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Young Cod Distribution and Abundance in West Greenland Inshore Areas, 1986

by

Holger Hovgård

Greenland Fisheries and Environment Research Institute
Tagensvej 135, 2200 Copenhagen N, Denmark

Abstract :

A young cod survey using links of gill nets with different mesh sizes was carried out in three inshore areas in southwestern Greenland during July and August 1986. Highest abundance of young cod were found in shallow and relatively warm water. Catches were dominated by the 1984 year-class. This year-class was abundant in all areas but with significantly higher densities in the northern area. The size of the 1985 year-class was found to be significantly smaller than the 1984 year-class but larger than the very weak 1983 year-class. Estimates of year-class strength correlate well with similar indices from bottom trawl surveys.

1. Introduction

Since 1984 the Greenland Fisheries and Environment Research Institute has conducted young cod investigations in inshore areas in West Greenland by the use of gill nets with different mesh sizes. The purpose of these surveys is to gain information on young cod distribution and abundance with the final aim of developing an index for year-class strength prediction.

The present work sums up the results from the survey in 1986. Some considerations regarding the interpretation of selection patterns of the gill nets is given elsewhere (Hovgård, 1987).

2. Materials and methods

Three working areas were selected in the southern, central and northern parts of the distribution area of the cod. These areas were the fiords around Qaqortoq (NAFO Div. 1F), Nuuk (1D) and Sisimiut (1 B) (fig. 1). An overview of the survey effort within these areas is given in Table 1.

Fishing were carried out with links of gill net containing net sections with 4 different mesh sizes ; 16.5, 24, 33 and 55 mm (knot to knot) arranged in random order (for details regarding the design and operations see Hansen & Lehmann, 1986). Nets were set either floating or at the bottom , depth ranging from 2 to 30 m. Average fishing time were 8.1 hours (range 4.2 to 13.7). Results are expressed as numbers caught per hour. The length of the fish caught was recorded as total length to the cm. below and age was determined by microscopic examination of otolith cross-sections.

During the work in Div. 1B and 1F temperature was recorded at each station by CTD measurements. In the Nuuk area, where the work was carried out by two biologists from a rubber boat this was not possible. However, a few CTD profiles were taken in this area at the end of the survey.

3. Results

3.1 Age and length compositions of the catch.

Total length distribution of the gill net catches is given in Fig 2. The apparent 3-modal distribution does not reflect the length frequency distribution in the population as it is largely caused by the choice of mesh sizes used in the survey (Hovgård, 1987).

Age-length keys for cod in the three areas are given in Table 2. The length of 1-year and 2-year old cod ranges from 9-18 cm and 14-39 cm, respectively. Within both age groups, the smallest cod were recorded in the northern area (Div. 1B). Due to the significant effect of net selection on the length frequencies there is little point in calculating mean size at age from the catches. However, from concurrent research fisheries with other gears the mean size of the 1-group and 2-group can roughly be estimated to be 13 cm. and 27 cm., respectively (Hovgård, 1987).

From length frequency distributions of the 2 years old cod a difference in growth rate between areas might be infered (fig 3). In all three areas the 2 year old cod has a two modal length frequency distribution which is caused by the selection of the nets. However, the proportion of cod in the two peaks differs considerably between the areas. The second mode, consisting of cod from 27 to 39 cm, accounts for 80 % of the 2-year old cod in Div. 1F, 61 % in Div. 1D and only 42 % in Div. 1B. This indicates a gradual decrease in mean size of this year-class from south to north.

3.2 Catch rate dependence on depth and temperature

The 1-year old cod are found primarily within the upper 10 m zone (Table 3). The 2-year group were more scattered as this age group was found in the entire depth range investigated (Tabel 4). In the southern and central area only low amounts of 2-year cod were taken below a depth of 15 m. In the northern area relative high CPUE's were recorded on all depths.

When scrutinizing plots of CPUE vs. temperature it appears that high CPUE-values are associated with relative high temperatures. High catch rates of 2 year old cod was for example only found at temperatures of 4°C and above (Fig 4). The temperature stratifications differ considerably between the areas (Fig 5). In the northern area average temperatures exceeding 4°C were found in the upper 25 m whereas such temperatures were only found within the upper 10 m in the central and southern area. It might therefore be that the depth related difference in distribution is caused by difference in temperature stratifcations between the areas.

3.3 Difference in abundance between areas

The statistical distributions of the CPUE values are positively skewed (dominance of low values) and a Kruskal-Wallis test (a non-parametric equivalent to a one-way ANOVA) was therefore used to test for difference in CPUE's between areas.

For the 1984 year-class the test showed statistical differences between the areas ($P < 0.01$) but with almost no differences between means in the Qaqortoq and Nuuk areas. Due to the marked differences in depth distribution of cod in the areas a test was also performed using only CPUE values for depth strata with high temperatures and high CPUE's (0-15 m in Qaqortoq and Nuuk, 0-25 m in Sisimiut). This test yielded similar results i.e. an overall significant difference among areas, but only marginal difference between Qaqortoq and Nuuk.

The CPUE's for the 1985 year-class also showed statistical differences between areas ($P < 0.01$). However, the difference between the northern and southern area was not significant. The same conclusion is reached when CPUE figures from deeper and cooler water layers are excluded. Some CPUE data, regarding this year-class, are also available from a different gill net link (cf. Hovgård, 1987). Although data from this gear are scarce they generally confirm the above findings (Table 5).

4. Discussion

The relatively restricted vertical distribution of small cod in coastal areas, i.e. with highest catch rates in the uppermost 10 to 20 m, is in line with the findings in the 1984 pilot trials and the 1985 young cod survey (Hansen, 1985; Hansen & Lehmann 1986). However, from research trawlings during the summer period (Nygård & Hovgård, 1987) it is known that cod is simultaneously found in deeper off shore areas in waters with relatively low temperatures (approx. 2°C).

As a rule of thumb cod is not fully recruited to bottom trawl surveys before an age of 3 to 5 years in the North Atlantic area (Palsson, 1984; Hylen et al, 1985; Anom. 1987). It has been shown that this, at least partly, can be caused by a differential gear avoidance for different age groups(Engås & Godø, 1986). Hovever, if a significant amount of small cod is found in very shallow non-trawlable areas, this might also help explaining why trawl surveys underestimate the numbers in the younger age groups.

The present survey shows that the highest abundance of the large 1984 year-class was found in the northern area (Div. 1B) This is in good agreement with the findings from the bottomn trawl surveys carried out by the Federal Republic of Germany during autumn 1985 and 1986, where highest abundance in both years was found in NAFO Div. 1B and 1C (Anon., 1987).

With only two years covered by surveys no reliable year-class predictions can be made. However, some rough estimates of relative year-class strength may be obtained by comparing CPUE values from the two surveys. As the 1985 survey covered only the area between Qaqortoq and Nuuk, only data from division 1D to 1F have been compared. Moreover, as the distribution of effort on depth differed between the two surveys, only CPUE data from depth strata with high abundance of cod were included in the trial. For the 2-year old cod this is the surface settings plus bottom settings down to 15 m and for the 1-year group bottom settings down to 10 m.

Mean CPUE from the two surveys are compared in Table 6. With the relative large number of observations at hand test of difference between means can be made with a t-test disregarding the skew distributions (central-limit theorem). Based on the CPUE for the 1-year old cod it can be concluded that the 1984 year-class is significantly stronger than the 1985 year-class. Likewise from the difference in mean CPUE for the 2-year old cod it can be stated that the 1984 year-class is significantly stronger than the 1983 year class.

By comparing mean CPUE for the 1983 and 1985 year-classes with that of the 1984 year-class a relative strength of the year-classes is obtained. These year-class indices are shown in the text table below where they are compared to similar values derived from the bottom trawl survey conducted by the Federal Republic of Germany (in both cases the 1984 year-class is indexed to 100). The two indices generally show the same trends.

Rough estimates of year-class strength from gill net and bottom trawl surveys.

	Year-class		
Survey	1983	1984	1985
Gill net	2	100	17
Bottom trawl	1	100	28

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Table 1 : Number of gill-net settings per area and depth (hours fished in brackets)

Area	Qeqertoq	Nuuk	Sisimiut
Division	1F	1D	1B
Period	2-8 July	28 July-8 Aug.	16-23 July
Depth			
Surface	10 (86)	-	6 (44)
0- 5 m	12 (107)	9 (67)	15 (120)
5-10 m	15 (127)	14 (97)	15 (122)
10-15 m	19 (158)	18 (128)	20 (164)
15-20 m	8 (73)	2 (22)	3 (20)
20-30 m	8 (60)	-	5 (47)

Surface indicates nets floating - all other settings are at the bottom.

Table 2 : Age-length keys from Qaqortoq (Div. 1F), Nuuk (Div. 1D) and Sisimiut (Div. 1B).

Area	Length	Age 1	2	3	4
Qaqortoq (Div. 1F)	9-11 cm.				
	12-14	8			
	15-17	16	2		
	18-20	1	7		
	21-23		20		
	24-26		19		
	27-29		18		
	30-32		25		
	33-35		25		
	36-38		5	13	
	39-41			6	
Nuuk (Div. 1D)	9-11 cm.				
	12-14	1			
	15-17	1			
	18-20		3		
	21-23		18		
	24-26		18		
	27-29		17		
	30-32		18		
	33-35		18		
	36-38		15	1	
	39-41		1	2	
Sisimiut (Div. 1B)	9-11 cm.	5			
	12-14	8	1		
	15-17	15	11		
	18-20		22		
	21-23		30		
	24-26		30		
	27-29		26	4	
	30-32		27	3	
	33-35		29	3	
	36-38		3	14	4
	39-41			2	

Table 3 : CPUE (number per hour) for cod of the 1985 year-class per area and depth.

Area	Qaqortoq	Nuuk	Sisimiut
Div.	1F	1D	1B
Surface	0.01	-	0.00
0- 5 m	0.69	0.00	0.02
5-10 m	0.09	0.00	0.12
10-15 m	0.03	0.01	0.03
15-20 m	0.00	0.00	0.05
20-30 m	0.07	0.00	0.02

Table 4 : CPUE (number per hour) for cod of the 1984 year-class per area and depth.

Area	Qaqortoq	Nuuk	Sisimiut
Div.	1F	1D	1B
Surface	0.21	-	1.55
0- 5 m	2.13	1.01	1.57
5-10 m	0.81	0.99	2.72
10-15 m	0.60	0.73	2.18
15-20 m	0.12	0.18	6.30
20-30 m	0.33	-	0.87

Table 5 : CPUE of 1-year old cod in links of gill nets used in char investigations (for a description of this gear see Hovgård, 1987). The number of sets is given in brackets.

Area	Qaqortoq	Nuuk	Sisimiut
Div.	1F	1D	1B
Depth			
Surface	0.39 (5)	-	-
0- 5 m	0.21 (2)	0.08 (2)	0.55 (5)
5-10 m	0.44 (2)	0.00 (2)	-
10-15 m	0.24 (4)	0.00 (3)	0.22 (5)

Table 6 : Comparisons between mean CPUE from surveys in 1985 and 1986. Test of difference in means are made by a t-test.

1 year old cod :

Survey	Year-class	Mean CPUE	Variance on CPUE	Effort no of sets	$P(\bar{x}=\bar{y})$
1985	1984	1.09	6.80	66	
					< 0.01
1986	1985	0.18	0.37	50	

2 year old cod :

Survey	Year-class	Mean CPUE	Variance on CPUE	Effort no of sets	$P(\bar{x}=\bar{y})$
1985	1983	0.02	0.01	96	
					< 0.01
1986	1984	0.92	1.88	97	

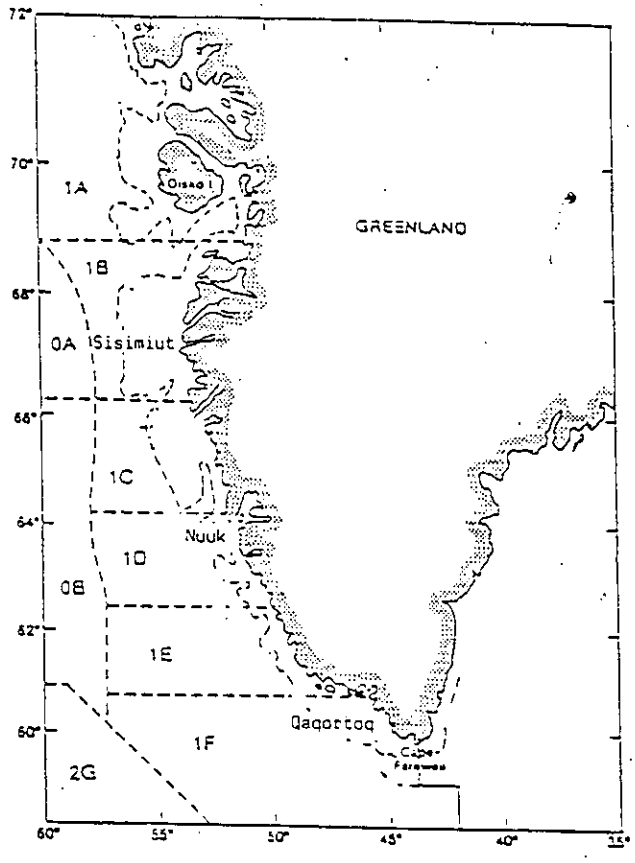

Fig. 1 : Map of southern Greenland showing the areas of Investigations.

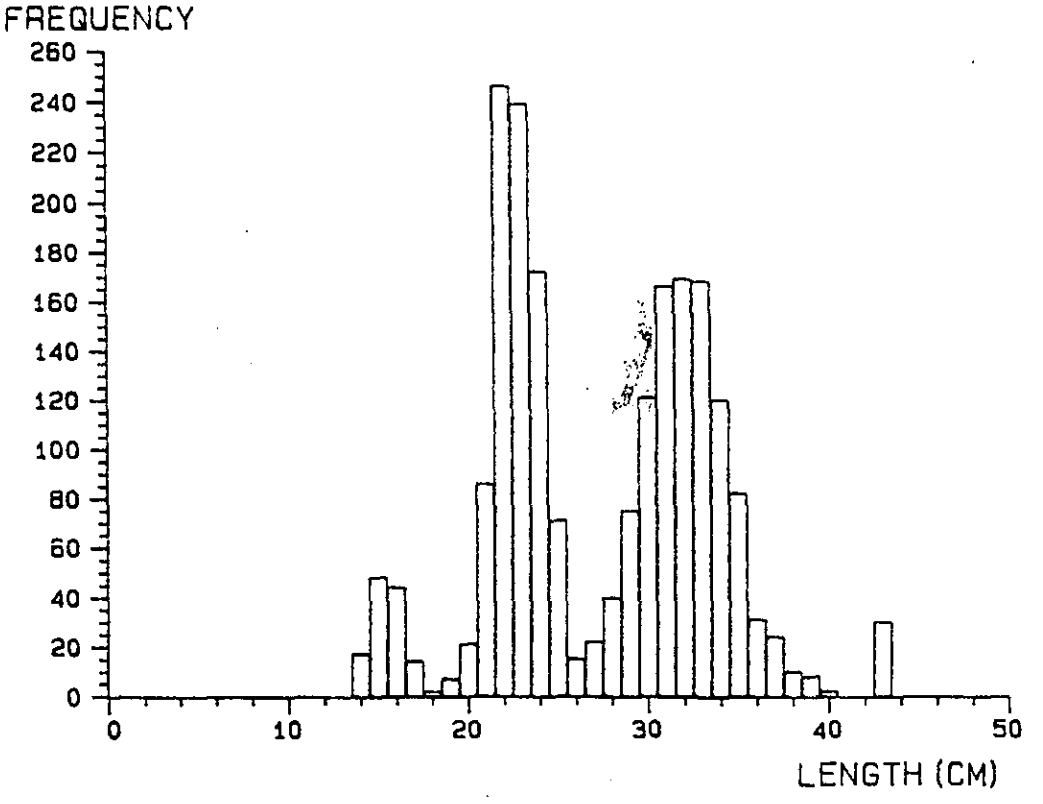

Fig. 2 : Length frequency distribution of cod found in the 1986 gill net survey.

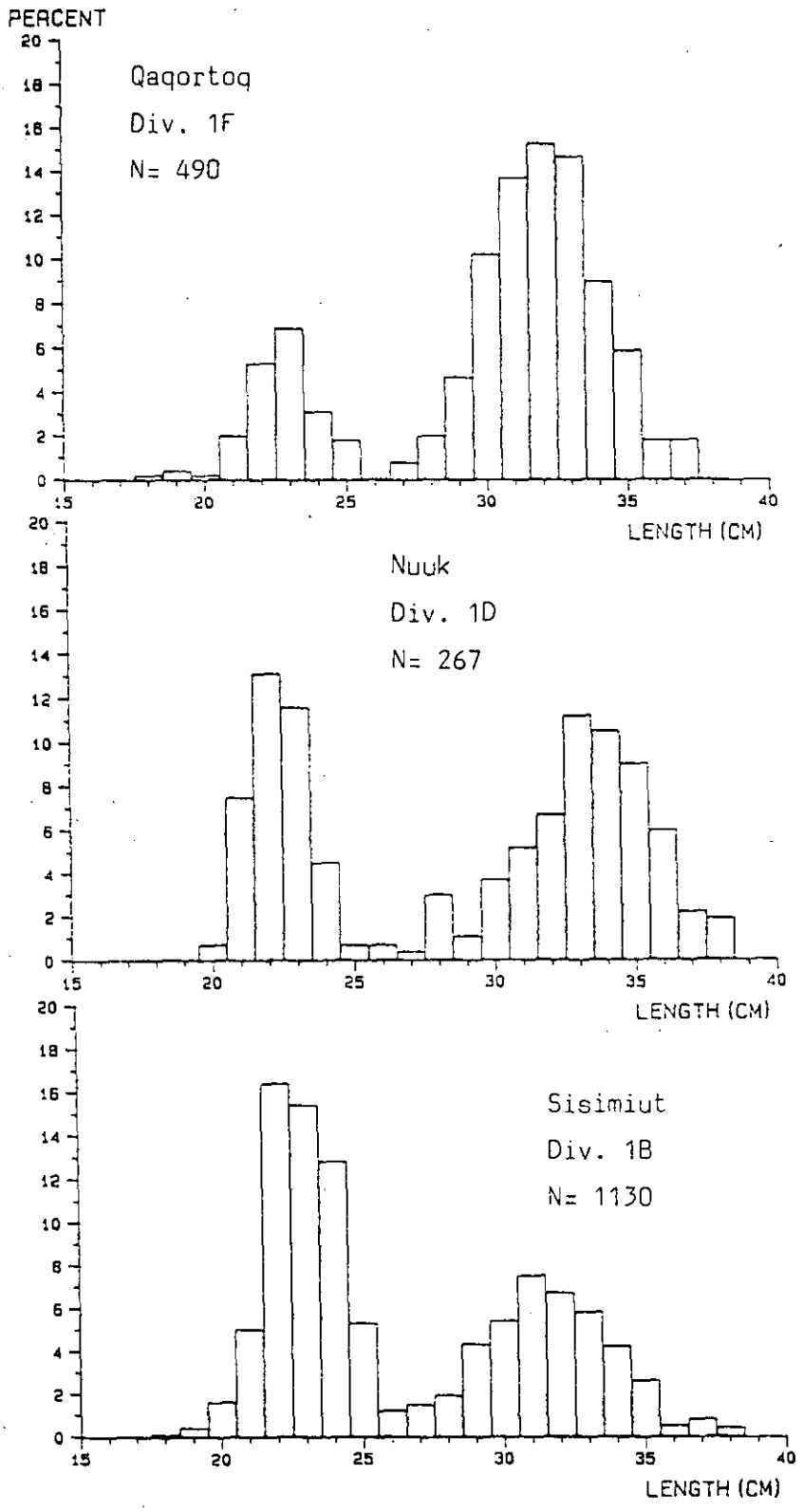

Fig. 3 : Length frequency distribution of cod between 18 and 38 cm. (approx. 2 year old cod), plotted by NAFO Divisions.

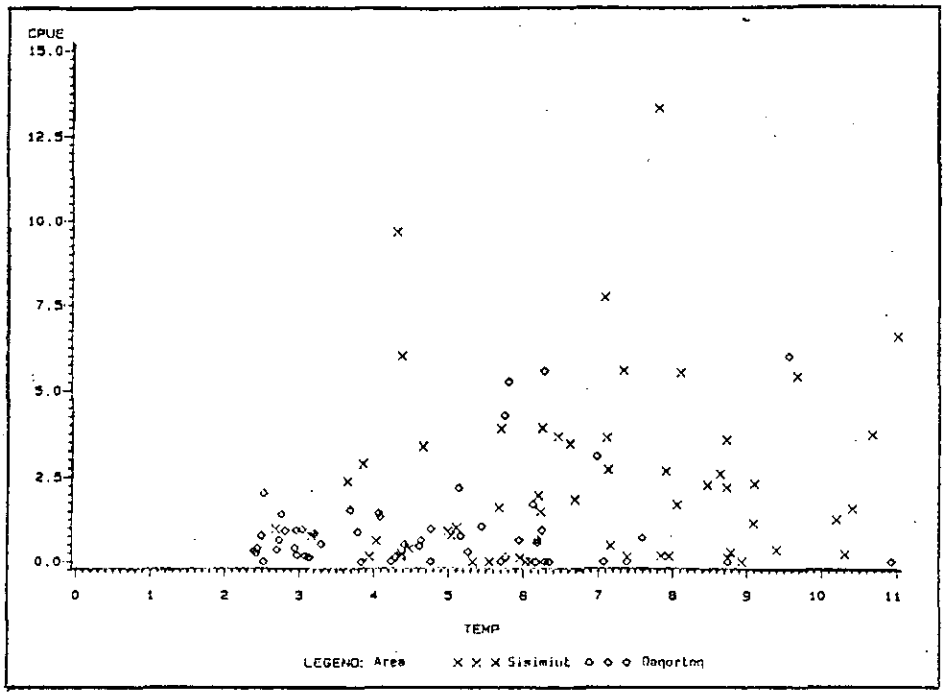

Fig. 4 : CPUE of 2-year cod plotted vs. water temperature

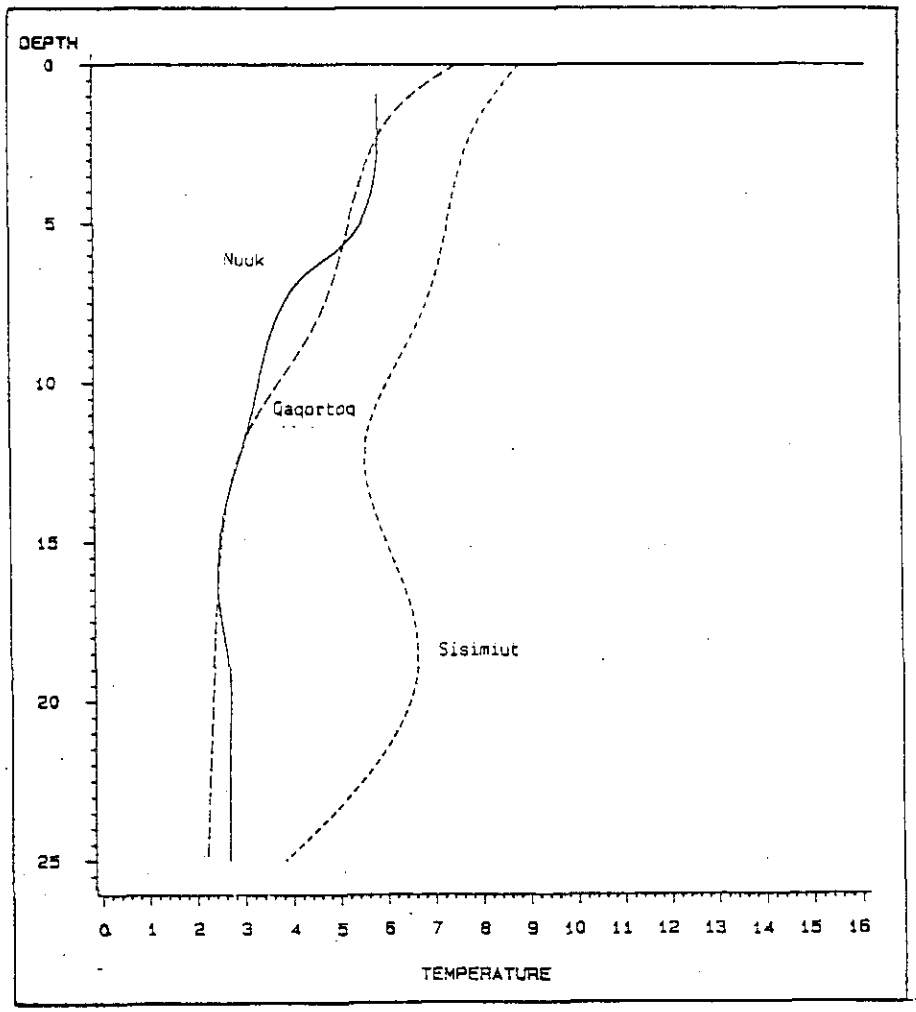

Fig. 5 : Temperature vs. depth in the Qaqortoq, Nuuk and Sisimiut areas, summer, 1986.