

Northwest Atlantic



Fisheries Organization

Serial No. N1158

NAFO SCR Doc. 86/42

SCIENTIFIC COUNCIL MEETING - JUNE 1986

Distribution of Young Cod in Coastal Regions of West Greenland, 1985

by

Holger Hovgard Hansen and Klaus Meyer Lehmann
Greenland Fisheries and Environment Research Institute
Tagensvej 135, DK-2200, Copenhagen N, Denmark

Abstract

A young fish survey was conducted in the inshore areas of South West Greenland (NAFO Div. 1D - 1F) during July and August 1985 using gillnets with different mesh sizes.

Young cod was caught mainly near bottom in very shallow water (0 - 10 m below the surface). No differences in catch rates between day and night settings were observed.

The 1984 year class was dominating in the catches and was evenly distributed within the area. The 1983 year-class was poorly represented and almost exclusively restricted to the Godthåb Fjord system.

1. Introduction

Knowledge of year-class strength of incoming year classes is of considerable importance when forecasting developments in the fisheries and giving management advices. At West Greenland this problem has been actualized by the pronounced reduction in stock size of cod in recent years. At present, any improvement of the fishery is dependent on recruitment of a strong year class, and should this occur, strong measures to protect fish below optimal sizes are recommended (Cornus et. al., 1985). Forecast of any such event well in advance is therefore of considerable importance for managers and politicians.

Year-class projections of West Greenland cod has traditionally been made in rather informal ways based upon information on larval abundance and upper layer temperatures in early summer. The use of data from larval surveys for predicting year-class strength has generally been questioned in the last decades (Sisenwine, 1985) and has lately led to a quite misleading projection for cod off West Greenland (Cornus et. al., 1985). In a work on recruitment of cod at West Greenland Hansen & Buch (1985) suggested that the water temperature might be of major importance for eggs spawned at West Greenland, but not affecting recruitment from outside the area. Thus temperature alone is not sufficient to predict future

recruitment to the West Greenland cod stock, and the authors suggested that predictions should be based on abundance estimates of young prerecruit cod.

Indications of young cod abundance at West Greenland have earlier been made by judging school numbers and sizes by means of visual observations from the shore or from small vessels in coastal waters. Species and year class compositions were determined by fishing with small hand seines. Although this method has serious drawbacks, notably its dependence on very calm weather and on subjective judgements, it did show substantial occurrence of 1-3 year cod in coastal waters. More recent trawl surveys, especially the surveys conducted by the Federal Republic of Germany have, on the other hand, also shown occurrence of young cod in the offshore areas.

The purpose of work presented in this paper is to try to work up a method usable for getting data in as well inshore as offshore areas, which can be used as indices for projections of year-class strength. However, as little information on distribution pattern was available, the main objective of the 1985 survey was to gain knowledge on distribution and behaviour of small cod, focusing on depth occurrence and spatial distribution. Some work was also made on diurnal variation in catch rates.

2. Material and methods

A pilot study was carried out in August 1984 in the Holsteinsborg area (Div. 1B) in order to try different gear types and get information on young fish distribution. The fishery was conducted with; a) gangs of gill net with different mesh sizes, b) long lines with small hooks, and c) fish traps. During these trials cod was caught only by the gill nets which, moreover, were the easiest gear to handle. For this reason only gill nets were used in the 1985 survey. Design and specifications on gill net used in 1985 are given in Fig. 1.

During fishing two links of net were always tied together. All CPUE figures refer therefore to catch per two links per hour.

It was planned to cover the area from Nanortalik to Holsteinsborg (Fig. 2) but due to an engine break down on the major research vessel only the coastal area from Nanortalik to Godthåb (60-64 Northern latitude) was properly covered. Sporadic net setting was made later at Sukkertoppen (Div. 1C), Holsteinsborg (Div. 1B), Godhavn and Umanaq (Div. 1A).

The spatial distribution was examined by fishing stations along the coast. On each station gill nets were set at a minimum of two different depths. Based on the pilot study these were at the start chosen at 10 and 25 m depth. Later, in view of the accumulating data, the standard depths were changed to 5-10 and 15-20 m respectively.

Most work was done from R V Misiliisoq (60 GRT, 4 crew members) covering the area from 60 to 63 N lat. The Godthåb area (around 64 N. lat.) was covered by 2-3 biologists with an inflatable rubber boat. Sampling periods and effort are shown in Table 1.

It was not possible to distinguish cod and Greenland cod below 20 cm from each other and 208 small gadoids were therefore taken for later electrophoretic analyses. These analyses, carried out by V. Simonsen at the University of Aarhus, showed that 98 % of the small gadoids were cod. In the analysis all gadoid smaller than 20 cm were assumed to be cod.

3. Results

3.1. Length and age of fish

During the survey a total of 1078 cod were caught. Of these 92% were below 40 cm. (Fig 3). Two modes in the length frequencies are seen : around 15 and 20 cm. respectively.

The two modes in the length distribution might be caused by gill net selectivity, as the two size groups are caught mainly by the two smallest meshes in the nets. A face value Petersen type interpretation of the length frequencies might thus be misleading.

The smaller group was caught in all areas except at the northern locality of Umanaq. In contrast the distribution of the second group was very restricted as it was almost exclusively found within the Godthåb Fjord system.

An age length key is given in Table 2. Data from the Godthåb area are not included in this table as the otoliths from this area were very difficult to read. With the limited distribution pattern of the 20-22 cm group this causes some interpretation problems. However, from the age-length key it seems justifiable to assume that these cod are belonging to the two year age group.

In the following analysis a quite pragmatic age-length relationship has been used, giving all cod between 13-18 cm an age of 1 year and cod between 19-25 cm an age of 2 year.

3.2. Diurnal variation in catchrates of small cod

Fishing on some stations was repeated to cover both night and day (night sets being defined as fishing after 12 pm). These stations were selected on the basis that the one year old cod should occur on the locality. Catch data of one year olds on these stations are given in Table 3. A two-way ANOVA was carried out (Table 4). The day/night effect was not statistically significant ($P = 0.74$), whereas the station effect was highly significant ($P < .001$).

The limited data on the catchrates of the two years old do not justify any formal testing but they do indicate that this group is also caught by the same rate day and night (Table 5).

In Greenland the length of the night is very short during summer and therefore the night sets were all fishing more in daylight than in actual darkness. The results do therefore not indicate that there is no diurnal behavioural cycle but merely that the time of fishing does not introduce much variation into the catch rates figures. Therefore, day and night sets are pooled in the following analysis.

3.3. Depth distribution

In the three southern areas, where most work took place, almost all one year old cod were caught within the upper 10m (Table 6). The high catchrates for floating nets in the Julianehåb Bugt area are probably artifacts caused by a wrong rigging of the floating nets at the beginning of the survey. After attaching more floats no cod was caught in floating nets. Thus it seems as if the one year old cod found inshore during the summer in 1985 was almost restricted to the bottom zone between 0 and 10 m.

Catch rates in the three northern areas are based on very limited effort and should hence not be interpreted too hard. However, there are signs of a somewhat different distribution pattern with more one year olds occurring deeper.

All two year old cod from the Godthåb Fjord area were caught at 0-10 m's depth. The effort inside the Godthåb Fjord system was evenly distributed between 0 - 10m and deeper waters indicating the same distribution pattern as for the one year old group.

3.4. Geographical distribution

As earlier stated the one year group was found from the Julianehåb Bugt to Godhavn on Disko Island, i.e. from Div 1F to 1A. However, as data from areas north of Godthåb are scarce, analysis on relative abundance is restricted to the areas Julianehåb Bugt, Frederikshåb/Fiskenæs and Godthåb.

Mean catch rates (upper 10m only) for these areas were 1.19, 1.23 and 0.68 cod per hour, respectively. A formal test of differences in means is somewhat difficult as the distribution is very skew (Fig. 5). Thus an addition or a removal of a single large catch will dramatically change the mean (eg. if removing the highest catch in Julianehåb and Frederikshåb/Fiskenæsset the 3 means are very much alike). On this ground it seems reasonable to assume a relatively uniform geographical distribution of one year cod from Nanortalik to Godthåb in 1985.

The distribution of 2 year old cod was much more restricted, as it was found almost exclusively within the Godthåb Fjord system (Fig. 6). It seems quite reasonable to assume that this year class is literally missing from the southern area, whereas its abundance more northerly is more difficult to judge due to the restricted effort there. Spawning is known to occur within the Godthåb Fjord system (Hansen, 1949) and the restricted distribution pattern could therefore also be interpreted as an indication of a local spawning population.

4.0. Discussion

The use of gill nets gives some advantages as compared to trawling. Most important, fishing can be done on all depths and on very rough bottom. A practical advantage is moreover that it can be used from literally all sizes and kinds of vessels. Possible drawbacks are that the selection process is quite complicated (Hamley, 1975) and that it is difficult to relate catch to some measure of area fished. During the continuation of the program in 1986 some work on the selection is planned, and settings on the offshore banks will also be tried.

The restricted vertical distribution of the small cod in coastal areas, i.e. between 0 and 10m, is somewhat surprising. It is unfortunately difficult to relate this distribution to findings in other areas as most young fish work are usually made by trawling.

During November/December 1985 large numbers of one year old cod were found offshore all along West Greenland by a trawl survey carried out by the Federal Republic of Germany (Anon., 1986). Whether these fish belong to an offshore population or whether they have migrated out of the coastal area during autumn is not known. However, it is interesting to note that the 1984 year class in both surveys were distributed over a wide area and that the 1983 year class, which in our survey had a coastal distribution almost restricted to the Godthåb Fjord, was nearly lacking in the trawl survey catches. This could be interpreted as a common origin of the inshore and offshore populations e.g. that both stock components derives from the same spawning population.

5. References

Anon., 1986: Report of the Working Group on Cod Stocks off East Greenland. ICES C.M. 1986/Assens: 11. (Mimeo).

Cornus, H. P., J. Messtorff, A. Schumacher, H. Hovgård Hansen, Sv. Aa. Horsted, T. Møller Jensen and K. M. Lehmann, 1985. Status of the West Greenland Cod Stock and Management Considerations. NAFO SCR Doc. 85/63 (MIMEO).

Hamley, J. M. 1975: Review of Gillnet selectivity. J. Fish. Res. Board Can. 32: 1943 - 1969.

Hansen, H. H. and E. Buch, 1986: Prediction of Year-class Strength of Atlantic Cod off West Greenland. NAFO Sci. Con. Stud. 10 (In press).

Hansen, P. H., 1949 : Studies on the biology of the cod in Greenland Waters. Rapp et Proc.-Verb. Vol. CXXIII : 1-85.

Sissenwine, M. P. 1984: Why do fish populations vary? In: Exploitation of Marine Communities (ed. R. M. May), Springer Verlag 1984.

Table 3 : Catch, effort and CPUE for day and night replications.
Only 1-year age group.

Area	Depth (m)	Date	Period	Catch (nos.)	Effort (hours)	CPUE (nos/Hour)
Juliane- håb Bugt	5	13/7	Day	90	7.83	12.28
	5	13/7	Night	111	12.00	9.25
	9	13/7	Day	0	8.33	0
	9	13/7	Night	5	11.66	0.42
	7	16/7	Day	17	8.33	1.93
	5	16/7	Night	39	11.17	3.49
Frederikshåb/ Fiskenæsset	3	21/7	Day	7	14.66	0.48
	5	20/7	Night	8	8.00	1.00
Godthåb	2	7/8	Day	18	4.75	3.79
	5	7/8	Night	22	10.08	2.18
	4	11/8	Day	1	8.33	0.12
	4	11/8	Night	6	13.25	0.45
Holsteinsborg	6	18/8	Day	3	5.00	0.60
	6	18/8	Night	7	14.00	0.50

£ Data from pilot study in 1984.

Table 4 : ANOVA of day/night difference in catch rates.

Model : $CPUE = \mu_y + A_j + B_j + \text{error}$
where A_j = station and B_j = day/night

Effect	SS	Df.	Ms	F	P
Station	158.6	6	26.4	31.43	0.0003
Day/night	0.1	1	0.105	0.13	0.7351
Error	5.0	6	0.841		
Total	163.7	13			

Table 5 : Catch of 2-year old cod inside Godthåb Fjord. Only data from 0 - 10m as no cod were caught below 10m.

Period	No. of sets	Catch	Total effort (hours)	CPUE
Day	8	20	41.25	0.48
Night	7	41	97.33	0.42

Table 6 : Catch pr hour of one year cod by area and depth.

Area	Juliane- håb	Frederikshåb /Fiskenæsset	Godthåb	Sukkertoppen	Holsteins- borg	Godhavn Umanaq
CPUE						
Surface	1.24	0	-	-	-	-
<5m	3.84	0.52	0.70	0	0	0
5-10m	0.41	1.21	0.37	0.03	0.34	0
10-15m	0	0.06	0.02	-	-	0
15-20m	0	0.27	0.05	0.15	0.09	0.02
20-30m	0	0	0.02	0.72	2.47	-
>30m	0	0	0	-	-	-

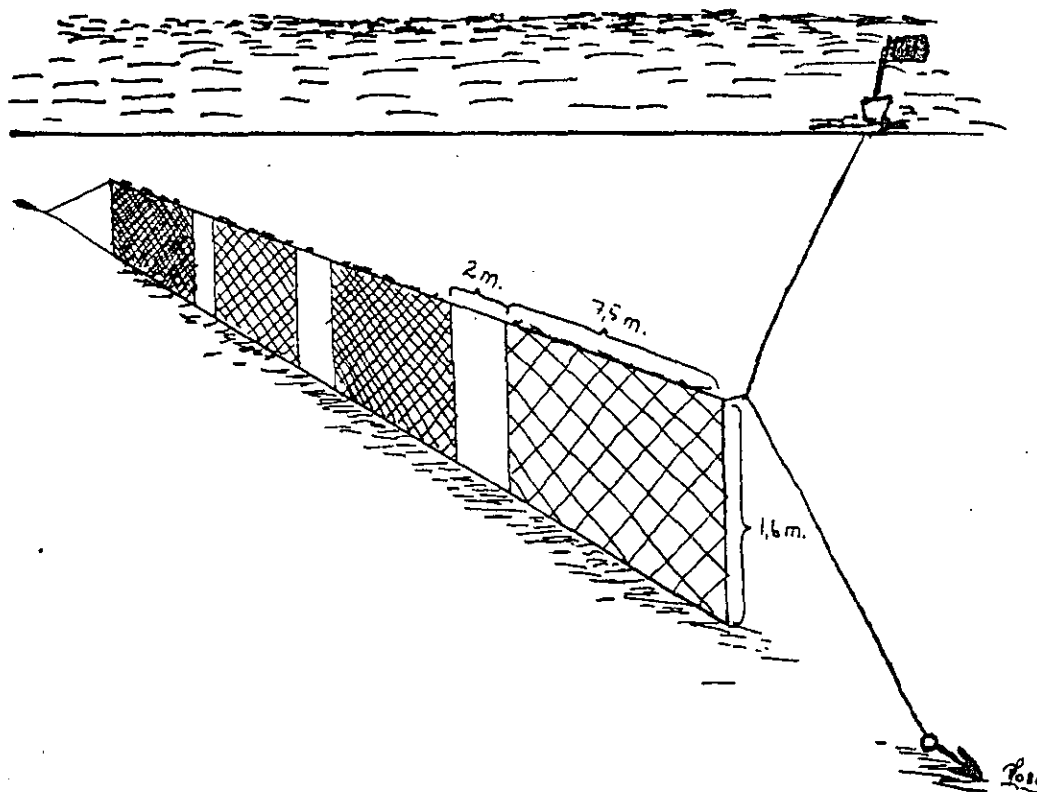
- indicates no fishery

Fig 1 : Design and specifications of the gill nets.

The nets consists of four sections of monofil net with different mesh sizes (c.f. table below). Each section mesures 1.6 x 7.5 m (cf. figure below). The sections are randomly distributed within each net. The nets were rigged either as sinking or floating nets.

During the fishery two nets were always tied together. The CPUE refers therefore to catch per two nets pr hour.

Mesh size				
knot to knot	16.5 mm	24 mm	35 mm	50 mm
Diameter of thread (mm)	0.28	0.38	0.33	0.28



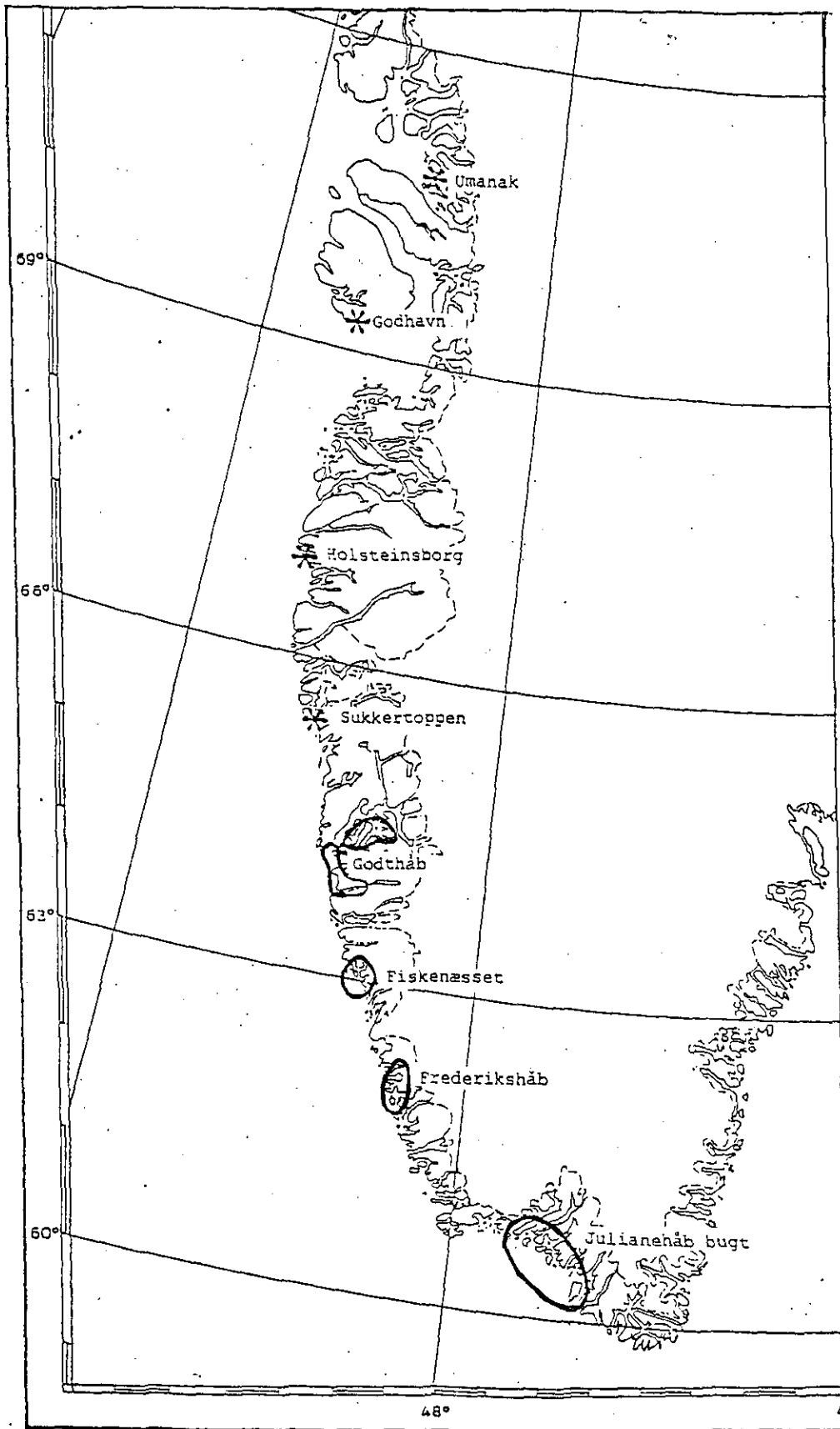


Fig 2 : Map showing the area of investigation. The locations of the sporadic northern settings are indicated by asterixes.

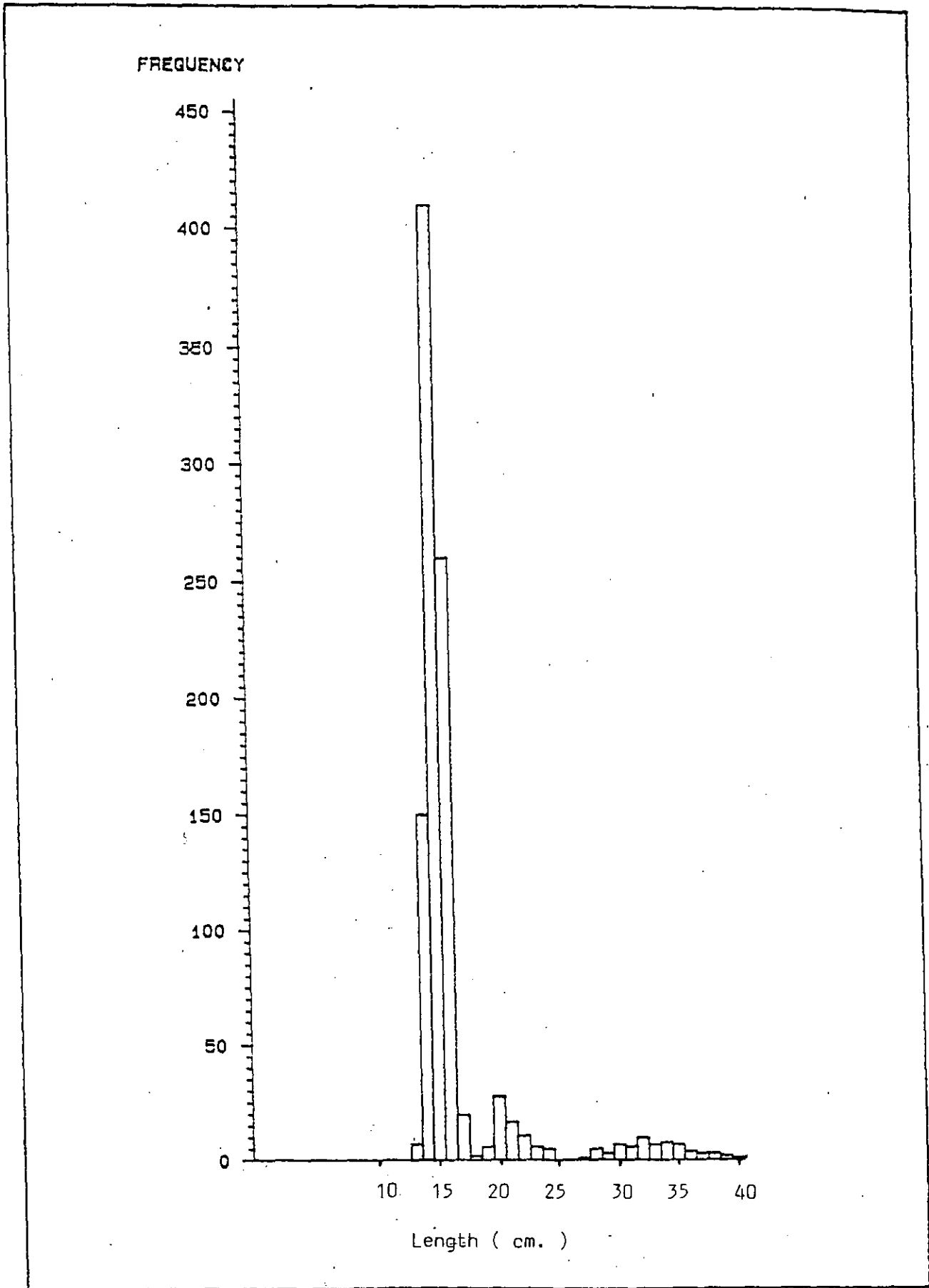
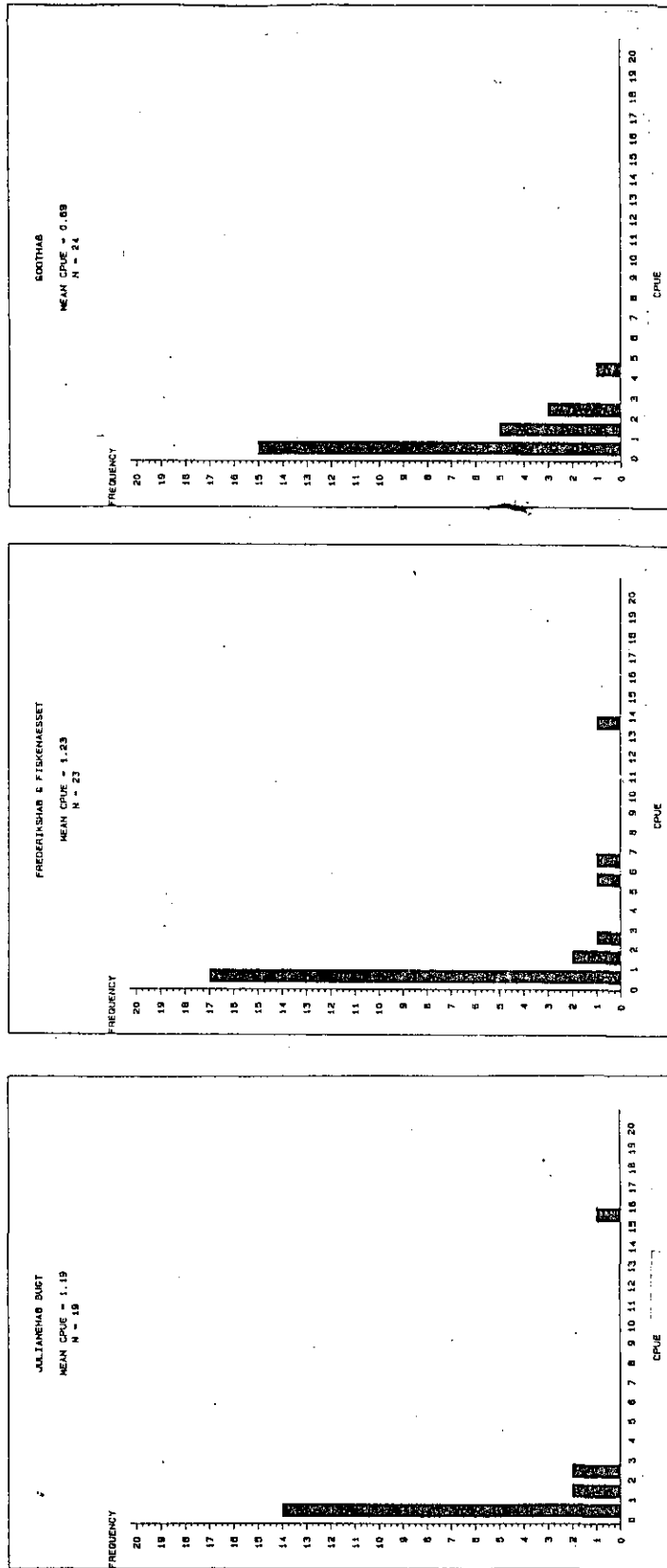


Fig 3 : Length frequencies of catch of cod less than 40 cm.

Fig 4 : CPUE frequency distributions from the upper 10 m zone from the three areas investigated.



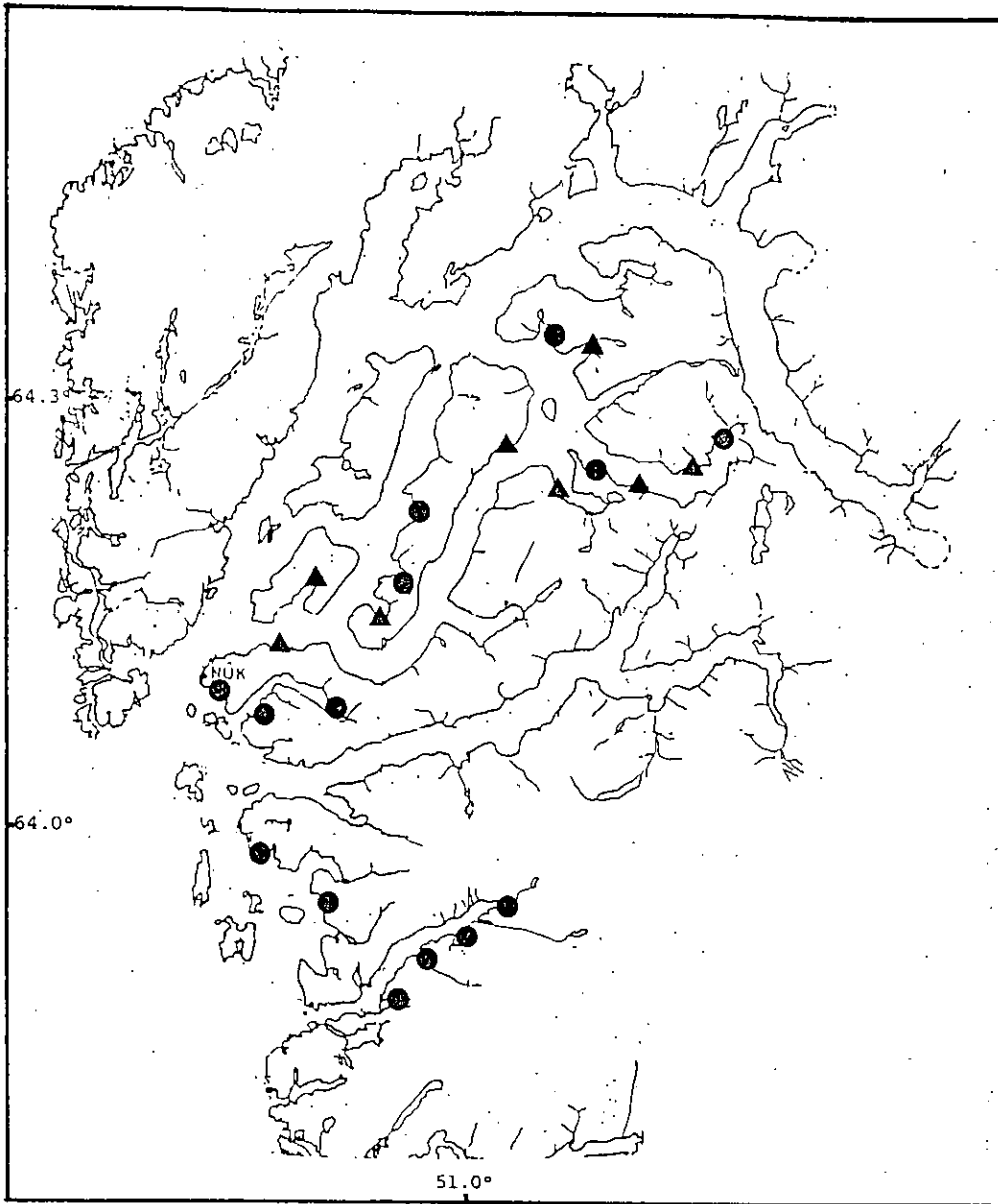


Fig 5 : A close up on the stations in the Godthåb area. Triangles indicates stations where the two year group were caught and circles indicates stations with no catch in that age group.