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Age and Growth of Haddock in Subarea 3

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For the study of the age were used scales taken from the body below the lateral line and in front of the second dorsal fin. After cleaning, the scales were placed on a strip of plastic (acetate of celluloid). The strip was then heated to soften the plastic. After the heating, the strip was passed through a roller by which the structure of the scales was "engraved" into the plastic to the effect that the age could be read by means of a projector. The method has the advantage of being quick, clean and sure.

The various subdivisions were sampled separately and later the results were compiled. The locations from where the material arrives are shown in Fig.1, Document No.13.

Subdivision 3N. Fig.1 gives the mean length for each age-group in basic figures and in %. The fish are measured in cms. The % of individuals of each age-group fished is a figure of great importance to the fishing industry, because it makes it possible to follow the fluctuations of the yield of the fisheries through the years. Further, the size, age and sexual stage are given in a tabular form for the separate months.

It should be noted that a small sample of 19 individuals from 3L is included in the material from 3N. This sample was too small to be studied separately, and further these two adjacent subdivisions are fairly closely related hydrographically and biologically.

The theoretical growth has been calculated from the size of the haddock and the width of the zones of the scales, and compared with the actually measured sizes; this latter is termed "real growth".

The theoretical growth is less than the real growth. This seems logical as the real growth is increased by the growth in the months which surpass the completion of full years, whereas the theoretical size is that which the individuals are supposed to reach at the completion of each year.

In the following table are recorded the average theoretical lengths for the three subdivisions separately and taken together.

Length of Fish at End of Each Year

Subdiv.	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}
3P	157	240	351	414.2	479.7	546	629	661.6	659	680
3O	163	245	320	369.1	416.6	481	492	543	592	
3N	154.2	237	315	368.1	415.8	447	516	562.6	588	620
Mean	158.2	240.9	328	381.7	431.4	500	597	634.6	644	660

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The growth curves (Fig.2) for males and for females show that up to the 3rd year the males are the larger but after that year the growth of the females is slightly stronger than that of the males. However, the difference is so small that the growth of the two sexes can be regarded as identical.

Subdivision 3O. 339 specimens were studied from this subdivision (see Fig.3). Also here theoretical growth is below the real growth but with a tendency to equalize after the 6th year.

The growth curves for males and females (Fig.4) are very close to one another (that of the males slightly inferior) during the first 6 years; thereafter they diverge. Much weight should not be attached to this observation as the number of older individuals is only small.

Subdivision 3P. The theoretic growth (Fig.5) is smaller than the real during the first 4 years; thereafter, however, somewhat stronger. This fact was observed by Harold Thompson for the haddock of the Grand Bank. Lozano Cabo has observed the same for the horse-mackerel.

Also in 3P, as in 3N, the males are larger than the females up to the third year, but thereafter slightly smaller (Fig.6).

Compilation of the Results from the 3 Subdivisions.

Of these three subdivisions, 3P shows the largest growth; then comes 3O, and as the last 3N.

In Fig.7 are summarized the growth data for all 3 subdivisions and shows that the theoretic growth is inferior up to the 5th year, thereafter superior to the real growth. Various reasons for this have been offered. As the problem has not been studied more closely in this investigation, no explanation shall be given here.

In Fig.8 are used growth figures presented by Thompson for haddock of the North Sea, Newfoundland and Iceland. Further is shown in the figure the growth for George's Bank and Brown's Bank (1949) as well as those reported in this paper. From the figure it appears that the growth is most rapid in George's and Brown's Bank and slowest in the North Sea.

It is of interest to note that on the Grand Bank of Newfoundland, the difference between sizes at the same age within a period of 15 years is no less than 15-20 cm., with an accentuated parallelism. For the North Sea Andersson has shown a similar difference of 5 cm. between the years 1929 and 1938, and states that the difference is due not to changes in temperature but an over-crowded population and consequent strong competition for food in 1929.

In the present case the difference in growth over the last 15 years might be caused, apart from what may result from differing methods of measuring, by the fact that Thompson's samples include mostly specimens from coastal regions; ours, however, individuals from the Grand Bank proper.

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Year-Classes. All individuals deriving from one and the same spawning period are termed a year-class.

It is useful to study the number or rather the percentage of individuals of each age fished in subsequent years with the aim of investigating fishing and natural mortality and the adjoint problem of over-fishing.

Figures 9, 10 and 11 show a predominance of the 1950 year-class, followed by those of 1951 and 1949. The corresponding ages are 5, 4 and 6 respectively.

Comparison of Various Methods for the Calculation of Age.

For the study of the age of haddock is generally used the scales as the reading of them is easy, although some difficulties may be found for the older individuals of 8-10 years. Needler states that in such individuals misreadings of 2-3 years are common in 10% of the material.

For this reason various parts of the skeleton have been tried for age-readings, first and foremost the otoliths. The reading of the otoliths is more difficult for the haddock than for the cod. A paper from the Biological Station in St. Andrews (N.B.) presents comparative data of age calculated from scales and otoliths of the same individuals, but read by various investigators. The conclusion of these experiments is that the otoliths give a higher age than the scales.

In order to find another means of age determination, we have investigated the skeleton and found that the hypural bone could be used for age-readings. In this bone are marked concentric lines for each year of age. A comparison between hypural bones and scales shows the same numbers of rings in both elements. Readings of age in hypural bones and scales of 52 specimens show 37 or 71% of agreements.

As it was only towards the end of this investigation that the hypural bone was investigated, much attention could not be dedicated to this problem. We have not found any earlier mentioning of this phenomenon for the haddock.

Table showing Correspondence Between Readings of Scales and Hypural Bones

Scales	Hypural bone: 1	2	3	4	5	6
1						
2		2	1			
3			13	4	1	
4				8	2	2
5				3	13	2
6						1

........./4.

This table shows that the hypural bones give higher ages than the scales. Thus both otoliths and hypural bones give ages higher than those from the scales. And here a doubt arises. Is it not possible that the scales are subject to external influences on their growth from a certain age? These influences could be changes in temperature, scarcity of calcareous salts in certain areas or seasons, changes in metabolism (spawning period), etc. On the otoliths and the hypural bone external factors could not work, they being subjected only to internal influences, this causing a closer correspondence between their structure and the age.

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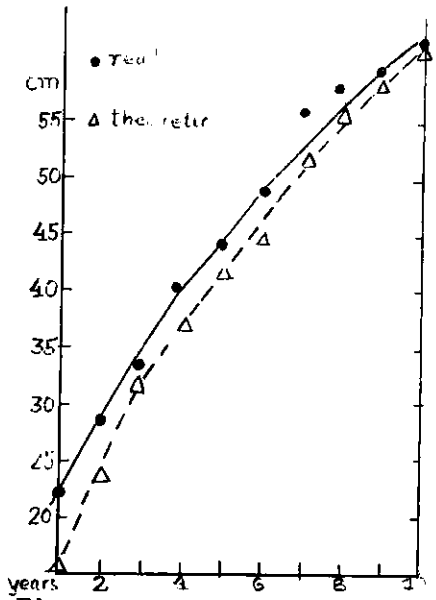

Figure 1. Real and theoretic growth curves. Subdivision 3 N, 732 specimens.

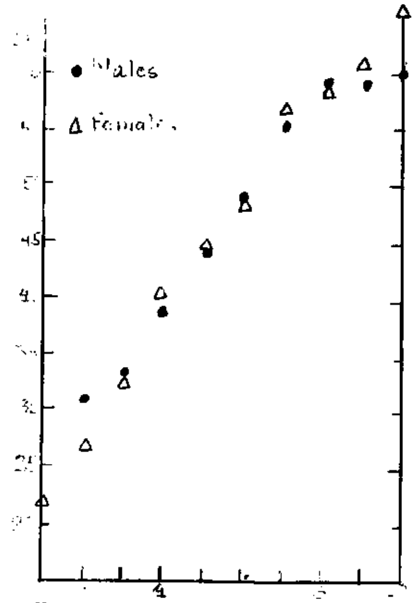

Figure 2. Growth curves for males and females. Subdivision 3 N.

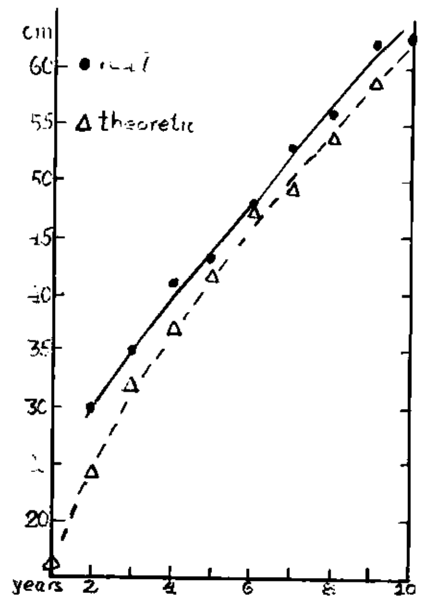

Figure 3. Real and theoretic growth curves. Subdivision 3 0, 339 specimens.

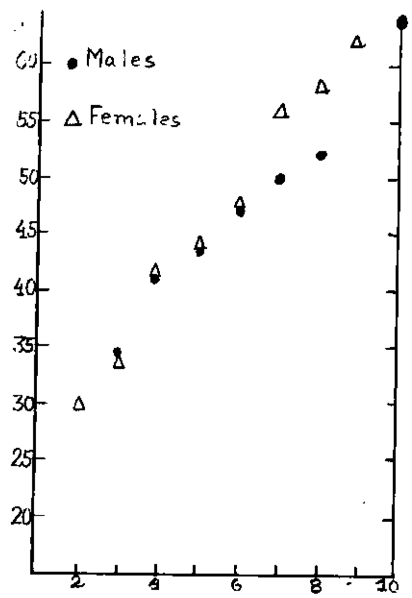

Figure 4. Growth curves for males and females. Subdivision 3 0.

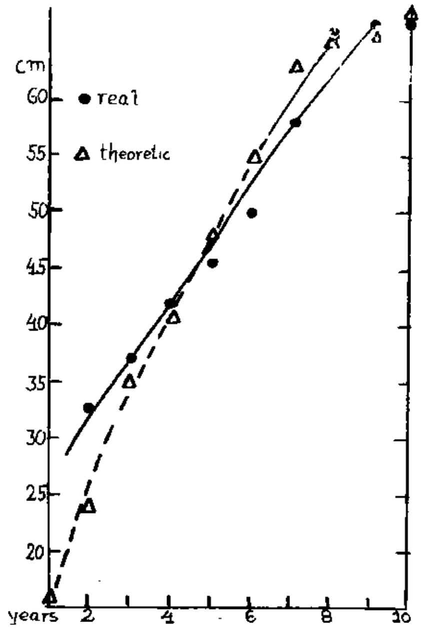

Figure 5. Real and theoretic growth curves. Subdivision 3 P, 174 specimens.

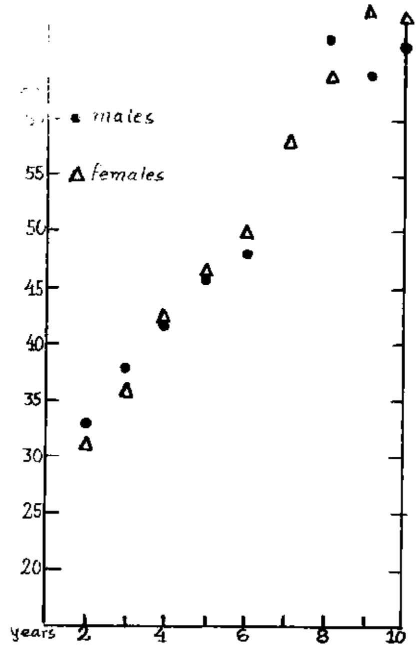

Figure 6. Growth curves for males and females. Subdivision 3 P.

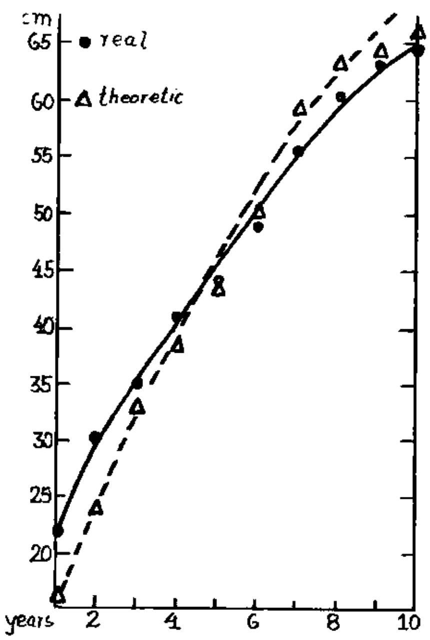

Figure 7. Real and theoretic growth curves. Subdivisions 3 O, 3 P, and 3 N, 1,275 specimens.

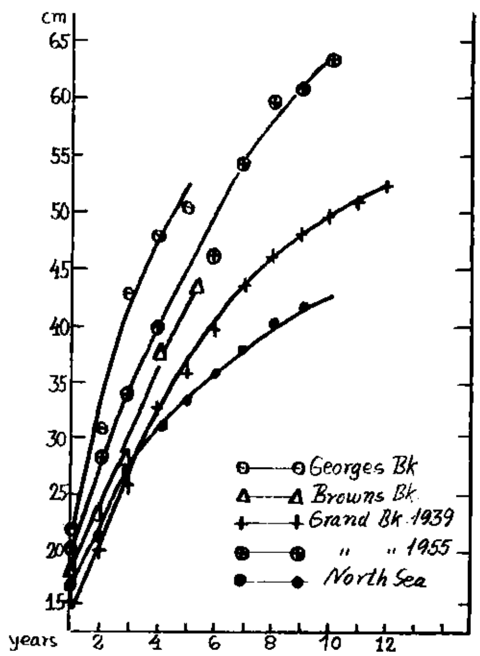

Figure 8. Haddock. Growth curves in various regions.

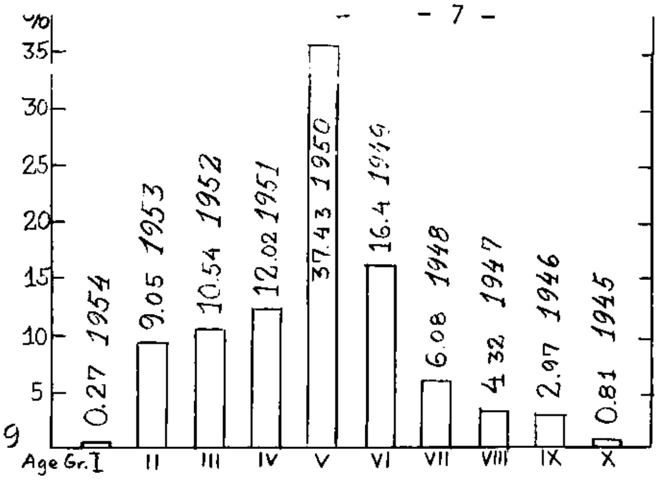

Fig. 9

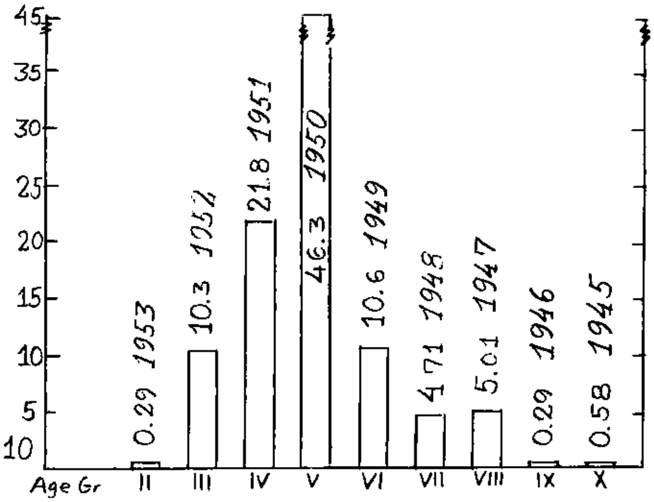

Fig. 10

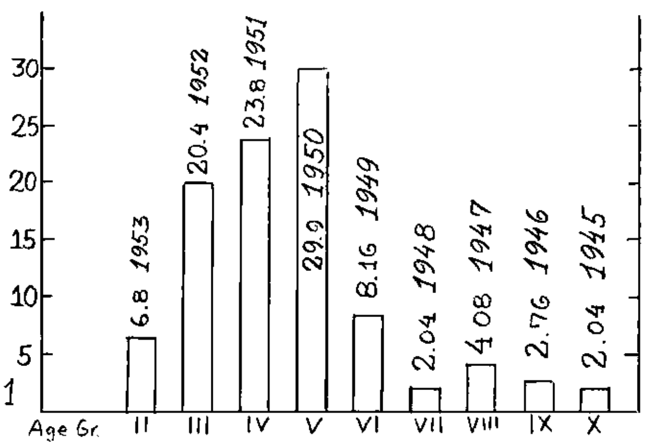

Fig. 11

Figures 9, 10 and 11. Haddock. Age distribution. Figure 9, Subdivision 3 N, summer 1955, 740 specimens. Figure 10, Subdivision 3 O, summer 1955, 399 specimens. Figure 11, Subdivision 3 P, spring 1955, 147 specimens. Frequency % and year-class indicated at the separate columns.

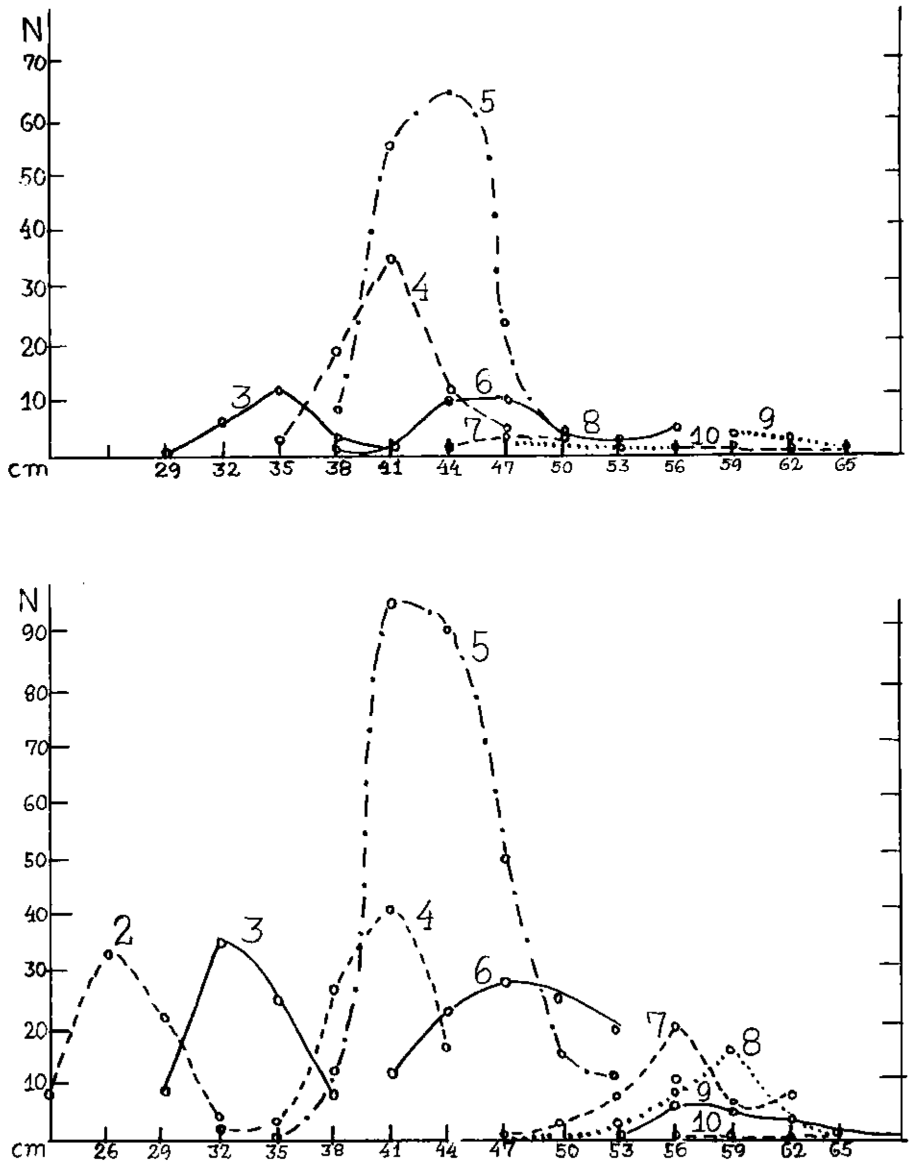

Figure 12. Size-distribution within the various age-groups (2-10). Subdivision 3 O above, 3 N below.