HARVESTED SPECIES

Krill

CCAMLR-2000 Survey

5.1 The Scientific Committee noted with pleasure WG-EMM's report of the success of the CCAMLR-2000 Survey of Subareas 48.1, 48.2, 48.3 and 48.4 which had been carried out in January–February 2000. The survey involved ships from Japan, Russia, UK and the USA. This survey had been the largest operation ever mounted in support of CCAMLR activities and was a significant milestone in the work of the Scientific Committee. The Scientific Committee congratulated the organisers of the survey and of the subsequent workshop which had achieved a considerable task of surveying such a large area and of estimating B_0 in such a timely fashion.

Krill Length-frequency Data, Biomass and Distribution from Area 48

5.2 A considerable amount of information on krill length frequencies, biomass and distribution had been collected by the CCAMLR-2000 Survey and by complementary later surveys in Area 48, as well as through the analysis of predator diets and from fisheries data during the austral summer of 1999/2000 (Annex 4, paragraphs 2.36 to 2.63). The Scientific Committee noted the complexity of this information which reflected variability at a number of time and space scales and endorsed WG-EMM's suggestion that these and other datasets be analysed at workshops during 2001.

Krill Length-frequency Data, Biomass and Distribution from Area 88

5.3 WG-EMM had examined data on krill biomass and demography from the Ross Sea (Annex 4, paragraphs 2.74 to 2.78). The Scientific Committee endorsed the Working Group's encouragement of the conduct of a standardised krill acoustic biomass survey in the Ross Sea, an area for which there was currently no precautionary catch limit. The designs and protocols of this survey should be submitted to WG-EMM for prior approval as had been done for the Australian survey of Division 58.4.1 and for the CCAMLR-2000 Survey.

Estimates of B_0, Potential Yields and Precautionary Catch Limits

5.4 The Scientific Committee reviewed the deliberations of WG-EMM on the derivation of a new krill biomass estimate and associated CV for Area 48 based on the results of the CCAMLR-2000 Survey (Annex 4, paragraphs 2.84 to 2.111). The biomass estimate of 44.29 million tonnes and the CV of 11.38% were endorsed as the best available for Area 48.

5.5 The potential yield of krill in Area 48, had been calculated by WG-EMM using the revised biomass and CV and no other new input parameters. The GYM had produced a γ of 0.091 resulting in a potential yield of 4.0 million tonnes which was endorsed by the Scientific Committee as the best available advice on a precautionary catch level for Area 48.

5.6 The Scientific Committee noted the revised biomass estimate for krill in Division 58.4.1 (Annex 4, paragraphs 2.36 to 2.63). The revised biomass of 4.83 million tonnes (CV 17%) differs from the earlier estimate (6.67 million tonnes, CV 27%) largely because of a recalculation of the effect of sound absorption during the survey. The Scientific Committee endorsed this new biomass estimate.

5.7 The potential yield of krill in Division 58.4.1, had been calculated by WG-EMM using the revised biomass and CV and no other new input parameters (Annex 4, paragraphs 2.112, 2.113 and 6.6). The GYM had produced a γ of 0.091 resulting in a potential yield of 0.44 million tonnes which was endorsed by the Scientific Committee as the best available advice on a precautionary catch limit for Division 58.4.1.

Subdivision of Precautionary Catch Limits

5.8 The Scientific Committee endorsed WG-EMM's assessment of the requirement for subdivision of potential yields as a precautionary measure in order to distribute fishing effort and thereby reduce the potential impact of fishing on land-based predators (Annex 4, paragraph 2.114).

5.9 Accordingly, the Scientific Committee endorsed the subdivision of the potential yield in Area 48 based on the proportion of survey transects in each subarea.

Subarea	Potential Yield (million tonnes)
48.1	1.008
48.2	1.104
48.3	1.056
48.4	0.832

5.10 The Scientific Committee noted WG-EMM's deliberation on subdivision of the potential yield of krill in Division 58.4.1 (Annex 4, paragraphs 2.120, 2.121 and 6.7 to 6.10). Evidence from the 1996 Australian survey had indicated that the biomass of krill in the east of Division 58.4.1 (115–150°E) was only half of that found in the west of the division (80–115°E) and that these two areas were oceanographically distinct.

5.11 The calculated potential yields for Division 58.4.1 west was 0.277 million tonnes and that for Division 58.4.1 east was 0.163 million tonnes. Dr Naganobu indicated, however, that while he was not opposed in principle to a subdivision of Division 58.4.1 the use of oceanographic data to subdivide areas required further consideration. Consequently he could not agree to the proposed subdivision of the potential yield in Division 58.4.1 at this time.

5.12 Some Members suggested that in the absence of a mechanism for subdividing the potential yield in this division, the Commission should adopt a procedure such as that which had been agreed for the precautionary limit for krill in Area 48 in 1991 and which is contained in Conservation Measure 32/X. This would involve a 'trigger level' of catch above which the overall yield would have to be subdivided into smaller management areas. It was suggested that an appropriate level for this 'trigger' might be 0.163 million tonnes (the calculated potential yield for Division 58.4.1 east) which is the level at which the Commission could be assured that krill in the east of the division would not be in danger of being overfished. For further discussion on trigger levels see section 7.

5.13 The Scientific Committee noted that the concept of a 'trigger level', above which further subdivision of the Area 48 catch limit would occur, is reflected in Conservation Measure 32/X which has stood since 1991.

5.14 The Scientific Committee noted that precautionary catch limits are levels that the catch should not exceed in relatively large statistical areas or divisions. The further division of statistical areas into smaller management units is a separate requirement to take into account the localised demands of land-based predators. Both approaches will be necessary as part of a precautionary management strategy.

5.15 WG-EMM had indicated that it may take five to 10 years before a full management procedure for krill was in place (Annex 4, paragraph 4.117). Consequently, the Scientific Committee recommended as a matter of priority that WG-EMM provide guidelines for methods to subdivide the krill potential yield in all areas as a precautionary measure to avoid concentrating fishing effort in small but critical areas, and to consider the level at which appropriate 'trigger levels' might be set.

5.16 There is evidence of significant changes in populations of a number of vertebrate species and of krill throughout the South Atlantic region. The spatial and temporal scales of these changes will have to be taken into account when deciding on the suite of management measures adopted.

Development of the GYM

5.17 The Scientific Committee endorsed the recommendation of WG-EMM that the documentation of the KYM and GYM should be completed and that this process should include a description of the input parameters and their characterisation (Annex 4, paragraph 2.110). This process should be coordinated in the Secretariat by the CCAMLR Data Manager.

5.18 Because of the mutual interest of WG-EMM and WG-FSA in the assessment work and particularly in the development of the GYM, it was suggested that the Convener of the WG-FSA subgroup on methods (Dr Constable) circulate a letter to participants in WG-EMM inviting their input to the work of this subgroup (Annex 5, paragraph 10.9(iv)).

Future Analysis of the CCAMLR-2000 Survey

5.19 The Scientific Committee endorsed the terms of reference and membership of the CCAMLR-2000 Survey Analysis Steering Group (Annex 4, Appendix F). A proposal to hold a workshop to further the analyses in May–June 2001 at the British Antarctic Survey, Cambridge, UK, was welcomed (SC-CAMLR-XIX-BG/30). Involvement of the IWC in this workshop was encouraged and CCAMLR involvement in a proposed IWC workshop in late 2001 was also recommended. The Scientific Committee noted that, because of the volume of data collected by the CCAMLR-2000 Survey, there would probably be requirements for further workshops to coordinate the publication of results.

5.20 The Scientific Committee endorsed the holding of the proposed third International Coordination Workshop to further collaborative analysis of ancillary data collected by vessels from Japan, Republic of Korea, Peru and the USA in Area 48 during 1999/2000 (Annex 4, paragraph 2.124).

5.21 A proposal by Dr B. Bergström (Sweden) to coordinate an ad hoc subgroup on population genetics was endorsed (Annex 4, paragraph 2.131).

5.22 The Scientific Committee recognised the need for further studies into improving the precision and accuracy of acoustic surveys to assess the abundance and dispersion of krill (Annex 4, paragraphs 2.127 and 2.128).

5.23 Efforts should be made to analyse acoustic data with the objectives of estimating the abundance and dispersion of myctophid fish which may be part of an alternative food web to krill (Annex 4, paragraphs 2.132 and 4.46).

Advice to the Commission

5.24 The new estimates of B_0 (44.29 million tonnes) potential yield and precautionary catch limit (4 million tonnes) for Area 48 should be accepted as the best available (paragraphs 5.4 and 5.5).

5.25 The subdivision of the potential yield in Area 48 to subareas, as outlined in paragraph 5.9, should be accepted. (For advice on trigger levels to smaller scale subdivision see paragraphs 7.21 to 7.24.)

5.26 The new estimates of B_0, (4.83 million tonnes), potential yield and precautionary catch limit (0.44 million tonnes) for Division 58.4.1 should be accepted as the best available (paragraphs 5.6 and 5.7).

5.27 The Scientific Committee reiterated its advice from last year (SC-CAMLR-XVIII, paragraph 5.14) that investigations into alternative methods of subdividing the krill potential yield as a precautionary measure to avoid concentrating fishing effort was viewed as a matter of priority for the work of WG-EMM.

5.28 The Scientific Committee recommended that krill biomass surveys using standard protocols should be conducted in other areas as soon as is practical. These areas should include regions where fishing has occurred in the past such as the Ross Sea (Subareas 88.1 and 88.2) and Division 58.4.2, as well as in ecologically important areas where no fishing has yet occurred, such as in the vicinity of Bouvet Island (Subarea 48.6) (Annex 4, paragraph 6.23).

Fish Resources

Fish and Squid Biology/Demography/Ecology

5.29 The Scientific Committee welcomed a number of important contributions on *D. eleginoides* and *D. mawsoni* which had been presented to WG-FSA (Annex 5, paragraphs 3.66 to 3.120). These included information on differences in age determination based on scales and otoliths, genetic techniques to separate stocks and identify fillets of *D. eleginoides* and *D. mawsoni* to species, and reproductive investigations on *Dissostichus* spp. ovaries.

5.30 The Scientific Committee noted the conclusions in paragraph 3.68 of WG-FSA's report (Annex 5) that otoliths provide a better estimation of age than scales for *Dissostichus* spp. and should be used for future age studies. The Scientific Committee endorsed the establishment by WG-FSA of an intersessional subgroup to review the biology and demography of species considered by the Working Group, as outlined in Annex 5, paragraph 10.9(v).

5.31 The Scientific Committee stressed that work to refine and validate age-determination methods, including the validation of annual formation of rings in otoliths, is of the highest priority for future assessments.

5.32 The Scientific Committee noted that differences may exist in the growth patterns of *D. eleginoides* between the sexes, and this is not taken into account in the assessment. The Scientific Committee endorsed the conclusion of WG-FSA that high priority should be given to the construction of separate growth curves for males and females of *D. eleginoides*, and techniques to integrate these patterns into the assessment model should be explored.

5.33 Observations made during recent surveys and commercial fishing in Subarea 48.3 indicated that large schools of *C. gunnari* were present pelagically by day. In addition, schools that were present on, or close to, the bottom often extended up to 50 m above the seabed. Such schools are very poorly sampled by bottom trawls used for assessment surveys.

5.34 The Scientific Committee noted other information on the mortality of, and physical damage to, crabs, taken in the experimental pot fishery for *D. eleginoides*.

Developments in Assessment Methods

5.35 The Scientific Committee welcomed the introduction of new or extended assessment methods (Annex 5, paragraphs 3.121 to 3.131). While some of these were not immediately useable by WG-FSA, the Scientific Committee was pleased by the number of new ideas coming forward. These new methods include techniques for integration of CPUE into the GYM models, a method to integrate environmentally driven distributions of fish stocks into the GYM, a method to assess the harvested population based on data from a tag–recapture experiment, and a method to estimate jointly recruitment and natural mortality from a time series of abundance of year classes.

Assessments and Management Advice

Assessed Fisheries

Dissostichus spp.

5.36 Assessments of long-term annual yield were reviewed for Subarea 48.3 and Division 58.5.2. Several input parameters to the GYM were reassessed, and new estimates of parameters were generated for Subarea 48.3 and Division 58.5.2. These assessments are detailed in Annex 5, paragraphs 4.103 to 4.178.

D. eleginoides at South Georgia (Subarea 48.3)

Standardisation of CPUE

5.37 Analysis of CPUE data was undertaken for Subarea 48.3 using the GLM, where new longline haul-by-haul data were available from the 1999/2000 season for vessels operating in Subarea 48.3. Details of the standardisation of the CPUE at South Georgia are described in Annex 5, paragraphs 4.109 to 4.117.

5.38 The Scientific Committee endorsed the CPUE analysis undertaken by WG-FSA this year, including the following modifications:

(i) the use of newly reported historical data for Ukrainian vessels operating in Subarea 48.3 in the seasons 1985/86 to 1988/89 and 1990/91; and

(ii) a reduction in the number of statistically significant effects.

5.39 The Scientific Committee noted that the adjusted, standardised catch rates declined substantially between 1994/95 and 1996/97, but have increased each season since then. The Scientific Committee also noted the trend in recent seasons towards increased longline fishing at shallow depths (300–700 m) has continued in the 1999/2000 season, particularly to the north of Shag Rocks.

Size at Capture

5.40 The Scientific Committee noted the declining modal length of catch-weighted length frequencies around South Georgia and Shag Rocks. This decline may be a result of a change in the size composition of the stock, a change in the fishing pattern, or both. As the smaller fish tend to be found in shallower water, the Scientific Committee recognised that the fishery may have moved into shallower depths in order to target the newly recruited and smaller fish.

Determination of Long-term Annual Yield using the GYM

5.41 The Scientific Committee endorsed the analysis undertaken by WG-FSA to revise the estimate of long-term annual yield using the GYM, with standardised CPUE being integrated into the final calculation of long-term yield, and data on recruitment from an extended series of trawl surveys.

5.42 The Scientific Committee noted that the selectivity pattern of *D. eleginoides* captured in the experimental pot fishery was not substantially different to the longline fishery, and endorsed the combination of catches from both fishing methods in the assessments.

5.43 The Scientific Committee was concerned about the uncertainty in the parameters for growth and the effect they may have on the assessments. A number of alternative approaches were examined by WG-FSA based on a re-evaluation of recruitment and natural mortality (M) (Annex 5, paragraphs 4.130 to 4.142). The Scientific Committee endorsed the use of the k value from last year's assessment pending further work to refine information on age and growth.

5.44 The Scientific Committee discussed the complexity of the relationships between growth, M and recruitment. The Scientific Committee recognised that the complex nature of these relationships precluded the presentation of a simple relationship between M and long-term yields computed by the GYM. However, the Scientific Committee noted that in the analyses conducted this year by WG-FSA, a reduction in M led to an increase in long-term yield, and the current estimate of yield was at the lower end of the range of values calculated this year.

5.45 During the course of the Scientific Committee meeting, an error was detected in the assessment of *D. eleginoides* in Subarea 48.3 in relation to the time series of recruitments used in the GYM (Annex 5, Table 33). The series included an estimate of the number of recruits from the 1998 year class (age-4 recruits in year 2002). This was based on the number of 1-year-old fish from the UK survey in 2000. Because fish of this size range tend to be very poorly represented in trawl survey samples, they are customarily not used in the estimation of recruitment.

5.46 The recruitment estimate in year 2002 was therefore deleted from the recruitment series in Annex 5, Table 33, mean recruit recomputed, and the GYM run with the corrected values. Annex 5, Table 34 is updated as follows: the mean $\log_e$(recruits) = 14.4813; the SE of mean $\log_e$(recruits) = 0.209; and the SD $\log_e$(recruits) = 0.783. The Scientific Committee endorsed these corrections to the assessment.

5.47 The estimate of yield from the GYM was 4 500 tonnes, with a median escapement of 0.54. Because of the reduced level of recruitment, this yield was lower than results obtained at last year's meeting (5 310 tonnes).

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

5.48 The Scientific Committee welcomed the considerable progress made at this year's meeting in refining the data inputs into the GYM, particularly with respect to incorporating a time series of recruitments and integrating the CPUE series into the assessment model. The Scientific Committee encouraged the continued development and testing of methods to integrate different indicators of stock status into assessments.

5.49 The Scientific Committee agreed that the estimate of yield from the revised GYM analysis (4 500 tonnes) should be used to set the catch limit for the 2000/01 season. Other management measures for *D. eleginoides* in Subarea 48.3 in the 2000/01 season should remain as for the 1999/2000 season.

5.50 Any catch of *D. eleginoides* taken in other fisheries in Subarea 48.3, such as the proposed pot fishery, should be counted against this catch limit.

D. eleginoides at South Sandwich Islands (Subarea 48.4)

5.51 Despite a catch limit of 28 tonnes for *D. eleginoides* (Conservation Measure 156/XVII), no fishing in this subarea was reported to the Commission during the 1999/2000 season. No new information was made available to WG-FSA on which to base an update of the assessment.

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

5.52 WG-FSA was unable at this year's meeting to consider the period of validity of the existing assessment. Therefore the Scientific Committee recommended that Conservation Measure 156/XVII be carried forward for the 2000/01 season. As last year, it was also recommended that the situation in this subarea be reviewed at next year's meeting with a view to considering the period of validity of the existing assessment.

D. eleginoides at Ob and Lena Banks (Division 58.4.4)

5.53 The Scientific Committee noted that new data from surveys were made available for Ob and Lena Banks, though due to limited time, these were not rigorously analysed. The Scientific Committee recommended that these data be analysed at the next WG-FSA meeting as they represent potentially valuable information for the evaluation of *D. eleginoides* stock status in Division 58.4.4.

D. eleginoides at Kerguelen Islands (Division 58.5.1)

5.54 A standardisation of CPUE of longline vessels was performed for the first time on data from Division 58.5.1 using the GLM. Results showed that the adjusted and standardised catch rates have increased between the 1996/97 and 1998/99 fishing seasons, while they decreased during the last two seasons, from 1998/99 to 1999/2000.

5.55 The Scientific Committee was informed that recent trawling operations for *D. eleginoides* around Kerguelen had yielded progressively smaller catches, and an increasing proportion of the catch is being taken using longline gear.

5.56 Prof. Duhamel regretted that it had not been possible for a French scientist to attend this year's meeting of WG-FSA. However, he noted that fine-scale data are currently provided to the Secretariat, and that these data could be useful for assessment purposes. Due to some concerns with respect to confidentiality, detailed haul-by-haul data from the Kerguelen EEZ have not been submitted to CCAMLR.

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

5.57 The French authorities have provided information that trawling and longlining will be conducted during the 2000/01 season. A decrease in fishing effort by trawling will continue, as previously decided.

5.58 The Scientific Committee discussed the role of WG-FSA in assessment decisions regarding fisheries for *D. eleginoides* in Division 58.5.1. At present, WG-FSA has a very limited capacity to conduct assessments or give advice concerning *D. eleginoides* population status or exploitation in Division 58.5.1. The Scientific Committee recommended that additional data be made available to WG-FSA for assessment purposes. The Scientific Committee also recommended that the presence of a French scientist would be highly beneficial at WG-FSA, and would greatly add to the understanding of the state of *D. eleginoides* stocks in Division 58.5.1.

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

5.59 The catch limit of *D. eleginoides* in Division 58.5.2 for the 1999/2000 season was 3 585 tonnes (Conservation Measure 176/XVIII) for the period 1 December 1999 to the end of the Commission meeting in November 2000. The catch reported for this division at the time of WG-FSA was 3 008 tonnes.

5.60 The analysis of long-term annual yield was updated with the estimated catch to the end of the season (the current catch limit plus the estimated IUU catches) taken from Division 58.5.2, new recruitment estimates, and the use of the recruitment time series in the GYM (Annex 5, paragraphs 4.170 to 4.174).

5.61 The Scientific Committee endorsed the analysis undertaken at this year's meeting of WG-FSA, including the carrying forward of parameters for growth, natural mortality, maturity and fishing selectivity from the 1999 assessment. The Scientific Committee agreed that the use of a range of M was appropriate due to uncertainties remaining in this parameter.

5.62 The Scientific Committee endorsed the estimate of long-term annual yield of 2 995 tonnes resulting from the decision rule concerning the probability of depletion. The median escapement for this level of catch was 0.547.

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

5.63 The Scientific Committee recommended that the catch limit by trawling for Division 58.5.2 in the 2000/01 season be revised to 2 995 tonnes, representing the long-term annual yield estimate from the GYM.

General Advice on *D. eleginoides* Assessments

5.64 The Scientific Committee expressed concern regarding the continuing level of uncertainty in many of the parameters used in the assessments, such as growth and natural mortality. Although some uncertainties have been taken into account, for example, using ranges of parameters in the assessments, there are critical decisions to be made at different stages in the work of WG-FSA. For example, the assessment of *D. eleginoides* in Subarea 48.3 required choosing between different options regarding growth and natural mortality.

5.65 The Scientific Committee recognised that taking full account of such uncertainties in the assessment process will require further work and sensitivity analyses during the intersessional period. It considered this to be an urgent priority.

5.66 The Scientific Committee requested that WG-FSA seek to develop selectivity functions for trawl surveys in all areas where *Dissostichus* spp. are targeted.

5.67 Regarding annual changes in the estimate of long-term annual yield, the Scientific Committee noted that this resulted in part from adjustment of the recruitment parameters in *D. eleginoides* assessments in Subarea 48.3 and Division 58.5.2. Changes in these parameters are expected from one year to the next in the early years of monitoring using trawl surveys. Figure 23 in WG-FSA's report (Annex 5) suggested that only after estimates of abundance for 15 to 20 cohorts have been obtained can it be expected that recruitment parameters will not change appreciably. Even then estimates may still be biased and result in some adjustments over time.

5.68 The Scientific Committee discussed the need for greater detail in the presentation of yield estimates, for example in the form of confidence limits. However, the Scientific Committee also noted that the current method of examining probabilities in achieving management objectives takes into account a level of confidence about the recommended yields. The Scientific Committee noted the importance of conveying to the Commission the probability of achieving management objectives.

5.69 Given the complexity of the current assessment techniques, there is a potential for error to creep into the quantitative process. The Scientific Committee requested that assessment checklists should be prepared by the Secretariat, in conjunction with WG-FSA, to minimise this potential in the future work of the Working Group.

5.70 Because the quantitative techniques used by WG-FSA have evolved into their current level of complexity, and these techniques sometimes involve non-standard fishery methods, the Scientific Committee recommended that formulas and guidelines for the various components of the assessment be thoroughly documented by the Secretariat in conjunction with WG-FSA.

5.71 The Scientific Committee agreed that much of the work performed at WG-FSA is time consuming, and that every effort should be made to accomplish as much as possible intersessionally. However, due to the fact that much of the data required for the assessment are presently submitted just prior to or at the meeting itself, many of the tasks can only be performed at the time of WG-FSA. The Scientific Committee again emphasised the importance of submitting data in accordance with reporting deadlines to allow for analysis as early as possible.

C. gunnari at South Georgia (Subarea 48.3)

5.72 The Scientific Committee noted that for the first time since the 1989/90 fishing season there had been substantial commercial fishing for *C. gunnari* in Subarea 48.3. Two vessels caught a total of 4 114 tonnes between 11 December 1999 and 31 January 2000.

5.73 WG-FSA undertook a new assessment of the fishery on the basis of catch/effort and biological data from the commercial fishery, including the reports of CCAMLR international scientific observers, and reports and data from two scientific bottom trawl surveys in January and February 2000, by the UK and Russia respectively.

5.74 The short-term projection method used at the last two meetings of WG-FSA was used, updated with the new information on biomass and age structure from the scientific surveys. Whilst endorsing the use of this method, the Scientific Committee noted the advice of WG-FSA that this is an interim approach, used to ensure there is a low probability of depleting the stock in the short term, and increased efforts should be made to address the issue of a longer term approach management of *C. gunnari* fisheries in the Convention Area (paragraph 5.91).

5.75 With a projected fishing mortality of 0.14, the catch limit satisfying the criteria in the projection was 11 895 tonnes over two years. This was made up of 6 760 tonnes in the first year (1 December 2000 to 30 November 2001) and 5 135 tonnes in the second year (1 December 2001 to 30 November 2002).

5.76 The Scientific Committee noted evidence presented to the meeting of WG-FSA that there was high variation in observed biomass of *C. gunnari* from bottom trawl census surveys carried out in various years. These differences in stock estimates could have been, at least in part, due to changes in behavioural patterns of the fish from year to year, especially vertical distribution. The Scientific Committee noted that there was an urgent need to assess patterns of vertical distribution and movements of *C. gunnari* under different circumstances and to seek improvements to the methodology of census surveys for this species, for example, involving acoustic equipment and pelagic fishing gear.

5.77 The Scientific Committee endorsed the advice of WG-FSA that the closed season adopted last year for the *C. gunnari* fishery in Subarea 48.3, to protect fish during the spawning season, should remain in place. In this regard, the Scientific Committee noted the discussion by the Working Group of the need to consider predator requirements and whether a closed season might be appropriate during peak periods of predator foraging activity. The Scientific Committee recommended that this and other topics be considered more fully by WG-FSA during a Workshop on Assessment Methods for Icefish (WAMI) recommended to take place during the intersessional period (paragraphs 5.91 and 5.92).

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

5.78 The Scientific Committee endorsed the advice of WG-FSA regarding the management of the *C. gunnari* fishery in Subarea 48.3 during the 1999/2000 season.

5.79 The total catch limit should be revised to 6 760 tonnes for the period 1 December 2000 to 30 November 2001, with the closed season remaining the same as last year (1 March to 31 May 2001).

5.80 Other management measures for *C. gunnari* in Subarea 48.3 set for the 1999/2000 season, as detailed in Conservation Measure 175/XVIII, should remain in force.

C. gunnari at Kerguelen Islands (Division 58.5.1)

5.81 The Scientific Committee noted the advice of WG-FSA that no new data were available for *C. gunnari* in Division 58.5.1. No commercial fishing for *C. gunnari* took place in this division during the 1999/2000 season and only fine-scale data from surveys had been available to the Working Group.

5.82 Prof. Duhamel reported to the meeting that a survey had been carried out by France in March–April 2000, but virtually no *C. gunnari* had been observed. The intention of the French authorities is that the fishery for *C. gunnari* will remain closed until a survey indicates there are sufficient concentrations to support renewed commercial activity. A survey is planned to take place during 2000/01.

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

5.83 The Scientific Committee endorsed the advice of WG-FSA that prior to any resumption of commercial fishing a survey of *C. gunnari* abundance should be conducted and the results analysed by the Working Group.

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

5.84 The commercial catch of *C. gunnari* in the 1999/2000 fishing season was 39 tonnes out of a catch limit of 916 tonnes. The strong cohort detected in a survey in 1998, now aged 4, had almost disappeared.

5.85 The Scientific Committee noted that a survey conducted on the Heard Island Plateau and Shell Bank in May 2000 detected a high abundance of principally 2-year-old fish on the Heard Plateau, but very few fish on Shell Bank.

5.86 The Scientific Committee endorsed the acceptance by WG-FSA of an assessment of yield over the next two years presented to the Working Group. This assessment had used the short-term projection methodology used previously, adopted during the 1997 meeting and used for the assessment of yield of this species in Subarea 48.3.

5.87 With a projected fishing mortality of 0.14, the catch limit satisfying the criteria in the projection was 2 150 tonnes over two years. This was made up of 1 150 tonnes in the first year (1 December 2000 to 30 November 2001) and 1 000 tonnes in the second year (1 December 2001 to 30 November 2002).

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

5.88 The Scientific Committee endorsed the advice of WG-FSA regarding the management of the *C. gunnari* fishery in Division 58.5.2 during the 1999/2000 season.

5.89 The total catch limit for the Heard Island Plateau part of Division 58.5.2 should be revised to 1 150 tonnes for the period 1 December 2000 to 30 November 2001. The fishery on Shell Bank should remain closed.

5.90 Other management measures for *C. gunnari* in Subarea 48.3 set for the 1999/2000 season, as detailed in Conservation Measure 177/XVIII, should remain in force.

Workshop on Assessment Methods for Icefish (WAMI)

5.91 The Scientific Committee noted the discussion by WG-FSA in paragraphs 10.1 to 10.6 of its report (Annex 5) on the need for a workshop on the development of management procedures for *C. gunnari* (as first discussed by the Scientific Committee in 1997 – SC-CAMLR-XVIII, Annex 5, paragraph 9.10).

5.92 The Scientific Committee noted that a fishery took place in Subarea 48.3 for the first time since the 1989/90 season and the results of two surveys in 2000 increased the urgency of the need to address management issues for this species. Also, discussions at WG-EMM and WG-FSA have indicated that this species has potentially complex interactions with other elements of the ecosystem and that these need to be taken into account when developing management procedures. The Scientific Committee endorsed the recommendation of WG-FSA that the workshop should proceed in the 2000/01 intersessional period, in accordance with the arrangements agreed by the Working Group (Annex 5, paragraphs 10.4 and 10.5).

Other Finfish Fisheries

5.93 The Scientific Committee noted that WG-FSA considered other finfish fisheries in Subarea 48.1 (Antarctic Peninsula), Subarea 48.2 (South Orkney Islands), Subareas 88.2 and 88.3 (Pacific Ocean Sector), and Divisions 58.4.1 and 58.4.2 (Antarctic Coastal Areas).

Antarctic Peninsula and South Orkney Islands (Subareas 48.1 and 48.2)

5.94 WG-FSA had received and considered an extensive review of the fisheries, status and biology of fish stocks in Subareas 48.1 and 48.2. The Scientific Committee endorsed the view that there appears to be little scope for reopening the fisheries in these two subareas in the near future given the comparatively low biomass of the most common fish species. The Scientific Committee welcomed the information that two new bottom trawl surveys are planned for these subareas by the USA and Germany in March 2001 and November–December 2001.

Management Advice

5.95 The Scientific Committee endorsed the advice of WG-FSA that Conservation Measures 72/XVII and 73/XVII should remain in force.

Divisions 58.4.1 and 58.4.2

5.96 The Scientific Committee noted that no fishing is planned for the Antarctic coastal area of Division 58.4.1 in the 2000/01 season. The Scientific Committee endorsed the recommendation of WG-FSA that this division should be closed to fishing, including exploratory fishing, until more experience has been gained from the results of exploratory fisheries in other parts of the Convention Area.

5.97 Both Divisions 58.4.1 and 58.4.2 are subject to exploratory trawl and longline fishery notifications, details of which are discussed in paragraphs 9.38, 9.39 and 9.43 to 9.46.

Management Advice

5.98 The Scientific Committee recommended that the Antarctic coastal area (south of 64°S) of Division 58.4.1 should be closed to fishing in the 2000/01 season (Annex 5, paragraph 4.98).

Pacific Ocean Sector (Subareas 88.2 and 88.3)

5.99 The Scientific Committee noted that no fishing took place in Subareas 88.2 and 88.3 during the 1999/2000 season. Both subareas are subject to exploratory fisheries notifications for the 2000/01 season, details of which are discussed in paragraphs 9.40, 9.43, 9.53 and 9.56.

Management Advice

5.100 The Scientific Committee recommended that Subarea 88.3 remain closed until more experience is gained in other exploratory fisheries (Annex 5, paragraph 4.98).

Electrona carlsbergi (Subarea 48.3)

5.101 The Scientific Committee noted that no new advice was available from WG-FSA regarding the fishery for *E. carlsbergi* in Subarea 48.3. The last year in which there were catches from the *E. carlsbergi* fishery was 1991/92 (51 865 tonnes). The fishery has not been assessed by WG-FSA since its meeting in 1994.

Management Advice

5.102 In the absence of new advice, the Scientific Committee recommended that Conservation Measure 174/XVIII be carried forward to the 2000/01 season.

5.103 The Scientific Committee requested WG-FSA to consider, at its next meeting, the currency of the existing assessment of *E. carlsbergi* in the context of the regulatory framework, and whether catch limits should continue to be set on the basis of the advice from the 1994 assessment, while no new information is available.

General By-catch Provisions

5.104 The Scientific Committee noted the discussion of by-catch in fisheries in the Convention Area in Annex 5, paragraphs 4.248 to 4.268. A wide variety of species are taken as by-catch in the Convention Area. Most are taken in small amounts by weight as detailed in Annex 5, Table 46. Skates, rays and macrourids (rat tails) are the principal by-catch species.

5.105 The largest by-catch (255 tonnes) was reported for the *D. eleginoides* longline fishery in Division 58.5.1 based on fine-scale data. Other large by-catches, from fine-scale data, occurred in the *Dissostichus* spp. longline fisheries in Subarea 88.1 (118 tonnes) and in Subarea 58.6 (81 tonnes).

5.106 The Scientific Committee encouraged the production of brief practical guides to help observers identify principal by-catch species at sea, particularly for species groups over which there is some concern, such as skates, rays and macrourids (rat tails) where accurate identification is important.

Management Advice

5.107 The Scientific Committee noted that substantial information regarding the amount of by-catch in various fisheries had been presented, but agreed that there remains an urgent need for the calculation and presentation of by-catch rates in both longline and trawl fisheries.

5.108 The Scientific Committee endorsed the establishment by WG-FSA of an intersessional subgroup to document the extent of by-catch in CCAMLR fisheries, as set out in Annex 5, paragraph 10.9(vi).

Future Work of WG-FSA

5.109 The Scientific Committee endorsed the future work of WG-FSA as outlined in Annex 5, paragraph 10.9, noting that the subgroup to determine total removals of *Dissostichus* spp. (including IUU catches) should be established irrespective of whether new Secretariat staff are hired to assist with the CDS (Annex 5, paragraph 10.9(ii)).

Crab Resources

5.110 The UK, Uruguay and the USA have expressed their intention to fish for crabs in the coming season. WG-FSA acknowledged that the USA has already fulfilled the requirement of an experimental harvest regime set out in Conservation Measure 150/XVIII.

5.111 The Scientific Committee noted the large by-catch rates of crabs in the experimental pot fishery for *D. eleginoides*. Few crabs were males above the legal size that could be retained, and the discard rate was above 95% for all species caught.

5.112 The Scientific Committee was concerned that the survival rates of discarded crab species caught as by-catch or in directed fisheries are insufficiently known and may result in large numbers of animals not surviving after being discarded.

Management Advice

5.113 The Scientific Committee reiterated its advice (SC-CAMLR-XVIII, paragraph 5.130) that since crab stocks have not been fully assessed, the conservative management scheme contained in Conservation Measure 181/XVIII is still appropriate. It tasked WG-FSA to reconsider the precautionary catch level of crabs during its next meeting as new scientific data become available, taking into account the potentially high mortality rates of discarded animals.

5.114 The Scientific Committee recommended that all vessels should conduct Phase 1 of the experimental harvest regime specified in Conservation Measure 150/XVIII. The US vessel notified to fish in 2000/01 has already fulfilled these requirements.

5.115 The Scientific Committee agreed that WG-FSA should continue considering mortality rates of discarded crabs and encouraged further research on this problem.

5.116 The Scientific Committee agreed that crabs caught as by-catch in other fisheries should be counted against the catch limit set for the directed fishery.

Squid Resources

5.117 No fishing took place in the 1999/2000 season. The Republic of Korea and the UK submitted a joint notification (CCAMLR-XIX/8) for an exploratory jig fishery for *M. hyadesi* in Subarea 48.3 (paragraph 9.60). The status of the observer requirement attached to this notification is discussed in paragraph 3.20.

5.118 The scientific basis on which the current precautionary conservation measure was based has not changed.

Management Advice

5.119 The Scientific Committee recommended that as this was an exploratory fishery the conditions of Conservation Measure 65/XII will apply.