

VERTICAL ENTRANCE INTO A TRAWL OF BARENTS SEA GADOIDS
AS STUDIED WITH A TWO LEVEL FISH TRAWL

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ABSTRACT

Catch figures of different demersal species(cod, haddock, saithe etc.) in the cod-ends of a two level trawl were examined using variable height of the separating panel(0.5, 0.75, 1.0 and 1.5 m).

Cod enters the trawl mainly in the lower part of trawl while haddock, and especially saithe, enter the trawl at higher levels. Diurnal and size dependant effects were recorded.

INTRODUCTION

In multispecies fisheries an important management tool is to regulate exploitation of individual species by quotas (TAC). Variations in year class strength and differences in growth rates might consequently result in varying relations of TAC between species from one year to another.

In the Barents Sea the main target species in white fish trawling are cod (Gadus morhua (L.)), haddock (Melanogrammus aeglefinus (L.)) and saithe (Pollachius virens (L.)). Fishermen have experienced problems to avoid catching cod as this species normally always occur at the same time on the same ground as the haddock. In situations when TAC for cod is at a low level and recruitment of haddock to the fishable stock is good, practical problems therefore arise how to catch this resource without overexploiting the cod. At present 15 % of cod is allowed to be taken as bycatch when fishing for other species after the cod quotas are fished.

Based on these facts as well as recent knowledge of difference in behaviour of cod and haddock when captured with trawl, FTFI has initiated a project to find out whether it is feasible to catch haddock selectively in the Barents Sea. The experiments described in this report were aimed to find out whether cod and haddock, when entering the trawl in deep waters in the Barents Sea behave in a similar way to that observed in shallower waters in the North Sea (Main and Sangster 1981, 1985, Bailey et. al. 1983, Galbraith 1983, Wardle 1983).

MATERIALS AND METHODS

Experiments were conducted during 3 weeks in October 1984 on commercial fishing grounds (120-350 m) off the coast of Northern Norway, Fig. 1. A commercial white fish trawler M/S "Jergul" (299 GBT, 1200 HP) was chartered for the experiments.

The design of the trawl is given in Fig. 2. The construction was

similar to multilevel trawls used by Marine Laboratory, Aberdeen (Baily et al 1983, Galbraith 1983), but some modifications were made to match the towing power and size of trawl board of the chartered vessel. The rigging specification indicated on Fig. 2 was used during last part of the experiments. The warp/depth ratio was normally about 2.5.

Four different heights of the separator panel were tested: 50 , 75 , 100 and 150 cm. The height of the separator fishing line could be altered by adjusting the lengths of vertical rope straps tied to the fishing line at 1 m intervals (Fig. 2). To secure lifing of the separator panel 6 pieces of 8" floats were attached at the joinings of the rope straps with the separator line. For identification each cod-end had different colours: red(upper) and black lower). The trawl boards used were steel, rectangular Vee-type(3.65x2.02 m, 1750 kg). Towing speed was 1.5- 1.8 m/s(3-3.5 knots), monitored both by ship log and Decca-Navigator. The duration of a tow was normally 3 hours. Wingspread and vertical opening of the trawl were measured with an acoustic trawl measuring system (SCANMAR).

The catch in each cod end were counted by species and all cod, haddock and saithe were mesasured to nearest cm below.

RESULTS

Gear performance

Headline height measurements indicated a vertical trawl opening of approximately 6.5 meters at 1.8 m/s(3.5 knots) towing speed. Wingspread was similarly recorded to 27-29 meters.

Although fluctuations were observed throughout a haul, primarily due to rough bottom and different warp-depth ratios, the above values are used as representative for the trawl geometry during the experiments.

The vertical straps between the fishing line and seperator line limit the maximum vertical opening of the lower trawl-entrance. The extra flotation on the separator lines give some lifting of this panel and

the real vertical opening is thus belived to be just less than the strop lenghts.

Meshsizes were found to be 134.7 mm and 134.6 mm(inner stretched) in upper and lower cod-ends, respectively. These meshsizes are average measurements of 20 meshes in the rear part of the cod-ends.

Experiments with the separator trawl.

15 hauls conducted in area C(Fig. 1)with depth range 200-250 meter are used in the following analyzis of catch results, because these cod, haddock and saithe were available in mixed concentrations. The other 31 hauls conducted throughout the trials were aimed to locate mixed concentrations of cod, haddock and saithe and to optimize gear performance.

Tables 1a-d summarizes the total catch in both cod-ends by species from these hauls with seperator panel set at 50, 75, 100 and 150 cm height above the fishing line, respectively. The ratios for the catches of different species in upper and lower cod-ends show different levels of vertical entrance. Most saithe (75%) were caught in the upper cod-end with 150 cm height of the panel. With the separator panel 100-150 cm above the fishing line about equal numbers of haddock were caught in both cod-ends. Similarly 50 % of the cod entered the trawl closer than 50 cm above the fishing line.

Flatfish were mainly found in the lower cod-end with all four settings of panel height.

The summarized data of total catch in tables 1-4 include hauls conducted throughout day and night. Figure 3 shows the proportions of commercial cod(>42 cm) and haddock(>39 cm) in the lower cod-end, for hauls carried out at different time of the day. The proportion of haddock in the lower cod-end is reduced in hauls carried out in the early morning for all four settings. The same situation was found for cod also, except with the panel height 150 cm above the fishing line.

Figures 4 and 5 show the proportions of different size groups (5 cm intervalls) in the lower cod-end for all four panel heights for cod and haddock, respectively. A significant difference in length distribution in the upper and lower cod-ends were found for both species in each setting (Kolmogorov Smirnov to sample test $p < 0.00$). From these figures it is evident that more small fish were caught in the lower cod-end than in the upper. They also show that larger haddock enter the trawl at a lower level than medium sized fish.

DISCUSSION

A general conclusion is that different species predominantly enter the trawl at different levels above the fishing line.

Typical groundfish (plaice, skates etc.) enter the trawl just above the fishing line. This result is in accordance with experiments with multilevel trawls and direct observations from shallower depth in the North Sea (Main & Sangster 1981, 1982, 1985).

Cod, which is classified as a typical groundfish from the North Sea experiments, show a more dispersed vertical entrance into the trawl in these trials. Although predominantly more cod entered the trawl below the haddock, the difference between these species is not so distinct as reported from the North Sea area.

Another result which also deviates from the North Sea experiments is that saithe seem to enter the trawl at higher level than all other species. 75-80 % of saithe entered the trawl higher than 150 cm from the fishing line. This finding is a confirmation of the fishermen's experience from trawling saithe in the area, that high opening bottom trawls are most efficient for catching this species.

Behaviour differences both with regard to vertical distribution and entering reaction as well as differences in gear design, might explain these different observations. It should be stated here that the

performance of the trawl was not directly observed as well as for most multilevel trawl experiments in the North sea.

The reasons for the observed significant differences in vertical entrance by sizes, and the diurnal effect both for cod and haddock are not evident from these experiments.

The catch of small fish in each codend might not reflect the true distribution of fish entering the trawl below and above the separator fishing line. Since the codends are situated above each other large number of small fish might be prevented from escapement through the lower codend. Direct observations have shown that most cod and haddock escape through the upper panel of a codend (unpubl. results).

The effect of such differences in codend selectivity are to overestimate number of small fish entering the trawl at a low level. Small fish eventually passing through the horizontal panel, mainly upwards will have the opposite effect on the distribution.

The results from these trials will be utilized in further efforts to find practical solutions for selective trawling of haddock and saithe, avoiding cod. A remotely controlled television vehicle (RCTV) will be used in these investigations.

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Table 1. Total catch distribution for different fish species in upper and lower codend with the separator panel set 50 cm above the fishing line (3 hauls).

Species	Top level				Bottom level				Total catch of each species
	% of total catch	Sizerange (cm)	Mean length (cm)	+/- 95% konf.	% of total catch	Sizerange (cm)	Mean length (cm)	+/- 95% konf.	
Cod	50.6	27-95	63.4	0.96	49.4	33-103	59.9	1.20	929
Haddock	69.6	26-80	51.4	1.23	30.4	31-80	50.6	2.29	629
Saithe	91.0	40-76	60.1	1.45	9.0	40-85	69.8	3.07	167
Long rough dab.	15.6	-	-	-	84.4	-	-	-	96
Witch	0.0	-	-	-	100.0	-	-	-	3
Skate	33.3	-	-	-	66.7	-	-	-	9
Catfish	0.0	-	-	-	100.0	-	-	-	1

Table 2. Total catch distribution for different fish species in upper and lower codend with the separator panel set 75 cm above the fishing line (5 hauls).

Species	Top level				Bottom level				Total catch of each species
	% of total catch	Sizerange (cm)	Mean length (cm)	+/- 95% konf.	% of total catch	Sizerange (cm)	Mean length (cm)	+/- 95% konf.	
Cod	32.7	34-129	64.8	0.89	67.3	28-99	61.3	0.72	1739
Haddock	51.8	25-82	53.2	1.10	48.2	23-77	49.2	1.29	919
Saithe	87.2	39-87	59.7	0.87	13.8	39-87	57.6	2.13	607
Long rough dab.	8.9	-	-	-	91.1	-	-	-	135
Lemon sole	0.0	-	-	-	100.0	-	-	-	11
Skate	16.1	-	-	-	83.9	-	-	-	31
Plaice	17.7	-	-	-	82.3	-	-	-	17
Catfish	4.5	-	-	-	95.5	-	-	-	22
Halibut	100	-	-	-	0.0	-	-	-	1
Porbeagle	100	-	-	-	0.0	-	-	-	1

Table 3. Total catch distribution for different fish species in upper and lower codend with the separator panel set 100 cm above the fishing line (5 hauls).

Species	Top level				Bottom level				Total catch of each species
	% of total catch	Sizerange (cm)	Mean length (cm)	+/- 95% konf.	% of total catch	Sizerange (cm)	Mean length (cm)	+/- 95% konf.	
Cod	34.4	32-126	63.6	0.84	65.6	32-95	61.4	0.74	1799
Haddock	60.0	22-75	54.8	1.07	40.0	27-75	55.5	1.21	1498
Saithe	87.8	40-102	63.1	1.02	12.8	39-89	60.1	2.92	427
Long rough dab.	17.9	-	-	-	82.1	-	-	-	140
Lemon sole	9.5	-	-	-	90.5	-	-	-	21
Skate	18.9	-	-	-	81.1	-	-	-	53
Catfish	0.0	-	-	-	100.0	-	-	-	1
Tusk	100.0	-	-	-	0.0	-	-	-	1

Table 4. Total catch distribution for different fish species in upper and lower codend with the separator panel set 150 cm above the fishing line (3 hauls).

Species	Top level				Bottom level				Total catch of each species
	% of total catch	Size range (cm)	Mean length (cm)	+/- 95% konf.	% of total catch	Size range (cm)	Mean length (cm)	+/- 95% konf.	
Cod	23.5	29-88	64.8	1.86	76.5	26-109	59.9	1.09	686
Haddock	45.3	21-77	57.9	2.30	54.7	27-79	52.7	2.44	243
Saithe	75.6	55-103	73.9	4.42	24.4	55-113	73.9	11.19	45
Long rough dab.	5.5	-	-	-	94.5	-	-	-	91
Skate	18.8	-	-	-	81.3	-	-	-	16

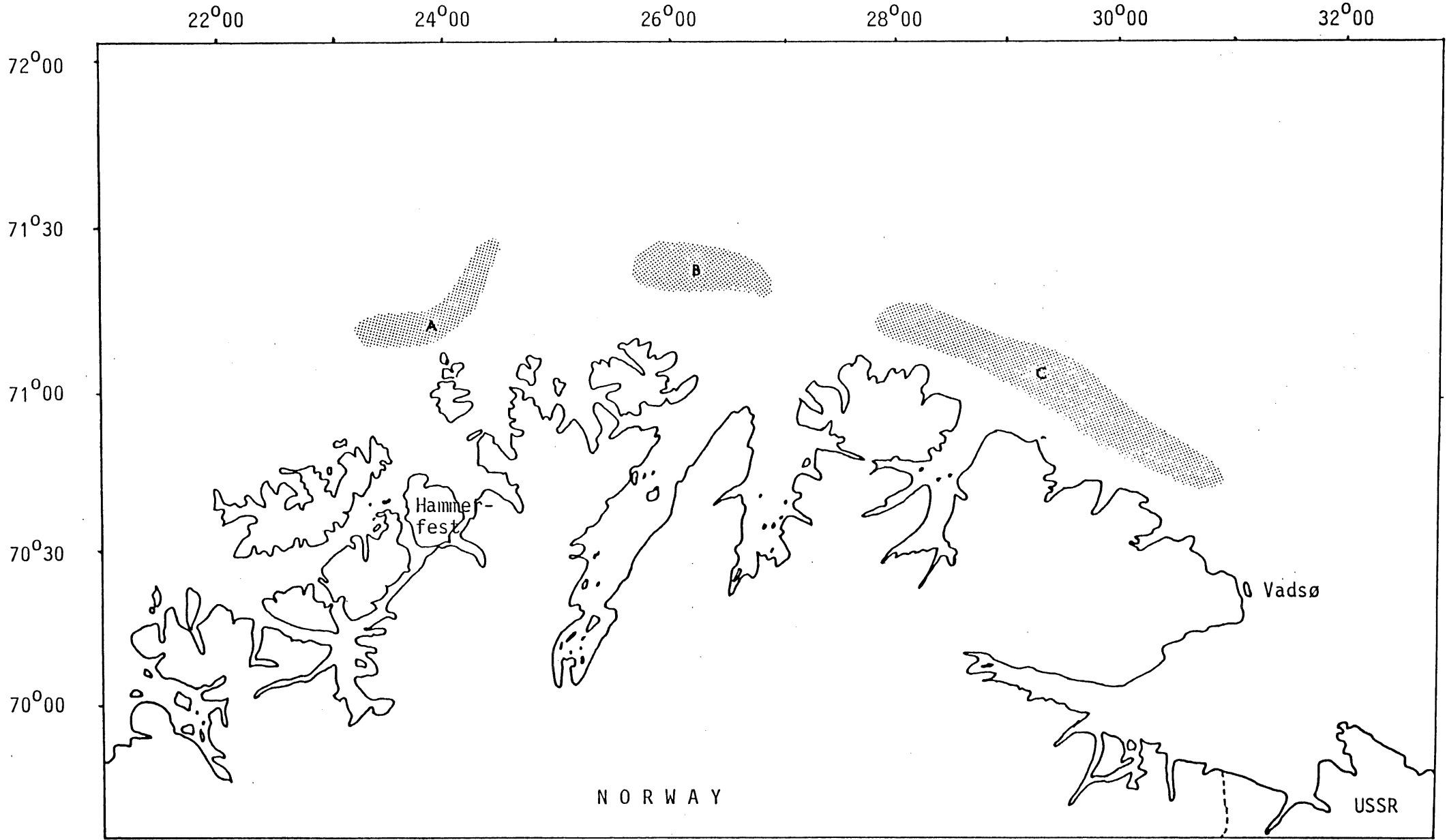


Fig. 1. Areas fished with the two level sampling trawl. A - Fruholmen, B - Sleppen, C - Mehamn fjorden - Makkaur.

TWO-LEVEL SAMPLING TRAWL FOR GADDOIDS (1200 HP)

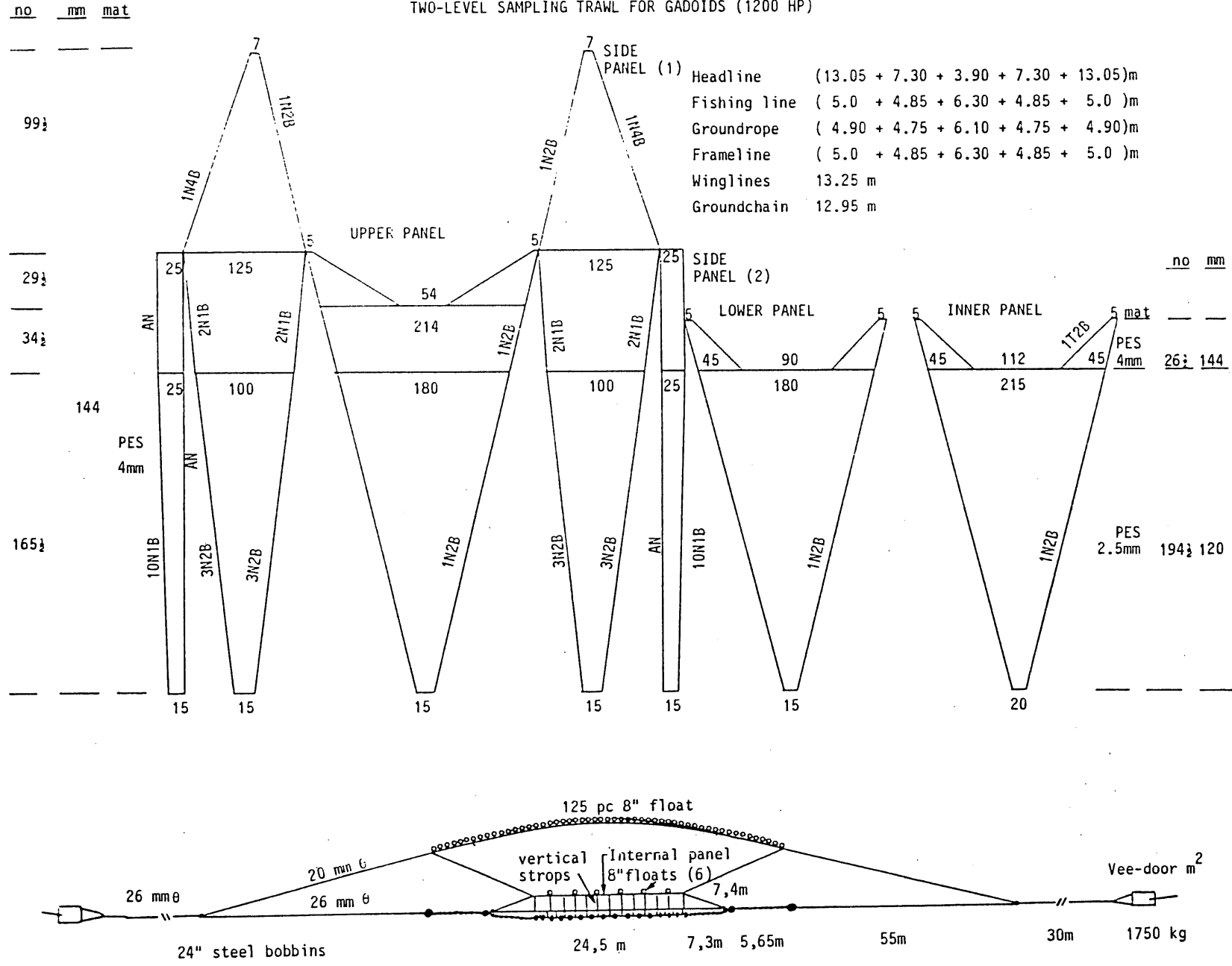


Fig. 2. Trawl design and rigging specifications (not to scale) of the two level sampling trawl.

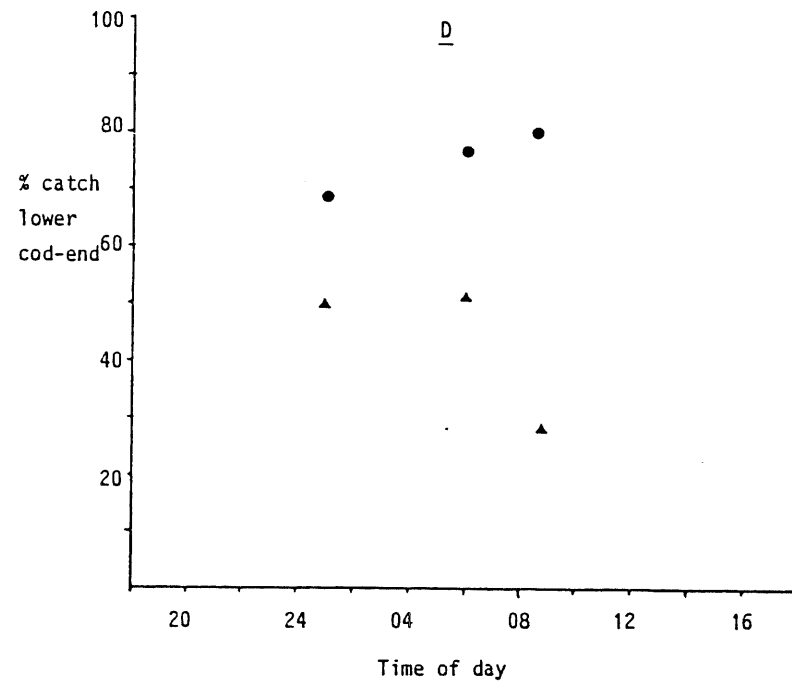
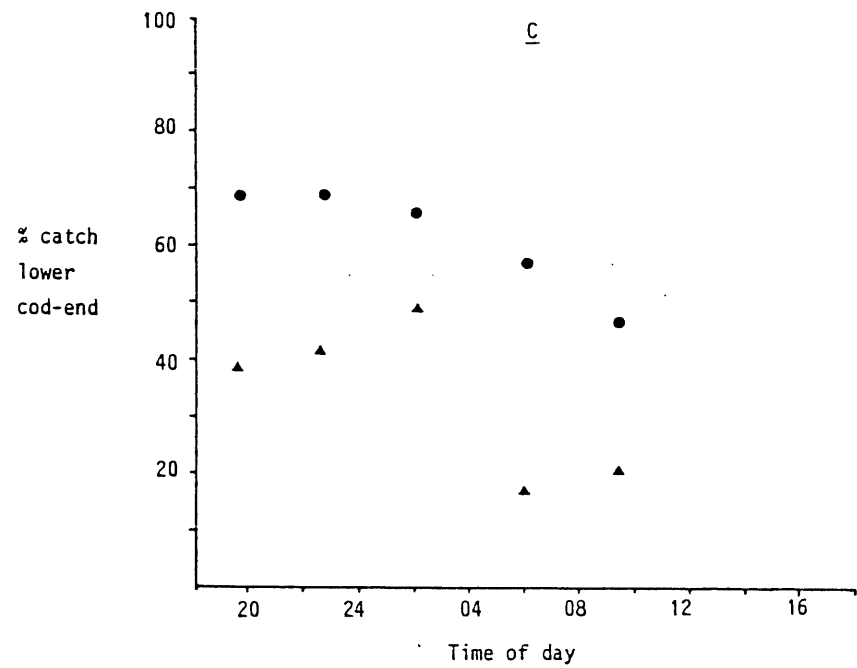
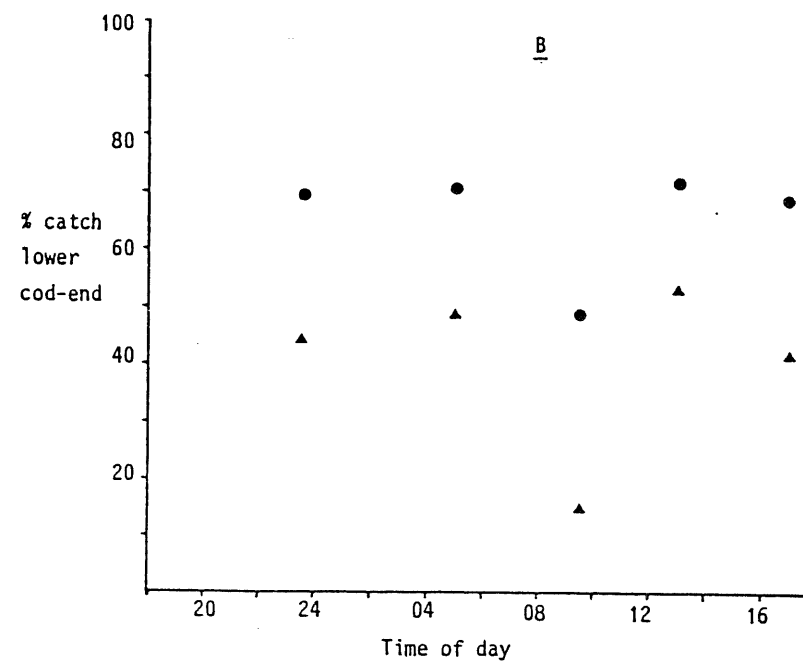
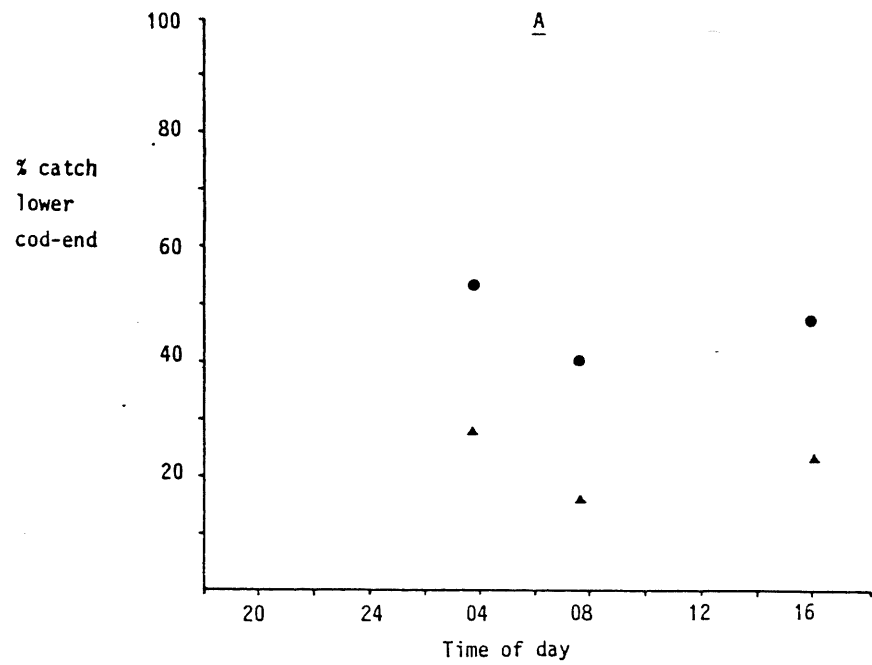


Fig. 3. The catch of cod and haddock in the lower codend as a function of daytime. Separator panel settings. A - 50 cm, B - 75 cm, C - 100 cm, D - 150 cm above fishing line. (Cod ● Haddock ▲)

COD

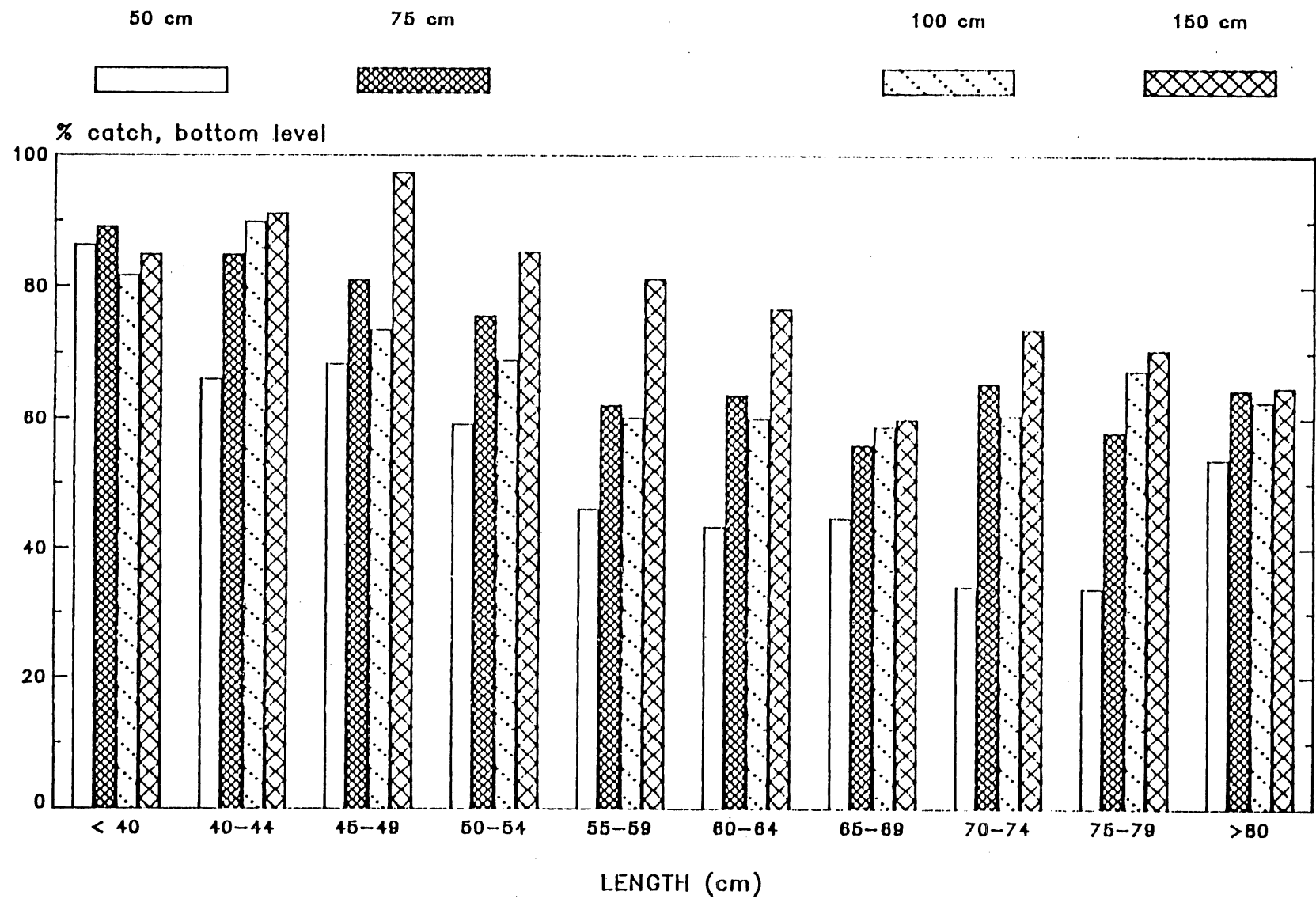


Fig. 4. The relative catch of cod for each lengthgroup in lower cod-end for all four settings.

HADDOCK

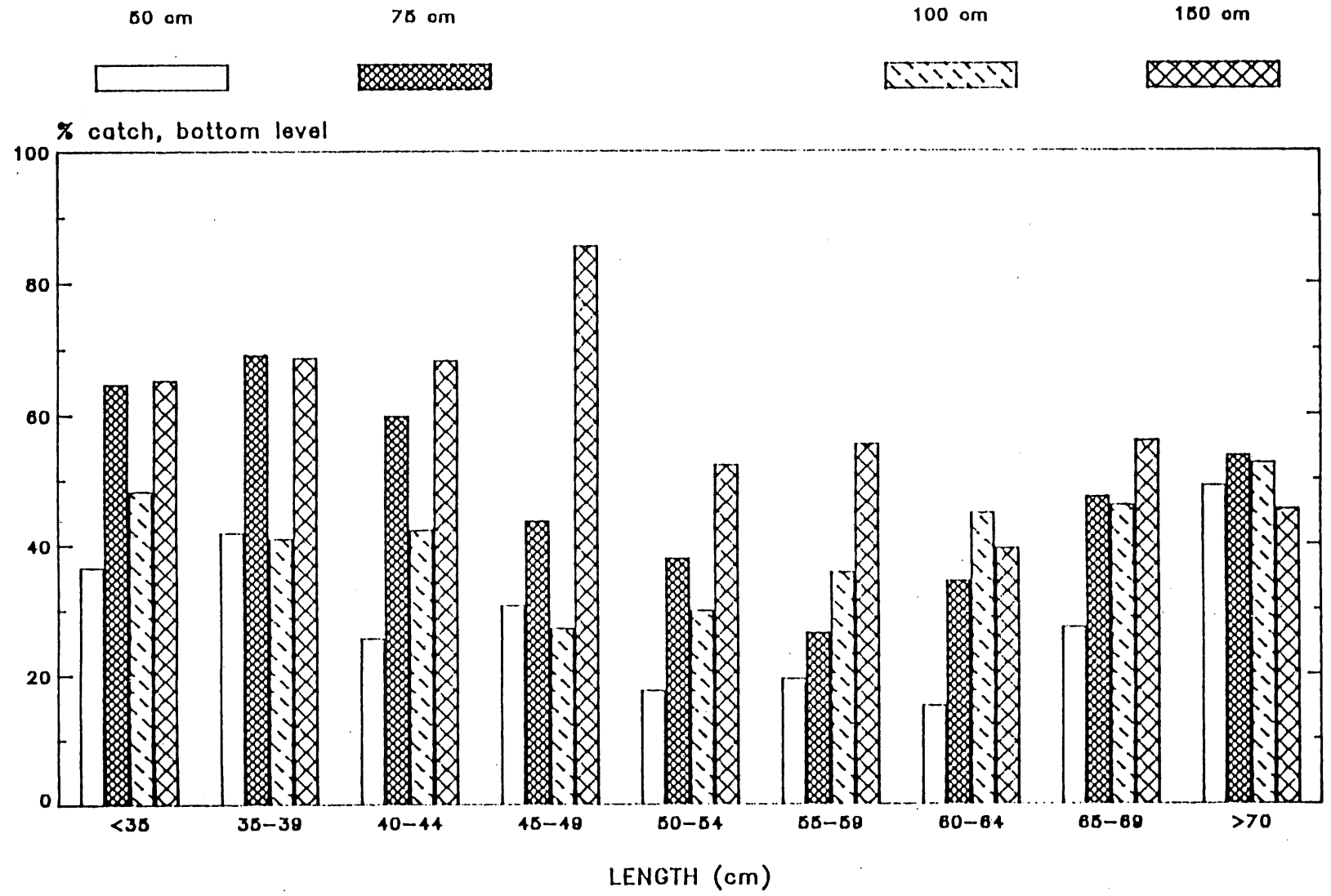


Fig. 5. The relative catch of haddock for each length group in lower cod-end for all four settings.