

ANNUAL MEETING - JUNE 1965Age and Growth of Cod caught by the Spanish trawler AQUILON in Subareas 2-4  
in 1964\*

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## INTRODUCTION

This paper presents a summary of the results of investigations on cod (Gadus morhua) in the ICNAF Convention Area in 1964, including growth and corresponding mean lengths by age-groups, relative abundance of year-classes in the ICNAF Divisions, age at first maturity and proportion of sexes.

## MATERIAL AND METHODS

Otoliths were collected on board the otter trawler "Aquilon" of the PYSBE Company from February to October 1964 in ICNAF Subareas 2, 3 and 4 (Fig. 1). The method of reading the otoliths is reported in previous papers. The otoliths were cut by hand and examined, without previous clearing, using a binocular microscope with low magnification and lateral light concentrated in a narrow strong band.

Samples were taken in August (579 specimens), September (405), May (264), October (169), June (122), July (109), February (104), March (78) and April (28) (Table 1). Almost all samples from March to October were from Divisions 2J, 3K and 3L. Divisions with the largest number of individuals sampled were: 3L (641 specimens), 2J (596), 3K (267) (Table 1). The total number of individuals sampled was 1793 of which 1565 (87.2%) provided otoliths for satisfactory age readings.

RESULTS

## Subarea 2

Division 2J. Table 1 shows that in this Division 596 specimens were studied of which 84% provided otoliths for satisfactory age readings. There were 41% males. Spawning marks showed on 12% of all individuals. The specimens were taken from March to June and in September and October.

The growth curve for 1964 shows some small differences from the growth curve for the years 1960, 61 and 62 combined (Fig. 2). The 1964 age-length data are 2.8 cm lower in the III age-group, and 4.8, 3.3, 9.0 cm higher in the X, XI and XII age-groups respectively. This is due, in part, to the scanty material for these groups and, in part, to the different growth rates of the year-classes. The values from the IV to IX age-groups in 1964 are fairly representative of the growth in Division 2J for the past years.

Figure 4 shows that the dominant year-class in 1964 was the 1958 one (6 years old). This year-class was also dominant in the Division in the preceding years (1960-62). However, the mean age fluctuated between 7.3 in 1960 to 6.8 in 1964. In 1961 it was 6.7 years and in 1962 7.4 years. The most abundant length-class is the 54-56 cm class (23.8%) (Fig. 4) and the mean length of all the individuals is 59.7 cm as compared with 58.4 cm in 1960, 57.4 cm in 1961 and 58.7 cm in 1962. There seems to be a slight increase in the mean length and mean age.

\*Tables of detailed data on length and age will be included in the ICNAF Sampling Yearbook for 1964.

Subarea 3

Division 3K. Of the 267 individuals studied 84% provided otoliths for satisfactory age readings (Table 1). There were 47% males. Spawning marks showed on 17% of all specimens sampled. The specimens were taken in May, June, August, September and October.

The growth curve for 1964 shows that the mean lengths for the IV to VIII age-groups fall on an almost straight line (Fig. 2). This is also true for the growth curve obtained for data from the years 1961, 1962 and 1964 combined. The values for the IV, V and VI age-groups in 1964 are about 1.5 cm lower than the values for those age-groups in the previous years; the VII, VIII, IX and XII age-classes deviate between 0.2 and 0.6 cm. The greater differences are for the X and XI age-groups (3.1 and 6.5 cm respectively). The growth rate in this Division is higher than in 2J.

Figure 4 shows that the dominant year-class in this Division as in 2J was the 1958 one (6 years old) (33.9%). The mean age in 1964 was 7.1 years; in 1961, 6.9 years and in 1962, 6.8 years. The dominant length was 60-62 cm (16%) and the mean length 61.8 cm, somewhat higher than in 2J. The mean length was practically the same as in 1962 and higher than in 1961 (59.5 cm). In this Division too, there has been a slight increase in the mean length and age.

Division 3L. The greatest number of specimens (641) were taken for study in this Division. Satisfactory age readings were obtained from 89% of the specimens. There were 43% males. Spawning marks were present on 10% of all specimens sampled. The specimens were taken in March and from May to August (Table 1).

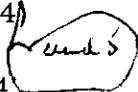
The growth rate is faster than in Divisions 2J and 3K, principally in the IV and over age-groups (Fig. 2). The mean length for the VI age-group in 1964 is 5 cm higher than the mean lengths of the age-groups 1960, 61 and 62 combined. The mean lengths for the VI to IX and XI age-groups are in agreement while those of the IV, V, X and XII age-groups showed positive deviations between 2 cm and 5.8 cm.

Figure 5 shows that the dominant year-class was the 1958 one (6 years old) (29%). The mean age was 6.4 years - higher than that of the preceding years 1960, 61 and 62, when it was about 5.5 years. The most abundant length-class was the 63-65 cm class. The mean length was 65.8 cm, higher than that in Divisions 2J and 3K and in the preceding years (1960 - 61.8 cm, 1961 - 60.2 cm and 1962 - 56.1 cm).

Division 3N. Table 1 shows that the sample consisted of 143 specimens of which 96% provided otoliths for satisfactory age readings. There were 43% males. Spawning marks were present on 6% of all specimens sampled. The captures were made in July and in August. The growth curve for 3N (Fig. 2) crosses the curve for 2J at the IV age-group, for 3K at the V age-group and for 3L at the VIII age-group. The 1964 values are in agreement with the mean growth curve only at the VII age-group. There was a difference of 6.4 cm for the III age-group.

~~Figure 5 shows that~~ the dominant year-class was the 1959 one (5 years old) (32.0%) and the mean age for the sample was 5.2 years. The most abundant length-class in the sample was 51-53 cm, the mean length 58.1 cm. Both the predominant length-class and the mean size are lower than in Divisions 2J, 3K and 3L (Fig. 4)

Subarea 4



Division 4R. The sample was smaller (45 specimens) than those from Divisions 2J, 3K and 3L. Satisfactory age-readings were made from otoliths from 93% of the specimens. There were 44% males. Spawning marks were found

on 11% of all specimens (Table 1). The specimens were taken in February, probably because the climatic conditions did not allow fishing in other areas.

The length distribution was between those of 4Vn and 4Vs (Fig. 5). The dominant year-class was the 1958 one (6 years old) (45%), and the most abundant length (26%) was 54-56 cm (mean length 57.5 cm).

Division 4Vn. Of the 59 specimens sampled, 97% provided satisfactory otoliths for age reading, 63% were males and 15% had spawning marks. The specimens were taken in February (Table 1).

The dominant year-class (44%) was the 1958 one and the mean age 5.9 years (Fig. 5). The length frequency is bimodal: 45-47 cm (25%) and 51-54 cm (26%), with a total mean length of 48.9 cm that is the lowest from all the Divisions studied.

Division 4Vs. From the 42 specimens, 83% provided satisfactory otoliths for age readings (Table 1), 38% were males - the lowest percentage in the present year - and 14.3% had spawning marks. The specimens were taken in March.

Figure 5 shows that the dominant year-class (31%) was the 1959 one (5 years old) but the mean age was 6.2 years because 20% of the cod were 6 years old and 14% were 7 and 8 years old. The most abundant length-group was the 63-65 cm group and the mean length was 65.7 cm. The length distribution is clearly greater than in 4Vn and 4R.

The growth curves of cod from Divisions of Subarea 4 in 1964 are given in Fig. 3 because we have found a great variation in the growth rate. If we compare the growth curves for cod from Divisions 4Vs, 4R and 4Vn with those from 3L, 3K and 2J we find that 4Vs has a growth rate as high as that of 3L; 4R very similar to that of 2J, and 4Vn rather lower than 2J. However the mean curves are not the same for 3L and 4Vs. It seems that in the lower age-groups (IV and V) the growth rate in 4Vs is higher than in 3L, while in the higher ones (VIII and X) it is lower. The data are rather scarce and this conclusion cannot be definitive.

It must be noted that, in a previous paper (FIGUERAS, 1964), the growth rate in Division 4V was given as higher than that in 2J, when the comparison should be with 4Vs and 4Vn and 2J. As we have seen above, 4Vs is higher and 4Vn lower than 2J.

#### AGE AT FIRST MATURITY

The number of specimens with spawning marks by sexes and divisions and within each division for year-classes 1947-1958 were studied. Of the 205 specimens showing spawning marks, the most (28%) belonged to the 1956 year-class (8 years old).

In Division 2J the mean age at first maturity was 6.1 years, in 3K and 3L it was 6.2 years. In general it was somewhat lower for males than for females except in Divisions 4R and 4Vs. However it must be noted that there were 125 female specimens to 80 males with spawning marks.

The mean age at first maturity for males and females combined was 5.8 years, somewhat lower than in previous years.

#### THE BROAD SECOND HYALINE ZONE.

In a previous paper, FIGUERAS (1963b) has remarked on the occurrence in some otoliths of a broad second hyaline zone. We thought then, that it occurred in relation to some ecological factors because of its somewhat regular distribution with more in Division 3K and less toward both the north and the south. In

the 1961 and 1962 samples we did not pay attention to this; now we have seen in the report on the ICNAF otolith photograph exchange scheme by BLACKER (1964) that he also noted this broad second hyaline zone. He suggested that it would be very interesting to study the problem of the validity of this second hyaline zone as a winter ring or as a check.

In our 1964 samples we found one specimen with this broad hyaline zone as a fifth zone rather than a second. We found too that the broad zone did not occur more often in females than in males as we stated earlier. The geographic distribution of the broad zoned otoliths was also different. They occurred less frequently in Division 3K and more frequently in Divisions 2J and 3L.

#### SUMMARY AND MAIN CONCLUSIONS

a) There is a slight increase in the mean length and mean age in Divisions 2J, 3K and 3L.

b) There is a remarkable difference between the growth rate in the Divisions of Subarea 4. Division 4Vs has the more accelerate rate and 4Vn the lesser one. In 4Vs the growth rate is similar to that in 3L, in 4R to that in 2J, and 4Vn has the lowest of those in the Divisions studied.

c) The age at first maturity is generally somewhat less than 6 years.

d) The proportion of males has increased (43.4% average) in comparison with the proportion in preceding years (1960, 61, 62).

e) The most common year-class is the 1958 one (6 years old) in all Divisions, except 4Vs and 3N, where it is the 1959 one (5 years old) but in the last two Divisions there is also a great number of specimens of the 1958 year-class.

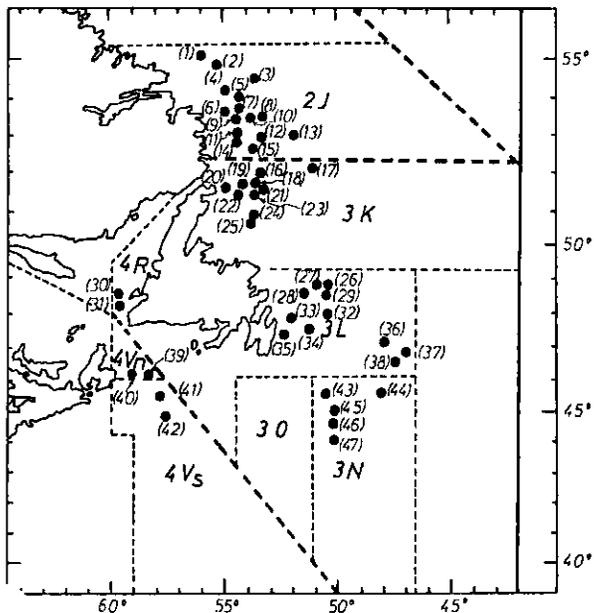
f) 2% of the otoliths had a second broad hyaline zone. In one instance it was found to be in the fifth and not the second zone.

#### References

- BLACKER, R. W. -1964. Report on the otolith photograph exchange scheme. 14th Annual Meeting of International Commission for the Northwest Atlantic Fisheries. Meeting Document 78.
- FIGUERAS, A. - 1957. Datos sobre la edad y crecimiento del bacalao de Terranova, Inv. Pesq. VIII, 3-14.
- 1962. Age and growth of cod caught by Spanish Fishing Vessels in Subarea 2-4 in 1961. ICNAF Ann.Proc. 12: 116.
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- 1963 b. Edad y crecimiento del bacalao en las Pesquerias del Atlàntico Noroeste en 1960. Inv. Pesq. , 22: 125-145.
- 1964. Edad y crecimiento del bacalao en las Pesquerias del Atlàntico Noroeste en 1962. Publ. Tècn. J. Est. de Pesca, Publ. nùm. 3: 249-261.

Table 1. Cod. Subareas 2, 3 and 4, 1964. Distribution of samples, sex ratio, otoliths read and otoliths showing spawning marks.

Div.	Sample No.	Date	Fish No.	Males %	Otoliths read No.	Otoliths with spawning marks No.
2J	16-24 41 95-96 99-116 119-127	Mar. Apr. May June Sept. Sept. Oct.	596	41	499	71
3K	25-27 33-40 42-45 59-60 97-98 118	May May June Aug. Sept. Oct.	267	47	224	46
3L	13-15 28-32 46-47 48 61-63 65-76 79-94	Mar. May June July Aug.	641	43	571	64
3N	49-58 64, 77, 78	July Aug.	143	43	137	8
4R	5-9	Feb.	45	44	42	5
4Vn	1-4	Feb.	59	63	57	9
4Vs	10-12	Mar.	42	38	35	6
TOTAL			1793		1565	209



a 1.- Map of the Convention Area with the location of the captures where the sun-lee have been caught. N° 1 corresponde to the samples 21,28. 2- 18,19,113,114. 3-107,112. 4- 22,5- 96. 6- 23. 7- 17,24. 8- 99-102,116,119,122,123. 9- 124-126. 10- 121. 11- 95. 12- 103. 13- 104,105. 14- 127. 15- 16,41. 16- 118. 17- 34,36,37. 18- 33,35,40,42,43. 19- 38,39. 20- 25-27. 21- 98. 22- 97. 23- 45. 24- 44. 25- 59,60. 26- 15,31. 27- 80,91-94. 28- 69. 29- 61-63,65-68. 70-74. 76,79,90. 30- 7-9. 31- 5,6,. 33- 32. 34- 28-30. 35- 46,47. 36- 14. 37- 13. 38- 48. 39- 1-3. 40- 4. 41- 10,11. 42- 12. 43- 64. 44- 51. 45- 49. 46- 50,54-58, 77,78. 47- 52,53.

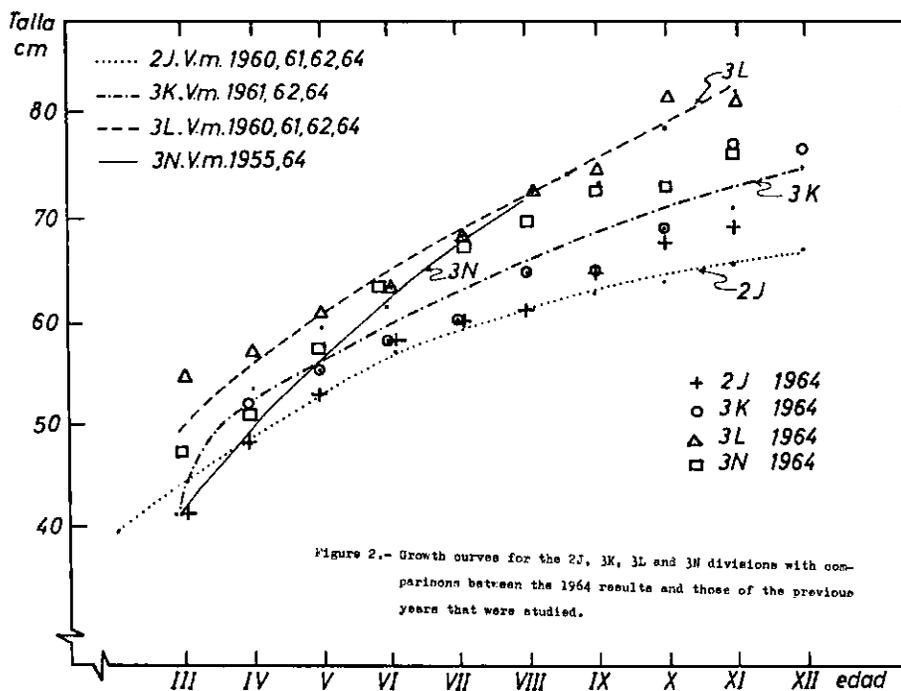


Figure 2.- Growth curves for the 2J, 3K, 3L and 3N divisions with comparisons between the 1964 results and those of the previous years that were studied.

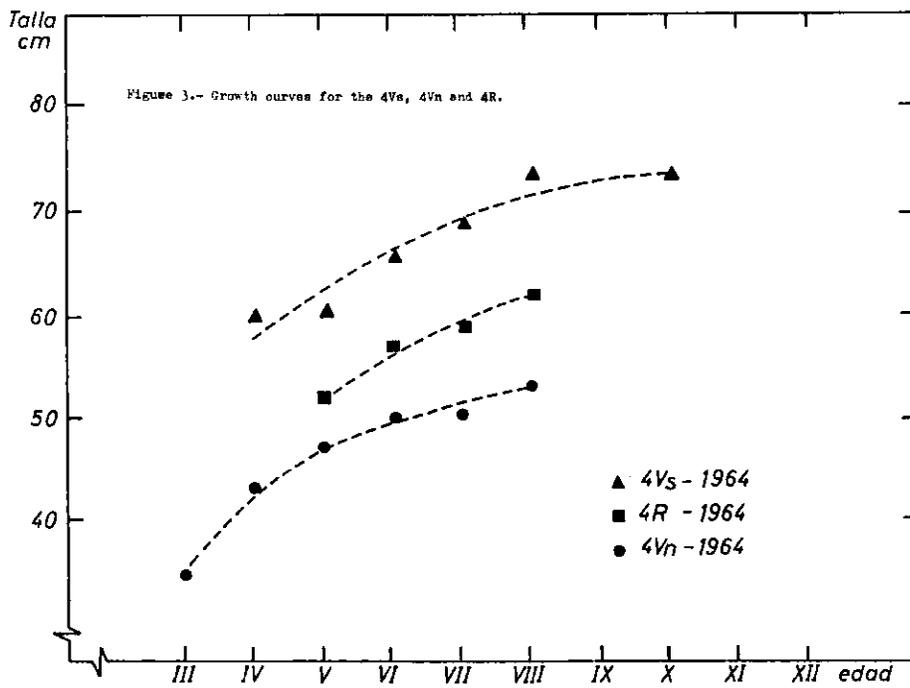


Figure 3.- Growth curves for the 4Vs, 4Vn and 4R.

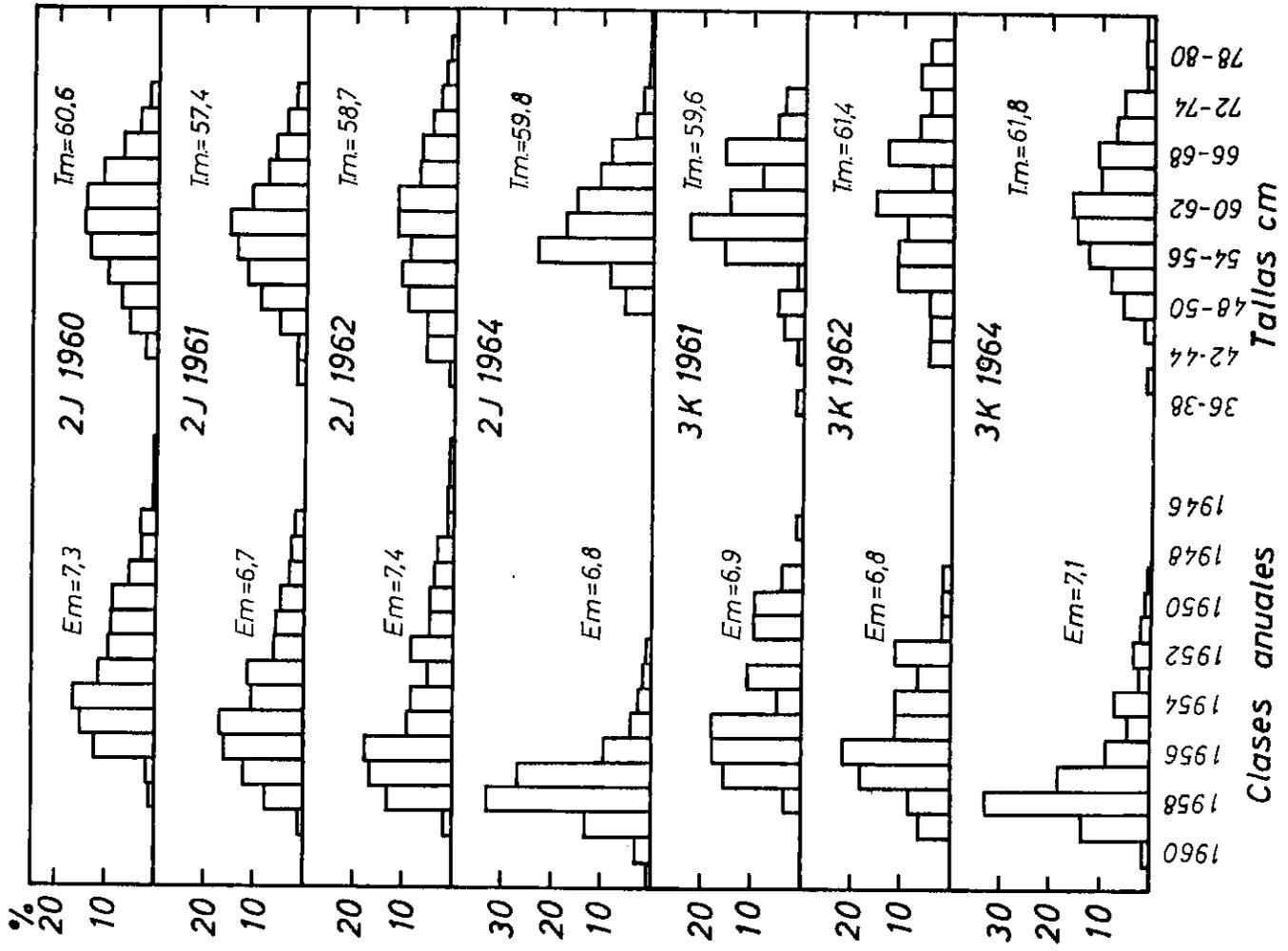


Figure 4.- The percentage graph of frequencies of year classes is shown on the left and that of the length groups on the right for the divisions 2J and 3K.

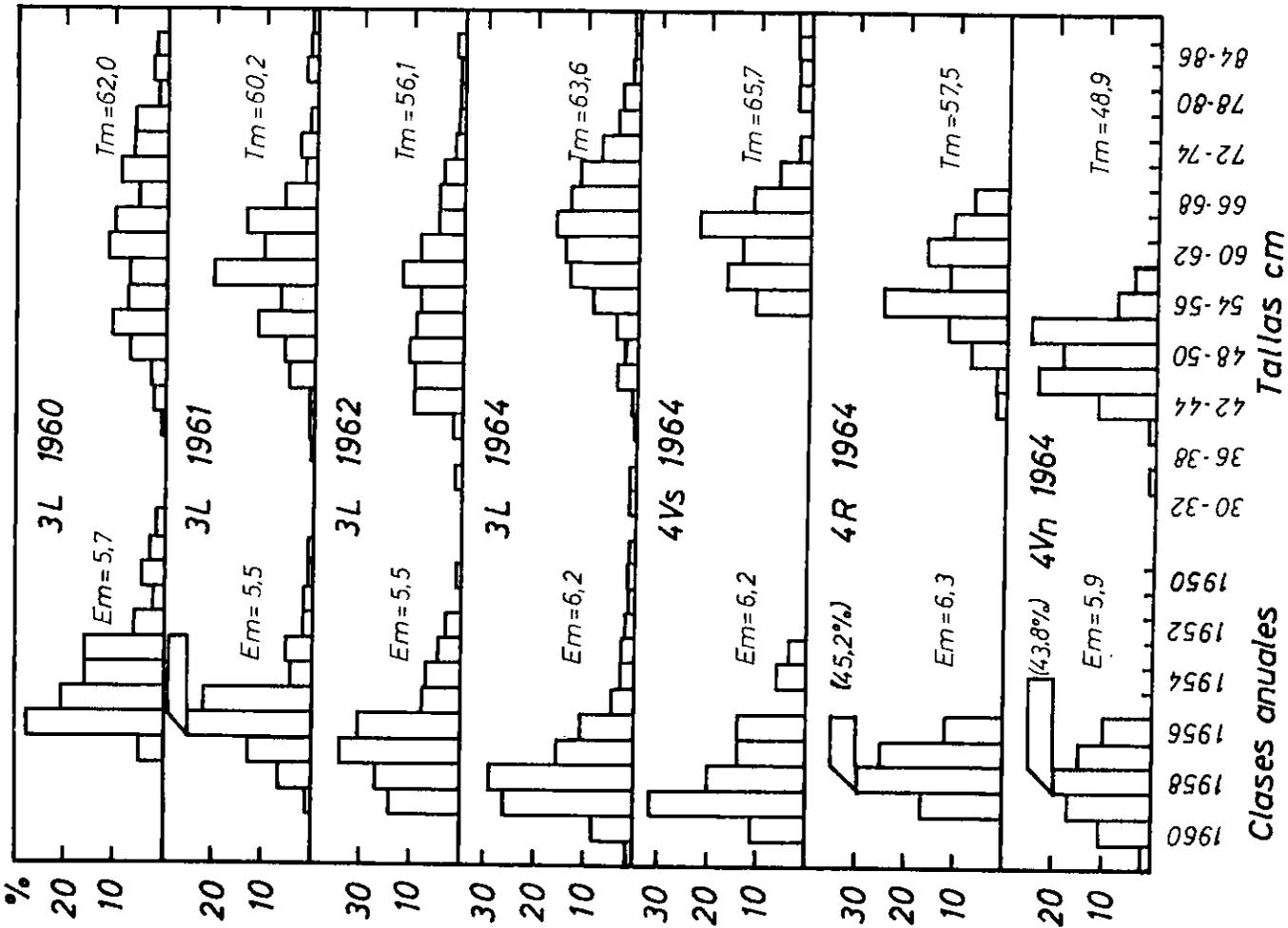


Figure 5.- Percentage graphs of frequencies of year classes on the left and that of the length groups on the right for the divisions 3L, 4Vs, 4R and 4Vn.