KRILL RESOURCES

Fishery Status and Trends

5.1 There has been an increase in the annual catches of krill over the past two years. Several nations reported improved success in preparing peeled krill products. A synopsis of national krill landings (in metric tonnes) is given below.

	Split-Year			
	1982/83	1983/84	1984/85	1985/86*
Chile	3 752	1 649	2 598	3 264
GDR	0	0	50	0
Japan	42 282	49 531	38 274	61 846
Republic of Korea	1 959	2 657	0	0
Poland	360	0	0	2 065
USSR	180 290	74 381	150 538	379 270
Total	228 643	128 218	191 460	446 445

* Preliminary figures

5.2 The catch reported by Chile was achieved by one vessel working for 43 days in Statistical Area 48. Next year it is planned that 2 ships will participate in the fishery.

5.3 Dr Shimadzu reported that the increase in the Japanese krill catch was due to an increase in the number of fishing vessels. Greater emphasis is now being placed on the preparation of peeled krill. He provided 3 kg of peeled krill for delegates to sample.

5.4 The Polish catches were part of an experimental study conducted mainly in the Elephant Island area (90 tonnes were taken from near South Georgia). It is intended to continue the study next season.

5.5 The total USSR catch was made up as follows:

Subarea 48.3	141 994	metric tonnes
Subarea 48.2	224 744	" "
Area 88	1 884	" "
Area 58	10 648	" "
	379 270	

The increased USSR catch was due to an increase in fishing effort.

5.6 The total catch for all nations for the 1985/86 season is the highest since the peak value in 1981/82 of 528 201 tonnes.

5.7 As in previous seasons, a substantial proportion of the 1985/86 catch was taken from Statistical Subarea 48.2 (South Orkneys), and it was questioned whether this had had any demonstrable effect on local krill-dependent predators. No information was available from which to draw any direct conclusions. The main fishing area is to the north of the South Orkneys 15–200 miles offshore. No long-term monitoring of krill or its predators has been undertaken in this area. Further discussion was referred to the agenda item dealing with ecosystem monitoring.

Further Data Requirements

5.8 The quality of the catch data being recorded was questioned. It was explained that the standard practice is to estimate total catch based on the amount of krill actually delivered on deck and not to use indirect estimates based on conversion factors applied to the amounts of commercial products.

5.9 Mortality due to krill passing through the meshes of nets is unknown. Research on this question is encouraged.

Biological Aspects Relevant to Stock Assessment

5.10 Discussion centred around the following main subject areas: stock separation, microscale density (swarming versus dispersed krill), near surface distribution, acoustic target strength, age determination and growth.

5.11 Dr Lubimova introduced a paper (SC-CAMLR-V/BG/25) with analyses of samples from around the Antarctic Continent which demonstrated the existence of 4 separate stocks. These are roughly centred in the Weddell Sea, Ross Sea, Prydz Bay and the Lazarev Sea. These stocks have been identified on the basis of water mass circulation. The small amount of mixing that takes place at the northern end of their range prevents separation of these stocks as indicated by biochemical and morphometric studies. They might however be considered as stocks for management purposes.

5.12 Two studies on microscale distribution were described. Dr Sahrhage reported that during early winter (May/June) in the area between east of Elephant Island and Adelaide Island, very few krill swarms were detected by the echosounders although dispersed krill were caught in RMT nets. However, to the northwest and north of Elephant Island, (a known krill fishing area), sizeable swarms were detected in the top 100 metres of the water column, a vertical distribution of swarms similar to that found in the summer. A few krill were also found at greater depths in RMT samples.

5.13 Australian scientists reported that during October they had observed a few krill swarms in the pack ice zone. These patches were characterised by the presence of whale, seal and bird predators. North of the shelf break, *Euphausia superba* predominated, but on the shelf, *E. crystallorophias* was more abundant. Observations by divers indicated that krill were feeding on epontic algae.

5.14 Dr. Lubimova introduced a paper by Dr. Yudanov (SC-CAMLR-V/BG/26) describing theoretical and practical studies aimed at detecting dispersed krill using echosounders. The study indicated that individual krill could be detected down to a depth of 50–60 metres.

5.15 The importance of detecting and quantifying krill near the surface was emphasised. Dr Everson reported on tests using a towed upward-directed transducer which had been used successfully to detect near-surface swarms. He stressed that even under calm conditions, such a system could not theoretically detect krill within one metre of the surface. Quantification is not possible because target strength is dependent on orientation and no information is available on orientation of the krill relative to the transducer beam.

5.16 Several studies investigating target strength were outlined. Dr Lubimova introduced a paper containing details of analysis of a TS experiment during FIBEX. (SC-CAMLR-V/BG/27). Scientists from Japan, Norway, USA and UK reported plans for TS experiments. It is clearly advantageous for all workers in this field to be fully informed of planned programs and results of individual studies. Dr Everson agreed to act as a clearing house for this information and report to the next meeting of the Scientific Committee.

5.17 Growth studies have been undertaken using biochemical techniques as well as population size frequency distributions. Scientists from USA have been working in conjunction with Dr Ettershank (Australia) to further develop and validate the lipofuscin assay technique. Similar studies are being planned by Japan and UK. Dr Beddington reported on analyses of size frequency distribution from 'Discovery Investigations' during the 1931–39 period. These indicated fast growth in summer and zero growth in winter. The

estimated growth rates indicate that krill would take about 6 years to get to their maximum size. Studies by USSR scientists on age and length of krill were presented as SC-CAMLR-V/BG/39 and an Australian paper on the moulting interval and growth of juvenile krill (SC-CAMLR-V/BG/36) was also presented.

5.18 Denzil Miller reported that the BIOMASS krill review was now two-thirds complete. The Committee acknowledged the large amount of work Mr Miller had done to provide such a good comprehensive review. They hoped that the project would be completed soon.

5.19 Attention was drawn to a recent FAO publication on krill catching and processing (FAO Tech Rep. 268).

Krill CPUE Simulation Study

5.20 Dr Beddington described the progress made in this study during the year. He had found it very difficult to find suitable, qualified consultants who could undertake the work at short notice. This had meant that it is now necessary to delay the whole study by about 10 months. Since no expenditure has been incurred, it was felt that this delay would have only minor implications for the CCAMLR budget.

5.21 The current intention is to conduct two parallel studies using Dr Butterworth (University of Cape Town) and Prof. Mangel (University of California at Davis) as consultants.

5.22 A document (SC-CAMLR-V/11) was presented to the Scientific Committee on the subject of krill modelling and simulation, indicating the view that meetings between USSR scientists working on this problem and the Convener and other experts working on the Krill Simulation Study should be arranged as soon as practicable.

5.23 One study would involve analysis of the USSR fishery, covering all aspects of the fishery including operation of scouting and commercial vessels. This would involve a visit to USSR by Dr Beddington and/or Dr Everson to ensure that the data that are being provided are suitable for the analyses. This visit would take place in the northern spring, allowing analysis to take place during the northern summer, leading to an interim report in time for the 1987 Scientific Committee meeting.

5.24 The other study would involve examination of the operation of Japanese fishing companies. Dr Shimadzu had kindly arranged a comprehensive itinerary for Dr Butterworth to accomplish this in October 1986. Analysis of both studies would proceed over the northern winter, leading to the preparation of an interim report for the 1987 Scientific Committee meeting.

5.25 The above studies would address the following objectives:

(a) develop a simulation model of a krill population capable of generating a range of spatial patterns of krill distribution and krill population dynamics;

(b) develop a model of fishing with the capacity to simulate a. range of fishing strategies;

(c) combine models (a) and (b) to explore the relationship between various measures of CPUE with changes in simulated krill abundance.

5.26 The remaining objective for the simulation study involved determination of the extent to which CPUE of individual vessels and fleets can be used as an index of abundance over large scale areas of the Southern Ocean. The reason for this is that although CPUE can be used as an estimator of local abundance, it is not clear how far away from the fleet such an index is reliable. This approach requires catch and effort data from the fishery and also independent survey data on krill abundance.

5.27 Recognising that the FIBEX acoustic data set is comprehensive in the south west Atlantic, Dr Everson had prepared a proposal for a workshop meeting which would involve analysis of that data set in conjunction with catch and effort data from the same area at the same time. The response to this suggestion was reasonably favourable. Criticisms arose, however, due to misunderstandings over the way the objectives had been defined and also due to fundamental disagreements voiced by USSR scientists over the survey design and analysis (SC-CAMLR-V/11). It was agreed that the basic approach was valid even though the period of time elapsed since the FIBEX survey would mean that contemporaneous catch and effort data might be difficult to obtain. SIBEX, a more recent study, stood a better chance of being cross-referenced to concurrent catch and effort data. Various national programs were described that were considered relevant.

5.28 It was agreed that a joint CCAMLR/BIOMASS workshop meeting should be held, hopefully in 1988, to investigate the topic. The Workshop would have the following terms of reference:

(i) The overall objective of the workshop shall be to determine the extent to which CPUE of individual vessels and fleets can be used as an index of abundance over large scale areas of the Southern Ocean.

(ii) To assemble, consolidate and validate data on krill abundance surveys by nets and hydroacoustics. These surveys must be independent of commercial fishing operations.

(iii) To assemble, consolidate and validate environmental data associated with these krill surveys.

(iv) To assemble, consolidate and validate krill catch and effort data in accordance with paragraph 5.9 of SC-CAMLR-IV from fishing operations that are concurrent with the independent surveys.

(v) To analyse the data in accordance with the objective in (i) above and report the conclusions to the Scientific Committee Meeting following the workshop.

5.29 Dr Everson agreed to act as Convener for the Workshop.

5.30 The following timetable was proposed:

		Completion Date
(i)	Convener collates outline information on krill abundance surveys	31 Dec 1986
(ii)	Definition of data formats	31 Dec 1986
(iii)	Convener circulates outline survey information and requests information indicating which surveys can be cross-referenced to concurrent catch and effort data	30 Apr 1987
(iv)	Convener calls for abundance survey and CPUE data	End 1987

(v) Data checking and validation Mid 1988

(vi) Workshop meeting late 1988

5.31 Concurrent with this proposed timetable is the requirement that analytical procedures be defined. Procedures had been outlined by scientists from USA and USSR (SC-CAMLR-V/11) which might be applicable. Members were requested to inform the Convener of any suitable analytical procedures known to them.

5.32 The Convener agreed to discuss and refine such procedures as might be deemed necessary to ensure the security of the data provided for the analysis. It was recognised that data security was an important consideration that applied both to commercial catch and effort data as well as survey data sets such as those of BIOMASS.

5.33 It was agreed that krill catch and effort data would be supplied in accordance with paragraph 5.9 of SC-CAMLR-IV.

5.34 The Committee welcomed the proposals by Japan and USSR to undertake simultaneous studies of krill abundance and CPUE during the next few seasons.

5.35 Scientists from USSR reported that it is still not current practice for commercial fishing vessels to record detailed catch and effort data in accordance with paragraph 5.9 of SC-CAMLR-IV. The Committee regretted this situation. It was strongly recommended for the purpose of this Study that the data specified in paragraph 5.9 be collected by commercial vessels operating in survey areas.

Advice to the Commission

5.36 The Scientific Committee had noted a large increase in krill catches from the region just north of the South Orkneys in Statistical Subarea 48.2. Information available to the Committee indicated that this level was likely to be maintained or increased. Some concern was expressed that the current level of fishing (with a catch during the last year of over 200,000 tonnes) might be having a significant effect on local predators. The Scientific Committee therefore recommended that detailed catch data for krill caught in sub-area 48.2 be reported to the Commission. The data should be reported in accordance with paragraph 4.19 (iii) of this Report, by the end of September 1987.