FISH RESOURCES

Fish Stock Assessment

4.1   Dr R. Hennemuth presented the report (SC-CAMLR-V/4) of the Ad Hoc Working Group on Fish Stock Assessment, which is attached as Annex 4. The group had met in Hobart from 1 to 5 September under Dr Hennemuth's Chairmanship.

4.2   The Committee noted that considerable progress had been made and thanked the members of the group, the Convener and the Rapporteur (Dr J. Gulland) for their hard work.

4.3   Information required for stock assessment has been available to the group from the current fisheries on most stocks of major importance. There are still, however, some significant shortcomings: these include gaps in the historical data series, lack of detailed catch and effort statistics, non-standard reporting of some length and age data, and the lack of any information other than total catches for some stocks, e.g. *Notothenia guntheri (Patagonotothen brevicauda guntheri)* and *Dissostichus eleginoides*. These gaps seriously inhibit the production of complete and accurate assessments.

4.4   A discussion of the Working Group's conclusions on the status of the stocks was deferred until a discussion of the agenda item 'Advice to the Commission' (paragraphs 4.38–4.65).

4.5   The Working Group had made a number of recommendations concerning future assessments of fish stocks; these concerned routine submission of data, the preparation of assessments, the co-ordination of surveys and the form of the advice on stock assessment matters.

4.6   The Working Group had made the suggestion that in future a different approach to the process of fish stock assessment should be considered. They suggested that initial routine assessments should be prepared by the Secretariat, that these be reviewed and further developed by an expert group which would then distribute a report to the Scientific Committee members for consideration at the next meeting. The Working Group indicated that it did not envisage that a further meeting of the Working Group would be necessary in the immediate future.

4.7   The Scientific Committee, after some extensive discussion of the matter, agreed to the following procedure. Following a specification of priority stocks for future assessment,

routine analysis will be prepared by the Secretariat. The new Convener of the Ad Hoc Working Group, Dr Kock, in consultation with the Chairman of the Scientific Committee and the Secretariat, will decide by 31 July 1987 whether there are sufficient data available to make a meeting of the Group desirable. If it is decided to hold a meeting, it will take place in Hobart just prior to the Scientific Committee meeting.

4.8   The Working Group had recommended that there was a need to co-ordinate fish stock surveys and mesh selectivity experiments in the Convention Area. Dr Sherman (USA) was asked to consult with Members on their plans for surveys and mesh selectivity experiments in the 1986/87 season. The results of this consultation are given in Annex 5.

4.9   It was agreed that it would be desirable to continue co-ordination of surveys and experiments both for the 1986/87 season and for the 1987/88 season. It was agreed that Dr Sherman be asked to consult with Members and to convene a meeting to ensure that both the methods used and the timing and location of the surveys were appropriate to the requirements of fish stock assessment.

4.10   The Working Group had also drawn attention to some problems encountered in framing management advice based on stock assessment work. Such advice should focus on matters relevant to the Convention e.g. degree of depletion, level of replacement yield or the degree to which recruitment had been affected by fishing. These matters cannot always be determined with certainty and the group had suggested that the Scientific Committee might discuss the possibility of introducing some relatively easily measurable criteria for bringing into effect different management measures. For example, these might include closure of a fishery when stock was estimated to be depleted to a specified level, or re-opening of a directed fishery when survey results indicated a recovery. The Scientific Committee noted that such ideas were relevant in the broader context of the Scientific Committee's work and deferred discussion until the Commission had considered the Australian delegation's paper (CCAMLR-V/11).

Further Data Requirements

4.11   The only formal requirement at present for submission of data is that STATLANT A and B forms should be submitted to the Secretariat by 30 September following the fishing season. The Working Group had recommended that the Scientific Committee consider further possible requirements for the routine submission of data. It was agreed that such data should be separated into biological data and data concerning catch and effort. Two small

groups were set up to develop proposals under the convenership of Dr Kock (FRG) [Biological Data] and Dr Shimadzu (Japan) [Catch and Effort Data].

Biological Data

4.12   Biological data including length frequency distributions, age and length data of the commercial catch and the population are also required for stock assessment. These data are normally obtained by sampling the commercial catch and during research vessel cruises. Although such biological data are normally reported in the scientific literature there is often a delay, due to publication time, before they are available. It is therefore recommended that such data as determined in paragraph 4.13 be submitted each year on the same fine spatial and temporal scales as the catch and effort data. Such data should be submitted by September 30 each year.

4.13   To overcome the problems of data not always being reported in accordance with agreed standards (SC-CAMLR-IV/3, p. 79, paragraph 9; SC-CAMLR-V/4, p. 2, paragraph 4), and to ensure that data were in a form suitable for fish stock assessment, the group on biological data recommended that data be reported in accordance with the methods described in BIOMASS Handbook No.13. These are:

Length – total length to the nearest cm below

Weight – total fresh weight (in g)

Maturity Stage – according to the five-point scale in the 1977 review by Everson
(FAO/GLO/SO/77/1)

Age – referring to 1 July as birthday (BIOMASS Handbook No. 8). Method used for
ageing to be stated.

4.14   The Scientific Committee agreed that representative length compositions be identified as coming from commercial or exploratory or research vessel catches and be recorded in 1 cm intervals only (Report of the Ad Hoc Working Group on Fish Stock Assessment 1985, p. 80, paragraph 9). If possible, historical data should be reported in the same way.

4.15   In addition to these data it was suggested that the following be supplied: length-weight relationships that are used in national laboratories to convert length into weight; weight (length) at age; and maturity at age.

4.16   The Scientific Committee recommended that

- the Commission initiate routine annual reporting of these data using the procedures outlined above.

Catch and Effort Data

4.17   It was agreed by the Scientific Committee that Members provide catch data by species and sub-area from the preceding season to the Fish Stock Assessment Working Group or Scientific Committee meetings.

4.18   Data should be recorded on formats already in use since 1985 (formats of Northeast Fisheries Center, Woods Hole Laboratory) and be sent to the Secretariat at least 6 weeks in advance of the next Working Group meeting. It is recommended, however, that the new Data Manager of CCAMLR (in close collaboration with the Convener of the Working Group on Fish Stock Assessment) revise these formats as soon as possible, based on the needs of the CCAMLR data-base and on experience already available in national laboratories and existing fishing conventions. A report on possible revisions should be submitted to the next meeting of the Scientific Committee. Furthermore, it is recommended that the new Data Manager arrange for the transfer of data to the Secretariat data-base by magnetic tapes.

4.19   The group on Catch and Effort Data reported, and the Committee confirmed, that at the Fourth Meeting of the Commission a decision was made regarding the collection and reporting of data from finfish populations (CCAMLR-IV, paragraph 45). The decision specified a detailed list of data to be collected and confirmed that three kinds of data would continue to be submitted: (i) annual updates of the inventory of commercial fishery data, (ii) STATLANT reports for the preceding seasons including separate reporting of effort data for finfish and krill operations, and (iii) to the greatest extent possible, summaries of catch and effort data on a fine scale, specifically on a spatial scale of 0.5° latitude by 1° longitude and a temporal scale of 10 days.

4.20   It was recognised that there is a shortage of fine-scale catch and effort data from commercial fishery operations. Most of the fish stock assessment analyses to date have

tended to concentrate on Virtual Population Analysis as a technique to determine stock trends. Much of the pertinent information for such analyses has been derived from research vessel data. This situation is likely to continue for several years until sufficient annual data, particularly on commercial catch and effort, have been accumulated. It was decided in 1985 that such data will be collected and archived. In the meantime, it is important to ensure that catch and effort data (as listed in paragraph 4.19 (iii)) are collected by all fishing nations. National scientists and the Fish Stock Assessment Working Group should be encouraged to broaden their analyses of Antarctic fish stocks for assessment purposes to the greatest extent practicable.

4.21   Although requirements for the collection of catch and effort data have been elaborated, the form and detail in which they are to be reported to the Scientific Committee for use by its Working Groups has not been determined.

4.22   The Scientific Committee recommended, therefore, that to facilitate the detailed analysis of catch and effort:

- the Commission initiate routine annual reporting of the data on finfish in the detail listed below:

(1)   nationality of fishing vessel
(2)   characteristic of operation; commercial/research
(3)   year, month and ten-day period
(4)   location/code of 0.5° latitude x 1° longitude
(5)   total catch
(6)   catch by species
(7)   number of hauls
(8)   hours fished.

4.23   The deadline for submission of such fine scale catch and effort data from commercial finfish fisheries should be September 30 each year. Formats for the submissions will be prepared and distributed by the Secretariat.

4.24   Dr Slosarczyk (Poland), Dr Lubimova (USSR) and Dr Ranke (GDR) indicated that their countries would have difficulty with reporting data on the scale specified in point (4) of paragraph 4.22.

4.25   In addition to the routine data reporting requirements discussed above (paragraphs 4.13–4.15), the Scientific Committee discussed what data should be sought as a priority during the next year. The Working Group had identified a number of stocks which had been exploited but for which no data were available (SC-CAMLR-V/4, Table 4), and others where data were insufficient for stock assessments to be made. The Scientific Committee agreed that additional data should be submitted in the next year for the following stocks:

Species	Area
Notothenia guntheri	48.3
Notothenia squamifrons	48.3 and 58.4.4

It also noted the need for data on *Dissostichus eleginoides* in all areas.

4.26   Dr Barrera-Oro (Argentina) requested that data on the species *Micromesistius australis* should be submitted.

Fish Age Determination

4.27   Dr T. Lubimova described the progress made by the Age Determination Workshop held in Moscow (14–19 July, 1986). The report of the Workshop had not yet been completed but the Rapporteur, Mr Martin White, was in correspondence with members and the report was expected to be finalised soon. The Scientific Committee expressed its thanks to Dr Lubimova, the Convener of the Workshop, and to the Rapporteur and the participants for their hard work.

4.28   The Workshop had concentrated on the main fish target species of the fisheries in the Convention Area and on *Pleuragramma antarcticum* which is an ecologically important species. Earlier workshops held under the auspices of the BIOMASS program were used as a starting point for the discussions. Material was considered from a wide variety of different structures which were used for comparative age-determination.

4.29   Although the Workshop was not able to reconcile all the problems involved in age determination, considerable progress was made. In summary, the results obtained were as follows:

Species	Material	Comments
Notothenia rossii	Scales	General agreement on ageing up to ages 8–10 but not beyond
Notothenia gibberifrons	Scales/Otoliths	General agreement on ageing up to age 7 but not beyond
Champsocephalus gunnari	Otoliths/Vertebrae	Very subjective with no general agreement
Pleuragramma antarcticum	Otoliths/Bones	Ageing may be possible but insufficient experience is available at this time in dealing with this species

4.30   Further work on these problems, including validation of ageing, will be facilitated by an exchange of material, to be coordinated by Dr Kock (FRG). Dr Kock will synthesise the results received and present a report initially to members taking part in the exchange. The Scientific Committee welcomed this initiative.

4.31   Dr Barrera-Oro (Argentina) referred again to the species *Micromesistius australis* which at irregular intervals migrates into the Scotia Sea area. Because there were discrepancies in the ageing of this species between scientists from different countries, he requested that material from this species be included in the exchange scheme.

Mesh Selectivity

4.32   Dr W. Slosarczyk (Poland) referred to experiments conducted by Polish scientists in the 1978/79 season (SC-CAMLR-V/BG/14). These experiments had been discussed at length by the Working Group (SC-CAMLR-V/4, paragraphs 62–64). Consistent results between different mesh sizes had been obtained for *C. gunnari* and *N. gibberifrons*. These results, however, were obtained with netting material not currently used in the commercial fishery.

4.33   Dr Slosarczyk and Dr Everson were asked to draft guidelines for mesh selectivity experiments. Their report was not received in time for discussion at the meeting. The main conclusions are included in Appendix 1 of Annex 5.

4.34   The clear need for more information on mesh selectivity had been identified at previous meetings of the Scientific Committee. The future plans for selectivity experiments are to be co-ordinated by Dr Sherman (USA) (paragraphs 4.8–4.9).

4.35   Dr T. Lubimova (USSR) drew the Scientific Committee's attention to a document prepared by colleagues in the USSR on the methodology of mesh selection experiments (SC-CAMLR-V/BG/41). It was agreed that a translation of this document would be made available to the Scientific Committee.

Mesh Size Measurement Specifications

4.36   At its last meeting, the Scientific Committee had noted the need for a clear specification of the method to be used for mesh measurement when mesh size regulations were in force.

4.37   It was agreed that it was desirable to have regulations similar to those in force in other fisheries organisations. The Scientific Committee recommended that the Commission incorporate the text of SC-CAMLR-V/8 in its mesh size regulations.

Advice to the Commission

Sub-Area 58.5 (Kerguelen Waters)

4.38   Annual landings of the main commercial fish species from area 58.5 in recent years have been as follows (in metric tonnes):

	1980	1981	1982	1983	1984	1985	1986
N. rossii	1,742	7,924	9,812	1,829	744	1,707	802
N. squamifrons	11,308	6,239	4,038	1,832	3,792	7,394	2,464
C. gunnari	1,631	1,122	16,083	25,852	7,127	8,253	17,137
D. eleginoides	138	40	121	128	145	6,677	459

4.39   The Working Group had reported that management measures applied by the French authorities, including the additional protection afforded to *N. rossii* last season, had halted the decline in the stocks. There is some evidence of a slight recovery in 1986 of the most depleted stock, that of *N. rossii*.

4.40   The Scientific Committee recommended that current Conservation Measures applied by the French Authorities should continue in this area and that the resolutions adopted by CCAMLR should remain.

Sub-Area 58.4.4

4.41   The Working Group had drawn attention to catches in area 58.4.4 amounting to some 10,000 tonnes since 1979, primarily of *N. squamifrons*. No data were available, and accordingly no assessments could be made of these stocks. The Scientific Committee calls the attention of the Commission to the need for data on these stocks so that proper assessments can be made.

Sub-Area 58.4.2

4.42   The Scientific Committee noted that a catch of nearly 1,000 tonnes of *Pleuragramma antarcticum* was taken in area 58.4 (sub-division unknown) in the 1984/85 season, with lesser catches taken in previous seasons. In view of the long coastline included in this area and the relevance of catches of this species to the proposed Prydz Bay study area for ecosystem monitoring, the Committee recommended that more detailed catch statistics and biological data be supplied for this species in all sub-areas of area 58.4.

Sub-Area 48.3 (South Georgia)

4.43   Annual landings of the main commercial fish species from area 48.3 in recent years have been as follow s (in metric tonnes):

	1980	1981	1982	1983	1984	1985	1986
N. rossii	24,897	1,651	1,100	866	3,022	1,891	70
C. gunnari	7,592	29,384	46,311	128,194	79,997	14,148	11,107
N. gibberifrons	8,143	7,971	2,605	0	3,304	2,081	1,679
N. guntheri	7,381	36,758	31,351	5,029	10,586	11,923	16,002

For further data see Table 3 of Report of Ad Hoc Working Group on Fish Stock Assessment, SC-CAMLR-IV/4.

4.44   At its fourth meeting, the advice provided by the Scientific Committee was that both directed and incidental catches from the depleted *N. rossii* stock should be kept to as near to zero as possible until there was evidence from experimental surveys that the stock is increasing (SC-CAMLR-IV, paragraph 4.68) and that a total prohibition on fishing in this area was the only way to ensure no catch of *N. rossii* (SC-CAMLR-IV, paragraph 4.70).

4.45   The Ad Hoc Working Group on Fish Stock Assessment had reported (SC-CAMLR-V/4 para 74) that:

  (a)   The stock of *N. rossii* was confirmed to be severely depleted.

  (b)   The stocks of *C. gunnari* and *N. gibberifrons* were currently well below their initial level and the combined replacement yield of these species plus those of *Chaenocephalus aceratus* and *Pseudochaenichthys georgianus* is small no more than a few thousand tonnes.

4.46   In the light of these results, the Scientific Committee recommended that the Commission take steps to ensure recovery of the fish stocks from their present status. In this regard it recommended as follows:

4.47   •   the current Conservation Measures for *N. rossii* should be maintained and that the resolution applying to the by-catch for this species in this area should be adopted as a Conservation Measure.

The Scientific Committee noted that the Fish Stock Assessment Working Group has estimated that the stock of *N. rossii* could be expected to increase in the absence of catches at a rate of approximately 30% per year. This projection implies that, in the absence of fishing, an improvement in the stock of *N. rossii* should be measurable from a series of several annual trawl surveys, along the lines of those conducted in 1984/85 (SC-CAMLR-IV/3).

4.48 • the current Conservation Measure involving the prohibition of fishing within 12 miles of the coast and current mesh regulations should remain.

4.49 In the case of *C. gunnari* and *N. gibberifrons*, the Scientific Committee recommended:

• the Commission consider the following possible management options which offer different degrees of protection and hence potential recovery rates for these stocks:

(1) A closure of the fishery in the area 48.3 to all fishing for a period of one year or more.

This option should ensure the greatest protection to the stocks which were estimated by the Working Group to be well below the level of their maximum net productivity.

(2) Prohibit a directed fishery on these stocks and keep the by-catch of these species as low as possible.

This option should ensure rapid recovery of the stocks which were estimated by the Working Group to be well below the level of their maximum net productivity.

(3) Specify that catch levels for these species be small and compatible with a recovery of the stocks. In this context it was suggested that catches of these species, together with catches of *C. aceratus* and *P. georgianus*, should be less than the estimated replacement yield of a few thousand tonnes.

This option should avoid further depletion of the stocks while permitting the fishery to continue.

A specific suggestion was that catch levels should be no more than had occurred in the 1985/86 season. This suggestion if adopted, would have the least effect on the fishery while limiting the risk of further depletion of the stocks.

4.50   In the case of *C. gunnari* a further option was identified, namely that the Commission considers:

- imposing no restrictions on catch levels, but relies on the current Conservation Measures and resolutions (including mesh regulations) to ensure conservation of the stock.

This option would allow a fishery to continue on *C. gunnari* while permitting an escapement of a proportion of sexually mature fish. Analysis of preliminary selection experiments had indicated that the mean length at first capture was close to the optimal, given the known growth and mortality parameters.

4.51   The Scientific Committee also discussed the possibilities of a multi-species approach to management measures in this area. However, it was not able to examine specific multi-species management options as sufficient data on all stocks, as well as on the detailed location of the fisheries for different species, were not available.

4.52   A particular problem in this respect concerned the fishery for *N. guntheri* around Shag Rocks. No data were available to assess this stock and hence the effect of different management measures could not be assessed. It was noted that because of the localised nature of this fishery, its continuation should be compatible with a low by-catch of other species.

Sub-Area 48.1 (Peninsula)

4.53   Annual landings of the main commercial fish species from area 48.1 in recent years have been as follows (in metric tonnes):

	1980	1981	1982	1983	1984	1985	1986
N. rossii	18,763	0	0	0	0	0	0
*C. gunnari**	1,087	1,700	0	2,604	0	0	0
N. gibberifrons	765	50	0	0	0	0	0

in 1979: 35,930 t; in earlier years: 0

4.54   The Working Group had reported that knowledge of the state of the stocks in the area is still poor. *N. rossii* is probably well below its initial abundance, and the abundance of

C. gunnari dropped after heavy fishing in 1978/79. There was no evidence to indicate that *N. gibberifrons* had been significantly affected by fishing.

4.55   There was no fishery in this area during the last season.

4.56   The Scientific Committee recommended that the Commission consider extending to a full Conservation Measure its resolution to Members to avoid a directed fishery for *N. rossii* in this area.

Sub-Area 48.2 (South Orkneys)

4.57   Annual landings of the main commercial fish species from area 48.2 in recent years have been as follows (in metric tonnes):

	1980	1981	1982	1983	1984	1985	1986
N. rossii	1,722	72	0	0	714	58	0
*C. gunnari**	5,231	1,861	557	5,948	4,499	2,361	2,682
N. gibberifrons	1,398	196	589	1	9,160	5,722	341

* 1978: 138,895 and 1979: 21,434 t; earlier years: 0

4.58   The Scientific Committee noted that the Commission had at its last meeting requested Members to refrain from a directed fishery for *N. rossii* in the area.   The Scientific Committee recommended that the Commission consider extending this request into a full Conservation Measure.

4.59   The Working Group had reported that the abundance of the main species in the catch, *C. gunnari*, is highly dependent on year class strength and is very much lower than when fishing started in 1977. *N. gibberifrons* is moderately heavily fished.

4.60   In discussion of the Working Group's assessment of the stock of *C. gunnari* two views emerged which have rather different implications for management.

4.61   One view accepted the assessment performed by the Working Group.

4.62   The other view was that except in special oceanographic circumstances which produce stable concentrations of krill (the food of *C. gunnari*), *C. gunnari* do not occur in dense concentrations in the area. These oceanographic conditions might have occurred only

during the period of heavy catches in 1977/78 and to a lesser extent in 1978/79. Dr Lubimova (USSR) described the experience of Soviet fisheries including aspects of the distribution of krill. These considerations lead to an alternative to the Working Group's assessment. However, no data were submitted to the Working Group to support this view.

4.63   If the Working Group's assessment is correct, the stock of *C. gunnari* is currently substantially below the level prevailing at the start of the fishery, and well below the level of maximum net productivity. In this case some management action is desirable. Some possible options identified for management were:

(1)   Prohibit a directed fishery on this stock and keep the by-catch of this species as low as possible.

This option should ensure the rapid recovery of *C. gunnari*, which was estimated by the Working Group to be well below the level of maximum net productivity.

(2)   Specify that catch levels on this species be sufficiently small to avoid further reduction in the stock.

This option should ensure that further declines in the stock are not the result of excessive fishing.

4.64   If the view outlined in 4.62 is correct, the situation is uncertain. For example, there is no evidence to indicate whether the stock is below its level of net maximum productivity or not.

4.65   It was not possible for the Scientific Committee to reach a unanimous view on which of the two possibilities was considered to most closely   reflect the true situation.

General Points

4.66   Dr Y. Shimadzu (Japan) commented that the high variability in recruitment of the species *C. gunnari* made its management extremely difficult. He therefore stressed the necessity of research on year class strength.

4.67   In order to reduce the current levels of uncertainty, the Scientific Committee recommended that co-ordinated surveys aimed at providing independent estimates of stock biomass should be encouraged (paragraphs 4.8–4.9).