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Estimates of capelin trawl efficiency by comparing the available fish with the actual catch

by

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ABSTRACT

Swept volume trawl efficiency for two different trawls were determined to be 28 and 60%, respectively by comparing the volume densities of capelin determined by echointegrator, with catch size and swept volume of the trawl. Escape of capelin through different parts of the trawl was examined by attatching small meshed bags at different positions of the trawl.

INTRODUCTION

In October 1977, M/S "Havdrøn" was on a cruise to the Barents Sea, trawling for capelin. From comparisons of netsonde recordings and catches of capelin with similar recordings of blue whiting made earlier the same year, it was assumed that the swept volume trawl efficiency for capelin was rather poor. Therefore, the following year on a similar cruise, an attempt was made to relate the volume densities of capelin layers/schools determined by a shipboard echo-integrator, with catch size and swept volume of the trawl.

MATERIAL AND METHODS

During the cruise two pelagic trawls were used: the so-called 2-metre trawl with 265 meshes (200 cm stretched mesh size) in circumference, and a Mong trawl of 880 meshes (40 cm stretched) circumference.

Four small meshed bags attatched to the meshes in different parts of the trawl were used to examine the escape of capelin.

Before the fishing started we had the opportunity to do an inter-ship echointegrator calibration with the R/V "G.O. Sars" and the USSR R/V "Poisk". The procedure followed was the same as described by RØTTINGEN (1978). The following conversions between "G.O. Sars" and "Havdrøn" were estimated:

Channel A: $M_{G.O.S.} = 4.5\ M_H - 1.1$ (r = 0.96)

Channel B: $M_{G.O.S.} = 6.2\ M_H + 8.1$ (r = 0.95)

When trawling the acoustic instruments were continuously watched to make sure that the whole capelin layer or school was within the integrated depths-interval. Later, the trawl-path as recorded by the netsonde, was drawn on the corresponding echogram of the ship echosounder.

The echointensity of each capelin layer or school in the trawl path was calculated by:

$$M_i' = \frac{M_{GOS} \times d}{D}$$

where $\underline{M_{GOS}}$ is the accumulated echointensity of the layer (school), $\underline{D}$ is the total area of the same layer, and $\underline{d}$ the area swept by the trawl, both measured on the echogram (Figure 1).

The integrated echointensity were converted to fish densities as described by NAKKEN and DOMMASNES (1975). According to the length distribution of the capelin and the length-volume relationship of capelin, the fish density in terms of numbers per unit area - p_A, were converted to fish volume (hl) per unit area - p_V. Applying thereafter the estimated net pathwidth - Yn -, following the procedure described by DICKSON (1975), the total amount of capelin available to trawl in each haul was calculated:

$$E = \sum_{i=1}^{i=k} p_{V_i} \quad [\ Yn \times 1\ nm\ ]$$

where -Yn- is expressed in nautical mile (nm) and K is number of nautical miles trawled

RESULTS AND DISCUSSION

The comparison of catch - C with the estimate - E is in principle similar to - comparing the results from one gear with the results from another. A common method of dealing with such data, is to plot the log of the ratios of the running sums of catch - C/ estimate E, with the 95% confidence limit found from the variance of the logs of each ratio as shown in Figure 2 (DICKSON 1975).

This method gave a mean trawl efficiency of the 2-metre trawl of 28% with 95% confidence ranging from 15% to 50% (Table 1).

Only hauls giving equal or more than 100 hl were included in the calculations. The Mong trawl gave only one valid haul (> 100 hl) with an efficiency of 78%. If the three hauls taken with this trawl are included in the calculations we get a mean trawl efficiency of 61% with 95% confidence limits ranging from 26% to 138%.

By comparing these results with the one given for an O-group sampling trawl - 81% (DICKSON 1975), it appears that trawl efficience (as expressed in terms of swept volume between upper wingtips and headline/groundline) to some extent depends on how far in front of the codend the small meshed panels are carried.

In the O-group sampling trawl the aft half of the belly consisted of panels with meshsize decreasing from 120 mm to 22 mm, the Mong trawl had panels with meshsize from 120 mm to 40 mm in the aft quarter of the belly, while the 2-metre trawl had 120, 80 and 60 mm meshsize panels just in front of the codend.

Heavily meshing of capelin in the 160 and 124 mm mesh-panels of the 2 m trawl could be due to: abrupt increased swimming in the attempt to escape the trawl at the moment of approaching the end of the trawl belly (SABOURENKOV 1977).

This was confirmed by the four small-meshed bags attatched to the meshes to examine escape through different parts of the trawl. The bags that were all attatched to the upper panels and in the regions with meshsizes: 2000 mm, 1000 mm, 400 mm and 160 mm, indicated relative escape of capelin in the proportions 1:1:5:24 respectively.

The fish available to the trawl were considered to be a part of those below the ship in the integrated layer. Besides the uncertainty of the relation between echo strength and fish density of small schooling fishes (ULLTANG 1977) another element of uncertainty is to what extent the trawl did hit the same capelin layers/schools that were integrated. It appeared that the capelin at this time was rather stationary. More than 9 out of 10 layers/schools integrated (in the coming path of the trawl) later on were identified by distance above bottom, extent, and duration from they were recorded by the ship echosounder till they were seen by the netsonde.

REFERENCES

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Table 1. Calculation of the swept volum trawl efficiency of the 2-meter trawl.

Haul No.	E	C	$\frac{\text{Sum E}}{\text{Sum C}}$	Log $\frac{\text{Sum E}}{\text{Sum C}}$	$\frac{E}{C}$	Log $\frac{E}{C}$ = X	X^2	$\pm \frac{2\ Sx}{\sqrt{N}}$
	450	150			3	0,4771	0,2276	
2	450	150	3,000	0,4771		0,4771	0,2276	
	502	480			1,045	0,0195	0,0004	
5	952	630	1,511	0,1792		0,4966	0,2280	0,4575
	480	400			1,200	0,0792	0,0063	
6	1432	1030	1,390	0,1431		0,5758	0,2343	0,2873
	388	275			1,411	0,1494	0,0223	
7	1820	1305	1,395	0,1445		0,7252	0,2566	0,2042
	841	140			6,007	0,7786	0,6063	
8	2661	1445	1,842	0,2652		1,5038	0,8629	0,2866
	1661	140			11,860	1,0740	1,1540	
9	4320	1585	2,726	0,4355		2,5778	2,0169	0,3482
	2190	200			10,950	1,0394	1,0804	
10	6512	1785	3,648	0,5620		3,6172	3,0973	0,3420
	670	220			3,040	0,4836	0,2339	
11	7182	2005	3,582	0,5541		4,1008	3,3312	0,2963
	678	150			4,520	0,6551	0,4292	
13	7860	2155	3,647	0,5611		4,7559	3,7604	0,2632

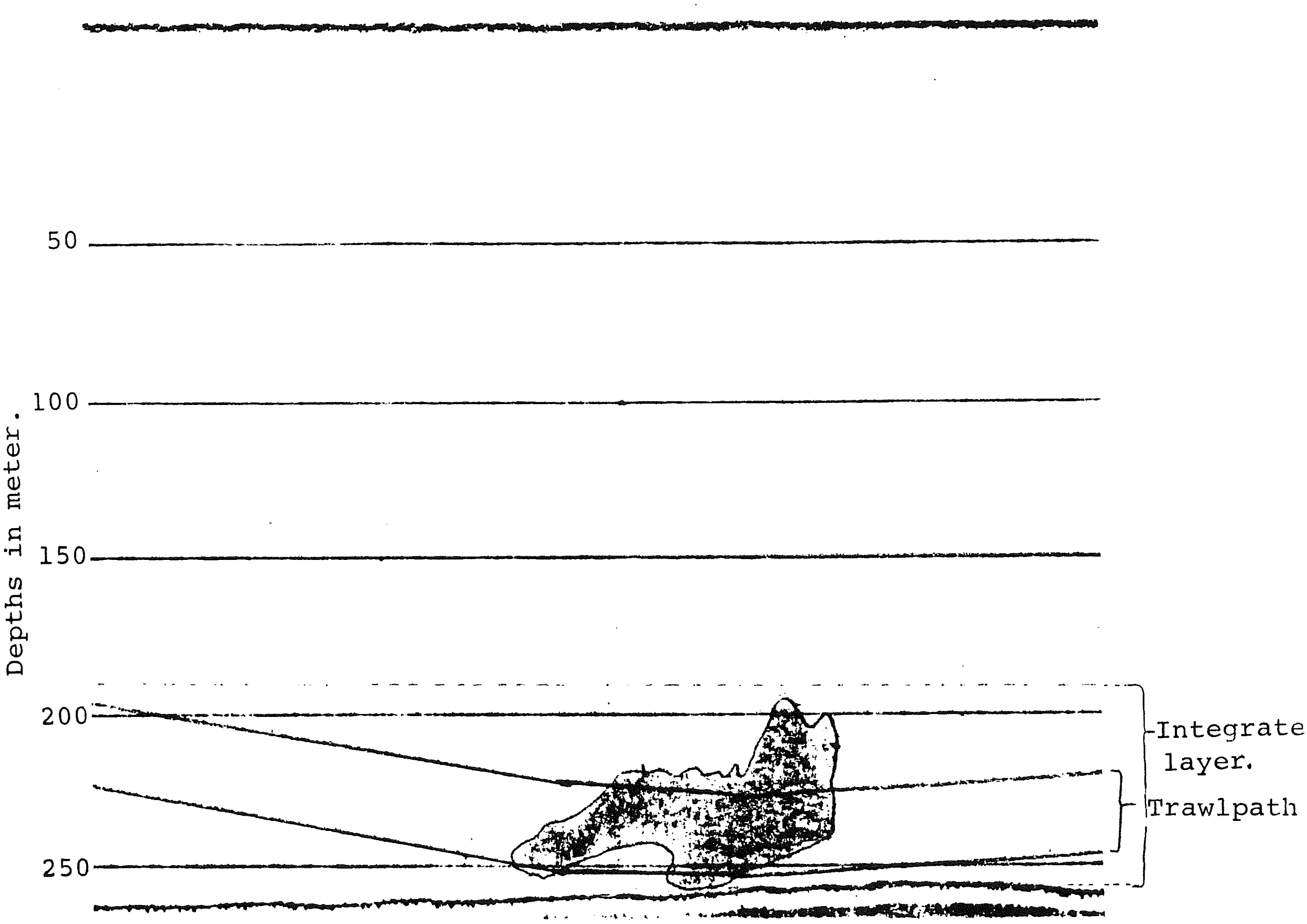
$$\begin{array}{r} 0,5611 \\ +\ 0,2632 \\ \hline 0,8243 \end{array}$$

Antilog. 0,8243 = 6,6731 $\qquad 6,6731^{-1} = 0,15$

Antilog. 0,5611 = 3,6399 $\qquad 3,6399^{-1} = 0,28$

$$\begin{array}{r} 0,5611 \\ -\ 0,2632 \\ \hline 0,2979 \end{array}$$

Antilog. 0,2979 = 1,9856 $\qquad 1,9856^{-1} = 0,50$



Area of school within the integrated layer: D
Area of school within the trawlpath : d
Echointensity of the whole school : M_{GOS}

Echointensity of the school within

the trawlpath: $M_i = \frac{M_{GOS} \times d}{D}$

Figure 1. An echogram with the trawlpath drawn through the integrated capelin school near bottom.

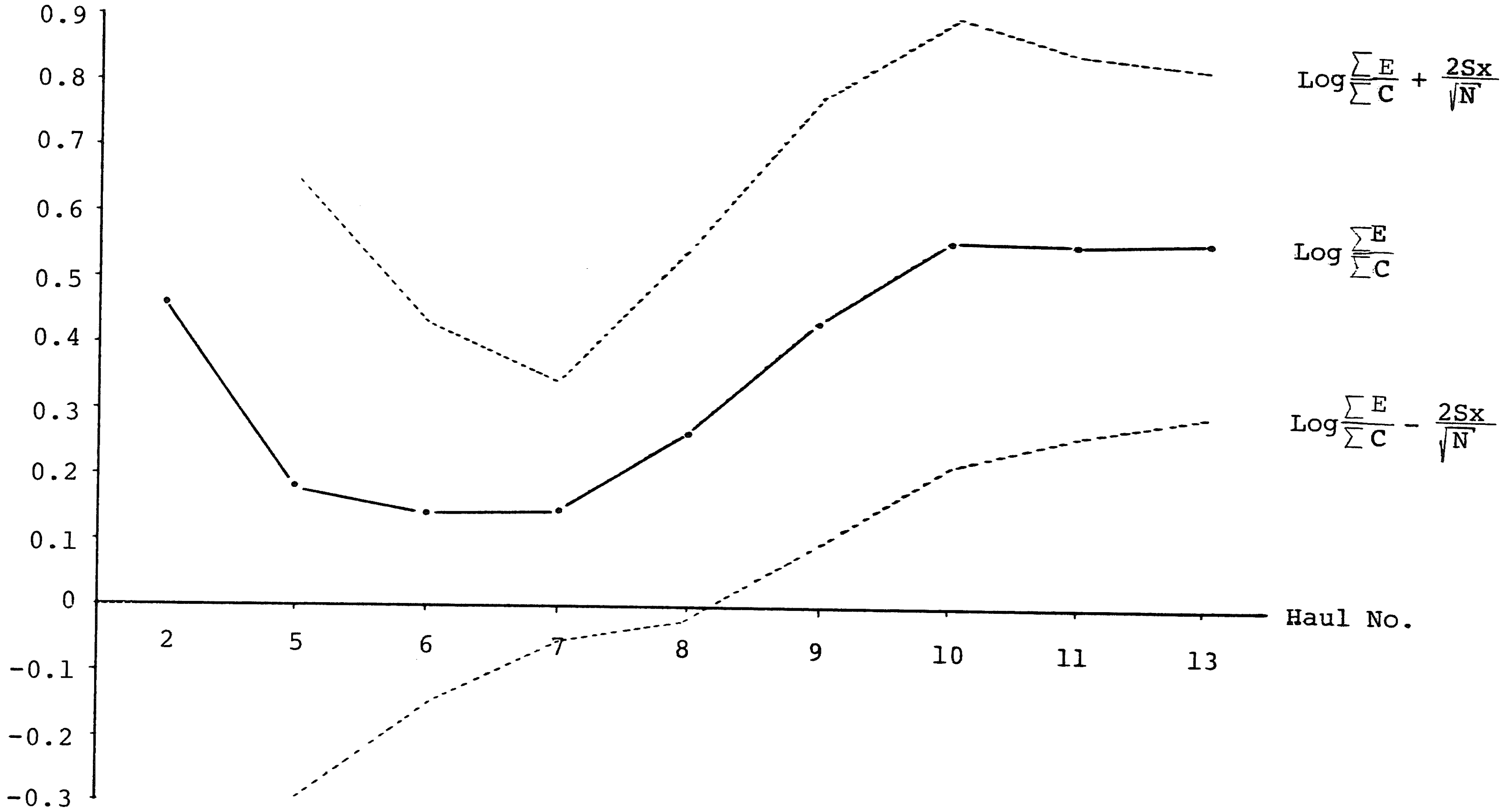


Figure 2. A plot of the log of the ratios of the running sums of acoustic estimate-E/ catch-C, with the 95% confidence interval.