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EXPLOITATION PERSPECTIVES OF THE ANTARCTIC KRILL RESOURCES

(Agenda Item 19c)

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1. Present state of the development activities for exploitation of krill resources

The existence of large amounts of krill, pelagic crustaceans somewhat resembling small shrimp, in the Antarctic, and their importance as food for baleen whales and other animals has been known for many years. Interest in commercial exploitation arose in the middle sixties, at a time when the baleen whale stocks had greatly declined due to heavy exploitation. This, however, required development of special catching techniques and of possibilities for utilization of the products. The Soviet Union was the first country to initiate systematic studies on the abundance and distribution of krill and the possibilities of capture and utilization, followed later by Japan. Norway, United States, New Zealand and Australia have carried out some experiments to test commercial possibilities. The Federal Republic of Germany now seems to have started preparations for a research and experimental cruise in the Antarctic in 1975 or 1976.

Different fishing methods were tried by the Soviet Union including mid-water trawling and side-trawls, some of the latter connected with a pumping device which continuously pumped the catch on board ship. During the past few years experimental commercial-type activities have been tried with one or two vessels, and a satisfactory catching technique would appear to have been developed. Two or three Soviet vessels are in the Antarctic this season to try commercial exploitation for a few months.

A Japanese vessel landed 59 metric tons of frozen krill in March 1973, caught with a mid-water trawl which proved to be inefficient. An improved trawl has been constructed, and the first results in the present Antarctic season gave rise to the expectation that this season 600 tons could be caught, which is considered to establish the commercial feasibility of the exploitation.

The frozen whole krill produced by Japan appears to have found a ready market for direct use in the same way as similar small Crustacea used traditionally in Japan. Research is being carried out on product diversification, including use as blenders in other fish products. The Soviet Union's vessels produce a shrimp paste by squeezing the liquid out of the animal tissues under pressure and coagulating the proteins contained in the liquid by heating. The proportion krill/paste is about 4:1. The paste is frozen in blocks for storing and transportation, is sold as krill paste directly or mixed with cheese, butter and other products, and is accepted in the USSR market although there are price problems. Krill paste contains 70-75% moisture and 13-20% proteins, high in essential aminoacids like arginine, lysine, leucine and phenylalanine.

An important problem for commercial exploitation remains that of finding sufficient krill concentrations. There appears to be considerable variation in the amount, distribution and/or detectability of the krill swarms in different years. More knowledge is required on the factors which govern the distribution and behaviour of the species in order to forecast the presence and location of exploitable krill concentrations, and further development of detection techniques is desirable. Present methods include visual detection of surface shoals and echo-sounding. Other problems are related with further product development and with production costs. The existing knowledge on the nature of the resource is summarized in the following sections.

2. Nature of the resource

Though other related species exist in the region, the main bulk of the krill resource consists of the Euphausiidae Euphausia superba Dana. This small pelagic crustacean (adults do not exceed 70 mm, the common adult length is 45-50 mm) is found all around the Antarctic in the region between the Antarctic convergence

(50-60°S.L.) and the continent. It is a species found mainly in the upper water layers down to 250 m and occurs often in swarms near or at the surface. The swarms may attain densities of 10-16 kg per cubic meter (Moiseev, 1970).

Apart from the summer period, the krill spends the greater part of its life in waters of a temperature of about 0°, below the ice or at the edge of the pack ice. During the summer it is most abundant in the high latitude coastal current in the East Wind zone and in the low latitude oceanic current from the Weddell Sea, and also in the regions of the Bransfield Strait and South Georgia (Mauchline and Fisher, 1960). The zone which shows the best possibilities for a commercial exploitation of krill is the Atlantic sector of the Antarctic Sea (Scotia Sea) and the waters around the Antarctic Peninsula.

The krill mature at the age of two complete years and, according to the data available in the literature, they die immediately after spawning. Others (e.g. Bargmann, 1945; and Marr, 1962) assume that the spent krill survive after spawning until the end of the Antarctic summer, when the phytoplankton declines. Thus, the life span extends over two winters and three summers.

Contrary to other Euphausiid species, Euphausia superba feeds almost exclusively on phytoplankton, i.e. is situated at a very low trophic level.

In the Scotia Sea juveniles and adults form separate swarms. Adults seem to concentrate around the islands in this area but swarms of juveniles have also been found there. In the oceanic areas catches consist mostly of juveniles (modal length of about 35 mm), with a reduced adult component. According to Shevtsov and Makarov (1969), during the first half of the summer the fishery can be based on the exploitation of adult krill, and at the end of the summer the juveniles, which are completing their summer feeding, provide good possibilities.

3. Estimates of the magnitude of the resource

The most recent Soviet papers consider the standing stock of Antarctic krill as being in the order of 800 to 5 000 million tons (Lyubimova et al, 1973) and the potential yield of the stocks at least 100 million tons (Lagunov et al, 1973). The latter figure agrees well with Gulland's estimate (1971) of an annual krill production of 200 million tons. Japanese estimates are also concurrent with this figure: Omura (1973) estimates the potential yield to be between 100 and 200 million tons per year, based on consideration of the annual consumption by whales, Moiseev (1970) estimated that before the decline of baleen whale populations these consumed at least 150 million tons of krill in a season. If other consumers are added we have a total annual consumption of 250-300 million tons.

It should be noted that even the smallest of these figures largely exceeds the present total annual world catches of aquatic resources (which were slightly over 65 million tons in 1972). However, despite the huge biological potential of the resource, two factors should be taken into account for an estimation of the harvestable yield: firstly, that the geographical and meteorological conditions in the region and the behaviour of the resource enable good catches to be obtained during a small part of the year only; secondly, that the area of exploitable concentrations appears to be limited to a relatively small section of the Antarctic, and that therefore only a small part of the total krill production in the whole Antarctic can be harvested. Nevertheless, it is believed that the harvestable yield of the resource could still be of the order of several tens of million tons.

4. International action

The total world fishery catches have nearly doubled every ten years during the last decades, to nearly 70 million tons in 1971. Estimates of the total world potential of marine fish of the conventional types indicate that the optimum catch of these fish is probably of the order of 100 million tons, less than double the present marine fish catch. Many of the remaining resources are species which are less attractive because of their value, accessibility or otherwise. It can be expected that the rate of increase in world fish production from conventional resources will slow down, and that in order to maintain a substantial increase, attention should more and more be directed at harvesting unconventional resources, of which krill would seem to promise possibilities. Some international bodies have paid attention to various aspects of the problems involved in the exploitation of the latter resources.

On the advice of the FAO Advisory Committee on Marine Resources Research (ACMRR), the Long-term and Expanded Programme of Oceanic Exploration and Research (LEPOR), which is coordinated by the International Oceanographic Commission (IOC), included project 2.6, to determine abundance, distribution and interrelations of the principal organisms of the Southern Ocean, together with their life histories, aggregation and migration characteristics, particularly as related to the environment, and to lay the scientific basis for efficient and rational harvesting of such organisms. The programme included conducting a cooperative survey of the living resources of the Antarctic seas (Revision of Part I - Scientific Content of the Expanded Programme, I.O.C. Sixth Session, Paris 1969), but so far it has received little follow-up with respect to krill resources.

ACMRR at its Seventh Session in March 1971 recommended that FAO should review the problem of obtaining better estimates of the potentials of unconventional resources, and noted that the world production of fish products allows for a considerable increase if unconventional species (amongst which krill was mentioned) can be used. FAO is now considering calling a small informal meeting of some senior officers of countries interested in krill exploitation and utilization to discuss the state of affairs, common problems, and possibilities for international cooperation. The interested countries are actively pursuing their research and development activities on the krill resources, but international coordination of these activities would be particularly useful in view of the high costs of operating in the Antarctic.

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