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NEAR-BOTTOM SAMPLING WITH BOTTOM AND PELAGIC TRAWLS

by*

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ABSTRACT

The Institute of Marine Research, Bergen, has carried out combined bottom trawl and acoustic surveys for cod and haddock in the Barents Sea - Svalbard area since 1981. These investigations have demonstrated clearly that the currently applied survey methods considerably underestimate the young age groups of cod. For haddock the survey abundance estimates have been considerably higher than those used in the stock assessment. Part of the problem has been shown to be be low bottom trawl efficiency for small fish. It has also been indicated that the pelagic trawl has low efficiency for cod.

In this paper variation in length and species composition from samples taken with a bottom trawl and with a pelagic trawl on and off bottom are analyzed. Differences in sampling efficiency and the problems connected with combining data from different trawls during routine surveys are discussed.

INTRODUCTION

The Institute of Marine Research, Bergen, has carried out combined bottom trawl and acoustic surveys for cod (Gadus morhua L.) and haddock (Melanogrammus aeglefinus L.) in the Barents Sea - Svalbard area since 1981. These investigations have demonstrated clearly that the currently applied survey methods considerably underestimate the young age groups of cod (Hylen, Nakken and Sunnanå 1986).

Investigation of the bottom sampling trawl efficiency has shown that both small cod and haddock are strongly underrepresented in the bottom trawl catches because of escapement under the trawl. However, the results also demonstrate considerable differences between cod and haddock escapement (Engås and Godø 1987). Investigations in the North Sea have shown species dependent differences in behavior in front of a bottom trawl: haddock in contrast to cod may escape over the headline of the trawl (Main and Sangster 1981). Similar behaviour differences have also been indicated for cod and haddock in the Barents Sea (Engås and Ona 1987).

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In the Barents Sea acoustic survey for cod and haddock, samples from bottom trawls and pelagic trawls are combined in the computation of absolute fish density. The vertical distribution of the cod and haddock stocks is dependent on total stock abundance (Hylen et al. 1986), or, as shown by Engås and Godø(1986), the vertical distribution in a limited area is dependent on the density of the two species. Hylen et al. (1986) focus on the demand for information on difference in catching efficiency of the two trawls to improve reliability of survey estimates.

In this paper variations in length and species composition from samples taken with a bottom trawl and with a pelagic trawl on and off bottom are analyzed. Differences in sampling efficiency and the problems connected with combining data from different trawls during routine surveys are discussed.

MATERIAL AND METHODS

The material was collected during a cruise with R/V "G.O. Sars" (70 m - 2250 HP) off the coast of Finmark 27 February - 2 March 1987 (position 71° 31' N, 27° 00' E). The experiments were carried out by alternating between bottom trawl hauls (BT, 7 hauls), pelagic trawl hauls on the bottom (PB, 7 hauls) and pelagic trawl hauls 1 - 3 m off the bottom (PT, 6 hauls). The trawl hauls lasted for 30 minutes. The trawling speed was 3 knots during bottom trawling, but varied from 2 to 3 knots during pelagic trawling. The experiments were carried out in a limited area, through day and night. The depth varied mainly from 340 to 360 m.

The bottom trawl was the standard Norwegian sampling trawl (Campelen 1800) for demersal fish and shrimps (Fig. 1). It was equipped with a rockhopper ground gear in contrast to the bobbins gear used during routine surveys (Godø and Engås 1987). The bridle length was 40 m. The pelagic trawl was a capelin trawl, which is the standard Norwegian pelagic sampling trawl. The trawl was modified by mounting a skirt with a rock-hopper ground gear under the fishing line (see also Fig. 2). The sweep length was 110 m, with a lower bridle extension of 2.5 m. Waco doors 6.0 m² (1500 kg) were applied on both trawl types.

Trawl geometry (trawl height and wingspread or doorspread) was measured by SCANMAR equipment.

The total catches were sorted for cod and haddock. The length distributions were determined by either measuring the total catch or a representative sample of it. The fish length was measured to the nearest centimeter below. The material is either analyzed by 5-cm groups or pooled in three size groups: small fish (< 30cm), medium-sized fish (30-49cm), and large fish (>49).

RESULTS

Trawl geometry

Mean values of the trawl geometry measurements are given in Table 1.

Table 1. Trawl geometry measurement. The variation of the measurement is indicated

	BT	PB	PT
Height	4.3m ±0.5m	21.0m ±2m	23.0m ±2m
Wingspread	18.5m ±0.5m	27.0m ±2m	27.0m ±2m
Doorspread	53.0m ±6m		

Length frequency distributions

The relative length distributions of cod and haddock are shown in Fig. 3. The length distributions of the PB and PT catches are similar. The main difference between BT and PT-PB catches was the considerably higher percentage of small fish (<30 cm) in the BT catches.

Catch comparison

A considerable difference in catch size between the various trawl haul types was observed (Table 2). The BT catches are by far the largest both for cod and haddock for all size groups.

Table 2. Mean catches in numbers (C) of cod and haddock per trawl haul by size group taken by bottom trawl (BT), pelagic trawl on the bottom (PB), and pelagic trawl 2m off the bottom. SD is the standard deviation.

	COD						HADDOCK					
	BT		PB		PT		BT		PB		PT	
No. hauls	7		7		6		7		7		6	
	C	SD	C	SD	C	SD	C	SD	C	SD	C	SD
Small	21	7.5	3	2.3	1	0.5	79	47.8	19	12.5	11	7.8
Medium	103	37.0	37	7.8	15	10.2	284	81.5	211	138.9	97	63.8
Large	23	14.2	8	6.0	2	2.3	6	3.5	4	3.2	1	0.6

When comparing the various types of haul, the superiority of BT is noteiced especially for small fish and for cod more than haddock (Tables 3 and 4). For medium sized and large fish, there is only a small difference between PB and BT catches of haddock (PB/BT= 0.74), in contrast to corresponding difference for cod (PB/BT= 0.36). The PT catches were the smallest for all size groups and for both species. However, no large difference in species composition between PT and PB was observed (Table 4).

Table 3. The relationship between the catches from the two types of pelagic trawl hauls (PB and PT) and the bottom trawl catches (BT)

	COD		HADDOCK	
	PB/BT	PT/BT	PB/BT	PT/BT
Small	0.14	0.05	0.24	0.14
Medium	0.36	0.15	0.74	0.34
Large	0.35	0.09	0.67	0.17

Table 4. Variation in species composition (cod/haddock) for the various types of trawl hauls and size groups.

	COD/HADDOCK		
	BT	PB	PT
Small fish	0.27	0.16	0.09
Medium fish	0.36	0.18	0.15
Large fish	3.83	2.00	2.00
Total	0.40	0.21	0.17

DISCUSSION

The superiority of the bottom trawl in catching all size groups of cod and small haddock can hardly be questioned. The results illustrate the problem of sampling cod and haddock representatively with the two different survey trawls, as discussed by Hylen et al. (1986), for when trawling on the same near-bottom acoustic recordings of cod/haddock with a pelagic trawl and a bottom trawl, the cod/haddock ratio increases by a factor of two. It is further noticed that there is no dramatic change in length and species composition when comparing pelagic trawl catches taken off and on the bottom. The main question is to what extent is it possible to explain the observation either by species-/length dependent vertical distribution or by behaviour.

The main difference between the PT and the PB trawl hauls is that the PB hauls, which are performed with the trawl on the bottom, exclude to a considerable extent the possibility of escapement under the trawl. Comparing the PB and the BT hauls several factors might affect the catching efficiency. The most important are supposed to be that BT has better bottom contact than PB, PB trawl has no herding selection, and its height is about five times the BT hight.

Diving of fish under the trawl during pelagic trawling is known to be a serious problem during survey sampling (Hylen, Nakken and Sunnanå 1986, Ona and Godø 1987). Escapement under the trawl has been shown to be a major problem for representative sampling of small cod and haddock by a bottom trawl equipped with bobbins gear in contrast to the same trawl equipped with a rockhopper (Engås and Godø 1987). Such escapement is also demonstrated by the current length data (Fig. 3). By touching the bottom with the pelagic trawl (PB hauls), the catches of both cod and haddock are doubled compared to hauls with the same trawl 2 m above bottom (PT hauls). However, the length and species composition are unchanged. Mesh selection in the pelagic trawl is possible, but experience from earlier experiments shows that bottom contact is the crucial factor for small fish catching efficiency (Engås and Godø 1987). The same paper shows that escapement under the bottom trawl affects the catches of cod more than the catches of haddock. We therefore expect a relative increase in cod catches when touching the bottom with the pelagic trawl. The bottom contact was probably not stable enough during the PB hauls to prevent the same length and species selection to occur as during the PT hauls. This is in accordance with results from experiments with a bottom trawl equipped with a too light rockhopper

ground gear (unpubl. material). The escapement under the trawl will tend to relatively underestimate cod in the PB and PT catches.

In contrast to escapement under the bottom trawl, which is most prominent for cod, escapement over the bottom trawl is most likely to occur for haddock (Main and Sangster 1981, Waldemarsen, Engås and Isaksen 1985, Engås and Ona 1987). The escapement of fish over the standard bottom trawl has not been quantitatively investigated, and it therefore impossible to compare the effect of over- and under- trawl escapement.

Species and length dependent differences in vertical distribution may also partly explain the obtained results (Hylen et al. 1986). Such differences are, however, difficult to investigate by comparing catches from different trawls as long as the relationship in catching efficiency between them is unknown.

The results from these experiments show that there is a dramatic shift in species composition when trawling on the same acoustic recordings with pelagic and demersal trawls. As indicated by the standard deviation, the haul to haul variation is big. Partly this is a result of day night variation (unpubl. material). The results demonstrate the complexity of sampling species composition representatively.

CONCLUSIONS

The current results are obtained by alternating the use of trawl gear from the same ship. The validity of comparisons of switch catches may be questioned because of variability in the results.

The main purpose of the experiments was to test a new trawl and develop methods for approaching comparability of pelagic and bottom trawl sampling in the Barents Sea surveys for cod and haddock. As such, the experiments were successful. In addition, important information for understanding sampling problems in the cod and haddock surveys was obtained. The experiments will be continued with some modifications in the equipment and procedures.

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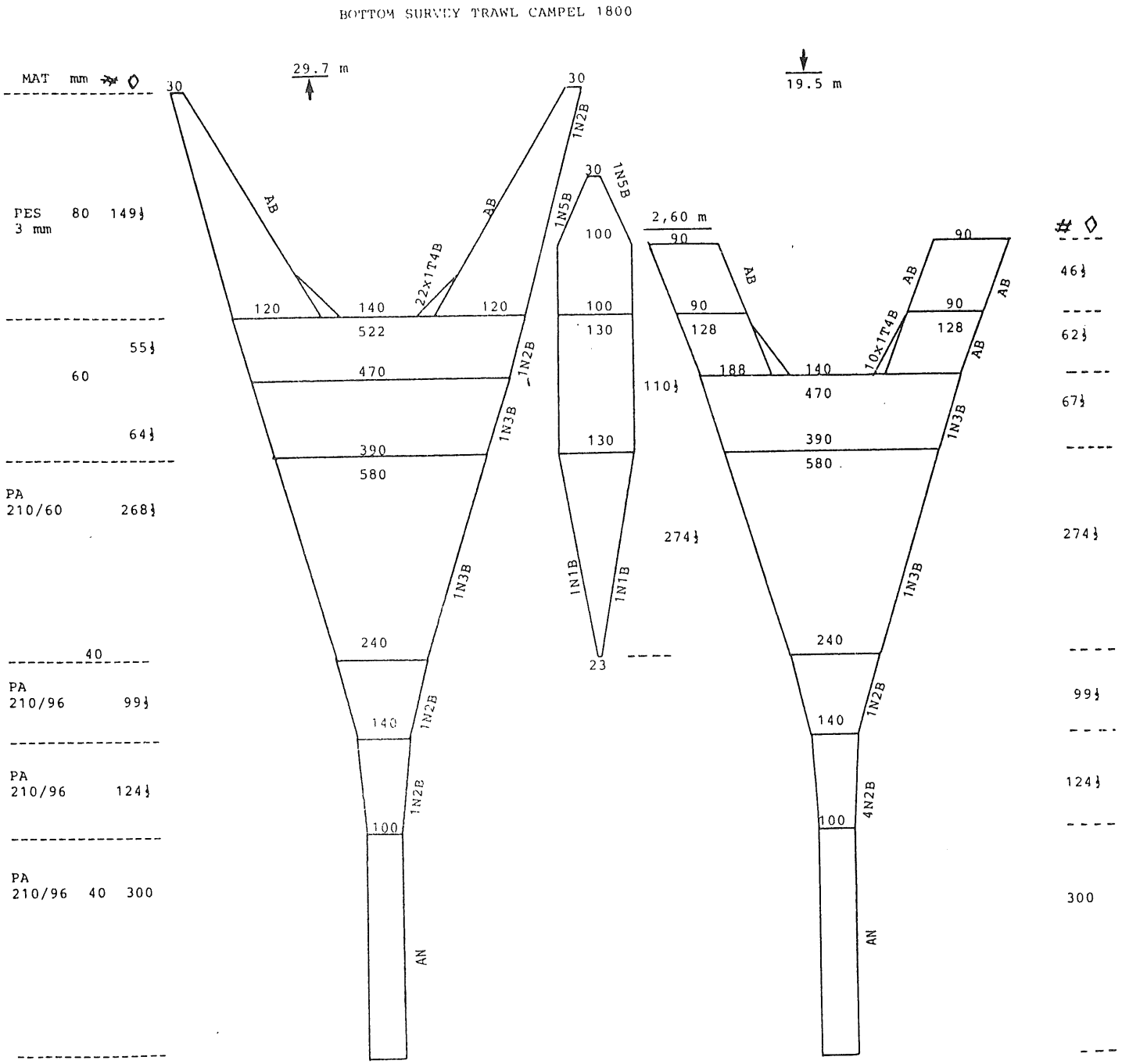

Fig. 1. Bottom survey trawl Campelen 1800.

Headline floats 90 x 200 mm

Groundgear: Rockhopper (rubber) with steel and rubber spacers

Bosom: 24 x 356 mm rubberdiscs

Wings: 96 x 356 mm rubberdiscs

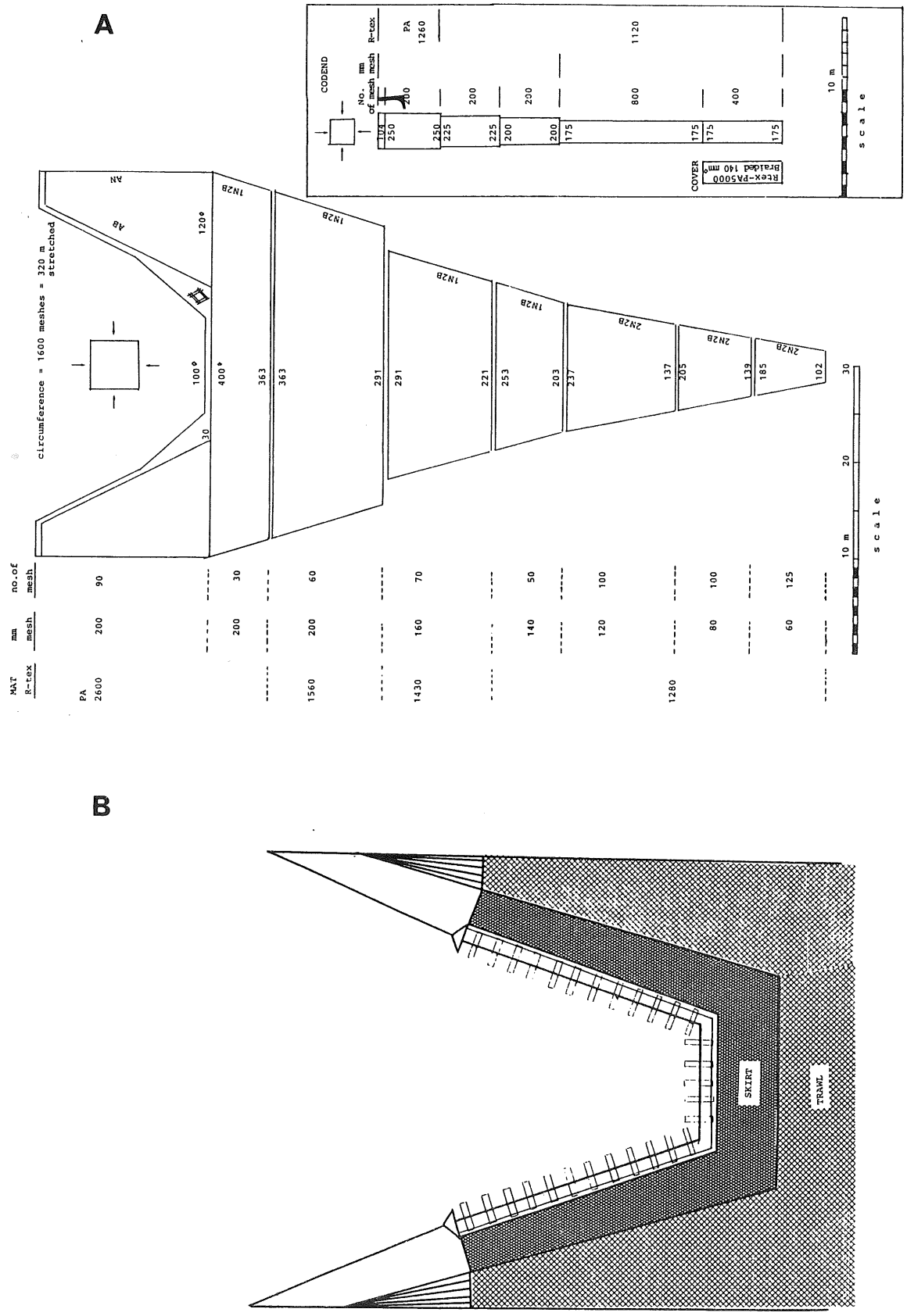

Fig.2. Standard pelagic survey trawl (A). Schematic presentation of the modifications of the botom panel with skirt and rockhopper (B).

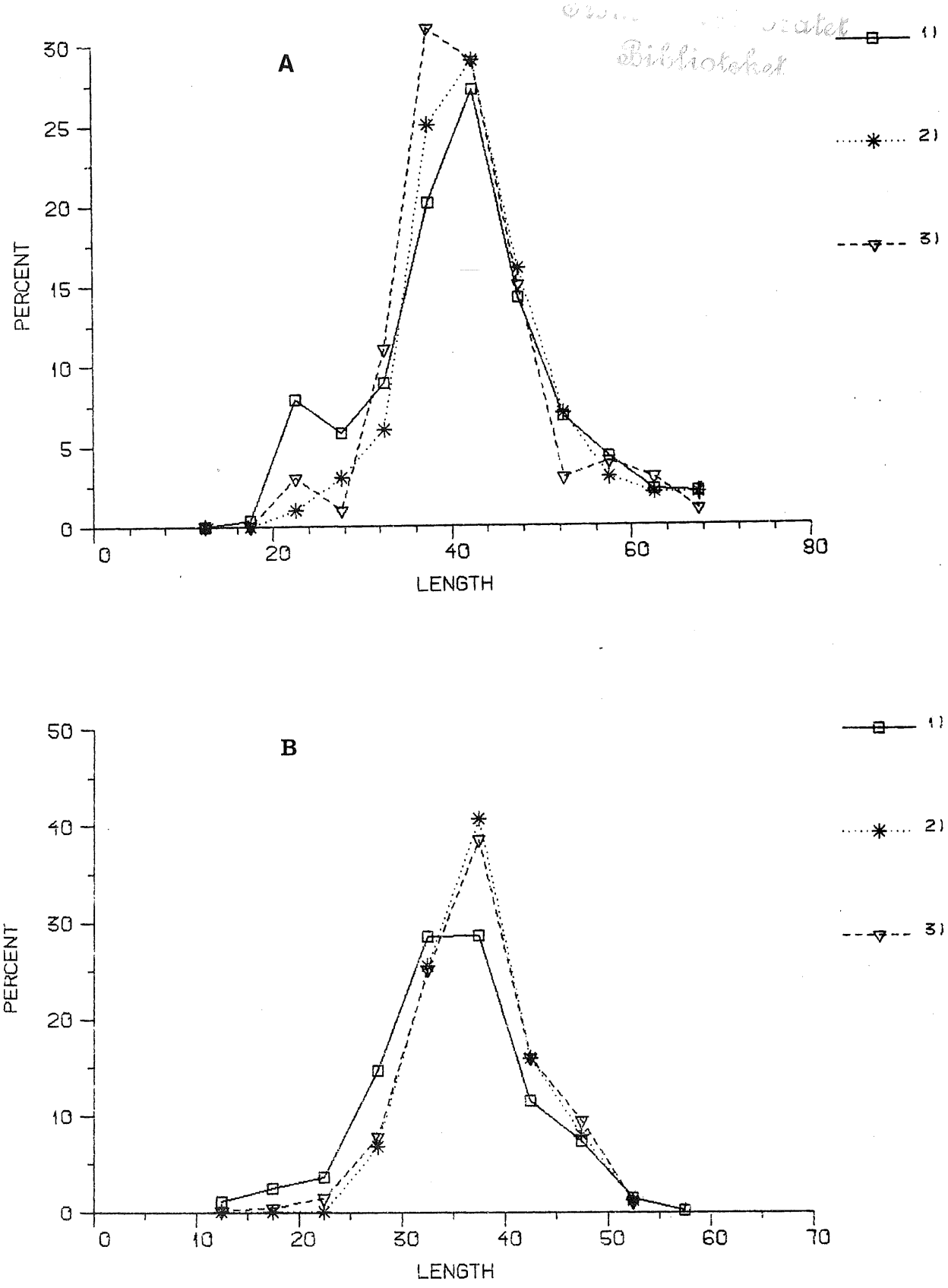

Fig. 3. Relative length distribution of cod A) and haddock B) in catches from bottom trawl 1), pelagic trawl on bottom 2) and pelagic trawl 2 m off bottom 3).