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Observations on the Haemoglobin Types of Cod in the Atlantic Ocean and the North Sea

by

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The haemoglobin type of approximately 1400 specimens of cod from 14 localities in the Atlantic and the North Sea has been determined. For an account of the technique and the nomenclature reference should be made to paper No. 128 presented to the Gadoid Fish Committee of ICES in 1961.

The results are shown in Table 1. The geographical distribution of the stations appears from Figure 1.

All the stations (1-9) from Iceland and Greenland showed very low (0.01-0.02) frequencies of the HbI^1 allele. These populations must be considered identical with respect to their haemoglobins.

On the American east coast there is an indication of an increase in the frequency of the HbI^1 allele from north to south. This observation is interesting when compared to the results obtained along the Norwegian coast, where the frequency increases from approximately 0.1 at the extreme north to approximately 0.6 at the extreme south (Conf. Paper No. 141, Gadoid Fish Committee, 1962). This parallel trend on the two sides of the Atlantic Ocean should of course be taken into consideration when we are going to speculate about the ecological factors influencing the gene frequencies of cod populations. In this connection it is planned to investigate the oxygen dissociation curves of the cod haemoglobines, with special attention paid to the possible influence of different temperature conditions.

The differences observed in the western Atlantic are certainly much smaller than those we meet with in European waters. The probable cline along the American coast needs confirmation by further sampling. It will be especially interesting to analyse material from near the southern limit of the cod's distribution in this area, i.e., off Maryland and Virginia.

Sample No. 10 from the Faroe Islands shows a frequency of 0.06. The fact that a homozygote HbI-1 individual occurs in this sample, in spite of the low frequency of the corresponding allele suggests heterogeneity. It is conceivable that this sample represents a population with gene frequencies comparable to those observed round Iceland (0.02), together with a slight admixture of fish from the northern North Sea, where the cod is known to possess the HbI^1 allele at a much higher frequency (approx. 0.6). The possibility of a homogeneous population with the inherent frequency of 0.06 is, however, not ruled out by this single sample. It should be noted that the Faroe cod population is easily distinguishable from its neighbours to the west and south-west, i.e., Norway and the northern North Sea, where only samples with much higher frequencies of the HbI^1 allele have been observed.

In the northern and middle North Sea we find frequencies similar to those observed in the Kattegat and the Danish Belt, i.e. approx. 0.6. If differences in haemoglobin gene frequencies do exist within this area, they must be small. On the other hand, one sample (No.14) from the southern North Sea, shows a radically different frequency, namely 1.00. Unfortunately this sample is rather small, comprising only 19 specimens. It must, however, be considered extremely improbable to draw at random 19 HbI-1 homozygotes from a population, where only about 60% of the HbI loci are occupied by the HbI^1 allele. Consequently, we are forced to conclude, that the cod population in the southern North Sea is different from the cod in the middle and northern North Sea, by possessing a significantly higher frequency of the HbI^1 allele. Our samples from the British North Sea coast (stations 11-13) do not at all indicate any tendency of the HbI^1 allele to increase in frequency towards the south. We may be dealing with an abrupt shift from one distinct population to an other, comparable to the situation observed in the Baltic, west of Bornholm. This important problem certainly requires further investigation.

Table 1. The distribution of haemoglobin types observed in samples of cod from the Atlantic Ocean and the North Sea (Stations 1-16 on Figure 1), compared with the distribution expected according to the Hardy-Weinberg law of genotype frequencies.

Haemoglobin type								
Station	Date		HbI-1	HbI-1-2	HbI-2	Other types	Total	Frequency of HbI^1 allele
1	2o-21/3/62	obs.	1	1o	64		75	o.o8
		exp.	o.5	11.o	63.5			
2	2o/7/62	obs.		6	72	2	8o	o.o4
		exp.	o.1	5.8	72.1			
3	25/8/61	obs.		4	84	2	9o	o.o2
		exp.	o.o	3.9	84.o			
4	18/9/61	obs.		1	54		55	o.o1
		exp.	o.o	1.o	54.o			
5	12/9/62	obs.		3	74	2	79	o.o2
		exp.	o.o	2.9	74.o			
6	11/8/61	obs.		1	79		8o	o.o1
		exp.	o.o	1.o	79.o			
7	25/5/62	obs.		3	74	3	8o	o.o2
		exp.	o.o	2.9	74.o			
8	28/7/61	obs.		3	84	3	9o	o.o2
		exp.	o.o	2.9	84.o			
9	3/8/62	obs.		2	66	3	71	o.o1
		exp.	o.o	2.o	66.o			
1o	9/4/61	obs.	1	6	65		72	o.o6
		exp.	o.2	7.6	64.2			
11	18-27/7/62	obs.	21	27	5		53	o.65
		exp.	22.5	24.1	6.5			
12	4/8/62	obs.	26	28	18		72	o.56
		exp.	22.2	35.6	14.2			
13	29/7/62	obs.	29	44	17		9o	o.57
		exp.	28.9	44.2	16.9			
14	december 1961	obs.	19				19	1.oo
		exp.	19.o	o.o	o.o			
15	7/3/62	obs.	1oo	118	33		251	o.63
		exp.	1oo.7	116.6	33.7			
16	1/6-13/8/61	obs.	63	59	19		141	o.66
		exp.	6o.7	63.6	16.7			

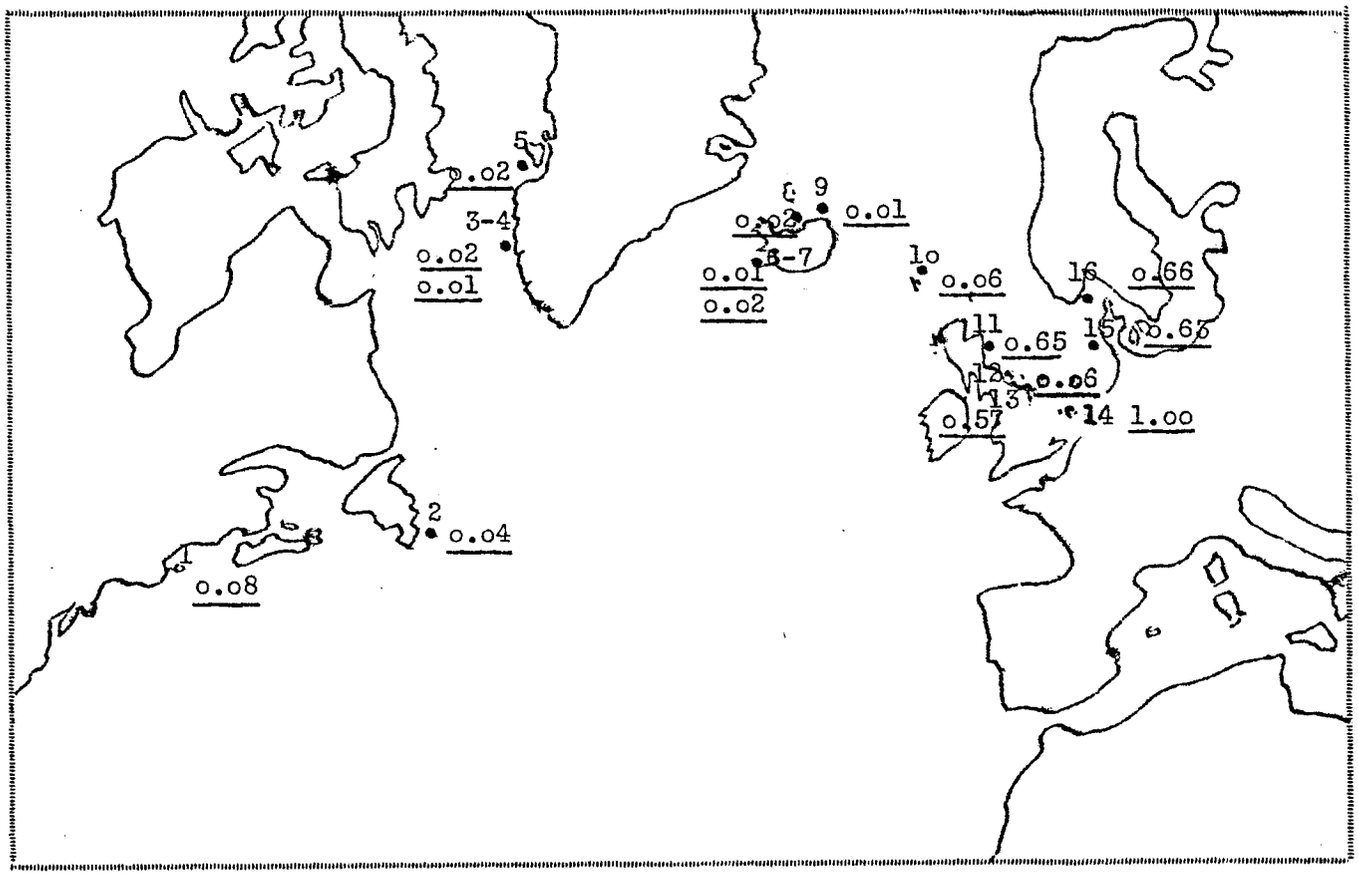
5
0.02
3-4
0.02
0.01
2
0.04
0.08
9
0.01
0.01
0.02
6-7
10
0.06
16
0.66
11
0.65
15
0.63
12
0.06
13
0.57
14
1.00

FIGURE 1