Can We Satisfactorily Estimate Variation in Krill Abundance?

I. EVERSON[1]

Summary. A knowledge of abundance and rates of change of abundance are basic requirements for fisheries models. Catch per unit of effort (CPUE) has traditionally been used in demersal fisheries assessments as an estimator of abundance. It is less satisfactory for pelagic fisheries. Evidence is given that CPUE estimated from data reported to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) does not provide a realistic index of krill abundance. Recognizing that there is a large natural year-to-year variation in krill abundance, it is important that this be quantified and separated from fishery-induced variation. The time-scale for such information is discussed in the light of the needs of fishery management.

1 Introduction

In studies of the variability of krill (*Euphausia superba*) populations, assessment of the impact of fisheries on the resource is of crucial importance. In this chapter I propose to look at information on variability in krill abundance from net haul and acoustic surveys and compare this with data from the fishery.

The krill fishery began in the late 1960's and expanded during the 1970's to a maximum annual catch of just over half a million tonnes (Fig. 1). Relative to estimated predator consumption rates the current total catch is small. However, if this catch were concentrated within a region where krill predators were restricted by, for example, foraging range from breeding sites, such a modest annual take could have serious implications. In this light it is essential to be able to distinguish between variations in krill abundance resulting from the effect of the fishery and those resulting from either natural variation in the krill population dynamics or variation induced by environmental factors.

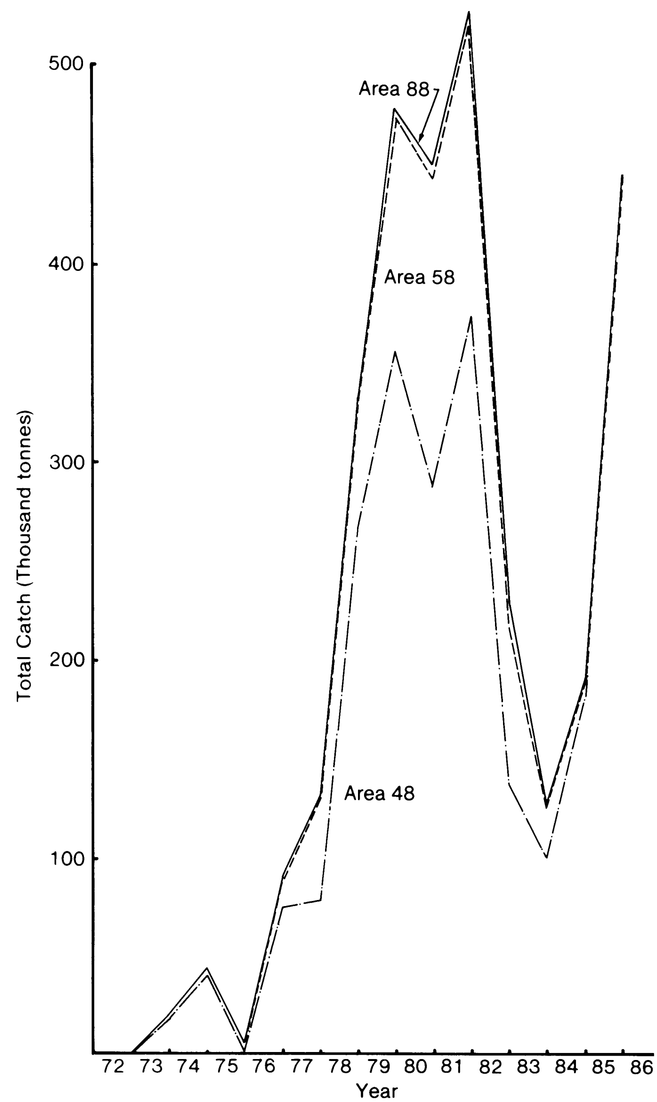

Fig. 1. Annual catch of the krill fishery by major area

2 Fishery Data for Use as an Estimator of Abundance

Traditionally Catch Per Unit of Effort (CPUE) has been used in fishery stock assessment as an estimator of abundance. The underlying assumption is that for a given unit of effort, measured in terms of hours of fishing, number of tows or some similar index, the catch will be proportional to the abundance of the resource. While this assumption holds reasonably well for many demersal resources, assessment of pelagic resources poses preater problems because of their greater tendency to aggregate. This means that a

1 British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 OET, United Kingdom

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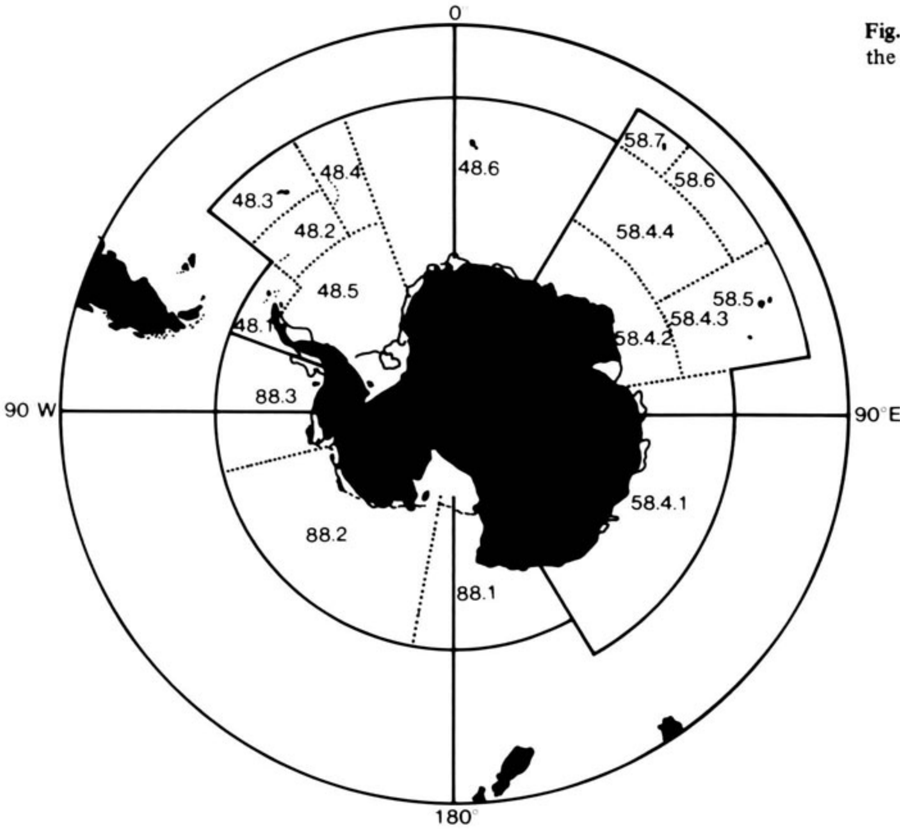

Fig. 2. Boundaries of statistical reporting areas in the Southern Ocean

significant proportion of the effort is diverted towards searching for fishable swarms, thus adding another factor that needs to be incorporated into the equation.

Summary catch and effort data are supplied annually to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) in the STATLANT A and STATLANT B formats and additional information is available in the scientific literature. The STATLANT data contain information on catch, identified by species, for each year, month, major gear type, vessel type, geographical subarea (Fig. 2) and target species. Unfortunately it has not been the universal practice to apportion the fishing effort between the various species either in terms of actual catch or intended catch. Where more than one species has been reported it is impossible to provide valid estimates of CPUE in mixed fishery situations unless the target species is identified. The present analysis has been restricted to situations where krill was the only species reported. The Japanese have provided STATLANT data over the full period of the fishery and have concentrated their fishing effort almost exclusively on krill. Their data have, therefore, been used as an example in this analysis.

3 The Japanese Krill Fishery

Combining data from all subareas within each season (Shimadzu 1985), there is a general increase in the mean annual catch per haul (Fig. 3). The only season when there

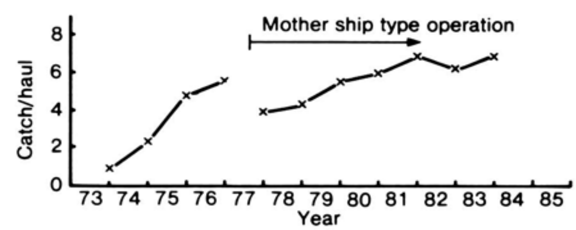

Fig. 3. Mean catch (t) per haul for the Japanese krill fishery

was a decline of greater than 10% was in the 1977/78 season, when the pattern of the operation changed. Prior to that time small numbers of vessels had been operating more or less independently while afterwards a mothership type operation using smaller nets was in progress until 1981/82. The mothership operation, by restricting the geographical range over which the catching could operate at any time, may have been the cause of the reduction. Subsequent to the 1977/78 season there was a steady increase in mean catch per haul, which may be a result of increased effectiveness of the vessels as in earlier years. The alternative explanation, that the low value in 1977/78 was a result purely of generally low krill abundance, cannot, however, be discounted.

A better CPUE index is likely to be derived from using time actually spent fishing as the unit of effort (Shimadzu 1985; Shimadzu and Ichii 1985). In terms of catch per hour's fishing, using the STATLANT B data, there is a wider year-to-year fluctuation leading to a major increase for the last three seasons (Fig. 4). A comparison of catch