https://doi.org/10.17895/ices.pub.9479

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INVESTIGATIONS INTO THE GROWTH-RATES OF THE COMMON DAB AND THE FLOUNDER IN THE SOUTHERN BALTIC

BY

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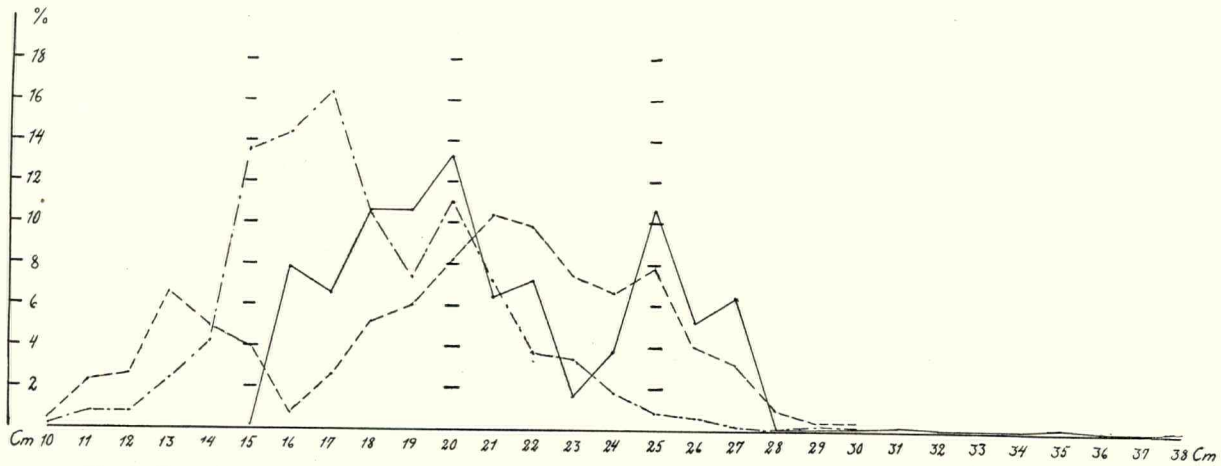

Fig. 1. Length curves of the Common Dab from the Bornholm area and off the south coast of Scania.
—·—·— Sept. 1921 (S 5). — — — — Oct. 1927 (S II, S VIII). ———— Sept. 1937 (Y III, Y X).
Positions of the stations: See Molander: Svenska Hydrogr.-Biolog. Komm. Skrifter, N.S., Biologi, Bd. I, No. 1, Tab. 1 and the chart.

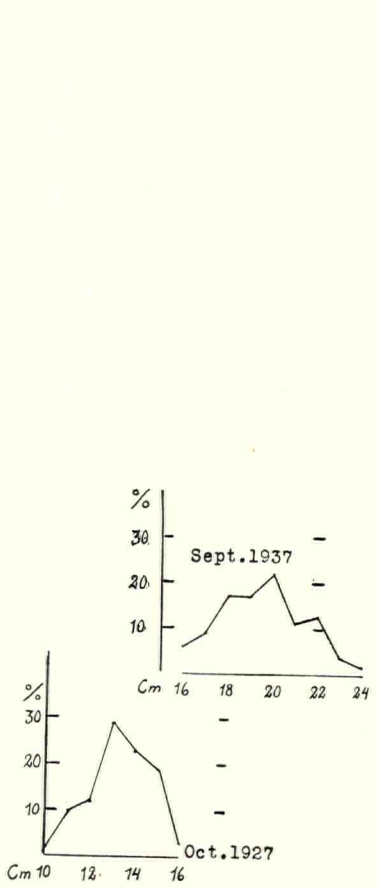

Fig. 2. II-Group.

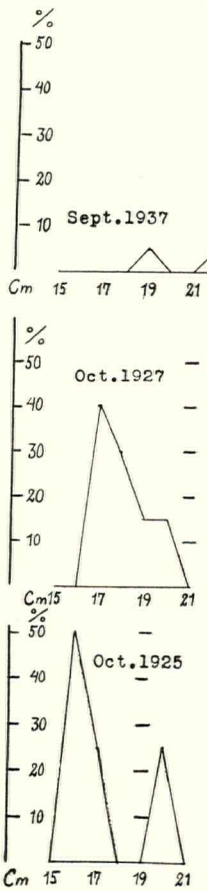

Fig. 3. III-Group.

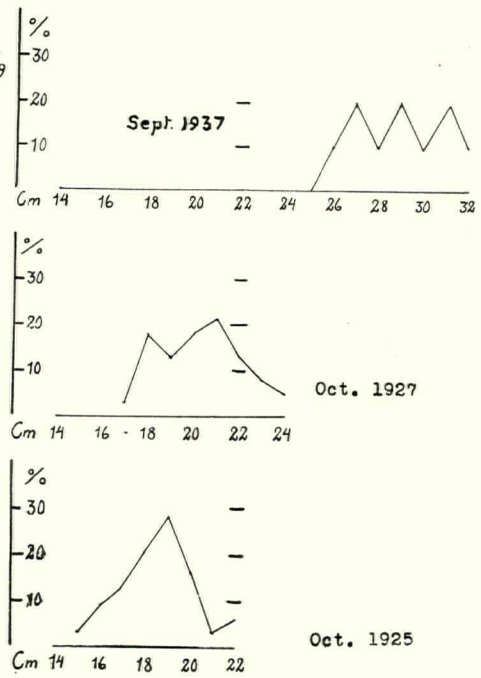

Fig. 4. IV-Group.

Figs. 2—4. Length Curves of the Common Dab.

I. The Common Dab.

AN examination of the length of common dab from the southern Baltic shows a strong increase in its average size from the time before trawl-fishing started there (1921) and onwards. It may be seen from Fig. 1 that the number of larger specimens has considerably increased and this was already distinctly noticeable in 1927. The increase in the average size and in the number of larger specimens has continued up to recent years (1937), as the length curves of Fig. 1 indicate. The average size for 1921 is 17·8 cm., for 1927 20·0 cm., and for 1937 21·6 cm.

If we go on examining the distribution of the length-classes of the common dab within their respective age-groups, we see to how high a degree the length of the common dab has increased during the above-mentioned period. On Fig. 2 I have established the curves indicating the distribution of length-classes within the age-group II. The curves show that in October 1927 specimens, between 10 and 16 cm. long, belonged to it. The vertex of the curve is situated at 13 cm. In September 1937, the sizes of the common dab of group II varied between 16 and 24 cm. and the vertex of the curve is

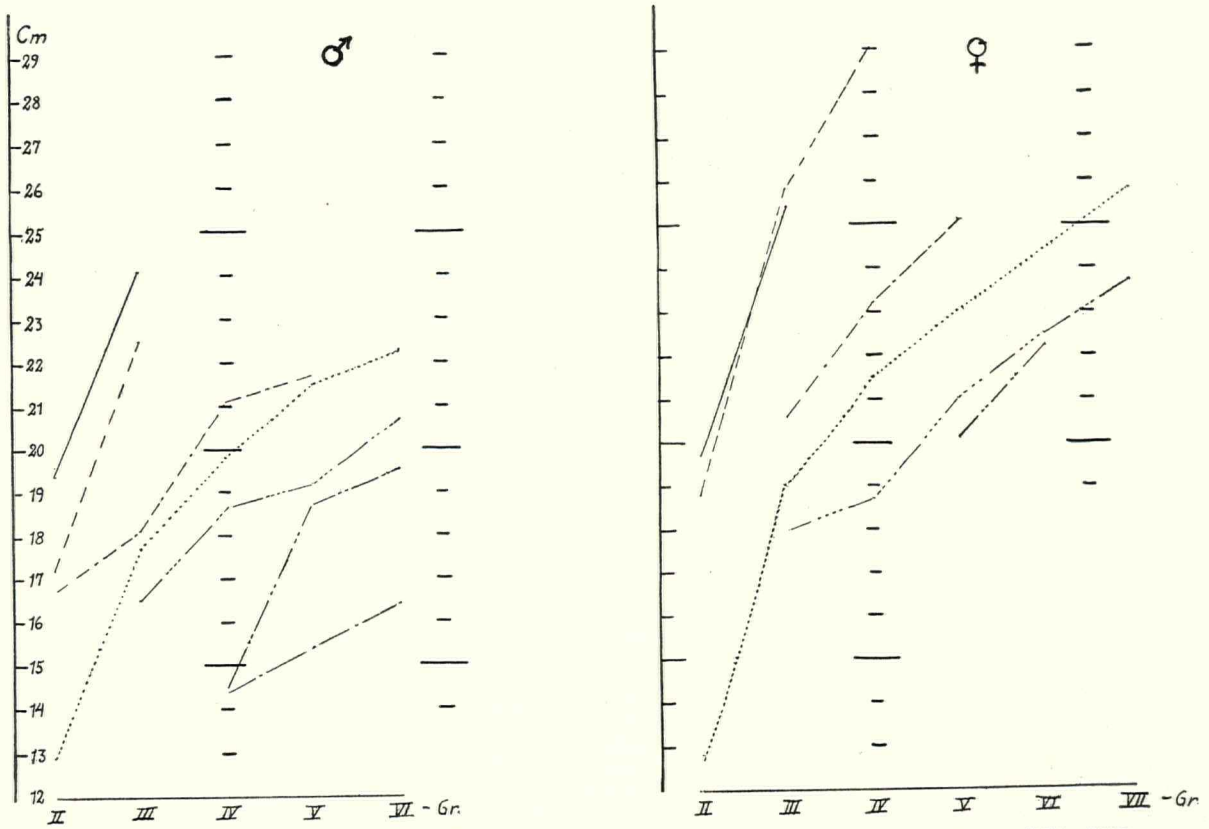

Fig. 5. Average length of the II—VII-groups of the Common Dab in the Southern Baltic 1919—1937.
— · — June 1919 (Y IV). —··—July 1919 (Gothland). —····— Oct. 1925 (Y X). ····· Oct. 1927 (S II, S VIII).
— —·— — Oct. 1931 (S IX). — — — — Sept. 1935 (S VIII). ———— Sept. 1937 (Y X).

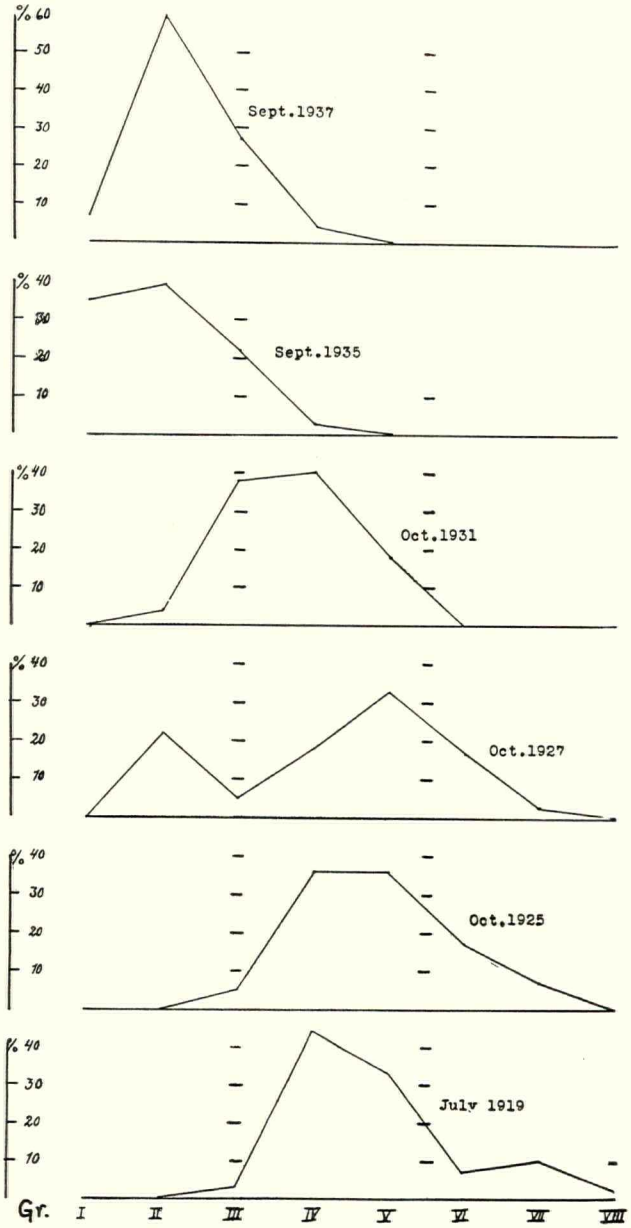

Fig. 6. Curves of the year-groups of the Common Dab in the southern Baltic, 1919—1937.

situated at 20 cm. Similar remarkable changes tending towards a greater length were also noticed in specimens belonging to groups III and IV (Fig. 3—4). Particularly pronounced is the change that took place from 1927 to 1937.

On Fig. 5 are drawn the curves indicating the rate of growth of the common dab, both males and females, for different years. The age determination according to which the curves of the rate of growth were established, were made on common dabs from the years 1925, 1927, 1931, 1935, and 1937. The

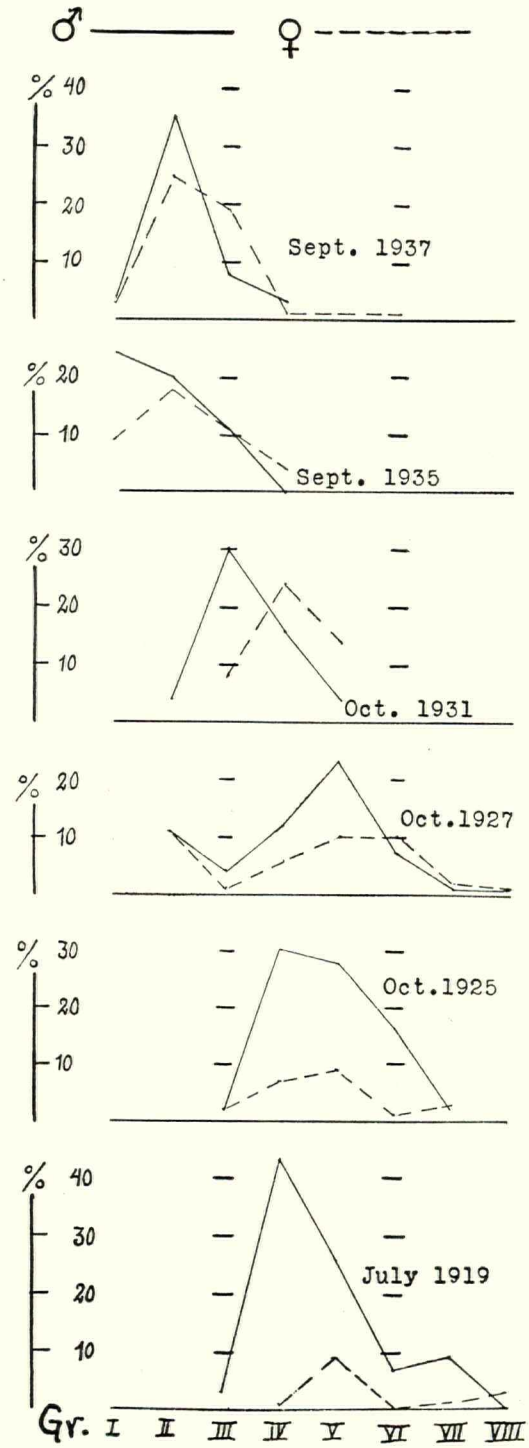

Fig. 7. Frequency curves of males (♂) and females (♀) of the Common Dab, 1919—1937.

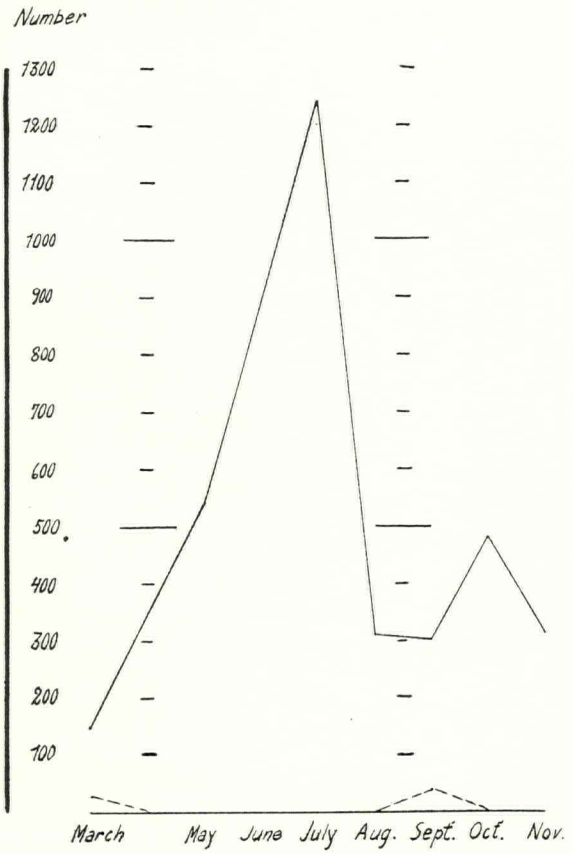

Fig. 8. Catches of Common Dab per trawling hour during March—November 1913—1923 ———— and in March and September 1937 in the Bornholm area and off the south coast of Scania. — — — —

samples were collected in September or October and were obtained by trawling in the deep area north and east of Bornholm and between Ystad and Rügen. Fish caught in herring trawl or in fine-meshed otter seine furnished the samples. For comparison's sake another curve has been drawn, indicating the rate of growth of common dab caught in July 1919, according to Hessle (Medd. från Kungl. Lantbruksstyrelsen, No. 243, 1923). Fig. 5 shows a somewhat higher rate of growth of the females (cf. E. M. Poulsen, Ber. Dan. Biol. Stat., XXXVIII, 1933). Further it is seen very clearly that the rate of growth of the common dab has strongly increased from 1919 to 1937. The rate of growth of the common dab in the southern Baltic is now higher than that indicated by Poulsen (*loc. cit.*) regarding common dab from the Kattegat. The rate of growth has been increasing steadily and continuously during the years in which research work has been carried out. It is indeed a particularly striking change that has taken place during those years regarding the rate of growth of the common dab. It implies at the same time a very significant improvement of the quality of the stock.

Corresponding with this alteration in the rate of growth we also find certain other features which can be said to characterize a fish stock in which the rate of growth of the specimens increases rapidly. It is above all the relation between the strengths of the different year-classes that alters considerably. In 1919 the stock consisted chiefly of older common dabs of the year-groups IV—VII (Fig. 6). This age distribution still prevailed on the whole in 1925 and 1927. In 1931 the presence of a considerably larger proportion of younger year-classes became manifest (groups III—IV). In

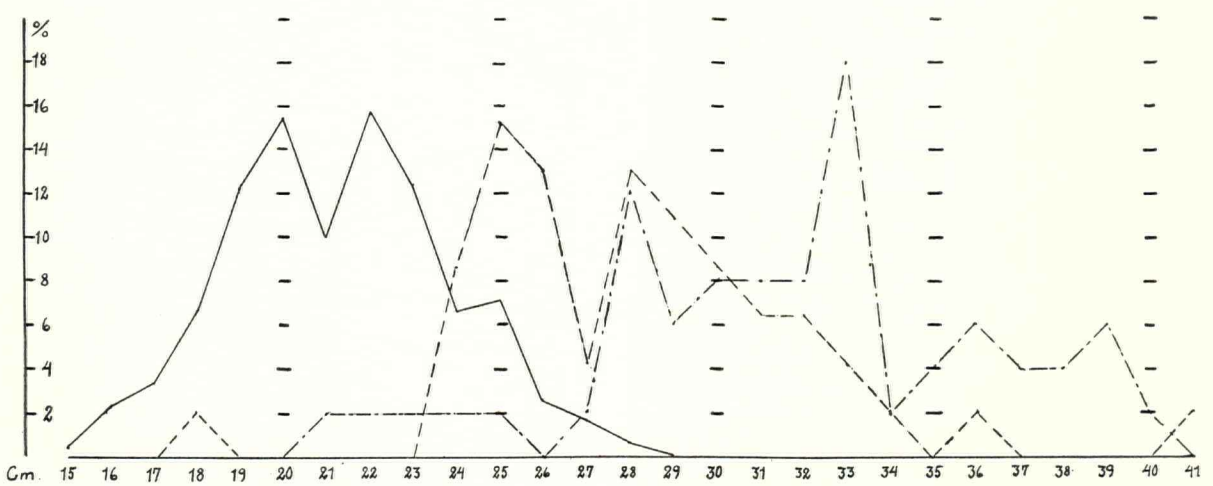

Fig. 9. Length curves of Flounder from the Bornholm area.
————May 1916 (S II). ···· Feb. 1930 (C VII). —·—·— March 1937 (SO IV).

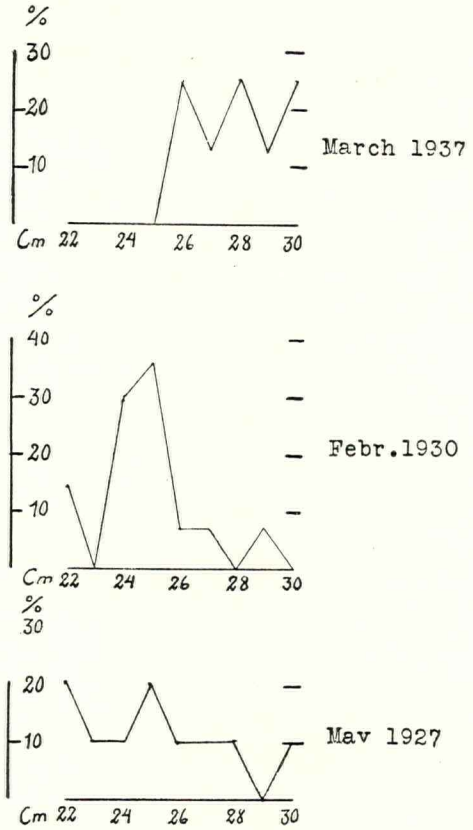

Fig. 10. Length curves of the IV-group of the Flounder.

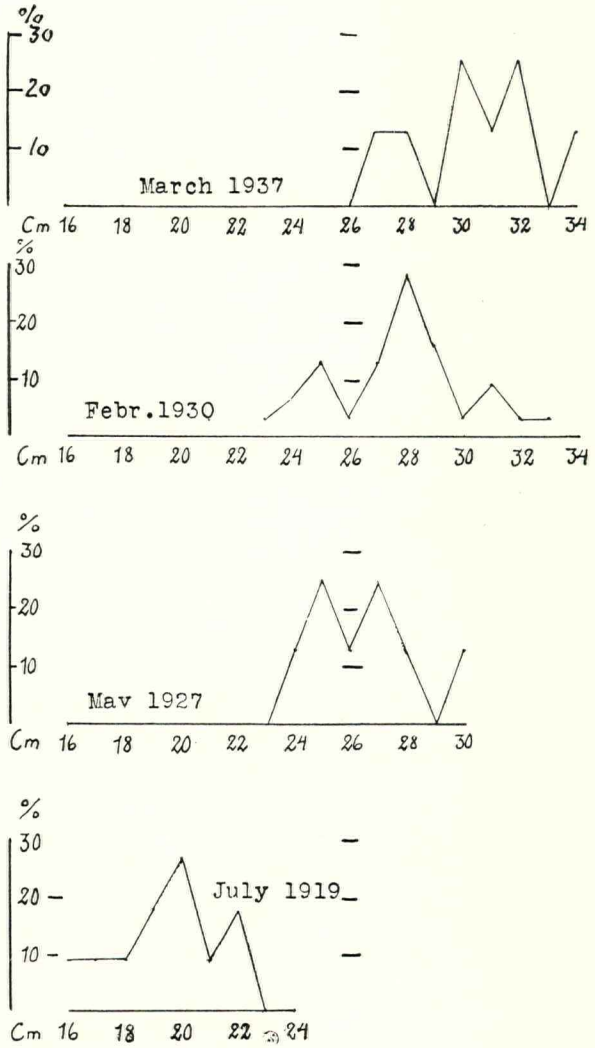

Fig. 11. Length curves of the V-group of the Flounder.

1935—1937 group II was predominant together with a not inconsiderable portion of group I. The older groups simultaneously disappeared more and more from the catches. It is interesting, too, to note in the same connexion that the numerical relation of males to females has also undergone a change. Formerly males outnumbered females even within the age-groups VII and VIII (Fig. 7). But concurrently with the increased rate of growth and the regrouping of the year-classes within the stock, the males' numerical superiority has become more and more confined to the younger year-classes while the females have correspondingly begun to preponderate more and more. Among the older fish females now always outnumber males. The strong decrease in numbers of the older males is especially characteristic and might well be closely connected with the strongly increased rate of growth. Thus in 1919 the average length of a 6-year-old male was 16·5 cm.; in 1937 a 2-year-old male was, on the average, nearly 19·5 cm. long. In 1937 4-year-old males reached a length of 27—29 cm.; in 1919 only 8-year-old or even still older females reached such a length. The males, therefore, do not appear to grow beyond a certain length and the life of a male seems to be shortened proportionately with the increase in the speed with which this length is attained.

The explanation of this marked increase in the rate of growth of the common dab is, of course, to be sought in the striking thinning out of the stock which was the consequence of the large-scale fishing carried out in the southern Baltic. A thinning out of the stock and the increased rate of growth that followed have already been pointed out by several authors with reference to the plaice and the flounder, and the examples here quoted point to similar conditions concerning the common dab. Fig. 8 shows the enormous difference between the

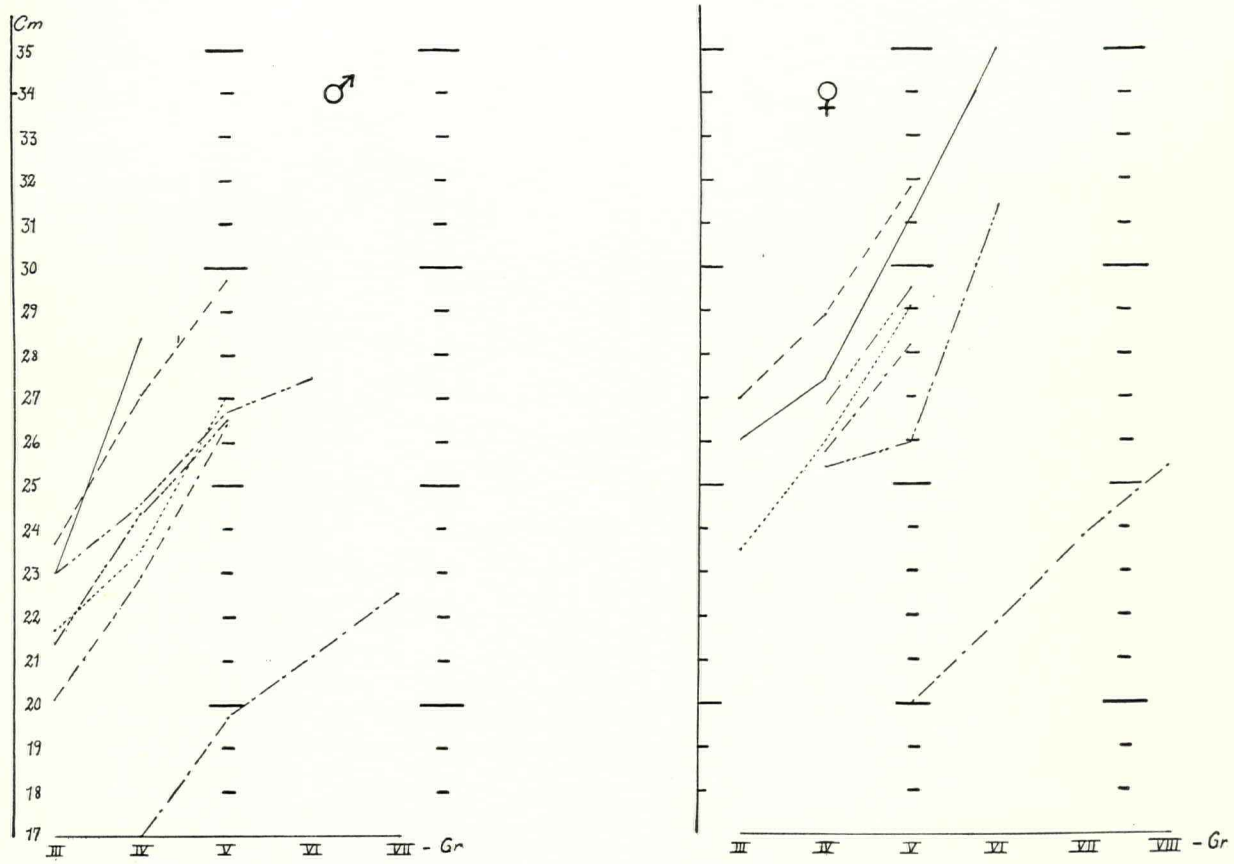

Fig. 12a. Average length of the III—VIII-groups of the Flounder in the southern Baltic during the spring months 1919—1937.

—·—· July 1919 —··—·· May 1927 —····— Feb. 1930 — — ·— — — · March 1931 ····· Feb. 1933.
— — — — March 1936 ———— March 1937

size of the catches of the years 1913—1923 and those of 1937. An examination of common dab catches from the waters off Gothland in June 1919 (Hessle, *op. cit.* 1923) showed that the rate of growth of the common dab was far better there than off the coast of Scania during the same period (Fig. 5). It was noticed at the same time that the common dab was relatively rare near Gothland while it was very abundant in the area off Scania. Even in this instance differences in the density of the stock have obviously brought about different rates of growth, in correspondence with what has happened in recent years, but to a much higher degree, regarding the stock of the southern Baltic.

II. The Flounder.

In two papers (Molander, Rapp. et Proc.-Verb., Vol. LXXVIII, 1932; Svenska Hydr. Biol Komm. Skr., N.S. Biologi, Bd. II, No. 1, 1937) I have dealt with the rate of growth of the flounder in the southern Baltic. The following report on this rate of growth is in the first place a summing up of the conclusions I had come to in the above-mentioned works, but it is also based upon research work carried out quite recently.

A comparison between the composition of the flounder stock in catches made with herring trawl in the southern Baltic, on the one hand before the large-scale fishing with drag-nets started there (May 1916), and on the other hand in more recent years (Feb. 1930, March 1931), shows that the

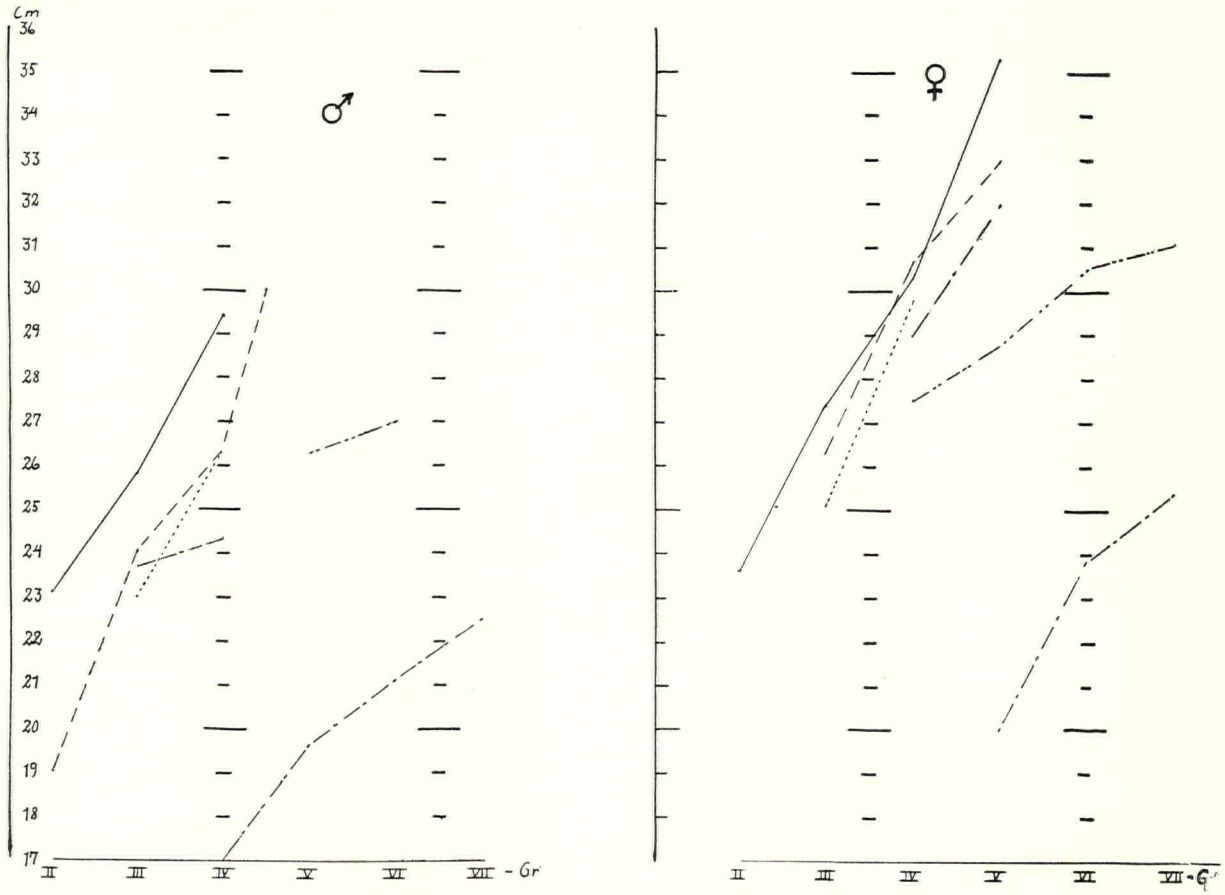

Fig. 12b. Average length of the II—VIII-groups of the Flounder in the southern Baltic during the autumn months 1919—1935.
—·—· July 1919 —··—·· Oct. 1926 — — ·— — — Oct. 1931 ····· Oct. 1932 — — — Sept. 1933 ——— Oct. 1935

average size of the flounder (Fig. 9) has considerably increased. While the average size in the catch of May 1916 was only 21·2 cm., it was 28·2 cm. in February 1930 and 31·7 in March 1937. How this average increase in the size of the flounder is distributed within the different year-classes, may be gathered from Fig. 10—11, where I have established the curves of the distribution of the length classes in percentage within the age-groups IV and V. Within group IV (Fig. 10) the curve shows, for the year 1927, two peaks, one at 22 cm. and the other at 25 cm.; for 1930 the curve shows a peak at 25 cm., and for 1937 the maxima of the curve have moved to 26, 28, and 30 cm. As to group V (Fig. 11), the continuous movement towards the higher length-classes already observed in group IV, appears here too, perhaps still more clearly, especially if compared with the size of the flounder in 1919. The change tending towards a greater length within groups IV and V is not quite so pronounced between 1927 and 1930, but from 1930 to 1937 on the other hand a very marked increase in the size of flounders has taken place.

Fig. 12 indicates the average length of males and females according to year-class, partly from the spring months of 1927—1937 (Fig. 12a) and partly from the autumn months of 1926—1935 (Fig. 12b). In the same figure I have also drawn a curve of the average length of the flounder in a sample from July 1919. All the samples examined come from the areas situated north and east of Bornholm and off the south coast of Sweden, which are regularly visited by Swedish fishermen (cf. M o l a·n d e r, Rapp. et Proc.-Verb., Vol. LXXVIII, 1932). They were obtained by fishing with a herring trawl or a fine-meshed otter seine (1935, 1937).

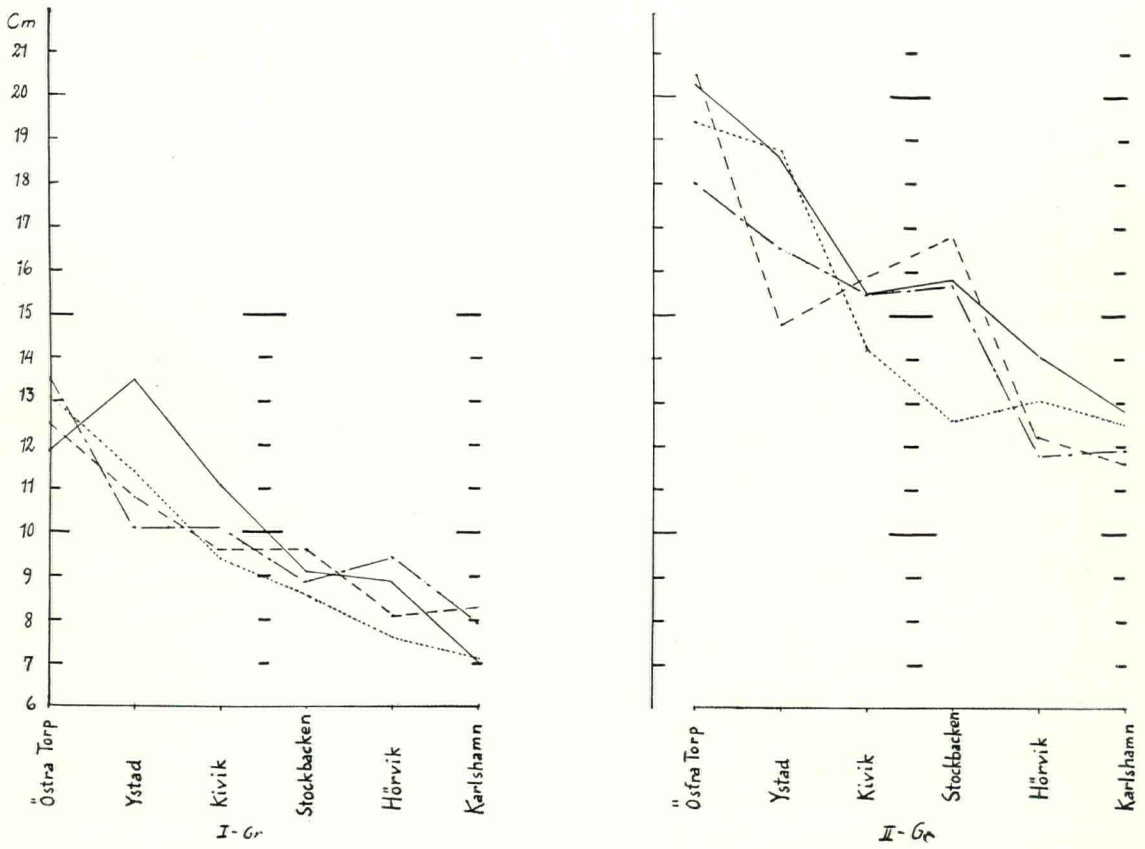

Fig. 13. Average length of the I—II-groups of the Flounder in the Swedish coastal area.
····· 1933 —·—·— 1934 — — — 1935 ——— 1937

Regarding the rate of growth of the flounder in the above-mentioned area we notice in the first place that it is considerably higher as regards the females. Further there appears to have been a particularly strong increase in the rate of growth from 1919 to 1926 or 1927. During the years that followed until the beginning of the thirties the increase has not kept up the same pace, and both spring and autumn samples show a relatively small change in the average size within the age-groups examined. During the most recent years (1936—1937) a fresh increase in the rate of growth seems however to have taken place. It appears especially in samples collected in spring months (Fig: 12a).

The examples of the rate of growth of the flounder in the southern Baltic which are given on Fig. 12 are all taken from material obtained within the deep areas where fishing with trawl and otter seine is practiced. It is, however, also interesting to follow the rate of growth of the young year-classes which preferably keep to the shallow water in the coastal area. Fig. 13 shows the average length of the flounder groups I and II from a number of stations along the coasts of Scania and Blekinge. It is not possible to find here any variations in the rate of growth worth mentioning, nor is it possible to observe any increase in the rate of growth during the above-mentioned years.

On the other hand the curves show a very clear decrease in the rate of growth of the flounder from the western stations of the Scanian coast (Östra Torp, Ystad) to stations on the east coast of Scania (Kivik, Stockbacken) or in Blekinge (Hörvik, Karlshamn).

Even if other factors, governing the rate of growth of the flounder, than those existing in deep areas are probably at work in coastal areas, it is nevertheless possible to prove by examples taken from catches made in the coastal waters that a definite correlation exists between the size of the stock and the rate of growth of the flounder (Fig. 14).

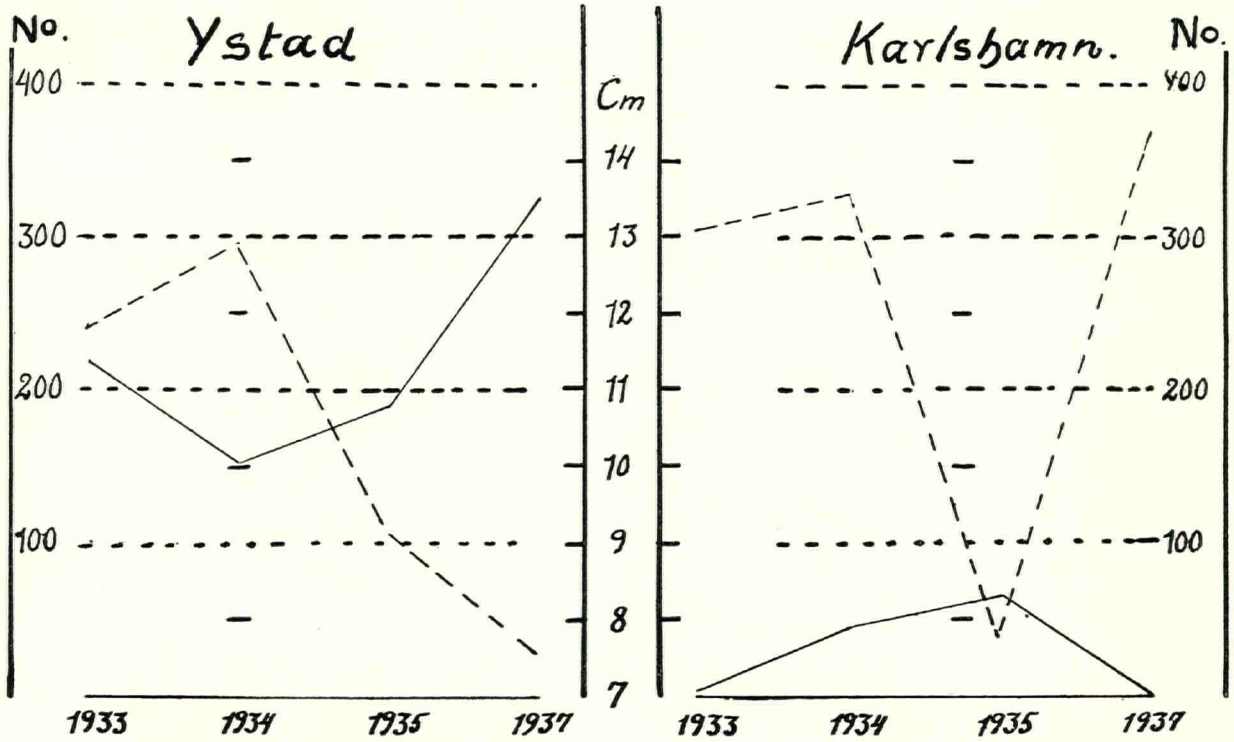

Fig. 14. Average length of the I-group of the Flounder in the coastal area off Ystad and Karlshamn ————. Number of specimens per 30 minutes trawling — — — —

Examples taken from Ystad and Karlshamn where the catches of younger flounders are usually good actually show that in the years when the catches are large the average size of the captured flounders is lower.

At the same time as this altered rate of growth manifests itself within the flounder stock of the southern Baltic, we also come across certain other features which often characterize a fish stock in which the rate of growth of the specimens is strongly increased(Fig. 15). Thus on Fig. 15 we see that the strength of the older year-classes has gradually decreased in the course of years and that the stock at present is chiefly recruited from the younger year-classes (III and IV). That the still younger year-classes do not appear is caused by the fact that they are not caught by the usual fishing implements. In this respect too a certain stabilization has taken place recently (1925—1937). We notice at the same time that a change takes place in the occurrence of males and females within the year-classes. During former years the males were strongly preponderant in spring-month catches (Fig. 16). In autumn when the stock of flounder in deeper areas is always smaller the females on the other hand seem, as a rule, to have been preponderant. But concurrently with the change in the rate of growth and the decrease in the older year-classes, the predominating proportion of males has gone over to the younger year-classes in which the females themselves appear more frequently than before. Among the older specimens (group V and older groups) females are now always preponderant and males have almost entirely disappeared. This disappearance of the older males has in all probability been caused by their strongly increased rate of growth, which again has caused them sooner to reach their maximum size.

The examples of alterations in the size and rate of growth of the flounder briefly described here must beyond all doubt be connected with the thinning out of the stock which has taken place as a result of the strongly increased fishing operations carried out in the southern Baltic. Fig. 17 shows to what extent the catches of flounder made during fishing experiments carried out onboard the research vessel "Skagerak" have decreased if we compare for instance the year 1922 with the years 1930, 1931, 1933, and 1937. The reduced landings of flounder in the harbours of Scania and Blekinge (M o l a n d e r, Sv. Hydr. Biol. Komm. Skr., N. S. Biologi, Bd. II, No. 1, 1937) point to the same

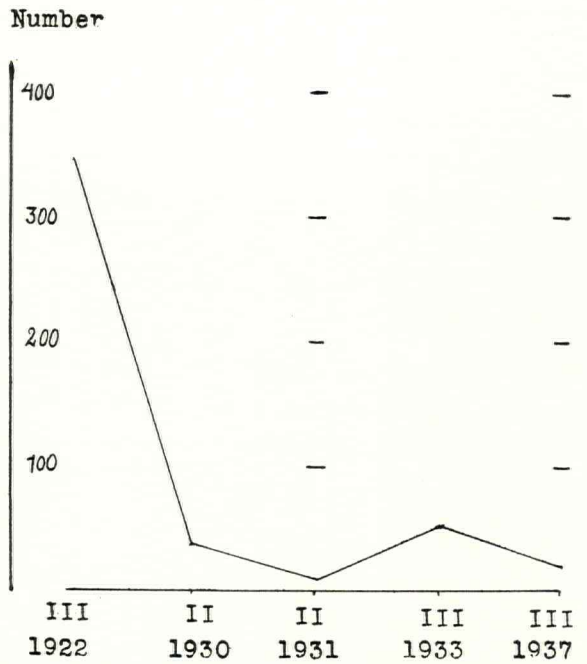

Fig. 17. Catches of Flounder per trawling hour (herring trawl) during Feb.—March 1922, 1930, 1931, 1933 and 1937 in the Bornholm area.

conclusion. It is not, however, uninteresting to record in this connexion that the rate of growth and also the distribution of the year-classes during recent years have become more and more stable, which may possibly indicate that the thinning-out process has reached the point at which it no longer exerts any influence upon the rate of growth. Still, the somewhat increased rate of growth of the flounder observed during the last two years may indicate that this thinning-out of the stock has not yet reached its extreme limit.

As to the rate of growth within the coastal area, the local differences I have pointed out are no doubt closely connected with varying physical conditions which consist above all in the continuous decrease in salinity from west to east. The stock may indeed become particularly dense at certain stations and in certain years, and in such cases the rate of growth may possibly suffer a strong local decrease, as shown on Fig. 14. Here, then, we come across the same conditions as were to be found in the overcrowded stock in deep waters. It shows incidentally how labile the rate of growth can be.

(Figs. 15 and 16: see page 100—101).

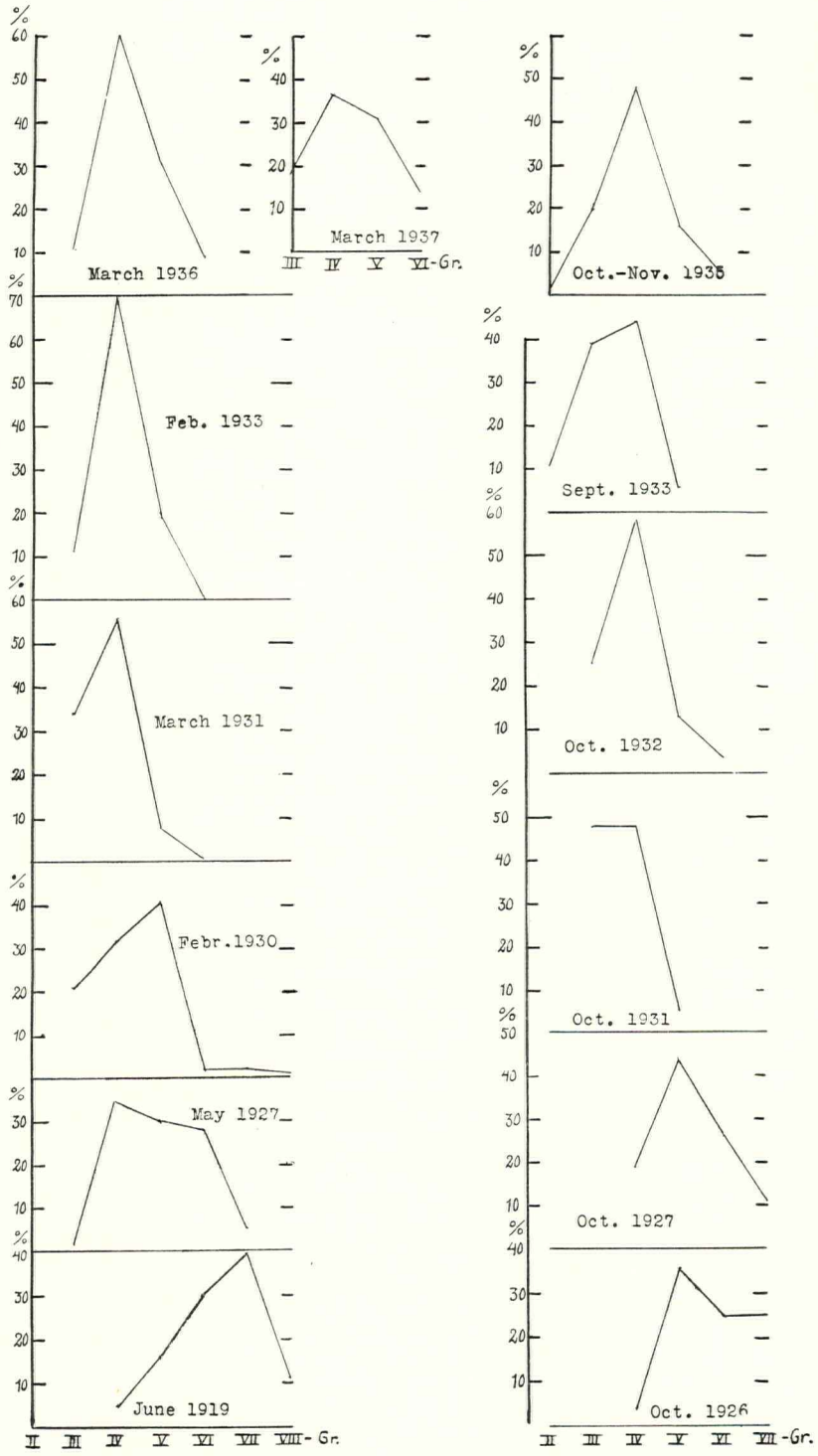

Fig. 15. Curves of the year-classes of the Flounder in the southern Baltic 1919—1937.

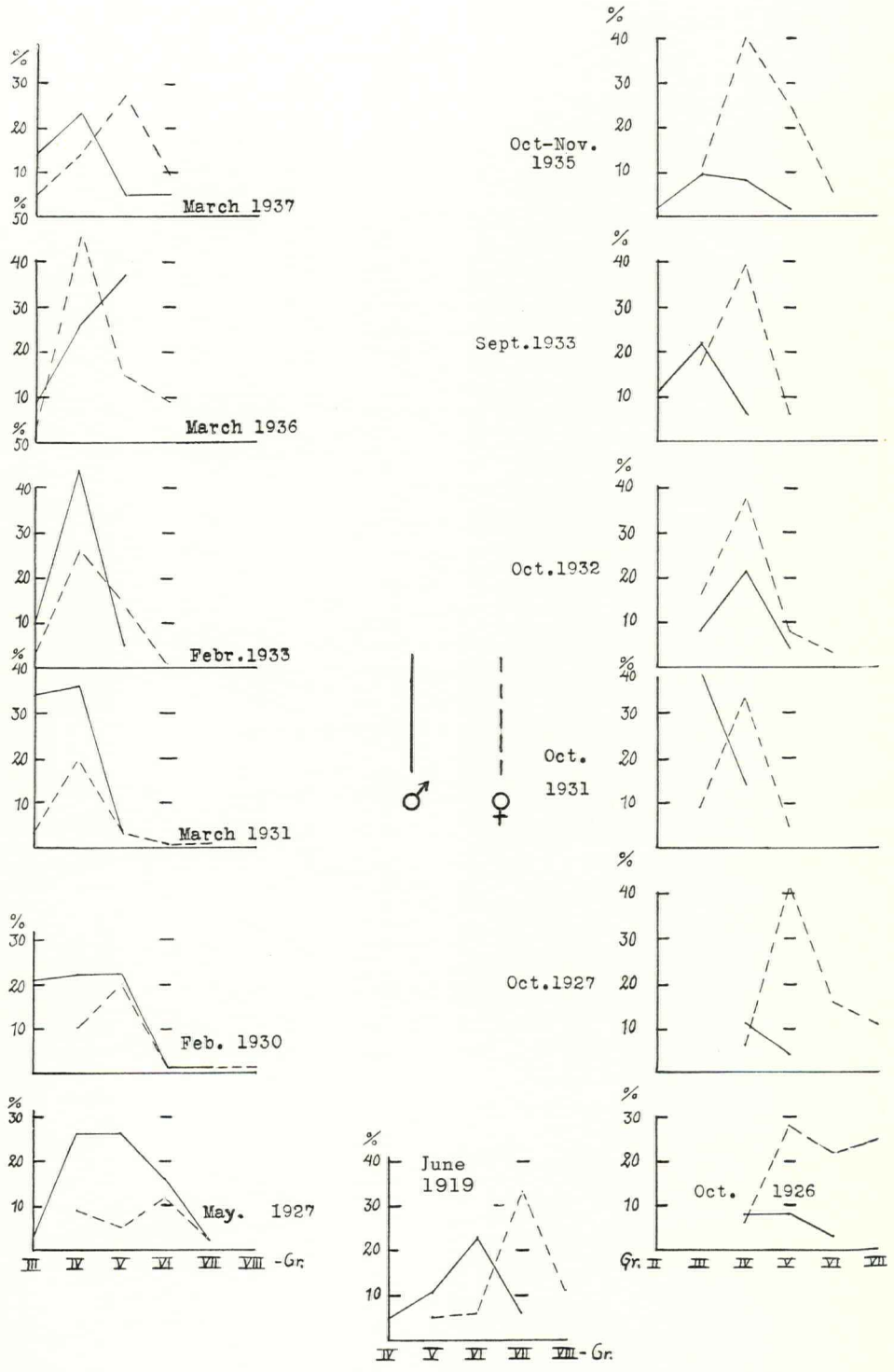

Fig. 16. Frequency curves of males (♂) and females (♀).