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Observations on Polar cod in the Barents Sea

by

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Introduction

The Polar cod (Boreogadus saida Lep.) has a very important place in the food chain in arctic waters, which has been pointed out by several authors the last years. This fish species is only little investigated, and relatively few facts have been published until the papers of Ponomarenko appeared (a.o. 1961, 1963, 1965).

The investigations in this paper are based mainly upon material from cruises of Norwegian research vessels in the Barents Sea and at the west coast of Spitsbergen during 1956-1965. None of the cruises had Polar cod investigations as the main task. All the data are from catches made with bottom-trawl.

Distribution

In the Barents Sea the Polar cod has its geographical distribution all over the area except in the south-eastern part (Fig. 1). Thus it is not found at the Russian coast west of 35°E or along the North Norwegian coast and on the banks off the Norwegian coast.

The bathymetrical distribution is variable. The Polar cod is mainly classified as a pelagic fish, but it is very often found at the bottom. This seems to be the case with several members of the Gadoid-family in the Barents Sea and is probably due to the feeding habits. Olsen (1962) classifies the Polar cod as a semi-pelagic fish.

The Polar cod prefers low temperatures, and its distribution is often associated with ice. As already Thielemann (1922) mentioned, the east-west distribution is related to the temperature variations. The Polar cod will, as a rule, occur mainly in those parts of the Barents Sea which have lowest temperatures, except for the spawning season. Ponomarenko (1961, 1963) found that the Polar cod had its maximum distribution in the eastern and northern parts of the Barents Sea in August/September, and migrated into waters with higher temperatures during the autumn. Therefore, during autumn and winter shoals migrate towards the coasts where the Polar cod may be found in great quantities in the eastern parts of the Barents Sea for spawning during the first months of the year (Andrijashev 1954). The study of the development of the gonads confirms this period for spawning (Ponomarenko 1965), but there seems to exist disagreement among different authors as to whether the main spawning takes place along the coasts or in the open sea.

Outside the spawning season the Polar cod seems to be found mainly at temperatures below zero. In June/July 1913 the data from Thielemann (1922) show that 72% of the catches were made at temperatures below zero (from 0° to -1.74°C) in the south-eastern areas of the Barents Sea. At the west coast of Spitsbergen in 1958 and 1960 45% and 65%, respectively, of the catches were taken at temperatures below zero (from 0° to -1.73°C) during July/August. Only few specimens were taken at temperatures higher than 2°C, but in 1958 nearly 49% of the catches were made between 1.5° and 2°C. As an average 72% of the catches of Polar cod were made at temperatures below zero in 1956-1965 in the central and eastern parts

of the Barents Sea. During autumn of these years sometimes nearly 100% of the catches were made at temperatures below zero (from 0° to -1.1°C), but during winter and early spring most of the catches were made in water between 1° and 2°C. The lowest percentage (appr. 25%) of the catches taken at temperatures below zero are found for December/January. The temperatures in the areas where Polar cod is found during the first months of the year vary from year to year, but do seldom exceed 4°C (Ponomarenko 1963). Olsen (1962) found Polar cod-fry distributed in temperatures of 4° to 7°C, but larger fish always below 3°C. Fig. 2 shows the percentage of Polar cod taken at temperatures below zero in some catches.

#### Size and Growth

Fig. 3 shows the size variations of Polar cod in % in some catches from Spitsbergen 1958-1960 and the Barents Sea 1956-1965 taken with bottom-trawl (the localities are marked in Fig. 1). It seems that a larger percentage of young fish is found at the coasts of Spitsbergen than in the central parts of the Barents Sea, at least outside the spawning season. This indicates a more northerly distribution of young age-groups, as also mentioned by Olsen (1962).

Olsen (1962) found the growth of the Polar cod to be 6-7 cm during the first year of life, and 3-3.5 cm a year from age 2 and older. Fig. 4 indicates the lengths of Polar cod of the different age-groups, based upon readings of otoliths made by the Institute of Marine Research, Bergen, and on material from the Barents Sea 1956-1965 (localities marked in Fig. 1).

The mean lengths of Polar cod from these investigations compared with those of previous authors are as follows:

Age-groups	M e a n l e n g t h s i n c m		
		Olsen (1962)	Klumov (1949)
0	-	4.7	-
I	9.3	-	-
II	14.2	13.8	15.7
III	16.7	16.6	18.9
IV	19.3	19.9	20.0
V	22.1	23.4	21.0
VI	24.3	-	-

From this it will be seen that the growth found from the present material and from the data of Klumov (1949) is somewhat lower than that found by Olsen (1962) from age 2 and older.

#### Maturity

Of 103 specimens from March 1963 and 47 specimens from July 1964 (sizes 7-30 cm), all belonging to the maturity stage 0, d.e. virgin or spents.

The maturity stages in 192 specimens from September/October 1963 and 88 specimens from November 1962 (sizes 8-28 cm), appear from the following Table 1. All catches were made in the central and eastern parts of the Barents Sea. The data correspond quite well with the fixation of the spawning time to the first months of the year, as stated by Ponomarenko (1965).

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Table 1. Comparison of length and stage of maturity

Length in cm	Sept.-Oct. 1960-1963 S t a g e s					November 1962 S t a g e s				
	0	I	II	III	Total	0	I	II	III	Total
8						1				1
9						-				-
10						5	1	1		7
11						6	-	-	3	9
12	5				5	4	1	1	5	11
13	3	2	1		6	2	-	-	8	10
14	-	5	3		8	1	-	-	8	9
15	2	15	2		19	-	-	-	6	6
16	-	20	8		28	-	-	-	4	4
17	-	12	10		22	2	1	1	7	11
18	1	5	21		27			1	1	2
19	1	6	18	1	26			1	1	2
20		4	16	2	22			1	3	4
21		1	11	-	12				3	3
22		2	7	1	10				3	3
23		2	2		4				1	1
24		-	1		1				1	1
25		1	-		1				4	4
26			-		-					
27			-		-					
28			1		1					
Total	12	75	101	4	192	21	3	6	58	88

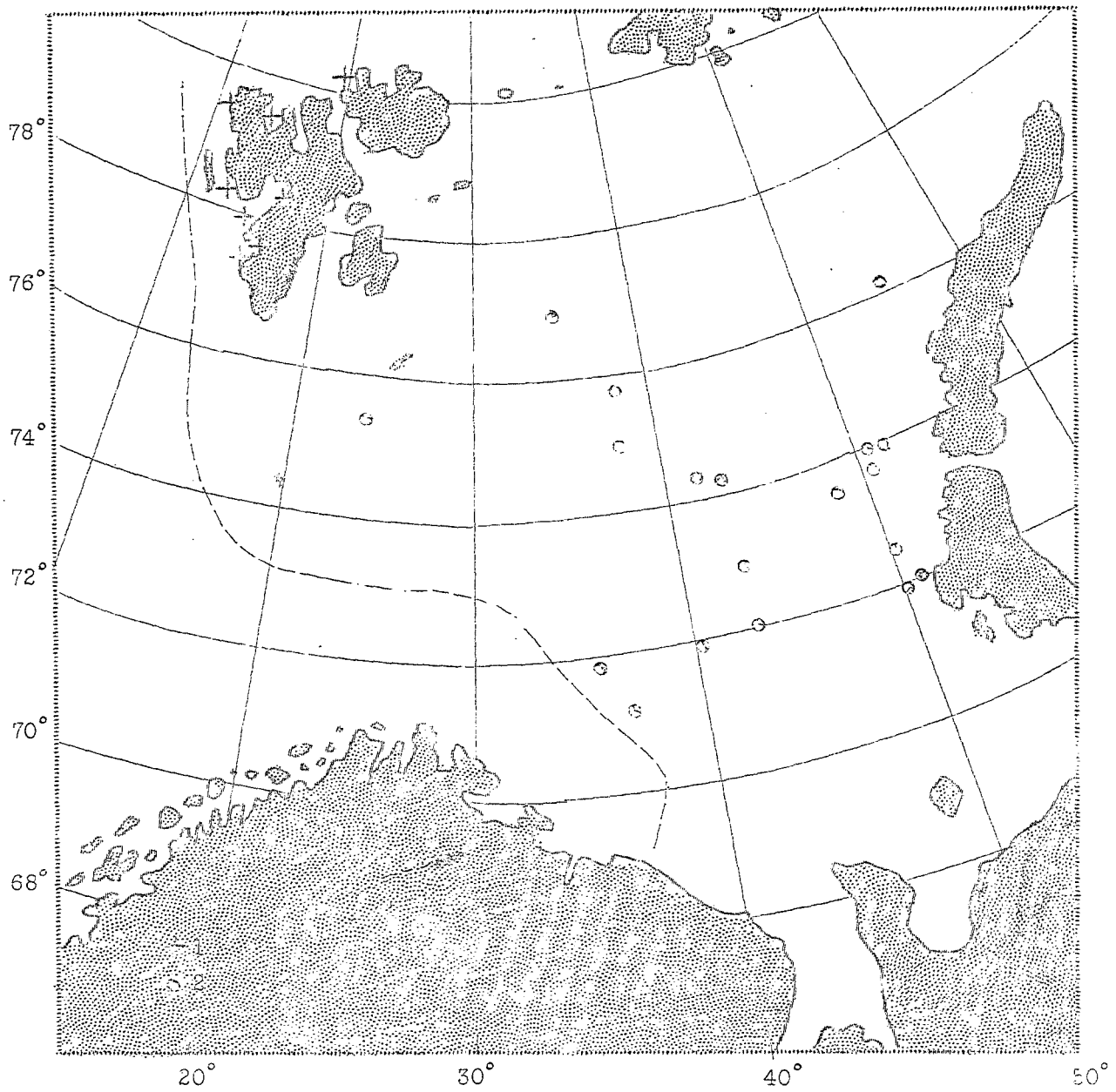
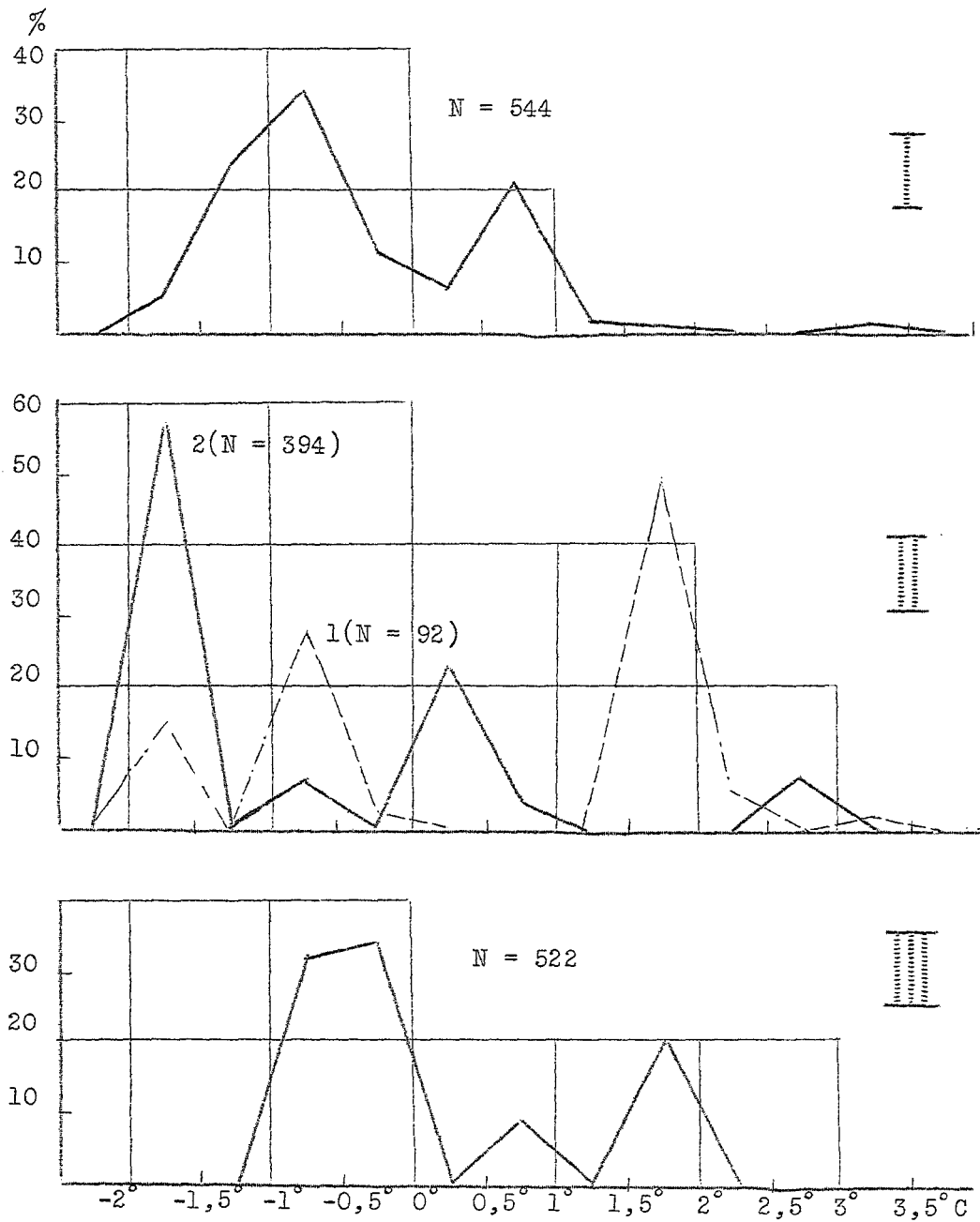


Figure 1. The dotted line indicates the western limit of the distribution of Polar cod in the Barents Sea.  
1: Catch-localities with bottom trawl 1958-1960  
2: Catch-localities with bottom trawl 1956-1965.



**Figure 2.** The distribution of Polar cod in % at the different temperatures in catches by bottom trawl. I: June/July 1913 (Thielemann 1922). II,1: July/August 1958, II,2: July/August 1960 (Hognestad 1961). III: September/November 1956-1965.

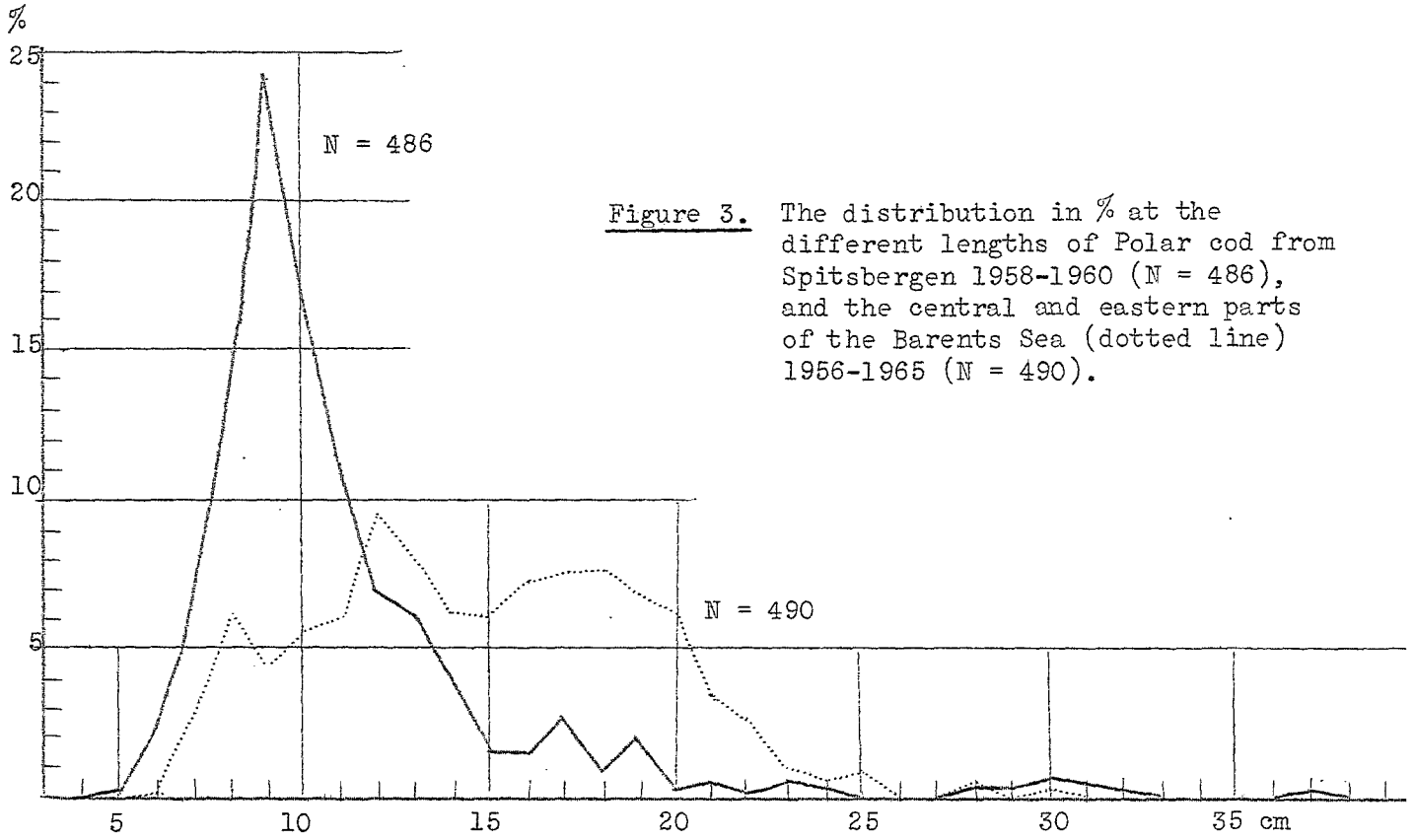


Figure 3. The distribution in % at the different lengths of Polar cod from Spitsbergen 1958-1960 (N = 486), and the central and eastern parts of the Barents Sea (dotted line) 1956-1965 (N = 490).

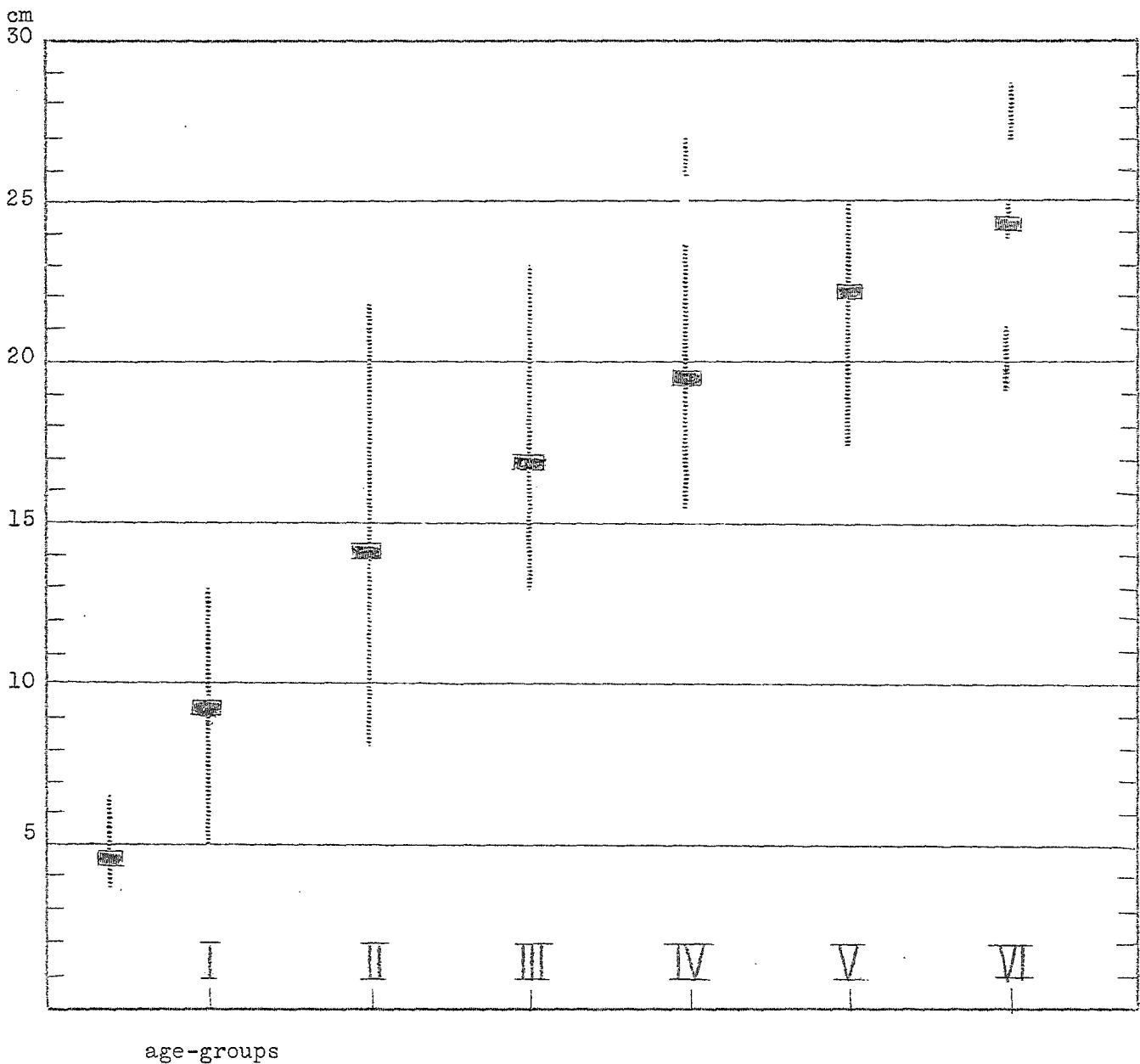


Figure 4. Ranges of lengths (mean lengths indicated by black blocks) of Polar cod at the different age-groups based on material from the central and eastern parts of the Barents Sea 1956-1965.