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Effects of Gill Net Selection on Survey Results in the Greenland Young Cod Survey

by

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Abstract

Size distribution of cod caught in links of gill net with different mesh sizes used in the Greenland young cod survey is compared to size distributions for three other gears. From these comparisons it is concluded that the size distribution of catches is very dependent on the choice of mesh sizes. Some considerations are also given to the selection process which is ascribed to two different catching processes and these are explained in terms of the relationships between fish sizes and mesh sizes. Finaly possible effects of selection on survey results are discussed.

1. Introduction

Prediction of year-class strength of recruiting year classes is of considerable importance when forecasting developments in the fisheries and when giving management advice. In the West Greenland area such predictions have previously been based on hydrographic observations and cod larvae abundance. In an evaluation of these prediction procedures Hansen and Buch (1986) concluded that temperature and larval data can provide some information on subsequent year-class strength but that precise predictions based on this information are difficult when the relative importance of the recruitment from East Greenland-Iceland is not known. For this reason the authors suggested that year-class predictions should be made from young-fish surveys.

The Greenland Fisheries and Environment Research Institute does not have access to any research vessel fitted for large-scale trawling operations and therefore a pilot survey trying different passive gears (gill nets, long lines and fish traps) was carried out in inshore waters in 1984. Only gill nets were successful, and in 1985 a survey was carried out in inshore areas by use of links of gill nets with different mesh sizes (Hansen & Lehmann, 1986). The result of that survey was generally in good agreement with the later autumn trawl survey by the Federal Republic of Germany as both surveys found a large 1984 year-class of cod. However, some problems were found in interpreting the results from the gill net catches due to lack of knowledge of the selection process of the nets.

The purpose of this work is to give a first evaluation of the effects of gill net selection on survey results.

2. Materials and methods

Data for this work derive mainly from the young-cod survey conducted in inshore areas of South West Greenland during summer 1986 (Hovgård 1987).

Most fishing operations were carried out with the standard net links also used in the 1985 survey. These links consist of net sections with 4 different mesh sizes, viz. 16.5 mm, 24 mm 33 mm and 55 mm, knot to knot. However, due to delivery problems with the 33 mm mesh size it was necessary to substitute about half of these sections with a 35 mm mesh size. For further details on design and operations see Hansen and Lehmann (1986).

In order to get independent information on the size distribution of cod, two other gear types were used concurrently in the inshore areas : 1) links of gill nets with mesh sizes of 10, 12.5, 16, 22, 25, 33, 38 and 45 mm (knot to knot), commonly used in the institute's char investigations and 2) jigs with small hooks.

Data on the size distribution in the offshore areas in the same period, taken from research trawl catches in Div. 1B-1D, are also used for comparison. Mesh size in the cod end was 20 mm, stretched mesh.

A summary on catch, effort, area coverage etc. of the various fishing operations is given in Table 1.

3. Results

The size distributions observed in catches for the various gears differ significantly (Fig. 1). The catches in the offshore trawl fishery and in the inshore jig fishery both show simple unimodal size distributions, dominated largely by the 1984 year-class. The mean size of cod in the jig catches is somewhat bigger than in the trawl catches, the modes being 27 and 25 cm, respectively. It is not possible to evaluate whether this difference is due to areal or selectivity factors.

The size distributions found in the catches from the two links of gill nets are less simple. The char link shows a 'rough' picture although generally it produces a bimodal distribution composed of the 1985 year-class (9-17 cm) and the 1984 year-class (19-39 cm). The standard link, used in the young cod survey, produces a distinct three modal distribution (modes at 15, 22 and 32 cm) which is not easily explained from the year-classes at hand. However, the size distributions for both links are mush easier to interpret when looking on catches from individual mesh sizes (Fig. 2 and 3). For both links a clear increase in the size of fish caught is seen from small to large mesh sizes.

For the standard net link it can also be seen that the two smallest mesh sizes show bimodal size distributions (fig. 2) As this was detected during the survey a small investigation of this phenomenon was made in the Nuuk area by observing and recording how the fish were caught in the net (Fig. 4). Fish were generally caught in only two ways, either with the net twine attached behind the gill cover or at the lips (Fig. 5). Within each mesh size the smaller fish were caught by the gills whereas the second mode consists of fish caught at the lips.

4. Description of the selection processes

Some simple properties of the gill net links used in the Grenland young cod surveys emerge from the present work.

The length distribution of fish caught within each mesh size shows a bimodal distribution which can be explained by two different ways of catching, i.e. the young cod are either attached behind the gillcover or at the lips. Both of these catching processes are quite selective as more than 95 % of the catches are made up by fish whose lengths differ by less than 15 % from the optimal length (table 2). As the increase between two successive mesh sizes is in the range of 1.4 this implies that fish between two modes are inefficiently caught. Of this reason the total size distribution from the net links reflects more the actual choice of mesh sizes than the underlying population structure (fig. 1).

The modal lengths (i.e. the cm. group of fish most efficiently caught) by both the gill- and lip caught fish can simply be related to mesh size (fig. 6). The mode of the gill-caught fish is proportional to mesh size : modal length (cm.)= 9.13 x mesh size (cm.) with a correlation coefficient R2=0.99. For the lip caught fish data are only available from the 16.5 and 24 mm mesh sizes. In both these nets the modes are found at approximately 1.5 times the modal length of the gill caught fish, thus also indicating a simple proportionality between length and mesh size (modal length= 14.41 x mesh size(cm.)).

Some considerations must also be given to the relative efficiency of the lip catching compared to the gill catching. This causes some problems as the number caught within each mode is dependent on the number of small cod available. However, by assuming that any size group of fish has equal availability for all mesh sizes, the relative efficiency of the two catching processes can be estimated by comparing the numbers caught by the gill in one net with the numbers caught by the lips in another net when looking at the same size group. By this procedure the efficiency of lip catching can be estimated to 20-25 % of gill catching (table 3).

5. Implications of selection on survey results

From the present work it is clear that the length frequency distribution in catches from the standard net links used in the Greenland young cod survey gives a biased picture of the true length distribution in the population, mainly caused by the existence of 'holes' in the selection pattern. These holes may give rise to some inaccuracies when using the catch rate of the net links as an index of year-class strength. This is due to the fact that size at age of cod off West Greenland differs significantly from year to year (Hansen, 1987) and it might thus be feared that the catch rate index is influenced by how well the true size distribution matches the selectivity of the mesh sizes used. Of this reason an introduction of intermediate mesh sizes (18.5 and 28 mm) is planned for the 1987 survey.

A more satisfactory solution is of course to develop a selection model enabling corrections for the actual choice af mesh sizes. Work on this project has been initiated.

6. References

Hansen, H. H., 1987 : Changes in Size at Age of Atlantic Cod off West Greenland, 1979-84. NAFO Sci. Coun. Studies 11 (37-42).

Hansen, H. H. & E. Buch, 1986 : Prediction of Year-class Strength of Atlantic Cod off West Greenland. NAFO Sci. Coun. Studies 10 : 7-11.

Hansen, H. H. & K. M. Lehmann, 1986 : Distribution of Young Cod in Coastal regions off West Greenland, 1985. NAFO SCR. Doc. 86/42.

Hovgård, H., 1987 : Young Cod Distribution and Abundance in West Greenland Areas, 1986. NAFO SCR: Doc. 87/32.

Table 1 : Summary of research fishery operations from where data are taken for this work

	NAFO Div.				
Gear	1B	1C	1D	1E	1F
Trawl					
Period	26/7-17/8	24-26/7	7-11/7	-	-
No of tows	30	8	12	-	-
No of cod	805	42	420	-	-
Stand. Gill net link					
Period	16-23/8	-	28/7-8/8	-	3-8/7
No of sets	64	-	43	-	72
No of cod	1218	-	277	-	598
Char gill net link					
Period	16-23/8	-	28/7-8/8	-	3/7-6/8
No of sets	10	-	7	-	13
No of cod	138	-	48	-	175
Jig					
Period	16-23/8	11-12/8	28/7-8/8	27/6	-
No of operations	6	2	5	1	-
No of cod	797	111	139	97	-

Table 2 : Mean and standard deviation for normal and log-normal frequency distributions around all modes. Length-groups refers to the sizerange usen when estimating parameters. The ± % indicates the 95% probability interval when asuming a log-normal distribution.

Mesh size	Site of atatch.	Length group	Mean	SD	Mean (log-tr. lgth)	SD	± %
16.5	Gill	14-18	15.5	0.89	2.74	.058	12.3
16.5	Lips	20-27	23.3	1.49	3.15	.065	13.7
24	Gill	20-28	22.8	1.19	3.12	.052	11.0
24	Lips	28-40	32.7	2.25	3.48	.069	14.8
34[1]	Gill	26-40	32.1	2.33	3.47	.072	15.5

[1] A combination of 33 and 35 mm mesh sizes were used during the survey. Standard deviations and confidence intervals are hence exaggerated for this mesh size.

Table 3 : Estimation of the effeciency of the lip catching process relative to gill catching by comparing the numbers caught by the two processes for selected size groups.

Size Group cm	Numbers caught At the lips	At the gills	Ratio (lip/gill)
19 - 26	135	669	.202
27 - 39	199	785	.254

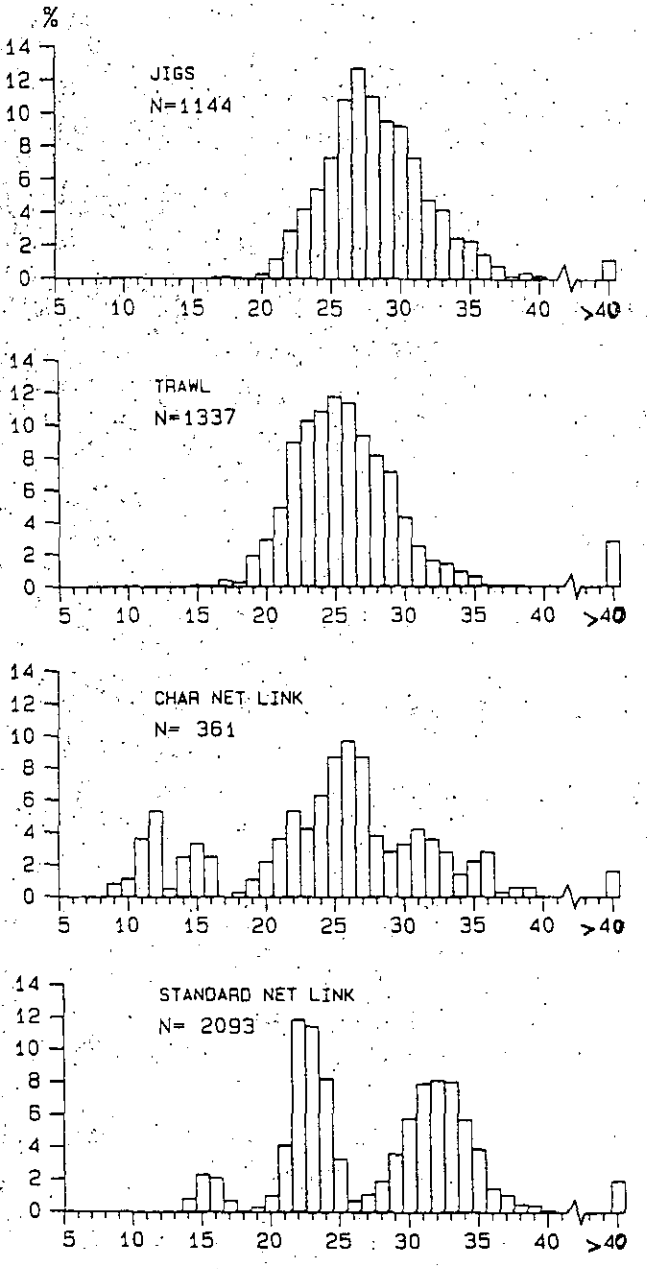

Fig. 1: Length frequency distributions of cod caught by jig, trawl, char and standard net links at West Greenland, July-August 1986.

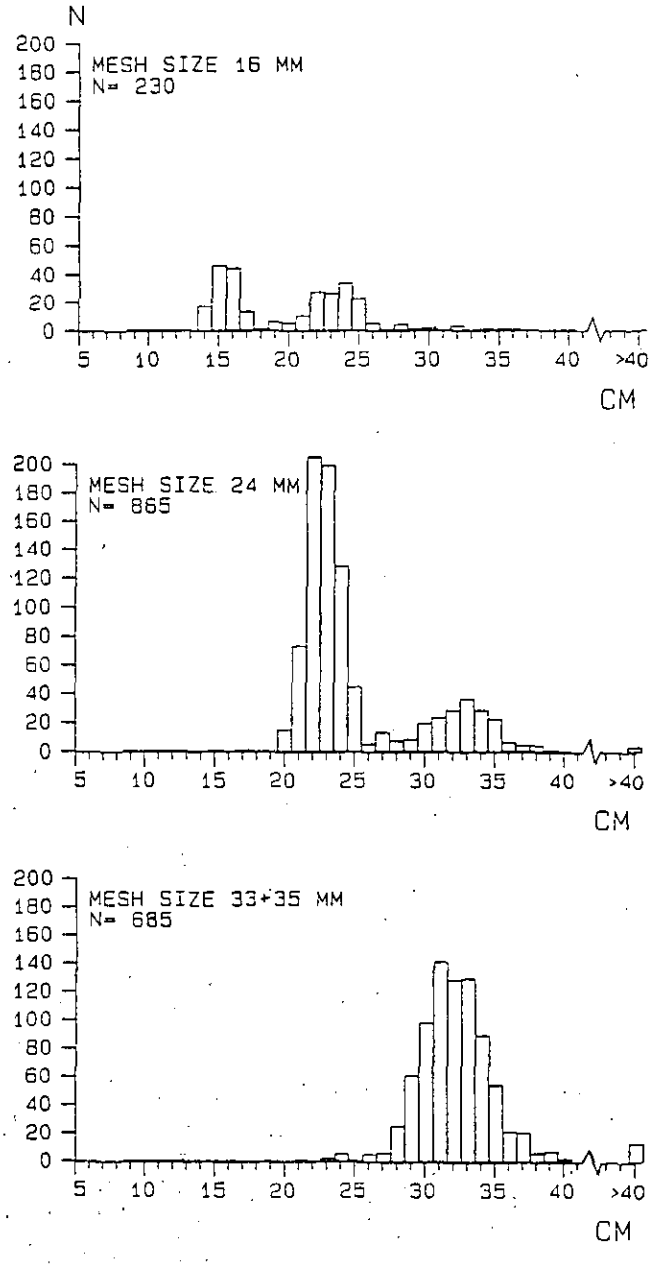

Fig. 2: Length frequency distributions from each mesh size in the standard net link. Catch in the 55 mm mesh size not shown due to a very low number caught.

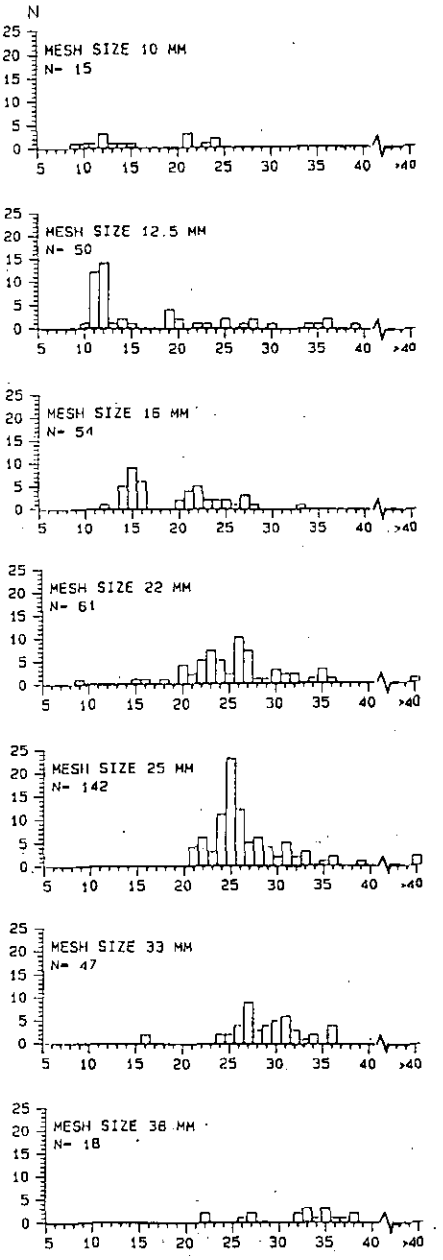

Fig. 3: Length frequency distribution from each mesh size in the char net link. Catch in the 45 mm mesh size not shown due to low catch.

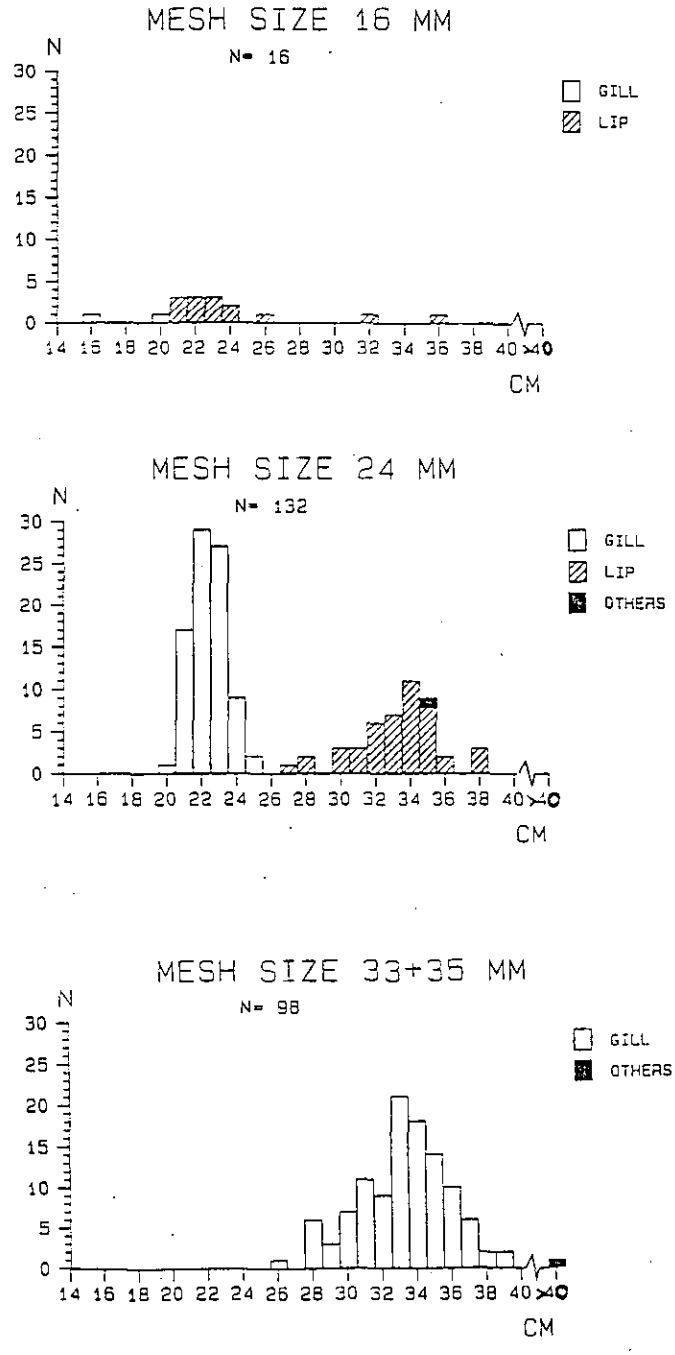

Fig. 4: Length frequency distribution from each mesh size in the standard net link in the Nuuk area, August 1986. The site of attachment of individual fish is indicated.

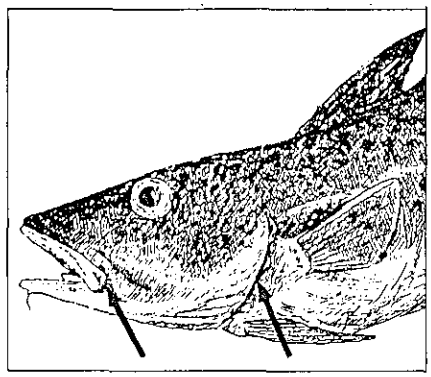

Fig. 5: Sketch showing the two most important structures which cause the attachment to the nets.

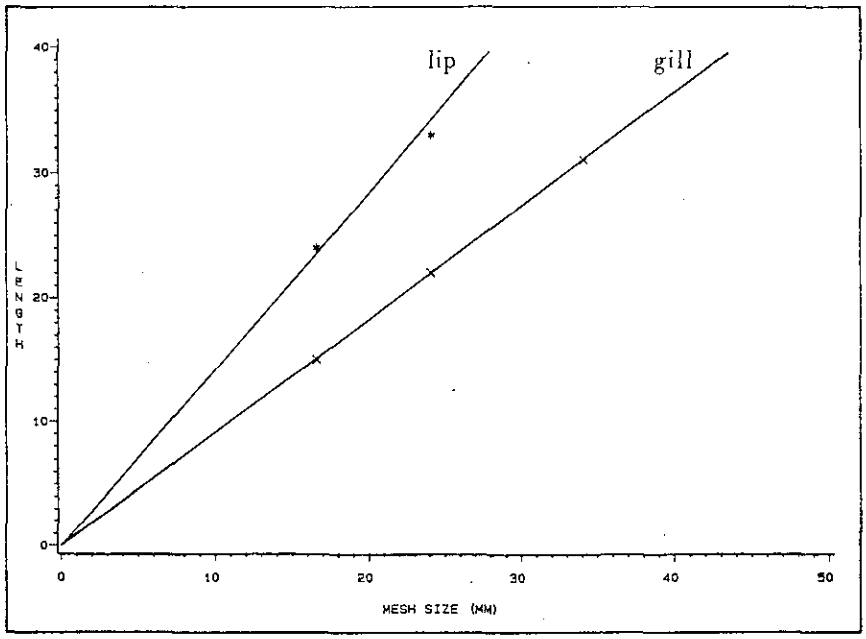

Fig. 6: Modal length for gill and lip caught cod plotted vs. mesh size. Lines based on regressions forced trough the ogive.