Abstract

This document presents the adopted record of the Seventh Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, 1988. Major topics discussed at this meeting include: krill resources, fish resources, squid resources, ecosystem monitoring and management, marine mammal and bird populations, co-operation with other organisations and the long-term program of work for the Scientific Committee. Reports of meetings and intersessional activities of subsidiary bodies of the Scientific Committee, including groups for Fish Stock Assessment, for Ecosystem Monitoring Program and for the Long-Term Program of Work for the Scientific Committee, are appended.

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REPORT OF THE SEVENTH MEETING OF THE SCIENTIFIC COMMITTEE

OPENING OF THE MEETING

1.1* The Scientific Committee for the Conservation of Antarctic Marine Living Resources met under the Chairmanship of Dr Inigo Everson (UK) from 24 to 31 October, 1988 at the Wrest Point Hotel, Hobart, Australia.

1.2 Representatives from the following Members attended the meeting: Argentina, Australia, Belgium, Brazil, Chile, European Economic Community, France, German Democratic Republic, Federal Republic of Germany, India, Japan, Republic of Korea, New Zealand, Norway, Poland, South Africa, Spain, Union of Soviet Socialist Republics, United Kingdom and United States of America.

1.3 At the invitation of the Scientific Committee, representatives from the International Whaling Commission (IWC) and the Scientific Committee on Antarctic Research (SCAR) attended the meeting as observers. Observers from the acceding states of Greece, Sweden and Uruguay participated by invitation.

1.4 Prof. D. Butterworth (University of Capetown) and Dr M. Mangel (University of California, Davis) attended the meeting as invited experts in connection with the Krill Simulation Study.

1.5 Observers were welcomed and encouraged to participate, as appropriate, in discussion of Agenda Items 2 through 8.

1.6 A List of Participants is at Annex 1. A List of Documents considered during the session is at Annex 2.

1.7 Responsibility for the preparation of the Scientific Committee's report was assigned to the following rapporteurs: Mr D. Miller (South Africa) krill resources, Dr J. Gulland (EEC) fish resources and squid resources, Dr J. Croxall (UK) ecosystem monitoring and management,

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* The first part of the number relates to the appropriate item of the agenda (see Annex 3).

Dr G. Chittleborough (Australia) marine mammal and bird populations, Dr J.-C. Hureau (France) budget for 1989, Dr E. Marschoff (Argentina) Krill/CPUE Simulation and Dr E. Sabourenkov (Secretariat) all other items.

1.8 A timetable for the meeting was drafted by the Secretariat taking into account the requirements for preparation, translation and distribution of the Report of the meeting. The Chairman reminded Members of the limited time available to the Scientific Committee and suggested that the timetable be used as a guide in helping to organise the Committee's work and not as a rigid arrangement.

ADOPTION OF THE AGENDA

1.9 The Chairman noted that since the preparation and distribution of the Preliminary Agenda an additional Subitem 3 (ii) 'Scientific Research Exemption Provision' was proposed by Australia under item 3 'Fish Resources'. Australia also proposed a rewording of item 6 'Marine Mammal and Bird Population Assessments' to read 'Marine Mammal and Bird Populations'. Explanatory notes have been distributed to Members as required.

1.10 The Provisional Agenda for the meeting had been circulated to Members in accordance with the Rules of Procedure. In presenting the Provisional Agenda, the Chairman mentioned a request addressed to the Scientific Committee by the Commission at its 1987 Meeting concerning a multi-faceted approach to the management of fish stocks. In particular, several options were requested in the provision of advice on stocks of *C. gunnari* and other species (CCAMLR-VI, paragraphs 83 and 84).

1.11 No amendments to the Provisional Agenda were proposed and the agenda was adopted (Annex 3).

REPORT OF THE CHAIRMAN

1.12 In his report, the Chairman referred to his circular letter (SC CIRC 88/1) in which he drew Members' attention to several specific items requiring action by the Scientific Committee prior to and at this meeting. The Chairman also informed Members on various activities which took place during the intersessional period.

1.13 The Working Group on CCAMLR Ecosystem Monitoring Program (Convener, Dr K. Kerry, Australia) did not meet in 1988. However, work continued by correspondence and within the Secretariat particularly on those topics identified by the Scientific Committee at its last meeting (SC-CAMLR-VI, paragraph 7.39). A Convener's Report was circulated as SC-CAMLR-VII/7.

1.14 Last year the Ad Hoc Working Group on Krill was established (Convener, Mr D. Miller, South Africa). During 1987/88 the Group worked by correspondence. The Convener's report was distributed as SC-CAMLR-VII/11 and SC-CAMLR-VII/BG/10.

1.15 The Working Group on Fish Stock Assessment met in Hobart, Australia from 12 to 20 October, 1988 (Convener, Dr K.-H. Kock, FRG). A report of the meeting was distributed as SC-CAMLR-VII/10.

1.16 An Informal Group on the Long-Term Program of Work for the Scientific Committee, chaired by Dr K. Sherman (USA) met in Hobart, Australia on 23 October, 1988.

1.17 The Steering Committee on Joint CCAMLR/IWC Workshop on the Feeding Ecology of Southern Baleen Whales met in May 1988 in San Diego (USA). CCAMLR was represented at the meeting by Mr D. Miller (South Africa) and Dr Y. Shimadzu (Japan). Their report was distributed as SC-CAMLR-VII/BG/9.

1.18 The invited experts, Prof. D. Butterworth and Dr M. Mangel had accomplished their research on the Simulation Study of Krill Fishing (SC-CAMLR-VII/BG/12 and SC-CAMLR-VII/BG/37). The Convener of the Krill Simulation Study, Dr J. Beddington, submitted a summary of their results (SC-CAMLR-VII/6).

1.19 In August, 1988 the Spanish version of the FAO/CCAMLR Species Identification Sheets was published and distributed to CCAMLR Members. This project is now complete.

1.20 The publication of proceedings of the IOC/CCAMLR Seminar on Antarctic Ocean Variability and Its Influence on Marine Living Resources, Particularly Krill is in proof stage. It was anticipated that this would be published by the end of 1988.

1.21 Last year at the conclusion of the Scientific Committee meeting an Action Plan containing the schedule of actions required of the Conveners, the Chairman and the Secretariat during the intersessional period was prepared by a group comprising the Chairman, two Vice-

Chairmen and the Conveners of the Working Groups. Required actions have been largely completed.

1.22 This year a total of 13 Working Papers and 48 Background Papers (some of which were prepared during the meeting) were submitted for the consideration of the Scientific Committee. All papers which met submission deadlines (11 Working Papers and 31 Background Papers) had been processed by the Secretariat and distributed as required.

KRILL RESOURCES

Fishery Status and Trends

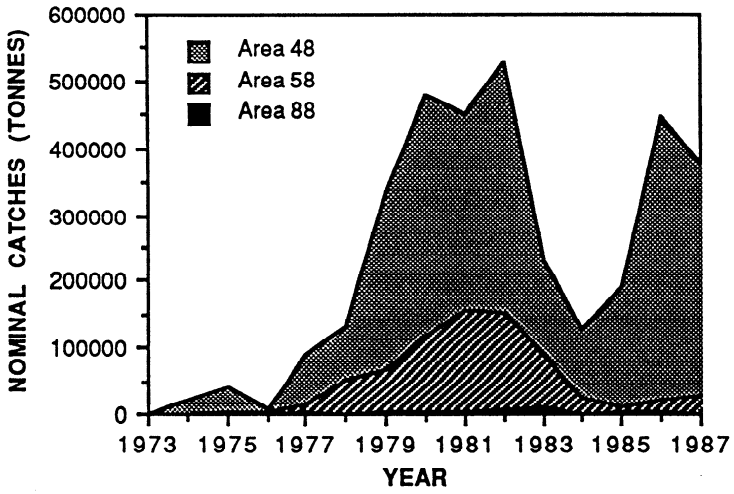
2.1 The total krill catch for 1987/88 was essentially similar to 1986/87, although a slight decrease of some 6 000 tonnes has occurred. A summary of national krill landings since 1983 is as follows:

Table 2.1: National krill landings (in tonnes) since 1982/83

	Split-Year*					
Member	1983	1984	1985	1986	1987	1988
Chile	3 752	1 649	2 598	3 264	4 063	5 938
GDR	0	0	50	0	0	0
Japan	42 282	49 531	38 274	61 074	78 360	73 112
Republic of Korea	1 959	2 657	0	0	1 527	1 525
Poland	360	0	0	2 065	1 726	5 215
Spain	0	0	0	0	379	0
USSR	180 290	74 381	150 538	379 270	290 401	284 873
Total	228 643	128 218	191 460	445 673	376 456	370 663

* The Antarctic split-year begins on 1 July and ends on 30 June. The column 'split-year' refers to the calendar year in which the split-year ends (e.g. 1988 refers to the 1987/88 split-year).

2.2 The total krill catch by statistical area and year since 1973 is illustrated in the figure below.



2.3 An analysis of the 1987/88 landings by area indicated a very slight reduction of catches in Area 48 as a whole compared with the previous year. In this regard, there was also an approximately nine-fold (75 000 tonnes) increase of the Soviet catch in Subarea 48.2 and a 26% (66 000 tonnes) reduction in Subarea 48.3.

2.4 In contrast, catches from Subarea 58.4 were down by 88% (6 490 versus 29 557 tonnes) from1986/87 levels.

2.5 With exception of the Soviet and Polish catches, krill catches by most nations were similar in 1987/88 to 1986/87 levels. Polish catches were, however, approximately 3 times (3 500 tonnes) higher while the Soviet catch was some 2% (6 000 tonnes) less. An increase in the Chilean catch of 46% (1 875 tonnes) and a subsequent reduction of 7% (5 248 tonnes) in the Japanese catch was also noted. With respect to the latter, Dr Shimadzu reported that this was a consequence of the withdrawal of one vessel from the Japanese operations in 1987/88.

2.6 In 1987/88, the total USSR krill catch (284 873 tonnes) was made up as follows:

Subarea 48.1	0	(319 tonnes in 1986/87)
Subarea 48.2	89 888	(9 731 tonnes in 1986/87)
Subarea 48.3	188 391	(254 480 tonnes in 1986/87)
Area 88	0	(288 tonnes in 1986/87)
Subarea 58.4	6 490	(25 583 tonnes in 1986/87)

2.7 Dr T. Lubimova (USSR) indicated that the slight decrease and areal redirection of the Soviet catches in 1987/88 was a result of the severe ice-conditions experienced during the most recent fishing season in Division 58.4.2.

2.8 Dr J. Gulland (EEC) drew the Committee's attention to recent discussions within the Commission Working Group for the Development of a Conservation Strategy concerning the value of information about future developments in the krill fishery. It was agreed that this information would be of interest to the Scientific Committee, particularly with respect to the formulation of management advice.

2.9 Most krill fishing nations indicated that recent trends (i.e. slight increases or decrease in catches from year-to-year) would continue. There was general recognition that such variations were largely dependent on economic (including marketing) factors, technological developments, the availability of fishing vessels and prevailing environmental conditions (especially effects of seasonal ice-cover on krill availability). Dr Lubimova indicated the possibility that Soviet catches in the near future may increase as a result of an increase in the overall areal coverage of that nation's krill fishery. Dr O. Østvedt (Norway) also indicated that Norwegian vessels may commence a small-scale krill fishery in the not too distant future.

Data Requirements

2.10 In response to the concern expressed at last year's Scientific Committee Meeting, (SC-CAMLR-VI, paragraph 4.12), Dr Lubimova indicated that catches taken within Area 58 during 1987/88 were from Division 58.4.2 and not from previous 'unknown' areas as had been recorded in the summary catch statistics (SC-CAMLR-VII/BG/1).

2.11 In accordance with the Commission's 1986 decision (CCAMLR-V, paragraph 71), the submission of detailed catch and effort data for Subarea 48.2 was requested. In addition, the Sixth Meeting of the Scientific Committee recommended that fine-scale catch and effort data should be reported wherever possible from the CEMP Integrated Study Regions (SC-CAMLR-VI, paragraph 4.14). These regions include the following statistical subareas and divisions:

Antarctic Peninsula - 48.1, 48.5 (partially) and 88.3 (partially)
South Georgia - 48.3
Prydz Bay - 58.4.2, 58.4.3 and 58.4.4 (partially).

2.12 Since the 1987/88 season the reporting format for fine-scale catch and effort data for krill is the same as that for fish.

2.13 To date, Brazil, Korea and Poland have submitted fine-scale catch and effort data for Subareas 48.1, 48.2 and (in the case of Poland) 48.3 for the 1987/88 season. Japan had submitted such data for Subarea 48.2 since 1985/86 to the present, and for Subarea 48.1 for the 1987/88 season.

2.14 In discussion concerning the above, Dr Lubimova indicated that Soviet data for the past season (1987/88) had been prepared but due to problems with verification they had only been recently submitted.

2.15 With regard to the reporting of fine-scale catch data from Subarea 48.2, Dr Y. Shimadzu (Japan) drew attention to the 1986 request of the Commission that such data should be submitted (CCAMLR-V, paragraph 71). He indicated that this decision was based on a large increase in the krill catch from this subarea in 1985/86 compared with previous years. However, since catch levels have substantially declined, Dr Shimadzu questioned the propriety of the continued submission of fine-scale catch data from Subarea 48.2. Given that the reporting of fine-scale data has also been requested for the Integrated Study Regions of CEMP (SC-CAMLR-VI, paragraphs 4.14), Dr Shimadzu expressed the view that the fine-scale reporting of krill catch data from Subarea 48.2 should not be continued.

2.16 In response to the above, the Committee noted that Subarea 48.2 is situated between two of the CEMP's Integrated Study Regions (48.1 and 48.3) and hence the continued reporting of fine-scale data from all three areas was emphasised.

2.17 Dr Shimadzu then drew the Committee's attention to a basic inconsistency in the original request for fine-scale effort data as set out in paragraph 71 of the Report of the Fifth Meeting of the Commission. As such, the request was ambiguous as to whether catch data alone, as opposed to both catch and effort data, was required. Dr Shimadzu indicated that in his opinion it is still unclear whether fine-scale effort data can be utilised in the evaluation of possible effects on localised predators as a consequence of krill fishing activities (SC-CAMLR-V, paragraph 5.36).

2.18 The Committee agreed that the issue of reporting fine-scale effort data needed to be resolved. However, despite Dr Shimadzu's reservations as to the ultimate utility of such fine-scale effort data the majority of Members agreed that theses data could be of some use to the CEMP.

2.19 The Committee therefore recommended that until such time as the value of fine-scale effort data in the determination of krill abundance trends could be irrevocably determined, every effort should be made to encourage the collection, and if possible submission to CCAMLR, of

such data. The reporting of fine-scale catch data for Subareas 48.1, 48.2 and 48.3 should continue.

2.20 Finally, in view of the need to improve knowledge of possible future developments in the krill fishery (paragraph 2.8 above), the Committee recommended that, whenever possible, information about such developments should be made available each year to the Scientific Committee.

Ad Hoc Working Group on Krill

2.21 At its 1987 Meeting, the Scientific Committee recognised the absence of a forum within CCAMLR for the in-depth review of current and past research on krill biology and ecology, or for the evaluation of its application in meeting the Convention's objectives. An ad hoc Group on Krill under the convenership of Mr D. Miller (South Africa) was therefore established and terms of reference were set out in paragraph 4.30 of the Report of the Scientific Committee's 1987 Meeting.

2.22 The Convener reported on the intersessional activities of the above Group (SC-CAMLR-VII/BG/10) and outlined a number of suggestions for future action (SC-CAMLR-VII/11).

2.23 In discussing the latter, the Committee recognised that a large number of papers submitted to the present meeting were directly pertinent to various topics which the Group had identified as being important in the execution of its function. In broad terms such papers dealt with acoustic target strength estimation (SC-CAMLR-VII/BG/30), evaluation of sampling efficiency and related problems (SC-CAMLR-VII/BG/7, 21, 22 and 40), studies of krill distribution at a variety of spatial and temporal scales (SC-CAMLR-VII/BG/13, 20, 25 and 40), and attempts to improve the general state of knowledge concerning various aspects of the krill fishery (SC-CAMLR-VII/BG/6, 12, 14 and 37).

2.24 Taking into account recent developments to co-ordinate national research on krill under the auspices of SCAR (SC-CAMLR-VII/12) and the wide variety and technical nature of the topics which the ad hoc Group is required to address, the Scientific Committee agreed to focus the Group's efforts on aspects of krill ecology most closely related to the krill fishery. This was viewed as an essential development in assisting the Scientific Committee to provide appropriate advice to the Commission.

2.25 Accordingly, the Scientific Committee recommended that the ad hoc Group should be constituted as a permanent Working Group on Krill under the convenership of Mr D. Miller (South Africa).

2.26 The terms of reference of the Working Group are to:

- review and evaluate methods and techniques for estimating krill abundance, taking note of the effects of patchiness and the influences of the physical environment;

- review and evaluate information concerning the size, distribution and composition of commercial krill catches, including likely future trends in these catches;

- liaise with the Working Group for the CCAMLR Ecosystem Monitoring Program for assessing any impact of changes in krill abundance and distribution on dependent and related species;

- evaluate the impact on krill stocks and krill fisheries of current and possible future patterns of harvesting, including changes brought about through management action, in order that the Committee may formulate appropriate scientific advice on krill to the Commission; and

- report to the Scientific Committee on information, and data, required from commercial krill fisheries.

2.27 In considering the Group's first term of reference, it was agreed that the Group would need to take account of the status of knowledge concerning the population structure, determination of growth and age, reproduction and fecundity and natural mortality of krill.

2.28 The Committee recognised that there is an urgent need for the Group to commence its work. It was therefore agreed that a meeting of the Group should be held during the intersessional period.

2.29 The major objective of this meeting will be to consider available information on the abundance and distribution of krill in selected subareas of the Antarctic. In order to achieve this the Group will need to review and evaluate:

(i) various estimation procedures used in the determination of krill abundance/ distribution;

(ii) knowledge concerning the spatial and temporal (both seasonal and annual) variability in krill stocks; and

(iii) the availability of relevant fisheries information.

2.30 It was agreed that many of the tasks which the Group would need to undertake at its meeting are complementary to developments within the Krill CPUE Simulation Study (see below). There would therefore be considerable value in holding the Group's meeting in conjunction with the planned Krill CPUE Workshop (see paragraph 2.40 below).

2.31 The Committee agreed that the meeting of the Group will be held at the Southwest Fisheries Center, La Jolla, USA during the period 7 to 14 June, 1989.

Krill cpue Simulation Study

2.32 Dr J. Beddington (UK) briefly outlined the results of the Krill CPUE Simulation Study (SC-CAMLR-VII/6).

2.33 The two consultants, Dr M. Mangel (University of California, Davis) and Prof. D.S. Butterworth (University of Cape Town) then introduced their modelling analyses which took account of data from the Soviet research vessels (SC-CAMLR-VII/BG/12) and Japanese commercial vessels (SC-CAMLR-VII/BG/37) respectively.

2.34 A model of krill distribution had been prepared using information from several national acoustic data sets. The same distributional model was used in both simulation studies.

2.35 During his presentation Dr Mangel drew attention to two additional documents pertinent to the model of the Soviet fishery research vessel operations which he had developed. The first (SC-CAMLR-VII/BG/14) described in some detail the operation of the soviet commercial fishery (information which Dr Mangel was not able to utilise in the development of his model). The second (SC-CAMLR-VII/BG/20) indicated that the underlying assumptions which the Consultants had made concerning the spatial distribution of krill stocks were compatible with other available data on krill distribution.

2.36 It was agreed that the two consultants' reports were of great interest but hat it would be extremely difficult to evaluate their content given the limited time that most Committee members had had to consider them. Dr E. Marschoff (Argentina) noted that this was a clear demonstration

of the problem associated with the late submission of documents for consideration during Scientific Committee proceedings. The Committee agreed with this view and that the matter of the timely submission and circulation of important papers was a matter of serious concern (refer paragraph 12.3).

2.37 Therefore, in accordance with the timetable outlined for the Simulation Study in last year's report (SC-CAMLR-VI, paragraph 4.41), the Committee recognised that further evaluation of the context of the consultant's reports was necessary to develop appropriate terms of reference for the evaluation workshop planned for 1989. A small task group was formed under the convenership of Dr E. Marschoff (Argentina) to undertake this task. A report of the deliberations of this group is appended at Annex 4.

2.38 In essence, both Consultants' studies concluded that certain catch dependent indices (in particular those containing some element of search time) could be used to assess levels of krill abundance and that improved models of krill distribution patterns need to be developed (preferably as a result of joint scientific and fishing vessel surveys). In addition, Dr Mangel indicated that, if possible, operational analyses of krill fishing operations should be undertaken by suitably qualified personnel.

2.39 Having considered the task group's summary, the Committee accepted its recommendations to proceed with the proposed workshop (SC-CAMLR-VI, paragraph 4.41).

2.40 The Committee recommended that the Workshop be held at the Southwest Fisheries Center, La Jolla, USA during the period 1 to 6 June, 1989.

2.41 The major tasks of the Workshop will be:

(i) to provide an opportunity for detailed and final discussions on the models developed by the consultants, and their implications for the potential use of CPUE to index krill abundance;

(ii) to consider refinements of the krill distribution model used in the consultants' studies in the light of further analyses of existing krill research survey data to be tabled at the Workshop, and to investigate whether such refinements altered the conclusions drawn from the existing studies;

(iii) to consider the practicality of the routine collection of various types of search time information in the light of analyses to be presented of experimental collection of

such data that has already taken place on Japanese vessels, and of some data from Soviet research vessels; and

(iv) to make recommendations to the Scientific Committee regarding the potential utility of CPUE to index krill biomass, the most effective and practical index or indices to be used, and the consequent requirements for routine data collection in the krill fishery.

2.42 Access to a mainframe computer must be available to the Workshop, so that the models developed by the consultants can be run in appropriate periods.

Advice to the Commission

2.43 In order to facilitate the development of appropriate scientific advice on krill, the Scientific Committee recommended that a permanent Working Group on Krill be formed. The primary function of this Group will be to evaluate available knowledge and formulate specific recommendations on the potential effects of krill fisheries with respect to the provision of the Convention. This Group should meet during the intersessional period in order to commence its tasks.

2.44 Having considered the report of the consultants for the Krill Simulation Study, it is recommended that a Workshop meeting be held to develop specific recommendations to the Scientific Committee on the implications of this study. This meeting should be held in conjunction with the Working Group's meeting.

2.45 Finally, the Committee recommended that the reporting of fine-scale catch data from Subarea 48.2 should continue. Similarly such data should also be reported from Subarea 48.1 and 48.3 (the Integrated Study Regions of the CEMP). Wherever possible, fine-scale effort data from all three areas should be collected, and should such data be shown to be useful, submitted to the Commission at some time in the future.

FISH RESOURCES

3.1 The Report of the Working Group, which had met at CCAMLR Headquarters, Hobart from 12 to 20 October 1988, was presented by the Convener, Dr K.-H. Kock (Federal Republic of Germany) and appended at Annex 5. The Committee noted that the new organisation of the

Group, which had worked in small sub-groups for the first week followed by the plenary session, had been successful, although shortage of time in the second week had prevented more than a brief examination of the possible effects of alternative long-term management strategies. This success was greatly helped by the support given by the Secretariat before and during the meeting, especially in data compilation and analysis.

3.2 The Committee noted that summary statements of the results of the stock assessments, modified from the format of similar summaries used by the International Council for the Exploration of the Sea for the northeast Atlantic, had been provided for most stocks in Subarea 48.3, and that it was planned to extend these summaries to the other stocks in 1989. It is hoped that the Commission will find these summaries useful.

3.3 The Working Group had noted that with the expansion of the Commission data base, more scientists were wishing to have access to the data contained therein. Where this access was for preparing studies to be submitted to future meetings of the Working Group, the data requested should be supplied, and the originators of the data informed. When data are required for other purposes, then the Secretariat will, in response to a detailed request, supply the data only after permission has been given by the originators of the data.

3.4 Progress was reported on a number of scientific topics. Studies on the use of micro-increments (daily rings) and weight of otoliths had shown promise, and this technique could help resolve the doubts arising in the use of conventional methods of age-determination. Related progress in the CCAMLR program of scale/otolith/bones exchange was also reported. A full report on this program will be presented next year.

3.5 A technique for sampling larval and post-larval fish with small-meshed samplers attached to bottom trawls had been developed by Polish scientists. This technique could be very useful in carrying out sampling of fish in their early life stages in the course of routine trawl surveys. The value of such sampling would be increased if the sampler could be equipped with an opening and closing device so that the fish caught close to the bottom could be separated from those in mid-water.

3.6 Results of mesh selectivity experiments were reported by Poland and Spain, to meet the request of the Commission made at its 1987 Meeting for mesh selectivity studies (CCAMLR-VI, paragraph 85). There were big differences noted in selectivity parameters between experiments. 50% length and selection factors were, however, determined for a number of species, though it was stressed that these only applied under conditions of moderate to low catch rates, and might

be lower under commercial conditions of high catches. Also, no experiments had been conducted outside Area 48.

3.7 The Working Group had been able to make assessments of a number of stocks in Areas 48 and 58, and the results of these assessments are set out in its report (see paragraphs 17 to 113 of Annex 5). The Committee congratulated the Working Group on the progress made, and on the increased number of stocks for which it had been possible to make assessments. It noted that many of these assessments had been based on one or another form of Virtual Population Analysis (VPA). In view of the number of ways in which the VPA technique can be applied, and the differences that can arise from using different forms of the technique (e.g. different ways of fitting to observed biomass) and from using different sets of input parameters, the Committee welcomed the progress being made by the Working Group in documenting more precisely the methods and input parameters used, and in examining the effect of using different parameters, e.g. different values of natural mortality. This progress needs to be continued.

3.8 The Delegation of Argentina repeated its concern first raised in the 1985 Meeting that in Subarea 48.3 (South Georgia) the species *N. gibberifrons* is heavily affected by being taken as by-catch (paragraphs 48 and 50 of Annex 5) and this was supported by Australia pointing out also that *N. rossii* continues to remain at a very low level.

3.9 Other delegations shared this concern over stocks that were mainly taken as by-catches, incidentally in fisheries directed at other species, but which were showing signs of being severely affected by fishing. In this connection, it was felt that in paragraph 65 of the Working Group's Report (Annex 5) the parts referring to possible options for the Commission were open to misinterpretation. The views of the Committee on this matter are set out in paragraph 3.16 below. With this exception, the Committee endorsed the Working Group's Report.

Scientific Research Exemption Provision

3.10 The Committee noted that some research vessels that might operate under research permits exempting them from the management regulations, were capable of taking large catches. So that the Committee could be in a position to advise on whether any catches taken might be large enough to be detrimental to the objectives of the regulations, detailed information was needed regarding the capacities of research vessels. It welcomed the tabulation of information set out in CCAMLR-VII/BG/5, but believed that some improvements were needed. In particular, it was very desirable to make a distinction between fishing capacity and processing and storage capacity. For most assessment surveys, a vessel capable of operating a standard

commercial trawl was necessary, but the total volume of the catch could be very small. There was also a need to ensure that the relevant information e.g. on storage capacity, was expressed in a standard form.

3.11 In cases where a research exemption had been granted, it was important that the Scientific Committee should be informed about the results of the research carried out, especially where it was likely that these results were relevant to the management policies. The Committee urged that such reports should be made as soon as possible.

Data Requirements

3.12 The Committee noted that the Working Group had identified a number of items of information and data that were needed to improve their assessments. These are set out in Annex 6.

3.13 The Working Group had also (see paragraphs 114 to 119 of Annex 5) made a number of proposals for changes in the details in which biological data and information from the commercial fisheries should be collected and reported to CCAMLR. The Committee endorsed these proposals. In doing so it emphasised the importance of providing length samples from the commercial vessels, as well as from research of scouting vessels.

Advice to the Commission

3.14 The main substance of the Committee's advice to the Commission in the assessments of the current state of the fish stocks, and of the effects of alternative measures, is set out in paragraphs 27 to 58 (as concerns Subarea 48.3); paragraphs 59 to 64 (as concerns Subareas 48.1 and 48.2); and paragraphs 66 to 113 (as concerns Area 58), Annex 5. The conclusions of the Committee regarding the by-catch problem referred to in paragraph 65 of Appendix 4 to Annex 5 are set out in paragraph 3.19 below. For Subarea 48.3 summaries of the assessments for the main species are set out in Appendix 4 to Annex 5, but it must be stressed that these summaries should be read in conjunction with the main body of the report.

3.15 In addition to providing this general advice, the Committee noted that the Commission had made specific requests, in respect of *C. gunnari* and other species, regarding mesh size, closed areas/seasons, TAC's to achieve low values of fishing mortality, and an evaluation of the

total finfish replacement yield on an area basis (CCAMLR-VI, paragraph 84). For the first three of these, answers can be provided in respect of Subarea 48.3:

- to achieve the target size of first capture of 32 cm for *C. gunnari* would require, under conditions of low catch rates, a 107 mm mesh. If selectivity of the net is less under commercial conditions of large catches, a correspondingly larger mesh would be required to achieve the desired results (see paragraph 31 of Annex 5);

- the Working Group had no new data concerning the effect of closed seasons and/or areas which would suggest alterations to the present closed area and closed seasons in Subarea 48.3 (see paragraph 41 of Annex 5);

- the TAC's to achieve target values of fishing mortality are:

	$F_{0.1}$	F_{max}	Reference in Annex 5
for *C. gunnari*	10 194	18 586	(paragraph 38)
N. gibberifrons			
if M = 0.25	256	450	(paragraph 53)
if M = 0.125	443	720	
P. georgianus	1 800		(paragraph 56)
C. aceratus	1 100		(paragraph 58)

  for *P. br. guntheri* no TAC could be calculated, but an alternative policy of limiting catches to around the level of recent years was suggested (paragraph 45 of Annex 5).

3.16 No calculation of total replacement yield was attempted by the Working Group. The Committee noted that *C. gunnari* was now the most important commercial species in most areas, and was subject to very large fluctuations in recruitment. Thus the growth in total population biomass in the absence of fishing (i.e. the replacement yield) varies greatly from year to year, being greatest when a strong year class is entering the stock. Calculation of a replacement yield for a particular year is difficult, and may not be a useful management target.

3.17 The Committee noted that recent catches of *N. gibberifrons* from Subarea 48.3 have been greatly in excess of the TACs set out above. Though this species is apparently mainly taken as a by-catch, there have been occasions when *N. gibberifrons* has been the target of a directed fishery; it would probably be necessary, if the TAC's set out above are to be achieved, that there should be no directed fishing for this species. The size of the by-catch for a given size of the fishery on other species may be reduced by modifications to fishing practice, e.g. by the replacement of bottom trawling with mid-water trawling. However, without additional

restrictions on the directed fishery, it may not be possible to keep the *N. gibberifrons* catches below the TAC.

3.18 If the TAC for *N. gibberifrons* in Subarea 48.3, based on $F_{0.1}$ were set, it would allow recovery of the exploited part of the stock in two to three decades (paragraph 51 of Annex 5). Catch levels in excess of the $F_{0.1}$ derived TAC for *N. gibberifrons* may not allow this part of the stock to recover within this time. The catch of *N. gibberifrons* would be expected to greatly exceed the designated TAC of this species if the TAC of *C. gunnari* is taken, and the proportion of by-catch remains at recent levels (Table 2 of Annex 5). There is a conflict between achieving the *C. gunnari* TAC and rebuilding the stock of *N. gibberifrons*.

3.19 The Scientific Committee draws the attention of the Commission to this issue of by-catch, pointing out that the Commission has to choose between full exploitation of one species and rebuilding another species within the time frame specified in Article II. In the absence of guidance from the Commission on the balance between these conflicting objectives, the Committee could not advise on the choice that should be made.

3.20 The Committee noted that the TAC's set out above had been based on a strategy of maintaining the fishing mortality at $F_{0.1}$. It stressed that this was only one of a number of alternative strategies, some of which might better achieve the objectives of the Commission than a constant $F_{0.1}$. It noted that the Working Group had started work on considering the long-term implications of alternative strategies (see paragraph 39 of Annex 5). When these studies have been further advanced the Committee will ben in a better position to advise the Commission regarding alternative strategies.

SQUID RESOURCES

Commercial Fishery

4.1 No commercial catches have been reported from the CCAMLR Convention Area since a catch of 2 tonnes was reported by the German Democratic Republic from Subarea 48.1 in 1979. However, as noted in the Committee's 1987 Report, the squid fisheries in the adjacent areas of the South Atlantic outside the CCAMLR Convention Area have become very important. There appears to be some interest in expanding these fisheries, possibly into the CCAMLR Convention Area.

4.2 The UK reported that a squid jigger had been sighted some 20 miles north of Bird Island, South Georgia, apparently fishing. No report has been received from this vessel, which may have been from a non-Member country.

Research

4.3 The USSR Delegation reported that in the course of research studies in the South Polar Front area, between 47°–53°S and 40°–25°W, directed primarily at meso-pelagic fish (the myctophid, *Electrona carlsbergi*) observations were made on squid. In addition to small incidental catches in trawls, some trials were made with lights and squid jigs. A few squid were attracted to the lights, and caught by jigs. The principal species caught in the trawl was *Martialia hyadesi*, a large species up to 30 cm in length.

4.4 The UK reported that research on squid was being carried out around South Georgia, and a paper had been presented to the 1988 SCAR Symposium.

4.5 The Committee emphasised the importance of further research on squid, particularly integrated studies linking squid to their food supplies and predators. Studies in the South Polar Front area were likely to be particularly fruitful.

ECOSYSTEM MONITORING AND MANAGEMENT

Report of the Convener of the Working Group for CEMP

5.1 Dr K.R. Kerry (Australia) presented the Report of the Working Group's Intersessional Activities in 1987/88 (Annex 7). The Working Group did not meet during this period but conducted work by correspondence and within the Secretariat, particularly on the tasks identified by the Scientific Committee at its last meeting and described in SC-CAMLR-VI, paragraph 7.39. The rRport was used as a basis for discussion of the current and future work of the Working Group.

Standard Methods for Monitoring Parameters of Predator Species

5.2 The methods to be used in monitoring the parameters of predatory species approved last year for inclusion in the CEMP (SC-CAMLR-VI, Annex 4, Appendix 4) were revised, published

(in English; translation into other languages is in progress), circulated to all Commission Members and other appropriate organisations.

5.3 These instructions will need revision in the light of operators experiences of using them in the field. Members are urged to convey suggestions for improvements to the Convener of the Working Group, so that he may arrange periodic review of the existing instructions, following which the Secretariat can issue revisions as necessary.

5.4 It was noted that the binding of the published booklet does not facilitate replacement of existing instructions with new ones. However, the Secretariat informed the Scientific Committee that it had felt obliged to select the cheapest binding for the initial printing run.

Summary of Members' CEMP Activities

5.5 A number of nations have initiated research as part of the CEMP. These efforts by national programs were welcomed by the Scientific Committee and are summarised in Annex 7.

5.6 To facilitate further co-ordination of Members' contributions to CEMP, the Scientific Committee noted that it is important that Members be informed of each others plans and activities. In this regard, most reports of Members' CEMP activities were deemed insufficiently explicit to assist the Working Group and the Scientific Committee in evaluating the precise nature of current and projected work on the predator parameters recommended for monitoring and on directed research, or to provide essential background information to potentially suitable parameters (SC-CAMLR-VI, paragraph 7.21).

5.7 To remedy this, the Convener, in conjunction with the Secretariat, was asked to prepare a new set of reporting sheets for Members' CEMP activities. This would be circulated for comment during the current meeting, completed by Members as soon as possible thereafter and returned to the Secretariat not later than 30 November, in order to ensure inclusion in the Appendix to the Convener's Report. A list of all tabled papers relevant to CEMP work would also be appended to this Report (Annex 7).

Data Reporting Formats for Existing Approved
Predator Monitoring Operations

5.8 Draft formats for seabird parameters, developed by the Convener and the CCAMLR Data Manager, were tabled at the present meeting (SC-CAMLR-VII/BG/8).

5.9 It is important to reach early agreement on the format and use of these forms to enable Members to submit to CCAMLR data from their current monitoring operations.

5.10 Therefore draft formats for fur seal parameters should be prepared immediately by the Working Group Convener and CCAMLR Data Manager. The complete set of draft seabird and seal data reporting forms should be circulated to Members before 30 November. Members' responses should be received by the Secretariat by 1 March.

5.11 Guidelines and requirements for submitting ecosystem monitoring data to the Secretariat have not yet been agreed. The Scientific Committee did, however, agree that the Working Group for CEMP should discuss this topic and develop guidelines at its 1989 intersessional meeting.

Registration and Protection of Approved
Land-Based Monitoring Sites

5.12 Last year the Working Group indicated that long-term shore-based monitoring of predator parameters would be helped if approved sites were accorded some form of protection (SC-CAMLR-VI, paragraph 7.18).

5.13 The need to provide protection arose from concern that unregulated human activity at monitoring sites could prejudice the efficient conduct of the monitoring operations and create additional sources of variation in the parameters being measured.

5.14 The Scientific Committee asked the Commission to consider how formal protection might best be achieved, taking account of procedures available within Article IX, paragraph 2, sub-paragraph (g) of the Convention and the existing systems of site protection under the Antarctic Treaty (SC-CAMLR-VI, paragraph 7.32).

5.15 The Scientific Committee asked the Convener of the Working Group for CEMP, in conjunction with the Secretariat to consider appropriate action in respect of registration

and protection for approved CEMP land based monitoring sites (SC-CAMLR-VI, paragraph 7.39(ii)).

5.16 The Commission noted that work on developing management plans for land based CEMP sites would be submitted for consideration at the next meeting (CCAMLR-VI, paragraph 55). It agreed that in developing these plans the term 'human interference' would not be interpreted to include fishing.

5.17 After considering the paper prepared by the Convener of the Working Group for CEMP and the Secretariat (SC-CAMLR-VII/3 Rev. 1), the Scientific Committee made the following suggestions (paragraphs 5.18 to 5.20) for the consideration and guidance of the Commission.

5.18 All sites where land based CEMP studies are underway or planned for the near future should be properly defined and registered as sites for CEMP monitoring.

5.19 Proposals for the registration of these sites should include:

(i) a clear description of the location and the key physical and biological features of the site, including a description of the markers and/or natural features that delineate the site and any proposed buffer zone(s) adjacent to the site;

(ii) a map and/or photographs showing the boundaries and key features of the proposed site and any adjacent buffer zone(s);

(iii) a description of the objectives and nature of CEMP monitoring studies being conducted or planned to be conducted at the site, including the species and parameters being monitored;

(iv) descriptions, as applicable, of any SSSIs, SPAs, historic monuments, and research of other facilities in or near the proposed CEMP site and any protective measures already applicable in or near the site as a result of actions taken previously under the Antarctic Treaty;

(v) a description, as applicable, of steps that have been or are being taken to ensure that the proposed listing will in no way reduce or compromise protection of areas afforded special protection under components of the Antarctic Treaty System, and

(vi) a draft management plan.

5.20 Draft management plans for proposed CEMP land-based sites and any adjacent buffer zones should include:

(i) the name, title, and mailing address of the individual and/or organisation responsible for planning and conducting CEMP studies at the proposed site;

(ii) description of the types of activities that could be conducted in or near the proposed CEMP site, at different times of the year, without jeopardising the ongoing or planned monitoring studies;

(iii) descriptions of the types of activities (including activities outside the site) that could impair or jeopardise the ongoing or planned monitoring studies;

(iv) descriptions of steps that should be taken to minimise damage or interference in cases where access to the CEMP study site is essential for other purposes (e.g. indicate anchor sites, access points, pedestrian routes, etc. that would avoid or minimise disturbance). This is one of the key elements of the management plan and should be specific and detailed; and

(v) the date when CEMP studies at the site are expected to be concluded. Many CEMP studies necessarily will be carried out for indefinite periods of time and it therefore will be impossible to anticipate when the studies might be concluded. In these cases, the results of the studies should be reviewed periodically (e.g. at five year intervals) and the approved management plan updated accordingly.

Sensitivity Analyses on Estimates of Predator Parameters Derived from Existing Data

5.21 Progress on this, beyond preparing summaries of potentially useful data sets, had been retarded by difficulties in defining the tasks in sufficient detail to develop appropriate analytical procedures.

5.22 From discussions at the meeting, it was agreed that there were at least four main topics of relevance. These are:

(i) a description of some of the statistical properties of the parameters being monitored (e.g. statistical distributions of parameter estimates; sample sizes to achieve desired levels of precision);

(ii) the power to detect differences in point estimates and to detect trends (e.g. the size of differences that can be detected between areas; the number of years that monitoring must be continued to detect a certain constant rate of change in the parameter);

(iii) the power to detect inter-dependencies, which might be time and space varying and non-linear (e.g. how does the trade-off between the number of penguin colonies sampled, and the intensity of sampling at each, change the ability to use inter-annual variability of krill to distinguish possible relationships between breeding success and krill abundance?); and

(iv) the potential adequacy of the data and estimates to meet the requirements of CCAMLR in distinguishing between natural variations in prey abundance and those induced by fishery activity.

5.23 While each of the above issues is important to the role of the Ecosystem Monitoring Program, it is also clear that they differ considerably in the ease with which they can be addressed. Many aspects of points (i) and (ii) can be examined with existing data and standard methodologies. There appear to be some data available for examining (iii), and the examination would in some cases require simulation studies. Examination of point (iv) would probably involve modelling studies, and would probably require evaluating how information from the Ecosystem Monitoring Program might be used by CCAMLR in the management of fisheries.

Standardisation of Sampling Design for Prey Monitoring

5.24 Limited progress has been made towards this important objective. However, the Scientific Committee noted the conclusions in the review of Members' responses on this topic (SC-CAMLR-VII/5):

(i) theoretically it is feasible to monitor krill in support of the predator monitoring studies agreed by CEMP;

(ii) proposed survey methods have been outlined (SC-CAMLR-VI/BG/8) which should be tested by simulation studies and also in the field; and

(iii) more information is needed on the depth distribution and degree of aggregation of krill with respect to time of day, geographical position and physical variables.

5.25 The review of hydroacoustic surveys in the Prydz Bay region, conducted during the BIOMASS Program (SC-CAMLR-VII/BG/40) provides additional relevant information on ways to improve the accuracy and precision of hydroacoustic surveys.

5.26 The main immediate requirements, in the context of prey monitoring to aid interpretation of predator parameters, are therefore:

(i) advice on appropriate survey design, frequency and duration;

(ii) standard methods for the technical elements of prey monitoring surveys about which there is general agreement (e.g. basic hydroacoustic techniques, net haul validations of targets etc.); and

(iii) results of field studies designed to investigate relationships between krill aggregations and distributions and time of day and other environmental variables.

5.27 There is also a need to continue to consider how trawl and other surveys might be used in quantitative monitoring of prey abundance.

Future Work of the Working Group for CEMP

5.28 The Scientific Committee reviewed the various tasks facing members in respect of the CEMP in order to identify the best ways of undertaking these.

Existing Approved Predator Parameters

Evaluation of Sites and Methods

5.29 (i) The Working Group for CEMP will review at its next meeting the list of selected and suggested sites where these parameters should be monitored. At that time,

consideration will be given to the comments provided by the SCAR Sub-committee on Bird Biology (SC-CAMLR-VII/12, page 14);

(ii) formal registration and protection of sites approved for monitoring predator parameters will proceed according to any procedures and guidelines established by the Commission (see paragraphs 5.12–5.16);

(iii) Members collecting data using the standard method sheets should inform the Working Group Convener of desirable improvements. He should then proceed as indicated in paragraph 5.3; and

(iv) the Working Group for CEMP will review the standard methods in the light of (iii) above and of statistical evaluations ('sensitivity' analyses) of the type indicated in paragraph 5.22 subparagraphs (i) and (ii).

Data Recording, Reporting and Analysis

5.30 (i) The draft forms developed by the Convener and Secretariat to assist members record data on approved parameters in the field (i.e. prior to summarising it on the Data Reporting Forms) should be circulated to Members for comment as soon as possible. The Working Group should revise these forms by correspondence and conduct a final review at their next meeting;

(ii) Members are requested to review, as set out in paragraphs 5.9 and 5.10, the draft formats intended for submitting data to the Secretariat. Data submission formats will be discussed and adopted by the Working Group at its next meeting; and

(iii) the Working Group for CEMP, in consultation with the CCAMLR Data Manager, will develop appropriate guidelines for the submission, validation, storage, access and analysis of data. To expedite discussions of this topic at the next meeting of the Working Group, the Data Manager was requested to consult with organisations already possessing relevant experience with these types of data and to prepare a report for the next meeting of the Working Group, proposing possible protocols for the CEMP.

Parameter Evaluation

5.31 To permit critical evaluation on the limitations of the present approved parameters, sensitivity analyses have been recommended. Members are asked to conduct the analyses outlined in paragraphs 5.22 (i) and (ii) on their own data sets and to report the results of this to the Convener, if possible in the form of a tabled paper for the next meeting of the Working Group. The Working Group Convener will consult with the Data Manager and other appropriate experts to provide Members, as soon as possible, with explicit instructions for the exact nature of the analyses required.

Directed Research

Potential Predator Monitoring Parameters

5.32 Members were reminded of the recommendation to report to the Working Group the results of evaluations of the potential for CEMP of additional monitoring parameters and the relevance of new technological advances (SC-CAMLR-VI, Annex 4, Table 4).

5.33 Members were encouraged to prepare such evaluation reports. It would be very helpful if any being prepared during the forthcoming year were made available to the Convener of the Working Group in advance of its next meeting.

Background Information Needed for Interpreting Changes in Monitored Predator Parameters

5.34 Members were encouraged to prepare reports on their research into the topics listed in SC-CAMLR-VI, Annex 4, Table 8 in advance of the next meeting of the Working Group.

Environmental Data Requirements

5.35 At its last meeting, the Working Group prepared a fairly comprehensive list of environmental data requirements to interpret predator–prey relationships (SC-CAMLR-VI, Annex 4, Table 6).

5.36 It was agreed that it would be very useful if the Working Group could start to develop appropriate standard method sheets for the environmental parameters deemed suitable to monitor now.

5.37 The Working Group should review environmental data requirements at its next meeting. To help in developing standard methods, the Convener was asked to request Members to provide information on methods currently in use to record these parameters.

5.38 The Working Group had previously noted the potential considerable value of imagery and data derived from satellite missions in providing information on environmental variability in and around the Integrated Study Regions and network sites (SC-CAMLR-VI, Annex 4, paragraph 36). It asked Dr Feldman (an invited expert to the 1986 Meeting of the Working Group) to investigate availability of appropriate environmental data (SC-CAMLR-VI, paragraph 7.13). The Working Group made a commitment to review, at its next meeting, the results of individual scientists' collaboration in this field with Dr Feldman. The Convener was asked to contact Dr Feldman to assess progress and also to make appropriate preparations for the review.

5.39 The draft plans for net sampling efficiency studies, production of which was to be co-ordinated by Dr Sherman (SC-CAMLR-VI, Annex 4, paragraph 63), should be circulated as soon as possible.

Prey Monitoring

5.40 A priority task within CEMP should be to develop prey monitoring operations to aid interpretation of predator parameters. Bearing in mind earlier discussions (paragraph 5.26), the Scientific Committee recommended the following procedure:

(i) the Working Group for CEMP should identify the characteristics of predators that need to be taken into account in prey survey design (SC-CAMLR-VII/5 provides some relevant examples);

(ii) simulation studies are likely to be particularly useful in generating advice on survey design, frequency and duration. Work including modelling krill distribution and behaviour is being undertaken within the Krill CPUE Simulation Study. The Working Group for CEMP should consult with the Working Group on Krill to develop this, and other relevant studies, to provide appropriate advice; and

(iii) the Working Group on Krill should arrange the production of standard method sheets for the technical aspects of prey surveys.

General

Co-ordination of Research in Integrated Study Regions

5.41 The report of the Convener identified a particular need for co-ordination of research between the numerous groups conducting monitoring operations at different sites (e.g. at King George Island* , South Shetland Islands) within the Antarctic Peninsula Integrated Study Region. The next meeting of the Working Group would provide a good opportunity for discussing this in detail. The Convener was asked to draw this matter to the attention of the relevant Members and to solicit suggestions on how best to proceed.

Analysis of Inter-dependence between Sampling Methods
and Results of Predator Monitoring and Changes in Prey Abundance

5.42 Earlier discussions (paragraphs 5.22 (iii) and 5.23) indicated the need to evaluate the availability of data relevant to undertaking such analyses and the probable need for simulation studies.

5.43 Members were requested to:

(i) identify precised questions relating to analyses of these types of inter-dependent relationships;

(ii) to suggest appropriate analyses for investigating these relationships;

(iii) indicate which data are needed adequately to conduct such analyses; and

(iv) indicate the extent to which such data are currently available.

The Working Group should review this information at its next meeting.

* Known in Argentina as Isla 25 de Mayo.

Relevance of CEMP to CCAMLR Management Strategies

5.44 It was noted earlier (paragraph 5.23) that CCAMLR will need to consider how information from CEMP might be used in the management of fisheries in the Convention Area. The Scientific Committee would welcome relevant advice from its working groups on this topic.

Report of the Meeting of the Steering Group of the CCAMLR/IWC
Sponsored Workshop on the Feeding Ecology of Southern Baleen Whales

5.45 The Steering Group for the Joint CCAMLR/IWC Workshop met in May 1988 in San Diego. The CCAMLR Scientific Committee was represented by Mr D. Miller (South Africa) and Dr Y. Shimadzu (Japan). Their report (SC-CAMLR-VII/BG/9) notes that the terms of reference and detailed focus of the proposed Workshop should ensure a functional evaluation of the minke whale as a potential indicator of changes likely to result from harvesting of krill.

5.46 The Scientific Committee therefore agreed that it was appropriate for CCAMLR to continue to support this Workshop.

5.47 It agreed that Mr D.Miller and Dr J. Bengtson (USA) should be appointed as the Co-conveners to represent CCAMLR in the future planning and conduct of the Workshop. The IWC have appointed Dr J.L. Harwood as their Convener.

5.48 The terms of reference of the Workshop are set out in SC-CAMLR-VII/BG/9. To fulfil these, the Steering Committee recommended that a suite of review papers and background documents (including results of commissioned analyses) should be available at the Workshop.

5.49 From the list of such requirements in the Steering Committee's report, tasks that CCAMLR is in the best position to arrange implementation of are:

(i) review of available knowledge on krill biology, particularly its summer distribution in the Antarctic, diurnal movements, swarming and other aspects of its behaviour;

(ii) review of distribution of commercial krill fishing activities and catches within the Antarctic. This should also include plots of activities and catches on as fine a geographical scale as possible and by month, by season or seasons (1972 to present combined); and

(iii) distribution of krill swarms from scientific surveys, incidental observations etc.

5.50 The comprehensive list of requirements prepared by the Workshop Steering Committee for documentation prior to the meeting included two items of particular interest of CCAMLR:

(i) analysis of body condition (blubber thickness, girth, carcass lipid content) of baleen whales in relation to food availability; and

(ii) review of annual trends in growth and reproductive rates of Antarctic baleen whales.

5.51 The Scientific Committee asked the Co-conveners:

(i) to identify the scientist(s) best able to provide the review papers indicated above; and

(ii) to consult with the CCAMLR Data Manager as to the best way of producing the appropriate data summaries.

5.52 The IWC had received an offer from the United States Southwest Fisheries Center at La Jolla to host the Workshop, which IWC requested should be held between September and November, 1989.

5.53 The Scientific Committee felt that the venue was appropriate; to avoid clashes with other meetings and activities of the Scientific Committee the Workshop should be held in early September.

5.54 The IWC had indicated that the existing financial allocations would be inadequate to cover the costs of the Workshop, especially including commissioning of appropriate review papers and analyses, the attendance of invited experts and the publication of the proceedings.

5.55 The Scientific Committee proposes to meet the cost of translating and publishing of the Report of the Workshop in sufficient numbers to meet its own needs and contribute to the cost of participation of the invited experts. Estimates of the expenditures are given in Annex 9. The USA is contributing US$15 000 in addition to covering the administration and computing costs of the Workshop.

Advice to the Commission

5.56 The Scientific Committee recommends that the Working Group for CEMP meets in 1989 and that Argentina's offer to host this meeting, which should be held at a time immediately adjacent to that of the CCAMLR/IWC Workshop on the Feeding Ecology of Southern Baleen Whales, be accepted.

5.57 The Scientific Committee draws the attention of the Commission to its advice on registration and protection of CEMP land based sites. Full details are to be found in paragraphs 5.19 and 5.20.

MARINE MAMMAL AND BIRD POPULATIONS

6.1 During the Sixth Meeting of the Scientific Committee it was agreed that it would be useful for the Committee to periodically review the status of marine mammal and bird populations in the Antarctic with particular attention to those populations whose numbers were trending upwards or downwards. This appraisal might be undertaken at intervals of three to five years.

6.2 Accordingly, a single sheet format was drawn up for summarising the status of a given species at a particular breeding locality. This format sheet was then sent to the SCAR Sub-Committee on Bird Biology, the SCAR Group of Specialists on Seals, and the Scientific Committee of the International Whaling Commission, seeking input of current information. Responses received during 1987–88 were presented at the Seventh Meeting of the Scientific Committee (SC-CAMLR-VII/9). These are discussed further in the 1988 reports of the respective SCAR groups (SC-CAMLR-VII/12).

6.3 While information sheets returned to date do not yet afford a fully comprehensive coverage of all data sources, they have stimulated interest in bringing together the various sets of long term data on the status of Antarctic seals and seabirds.

6.4 In considering these initial data, the following general comments made by the SCAR Sub-Committee on Bird Biology were of particular interest to the Scientific Committee:

(a) While most downward trends in seabird populations appear to be attributable to the direct or indirect effects of human activities, no decrease can be linked at present with commercial harvesting in Antarctic waters.

(b) In the case of the Wandering albatross (*Diomedea exulans*), the decline is probably mainly due to incidental mortality associated with fishing operations outside the Convention Area.

(c) Increases in some populations (especially of penguins) may be due to increased availability of food at sea, but the precise nature of this is uncertain and, at least for the King penguin (*Aptenodytes patagonicus*), may be compounded by recovery from previous overexploitation.

6.5 The SCAR Group on Specialists on Seals observed that the abundance of the Antarctic fur seal (*Arctocephalus gazella*) is continuing to increase throughout the species' range. Around South Georgia, the focal point of this expansion, the greatly increased numbers of wintering male fur seals, which take some fish (including *Notothenia rossii*) in their diet, might have implications for the population dynamics of these fish.

6.6 From the census data available, the population of southern elephant seal (*Mirounga leonina*) at South Georgia appears to be stable while populations of this species in the Indian Ocean sector are presently declining. In the Patagonia region and the South Shetland Islands region, fluctuations in elephant seal numbers were suggested to be linked with the El Niño Southern Oscillation event (SC-CAMLR-VII/BG/33, 34 and 35).

6.7 The SCAR Group of Specialists of Seals considered the data from surveys of seals of the Antarctic pack ice, noting in particular declines in population density values for crabeater seals (*Lobodon carcinophagus*), based on census data taken during the late 1960's and in 1983. The Scientific Committee endorses the recommendation of the SCAR Group of Specialists on Seals calling for repeated surveys of seals in selected areas of the pack ice to establish the basis for a reliable assessment of trends over a number of years. National programs were urged to take advantage of opportunities that may arise to conduct censuses of ice seals from ships cruising through pack ice area.

6.8 The Committee agreed that the value demonstrated by these initial steps in bringing together data on the status of marine mammal and bird populations in the Antarctic warranted further development of the process. It was stressed that attention should be focused upon counts made at a breeding site or defined area over a number of years under standard conditions, rather than single counts or estimates made in various seasons. The format sheet might be revised to this end.

6.9 Further consideration was given to the most practical means of extending this review of population trends. Recognising the valuable contributions made by the two sub-groups of SCAR in the initial phase, the Committee requests the Executive Secretary to thank them for the first step and to ask them if they would be prepared to continue to assemble such data on trends in Antarctic seals and seabirds and to review the material from time to time. On the understanding that both groups meet biennially, the material might be updated at their next meeting and reviewed at the following one, thus reporting to the Scientific Committee of CCAMLR within the time frame originally proposed.

6.10 The Scientific Committee of the IWC has advised that it plans to complete a major review of selected whale stocks in 1990 and will forward the results to the Scientific Committee of CCAMLR as soon as available.

CO-OPERATION WITH OTHER ORGANISATIONS

7.1 The CCAMLR Scientific Committee was represented at the following meetings during the intersessional period:

XX Meeting of SCAR, Dr J. Croxall
(SC-CAMLR-VII/12)

1988 Annual Meeting of the IWC Scientific Committee,
Dr W. de la Mare
(SC-CAMLR-VII/BG/42)

76th Statutory Meeting of ICES, Dr O. Østvedt
(SC-CAMLR-VII/BG/45)

7.2 The observers presented their reports to the Scientific Committee. Actions required of the Scientific Committee arising from these meetings are reported and discussed in detail under the relevant agenda items.

7.3 A large number of SCAR groups met in association with XX SCAR and many of these discussed items of relevance to CCAMLR. The report of the CCAMLR observer (SC-CAMLR-VII/12) summarises the highlights of the main meetings. The annexes to the report contain reports of the following meetings:

- Bird Biology Subcommittee of SCAR Working Group on Biology
- Group of Specialists on Seals
- Group of Specialists on Southern Ocean Ecology.

7.4 The attention of the Scientific Committee was drawn to some specific suggestions addressed to CCAMLR, in particular related to changes in selected species and sites of CEMP, changes in the status of existing protected sites of relevance to CEMP, proposals on monitoring the effect of plastic pollution and entanglement in marine debris on marine animals, and possible initiatives involving establishment of marine buffer zones.

7.5 It was decided that the requests by SCAR for CCAMLR to establish programs monitoring levels and effects of plastic pollution and entanglement in marine debris on marine birds and seals should be referred to the Commission.

7.6 The SCAR also established two new sub-groups on krill biology and physiology and on fish biology and physiology. Both groups were seen as entirely complementary to the CCAMLR groups.

7.7 An introduction to the BIOMASS data base gives details on the work of the BIOMASS Data Centre and its services (SC-CAMLR-VII/BG/27). The meeting of the BIOMASS Executive in September 1988 encouraged co-operation between the BIOMASS Data Centre and the CCAMLR Data Base. It was suggested that in future both data bases could work closer together or even might be merged. The Scientific Committee welcomed these opportunities.

7.8 The item of central interest in the report of the CCAMLR observer at the 1988 Meeting of the IWC Scientific Committee (SC-IWC) was the further planning of the Joint IWC/CCAMLR Workshop on the feeding ecology of baleen whales. This is described in detail in the separate documents SC-CAMLR-VII/BG/8 and SC-CAMLR-VII/BG/9 and paragraphs 5.45 to 5.55 of this report. The SC-IWC has continued its work on the Comprehensive Assessment of Whale Stocks. The planned workshop for the analyses of genetic and biochemical materials to assist in stock identification is of particular interest to CCAMLR.

7.9 A joint cruise to study Antarctic biology, the European 'Polarstern' Study (EPOS) of the European Science Foundation (ESF) was commenced in October 1988 and would continue for six months (SC-CAMLR-VII/BG/29). Seven CCAMLR members out of twelve participating countries are taking part in this study. This cruise is in three legs, studying sea-ice biota, pelagic systems and fish and benthos.

7.10 A calendar of future meetings was discussed (CCAMLR-VII/BG/16) and it was agreed that the Scientific Committee would be represented at the meetings as indicated below:

77th Statutory Meeting of ICES, Netherlands, 5–12 October, 1989
- Dr O. Østvedt

1989 Annual Meeting of IWC Scientific Committee, USA
20 May – 5 June, 1989
- Dr W. de la Mare

Meeting of the BIOMASS Executive, Spain, June 1989
- Dr J.-C. Hureau

SCAR Workshop on 'Ecology of the Antarctic Sea Ice Zone', Norway
September or October, 1989
- Dr J.-C. Hureau

EPOS-related meetings, FRG during 1989
- Dr J.-C. Hureau

REVIEW OF THE LONG-TERM PROGRAM OF WORK OF THE SCIENTIFIC COMMITTEE

8.1 The practice in the past has been for the Chairman in collaboration with the Vice-Chairmen, Conveners of the Working Groups and the Secretariat to draw up a plan of intersessional activities. Initially, this plan was introduced with the aim of assisting the Secretariat in organising its activities during the year. More recently it has included action required from the Conveners and the Chairman.

8.2 It was suggested that such a plan might also be of assistance to all Members in preparation for the annual meetings of the Committee and its subsidiary bodies. The Scientific Committee endorsed this proposal. A plan of intersessional activities for 1988/89 will be drafted after the meeting and circulated to Members within several weeks.

8.3 The Scientific Committee during its 1987 Meeting recognised the need for promoting further co-ordination of national research programs. It was agreed that the Informal Group on the Long-Term Program of Work should meet prior to the 1988 Meeting of the Scientific Committee to review 'mechanisms for ensuring that the research activities of Member countries facilitate the work of the Committee' (SC-CAMLR-VI, paragraph 11.8).

8.4 The Group met on 23 October 1988. The Convener, Dr K. Sherman (USA) presented the meeting's report (SC-CAMLR-VII/13), which was adopted with minor revisions by the Scientific Committee (Annex 8).

8.5 The Group concentrated its effort in discussing three major topics:

(i) obtaining information on national programs' research plans as they relate to CCAMLR;

(ii) co-ordination of multinational research, monitoring, and survey efforts; and

(iii) identification and prioritisation of the long-term information needs of CCAMLR (long-term strategy of the Scientific Committee).

8.6 A summary of research programs of CCAMLR Members for 1988/89, 1989/90 and 1990/91 seasons was prepared by the Secretariat on the basis of information extracted from the Members' Activities Reports. This summary was updated during the meeting of the Scientific Committee and distributed as SC-CAMLR-VII/BG/48.

8.7 It was noted that the Secretariat had experienced some difficulty in extracting information in sufficient detail from the standard reports of Members Activities. It was agreed that a more specific request would be formulated. A question was also raised as to whether national representatives to the Scientific Committee or to the Commission should be responsible for providing this information.

8.8 The Scientific Committee decided that in the future the Secretariat should circulate requests of information on planned research to national CCAMLR representatives. The request should clearly indicate which information is required for Scientific Committee purposes. The Secretariat should maintain and annually distribute a summary of national research plans.

8.9 The co-ordination of national research, monitoring and survey efforts may best be achieved by identifying research priorities more clearly. The Group suggested that it might be useful to convene a small group routinely to identify and evaluate the various proposed tasks of the Scientific Committee. Several other steps in the development and implementation of a long-term plan of work of the Scientific Committee were proposed by the Delegation of USA (SC-CAMLR-VII/BG/47).

8.10 The Scientific Committee endorsed the steps outlined in the US proposal, but noted that required activities could be taken in existing groups and did not require, at present, the establishment of new one.

8.11 A special methodology was elaborated and successfully used in the Southwest Fisheries Center (La Jolla, USA) for the elaboration of a strategic framework of long-term research plans. Dr I. Barrett (USA), Director of this Center, introduced this methodology to the Scientific Committee. Although it was not known if this methodology had been used in other international organisations, two CCAMLR meetings on krill are presently planned at La Jolla and participants of these meetings were invited to try this methodology. Additional documentation will be submitted to the Secretariat.

Conservation Strategy

8.12 The Commission's Working Group for the Development of a Conservation Strategy convened an ad hoc Technical Sub-Group to advise it on 'performance criteria for assessing different conservation strategies'. The Sub-Group reported to the Working Group which met immediately prior to the Scientific Committee. As the Working Group had not finished its work at the time of the Scientific Committee meeting, this item was not discussed.

BUDGET FOR 1989 AND FORECAST BUDGET FOR 1990

9.1 The Scientific Committee developed a proposal for the 1989 Budget and the Forecast Budget for 1990 in accordance with the recommendations made for activities during the forthcoming intersessional period. The proposed Budgets for 1989 as approved by the Commission is given in Annex 9.

ELECTION OF CHAIRMAN OF THE SCIENTIFIC COMMITTEE

10.1 Dr Y. Shimadzu (Japan), Vice-Chairman of the Scientific Committee, proposed that Dr I. Everson (UK) be elected for a second term as Chairman of the Scientific Committee. It was mentioned that the Scientific Committee had been guided successfully in the past by Dr D. Sahrhage (FRG) and the present Chairman with great scientific knowledge, experience and dedication to Antarctic research.

10.2 This motion was seconded by Dr E. Marschoff (Argentina), the other Vice-Chairman. In accordance with Rules 3 and 8 of the Scientific Committee, Dr I. Everson was unanimously re-elected for the period from the end of the Seventh Meeting until the end of the meeting in 1990.

10.3 Dr Everson expressed his appreciation for the great support he had received from the members of the Scientific Committee over the past two years and looked forward to continuing fruitful and enjoyable collaboration over the next two years.

NEXT MEETING

11.1 In accordance with discussions held during the 1987 Meeting, hotel bookings have been made in Hobart for the Eighth Meeting of the Scientific Committee and Commission for the period 5 to 18 November 1989.

11.2 It was noted that the Working Group on Fish Stock Assessment Meeting has been planned in association with the Eighth Meeting of the Scientific Committee, and is tentatively scheduled for the period 25 October to 2 November 1989.

11.3 The timing and venue of future meetings will be discussed by the Commission.

OTHER BUSINESS

12.1 The Delegation of Argentina was concerned hat a number of important background documents were not distributed prior to the meeting. This prevented national scientists discussing the papers and providing their comments to the delegation participating at the meeting.

12.2 It was decided that the Secretariat should distribute to Members all background papers which were submitted prior to the imposed deadline in advance of the meeting.

12.3 Dr G. Duhamel (EEC) noted that a number of background papers were received after the imposed deadline. Some of them were still being distributed and would not be discussed at the meeting. It was acknowledged that two of these papers were prepared during the meeting following specific requests of working groups or as the result of current discussions. The Committee encouraged the Secretariat to enforce the deadlines for submission of documents for future meetings.

12.4 Given current initiatives aimed at assessing the impact of global change (e.g. the International Geosphere Biosphere Programs, IGBP), Mr D. Miller (South Africa) proposed a future agenda item for the Scientific Committee. This would be aimed at keeping the Scientific Committee and Commission informed on developments in the monitoring of global change. The attention of the Committee was drawn to current initiatives being undertaken by the United States which are addressing the problem of ozone layer depletion.

12.5 The Scientific Committee felt it was necessary to maintain awareness of these developments and their possible effects on the environment but decided that it would be inappropriate to consider this under a separate agenda item.

ADOPTION OF THE REPORT

13.1 The Report of the Seventh Meeting of the Scientific Committee was reviewed and adopted.

CLOSE OF THE MEETING

14.1 The Chairman thanked Members and other participants, in particular the Conveners of Working Groups, rapporteurs and the Secretariat for their co-operation and support. He also extended his thanks to the interpreters and translators, and closed the meeting.

ANNEX 1

LIST OF MEETING PARTICIPANTS

LIST OF MEETING PARTICIPANTS

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Mr Peter HEYWARD
Antarctic Division

	Mr Bill DE LA MARE Special Adviser
	Dr Keith SAINSBURY CSIRO Division of Fisheries Research
	Mr Dick WILLIAMS Antarctic Division
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	Mr Roger FRANKEL Antarctic Section Department of Foreign Affairs & Trade
	Dr Raoul MIDDELMANN Australian Fisheries Service Department of Primary Industries and Energy
	Ms Judith LAFFAN Antarctic Section Department of Foreign Affairs & Trade
	Dr Geoff KIRKWOOD Principal Research Scientist CSIRO Division of Fisheries Research
	Dr Stephen NICOL Antarctic Division
	Mr Brendan DORAN Antarctic division
	Ms Sharon MOORE Antarctic Division
	Ms Linda HAY Antarctic Division
	Ms Lyn GOLDSWORTHY Representative on Non-Governmental Organisations
	Dr Andrew CONSTABLE Representative on Non-Governmental Organisations

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Adviser:	Alcides Gastão Rostand PRATES First Secretary Ministry of External Relations Brasilia

CHILE

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EEC

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	Mr Hywel DUCK Secretariat General Council of Ministers of the European Communities Brussels
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Alternate Representative:	Mr Wojciech KALUZA First Secretary Embassy of the Polish People's Republic Canberra

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	Dr Robert HOFMAN Scientific Program Director Marine Mammal Commission Washington, D.C.
	Dr Polly A. PENHALE Program Manager Polar Programs National Science Foundation Washington, D.C.
	Dr William OVERHOLZ National Marine Fisheries Service Woods Hole
	Dr Izadore BARRETT Director, Southwest Fisheries Center National Marine Fisheries Service La Jolla
	Dr. Michael TILLMAN National Marine Fisheries Service Washington, D.C.
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Dr Marc MANGEL
Department of Mathematics
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SCIENCE OFFICER	Dr Eugene SABOURENKOV
DATA MANAGER	Dr Larry JACOBSON
ADMINISTRATIVE/FINANCE OFFICER AND MEETING DOCUMENTS OFFICER	Mr Terry GRUNDY
PERSONAL ASSISTANT TO THE EXECUTIVE SECRETARY	Ms Geraldine NICHOLLS
SECRETARY	Mrs Genevieve NAYLOR
ASSISTANT DOCUMENTS OFFICER	Mrs Rosalie MARAZAS
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	Mrs Deb FRANKCOMBE
	Mrs Raewyn HODGES
	Mrs Christine WOOLFORD

ANNEX 2

LIST OF MEETING DOCUMENTS

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SCIENTIFIC COMMITTEE DOCUMENTS

SC-CAMLR-VII/1	PROVISIONAL AGENDA FOR THE SEVENTH MEETING OF THE SCIENTIFIC COMMITTEE FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES
SC-CAMLR-VII/2	ANNOTATION TO THE PROVISIONAL AGENDA FOR THE SEVENTH MEETING OF THE SCIENTIFIC COMMITTEE Chairman of the Scientific Committee
SC-CAMLR-VII/3	REGISTRATION OF MONITORING SITES Convener of the Working Group for CEMP and the Secretariat
SC-CAMLR-VII/3 Rev. 1	REGISTRATION OF MONITORING SITES Convener of the Working Group for CEMP and the Secretariat
SC-CAMLR-VII/4	REPORT OF THE SEVENTH MEETING OF THE SCIENTIFIC COMMITTEE
SC-CAMLR-VII/5	CCAMLR ECOSYSTEM MONITORING PROGRAM. MONITORING PREY I. Everson (UK)
SC-CAMLR-VII/6	REPORT ON THE KRILL CPUE SIMULATION STUDY Convener (J. Beddington)
SC-CAMLR-VII/7	WORKING GROUP FOR THE CCAMLR ECOSYSTEM MONITORING PROGRAM. REPORT IN INTERSESSIONAL ACTIVITIES IN 1987/88 Convener (K.R. Kerry)
SC-CAMLR-VII/7 Rev. 1	WORKING GROUP FOR THE CCAMLR ECOSYSTEM MONITORING PROGRAM. REPORT IN INTERSESSIONAL ACTIVITIES IN 1987/88 Convener (K.R. Kerry)
SC-CAMLR-VII/8	MATTERS ARISING FROM THE MEETING OF THE STEERING COMMITTEE FOR THE JOINT CCAMLR/IWC WORKSHOP ON THE FEEDING ECOLOGY OF SOUTHERN BALEEN WHALES D.G.M. Miller and Y. Shimadzu CCAMLR Representative

SC-CAMLR-VII/9	STATUS OF POPULATIONS OF ANTARCTIC MARINE MAMMALS AND BIRDS Australia
SC-CAMLR-VII/10	REPORT OF THE FISH STOCK ASSESSMENT WORKING GROUP (HOBART, AUSTRALIA, 12–20 OCTOBER, 1988)
SC-CAMLR-VII/11	CCAMLR AD HOC WORKING GROUP ON KRILL SUMMARY OF ACTIVITIES DURING 1987/88 AND SUGGESTIONS FOR FUTURE ACTION Convener (D.G.M. Miller)
SC-CAMLR-VII/12	REPORT OF CCAMLR OBSERVER TO SCAR 1988 Observer (J.P. Croxall)
SC-CAMLR-VII/13	REPORT OF THE INFORMAL GROUP ON THE LONG-TERM PROGRAM OF WORK FOR THE SCIENTIFIC COMMITTEE DRAFT Convener (K. Sherman)

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SC-CAMLR-VII/BG/1	SUMMARY OF KRILL CATCHES Secretariat
SC-CAMLR-VII/BG/2	SUMMARY OF FISHERIES DATA Secretariat
SC-CAMLR-VII/BG/2 Rev. 1	SUMMARY OF FISHERIES DATA Secretariat
SC-CAMLR-VII/BG/3	BIRD ISLAND MONITORING PROGRAM J.P. Croxall et al. (UK)
SC-CAMLR-VII/BG/4	BIRK ISLAND SOUTH GEORGIA ENVIRONMENTAL ASSESSMENT W.N. Bonner (UK) and J.P. Croxall (UK)
SC-CAMLR-VII/BG/5	FISH PREY OF THE WANDERING ALBATROSS *DIOMEDEA EXULANS* AT SOUTH GEORGIA J.P. Croxall et al. (UK)
SC-CAMLR-VII/BG/6	DESTRUCTION OF ANTARCTIC TERRESTRIAL ECOSYSTEM BY A RAPIDLY INCREASING FUR SEAL POPULATION R.I. Lewis Smith (UK)

SC-CAMLR-VII/BG/7	SURVEY DESIGN TO ESTIMATE KRILL ABUNDANCE DURING FIBEX I. Everson et al. (UK)
SC-CAMLR-VII/BG/8	CCAMLR ECOSYSTEM MONITORING PROGRAM. PREDATOR MONITORING PARAMETERS. DATA REPORTING SHEETS DRAFT Secretariat
SC-CAMLR-VII/BG/9	REPORT TO THE SCIENTIFIC COMMITTEE OF CCAMLR ON THE MEETING OF THE STEERING COMMITTEE FOR THE JOINT CCAMLR/IWC WORKSHOP ON THE FEEDING ECOLOGY OF SOUTHERN BALEEN WHALES D.G.M. Miller and Y. Shimadzu CCAMLR Representatives
SC-CAMLR-VII/BG/10	INTERSESSIONAL ACTIVITIES OF THE CCAMLR AD HOC WORKING GROUP ON KRILL Convener (D.G.M. Miller)
SC-CAMLR-VII/BG/11	SELECTIVITY OF STANDARD POLISH COMMERCIAL TRAWL CODENDS ON ANTARCTIC FISHING GROUNDS J. Zaucha (Poland)
SC-CAMLR-VII/BG/12	ANALYSIS AND MODELLING OF THE SOVIET SOUTHERN OCEAN KRILL FLEET M. Mangel (Invited Expert)
SC-CAMLR-VII/BG/13	KRILL AGGREGATION CHARACTERISTICS: SPATIAL DISTRIBUTION PATTERNS FROM HYDROACOUSTIC OBSERVATIONS D.G.M. Miller and I. Hampton (South Africa)
SC-CAMLR-VII/BG/14	SOME PECULIARITIES OF THE USSR KRILL FISHERY AND POSSIBILITIES TO USE FISHERY STATISTICS IN STUDIES OF KRILL BIOLOGY AND STOCKS V.N. Dolzhenkov et al. (USSR)
SC-CAMLR-VII/BG/15	PRELIMINARY RESULTS OF RESEARCH ACTIVITIES OF RV *EVRIKA* IN THE SCOTIA SEA IN JANUARY–MARCH 1988 L.I. Maklygin et al. (USSR)

SC-CAMLR-VII/BG/16	LARGE-SCALE PECULIARITIES OF PHYTOCENOSIS SPECIES COMPOSITION IN THE SURFACE AND LAYER IN THE ANTARCTIC ATLANTIC AND INDIAN OCEAN SECTORS R.R. Makarov and K.P. Federov (USSR)
SC-CAMLR-VII/BG/17	UNITED STATES SEABIRD RESEARCH UNDERTAKEN AS PART OF THE CCAMLR ECOSYSTEM MONITORING PROGRAM, 1987–1988 United States of America
SC-CAMLR-VII/BG/18	PRELIMINARY REPORT OF THE 1987–1988 NMFS ANTARCTIC MARINE LIVING RESOURCES PROGRAM MARINE MAMMAL AND BIRD FIELD RESEARCH United States of America
SC-CAMLR-VII/BG/19	PHYSICAL OCEANOGRAPHIC SETTING OF THE *SIEDLECKI* JANUARY 1987, SOUTH SHETLAND ISLAND DATA SET United States of America
SC-CAMLR-VII/BG/20	PATTERNS AND PROCESSES IN THE DISTRIBUTION AND DYNAMICS OF ANTARCTIC KRILL United States of America
SC-CAMLR-VII/BG/21	JOINT POLISH/AMERICAN HYDROACOUSTIC SURVEY OF ELEPHANT ISLAND IN THE VICINITY OF KING GEORGE ISLAND, 1988 United States of America
SC-CAMLR-VII/BG/22	STATISTICAL PROBLEMS IN KRILL STOCK HYDROACOUSTIC ASSESSMENTS United States of America
SC-CAMLR-VII/BG/23	RESULTS OF FISH STOCK ASSESSMENT SURVEY, SOUTH GEORGIA, DECEMBER 1987 – JANUARY 1988 United States of America
SC-CAMLR-VII/BG/24	SHIFTS IN THE DEMERSAL FISH COMMUNITY OF SOUTH GEORGIA United States of America
SC-CAMLR-VII/BG/25	ACOUSTIC DATA ANALYSIS AND MODELS OF KRILL SPATIAL DISTRIBUTION United States of America
SC-CAMLR-VII/BG/26	DISTRIBUTION OF PHYTOPLANKTON IN THE MIXED LAYER: IMPLICATION FOR KRILL ABUNDANCE United States of America

SC-CAMLR-VII/BG/27	INTRODUCTION TO THE BIOMASS DATABASE SCAR
SC-CAMLR-VII/BG/28	RESULTS ON AN EXPLORATORY FISHING CRUISE IN THE AREA 58.6 G. Duhamel (France) EEC Representative
SC-CAMLR-VII/BG/29	THE EUROPEAN *POLARSTERN* STUDY (EPOS) J.-C. Hureau, European Science Foundation, Member of the EPOS Management Group
SC-CAMLR-VII/BG/30	TARGET STRENGTHS OF ANTARCTIC KRILL (*EUPHAUSIA SUPERBA*) I. Everson et al. (UK, Norway)
SC-CAMLR-VII/BG/31	FORAGING ENERGETICS OF GREY HEADED ALBATROSSES (*DIOMEDEA CHRYSOSTOMA*) AT BIRD ISLAND, SOUTH GEORGIA D.P. Costa (USA) and P.A. Prince (UK)
SC-CAMLR-VII/BG/32	AUSTRALIAN RESEARCH ON ANTARCTIC BIRD AND SEAL DIETS Delegation of Australia
SC-CAMLR-VII/BG/33	THE POPULATION OF *MIROUNGA LEONINA* AT STRANGER POINT (25 DE MAYO - KING GEORGE I.) Delegation of Argentina
SC-CAMLR-VII/BG/34	ELEPHANT SEAL, *MIROUNGA LEONINA*, STOCK IDENTIFICATION USING DNA FINGERPRINTS Delegation of Argentina
SC-CAMLR-VII/BG/35	IS THE UNUSUAL PRESENCE OF *CALIDRIS FUSCICOLLIS* IN ANTARCTICA AN INDICATOR OF ENVIRONMENTAL CHANGE? Delegation of Argentina
SC-CAMLR-VII/BG/36	BIBLIOGRAPHY ON ANTARCTIC SQUID Secretariat
SC-CAMLR-VII/BG/37	A SIMULATION STUDY OF KRILL FISHING BY AN INDIVIDUAL JAPANESE TRAWLER D.S. Butterworth (Invited Expert)
SC-CAMLR-VII/BG/38	WORKSHOP ON ULTRAVIOLET RADIATION AND BIOLOGICAL RESEARCH IN ANTARCTICA Delegation of USA

SC-CAMLR-VII/BG/39	BIOMASS/CCAMLR KRILL REVIEW D.G.M. Miller and I. Hampton (South Africa)
SC-CAMLR-VII/BG/40	HYDROACOUSTIC SURVEYS OF THE DISTRIBUTION AND ABUNDANCE OF KRILL: PRYDZ BAY REGION - FIBEX ADBEX II AND SIBEX II Delegation of Australia
SC-CAMLR-VII/BG/41	REPORT OF THE WORKSHOP ON ANTARCTIC FISH AGE DETERMINATION (Moscow, USSR, 14–19 July, 1986)
SC-CAMLR-VII/BG/42	OBSERVER'S REPORT FROM THE 1988 MEETING OF THE SCIENTIFIC COMMITTEE OF THE INTERNATIONAL WHALING COMMISSION Observer (W.K. De La Mare)
SC-CAMLR-VII/BG/43	SELECTIVITY PARAMETERS FOR *NOTOTHENIA GIBBERIFRONS* LÖNNBERG, 1905 AND *CHAMPSOCEPHALUS GUNNARI* LÖNNBERG, 1905 OBTAINED DURING '8611 ANTARCTICA' EXPEDITION Delegation of Spain
SC-CAMLR-VII/BG/44	BRIEF REPORT OF THE FIFTH ANTARCTIC SURVEY CRUISE OF JFA R/V *KAIYO MARU* Delegation of Japan
SC-CAMLR-VII/BG/45	REPORT OF THE 76TH STATUTORY MEETING OF THE INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES) O.J. Østvedt (ICES)
SC-CAMLR-VII/BG/46	ASSESSMENT OF GREEN NOTOTHENIA (*NOTOTHENIA GIBBERIFRONS*, LÖNNBERG, 1905) STOCKS IN THE ANTARCTIC PENINSULA SUBAREA V.A. Boronin (USSR)
SC-CAMLR-VII/BG/47	DEVELOPMENT AND IMPLEMENTATION OF A LONG-TERM PROGRAM OF WORK Delegation of USA
SC-CAMLR-VII/BG/48	RESEARCH PROGRAMS OF CCAMLR MEMBERS FOR 1988/89, 1989/90 AND 1990/91 SEASONS Secretariat

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CCAMLR-VII/1	PROVISIONAL AGENDA FOR THE SEVENTH MEETING OF THE COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES
CCAMLR-VII/2	ANNOTATION TO THE PROVISIONAL AGENDA FOR THE SEVENTH MEETING OF THE COMMISSION Executive Secretary
CCAMLR-VII/3	PROVISIONAL AGENDA FOR THE STANDING COMMITTEE ON ADMINISTRATION AND FINANCE
CCAMLR-VII/4	EXAMINATION OF THE AUDITED FINANCIAL STATEMENTS AND APPOINTMENT OF AN EXTERNAL AUDITOR Executive Secretary
CCAMLR-VII/5	REVIEW OF THE 1988 BUDGET, DRAFT 1989 BUDGET AND FORECAST 1990 BUDGET Executive Secretary
CCAMLR-VII/6	REGISTRATION AND PROTECTION OF MONITORING SITES Convener of the Working Group for CEMP and the Secretariat
CCAMLR-VII/7	REVIEW OF EXPENDITURES Executive Secretary
CCAMLR-VII/8	SECRETARIAT STAFFING Executive Secretary
CCAMLR-VII/9	UNITED STATES ACTIVITIES RELATED TO ASSESSMENT AND AVOIDANCE OF INCIDENTAL MORTALITY OF ANTARCTIC MARINE LIVING RESOURCES United States of America
CCAMLR-VII/10	PROPOSAL TO ESTABLISH A STANDING COMMITTEE ON CONSERVATION MEASURES Delegate of the German Democratic Republic
CCAMLR-VII/11	REPORT OF THE MEETING OF THE WORKING GROUP FOR THE DEVELOPMENT OF A CONSERVATION STRATEGY FOR ANTARCTIC MARINE LIVING RESOURCES

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CCAMLR-VII/MA/2	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 SPAIN
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CCAMLR-VII/MA/4	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 USSR
CCAMLR-VII/MA/5	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 SOUTH AFRICA
CCAMLR-VII/MA/6	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 POLAND

CCAMLR-VII/MA/7	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 JAPAN
CCAMLR-VII/MA/8	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 AUSTRALIA
CCAMLR-VII/MA/9	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 FEDERAL REPUBLIC OF GERMANY
CCAMLR-VII/MA/10	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 BRAZIL
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CCAMLR-VII/MA/13	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 CHILE
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CCAMLR-VII/MA/17	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 NORWAY
CCAMLR-VII/MA/18	REPORT OF MEMBER'S ACTIVITIES IN THE CONVENTION AREA IN 1987/88 GERMAN DEMOCRATIC REPUBLIC

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CCAMLR-VII/BG/7	MEMBER'S REPORT ON ACTIVITIES ON ASSESSMENT AND AVOIDANCE OF INCIDENTAL MORTALITY OF ANTARCTIC MARINE LIVING RESOURCES 1987/88 Argentina
CCAMLR-VII/BG/8	COMPLIANCE WITH CONSERVATION MEASURES IN FORCE Secretariat
CCAMLR-VII/BG/9	SCIENTIFIC RESEARCH EXEMPTION PROVISION Secretariat
CCAMLR-VII/BG/10	REPORT ON THE ASSESSMENT AND AVOIDANCE OF INCIDENTAL MORTALITY IN THE CONVENTION AREA IN 1987/88 UNITED KINGDOM

CCAMLR-VII/BG/11	REPORT ON THE ASSESSMENT AND AVOIDANCE OF INCIDENTAL MORTALITY IN THE CONVENTION AREA IN 1987/88 REPUBLIC OF KOREA
CCAMLR-VII/BG/12	REPORT ON THE ASSESSMENT AND AVOIDANCE OF INCIDENTAL MORTALITY IN THE CONVENTION AREA IN 1987/88 USSR
CCAMLR-VII/BG/13	REPORT OF THE CCAMLR OBSERVER TO THE INTERNATIONAL WHALING COMMISSION Observer, New Zealand
CCAMLR-VII/BG/14	REPORT ON THE ASSESSMENT AND AVOIDANCE OF INCIDENTAL MORTALITY IN THE CONVENTION AREA IN 1987/88 AUSTRALIA
CCAMLR-VII/BG/15	STATEMENT FROM IOC Secretary IOC
CCAMLR-VII/BG/16	INTERNATIONAL MEETINGS OF INTEREST TO CCAMLR Secretariat
CCAMLR-VII/BG/17	REPORT OF THE CCAMLR OBSERVER TO CCAS 1988 Observer, Belgium
CCAMLR-VII/BG/18	OFFICIAL OPENING SPEECH TO THE SEVENTH MEETING OF THE COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES E. Samoteikin (USSR Ambassador Extraordinary and Plenipotentiary to Australia)

ANNEX 3

AGENDA FOR THE SEVENTH MEETING OF THE SCIENTIFIC COMMITTEE

AGENDA FOR THE SEVENTH MEETING
OF THE SCIENTIFIC COMMITTEE

1. Opening of the Meeting
   - (i) Adoption of the Agenda
   - (ii) Report of the Chairman

2. Krill Resources
   - (i) Fishery Status and Trends
   - (ii) Report of the Intersessional Work of the Ad Hoc Working Group on Krill
   - (iii) Progress Report on Simulation Study
   - (iv) Data Requirements
   - (v) Advice to the Commission

3. Fish Resources
   - (i) Fish Stock Assessment - Report of the Working Group
   - (ii) Scientific Research Exemption Provision
   - (iii) Data Requirements
   - (iv) Advice to the Commission

4. Squid Resources
   - (i) Fishery Status
   - (ii) Biological Aspects Relevant to Stock Assessment
   - (ii) Advice to the Commission

5. Ecosystem Monitoring and Management
   - (i) Report of the Convener of the Working Group for CEMP
   - (ii) Report of the Meeting of the Steering Group for the CCAMLR/IWC Workshop on the Feeding Ecology of Southern Baleen Whales
   - (iii) Data Requirements
   - (iv) Advice to the Commission

6. Marine Mammal and Bird Populations

7. Cooperation with Other Organisations
   (i) Reports of CCAMLR Representatives at Meetings of Other International Organisations
   (ii) Nomination of SC-CAMLR Observers to Meetings of Other International Organisations

8. Review of the Long-Term Program of Work of the Scientific Committee
   (i) Activities in the Intersessional Period
   (ii) Coordination of Field Activities for the 1988/89 and 1989/90 Field Seasons
   (iii) Conservation Strategy

9. Budget for 1989 and Forecast Budget for 1990

10. Election of Chairman of the Scientific Committee

11. Next Meeting

12. Other Business

13. Adoption of the Report of the Seventh Meeting of the Scientific Committee.

ANNEX 4

REPORT OF THE TASK GROUP ON EVALUATION OF EXPERTS' REPORTS ON KRILL SIMULATION STUDY

REPORT OF THE TASK GROUP ON EVALUATION OF EXPERTS' REPORTS ON KRILL SIMULATION STUDY

The Group considered the models of the Soviet krill fishery presented by Dr Mangel (SC-CAMLR-VII/BG/12) and of the Japanese krill fishery by Professor Butterworth (SC-CAMLR-VII/BG/37). Certain aspects of the models were clarified in response to questions. However, because the reports presented were very long and had only become available shortly before the meeting, full and detailed consideration and discussion of them was not possible, and was postponed to the planned future workshop as discussed hereunder.

2. The operating patterns, and hence the CPUE data, are of a different nature for the two fishing fleets considered. Japanese vessels operate independently for most of the time, and each is responsible for both finding and fishing krill aggregations. However, it does seem that krill location information is shared between the Japanese ships to some extent. In contrast, the Soviet vessels work in close co-operation; usually their fishing fleet is supported by several research vessels whose specific responsibility is location of the krill aggregations. The data from these research vessels are particularly useful for larger scale distribution studies.

3. Both papers presented used identical underlying models of the krill distribution, which consisted of a 'patches within patches' structure - specifically smaller-scale 'swarms' within larger-scale 'concentrations' of krill. The parameter values used for this distribution were derived from the FIBEX surveys. Because the majority of swarms found in the FIBEX surveys were small, a 'selectivity' effect was included in the fishing operation models of both studies so that only the larger swarms were selected by the fishery. Nevertheless, this gave rise to problems in having the model of the Japanese fishery produce output typical of real commercial operations, and it was generally felt that this might be because the fisheries operated on the larger 'layers' of krill rather than on 'swarms'.

4. The distribution of krill biomass between different kinds of aggregations (such as 'swarms' and 'layers') was noted as a possible contributing difficulty to the use of CPUE indices. There is no information available on the frequencies with which different types of aggregation occur, or how these depend on environmental or biological factors. If the relative frequencies do not change with variations in the overall krill biomass, the functional relationships deduced between krill biomass and various CPUE indices would be unaffected, though the levels of precision associated with such indices would be poorer; however, any density dependent changes in these frequencies would affect the form of these relationships, and hence the assessed utility of the various CPUE indices. The consultants suggested that

the existing models might be adjusted relatively simply to take these different aggregation types into account by multiplying the existing distribution parameter values by constant factors.

5. Both models had considered only the krill distribution in the horizontal plane, on the assumption that the mouth opening of nets was sufficient to encompass the depth range of most swarms. It was suggested that this might not be an adequate approximation where layers are concerned.

6. The meeting noted that in reality the distribution of krill that are fished by vessels are ephemeral, rather than invariant in time as assumed in the models. Temporal distributional effects had not been included in the models because of the absence of appropriate quantitative survey data to parameterise them. The manner in which the simulated vessels react to bad weather situations had been used in the models to mimic concentrations dispersion, but this procedure may not provide an adequate description of these effects.

7. Difficulties in the use of CPUE as in index of abundance are not peculiar to krill fisheries; the same difficulties have already been recognised to apply to many fisheries (particularly for pelagic schooling fish) around the world. Preliminary consideration of the results of the simulation studies suggests that it may be possible for CPUE measures to provide a good index of changes in the average abundance of krill within a concentration if searching time within and between concentrations can be distinguished (for, say, Japanese fishing vessels). Data from the Japanese vessels do not appear to be able to index changes in the number and size of krill concentrations, but this may be possible using data from Soviet research vessels.

8. It was generally agreed that all the aspects above, and also further details of the models, might be appropriately discussed in the Workshop planned to culminate these simulation studies and to produce final advice on this issue.

9. This meeting should be preceded by an exchange of correspondence on the details of the models between interested members and the consultants. This will be facilitated by the Fortran source code for one of the simulation model programs already having been made available through the Secretariat.

10. Further prerequisites for the success of Workshop were identified as follows:

(a) The krill distribution model underlying the studies may need refinement based on further analyses of existing research survey data for krill. Dr Macaulay, Mr Miller and Prof. Butterworth, and possibly other delegates, will undertake such work for presentation at the Workshop.

(b) The practicality of collection of searching time information by Japanese vessels needs examination. Dr Shimadzu will report on the results of an exercise already carried out by Japanese vessels in this regard.

(c) Information from Soviet research vessels (covering wider areas than typical fishing vessels) will be provided to Dr Mangel for analysis to be discussed at the Workshop.

11. The date and venue of this Workshop are to be determined by the Scientific Committee, but it was felt desirable to advise that:

(a) The most appropriate date is between May and August; this would allow sufficient time to circulate the report of the Workshop before the next meeting of the Scientific Committee.

(b) Computer support (mainframe) will be required at the venue so that the simulation models can be run within reasonable time periods.

(c) Financial implications of the Workshop will need to include allowance for further work by the consultants, travelling expenses, secretarial assistance, computer time and report preparation.

ANNEX 5

REPORT OF THE FISH STOCK ASSESSMENT WORKING GROUP

(Hobart, Australia, 12–20 October, 1988)

REPORT OF THE FISH STOCK ASSESSMENT WORKING GROUP

(Hobart, Australia, 12–20 October, 1988)

INTRODUCTION

The Meeting of the Working Group was held at the CCAMLR Headquarters, Hobart Australia from 12 to 20 October, 1988. The Convener (Dr K.-H. Kock, FRG) opened the meeting and the agenda (Appendix 1) was adopted. A list of those attending is given in Appendix 2. Dr J.A. Gulland was appointed as rapporteur. A list of documents considered at the meeting is given in Appendix 3.

GENERAL MATTERS

Presentation of Assessment Results

2. It was noted that standard formats had been established in other Commissions for the presentation of summary results of assessment studies (WG-FSA-88/3). These had clear advantages for both the assessment scientists and for the Commissioners. A standard format has therefore been used in this report for Subarea 48.3, and these summaries are attached as Appendix 4 of this report. For other areas it was not possible to produce summaries at this meeting, but it is planned that such summaries will be produced for all areas in the future, perhaps amended in the light of the particular needs of the Commission.

Data Availability

3. The regular information on catch and effort statistics on STALANT forms and routine biological information was received by the start of the meeting though some STALANT data were received after the 30 September deadline. Summaries of data available for the Working Group are in documents WG-FSA-88/6–12, 17–19, 27 and 25.

4. It was noted that as the database is becoming well established, it is increasingly likely that Members of the Working Group will wish to have access to the database for

intersessional work. This could raise problems of confidentiality, especially in relation to data collected by individual scientists, and not yet included in published studies. At the same time it was very important that when studies were being made for submission to CCAMLR, that the scientists concerned did have access to all relevant material in the Commission database.

5. It was then agreed that where scientists needed data for studies to be submitted to future meetings of the Working Group, data requested by them should be supplied by the Secretariat, who should inform the originators of the data that this was being done. If data are required for other purposes, e.g. for publication in scientific journals, then the Secretariat will, in response to a detailed request, supply the data only after permission has been given by the originators of the data.

6. It was stressed that it was highly desirable that anyone planning data analyses should take advantage of the Working Group meetings to inform other scientists of their plans and promote co-operation in analysis and publication between the suppliers and users of the data.

7. The FRG was going to complete the study (WG-FSA-88/14) reported to the present meeting, Australia was to make a review of *Champsocephalus gunnari*, and the UK would be studying the South Georgia stocks with particular reference to recruitment patterns and dynamics. Poland, Spain and USSR would be reviewing the mesh selectivity data.

Growth Studies

8. It was noted that problems still arose in relation to age determination, especially for *N. rossii* and this made VPA and other routine analyses difficult (see below). A paper by Prof. Radtke, (University of Hawaii) had been submitted to the 1987 Scientific Committee meeting (SC-CAMLR-VI/BG/43) but received too late for discussion. This described the use of microincrements on otoliths (daily rings), and a simple approximation to age determination based on otolith measurements.

9. Use of microincrements (daily rings) was also reported for *Pseudochaenichthys georgianus* at South Georgia (WG-FSA-88/21), by Linkowski and Traczyk (Sea Fisheries Institute, Gdynia) in a paper originally presented at the Sixth European Ichthyological Congress, giving a simple method of examining fish age by taking the weight of its otolith.

10. The use of daily rings has proved very valuable in other species of fish for which ageing by other methods has been difficult. In the case of *N. rossii* and *C. gunnari*, there appear to be discrepancies between the daily ring counts and other methods, the former tending to give the older age. It was impossible to consider this problem at the present meeting and those interested were urged to contact Prof. Radtke during the intersessional period. Approaches to be used could include direct comparisons of age determinations of the same fish and at least for *C. gunnari*, comparison with the progression of modes in the length frequencies.

11. A particular problem has arisen in respect of age/length keys for *N. rossii* and *C. gunnari* reported in some recent years. In some cases there are discrepancies between different keys reported by the same country, apparently because the age determinations have been done by different institutions. These discrepancies have made it very difficult to construct consistent series of catch at age for use in VPA and other studies. The Working Group recommends that the affected age readings be revised as far as possible to obtain consistent readings.

12. The Convener noted that the CCAMLR fish otoliths/scales/bones exchange system was progressing well (WG-FSA-88/30), and that a full report should be presented to the Scientific Committee in 1989.

Distribution of Larval Fish

13. The use of small-meshed samplers attached to bottom trawls used in research vessel surveys was reported by Slósarczyk and Wojcik (Sea Fisheries Institute, Gdynia) (WG-FSA-88/20). These had proved successful in sampling larval and post larval fish (10–30 mm), as well as some 0-group fishes. These samplers appear to provide a useful technique for examining the distribution of these sizes of fish which can be done easily during the course of routine trawl surveys. Construction of an opening and closing sampler would be very valuable in allowing samples to be taken close to the bottom without incidental catches taken in midwater. This bottom zone is normally not sampled because of the danger of damage to, or loss of, plankton nets.

Mesh Selectivity

14. Mesh Selection experiments were reported by Poland and Spain. These showed that there were big differences in the selectivity (as measured by the 50% selection length, L_{50}, or the selection factor (SF) – L_{50}/mesh size) between experiments. The differences could be largely explained by differences in the netting twine, or in the volume of catches, with thick twine and high catches reducing selectivity. This means that care should be taken in applying research results (at low catch rates, generally not more than 500 kg/hour), to commercial conditions (1–1.5 tonnes/hour or more). The selectivity values quoted here should be considered as upper limits to the selection achieved under commercial conditions. In commercial practice it is likely that fewer fish than predicted will be released by a mesh of a given size, and that a larger mesh than predicted would be needed to achieve a given selection effect. In summary, the results were as given in Table 1 (more detailed information is available in an internal working paper):

Table 1: Summary results of mesh selection experiments.

Species	Mesh Size (as measured)	L_{50} cm	SF	Mean catch/hr (kg)
C. gunnari	68	20.0	2.94	583
South Georgia	67	23.5	3.48	1 167
	88	23.0	2.56	970
	124[b]	(21–23)[a]	(1.77)	NA
	125[b]	(21–29)[a]	(1.68–2.32)	NA
S. Orkneys	68	21.3	3.11	87
	125[b]	32	2.56	NA
Elephant Island	68	21.3	3.11	121
and S. Shetlands	88	28.0	3.22	241
	110	31.1	2.82	369
	68	19.7	2.89	70
P. br. guntheri				
Shag Rocks	67	20.0	2.97	1 163
N. gibberifrons	68	19.5	2.87	556
S. Georgia	88	18.2	2.02	971
	124[b]	(30)[a]	(2.42)	NA
S. Orkneys	68	20.8	3.04	81
Elephant Island	68	19.6	2.86	121
and S. Shetlands	68	18.4	2.70	69
	88	19.8	2.28	241
	88	25.0	2.88	750
	110	31.2	2.84	241
	110	23.6	2.10	993
	110	29.4	2.64	8
	124[b]	(16–20)[a]	(1.3–1.6)	NA
C. aceratus	68	(17.9)[a]	(2.63)	615
S. Georgia	88	20.6	2.29	966
	124[b]	(17.5)[a]	(1.41)	NA
	125[c]	(21.0)[a]	(1.75)	NA
S. Orkneys	68	(15.2)[a]	(2.22)	82
	125[c]	(21)[a]	(1.68)	NA
Elephant Island	88	21.5	2.48	241
and S. Shetlands	110	23.0	2.09	434
	124[b]	(20–26)[a]	(1.61–2.1)	NA

[a] selection curve not well defined
[b] with thick twine
[c] chafer

15. For *C. gunnari* the mean SF for the eight experiments with normal twine and no chafer is 3.01; though other factors can be derived by making more adjustments for differences in catch rate, length of tow, stock structure, etc., this appears to be a reasonable estimate for research conditions of low catch rates.

16. For *P. br. guntheri* only one value is available, but this probably gives an acceptable estimate of the selection factor. For *C. aceratus* estimates of selection factor are highly variable, and no clear conclusion can be reached. There are also doubts concerning some of

the values for *N. gibberifrons*, but the selection factors are less variable; the mean of all ten observations with normal twine without chafer is 2.62.

STATISTICAL AREA 48

Subarea 48.3 (South Georgia)

17. The history of the catches in the South Georgia region is given in Table 2. This shows clearly how fishing effort has been switched from one species to another, leading to high variability in annual catches. The 1988 catch was slightly below that in 1987, principally because of a drop in catches of *C. gunnari* in line with the Commission's recommendations.

Notothenia rossii

18. The Commission's recommendations have aimed to keep the catches of this species to as low a level as possible. Reported catches in 1987/88 fell to 197 tonnes, just below the 1987 level.

19. This stock remains at a very low level. The biomass estimated by joint US/Polish research surveys fell from just under 4 000 tonnes in 1986/87 to 1 000 tonnes in 1987/88, though earlier surveys by Spain and FRG gave higher values (11 471 tonnes in 1986/87 and 12 781 in 1984/85 respectively). The differences between surveys and the great apparent drop between 1986/87 and 1987/88 are not easy to explain but may be related to the patchy distribution of this species. However, the surveys are consistent in showing extremely low stock levels compared with those at the beginning of the fishery.

Table 2: Catches of various finfish species from Subarea 48.3 (South Georgia Subarea) by year. Species are designated by abbreviations as follows: TOP (*Dissostichus eleginoides*), NOG (*Notothenia gibberifrons*), NOR (*Notothenia rossii*), NOS (*Notothenia squamifrons*), NOT (*Patagonotothen brevicauda guntheri*), SSI (*Chaenocephalus aceratus*), ANI (*Champsocephalus gunnari*), SGI (*Pseudochaenichthys georgianus*) and LXX (*Myctophidae spp.*).

Split -year	TOP	NOG	NOR	NOS	NOT	SSI	ANI	SGI	LXX	OTHERS	TOTAL
1970	0	0	399 704	0	0	0	0	0	0	0	399 704
1971	0	0	101 558	0	0	0	10 701	0	0	1 424	113 713
1972	0	0	2 738	35	0	0	551	0	0	27	3 351
1973	0	0	0	765	0	0	1 830	0	0	0	2 595
1974	0	0	0	0	0	0	254	0	0	493	747
1975	0	0	0	1 900	0	0	746	0	0	1 407	4 053
1976	0	4 999	10 753	500	0	0	12 290	0	0	190	28 732
1977	441	3 357	7 945	2 937	0	293	93 400	1 608	0	14 630[a]	124 611
1978	635	11 758	2 192	0	0	2 066	7 557	13 015	0	403	37 626
1979	70	2 540	2 137	0	15 011	464	641	1 104	0	2 738[b]	24 705
1980	255	8 143	24 897	272	7 381	1 084	7 592	665	505	5 870	56 664
1981	239	7 971	1 651	544	36 758	1 272	29 384	1 661	0	12 197[c]	9 167
1982	324	2 605	1 100	812	31 351	676	46 311	956	0	4 901	89 036
1983	116	0	866	0	5 029	0	128 194	0	524	11 753[d]	146 482
1984	109	3 304	3 022	0	10 586	161	79 997	888	2 401	4 274	104 742
1985	285	2 081	1 891	1 289	11 923	1 042	14 148	1 097	523	4 238	38 517
1986	564	1 678	70	41	16 002	504	11 107	156	1 187	1 414	32 723
1987	1 199	2 842	216	183	8 810	337	71 141	119	1 102	1 910	87 859
1988	1 809	5 219	197	1 560	13 424	312	34 573	397	14 868	1 456	73 815

[a] Includes 13 724 tonnes of unspecified fish caught by the Soviet Union
[b] Includes 2 387 tonnes of unspecified Nototheniidae caught by Bulgaria
[c] Includes 4 554 tonnes of unspecified Channichthyidae caught by the Federal Republic of Germany
[d] Includes 11 753 tonnes of unspecified fish caught by the Soviet Union

20. Uncertainties on recent age determinations have made it difficult to carry the VPA calculations beyond about 1984/85, but the analysis up to that time, and the low survey biomass estimates confirm the picture of a very low stock. This is related to a very low level of recruitment. Year-class strength as measured at 2 years old seems to have dropped in two rather abrupt steps – from around 50 million individuals annually for the stock observed at the beginning of the fishery, to some 8–10 million fish annually for the year-classes born between 1968 and 1975, and then to 3 to 4 million. The timing of these drops does not coincide exactly with the drops in adult stock caused by the big pulses in fishing.

21. Though the reduction in adult stock must be having an effect on recruitment other factors may be acting, perhaps by increasing the mortality on larval or pre-recruit fish. Until some of the uncertainties concerning recruitment are removed it is difficult to predict the quantitative effect on future recruitment of changes in adult stocks.

22. In view of the uncertainties about this stock it is important that its status should be carefully monitored. This can be done by regular research surveys, but these need to be carefully designed to take account of the highly patchy distribution of the adults, and the fact that the younger year-classes are distributed inshore.

Champsocephalus gunnari

23. Catches in 1987/88 were 34 573 tonnes, just below the catch limit of 35 000 tonnes, and less than half the 71 000 tonnes taken in 1986/87. One trawl survey was carried out, by the joint US/Polish expedition (SC-CAMLR-VII/BG/23), and gave a biomass of 16 533 tonnes in December 1987/January 1988, compared with an estimate of 52 672 tonnes for the similar survey in the same period of 1986/87. Because a bottom trawl with a vertical opening of 4 m was used, it is probable that this underestimates the true biomass.

24. Catch and effort statistics from the Soviet fisheries are available since 1982/83 and these allow an index of abundance to be calculated. These calculations were based on the monthly figures reported on STALANT B forms, and were limited to those months for which *C. gunnari* made up at least 75% of the catch, i.e. was the main target species. The resulting indices of abundance, calculated as the mean of the monthly catch per hour, (in tonnes), for bottom and mid-water trawls, were as follow (bracketed figures are those based on only one month's data, which are probably less reliable).

Season	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88
OTM	3.85	3.32	(2.19)	(2.20)	4.75	2.73
OTB	7.12	5.42	(4.44)	no data	2.73	1.99

25. The decline in the index based on the midwater trawl is less than that based on the bottom trawl. It is probable that the bottom trawl index is the more reliable in the early seasons because the midwater trawl technique was still being developed for use of *C. gunnari*. In the most recent years the midwater trawl technique has been well established and the bulk of the catch was taken in midwater trawls. Both series agree in showing a substantial decline (by 43% for midwater and 27% for bottom trawl) between 1986/87 and 1987/77.

26. Catch at age data show that catches in the last two seasons have been provided largely by the 1985 year-class, with a smaller contribution by the 1984 year-class, and older fish have been very scarce. These two year-classes have been largely fished out.

Effects of Uncertainties in Natural Mortality

27. Yield per recruit calculations show that considerable improvements in yield can be achieved by allowing the fish of grow to a larger size. This can be seen by considering the changes in the total biomass of a cohort in the absence of fishing.

Age	1	2	3	4	5	5	6
Fish weight (g)	15	72	152	314	438	571	616
Cohort biomass	(kg per 1 000 recruits at age 1)						
M = 0.40	15	48	68	95	88	77	56
M = 0.35	15	51	76	110	108	100	75
M = 0.25	15	56	92	148	161	163	137

28. Because of the uncertainties that surround the value of the natural mortality, three values were used – 0.35 (as used on the VPA's) and 0.4 and 0.25. These do affect the detailed conclusions, changing the age at which a cohort would achieve its greatest weight from age 4 (if M=0.40) to 6 (if M=0.25). However, in all cases there is a considerable increase in the biomass up to age 4. Thus if a cohort is harvested predominantly at ages 2 and 3 (as was the case for the recently recruited classes), the yield is greatly reduced compared with that if it were taken at higher ages (4–6). The gain, as between harvesting at 3 (76), and 4 (110) for M=0.35 is some 45%. Since the actual catches in the two seasons was over 100 000 tonnes, the gain as compared with harvesting the same year-classes two years earlier, could be around 40 000 tonnes.

Calculations of Yield per Recruit

29. The results of fishing with different ages at first capture can also be presented, for M=0.35, in a more usual table showing yield per recruit as a function of fishing mortality and age at first capture. This is shown in the table below, calculated from the Thompson and Bell model, using ages up to 10.

Fishing Mortality	Age at first capture[(a)]			
	2	3	4	5
1.4	.074	.104	.135	.130
1.2	.076	.105	.133	.127
1.0	.079	.107	.131	.124
0.8	.083	.108	.127	.119
0.7	.085	.108	.125	.115
0.6	.087	.108	.121	.110
0.5	.089	.106	.116	.105
0.4	.089	.103	.109	.097
0.3	.087	.096	.098	.085
0.2	.079	.082	.081	.069
0.1	.056	.056	.052	.044
Value of $F_{0.1}$	.245	.326	.455	.554

[(a)] assuming knife-edged recruitment

30. The pattern of fishing has varied considerably from year to year, but the fishing mortality has been often high (1.0 or even more), with the effective age at fist capture between 2 (as in 1981 and 1985) and 3. These values are underlined in the table. It will be seen that considerable increases in yield per recruit can be achieved by increasing the effective age at first capture. Reducing the fishing mortality will increase the yield per recruit slightly, but will bring other benefits (reduced variability in the annual catches, and the possibility of substantially reduced costs).

Control of the Age at First Capture

31. The degree to which the age at first capture should be increased depends on the level of fishing mortality, but unless there are very substantial reductions in F, the optimum would be 4 years (i.e. around 32 cm, Kock et al., 1985). One standard way of achieving this change is to introduce a larger mesh. Earlier it was shown that under conditions of low catch rates, the selection factor is about 3.0, i.e. a 80 mm mesh corresponds to a mean size at first capture of 24 cm, which is above the mean length at first maturity, but well below the optimum size based on the yield per recruit analysis. A length at first capture of 32 cm would require a 107 mm mesh. However, as suggested earlier, it is possible that under commercial conditions of large catches the selectivity of the net may be much less, so that a correspondingly larger mesh would be required to achieve the desired result. The Working Group did not have the information to quantify the effect of any reduced selectivity at high catch rates.

32. If the use of a mesh size substantially bigger than the present 80 mm does not result in an appreciable increase in the effective size at first capture, then there may be other ways of achieving a broadly similar result. The recruitment is highly variable, so if fishing effort is kept low when a strong year-class is entering the fishery (i.e. is 2 and 3 years old), and is allowed to increase only when the fish are 4 years old, this would allow considerable protection to the young fish of those strong year-classes. Also to the extent that the fishery can target on the more abundant age groups, it should also give some protection to the young fish in the weaker year-classes. Such a consideration would give support to the policy, when setting TAC's, if taking a conservative view of the strength of incoming year-classes. If they turn out to be strong, TAC's in later years can readily be adjusted upwards.

33. Another method, used in the fishing for some species around Kerguelen, is to set a minimum fish size, with the requirement that any incidental catches of undersized fish should be discarded. The Working Group did not have time to evaluate this method.

VPA Calculations

34. Two sets of VPA's were run, using Soviet and Polish age-composition data. The former set was based on the Soviet report (WG-FSA-88/32), and no attempt was made to modify the tuning methods reported in that document to take account of survey and other information. The VPA using Polish data was tuned to the 1987/88 biomass estimate from the joint Polish/US survey.

35. In using the Polish/US survey data it had to be recognised that the use of a bottom trawl gave rise to figures that are underestimates of the true biomass. Assuming that the degree of underestimation was consistent from year to year, the survey biomass estimate of 16 533 tonnes for 1987/88 was increased by a factor of 2.85, the ratio of the 1986/87 survey estimate (52 670 tonnes) to the biomass of 150 000 tonnes agreed by the Working Group at its 1987 meeting based on the Spanish survey in 1986/87 (Balguerias et al., 1987). The resulting figures of biomass at different times were then as follows:

Date	Survey	VPA (Polish data)	VPA (Soviet data)[a]
July 1986		139 565	128 677
Dec 86/Jan 87	150 000		
July 1987		69 836[b]	67 158
Dec 86/Jan 87	47 082		
July 1988		31 377[b]	53 109[c]

[a] Run made in CCAMLR, and differs slightly from original Soviet figures

[b] The 1988 figure, and to a lesser extent, the 1987 figure is too low because no allowance was made for recruitment

[a] Assuming a low level of recruitment of 400 million fish

36. The stock at the beginning of the 1988/89 season was estimated directly from the survey data, using the age-frequencies observed in the surveys, and adjusting the actual numbers of age to match the corrected figures of biomass. Using this method the only assumption that had to be made about recruitment was that the age 1 fish were properly represented in the surveys. To the extent that they are under-represented, the biomass estimates will be too low. This method gave the following estimates of exploitable biomass in July 1988:

(i) based on 1986/87 survey 65 792 tonnes
(ii) based on 1987/88 survey 48 023 tonnes

37. Bearing in mind that the approaches are largely independent the degree of agreement is encouraging, with the Soviet figure being roughly the central estimate. However, all estimates of current biomass are subject of uncertainties concerning the level of recruitment.

Calculation of TAC

38. To produce an estimate for a TAC for 1988/89 several estimates of $F_{0.1}$ were available depending on the vector of F at age, and also on the values of weight at age used. After some discussion the Working Group agreed to use values of $F_{0.1} = 0.313$, and $F_{max} = 0.645$ derived from data given by Borodin and Kochkin (WG-FSA-88/32); these differ slightly from those given in the earlier table, but the difference is not large. The corresponding values of TAC for 1988/89, applied to the Soviet estimate of biomass are:

for $F_{0.1}$ 10 194 tonnes
F_{max} 18 586 tonnes

It was noted that because the fish concerned are small, uncertainties in recruitment will have little effect on these estimates.

Long-Term Management Plans

39. The Working Group stressed that management policy should not be focussed narrowly on the level of catch in the following year, but should give priority to ensuring the long-term productivity of the resource. It drew attention to Figures 3a-3c (SC-CAMLR-VI, Annex 5), which illustrated how reduced levels of fishing mortality gave much improved spawning stock abundance, while, except in the short-term, the reduction in catch would be small. When the stock is currently at a low level, there are a number of alternative strategies, in addition to those involving different constant level of F. For example, F may be kept at a very low level for a number of years (e.g. 5) until the stock is well re-built, and thus increased, to the long-term target. Figure 1 shows the trajectory of relative stock size for three strategies applied to a stock currently at a low level (such as the 1988 *C. gunnari* stock), using an average value of recruitment of 562 million. These strategies were:

$F_{0.1}$; F_{max}; and a low F for 5 years, followed by $F=F_{0.1}$

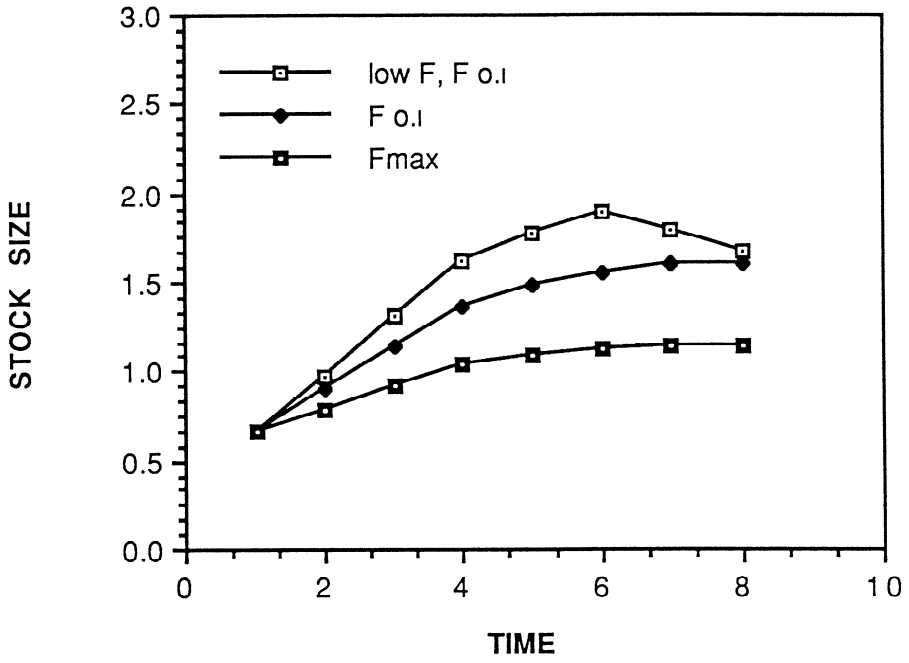

Figure 1: Long-term stock size forecast to compare the effect of different management strategies

Research Requirements

40. The most important research work for management purposes is to obtain early estimates of the strength of incoming cohorts. Since the 0-group is largely pelagic this would require surveying with a mid-water trawl and such surveys are now of high priority. To be of significant value, they would need to be continued over a series of years. The Group noted that a number of bottom trawl surveys have been carried out which have the potential for producing indices of recruitment, which could be calibrated with VPA results, or midwater trawl surveys.

41. At its 1987 Meeting the Commission had requested advice for *C. gunnari* on, *inter alia*, the effect of closed seasons and/or areas to protect young fish and reduce by-catch. The Working Group had no new data concerning this matter which would suggest alterations to the present closed area and closed seasons in Subarea 48.3.

Patagonotothen br. guntheri

42. This is a small species only caught in significant quantities by a directed Soviet fishery in the Shag Rocks area.

43. Length and age data are available for most years. These indicate that the fishery has been largely based on ages 2–4, and there is little indication of much change in age composition during the period. This would suggest a relatively high value of natural mortality, with a moderate or low fishing mortality. An estimate of biomass of 81 000 tonnes is available from the Spanish survey (Balguerias et al., 1987) carried out in 1986/87, and this could help fix the terminal value of F for VPA calculations.

44. Problems were met in calculating VPA's in setting an appropriate value of M, and in the catch-at-age data, where there are some differences between reported data sets. A value of M=0.90 has been used in the Soviet report (WG-FSA-88/33), while Kock and Koester (WG-FSA-88/14) used different catch-at-age data and values of M=0.35 (from Pauly's 1980 equation) and M=0.55 (from a Soviet publication in 1984). It was felt that a value of M as low as 0.35 was not consistent with the observed age-composition at the beginning of exploitation, while M=0.9 seemed rather high. It was not possible in the time available to re-calculate VPA's, but using the variation of fishing mortality with age found in the Soviet report, yield per recruit calculations were made with alternative values of M. This gave the following estimates:

M	0.35	0.55	0.7	0.9
$F_{0.1}$	0.58	0.79	1.04	1.54
F_{max}	1.51	>3	>3	>3

45. In the absence of better estimates of M it is not possible to suggest a TAC that would achieve $F_{0.1}$. An alternative policy, which would serve to ensure that fishing did not expand to an excessive degree might be to limit catches to around the level of recent years.

Research Requirements

46. It would be desirable to recalculate the VPA's tuning them to the biomass estimates, and to examine the early age-composition data to produce a better estimate of M.

Notothenia gibberifrons

47. Moderate catches of this species have been taken in nearly all years, with a peak of over 11 000 tonnes in 1978. There is a suggestion of a decline, with average catches of 6 200 tonnes and 3 000 tonnes in successive 5-year periods, but the 1988 catch was well above the recent average.

48. Catch-at-age data have been estimated from commercial length frequencies and age-length keys for all years up to 1985. This has enabled VPA analyses to be run up to 1985, but the absence of commercial length-frequency data for the 1986, 1987 and 1988 seasons have made it impossible to bring the analyses more up to date. The simple examination of the catch-at-age data shows a very big shift from a fishery based on old fish (mostly over 12 years old) in 1976, to one consisting of younger fish, mainly 7 to 10. This presumably indicates a substantial impact of fishing.

VPA Calculations

49. In previous VPA analyses a value of M=0.25 had been used, but such a high value appears inconsistent with the presence of so many old fish in the early years of the fishery, and the VPA calculations were repeated using M=0.125. These two values of M implied different patterns of fishing mortality with age. For M=0.25 it was assumed F increased linearly from 0 at age 1 to full recruitment at age 10. For M=0.125 F increased from 0 at age 1 to full recruitment at age 7.

50. Three estimates of biomass are available from surveys – 15 762 tonnes from an FRG survey in 1984/85, and 13 129 and 7 798 tonnes from Polish/US surveys in 1986/87 and 1987/88. The VPA calculations were tuned to the 1984/85 survey data, and the resulting projections, using median levels of recruitment, for M=0.125 gave a better agreement with the later surveys than those for M=0.25. Using the values of M=0.25 implied that the year-classes supplying the large catches of old fish at the beginning of the fishery must have been distinctly larger than those in recent years, and that there has been a large decline of biomass. Using M=0.125 gives more reasonable results, but still indicates that the stock has been very heavily fished, and that the 1988/89 level is only some 17% of the initial value. The spawning stock biomass has been reduced still more, to some 12% of the initial level.

Management Policies

51. In the long-term, holding the fishing mortality at $F_{0.1}$ would allow the stock to recover to levels at which annual catches (assuming average recruitment) could be maintained at some 2 400–2 900 tonnes annually (for M=0.25 and M=0.125 respectively). Recovery to these levels would take some 30 years, but stock abundance, and annual catches would recover to some 90% of the long-term value within 10–15 years.

52. Yield per recruit calculations indicate that $F_{0.1}$=0.209 (if M=0.25) or 0.0935 (if M=0.125). Corresponding F_{max} values are 0.425 and 0.157 respectively. Recent values of F have been in excess of these values.

53. Recruitment does not seem to have varied greatly so short-term projections using average values of recruitment for the incoming year-classes are probably reasonable. TAC's for 1988/89 to achieve $F_{0.1}$, based on projections of the VPA outputs would be as follows:

	$F_{0.1}$	F_{max}
if M = 0.25	TAC = 259 tonnes	450 tonnes
if M = 0.125	TAC = 443 tonnes	720 tonnes

(Note that though the assumption of M=0.125 implies a lower value of $F_{0.1}$, the TAC is higher because the VPA calculations result in a higher estimate of current biomass). Since *N. gibberifrons* is taken largely as a by-catch, implementation of a TAC could raise problems. These problems are discussed in paragraph 65 below.

Research Requirements

54. Data on commercial length frequencies and age-length keys are required for recent years. Surveys should be continued to monitor the stock.

Pseudochaenichthys georgianus

55. Appreciable catches of this species have been taken in only one year (13 000 tonnes in 1977/78). Otherwise it is only a by-catch. Surveys in 1984/85 (by FRG) and in 1986/87 and 1987/88 (joint Polish/US surveys) have provided estimates of biomass between 4 600 and 11 400 tonnes. Some of this variation is probably due to the substantial variation in year-class strength, as indicated by the length-frequency data which covers most years.

56. No VPA analyses have been attempted, but yield-per-recruit calculations have been presented by Kock et al. (1985) and these indicate a value of $F_{0.1}$ of around 0.3. To achieve this in 1988/89, using a mean biomass of 8 000 tonnes from the survey data, would require a catch of some 1 800 tonnes.

Chaenocephalus aceratus

57. Catches have been small in all years, with a maximum of 2 000 tonnes in 1977/78, nevertheless small catches, probably taken incidentally haven been reported in most years. The biomass is also small, with estimates of 10 820 tonnes and 6 600 tonnes being obtained from the joint Polish/US surveys in 1986/87 and 1987/88 respectively and 11 542 tonnes in FRG survey in 1984/85. There is some indication of a change in size compositions during the history of the fishery, with larger fish becoming less frequent. This is consistent with there being a moderate impact of fishing, as is also indicated from the ratio of mean annual catch to mean biomass (about 0.08).

58. No VPA calculations have been attempted, but yield per recruit calculations have been published by Kock et al. (1985). These indicate values of $F_{0.1}$ of 0.15 (for females) and 0.18 (for males). Applying these to the mean biomass estimates from the surveys (8 000 tonnes) gives a TAC for 1988/89 of some 1 100 tonnes.

Subarea 48.1 (Peninsula) and 48.2 (S. Orkneys)

59. Fishing in Subareas 48.1 and 48.2 have been only sporadic and recent catch levels have been low (Tables 3 and 4). Of the species that have supplied significant catches in the past, no catches of *N. rossii* were reported in any of the last three seasons, and only very small catches of *C. gunnari*. No new assessments were attempted of these stocks.

Table 3: Catch by species in Subarea 48.1

	Notothenia rossii	*Champsocephalus gunnari*	Pisces nei	Total
1979	470	35 930	15 797[1]	52 197
1980	18 763	1 087	6 301[2]	26 151
1981		1 700	4 316[3]	6 016
1982				
1983		2 604	16	2 620
1984				
1985				
1986				
1987		75	62	137
1988			2	2

[1] Mainly *C. wilsoni* and *N. gibberifrons*
[2] Mainly *C. wilsoni*
[3] Unknown species

Table 4: Catch by species in Subarea 48.2

	Notothenia rossii	*Champsocephalus gunnari*	*Notothenia gibberifrons*	Pisces nei	Total
1978	85	138 895	75	2 607	141 662
1979	237	21 439	2 598	3 250[1]	27 524
1980	1 722	5 231	1 398	6 203[2]	14 554
1981	72	1 861	196	3 274	5 403
1982		557	589	2 211	3 357
1983		5 948	1	12 463[3]	18 412
1984	714	4 499	9 160	1 583	15 956
1985	58	2 361	5 722	531	8 672
1986		2 682	341	100	3 123
1987		29	3	3	35
1988		1 336	4 469		5 805

1 Mainly *Champsocephalus gunnari*
2 *Pseudochaenichthys georgianus* and unidentified Nototheniids and Channichthyids
3 Unknown species

60. The only species with significant catches was *N. gibberifrons* with 4 469 tonnes reported from Subarea 48.2 in 1987/88 and a new assessment was attempted using VPA.

61. The database is poor, but sufficient length data and age-length keys were available to estimate the annual catch-ag-age, with interpolation being needed in some years. A survey in 1984/85 season gave an estimate biomass of 12 000 tonnes. Unfortunately, no age or length data were available for the 1987/88 catches. In the VPA the same values of M (0.25 and 0.125) and patterns of fishing mortality with age were used as in South Georgia; and the runs were tuned to the 1984/85 biomass.

62. Projection of the stock to 1989 using median recruitment gave the following results:

Value of M	Stock in 1979		Stock in 1989		Ratio	
	Total	Spawning	Total	Spawning	Total	Spawning
0.125	12 472	5 992	13 515	8 526	1.08	1.42
0.250	20 442	11 733	11 571	4 319	0.57	0.37

These results do not indicate any severe impact of fishing since exploitation started in 1979, especially if natural mortality is low.

63. Yield-per-recruit calculations gave the following results:

	If M=0.125	If M=0.25
$F_{0.1}$	0.108	0.248
F_{max}	0.186	0.515
Mean F (1979–1985)	0.31	0.177

(Although mean F in the period was greater than F_{max}, the effective cessation of fishing in 1985/86 and 1986/87 would have allowed some recovery.)

Research Requirements

64. To provided improved assessment of this stock age and length data from the most recent catches are needed. Another survey, to provide an up-to-date estimate of biomass is also desirable.

General Consideration on the Application of TAC's

65. At both South Georgia and Kerguelen several species are taken in significant quantities as by-catch in fisheries directed at other species. When, as in the case of *N. rossii*, these catches may be comparable with, or even exceed, the desirable TAC for the by-catch species there can be several problems. Restricting the directed fishery on some less heavily exploited species (e.g. *C. gunnari* when a good year-class is present) could lead to losses in the catches of the target species. There has therefore to be some kind of trade-off. If the by-catch is of a species that potentially, once the stock has been rebuilt, can supply substantial catches (e.g. N. *rossii*) some restrictions and losses to the targeted fishery on other species should be accepted as a sound investment for the future. Conversely, if the by-catch species is never likely to provide very large catches (e.g. *N. gibberifrons*) some excess over the desired TAC may have to be accepted in order to optimise the directed fishery on the more valuable species, provided that this does not lead to further significant depletion of the stock.

STATISTICAL AREA 58

Introduction

66. In this area fishing takes place only in Subareas 58.4 and 58.5.

67. No results from mesh selectivity investigations are available for Statistical Area 58. Such results are necessary to formulate recommendations for management of the basis of the yield-per-recruit analyses of the major stocks.

68. A summary of catches reported from Area 58 is given in Table 5. It will be seen that up to the 1979/80 season very few data are available that give the subarea of capture. From that time onwards reported catches have been largely from Division 58.5.1 (Kerguelen), with small catches of *N. squamifrons* from Division 58.4.4 (Ob and Lena Banks). Detailed analyses have therefore been restricted to those stocks, but some information is available from other subareas, which are discussed first.

69. A recent exploratory survey in Subarea 58.6 (Crozet) (SC-CAMLR-VII/BG/28) indicates that stocks of *N. squamifrons* and *N. larseni* do not contain fish of commercially exploitable size. Two small concentrations of *D. eleginoides* were found but do not appear to be sufficiently large to support a direct fishery. It is recommended therefore that Subarea 58.6 should remain closed to all fishing and that in the interest of obtaining information on an essentially unexploited stock another survey should be undertaken in 5–6 years time.

70. As far as 58.7 (Prince Edward Islands) in concerned, it was noted that South Africa will probably undertake an exploratory fishing survey around the Prince Edward Islands within the next two years. It was agreed that such a survey would be important for the determination of natural mortality in what have been hitherto unexploited stocks.

Table 5: Total catches by species and subarea in Area 58. Species are designated by abbreviations as follows: TOP (*Dissostichus eleginoides*), NOR (*Notothenia rossii*), NOS (*Notothenia squamifrons*), ANS (*Pleuragramma antarcticum*), ANI (*Champsocephalus gunnari*), LIC (*Channichthys rhinoceratus*), MZZ (Unknown), SRX (*Rajiformes spp.*).

Split	TOP				NOR			NOS			ANS		ANI			LIC	MZZ			SRX
Year	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	58	58.4	58.5	
1971	XX				63636			24545					10231				679			
1972	XX				104588			52912					53857				8195			
1973	XX				20361			2368					6512				3444			
1974	XX				20906			19977					7392				1759			
1975	XX				10248			10198					47784				575			
1976	XX				6061			12200					10424				548			
1977	XX				97			308					10450				11			
1978	196	-	2	-	46155			31582		98	234		72643		250	82	261			
1979	3	-	-	-				1307					*101				1218			
1980		56	138	-			1742		4370	11308				*14	1631	8		239		
1981		16	40	-		217	7924		2926	6239					1122	2		375	21	
1982		83	121	-		237	9812		785	4038		50			16083			364	7	
1983		4	128	17			1829		95	1832		229			25852			4	17	1
1984		1	145	-		50	744		203	3794					7127				**611	17
1985		8	6677	-		34	1707		27	7394		966		*279	8253			11	7	4
1986		8	459	-		-	801		61	2464		692		*757	17137					3
1987		34	3144	-		2	482		930	1641		28		*1099	2625			22		
1988		4	554	488		-	21		5302	41		66		*1816	159					

* Probably wrong identification (might be *C. wilsoni*)
** Mainly RAJIDS

NB Before 1979/80 catches reported in Area 58 mainly concern Division 58.5.1 (Kerguelen Subarea)

Subarea 58.4

71. It was agreed that reporting of catches of *P. antarcticum* in Subarea 58.4 were not sufficiently detailed to establish where such catches were taken and whether these were from one or more stocks. Both fine-scale reporting and analysis of catch levels is needed to establish the distribution of *P. antarcticum* stocks in Subarea 58.4 as a whole. Some reported catches in 1985 and 1986 indicate that a fishery is beginning for the species but available data are insufficient to assess stocks.

72. The review of available catch statistics for Division 58.4.1 and 58.4.2 indicated that certain Channichthyids may have been incorrectly reported. For example, it is probable that fish reported as *C. gunnari* for 1980 and for 1985 to present in the catch summaries (SC-CAMLR-VII/BG/2, pp 64–66) for Subarea 58.4, were *C. wilsoni*. It is therefore recommended that care should be taken in the future to report catches by species correctly.

73. Additional data on all exploited stocks of Channichthyids (see Table 3) are required urgently for assessments at the next meeting of the Working Group.

Division 58.4.4 (Ob and Lena Bank)

74. Catches of three species (*N. rossii*, *N. squamifrons* and *D. eleginoides*) are reported for the whole of Subarea 58.4 (see Table 5). Of these only *N. squamifrons* is caught in significant levels.

Notothenia squamifrons

Table 6:

Split year ending	Recommended TAC	Agreed TAC	Actual landings (tonnes)	Spawner biomass (tonnes)	Mean F
1980			4 340	NA	NA
1981			2 926	NA	NA
1982			785	NA	NA
1983			95	NA	NA
1984			203	NA	NA
1985			27	NA	NA
1986			61	NA	NA
1987			930	NA	NA
1988			5 302	NA	NA

The Fishery

75. Catches are variable (Table 6) and appear to reflect diversion of effort from the Kerguelen finfish fishery (see Tables 5 and 8) or the Antarctic krill fishery in the southern Indian Ocean. At present it is not possible to determine the proportionate composition of the total catch as being from either Ob or Lena. It appears that the stocks of *N. squamifrons* on these two seamounts should be considered separately.

Conservation Measures in Force

76. 80 mm mesh size restrictions for directed fishing on *N. squamifrons* (Conservation Measure 2/III).

77. All other conservation measures are applicable in this subarea as outlined for Division 58.5.2 (see below).

Data Assessments

78. Attempts were made to assess the stock, using a VPA, but problems were met owing to the lack of biomass estimates to tune the VPA, uncertainties concerning M, and the lack of separation between the catches from the Ob and Lena stocks. No reliable results could therefore be obtained.

Recruitment

79. No information on recruitment is available.

State of the Stock

80. This in unknown at present and given the current availability of data, improved fine-scale data submission will improve the state of knowledge concerning *N. squamifrons* stocks on Ob and Lena. An estimate of biomass from surveys is needed to tune the VPA calculations.

Management Advice

81. Exploratory scientific surveys to assess the biomass of the stocks are required for this subarea. In addition, it is recommended that fine-scale reporting and submission of data should be carried out so as to enable separate assessments of the stocks on Ob and Lena respectively.

Division 58.5.1 (Kerguelen)

Notothenia rossii

Table 7:

Split year ending	Recommended TAC	Agreed TAC	Actual landings (tonnes)	Spawner biomass (tonnes)[c]	Mean F[a]
1971			63 636		
1972			104 588		
1973			20 361		
1974			20 906		
1975			10 248		
1976			6 061		
1977			97		
1978			46 155		
1979			0		
1980			1 742		0.393
1981			7 924		1.358
1982			9 812	5 396	1.132
1983			1 829	3 327	0.362
1984			744	2 936	0.760
1985		0[b]	1 707	1 876	
1986		0[b]	801		
1987		0[b]	482		
1988		0[b]	21		

a Mean F for ages 4 to 13+
b Avoidance of direct fisheries (CCAMLR Resolution 3/IV) and by-catch only allowed (Franco-Soviet Fishery Contract)
c Derived from VPA

The Fishery

82. There was a steady decline in catches from high level at the start of the fishery in 1970/71 to a low of 97 tonnes in 1976/77, with an isolated high catch in 1978, just before the declaration of an EEZ (Table 7). After a closure of the area from July 1978 to October 1979, the fishery recommenced at a moderate level, and then declined to low catches. Only the adult part (age 5+ years) of the stock has been exploited. Since 1985 directed fishing has been prohibited and by-catches have declined steadily.

Conservation Measures in Force

83. (i) Fishing other than for scientific purposes is prohibited in waters within 12 nautical miles around Kerguelen. (Arrêté N°: 18, 16.05.80).

(ii) Minimum mesh size of 120 mm for trawls used in directed fishing (Arrêté N°: 20, 2-08-85 taken in application of Conservation Measure 2/III).

(iii) Directed fishing on stock of *N. rossii* in Statistical Subarea 58.5 has been prohibited since 1985. (In application of Resolution 3/IV).

(iv) Maximum allowed by-catch of 500 tonnes in 1987 and 1988 (i.e. total landings in these years are by-catch).

(v) All the fishing grounds in Division 58.5.1 are closed yearly in May and June, Sector 4 (west of 69°30'E and south of 49°30'S) is closed in April and Sector 1 (east of 69°30'E and south of 50°S) is closed from 15 September to 1 November (Arrêté N°: 32 of 22-10-84).

(vi) There is a system for the weekly reporting of catches. Catch statistics and data are reported daily on a trawl-by-trawl basis (logbooks provided by the French authorities).

(vii) A system of inspection and observation was established in 1980.

(viii) Only a limited number of trawlers is allowed on the fishing grounds (number revised each year).

Data and Assessments

84. Data from several sources (biomass surveys, CPUE indices of abundance, yearly length frequency distribution, VPA analysis) lead to a similar assessment. Estimates of stock size from VPA on short period data (1980 to 1984) (Fig.2) and swept area biomass surveys in 1987 and 1988 (WG-FSA-88/22 Rev. 1) give figures of 18 000 to 28 00 tonnes. Analysis of CPUE data shows a steady decline in abundance from 1980 to 1982 due to a direct fishery on the spawning ground and a slight rise from then until 1986 after cessation of direct fishing. The present stock size represents a dramatic decline from the early years of the fishery, when 168 000 tonnes were caught in the first two years of exploitation. In addition, the 1987 and 1988 surveys show that adult fish comprise only about 25% of the stock, i.e. 5 000 to 6 000 tonnes.

Management Advice

85. The slight rise in stock abundance indicated by CPUE results suggests that the stock is beginning to recover (Fig. 3). However, the very low stock size compared to its original state suggests that even with zero catch, recovery will be a long process (WG-FSA-87/8 Rev. 1 and 87/15).

86. Prohibition of a directed fishery on this species should continue for the foreseeable future to allow the stock to recover. In addition the by-catch should be kept as low as possible for the same reason. The current permitted by-catch of 500 tonnes (see paragraph 83 (iv)) represents 10% of the estimated adult biomass.

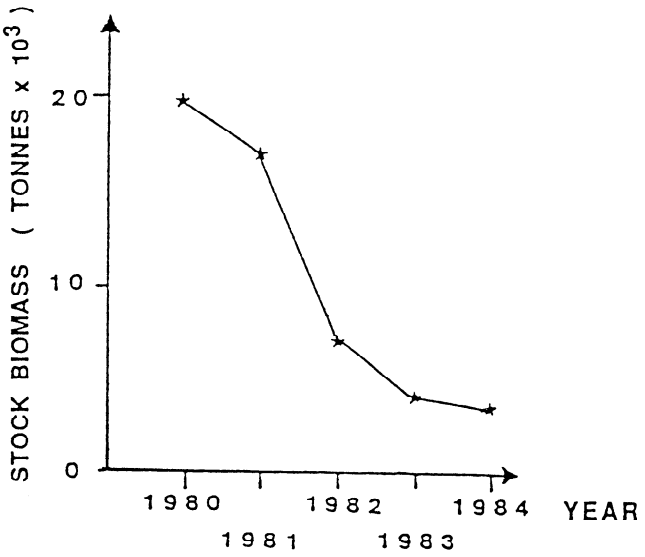

Figure 2: Short term tendencies in the Total Biomass (tonnes x 10^3) for the *Notothenia rossii* Kerguelen Shelf stock. VPA analysis (Duhamel, 1987).

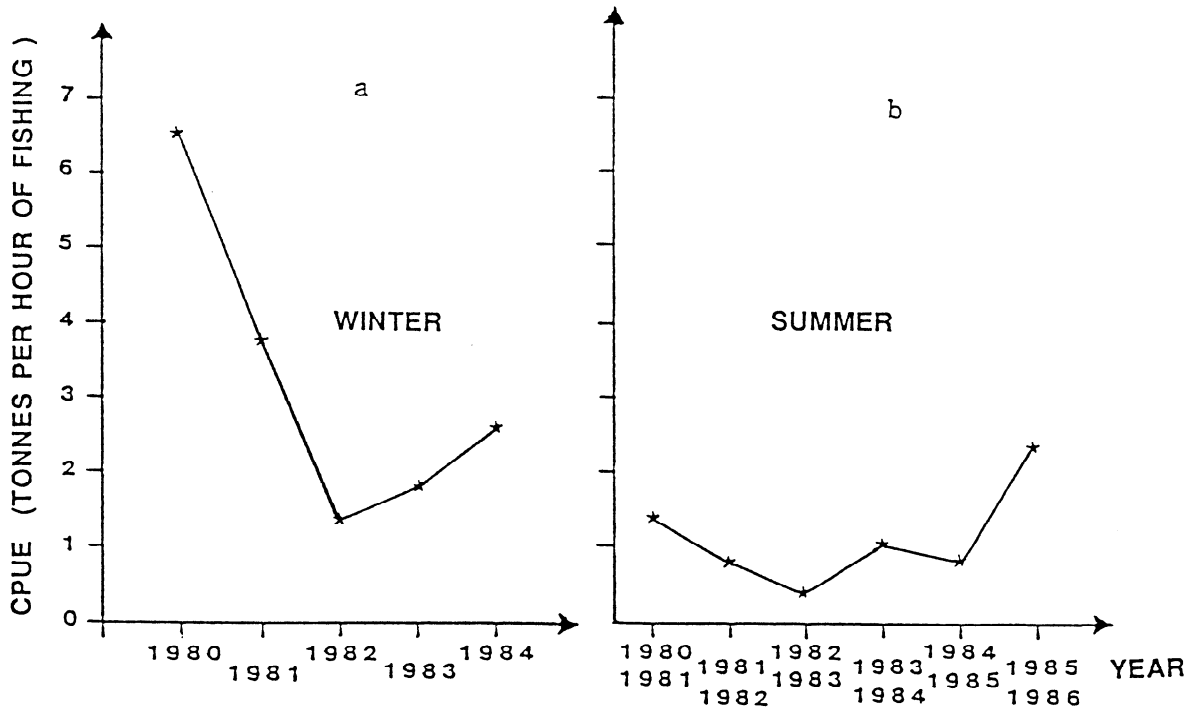

Figure 3: Yearly values of CPUE index of abundance (tonnes/hour) in the *Notothenia rossii* Kerguelen Shelf stock - (a) Southern Winter (b) Southern Summer (Duhamel, 1987).

Research Requirements

87. Since there is no direct fishery, it will be useful to establish a program to study pre-recruits in coastal waters to assess the stocks and detect any changes in abundance of the juvenile portion of the population.

Champsocephalus gunnari

Table 8: Assessment Summary for *C. gunnari* in Division 58.5.1

Split Year Ending	TAC	Skif Bank			Kerguelen Shelf			
		Actual Landing (tonnes)	Cohort (Yr)	Mean F	Actual Landings (tonnes)	Cohort (Yr)	Spawner Biomass (tonnes)	Mean F
1971					10 231			
1972					53 857			
1973					6 512			
1974					7 392			
1975					47 784			
1976					10 424			
1977					10 450			
1978					72 893	‘76		
1979					0			
1980		1			1 630	‘76		
1981		992	‘78	2.53	130	‘79		
1982		1 024	‘78	1.00	15 059	‘79		0.49
1983		4		0.01	25 848	‘79		1.86
1984		904	‘81	1.84	6 223	‘79		1.00
1985	x	223	‘81	1.00	8 030	‘82		0.52
1986	x	0			17 137	‘82		1.00
1987	16 000[a]	2 625	‘84	7.48	0			
1988	12 500[b]	2			157	‘85		

[a] refers to period 1 October 1986 – 31 December 1987 for Division 58.5.1
[b] refers to period 1 January 1988 – 31 December 1988 for Division 58.5.1

The Fishery

88. There are two separate stocks in Division 58.5.1 (Skif Bank and Kerguelen Shelf) (Duhamel, 1987). Catches are variable and reflect fairly closely a three-year cycle in recruitment (Figures 4 and 5). Since the declaration of an EEZ in 1978, maximum catches on the Kerguelen Shelf were taken in 1983 and 1986 on the 1979 and 1982 cohorts respectively (see Table 8).

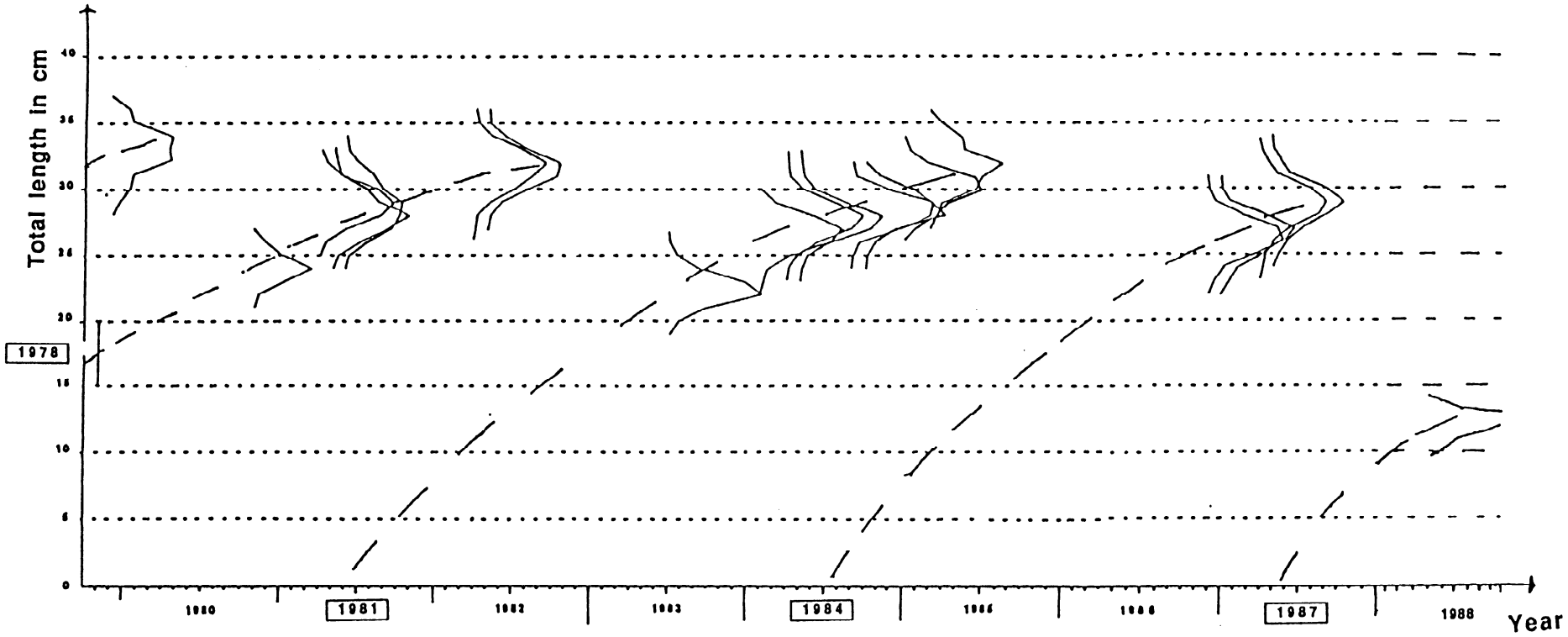

Figure 4: Length frequency distribution (cm) obtained for the Skif Bank *Champsocephalus gunnari* stock from 1979 to 1988. Mean growth curve showing the successive cohorts (Duhamel, 1987).

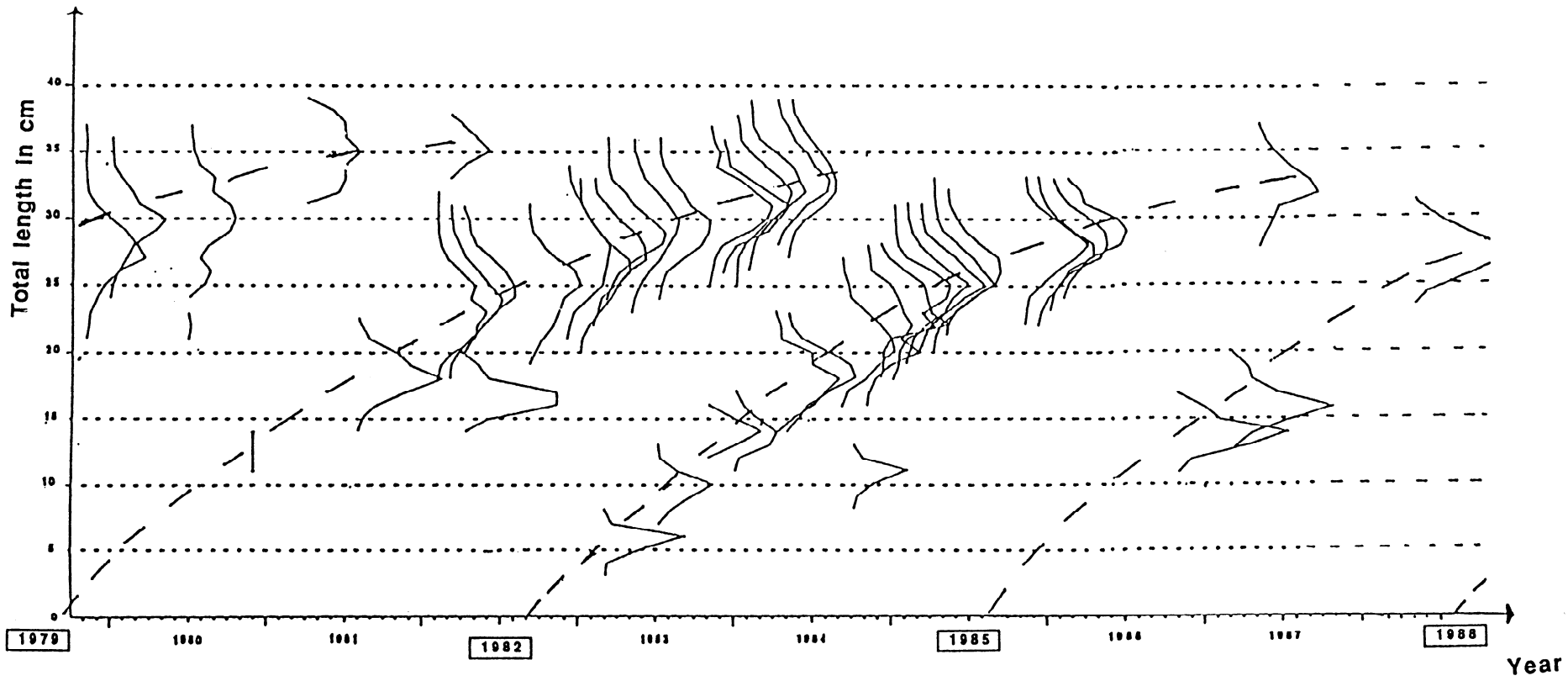

Figure 5: Length frequency distribution (cm) obtained for the Kerguelen Shelf *Champsocephalus gunnari* stock from 1979 to 1988. Mean growth curve showing the successive cohorts (Duhamel, 1987).

Conservation Measures in Force

89. (i) Minimum mesh size of 80 mm for trawls used during directed fishing on *C. gunnari* (Arrêté N° 20 of 2-08-85 taken in application of Conservation Measure 2/III).

(ii) Minimum size limit of 25 cm (Arrêté N° 20 of 2-08-85).

(iii) Catch quotas set from 1985 onwards under the joint French-Soviet agreement (see Table 8).

(iv) Conservation measures as for *N. rossii* in Division 58.5.1 (see subitems (i), (v), (vi), (vii) and (viii) in paragraph 83 above).

Data Used in Assessments

90. Comprehensive length and age data for both Skif and Kerguelen Shelf since 1980.

91. Survey estimates of biomass for both stocks in 1987 and 1988 (WG-FSA-88/22 Rev. 1).

92. Indices of abundance from catch-per-unit-effort data since 1980 for both stocks (Figs 6 and 7).

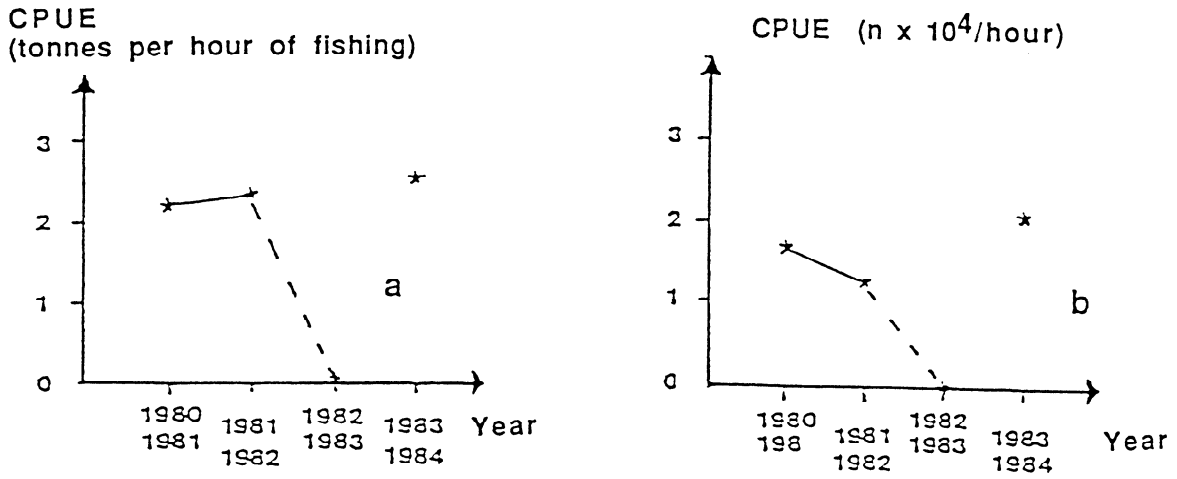

Figure 6: Yearly values of CPUE indices of abundance (a) tonnes/hour; (b) n x 10^4/hour obtained for the *Chaenocephalus* Skif Bank stock (Duhamel, 1987).

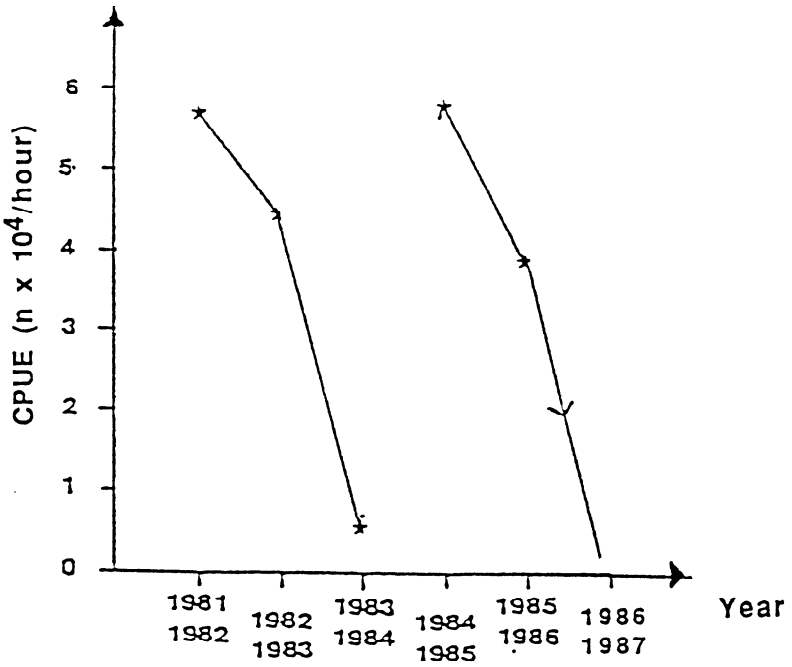

Figure 7: Yearly values of CPUE index of abundance (n x 10^4/hour) for the *Champsocephalus gunnari* Kerguelen Shelf stock in the NE sector (Duhamel, 1987).

93. The strengths of the three outstanding cohorts in the two areas can be calculated by simple cohort analysis, using M=0.35 (see Table 9). The 1984/85 cohort was tuned to the biomass survey, and all other cohorts were assumed to be exhausted by age 5 since no fish 5 or older were found in samples of the catch.

Fishing Pattern

94. Fishing mortality affects age classes 3+ with the age of maturity being 3 years. Fishing mortality is greater on the Skif Bank than on Kerguelen Shelf. The fishery is directed on specific cohorts (see Table 9) up to a maximum age of four years.

Table 9: Cohort sizes of the major cohorts of *C. gunnari* in the Kerguelen Area.

	Kerguelen Shelf	
	Cohort Size x 10^7 (at age 1)	Remarks
1979/80	117.0	Assuming that the Cohort exhausted at Age 5
1982/83	55.2	Assuming that the Cohort exhausted at Age 5
1985/86	1 149	From Biomass Survey 429 052 tonnes - Age 2[1]
	Skif Bank	
1977/78	4.4	Assuming that the Cohort exhausted at Age 5
1980/81	2.7	Assuming that the Cohort exhausted at Age 5
1983/84	5.7	Assuming that the Cohort exhausted at Age 5

1 Age 2 fish are calculated to be of mean weight 75.2 g. Derived from a mean length of 24.4 cm and length weight relationship $w_t = 0.0013688L_t^{3.4163}$

Recruitment

95. Good year classes are produced every 3 years over a period of 10 years. The production of one good year-class appears to coincide with the time of peak spawning of the previous year-class. The variable recruitment prevents the elucidation of underlying causes or relation to stock size. No direct investigations of recruitment have been undertaken.

State of Stock

96. Once a strong cohort recruits to the fishery it is heavily exploited. Fish older than 4–5 years are not found in the fishery. Catch levels depend on the strength of the recruiting cohort. Estimation of the stock biomass should be undertaken on pre-recruit fish of 3 years since younger animals are pelagic and therefore likely to be underestimated by bottom trawl surveys (see WG-FSA-88/22 Rev. 1).

Management Advice

97. Reduction in fishing effort would increase the number of cohorts available to the fishery. The structure of the present stocks and the current minimum size limit in force do not allow continuous exploitation of either Kerguelen Shelf of Skif Bank. A pattern of 'pulsed' fishing effort appears to give an appropriate exploitation policy provided that exploitation of a strong cohort is not allowed to start until the fish have grown to the size at sexual maturity.

Notothenia squamifrons

Table 10:

Split year ending	Recommended TAC	Agreed TAC	Actual landings (tonnes)	Spawner biomass (tonnes)	Mean F
1971			24 545[a]	NA	
1972			52 912[a]	NA	
1973			2 368[a]	NA	
1974			19 977[a]	NA	
1975			10 198[a]	NA	
1976			12 200[a]	NA	
1977			308[a]	NA	
1978			31 582[a]	NA	
1979			1 307[a]	NA	
1980			11 308	13 157	0.89
1981			6 239	5 726	0.63
1982			4 038	4 334	0.40
1983			1 832	4 542	0.18
1984			3 794	6 395	0.33
1985			7 394	5 916	1.12
1986			2 464	2 173	0.65
1987		5 200[*]	1 635	1 662	0.72
1988		2 000[*]	39	1 233	NA

[a] Includes catches from Division 58.4.4 and possibly Subarea 58.6
[*] See notes (a) and (b) in Table 5

The Fishery

98. Prior to the declaration of an EEZ around Kerguelen by France (3 February 1978), it is not possible to separate catches taken in Subarea 58.5 from those in Subarea 58.4. Since 1980 there has been a steady decline in catches with an indication of a small increase in 1984 and 1985. This probably resulted from a re-direction of fishing effort in relation to a low level abundance of *C. gunnari*, the main target species of the Kerguelen fishery (see Table 8).

Conservation Measures in Force

99. (i) Prohibition of fishing on *N. squamifrons* (and to other species) between 15 September to 1 November for protection of spawning stock (area south of 50°S and east of 69°30'E) (Arrêté N°: 32 of 22/10/1984).

(ii) Minimum mesh size of 80 millimetres for trawls used in directed fishing for *N. squamifrons* (for protection of young fish) (Arrêté N°: 20 of 2/08/1985 in application of Conservation Measure 2/III).

(iii) Catch limits have been set since 1987 under the joint French/Soviet agreement (see Table 10).

(iv) Conservation Measure as for *N. rossii* in Division 58.5.1 (see subitems (i), (v), (vi), (vii) and (viii) in paragraph 83 above).

Data and Assessments

100. Comprehensive length frequency distribution data are available from the commercial fisheries (Fig. 9). Other available data were an index of abundance from catch and effort data (Fig. 10), and biomass survey estimates of stock abundance in 1987 and 1988 (WG-FSA-88/22 Rev. 1).

101. VPA analysis was preformed using terminal fishing mortality rate of 0.72 derived from a total mortality estimated from a catch-curve in the final year of exploitation minus natural mortality. Figure 8 shows the trends in biomass obtained from this VPA.

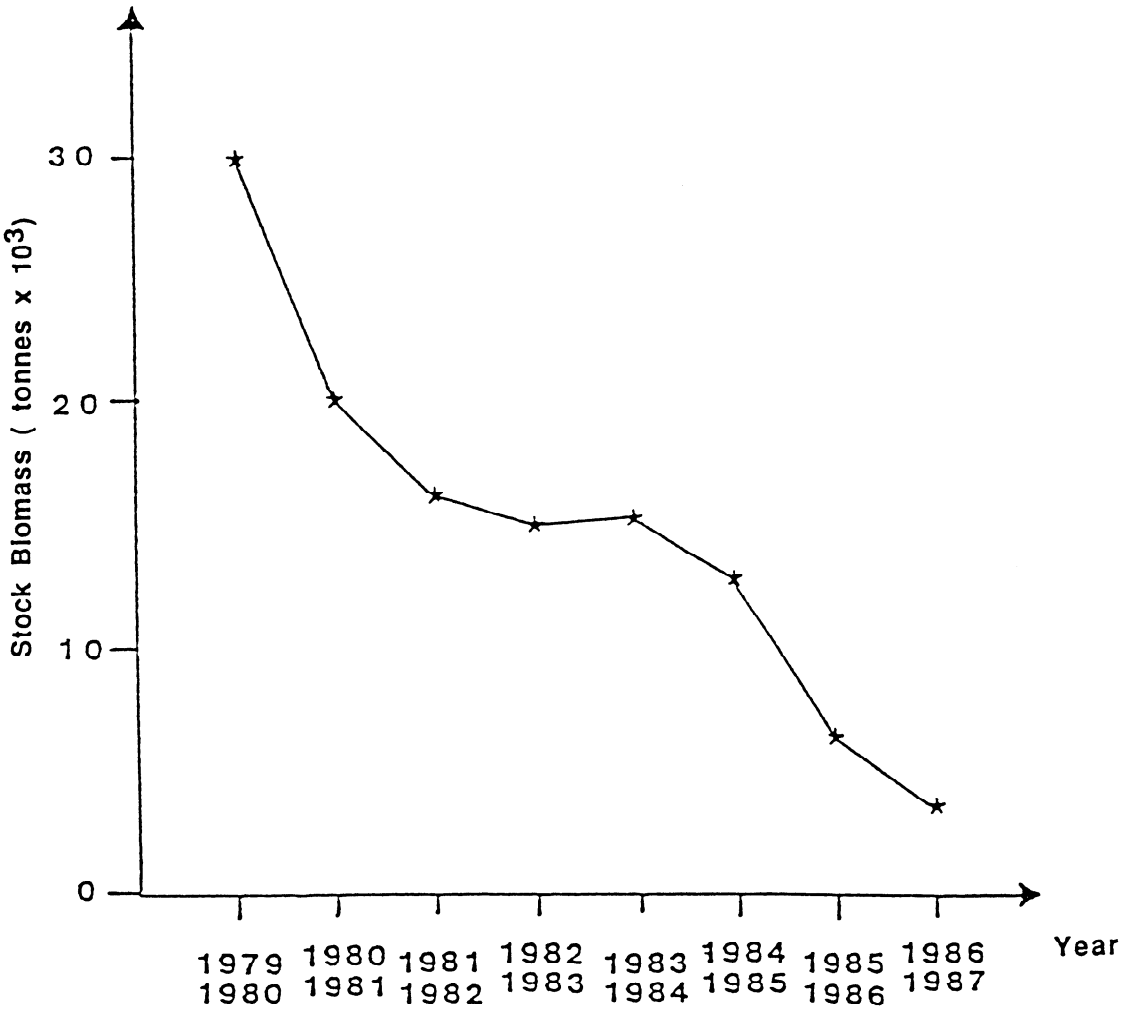

Figure 8: Tendencies in the total biomass (tonnes x 10^3) in the *Notothenia squamifrons* Kerguelen Shelf stock. VPA analysis (Duhamel, 1987).

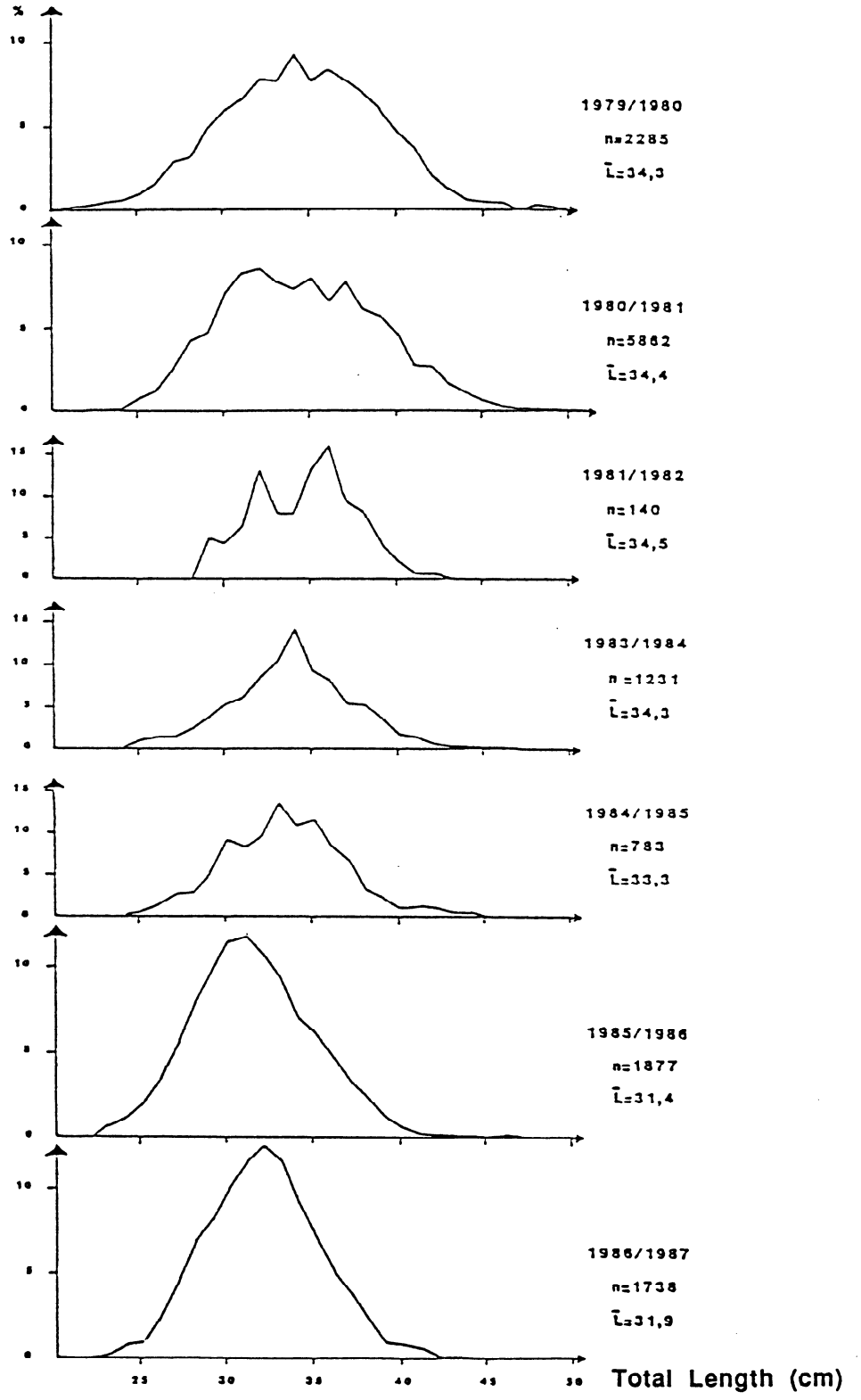

Figure 9: Yearly summer length frequency distribution for *Notothenia squamifrons* Kerguelen Shelf stock from 1979 to 1987 in the Southern sector (Duhamel, 1987).

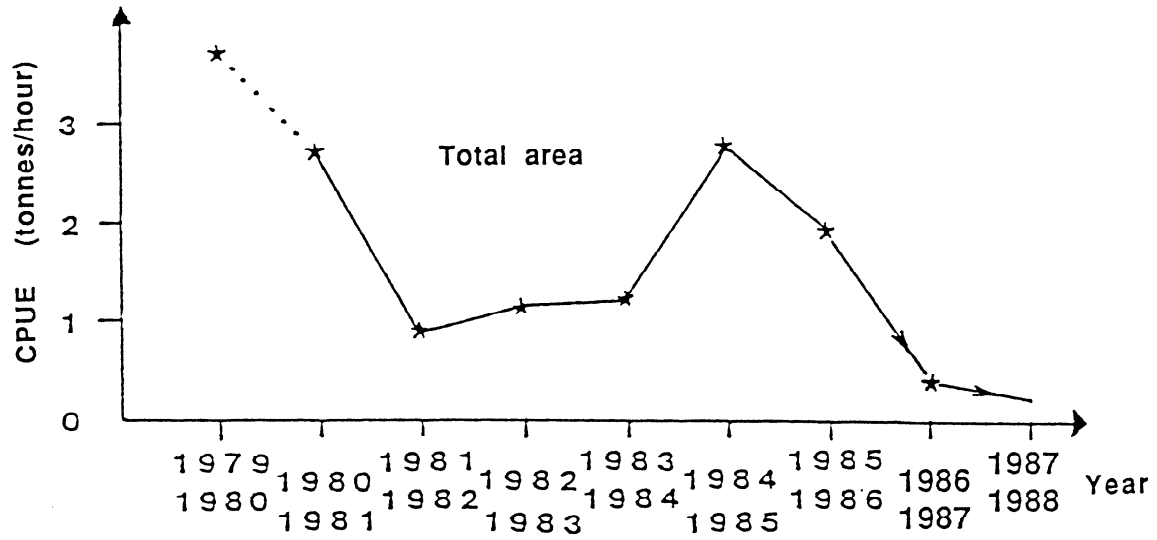

Figure 10: Yearly values of CPUE index of abundance (tonnes/hour) for the *Notothenia squamifrons* Kerguelen Shelf stock (Duhamel, 1987).

Fishing Pattern

102. Fishing mortality affects age classes 5+ with the age of maturity being 9 years.

Recruitment

103. No information is available concerning trends in recruitment (whether constant or variable) for this species.

State of the Stock

104. Both CPUE data (Fig. 10) and catch levels indicate that the stock remains at a low level. Catches in the last two years have been less than catch limits for those seasons.

105. The relatively long VPA time series also indicates that the stock biomass has decreased substantially except for the elevation observed in 1984 (see above). The VPA based stock estimate for 1986/87 was less than 5 000 tonnes which agrees quite closely with

stock estimates of 9 000 and 5 500 tonnes obtained by direct survey (swept area method) in 1987 and 1988 respectively.

Management Advice

106. A lack of information on recruitment patterns makes it difficult to provide objective predictions of future stock trends. However, given the observed trends in exploitation and present status of stock the future potential of the stock will be protected by closure of the direct fishery on *N. squamifrons* in Division 58.5.1. Similarly, recovery of an already depleted stock will be facilitated.

107. Given that about 15% of the current total stock biomass is comprised of adults and that fishing on other species in the area will continue, then an acceptable level of by-catch should be selected. As the current quota levels have not been attained, it is recommended that any future by-catch levels should be substantially lower than the present quotas.

Research Requirements

108. Data are required on the following:

- recruitment patterns
- mesh selectivity to improve management advice based on yield-per-recruit calculations
- some off-shore banks may harbour unexploited stocks in Division 58.5.1. Surveys need to be undertaken prior to any exploitation in order to determine natural mortality.

Other Stocks

109. *D. eleginoides* has been exploited since 1985. The annual catch has dropped from 6 677 tonnes in 1985 to 554 tonnes in 1988 (see Table 5). The available estimate of stock biomass (WG-FSA-88/22 Rev. 1) probably represents an over-estimate given that the species is patchily distributed and that only the juvenile and sub-adult portions of the stock were

surveyed. The trend in catch is similar to that for other main *Notothenііd* stocks. This would imply that strong conservation measures are required immediately and that adequate data collection procedures should be implemented.

110. *C. rhinoceratus*. No direct fishery is conducted on this species and it is considered to represent a by-catch species. There are no separate catch statistics for *C. rhinoceratus* as these are included in the catch data for *C. gunnari*. The estimation of biomass by trawl surveys (1987 and 1988) indicate that the stock appears to be stable (WG-FSA-88/22 Rev. 1) but the level is low (±20 000 tonnes).

Division 58.5.2 (Heard Island)

111. Few data are available for this area. It is thought that some fishing was carried out prior to the establishment of an EEZ by Australia in 1979. In 1977/78 43 744 tonnes of the 54 252 tonnes of *C. gunnari* caught in Area 58 were attributed to Division 58.5.1 (Kerguelen). It is thought the remanning 10 508 tonnes were taken in the Division 58.5.2.

112. Since 1979 no fishing has taken place in the area. A joint Soviet/Australian research cruise in 1987 (SC-CAMLR-VI/BG/16) encountered some small stocks of *C. gunnari*, but very low catches of other species were taken. Before any exploitation can take place much more work is necessary to determine the size of the stocks and their identity. There are already some indications that the stocks of *C. gunnari* on outlying banks are separate from those on the main Heard Island Shelf.

Conservation Measures in Force

113. (i) Directed fishery in the stocks of *Notothenia rossii* in Statistical Subarea 58.5 is prohibited (Resolution 3/IV).

(ii) 80 mm mesh size restriction for direct fishery on *C. gunnari* and *N. squamifrons* (Conservation Measure 2/III).

(iii) 120 mm mesh size restriction for directed fishery on *D. eleginoides* and *N. rossii* (Conservation Measure 2/III).

FUTURE WORK

Data Requirements

114. The Working Group noted that although there had been a general improvement in the availability of data for stock assessments, there were still deficiencies in the data submitted for some stocks as well as problems with the dates on which some data were received by the Secretariat.

115. It was agreed that there was a general need for representative length composition data from the commercial fisheries. It is possible to use other biological data (e.g. age/length, maturity and mean weight at age data) collected during research or exploratory fishing but length composition data from the commercial fisheries are necessary for assessment work. The Group recommended that the Scientific Committee take the necessary action to ensure that these data are submitted to the Secretariat.

116. There was some concern that analyses presented by the USSR representatives had been carried out using different data than those available in the CCAMLR database. The USSR representative informed the Group that the biological data submitted to the Secretariat had been collected during research and exploratory fishing and that they had subsequently been able to obtain length composition data for their analysis that had been collected during commercial fishing. These data should be reported to CCAMLR.

117. The Group welcomed this improvement and looked forward to early submission of the commercial length composition data to the CCAMLR database. It was emphasised, however, that earlier notification regarding the availability of theses data would have avoided a considerable amount of unnecessary work in the preparation of the old data by other participants at the Meeting. Members were urged to keep the Convener and Secretariat informed of the work they were undertaking for future meetings so as to minimise the amount of time wasted in redundant preparations and analyses.

118. Representatives drew attention to some problems that had arisen with regard to the collection and submission of fine-scale biological data. The major concern was with the amount of work involved in the aggregation and submission of age/length, mean length, mean weight and sexual maturity data by ten day periods and fine-scale grids.

119. The Group agreed that it was desirable to continue reporting length composition data by ten day periods and fine-scale grids as currently prescribed but that other forms of biological data (i.e. age/length, weight and sexual maturity data) could be aggregated and reported by larger temporal and spatial scales (i.e. months and subarea or divisions). It was pointed out that some provision should be made on the form for identification of the stock from which the data were obtained. The Data Manager was directed to discuss the problem with participants and to develop specific proposals for revision of the forms and instructions for reporting fine-scale biological data.

Data Analyses Required Prior to Next Meeting

120. The Group expressed satisfaction with the preparations for the current meeting and agreed that in general the same should be done for next meeting.

Workshop for Refinement of Biomass Estimates

121. The need for such a meeting was identified last year and tentative plans were made but did not come to fruition. It was agreed that participants would consider, during the intersessional period, the issues and problems that might be addressed during a workshop concerned with biomass estimation and that specific proposals concerning the scope of such a workshop would be discussed at the Working Group's next meeting.

New Approaches to Assessment Work

122. It was suggested that virtual population analyses should be carried out on the basis of time steps smaller than one year for species that grow quickly (e.g. *P. br. guntheri* and *C. gunnari*) but there were some questions as to whether the necessary data were available. It was agreed, however, that software and data for such analyses should be prepared by the Secretariat for use at the Working Group's next meeting.

123. The Working Group recommended that the Scientific Committee undertake the work of co-ordinating prerecruit abundance surveys for important fish stocks so that such surveys could commence as soon as possible.

124. It was suggested that the Working Group make use of stochastic projections based on historical recruitment levels in the formulation of management advice. It was agreed that software for such simulation analyses should be prepared by the Secretariat for use at the Working Group's next meeting.

125. It was suggested that the Working Group should, in the future, pay more attention to statistical details in its assessment work (e.g. determination of confidence intervals for biomass estimates) and that sensitivity analyses should be routinely employed to determine the effects of analytical uncertainties on management advice.

126. It would be desirable if a computer capable of operating MS-DOS with 5 and $3^1/_2$ inch disks were available, to enable participants to operate their own programs and to exchange data.

Organisation of Next Meeting

127. It was agreed that the timing of the current meeting was satisfactory and that its duration was adequate. It was recommended, however, that in future meetings of other working groups not be scheduled so as to occur between the meeting of the Fish Stock Assessment Working Group and the meeting of the Scientific Committee because such arrangements effectively reduce the amount of time available for assessment work.

128. There was general agreement that subgroups had been able to deal effectively with the assessment work for all of the stocks. It was suggested, however, that the entire Working Group needed to spend additional time reviewing input data prior to the assessment work by the subgroups and that the Working Group as a whole should spend more time reviewing the assessments themselves.

129. The Group expressed great satisfaction with the preparations made by the Data Manager (Larry Jacobson) and his staff, for the present meeting, and agreed that the Data Manager, the Convener of the Working Group and the Chairman of the Scientific Committee should meet and discuss preparations for the next meeting during the intersessional period.

130. Dr Karl-Hermann Kock agreed to continue as Convener of the Working Group for another year.

APPENDIX 1

AGENDA FOR THE MEETING

Working Group on Fish Stock Assessment
(Hobart, 12–20 October, 1988)

1. Opening of the meeting

2. Adoption of the agenda

3. Review of material for the meeting
   - 3.1 Data confidentiality
   - 3.2 Catch and effort statistics
   - 3.3 Size and age composition data
   - 3.4 Other available biological information
   - 3.5 Mesh selection experiments
   - 3.6 Assessments prepared by Member countries and the Secretariat
   - 3.7 Other relevant documents

4. Questions raised and information needed by the Commission

5. Demonstration of software for assessment work

6. Organisation of assessment work

7. Policy advice

8. Management advice
   - 8.1 Mesh size regulations
   - 8.2 Closed areas/seasons
   - 8.3 Catch quotas
   - 8.4 Other approaches to controlling fishing mortality
   - 8.5 By-catch in directed fisheries
   - 8.6 Uncertainties in the advice and policy alternatives

9. Future work
    - 9.1 Data requirements
    - 9.2 Data analyses required prior to the next meeting
    - 9.3 Workshop for the refinement of biomass estimates
    - 9.4 New approaches to assessment work
    - 9.4 Organisation of the next meeting

10. Other business

11. Adoption of the report

12. Closure of the meeting.

APPENDIX 2

LIST OF PARTICIPANTS

Working Group on Fish Stock Assessment
(Hobart, 12–20 October, 1988)

Dr K.-H. Kock (Convener, FRG)

Dr I. EVERSON (S.C. Chairman, UK)

Mr E. BALGUERIAS (Spain)

Dr J. BEDDINGTON (UK)

Dr R. BORODIN (USSR)

Dr G. DUHAMEL (EEC)

Dr W. DE LA MARE (Australia)

Dr J. GULLAND (EEC)

Prof. J.-C. HUREAU (France)

Mr S. IGLESIAS (Spain)

Mr A. MAZZEI (Chile)

Mr D. MILLER (South Africa)

Dr B. OVERHOLTZ (USA)

Mrs N. PRUSOVA (USSR)

Dr K. SHUST (USSR)

Dr W. SLOSARCZYK (Poland)

Dr K. SULLIVAN (New Zealand)

Dr R. WILLIAMS (Australia)

Dr. L. JACOBSEN (CCAMLR Secretariat)

Dr. E. SABOURENKOV (CCAMLR Secretariat)

Dr D. POWELL (CCAMLR Secretariat)

APPENDIX 3

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 12–20 October, 1988)

Meeting Documents:

WG-FSA-88/1	Draft Agenda
WG-FSA-88/2	Annotated Draft Agenda
WG-FSA-88/3	Sample of Standard Format for Presenting Assessment Results (Prepared by the Convener of the Working Group on Fish Stock Assessment and the Secretariat)
WG-FSA-88/4	List of Documents
WG-FSA-88/5	List of Participants
WG-FSA-88/6	Summary of Length Composition Data Submitted Prior to 1988: *Champsocephalus gunnari*, Subarea 48.3 (Secretariat)
WG-FSA-88/7	Summary of Length Composition Data Submitted Prior to 1988: *Patagonotothen brevicauda guntheri*, Subarea 48.3 (Secretariat)
WG-FSA-88/8	Summary of Length Composition Data Submitted Prior to 1988: *Notothenia gibberifrons*, Subarea 48.3 (Secretariat)
WG-FSA-88/9	Summary of Length Composition Data Submitted Prior to 1988: *Chaenocephalus aceratus*, Subarea 48.3 (Secretariat)
WG-FSA-88/10	Summary of Length Composition Data Submitted Prior to 1988: *Pseudochaenichthys georgianus*, Subarea 48.3 (Secretariat)
WG-FSA-88/11	Summary of Length Composition Data Submitted Prior to 1988: *Notothenia rossii*, Subarea 48.3 (Secretariat)

WG-FSA-88/12	Summary of Length Composition Data Submitted Prior to 1988: *Dissostichus eleginoides*, Subarea 48.3 (Secretariat)
WG-FSA-88/13	MT *Lord Shackleton* Antarctic Voyage to South Georgia, 8 to 24 January, 1988 (United Kingdom)
WG-FSA-88/14	The State of Exploited Fish Stocks in the Atlantic Sector of the Southern Ocean in 1988 (K.-H. Kock and F.-W. Köster)
WG-FSA-88/15	Age Determination of *Notothenia gibberifrons* from the South Shetland Islands, Antarctic Peninsula Subarea (Subarea 48.1) (Esteban Barrera-Oro, Argentina)
WG-FSA-88/16	Major Biological Parameters of the Antarctic Fish in the Convention Area (USSR Delegation)
WG-FSA-88/17	Availability of Catch and Biological Data (Secretariat)
WG-FSA-88/18	Data and Stock Assessments for Fish Stocks in the Convention Area (Secretariat*) *This is an exact copy of the document by the same name distributed at the Working Group's 1987 meeting as WG-FSA-87/4
WG-FSA-88/19	Summary of Length Composition Data Submitted Prior to 1988: *Notothenia squamifrons*, Subarea 58.4.4 (Secretariat)
WG-FSA-88/20	Results of Fish Larvae Sampling by Means of Fine-Meshed Samplers Attached to a Bottom Trawl (W. Slósarczyk and I. Wójcik, Sea Fisheries Institute, Gdynia, Poland)
WG-FSA-88/21	Age and Growth of *Pseudochaenichthys georgianus* Norman, 1937 (Channichthyidae) from the South Georgia Area (T.B. Linkowski and R. Traczyk, Poland)
WG-FSA-88/22	Distribution, Abundance and Evaluation of the Biomass of Nototheniid and Channichthyid Species on the Kerguelen Shelf (Area 58.5.1) During the Summer Seasons (February – April) 1987 and 1988 (G. Duhamel, France, EEC Representative)

WG-FSA-88/23	Using the Eve Editor on the VAX (Secretariat)
WG-FSA-88/24	Summary of Length Composition Data Submitted Prior to 1988: *Champsocephalus gunnari*, Subarea 48.2 (Secretariat)
WG-FSA-88/25	Fine-Scale Length Composition Data Submitted During 1988 (Secretariat)
WG-FSA-88/26	Separable Virtual Population Analysis Program - User's Guide (Secretariat)
WG-FSA-88/27	Virtual Population Analysis Program - User's Guide (Secretariat)
WG-FSA-88/28	Software for Fish Stock Assessment (Secretariat)
WG-FSA-88/29	Format Specifications for Reporting Fine-Scale Biological Data to the CCAMLR Secretariat (Secretariat)
WG-FSA-88/30	CCAMLR Antarctic Fish Otoliths/Scales/Bones Exchange System Progress Report (Submitted by the Convener of the Fish Stock Assessment Working Group)
WG-FSA-88/31	Preliminary Results of a Bottom Trawl Survey Around Elephant Island in October and December 1987 (K.-H. Kock)
WG-FSA-88/32	*Champsocephalus gunnari* Stock Status in the South Georgia Area (R. Borodin, P. Kochkin)
WG-FSA-88/33	*Notothenia (p.) gibberifrons* Stock Status and TAC Estimation in the Area of Shag Rocks (Subarea 48.3) (K. Shust and R. Borodin)
WG-FSA-88/34	Evaluation of the Results of Trawl Selectivity Experiments by Poland and Spain in 1978/79 and 1986/87 (W. Slósarczyk, E. Balguerias, K. Shust, S. Iglesias)

Other Documents:

SC-CAMLR-VII/BG/11	Selectivity of Standard Polish commercial Trawl Codends on Antarctic Fishing Grounds (J. Zaucha, Poland)
SC-CAMLR-VII/BG/23	Results of Fish Stock Assessment Survey, South Georgia, December 1987 – January 1988 (United States of America)
SC-CAMLR-VII/BG/24	Shifts in the Demersal Fish Community of South Georgia (United States of America)
SC-CAMLR-VII/BG/28	Results of an Exploratory Fishing Cruise in the Area 58.6 (G. Duhamel, France, EEC Representative)

Other Papers Referred to in the Report:

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KOCK, K.-H., G. DUHAMEL, J.-C. HUREAU. 1985. Biology and status of exploited Antarctic fish stocks. Biomass Scientific Series 6: 143 p.

Report of the Ad Hoc Working Group on Fish Stock Assessment, 1987. SC-CAMLR-VI, Annex 5: 185–234.

APPENDIX 4

ASSESSMENT SUMMARIES FOR FINFISH SPECIES IN SUBAREA 48.3

(South Georgia Subarea)

ASSESSMENT SUMMARY FOR *CHAMPSOCEPHALUS GUNNARI* IN SUBAREA 48.3

Split-Year Ending	Recommended TAC[a]	Agreed TAC	Actual Landings (tonnes)	Biomass (tonnes) [e]	[f]	Mean F[b] [f]
1971	-	-	10 701	na	na	
1972	-	-	551	na	na	
1973	-	-	1 830	na	na	
1974	-	-	254	na	na	
1975	-	-	746	na	na	
1976	-	-	12 290	na	241 000	0.06
1977	-	-	93 400	108 000	192 000	0.68
1978	-	-	7 557	21 000	49 000	0.16
1979	-	-	641	33 000	55 000	0.01
1980	-	-	7 592	94 000	89 000	0.02
1981	-	-	29 384	164 000	146 000	0.17
1982	-	-	46 311	169 000	207 000	0.18
1983	-	-	128 194	215 000	223 000	1.12
1984	-	-	79 997	117 000	114 000	1.48
1985	-	-	14 148	59 000	67 000	0.17
1986	-	-	11 107	100 000	106 000	0.09
1987	-	-	71 142	129 000	167 000	0.69
1988	31 500	35 000	34 573	67 000	72 000	0.88

[a] TAC = Total Alowable Catch
[b] mean F (instantaneous rate of fishing mortality) for ages 2–9
[c] na = not available
[d] at $F_{0.1} = 0.21$
[e] based on VPA
[f] based on VPA using Polish data, M=0.35

The Fishery:

High variability in recruitment makes the stock abundance vary greatly. During years of high abundance (1977, 1983/84, 1987) there is an important directed fishery.

Conservation Measures in Force:

(1) Fishing, other than for scientific purposes, prohibited in waters within 12 nutical miles around South Georgia (Conservation Measure 1/III).

(2) Minimum mesh size of 80 millimetres for trawls used in directed fishing for *C. gunnari* (for protection of young fish) (Conservation Measure 2/III).

(3) Total allowable catch of 35 000 tonnes for 1987/88 fishing season (Conservation Measure 8/VI).

(4) System for reporting catches on the basis of 10-day period (Conservation Measure 9/VI).

(5) Prohibition of a directed fishing on *C. gunnari* between 1 April and 1 October, 1988 for protection of young fish (Conservation Measure 10/VI).

Data and Assessments:

Good age and length data are available for most seasons, and Soviet catch/effort from STALANT forms from 1982/83. Several estimates of biomass are available from research surveys, inlcuding the 1987/88 season (joint US/Polish survey). These allow standard yield per recruit calculations to be made, and VPA to be run, tuned to most recent surveys.

Fishing Pattern:

Fishing mortality has been very high from age 2 onward in several seasons and tends to be targeted on the most abundant age-groups.

Recruitment:

Good year classes are believed to be produced at intervals of 3–4 years. The high variability in recruitment prevents however, identification of a clear trend, or relation to stock size. The most recent good year class was that born in 1985.

State of the Stock:

Because of the high fishing mortality older fish (5+), which were common at the beginning of the fishery, are now very scarce. The abundance of the stock depends on the strength of the youngest age-groups (2 and 3). The strong 1985 year class gave a good abundance at the beginning of the 1987 season, but this has been largely fished out.

Management Advice:

The average gross yield would be increased, the year-to-year variability in catches decreased, by allowing the fish to grow to a larger size before being caught. This might be done either by reducing the overall fishing mortality, or by incresing the mean size of first capture.

Unless there are very substantial reductions in fishing mortality the age (size) at first capture should be increased to around 4 years (32 cm). For a selection factor of 3.0 this would require the use of mesh size of about 107 mm mesh.

If there is no change in the present age at frist capture, the to achieve target fishing mortalities in 1988/89 would require the following TACs:

for $F_{0.1}$ 10 194
for F_{max}18 586

Data Requirements:

Estimates are neede of this strength of recruiting year-classes. This might be best done by surveying with a midwater trawl.

At its 1987 Meeting the Commission had requested advice for *C. gunnari*, on *inter alia*, the effect of closed seasons and/or areas to protect young fish and reduce by-catch. The Working Group had no new data concerning this matter which would suggest alterations to the present closed area and closed seasons in Subarea 48.3.

ASSESSMENT SUMMARY FOR *NOTOTHENIA GIBBERIFRONS* IN SUBAREA 48.3 (SOUTH GEORGIA SUBAREA)

Split-Year Ending	Nominal Catches (tonnes)	Estimates Biomass [a]	Mean F[a]
1976	4 999	44 000	0.20
1977	3 727	39 000	0.13
1978	11 758	36 000	0.70
1979	2 540	27 000	0.15
1980	8 143	29 000	0.60
1981	7 971	23 000	1.00
1982	2 605	17 000	0.36
1983	0	17 000	0
1984	3 304	19 000	0.24
1985	2 081	16 000 (15 762)[c]	0.15
1986	1 678	14 000	NA
1987	2 842	13 129[b]	NA
1988	5 219	7 798[b]	NA

[a] from VPA using M=0.125
[b] from joint Polish/US surveys
[c] from FRG Survey

The Fishery:

Moderate catches have been taken in most years with a peak of 11 000 tonnes in 1978.

Conservation Measures in Force:

General conservation measures for Subarea 48.3 apply.

Data and Assessments:

Length and age data are available for most years up to 1985, but are not available for the 1986, 1987 and 1988 seasons.

Fishing Mortality:

Fishing mortality is moderately high, with recruitment being spread between ages 1–7.

Recruitment:

There is no clear indication of any trend in recruitment.

State of the Stock:

The stock has been depleted by heavy fishing, with current stock in some 17% of the initial population.

Forecast:

Holding fishing mortality at $F = F_{0.1}$ would enable the stock to recover to a level yielding a sustained annyal catch of some 2 400–2 900 tonnes. Recovery to some 90% of this level would take some 10–15 years.

TACs for achieving $F_{0.1}$ and F_{max} would be:

	$F_{0.1}$	F_{max}
if M=0.25	259 tonnes	450 tonnes
if M=0.125	443 tonnes	720 tonnes

Since *N. gibberifrons* is taken largely as a by-catch, implementation of a TAC could raise problems. These problems are discussed in paragraph 64 below.

Recommendations:

Data on commercial length and age composition are needed for recent years. Surveys should be continued.

ASSESSMENT SUMMARY FOR *CHAENOCEPHALUS ACERATUS*
IN SUBAREA 48.3 (SOUTH GEORGIA SUBAREA)

Split-Year Ending	Nominal Catches (tonnes)	Biomass	Fishing Mortality
1977	293		NA
1978	2 066		NA
1979	464		NA
1980	1 084		NA
1981	1 272		NA
1982	6 76		NA
1983	0		NA
1984	161		NA
1985	1 042		NA
1986	504		NA
1987	338	10 816[(a)]	NA
1988	312	6 642[(a)]	NA

[(a)] from joint Polish/US surveys

Catches:

Catches in all seasons have been small. This species is only taken incidentally a fisheries directed to other species.

Conservation Measures in Force:

The general conservation measures for Subarea 48.3 apply.

Data and Assessments:

Length composition data are available for most years. Biomass estimates from surveys are available for 1986/87 and 1987/88. No VPA calculations have been attempted.

Fishing Mortality:

No reliable information.

Recruitment:

No reliable information.

State of the Stock:

There is some indication of an effect of fishing on the length compostion. Large fish (50–60 cm) were the commenest group in the early years, but are now less abundant.

Recommendations:

Kock et al. (1985) Table 54 gives a value fo $F_{0.1}$ for a mean age at first capture of 0.15 for females and 01.8 for males. This mean age applied to the recent biomass (ca 8 000 tonnes) implies a TAC of around 1 100 tonnes. Length data should be continued to be collected, and up-to-date age-length keys developed.

Data Requirements:

Length sampling of commercial catches shall be continued.

ASSESSMENT SUMMARY FOR *PSEUDOCHAENICHTHYS GEORGIANUS* IN SUBAREA 48.3 (SOUTH GEORGIA SUBAREA)

Split-Year Ending	Nominal Catches (tonnes)	Biomass	Fishing Mortality
1977	1 608		NA
1978	13 015		NA
1979	1 104		NA
1980	665		NA
1981	1 661		NA
1982	956		NA
1983	0		NA
1984	888		NA
1985	1 097	8 134[(a)]	NA
1986	156		NA
1987	120	4 579[(b)]	NA
1988	397	11 412[(b)]	NA

[(a)] from FRG survey
[(a)] from joint Polish/US surveys

Catches:

Large catches have been taken in only one season (1977/78). Otherwise this species is mostly taken on by-catch.

Conservation Measures in Force:

General conservation measures for Subarea 48.3 apply.

Data and Assessments:

Estimates of biomass are available from surveys. Good length frequency data are available for 1977/78 and some age length frequencies in other years. Age determinations have been made by microincrements (daily rings) and other methods. No VPA calculations have been attempted.

Fishing Mortality:

No reliable information, but presumably small in recent years.

Recruitment:

There are suggestions from year-to-year changes in length frequency that recruitment varies considerably. It also appears that a strong year-class, (modal length around 45 cm during the 1987/88 survey) is now present in the stock.

State of the Stock:

The species appears to be fairly short-lived. Chatches have been very light since 1978, so it is probable that the stock is not far from its unexploited state.

Recommendations:

The yield per recruit information in Kock et al. (1985), (Figures 57 and 58 and Table 54) suggest the $F_{0.1}$ for the likely age at first capture (3), is around 0.3. Using hte mean biomass of the 3 recent surveys (ca 8 000 tonnes), would imply a TAC of around 1 800 tonnes.

ASSESSMENT SUMMARY FOR *NOTOTHENIA ROSSII* IN SUBAREA 48.3 (SOUTH GEORGIA SUBAREA)

Split-Catches Ending	Nominal Biomass (tonnes)	Spawner Estimates[c] (tonnes)[a]	Biomass Mean F[b]	Year
1970	399 704	566 927		1.56
1971	101 558	122 137		2.65
1972	2 738	14 557		0.53
1973	0	16 598		0.004
1974	0	22 333		0.00
1975	0	31 047		0.0007
1976	10 753	39 333	35 682[d]	0.65
1977	8 365	38 196		0.62
1978	2 192	35 881	9 325[d]	0.48
1979	2 137	35 643		0.52
1980	24 897	31 150		2.96
1981	1 651	6 486		0.74
1982	1 100	6 890		0.42
1983	866	9 420		0.27
1984	3 022	11 743		0.69
1985	1 891	10 376	12 781[d]	0.37
1986	70	10 378		0.01
1987	216		11 471[e] 4 528[f]	0.04
1988	197		1 049[r]	

[a] based on VPA with M = 0.2, biomass was adjusted to 1984/85 biomass estimation from FRG survey (Kock, 1985)

[b] Mean F for ages 5–12 in VPA

[c] from research vessel survey

[d] FRG

[e] Spain

[f] US/Polish

Catches:

A very large directed fishery took place in the 1970/71 and 1971/72 seasons and smaller directed fisheries in 1976 and 1980. Otherwise catches have been taken as by-catch in fisheries based largely on other species.

Conservation Measures in Force:

(1) Fishing other than for scientific research purposes is prohibited in waters within 12 nautical miles of South Georgia (Conservation Measure 1/III).

(2) the use of pelagic and bottom trawls having the mesh-size in any part of the trawl less than 120 mm is prohibited (Conservation Measure 2/III).

(3) Directed fishing on *N. rossii* in 48.3 is prohibited. By-catches of *N. rossii* in fisheries directed to other species shall be kept to the level allowing the optimum recruitment to the stock (Conservation Measure 3/IV).

(4) The total catch of *C. gunnari* in the 1987/88 season shall not exceed 35 000 tonnes in 48.3 After such time as that total catch ahs been reached *C. gunnari*, *N. rossii*, *N. gibberifrons*, *C. aceratus* and*P. georgianus* shall not be taken in 48.3 except for scientific purposes (Conservation Measure 8/VI).

(5) Directed fishing on *C. gunnari* in 48.3 from 1 April until 1 October 1988 is prohibited. During the protected period*C. gunnari*, *N. rossii*, *N. gibberifrons*, *C. aceratus* and *P. georgianus* shall not be taken in 48.3 except for scientific research purposes (Conservation Measure 10/VI).

Data and Assessments:

Length and age data are available for most seasons, and biomass estimates have been made from a number of research surveys, more recently in 1987/88.. Problems with interpretation make the age data unsuitable from 1985 onwards, but VPA have been run up to that date.

Fishing Mortality:

Fishing mortality has been very high from age 4 onwards in the seasons of directed fishing. The younger fish are largely in the fjords and unaccessible to fishing.

Recruitment:

Recruitment is now very much lower than it must have been in the 1960's. The decrease seems to have taken place in abrupt steps, and though this has occurred during a period when the stock was in decline, the relation between stock abundance and recruitment does not appear to be simple.

State of the Stock:

Stock abundance is now very low and will not improve appreciably until recruitment increases.

Management Advice:

No significant catches can be taken until recruitment increases and the stock begins to recover. Any fishing on the depleted stock will delay the recovery and reduce the probability of better recruitment.

Research Requirements:

The current doubts about age determination should be resolved. More needs to be understood about possible factors affecting recruitment. It would also be desirable to establish methods of monitoring the younger, pre-recruit fish.

ASSESSMENT SUMMARY FOR *PATAGONOTOTHEN BREVICAUDA GUNTHERI* IN SUBAREA 48.3 (South Georgia Subarea)

Split-Year Ending	Nominal Catches (tonnes)	Estimated Biomass [(a)]	Estimated Biomass [(b)]	Mean F [(b)]
1979	15 011		96 000	1.09
1980	7 381		101 000	0.48
1981	36 758		108 000	1.35
1982	31 351		76 000	1.91
1983	5 029		59 000	0.45
1984	10 586		57 000	1.02
1985	11 923		70 000	0.54
1986	16 002		79 000	0.83
1987	8 810	81 000	121 000	0.96
1988	13 424		122 000	

[(a)] from Spanish survey
[(b)] from Soviet survey

Catches:

This is only caught in a Soviet directed fishery in the Shag Rocks area.

Conservation Measures in Force:

(1) The general measures for Subarea 48.3 apply.

Data and Assessments:

Length and age data are available for most years and a VPA has been calculated. An estimate of biomass of 81 000 tonnes in 1986/87 is available from a Spanish survey.

Fishing Mortality:

Fishing mortality appears to be moderately high with ages 2–4 predominantly in the catches.

Recruitment:

There is no indication of any trend in recruitment.

State of the Stock:

It does not appear that fishing is having a serious impact on the stock.

Forecast:

There are uncertainties about the value of M which made it difficult to make forecasts.

Recommendations:

No estimate could be made of a TAC corresponding to target fishing mortalities. An alternative strategy would be to hold catches at the level of recent years.

Data Requirements:

VPAs need to be tuned to the biomass estimates. Early age composition data should be examined to produce better estimates of M.

ANNEX 6

FUTURE WORK OF THE FISH STOCK ASSESSMENT WORKING GROUP
DATA REQUIREMENTS

FUTURE WORK OF THE FISH STOCK ASSESSMENT WORKING GROUP
DATA REQUIREMENTS

- Estimate of natural mortality M: all species

- Recruitment information: all species

- Recruitment indices: *C. gunnari* (paragraph 40):

- Catches:

    - to be reported for the fishery in Subarea 48.1 for 1987/88

    - to be reported for Ob and Lena Bank stocks of *N. squamifrons* separately (paragraph 81)

    - to be reported for *P. georgianus* and *C. aceratus* in the Soviet fishery. Catches are so far contained in the category 'unspecified'.

- Length compositions: from Soviet commercial fishery (paragraphs 115 to 117)

- Consistent length and age data from the commercial fishery (paragraph 11), in particular for the past 2–3 years:

    - for *N. gibberifrons* in Subarea 48.3 (paragraph 50)

    - for *C. aceratus* in Subarea 48.3 (paragraphs 54 and 55)

    - for *P. georgianus* in Subarea 48.3 (paragraphs 54 and 55)

    - all species in Subareas 48.1 and 48.2

- Biomass estimates from bottom trawl surveys:

    - all Area 48 (i.e. paragraphs 22 and 64)
    - Division 58.4.4 (paragraphs 80 and 81)

- Mesh selectivity experiments reflecting commercial conditions:
    - all areas, in particular Area 58 (paragraphs 14 and 67)
- Distribution of juvenile fish and by-catch species (paragraph 41) to assess effect of closed season/area
- Fine scale catch an effort and biological data as decided in 1987 (paragraphs 71, 81, 118 and 119)
- Review of catch statistics in Division 58.4.1 (paragraph 72)
- Data on exploited Channichthyid stocks in Subarea 58.4 (paragraph 73).

ANNEX 7

WORKING GROUP FOR THE CCAMLR ECOSYSTEM MONITORING PROGRAM
REPORT ON INTERSESSIONAL ACTIVITIES IN 1987/88

WORKING GROUP FOR THE CCAMLR
ECOSYSTEM MONITORING PROGRAM
REPORT ON INTERSESSIONAL ACTIVITIES IN 1987/88

The Working Group for the CEMP (WG-CEMP) did not meet during the intersessional period. However, work continued by correspondence and within the Secretariat particularly on those tasks identified by the Scientific Committee at its last meeting (SC-CAMLR-VI, paragraph 7.39). The following provides a summary of progress made.

PUBLICATION OF THE STANDARD METHODS

2. These were published in English in a booklet entitled 'Standard Methods for Monitoring Parameters of Predatory Species'. Included were methods for eight parameters for penguin species and two parameters for fur seals. Translation into other languages is being undertaken. Assistance from scientists from appropriate countries has been sought to ensure accurate translation of the scientific concepts.

SUMMARY OF MEMBERS' CEMP ACTIVITIES

3. At the time of preparing this report, the Secretariat had received reports to the Commission of activities from eleven Members (SC-CAMLR-VI, paragraph 7.39(i)). Details of these were extracted from the reports and appended (Appendix 1).

4. It is pleasing to note the number of national monitoring programs which have been established and the research being undertaken in support of, or related to the CEMP. Details of these programs are included in the papers submitted for discussion at the meeting of the Scientific Committee. A list of these papers is given at Appendix 2.

5. Australia, Brazil, Japan, United Kingdom and USA indicated that they were undertaking studies within the Convention Area which could be considered as contributing to the predator monitoring program. None stated explicitly which parameters and species were being monitored.

6. All eleven Members indicated they were undertaking studies of environmental parameters and of prey which may contribute to the program.

PROPOSALS FOR DATA REPORTING FORMATS FOR EXISTING APPROVED PREDATOR MONITORING OPERATIONS

7. Data formats and relevant instructions for the submission of data on penguins were drafted and comments sought from the Chairman of the SCAR Subcommittee on Bird Biology. Additional comments were also obtained from the Subcommittee itself at its meeting in August 1988.

8. Subsequently, the data formats were revised considerably in conjunction with the CCAMLR Data Manager as requested in paragraph 7.34 of SC-CAMLR-VI. These are set out on forms which will be circulated in draft form at the meeting of the Scientific Committee. They will allow for the presentation of summary data including statistical parameters in a manner which is easy to transfer to the CCAMLR data centre.

9. Forms for the collection of field data have been drafted concurrently. The use of these forms is optional however, as several scientists have developed other methods for recording their data in the field. The forms have been produced to assist in recording data in a systematic manner that will ensure all necessary information is obtained and that it can be easily transferred onto the data reporting forms.

PROPOSALS FOR THE REGISTRATION AND PROTECTION OF APPROVED LAND BASED MONITORING SITES

10. It was considered that the protection of land based sites required the Scientific Committee to identify and register the site and then for the Commission to protect the site by means of a conservation measure. Accordingly, two papers have been prepared, SC-CAMLR-VII/3 ‘Registration of Monitoring Sites’ and CCAMLR-VII/6 ‘Registration and Protection of Monitoring Sites’ for consideration of the Scientific Committee and the Commission respectively. A draft conservation measure is included for the consideration of the Commission.

PROGRESS A SENSITIVITY ANALYSIS ON ESTIMATES OF PREDATOR PARAMETERS DERIVED FROM EXISTING DATA

11. A summary of published data which may be of use in a sensitivity analysis has been prepared by the Secretariat. This data summary refers to all the parameters identified for

monitoring of Adélie penguins. Discussions were held with Dr G. Kirkwood and Dr K. Sainsbury, CSIRO Division of Fisheries, Hobart and the Secretariat in an attempt to define the tasks and to identify a suitable person to be employed to undertake the analysis. It became clear that the task needed to be defined in more details and should be the subject of further consideration by the Working Group for the CEMP.

PROGRESS TOWARDS STANDARDISATION OF SAMPLING DESIGN FOR PREY MONITORING

12. This requirement was set out in paragraph 7.39(vi) of SC-CAMLR-VI. It reiterates the requirement identified in paragraph 7.37 which also requires Members to provide Dr Everson with information relevant to the design of surveys to estimate krill abundance and to provide net haul samples of krill on spatial and temporal scales consistent with the predator monitoring operations in the integrated study areas. As requested, Dr Everson has sought information (SC-CIRC 88/1) from Members who had not already provided information. A Summary of the very limited number of responses is presented separately (SC-CAMLR-VII/5, 'CCAMLR Ecosystem Monitoring Program, Monitoring Prey'). The spatial scales over which prey surveys should be conducted to link with monitoring of the predator variables were discussed. Standard Methods A5, A7, A8, C1 and C2 determine variables which may be linked to prey using a radial transect method as proposed earlier.

13. Simulation studies were suggested as a means of providing guidance for the setting up of surveys.

Dr Everson concludes that:

(i) Theoretically it is feasible to monitor krill in support of the predator studies agreed by CEMP.

(ii) Proposed survey methods have been outlined (Everson 1988) which should be tested by simulation studies and also in the field.

(iii) More information is needed on the depth distribution and degree of aggregation of krill with respect to time of day, position and physical variables.

GENERAL COMMENTS

14. (i) Members are required to follow the standard methods which have been established if they are to be considered to be participating the CEMP. To date, no Member has indicated that they are in fact doing this, however, it is clear that activity related to the monitoring program has begun and will increase.

(ii) Several Members appear to be conducting monitoring related programs on penguins in the vicinity of King George Island. The degree to which they are co-operating was not identified. However, it would seem that close co-operation between scientists from Member countries will become important and that co-ordination of such programs will be required. The need for regional co-ordination has been discussed in previous meetings.

(iii) The elaboration of methods for monitoring of prey even if they are interim and the initiation of a prey monitoring program is essential for the interpretation of data on predator variables and is thus of high priority. Further discussion may be needed to define the requirements and then the methods for use in each of the integrated study areas as requested in paragraph 7.38 of SC-CAMLR-VI.

(iv) The linkage between the abundance and variability of prey and the variables being monitored for the predators has been discussed briefly in previous meetings of WG-CEMP. Now that standardised methods have or are being developed and as the Monitoring Program progresses this aspect needs further and detailed discussions.

CONCLUSION

15. This report sets out progress made during the intersessional period. It is clear from several of the issues where progress could not be made that further detailed discussions need to be held within the WG-CEMP. Particularly important issues include the requirements for sensitivity analysis and the development of detailed methods for monitoring prey. In order to address these issues and to maintain momentum in developing the program, a meeting the WG-CEMP should be held in 1989.

REFERENCE

EVERSON, I., 1988. Prey Monitoring Surveys. SC-CAMLR-VI/BG/8: 1–10.

APPENDIX 1

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: Argentina

Scientific objective(s) of program(s):

1. Elephant seals: population size, marking, milk and blood samples

2. Weddell seal: CEMP parameters

3. Adelie: arrival weight, first incubation shift, annual trends in population size, demography (Method A), fledging weight;
   Chinstrap: annual trends in population size, breeding success (Method B)

4. Adelie: breeding success (Method B), diet
   Antarctic fur seal: population size

Location(s) of program(s):

1. Jubany Base, King George (S. Shetlands)
2. Orcadas Base, S. Orkneys
3. Jubany Base, King George (S. Shetlands)
4. Orcadas Base, S. Orkneys

Time span for program(s):

1–2. Not specified
3. Summer 1987/88
4. Summer 1987/88

Facilities, gears and equipment used:

1–4. Not specified

Is another country involved in the program(s)?

1–4. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1–4. Not specified

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: Australia

Scientific objective(s) of program(s):

1. Breeding biology of crabeater seals
   - to increase knowledge of the biology of crabeater seals during their breeding season

2. Assessment of the breeding population of crabeater seals in the Prydz Bay region
   - to record the distribution and estimate the abundance of breeding crabeater seals, through observations and detailed census
   - to investigate the presence of seals in relation to ice type and amount, proximity to the continental shelf and presence of zooplankton

3. Emperor and Adelie penguins
   - to investigate the diet, metabolic rate and foraging range of Emperor and Adelie penguins, in order to understand their role as predators in the marine ecosystem

4. Origin of krill-based ecosystem
   - to identify the time of origin of the krill based ecosystem
   - to make comments on the taxonomy of the *Euphausiacea*, and possibly to contribute to the question of their origin and evolution

Location(s) of program(s):

1.–2. MacRobertson Land coast (approximately Cape Darnley to Mawson and offshore)
3. Magnetic Island, near Davis, and Auster and Taylor rookeries, near Mawson
4. Prydz Bay

Time span for program(s):

1–2. October–November 1987 (field work)
3. November 1987–September 1988 (field work)
4. October 1987 (field work)

Facilities, gears and equipment used:

1–2. R/V *Nella Dan*
3. Land based
4. M/V *Lady Franklin*

Is another country involved in the program(s)?

1–4. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1. K.R. Kerry, Antarctic Division, Hobart
   P. Shaughnessy, CSIRO, Canberra
2. K.R. Kerry, Antarctic Division, Hobart
3. H. Burton, Antarctic Division, Hobart
4. P.G. Quilty, Antarctic Division, Hobart

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: Brazil

Scientific objective(s) of program(s):

Marine and Continental birds of Antarctic and sub-Antarctic regions (including Adelie and Chinstrap penguins)
- weight dynamics
- arrival and fledging weights
- breeding success
- Man's impact

Location(s) of program(s):

S. Shetlands (Elephant Is)

Time span for program(s):

Long-term project
November 1987–April 1988 (same in 1988/89–1990/91)

Facilities, gears and equipment used:

Research vessels
Land based

Is another country involved in the program(s)?

Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

Not specified

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: Chile

Scientific objective(s) of program(s):

1. Ecological studies of Antarctic fur seal

2. Trophic studies of tetrapod's community, collection of stomachs of 45 birds (no species)

Location(s) of program(s):

1–2. Cape Shirreff, Livingston Island (S. Shetlands)

Time span for program(s):

1–2. December 1987 – February 1988

Facilities, gears and equipment used:

1–2. Land based

Is another country involved in the program(s)?

1–2. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1–2. Not specified

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: France

Scientific objective(s) of program(s):

1. Reproduction biology of species of petrels

2. Investigation of predator-prey relationships among birds and mammals in Crozet Is.

3. Study of changes in the population of 8 species of birds and of the Weddell seal

Location(s) of program(s):

1. Kerguelen Is (58.5.1)
2. Crozet Is (58.6)
3. Adelie Land (58.4.1)

Time span for program(s):

1–3. Not specified

Facilities, gears and equipment used:

1–2. Not specified

Is another country involved in the program(s)?

1–2. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1–2. Not specified

3. Drs P. Jouventin and D. Robineau

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: Federal Republic of Germany

Scientific objective(s) of program(s):

Monitoring of krill abundance by net hauls along 14 transects including all SIBEX transects

Location(s) of program(s):

Elephant Island to Adelie Island (Antarctic Peninsula)

Time span for program(s):

October to December 1987
Ongoing program since 1983 on standard transects

Facilities, gears and equipment used:

R/V *Polarstern*

Is another country involved in the program(s)?

National program

Name of chief investigator/contact point who can be contacted about the program(s):

Dr Volker Siegel, Institut für Seefischerei, Bundesforschungsanstalt für Fischerei, Palmaille 9, D–2000 Hamburg 50, FRG

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: Japan

Scientific objective(s) of program(s):

1. Adelie penguin census, feeding behaviour, populations census, diving depth and water temperature (direct CEMP)

2. Minke whale survey: Density/patchiness and school size, reproductive rates, age at sexual maturity, cohort strength, stomach contents, blubber thickness

3. Krill survey: target strength, biological samples, oceanographic samples

Location(s) of program(s):

1. Syowa Station
2. Not specified
3. Scotia Sea

Time span for program(s):

1. December 1987
2. Not specified
3. 28 October 1987 – 16 March 1988

Facilities, gears and equipment used:

1. TD recorders, land based

2. Sighting and sampling, vessel

3. R/V *Kayo Maru*, echo sounders and echo integrators

Is another country involved in the program(s)?

1–3. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1. Dr N. Saito, National Institute of Polar Research, 9–10 Kaga 1 chome, Itabashi-ku, Tokyo 173

2. Not specified

3. Dr Y. Shimadzu, Research Co-ordination Section, Japan Fisheries Agency, 2–1, 1-chome, Kasumigaseki, Chiyoda-ku, Tokyo 100.

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: New Zealand

Scientific objective(s) of program(s):

1. Adelie: foraging

2. Adelie: tracking during feeding in the sea

3. Aerial survey of penguin colonies

Location(s) of program(s):

1. Cape Bird
2. McMurdo Sound
3. Ross Sea

Time span for program(s):

1–3. Not specified

Facilities, gears and equipment used:

1–2. Land based
3. Aircraft C-130

Is another country involved in the program(s)?

1–3. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1–3. Not specified

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: South Africa

Scientific objective(s) of program(s):

1. The relationship between the population dynamics of selected seasonal species and their prey (Macaroni penguin)

2. Breeding success, diet and breeding behaviour of seabirds (in particular, Macaroni penguin) (can be considered of relevance to CEMP)

Location(s) of program(s):

Prince Edward Is and SANAE Station

Time span for program(s):

Not specified

Facilities, gears and equipment used:

Not specified

Is another country involved in the program(s)?

Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

Not specified

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: UK

Scientific objective(s) of program(s):

1. Penguin demography and deferred sexual maturity

2. Antarctic fur seal - reproductive success

3. Spatial and temporal variability in the key interactions of the ecosystem (food <— krill <— predators)

4. Monitoring of the breeding population size (Signy Is) of selected penguin colonies (direct CEMP)

Location(s) of program(s):

1–3. Signy (S. Orkneys)
4. Bird Is (S. Georgia), Signy Is (S. Orkneys)

Time span for program(s):

1–4. Not specified

Facilities, gears and equipment used:

1–4. Land based

Is another country involved in the program(s)?

1–4. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1–4. Drs J.P. Croxall and I.L. Boyd

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: USA

Scientific objective(s) of program(s):

1. Fish stock assessment survey
   Krill assessment survey/calibration experiments
2. Marine mammal and bird monitoring
3. Seabird ecology and behaviour
4. Seabird ecology
5. Physiological ecology and energetics of Adelie penguins
6. Population biology and energetics of krill

Location(s) of program(s):

1. S. Georgia, Bransfield Strait, off Elephant Is
2. Seal Island, South Shetland Islands, Palmer Station, Anvers Island
3. Admiralty Bay, King George Island
4. Weddell Sea
5. Palmer Station
6. Bellingshausen Sea

Time span for program(s):

1. November 1987 – February 1988
2. December 1987 – February 1988
3. September 1987 – February 1988
4. June – August 1988
5. December 1987 – January 1988
6. December 1987 – March 1988

Facilities, gears and equipment used:

1–6. Not specified

Is another country involved in the program(s)?

1. Co-operation with Poland
2. Chile
3–6. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1. Dr K. Sherman
2. J. Bengtson
3. W. Trivelpiece
4. D. Ainley
5. M. Chapell
6. R. Ross, L. Quetin

CEMP RESEARCH ACTIVITIES IN 1987/88 SEASON

Country: USSR

Scientific objective(s) of program(s):

1. Integrated studies of spatial and temporal distribution of krill and factors affecting krill concentration (direct CEMP)

2. Structure and functions of the pelagic community of the Scotia Sea

3. Oceanographic trawl and integrated hydroacoustic surveys

4. Spatial and temporal distribution of krill and environment factors affecting

Note: Inventory of data collected and preliminary results

1–3. Grid Map of sampling stations
Chlorophyll concentration data
Krill density distribution data
Water temperature data
Silicon concentration data (surface waters)
Water circulation data
Primary production (surface waters)
Krill biological samples
Phyto- and zooplankton samples

Location(s) of program(s):

1–3. Scotia Sea and adjacent waters from 52°–53°S to the ice-edge, including:
S. Georgia Is
S. Orkney Is
S. Shetland Is
4. Kosmonavtov and Sodruzhestro Seas south of 60°S to the ice edge between 30° and 90°E

Time span for program(s):

1–3. January – April 1988
4. Not specified

Facilities, gears and equipment used:

1–3. R/V *Evrika*
Isaacs-Kidd Trawl for krill sampling

4. Bottom and pelagic trawl samples and oceanographic stations

Is another country involved in the program(s)?

1–4. Not specified

Name of chief investigator/contact point who can be contacted about the program(s):

1–4. VNIRO Research Institute, 17a V. Krasnoselskaya Street, Moscow, USSR

APPENDIX 2

LIST OF BACKGROUND PAPERS RELEVANT TO CEMP AND PRESENTED FOR CONSIDERATION AT THE SEVENTH MEETING OF THE SCIENTIFIC COMMITTEE

SC-CAMLR/VII/BG/3	BIRD ISLAND MONITORING PROGRAM J.P. Croxall et al. (UK)
SC-CAMLR/VII/BG/4	BIRK ISLAND. SOUTH GEORGIA. ENVIRONMENTAL ASSESSMENT W.N. Bonner and J.P. Croxall (UK)
SC-CAMLR/VII/BG/7	SURVEY DESIGN TO ESTIMATE KRILL ABUNDANCE DURING FIBEX I. Everson et al. (UK)
SC-CAMLR/VII/BG/9	REPORT TO THE SCIENTIFIC COMMITTEE OF CCAMLR ON THE MEETING OF THE STEERING COMMITTEE FOR THE JOINT CCAMLR/IWC WORKSHOP ON THE FEEDING ECOLOGY OF SOUTHERN BALEEN WHALES D.G.M. Miller and Y. Shimadzu CCAMLR Representatives
SC-CAMLR/VII/BG/15	PRELIMINARY RESULTS OF RESEARCH ACTIVITIES OF RV *EVRIKA* IN THE SCOTIA SEA IN JANUARY–MARCH 1988 L.I. Maklygin et al. (USSR)
SC-CAMLR/VII/BG/17	UNITED STATES SEABIRD RESEARCH UNDERTAKEN AS PART OF THE CCAMLR ECOSYSTEM MONITORING PROGRAM, 1987–1988 W.R. Frazer et al. (USA)
SC-CAMLR/VII/BG/18	PRELIMINARY REPORT OF THE 1987–1988 NMFS ANTARCTIC MARINE LIVING RESOURCES PROGRAM. MARINE MAMMAL AND BIRD FIELD RESEARCH J.B. Bengtson (USA)
SC-CAMLR/VII/BG/19	PHYSICAL OCEANOGRAPHIC SETTING OF THE *SIEDLECKI* JANUARY 1987, SOUTH SHETLAND ISLAND DATA SET A.L. Gordon (USA)
SC-CAMLR/VII/BG/20	PATTERNS AND PROCESSES IN THE DISTRIBUTION AND DYNAMICS OF ANTARCTIC KRILL S.A. Levin, A. Morin and T.H. Powell (USA)

SC-CAMLR/VII/BG/21	JOINT POLISH/AMERICAN HYDROACOUSTIC SURVEY OF ELEPHANT ISLAND AND THE VICINITY OF KING GEORGE ISLAND, 1988 M.C. Macaulay (USA)
SC-CAMLR/VII/BG/22	STATISTICAL PROBLEMS IN KRILL STOCK HYDROACOUSTIC ASSESSMENTS M.C. Macaulay (USA)
SC-CAMLR/VII/BG/31	FORAGING ENERGETICS OF GREY HEADED ALBATROSSES DIOMEDEA CHRYSOSTOMA AT BIRD ISLAND, SOUTH GEORGIA D.P. Costa (USA) and P.A. Prince (UK)
SC-CAMLR/VII/BG/32	AUSTRALIAN RESEARCH ON ANTARCTIC BIRD AND SEAL DIETS R. Williams (Australia)
SC-CAMLR/VII/BG/33	THE POPULATION OF *MIROUNGA LEONINA*, AT STRANGER POINT (25 DE MAYO – KING GEORGE I.) D.F. Vergani, Z.B. Stanganelli (Argentina)
SC-CAMLR/VII/BG/34	ELEPHANT SEAL, *MIROUNGA LEONINA*, STOCK IDENTIFICATION USING DNA FINGERPRINTS D.F. Vergani, C.A. Aguirre and R.V. Rivers Pomar (Argentina)
SC-CAMLR/VII/BG/35	IS THE UNUSUAL PRESENCE OF CALIDRIS FUSCICOLLIS IN ANTARCTICA AN INDICATOR OF ENVIRONMENTAL CHANGE? D.F. Vergani, C.A. Aguirre and D. Montali (Argentina)
SC-CAMLR/VII/BG/40	HYDROACOUSTIC SURVEYS OF THE DISTRIBUTION AND ABUNDANCE OF KRILL: PRYDZ BAY REGION – FIBEX, ADBEX II AND SIBEX II I.R. Higginbottom, K.R. Kerry and S.E. Wayte (Australia)

ANNEX 8

REPORT OF THE INFORMAL GROUP ON THE LONG-TERM PROGRAM OF WORK FOR THE SCIENTIFIC COMMITTEE

REPORT OF THE INFORMAL GROUP ON THE LONG-TERM PROGRAM OF WORK FOR THE SCIENTIFIC COMMITTEE

INTRODUCTION

The Informal Group on the Long-Term Program of Work for the Scientific Committee met on 23 October 1988 immediately prior to the Seventh Meeting of the CCAMLR Scientific Committee.

2. The Convener of the Group, Dr K. Sherman (USA), welcomed participants, who represented most of the members of the Scientific Committee. Dr J. Bengtson (USA) was appointed rapporteur.

3. Dr Sherman reviewed the rationale for the Informal Group's work, and outlined the purpose of the meeting. The ecosystem approach to the conservation and management of Antarctic living marine resources requires a more comprehensive approach to research and monitoring efforts in support of the Convention's objectives than is generally practiced in other international commissions concerned with marine resources.

4. The present emphasis in CCAMLR on studies of the dynamics of fish, krill and dependent and related predator species in relation to the effects of fishing and environmental changes on populations is resulting in considerable scientific activity.

5. Because of the expense and logistic difficulties of conducting assessments, monitoring and directed research in the Antarctic, it is important that the Scientific Committee prepare and annually update long-range plans and short-term annual plans that will encourage effective co-ordination and integration of national research and monitoring activities in support of CCAMLR.

6. Efforts during the past two years to promote planning and co-ordination have resulted in several excellent examples of co-ordinated research programs and collaborative work between two or more countries. Such efforts represent an encouraging movement towards a well integrated research and monitoring effort that is evolving from the needs identified by the various working groups of the Scientific Committee.

7. Recognising the need for promoting further co-ordination of activities, the Scientific Committee during its 1987 meeting agreed that the Informal Group on the Long-Term Program of Work should meet prior to the 1988 meeting of the Scientific Committee to review the 'mechanisms for ensuring that the research activities of Member countries facilitate the work of the Committee' (SC-CAMLR-VI, paragraph 11.8).

PLANNING AND CO-ORDINATION

8. Members participating in the discussion of the long-term program of work concurred that as the activities undertaken by the Scientific Committee become more numerous and complex, it is important to give increased consideration to planning and co-ordination. In this regard, it was agreed that there are three topics to which the Scientific Committee should give particular attention:

(i) obtaining information on national programs' research plans as they relate to CCAMLR

(ii) co-ordination of multinational research, monitoring, and survey efforts, and

(iii) identification and prioritisation of the long-term information needs of CCAMLR (long-term strategy of the Scientific Committee).

9. It was noted that some progress is being made on the first two points listed above, through the compilation of summaries of Members' planned activities as well as through the initiation of joint, collaborative research among some Members. Identifying and prioritising the long-term data requirements of CCAMLR is an area that needs further attention by the Scientific Committee.

INFORMATION ON NATIONAL PROGRAM PLANS

10. The Secretariat kindly provided the Group with two papers to aid its discussions: 'Research Programs of CCAMLR Members for 1988/89, 1989/90 and 1990/91 Seasons', prepared by the Science Officer, and the 'Report of the Informal Group on the Long-Term Program of Work for the Scientific Committee'. A review of the research programs report by meeting participants led to the general conclusion that the summary was incomplete. To update the document, Members were asked to provide more recent information to the Science

Officer no later than Tuesday, 25 October. It was noted that updated information on plans from observer countries would be welcomed. The updated information was collated an redistributed by the Secretariat as SC-CAMLR-VII/BG/48.

11. Mr D. Miller (South Africa) noted that it is difficult for the Secretariat to extract information in sufficient detail from the standard reports of Members' activities. Therefore, the Group agreed that Members should annually prepare and submit to the Secretariat summaries of their plans, as possible, for the next three years. The format to be used should be the same as the one agreed at the Group's 1987 meeting, which provides more details than the standard reports of Members' activities.

12. Representatives from Spain, Poland, USSR, USA and Norway in particular expressed interest in obtaining as much specific information on national plans as possible during the present meeting. This information is considered especially important in assisting scientists and administrators in planning national programs or directed research in support of CCAMLR.

13. Dr T. Lubimova (USSR) suggested that in preparing summaries of plans for future work, it would be useful if Members not only outlined specific activities, but also indicated those research topics felt to be most important from that country's point of view. This information would allow Members to be aware of what research topics are likely to be emphasised by various nations in support of CCAMLR.

CO-ORDINATION OF RESEARCH, MONITORING AND SURVEY EFFORTS

14. Participants expressed considerable support for continuing to explore means for improving the co-ordination of national research and monitoring programs in a manner that would include the Secretariat, the Chairman of the Scientific Committee and Conveners of the Working Groups. The Group expressed an interest in exploring possible means for moving the planning and co-ordination process forward and in addressing this issue during the full meeting of the Scientific Committee under the agenda item relating to long-term planning.

15. The Group agreed that it would be desirable to summarise annually the assessment, monitoring, and other activities considered as high priorities for co-ordinated multi-national participation. It was felt that it would be useful for the Conveners of the various Working Groups to develop these summaries based on their groups' recent discussions.

16. Several Members expressed their view that it would be desirable for the Group to co-ordinate field activities carried out by various nations in support of CCAMLR objectives. Facilitating co-ordination of the scheduling and technical aspects of certain surveys and research activities would promote efficient use of the financial and logistic resources that nations commit to CCAMLR issues.

17. It was noted that co-ordination of various activities (e.g. trawling, surveys, monitoring) should include not only the activities for the forthcoming season but also activities anticipated for future seasons (e.g. 2–5 years).

LONG-TERM INFORMATION NEEDS AND PRIORITIES

18. Several Members noted that within their national programs, it would greatly aid their decisions regarding the selection of research topics in support of CCAMLR if there were a clearer indication from the CCAMLR Scientific Committee as to which topics should be afforded priority. Having a clear indication of priorities would provide a means for countries that are in a position to undertake directed research to adjust their national programs accordingly.

19. Several Members expressed their view that it would be desirable for the Scientific Committee to be more explicit in identifying research needs of high priority. By identifying research priorities more clearly, the Scientific Committee is likely to be in a better position to influence the research topics chosen by national programs by indicating areas of greatest need from the Scientific Committee's point of view.

20. It was suggested that it might be useful to convene a small group routinely to identify and rank by priority the various proposed tasks of the Scientific Committee. It may be desirable for this Group to be composed of the Chairman of the Scientific Committee, the Secretariat, and Conveners of the various working groups.

ANNEX 9

SCIENTIFIC COMMITTEE BUDGET FOR 1989
AND FORECAST BUDGET FOR 1990

SCIENTIFIC COMMITTEE BUDGET FOR 1989
AND FORECAST BUDGET FOR 1990

The Scientific Committee is proposing to undertake five major activities involving expenditure by the Commission in the coming year. One project, the publication of a data manual, for which A$10 500 been included in the forecast 1989 budget has been deferred and the forecast expenditure of A$36 000 for the Ecosystem Monitoring Program in 1989 has been reduced to A$19 000. The total expenditure for 1989 is A$134 800. The expenditure forecast for 1989 in last year's budget was A$170 500.

KRILL CPUE SIMULATION STUDY

2. This study will end in 1989. The workshop will be held in early June in 1989 in the USA. The estimated costs of the work are:

	1989	1990
Consultant's fees	8 000	
Consultant's Travel	8 000	
Translation and publication of Report	14 000	
Administration	2 000	
	A$32 000	Nil

JOINT CCAMLR/IWC WORKSHOP ON THE FEEDING ECOLOGY OF SOUTHERN BALEEN WHALES

3. The Workshop will be held in the United States and involve participation of a number of invited experts who will carry out specified studies in preparation for the workshop.

4. The IWC has estimated the costs of participation of the invited experts at A$ 60 000.

5. The US has made a contribution of US$15 000 towards the cost and in addition has agreed to meet the administrative and computing costs of the workshop.

6. The Scientific Committee proposes to meet the cost of translating and publishing the report of the workshop in sufficient numbers to meet its own needs and to contribute to the cost of participation of the invited experts.

Estimates of the expenditures are:

	1989	1990
Contribution to costs of experts	7 000	
Translation and publication of Report	13 000	
	A$20 000	Nil

MEETING OF THE AD HOC WORKING GROUP ON KRILL

7. This Group was set up at the last meeting and begun its work by correspondence during the past year. The Scientific Committee has agreed that the Group should meet as soon as possible to review and evaluate available information on the distribution and abundance of krill in selected subareas in the Antarctic. This meeting will be held at the same location and immediately before or after the Workshop on the Krill CPUE Stimulation Study.

The estimated costs are:

	1989	1990
Translation and publication of Report	14 000	
Administration	2 000	
	A$16 000	A$17 000

MEETING OF THE FISH STOCK ASSESSMENT WORKING GROUP

8. A meeting of this Group will be necessary in the coming year to assess the status of finfish stocks in the Convention Area. The meeting will be held at the Headquarters.

The estimated costs are:

	1989	1990
Translation and publication of Report	12 000	
Computing	1 000	
Administration	5 000	
	A$18 000	A$19 000

MEETING OF THE WORKING GROUP FOR
THE CCAMLR ECOSYSTEM MONITORING PROGRAM

9. There was no meeting of this Group in 1988. A meeting is necessary during the1989 intersessional period to consider a number of substantive topics including: predator monitoring, protocols for prey monitoring, data handling, experimental design and program coordination. The meeting will be held in Argentina on a date to be decided. During 1988 the Group developed and published Standard Methods Sheets for Monitoring Predators. These will be updated in 1989 to take account of refinements and additional information.

The estimated costs are:

	1989	1990
Translation and publication of Report	12 000	
Administrative costs	5 000	
Update Standard Method Sheets	2 000	
	A$19 000	A$20 000

SECRETARIAT TRAVEL

10. During the next year the Scientific Committee recommends that Secretariat staff undertake the following activities in order to give necessary support to the program:

Data Manager:

- attend a meeting with the Convener and the Chairman to plan for the Fish Stock Assessment Working Group Meeting

- visit ICES for discussions on analytical techniques and to obtain analysis programs,

- attend Krill CPUE Workshop and Meeting of the Working Group on Krill

- visit data centres involved with data similar to that to be collected in the Ecosystem Monitoring Program.

Science Officer:

- attend and provide support for the Ecosystem Monitoring Working Group Meeting.

The estimated costs are:

	1989	1990
	21 000	22 200

Contingency

The Contingency is calculated at 7% of all items.

The estimates are:	8 800	5 500
Sub Total	A$134 800	A$83 700
Less Drawings from the Norwegian Contribution Special Fund	25 100	20 500
	A$109 700	A$63 200

SUMMARY SCIENTIFIC COMMITTEE BUDGET

	1989 A$	1990 A$
Krill CPUE Simulation Study	32 000	0
Joint CCAMLR/IWC	20 000	0
Ad Hoc Working Group on Krill	16 000	17 000
Fish Stock Assessment Working Group	18 000	19 000
Ecosystem Monitoring Program	19 000	20 000
Secretariat Travel	21 000	22 200
Contingency	8 800	5 500
Sub-Total	134 800	83 700
Less Drawings from the Norwegian Contribution Special Fund	25 100	20 500
Total from Commission Budget	A$109 700	A$63 200