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Expected Length Distribution of cod in West Greenland Waters, 1988-90

by

Holger Hovgård

Greenland Fisheries Research Institute, Tagensvej 135
DK-2200, Copenhagen N, Denmark

Introduction

In the West Greenland area, a minimum landing size for cod of 40 cm is presently in force. The landed cod is subsequently sorted in two groups: 40-55 cm and above 55 cm. The large cod are given a price of roughly double that of small cod.

In order to optimize the fisheries from an economical point of view, it is important for the managers of the fisheries to know the size distribution of the cod in the coming years, and the Greenland Home Rule Authorities have, therefore, requested that "the expected length distribution of the fishable stock in 1988-1990 should be described".

Materials and Methods

To predict length distributions, it is necessary to have information on mean length at age and on the length distribution at different times.

Mean length

Mean length at age of cod in the West Greenland area is known to show very wide variations (Hansen, 1949; Hansen 1987) which has been attributed to growth conditions which vary between areas, years and year-classes of cod. For this reason, it is difficult to rely on any previously used age-length relationship. Instead the observed mean length at age for the 1984 year-class, found by the Federal Republic of Germany surveys, has been used to calculate future size-at-age using the von Bertalanffy equation (Table 1). As little or no growth occurs between the first and second quarters of the year, the annual length increment has been evenly distributed on the periods from 2nd to 3rd quarter, 3rd to 4th quarter, and 4th to 1st quarter (Fig. 1).

Dispersion

It is assumed that the length of cod at a specific age is normally distributed around the mean length. Information of the relation between the mean and the standard deviation was compiled from

samples from the commercial fisheries during 1983-84 as 4-7 year-old fish were abundance in that period (Fig. 2). For this period it was found that the standard deviation was proportional to the mean

$$STD = 0.074 * Mean$$

However, as the variance in the population can be split up in two components

$$S^2_{population} = S^2_{between\ samples} + S^2_{within\ samples}$$

the standard deviation found for single samples will underestimate the std. on the population.

From the results of the 1987 Federal Republic of Germany survey, the standard deviation on the length distribution of the 1984 year-class could be calculated as 11.6% of the mean.

Therefore, in the following analysis it is assumed that the standard deviation is proportional to the mean with a coefficient of variation of 11.6%.

Results

The proportion of cod in the three different size groups (<40, 40-55 and >55 cm) is given on a quarterly basis in Table 2. Until 3rd quarter at age 3, the majority of cod are below the minimum landing size. From this time and until the 4th quarter at age 5, the landing category of small cod is the largest. From then on the majority of fish exceeds 55 cm.

At present, the stock is dominated by the large 1984 year-class. The size of the 1985 year-class is estimated to be about a fourth of the 1984 year-class (Anon, 1988) whereas the 1986 year-class is almost non-existent. As the number of cod older than those of the 1984 year-class is also insignificant the expected size distributions in the cod catches during 1988-90 can be evaluated by considering only the 1984 and 1985 year-classes (Fig. 3).

During 1988 a considerable proportion of the stock (30-10%) will be below the landing size. From 1989 onwards the number of cod below 40 cm will, however, be insignificant. The proportion of cod above 55 cm is small during 1988 but will increase markedly during 1989. In 1990, cod above 55 should dominate the catches.

Discussion

The calculations of the proportions of cod in the different size categories given in Table 2 and Fig. 3 are based on numbers-per-length group. As the weight of cod increases exponentially with its length, it implies that the proportion of the different size categories measured by weight will have a relatively larger dominance of cod in the large size categories. Measured by weight, the large size categories will thus be dominating by summer 1989.

The size distribution is also influenced by the size selectivity of fishing gears. Some consideration on the effects of selectivity will be given below for the most important gears.

Pound net: Pound nets retain all cod above approximately 25 cm, and the length distribution in

pound-net catches will, therefore, reflect the size distribution in the stock. Considerable discarding is expected during the summer of 1988 and about 50% of the catch weight in 1989 will be of the small-size category (40-55 cm).

Trawl: Mesh size of 140 mm is commonly used by the Greenland fleets. The 50% retention length of this mesh size is given as 47.6 cm (Jensen, 1980) and a selection curve for this gear is stipulated in Fig. 4. The selection pattern of the trawl will favor larger cod in the catch and it can be expected that 50% by weight of the trawl catches will exceed 55 cm by late 1988 or early 1989.

Longlines: Longlines catch cod below a size of 55 cm quite ineffeciently (Fig. 4) and can therefore be expected to catch almost exclusively large cod. With few large cod at hand, this fleet might generally have poor catch prospects before 1990.

Gillnet: The selectivity of cod by gillnet is simply related to mesh size with

Modal length (cm) = 9.1 * mesh size (cm, bar length)

(Hovgård, 1988) and few fish are caught at a length of less than 90% of the modal length. This implies that a catch of only large cod can be achieved by using mesh sizes of 65 mm (bar length).

Finally, it must be noted that size-at-age, and especially the relative abundance of the two year-classes, might differ between areas. For instance, the 1985 year-class was found more southerly than the 1984 year-class in the Federal Republic of Germany trawl survey in November (Anon, 1988). This year-class has also been very weak in the coastal and fjord areas of Nuuk (Hovgård, 1987; Hovgård and Nygård, 1988). Spatial and temporal differences will therefore, to some extent, blue overall tendencies in special cases.

References

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Table 1. Observed mean length from German (FR) autumn surveys and calculated lengths by the von Bertalanffy equation. Estimated equation parameters are: K=0.20, L_∞= 85.7, t_o = -0.45.

Age	Observed length	Calculated length
1	21.6	21.6
2	33.2	33.2
3	42.7	42.7
4		50.5
5		56.9
6		62.1
7		66.4

Table 2. Expected mean length and proportions of number of cod in three size categories for cod of the 1984 and 1985 year-classes at age 3-6 given on a quarterly basis.

Age	Quarter	Mean length	Std.	% of cod <40 cm	40-55 cm	>55 cm
3	1	36.37	4.22	80.5	19.5	0
	2	36.37	4.22	80.5	19.5	0
	3	39.54	4.59	54.0	46.0	0
	4	42.71	4.95	29.1	70.2	0.7
4	1	45.31	5.26	15.6	81.3	3.1
	2	45.31	5.26	15.6	81.3	3.1
	3	47.91	5.56	7.8	82.1	10.1
	4	50.51	5.86	3.7	73.9	22.4
5	1	52.63	6.11	1.9	63.2	34.9
	2	52.63	6.11	1.9	63.2	34.9
	3	54.76	6.35	1.0	50.5	48.5
	4	56.89	6.60	0.5	38.2	61.3
6	1	58.63	6.80	0.3	29.4	70.3
	2	58.63	6.80	0.3	29.4	70.3
	3	60.37	7.00	0.2	25.1	74.7
	4	62.11	7.20	0.1	16.0	83.9

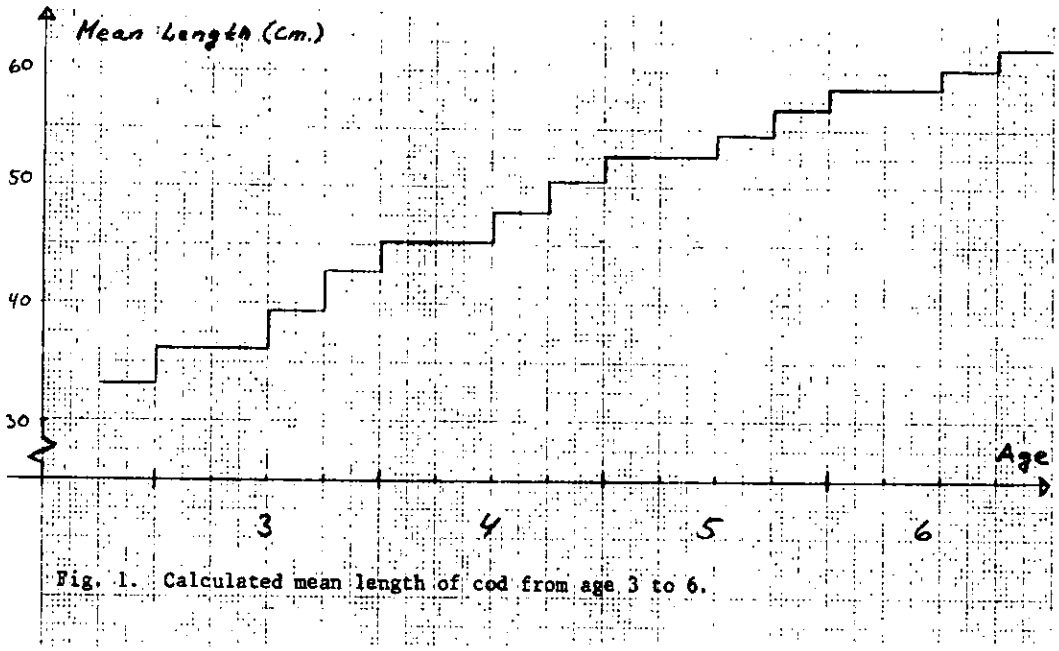

Fig. 1. Calculated mean length of cod from age 3 to 6.

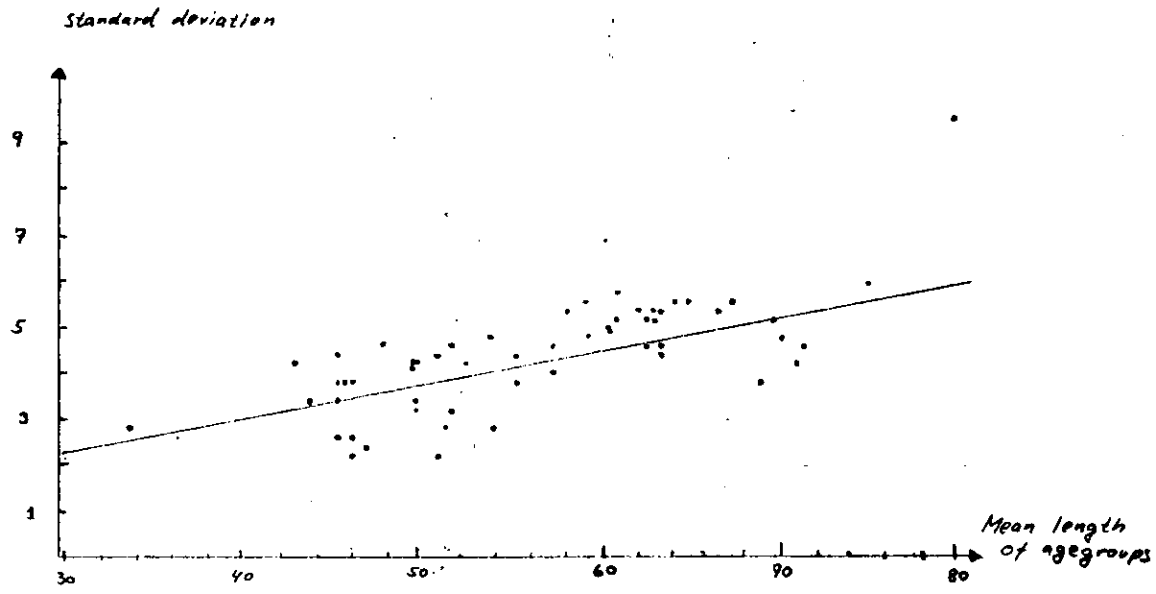

Fig. 2. Standard deviation vs mean length of different age groups in individual samples of commercial catches during 1983 and 1984. Regression line forced through the origin.

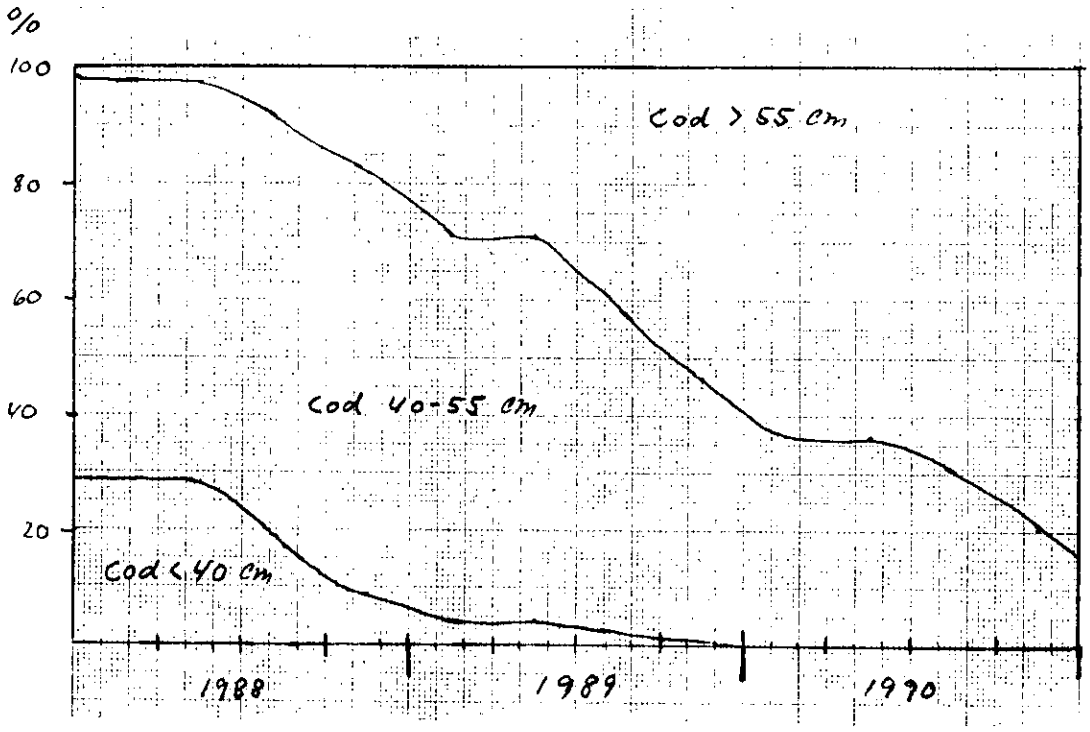

Fig. 3. Expected size distribution during 1988-90 of the year-classes 1984 and 1985 combined assuming relative year-class size of 4:1.

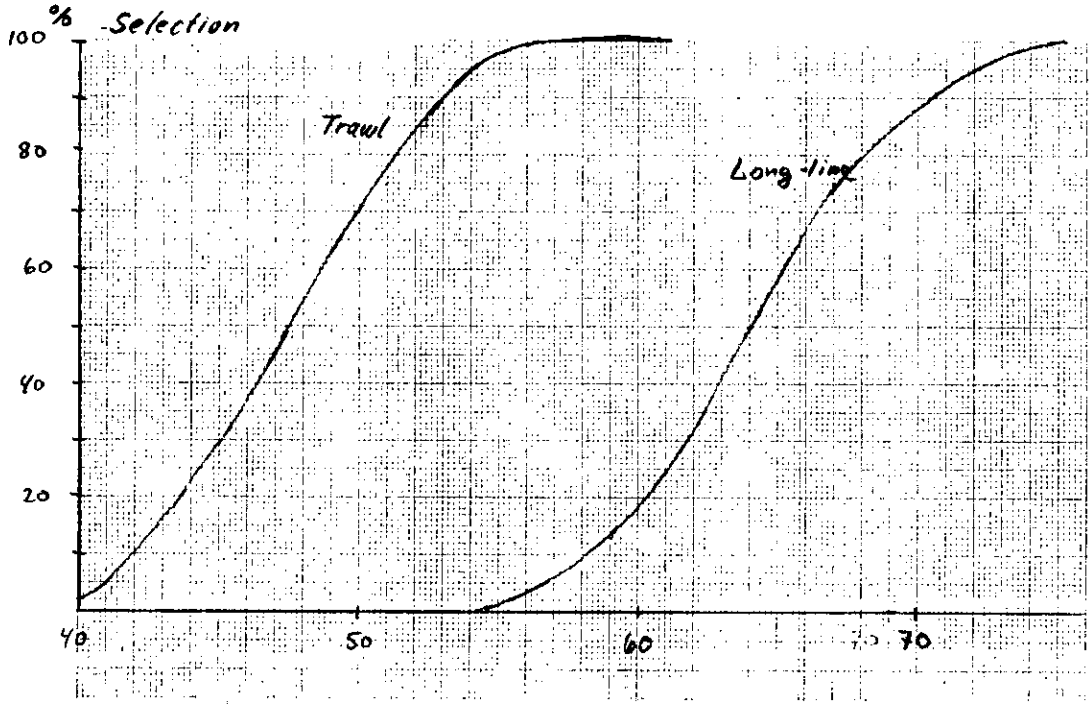

Fig. 4. Percent selection of trawl (140 mm) and longline vs cod length. 50% retention length for trawl taken from Jensen (1980) and range of selection span interpretated from Bohl (1967). Long-line selection form Hovgård et al., 1988. Both curves drawn by hand.