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On the Estimation of Cod and Haddock discarded  
by Trawlers using different Chafers

by

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Introduction

The quantities of fish landed annually from different fishing grounds are as a rule correctly recorded. However, these data relate only to the quantities caught of those species which are not subject to discarding at sea. For commercial species as cod and haddock, which are subject to discarding at sea in the North-east Atlantic, information on the discarding rate are required before the actual catch could be determined from the landing statistics.

In the North-east Atlantic cod and haddock are mainly discarded by trawlers. Since the principal factor governing the sizes of fish which escape from the cod-end, is the effective mesh size (Margetts et al. 1964), the discarding rate can be decreased by using larger effective mesh size in the cod-end. In many fisheries a larger effective mesh size in the cod-end might cause a long term gain in yield, as estimated for the cod and haddock fisheries in the North-east Atlantic (Anon 1960, 1961, 1965). For making these calculations the rejection rate in different length groups must be known (Gulland 1959). In order to increase the reliability of the estimated long-term gain for cod and haddock by increasing mesh size in the North-east Atlantic, sampling of discarding data was started in November 1964 (Hysten 1965).

Method of estimating quantities caught and discarded

The rejection rate can be estimated by several methods. Four are described by Keir (1960) and Jean (1963):

1. Measuring a sample of the catch (before the small fish are discarded) at sea and comparing these measurements with a sample of the landings.

2. Measuring all, or a sample of the discarded fish at sea. If only a sample is measured, the rest have to be counted. A sample of the landing has to be measured during the unloading.

3. Measuring a sample of the catch at sea and all fish or a sample of the fish discarded.

4. Recording in logbooks after each haul total weight of the catch or the total landings together with the weight of the discards.

A more indirect method was used by Sahrhage (1958 and 1959):

5. Measuring a sample of the landings from commercial fishing vessels during unloading and a sample of the catch (before discarding) of a research vessel fishing in the same localities, to the same time and with the same effective mesh size as used by the commercial fleet.

6. When it is not possible to estimate the quantity of discarded fish, usable estimates can be obtained by using the mean quantity and size composition of the landings and the average mortality and growth figures established from research vessel catches (Hempel and Sahrhage 1960).

A sampling program in accordance with method 1-3 has to be carried out by a man from the institute onboard the trawlers.

#### Material

In spring 1965 an agreement between the Norwegian Marine Research Institute and three Norwegian trawling companies made it possible to study the discarding of cod and haddock by trawlers using slightly different chaferes (Table 1); a sampling program was made in accordance with method 2. Two of the trawlers which took part in the experiments fished at East-Finnmark Coast in May-June 1965; the third was fishing at Bear Island and at the Finnmark Coast in May.

Trawler A used no chafer at Bear Island, but at the Finnmark Coast a net with the same mesh size as in the cod-end was used, fastened on top of the posterior part of the cod-end (Table 1). The trawler B used double net in the posterior part of the cod-end, trawler C a double net in the whole length of the cod-end.

Some variations were observed in the catches of the 126 hauls made, and the number of fish measured from each haul depended of the size of the catch. As an average, about 18 percent of the cod selected for landing, and about 47 percent of the discarded fish were measured (Table 2), while about 2 percent of the haddock landed and 17 percent of the discarded fish were measured (Table 2).

Length distribution of the total landings and total discards have been estimated on the assumption that the length distributions of measured fish discarded, and if those taken for human consumption give random samples of the total landings and total discards respectively. Total weights of landings and discards respectively were estimated by the calculated length distributions of the landings and discards respectively, and by a length/weight relation.

### Cod discards

At Bear Island cod up to 49 cm were discarded (Fig. 1), but the number of fish discarded were small, and the data give no picture of the discarding practice. At the Finnmark Coast fish up to 50 cm were discarded by trawlers A and B (Fig. 2) while fish up to 42 cm were discarded by trawler C. This feature indicate a varying discarding practice, which fact is also reflected in the retention curves for landing (Fig. 3). These curves are concentrated in three groups with those for Bear Island between the curves for the Finnmark Coast. The 50 percent retention length for landing is estimated to 41.5 cm for the Bear Island catches (Hyllen 1965) and to 37.5 cm and 45 cm for the Finnmark Coast.

Variations in the estimated total discarding rates were also observed (Table 3). Small quantities were discarded at Bear Island, and 7-24 percent in number and 2.5-10 percent weight were discarded at the Finnmark Coast.

### Haddock discards

The selection for landing of haddock took part over the length groups 37-49 cm (Fig. 4), and the selection curves for landing (Fig. 5) were similar to those found for cod. The 50 percent retention length was estimated to 42 and 43.5 cm for trawlers A and B respectively, and the discarding rates were estimated to 29-68 percent in number and 17-46 in weight (Table 3). However, the high rejection rate of trawler B was mainly due to one haul which was taken inside the 4 mile limit. About 90 boxes out of 180 were discarded from this haul.

### Discussion

At the moment the legal mesh size in the North-east Atlantic is 120 mm for cod-ends made of manilla, sisal, polyethylene and polypropylene, and 110 mm for cod-ends made of hemp, cotton, polyester and polyamide. However, for Norwegian trawlers the legal mesh size is 10mm larger~~larger~~. Different types of chafers may be used. Chafers constructed according to ICNAF specifications (Saetersdal 1958), or consisting of a series of flaps or netting attached at intervals along the cod-end, have no appreciable effect on cod-end selectivity (Evertson 1959, Saetersdal 1960). However, a double cod-end reduces the selection with about 20 percent (Anon. 1964),

The experiments were run at different times, and in different localities. Variations in discarding rates (Table 3) may therefore to a certain extent have been caused by variations in abundance of the various length groups on the fishing grounds. However, factors affecting the selectivity of the gear also influence the discarding rates. Factors such as size of catch, characteristics of vessel and gear

(Margetts et al. 1964), towing speed and duration of tow are of interest in this connection. Trawlers A and B being of larger tonnage than C used a towing speed of 3-4 and 3 knots respectively. However, the effect of these factors on the selection and the discarding rate is masked by differences in the gear selectivity. Since the cod-end used at Bear Island has a 50 percent retention length for cod of 48.1 cm and the 50 percent retention length for landing in this area was 41.5 cm (Hyllen 1965), the low discarding rate may have been due to the cod-end without chafer (Table 3). Trawler B was fishing off Nordkyn 14 days later than trawler A. However, A did not fish inside the 6 mile limit, while B was fishing close to the 4 mile limit. Trawler B rejected about 6 percent in weight and 15 percent in number of cod in this area, which figures are higher than those estimated for trawler A (Table 3). This feature may to some extent have been caused by the longer chafer with the smaller mesh size used (Table 1).

The variations observed in the rejection rates of cod estimated for trawlers B and C (Table 3), are partly due to differences in retention for landing (Fig. 3), partly to differences in the length distributions of the catches (Fig. 2). Both trawlers fished at the 4 mile limit in the same area, trawler B 14 days later than C. Trawler C used a double cod-end in the whole length, while B had only chafer in the posterior part of the cod-end. The double cod-end in the trawl of C may have reacted as a trawl with smaller mesh size than that used by B, even if the mesh size in the chafer was larger. In this case the smaller amount of bigger fish in the catch of trawler C is caused by a less efficiency on bigger fish, a phenomenon which is shown in several experiments with different mesh sizes (Beverton and Holt 1957; Konstantinov 1963).

The trawlers which took part in the experiments landed their catches at different ports and to different prices. Trawlers A and B got less paid for smaller fish than for bigger fish, while trawler C got the same price for all sizes of fish. However, C fished near the landing port, while the others fished some distance away. In a trawler fishing near the landing port and gets the same price for all fish above the minimum size, the fishermen are interested in loading up the vessel without regard to fish size, because of the short time lost in steaming to and from the fishing localities. Trawlers fishing some distance from the landing port and in addition being less paid for smaller than for bigger fish try to select the bigger fish for landing.

A comparison of the selection curves of cod-ends with different mesh sizes and the retention curves for landing indicates that a small number of cod would be rejected from trawlers using cod-ends with 130 mm effective mesh size (Fig. 3) and with the same rejection practice as trawler C. However, some cod and haddock would be discarded by trawlers using a 130 mm cod-end and the same discarding practice

as trawler A and B. With an effective mesh size of 150 mm the rejection will be insignificant:

Even if the smaller cod is returned to the sea as soon as possible, their survival is low (Jean 1963). It is also most unlikely that any appreciable number of discarded haddock would survive (Anon. 1962). A larger effective mesh size in cod-ends will therefore reduce this vastage and give a future benefit to the fishery.

#### Summary

1. An agreement between the Norwegian Marine Research Institute and three Norwegian trawling companies made it possible to study during May-June 1965 the discarding of cod and haddock in the North-east Atlantic by trawlers when using different chafers.

2. Few cod were discarded at Bear Island by a trawler using a single cod-end made of ulstron with a mesh size of 120 mm. At the Finnmark Coast in trawlers using either a small topside chafer on the posterior part of the cod-end or double cod-ends of different length made of ulstron/nylon with a mesh size of 120 mm the discarding rates for cod were estimated to 7-24 percent in number and 2.5-10 percent in weight. At the Finnmark Coast the discarding rates of haddock were estimated to 29-68 percent in number and 17-46 percent in weight.

3. An important factor affecting cod discards at sea are the sizes of fish selected for landing. When smaller fish are less paid for than bigger, the latter are preferred for landing.

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Table 1. Cod-ends and chafers used.

Trawler No.	Fishing area	Cod-end		Type	Chafers	
		Mesh size	Material		Mesh size	Material
A	Bear Island	126.1	Ulstron	None		
A	Finnmark Coast	"	"	25 meshes net on the posterior part of cod-end	121.8	Ulstron
B	"	120.8	"	50 meshes double cod-end, chafers fastened only in front	97.1	"
C	"	About 120	Nylon	Double cod-end, chafers fastened only in front	about 120	Courlens

Table 2. Cod and haddock landed, discarded and measured.

Trawler No.	Locality	Time	No. of hauls	Landings			Discards		
				Boxes	Boxes	No.	Boxes	Boxes	No.
A	Bear Island	12/5-14/5-65	12	131.5	39.5	1482	0.2	0.2	27
A	W. Finnmark	15/5-16/5-65	5	29.1	14	422	2.2	2.2	229
A	E. "	16/5-19/5-65	17	244	80	2675	5.6	5.6	656
B	"	30/5- 8/6-65	70	1548	133	5635	155.4	65.2	8486
C	"	22/5-25/5-65	19	207	134	11101	5.8	5.8	1212
<u>Haddock</u>									
A	W. Finnmark	15/5-16/5-65	5	2.4	0.4	31	0.7	0.7	108
A	E. "	16/5-17/5-65	6	2.6	0.6	40	0.9	0.9	110
B	"	30/5- 8/6-65	39	169	2	115	140.5	22.6	3300

Table 3. Percentage discards, by number and by weight, of cod and haddock.

Trawler No.	Locality	Time	Landings		Discards		Percent discarded	
			No.	Weight	No.	Weight	No.	Weight
<u>Cod</u>								
A	Bear Island	12/5-14/5-65	4934	8786	27	23	0.5	0.3
A	W. Finnmark	15/5-16/5-65	877	1842	229	157	20.7	7.9
A	E. "	16/5-19/5-65	8159	16053	656	459	7.4	2.8
B	"	30/5- 8/6-65	65586	119646	20137	13194	23.5	9.9
C	"	22/5-25/5-65	17151	20296	1212	517	6.6	2.5
<u>Haddock</u>								
A	W. Finnmark	15/5-16/5-65	267	304	108	61	28.8	16.7
A	E. "	16/5-17/5-65	173	208	110	67	38.9	24.4
B	"	30/5- 8/6-65	9718	13733	20514	11744	67.9	46.1

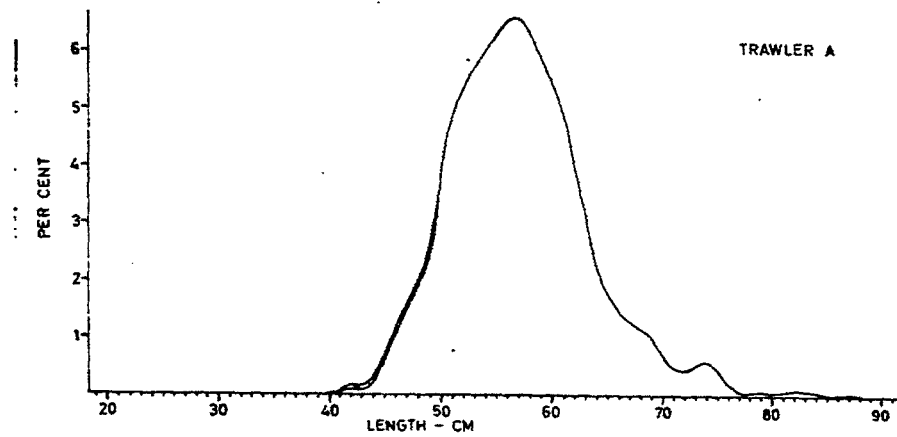


Figure 1. Length distribution of cod caught at Bear Island 12th-14th May 1965.

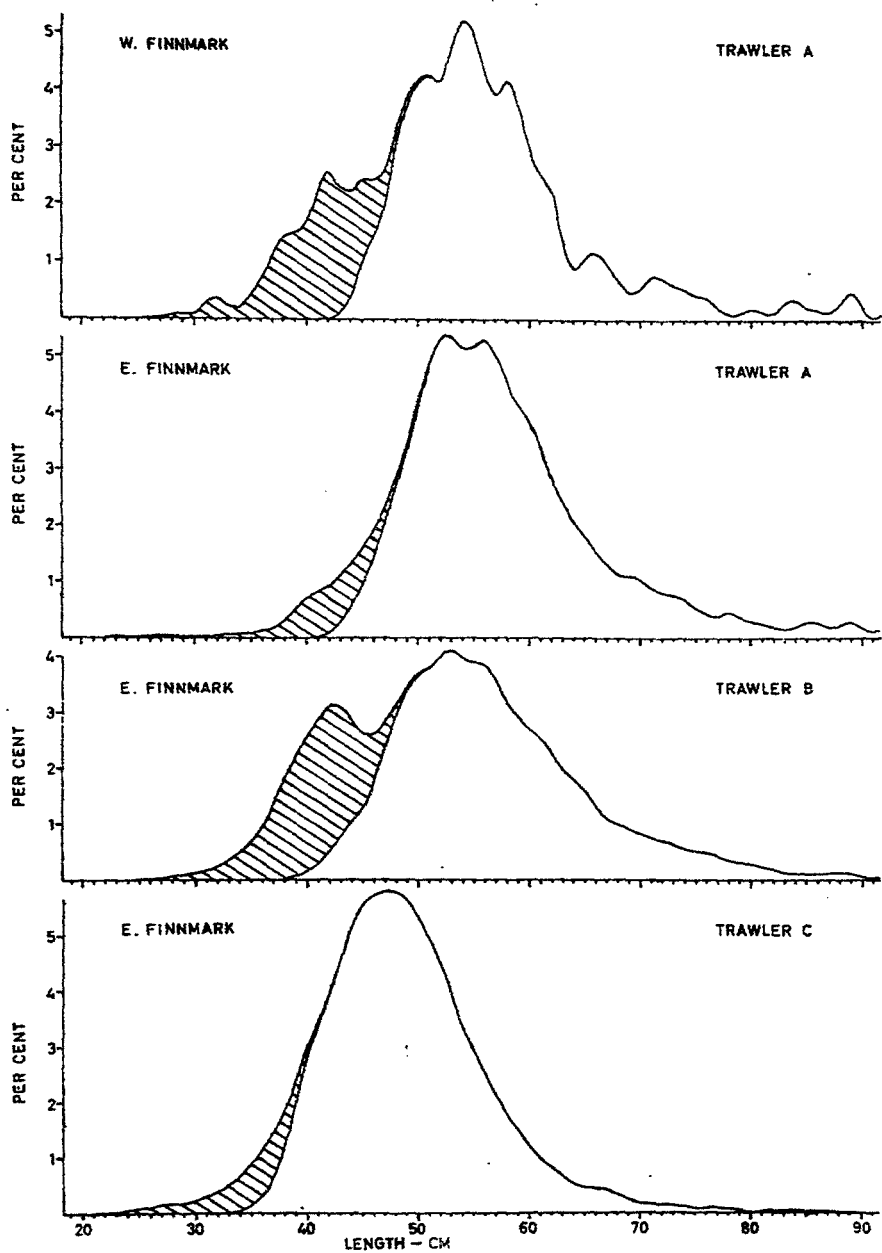


Figure 2. Length distribution of cod caught at the Finnmark coast 16th May - 8th June 1965.



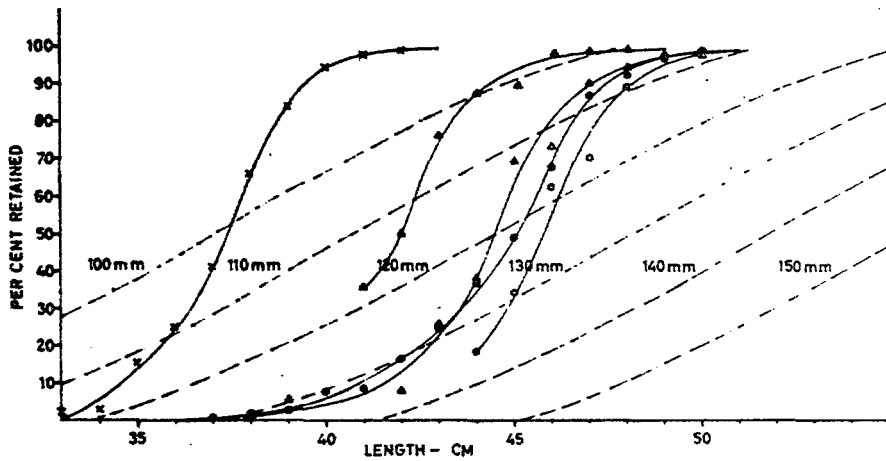


Figure 3. Selection curves for landing of cod caught by trawler A, B and C at the Finnmark coast and the curve given for Bear Island ( Hysten 1964 ) plotted together with selection curves of cod - ends made of manila / ulstron ( - - - ). A selection factor of 3,7 is used ( Margetts et al. 1964 ).

- Trawler A, W. Finnmark
- ▲ Trawler A, E. Finnmark
- Trawler B, E. Finnmark
- × Trawler C, E. Finnmark
- ▲ Bear Island

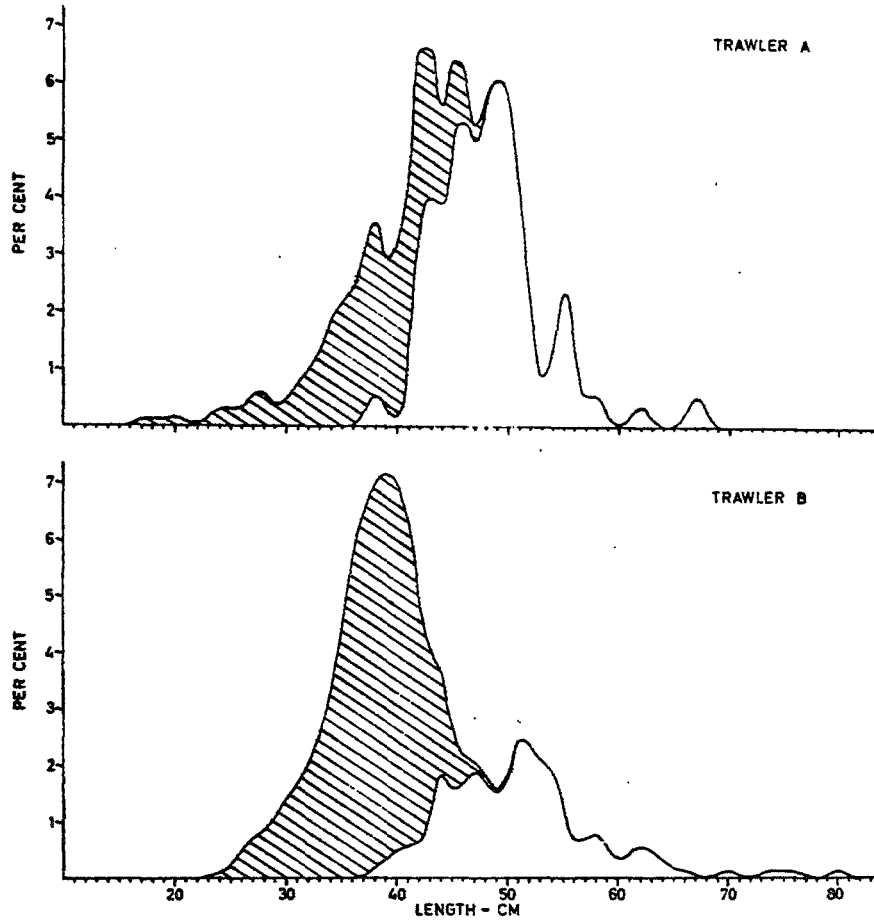


Figure 4. Length distribution of haddock caught at the Finnmark coast in the period 15th May - 8th June 1965 by trawler A and B.

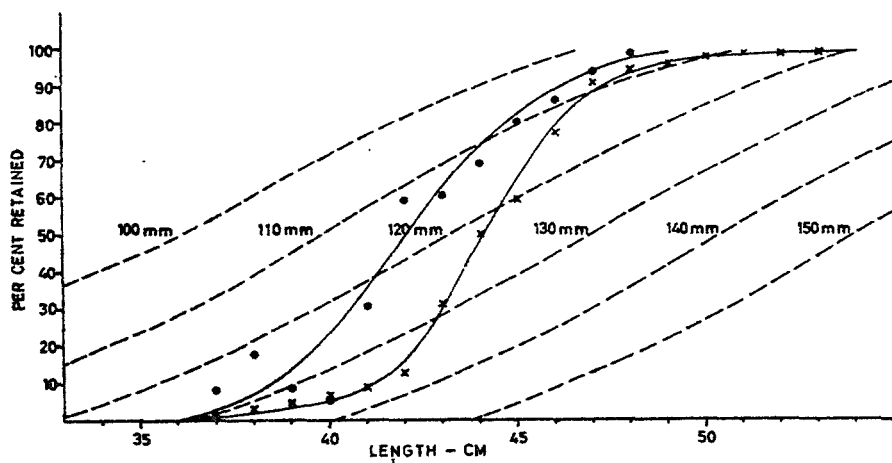


Figure 5. Selection curves for landing of haddock caught at the Finnmark coast plotted together with selection curves of cod-ends made of manila / ulstron ( - - - ). A selection factor of 3,6 is used ( Margetts et al. 1964 ).

- Trawler A
- × Trawler B