KRILL RESOURCES

5.1 The sixth meeting of WG-Krill was held in Cape Town (South Africa) from 25 July to 3 August 1994, and was chaired by the Convener, Mr Miller.

5.2 Monthly catch data were submitted in accordance with Conservation Measure 32/X from Chile, Japan, Poland and Ukraine. In addition, Chile has submitted a full set of haul-by-haul data.

5.3 The total catch of krill reported for the 1993/94 season in SC-CAMLR-XIII/BG/1 Rev. 1 is shown in Tables 3 and 4. It was reported that a non-member (Latvia) had taken a small catch in Statistical Area 48, but it was not known in which subarea the catch was taken.

Table 3: National krill landings (in tonnes) since 1985/86 based on STATLANT returns.

Member	Split-Year*								
	1986	1987	1988	1989	1990	1991	1992	1993	1994
Chile	3264	4063	5938	5329	4501	3679	6066	3261	3834
Germany	0	0	0	0	396	0	0	0	0
Japan	61074	78360	73112	78928	62187	67582	74325	59272	62322
Latvia									71
Republic of Korea	0	1527	1525	1779	4040	1211	519	0	0
Poland	2065	1726	5215	6997	1275	9571	8607	15911	7915
Spain	0	379	0	0	0	0	0	0	0
USSR**	379270	290401	284873	301498	302376	275495	0	0	0
Russia							137310	4249	965
South Africa									3
Ukraine							61719	6083	8708
Total	445673	376456	370663	394531	374775	357538	288546	88776	83818

* 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., 1989 refers to the 1988/89 split-year).

** Although the formal date for separation of the former USSR was 1 January 1992, for comparative purposes statistics are compiled here for Russia and Ukraine separately for the complete split-year, i.e. 1 July 1991 to 30 June 1992.

Table 4: Total krill catch in 1993/94 by area and country. The catch for 1992/93 is indicated in brackets.

Subarea /Area	Chile		Japan		Latvia		Poland		Russia		South Africa		Ukraine	
41.3.2							0	(2506)						
48.1	3834	(3261)	41251	(29665)			0	(4790)		(0)				(0)
48.2			7029	(10049)			6833	(2621)					5253	(0)
48.3			13143	(13763)			1082	(5995)	965	(4199)	3	(0)	3455	(6083)
48.6			0	(33)										
48.?					71	(0)								
58.4.1			899	(5762)						(50)				
Total	3834	(3261)	62322	(59272)	71	(0)	7915	(15912)	965	(4249)	3	(0)	8708	(6083)

Subarea /Area	Total	
41.3.2	0	(2506)
48.1	45085	(37716)
48.2	19115	(12670)
48.3	18648	(30040)
48.6	0	(33)
48.?	71	(0)
58.4.1	899	(5812)
Total	83818	(88777)

5.4 WG-Krill recommended that the *Statistical Bulletin* include details of total effort on the same temporal and spatial scales as catch data. In SC-CAMLR-XIII/BG/11 the Data Manager proposed a number of revisions to the format of the *Statistical Bulletin*, one of which would give effect to the recommendation of WG-Krill. The Scientific Committee recommended that future editions of the *Statistical Bulletin* report total effort in the format given in SC-CAMLR-XIII/BG/11.

5.5 A study of length frequency data from the Japanese commercial fishery was submitted to WG-Krill. The Scientific Committee encouraged the continued submission of length frequency and haul-by-haul information which is useful for assessing the overlap between the segment of the krill population exploited by the fishery and that by predators, as well as providing information on length at recruitment to the fishery.

5.6 Results of recent work by Japan on the by-catch of young fish in commercial krill trawls suggest an inverse relationship between the density of krill swarms and the by-catch of young fish. The Scient ific Committee encouraged further work of this nature, but emphasised the need to follow the standard method for sampling fish by-catch during krill fishing set out in the *Scientific Observers Manual* (see also paragraph 2.81).

5.7 It was noted that attempts had been made to derive a composite index of krill abundance from the joint Chilean/US study using acoustic and fisheries data off Elephant Island. No information has been received on the practicality of collecting search time information at random times as described in SC-CAMLR-XII, Annex 4, paragraph 5.31. Pilot studies are encouraged despite the recognised difficulty of measuring search time information directly.

5.8 The Scientific Committee was informed that the fishing plans of Japan, Chile and Ukraine for 1994/95 were similar to the fishing operations of those countries last season. An Australian company is still interested in fishing for krill with one to four vessels, catching up to 80 000 tonnes per year, but it is uncertain whether this venture will proceed in the next year. India, in response to a request for information on reports that it had plans to undertake some krill fishing (see SC-CAMLR-XII, Annex 3, paragraph 3.12), informed the Scientific Committee that at present there were no plans to harvest krill. The Scientific Committee expressed its continued interest in knowing future plans with respect to potential krill catch levels and fishing areas.

ESTIMATION OF KRILL YIELD

5.9 A Workshop on Evaluating Krill Flux Factors was held immediately prior to the meeting of WG-Krill. The workshop calculated water and krill fluxes for a number of small regions within Statistical Area 48 for which there are sufficient data. Data on krill distribution and abundance were available from FIBEX, and oceanographic flow rates were available from the Fine Resolution Antarctic Model (FRAM) and from German and Japanese geostrophic calculations. However, there is a lack of hydroacoustic and oceanographic data collected simultaneously over the same areas, and the geographical coverage of the existing data is limited. Nonetheless, the results showed that horizontal transport of krill is an important factor in the overall stock distribution and needs to be considered in the development of management advice for krill fisheries. The analyses provided a range of values which can be used to examine the flux of krill in relation to fishery and predator demands in particular regions.

5.10 The Scientific Committee considered that there were two important scales over which to consider the effects of krill flux. The first is the scale of statistical areas and subareas, where the question is how to take the flux of krill into account when calculating catch limits. The second scale is a much smaller one which relates to the flux of krill within the foraging ranges around predator colonies where these overlap with krill fisheries.

5.11 There are additional oceanographic data sets that could be used in refining the flux calculations, and the Scientific Committee encouraged further data submissions. In particular, there is a large body of drifter and buoy data (mainly collected by the USA) which would be very useful for indicating regions of rapid water transport with little eddy activity and areas of high eddy activity and drifter retention. The Scientific Committee agreed that repeated surveys of particular regions on a small scale (about 10 000 to 120 000 km^2), such as carried out under AMLR and LTER, which include both biology and oceanography, were particularly useful, and that further studies based on direct current measurements were needed in key areas such as shelf and shelf-break regions. The development of coupled biological-oceanographic models is an area of research which will be kept under review by the Scientific Committee and its Working Groups.

5.12 Dr M. Naganobu (Japan) noted that there may be considerable aggregations of krill close to the sea bottom and that there may be a seasonal vertical flux of krill which could also be an important factor in the movement and concentration of krill. He reported that Japan would be conducting studies to investigate this hypothesis in the coming season.

5.13 WG-Krill had reviewed new work relevant to hydroacoustic investigations of krill, survey design and modelling studies on krill aggregation. Various aspects of krill acoustic target strength determination and survey design had been discussed. With respect to survey design, the Scientific Committee recognised the need to consider further the circumstances in which random or regular survey designs were to be preferred.

5.14 The Scientific Committee noted WG-Krill's endorsement of Australian plans to carry out a survey of krill biomass in Division 58.4.1. The Scientific Committee endorsed WG-Krill's view that if the survey were undertaken according to the design which had been submitted, the results would be suitable for providing a standing stock estimate to be used as the basis for setting a precautionary catch limit for this division.

KRILL YIELD CALCULATIONS

5.15 The population model and computer program used to calculate potential krill yield were updated during the year and the program verified by the Secretariat. The computer code has been updated to include the recruitment module reported to WG-Krill at its 1993 meeting (WG-Krill-93/13).

5.16 New estimates of recruitment variability were obtained using the proportion of recruits in the population estimated from length density data. Data available last year and new data which had been submitted in response to the request from the Scientific Committee were analysed to obtain new estimates of the average and variance in recruitment proportion. Mean recruitment proportions by age are similar, although variances of the individual estimates are much lower for 1-year-old as opposed to 2-year-old recruitment. Combined results tend to be dominated by estimates of 1-year-old recruitment since values were combined by inverse variance weighting.

5.17 Refinements to the model were planned to take into account probable correlation between growth and mortality, but submissions to WG-Krill indicated that no reliable information on the relationship between growth and mortality for crustacea was available. WG-Krill has identified two options for further investigations of the properties of the yield model with respect to potential correlations between these two variables (Annex 5, paragraphs 4.88 and 4.89).

CRITERIA FOR SELECTING APPROPRIATE VALUE OF γ
(Annex 5, paragraphs 4.92 to 4.98)

5.18 Over the past several years, the Working Group has been developing the krill yield model to calculate the proportion (γ) of a survey estimate of the pre-exploitation krill biomass (B_0) that can be set as a precautionary catch limit. At this year's meeting of WG-Krill and during discussions in the Joint Working Group, the following three decision rules were developed for determining the value of γ to be used in calculating a precautionary catch limit:

(i) choose γ_1, so that the probability of the spawning biomass dropping below 20% of its pre-exploitation median level over a 20-year harvesting period is 10%;

(ii) choose γ_2, so that the median krill escapement in the spawning biomass over a 20-year period is 75% of the pre-exploitation median level; and

(iii) select the lower of γ_1 and γ_2 as the level of for calculation of krill yield.

5.19 To illustrate what the three decision rules mean, it is necessary to give some background on the krill yield model. The krill yield model uses computer simulations to determine the statistical distribution of the abundance of krill for a given level of exploitation over a period of 20 years. The model initially assumes a given biomass of krill, divided into a number of age classes. The model calculates the biomass year by year, by adding an amount for annual growth and deducting an amount corresponding to natural mortality. The biomass of each year's recruits is added and the effects of a constant annual catch of $\gamma * B_0$ are deducted from the biomass each year. Variability in the simulated population biomass in each year arises because the recruitment to the population in each year is drawn from a statistical distribution which reproduces the statistical properties of the estimates of proportional recruitment obtained from length composition data collected during krill surveys.

5.20 A value for γ is selected by finding the value which results in the statistical distributions of the outcome of many repetitions of the simulation model meeting selected criteria. The model allows for uncertainty in estimates of unexploited biomass as well as uncertainty in estimates of key demographic parameters such as growth and mortality, by drawing values for each parameter from appropriate statistical distributions for each repetition of the model.

5.21 The model is run with $\gamma = 0$ (i.e., no catches) to produce the distribution of spawning stock biomass, shown in Figure 1 as distribution A. The midpoint of this distribution is a number representing the median unexploited spawning stock biomass. If γ is given a value greater than zero, the simulated biomass is reduced by the effects of fishing.

5.22 The selection of γ values used to date has taken into account two criteria. The primary criterion, or decision rule, has been the value of γ which leads to a 10% probability of the spawning biomass dropping below 20% of its pre-exploitation median level over a 20-year harvesting period. Applying this criterion requires the examination of the statistical distribution of the lowest population size (expressed in terms of spawning biomass) in any year over the 20 years of each simulation, collected over hundreds of replicates. This distribution is shown in Figure 1(a) as distribution B. The probability of attaining a lowest spawning stock biomass less than 20% of its pre-exploitation level is estimated from the relative frequency of this event over the set of replications for a range of values of γ. The selected value of γ is that which has this relative frequency at 10%. This corresponds to the first decision rule.

5.23 This first decision rule was aimed at meeting the requirement for stable recruitment in the krill stock by not allowing the spawning biomass to drop to very low levels, where the chance for successful recruitment may be impaired. Although the probability of 10% is somewhat arbitrary, it is consistent with values used in managing other fisheries. This particular decision rule, however, is derived from a single-species approach. At last year's meetings, WG-Krill and the Scientific Committee had preliminary discussions on decision rules that afford some protection to krill predators in accordance with the provisions of Article II. This year, the second decision rule given above was derived as a first attempt to give some explicit effect to the requirements under Article II.

5.24 The second rule also leads to a value of γ which is determined by the statistical distribution of the spawning stock biomass at the end of the 20-year period used in each simulation. The criterion embodied in this part of the rule is illustrated in Figure 1(b). As before, A is the distribution of spawning stock biomass without fishing. C is the distribution of spawning stock biomass after 20 years of exploitation corresponding to a given γ. The selected value of γ_2 is that which results in C having a median equal to 75% of the median of A.

(a)

(b)

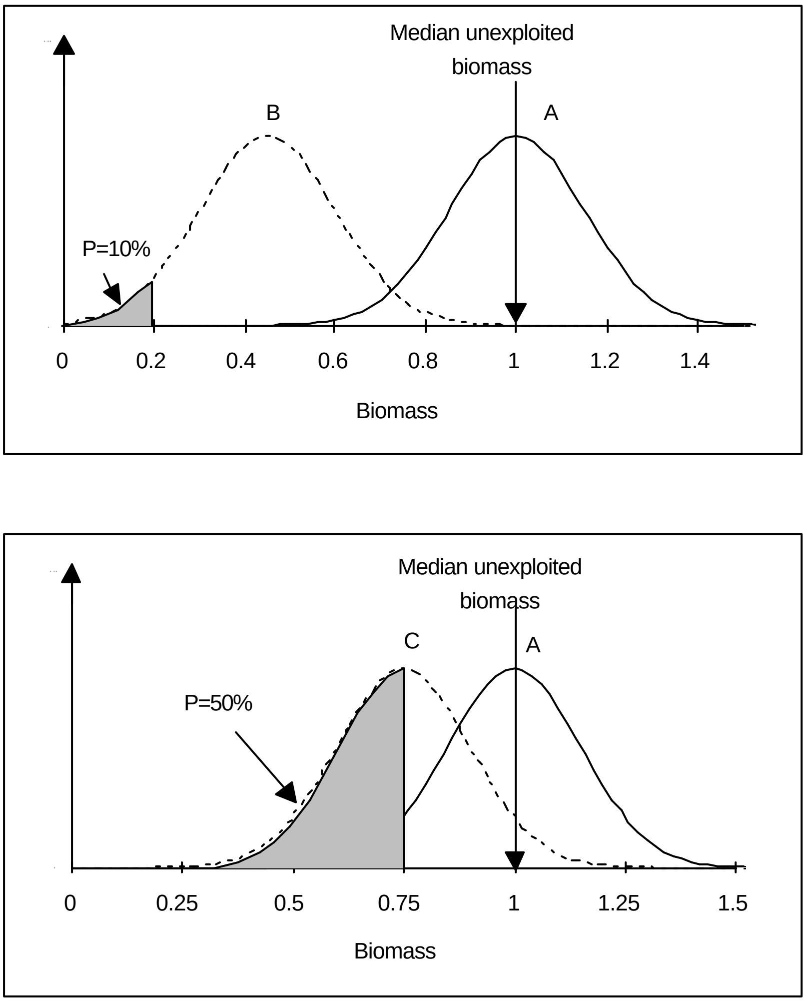

Figure 1: Distribution of biomass of krill under different management regimes.

A is the statistical distribution of biomass in any year for a population which has not been exploited. B in (a) is the statistical distribution of lowest spawning stock biomass over 20 years with catches γ_1 B_0. C in (b) is the statistical distribution of spawning stock biomass after 20 years of exploitation with annual catches γ_2 B_0.

5.25 The values of γ_1 and γ_2 will usually be different, and so the third decision rule chooses one of the two values. Whether γ_1 or γ_2 is the greater depends largely on the degree of variability in recruitment and the variance of the estimate of unexploited biomass B_0. Let the criteria corresponding to the values γ_1 and γ_2 be designated as the 'recruitment criterion' and the 'predator criterion' respectively. The lower of the two values is chosen because it means that the criterion corresponding to that part of the decision rule is just attained, and the criterion corresponding to the higher value of γ will be exceeded. Conversely, if the higher of the two γ values were chosen, the criterion corresponding to the lower γ value would not be met. There are two possible results for γ_1 and γ_2 as set out in Table 5 and four possible outcomes from choosing γ_1 or γ_2. It can be seen that only by choosing the lower of γ_1 or γ_2 that the two criteria relating to recruitment or predator requirements are met or exceeded. Choosing the higher value automatically leads to a failure to fulfil one or other of the two criteria.

Table 5: Outcome of choosing the higher or lower value of γ under conditions where $\gamma_1 > \gamma_2$ or $\gamma_1 < \gamma_2$.

	Choose higher value of γ	Choose lower value of γ
$\gamma_1 > \gamma_2$	Predator criterion not met Recruitment criterion met	Predator criterion met Recruitment criterion exceeded
$\gamma_1 < \gamma_2$	Predator criterion met Recruitment criterion not met	Predator criterion exceeded Recruitment criterion met

5.26 The Scientific Committee agreed that use of the three decision rules is appropriate for determining precautionary catch limits for krill. It recognised that the levels used in the two criteria are somewhat arbitrary and they will need to be revised from time to time. The recruitment criterion of 10% probability of the lowest biomass being less than 20% of the unexploited level will need to be revised to take into account any information which becomes available on the relationship between stock and recruitment. A revision of the predator criterion of median spawning stock biomass at 75% of the unexploited level would require better information on the functional relationship between abundance of prey and recruitment in predator populations. The 75% level is chosen as the midpoint between taking no account of predators (i.e., treating the krill fishery as a single-species fishery), and providing complete protection for predators (i.e., no krill fishery). WG-CEMP has begun to develop some models to explore the possible form of these functional relationships. However, the Scientific Committee recognised that it will take considerable time to acquire the information needed to provide advice on revised values for either the recruitment or the predator criterion levels.

YIELD ESTIMATES (Annex 5, paragraphs 4.99 to 4.110)

5.27 Results from the krill yield model incorporating the updated estimates of average recruitment proportion and its variability are presented in paragraphs 4.99 to 4.110 of the report of WG-Krill (Annex 5). Given the unusually high variance in the set of estimates of proportions of recruits based on 1-year-olds, the values for γ were calculated using only the recruitment proportions from 2+ krill.

5.28 The first decision rule resulted in $\gamma_1 = 0.149$ and the second decision rule $\gamma_2 = 0.116$. Full results (using 2+ recruitment) for both γ values are given in Table 6.

Table 6: Results of the krill yield model for the two decision rules.

Statistic		First Decision Rule P = 0.10 $\gamma_1 = 0.149$	Second Decision Rule M = 0.75 $\gamma_2 = 0.116$
Probability of spawning biomass falling below 0.2 over 20-year harvest period	(Prob)	0.10	0.04
Median spawning biomass level at the end of 20 years	(Med)	0.68	0.75
Lower 5%-ile spawning biomass	(Low)	0.25	0.38

5.29 The Scientific Committee noted that the values of γ_1 and γ_2 lie between the values of 0.1 and 0.165 determined by WG-Krill in 1993. The third decision rule, indicating that the lower of the two values should be chosen, determines that a γ value of 0.116 should be used in calculations of precautionary catch limits.

5.30 The sensitivity of the results to size at 50% recruitment to the fishery was also investigated for variations of ±5 mm in the distribution assumed for length at 50% recruitment (r_{50}). The results showed that most changes in γ are not too substantial (~10%) for the changes in r_{50} used in the tests. Although the Scientific Committee noted that there is some need to determine whether actual values of this parameter are likely to be covered by the ranges of the distributions used in the sensitivity tests, it was considered that the values currently used are likely to fall within the ranges used in the model.

ADVICE ON KRILL FISHERY MANAGEMENT
(Annex 5, paragraphs 5.1 to 5.33)

Precautionary Catch Limits (Annex 5, paragraphs 5.1 to 5.26)

Estimates of Potential Yield (Annex 5, paragraphs 5.1 to 5.17)

5.31 WG-Krill examined the need for possible upward adjustment of survey estimates of B_0 to account for flux. The Working Group developed an analysis which confirmed that such an adjustment may not be necessary if catch limits were to be calculated over a series of contiguous areas from a near-synoptic survey. This was the assumption used in calculating the existing overall precautionary limit for Statistical Area 48. The analysis showed that applying this assumption to the subarea survey estimates of B_0 constituted a sufficiently conservative basis for management, provided that the regions for which precautionary limits were set did not contain more than one self-sustaining stock. This should allow catch limits to be set for all subareas for which biomass estimates are available. This approach was applied to calculate the precautionary catch limits shown in column A of Table 7. The revised catch limit for krill in Statistical Area 48 is 4.1 million tonnes.

Table 7: Precautionary limits on krill catches in various areas, based on the formula $Y = \gamma B_0$, where $\gamma = 0.116$. Units are 10^6 tonnes. Two methods of calculating catch limits by subarea are given: (A) allocation proportional to biomass estimate for subarea; and (B) allocation on the basis of previous recommendation (see SC-CAMLR-XII, Annex 4, Table 5). B_0 values are taken from SC-CAMLR-XII, Annex 4, Table 4.

Subarea/ Division	B_0		$Y = \gamma B_0$	Catch Limit by Subarea			1993/94 Catch
				A	B		
48.1	13.6}			1.58	1.39	(34%)	0.045
48.2	15.6}	30.8	3.57	1.81	2.01	(49%)	0.019
48.3	1.5}			0.18	1.07	(26%)	0.019
48.4	-			0	0.21	(5%)	0
48.5	-			0	0.21	(5%)	0
48.6	4.6		0.53	0.53	0.49	(12%)	0
Total 48		35.4	4.10				0.083
58.4.2	3.9		0.45				

5.32 Conservation Measure 46/XI specifies subarea maxima that currently apply in addition to the present overall precautionary catch limit of 1.5 million tonnes for krill in Statistical Area 48 (Conservation Measure 32/X).

5.33 Four views were put forward as to how the revised calculation of a limit of 4.1 million tonnes for Statistical Area 48 (see Table 7) should be treated and subdivided:

- the first view was that the revised precautionary limit of 4.1 million tonnes should replace the existing value of 1.5 million tonnes, and that it should be subdivided according to column A in Table 7;

- the second view was that the overall precautionary catch limit should be revised to 4.1 million tonnes, and that it should be subdivided according to column B in Table 7;

- the third view was that there was no need to revise either the 1.5 million tonne overall limit of Conservation Measure 32/X for Statistical Area 48 or the subarea maxima that currently apply in Conservation Measure 46/XI; and

- the fourth view was that the overall precautionary catch limit should be revised to 4.1 million tonnes, but that neither column A nor column B provided an acceptable basis for subdivision.

5.34 The first approach follows from the management strategy put forward in Appendix F of the WG-Krill report (Annex 5) which implies that the limits for subareas should be based solely on biomass estimates for those subareas (so that, *inter alia*, zero limits apply in subareas where there has as yet been no survey). Advocates of this approach queried the use of historic catch data as a guide towards subdivision, arguing that this was not a sound approach in the longer term, as the fact that a particular level of catch has been maintained over a limited period constitutes no guarantee that it is sustainable.

5.35 One reservation expressed concerning this approach was that it was unreasonable to reduce the existing limits for Subareas 48.4 and 48.5 from 75 000 tonnes to zero. Another was that the resultant decrease for Subarea 48.3 from 360 000 to 180 000 tonnes was inappropriate, as it was an artefact of the low coverage of this subarea achieved in the FIBEX survey used to provide the B_0 estimate.

5.36 In response to these concerns, proponents of the approach in paragraph 5.34 argued that:

(i) these low values provided an appropriate incentive to organise surveys of these subareas (for the first time, or on a more extensive basis than previously);

(ii) the approach, consistently applied, obviated the need for considering only the results from near-synoptic surveys in setting precautionary catch limits - hence other surveys in, for example, Subarea 48.3 in addition to FIBEX, could be considered in refining the estimate of B_0 for that subarea;

(iii) the situation for subareas with zero limits (because of the absence of a prior survey) might be reconsidered in the context of limited allowances for exploratory fisheries; and

(iv) further flux studies might provide evidence of a sufficiently large transfer of krill between, say, Subareas 48.2 and 48.3 to negate an hypothesis that these subareas contained effectively separate self-sustaining stocks, thus allowing them to be combined for the purpose of setting precautionary catch limits.

5.37 The second view showed agreement with the revision of the overall precautionary catch limit to 4.1 million tonnes. However, it considered that the matter of subdivision had already been discussed at length at previous meetings, and that the subdivision proportions for each subarea then agreed (SC-CAMLR-XII, Annex 4, Table 5) should be applied pending further detailed consideration of this matter (since little time had been available to study the strategy advanced in Appendix F of the report of WG-Krill). These percentages are based on taking the average of the proportion of FIBEX survey estimates and the proportion of the historic catch in a subarea of Statistical Area 48 and adding 5%. The results of such a subdivision, and the percentages upon which it is based, are shown in column B, Table 7.

5.38 In support of this view Dr Naganobu stressed the following points:

(i) the 1994 meeting of WG-Krill recognised the revised precautionary limit of 4.1 million tonnes as the best scientific value for Statistical Area 48 at this stage. It is therefore quite reasonable to accept the overall catch limit of 4.1 million tonnes;

(ii) it is quite unreasonable to reduce without any scientific evidence the existing catch limits for Subareas 48.4 and 48.5 from 75 000 tonnes to zero, as shown in column A. The resultant decrease for Subarea 48.3 from 360 000 to 180 000 tonnes is also inappropriate, because the low coverage of this subarea was apparent in the FIBEX survey. If there had been a wider range survey than the FIBEX survey, he believed that values of biomass higher than the current figure would have been attained;

(iii) the values in column A do not accord with the percentages adopted for the subdivisions in the context of the overall limit of 1.5 million tonnes for Statistical Area 48 which was agreed after lengthy argument. He therefore considered it appropriate to continue to allocate catch limits to subdivisions by percentages, not an overall catch limit and/or biomass; and

(iv) Japan considers that in the approach proposed in paragraph 5.36(iii) and Annex 5, paragraph 5.9 (that the situation for subareas with zero limits - because of the absence of a prior survey - might be reconsidered in the context of limited allowances for exploratory fisheries), the imposition of such limits would be tantamount to restricting the area available for krill fishing.

5.39 A reservation concerning the application of the percentages in column B was that they were adopted for an allocation in the context of an overall limit of 1.5 million tonnes for Statistical Area

48. It was argued that these percentages had not been intended to extend to a higher figure for the overall precautionary catch limit, as was now under consideration.

5.40 The third view was that biomass estimates used in the krill yield model were based upon data:

(i) collected in 1981 and therefore outdated and of no practical use; and
(ii) possibly collected during a year when the krill biomass was high.

In addition, indications of the likely levels of fishing for the next season were considerably less than the trigger level of 0.62 million tonnes given in Conservation Measure 46/XI. Accordingly, there was no immediate need to revise either the subdivision maxima of Conservation Measure 46/XI or the 1.5 million tonnes overall limit of Conservation Measure 32/X for Statistical Area 48.

5.41 Dr Naganobu noted that although paragraph 5.40 mentions that there is no immediate need to revise 1.5 million tonnes in Conservation Measure 32/X because of likely low catch levels in the next fishing season, it is neither scientific nor reasonable not to do so since, following that logic, it would have been unnecessary to adopt Conservation Measures 32/X or 46/XI for the very same reason.

5.42 He furthermore stressed that WG-Krill had agreed that the revised catch limit represented the best scientific advice available and he therefore suggested that the 4.1 million tonne catch limit should be adopted by the Scientific Committee.

5.43 Dr T. Ichii (Japan) recalled that at last year's meeting the Scientific Committee was unable to agree on a recommendation for a revised catch limit even though the Scientific Committee had accepted a revised estimate for B_0. He was disappointed that the Scientific Committee was again unable to agree on a revised limit even though a revised value for γ was available. He was concerned that the lack of agreement would reflect badly on the credibility of the Scientific Committee.

5.44 The fourth view was that the overall precautionary catch limit could be revised upward to 4.1 million tonnes but that it was not possible at this stage to suggest an appropriate allocation to subareas.

5.45 Several Members stressed that the overall catch limit could only be revised upwards in conjunction with an appropriate allocation scheme designed to ensure that the overall catch would be distributed over the subareas (see paragraph 5.32).

REFINING OPERATIONAL DEFINITIONS OF ARTICLE II
(Annex 5, paragraphs 5.21 to 5.23)

5.46 The Scientific Committee agreed that the development of the three decision rules for the selection of γ constituted significant progress on the refinement of operational definitions. In particular, the development of operational definitions that consider both predator and krill needs were welcomed. The Scientific Committee recommended the continued development of such operational definitions.

5.47 The Scientific Committee noted that the krill yield model has been refined and the key parameters of the model are now based on analyses of empirical data. The Scientific Committee noted that the revised overall precautionary catch limit for Statistical Area 48 has been obtained using empirical data and methods. A major problem now lies in the allocation of precautionary limits to subareas within Statistical Area 48. The two approaches proposed by WG-Krill each result in anomalies. The Scientific Committee was not able to offer any further advice at this time which would clarify the basic approach to be followed or provide possible means of resolving such anomalies.

DATA REQUIREMENTS (Annex 5, paragraphs 5.24 and 5.26)

5.48 The Scientific Committee endorsed the list of data requirements set out in Annex 5, Table 3.

5.49 WG-Krill received an offer from Chile to present data on haul start times and duration. The Scientific Committee agreed that these data would be useful. Analyses of parameters such as catch/towing hour could show seasonal trends. In addition, the data would be of use in fishery behaviour models. The Scientific Committee therefore recommended that such data should be presented to the next meeting of WG-EMM[2].

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2 At this meeting of the Scientific Committee it was agreed that the Working Groups on Krill and CEMP be merged into a new Working Group on Ecosystem Monitoring and Management (WG-EMM) (see paragraph 7.40).