

KRILL RESOURCES

CPUE as an estimator of krill abundance

5.1 Dr W. Ranke (GDR), Convener, introduced the report of the ‘Workshop on Krill CPUE’ (Annex 6). Due to unforeseen circumstances, he had been unable to be present for the first part of the meeting and thanked Dr I. Everson (UK) for chairing the meeting for that period. He also thanked Mr D. Miller (South Africa) for preparing a comprehensive account of the meeting.

5.2 The Working Group had considered how CPUE data had been used in other fisheries and had looked for parallels in krill fisheries.

5.3 The Japanese krill fishery appears to have characteristics, at least during the peak of the fishing season, such that catch per unit fishing time can be used as an index of local density. Whilst valid for the immediate vicinity of the fishing vessel or fleet, or possibly larger areas, such an index might be difficult to apply to larger areas without additional information such as search-time or inter-krill-concentration distance.

5.4 The Soviet fisheries strategy is different from that of the Japanese and whilst local abundance might be estimated in the same way, the different operational procedures would require different analytical procedures to provide abundance estimates for larger areas.

5.5 A range of relationships between CPUE and overall krill density is possible. In order to explore this range, and in particular, to identify the type of effort data which will reflect properly the relationship between CPUE and abundance, the Working Group had recommended that an exploratory simulation study would be required for which the following broad terms of reference were proposed:

- (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;

- (d) in addition, examine how catch and effort data may be combined with independent survey data, based on hydroacoustic methods or research trawls, in order to obtain an index of abundance applicable to larger areas.

5.6 It was agreed that the BIOMASS acoustic data sets might provide valuable information on krill swarm spatial distribution. Tentative plans for BIOMASS workshops on this subject were therefore welcomed.

5.7 The Scientific Committee fully accepted the need for such a simulation study and recommended the following procedure for its implementation:

- (i) to entrust Dr J. Beddington (UK) with an overall responsibility for the project;
- (ii) to employ, at CCAMLR expense, consultant(s) with professional experience in modelling and complex statistical analyses required for this study;
- (iii) initially, Dr Beddington would correspond with nominated experts from Japan, USSR and other fishing states, as well as other members interested in taking part;
- (iv) members involved in this study should ensure that the requisite data are made available to the Workshop referred to in item (vi) below and are encouraged to undertake relevant studies within their national research programs;
- (v) it is proposed that Dr Beddington would organise visits to both USSR, Japan and if necessary other fishing states to work with the experts to be nominated by the countries so as to assist them in tasks defined in paragraph 5.5;
- (vi) that a final workshop, under the convenership of Dr Beddington would be held for a period of about 2 weeks at Hobart or another suitable location;
- (vii) the budgetary implications of this program are that participation by members should be at national expense. The cost for the consultant(s) and other services would be borne by the Commission;
- (viii) an interim report should be presented to the next meeting of the Scientific Committee in 1986 and a final report at the 1987 meeting;

- (ix) the reports would require review and technical discussion at the Scientific Committee, leading to the formulation of specific data requirements for estimating krill abundance by CPUE or by the survey methods.

5.8 Some confusion arose as to the appropriate list of basic data to be collected. As a basis for discussion, the Krill CPUE Workshop had used a list agreed at the Woods Hole Meeting (SC-CAMLR-III, Annex 6) as opposed to the revised version in SC-CAMLR-III, Appendix 6. It was agreed that the former list, revised by the Workshop in the light of its specific requirements, should be used. The variables are listed below in paragraph 5.9 (i–iv).

5.9 In order to allow experts to undertake theoretical studies concerning methods of applying search time and CPUE data to the estimation of krill abundance over large areas, krill fishing countries are requested to make available samples of data listed below (e.g. covering the operations of one fleet for two seasons). At the same time it was taken into account, that the Soviet data could presently be provided only from research vessels.

(i) Description of Vessel

- name of ship
- type of vessel
- registration number and port of registration
- ship nationality
- gross registered tonnage
- length overall (m)
- maximum shaft power (kW at ... rev/min or horse power)

(ii) Description of Gear

- trawl type (according to FAO nomenclature)
- code number for trawl type
- mouth opening or length of bottom rope and length of upper rope (m)
- effective area of mouth
- mesh size at codend (mm stretched)
- liner mesh size (mm)
- underwater acoustic equipment, echosounders (types and frequencies), sonar (types and frequencies), netsonde (yes/no)

(iii) Tow Information

- date
- position at start of fishing (in degrees and minutes)

- time at start of fishing (in hour and minutes GMT; if local time, indicate the variation from GMT)
- time at end of fishing (before hauling)
- fishing depth (m) (only if midwater trawl)
- direction of trawling (if the track changed during trawling, give the direction of the longest part of the track)
- towing speed (knots) - comment on gear performance

(iv) Catch Records for Each Tow

- estimated total catch (kg)
- approximate species composition (percent of total)
- weight (kg) of krill
- average size of krill (mm) or commercial size categories (e.g. S,M,L).

5.10 Because of the specific purpose of the Krill CPUE Workshop, no advice concerning regulatory measures was provided to the Commission.

5.11 The attention of the Commission is drawn to certain ongoing data requirements and in particular to the need:

- (a) to continue with the collection of catch and effort data in accordance with current national practice;
- (b) to make every effort to collect data listed in paragraph 5.9 as a matter of routine;
- (c) to collect data from fisheries research vessels integrated with catch data from fishing fleets wherever possible.

5.12 For the purposes of the simulation study vessels would remain anonymous and precise locations would not be identified.

5.13 In adopting the report the Scientific Committee noted the provisions for supply of environmental data as listed in SC-CAMLR-III, Appendix 6 and recommended that where possible these be collected.

5.14 The Scientific Committee indicated that it expected the proposed scientific work on this problem should ensure the Scientific Committee would be able to give the Commission guidance on the regular submission of krill catch and effort data in the future.

Other methods of krill abundance estimation

5.15 The Scientific Committee had received from the SCAR Group of Specialists on the Southern Ocean Ecosystems and their Living Resources an advance copy of the report on the Post-FIBEX Acoustic Workshop, held in Frankfurt in September 1984. The report highlighted several important points which were taken note of and discussed.

- a) Statistical analysis had been refined so as to take full advantage of the survey design.
- b) Only those data collected in accordance with the survey design had been used in the analysis.
- c) Detailed examination by national groups of their data with respect to calibration constants had meant that many Mean Volume Backscattering Strength (MVBS) values had had to be revised.
- d) A revised target strength/size relationship was provided.

5.16 The net effect of all these changes was that the estimated biomass of krill within the FIBEX area was now only one eleventh of the initially estimated value. Furthermore, the value is very much less than would be expected by comparison with information on krill consumption by predators, estimated krill production based on conversion ratios from primary production, and the current fishery. Because of this disparity, it was considered vital to reappraise all these estimates.

5.17 The Committee was pleased to note that an independent project aimed at studying all aspects of target strength is currently being planned.

5.18 The FIBEX study did not estimate dispersed krill or those present near the surface. Certain national programs are addressing these problems.

5.19 The Scientific Committee recognised that greater refinement was necessary with the indirect estimates of krill abundance, particularly with respect to providing variances associated with the various estimators.

5.20 The report of the Post-FIBEX Acoustic Workshop was seen as being a valuable contribution to the study of krill because it had provided comprehensive analytical

procedures, highlighted deficiencies in the methodology and provided a stimulus to further research. The Committee felt that BIOMASS should be commended for initiating and sponsoring the project.

Current information on krill abundance

5.21 The reported low abundance of krill in the Atlantic sector during the 1983/84 season was discussed (see paragraphs 8.6 – 8.9 of SC-CAMLR-III). Examination of the data indicated that the cause was natural variability in water circulation causing a low abundance in some areas such as South Georgia. Further investigations during the 1984/85 season showed that there was low krill abundance around Elephant Island and the northern part of Bransfield Strait while dense concentrations were observed in the southeast of the Bransfield Strait* and off Joinville Island.

5.22 In the Prydz Bay region, krill had been concentrated to the south in contrast to FIBEX observations, when krill were distributed over the whole region.

5.23 Short-term variation in krill abundance was seen as being a key factor in understanding ecosystem interactions involving krill. The Scientific Committee looked forward to the results and conclusions of the SIBEX studies.

Fishery status and trends

5.24 Statistics on the overall krill landings in the Convention Area in recent years show a steep decline from about 528,000 tons (1981/82) to about 229,000 tons (1982/83) and only about 128,000 tons (1983/84).

5.25 The USSR landings in 1983/84 was 74,000 tons. This is lower than in previous seasons, due to technological problems with processing and this is expected to continue for the next two years.

* Known in Argentina as Mar de la Flota

5.26 The Japanese landings in 1983/84 was 49,531 tons, which in 1984/85 was reduced to 39,000 tons as a result of a reduction in the number of fishing boats operating. This was due mainly to increased market competition from *Euphausia pacifica* which are caught around Japan.

5.27 A synopsis of national krill catches is given below (in metric tons):

<u>Fishing Country</u>	<u>Split Year</u>	
	1982/83	1983/84
CHILE	3752	1649
JAPAN	42282	49531
REPUBLIC OF KOREA	1959	2657
POLAND	360	0
USSR	<u>180290</u>	<u>74381</u>
TOTAL	<u>228643</u>	<u>128218</u>

BIOMASS review on krill

5.28 The Scientific Committee was informed that the BIOMASS review on krill had still not been completed. Some rewriting will now be necessary in the light of conclusions of the post-FIBEX Acoustic Workshop, whilst other sections still need to be written. Mr D. Miller was currently co-ordinating the work. The Chairman of the Scientific Committee received a request from the Convener of the SCAR Group of Specialists on the Southern Ocean Ecosystems and Their Living Resources to enter into contractual arrangements with CCAMLR for obtaining additional funds for the publication of this resources review.

Priority topics for next meeting

5.29 Several topics of krill research were highlighted for discussion at the next meeting of the Scientific Committee. Members were asked to consider these and provide background papers wherever possible.

5.30 The following subjects were identified as being of particular importance:

- a) Age Determination and Growth
- b) Stock Separation
- c) Target Strength
- d) Estimation of abundance of near surface and dispersed krill.