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The Plankton Production in the South-Eastern Baltic and its Effect on the Biology of the Herring

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Long-term studies on the production of plankton in the south-eastern Baltic have made it possible to get an idea of the average plankton production in this area in the different years. Several thousand samples were collected at more than 1,000 stations, but nevertheless the material investigated was rather fragmentary.

The estimate of the plankton production was made from the mean monthly plankton biomass in the various regions. Since most data were collected in the south-eastern region, this paper deals particularly with that region. It was attempted to investigate the relation between some biological features of plankton feeding fish (length, growth-rate, condition, recruitment of year-classes) and the plankton production in 1951-1960.

From graphic comparison of plankton production and herring biology it was assumed that there is a definite relation between the two. Both autumn and spring herring were investigated.

Three phases were distinguished in the ten-year period of investigation. The first, 1951-54, is a period of average conditions and mean effect on the fish stocks. The year 1951 is the poorest in this period. The plankton production is poor and the same holds good for the growth-rate of the spring herring. The observations were confirmed by the Fulton coefficient of condition 'K' (calculated in the months July-November on fish at maturity stage II-III after the Maier scale), the value of which was also low.

The material concerning plankton investigations in the years 1952-53 is very fragmentary, and there is a lack of data for the most productive months. Judging from the length increment of both spring and autumn spawning herring and the Fulton coefficient the production of plankton was rather normal.

The following 3-year period (1955-1957) showed very different plankton and fish production. The year 1955 was a good one as regards plankton production. The value of l_1 in the autumn herring (hatched in the autumn of the preceding year), and particularly that of l_2 in the spring herring was high. The t_2 of the spring herring was also good. Similarly the condition coefficient 'K' reached a high value. Only the l_1 for the spring herring was lower in 1955 than in former years.

The year of 1956 was the poorest one in the period in question. The data on plankton production in that year are based on abundant material and are, therefore,,fairly reliable. Even the maximum values of the various properties were low and that applies also to the production of fish mass. The herring attained in that year exceptionally low indicators. The l_1 and l_2 were lowest for the spring herring as was the l_1 for the autumn herring hatched in the autumn of 1955. The growth-rate was also very low amounting only to 3.5 cm, which is the lowest value for the period covered by the investigations. The same was true as regards the Fulton coefficient.

The year 1957 showed the best plankton production followed by an increase in the production of fish. This was particularly marked in the growth-rate of the spring herring, amounting to 7.8 cm. Thus the dificiency observed in 1956 was balanced and the herring attained as two year-old the proper mean length of its age. The Fulton coefficient reached the unrecorded value of 0.70.

The 3-year period that followed (1958-1960) was an average one both as regards plankton production, the sizes attained by one and two year-old herring, and the Fulton coefficient.

How was this production of plankton reflected in the recruitment of the herring stock of the spring and autumn spawners and thus in the replenishing of the commercial stock ? We have no classical patterns here as we had in the former cased. Both races of herring have undergone very curious changes in number for many years. The autumn herring predominated in the herring stock in the Gdańsk region before the war. The situation changed in the years 1940-1946 when the spring spawning herring predominated in the catches. This was most likely due to the several severe winters in this period. Since 1952 when the observations commenced, the density of the races expressed as yield in kg per day's fishing of a cutter have again undergone changes. The autumn brood of one year and the spring brood of the next grow on parallel lines and give rise to a stock of juvenile fish; they can be considered as a single brood growing up under the same conditions and jointly making out the commercial stock.

From 1958 the size of the year-classes increased; this increase was more marked in the autumn herring than in the spring herring. Owing to this fact the autumn herring greatly contributed to the increase of the stock during this period.

In order to make a survey of the phenomena discussed above we have tried to fit them in a frame applying a 5-degree scale. In every phenomenon the minimum values (the poorest) and the maximum values (the best) were accepted as the extreme degrees, and the intermediary values were divided proportionally into 3 further degrees. We thus obtained the picture presented in Figure 1. A general agreement is observed between all the phenomena, especially in the period of the greatest contrasts.

The agreement between the production of plankton and herring must be considered as a general natural law. The hydrological factors have also been considered. The winter conditions in the sea seem to be the most determining factor. Using the 5-degree scale the temperature conditions at the break of winter and spring and in 30-60 m depth were compared, because winter conditions still remain in this depth even when spring has influenced the surface temperatures.

The course of the graph (Fig. 1) illustrating the phenomenon is similar throughout the 10-year period to the phenomena discussed above.

Further studies are required to establish whether the temperature is a direct factor influencing the concurrence of the phenomena discussed, or an indirect one ruling the factors of basic production and, in turn, the further links of life.

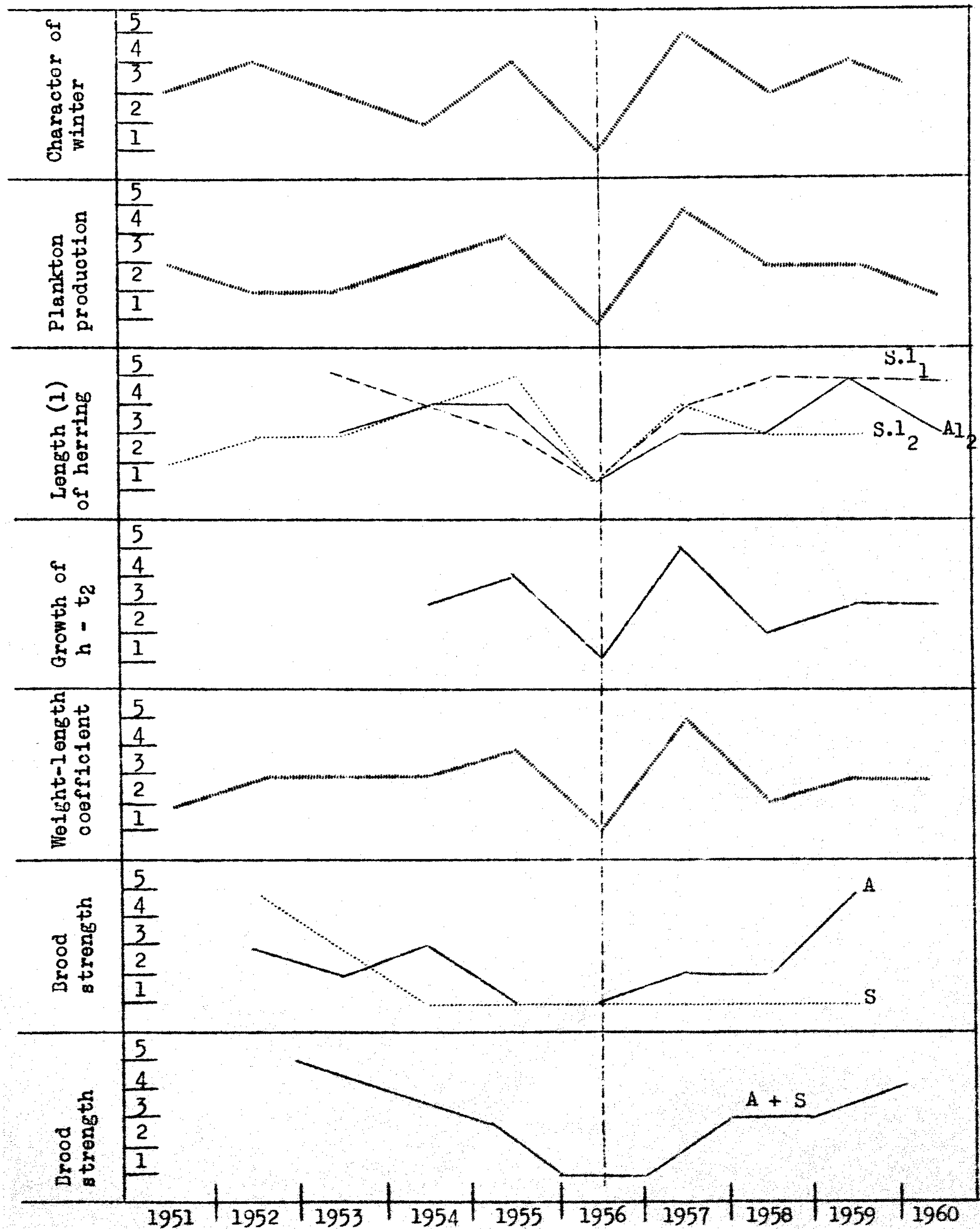

Figure 1. Plankton production in the south-eastern Baltic and its effect on the biology of the herring.

Scale for winter: 1 = very cold; 2 = cold; 3 = mean; 4 = mild; 5 = very mild.

Scale for other features: 1 = very small; 2 = small; 3 = mean; 4 = good; 5 = very good.