

KRILL RESOURCES

FISHERY STATUS AND TRENDS

2.1 The krill catch for the 1992/93 season was 70% less than in 1991/92 and totalled 88 000 tonnes (Table 2.1).

Table 2.1: National krill landings (in tonnes) since 1984/85 based on STATLANT returns.

Member	Split-Year*								
	1985	1986	1987	1988	1989	1990	1991	1992	1993
Chile	2598	3264	4063	5938	5329	4501	3679	6066	3261
Germany	50	0	0	0	0	396	0	0	0
Japan	38274	61074	78360	73112	78928	62187	67582	74325	59272
Republic of Korea	0	0	1527	1525	1779	4040	1211	519	0
Poland	0	2065	1726	5215	6997	1275	9571	8607	15910
Spain	0	0	379	0	0	0	0	0	0
USSR**	150538	379270	290401	284873	301498	302376	275495	0	0
Russia								137310	2998
Ukraine								61719	6083
Total	191460	445673	376456	370663	394531	374775	357538	288546	87524

* 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, statistics are compiled here for Russia and Ukraine separately for the complete split-year, i.e. 1 July 1991 to 30 June 1992 for comparative purposes.

2.2 The total krill catch by subarea and country for 1991/92 and 1992/93 is given in Table 2.2.

Table 2.2: Total krill catch in 1992/93 by area and country. The catch for 1991/92 is indicated in brackets.

Subarea /Area	Chile	Japan	Republic of Korea	Poland	Russia	Ukraine
48.1	3261 (6066)	29665 (61598)	0 (519)	7294 (641)	0 (8975)	
48.2		10049 (272)		2621 (2742)	0 (80142)	0 (20333)
48.3		13763 (12405)		5995 (5224)	2948 (48163)	6083 (41386)
48.4						
48.6		33 (0)				
58.4.1		5762 (0)			50 (0)	
88						
Total	3261 (6066)	59272 (74325)	0 (519)	15910 (8607)	2998 (137310)	6083 (61719)

Subarea /Area	Total	
48.1	40220	(77799)
48.2	12670	(103489)
48.3	28789	(107178)
48.4		
48.6	33	(30)
58.4.1	5812	(0)
88		(50)
Total	87524	(288546)

2.3 Table 2.2 shows that catches by Chile and Japan decreased and those of Poland increased in the 1992/93 season. The combined fleets of Russia and Ukraine have substantially reduced their catch levels since 1991/92.

2.4 Dr K. Shust (Russia) stated that it is not possible to forecast precisely the level of catches for 1993/94. He anticipated that four or five vessels may participate in the krill fishery and further supposed that some of this activity may have the form of joint-ventures.

2.5 Dr M. Naganobu (Japan) indicated that catches by Japanese vessels in 1993/94 will be about the same level as recent years.

2.6 Mr Z. Cielniaszek (Poland) stated that the increase in krill catches during last season is not going to continue in the future.

2.7 Dr V. Yakovlev (Ukraine) reported Ukrainian activities related to krill fishery. He stated that differences between STATLANT and fine-scale data submissions were the result of incomplete information provided by the vessels. Furthermore, he stated that fine-scale data from July to August 1992 had been prepared and submitted to this meeting. He anticipated that six Ukrainian vessels would participate in the krill fishery during 1994 and that observers would be deployed on some of these. A detailed report of Ukrainian activities was submitted as CCAMLR-XII/BG/15.

2.8 The Commission's attention is drawn to India's reported interest in participating in the krill fishery (Annex 4, paragraph 3.12).

2.9 As stated in the past, the Scientific Committee agreed that it would still be valuable if fishing Members could indicate the number of vessels planning to fish for krill in the forthcoming season, their catching capacities and proposed fishing grounds. While many Members again expressed their reservations as to the practicality of this, there was general agreement that the marked reductions in

krill catches during the most recent season indicate that the fishery is in a particularly dynamic state and such information would be useful in anticipating substantial changes in catch levels in the future.

2.10 Lic. E. Marschoff (Argentina) asked about responsibilities for submitting data to CCAMLR in the cases of such joint ventures, particularly when a non-member country participated in the venture. Members also discussed the issue of responsibility for reporting data when two Members carry out a joint venture. The Scientific Committee agreed that this issue should be brought to the Commission's attention, especially regarding:

- (i) which country is responsible for submitting the data arising from joint ventures in the Convention Area to CCAMLR?
- (ii) how should responsibilities be delimited in cases where a member and a non-member nation start a joint fishing venture in the Convention Area?

2.11 The observer from FAO (Dr R. Shotton) stated that in the case of submission of fisheries data to FAO, the catches are attributed to the country of registration of the vessel concerned.

REPORT OF THE WORKING GROUP ON KRILL

2.12 The Fifth Meeting of the Working Group on Krill (WG-Krill) was held in Tokyo, Japan from 4 to 12 August 1993 under the convenership of Mr Miller. The report of the meeting is attached as Annex 4.

Review of Information from the Fisheries (Annex 4, paragraphs 3.1 to 3.40)

2.13 The Scientific Committee noted that WG-Krill had indicated it would be useful to obtain information on anticipated product demands as this might affect the location and activities of the fishery (Annex 4, paragraph 3.5).

2.14 With respect to the submission of data to WG-Krill, the Scientific Committee noted that analyses of Japanese fine-scale catch and effort data had been submitted for a number of years and that good use of these data had been made (Annex 4, paragraphs 3.13 and 3.14).

2.15 Dr Naganobu stated that last year Japan had agreed to submit krill fishery data at a resolution of 10 x 10 n miles and that data will continue to be provided in the future. Furthermore he stated that next year Japan plans to submit historical fine-scale data.

2.16 The Scientific Committee thanked Japan for providing the fine-scale data and also data on a scale of 10 x 10 n miles and looked forward to receiving further historical data in the near future.

2.17 The necessity for, and the continued difficulties experienced in, submitting historical commercial krill catch data at a variety of scales from the former Soviet Union were noted.

2.18 The Scientific Committee noted that data were held in the Russian Federation in three forms: as hard copy in summary reports and 15-day reports with additional information being held on magnetic tape. It was noted that the examples of fine-scale summaries of historic data provided to WG-Krill were in a format compatible with the CCAMLR database.

2.19 The Scientific Committee noted that it would be a major task to prepare all these data for submission to CCAMLR and Members were encouraged to assist with this effort where possible. It was noted that scientists from Russia and the USA were attempting to expedite this work.

2.20 Dr S. Kim (Republic of Korea) informed the Scientific Committee that since the preparation of Table 1 of Annex 4, the Republic of Korea had reported fine-scale data for 1988.

2.21 The observer from Ukraine stated that Ukraine has a substantial dataset on krill catches in Division 58.4.2 from 1978 to 1984 and that they would also like to explore ways in which these data, with the help of other Members, could be made available to CCAMLR. He noted that fine-scale data from 1978 were submitted at the meeting.

2.22 The Scientific Committee again noted the value of haul-by-haul data from both the Japanese and Chilean krill fisheries analysed in several papers submitted to the Working Group and the submission of length frequency data by Japan (Annex 4, paragraphs 3.22 and 3.23).

2.23 In this connection, the important role of Scientific Observers aboard commercial krill fishing vessels was also highlighted. The Scientific Committee took note of WG-Krill's indication that it will be some time before comprehensive observer reports become available under the Scientific Observers Scheme and the utility of the *Scientific Observers Manual* can be effectively assessed (Annex 4, paragraph 3.25).

2.24 The Scientific Committee reviewed developments concerning assessment of the incidental by-catch of fish during krill fishing operations (Annex 4, paragraphs 3.26 to 3.34) (see also paragraph 3.80).

2.25 The Scientific Committee noted recent developments and WG-Krill's deliberations on the problem of assessing the mortality of krill not retained during trawling (Annex 4, paragraphs 3.35 to 3.38). It endorsed the Working Group's call for independent validation by the Secretariat of the model addressing the problem, a need to undertake sensitivity tests of the model and for experiments to be undertaken to test some of its basic assumptions.

2.26 Preliminary results of a joint Chilean/US initiative to address the problem of deriving a Composite Index of Krill Abundance were noted (Annex 4, paragraph 3.39). A full report of these results will be submitted to the next meeting of WG-Krill.

Estimation of Krill Yield (Annex 4, paragraphs 4.1 to 4.83)

Krill Flux in Statistical Area 48 (Annex 4, paragraphs 4.1 to 4.10)

2.27 The Scientific Committee noted WG-Krill's deliberations on the effects of water movement on krill distribution, particularly in the context of improving the estimation of potential yield.

2.28 There was agreement that a considerable body of data could be brought to bear on the problem of krill fluxes. The Scientific Committee endorsed the Working Group's proposal for a workshop which would attempt to calculate integrated mass flows across subarea boundaries in Statistical Area 48 (Annex 4, paragraph 4.4).

2.29 This "Workshop on Evaluating Krill Flux Factors" should have the following terms of reference:

- (i) to use existing data to:
 - (a) determine water mass transport across the boundaries of selected ocean areas in terms of velocity profiles normal to the boundaries, integrated over the depth range 0 to 200 m;
 - (b) determine krill density along each of the selected boundaries;

- (c) determine the mean retention time of particles in selected small areas;
- (ii) to use information from (i) to calculate the passive krill fluxes across the boundaries;
and
- (iii) to propose methods for further studies on questions of krill fluxes.

2.30 A steering committee comprising Drs de la Mare, Agnew and Naganobu and Mr Miller was appointed to oversee the Workshop preparations. The Scientific Committee agreed that the minimum dataset required for the Workshop should be a specified set of integrated water mass transport velocity profiles obtained from the FRAM model, along with both hydrographic data and acoustic density estimates from the BIOMASS Program. Additional datasets should be prepared according to specifications set out in Annex 4, Appendix E. Data should be submitted to the Secretariat at least two months in advance of the Workshop in order for them to be incorporated into a database in the form required. It was agreed that it would be necessary to postpone the Workshop if the specified data were not available in good time.

2.31 The Steering Committee will correspond during the intersessional period with a view to evaluating whether the Workshop should take place and if it is to take place, to agree on the two invited experts.

2.32 Financial provision for the Workshop has been included in the proposed Scientific Committee budget for 1994. This budget includes provision for the attendance of two invited experts.

Estimation of Effective Biomass (Annex 4, paragraphs 4.11 to 4.40)

2.33 The Scientific Committee endorsed without comment WG-Krill's call for further work regarding acoustic methods (Annex 4, paragraphs 4.15, 4.16, 4.20 and 4.22).

2.34 With respect to estimating krill biomass in Statistical Area 48, the Scientific Committee noted that WG-Krill had re-analysed the FIBEX acoustic data in accordance with the Scientific Committee's request (SC-CAMLR-XI, paragraphs 2.35 and 2.107).

2.35 The Scientific Committee agreed with WG-Krill's conclusion that the estimates of krill biomass in Statistical Area 48 from FIBEX have now been refined as far as is practical.

2.36 The revised FIBEX biomass estimates (Annex 4, Table 4) differ from those presented to the Scientific Committee last year (SC-CAMLR-XI, Annex 4, Table 2):

- the total biomass for Subarea 48.1 is increased from 10.5 to 13.6 million tonnes (Annex 4, paragraphs 4.26, 4.27 and 4.31); and
- the total biomass for Subarea 48.2 is increased from 9.4 to 15.6 million tonnes (Annex 4, paragraphs 4.28 and 4.31).

2.37 Various other reports presented to WG-Krill on the estimation of krill biomass in Statistical Area 48 were noted (Annex 4, paragraphs 4.32 to 4.38).

Near-synoptic Survey(s) in Statistical Area 48
(Annex 4, paragraphs 4.41 to 4.54)

2.38 In response to requests from both the Scientific Committee (SC-CAMLR-XI, paragraphs 2.69, 2.107, 2.116 and 2.117) and Commission (CCAMLR-XI, paragraphs 4.14 and 4.15), WG-Krill had considered the question of carrying out near-synoptic surveys in various statistical areas in the near future.

2.39 The Scientific Committee agreed that the primary purpose of such surveys would be to improve estimates of B_0 (pre-exploitation biomass) used in the population model to estimate sustainable yield (see also paragraphs 2.41 to 2.47). It further agreed that designated survey areas would be most likely to include large portions of Statistical Area 48 and smaller portions of Statistical Area 58 (Annex 4, paragraph 4.41).

2.40 The Scientific Committee concurred with WG-Krill's conclusion that although current fishing levels in Statistical Area 48 are low with respect to the precautionary catch limit of 1.5 million tonnes set by Conservation Measure 32/X (Annex 4, paragraph 4.43), there is a need to begin developing plans for, and designing, suitable near-synoptic surveys in parts of Statistical Areas 48 and 58 (Annex 4, paragraphs 4.43 and 4.44).

2.41 The Scientific Committee agreed that the Convener of WG-Krill should coordinate an *ad hoc* correspondence group in the forthcoming intersessional period to tackle the problem of designing near-synoptic surveys to estimate B_0 . This group will report to WG-Krill's next meeting (Annex 4, paragraph 4.47).

2.42 In considering the question of krill surveys in general, the Scientific Committee agreed that there is no urgent need to put aside funds for the Russian KRAM project at this time (Annex 4, paragraphs 4.49 to 4.53).

2.43 Dr de la Mare stated that Australia plans to conduct a survey of part of Division 58.4.1 in February 1996 to estimate krill biomass. He sought expressions of interest from Members who might be able to participate in the survey so as to extend coverage to a larger proportion of Division 58.4.1. A detailed survey plan will be presented at the next meeting of the Working Group.

Refinement of Yield Estimate Calculations (Annex 4, paragraphs 4.55 to 4.83)

2.44 The Scientific Committee noted that various refinements to the process and model used to calculate krill potential yield had been carried out during the intersessional period and were presented to WG-Krill (Annex 4, paragraphs 4.55 to 4.83 and papers WG-Krill-93/12, 13 and 42 in particular).

2.45 It was also noted that specific account had been taken of uncertainties in the values of various biological parameters and that the problems encountered in reconciling independent estimates of yield using the same underlying model (SC-CAMLR-XI, paragraphs 2.41 and 2.42) had been rectified through the verification procedure proposed by the Scientific Committee (Annex 4, paragraph 4.55).

2.46 Differences in this year's results compared with those presented last year were acknowledged (Annex 4, paragraphs 4.56 to 4.59).

2.47 The Scientific Committee endorsed WG-Krill's recommendations (Annex 4, paragraphs 4.60 to 4.64 and Appendix E) with respect to improving inputs into the model and the criteria used for selecting a value for γ (the multiplication factor that provides an estimate of potential yield).

2.48 Prof. J. Beddington (UK) welcomed the substantial progress that had been made. He stated that he believed it was now timely for the results to be related to particular CCAMLR areas so that the implications of the work for particular conservation measures could be assessed.

2.49 Dr de la Mare noted that the model was used for calculating the potential yields on which Conservation Measures were based. As such, the results were already related to particular areas.

He agreed, however, with Prof. Beddington that this may not be obvious from the reports of WG-Krill.

2.50 The Scientific Committee agreed that there was a need for greater clarity in describing and presenting the relationships between the various components which go into calculating potential yield in particular areas. WG-Krill was requested to take note of this in its future presentations on this topic.

2.51 The Scientific Committee also agreed that a significant breakthrough had been made in WG-Krill's ongoing efforts to assess krill recruitment and its variability (Annex 4, paragraphs 4.65 to 4.73). It endorsed WG-Krill's proposals to investigate the effects of selectivity on numerical density-at-length samples (Annex 4, paragraphs 4.68 to 4.70) and that the Secretariat be tasked with validating the proposed recruitment model (WG-Krill-93/12) as well as the computer programs associated with its analysis (WG-Krill-93/13) (Annex 4, paragraph 4.73).

Ecological Implications of Krill Fishing (Annex 4, paragraphs 5.1 to 5.45)

Location and Timing of Fishery (Annex 4, paragraphs 5.1 to 5.32)

2.52 At its last meeting, the Scientific Committee had sought WG-Krill's advice on possible measures to ensure that krill catches are not concentrated in areas close to predator colonies (SC-CAMLR-XI, paragraphs 2.78 and 5.39 to 5.43). The Scientific Committee endorsed WG-Krill's discussion on this matter (Annex 4, paragraphs 5.1 to 5.11) and its deliberations may be found in paragraphs 8.30 to 8.44.

2.53 The Scientific Committee agreed that the Japanese study of 10 x 10 n miles catch data presented to WG-Krill not only offered an important contribution to the Working Group's work, but also served to emphasise the importance of reporting fine-scale data (Annex 4, paragraph 5.9). Further research along the lines of the Japanese study was encouraged.

Relation of Fishing to Krill Predators
(Annex 4, paragraphs 5.12 to 5.25)

2.54 Using the framework developed by the Joint Meeting of WG-Krill and WG-CEMP in 1992 (SC-CAMLR-XI, Annex 8, Appendix 1), WG-Krill reviewed initial attempts to model inter-relationships

between krill, dependent predators and the fishery by means of a one-way interaction model (Annex 4, paragraphs 5.12 to 5.21).

2.55 The Scientific Committee noted that WG-Krill's discussion concerning the simulation analysis had resulted in a number of questions being posed to the originators of the data via WG-CEMP. It noted that WG-CEMP had responded to most of these questions in its report and had requested answers to the remaining ones by correspondence. Furthermore, WG-CEMP had indicated that the model would be significantly improved by using year-specific values and had requested that these data be supplied. The Scientific Committee endorsed this approach.

2.56 The Scientific Committee noted the suggestion of WG-Krill for future modifications to the model and agreed that it would be useful to undertake these once analyses based on the original model had been carried out with the corrected data and with the modifications suggested by WG-CEMP.

2.57 Some members of the Scientific Committee commented that the development of models of functional relationships between krill dependent predators and the fishery should run in parallel to field research.

Status and Role of CPUE Indices (Annex 4, paragraphs 5.26 to 5.32)

2.58 The Scientific Committee endorsed WG-Krill's view that it is important to distinguish between the use of CPUE information for the purpose of estimating krill biomass and its uses for other purposes, such as using CPUE as a measure of local density (Annex 4, paragraph 5.27). It reiterated the importance of collecting and submitting catch and effort data from the krill fishery.

2.59 In the context of using CPUE indices to improve current understanding of the relationship between local krill abundance and fishery, the Scientific Committee encouraged fishing nations to investigate the feasibility and cost of recording search time information from the fishery along the lines outlined by WG-Krill (Annex 4, paragraphs 5.31 and 5.32).

Effects of Management Measures on Krill Fishing
(Annex 4, paragraphs 5.33 to 5.40)

2.60 A simulation study of the consequences of different extents and locations of closed areas on the krill fishery in Subarea 48.1 (SC-CAMLR-XI, paragraphs 5.41 and 5.42) had been submitted to the Working Group in response to a former request by the Scientific Committee (WG-Krill-93/14).

2.61 The Scientific Committee agreed with WG-Krill that the Secretariat model was a good first attempt and that it could serve as a basis for further developments. The availability of fine-scale data from vessels operating in different locations during the entire fishing season was recognised as important in future efforts to refine the model (Annex 4, paragraph 5.38). The submission of such data was again encouraged.

2.62 It also agreed that it would be useful to receive operational information from the fishery on the underlying reasons for fishing off both the Elephant and Livingston Islands (Annex 4, paragraph 5.37).

2.63 The Scientific Committee noted the desire of WG-Krill to continue the dialogue with fishing nations concerning the consequences of potential precautionary management measures for localised areas in Subarea 48.1 (see also Annex 4, paragraph 5.39). This topic is discussed further in paragraphs 8.42 to 8.44.

Liaison with WG-CEMP (Annex 4, paragraphs 5.41 and 5.45)

2.64 Close liaison between WG-Krill and WG-CEMP was endorsed in the interests of developing feedback management procedures and in developing predator/prey interaction models in Subarea 48.1 as well as other subareas (Annex 4, paragraphs 5.41 to 5.43).

2.65 The Scientific Committee noted that the continuing development of krill and krill-predator interaction models (see paragraphs 2.53 to 2.57 and 8.46 to 8.51) will facilitate future progress on evaluating the statistical performance/cost effectiveness of possible experimental harvest regimes to distinguish between natural variation in predator performance and effects due to fishing (Annex 4, paragraph 5.45).

Precautionary Catch Limits on Krill Catches
(Annex 4, paragraphs 6.1 to 6.14)

2.66 Dr Naganobu indicated that WG-Krill had, at its 1992 meeting, used $\gamma=0.063$ in the estimation of krill potential yield even though Japan had submitted a paper suggesting that 6.3% is too low based on a simplified version of the yield estimation model (SC-CAMLR-XI, Annex 4, paragraph 2.41). He recalled that at WG-Krill's most recent meeting in Tokyo, the Working Group concluded that the adequate cross-checks of the yield estimation approach had been carried out by the Secretariat and Japanese scientists and that a value of $\gamma=0.165$ is consistent with criterion used previously by the Working Group.

2.67 However, Dr Naganobu stressed that he could accept the value of $\gamma=0.1$, given that:

- (i) the estimate of γ has changed over the past three meetings from 0.1 in 1991 to 0.063 in 1992, to 0.165 this year;
- (ii) $\gamma=0.1$ has been generally accepted as the traditional criterion for potential yield estimation; and
- (iii) $\gamma=0.1$ also takes implicit account of the agreed concepts of Article II (see discussion in Annex 4, paragraph 6.6).

2.68 Therefore, Dr Naganobu and some other Members concluded that, in their opinion, the Scientific Committee should endorse $\gamma=0.1$ as a working value at the present time until a more reliable value of γ becomes available.

2.69 The Scientific Committee agreed that for the time being $\gamma=0.1$ should be used.

2.70 The implications of the chosen γ level expressed as a proportion of median levels in the absence of exploitation are given in the following table. The Scientific Committee noted that the implication for future krill spawning biomasses contained in this table is consistent with the Commission's agreed concepts in relation to operational definitions of Article II set out in paragraph 6.5 of the WG-Krill report (Annex 4).

Statistic	$\gamma = 0.1$
Probability of biomass falling below 0.2 over 20-year harvest period	0.02
Biomass level at the end of 20 years:	
median	0.78
lower 5% -ile	0.41

2.71 The Scientific Committee agreed that the current best estimates of krill potential yield are as follows. These are shown together with the catch levels reported for the 1992/93 season.

Area/Division	B_0 (million tonnes)	Y (million tonnes) $\gamma = 0.1$	1992/93 Catch (million tonnes)
48.1 + 48.2 + 48.3	30.8	3.08	0.08
48.6	4.6	0.46	0
58.4.2	3.9	0.39	0

2.72 The Scientific Committee noted the following:

- (i) the estimates of B_0 are now some 12 years old;
- (ii) the current value for γ may be reconsidered following further development of the recently initiated krill-predator modelling studies (paragraphs 2.54 to 2.57);
- (iii) data derived estimates of certain biological parameters (particularly krill recruitment and variability - paragraphs 2.47 and 2.51) will only be available next year. The ranges of such parameters are vital for predicting the statistical distributions of krill biomass for different γ values; and
- (iv) only in 1994 will it be possible to take these estimates, along with other refinements to the krill potential yield model (Annex 4, Appendix E), into account in providing improved predictions for alternative choices of γ .

2.73 In this connection, Dr Naganobu stated that:

- (i) the Scientific Committee at its last meeting had endorsed the catch limits recommended by WG-Krill (SC-CAMLR-XI, paragraph 2.67; SC-CAMLR-XI, Annex

4, paragraph 6.1) prior to full validation of the model underlying estimation of krill potential yield (SC-CAMLR-XI, paragraph 2.41);

- (ii) WG-Krill had this year concluded that adequate validation of the yield estimation model had been carried out and that the ensuing results could be accepted (Annex 4, paragraph 4.55); and
- (iii) the best B_0 estimate of 30.8 million tonnes has been obtained from the re-analyses of the FIBEX data (paragraph 2.36).

2.74 For these reasons, Dr Naganobu concluded that the Scientific Committee should endorse the new yield estimate of 3.08 million tonnes contained in the table in paragraph 2.71 for Subareas 48.1, 48.2 and 48.3.

2.75 Lic. Marschoff indicated that the estimation of B_0 obtained from the re-analysis of the FIBEX data is associated with a high level of uncertainty and this fact should be drawn to the attention of the Commission.

2.76 The Scientific Committee noted that the information contained in the previous paragraphs may have some relevance for the precautionary catch limit currently contained in Conservation Measure 32/X. Similarly, it would also be relevant to the subarea allocation of this limit set out in Conservation Measure 46/XI.

2.77 The Scientific Committee advised the Commission that as developments in the scientific information underpinning such calculations of yield are made, the estimates of yield are likely to change. Noting the currently low prevailing catch levels in relation to the limit in Conservation Measure 32/X, the Scientific Committee sought the Commission's guidance on the frequency and magnitude by which krill catch limits may be adjusted in the light of changes in the scientific information underpinning such limits.

2.78 The Scientific Committee acknowledged that revision of current B_0 estimates for Division 58.4.2 should be available for consideration at WG-Krill's next meeting (Annex 4, paragraph 6.12).

2.79 It was agreed that high priority should also be afforded to planning a biomass survey in Division 58.4.1 since fishing was undertaken there during the most recent season (Annex 4, paragraphs 6.10 and 6.11) (see paragraph 2.43).

2.80 With respect to Division 58.4.2, the Scientific Committee agreed that the precautionary catch limit for this division set out in Conservation Measure 45/XI should not be revised at this stage, given the anticipated revision of the existing B_0 value, together with another estimate of this parameter based on the results of a recent survey undertaken by Australia in part of this division (Annex 4, paragraph 6.12).

Refining Operational Definitions of Article II (Annex 4, paragraphs 6.15 to 6.18)

2.81 The Scientific Committee noted that the method currently utilised by WG-Krill to provide estimates of krill potential yield already takes account of the first two concepts agreed by the Commission (CCAMLR-IX, paragraph 4.17) as operational definitions of Article II (Annex 4, paragraph 6.15).

FUTURE WORK OF WG-KRILL

2.82 The Scientific Committee noted that WG-Krill continues to make significant progress in its work. This refers, in particular, the refinement of procedures to calculate potential yield, the development of an approach to estimate recruitment variability, initial attempts to model functional relationships between krill, predators and the fishery, and the implementation of a procedure to plan future near-synoptic surveys of krill biomass.

2.83 The Scientific Committee endorsed the following topics as having the highest priority for WG-Krill in the forthcoming year:

- (i) the holding of a workshop to investigate water flux and krill movement in Statistical Area 48;
- (ii) estimation of total effective biomass in Division 58.4.2;
- (iii) further estimation, refinement and validation of methods to calculate potential yield and precautionary limits in various statistical areas and subareas, including refinements of the underlying model used to estimate yield as well as its input parameters (especially recruitment and recruitment variability);

- (iv) evaluation of procedures to collect search time information from the krill fishery and assessment of the associated practicalities and costs;
- (v) validation and sensitivity analyses of the model describing mortality arising from krill passing through net meshes during trawling; and
- (vi) refinement, in association with WG-CEMP, of models describing functional relationships between krill, predators and the fishery.

2.84 In addition, WG-Krill should continue to address issues associated with survey design, acoustic assessment of krill biomass, and the development of approaches to management.

2.85 In order to address the above issues, which are fundamental to the development of advice on krill, the Scientific Committee recommended that WG-Krill should meet during the intersessional period for approximately one week during 1994. The proposed Workshop on Evaluating Krill Flux Factors should be scheduled for a period of three days immediately prior to the Working Group's meeting.

2.86 The Scientific Committee noted the convergent nature of many of the matters being considered by WG-Krill and WG-CEMP. Members were requested to give consideration to an appropriate format whereby such matters could be most effectively dealt with in future meetings of the two Working Groups with a view to having more in-depth discussions at the Scientific Committee's 1994 meeting. Items to be considered would include some combination of WG-Krill and WG-CEMP's annual meetings and possible modification of WG-Krill's terms of reference. These topics will be included in the agenda for the Working Group's next meeting. A joint meeting of WG-Krill and WG-CEMP is planned for the annual meetings of the two Working Groups.

DATA REQUIREMENTS

2.87 The Scientific Committee was pleased to note the large number of papers tabled at WG-Krill and that these contained information relevant to the data requirements identified at the Working Group's 1992 meeting (SC-CAMLR-XI, Annex 4, Table 6). The Scientific Committee endorsed WG-Krill's updated table of information requirements (Annex 4, Table 6) and in particular:

- (i) the requirement to submit fine-scale catch and effort data from all subareas and the ISRs remains. Historical fine-scale catch data is still required for Statistical Area 58;

- (ii) the ongoing requirement to submit length frequency data from commercial vessels, haul-by-haul data (irrespective of proximity to CEMP sites) and information on the number/capacity of fishing vessels also remains;
- (iii) progress on the submission of historical fine-scale data from the former Soviet fishery is encouraged; and
- (iv) reports are encouraged on the anticipated costs and practicality of collecting and submitting search time information from the krill fishery in accordance with recommended procedures.

ADVICE TO THE COMMISSION

Specific Advice

2.88 Members are encouraged to investigate ways to facilitate the submission of historical catch data from the krill fishing fleets of the former Soviet Union (paragraph 2.17).

2.89 Analysis of the FIBEX data to estimate krill biomass has progressed as far as is practicable (paragraph 2.35).

2.90 Fishing nations are encouraged to investigate the feasibility and cost of recording search time information from the krill fishery (paragraph 2.59).

2.91 The Commission's attention is drawn to the Scientific Committee's deliberations on the estimation of krill yield in relation to the formulation of precautionary catch limits on krill (paragraphs 2.66 to 2.75).

2.92 Conservation Measures 32/X and 46/XI are currently in force. The latter measure applies to both the 1992/93 and 1993/94 seasons.

2.93 Conservation Measure 45/XI should not be revised at this stage, given the anticipated revision of the yield estimates for Division 58.4.2 (paragraphs 2.78 and 2.80).

2.94 The Commission's guidance is sought on the frequency and magnitude by which krill catch levels may be adjusted in the light of changing scientific information (paragraph 2.77).

General Advice

2.95 WG-Krill should hold an intersessional meeting during 1994 in order to continue work set out in paragraphs 2.83 to 2.86. A workshop on evaluating krill flux factors should be held immediately prior to this meeting. A joint meeting of WG-Krill and WG-CEMP will be held around the same time.

2.96 Members are requested to give consideration to an appropriate format whereby matters of common concern can be most effectively dealt with at future meetings of WG-Krill and WG-CEMP (paragraph 2.86).

2.97 Sensitivity tests and specific experiments should be undertaken to validate the proposed model on krill mortality resulting from passage through net meshes during trawling operations (paragraph 2.25).

2.98 An *ad hoc* correspondence group (coordinated by the Convener of WG-Krill) has been established to address the problem of designing future near-synoptic surveys during the forthcoming intersessional period (paragraph 2.41).

2.99 High priority should be afforded to designing a biomass survey in Division 58.4.1 in the near future (paragraph 2.79).

2.100 The Secretariat should validate and incorporate the new krill recruitment model into the procedures to calculate potential yield (paragraph 2.51).

2.101 To further assess the possible impact of krill fishing on krill predators, very fine-scale analyses of catch and effort data are encouraged (paragraph 2.53).

2.102 WG-Krill, in consultation with WG-CEMP, should continue developing functional models of interactions between krill, predators and fishery (paragraph 2.55).

2.103 The specific data requirements listed in paragraph 2.87 should be addressed as a matter of priority.