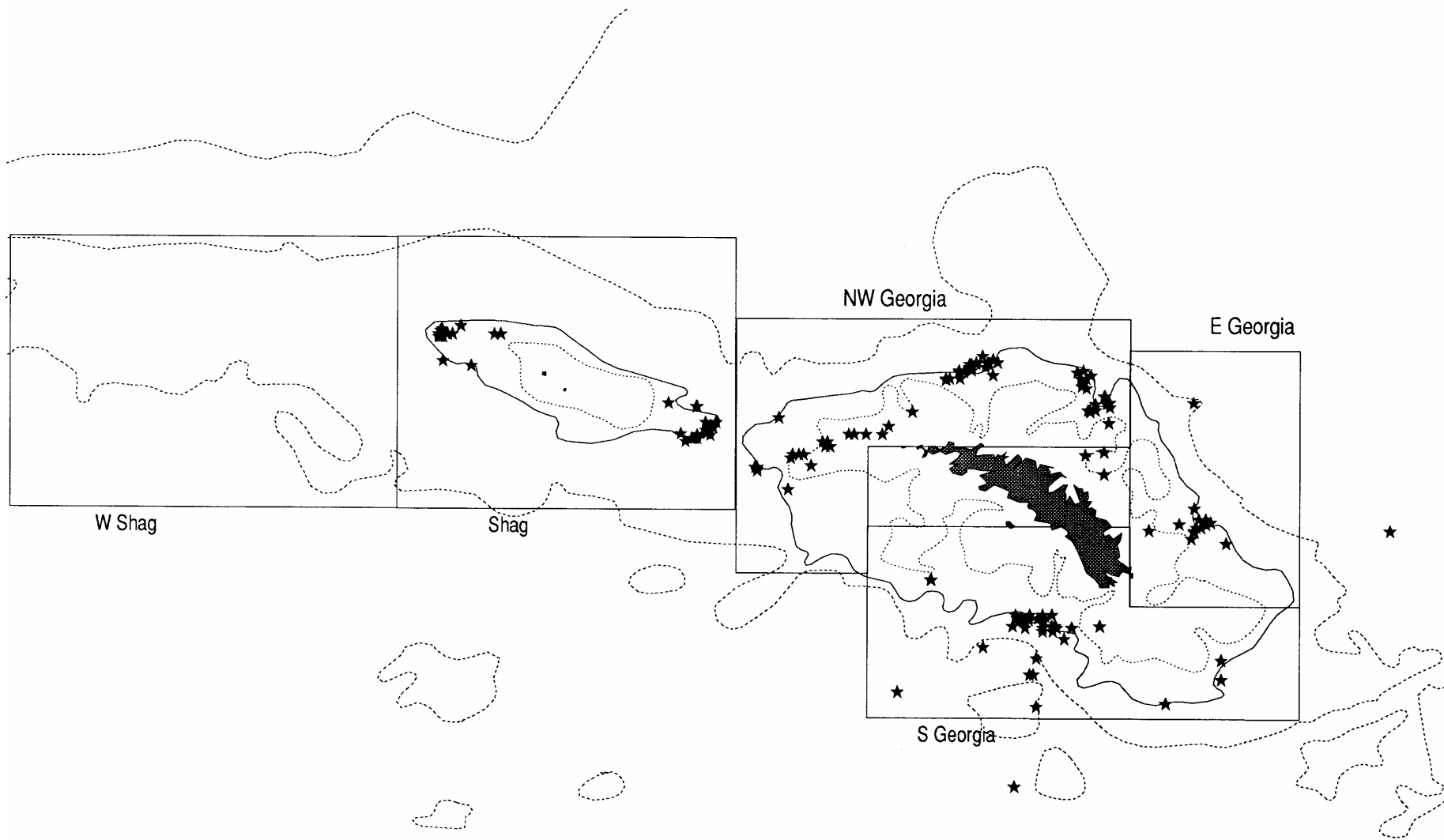


Figure 1(a): Locations of longline catches in Subarea 48.3 during 1993/94.



Figure 1(b): Locations of longline catches in Subarea 48.3 during 1994/95.

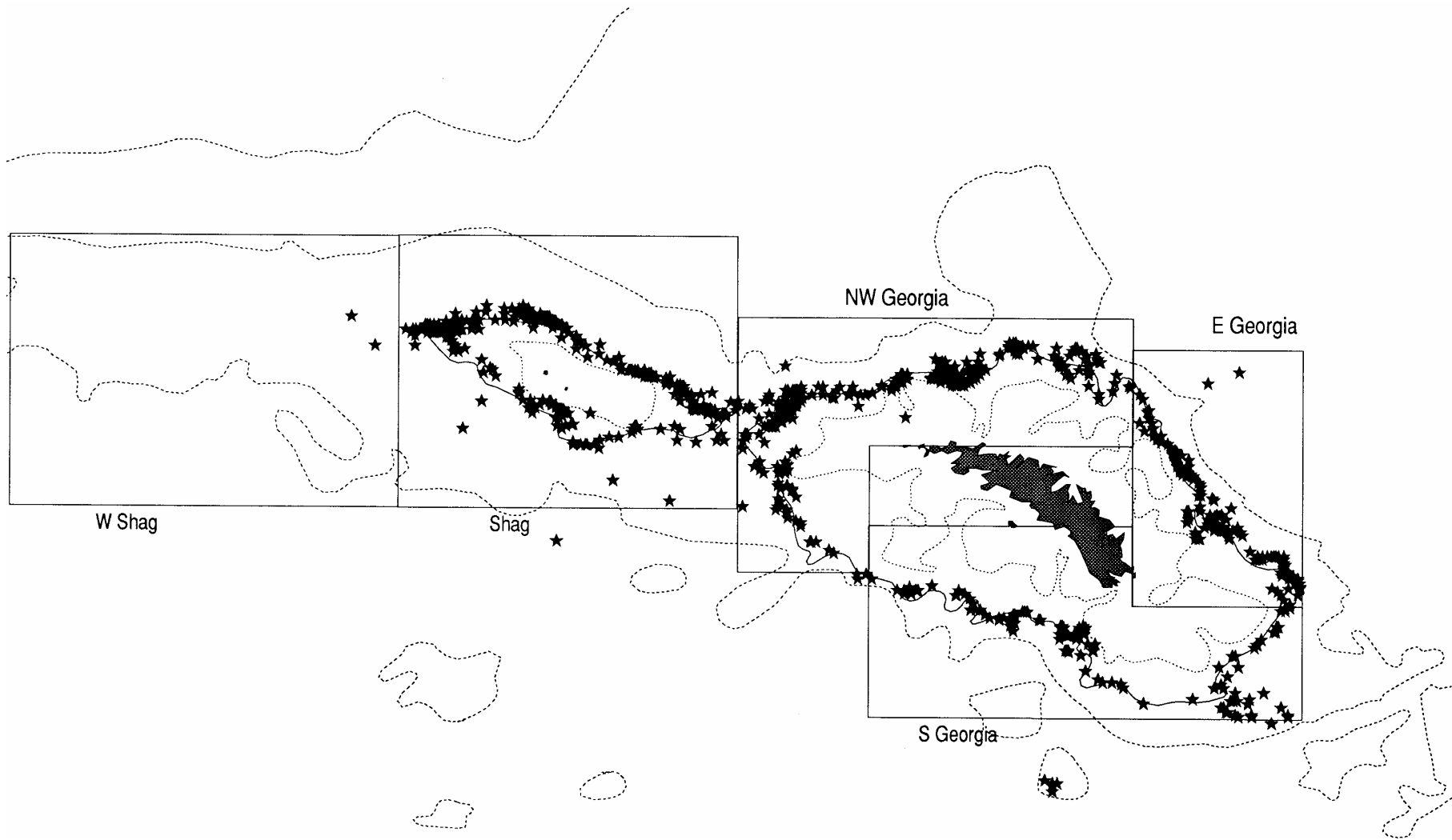


Figure 1(c): Locations of longline catches in Subarea 48.3 during 1995/96.

Table 6: Estimated catches of *D. eleginoides* in Subarea 48.3 and adjacent Rhine and North Banks and TACs agreed by the Commission for Subarea 48.3 (tonnes).

Split-year	Fishing Season	TAC	Catch Reported to CCAMLR for the Fishing Season ¹	Catch Reported to CCAMLR for the Split-year	Estimate of Unreported Catch (split-year)	Best Estimate of Real Catches
1989/90				8156	345	8501
1990/91	2 November 1990 – 25 August 1991	2500	2200 ²	3639	565	4206
1991/92	2 November 1991 – 10 March 1992	3500	3150	3842	3470	7312 ⁵
1992/93	6 December 1992 – 5 February 1993	3350	2694	3089	2500	5589
1993/94	15 December 1993 – 15 September 1994	1300	537	460	6145	6605
1994/95	1 March – 10 May 1995	2800	2635	3301	2870	6171
1995/96	1 March – 24 July 1996	4000	3871 ³	4362	? ⁴	4362 + ?

¹ From form C2 except where indicated

² From Statlant reports

³ From five-day catch reports

⁴ No new quantitative information was available to the Working Group to estimate unreported catches during 1995/96.

⁵ The best estimate of real catch for 1991/92 was erroneously given as 6 309.6 in Table 6 of last year's report (SC-CAMLR-XIV, Annex 5) due to an arithmetical mistake.

Scientific Observer Reports

4.48 As in 1994/95, all longline vessels operating in Subarea 48.3 were required to have on board scientific observers appointed under the CCAMLR Scheme of International Scientific Observation. The Working Group received a number of reports from observers (WG-FSA-96/21, 96/22, 96/40, 96/47 and 96/52). Only information of relevance to assessment work was considered under this agenda item.

4.49 At the start of the meeting, the majority of the data recorded by observers and submitted to the Secretariat had not been entered into the CCAMLR database. This was because in most cases the data were submitted only shortly before the meeting and mostly not using the standard CCAMLR format. Data from only 4 out of 16 vessels were entered into the database. Length frequency data from only one vessel had been entered. The problems of data formats and submission are discussed under Agenda Item 3 (paragraphs 3.10 to 3.19).

Conversion Factors

4.50 The conversion factor being used on the Chilean longliner *Puerto Ballena* to calculate total fresh weight from product was 1.43 (fresh weight = 1.43 x product weight). The CCAMLR observer on board calculated that 1.53 would have been more appropriate (WG-FSA-96/22). However, there was an additional problem leading to underestimation of the fresh weight of the catch. The weight of product was routinely being measured from individual fish to the nearest kilogram below (i.e. a fish of 1.7 kg would be recorded as 1.0 kg). This practice leads to an underestimation of the weight of product, and consequently an underestimation of the size of the total catch. The observer estimated that in order to obtain a realistic estimate of the catch, a conversion factor of 1.7 should have been applied. According to these figures, therefore, the catch of the *Puerto Ballena* reported to the Secretariat was underestimated by about 16%.

4.51 Table 7 summarises the conversion factors for *D. eleginoides* applied by longline vessels in the Convention Area. According to the CCAMLR database, all of these factors relate to headed and gutted product. However, the range of values is from 1.408 to 1.86. The Working Group noted that the variation between vessels may arise from differences in the method of processing and also the season when the values were estimated. The data indicate that some factors may be standard values used in the industry. For example, 1.408 is used by both a Chilean vessel and a vessel from the Republic of Korea. Also, one vessel may use more than one factor. The Republic of Korea had only one vessel operating in the Convention Area during 1995/96, but there are four different conversion factors listed. The Working Group welcomed the report of the CCAMLR observer on the *Puerto Ballena*, which highlighted a potential problem of underestimation of the size of the catch arising from the application of an inappropriate conversion factor. The Working Group agreed that more information was needed on values of conversion factors and methods of their estimation and application on board fishing vessels. This information should be collected by CCAMLR observers placed on board longline vessels in the Convention Area (paragraphs 3.7 to 3.19).

Table 7: Summary of conversion factors for *D. eleginoides* applied by longline vessels in the Convention Area.

Split-year	Country	Vessel Code	Conversion Factor <i>D. eleginoides</i> Headed and Guttled ¹
1995	Argentina	6018	1.54
1995	Argentina	6019	1.86
1996	Argentina	29	1.5264
1996	Argentina	42	1.5
1996	Argentina	42	1.765
1995	Chile	2031	1.538
1995	Chile	2032	1.408
1995	Chile	6001	1.538
1995	Chile	6002	1.538
1995	Chile	6003	1.538
1995	Chile	6004	1.538
1996	Chile	2022	1.408
1996	Chile	2022	1.538
1996	Chile	2022	1.631
1996	Chile	2031	1.408
1996	Chile	2032	1.408
1996	Chile	6003	1.43
1996	Chile	6004	1.43
1996	Chile	6005	1.54
1996	Chile	6025	1.408
1996	Chile	6026	1.43
1997	Chile	2022	1.538
1997	Chile	2031	1.408
1997	Chile	6025	1.408
1995	Republic of Korea	4	1.398
1996	Republic of Korea	4	1.408
1996	Republic of Korea	4	1.47
1996	Republic of Korea	4	1.68
1997	Republic of Korea	4	1.47
1996	Ukraine	844	1.563
1996	Ukraine	1336	1.563
1996	USA	27	1.613

¹ WG-FSA-96/47 reported a conversion factor of 1.67 used by the US longliner *American Champion* outside the Convention Area.

Information on Discards of *D. eleginoides* and Loss Rates from Hooks

4.52 At previous meetings the Working Group has expressed Country over the possible scale of discards of *D. eleginoides*, particularly due to the condition known as 'jellymeat'. No new information was available at this year's meeting. The Working Group recommended that the Scientific Observer Logbook format be amended to include provision for the recording of discards (see also paragraphs 3.10 to 3.13).

4.53 Observers commented that it was difficult to estimate rates of loss of fish from hooks. WG-FSA-96/22 noted that loss rates increased when the ship was rolling heavily. The Captain of the *Puerto Ballena* estimated that the loss rate was in the order of 10%, however the Working Group considered that this needed further investigation.

Information on By-catch and Incidental Mortality

4.54 Information on by-catch of various fish species in the longline fishery is discussed under Agenda Item 5. Information on incidental mortality arising from longline fishing is discussed under Agenda Item 7.

Gear Loss

4.55 WG-FSA-96/57 presents information on loss of hooks during longline fishing in Subarea 48.3. This is reviewed under Agenda Item 7.

Baiting Efficiency

4.56 According to WG-FSA-96/6, the proportion of hooks baited in mechanised longline fishing (i.e. using the autoliner method) varies between 85% and 95%. This paper, which also reports on the loss of baits due to seabirds (mainly fulmars) in the north Atlantic, is discussed further under Agenda Item 7.

Non-reporting of Zero Catches

4.57 At last year's meeting the Working Group expressed concern at the apparent non-reporting of zero catches from longline fishing in Subarea 48.3. During the intersessional period, the Secretariat circulated revised instructions for the reporting of information from longline fisheries. This included specific instructions that data from all longlines should be reported, including those with zero catch. No zero catches are recorded in the CCAMLR database for the period 1991/92 to 1994/95. Forty-eight longlines with zero catch, out of a total of 1 251 fished, have been reported to date in format C2 for fishing during the 1995/96 season. The Working Group welcomed this apparent improvement in data reporting and noted that the number of lines with zero catches missing from previous years is probably only a small proportion of the total number fished.

Fish Movements

4.58 WG-FSA-96/44 presented information on changes in the sex ratio of *D. eleginoides* between March and July 1996. Females were more abundant in longline samples, except during May, when the proportion of males at the size of sexual maturity in the catch increased. Several possible explanations were proposed, including the suggestion that the fish undertake reproductive migrations. Information from the observer data indicates that females mature earlier in the season than males. The Working Group agreed that consideration would have to be given to separating males and females in future assessment work on this species and that more studies on the reproductive behaviour of *D. eleginoides* should be undertaken.

Environmental Factors

4.59 Several papers submitted to the Working Group reported information on the relationship between CPUE and environmental factors (WG-FSA-96/4, 96/22 and 96/48). At present the format for reporting data from the commercial fishery does not include environmental information, however, the observer format includes a summary of meteorological conditions, including weather and sea conditions. No analysis of this relationship was undertaken at this year's meeting, but the Working Group agreed that it should be considered in future analyses. With this in mind, the Working Group requested the Secretariat to investigate the possibility of obtaining meteorological information from Subarea 48.3 and other areas where there are fisheries for *D. eleginoides*.

Assessments and Other New Information Presented to the Working Group

Separable Sequential Population Analysis (SPA)

4.60 SC-CAMLR-XV/BG/14 presented an analysis of catch-at-age and effort data from the period 1992 to 1996 from the *D. eleginoides* fishery in Subarea 48.3 using a separable SPA. This is the first time that catch-at-age data have been estimated and analysed for this fishery. The source of the length frequency data was not given in the paper, but the age/length key from a single vessel fishing in 1991 was used to convert length distributions into catch at age. The effort data was an estimate of nominal effort in terms of total number of hooks set per year in the fishery.

4.61 To reduce the number of parameters estimated by the model, several assumptions were made. A single mean value for recruitment was estimated for all ages in year 1 and for subsequent recruitments. A single selectivity function (of the form proposed by Deriso et al., 1985) was estimated for all years. A fully recruited F was estimated for each year.

4.62 The results of the analysis suggested a dome-shaped selectivity function, peaking at age 10. Fully recruited F ranged from 0.05 to 0.12 during the period. Spawning stock biomass declined from 105 000 tonnes to 89 000 tonnes over the period 1992 to 1996. Mean recruitment at age 4 was about 3 million fish. This compares to a mean value of 2.8 million fish calculated from swept-area trawl surveys at this year's meeting.

4.63 The Working Group considered that catch-at-age analysis using approaches such as SPA or VPA provides a useful alternative approach to estimating exploitation rates and spawning stock biomass. However, the Working Group noted the preliminary nature of the analysis and suggested that further developments could investigate the use of standardised CPUE data. The Working Group would also welcome further information on the source and derivation of the catch-at-age data. Further application of these models will require additional age/length data. However, the Working Group encouraged further analyses of such models, because they have the potential to provide an independent assessment of the stock, which can be compared to the results from the generalised yield model.

Other Information

4.64 Several papers submitted to the meeting contained new information of relevance to stock assessment. WG-FSA-96/22 included information on length-at-sexual-maturity and length-weight parameters estimated from fish sampled during the 1995/6 season. WG-FSA-96/43 provided length-weight parameters estimated from fish measured on the Argentinian shelf (1994/95) and in Subarea 48.3 (1994). WG-FSA-96/42 provided von Bertalanffy growth parameters estimated from samples taken from longline vessels in Subarea 48.3 in 1995 (January to May) and from research vessel trawl catches in 1995. SC-CAMLR-XV/BG/14 provided an age/length key based on samples taken by the Chilean longliner *Friosur V* in Subarea 48.3 in January to May 1991.

Work Undertaken at WG-FSA-96

4.65 Several recommendations for future work on the assessment of *D. eleginoides* in Subarea 48.3 were made by the Scientific Committee and Working Group at last year's meetings (SC-

CAMLR-XIV, paragraphs 4.48 and 4.51; Annex 5, paragraphs 5.72, 5.75 and 5.76 and Appendix E, paragraph 2.72). In accordance with these recommendations, the work undertaken at this year's meeting focused on four main areas:

- (i) revision of the length-density analysis undertaken at last year's meeting, using additional survey data;
- (ii) consideration of the effects of varying the decision rule criteria applied in the generalised yield model;
- (iii) revision of the stock simulations undertaken at last year's meeting, using the improved generalised yield model with various alternative input parameters, including revised parameters in the recruitment function; and
- (iv) examination of methods of monitoring the status of the population, including analysis of trends in standardised CPUE and length samples taken from the fishery.

Length-Density Analysis

4.66 The procedure used last year to derive a recruitment function for *D. eleginoides* from stratified trawl survey data (SC-CAMLR-XIV, Annex 5, paragraphs 5.44 to 5.49; de la Mare, 1994) was repeated at this year's meeting. Additional data were analysed from the following bottom trawl surveys in Subarea 48.3:

Russia	1985/86
US/Poland	1986/87
US/Poland	1987/88
Argentina	1995/96

4.67 One problem which has arisen previously in this type of analysis is that, in some strata, only a small number of hauls contained *D. eleginoides*. The maximum likelihood method for fitting the mixture distribution requires at least two non-zero observations for each length class. However, this condition is frequently not met for all length classes for those strata with only a few hauls. WG-FSA-96/38 presented a method for pooling density-at-length data across strata to give an equivalent single-stratum dataset, to which the mixture-fitting method can be applied. Data are rescaled to take account of different sampling intensities in each stratum, such that the mean of the rescaled data is the same as the stratified mean of the raw data. This was achieved using the following expression:

4.68 For k strata, the density data from each haul are rescaled by the composite sampling fraction:

$$D_{i,j} = d_{i,j} \frac{A_i}{\sum_k A_k} \cdot \frac{\sum_k n_k}{n_i}$$

where $D_{i,j}$ is the rescaled density at length for haul I in stratum j , $d_{i,j}$ is the original density-at-length estimate for that haul, and A_i and n_i are the area and number of hauls in stratum I respectively.

4.69 The absolute abundance estimates for each year class in the surveys analysed at this year's and last year's meetings are shown in Table 8. The number of recruits was standardised to age 4 by correcting the numbers of 3- and 5-year-olds for the effects of natural mortality. In some cases the same cohort is represented as a different year class in different surveys. In these cases, the number of recruits was estimated from the average of the recruit numbers from the different surveys. The resultant estimates of recruits at age 4 in each year are given in Table 9.

Table 8: 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	1.15	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	0.269	0.172	0.186	0.097	0.208	0.159
UK 1994 depth 2	1.306	0.919	1.160	0.262	-	-
UK 1994 depth 3	0.456	0.240	0.611	0.231	0.691	0.300
Total	2.031	0.965	1.957	0.363	0.899	0.340

Table 8 (continued)

Survey	N ₃	Standard Error (N ₃)	N ₄	Standard Error (N ₄)	N ₅	Standard Error (N ₅)
UK 1992 depth 1	2.410	0.791	-	-	-	-
UK 1992 depth 2	10.236	3.651	0.171	0.949	0.213	0.239
UK 1992 depth 3	4.449	1.101	0.879	0.756	0.633	0.443
Total	17.095	3.895	1.050	1.213	0.846	0.503
UK 1991 depth 1	0.263	0.118	0.049	0.038	0.107	0.064
UK 1991 depth 2	0.109	0.068	0.048	0.024	0.105	0.054
UK 1991 depth 3	0.053	-	0.245	0.134	1.294	0.961
Total	0.425	0.136	0.342	0.141	1.506	0.965
UK 1990 depth 1	2.680	2.662	12.262	11.239	7.813	7.000
UK 1990 depth 2	0.107	0.064	0.150	0.116	0.306	0.191
UK 1990 depth 3	0.020	-	0.017	-	0.075	0.056
Total	2.807	2.663	12.429	11.240	8.194	7.003
US/Poland 1988	0.555	0.177	0.528	0.267	0.145	0.044
US/Poland 1986	1.853	0.533	1.947	1.492	0.084	0.049
USSR 1986	-	-	0.593	0.296	2.323	1.016

Table 9: 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	2.395
1990	2.862
1989	7.811
1988	0.706
1987	1.242
1986	7.098
1985	5.044
1984	0.528
1983	0.583
1982	1.270
1981	1.359

4.70 As at last year's meeting, the recruitment estimates were used to estimate a lognormal recruitment function for use in the stock projections undertaken with the generalised yield model. The numbers of fish at age 4 in each year of the simulation are drawn from a lognormal distribution. The mean and standard deviation of the distribution were derived by the sample mean and variance of the numbers of fish. The Working Group again noted that this procedure assumed that there was no trend in recruitment over the time period of the estimated recruitments. The parameters of the recruitment function estimated at this year's meeting are compared to those from last year in Table 10.

Table 10: Parameters for the lognormal recruitment function.

	WG-FSA-95	WG-FSA-96
Mean number of recruits at age 4	4 463 000	2 826 000
Standard deviation		2 478 000
Lognormal mean	14.637	14.569
Lognormal standard error		0.209
Lognormal standard deviation	1.161	0.755

4.71 Absolute recruitment estimated from the enlarged dataset of nine surveys was about 37% lower than last year's estimate, and the variance was reduced.

4.72 The Working Group agreed that the recruitment function shown in Table 10 above was the best information currently available on the recruitment of *D. eleginoides* for use in the generalised yield model. It was noted that additional data from surveys by Russia, Germany and Argentina would be available for analysis at next year's meeting.

4.73 The Working Group reiterated its concern expressed last year that trends in recruitment could introduce bias into the recruitment function and that care should be taken to examine the data for such trends. Information from earlier surveys (e.g. Germany 1975/76 and 1977/78) would provide additional information on this.

Generalised Yield Model

4.74 The generalised yield model has been refined since last year's meeting. A detailed description and explanation of the current method is provided in Constable and de la Mare (1996) and in paragraphs 3.65 to 3.69.

Application of the Decision Rule in the Generalised Yield Model

4.75 In using the generalised yield model at last year's meeting, the Working Group considered the results of the projections in relation to the decision rule for γ_1 , i.e. that the probability of the spawning stock biomass falling below 20% of its initial level during the projection period, should not exceed 10%. This was considered to be the most reasonable basis on which to base guidelines for the limits on total removals of *D. eleginoides* in Subarea 48.3 in the 1995/96 season. The Scientific Committee noted that the probability level (10%) in the γ_1 decision rule was not purely a scientific question and that the Commission may wish to consider this matter further. However, before this

could be done, the Commission would require more information and advice from the Scientific Committee. To this end, the Scientific Committee tasked the Working Group with giving this issue detailed consideration at this year's meeting.

4.76 A series of test runs of the yield model was made, in order to explore the implications of variations in the decision rule criteria. These test runs were made using the same data inputs as in Table 14 (see paragraph 4.95). The results of these runs are illustrated in Figures 2(a) and 2(b). Catch levels in these graphs are presented in relative terms. This is because the graphs are not meant to be used to consider specific catch levels, but rather to illustrate the relative effects of changing the basis of the decision rule.

4.77 The first component of the decision rule is the critical level of spawning stock biomass used to characterise a depletion event during the course of a projection run. Five critical levels of spawning stock biomass, ranging from 0.1 to 0.5 of the median level at Time 0, are represented by the five lines on the graph in Figure 2(a). The critical level used last year is represented by the line labelled 0.2.

4.78 The second component of the decision rule is the probability of the spawning stock falling below a particular critical level. This is represented by the vertical axis of the graph in Figure 2(a). The γ_1 decision rule is therefore represented by the intersect of the line labelled 0.2 with the probability level of 0.1. At this point on the line the level of the relative catch is 1.0.

4.79 Having identified a particular reference point on the graph such as γ_1 , it is straightforward to explore the implications of changing the decision rule criteria. For instance, increasing the critical level of spawning stock biomass to 0.3, at a probability of 0.1, reduces the level of relative catch by 0.2, from 1.0 to 0.8. Similarly, if the critical level remains fixed at 0.2, but the probability level is reduced from 0.1 to 0.05, the level of relative catch falls by about 0.17 to 0.83.

4.80 Figure 2(b) illustrates the status of the median spawning stock biomass at the end of a projection period relative to the median spawning stock biomass at Time 0. At the relative catch level of 1.0, the status of the spawning stock biomass is about 0.53. A drop in the relative catch of 10% increases the relative spawning stock by about 5%.

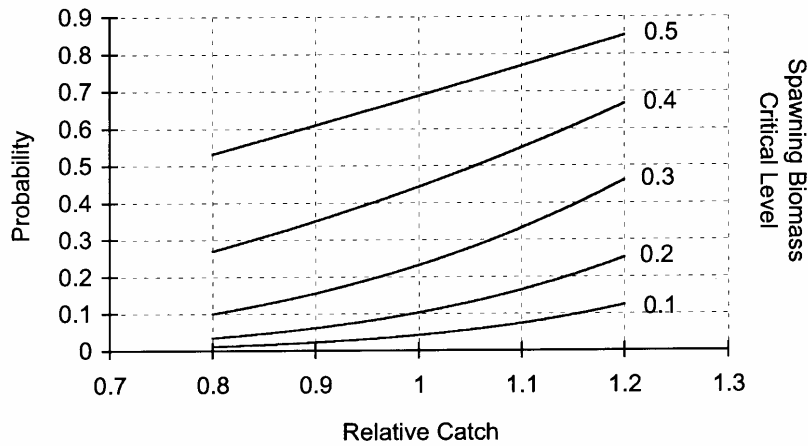


Figure 2(a): *D. eleginoides* – Subarea 48.3: relationship between the decision rule criteria and relative catch level. Probabilities of falling below a critical level of spawning biomass relative to the median spawning biomass at Time 0 for a range of catches using parameters from the final run.

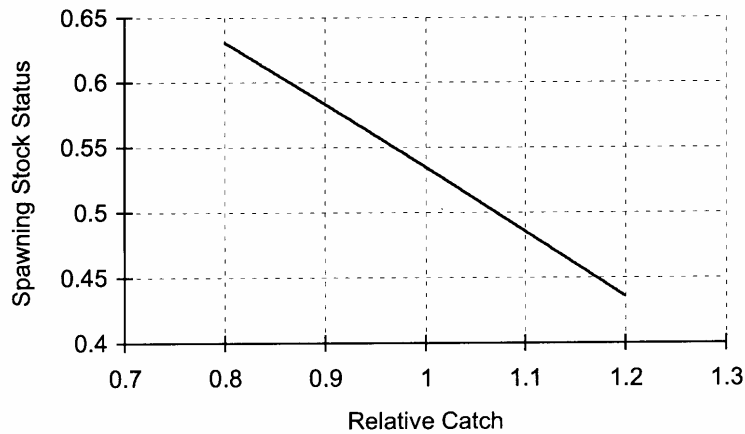


Figure 2(b): *D. eleginoides* – Subarea 48.3: relationship between the status of spawning stock biomass and relative catch. Median status of the spawning biomass at the end of a projection period relative to the median spawning biomass at Time 0 for a range of catches using parameters from the final run.

Data Inputs and Sensitivity Analyses

4.81 Table 11 presents the data inputs for the base case test run of the generalised yield model. In summary, the parameters shown are the same as those used at last year’s meeting with the exception of the new parameters for the recruitment function (estimated from the length-density analysis), a revised maturity ogive and the 1995/96 reported catch.

Table 11: Input parameters for projections of the generalised yield model for the baseline test of an annual catch of 5 000 tonnes of *D. eleginoides* in Subarea 48.3.

Category	Parameter	<i>D. eleginoides</i>
Age composition	Recruitment age in simulation	4
	Number of age classes (21 oldest classes were combined into a single group)	56
Resolution	Number of increments per year	360
Natural mortality	Mean annual M	0.16
	Age-specific variation in M (m_{a+t})	constant = 1
Fishing mortality	Length of fish when 50% of individuals of that size are recruited to fishery (l_m)	70
	Length range over which recruitment occurs (l_r)	10
	Age-specific selection	none
	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
	K	0.088
Weight-length ($W = aL^b$)	a	2.5E-05
	b	2.8
Spawning biomass	Maturity ogive by length (m_m)	a = -10.588, b = 0.1144
	Proportion mature = $\frac{1}{1 + e^{-(a+b \cdot Length)}}$	
	Increment in year when spawning begins	180
	Number of increments in spawning season	1 (knife edge)
Recruitment	Log (mean)	14.569
	Lognormal standard error	0.209
	Lognormal standard deviation	0.755
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)	8501,4206,7309, 5589,6605,6171, 4362
	Number of years to project stock following known catch period	35
	Random no. seed	-24189
Decision rules	Reference point for assessment of long-term annual yield	0.2.SB ₀ median

4.82 Two new length-weight relationships were submitted to the Working Group this year. One, in WG-FSA-96/43, was estimated from a combination of samples from the Argentinian shelf and from South Georgia. The other was estimated from data collected by the observer on the Chilean longliner *Puerto Ballena* (WG-FSA-96/22):

	a	b
WG-FSA-96/43	5.32 e ⁻⁶	3.15
WG-FSA-96/22	1.23 e ⁻⁵	2.96
WG-FSA-95	2.5 e ⁻⁵	2.8

4.83 The relationship from WG-FSA-96/22 was very similar to the relationship used for the assessment at last year's meeting. The relationship from WG-FSA-96/43 was different, however the

Working Group was concerned that the sample from which these parameters were estimated contained only a few fish over 80 cm in length. The Working Group agreed that the best approach for this year was to use the same relationship used at last year's meeting.

4.84 A revised maturity ogive by length was estimated from data analysed at last year's meeting, with the addition of maturity-at-length data compiled by the observer on the Russian longliner *Itkul*. Additional length and maturity data for *D. eleginoides* had been submitted to the Secretariat for the 1995/96 season, however these data were not in the standard CCAMLR format and had not been entered into the database at the time of the meeting. They were therefore not available for analysis this year.

4.85 Three criteria were considered for calculating the percentage of mature fish at length:

- (i) considering all fish of stage II and above as mature;
- (ii) considering all fish of stage III and above as mature; and
- (iii) considering all fish of stage III and above as mature, with the addition of all fish of stage II which were larger than 75 cm.

The third criterion was applied in an attempt to distinguish between stage II fish which had previously spawned and stage II fish which were entering maturity for the first time. Data from the *Itkul* were used to test the effect of these three criteria on the maturity ogive. Maturity functions were calculated for each of the three datasets by non-linear regression. The three resulting logistic curves of maturity at length were very similar, with only 3 cm difference between L_{50} for criteria (i) and (iii). The Working Group agreed that the best approach for this year's meeting was to consider only fish of stage III and above as mature. The resulting logistic curve of maturity-at-length is illustrated in Figure 3.

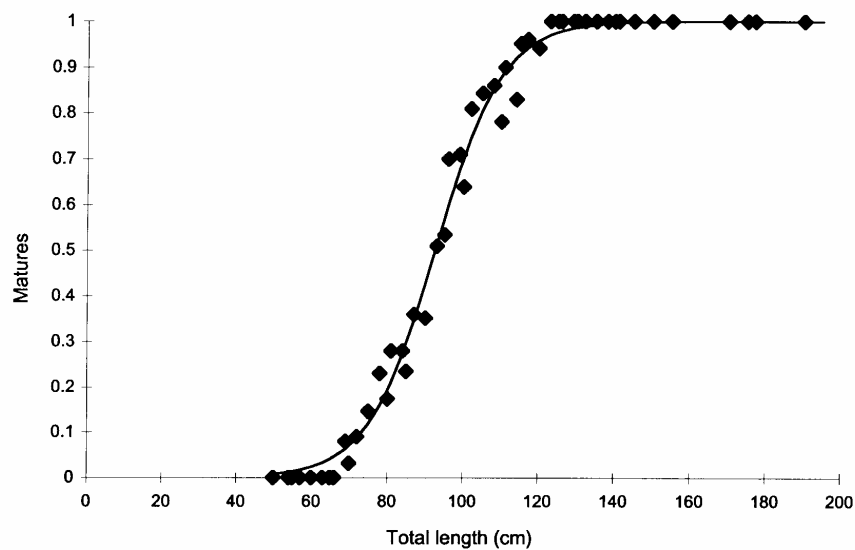


Figure 3: Logistic curve fitted to maturity-at-length data for *D. eleginoides* sampled from commercial longline fishing in Subarea 48.3.

4.86 During the course of the analysis of maturity at length, marked differences were noticed between males and females. Males mature earlier than females. L_{50} for males is about 70 to 75 cm, whilst that for females is about 90 to 95 cm (see also WG-FSA-96/22). The present version of the generalised yield model requires the specification of a single maturity ogive. However, the Working Group agreed that consideration should be given to splitting males and females in future assessments.

4.87 Having completed the base case test run, a number of additional runs were undertaken to test the sensitivity of the results of the projections to certain input parameters. The input parameters tested in these runs are listed in Table 12. A nominal annual catch of 5 000 tonnes was used for the base case test run and all the subsequent tests for sensitivity.

Table 12: Input parameters used in sensitivity tests.

Input Parameter to be Tested	Rationale
Duration of the projection period	The projection period used at last year's meeting was 35 years, chosen because it was considered to be in line with the estimated lifespan of the fish. Two alternative durations were investigated: 25 years and 45 years.
Catches in the most recent year	In the past, reported catches were thought to have formed only part of the total removals of fish from Subarea 48.3. Although there were reports that the level of unreported fishing had fallen in 1995/96, the Working Group had no specific information on the actual level of such catches. Values for the period 1990 to 1995 have remained reasonably constant. It was therefore agreed to calculate the average best estimate of real catches provided at last year's meeting (SC-CAMLR-XIV, Annex 5, Table 6), i.e. 6 230 tonnes ¹ , and test the sensitivity of the model to the input of this catch in 1995/96 instead of the reported catch. This would also provide a test of the sensitivity to under-reported catch arising from the use of poorly-estimated conversion factors.
Size of fish selected in the fishery	Previous studies have demonstrated strong size selectivity by longline gear, which can vary considerably with hook type (e.g. Moreno, 1991). Also, length frequency distributions indicate that a greater proportion of larger fish are females (e.g. WG-FSA-96/22). At last year's meeting all fish greater than 70 cm were considered to be fully recruited. However, catch samples indicate that larger fish are under-represented in the catch. In samples analysed at this year's meeting, 95% of fish were between 63.5 cm and 130 cm. A simple knife-edge selectivity function was devised, which assumes that all fish between these lengths are fully recruited. Fish outside this range were assumed to have a selectivity of 0. The sensitivity of the model to these two selectivity functions (last year's and this year's) was tested.
von Bertalanffy growth parameters	WG-FSA-96/42 provided new growth parameters for <i>D. eleginoides</i> in Subarea 48.3 ($L = 207\text{cm}$, $k = 0.075$, $t_0 = -0.29$). The curve is quite different to the one used at last year's meeting (see Figure 4). The Working Group agreed to test the sensitivity of the results to change in the growth parameters.
M	In a test similar to that performed at last year's meeting, the effect of varying M over the range 0.12 to 0.2 was investigated.

¹ This figure was calculated and used in the assessment before the arithmetical error in Table 6 of last year's report (SC-CAMLR-XIV, Annex 5) was discovered and corrected (see Table 6 of this report). The corrected mean value is 6397 tonnes. The Working Group considered that this minor error in the history of known catches would have negligible effect on the outcome of the projections.

Results of Sensitivity Analyses

4.88 The results of the sensitivity analyses are shown in Table 13. This table lists the input parameters for each test. Code 'B' indicates the base case – i.e. the parameters shown in Table 11. The results are presented as the probability of depletion below 0.2 of median spawning stock biomass at Time 0 (γ_1), and the relative status of the spawning stock biomass at the end of the projection period (γ_2).

Table 13: Results of sensitivity tests.

Test	Years of Projection	Known Catches	Size of Fish Selected in Fishery	von Bertalanffy Parameters	M	Probability of Depletion below $0.2.SB_0$ median	Status at End
1	B	B	B	B	B	0.019	0.611
2	B	B	63.5-130 cm ¹	B	B	0.086	0.531
3	B	Recent-year estimated catch = 6230	B	B	B	0.019	0.610
4	B	B	B	WG-FSA-96/42 ²	B	0.015	0.630
5	B	B	B	B	0.12-0.2	0.043	0.615
6	25	B	B	B	B	0.013	0.631
7	45	B	B	B	B	0.029	0.611

B Base conditions as in Table 11

¹ Knife-edge boundaries to selection in fishery

² von Bertalanffy $K = 0.0748$, $L = 207.0$, $t_0 = -0.2898$

4.89 The results of the sensitivity analyses should be considered in relation to the results of the base case test. The probability of depletion on this run was 0.019.

4.90 The introduction of the adjusted selectivity function in Test 2 has a substantial influence on the results. The probability of depletion increased by more than 4.5 times to 0.085. This is because the catch is assumed to be taken over a more restricted range of lengths than in the original selection function.

4.91 The increase of the catch from 4 362 to 6 230 tonnes in the most recent year had no discernible effect on the results. The Working Group noted that this was to be expected since the change in catch represented only 4% of the estimated total historical catch used in the projection.

4.92 The alternative von Bertalanffy growth parameters (WG-FSA-96/42) resulted in a lower probability of depletion of the spawning stock biomass, because in this model fish of a given length were heavier. No adjustment of M was made for these alternative parameters (at last year's meeting M was estimated from the growth parameters using the Beverton and Holt method).

4.93 The results were sensitive to the introduction of uncertainty in M . The level of uncertainty applied increased the probability of depletion from 0.019 to 0.043, although the status of the spawning stock at the end of the projection was unchanged. Sensitivity to uncertainty in M was also investigated at last year's meeting, but in that case there was no appreciable change in the probability of depletion compared to M fixed at 0.16. The result achieved at this year's meeting is different from last year due to the refinements in the program introduced during the intersessional period, which have improved the way in which stock status is assessed during the projection (see paragraphs 3.65 to 3.69; Constable and de la Mare, 1996).

4.94 Reducing the period of the projection to 25 years reduced the probability of depletion to 0.013. Increasing it to 45 years increased the probability to 0.029.

4.95 On the basis of these sensitivity analyses, the Working Group agreed on the parameters to be used for the final run of the yield model, which would correspond to the γ_1 decision rule. The decisions taken by the Working Group, and the underlying rationale, are summarised in Table 14. Several areas were identified where further analyses would be desirable, but limited time during the meeting precluded the undertaking of additional work. Suggested additional work is discussed in paragraph 9.5.

Table 14: Summary of decisions taken by the Working Group and the underlying rationale for those decisions.

Agreed Input for Final Convergence Run of the Yield Model	Rationale
Years of projection = 35	A 35-year duration was used in the projections at last year's meeting on the assumption that this was a reasonable approximation to the lifespan of the fish. The Working Group agreed that this remained the most reasonable basis for the duration of the projection runs.
Catch in the most recent year = 6 230 tonnes	Although the Working Group had little information on the magnitude of unreported catches, the average over the period 1990 to 1995 was considered to be a reasonable best guess. In addition, the Working Group noted that the catches reported to the Secretariat might be underestimates due to problems with conversion factors (paragraphs 4.50 and 4.51).
Size of fish selected in the fishery = 63.5 to 130 cm	There was strong evidence from length frequency distributions that larger fish are under-represented in the catch. The Working Group noted that using this selection function substantially increased the probability of depletion for a given level of catch. It was agreed that pending the development of a more realistic selection function, this approach would be taken at this year's meeting. The Working Group also noted that the independent analysis carried out using SPA showed that the selectivity function was dome-shaped (SC-CAMLR-XV/BG/14).
von Bertalanffy growth parameters = as in Table 11	Curves for the alternative von Bertalanffy growth parameters are plotted in Figure 4. Mean ages at length calculated from the age/length key provided in SC-CAMLR-XV/BG/14 are superimposed on this graph. The Working Group expressed concern that the ages of larger fish might be underestimated. The parameters from WG-FSA-96/42 resulted in a substantial decrease in the probability of depletion.

M integrated over the range 0.12 to 0.2

In view of the sensitivity of the results to uncertainty in M, the Working Group agreed that the most reasonable approach for this year was to integrate over the range 0.12 to 0.2.

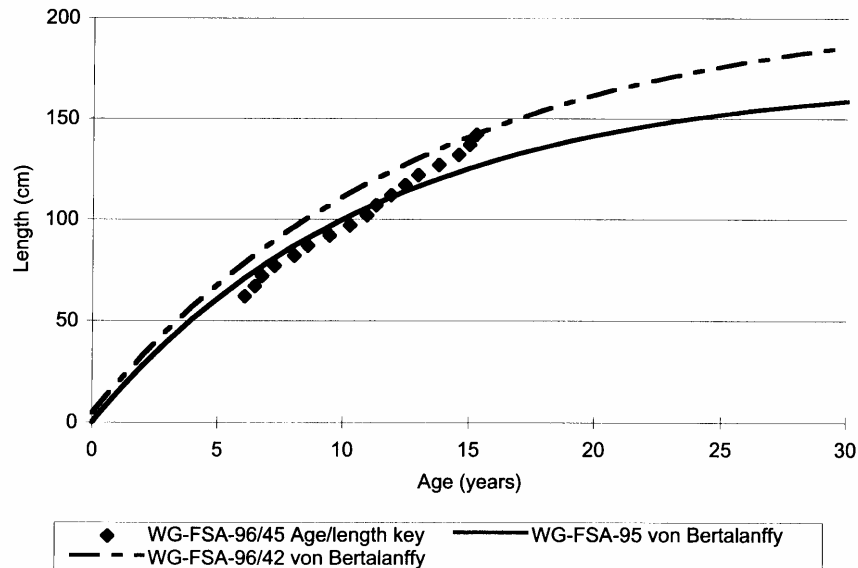


Figure 4: von Bertalanffy growth curves for *D. eleginoides* in Subarea 48.3.

4.96 Using the input parameters specified in Table 14, a final convergence projection was run to determine the catch level consistent with the γ_1 decision rule. This catch level was 5 000 tonnes. At this level of catch the ratio of median spawning stock biomass to the pre-exploitation level was 53%. The Working Group noted that this catch level was an increase of 25% compared to the result from last year's meeting. A change from last year's result was to be expected for three principal reasons:

- (i) refinements in the formulation of the yield model which improve the method of identifying depletion below a critical level within a simulation run (see paragraphs 3.67 and 3.68);
- (ii) revision of the recruitment function based on data from four additional bottom trawl surveys in Subarea 48.3; and
- (iii) changes in other input parameters (see Table 14).

Standardisation of CPUE Indices

4.97 Estimates of annual catches per vessel-day for the fishing seasons 1991/92 to 1995/96 are shown in Table 15. Measured in this way, the 1995/96 catch rate was lower than that in the

previous year, although it was higher than the catch rate in 1993/94. The Working Group noted, however, that such a comparison failed to take account of changes in the fishing fleet, location and timing of catches and the numbers of hooks deployed.

Table 15: Estimates of annual catch per vessel-day calculated from data submitted on form C2 and in five-day catch and effort reports. Fishing seasons are defined as the period 1 October to 30 September.

Fishing Season	Tonnes/Vessel-Day
1991/92	8.02
1992/93	6.95
1993/94	3.18
1994/95	5.46
1995/96	3.38

4.98 Following 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 accounting for the effects of any other factors/covariates that add to the variability in observed CPUE.

4.99 The GLM analyses followed the approach used at the 1995 meeting of the Working Group. Details of the methodology are provided in SC-CAMLR-XIV, Annex 5, Appendix G.

4.100 The GLMs were fitted to haul-by-haul data submitted on form C2 over the period 1992 to 1996. 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 vessel, year, month, area, depth and bait type were considered as predictor variables. Year was defined as fishing season rather than split-year, and a single fishing season was defined as the period 1 October to 30 September.

4.101 Last year the Working Group considered four indices of CPUE: kilogram per hook, numbers per hook, kilogram per hook-hour and numbers per hook-hour. At this year's meeting it was decided to confine the analysis to numbers per hook and kilogram per hook due to concerns over the measurement of soak time (SC-CAMLR-XIV, Annex 5, paragraph 5.35).

4.102 The data were checked for errors before conducting the analyses. This was necessary to exclude records that were spurious or incomplete. The number of records with at least one data omission or inconsistency are provided in Table 16. Some of the hauls had multiple omissions or inconsistencies. Summing the numbers in Table 16 therefore overestimates the total number of data problems. The raw dataset contained 5 163 records, and the final dataset contained 2 740 records.

Table 16: Number of records affected by data problems in GLM analyses of CPUE data from the *D. eleginoides* fishery in Subarea 48.3.

Problem	Number of Records
Position not reported	1595
Number of hooks not reported	10
Number of hooks > 0 but < 1000	2
Number of hooks = 0	38
Start depth not reported	27
Start depth = 0	479
Start depth > 3000	29
Bait type not reported	53
Soak time not reported	3
Soak time < 0	17
Month not reported	1
Catch kilograms not reported	40
Catch numbers not reported	64
Catch kilograms = 0 but catch numbers > 0	737
Catch numbers = 0 but catch kilograms > 0	136

4.103 The Working Group noted that, while checking for errors was necessary to conduct the GLM analyses, it resulted in a substantial loss of information. The Working Group recalled its view that when haul-by-haul data are submitted to the Commission they should be of the highest possible quality and every effort should be made to ensure that all data types are reported (SC-CAMLR-XIV, Annex 5, paragraph 5.36). In this regard, the Working Group encouraged Members to resubmit historical haul-by-haul data for observations that have been omitted or are inconsistent. In particular, the Working Group noted that many more hauls could be included in the GLM analyses if positional data were reported for hauls where that information is currently missing.

4.104 Vessel, year, area and depth contributed significant sources of variation to haul-by-haul CPUE (Table17). The vessel effect was the most significant component of variability in CPUE. The year effect was the second most significant component of variability in catch rates.

Table 17: Analysis of deviance tables from GLMs fitted to catch rate data from the longline fishery for *D. eleginoides* in Subarea 48.3. Factors/covariates were entered into the models in order from top to bottom.

Factor/Covariate	Residual df	Residual Deviance	p
	Numbers/Hook		
NULL	2739	4982	< 0.01
Vessel	2714	3421	< 0.01
Year	2710	3336	< 0.01
Area	2706	3260	< 0.01
Depth	2705	3226	< 0.01
	Kilogram/Hook		
NULL	2739	8696	< 0.01
Vessel	2714	5929	< 0.01
Year	2710	5769	< 0.01
Area	2706	5621	< 0.01
Depth	2705	5571	< 0.01

4.105 The time series of predicted year effects on numbers per hook is plotted in Figure 5, and the corresponding time series for kilogram per hook is plotted in Figure 6. Standardised numbers per hook have been fairly stable during the period 1992 to 1996. There was an increase in standardised numbers per hook during the 1992/93 fishing season, but the effect of this year was poorly estimated. Similar comments can be made for standardised kilogram per hook. This measure of CPUE has also been fairly stable during the period 1992 to 1996 with a slight increase during the 1992/93 fishing season.

4.106 Figures 5 and 6 also illustrate the annual trends in non-standardised catch rates (depicted by the dashed lines). These trends are consistent with the trends in standardised catch rates and show an increase in 1993, with relative stability during the rest of the time series.

4.107 In general, the GLM analyses indicated that there has not been an appreciable decline in standardised CPUE during the period 1992 to 1996. The Working Group recalled its view that standardised catch rates should be more sensitive to declining abundance than non-standardised catch rates (SC-CAMLR-XIV, Annex 5, paragraph 5.40), but questioned whether standardised CPUE would be useful for validating predictions from the generalised yield model (SC-CAMLR-XIV, Annex 5, paragraph 5.41).

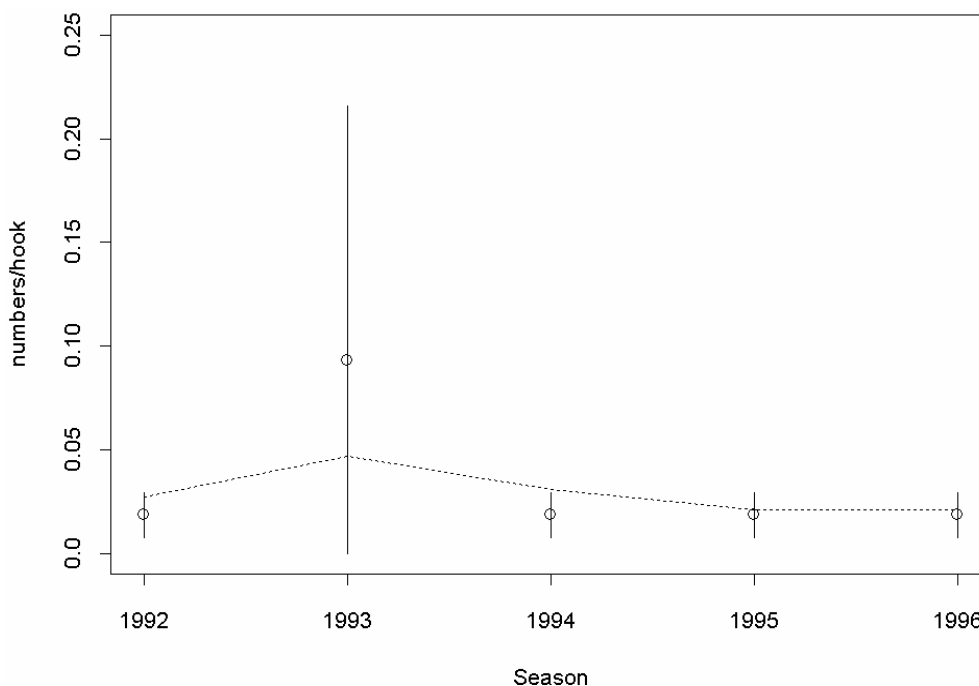


Figure 5: Time series of predicted year effects on numbers per hook.

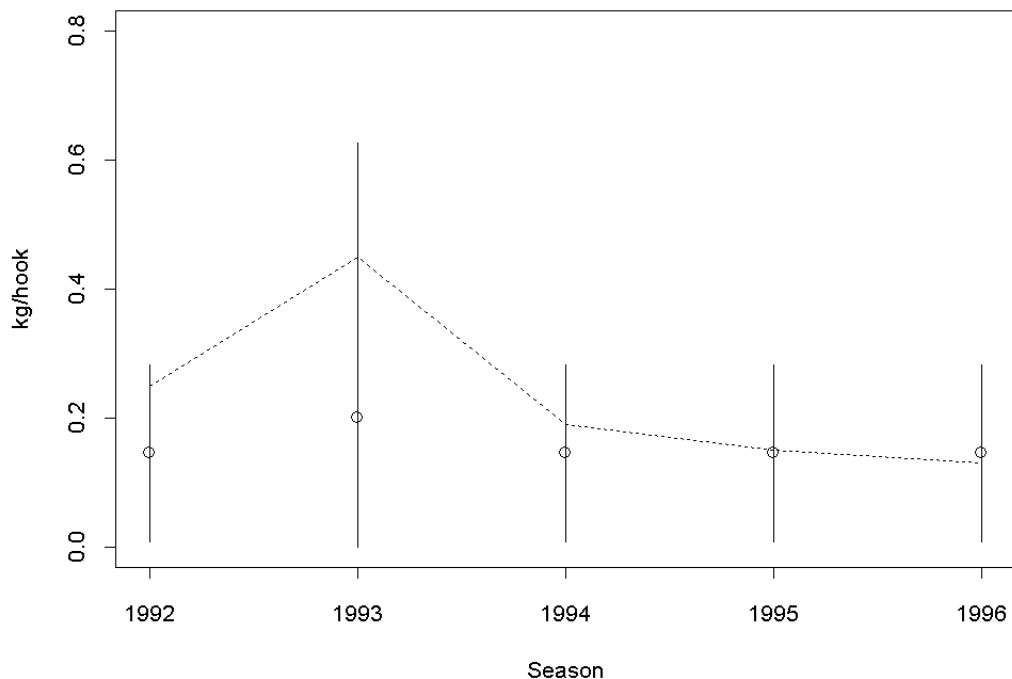


Figure 6: Time series for kilogram per hook.

4.108 The Working Group agreed to consider whether information other than CPUE would be useful for validating predictions from the generalised yield model.

Length Frequency Data

4.109 Data for haul-by-haul analysis of length frequencies were available for only 10 ships (9 from the commercial dataset and 1 observer's dataset) in the 1996 season. Data from other commercial or observer sources were either a combination of several hauls or have not yet been entered into the CCAMLR database. It was noted that the whole dataset needs validation and completion before it can be used fully by the Working Group.

4.110 Since no interannual comparisons could be performed at this meeting, the analysis was restricted to the general properties of statistics derived from length frequencies from each haul.

4.111 The mean length was consistently larger than the median, indicating a right-skewed distribution. Highly significant, positive Spearman coefficients were found for the association between mean length in the catch and starting depth of the haul, in all areas where sufficient information was available. Overall and regional mean lengths stratified by ship and haul for 1996 had CVs in the region of 5%. Variability among regions was small (in the order of 3 to 4 cm).

4.112 Frequency distributions of the mean-median difference were rather homogenous in all regions, while the correlation between mean and variance was low.

4.113 It was agreed that the analysis of the length distribution of catches should be pursued in the intersessional period. The Working Group recommended that the Secretariat be requested to complete and validate the available dataset.

Conclusion

4.114 The analyses of standardised CPUE did not indicate any trends in the status of the stock. The Working Group therefore considered that the results of the yield model projection, using the input parameters shown in Table 10, was a reasonable basis on which to set guidelines for the limits on total removals of *D. eleginoides* in Subarea 48.3 during the 1996/97 season.

Future Work

4.115 At last year's meeting, the Working Group identified a number of areas of future work, some of which have been investigated at this year's meeting. The following areas of future work were identified at this year's meeting:

(i) Length-density analysis:

Any data from trawl surveys in Subarea 48.3 that have not been resubmitted to the Secretariat since the 1995 meeting of the Working Group should be resubmitted to enable them to be re-entered into the CCAMLR database, which has undergone some restructuring in the intersessional period. This will enable the data to be analysed using the length-density method to provide further information on recruitment of *D. eleginoides* in Subarea 48.3.

(ii) Generalised yield model:

(a) The Working Group identified a number of further sensitivity analyses, including:

- age-dependent M
- alternative selectivity functions
- errors associated with von Bertalanffy parameters
- differences in maturity ogives and selectivity between males and females.

- (b) The Working Group also recommended a study on the biological rationale for the critical level of spawning stock biomass in the γ_1 decision rule, particularly in relation to the issue of stock recovery embodied in Article II of the Convention.

(iii) Methods of monitoring the status of the population:

- (a) Standardisation of CPUE:

In order to increase the amount of data available for the analysis of CPUE, the Working Group strongly encouraged the reporting of existing haul-by-haul data from the longline fishery prior to 1992. Information missing from the database for haul-by-haul data for 1992 onwards was also required as a matter of urgency. The Working Group recommended that the Secretariat be requested to undertake a data audit during the intersessional period and submit specific requests to the appropriate national authorities for the submission of data missing from the database.

An investigation of the potential for developing age-specific indices of CPUE is required.

- (b) Analysis of length distributions:

The Working Group agreed that the analysis of length distribution should be pursued in the intersessional period. This will require entry of all available length-frequency data into the CCAMLR database, validation of the dataset and circulation of a request to Members to supply additional historical data where positional information is missing.

- (c) The Working Group considered that other methods of validating the results of the generalised yield model should be investigated. Possible approaches include scientific surveys on the recruited stock and catch-at-age assessment methods. The Working Group agreed that catch-at-age methods might prove useful in the future as the time series of data increases and more data on length distributions and age at length become available (see also paragraphs 4.60 to 4.63).

(iv) Stock structure:

- (a) The Working Group again noted that catches of *D. eleginoides* are taken both inside Subarea 48.3 and outside the Convention Area in waters adjacent to Subarea 48.3. The Working Group requested that Members with information relating to catches taken in waters adjacent to the Convention Area be urged by the Commission to submit this information to the Secretariat for consideration in assessments.
- (b) Although the question of stock structure of *D. eleginoides* remains open the Working Group welcomed information on progress being made in this area (see paragraph 4.58).

Management Advice

4.116 The Working Group welcomed the refinements to the analysis using the generalised yield model made during the intersessional period and at this year's meeting, and noted a number of further refinements which could be undertaken in the future.

4.117 Although the Working Group had little information on unreported catches during the 1995/96 season, the assessment had been undertaken under the assumption that the true removals of fish in Subarea 48.3 in the 1995/96 season were equal to the average of the best estimate of real catches over the period 1989/90 to 1994/95 (equal to 1.43 times the reported catch in 1995/96). The Working Group reiterated its advice of last year that future illegal catches would continue to hinder severely attempts to make reliable stock assessments and requested that the problem be addressed as a high priority.

4.118 The Working Group noted that, as at last year's meeting, the assessment of yield was based on the expectation that future catches would be taken only by longline vessels. Use of other types of fishing gear, such as trawls, would change the age structure of the catch. The Working Group made no assessment of the effects of such catches for this fishery at this year's meeting. The Working Group therefore recommended that the directed fishery for *D. eleginoides* in Subarea 48.3 should be restricted to longliners during the 1996/97 season. Should there be an interest in trawling for *D. eleginoides* in Subarea 48.3 in the future, then the assessment using the generalised yield model could be adjusted to take this into account. However, the Working Group recalled previous advice on bottom trawling in Subarea 48.3 (SC-CAMLR-XIV, Annex 5, paragraphs 6.27 to 6.29).

4.119 As requested by the Scientific Committee, the Working Group has provided advice, in paragraphs 4.75 to 4.80 and Figures 2(a) and 2(b), on the relative effects on catch levels of departing from the γ_1 decision rule (i.e. that the probability during the projection period of the spawning stock biomass falling below 20% of its initial level should not exceed 10%). No specific decision rule criteria, other than γ_1 and γ_2 (the median status of the spawning stock biomass at the end of the projection period should not fall below 50% of the median pre-exploitation level), were considered at this year's meeting, however the Working Group agreed that more detailed consideration should be given to the critical level of spawning stock biomass in the γ_1 decision rule at next year's meeting.

4.120 The results of the projections using the generalised yield model indicated that an annual catch of 5 000 tonnes, applied over a period of 35 years, was consistent with the γ_1 decision rule. At this level of catch, the ratio of median spawning stock biomass at the end of the projection period to the pre-exploitation level was 53%. The Working Group recommended that this should be the basis for setting the catch limit for *D. eleginoides* in Subarea 48.3 during the 1996/97 season. However, the Working Group noted that this assumed that the actual removals of fish would be no greater than the catch limit.

4.121 Additional information on the implications of changing the period of the fishing season to reduce incidental mortality of seabirds is given in paragraphs 7.72 to 7.77.

4.122 The analysis of CPUE data undertaken at this year's meeting was hindered by omissions from the haul-by-haul dataset, particularly of positional information. This highlighted the importance of collecting catch and effort information in as much detail as possible. The Working Group recommended the continuation of the current provisions for reporting haul-by-haul and biological information from the fishery. The Working Group also strongly encouraged the reporting of existing haul-by-haul data from the longline fishery prior to 1992, and of information missing from the database for haul-by-haul data from 1992 to the present (paragraphs 4.103).

4.123 The Working Group again recognised the importance of the biological data and other information collected by scientific observers to assessment work and recommended that the 100% observer coverage applied to this fishery over the past three seasons be maintained. The Working Group also noted the importance of timely submission to the Secretariat of data from observer trips, in the appropriate formats, to enable them to be made available for consideration by the Working Group (paragraph 3.16(vi)).

Champscephalus gunnari (Subarea 48.3)

Commercial Catch

4.124 In accordance with Conservation Measure 97/XIV, a 1 000-tonne TAC was in place for the fishery for *C. gunnari* during the 1995/96 season. However, there was no commercial catch of *C. gunnari* for the season and there has now been no substantial reported commercial catch in Subarea 48.3 since March 1990.

Research Surveys

4.125 A research bottom trawl survey was conducted in Subarea 48.3 in March/April 1996 using the RV *Dr Eduardo L. Holmberg*. The methods and results of this survey are reported in WG-FSA-96/27 and 96/30.

4.126 This is the third such survey of the area using the same gear and methodology and the three surveys are regarded as the start of a time series of relative abundance indices of *C. gunnari* in this subarea. The three abundance indices have shown a steady increase which suggests some increase in the stock during this period.

4.127 Another aim of the surveys has been to investigate the variability in the spatial distribution of *C. gunnari* in Subarea 48.3. The results of this work suggested a positive spatial correlation of catch rates between stations up to a distance of at least 8 n miles apart and a degree of concordance between catch rates at the same stations between successive years.

4.128 The length- and age-composition data collected during the 1994, 1995 and 1996 Argentinian surveys from South Georgia were compared. The size distribution of catches taken in the 1996 survey was very similar to that in 1995 with two modes, one at 17 cm (1-year-old fish) and one at 27 cm (2- and 3-year-old fish) (WG-FSA-96/27). In contrast, the 1994 survey had a much greater proportion of fish larger than 30 cm, and a dominant mode at about 24 cm (2-year-old fish).

4.129 An acoustic survey of the area surrounding South Georgia and Shag Rocks (Subarea 48.3) was carried out in February 1996 using the RV *Atlantida* (WG-FSA-96/59). The survey was confined to a depth range of 100 to 500 m, and regular transects were followed. Forty-five pelagic trawls were carried out to identify species and obtain representative length frequency distributions. The estimate of *C. gunnari* biomass from the acoustic survey equalled 43 600 tonnes.

4.130 The Working Group noted that this was the first time that standing stock estimates had been made for Channichthyidae as part of a major acoustic survey. Bearing in mind that any commercial trawl fishery in Subarea 48.3 would be restricted to the use of midwater trawls, the use of acoustics, whereby the pelagic component of the stock is identified, is a potentially valuable method to employ and as such was welcomed by the Working Group.

4.131 Given the time available, however, the Working Group was unable to consider the results in full. There were a number of questions regarding the survey design, calibration and target identification which were unable to be resolved at the meeting. In particular:

- (i) the acoustic equipment was calibrated in Norway in water temperatures of 14°C and it was unclear whether a correction had been made to account for the lower water temperatures experienced during the survey;
- (ii) there were substantial amounts of krill in the survey area at the time and it was unclear whether this had been excluded from the biomass estimates;
- (iii) it is unclear how the stratification used in the survey was derived and how the transects were allocated into those strata, and how possible autocorrelation between adjacent portions of the transects have been treated; and
- (iv) there was uncertainty over the values used for target strengths for *C. gunnari* and other species in the analysis.

4.132 Dr Gasiukov drew the attention of the Working Group to the fact that the estimates from the acoustic survey could be improved if the data from the Argentinian bottom trawl survey carried out this season were used for species identification and calculation of the mean weight of fish. The Working Group agreed that further consideration of the methods used to separate krill from the overall biomass estimate would be useful.

4.133 The Working Group hoped that these issues could be addressed in the intersessional period and would consider the results in detail at the next meeting with a view to using them in future assessments.

4.134 The size distribution of fish caught by pelagic trawl during the Russian survey was very similar to that from the Argentinian bottom trawl survey.

4.135 Because of the shortness of the time series of relative abundance from the Argentinian trawl survey, questions surrounding the single estimate of abundance from the Russian acoustic survey, and the clearly-identified need to develop an appropriate long-term management plan, the Working Group considered that an assessment at this time was inappropriate.

Development of a Long-term Management Plan for *C. gunnari* in Subarea 48.3

4.136 The Working Group considered that a number of issues need to be considered and tasks carried out before a long-term management plan could be developed. These issues are listed below.

Literature Review

4.137 The biology and ecology of *C. gunnari* throughout the Convention Area were recently reviewed by Kock and Everson (WG-FSA-96/24). It is recommended that a review of previous stock assessments and of the data requirements for such assessments be carried out.

Commercial Fishery

4.138 Historical landings, haul-by-haul, length frequency, and catch-at-age data from the commercial fishery are probably incomplete. The Working Group recommended that the existing data be made available on databases for modelling purposes. The Working Group also recommended that every effort be made to forward any outstanding historical commercial fisheries data to the Secretariat.

Stock Structure

4.139 The current knowledge of stock structure throughout the Convention Area was reviewed by Kock and Everson (WG-FSA-96/24). Differences in biological characteristics, morphometric and meristic characters, and parasite loadings suggest different stocks of *C. gunnari* on each of the major shelf areas. It is currently considered that fish from Subarea 48.3 (including both South Georgia and Shag Rocks) comprise one stock. However, the absence of larger adult fish from this area remains an enigma. The Working Group noted that research on gene flow is planned to be carried out by the UK, and that this may resolve some of the uncertainty.

Abundance Indices

Bottom Trawl Surveys (recruited biomass)

4.140 The Working Group noted there had been a number of surveys carried out by different countries using different gear, different vessels, different methods and at different times of year, etc., and analysed using different programs. They considered that time series of relative abundance using standardised bottom trawl gear and a standardised methodology was probably the most promising method of monitoring the stock.

4.141 The Working Group was pleased to note that Dr Gasiukov had submitted data from eight Russian bottom trawl surveys in Subarea 48.3 from the period 1974 to 1991.

4.142 The Working Group recommended that:

- (i) a comprehensive list of the surveys be compiled;
- (ii) data from any outstanding surveys be requested;
- (iii) all appropriate surveys be analysed using a standard trawl survey biomass program;
- (iv) where possible, the data be disaggregated by age (1, 2, 3 years old?);
- (v) the results be tabled for each time series; and
- (vi) an attempt to standardise the different trawl survey time series be made using GLMs.

Juvenile Fish Surveys

4.143 A number of trawl surveys of pre-recruit and young fish have been carried out by USSR/Russia (WG-FSA-96/60). The Working Group noted that it would be very useful to have an index of juvenile fish for predicting future strong recruitment to the fishery. It was also noted that existing surveys of adult fish are providing indices of abundance of pre-recruits (2-year-olds).

4.144 The Working Group recommended that a comprehensive list of pre-recruit surveys needs to be compiled, any outstanding survey data requested and the surveys analysed in a standard manner.

Acoustic Surveys

4.145 The first quantitative acoustic survey of this stock was carried out in 1996. The Working Group was very interested in this new approach, and considered that a time series of such surveys could be very useful in monitoring trends in relative abundance. However, it also noted that target identification was a major problem which would need to be overcome. Distinguishing *C. gunnari* from other species such as krill and myctophids requires the use of multifrequency transponders and pelagic trawling to identify echo marks.

4.146 The Working Group noted that the timing of the survey and survey design are both important issues which could usefully be reviewed. The Working Group also considered that a big improvement in our knowledge could be made by running bottom trawl and acoustic surveys simultaneously.

Catch per Unit Effort

4.147 The Working Group noted that a standardised CPUE analysis was carried out in 1990 (SC-CAMLR-IX, Annex 5, paragraphs 46 and 47) using multiplicative models (GLMs). Attempts to carry out CPUE analysis may be thwarted by the paucity of haul-by-haul data, the mixture of bottom and pelagic trawling and the reduced usefulness of such an index without length frequency data. The Working Group considered that an analysis of CPUE data may be useful in the future if the fishery is re-established, and recommended that the previous analysis be re-examined.

Biological Parameters

4.148 Biological parameters were not considered in detail by the Working Group. Possible sources include recent Working Group reports, G. Parkes' PhD thesis, and Kock and Everson (WG-FSA-96/24). The Working Group considered that the biological parameters would need to be reviewed before an assessment can be made, but also noted that the models are likely to be most sensitive to uncertainty over the interannual variability in M , and age-dependent M .

Ecosystems/Environmental Interactions

4.149 A number of recent papers have recently considered interactions between *C. gunnari*, krill, and fur seals (e.g. WG-EMM-96/43 and WG-FSA-96/17). The current working hypothesis is that in krill-rich years seals and icefish both feed on krill and icefish are in good condition, show increased growth, and possibly good recruitment (in terms of numbers of eggs and larvae). In krill-poor years, the icefish condition indices are low, gonadal development is poor, and the importance of icefish in the diet of fur seals increases and the icefish consequently suffer a high natural mortality. Evidence on which this hypothesis is based comes from icefish condition indices, seal diet, krill availability and food budget modelling exercises.

4.150 Work is already planned on studies to investigate the relationships between krill distribution and abundance in Subareas 48.1, 48.2 and 48.3 at a workshop planned for 1997 and requested by WG-EMM (Annex 4, paragraph 6.93). The Working Group welcomed this development and looked forward to considering the workshop report in its review of ecosystem interactions involving *C. gunnari*.

4.151 The Working Group considered it essential to understand the ecosystem processes occurring. A number of issues still need to be addressed, including:

- (i) the value of natural mortality in krill-rich and krill-poor years;
- (ii) the seasonality of natural mortality due to seal predation;
- (iii) the ability to predict krill availability in the area;
- (iv) appropriate escapement levels of *C. gunnari* in krill-rich and krill-poor years; and
- (v) the mechanisms of interaction between fish and predators.

Modelling

4.152 Single-species assessment models could include the use of a wide variety of biomass-dynamic and age-structured models (e.g. modified de Lury model, stock reduction analysis, VPA etc.).

4.153 However, the Working Group considered that conventional single-species models were not suitable and that multispecies models which took into account both the population dynamics of *C. gunnari* and this species' interactions with krill and fur seals would be more appropriate. The Working Group considered that the development of such models should be given high priority.

Long-term Management Strategy

4.154 The Working Group considered that two steps were necessary in the development of a management strategy. The first step was to develop a model which could encompass all possible alternative states of nature. This model would need to include the various alternative hypotheses, assessment methods and data types. The second step would be to determine how a particular management strategy would work given a certain hypothesis and assessment method.

4.155 The Working Group recognises that it would require a large amount of resources to develop a long-term management strategy for this fishery. However, there are a number of reasons why such a strategy should be given a high priority:

- (i) although the plan would be focused on *C. gunnari* in Subarea 48.3, the procedures and methodology developed would be applicable to the future development of management plans for *C. gunnari* in other areas and for other species;
- (ii) in the past the catch of *C. gunnari* in Subarea 48.3 has exceeded 100 000 tonnes, and there is likely to be a continued interest in reopening this fishery;
- (iii) the biological system being modelled is relatively simple (compared with other multispecies systems), and there is strong evidence that the inter-relationships have a major impact on the stock, and these interactions are probably tractable; and
- (iv) this provides a very good opportunity to try and develop a multispecies model which would show the commitment of CCAMLR to take into account ecosystems and environmental interactions when managing fisheries within its region.

Management Advice

4.156 Because of the short nature of the time series of relative abundance from the Argentinian trawl survey, and the questions surrounding the single estimate of abundance from the Russian acoustic survey, and because of the clearly-identified need to develop an appropriate long-term management plan, the Working Group considered that an assessment at this time was inappropriate.

4.157 The Working Group reiterated its advice from last year that a long-term management plan be developed for this fishery and noted that, despite the magnitude of the task, this remains a high priority (see paragraph 4.155).

4.158 The Working Group noted that at last year's meeting, the Commission stated (CCAMLR-XIV, paragraph 8.26) that the fishery should be closed until the Scientific Committee has:

- (i) provided advice on a long-term management strategy for the stock; and
- (ii) provided advice on the reopening of closed fisheries;

or has provided unanimous advice on an appropriate TAC for *C. gunnari* in Subarea 48.3.

4.159 Drs P. Gasiukov (Russia), V. Gerasimchuk and E. Gubanov (Ukraine) considered that data collected during bottom trawl surveys carried out by Argentina from 1994 to 1996 could be used to evaluate the current status of the *C. gunnari* stock. As this survey was carried out over three consecutive years and its design has not changed, the indices of abundance are comparable. In 1995, WG-FSA concluded that there had been a significant increase in fish density between the 1994 and 1995 surveys (SC-CAMLR-XIV, Annex 5, paragraph 5.93). The survey carried out in 1996 showed a further substantial increase in the biomass of *C. gunnari*.

4.160 Further, they considered that the Russian acoustic survey showed that the biomass estimate of *C. gunnari* is not less than 43 000 tonnes, but in reality this may be an underestimate because a midwater trawl was used for species identification and calculation of mean weight. It is noted that both the Argentinian trawl survey and Russian acoustic survey show a strong 1994 year class.

4.161 Drs Gasiukov, Gerasimchuk and Gubanov concluded that these results show that the *C. gunnari* stock has recovered to the point at which it is possible to open a commercial fishery. Management advice can be formulated by comparing the biomass estimates from the trawl surveys with the catches made in the same year as the survey (SC-CAMLR-X, Annex 6, paragraph 7.26).

Table 18: Reported catches (tonnes) and summary of biomass estimates (tonnes) in Subarea 48.3 (extraction from SC-CAMLR-X, Annex 6, Table 3).

Season	Catch	South Georgia Biomass	CV (%)	Shag Rocks Biomass	CV (%)	Source
1984/85	14144	15821	101			SC-CAMLR-IX/BG/11
1984/85		17232				SC-CAMLR-IX
1986/87	71151	151293	95	62867	87	Balguerías, 1989
1986/87		50414	18	10023	55	SC-CAMLR-XI/BG/12
1986/87		47312	-			Sosinski and Skora, 1987
1987/88	34620	15086	21	1447	78	SC-CAMLR-XII/BG/23
1987/88		15716		506		SC-CAMLR-IX
1987/88		17913	-			Sosinski, unpublished
1988/89	21356	21069	50			WG-FSA-89/6
1988/89		22328				SC-CAMLR-IX
1988/89		31686	45			Parkes, unpublished
1989/90		95404	63	27900	83	SC-CAMLR-IX, Annex 5

4.162 It can be seen from this table that the catches of *C. gunnari* sometimes exceed the biomass estimates from trawl surveys. Furthermore, the catches did not result in a decrease in the biomass estimates in the following year. For example, following the 1988/89 catch of 21 000 tonnes, the total biomass estimate in 1989/90 from the UK trawl survey around South Georgia was 95 000 tonnes.

4.163 Taking into account:

- (i) the results of a comparison of biomass estimates and corresponding catches in the same year;
- (ii) the successive increase in relative abundance in recent Argentinian surveys; and
- (iii) the estimate of total biomass of around 43 000 tonnes by the Russian acoustic survey;

Drs Gasiukov, Gerasimchuk and Gubanov recommended that, bearing in mind the precautionary approach, the fishery for *C. gunnari* should be opened with a TAC of 13 000 tonnes. This value is the lower 95% confidence interval of the 1994 UK survey trawl survey biomass estimate.

4.164 The rest of the participants of the Working Group considered that they were unable to provide advice on an appropriate long-term management strategy or TAC at the present time and that the situation regarding the assessment of *C. gunnari* remained substantially the same as at last year's meeting.

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

4.165 Estimates of biomass and size composition were available from the Argentinian bottom trawl survey and Russian acoustic survey around South Georgia (WG-FSA-96/27 and 96/49). For similar reasons to those outlined above for *C. gunnari* (paragraph 4.135), no assessment of these stocks has been attempted.

Management Advice

4.166 The Working Group reiterated its advice from previous years concerning these species. In the absence of any new assessment of these species the Working Group recommended that

Conservation Measures 2/III, 3/IV and 95/XIV remain in force and that Conservation Measure 76/XIII be extended to the 1996/97 season.

Electrona carlsbergi (Subarea 48.3)

4.167 No new data were available.

Management Advice

4.168 The Working Group reiterated its advice from 1995 concerning this species (SC-CAMLR-XIV, Annex 5, paragraphs 5.116 and 5.117). In the absence of any new information on this species, the Working Group recommended that Conservation Measure 96/XIV be carried forward for the 1996/97 season.

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

General Information about the Fishery

4.169 On 4 November 1995 (immediately following the Fourteenth Meeting of the Commission), the US fishing vessel, *American Champion*, began its second season of participation in the exploratory crab fishery and initiated Phase 2 of Conservation Measure 90/XIV (the provisions of Phase 2 require vessels to concentrate fishing effort in three squares, each measuring approximately 26 n miles²). The vessel continued to target *P. spinosissima* with *P. formosa* being returned to the sea.

4.170 The *American Champion* completed Phase 2 of the experimental harvest regime on 20 November 1995 and continued standard commercial operations until 29 January 1996, when it stopped participating in the fishery.

4.171 In accordance with the 10-day Catch and Effort Reporting System set forth in Conservation Measure 61/XII, data for the last two 10-day periods of the 1994/95 crab fishing season (the periods beginning 11 October and 21 October 1995) have been submitted to CCAMLR. Data from the entire 1995/96 crab fishing season have also been submitted in accordance with Conservation Measure 61/XII. Summary catch and effort information from the 1994/95 and 1995/96 crab fishing seasons is provided in Table 19.

4.172 By-catch of *D. eleginoides* during the 1995/96 crab fishing season was lower than by-catch during the 1994/95 season. Information on the by-catch of *D. eleginoides* during these two fishing seasons is given in Table 20.

Table 19: Catch of *P. spinosissima* (KCV) during the 1994/95 and 1995/96 crab fishing seasons.

Start of 10-day Period	Catch KCV (numbers)	Catch KCV (kg)	Pots Fished	Hours Fished	CPUE (numbers/pot)
1994/95 season:					
1 September	3198	2677	847	84	3.78
11 September	2827	2541	960	125	2.94
21 September	36398	32125	2220	240	16.40
1 October	50114	41985	2040	240	24.57
11 October	49218	39429	1600	168	30.76
21 October	23068	18046	948	120	24.33
Totals 1994/95	164823	136803	8615	977	19.13
1995/96 season:					
1 November	30558	23960	1528	168	20.00
11 November	87767	72709	2608	218	33.65
21 November	58210	49572	2620	231	22.22
1 December	17883	14860	711	49	25.15
11 December	58283	47102	2723	240	21.40
21 December	66376	57555	3099	264	21.42
1 January	17482	14861	952	78	18.36
11 January	45921	39093	1462	131	31.41
21 January	46263	40101	1758	205	26.32
Totals 1995/96	428743	359813	17461	1583	24.55
Grand Totals	593566	496616	26076	2560	22.76

Table 20: By-catch of *D. eleginoides* (TOP) during the 1994/95 and 1995/96 crab fishing seasons.

Start of 10-day Period	Catch TOP (numbers)	Catch TOP (kg)	Numbers of TOP/pot	Catch TOP/pot (kg)	kg TOP/kg KCS
1994/95 season:					
1 September	77	196	0.09	0.23	0.07
11 September	133	418	0.14	0.44	0.16
21 September	1039	4291	0.47	1.93	0.13
1 October	460	2090	0.23	1.02	0.05
11 October	188	933	0.12	0.58	0.02
21 October	0	0	0.00	0.00	0.00
Totals 1994/95	1897	7928	0.22	0.92	0.06

Table 20 (continued)

Start of 10-day Period	Catch TOP (numbers)	Catch TOP (kg)	Numbers of TOP/pot	Catch TOP/pot (kg)	kg TOP/kg KCS
1995/96 season:					
1 November	152	631	0.10	0.41	0.03
11 November	65	259	0.02	0.10	0.004
21 November	0	0	0.00	0.00	0.00
1 December	0	0	0.00	0.00	0.00
11 December	0	0	0.00	0.00	0.00
21 December	0	0	0.00	0.00	0.00
1 January	0	0	0.00	0.00	0.00
11 January	0	0	0.00	0.00	0.00
21 January	0	0	0.00	0.00	0.00
Totals 1995/96	217	890	0.01	0.05	0.002
Grand Totals	2114	8818	0.08	0.34	0.02

4.173 The *American Champion* has surrendered its US-issued permit to fish for crabs in Subarea 48.3. American Seafoods South America (the company which manages *American Champion*) does not currently consider this fishery to be economically viable, and the US is not aware of any other vessels intending future participation in the Antarctic crab fishery.

Information Collected from the Experimental Harvest Regime and Implications for Stock Assessment

4.174 Analyses of data collected during Phase 1 of the experimental harvest regime are presented in WG-FSA-96/34. GLMs fitted to haul-by-haul catch and effort data show that fishable concentrations of male *P. spinosissima* are highest off the northern coast of South Georgia, between depths of about 180 and 550 m.

4.175 With regard to stock assessment, the analyses conducted on data collected during Phase 1 indicate that local estimates of crab abundance should not be extrapolated to the whole of Subarea 48.3 solely on the basis of depth-specific seabed area; extrapolations must consider area-specific differences in crab density.

4.176 Analyses of data collected during Phase 2 of the experimental harvest regime are also presented in WG-FSA-96/34. Simple linear models fitted to CPUE and cumulative catch data from the three depletion experiments did not have significant, negative slopes. Depletion events were probably not realised/recognised because there was a significant amount of interhaul variability in CPUE and mark-recapture data illustrated that the depletion experiments were probably not closed to immigration since individual crabs are capable of moving over large distances.

4.177 Results from Phase 2 of the experimental harvest regime suggest that there is not much scope for using depletion estimators to estimate local abundances of *P. spinosissima*.

4.178 At its last meeting, the Working Group requested that data be collected for estimating the size at sexual maturity of *P. formosa* (SC-CAMLR-XIV, Annex 5, paragraph 11.2). These data were collected during the 1995/96 crab fishing season and an analysis is presented in WG-FSA-96/35. The document describes a new method for estimating size at maturity from claw and body size data on male crabs; the method uses smoothing splines. Using the new method, the estimated size at maturity for *P. formosa* is 80 mm carapace length. Since the dataset contained a large number of crabs with regenerating claws, there was considerable uncertainty in the estimated size at maturity.

4.179 Given the uncertainty in the estimated size at maturity and the lack of information on growth rates for *P. formosa*, a wide range of minimum size limits are likely to be feasible options for managing this species. The Working Group noted the conclusion in WG-FSA-96/35 and agreed that there is not a sufficiently strong biological reason to revise the current size limit on *P. formosa* (90 mm carapace width) set forth in Conservation Measure 91/XIV.

Assessment

4.180 Noting that the Antarctic crab fishery does not currently appear to be commercially viable and that there is no indication that new vessels are planning to enter this fishery, the Working Group determined that it was not necessary to conduct an assessment of the crab stocks in Subarea 48.3.

General Comments on the Experimental Harvest Regime

4.181 The Working Group agreed that the experimental harvest regime set forth in Conservation Measure 90/XIV had provided valuable information. In particular, the wide geographic distribution of fishing effort required by Phase 1 was useful for learning about the distribution of *P. spinosissima* around South Georgia and determining where the areas of high crab abundance are located. The Working Group further noted that the experimental harvest regime was successful in providing information about whether the crab fishery was likely to be economically viable.

4.182 The Working Group noted that the purpose of Phase 2 was to determine whether local depletion estimators could be used in an assessment of the crab stock (SC-CAMLR-XIV, Annex 5, paragraph 5.124) and agreed that the implementation of this phase during the 1995/96 fishing season

had successfully shown that such estimators would not be appropriate for estimating the abundance of *P. spinosissima*. If, in the future, it is necessary to make an assessment of the crab stock in Subarea 48.3, the Working Group agreed that it would be necessary to consider other methods of estimating abundance.

4.183 The Working Group recognised that if new vessels enter the Antarctic crab fishery it would not be useful for these vessels to conduct depletion experiments during Phase 2 of the experimental harvest regime. In this regard, the Working Group agreed that it might be useful to redraft Phase 2 of the regime and require each vessel to repeat Phase 1 or to conduct a tagging study during its second season of participation in the crab fishery.

4.184 The Working Group recognised the successes of Phase 1 of the experimental harvest regime and recommended that the Commission consider methods of distributing fishing effort over a wide geographic area when deliberating on appropriate management methods for other new and exploratory fisheries in the Convention Area (see also paragraph 4.20).

Management Advice

4.185 The Working Group recalled the Commission's view that exploratory fisheries should provide information that is useful for developing an assessment of the target species and recognised that the experimental harvest regime set forth in Conservation Measure 90/XIV has already provided such information. The Working Group recommended that Conservation Measure 90/XIV should remain in force, but, if new vessels enter the fishery, the Commission may wish to revise Phase 2 in light of the comments made in paragraph 4.183.

4.186 Since the crab stock was not assessed, the Working Group recognised that a conservative management scheme is still appropriate for this fishery. In particular, the Working Group noted that the fishery should continue to be controlled by direct limitations on catch and effort, as well as by limitation on the size and sex of individual crabs which may be retained in the catch. The Working Group noted that Conservation Measure 91/XIV contains such limitations and recommended that this measure should continue to be applied to the crab fishery in Subarea 48.3.

Martialia hyadesi (Subarea 48.3)

4.187 A research survey using a Korean squid jigger was carried out in Subarea 48.3 (WG-FSA-96/21) (see paragraphs 3.56 and 3.57). An assessment of *M. hyadesi*, based on predator food consumption rates, was presented in WG-FSA-96/20.

4.188 A notification of the intent to conduct a new fishery for *M. hyadesi* in Subarea 48.3 during the 1996/97 season has been lodged jointly by the Republic of Korea and the UK. Management advice is given in paragraph 4.14.

South Sandwich Islands (Subarea 48.4)

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

Management Advice

4.190 In the absence of any new information on this species, the Working Group recommended that Conservation Measure 92/XIV be carried forward for the 1996/97 season.

Bouvet Island (Subarea 48.6)

4.191 No information was available to make any assessment of this area.

4.192 Notifications of the intention to conduct new fisheries for *D. eleginoides* in Subarea 48.6 during the 1996/97 season have been lodged by Norway and South Africa. Management advice is given in paragraphs 4.20 to 4.30.

Statistical Area 58

4.193 Total catches by species and subarea in Statistical Area 58 for the 1996 season are shown in Table 21.

Table 21: Total catches by species and subarea in Statistical Area 58. Species are designated by abbreviations as follows: ANI (*Champocephalus gunnari*), LIC (*Channichthys rhinocerotus*), TOP (*Dissostichus eleginoides*), NOR (*Notothenia rossii*), NOS (*Lepidonotothen squamifrons*), ANS (*Pleuragramma antarcticum*), MZZ (Unknown), SRX (*Rajiformes spp.*), WIC (*Chaenodraco wilsoni*).

Split-Year	ANI		LIC	WIC	TOP				NOR			NOS			ANS		MZZ			SRX	
	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-Year	ANI		WIC	TOP		NOR	NOS		ANS			
	58.5.1	58.5.2	58.4.2	58.4.4	58.5.1	58.6	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	-	-

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.

Antarctic Coastal Areas (Divisions 58.4.1 and 58.4.2)

4.194 No new information was available to make any assessment of this area.

Banzare Bank (Division 58.4.3)

Dissostichus spp. (Division 58.4.3)

4.195 Notification of the intention to conduct a new fishery for *Dissostichus* spp. in Division 58.4.3 during the 1996/97 season has been lodged by Australia (see paragraph 4.16).

Ob and Lena Banks (Division 58.4.4)

4.196 At CCAMLR-XIII, a conservation measure to allow a commercial catch of 1 150 tonnes of *L. squamifrons* to be taken over a two-year period (Conservation Measure 87/XIII) was approved at the request of Ukraine, provided a biomass survey was undertaken. No fishing took place during the 1994/95 and 1995/96 seasons, and so no new data were available.

4.197 Notification of the intention to conduct a new fishery for *D. eleginoides* in Division 58.4.4 during the 1996/97 season has been lodged by South Africa. Management advice is given in paragraphs 4.20 to 4.30.

Management Advice

4.198 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, will lapse at the end of the 1995/96 season. The Working Group noted that Ukraine has again expressed an interest in undertaking a biomass survey of the area in the 1996/97 season. The Working Group recommended that this conservation measure be extended to the 1996/97 season provided that the survey is of the design approved by the Scientific Committee (CCAMLR-XIII, paragraphs 8.52 and 8.53).

Kerguelen Islands (Division 58.5.1)

Dissostichus eleginoides (Division 58.5.1)

4.199 In 1995/96 commercial fishing was carried out by French trawlers in the northern and eastern sectors of the shelf and Ukrainian longliners in the western sector. The total catches are reported in Table 21.

4.200 On the western slope of the shelf, two Ukrainian longliners caught 1 003 tonnes of *D. eleginoides*. The catches were lower than the 1 400-tonne limit recommended in 1993 (SC-CAMLR-XII, Annex 5, paragraph 6.129). The catch level has been voluntarily limited by the French authorities.

4.201 The northern sector catches by French trawlers dropped from 3 164 tonnes in 1995 to 2 574 tonnes in 1996. A 2 800-tonne catch limit had been imposed on the trawlers. The fishing trip of one of the trawlers was short, which explains why the catch limit was not reached. The eastern sector catches increased from 810 tonnes in 1995 to 1 029 tonnes in 1996. The French authorities had imposed a limit of 1 000 tonnes in this sector as a preventative measure to restrict fishing effort.

4.202 A joint scientific exploratory deep-sea longline fishing cruise (Japan/France) was conducted from February to April 1996 off the Kerguelen Shelf. Depths from 300 to 1 500 m were investigated at 145 non-duplicated stations. A total catch of 263 tonnes was recorded.

Standardisation of Catch per Unit Effort

4.203 The Working Group 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 at the 1995 meeting of the Working Group, and details of the methodology are provided in Appendix G of last year's report (SC-CAMLR-XIV, Annex 5). At its last meeting the Working Group also used a GLM to analyse CPUE data from the Ukrainian longline fishery in Division 58.5.1. Additional data were not available to update the analysis of CPUE data from the Ukrainian longline fishery and the analysis at this year's meeting was limited to data from the trawl fishery.

4.204 The GLM was fitted to haul-by-haul data from the French and Ukrainian trawl fisheries operating off the northern and eastern coasts of Kerguelen during the period 1990 to 1996. Kilograms per hour towed was used as the response variable, and vessel, year, month, area and depth were considered as predictor variables. Year was defined as calendar year.

4.205 The Working Group thanked Prof. Duhamel for providing both new and historical data from the Kerguelen trawl fishery (the analysis conducted during the Working Group's last meeting had been restricted to data collected during 1994 and 1995).

4.206 Vessel, year, month, area and depth contributed significant sources of variation to haul-by-haul CPUE from the trawl fishery (Table 22). The vessel effect was the most significant component of variability in CPUE and the year effect was the next most significant.

Table 22: Analysis of deviance tables from GLM fit to catch rate data from the trawl fishery for *D. eleginoides* in Division 58.5.1. Factors/covariates were entered into the models in order from top to bottom.

Factor/Covariate	Residual df	Residual Deviance	p
NULL	4519	3706	
Vessel	4511	3312	< 0.01
Year	4505	3179	< 0.01
Area	4504	3173	0.02
Month	4493	3101	< 0.01
Depth	4492	3094	0.01

4.207 Figure 7 illustrates the effects of year, vessel, area and depth on standardised catch rates from the trawl fishery. In general, standardised CPUE was low during the period 1990 to 1992 and higher during the period 1993 to 1996. There were vessels with high, intermediate, and low catch rates, and the differences between the northern and eastern fishing grounds were minimal. Standardised CPUE decreased with increasing depth.

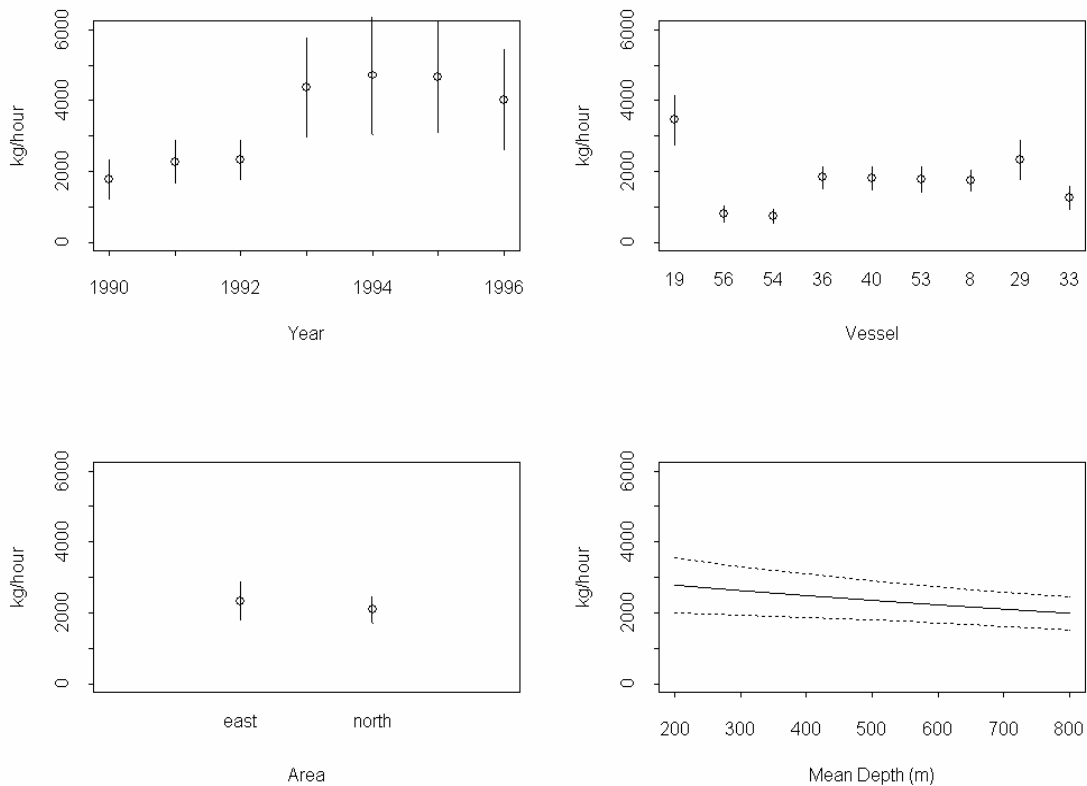


Figure 7: Illustration of the effects of year, vessel, area and depth on standardised catch rates from the trawl fishery.

4.208 Prof. Duhamel noted that the increase in standardised CPUE between 1992 and 1993 (see Figure 7) was probably a result of the fishermen locating the most productive trawling grounds.

4.209 Prof. Duhamel also noted that vessel-specific differences in standardised catch rates were likely to be a result of differences in fishing strategy.

4.210 The Working Group noted that the CPUE-depth relationship illustrated in Figure 7 was consistent with results from the analysis conducted at its last meeting.

4.211 In general, the GLM analysis supported the view that there has not been a decline in trawl catch rates.

Management Advice

4.212 The French authorities have allocated a TAC to the two trawling sectors for the 1996/97 season. A maximum of 2 500 tonnes applies to the northern sector and a 1 000-tonne limit applies in the eastern sector. The longlining catch limit in the western sector has already been established for the end of 1996 (October to December). A TAC of 500 tonnes applies for two vessels only. The level of catch in the first six months of 1997 is not expected to increase and will be in line with the 1993 recommendations of WG-FSA.

4.213 For the western sector longline fishery no further analysis of *D. eleginoides* has been undertaken. However, since there has been no decline in the trends of CPUE in recent years (WG-FSA-93/15 and subsequent data) the Working Group recommended that the value of the long-term sustainable yield estimated at the 1994 meeting of 1 400 tonnes per split-year be continued.

4.214 For the northern sector trawl fishery the GLM analysis has not detected a significant decline in trawl catch rates in recent years. The Working Group therefore recommended that the TAC of 2 500 tonnes set by the French authorities, which is a slight decrease from the 2 800 tonnes set in the previous year, be endorsed.

4.215 For the eastern sector, for which 1995/96 was the second year of fishing, the 1 000-tonne limit, set in 1995/96 by the French authorities was considered appropriate as a precautionary catch limit for 1996/97.

4.216 The Working Group felt 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 be made to acquire haul-by-haul data collected on board Ukrainian longline vessels from the Ukrainian authorities.

Champscephalus gunnari (Division 58.5.1)

4.217 The Secretariat has verified the accuracy and completeness of the new data reported for the Soviet fishery for *C. gunnari* in Subarea 58.5 between 1970 and 1978 (SC-CAMLR-XIV, Annex 5, Table 20). Fine-scale data for these fisheries are not yet available (WG-FSA-96/7).

4.218 The 1991 year class has not been fished as its biomass is thought to be low following fishing activities in 1994/95. In order to obtain information on the new cohort, it was requested that a trawler carry out a number of hauls in the area in which aggregations have traditionally been found. Six hauls (at the end of March 1996) were carried out by bottom trawl at depths of 200 to 280 m (codend mesh size: 30 mm). Fish aged 4+ from the 1991 year class were still present ($\bar{L} = 36.4$ cm, $n = 414$), but fish aged 1+ from the 1994 year class, a large number of which were found to be caught in the mesh, predominated in all areas ($\bar{L} = 16.6$ cm, $n = 882$). The largest haul gave a yield of 4 tonnes per hour (5 tonnes caught). It should be noted that the 1992 year class ($\bar{L} = 29$ cm, $n = 175$) was observed at the edge of the shelf during the southeastern survey for *L. squamifrons*, however its abundance is very low.

4.219 Most of the fish are currently below the legal size limit of 25 cm and so this will restrict the landings from the fisheries during 1996/97.

4.220 In order to assess pre-recruit biomass (year class 1994), a trawl survey has been scheduled for the 1996/97 summer season. A week of trawling is planned, with a total of between 40 and 50 hauls to be carried out. A random trawl survey will be conducted, with stations allocated to strata based on their area. The results may be available for assessment at the next meeting.

Management Advice

4.221 The Working Group reiterated its advice from last year (SC-CAMLR-XIV, Annex 5, paragraphs 5.151 and 5.152) that the fishery for *C. gunnari* in Division 58.5.1 be closed until at least the 1997/98 season, when the cohort born in 1994 will have had an opportunity to spawn. Before this cohort is fished, it is recommended that a pre-recruit biomass survey be conducted in the 1996/97 season to evaluate the strength of the cohort at age 2+. These data should be evaluated at the 1997 meeting of WG-FSA, and an appropriate level of catch recommended.

Notothenia rossii (Division 58.5.1)

4.222 No new data on the stocks of this species are available.

Management Advice

4.223 The Working Group reiterated advice from previous meetings that the fishery for *N. rossii* remain closed until a biomass survey demonstrates that the stock has recovered to a level that will support a fishery (SC-CAMLR-XIII, Annex 4, paragraphs 4.120 to 4.123).

Lepidonotothen squamifrons (Division 58.5.1)

4.224 As indicated last year (SC-CAMLR-XIV, Annex 5, paragraph 5.138), two French trawlers carried out exploratory fishing in the areas in which concentrations of *L. squamifrons* have traditionally been found (southeastern sector of the area) in order to obtain CPUE and length frequency data. The vessels carried out their operations during two different periods:

- (i) end of October 1995:
 - (a) 12 hauls were carried out between the eastern and southern parts of the shelf;
 - (b) three hauls were made on West (Zapadnaya) Bank; and
 - (c) five hauls were carried out on the northern part of Pike (Shchuchya) Bank.

No aggregations were encountered. The length frequency data obtained were only for immature fish (less than 33 cm in length).

- (ii) beginning of March 1996:
 - (a) 21 hauls were carried out in the southeastern and one in the southern area of the shelf;
 - (b) three hauls on West (Zapadnaya) Bank; and

(c) two hauls on the northern part of Pike (Shchuchya) Bank.

L. squamifrons was not encountered on the two banks but one aggregation was detected in the southeastern area of the shelf (south of 50°S at depths of 300 to 330 m). The total catch from this aggregation was 16 tonnes, with an average CPUE of 1.25 tonnes per hour (± 0.71 , $n = 6$). The length of fish ranged from 25 to 43 cm ($\bar{L} = 33.0$ cm, $n = 2\ 090$).

4.225 These results confirm that the distribution of the stock and its areas of aggregation remain unchanged, but are extremely dependent on the time at which the survey is undertaken.

4.226 A specific survey will, however, be required in order to obtain an estimation of the biomass and of the potential fishable resources.

Management Advice

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

Heard and McDonald Islands (Division 58.5.2)

Dissostichus eleginoides (Division 58.5.2)

4.228 In 1994 and 1995, the Working Group assessed potential yields of *D. eleginoides* in Division 58.5.2 in a manner similar to assessments of krill yield. This was because the only information available consisted of two estimates of biomass from trawl surveys in previous years. In these assessments, a proportion of the estimated biomass is determined that satisfies the two decision rules used by the Commission (see SC-CAMLR-XIII, paragraphs 5.18 to 5.26 for a discussion on the application of these rules). The 1995 assessment was undertaken using estimates of population parameters from Subarea 48.3, which were applied in this case because of the absence of estimates from the local stock. The Working Group noted at last year's meeting that improved techniques developed in 1995, such as that for estimating recruitment in Subarea 48.3, should be used in future assessments of the stock in Division 58.5.2. At this year's meeting, the Working Group undertook a new assessment of yield for this stock, applying the improved method of estimating recruitment (described in WG-FSA-96/38) and the refined version of the generalised yield

model (paragraphs 3.65 to 3.69). It was expected that these changes would provide substantially different results from last year's assessment.

4.229 The generalised yield model was applied this year with estimates of recruitment derived from two trawl surveys, taken from WG-FSA-96/38, employing the same method used for *D. eleginoides* in Subarea 48.3 (paragraphs 4.67 and 4.68). These new recruitment estimates demonstrated that the majority of the biomass comprised young fish aged 3 to 5 years, with only the age classes up to about year 10 represented (Tables 1 and 2 in WG-FSA-96/38).

4.230 The numbers of fish estimated for age class 4 for cohorts born in 1985 to 1991 are given in Table 23.

Table 23: Recruitment to the stock of *D. eleginoides* in Division 58.5.2 as numbers of fish by year-class at age-class 4, estimated from trawl surveys at Heard Island (from WG-FSA-96/38).

Cohort	Number of Fish at Age 4 (millions)
1991	2.120
1990	4.214
1989	1.749
1988	1.773
1987	3.435
1986	1.584
1985	1.635

4.231 The numbers of fish at age 4 in each year of the simulation are drawn from a lognormal distribution. The mean and standard deviation of the distribution are derived by the sample mean and variance of the numbers of fish given in Table 23. The resultant estimates are:

Mean number of recruits at age 4	=	2 359 000
Standard deviation	=	1 041 000
Lognormal mean	=	14.585
Lognormal standard error	=	0.159
Lognormal standard deviation	=	0.422

4.232 Biological parameters required for input into the generalised yield model are unknown for Heard Island. A maturity-at-length ogive is known for fish caught in the trawl fishery in the adjacent Division 58.5.1 around Kerguelen Island. However, this ogive may not be representative of the whole stock because trawl fisheries for *D. eleginoides* take smaller fish. Other biological parameters, such as length at age and natural mortality, are unknown for the region. As a consequence, the biological parameters used in the model were taken from the assessments in Subarea 48.3. The Working Group agreed that, wherever possible, biological parameters used in

the analysis should be derived from within one area as the estimates of these parameters are not independent. The application of the maturity ogive from Division 58.5.1 would not be appropriate until larger fish were included in the development of the ogive and a length-at-age model and estimates of M were available for the same area.

4.233 Applying the generalised yield model to *D. eleginoides* in Division 58.5.2 requires an age-specific selectivity function which takes into account the fact that the catches will be taken by trawling. No commercial trawling has taken place for *D. eleginoides* in the division, and so the age distribution of trawl catches from the adjacent Kerguelen fishery was estimated from commercial length frequency data using the age/length key given in SC-CAMLR-XV/BG/14. The estimated age distribution shows the effects of variability in recruitment, both in the age/length key and in the length distribution of the catches. The age distribution averaged over a number of years would be a smooth curve, and so a smooth function, based on a gamma distribution, was fitted to the age distribution. The estimated and fitted age distributions are shown in Figure 8. The age specific selectivity was calculated as the ratio of the numbers at age in catch at age curve to the numbers of fish that would occur in the corresponding age classes, assuming that natural mortality is 0.16 for all ages in the range. The values for age-specific selectivity are shown in Table 24.

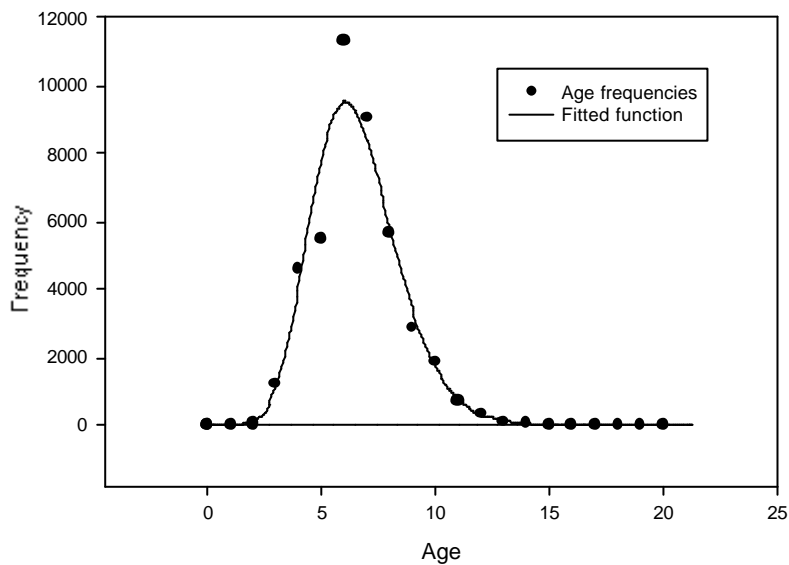


Figure 8: Estimated and fitted age distributions.

Table 24: Age specific selection function for *Dissostichus* trawl fisheries (scaled to unity at age 6).

Age	Selectivity
3	0.070
4	0.311
5	0.699
6	1.000
7	1.038
8	0.849
9	0.579
9	0.341
10	0.179
11	0.085
12	0.037
13	0.015

4.234 The assessment of yield made by the generalised yield model used the same input parameters as the assessment in Subarea 48.3 but with the new recruitment estimate and the selectivity function derived for a trawl fishery. The application of the decision rules to the trawl fishery in Division 58.5.2 is shown in Figures 9(a) and 9(b). The methods used to generate these figures and ways in which they can be interpreted are discussed in the presentation for Subarea 48.3 (paragraphs 4.76 to 4.80). These figures differ from those for Subarea 48.3 because of the differences between areas in the recruitment parameters and fishing selectivity functions.

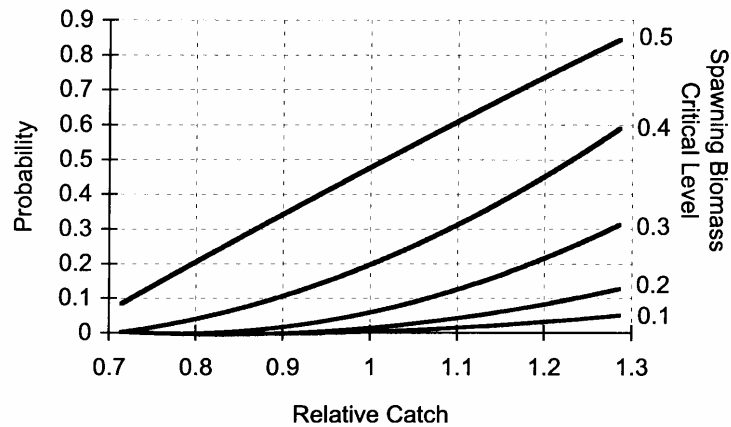


Figure 9(a): *D. eleginoides* in Division 58.5.2: Probabilities of falling below a critical level of spawning biomass relative to the median spawning biomass at Time 0 for a range of catches using parameters from the final run.

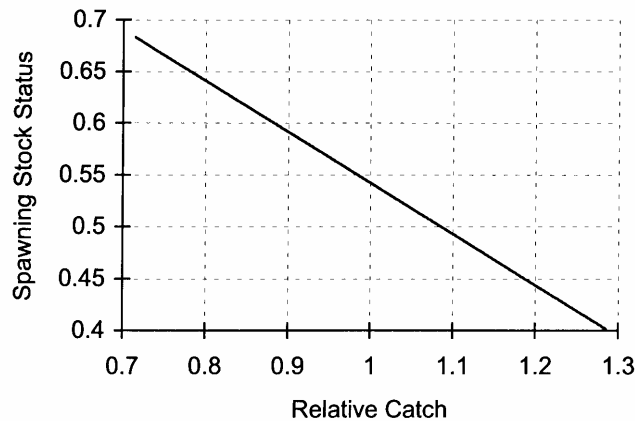


Figure 9(b): *D. eleginoides* in Division 58.5.2: Median status of the spawning biomass at the end of a projection period relative to the median spawning biomass at Time 0 for a range of catches using parameters from the final run.

4.235 The catch that satisfies the decision rules (γ_2 in this case) is 3 800 tonnes. At this catch level the probability of depletion was 0.04, but the ratio of median spawning stock biomass at the end of the projection period to the pre-exploitation level was 0.5. This catch level is substantially different to the figure estimated at last year's meeting (297 tonnes). Two factors are responsible for this increase. The first is the refinement to the generalised yield model since last year (paragraphs 3.65 to 3.69). The second is the use of the new estimate of recruitment, rather than total biomass in the calculations. The assessment of recruitment revealed that the biomass estimates used in 1995 were underestimates of the stock biomass because the trawl surveys had sampled mostly the younger age classes.

Management Advice

4.236 The Working Group welcomed the refinements to the analysis using the generalised yield model made during the intersessional period and at this year's meeting, and noted a number of further refinements which could be undertaken in the future.

4.237 The Working Group noted that the assessment of yield was based on the expectation that future catches will be taken only by trawling. Fishing with other types of gear, such as longlines, would change the age structure of the catch. The Working Group made no assessment of the effects of such catches in this division at this year's meeting. The Working Group therefore recommended that the directed fishery for *D. eleginoides* in Division 58.5.2 be restricted to trawling during the 1996/97 season. Should there be an interest in longlining for *D. eleginoides* in Division 58.5.2 in the future, then the assessment using the generalised yield model could be adjusted to take this into account.

4.238 As requested by the Scientific Committee, the Working Group has provided advice on the relative effects on catch levels of departing from the current γ_1 decision rule (i.e. that the probability that of the spawning stock biomass falling below 20% of its initial level during the projection period, should not exceed 10%). It was noted that in the case of the fishery for *D. eleginoides* in Division 58.5.2, it was the γ_2 decision rule which was limiting on the catch level rather than γ_1 (as in the case of Subarea 48.3). No specific decision rule criteria, other than γ_1 and γ_2 , were considered at this year's meeting. The Working Group agreed, however, that more detailed consideration could be given to the critical level of spawning stock biomass at next year's meeting.

4.239 The results of the projections using the generalised yield model indicated that an annual catch of 3 800 tonnes applied over a period of 35 years was consistent with the γ_2 decision rule. At this level of catch the probability of the spawning stock biomass falling below the 20% critical level was 0.04. The Working Group recommended that this should be the basis for setting the catch limit for *D. eleginoides* in Division 58.5.2 during the 1996/97 season.

4.240 The Working Group recognised the importance to the assessment work of biological data and information collected from this area. This information can be collected both by scientific surveys and through a scientific observer program. In view of the urgent need for information, the Working Group recommended that a requirement for 100% observer coverage be applied to this fishery for the 1996/97 season. The Working Group also reiterated the importance of timely submission to the Secretariat of data from observer trips, in the appropriate formats, to enable them to be made available for consideration by the Working Group (paragraph 3.16(vi)).

Champscephalus gunnari (Division 58.5.2)

4.241 No fishery for this species has been reported in recent times, although Conservation Measure 78/XIV set a precautionary TAC of 311 tonnes for *C. gunnari* on the basis of results from Australian biomass surveys.

Management Advice

4.242 In the light of experience with the fishery for this species in Division 58.5.1 (SC-CAMLR-XIV, Annex 5, paragraphs 5.146 to 5.152), it is recommended that the fishery for *C. gunnari* in Division 58.5.2 also avoid the taking of fish smaller than the size at first spawning (about 28 cm total length).

Crozet and Prince Edward Islands (Subareas 58.6 and 58.7)

4.243 No information was available to make any assessment of these areas.

4.244 Notification of the intention to conduct a new fishery for *D. eleginoides* in Subareas 58.6 and 58.7 during the 1996/97 season has been lodged by South Africa. Management advice is given in paragraphs 4.20 to 4.30.

Pacific Ocean Sector (Area 88)

4.245 No information was available to make any assessment of this area.

4.246 Notification of the intention to conduct a new fishery for *D. eleginoides* in Subareas 88.1 and 88.2 during the 1996/97 season has been lodged by New Zealand (see paragraph 4.17). Management advice is given in paragraphs 4.20 to 4.30.

Resumed/Reopened Fisheries

4.247 The Commission, at last year's meeting, recognised that no clear policies or measures exist to manage fisheries which have been closed but are under consideration for reopening (CCAMLR-XIV, paragraph 8.26). The Commission agreed that this topic should be discussed at the next Scientific Committee meeting. The Working Group considered a proposal outlining the need for procedures to govern the reopening of a closed fishery (SC-CAMLR-XV/BG/11).

4.248 There was considerable debate over the definition of a resumed fishery, under what conditions a fishery might be reopened, and whether the existing conservation measures for new (Conservation Measure 31/X) or exploratory (Conservation Measure 65/XII) fisheries could be used in such instances. It was recognised that fisheries may lapse for a variety of reasons (including both economic and sustainability factors), and may therefore need to be considered on a case-by-case basis.

4.249 The Working Group agreed that information and procedures similar to those required for the initiation of a new fishery (Conservation Measure 31/X) and/or for the execution of an exploratory fishery (Conservation Measure 65/XII) should be required during the resumption of a closed fishery. For example, a Data Collection Plan and a Research and Fishery Operation Plan, which are required for new and exploratory fisheries, should be considered.

4.250 However, the Working Group recognised that the requirement for a survey prior to the resumption of a fishery might best be considered on a case-by-case basis. For example, the Commission requires a survey be completed before closed areas (Subareas 48.1 – Conservation Measure 72/XII and 48.2 – Conservation Measure 73/XII) are reopened for fishing and has required a survey be conducted before directed fishing on a depleted species is resumed (Conservation Measure 97/XIV). However, it does not require a survey before the initiation of a new fishery and may not require a survey before reopening a fishery which had closed for reasons other than suspected stock depletion.

4.251 In all cases, it was considered highly desirable for prior notification of the intention to resume a fishery be provided so that an appropriate assessment of the status of the stock could be made and appropriate management advice given to the Scientific Committee. To this end, the Working Group recommended that the Commission maintain a register of lapsed fisheries.

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, paragraphs 7.1 to 7.59) that related directly to the work of WG-FSA.

5.2 Throughout Subareas 48.1, 48.2 and 48.3, the abundance of krill was higher in 1995/96 than in previous years. In Division 58.4.1, a survey carried out in 1996 has shown that the abundance of krill was higher in the western part of the division than in the eastern part, but no historical survey data were available for comparison with the results of this survey.

5.3 Ecosystem implications of proposed new fisheries were discussed by WG-EMM. These were considered under Agenda Item 4.2 (see paragraph 4.32).

5.4 Comprehensive sea-surface temperature (SST) data have been acquired by the Secretariat, and WG-EMM recommended that comprehensive bathymetric data should also be acquired. The usefulness of bathymetric data for estimating relative areas of fishable seabed was emphasised during WG-FSA's discussions of proposals for new fisheries for *D. eleginoides* (see paragraph 4.20). It was noted that sea-ice indices may also prove useful for the work of WG-FSA.

5.5 As the primary current focus of WG-EMM is on krill and its dependent species, interactions between WG-EMM and WG-FSA are relatively minor for most of the fish stocks of concern to WG-FSA. However, ecosystem assessments will clearly form a valuable adjunct to studies on the long-term management of *C. gunnari* (see paragraphs 4.149 to 4.151).

5.6 WG-EMM has devoted considerable time to discussions of multifrequency acoustic techniques in surveys, and related topics. WG-FSA agreed that it would be appropriate for WG-EMM to take the lead on acoustic survey methodology and it agreed that it would refer technical questions to WG-EMM as appropriate.

5.7 WG-EMM recommended that more extensive studies of the occurrence of fish in krill catches should be carried out (Annex 4, paragraphs 6.1 to 6.3). In particular, additional studies covering the entire fishing season were needed. The by-catch of fish in krill trawls has also been considered by an intersessional WG-FSA correspondence group. The interim report from this group is in WG-FSA-96/41.

5.8 The WG-FSA correspondence group identified a number of available datasets and several other datasets for which little or no information was available. Of these latter datasets, a complete record of Russian krill survey data for 1967 to 1990 has now been prepared and made available to the Secretariat (WG-FSA-96/17). The remaining data are expected to be acquired by the Secretariat by early 1997.

5.9 It was noted that before the newly-acquired data could be used by the correspondence group, it was necessary that these data be entered into the CCAMLR database. If this were to be done by the Secretariat, then a suitable budget provision would have to be made.

5.10 In addition to the data identified in WG-FSA-96/17 and 96/41, the Working Group noted with appreciation that additional information on fish by-catches in krill trawls was presented in WG-FSA-96/18 and 96/19.

5.11 The Working Group thanked the correspondence group for its work. Provided the data entry can be accomplished, it was agreed that the correspondence group should analyse all the available fish by-catch data and report progress to the next meeting of WG-FSA.

5.12 An alternative and useful way of addressing the problem of fish by-catches in the krill fishery is to look at the distribution of juvenile fish directly. New information on juvenile fish distribution was presented in WG-FSA-96/58 and 96/60.

Ecological Interactions

5.13 A number of papers tabled at this meeting addressed ecological interactions between the fisheries and various by-catch species.

5.14 WG-FSA-96/8 described the distribution of South Georgia albatrosses and their interactions with fisheries. While much of the material in this paper is more directly related to incidental mortality, which is discussed under Agenda Item 7 (see paragraph 7.70), there was new information on foraging grounds and migration routes from band recoveries and satellite tracking. Interactions of seabirds, seals and whales with the squid *M. hyadesi*, for which there is a proposal to initiate a new fishery (see paragraphs 4.8 to 4.14), are discussed in WG-FSA-96/20.

5.15 WG-FSA-96/11 and 96/36 reported information on by-catches from longline fishing around Kerguelen (Division 58.5.1). In WG-FSA-96/11, it was found that the by-catch was low during longline fishing directed at toothfish in 1994/95 and 1995/96 at around 500 m depth. This indicated that longlining is a highly target-specific method of fishing in the toothfish fishery, at least at these depths. However, experimental longline fishing carried out around Kerguelen over a wider range of depths (300 – 1 700 m) in 1996 (WG-FSA-96/36) produced a by-catch of 10 species of fish, of which the numerically dominant species were grenadier and two species of skates. Two species of large sharks were also taken (sleeper shark (*Somniosus microcephalus*) and porbeagle shark (*Lamna nasus*)).

5.16 The Working Group agreed that both rays and large sharks are likely to be more vulnerable to overfishing than the target species for the longline fishery (*D. eleginoides*). Close attention should be paid to by-catches of potentially vulnerable species. Dr de la Mare noted that sleeper sharks had also been taken and released alive in the trawl fishery for *D. eleginoides* around Macquarie Island.

5.17 The Working Group noted that observers already record the biomass of by-catches by species in *D. eleginoides* fisheries. However, it is not always clear whether these by-catches are actually discarded or whether some are retained. As some potential by-catch species are commercially valuable, it was important that records be kept of whether or not by-catches are retained. The observation forms need to be amended to allow this information to be recorded.

5.18 The other primary ecological interactions with the longline fishery involve marine mammals. Two types of interactions occur: fish on longlines can be damaged or removed by marine mammals, and marine mammals can be injured or killed through entanglement in the fishing gear.

5.19 WG-FSA-96/12 discussed the impact of marine mammals on the longline fishery for *D. eleginoides* around Kerguelen in 1995/96. The main impact is due to fur seals, which damage or remove fish directly from the longlines. There were no observations of fur seals being tangled in the longline gear. Sperm whales have been observed in the vicinity of longlines and may be taking fish from the lines.

5.20 The presence of sperm whales, killer whales and fur seals in the vicinity of a Chilean longliner has also been reported in Subarea 48.3 in 1996 (WG-FSA-96/22). Fish loss due to sperm whales was estimated to be low, but fish loss due to killer whales was considerable, with commonly only a few fish being left on the line. Sperm whales became entangled in the line, which subsequently broke.

5.21 WG-FSA-96/52 also reported observations of sperm whales, killer whales, Antarctic fur seals and southern sea elephants in the vicinity of a Russian longliner operating in Subarea 48.3 in 1996. Killer whales, a sperm whale and southern sea elephants were observed to take fish from the longline, with killer whales being the most active. In nine longlines, all or part of the catch was reportedly eaten by killer whales (at least 380 fish). One sperm whale was observed to have been entangled in the main line. The longline was lost when attempts were made to release the whale. Dr Everson advised that there have also been reports of interactions between cetaceans (sperm whales and killer whales) and longline fishing operations around South Georgia.

5.22 The Working Group agreed that interactions between marine mammals and longline fishing operations were a continuing problem for which there is no obvious solution. It is apparent that in some cases, the number of fish taken by marine mammals can be substantial. If so, it may become necessary to take these into account during assessments, as they are not currently counted amongst landings. It was noted that observers are required to make quantitative estimates of the number of fish taken by marine mammals, but it was recognised that this is often very difficult. The other most frequent type of interaction occurred when sperm whales became entangled in longlines.

5.23 WG-EMM-96/31 reported that, on the basis of studies over six years, mainly coastal fish species are found in the diet of blue-eyed shags. *Notothenia coriiceps* and *Harpagifer antarcticus*, the most abundant inshore fish species, formed the bulk of the diet, while *N. rossii* and *G. gibberifrons* comprised a low proportion with no apparent trend over the years. These studies will continue into the future and it may be possible to monitor the abundance of these species using such dietary data. The Working Group looked forward to seeing future analyses of these data.

RESEARCH SURVEYS

Simulation Studies

6.1 At its 1995 meeting, WG-FSA endorsed the use of simulation studies to tackle specific survey design questions and identified a number of other fields in which simulation studies may be applied (SC-CAMLR-XIV, Annex 5, paragraphs 7.1 and 7.2).

6.2 The Working Group noted that little progress has been made, although the Working Group did note that simulations of the properties of sampling methods, such as those described in WG-FSA-96/56, are likely to be useful in evaluating the efficacy of such methods.

6.3 In the light of the above, WG-FSA concluded that in future it will consider developments in various simulation approaches under its deliberations on developments in assessment methods (e.g. under Agenda Item 3).

6.4 WG-FSA-96/56 outlines an approach to obtain representative samples of fish from commercial longline catches (see also paragraph 6.2). The Working Group welcomed this approach and encouraged the authors to develop the scheme so as to provide a working protocol for incorporation into the *Scientific Observers Manual*.

Recent and Proposed Surveys

6.5 Details of recent fish surveys have been addressed where appropriate during other WG-FSA deliberations (see paragraphs 3.20 to 3.22 especially). However, the Working Group noted various matters associated with specific surveys.

6.6 Such matters included:

- (i) the termination of the UK survey in Subarea 48.3 during September 1996 for operational reasons;
- (ii) the successful completion of a joint Japanese/French deepwater survey in Division 58.5.1 (including the lodging of haul-by-haul data in the CCAMLR database); and

- (iii) a survey by Spanish scientists participating in a German cruise on board *Polarstern* (January to March 1996) in Subarea 48.5 (Weddell Sea – Cape Norvegica to Halley Bay areas).

6.7 Dr Gasiukov drew WG-FSA's attention to the results of a recent Russian survey to estimate fish biomass in Subarea 48.3 using both acoustics and trawling during January and February 1996 (WG-FSA-96/59). Further discussions of these results are given in paragraphs 4.129 to 4.135.

6.8 In respect of future surveys, the following developments were noted.

6.9 As part of its AMLR program, Dr Holt indicated that the US is intending to commence fish surveys in Subarea 48.1 (in the vicinity of Elephant Island) from 1997. Such surveys will be undertaken regularly thereafter and the US indicated that it welcomed input from other Members with expertise in fish survey work as well as advice from WG-FSA on aspects of survey design. The Working Group welcomed this development, particularly since the current status of fish stocks in Subarea 48.1 is uncertain and fishing in the area has been closed under Conservation Measure 72/XII.

6.10 Dr Gubanov indicated that Ukraine, while still interested, has not yet been able to undertake a survey of *L. squamifrons* at Lena and Ob Banks (Division 58.4.4) subject to the provisions of Conservation Measure 87/XIII. Further advice on the proposal is given in paragraph 4.196.

6.11 WG-FSA noted with appreciation France's impending survey of *C. gunnari* in Division 58.5.1 during February 1997. Prof. Duhamel's offer to submit the data from this survey to the Working Group's next meeting was welcomed.

6.12 Dr K.-H. Kock (Chairman, Scientific Committee) informed the Working Group that Germany will be undertaking a demersal fish survey of the Elephant Island area (Subarea 48.1) during November/December 1996 on board the *Polarstern*. Results from this survey will be submitted to the 1997 meeting of WG-FSA.

6.13 Lic. Marschoff informed the Working Group that a fish survey will be undertaken on board *Dr Eduardo L. Holmberg* in Subarea 48.3 in the first quarter of 1997. Results of the survey will be submitted to the next meeting of WG-FSA.

INCIDENTAL MORTALITY ARISING FROM LONGLINE FISHING

Intersessional Work

7.1 The program of intersessional work, developed at the end of last year's meeting (WG-FSA-96/32 appendix), was conducted by the Secretariat as described in WG-FSA-96/32.

7.2 Dr Sabourenkov reported that all reports and relevant information from last year's meeting had been circulated to the members of the ad hoc Working Group on Incidental Mortality Arising from Longline Fishing (WG-IMALF) and to other organisations as instructed. He requested that members of WG-IMALF suggest changes to the membership as appropriate. It was recollected that two additional members, J. Molloy and J. Dalziell (New Zealand) had been suggested informally last year. Mr N. Klaer and Dr G. Tuck (Australia) and Dr Kock were recommended as additional members of WG-IMALF.

7.3 The Working Group noted that despite the efforts of the Secretariat to exchange information with a range of international organisations (see SC-CAMLR-XIV, Annex 5, paragraph 8.5), CCAMLR had still received very few positive or informative responses from these organisations (see also SC-CAMLR-XIV, paragraph 3.27).

7.4 Australia, France, New Zealand and the UK had responded to the request of the Scientific Committee (SC-CAMLR-XIV, paragraph 3.28(i)) for information on steps taken or planned by Members in addressing the topic of incidental mortality of seabirds associated with fisheries, especially longline fishing, in waters under their jurisdiction adjacent to the Convention Area and in other regions where seabirds from the Convention Area might be affected. These responses are discussed in paragraphs 7.56 to 7.65 below.

7.5 The book *Fish the Sea Not the Sky*, aimed at reducing incidental mortality of seabirds and improving efficiency of demersal longline fisheries, was produced during the year (WG-FSA-96/32, paragraphs 9 to 12). The Working Group congratulated the Secretariat and especially the Science Officer on this achievement. It also thanked Mr N. Brothers (Tasmanian Parks and Wildlife, Australia) for his initial work on the project and all those who helped in the final production, especially Mr G. Robertson and other staff at the Australian Antarctic Division. The generosity of Australia in providing additional funds to ensure production in all Commission languages was particularly appreciated.

7.6 It was agreed that well-targeted distribution of this book was very important; the following were seen as priority recipients:

- (i) all vessels conducting demersal longlining in the Convention Area;
- (ii) all vessels conducting demersal longlining in areas adjacent to the Convention Area;
- (iii) the managers of fishing companies operating vessels conducting demersal longlining in either the Convention Area or areas adjacent to it; and
- (iv) all CCAMLR scientific observers on board demersal longlining vessels.

7.7 It was envisaged that, as these recipients would need to be identified in the first instance by CCAMLR Members, distribution of these copies would be undertaken by the Members. In undertaking this distribution, Members were asked to take all appropriate steps to encourage a positive attitude amongst fishermen towards modifying their fishing practices in the manner detailed in the book. It was also recommended that the Secretariat provide copies of the book to other international fisheries forums with priority being given to those regulating longlining.

7.8 The Working Group agreed that the message contained in the book *Fish the Sea Not the Sky* was clear and succinct. It advised the Scientific Committee to investigate producing a flyer, poster and/or sticker which could be used to reach a wider audience than the book alone.

7.9 WG-FSA also agreed that the evaluation of the effectiveness of the book should be an integral part of efforts to educate fishermen. Accordingly, it was requested that Members advise the Secretariat of the addresses of recipients.

7.10 Additionally, it was agreed that observers should be asked to comment on whether the book was present on the vessels on which they are deployed, how effective it was in influencing fishing activities and any suggestions for improvements.

7.11 The proposed seabird identification manual (SC-CAMLR-XIV, paragraph 3.28(iii)) had been described in a formal submission by New Zealand to CCAMLR (CCAMLR-XV/13).

7.12 The Working Group endorsed the scope and projected content of the manual and noted that New Zealand was well placed to undertake the task in terms of expert authors and artist. However, the Working Group expressed concern that: (i) the support being sought from CCAMLR (A\$24 000) was at a level where it would compete directly with the very highest of CCAMLR's own priorities; and (ii) the proposal did not include provision for editions in languages other than English.

7.13 The Working Group suggested that the Scientific Committee might advise that while the proposal could not at present be amongst the high priorities of the Scientific Committee itself, it could be a very important initiative for the Commission, particularly if, for instance, support for production in French, Spanish and Russian could be achieved without displacing any higher-priority CCAMLR objectives. The Working Group suggested that funding for the basic production might readily be raised via international conservation agencies and/or commercial sponsorship.

7.14 Proposals for banding and genetic studies to help determine the origin of birds caught in longlines (SC-CAMLR-XIV, paragraph 3.28(v) and Annex 5, paragraph 8.34) had been referred to SCAR for advice. The report of the CCAMLR Observer to SCAR (SC-CAMLR-XV/BG/12) indicated that SCAR advised that:

- (i) its previous experience in trying to develop and coordinate multinational banding programs (for giant petrels) suggested that it was preferable for those Members currently banding albatrosses to undertake an appropriately intensive banding project by mutual agreement; and
- (ii) appropriate genetic studies offered great promise but would require expert advice and facilities and fairly substantial funding. SCAR had referred this request to its newly formed Subcommittee on Evolutionary Biology of Antarctic Organisms (meeting in Brazil in 1997) for specialist advice.

7.15 Following the renewed request (SC-CAMLR-XIV, paragraph 3.28(vi)) for information on existing and proposed monitoring of albatrosses, giant petrels and white-chinned petrels, responses (additional to those from the UK in SC-CAMLR-XIV, Annex 5, paragraph 8.31 and New Zealand in SC-CAMLR-XIV, paragraph 3.44) had been received from South Africa (indicating extension of existing programs on albatrosses at Marion Island for a further five years) and New Zealand.

7.16 Dr M.J. Imber (New Zealand) had indicated in correspondence that relevant work was in various stages of progress in New Zealand on 11 albatross taxa, northern giant petrel and two *Procellaria* petrel species. Work on white-chinned petrels, however, was a low priority in New Zealand because of the apparent rarity of these species in fishery by-catch in the region.

7.17 The Working Group welcomed the reports on these studies. It noted that information had yet to be received on relevant monitoring programs being undertaken by French scientists at Kerguelen and Crozet Islands and by Australian scientists at Macquarie.

7.18 In this context Mr I. Hay (Australia) noted that:

- (i) Dr Robertson is about to undertake observations in the toothfish longline fishery conducted around the Falklands/Malvinas Islands, including monitoring the relative effectiveness of different types of bird lines and other incidental mortality mitigation measures;
- (ii) censusing and monitoring studies, coordinated by Dr R. Gales (Australia) of wandering albatross, black-browed albatross, grey-headed albatross, light-mantled sooty albatross and southern and northern giant petrels is continuing at Macquarie Island. The studies, which also examine the breeding success of the populations, are expected to continue until 2001; and
- (iii) opportunistic monitoring of albatross and petrel populations at Heard Island is expected to be conducted this austral summer during a three-day visit.

7.19 The Scientific Observer Logbook for longline fisheries was developed, published and circulated by the Secretariat during the year (WG-FSA-96/32, paragraphs 15 to 16). Further discussion of logbooks and their use by observers appears in paragraphs 3.10 to 3.19.

7.20 In response to the Scientific Committee's recommendation concerning the collection of specimens from seabirds killed on longlines (SC-CAMLR-XIV, paragraph 3.32(i)), the logbook forms now contain an entry indicating the place of deposition and the scientists responsible for this material. The request to Members to notify CCAMLR of the identity of birds killed and the number of specimens taken was reiterated.

7.21 No responses had been received to the request for research into ways of reducing the by-catch of white-chinned petrels at night (SC-CAMLR-XIV, paragraph 3.32(ii)).

7.22 Responses to the request for information on the use and effectiveness of longline systems for releasing baited lines underwater (SC-CAMLR-XIV, paragraph 3.46) had been received from New Zealand, Norway and the USA.

7.23 In correspondence, Dr Imber reported that two contracts funded by Conservation Services Levies (CSL) were concluded during the 1995/96 fishing year to develop underwater setting devices suitable for use on domestic pelagic longline vessels. The contractors are required to produce a working prototype and a report describing the device. The two contractors have used different approaches in developing the underwater setting devices. One has constructed a slotted chute to 3

m under the surface, down which the baited hook and snood is fed, while the other has built a mechanism which shoots a capsule containing the baited hook up to 10 m underwater – the capsule (which is attached to a cable) springs open upon reaching maximum depth, ejecting the bait; the capsule is then recovered and reloaded. Preliminary sea trials have been undertaken on both devices, and they are now in the final stages of refinement. If either or both of the devices are considered to be worth further investment, an experimental program to test their effectiveness in reducing seabird by-catch will be undertaken during the 1996/97 fishing year. The Working Group commended this work and looked forward to receiving reports on the use of the devices.

7.24 In WG-FSA-96/6, Dr S. Løkkeborg (Norway) described tests in the North Atlantic of a system (produced by Mustad) of setting lines through a funnel that guided the baited line beneath the sea surface. Seabird by-catch was significantly reduced using this method although it was slightly less effective than using conventional line setting with streamer lines to scare birds away. The lower efficiency of the underwater setting system in this comparison was probably due to the length of the funnel being insufficient to counteract propeller wake and turbulence which tended to bring the bait to the surface. Mustad has indicated to the Secretariat that it hopes to introduce modifications to improve performance. The Working Group commended the study and encouraged further trials using improved funnels. It was noted, however, that this system is only feasible for deployment of autoline systems and is not suitable for the Spanish method.

7.25 Dr Watters reported that the *American Champion* attempted use of a device for setting underwater, but this was discontinued after approximately one week due to line tangling problems.

Reports on Incidental Mortality of Seabirds during Longline Fishing

Data from the Convention Area

Observations for 1995

7.26 The plan of intersessional work had provided for further validation and analysis of the 1995 data (see WG-FSA-96/32, appendix and 96/26). However, because the Scientific Observer Data Analyst was not appointed until mid-May and the priority was to develop the scientific observer database (as described briefly in WG-FSA-96/25) and to enter and analyse 1996 data, there had been insufficient time to undertake any re-analysis of 1995 data. Given the amount of 1996 data that would need intersessional analysis, it was unlikely that further work on the 1995 data would be performed in the coming year. However, it was noted that some re-analysis of 1995 data had taken place in revising WG-FSA-95/42 for publication in *CCAMLR Science*.

Observations for 1996

Data Submission

7.27 The Scientific Observer Logbook for longline fisheries was published and distributed by the Secretariat in January 1996. Three completed logbooks from the *D. eleginoides* fishery in Subarea 48.3 were received in time to complete data entry before this meeting. A total of 16 cruises were carried out during 1995/96 in this area, and all were observed. Additional observer cruise data were received by the Secretariat for the remaining cruises just prior to this meeting, but due to the time required for data entry, these data are not currently available in computerised form (see Table 25 for a summary of data submitted to date).

Table 25: Summary of observer data received by the Secretariat for the longline *D. eleginoides* fishery in Subarea 48.3 for the 1995/96 period.

Vessel	Designating State	End of fishing in CCAMLR Area	Received	Entered	Data Type
<i>Antarctic III</i>	Chile	8/3/96	27/9/96	Logbook	logbook, cruise report
<i>Vieirasa Doce</i>	Chile	25/3/96	27/9/96	Logbook	logbook, cruise report, C2
<i>Aquatic Pioneer</i>	Chile	9/3/96	27/9/96		cruise report, C2
<i>Ercilla</i>	Argentina	22/6/96	7/10/96		cruise reports, C2, biological
<i>Faro de Hercules</i>	Argentina	12/5/96	7/10/96		cruise reports, C2, biological
<i>Friosur III</i>	Argentina	30/6/96	7/10/96		cruise report, set information, biological information
<i>Isla Camilla</i>	Argentina	24/6/96	7/10/96		cruise reports, C2, set information, biological information
<i>Isla Sofia</i>	Argentina	22/7/96	7/10/96		cruise report, C2
<i>Maria Tamara</i>	Argentina	13/3/96	7/10/96		cruise report
<i>Antonio Lorenzo</i>	Argentina	18/3/96	7/10/96		cruise report
<i>Magallanes III</i>	Argentina	24/5/96	7/10/96		cruise reports, C2, set information, biological information
<i>Mar del Sur I</i>	Argentina	19/6/96	7/10/96		cruise reports, C2, set information, biological information
<i>Puerto Ballena</i>	Germany	11/5/96	19/8/96	Logbook	logbook, cruise report
<i>Ihn Sung 66</i>	Russia	1/7/96	10/9/96		cruise report
<i>Itkul</i>	Ukraine	17/7/96	7/10/96		cruise report
<i>American Champion</i>	Chile	11/4/96	27/9/96		cruise report, C2

7.28 The data submitted by the Argentinian observers were in several different formats, most of which are not used by CCAMLR. This makes data entry difficult, as the data need to be reorganised in such a way that they are compatible with the current database. It is estimated that it will take at least a further three months to have all of the 1995/96 observer data entered into the database and verified. This time could have been reduced if the data had been submitted using the Scientific

Observer Logbook format. Lic. Marschoff advised that he would investigate this and report back to the Working Group.

7.29 The Working Group commended the three observers who had submitted logbooks in timely fashion and particularly J. Selling (Germany) who provided much additional information enabling valuable supplementary observer reports (WG-FSA-96/22 and 96/31) to be submitted.

7.30 The Working Group expressed concern in respect of the other observer material, noting that:

- (i) most reports had arrived much too late for analysis;
- (ii) many reports were not in the specified formats; and
- (iii) there were considerable potential uncertainties concerning the validity/accuracy of some of the data.

7.31 The Working Group noted that because of this it had been largely unable to evaluate much of the data required for the proper management of the *D. eleginoides* fishery in Subarea 48.3, in respect of its interactions with seabirds.

Demersal Longline Seabird By-catch and By-catch Rates in Subarea 48.3 during 1995/96 – Preliminary Results

7.32 Further details relating to the four sets of observer data used in the main analysis are summarised in Table 26.

7.33 WG-FSA-96/26 provides an analysis of mean seabird catch rates from 4 of 16 vessels known to have fished for *D. eleginoides* in Subarea 48.3 in the 1995/96 fishing period. Both vessel logbooks and observer cruise reports are required to carry out analyses of seabird by-catch rates. Further relevant data have been submitted to the Secretariat, but will not become available until data entry has been completed. The results presented here are to be treated with caution due to the small sample sizes, and should also be regarded as preliminary until all relevant data have been analysed. No estimates of the variance of mean values have been calculated, although methods of doing so are available (e.g. WG-FSA-96/66). To allow comparison of estimates among years or other strata, estimates of variance are required. The implementation of suitable methods for such calculations will be pursued intersessionally.

Table 26: Summary of observation programs on longline fisheries conducted in the 1995/96 season, in accordance with Conservation Measure 80/XIII, by observers designated under the CCAMLR Scheme of International Scientific Observation.

Flag State	Vessel	Fishing Method	Observer	Subarea/ Fishery	Streamer Line	Period of Observation	Report	Data Reported
Chile	<i>Puerto Ballena</i>	LLS Spanish	Germany: J. Selling	48.3 <i>D. eleginoides</i>	Own design	22/2 - 17/5/96	Observer Cruise Log	Cruise, vessel, catch and IMALF details
Republic of Korea	<i>Ihn Sung 66</i>	LLS Spanish	Russia: A. Kozlov	48.3 <i>D. eleginoides</i>	CCAMLR and own design	26/2 - 27/7/96	Observer Cruise Report	Cruise, catch and IMALF details
Argentina	<i>Antarctic III</i>	LLS Auto	Chile: J. Soto	48.3 <i>D. eleginoides</i>	Own design	2/3 - 8/3/96	Observer Cruise Log	Cruise, vessel, catch and IMALF details
Argentina	<i>Vieirasa Doce</i>	LLS Spanish	Chile: V. Briones	48.3 <i>D. eleginoides</i>	CCAMLR design	5/3 - 25/3/96	Observer Cruise Log	Cruise, and vessel details

Table 27: Observed seabird catches.

Vessel	Obs C2	Obs Log	Obs Hooks	Total Hooks	% N sets	Observed Birds Caught								
						Night	Dead Day	Total	Night	Alive Day	Total	Night	Total Day	Total
<i>Antarctic III</i>	Yes	Yes	52.9	73.9	89	2	0	2	0	0	0	2	0	2
<i>Vieirasa Doce</i>	Yes	Yes	204.2	204.2	81			[42]						
<i>Aquatic Pioneer</i>	No	No		23.8										
<i>Ercilla</i>	Yes	No		544.8										
<i>Faro de Hercules</i>	Yes	No		706.5										
<i>Friosur III</i>	Yes	No		1115.5										
<i>Isla Camilla</i>	Yes	No		1114.6										
<i>Isla Sofia</i>	Yes	No		369.0										
<i>Maria Tamara</i>	No	No		11.3										
<i>Antonio Lorenzo</i>	No	No		40.0										
<i>Magallanes III</i>	Yes	No		537.8										
<i>Mar del Sur I</i>	Yes	No		1014.0										
<i>Puerto Ballena</i>	Yes	Yes	233.3	906.4	53	29	111	140	17	10	27	46	121	167
<i>Ihn Sung 66</i>	Yes	No	512.6	1459.1	53	1	7	8	24	15	39	25	22	47
<i>Itkul</i>	No	No		646.3										
<i>American Champion</i>	Yes	No		754.8										
Total			1003.0	9521.9	61	32	118	150	41	25	66	73	143	216

Note: % N sets indicates the proportion of observed sets made at night (between nautical twilights)

7.34 A summary of the data for observed seabird by-catch is given in Table 27. Only 3 cruises of the 16 provide sufficient information for the calculation of mean catches and catch rates. One cruise (*Vieirasa Doce*) provides information on total seabird catches without an indication of whether the catches were made at night or during the day, so those data have been excluded from further examination. For the purposes of this examination, vessels without observer data at this stage will be referred to as 'unobserved'.

7.35 Catch and release of live seabirds appears to be common in this fishery, with 66 of 216 observed seabird captures (31%) resulting in a live release. There is no information presently available on the fate of seabirds released alive, but an unknown proportion of them would probably die. This, in combination with an unknown number of birds which were hooked and killed but lost from the line prior to hauling (an estimate of 27% for tuna longline fisheries is given in WG-IMALF-94/6) suggests that reported numbers of dead birds significantly underestimates the total kill due to fishing activities.

7.36 Conversion of catches of birds given in Table 27 to observed by-catch rates is given in Table 28. For the three cruises examined, catch rates show considerable variability among vessels. This suggests that any measure of variance which may be calculated for the mean values would be high. As also shown in WG-FSA-96/26, mean catch rates of birds not released alive during the day were approximately six times higher than night catch rates. For birds released alive there is little difference between night and day catch rates. Given the small sample size, however, no conclusion should be made on this observation at this time.

7.37 The mean percentage of observed sets carried out at night was 61%. This contravenes Conservation Measure 29/XIV, paragraph 2, which states that longlines shall be set at night. As the catch rate for killed birds has been observed to be much higher during the day, a considerable proportion of the seabird mortality would have been avoided if this conservation measure was followed.

7.38 Estimates of total by-catch of seabirds by all vessels are given in Table 29. Estimates were derived by assuming that the proportion of night sets for vessels without data at this stage was the same as the observed mean. Mean catch rates for all observed vessels given in Table 26 were then used to construct an estimate of the total seabird catch for unobserved vessels.

7.39 Also given in Table 29 are total seabird catches recorded on C2 data forms. There appears to be large discrepancies between these records for observed vessels, indicating misrecording of either observer or vessel records. For the *Ihn Sung 66*, 53% of sets were observed, and 47 seabirds were observed caught for these sets. The C2 vessel statistics for all sets record a total of

41 seabirds caught. For the *Puerto Ballena*, 69% of sets were observed, and 167 seabirds were observed caught for these sets with 140 of these killed. The C2 vessel statistics for all sets record a total of 131 seabirds killed, and no statistics were given for those released alive. Such discrepancies clearly require further investigation.

7.40 Table 29 indicates that all 16 vessels in the *D. eleginoides* fishery in Subarea 48.3 during 1995/96 caught in the order of 2 300 seabirds, of which 1 618 were dead and 682 were released alive. It was expressly noted, however, that these estimates are extrapolated from just 3 (of 16) datasets which may not be fully representative of the overall picture; revised estimates will be provided as soon as intersessional analysis of the remaining data is complete. Nevertheless, the present estimates are the best that can be made with the available data.

7.41 To estimate numbers caught by species, an estimate of the species composition of the catch for the fishery is required. Two sources of this information were investigated: observed catch composition, and vessel-reported C2 catch composition. Composition of observed catch is given in Table 30, and vessel C2 catch composition is given in Table 31. Only five species were reported by observers, compared with nine in the vessel C2 reports. Observed captures gave a total sample size of 169, while the vessel C2 sample size was 787. While there may be reason to give greater weight to observed records due to discrepancies already outlined, the larger sample of the vessel C2 records has been selected for use in this case. As an estimate of percentage catch composition is required, under- or over-reporting is not an issue. Of importance is that the sample is random in relation to the total catch, and that the sampled birds are correctly identified. The accuracy of identification by observers and persons completing vessel details should be investigated.

7.42 Estimates of percentage catch composition by identified species were constructed in Table 31 by proportional distribution of catch identified as 'birds' to albatrosses, petrels and shearwaters, and Antarctic terns. Then, catches given as just 'albatrosses' or 'petrels and shearwaters' were proportionately distributed over individual species within those groups. This resulted in estimates of total catch by identified species, and the percentage species composition given in the table. Estimates of total catch by species for the fishery were then made by multiplying the species composition proportions by the estimated total fishery seabird catch given in Table 29. Results in Table 31 indicate that of the birds captured, 1 498 were albatrosses and 747 were petrels. Of these, it was estimated that 1 055 albatrosses and 527 petrels were killed. Note that these are also extrapolated estimates (see paragraph 7.40).

Table 28: Observed seabird catch rates.

Vessel	Obs C2	Obs Log	Obs Hooks	Total Hooks	% N sets	Observed Catch Rates								
						Night	Dead Day	Total	Night	Alive Day	Total	Night	Total Day	Total
<i>Antarctic III</i>	Yes	Yes	52.9	73.9	89	0.042	0.000	0.038	0.000	0.000	0.000	0.042	0.000	0.038
<i>Vieirasa Doce</i>	Yes	Yes	204.2	204.2	81									
<i>Aquatic Pioneer</i>	No	No		23.8										
<i>Ercilla</i>	Yes	No		544.8										
<i>Faro de Hercules</i>	Yes	No		706.5										
<i>Friosur III</i>	Yes	No		1115.5										
<i>Isla Camilla</i>	Yes	No		1114.6										
<i>Isla Sofia</i>	Yes	No		369.0										
<i>Maria Tamara</i>	No	No		11.3										
<i>Antonio Lorenzo</i>	No	No		40.0										
<i>Magallanes III</i>	Yes	No		537.8										
<i>Mar del Sur I</i>	Yes	No		1014.0										
<i>Puerto Ballena</i>	Yes	Yes	233.3	906.4	53	0.235	1.012	0.600	0.137	0.091	0.116	0.372	1.104	0.716
<i>Ihn Sung 66</i>	Yes	No	512.6	1459.1	53	0.004	0.029	0.016	0.088	0.062	0.076	0.092	0.091	0.092
<i>Itkul</i>	No	No		646.3										
<i>American Champion</i>	Yes	No		754.8										
Total						0.053	0.299	0.150	0.067	0.063	0.066	0.120	0.362	0.215

Table 29: Estimated total seabird catch.

Vessel	Obs Hooks	Total Hooks	% N sets	Estimated Total Birds Caught									Totals from C2 Forms		
				Dead			Alive			Total			Dead	Alive	Total
				Night	Day	Total	Night	Day	Total	Night	Day	Total			
<i>Antarctic III</i>	52.9	73.9	89	2.79	0.00	2.79	0.00	0.00	0.00	2.79	0.00	2.79	4	0	4
<i>Vieirasa Doce</i>	204.2	204.2	81	8.71	11.58	20.29	11.16	2.45	13.61	19.87	14.04	33.90	41	0	41
<i>Aquatic Pioneer</i>		23.8	61	0.76	2.79	3.55	0.97	0.59	1.56	1.73	3.39	5.11			
<i>Ercilla</i>		544.8	61	17.38	64.09	81.48	22.27	13.58	35.85	39.65	77.67	117.32			
<i>Faro de Hercules</i>		706.5	61	22.54	83.12	105.66	28.88	17.61	46.49	51.42	100.73	152.15	132	33	165
<i>Friosur III</i>		1115.5	61	35.59	131.23	166.82	45.60	27.80	73.40	81.19	159.04	240.23	48	6	54
<i>Isla Camilla</i>		1114.6	61	35.56	131.12	166.68	45.56	27.78	73.34	81.12	158.91	240.02	35	3	38
<i>Isla Sofia</i>		369.0	61	11.77	43.41	55.18	15.08	9.20	24.28	26.86	52.61	79.47			
<i>Maria Tamara</i>		11.3	61	0.36	1.32	1.68	0.46	0.28	0.74	0.82	1.60	2.42			
<i>Antonio Lorenzo</i>		40.0	61	1.28	4.71	5.98	1.64	1.00	2.63	2.91	5.70	8.61			
<i>Magallanes III</i>		537.8	61	17.16	63.28	80.43	21.99	13.41	35.39	39.14	76.68	115.83			
<i>Mar del Sur I</i>		1014.0	61	32.35	119.30	151.65	41.45	25.27	66.73	73.80	144.57	218.37	197	3	200
<i>Puerto Ballena</i>	233.3	906.4	53	112.67	431.25	543.92	66.05	38.85	104.90	178.72	470.10	648.82	131	0	131
<i>Ihn Sung 66</i>	512.6	1459.1	53	2.85	19.93	22.77	68.32	42.70	111.01	71.16	62.62	133.78	8	33	41
<i>Itkul</i>		646.3	61	20.62	76.04	96.66	26.42	16.11	42.53	47.04	92.14	139.18			
<i>American Champion</i>		754.8	61	24.08	88.80	112.88	30.85	18.81	49.67	54.94	107.61	162.55	113	0	113
Total	1003.0	9521.9	61	346.47	1271.97	1618.44	426.69	255.45	682.13	773.15	1527.42	2300.57	709	78	787

Note: shaded regions indicate extrapolated estimates (derived as indicated in paragraph 7.40).

Table 30: Species catch summaries from observer logbooks and cruise reports.

Species	Code	Dead			Alive			Total		
		Night	Day	Total	Night	Day	Total	Night	Day	Total
Grey-headed albatross	DIC	0	3	3	0	0	0	0	3	3
Black-browed albatross	DIM	7	93	100	9	11	20	16	104	120
Wandering albatross	DIX	0	0	0	0	1	1	0	1	1
Southern giant petrel	MAG	0	0	0	0	5	5	0	5	5
White-chinned petrel	PRO	3	36	39	0	1	1	3	37	40
Total		10	132	142	9	18	27	19	150	169

Table 31: Species catch summary from C2 forms and estimated total catch proportions.

Species	Code	Dead				Alive				Total			
		Recorded	Est	%	Total	Recorded	Est	%	Total	Recorded	Est	%	Total
Birds	BIZ	2				0				2			
Albatrosses	ALZ	89				1				90			
Grey-headed albatross	DIC	19	23.61	3.33	53.90	0	0.00	0.00	0.00	19	23.12	2.94	67.59
Black-browed albatross	DIM	310	385.25	54.34	879.42	45	45.92	58.87	401.57	355	431.99	54.89	1262.80
Royal albatross	DIP	1	1.24	0.18	2.84	0	0.00	0.00	0.00	1	1.22	0.15	3.56
Wandering albatross	DIX	35	43.50	6.13	99.29	4	4.08	5.23	35.70	39	47.46	6.03	138.73
Sooty albatross	PHU	7	8.70	1.23	19.86	0	0.00	0.00	0.00	7	8.52	1.08	24.90
Identified albatrosses		372				49				421			
All albatrosses		461	462.30	65.21	1055.30	50	50.00	64.10	437.27	511	512.30	65.10	1497.57
Petrels and shearwaters	PTZ	119				3				122			
Southern giant petrel	MAG	5	10.39	1.47	23.72	22	25.00	32.05	218.63	27	51.90	6.59	151.71
Northern giant petrel	MAH	2	4.16	0.59	9.49	0	0.00	0.00	0.00	2	3.84	0.49	11.24
White-chinned petrel	PRO	104	216.10	30.48	493.30	0	0.00	0.00	0.00	104	199.91	25.40	584.37
Identified petrels, shearwaters		111				22				133			
All petrels, shearwaters		230	230.65	32.53	526.51	25	25.00	32.05	218.63	255	255.65	32.48	747.32
Antarctic tern	STV	16	16.05	2.26	36.63	3	3.00	3.85	26.24	19	19.05	2.42	55.68
Total		709	708.99	100.00	1618.44	78	78.00	100.00	682.13	787	787.00	100.00	2300.57

Notes: Shaded regions indicate extrapolated estimates (derived as indicated in paragraph 7.42); Est indicates total recorded catch after redistribution to identified species; % is the estimated proportion of the recorded catch which applies to each species; Total is the estimated total catch of each species after multiplying percentage proportions by the total estimated seabird catches given in Table 27.

7.43 No estimates of the effectiveness of mitigation measures such as streamer lines, avoidance of offal discharge or underwater setting were made due to the very small sample sizes in the limited datasets available for analysis at the meeting. As more data become available, such analyses should certainly be carried out.

7.44 Some suggestions for future improvement of analyses of seabird catch and catch rates are as follows:

- (i) areas of discrepancy in data supplied should be investigated and rectified;
- (ii) an evaluation of the accuracy of species identifications carried out by observers and vessels should be made;
- (iii) estimates of the variance of mean catch and catch rate estimates are required to allow cross-year and cross-strata statistical comparisons;
- (iv) statistical analysis of the effectiveness of mitigation measures should be carried out as more data becomes available; and
- (v) methods for stratification of the data for the calculation of seabird by-catch and by-catch rates should be given more thought in relation to time (seasonal effects, night setting), area (are there areas within the fishery where species abundance varies?), and vessel effects (bird lines, offal discharge, underwater setting, bait thawing, etc.).

7.45 Additional supplementary information from some of the observers' reports is extracted and summarised below.

7.46 The report (WG-FSA-96/31) of the observer on the *Puerto Ballena* includes data showing that:

- (i) black-browed albatrosses are particularly susceptible to capture during the day with white-chinned petrels equally susceptible to capture during the day and night;
- (ii) the behaviour and abundance of black-browed albatrosses is such as to dominate other seabirds for access to baits. Only white-chinned petrels, which can dive for baits, can readily operate outside the influence of black-browed albatrosses and therefore be commonly caught;

- (iii) catch rates of both black-browed albatrosses and white-chinned petrels were substantially reduced after early May (presumably reflecting post-breeding migration/dispersal);
- (iv) three-quarters of the birds observed as being caught were taken on 11 (10%) hauls. In at least three of these cases the longline was at an angle or perpendicular to wind/wave direction, which prevented the streamer line covering the area where the baited hooks entered the water;
- (v) with three exceptions, all lines with considerable by-catch of birds were set during daylight; and
- (vi) of 139 black-browed albatrosses handled, all of which were adults, 5 (4%) were banded at Bird Island. This proportion is much higher than the percentage of banded birds in the overall South Georgia black-browed albatross population (<0.1%). The status of the birds caught is consistent with the observed reduction in survival rates of adult black-browed albatrosses at Bird Island study colonies (SC-CAMLR-XV/BG/7).

7.47 The report (WG-FSA-96/40) of the observer on the *Ihn Sung 66* indicates that:

- (i) 47% of sets were made in daylight hours (i.e. outside the times defined in Conservation Measure 29/XIV);
- (ii) most of the birds caught were taken during the early part of the March–July fishing season; and
- (iii) seven of the eight dead birds were subsequently identified in the Falkland/Malvinas Islands as six adult black-browed albatrosses and one adult wandering albatross (ringed at Bird Island).

7.48 The report (WG-FSA-96/52) of the observer on *Itkul* indicated that:

- (i) relatively few birds were caught: 24 in total, comprising 20 white-chinned petrels, 3 black-browed albatrosses and 1 wandering albatross (ringed at Bird Island);
- (ii) from late May onwards (to mid-June) no birds were caught, probably due to a reduction in the number of birds in the fishing area;

- (iii) a number of difficulties (listed in detail) were experienced with the recording forms (these have largely been rectified in the revision of the logbook); and
- (iv) agreements for payment of observers have not been honoured; the observer suggests that CCAMLR might be able to act as the fund holder for payment of observers.

7.49 A report by Ukrainian observers (WG-FSA-96/50) provides summary information on mitigation methods in use in Division 58.5.1 in 1995/96 which, except for the discharge of offal during the set (designed to distract birds), were consistent with Conservation Measure 29/XIV.

7.50 WG-FSA-96/47 is a preliminary report which indicates that only one bird was caught by the *American Champion* in 35 days of fishing near the Prince Edward Islands in August/September 1996. A more comprehensive report from this cruise will be submitted by South Africa in due course; although obtained from outside the Convention Area, the results will be of interest to CCAMLR because fishing was carried out close to the boundary of the Convention Area.

7.51 The Working Group made the following comments on the analyses undertaken and the reports received.

- (i) It expressed concern that all logbook data so far analysed and all detailed observer reports received to date indicated failure to comply with the provisions of Conservation Measure 29/XIV, especially in respect of daytime setting, but also with respect to discharge of offal on the same side as the haul. There is a need to re-emphasise that both these practices lead to increased bird-bait or bird-fish interactions and inevitably reduce fishing efficiency. It is essential that vessels conform strictly to the provisions of Conservation Measure 29/XIV.
- (ii) Daytime setting undoubtedly is the major contributor to the relatively high overall catch rates of birds reported in 1995/96.
- (iii) The number of black-browed albatrosses being caught – and to a lesser extent that of wandering and grey-headed albatrosses and white-chinned petrels – is a matter of serious concern.
- (iv) There is increasing evidence that after early May interactions with albatrosses, especially black-browed albatrosses, and white-chinned petrels decrease greatly.

7.52 The Working Group commended the Scientific Observer Data Analyst for his work in developing the database and undertaking initial data analysis. The Working Group noted that this

work had greatly enhanced its ability to analyse data in an effective and comprehensive way. The small amount of analysis undertaken this year had been due simply to the absence or lateness of submitted data and its submission in inappropriate formats. Arising from this, there was a requirement for very substantial intersessional data analysis of information provided by scientific observers. The Working Group recommended that the Scientific Observer Data Analyst post should be funded throughout the intersessional period to enable this work to be undertaken as a matter of high priority.

Demersal Longline Seabird By-catch in Division 58.5.1

7.53 WG-FSA-96/10 reports on catch rates of seabirds around Kerguelen from 1993/94 to 1995/96 and the efficacy of mitigating measures in use. The longline system was a Mustad autoliner used both during the day and at night. Offal was discharged on the opposite side to the haul to attract birds away from setting/hauling operations; to scare birds away from the baited line during setting, a line as specified in Conservation Measure 29/XIV was used (this was used only during the day and in part of the 1995/96 season). A total of 529 birds (86% white-chinned petrels, 6% black-browed albatrosses, 5% grey-headed albatrosses, 2% wandering albatrosses) were caught during 291 sets (655 000 hooks) at a mean rate of 0.81 birds/1 000 hooks (with the maximum value for a single set of 10.4 birds/1 000 hooks when the streamer line became entangled with the fishing line). The number of birds caught varied significantly between years (very high in 1995/96) and month (high in October/November, low in December/January increasing to high levels from February to March). The number of birds caught at night was lower, but not significantly so, than during the day, although differences may be masked because white-chinned petrels (active both during the day and at night) formed the bulk of the seabird catch. The presence of offal produced significantly lower by-catch rates in two of the three years. However, in WG-FSA-96/10 the continuing use of offal to distract birds is not recommended because although it may confer a short-term advantage, in the longer term it probably attracts more birds to boats, thereby increasing both catch rates and bait loss. The streamer line design was not as effective as expected because of the relevant rapid adaptation to its presence by birds and the heavy sea conditions in the Kerguelen area which reduce its positive effects.

7.54 The Working Group thanked Mr D. Capdeville (France) for his thorough study which reinforced a number of important points which had been incorporated into the existing conservation measure. The Working Group endorsed the comments relating to offal discharge. It reiterated the need to continue to assess the effectiveness of the CCAMLR streamer line in further seasons.

Data from Outside the Convention Area

7.55 New Zealand, UK, Australia and France responded to requests for information relating to measures used to mitigate by-catch outside the Convention Area (see paragraph 7.4). Some of these responses also contained information on levels of seabird by-catch.

7.56 Dr Imber reported by correspondence that, regarding measures to mitigate by-catch in the New Zealand region in September 1993 the Fisheries (Commercial Fishing) Regulations 1986 Amendment 6 came into effect to standardise requirements for Japanese and domestic longliners. This requires all tuna longliners to deploy bird-scaring devices at all times, as a minimum standard. The CCAMLR streamer-line design was adopted. New Zealand fisheries legislation has been amended to provide funding for a range of projects designed to assess and mitigate impacts of domestic commercial fishing on protected species of marine wildlife. This allows the Crown to recover its costs from the Fishing Industry in respect of the provision of these conservation services (CSL). A project funded through CSL for the fishing year 1995/96 provided for the supply of an approved design for streamer lines to domestic fishermen (the intention was to supply all boats but a few were unavoidably missed) and advice on various methods for avoiding seabird by-catch. CSL also provided for the collection by fisheries observers of good statistical data on by-catch, processing and analysis of that data, recovery of seabird carcasses, some population monitoring, and the development of a population management plan for wandering albatrosses. In the 1995/96 fishing year only domestic fishermen operated in the tuna fishery in the New Zealand EEZ.

7.57 Dr Croxall summarised information received from the Fisheries Department of the Falkland Islands Government. Commercial longlining for *D. eleginoides*, commenced in 1994, is still regarded as being exploratory with no more than two vessels being licensed to fish at any given period. Although no legislation to mitigate seabird mortality has yet been introduced, license conditions are imposed to mitigate seabird mortality which require the use of CCAMLR-type measures, such as setting lines at night, the use of streamer lines, avoidance of dumping offal during hauling and setting operations and the use of heavily weighted lines. In addition, the company currently licensed to fish (Consolidated Fisheries Limited) and Australia funded the observation in 1995 by Mr Brothers resulting in WG-FSA-95/58, which reviewed the Spanish system of longlining from the perspective of mitigating seabird mortality. Incidental mortality of seabirds is recorded in the catch logbooks. In 1994 and 1995 the overall seabird catch rates were 3.07 birds per 4.58 million hooks (0.067 birds/1 000 hooks) and 1.39 birds per 2.75 million hooks (0.051 birds/1 000 hooks) respectively. Maximum rates reached 4.79 and 5.00 birds/1 000 hooks, but the problems that caused these (chiefly insufficient weighting of the line and too much tension during setting) have since been corrected. The species caught were predominantly black-browed albatrosses (87%), grey-headed albatrosses (7%) and white-chinned petrels (4%).

7.58 Australia tabled a suite of papers (WG-FSA-96/62 to 96/66) summarising various aspects of its recent work on interactions between longline fisheries and seabirds. Mr Hay reported that from November 1995 the use of streamer lines has been mandatory within the Australian Fishing Zone (AFZ) for all tuna longlines during setting operations when fishing south of 30°S.

7.59 WG-FSA-96/65 describes effort trends in the tuna longline fisheries of the Southern Ocean, and also factors that may affect catch rates. The paper focuses on the Japanese southern bluefin tuna fishery, historically the dominant and best-documented fishery south of 30°S. However, this fishery is not the only longline fleet operating in the Southern Ocean, and in 1992 it constituted only about 44% of the estimated tuna longline effort below 30°S. It is clear that seabird by-catch is a significant problem for the Japanese longline fishery and more data need to be collected and analysed to gain further insights into the problem. The paper's main conclusions are:

- (i) there has been a recent reduction in Japanese effort (effort 1994 ~48% of 1986);
- (ii) fishing occurs predominantly in quarters 2 and 3 (April–September);
- (iii) the fishery has contracted and shifted areas of operation;
- (iv) the use of mitigation devices by Japanese vessels has increased within the Australian and the New Zealand EEZs;
- (v) the use of monofilament mainlines has increased with possible increases in seabird by-catch; and
- (vi) there have been recent and large increases in effort by other fleets (especially Taiwan).

7.60 WG-FSA-96/64 presents summary tables of seabird by-catch observations on Australian tuna longline vessels. Its main findings are:

- (i) no birds were caught in the Cairns area from 20 598 observed hooks (50 sets);
- (ii) two birds were caught (1.09 birds/1 000 hooks) from 1 830 observed hooks (4 sets) off New South Wales; and
- (iii) eight birds were caught (0.29 birds/1 000 hooks) from 27 682 observed hooks (27 sets) off Tasmania.

WG-FSA-96/63 provides more detailed information on the data from 12 observer cruises summarised in WG-FSA-96/64.

7.61 WG-FSA-96/62 summarises data available from five Real Time Monitoring Program (RTMP) observer cruises by Australian observers in 1995. There is little information on seabird by-catch on the high seas. Information from the high seas is important, due to differences in abundance, species composition by region and distance from land. The RTMP was set up in 1991 to provide timely and reliable information on catch and effort, verification and collection of additional data (e.g. biological samples). In 1995 it was agreed that information on ecologically-related species (including seabirds) should also be collected (e.g. data on by-catch, mitigation measures). The main findings and conclusions of the paper are:

- (i) 182 sets were observed, 72% in the southeastern Indian Ocean, 28% off South Africa;
- (ii) all observed vessels had streamer lines and these were used except for one set (3.9 birds/1 000 hooks for that set);
- (iii) catch rates varied from 0 to 0.37 birds/1 000 hooks by cruise;
- (iv) the catch rate on one vessel decreased dramatically after reconfiguration of the streamer line;
- (v) there is a need for adequate observer coverage in order to obtain reliable estimates of by-catch rates (e.g. here only three vessels covered, variation within/among vessels);
and
- (vi) the presence of observers contributes to reducing by-catch.

7.62 WG-FSA-96/66 presents the methodological approach to, and results of, estimating total seabird catch and catch rates (with associated variances) by season and area. The methods are applied to observer data from the AFZ. Estimates of by-catch by species are also produced. Results suggest that the total seabird by-catch by Japanese longliners operating in Australian waters was 2 981 (CV 17%) in 1992, 3 590 (CV 15%) in 1993 and 2 817 (CV 19%) in 1994.

7.63 The Working Group welcomed these detailed and useful reports. It noted that the reports:

- (i) confirmed that by-catch of albatross species breeding within the Convention Area (especially wandering albatross, black-browed albatross, grey-headed albatross) is prevalent in waters outside the Convention Area;
- (ii) supported (and often provided greater detail based on the use of more data) the conclusions of CCAMLR with respect to mitigating methods (e.g. the efficacy of streamer lines in reducing by-catch); and
- (iii) include details of methods (especially WG-FSA-96/66) that would be very applicable to the analysis of full sets of CCAMLR data (see also paragraph 7.51).

7.64 The Working Group also understood that Australian conservation agencies were conducting complementary research into aspects of seabird/longline fishery interactions and encouraged Australia to submit reports of this work to CCAMLR.

7.65 WG-FSA-96/9 reports the results of a joint investigation by French and Australian scientists relating population change in wandering and Amsterdam albatrosses at Crozet, Kerguelen and Amsterdam Islands to changes in the location and intensity of longline fishing (principally for southern bluefin tuna outside the Convention Area but also for *D. eleginoides* inside the Convention Area) in the Indian Ocean. The main conclusions of the paper are:

- (i) that wandering albatross populations at Crozet and Kerguelen Islands have declined markedly, but have shown slow recovery since 1986;
- (ii) the population of the endangered Amsterdam albatross appears to have similarly recovered since 1985, but remains close to extinction;
- (iii) demographic study of the Crozet population indicates that the earlier decline was mainly the result of increased adult mortality, and secondarily of low recruitment;
- (iv) satellite tracking studies of breeding birds and band recoveries of non-breeding birds indicate that during and outside the breeding season these populations are in contact with longline fisheries, mainly the pelagic Japanese southern bluefin tuna fishery and, to a lesser extent, the very limited *D. eleginoides* fishery operating on the Kerguelen shelf;

- (v) decreased fishing effort and concentration outside the central Indian Ocean by the Japanese fishery during recent years has probably resulted in the slow recovery of these albatross populations as a result of improved adult survival and recruitment; and
- (vi) longline fisheries still represent a major threat to great albatross populations, most of which are still declining in the Southern Ocean.

7.66 Information on tuna-seabird interactions of interest to CCAMLR is also presented in the report of the Ecologically Related Species (ERS) Working Group of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). This report sets out the terms of reference of ERS and its response to a set of questions posed to it.

7.67 The Working Group was pleased to note the establishment of the ERS by CCSBT and:

- (i) noted that the responses to many of the seabird-related questions were very consistent with the conclusions CCAMLR had reached at previous meetings in relation to the nature, magnitude and significance of interactions between seabirds and longline fisheries. That is, that significant declines have been observed for a number of albatross and other seabird populations; that significant levels of seabird by-catches are associated with longline fisheries; that the magnitude of the by-catch is sufficient to be the primary cause of the observed declines and that the population biology and demography of many albatross species suggests that the current by-catch levels are not sustainable;
- (ii) noted that the references cited included many derived from research within the CCAMLR Convention Area;
- (iii) recommended that CCAMLR should encourage the ERS Working Group, in the interests of promoting efficient fishing practice and reducing by-catch of seabirds (especially albatrosses), to consider moving rapidly to implement provisions, similar to those of CCAMLR, designed to reduce seabird mortality, especially in those regions adjacent to the Convention Area;
- (iv) recommended that CCAMLR should seek to promote closer liaison between relevant work of its WG-FSA and CCSBT-ERS by requesting that it provide for the attendance of a CCAMLR observer at ERS meetings;

- (v) recommended that CCAMLR should request that the reports of the ERS meetings and the supporting papers should be submitted to CCAMLR; and
- (vi) suggested that CCAMLR and CCSBT should plan to hold a joint meeting of CCSBT-ERS and CCAMLR ad hoc WG-IMALF.

7.68 The Working Group expressed the hope that other conventions regulating longline fishing would follow the lead of CCSBT in establishing groups to tackle the problem of seabird-longline fishery interactions; from the CCAMLR perspective there were particular priorities in doing this for the Indian Ocean (via the incipient IOTC) and the Atlantic Ocean (ICCAT).

Information Relevant to Fisheries Management

7.69 Dr Croxall recollected that last year WG-FSA-95/43 (Croxall and Prince, 1996) identified the period March to mid-May (the brooding period) as the time when there was greatest overlap (and thereby higher potential for interaction) between at-sea distribution of wandering albatrosses foraging from breeding colonies at South Georgia and the longline fishery for *D. eleginoides*.

7.70 WG-FSA-96/8 briefly recapitulates this, and by summarising the at-sea distribution of black-browed and grey-headed albatrosses breeding at South Georgia, provides a preliminary assessment of overlap between these species and the longline fishery. In particular, grey-headed albatrosses feed in waters of the Antarctic Polar Frontal Zone (see also WG-FSA-96/20) and have limited potential for (and there have been few direct observations of) interactions with longline fishing vessels, except in transit to and from their breeding colonies. In contrast, black-browed albatrosses are most commonly associated with shelf slope areas around South Georgia, where their feeding areas are coextensive with the longline fishery. WG-FSA-96/8 also contains data on the post-breeding migrations of black-browed albatrosses – confirming their rapid movement in April/May to South African waters (and their consequent vulnerability to longline fisheries in this region). Post-breeding dispersal of grey-headed albatrosses is poorly known but now includes Pacific Ocean as well as Indian Ocean/ Australasian areas.

7.71 The Working Group agreed that because of the:

- (i) extensive overlap between black-browed albatross feeding and longline fishing areas;
- (ii) ready association of black-browed albatrosses with fishing vessels and their dominant behaviour in attempting to feed on bait;

- (iii) large numbers of birds (especially adults and individuals known to breed at South Georgia) currently being caught around South Georgia;
- (iv) continuing failure to implement the full range of mitigating measures (as specified in Conservation Measure 29/XIV) to give maximum potential reduction in incidental mortality of seabirds;
- (v) observed significant declines in monitored black-browed albatross populations at South Georgia (SC-CAMLR-XV/BG/7);
- (vi) observed decreases in adult survival rates of black-browed albatrosses at South Georgia since longline fishing started in the area (SC-CAMLR-XV/BG/7); and
- (vii) reduction in catch rates of black-browed albatrosses after late April to early May (see e.g. paragraphs 7.46 and 7.48);

it would be highly desirable, in order to minimise the incidental mortality of seabirds, especially albatrosses, to delay the start of longline fishing in Subarea 48.3 until at least the beginning of May. This would also afford protection to wandering albatrosses at the time of year when they are most vulnerable and provide similar protection for grey-headed albatrosses throughout most of their chick-rearing period.

7.72 The Convener reminded participants that last year the Scientific Committee recommended to the Commission (SC-CAMLR-XIV, paragraphs 4.57 and 4.58) that, given that there would be full compliance with Conservation Measure 29/XIV, the fishing season of 1 March to 31 August be retained for 1995/96. It also requested Members to collect and/or provide data for assessing the consequences of delaying the start of the fishing season for *D. eleginoides* until 1 May.

7.73 It was clear from the observer reports that there had been less than full compliance with Conservation Measure 29/XIV in the *Dissostichus* fishery in Subarea 48.3.

7.74 Last year the concern was raised that delaying the start of fishing for *D. eleginoides* in Subarea 48.3 might cause increased fishing during the *D. eleginoides* spawning season (SC-CAMLR-XIV, Annex 5, paragraph 8.71). Data presented this year (WG-FSA-96/44) indicate that the spawning season starts in May and extends into August.

7.75 However, it was noted that unless fishing was delayed until after the end of the spawning season there would be little difference, in terms of consequence for fish stocks, between starting fishing in May and earlier in the year. Analysis of catch rates for fishing undertaken during the spawning season would be a useful element of future work.

7.76 No information had been provided by Members to WG-FSA on the consequences of delaying the start of the *D. eleginoides* fishing season in Subarea 48.3 until 1 May. It was recognised, however, that delaying opening this fishery until May might require a closure of the fishery later than the current date of 31 August (a date chosen to allow adequate time to meet the data reporting requirements in advance of a meeting of WG-FSA in mid-October). This would result in fishing during the period of worst weather conditions at sea in Subarea 48.3 and would make it much more difficult for vessels to restrict cost-effective fishing to night-time setting operations.

7.77 The Working Group agreed on the importance of drawing these issues to the attention of the Scientific Committee and Commission for consideration in the formulation of the appropriate conservation measures for this fishery.

Conservation Measure 29/XIV

7.78 No specific recommendations for modification of this conservation measure had been received or suggested.

Advice to the Scientific Committee

7.79 The Working Group commended the efforts of the many people who contributed to the production of *Fish the Sea Not the Sky*. The Scientific Committee should ask the Commission to request Members to undertake well-targeted distribution of this book to the priority recipients listed in paragraph 7.6 and to undertake further distribution and evaluation as indicated in paragraphs 7.7 to 7.10.

7.80 The Scheme of International Scientific Observation has continued to develop in a useful manner. Despite some problems associated with meeting appropriate reporting standards and submitting data in a timely manner (hopefully to be resolved with revised procedures), the reports provide much useful data. Unfortunately, because only 3 out of 16 observer logbooks were received at the time of the meeting, it was not possible to conduct the same level of analyses as last year. With further analyses and validation of some data, to be tackled intersessionally, a more

comprehensive analysis of incidental mortality of seabirds in the Convention Area in 1996 should be possible.

7.81 The CCAMLR Scheme of International Scientific Observation is a crucial element in tackling the problem of seabird mortality arising from longline fishing. There is a particular need to:

- (i) improve the flow of information to and from observers. It was considered that the appointment of a technical coordinator, by each Member which provides CCAMLR observers, would be the most effective means of resolving difficulties in this area (e.g. receipt and distribution of observer instructions, dispatch of observer reports, resolution of queries from the Secretariat concerning observer reports, training of observers, etc.);
- (ii) facilitate more timely processing and provision of data by the Secretariat. Scientific Observer Logbooks and cruise reports should be submitted no later than one month after the end of the observed cruise and in the correct format;
- (iii) revise the content and format of the *Scientific Observers Manual* (to include instructions and procedures contained in the current manual and logbooks, adoption of a loose-leaf format and inclusion of completed examples of data recording forms);
- (iv) publish the *Scientific Observers Manual* in all four CCAMLR languages to reduce erroneous data due to misinterpretation of instructions; and
- (v) prioritise the list of major data collection tasks for observers working on longline vessels (see Table 2, paragraph 3.18). A single observer must complete all high and medium priority tasks and should complete those tasks given low priority as far as possible.

7.82 Comprehensive observer coverage is essential to the acquisition of the appropriate data with which to manage longline fisheries. 100% observer coverage should be maintained as a matter of priority; Members able to make provision for two observers are strongly encouraged to do so.

7.83 The results of the analyses performed at the Working Group meeting, although preliminary in nature due to the small size of the datasets, indicate that:

- (i) seabird mortality, especially of albatrosses, from longlining in the Convention Area is a serious problem with relatively high overall catch rates reported in 1995/96;

- (ii) black-browed albatrosses are especially susceptible to capture during the day. Catch rates of black-browed albatrosses and white-chinned petrels were substantially reduced after early May (probably reflecting post-breeding migration/dispersal) indicating that appropriate restrictions on the timing of the fishery have the potential to reduce seabird mortality substantially; and
- (iii) daylight setting and the incorrect or ineffective use of streamer lines were major causes of high levels of seabird mortality.

7.84 The available reports clearly indicate that daytime setting, in contravention of Conservation Measure 29/XIV, is occurring frequently (in approximately one-third of all sets for which data were available in the database). This is of serious concern as daytime setting is clearly linked to high levels of seabird mortality. The Scientific Committee should ask the Commission to request Members to take all appropriate steps to ensure compliance with all aspects of the conservation measure, thereby achieving substantial reduction in seabird by-catch and more cost-effective fishing.

7.85 Conservation Measure 29/XIV should be retained in its present form.

7.86 Members were encouraged to continue work to assess and improve the effectiveness of the streamer line as currently specified in Conservation Measure 29/XIV.

7.87 Useful progress has now been made in developing techniques to allow underwater setting of longlines. The Scientific Committee should give the strongest encouragement to further work to improve existing devices and to test new methods, especially those that could be used with the Spanish method of longline fishing.

7.88 Furthermore, the Scientific Committee should re-emphasise that research on the effectiveness of such measures should not only be undertaken in a manner consistent with the spirit of Conservation Measure 64/XII, but also that when underwater setting devices are being tested it is still a requirement to adhere to the provisions of Conservation Measure 29/XIV.

7.89 The Working Group commended the work of the Scientific Observer Data Analyst in developing the database and undertaking initial analysis; this has substantially enhanced the Working Group's ability to analyse data effectively. In view of the substantial amount of intersessional work planned, arising in part from the small number of data reports submitted on time, the Working Group asked the Scientific Committee to continue to fund, as a matter of high priority, the position of Scientific Observer Data Analyst throughout the intersessional period.

7.90 The volume of work involved within this agenda item makes it essential to commence work at the start of the WG-FSA meeting. Effective progress this year was largely due to the preliminary input of the Scientific Observer Data Analyst and to the presence of and input by staff from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Division of Fisheries, Hobart).

7.91 The Working Group received much useful data from outside the Convention Area. The establishment of a Working Group to consider seabird-tuna fishing interactions by CCSBT was also a welcome development. However, CCAMLR should encourage CCSBT to implement seabird mortality mitigation measures, based at least in part on CCAMLR Conservation Measure 29/XIV, and seek to improve liaison as suggested in paragraph 7.67.

7.92 The Scientific Committee should encourage the Commission to continue to develop links with other international fisheries forums, especially those dealing with longline fisheries in the Indian and Atlantic Oceans, with a view to encouraging greater efforts to tackle the problem of seabird-longline fishery interactions (paragraph 7.68).

OTHER INCIDENTAL MORTALITY

8.1 The Working Group reviewed the information available on incidental mortality of marine mammals and seabirds arising from fishing gear other than longlines, and incidental mortality of species other than birds caused by longlines.

8.2 Prof. Duhamel informed the Working Group that the use of net monitor cables in the trawl fishery around Kerguelen Islands has been prohibited. Since the inception of the prohibition, no incidental mortality caused by the trawl fishery has been observed.

8.3 Mr G. Benavides (Chile) reported that Chilean observers have recorded entanglement of marine mammals with longlines, resulting in the death of one Weddell seal and one fur seal in the fishery for *D. eleginoides* in Subarea 48.3.

8.4 Further information on interactions of marine mammals with fishing gear is given in paragraphs 5.14 to 5.22.

8.5 Instances of birds in breeding colonies impaled on or regurgitating hooks have been reported to CCAMLR in recent years (e.g. SC-CAMLR-XIV/BG/9, SC-CAMLR-XV/BG/4). WG-FSA-96/57 attempts to quantify hook loss in longline fisheries in Subarea 48.3 in recent years. In the last three years 320 000 hooks (6.4% of those set) have been lost; there is, however, considerable variation between

years (even for the same vessel) and between vessels. As WG-FSA-96/57 notes, loose hooks lost overboard pose few environmental problems but loss of sections of line and hooks remaining in fish heads subsequently thrown overboard do pose threats to marine life (especially seabirds, but also *D. eleginoides*).

8.6 Hooks and hooks with snoods are also lost overboard, attached to the discarded heads of *D. eleginoides*. Hooks have been found in the stomachs of *D. eleginoides*, suggesting that discarded heads have been scavenged. Such discards also represent a danger for birds feeding on discharged offal. Another potential problem is the loss of sections of longline with hooks attached. Although the frequency of such loss is unclear, it is more likely in autoliners of the 'Mustad' type than in gear rigged using the Spanish system.

Hook Loss

8.7 The Working Group endorsed the conclusion of WG-FSA-96/57 that observers should be requested to record hook loss and the loss of sections of line. Provision for this has now been made in the current revision to the logbook.

FUTURE WORK

9.1 The Working Group noted that the high priority tasks set out below and the requirement to process data from the rapidly expanding fisheries for *Dissostichus* spp. will add substantially to the already considerable workload of the CCAMLR Secretariat. This may have additional financial implications.

Data Requirements

9.2 The Working Group requested the Secretariat to correspond with appropriate scientists and authorities in Member countries in order to acquire the following:

D. eleginoides Haul-by-haul data which are required to complete datasets, particularly with
Subarea 48.3 respect to positional information and other items specified in Table 16.

Haul-by-haul length frequency data from earlier bottom trawl surveys to be used for analyses of recruitment abundance (paragraphs 4.72 and 4.113).

Catch data from areas adjacent to the Convention Area (paragraph 4.44).

C. gunnari Haul-by-haul, catch and age data from earlier commercial fisheries (paragraph
Subarea 48.3 4.138).

Information on surveys as set out in paragraph 4.142.

D. eleginoides Haul-by-haul data from the Ukrainian fishery (paragraph 4.216).
Division 58.5.1

9.3 The Working Group noted that the CCAMLR database should be reviewed in order to determine which datasets are still incomplete and which data are missing. This information would also be used to identify which particular data from the datasets mentioned in paragraph 9.2 above need to be requested from Members.

Other Intersessional Activities

9.4 The Working Group identified the following tasks as high priority in the Data Management work of the Secretariat:

- (i) Preparation of an inventory of, and users' guides for, the CCAMLR database.
- (ii) Development and application of methods for validation of data entries into the database.
- (iii) Preparation of data files for length-density analyses of *D. eleginoides* from trawl surveys (paragraph 4.113).
- (iv) Completion and validation of the entry of data from the 1995/96 observer programs (paragraph 4.84).
- (v) Request information on fisheries activities by non-Members (paragraph 3.26);
- (vi) Production of tables of areas of seabed within depth strata (similar to those produced by Everson and Campbell (1990)).

- (vii) Revision (in consultation with Dr Rodhouse) of catch and effort and biological data forms for the 1995/96 squid jigging fishery in Subarea 48.3 (paragraph 4.14).

9.5 The Working Group also identified the following intersessional activities which should be carried out by WG-FSA participants, the Convener or the Secretariat:

- (i) Development of multispecies models for *C. gunnari* as described in paragraph 4.153: WG-FSA participants.
- (ii) A correspondence group should address aspects of acoustic survey conducted by Russia in Subarea 48.3 in 1995/96 (paragraphs 4.131 to 4.133): Convener, Dr Everson, Dr Gasiukov.
- (iii) Analyses of surveys using standard methods (paragraph 4.142): WG-FSA participants.
- (iv) Review of biological reference points for decision criteria (paragraphs 4.75 and 4.95):
 - (a) include the subject in the agenda of the next meeting: Convener;
 - (b) prepare a review of available literature: Science Officer.
- (v) Enhance generalised yield model to include sexes separately (paragraph 4.86): Convener, Dr Constable.
- (vi) Submission of information on mesh/hook selectivity (paragraph 3.22): WG-FSA participants.
- (vii) Consider methods of validating predictions of generalised yield model (paragraphs 3.69 and 4.109): WG-FSA participants.

9.6 Other tasks for the Secretariat identified by the Working Group for the 1996/97 intersessional period include:

- (i) Distribution of *Fish the Sea Not the Sky* as set out in paragraph 7.6.

- (ii) Revision of the *Scientific Observers Manual* to include forms and instructions from the Scientific Observers Logbook for longline and trawl fisheries as set out in paragraph 3.16.

9.7 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-XV 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.

OTHER BUSINESS

License for Fishing Operations

10.1 Lic. Marshcoff noted that a CCAMLR observer (WG-FSA-96/52) mentioned the existence on board the vessel of a license for fishing operations in the area which was not required under CCAMLR regulations. He noted that this issue will be further considered at the coming meeting of the Commission.

10.2 The Working Group noted that this topic was not appropriate for consideration at its meeting.

Experts for the Editorial Board

10.3 WG-FSA noted that the Editorial Board of *CCAMLR Science* requires input from a small number of experts in each of the Working Groups to provide advice on which papers should be sent out for peer review.

10.4 It was agreed that in future, the identification of experts should be formalised as an early item on the Working Group's agenda.

10.5 Further, the Scientific Committee's attention was drawn to the fact that the editorial policy of *CCAMLR Science* has been subject to a variety of interpretations during the paper selection process. Clarification of the application of the editorial policy was therefore sought.

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. He also thanked the Secretariat for its sterling support, particularly as they were short-staffed due to the absence of a Data Manager.

12.2 On behalf of the Working Group, Dr Miller thanked the Convener for his guidance and calming influence.

12.3 The Convener then closed the meeting.

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AGENDA**Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 16 October 1996)**

1. Opening of the Meeting
2. Organisation of the Meeting and Adoption of the Agenda
3. Review of Available Information
 - 3.1 Data Requirements Endorsed by the Commission in 1995
 - 3.2 Fisheries Information
 - (a) Catch, Effort, Length and Age Data
 - (b) Scientific Observer Information
 - (c) Research Surveys
 - (d) Mesh/Hook Selectivity and Related Experiments Affecting Catchability
 - (e) Unreported Catches
 - 3.3 Fish and Crab Biology/Demography/Ecology
 - 3.4 Developments in Assessment Methods
4. Assessments and Management Advice
 - 4.1 Definition of Fishing Grounds
 - 4.2 New Fisheries
 - 4.3 Antarctic Peninsula (Subarea 48.1)
 - 4.4 South Orkney Islands (Subarea 48.2)
 - 4.5 South Georgia (Subarea 48.3) – Finfish
 - 4.6 South Georgia (Subarea 48.3) – Crabs
 - 4.7 South Sandwich Islands (Subarea 48.4)
 - 4.8 Antarctic Coastal Areas (Divisions 58.4.1 and 58.4.2)
 - 4.9 Ob and Lena Banks (Division 58.4.4)
 - 4.10 Kerguelen Islands (Division 58.5.1)
 - 4.11 Heard Island (Division 58.5.2)
 - 4.12 Pacific Ocean Sector (Area 88)
 - 4.13 Reopening Fisheries

5. Considerations of Ecosystem Management
 - 5.1 Interactions with WG-EMM
 - 5.2 Ecological Interactions (e.g. multi-species, benthos, etc.)
6. Research Surveys
 - 6.1 Simulation Studies
 - 6.2 Recent and Proposed Surveys
7. Incidental Mortality Arising from Longline Fishing
8. Other Incidental Mortality
9. Future Work
 - 9.1 Data Requirements
 - 9.2 Software and Analyses to be Prepared or Developed Prior to the Next Meeting
10. Other Business
11. Adoption of the Report
12. Close of the Meeting.

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WG-FSA-96/3	LIST OF DOCUMENTS
WG-FSA-96/4	BRIEF INFORMATION ON FISHING OPERATIONS CONDUCTED BY SRTM <i>PRIMORETS</i> INSIDE ECONOMIC ZONE OF KERGUELEN ISLANDS DURING THE PERIOD OF 1994/95 A. Vertunov, V. Frimer and V. Chikov (Ukraine)
WG-FSA-96/5	SUMMARISED DATA ON OPERATION OF RTMS <i>VOZROZHDENYE</i> INSIDE ECONOMIC ZONE OF KERGUELEN ISLANDS DURING THE SEASON OF 1994/95 E. Goubanov and Yu. Domashenko (Ukraine)
WG-FSA-96/6	SEABIRD BY-CATCH AND BAIT LOSS IN LONGLINING USING DIFFERENT SETTING METHODS S. Løkkeborg (Norway)
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- WG-FSA-96/48 DEPENDENCE OF CATCHES OF *D. ELEGINOIDES* ON ENVIRONMENT FACTORS INSIDE STATISTICAL AREA 58.5.1 (KERGUELEN ISLAND) – (CONSERVATION MEASURE 29/XIV)
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- WG-FSA-96/49 REPORT ON OPERATION OF THE UKRAINIAN FLEET INSIDE THE DIVISION 58.5.1 (KERGUELEN ISLAND) DURING THE PERIOD 1991–1996
E.P. Goubanov, A.S. Petrenko and V.V. Krakatitsa (Ukraine)
- WG-FSA-96/50 REPORT ON ESTIMATES AND AVOIDING SIDE MORTALITY OF MARINE RESOURCES OF ANTARCTIC REGION INSIDE THE DIVISION 58.5.1 (KERGUELEN ISLAND) – (CONSERVATION MEASURE 29/XIV)
E.P. Goubanov and A.S. Petrenko (Ukraine)
- WG-FSA-96/51 OBSERVER LOGBOOKS (TRAWL FISHERIES)
Secretariat
- WG-FSA-96/52 EXTRACT FROM REPORT ON SCIENTIFIC OBSERVATION DURING PATAGONIAN TOOTHFISH, *DISSOSTICHUS ELEGINOIDES*, FISHERY ON BOARD SRTM 'ITKUL' IN SUBAREA 48.3 IN THE PERIOD OF 17 MARCH TO 17 JULY 1996
A.K. Zaitsev (Ukraine)
- WG-FSA-96/53 A METHOD TO ESTIMATE FISH GROWTH PARAMETERS USING HARD STRUCTURE WITHOUT BACK CALCULATION
A. Aubone and D.R. Hernández (Argentina)

- WG-FSA-96/54 A SHORE-BASED RANDOMISED SAMPLING DESIGN USED IN THE ARTISANAL LONGLINE FISHERY FOR *DISSOSTICHUS ELEGINOIDES* OFF CENTRAL CHILE
J. Ashford (UK), P. Rubilar (Chile) and C. Jones (USA)
- WG-FSA-96/55 DETERMINATION OF STOCK STRUCTURE AND MOVEMENT-AT-AGE IN PATAGONIAN TOOTHFISH (*DISSOSTICHUS ELEGINOIDES*) THROUGH LASER-BASED ANALYSIS OF OTOLITHS – A REPORT ON PROGRESS
J. Ashford and I. Everson (UK) and C. Jones (USA)
- WG-FSA-96/56 A RANDOMISED SAMPLING DESIGN USED IN THE LONGLINE FISHERY FOR *DISSOSTICHUS ELEGINOIDES* IN THE SOUTHERN INDIAN OCEAN
J. Ashford (UK) and G. Duhamel (France)
- WG-FSA-96/57 LOSS OF HOOKS DURING LONGLINE FISHING IN SUBAREA 48.3
G. Parkes and J. Jones (UK)
- WG-FSA-96/58 DATA ON JUVENILE FISH SURVEYS WITHIN SOUTH GEORGIA
Z.A. Frolkina (Russia)
- WG-FSA-96/59 EXPERIMENTAL ACOUSTIC ESTIMATION OF BATHYPELAGIC FISHES BIOMASSES FROM THE SOUTH GEORGIA AND SHAG ROCK SHELF AREAS WITH TRAWL SAMPLING (RV *ATLANTIDA*, FEBRUARY 1996)
V.M. Yorobyov, P.A. Bukatin, V.A. Severin, G.A. Frolkina, V. Yu. Sunkovich, M.I. Polischuk, V.N. Shnar and A.M. Abramov (Russia)
- WG-FSA-96/60 DISTRIBUTION OF YOUNG ICEFISHES IN THE SOUTH GEORGIA SHELF AREA ON THE BASIS OF JUVENILE SURVEYS DATA
Zh. A. Frolkina and I.A. Trunov (Russia)
- WG-FSA-96/61
Rev. 1 REPORT OF THE FIRST MEETING OF THE CCSBT'S ECOLOGICALLY RELATED SPECIES WORKING GROUP
Wellington, New Zealand, 18 to 20 December 1995
- WG-FSA-96/62 RECENT INFORMATION RELATED TO SEABIRD BY-CATCH ON THE HIGH SEAS
T. Polacheck and A. Betlehem (Australia)
- WG-FSA-96/63 SOME OBSERVATIONS ON SEABIRD BY-CATCH FROM AUSTRALIAN LONGLINE FISHING VESSELS
W. Whitelaw (Australia)
- WG-FSA-96/64 SUMMARY TABLES OF AVAILABLE INFORMATION ON SEABIRD BY-CATCH BY AUSTRALIAN TUNA LONGLINE VESSELS
T. Polacheck (Australia)

WG-FSA-96/65	TRENDS IN TUNA LONGLINE FISHERIES IN THE SOUTHERN OCEANS AND IMPLICATIONS FOR SEA BIRD BY-CATCH T. Polacheck and G. Tuck (Australia)
WG-FSA-96/66	BY-CATCH OF ALBATROSSES AND OTHER SEABIRDS BY JAPANESE LONGLINE FISHING VESSELS IN THE AUSTRALIAN FISHING ZONE FROM APRIL 1992 TO MARCH 1995 N. Klaer and T. Polacheck (Australia)
OTHER DOCUMENTS	
CCAMLR-XV/7	NOTIFICATION OF THE INTENTION OF THE REPUBLIC OF KOREA AND THE UNITED KINGDOM TO INITIATE A NEW FISHERY Delegations of the Republic of Korea and the United Kingdom
CCAMLR-XV/8 Rev. 1	NOTIFICATION OF NEW ZEALAND'S INTENTION TO INITIATE A NEW FISHERY Delegation of New Zealand
CCAMLR-XV/9	NOTIFICATION OF AUSTRALIA'S INTENTION TO INITIATE A NEW FISHERY Delegation of Australia
CCAMLR-XV/10 Rev. 1	NOTIFICATION OF NORWAY'S INTENTION TO INITIATE A NEW FISHERY Delegation of Norway
CCAMLR-XV/11	NOTIFICATION OF SOUTH AFRICA'S INTENTION TO INITIATE NEW FISHERIES Delegation of South Africa
CCAMLR-XV/13	A PROPOSAL FOR PUBLICATION OF A SEABIRD IDENTIFICATION MANUAL Delegation of New Zealand
CCAMLR-XV/BG/10	DRAFT IUCN RESOLUTION ON SEABIRD BY-CATCH IN LONGLINE FISHERIES Secretariat
SC-CAMLR-XV/BG/1 Rev. 1	CATCHES IN THE CONVENTION AREA 1995/96 Secretariat
SC-CAMLR-XV/BG/7	POPULATION CHANGES IN ALBATROSSES AT SOUTH GEORGIA Delegation of United Kingdom

- SC-CAMLR-XV/BG/11 NEED FOR PROCEDURES TO GOVERN THE RESUMPTION OF FISHERIES TARGETING SPECIES NOT PRESENTLY HARVESTED BUT FOR WHICH A FISHERY PREVIOUSLY EXISTED
Delegation of USA
- SC-CAMLR-XV/BG/14 TRENDS OF THE *DISSOSTICHUS ELEGINOIDES* STOCK USING THE SEQUENTIAL POPULATION ANALYSIS (SPA) MODEL IN SUBAREA 48.3: 1992 TO 1996
Delegation of Chile
(Submitted in English and Spanish)
- WG-EMM-96/31 FISH IN THE DIET OF THE BLUE-EYED SHAG *PHALACROCORAX ATRICEPS* AT THE SOUTH SHETLAND ISLANDS: SIX YEARS OF MONITORING STUDIES
R. Casaux and E. Barrera-Oro (Argentina)
- WG-EMM-96/43 INTER-ANNUAL VARIATION IN CONDITION INDEX OF THE MACKEREL ICEFISH *CHAMPSOCEPHALUS GUNNARI*
I. Everson (United Kingdom), K.-H. Kock (Germany) and G. Parkes (United Kingdom)
- WG-EMM-96/52 PRELIMINARY RESULTS ON BY-CATCH OF FISHES CAUGHT BY THE FISHERY VESSEL *CHIYO MARU NO. 3* TO THE NORTH OF THE SOUTH SHETLAND ISLANDS (FEBRUARY TO MARCH, 1996)
S. Kawaguchi, T. Ichii and M. Naganobu (Japan)
(abstract only)
- ADDENDUM TO DATA SUBMISSIONS
WG-FSA-96/37

1996 ASSESSMENT SUMMARIES

Assessment Summary: *Dissostichus eleginoides*, Subarea 48.3

Source of Information: This report

Year:	1991	1992	1993	1994	1995	1996	Max ²	Min ²
Recommended TAC					-	4000		
Agreed TAC	2500 ⁴	3500	3350	1300	2800	4000		
Landings	3843	3703	2990	604	6171 ⁵	3871 ⁶		
Survey Biomass	335 ^{+a}	19315 [*]	3353 [*]		14923 ^{*a}		2012 ^{*b}	
	3020 ^{+b}	885 ⁺	2460 ⁺		4831 ^{+a}		67259 ^{+b}	
Surveyed by	UK	UK		UK ^a				
				Arg ^b				
Stock Biomass ³			11000-					
			17000					
Recruitment (age...)								
Mean F (.....) ¹								

Weights in tonnes

¹ ... weighted mean over ages (...)

* Shag Rocks

² Over period 1982 to 1992

+ South Georgia

³ Estimated from cohort projections

⁴ TAC from 1 November 1990 to 2 November 1991

⁵ Estimated by WS-MAD from various sources

⁶ For the period 1 March 1996 to 24 July 1996

Conservation Measures in Force: 92/XIV, 93/XIV and 94/XIV

Catches: Reported catches 1995/96 split-year = 4 362 tonnes, 1995/96 season (1 March to 24 July 1996) = 3 871 tonnes.

Data and Assessment: Revision of stock projections made at the 1995 meeting using the refined generalised yield model with revised input parameters. Standardisation of CPUE using generalised linear model did not show any trends in the status of the stock.

Fishing Mortality:

Recruitment: Estimated from trawl survey data using the same method as last year with four additional surveys (length-density analysis). Mean recruits at age 4 = 2.8 million.

State of Stock: Total removals of 5 000 tonnes per annum for 35 years consistent with γ_1 decision rule in generalised yield model. Ratio of spawning stock biomass at the end of the projection period to the pre-exploitation level was 53%.

Forecast for 1996/97: Recommended TAC of 5 000 tonnes and other conservation measures to remain in force.

Assessment Summary: *Dissostichus eleginoides*, Division 58.5.1

Source of Information: This report

Year:	1991	1992	1993	1994	1995	1996	Max ²	Min ²	Mean ²
Recommended TAC									
Agreed TAC									
Landings	1848	7492	2722	5083	5534	4869	7492	121	
Survey Biomass									
Surveyed by									
Sp. Stock Biomass ³									
Recruitment (age...)									
Mean F (.....) ¹									

Weights in tonnes, recruits in

¹ ... weighted mean over ages (...)

² Over period 1982 to 1994

³ From VPA using (.....)

Conservation Measures in Force: None. Recommendation not to exceed 1 400 tonnes in western fishing grounds (CCAMLR-XII, paragraph 4.21).

Catches: Northern sector, French trawlers = 2 574 tonnes. Eastern sector, French trawlers = 1 029 tonnes. Western sector, Ukrainian longliners = 1 003 tonnes. Scientific exploratory deep-sea longline fishing cruise (Japan/France) = 263 tonnes.

Data and Assessment: New data for recent and historical fishing submitted for the trawl fishery. Standardisation of CPUE using a generalised linear model did not show any decline in catch rates.

Fishing Mortality:

Recruitment:

State of Stock: No declining trends apparent in CPUE.

Forecast for 1996/97: TACs set by the French authorities: northern sector trawl fishery = 2 500 tonnes, eastern sector trawl fishery = 1 000 tonnes, western sector longline fishery = 1 400 tonnes.

Assessment Summary: *Dissostichus eleginoides*, Division 58.5.2

Source of Information: This report

Year:	1991	1992	1993	1994	1995	1996	Max ²	Min ²	Mean ²
Recommended TAC				297	297	297			
Agreed TAC						297			
Landings	0	0	0	0	0	0			
Survey Biomass	17714	3179		11880					
Surveyed by	Australia								
Sp. Stock Biomass ³									
Recruitment (age...)									
Mean F (.....) ¹									

Weights in tonnes, recruits in

¹ ... weighted mean over ages (...)

² Over period 1982 to 1992

³ From VPA using (.....)

Conservation Measures in Force: 78/XIV - TAC 297 tonnes.

Catches: None.

Data and Assessment: Revision of stock projections made at the 1995 meeting using the refined generalised yield model with revised input parameters (from Subarea 48.3) and a new recruitment function based on trawl survey data from 1990 and 1993.

Fishing Mortality:

Recruitment: Estimated from trawl survey data using the length-density method. Mean recruits at age 4 = 2.4 million.

State of Stock: Total removal of 3 800 tonnes per annum for 35 years consistent with γ_2 decision rule in generalised yield model. Probability of spawning stock biomass falling below 0.2 of its initial level during the projection period = 0.04.

Forecast for 1996/97: Recommended TAC = 3 800 tonnes with scientific observers on all vessels operating in the fishery.