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International Council for the Exploration of the Sea

CM 1975/H:14
Pelagic Fish (N) Committee

AN ASSESSMENT OF CHANGES RESULTING FROM THE USE OF NETS WITH A SANDEEL MESH IN THE NORTH SHIELDS SPRAT FISHERY DURING THE 1973-74 SEASON

by

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ABSTRACT

Changes resulting from the use of sandeel mesh in the North Shields sprat fishery are examined in relation to length and age distributions, and an assessment is made of the gains and potential losses to the fishery arising from the use of this mesh. The selectivity of standard sprat mesh (9 mm bar) is also estimated from the relative length distributions of fish caught by the 2 mesh sizes (standard sprat and sandeel).

INTRODUCTION

The 1973-74 season was notable in that the fishery became concentrated close inshore along the Durham coast between the Tyne and Tees. The inshore nature of the fishery is illustrated by Table 1, which summarises effort and catch data by nautical mile zones for each month and the season. It will be noted that over half the catch was taken within the 3 mile limit. This was largely due to a prevailing weather pattern of severe westerly winds over most of the season, which effectively prevented the vessels from operating more than a few miles off the coast, combined with the fact that there were also some good concentrations of fish within the 6 mile limit.

The season was also remarkable for the very large quantities of smaller first-year sprat (1973 yearclass) present within the inshore region.

The fishery commenced in the second week of December 1973, with good catches and large concentrations reported 4-10 nautical miles off the coast between Seaham and Hartlepool. At this time a fairly high proportion (about 20% by number) of smaller sprat (< 9 cm) were evident in the catches and the fishermen maintained that there were very large quantities of small sprat available which were not being effectively caught with their standard sprat mesh (about 9 mm bar). A number of Grimsby vessels using sandeel mesh in their cod-end sleeves (made up of 'Raschel' knotless weave netting, with a lumen measuring about 4 x 5 mm) made greatly increased catches of the very small sprat (less than 7 cm in length) and this led to most of the fleet changing over to using the smaller mesh early in January. In that month the proportion of fish less than 9 cm in length rose to 77% in the catches sampled.

The use of sandeel mesh probably provided a fairly complete representation of first-year fish in the area, whereas in past seasons only the larger members of this age group were normally represented in the catch. In the 1969-70 season, during February and March, the fishing similarly became concentrated mainly within 3 miles of the coast in the same region and first-year sprat (1969 yearclass) were also strongly represented. At that time, however, only the larger component were caught, with a length range of 5.5-9.5 cm and modal length at 7.5 cm.

CHANGES IN THE LENGTH AND AGE COMPOSITION OF THE CATCH DUE TO THE USE OF SANDEEL MESH

Samples taken in December 1973 (when sprat mesh was in general use) and January 1974 (when sandeel mesh had been generally introduced) are compared in Figure 1. This clearly illustrates the very considerable increase in the proportion of smaller sprat taken with the finer mesh and the corresponding reduction in average age of the catch. This change is unlikely to have resulted either from a change in the area sampled, since this was substantially the same in each month, or from any systematic change in population structure within the area. This was evident when a comparison was made between the length structure of samples grouped by increasing distances from the coast up to a maximum of 13 nautical miles offshore.

AN ASSESSMENT OF THE SELECTIVITY OF STANDARD SPRAT MESH (9 mm BAR)

The use of sandeel mesh also provided data for the estimation of the selectivity of the standard mesh normally used in sprat fishing.

Ideally, retention curves are determined by using a small mesh cover over the mesh under investigation, or by carrying out sets of tows which are closely parallel in time and area but use different mesh sizes. The data available from the fishery is thus far from ideal in this respect since it involved different times and sampling locations although the latter were within the same general area. There was also a marked change in the catch per unit effort between December and January, and it was thus not possible to directly compare the 2 length distributions. However, it was found that amongst those vessels sampled in December and January there were 2 which were sampled fairly closely in time and area in each month, and that these probably provided the best comparison available. The length and age distributions of their individual catches are shown in Figure 2. It will be noted that these typify the general changes shown in Figure 1. A 'knife-edge' selection length was then determined for the sprat mesh used in December on the basis of:

i. each individual vessel (A and B);

ii. all the vessels sampled.

The selection lengths were determined using the cumulative percentage method and the results were as follows:-

VESSEL A	8.9 cm
VESSEL B	8.5 cm
OVERALL	8.6 cm

In order to confirm that these estimates were likely to be of the right order a check experiment was carried out using standard sprat mesh and some freshly preserved fish. These were individually pushed into the mesh after their body dimensions had been measured, they were categorised as to whether they passed through readily, would only pass with difficulty (ie were possible 'stickers') or were fairly definitely retained by meshing solidly along the first quarter or so of the body. A retention curve was constructed from the results, and this is shown in Figure 3. The 50% retention point falls at about 8.5 cm. The experimental result is thus in good agreement with that derived from the catch length distributions, and the knife-edge selection length thus determined was used to estimate the gains (and potential losses) to the fishery resulting from the use of sandeel mesh.

GAINS AND POTENTIAL LOSS TO THE FISHERY RESULTING FROM THE USE OF SANDEEL MESH

The actual gains and potential losses to the fishery brought about by using the smaller mesh are summarised in Table 2. This shows the number, weight and value of the additional fish caught in the 1973-74 season in relation to the total catch, and the potential loss in the 1974-75 season due to the extra catch of the 1973 yearclass in its first winter.

The increased catch was numerically very high, amounting to 47% of the total (88% in relation to first year fish only), but in terms of weight and value it amounted to only 11% of the total.

Vessels preferentially fishing on the small sprat (ie those with catches containing more than around 80-90% of small fish) would obviously have derived a substantial advantage from using the smaller mesh. However, the quality of this additional catch was low for fish meal use, due in part to the low oil content of these small sprat. This has led to a reaction by the fish meal processors against utilising these very small fish.

By comparing the distributions of otolith first winter ring diameters in the same yearclass in 2 successive seasons it is possible to assess the loss of biomass of 2 year-old fish to the fishery as a result of their capture as one year-olds. The estimated average weight (9.93 gms) was slightly less than that (10.25 gms) of the 2 year-olds actually caught in the 1974-75 season, but this was probably due to a bias towards the lower end of the range of winter ring diameters in the additional one year-olds taken by sandeel mesh. The natural mortality rate was assumed to be 50% per annum ($M = 0.7$), and the potential survivors from the additional catch of first year fish thus amounted to about 498 million fish weighing some 4,942 tonnes when 2 years old. This compares with the catch-gain of one year olds of 1,393 tonnes (valued at £52,934) in the 1973-74 season.

NORTH SHIELDS SPRAT FISHERY: 1973-74 SEASON

TABLE 1 Effort and catch data for the 1973-74 season by months and nautical mile limits

	N MILE RANGE LIMITS								TOTALS	
	0-3'		3-6'		6-12'		12-15'			
	NO OF TRIPS	TONNES CATCH	NO OF TRIPS	TONNES CATCH	NO OF TRIPS	TONNES CATCH	NO OF TRIPS	TONNES CATCH	NO OF TRIPS	TONNES CATCH
December	24	739	58	1,876	27	718	7	229	116	3,562
January	191	3,749	72	1,880	49	1,779	9	201	321	7,609
February	124	3,056	6	176	5	30	-	-	135	3,262
March	26	514	6	180	2	95	-	-	34	789
SEASON	365	8,058	142	4,112	83	2,622	16	430	606	15,222
%	60.23	52.94	23.43	27.01	13.70	17.23	2.64	2.82	100.00	100.00

TABLE 2 Summary of gains and losses to the North Shields Sprat Fishery arising from the use of sandeel mesh in the 1973-74 season (Herring by-catch excluded)

	Season's totals for first year fish only	Gain from using sandeel mesh	Season's totals for all age groups	% gain from use of sandeel mesh
NUMBER (millions)	1,127.7	995.4	2,119.0	47.0
WEIGHT (tonnes)	1,691	1,393	12,247	11.4
VALUE (@ £38/tonne)*	£64,258	£52,934	£465,386	11.4

POTENTIAL LOSSES AS 2-YEAR-OLDS IN THE 1974-75 SEASON

	Potential losses	Actual catch of 2-yr-olds
NUMBER (millions)	497.7	1,228.4
WEIGHT (tonnes)	4,942	12,595
VALUE (@ £25/tonne)*	£123,550	£314,875

(*Values represent average levels for fish meal outlets in each season)

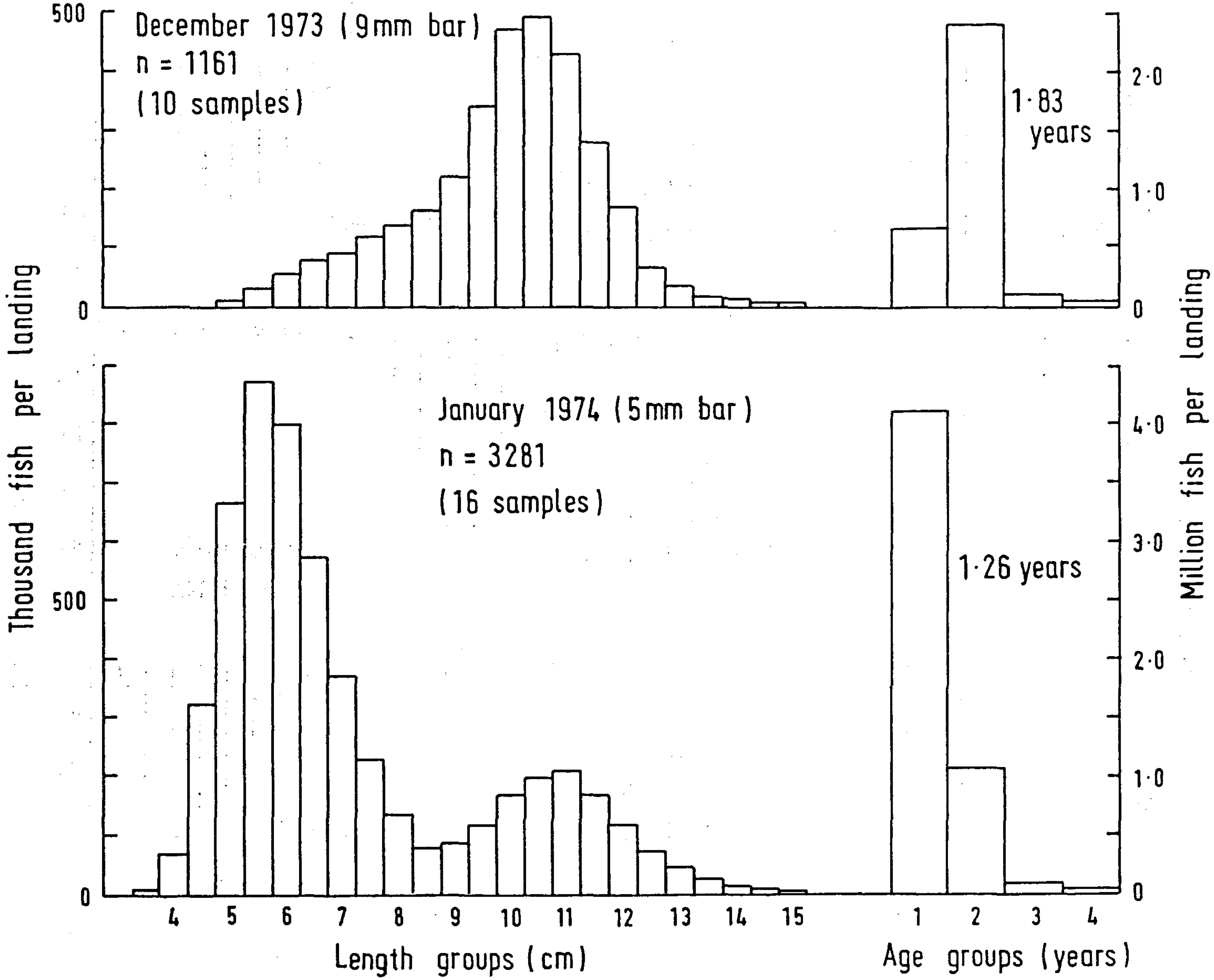

Fig 1. North Shields sprats 1973-74 season

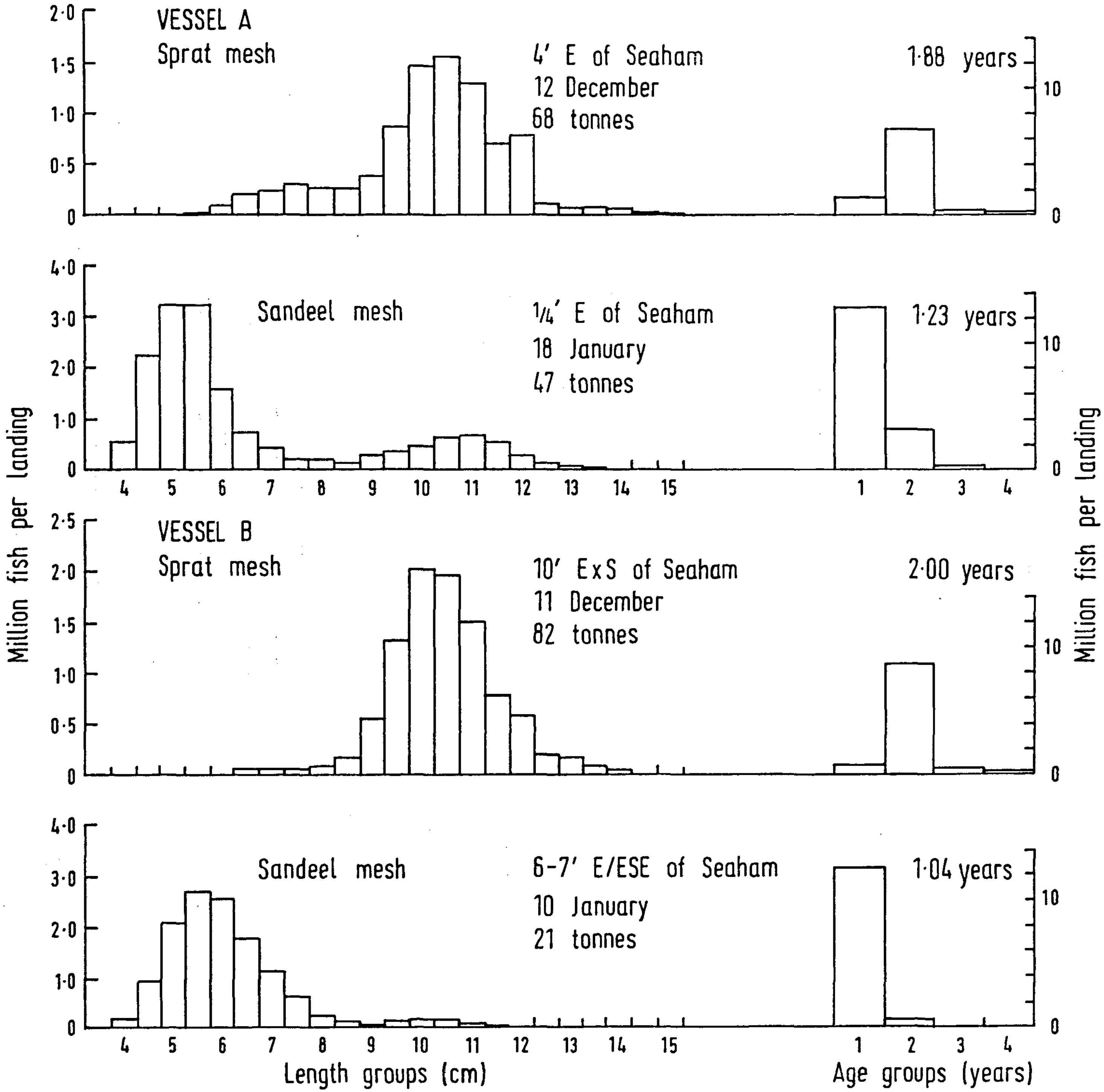

Fig 2. North Shields sprat fishery 1973-74 season

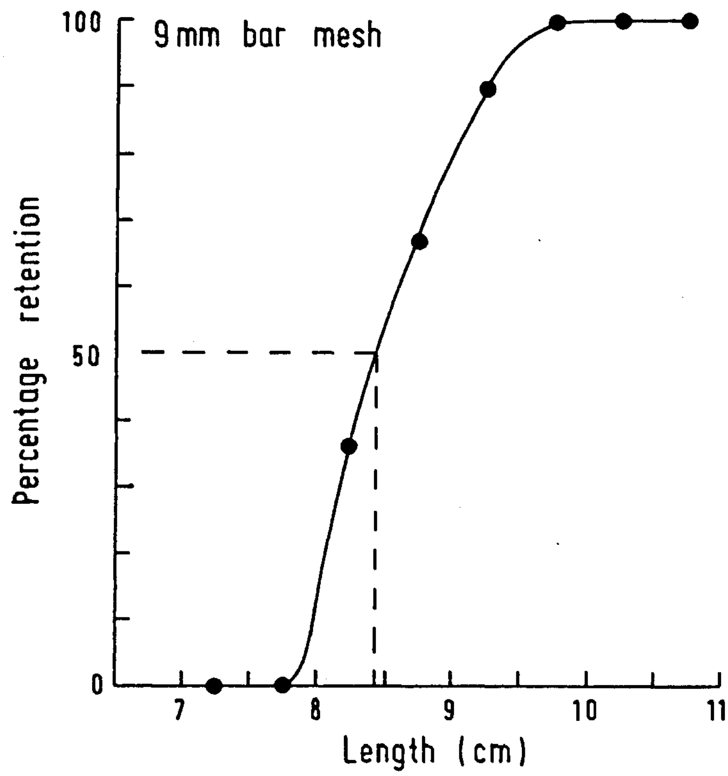

Fig 3. Experimentally derived mesh retention curve.

APPENDIX

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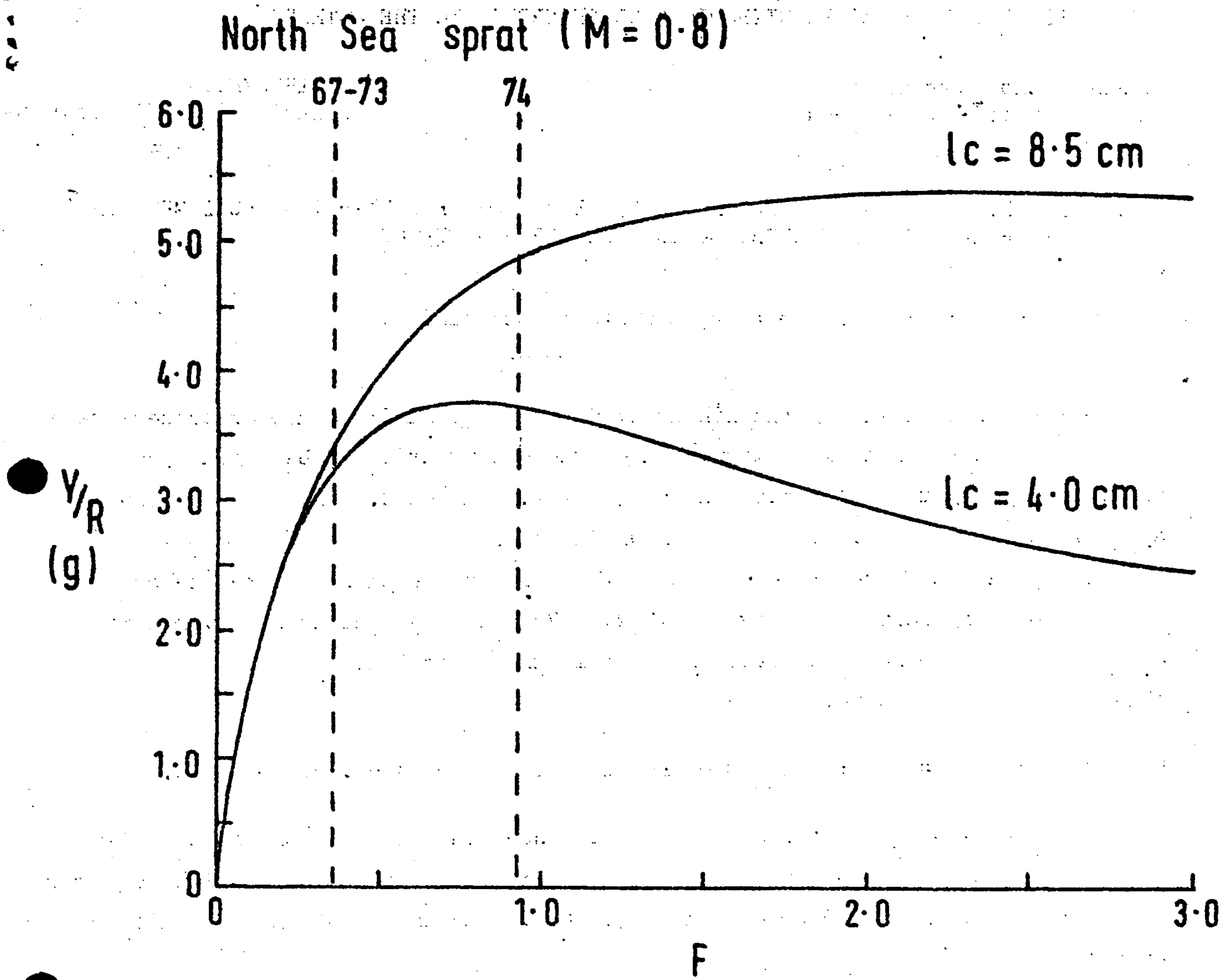
A further analysis on the likely effects of unrestricted use of sandeel mesh in the North Sea sprat fisheries involved the construction of Beverton & Holt yield curves for two selection lengths (l_c = 4.0 cm and 8.5 cm) corresponding to sandeel and sprat mesh. These are shown in Figure 4.

The parameters used were estimated from all the samples of sprat taken during the Young Herring Surveys of 1972, 1973 and 1974, and these covered most of the total distributional area of sprat in the North Sea. These were the following:

W_∞ = 30.4 cm; K = 0.62; t_{MAX} = 6 yrs, t_r = 1 yr; t_o = -0.22; M = 0.8.

A comparison of the two curves clearly shows that the use of sandeel mesh (l_c = 4.0 cm) would reduce the yield per recruit quite markedly, particularly when F exceeded 0.8, whereas for sprat mesh (l_c = 8.5 cm) an asymptotic level is approached.

Approximate estimates for the levels of fishing mortality on North Sea sprat in recent years were calculated from data contained in the Report of the Herring Assessment Working Group (1975). These are shown in Figure 4 as an average for the 7-year period 1967-73, and for 1974, when the total North Sea sprat catch increased to nearly 300 000 tons. The values suggest that with F = 0.9 the yield per recruit using sandeel mesh would have begun to decline, but not attained its maximum for sprat mesh.



Yield curves for North Sea sprat with lc = 4·0 cm and 8·5 cm