THE DETERMINATION OF AGE IN HALIBUT AND THE AGE DISTRIBUTION OF SPAWNING HALIBUT IN NORTH NORWAY 1956.

By

Steinar Olsen

The main Norwegian fishery for large halibut is the gill net fishery during the spawning season. This fishery was started in the season 1936 - 37, during which the quantity landed was three doubled compared with the previous years, before the invention of the halibut net. To prevent an overfishing and a market collapse, the fishing for halibut by means of gill nets has been prohibited from 15. of December till the end of February.

Last season our institute carried out a fishing experiment by means of gill nets in the closed period to study the relative abundance of halibut throughout the season and to collect age and length material not obtainable from market samples.

Before we start discussing the age distribution revealed by this material, I should like to say some words about the procedure of determining age in halibut. This is in fact a rather difficult task.

We use only otoliths in determining the age of halibut. The method employed is about the same as used by Devold in his work on the North Atlantic Halibut and Net Fishing (1938) [1].

The otolith is broken in two pieces right across the nucleus. The nucleus is easily localised if the otolith is held towards the light. With some experience we usually succeed in obtaining a relatively smooth surface when the otolith is broken. If the growth zones are clear and distinct they are easily counted by transmitted light in the microscope by an enlargment of 15 to 25 X.

In order to remove light reflexes from the uneven broken surface, it can be moisted with a mixture of glycerin and water. In case the surface is too coarse, or the breaking point does not go through the nucleus, the otolith has to be ground down and polished.

[1] DEVOLD, FINN 1938. The North Atlantic Halibut and Net Fishing. Rapp. Norwegian Fishery Marine Invest. Vol.V, No.6.

The halibut otoliths are flat and have an uneven shape. On account of the assymetrical head of this fish, the right and left otoliths are not alike. They are both of about the same length and width. The left otolith (from the white side of the fish) has, however, its greatest thickness at the nucleus which is found in about the centre of the longitudinal axis. The largest transversal section is thus the one going through the nucleus. The right-side otolith (from the dark side of the fish) has an even thickness all over, and the nucleus is found near one end. A cross-section in the centre of the longitudinal axis will in this otolith not go through the nucleus.

The difference between the two otoliths is also shown quite clearly in the inner structure. A cross-section through the nucleus of the right otolith, will show the growth zones on the lateral sides of the nucleus to be so narrow and so densely compressed that they are impossible to trace. In a similar cross-section through the otolith taken from the left (white) side of the head the zones are more easily traced.

Also the zones found in the dorsal and ventral portions of the cross-section are more distinct in the otolith taken from the left side. These differences make the left otolith more suitable for age-determination than the one taken from the right side.

For specimens 6 - 7 years of age or younger it is not neccessary to break the otolith. The growth zones in such young specimens are easily counted by reading the otoliths unbroken in transmitted light. In such young specimens the difference between the right and left otolith is not so great, and both may show the growth zones in satisfactory manner.

In older specimens it is, however, always neccessary to break the otolith. Otherwise one will ordinarily overlook some of the outermost growth-zones. This is particularly true in regard to otoliths of halibut having reached sexual maturity. Apparantly the growth zones formed after a fish has reached sexual maturity, have a somewhat different structure than earlier in life. The opaque zones become more narrow and the hyaline zones become clearer and more sharply defined. Furthermore, there seems to be other differences which are more difficult to define properly. The determination of number of spawning-zones in halibut, in our experience, neccessitates long experience and perhaps also a special talent for such work. It must be admitted

that the determination of spawning zones in our own material in many cases are founded more or less on personal judgement. We are, however, working on the problem of more clear definitions of the special features of the spawning zones in order to avoid the arbitrariness which may occur at present.

It must be emphasized that hitherto no definite proof has been given that the growth-zones in halibut otoliths really are annually. This has been proved for other species of fish. In regard to halibut we can only accept it as probable hypothesis. At the Norwegian Institute of Marine Research we are at present collecting material for an investigation of the correctness of the hypothesis. The material at hand gives several indications of positive nature. It may for instance be mentioned that the hyaline zones in the halibut otoliths apparantly are formed during winter, and that the opaque zones are formed during summer. Furthermore we have found a good correlation between the length and estimated age of the halibut.

The fishing experiment was carried out from 11. of January to 27. of February by means of an ordinary fishing vessel, and the total catch was 1070 halibut. The age material comprises 780 males and 95 females. The samples of males are grouped in four groups according to time, but as concerns the females the low number of specimens does not allow such a grouping. Fig. 1 shows the age distribution in the different catch groups and in the totals of males and of females.

The age distribution shows aproximately the same features in all four catch groups as concerns fish of the age 17 - 18 years and more, but in the first group, that from 11. to 21. of January, the young fish is more or less lacking.

In the age distribution of the whole material of males you may also notice that the 13 year-olds are stronger represented than the neighbouring age groups. On the contrary the 19 year-olds are evidently weaker represented than the neighbouring age groups. This feature is also evident in the different catch groups, and in spite of the low number you also find a remarkable similar age distribution in the females. Here too the maximum frequensis are found in the age groups 18 to 20 years, the 13 year-olds are relatively strong and the 19 year-olds weak represented. The only thing that differs significantly is that the material of females comprise a number of very old specimens with a maximum age of 43 years, while the age distribution stops at about 30 years in the males.

In table I you find the spawning age and the number of first time spawners in the different catch groups and in the whole material. There is no great different in the spawning age of the different catch groups, but there is a remarkable difference in the number of first time spawners. In the first catch group, that from the 11. to the 21. of January, the first time spawners were missing completely, but from then on they were present in steadily increasing numbers.

The length material also includes 114 tagged fish. Most of these were caught during the first week of the experiment. Hence, the first catch group is better represented than in the age material. In fig. 2, which shows the deviation in length from the mean, you see that there is a lack of small fish in the first catch group as compared with the other ones, and this is in good correspondance with the lack of young fish which was observed in the age material.

Fig. 3 shows the length distribution of the whole material of males and of females. The most striking feature is the great difference in length between the sexes, and this explains the very strange sex proportion in the catches. The halibut nets used are of a mesh size of about 21 cm between the knots, and the fish caught by such nets are mainly of a size between 110 and 140 cm. In that way our material is strongly biased as the medium aged males and the youngest females are overrepresented.

However, in spite of these discrepancies, it seems just to conclude from the age distribution observed, that there has not been very great variations in the relative strengths of the year classes of the stock of halibut in this area. Though, the frequensis observed in the 13 and the 19 year-olds shows that such variations may occur in this species of fish too, quite similar to what is well known for instance in cod and herring.

Another thing which may be concluded from this material is that the total mortality of the mature halibut must be rather low. In the present material of males there is an aproximately constant yearly reduction in the year classes from age group 20 to 27 of 28 per cent, and this is in any case a maximum value since the older age groups are underrepresented.

We mentioned that the deduction of spawning zones in the halibut otolith is based more or less on personal judgement.

Concequently, we cannot rely perfectly on these deductions. However, if the deductions of spawning zones are fearly correct, the time distribution of first time spawners explains the lack of young fish during the first time of the experiment, and indicates a later arrival of the first time spawners to the spawning places. It is interesting to notice that this is a habit which is known in other species of long migrating fishes also, for instance cod and herring.

Table I. Age Distribution at first spawning.

Spawning age years	11/1 - 21/1 No.	%	23/1 - 1/2 No.	%	3/2 - 13/2 No.	%	15/2 - 27/2 No.	%	Total males No.	%	Females No.	%
6			1	0.4					1	0.2		
7			2	0.9	1	0.7			3	0.5		
8	2	2.7	4	1.7	3	2.0	3	1.7	12	1.9	2	2.3
9	4	5.5	17	7.4	8	5.4	6	3.5	35	5.6	2	2.3
10	5	6.8	23	10.0	15	10.1	11	6.3	54	8.6	5	5.8
11	9	12.3	34	14.8	18	12.1	11	6.3	72	11.5	3	3.5
12	10	13.7	37	16.1	22	14.8	27	15.5	96	15.3	5	5.8
13	12	16.4	31	13.5	21	14.1	34	19.6	98	15.7	7	8.0
14	10	13.7	33	14.3	19	12.7	26	15.0	88	14.1	16	18.4
15	9	12.3	19	8.3	16	10.7	19	10.9	63	10.1	14	16.1
16	4	5.5	18	7.8	14	9.4	17	9.8	53	8.5	12	13.8
17	6	8.2	8	3.5	9	6.0	11	6.3	34	5.4	7	8.0
18	2	2.7	3	1.3	3	2.0	8	4.6	16	2.6	9	10.3
19							1	0.6	1	0.2	2	2.3
20											3	3.5
N.	73		230		149		174		626		87	
M.	13.07		12.53		12.92		13.48		12.95		14.63	
1st. time spawners	0	-	23	10.0	21	13.4	30	17.2	74	11.9	12	12.6
Indeter-minable	16	18.0	48	17.3	40	21.1	50	22.3	154	19.8	8	8.4

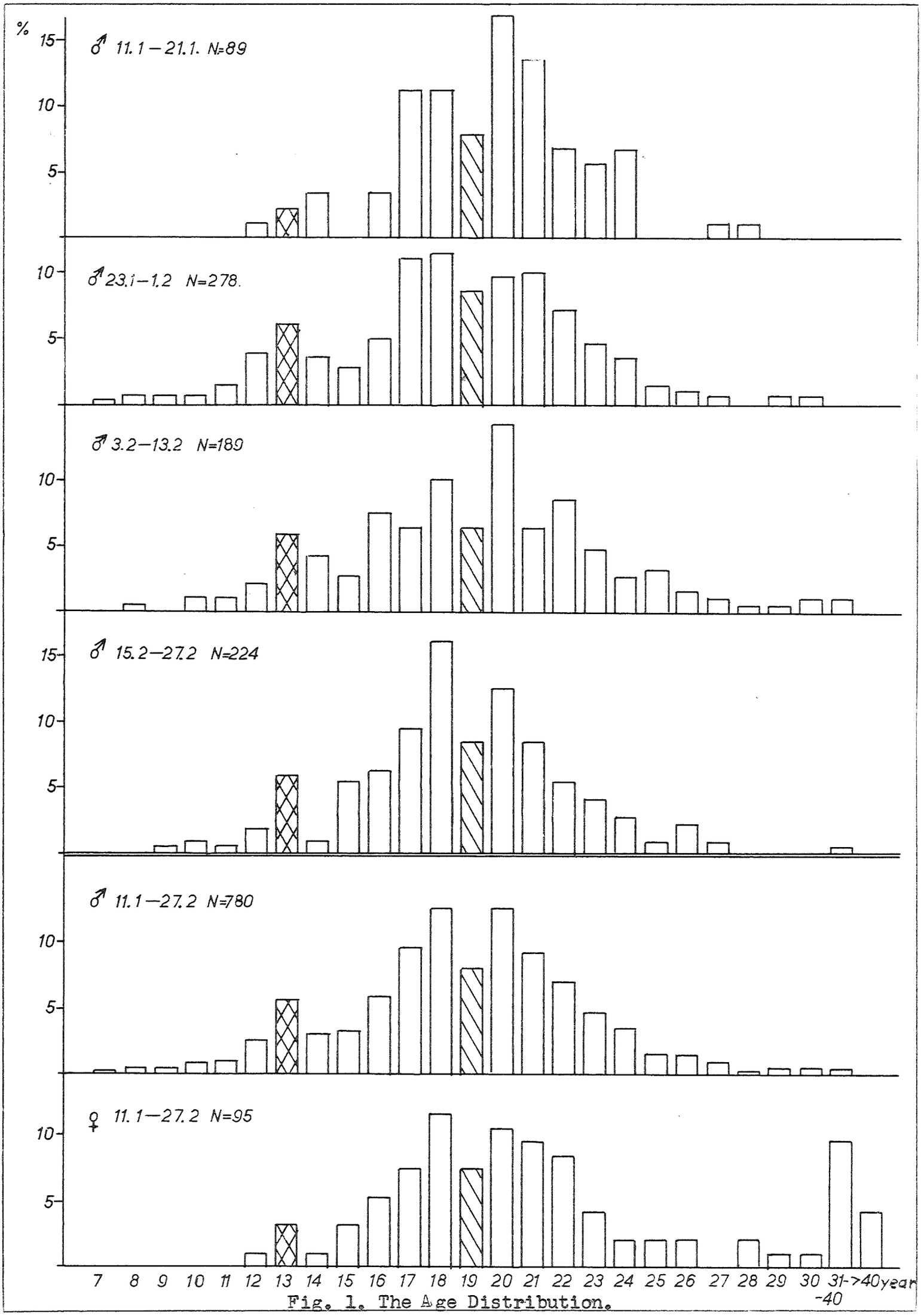

Fig. 1. The Age Distribution.

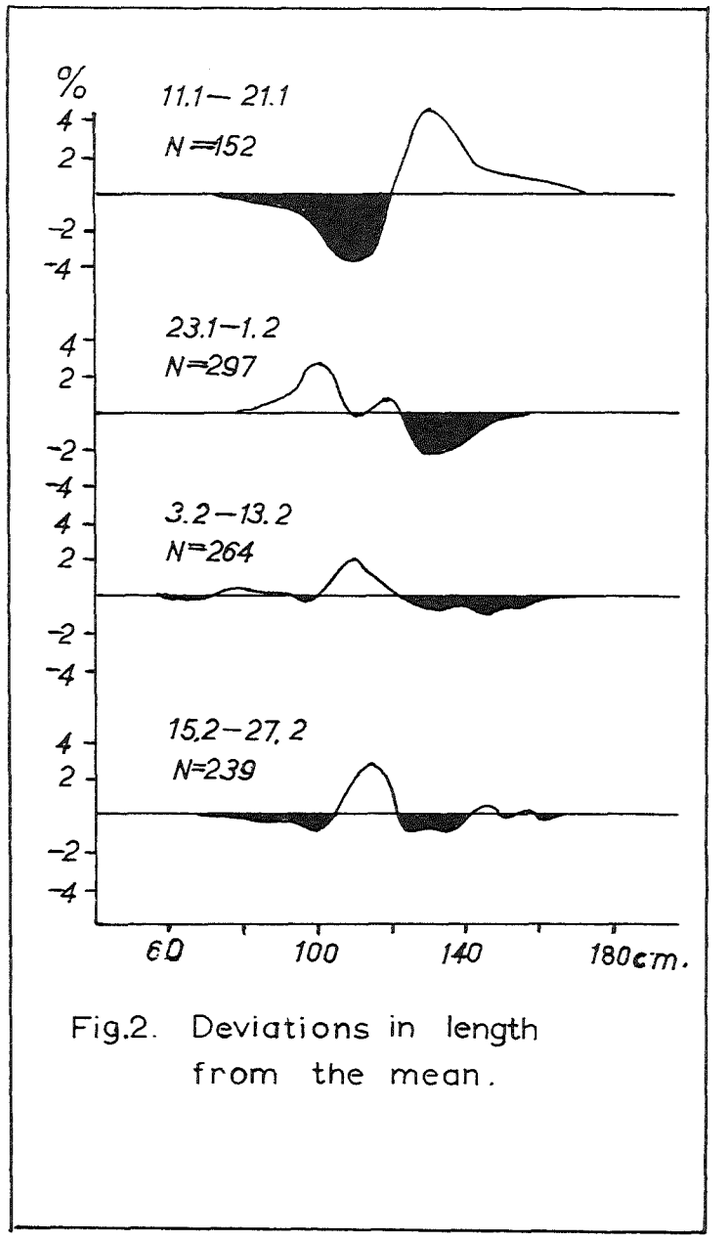

Fig.2. Deviations in length from the mean.

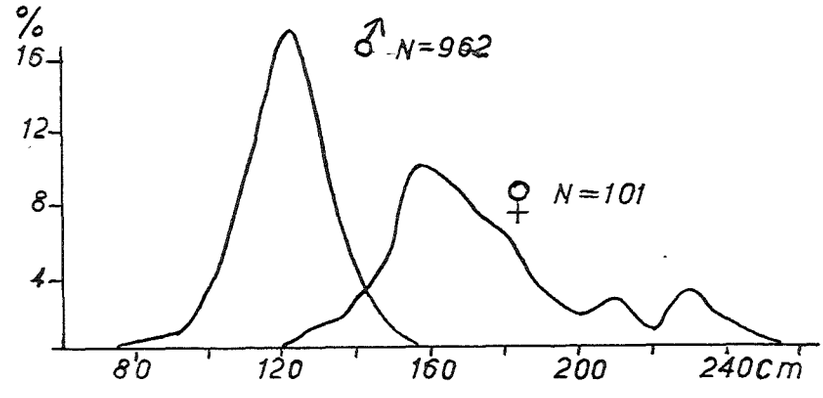

Fig.3. Length frequency distribution in males and in females