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Redfish Selectivity Study on Flemish Cap, May 1981

by

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ABSTRACT

Selection parameters for the 90 and 120 mm mesh kapron codends were determined from parallel and alternate fishing operations by two commercial trawlers engaged in the redfish fishery on Flemish Cap. The results show 50% retention lengths of 28.4 and 31.4 cm and selection factors of 3.1 and 2.6 for the 90 and 120 mm mesh codends respectively. A total length-girth relationship was determined and the results compared with those reported by other authors. Visual observations on most of the sets with the 120-mm mesh codend indicated the escapement of large numbers of redfish once the codend was at the surface, implying an unnecessary loss of the resource.

INTRODUCTION

During the 1978 Annual Meeting of ICNAF, the Standing Committee on Research and Statistics (STACRES) noted with concern the reports of Canadian fishermen that the use of the current mesh size regulation in trawls in Division 3M resulted in significant quantities of redfish floating out through the meshes at the surface and being lost from the codend during the process of taking the catch on board (ICNAF, 1978). At that time, STACRES suggested some lines of research aimed at providing advice on the question of the possible exemption for redfish from the current mesh size regulations in Division 3M and evaluating the implications of a reduction in the minimum mesh size for this species on the short-term yields. Current ICNAF mesh size regulations (ICNAF Comm. Doc. 78/VI/1) provide for a minimum mesh regulation of 130 mm manila or the equivalent for other materials, e.g. 120 mm Kapron (polyamide), for redfish as well as for other groundfish species in ICNAF Division 3M.

Several papers dealing with these matters were reviewed by STACRES at the 1979 Annual Meeting (Stevenson, MS 1979; McKone, MS 1979; Chekhova and Konstantinov, MS 1979), and other authors presented summaries of available data in trawl selectivity of Atlantic redfish (Clay, MS 1979a, b; Ivanova, MS 1979). It was concluded that there should be no change in the minimum mesh size for redfish on Flemish Cap in view of the uncertainties about the effects of decreased mesh sizes on the redfish and cod resources (ICNAF, 1979).

At its Second Annual Meeting in September 1980, the Fisheries Commission of NAFO considered the Canadian proposal for the regulation by a minimum mesh size for the fishery on groundfish in the Regulatory Area (NAFO, MS 1980), which established a 130-mm mesh size (irrespective of material) to be applied in waters under Canada's fishery jurisdiction (except for the redfish fishery in Div. 3NOP and the silver hake fishery in Subarea 4). This proposal (effective 1 July 1981) was questioned by Cuba and USSR in relation to the Div. 3M redfish fishery, suggesting that the use of a 130-mm mesh would result in great escapement

and consequently in economic loss.

Taking into account the observations of the Canadian fishermen and the uncertainties relative to the effect of decreasing the mesh size, Cuba proposed, according to its means, to conduct a selectivity experiment on board of commercial trawlers, with the main objective of adding some new information on different mesh-sized codends and to compare the actual regulation mesh size codend with another of smaller mesh.

During the last few years, Cuban trawlers have been using kapron (polyamide synthetic material) codends in the different operational areas of the Northwest Atlantic, i.e. Scotian Shelf, Grand Bank, Flemish Cap, etc. The present study involved the use of kapron codends in order to increase the knowledge of selectivity parameters with this type of material.

MATERIALS AND METHODS

The selectivity experiment was carried out on board two Cuban commercial vessels during 3-25 May 1981. Technical data for both vessels are summarized in Table 1. Both vessels used midwater trawls (No. 80) constructed of kapron material. This commercial trawl, made in Cuba, is commonly on Cuban trawlers in their fishing operations. The general dimensions and characteristics of this gear are shown in Table 2.

In this study, the alternate haul method together with one of its variants, parallel fishing, was used. According to Pope *et al.* (1975), in the alternate haul method, the selection curve is estimated from hauls in which the codend is uncovered (i.e. fished naturally), and the length distribution of the fish over the total or major part of the selection range in the area where fishing takes place may be obtained by estimating the size distribution of the fish on the grounds from hauls using a codend of much smaller mesh size than that of the codend whose length selection curve is to be determined. Thus, a direct comparison of this size distribution with that of the catches by the experimental codend provides estimates of the percentage retention at each length by the experimental codend.

During the experiment, three kapron codends with mesh sizes of 120, 90 and 60 mm (commercial rated sizes) were used, the 120 and 90-mm codends being the experimental ones for which selection curves are to be estimated. Codend mesh size measurements were made with a flat wedge-shaped gauge inserted in the mesh under a pressure of 5 kg. Each set of measurements consisted of measuring 20 consecutive meshes running parallel to the long axis of the codend. Mean mesh sizes, with standard deviations and standard errors, are given in Table 3. Mean mesh sizes were used in all calculations.

The two vessels involved in the experiment (*Rio La Palma* and *Rio Bayamo*) began parallel fishing on the same ground over the same extended period, and after one vessel left the area (the ship with the 90-mm mesh codend), the other one kept on fishing alternatively with the 120- and 60-mm mesh codends. During the parallel fishing, the vessels were a few miles apart but maintained communication most of the time during the simultaneous setting, towing and retrieval of the trawl. One biologist on each vessel was in charge of the development of the experiment.

During the study, one vessel (*Rio La Palma*) fished entirely with the 90-mm kapron codend, while the other vessel (*Rio Bayamo*) fished alternatively with 120 and 60 mm kapron codends. This allowed the comparison between the 90 and 60 mm codends by parallel fishing (thus obtaining the selection ogive for the 90 mm codend), and comparison between the 120 and 60 mm codends by alternate fishing (thus obtaining the selection ogive for the 120 mm codend). As commercial vessels, the ships kept on fishing all the time where the major concentrations of redfish occurred, mainly in the northern and northwestern region of the Flemish Cap (Fig. 1) in depths ranging from 395 to 450 m.

Because redfish are known to concentrate near the bottom during the day and disperse in the pelagic zone during the night, daylight hauls were only considered, thus eliminating the possible bias between daily and nightly hauls. The off-bottom variant of the midwater trawl was used by both vessels. The gear was

was towed at depths where schools were detected, and concentrations were observed passing into the net through a net-sounder attached to the headrope.

A total of 44 hauls were made by both vessels, 8 pairs of parallel hauls and 28 alternate hauls. All relevant details were recorded for each haul (position, depth, time, duration and catch). A random sample of 400 redfish were taken from all daylight sets and measured as total length to the nearest cm.

The series of data obtained during the experiment with the three codends were analyzed according to the methodology proposed by Pope *et al.* (1975), providing selection ogives for the 120 and 90 mm mesh codends. The selection curves were fitted by eye, taking into account that this method provides unbiased estimates of the 50% points which are very close to those obtained by the maximum likelihood method (Pope *et al.*, 1975). The 50% retention length was also calculated by the moving average method and compared with that of fitting by eye. The length compositions of each haul were adjusted to catches per two-hour tows and then summed to obtain a single selection ogive for each experimental codend (120 and 90 mm), thus eliminating between-haul variation. Finally, the percentage retention values at each length group were adjusted by taking an average of these values, equating these to 100% retention and adjusting all the other values correspondingly.

Considering the importance of girth when conducting mesh selection studies and its highly positive correlation with length of fish, a stratified sample of 165 redfish (22-45 cm) was obtained for girth and total length measurements. The maximum head girth was measured with a flexible measuring tape.

RESULTS AND DISCUSSION

Catches consisted mainly of mentella-type redfish with no by-catch of other fish species. Selection ogives fitted by eye for the two experimental codends indicated 50% retention lengths of 28.4 and 31.4 cm for the 90 and 120 mm kapron codends respectively (Fig. 2). The 50% retention lengths, obtained by moving average of 3 points, were 28.2 and 31.0 cm for the 90 and 120 mm mesh codends. These results are very close to those obtained by fitting the curve by eye. As it is usual in Bardell and alternate haul selectivity experiments, retention percentages greater than 100% were obtained for the largest fish.

Table 4 shows the 50% retention lengths, selection ranges and selection factors for each experimental codend. Selection range, as generally expected, increased with mesh size (5.0 cm for 90 mm codend and 8.2 cm for 120 mm codend), while selection factors decreased (3.1 and 2.6). These values fall within the historical range obtained for the redfish in the selectivity studies.

Clay (MS 1979a), from joint mesh selection studies on the Scotian Shelf in 1977 using the covered codend method and adjusting the curves by eye, reported 50% retention lengths of 28.5 and 29.0 cm for redfish in 90 and 120 mm mesh kapron codend. In the present study a similar value for the 90 mm codend was obtained, while a slightly different one was found for the 120 mm. However, Clay (MS 1976b) for 90 and 120 mm codends, gives 50% retention lengths of 22.0 and 32.5 cm, which are quite different from those indicated above.

Catches in both experimental codends consisted of redfish having a bimodal length composition, with modes at 28 and 35 cm (Fig. 3 and 4). Fish of the 28-cm modal group were found to be much more abundance (for both codends) than fish around the 35 cm modal group. The same size distribution was evidence in catches by the 60 mm codend. Length frequencies of the catches, together with the 50% retention lengths and the selection ranges, for the 90 and 120 mm codends are shown in Fig. 5. It should be noted that the 50% retention length for the 90 mm codend lies very close to the mode of the most abundant size group, whereas the 50% retention length for the 120 mm codend is above this mode (28 cm).

Fig. 6 indicates the straight line corresponding to the total length-girth relationship, computed from a stratified sample of 165 redfish in the 22-45 cm size range. The resulting equation, $G(cm) = 0.72\ L(cm) - 2.23$, gives a slope value which is very close to that found by Clay (MS 1979a) but with a different intercept.

Visual observations made on board the vessel using the 120 mm mesh codend indicated considerable escapement of redfish from the codend at the surface. These observations could not be quantified, but they constitute field observations made during an actual selectivity experiment.

The results given in this paper imply the necessity of analyzing the short-term and long-term gains and losses, in order to determine the appropriate mesh size for the redfish fishery.

ACKNOWLEDGEMENTS

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Table 1. Technical data for the commercial vessels involved in the selectivity experiment.

Vessel characteristics		
Names	-	Rio Bayamo and Rio La Palma
Model	-	TACSA 95 TFA
Length overall	-	106.7 m
Beam	-	14.5 m
Draft	-	6.01 m
Gross register	-	2034.87 mt
Net register	-	1160.21 mt
Power	-	4400 HP
Speed	-	16 knots
Type of ship	-	Stern trawler/freezer

Table 2. Gear specifications for the midwater trawls used in the selectivity experiment.

Gear characteristics		
Type of trawl	-	pelagic
Footrope length	-	80 m
Headrope length	-	80 m
Headrope height	-	26-32 m
Wing spread	-	58-64 m
Length of bridles	-	100 m
Type of doors	-	rectangular (Siuberkruv)
Door weight	-	1600 kg
Door dimensions	-	3.58 x 2.25 m^2
Mesh size (wings)	-	3 m
Mesh size (body)	-	800 mm
Mesh size (codend)	-	120 mm, 90 mm, 60 mm
Footrope rollers	-	Steel weights, 500 and 600 mm diameter

Table 3. Results of mesh size measurements of kapron codends used in the selectivity experiment.

	60-mm codend					90-mm codend					120-mm codend					
Mesh	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6
1	64	62	64	60	62	92	90	95	90	95	114	120	118	122	120	120
2	58	62	66	62	64	92	93	90	95	90	118	118	122	122	120	118
3	58	68	64	66	64	92	92	92	94	92	120	122	118	118	116	116
4	66	64	68	66	62	94	95	94	90	95	118	120	120	120	118	118
5	64	68	66	64	62	92	88	90	92	90	126	118	120	122	118	120
6	60	62	68	64	60	94	90	90	90	90	122	120	124	122	118	122
7	58	66	62	68	62	92	94	90	95	94	124	122	118	118	120	124
8	60	56	66	66	60	90	95	92	92	96	118	124	120	116	120	118
9	62	60	60	64	62	92	95	90	90	92	120	120	122	120	124	120
10	60	60	62	62	62	94	95	92	92	90	120	118	118	122	118	120
11	58	58	64	60	68	90	94	95	90	94	116	120	120	120	126	120
12	62	62	64	60	60	88	90	94	95	92	120	122	124	124	124	124
13	58	60	62	58	66	88	93	92	92	90	118	124	122	118	122	118
14	62	64	66	62	68	88	95	95	90	90	116	120	120	122	124	120
15	60	58	66	60	62	86	94	90	95	92	116	122	122	118	120	118
16	58	62	62	62	64	90	90	92	90	93	124	120	120	118	118	120
17	62	62	60	58	58	90	92	90	92	90	124	120	118	124	120	118
18	64	62	60	58	62	86	90	92	90	92	120	120	118	120	124	122
19	58	58	58	58	60	90	90	90	95	94	122	118	118	122	118	122
20	60	60	60	62	60	92	92	92	92	96	126	122	120	120	124	122
Mean	60.60	60.90	63.40	61.90	61.70	90.60	92.38	91.85	92.25	92.35	120.1	120.5	120.1	120.4	120.6	120.0
SD	2.52	2.38	2.90	2.93	1.86	2.43	2.25	1.87	2.05	2.15	3.46	1.82	1.99	2.21	2.83	2.15
SE	0.56	0.53	0.65	0.65	0.41	0.54	0.50	0.42	0.46	0.48	0.77	0.41	0.44	0.49	0.63	0.48

Table 4. Summary of selectivity parameters for redfish in 90 mm and 120 mm mesh codends.

Codend	50% retention length		Selection range (25-75%)	Selection factor
	By-eye fit	Moving aver.		
90 mm	28.4 cm	28.2 cm	5.0 (24.8-29.8) cm	3.1
120 mm	31.4 cm	31.0 cm	8.2 (26.2-34.4) cm	2.6

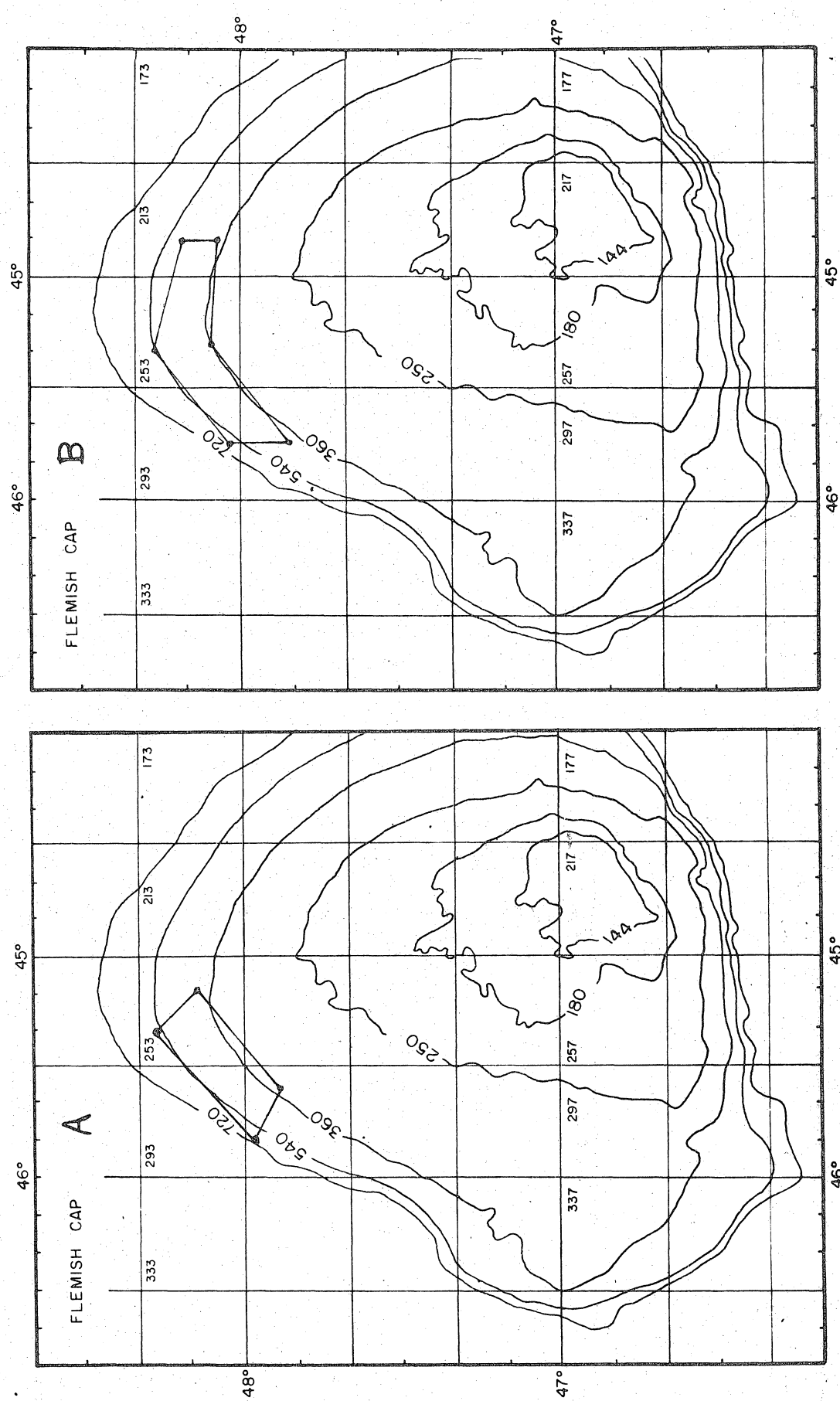

Fig. 1. Maps indicating the area where the parallel fishing experiment (A) was conducted (90 and 60 mm codends), and where alternate fishing experiment (B) took place (60 and 120 mm codends).

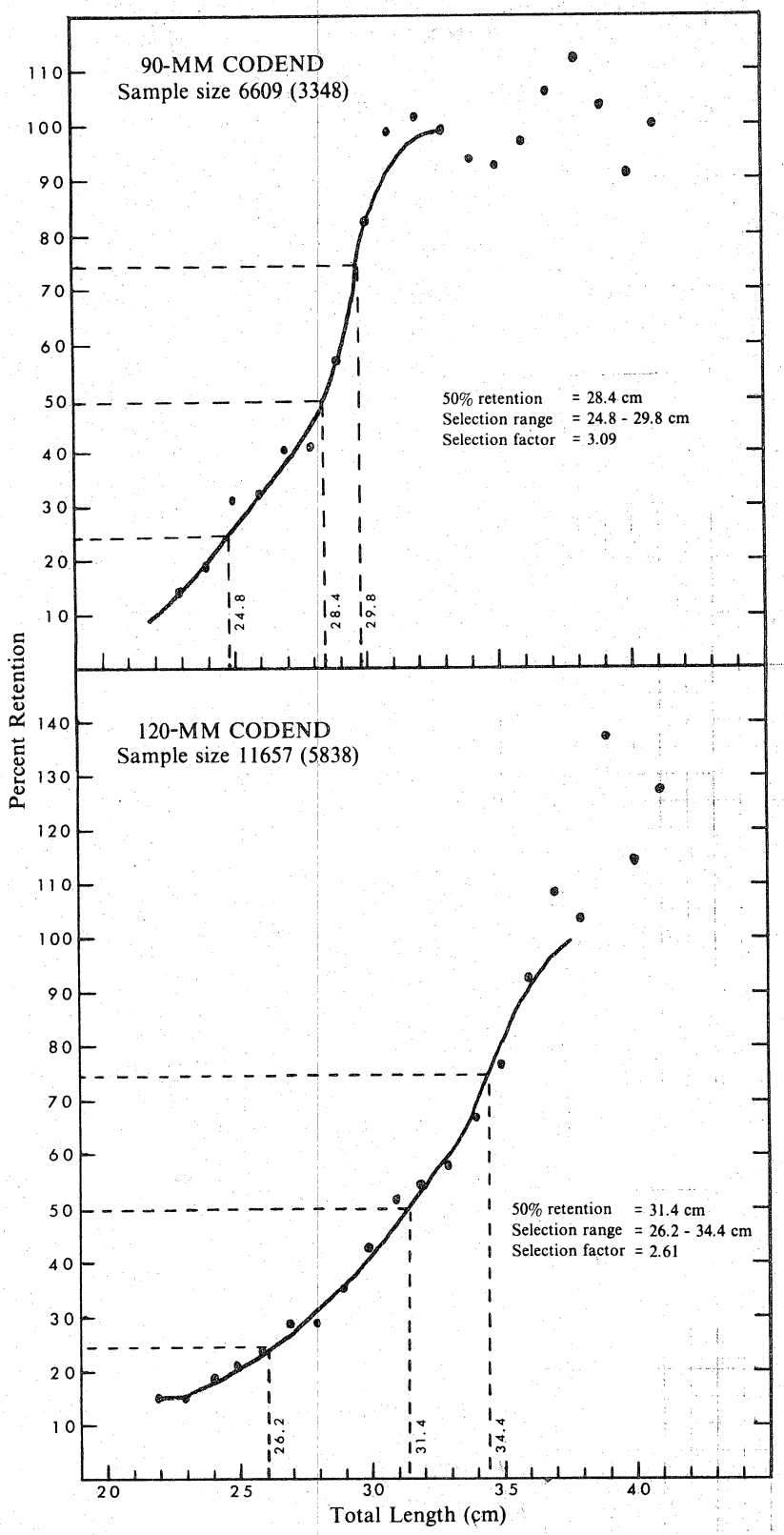

Fig. 2. Selection curve for the redfish from Division 3M.

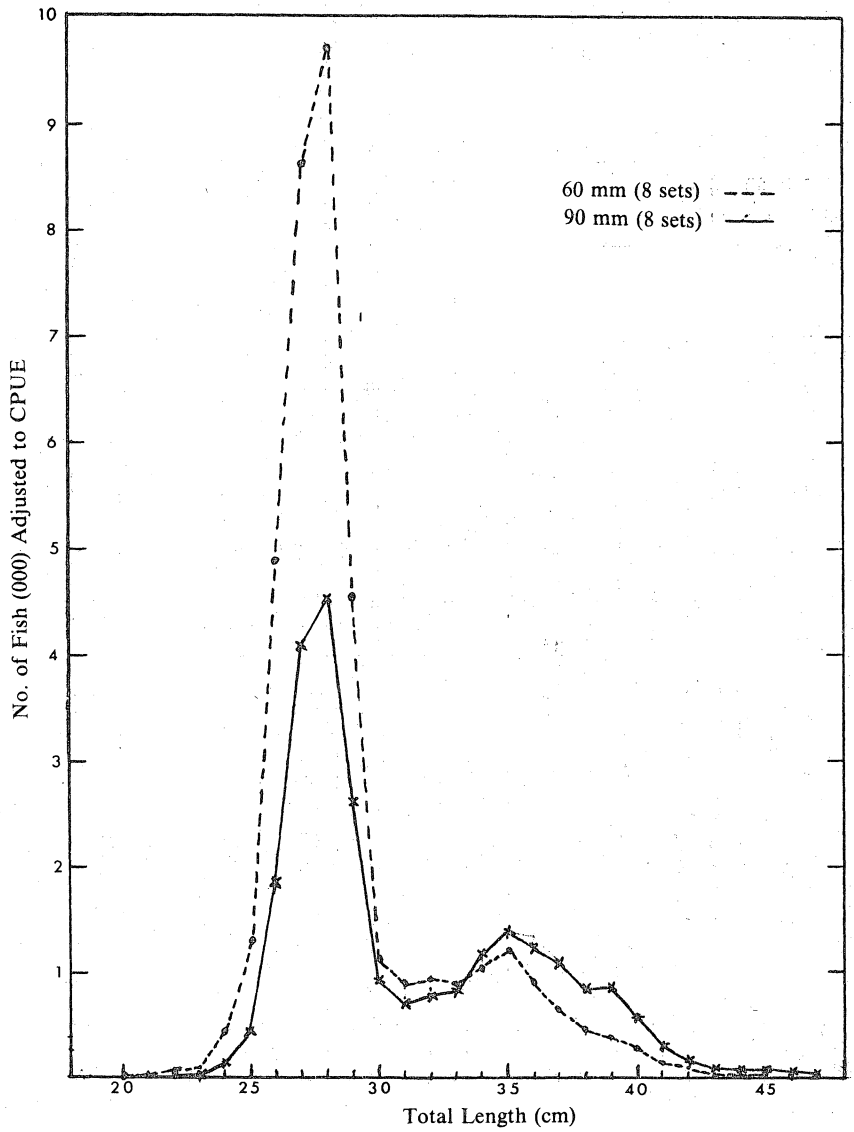

Fig. 3. Length composition of redfish catches for the 90 mm codend (experimental) and the 60 mm codend (comparative).

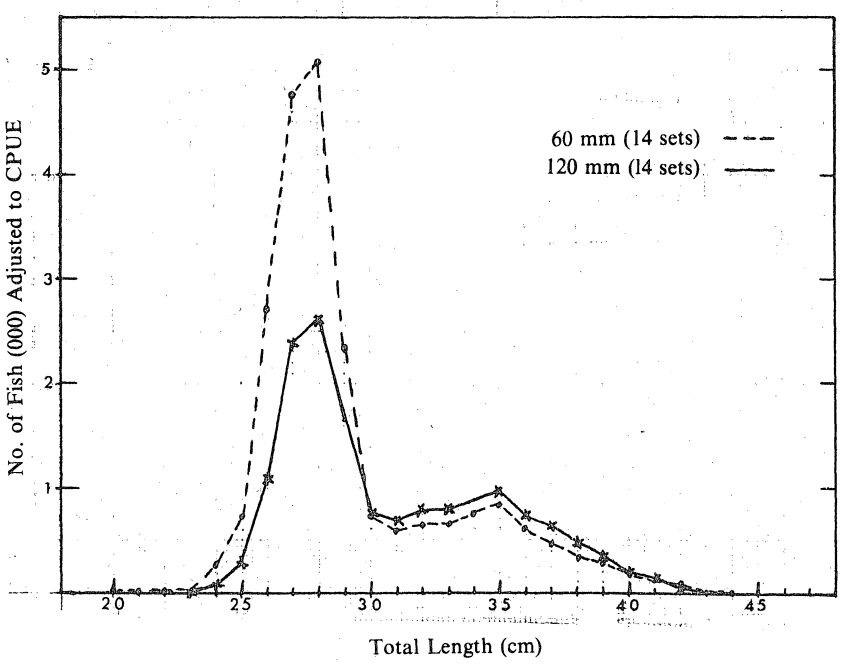

Fig. 4. Length composition of redfish catches for the 120 mm codend (experimental) and the 60 mm codend (comparative).

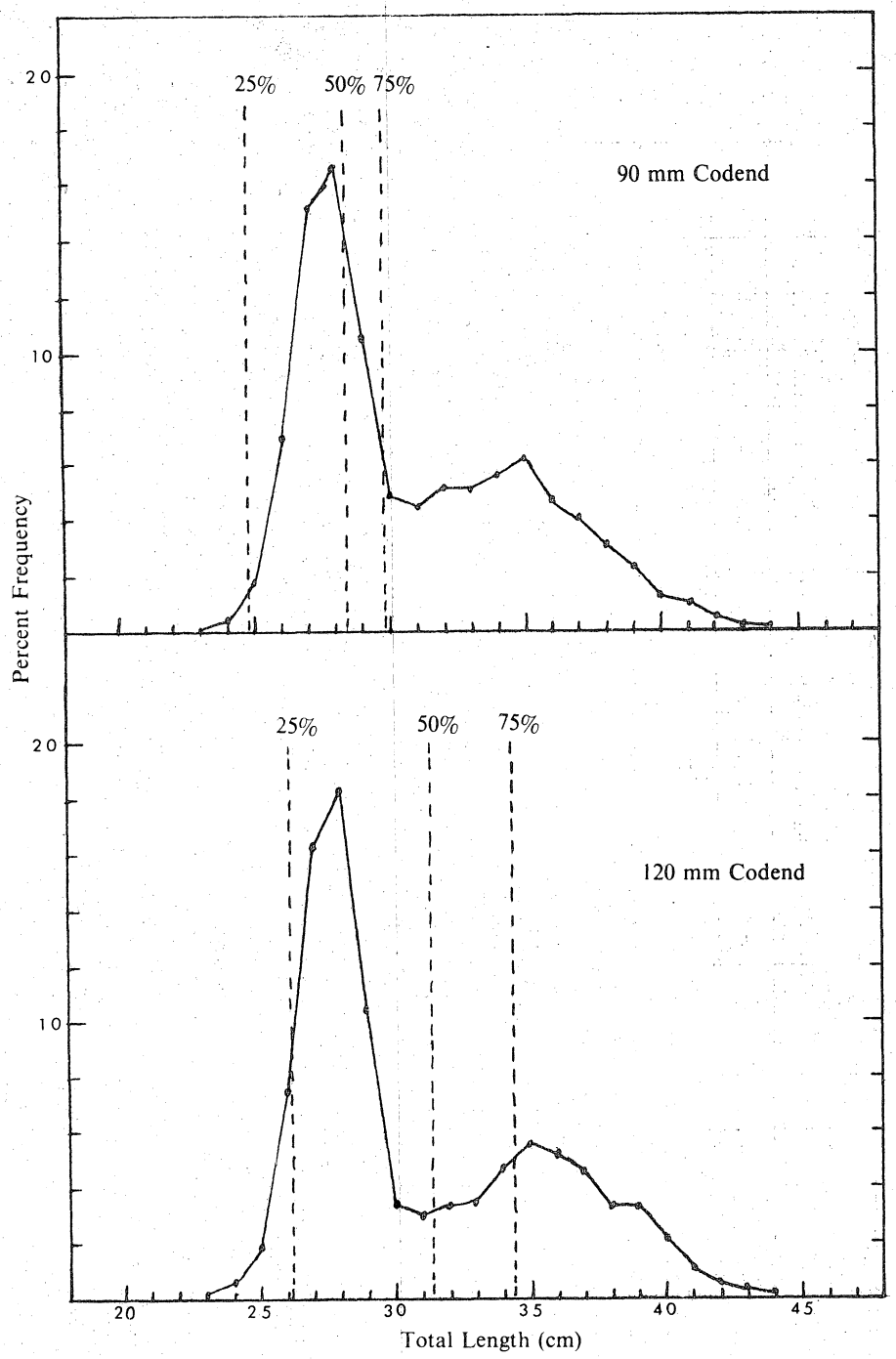

Fig. 5. Length frequency of the redfish catches showing the location of the 50% retention length and selection ranges for 120 and 90 mm codends.