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6.

Further Observations on Spent Herring with Remarks on Fluctuations and Oscillation.

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3115

Systematic observations on the community of spent herring which accumulates every year along the French-Belgian coast have been carried on uninterruptedly during the fishing seasons of the last six years. This community of nearly pure spent herrings that returns regularly to our coast after the autumn spawning to remain for more than two months in a close vicinity to the shore, although very small in comparison with the immense shoals of the North Sea, offers excellent opportunities for general biological studies on the species. We beg to remind the readers of our previous papers, that our method consists in the analysis of a great number of small samples. Each sample of 25 fishes is obtained from the fishermen on each of the fishing days of the herring season. Each herring was submitted to the eight points of analysis which are now considered classical:

1) length
2) weight
3) sex
4) stage of gonads
5) quantity of mesenteric fat
6) age and growth from scales
7) number of vertebrae
8) content of stomach

It is intended to proceed with the same work for several years to come and to add yearly one step to the biological scale of the shoal. As seen in the diagram, the material collected in the season 1936 has been worked out already and a new step added to the scale.

A general Report on the results of the successive years will be published this year, may-be next year if the addition of the results of another year is found expedient.

For the present I shall simply call attention to certain peculiarities of the evolution of the year-classes that do not appear clearly enough in a columnar biological scale. In diagram no. 2, I have drawn a representation of the variation of percentages in a different way: each year-class is taken separately from its first appearance as fishery material and its evolution is followed to its extinction or near to it.

1. On the first coordinate, — on the left, — are plotted the percentages of each of the year groups of the six seasons that have been as yet under observation, at the time of their first appearance, — that is at the age of 3 years. They occupy various positions on the line and their variation during this period of years, may be called a fluctuation.

2. If we take the same year-groups on their second appearance, — that is in their 4th year of age, we make a similar remark: the figures of all percentages still occupy different levels. But there is a more interesting feature to be noted: that is, that they are all higher than in the preceding year. There is thus a constant increase in the number of herrings on their second migration to our coast. No exception to that rule has been observed, up to the present.

3. The right hand part of the graph shows a remarkable uniformity in the direction of the lines of percentages: they all, invariably after the 4th year of age, take a sloping direction indicating a gradual decrease in the number of herrings of each of the successive generations that have come to our coast after spawning, since the starting of our regular system of observation.

Forecast for the season 1936—37.— Good shoals may be expected for the following reasons:

a) the 1931-class which has played an important part in the rich seasons 1934—1935 and 1935—1936, will in 1936—1937 be at the first stage of reduction only;

b) a good remnant of the famous 1929-class is likely to survive;

c) the youngest class, 1932, attaining in 1936 the highest percentage hitherto recorded at the first appearance, will be reaching in 1936—1937, the augmentative stage of 4 years.

Our diagram no. 2, exposing the fluctuation and evolution of successive year-groups continuously recorded, may be useful for the drawing of forecasts concerning our shoal of littoral spents. Possibly also it could be adapted to the prevision of the future

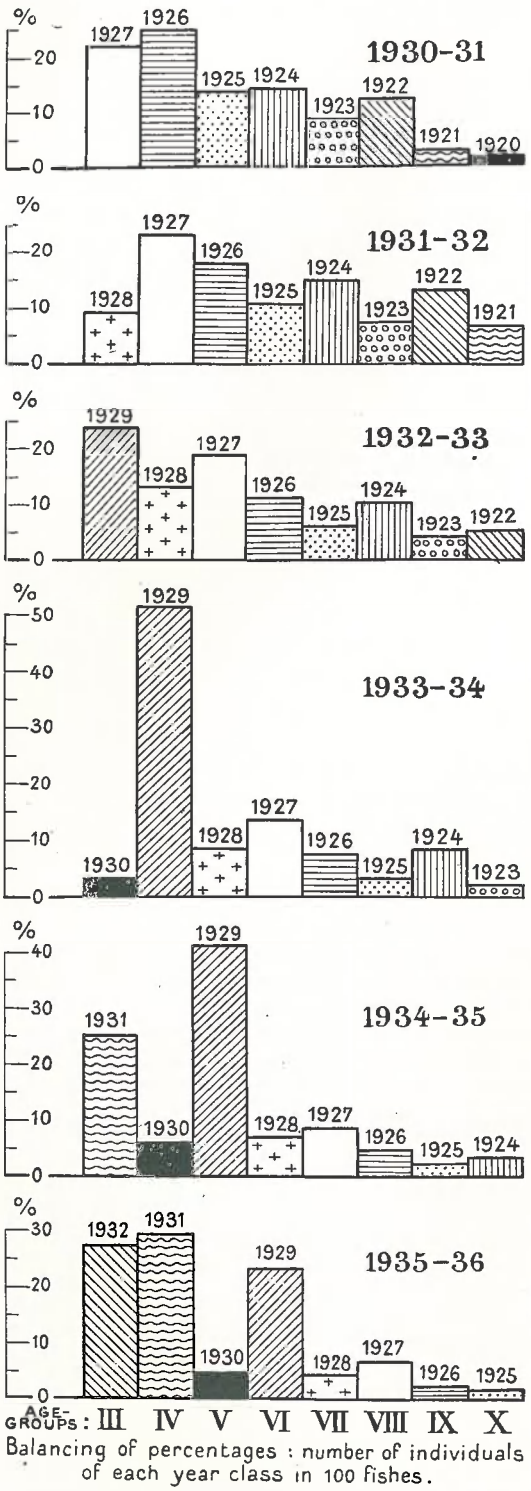

Fig. 1. Percentage number of individuals in each year-class.

1930—31

Number of herrings examined	1,167
Mean weight of a day's capture	8,338 kg
Total weight landed in the season	18,360,596 kg
Mean value of 100 kg	71 fr.
Total value of the season	13,008,930 fr.
Number of individuals destroyed	217,002,545

1931—32

Number of herrings examined	783
Mean weight of a day's capture	5,225 kg
Total weight landed in the season	3,383,750 kg
Mean value of 100 kg	108 fr.
Total value of the season	3,642,806 fr.
Number of individuals destroyed	34,992,241

1932—33

Number of herrings examined	1,000
Mean weight of a day's capture	4,514 kg
Total weight landed in the season	2,673,185 kg
Mean value of 100 kg	91.50 fr.
Total value of the season	2,446,867 fr.
Number of individuals destroyed	29,405,035

1933—34

Number of herrings examined	1,479
Mean weight of a day's capture	7,600 kg
Total weight landed in the season	7,455,800 kg
Mean value of 100 kg	75 fr.
Total value of the season	5,577,441 fr.
Number of individuals destroyed	76,861,050

1934—35

Number of herrings examined	1,200
Mean weight of a day's capture	14,632 kg
Total weight landed in the season	12,322,990 kg
Mean value of 100 kg	31.52 fr.
Total value of the season	3,856,044 fr.
Number of individuals destroyed	123,553,199

1935—36

Number of herrings examined	1,300
Mean weight of a day's capture	11,120 kg
Total weight landed in the season	8,595,895 kg
Mean value of 100 kg	62 fr.
Total value of the season	5,328,754 fr.
Number of individuals destroyed	81,965,880

Number of herrings examined in 6 years: 6,929

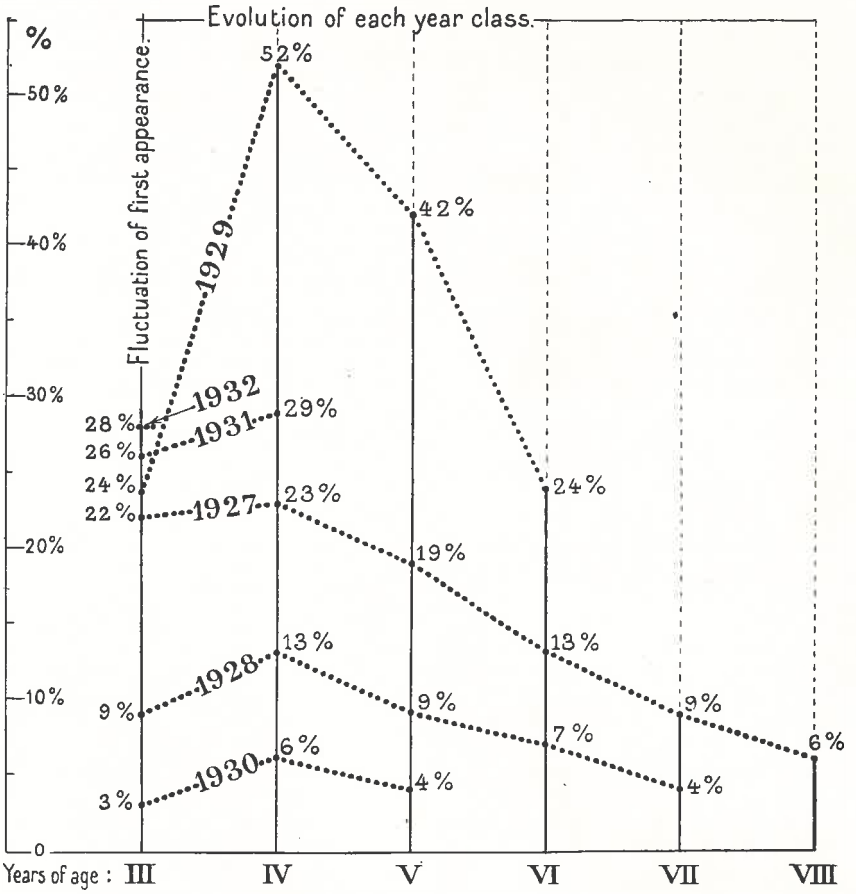

Fig. 2.

composition of certain larger communities of other kinds of herrings in the North Sea.

To these data I beg to add a few remarks concerning the probable cause of the fluctuation of the successive generations and of the strangely constant character of the evolution of each of them.

1°. The causes of *fluctuations* may be of various orders:

a) a group may have been poor from its origin, as a consequence of a deficient production of eggs in the ovaries or of unfavourable external conditions at the time of hatching and first development of the larvae;

b) external conditions prevailing after the spawning of the spent herrings may have been such as to directly favour, or, conversely, to oppose the coming of the spawners to our region in great number. External circumstances may thus have been partly the regulating factor of the abundance or scarcity of spent herrings in the resting place of our coast.

2°. The cause of the strangely *regular oscillation* in the number of spents, reaching our coast in successive years, appears much more difficult to determine. Why do the spawners of any generation appear in larger number, as spents, on their second coming to our coast, — that is: why are they constantly more abundant at the age of 4 years than at 3 years? Why are they always coming in greater number at four years than at three?

As an attempt to explain this curious fact one may perhaps accept the following, somewhat risky, hypothesis: let us admit that, out of the lot of herrings that have spawned in the southernmost part of the Flemish Sea, not all but only a certain number come to our coast to recover after the fatiguing operation of spawning, — others, being less fatigued, are able actively to swim away with the residual current and never touch our coast. The next year, however, as herrings of 4 years, they lay a greater quantity of eggs and, being more fatigued, they have a stronger tendency to remain in coastal water to rest. But, in the 5th year of age, and afterwards, they seem to suffer less from the spawning and a smaller number of them require a period of rest in the close vicinity of the coast, — the stronger ones leaving continuously the spawning grounds and swimming away to other regions. Meanwhile, the causes of mortality are in action and the number of herrings of each generation is gradually reduced to complete extinction.

I submit these facts, remarks and deductions to those of our colleagues who pay special attention to the general question of fluctuations and of their causes and mechanism. Personnally, I am of the opinion that the results of a few more years of continuous observations are needed before the causes and mechanisms of the fluctuation and of the general evolution of the successive generations composing our annual shoal of spent herrings can be determined with satisfactory precision. If confirmed by further records, these remarks may lead to the conclusion that variations, either angular or sinusoid, when presenting a certain degree of constancy and regularity, are due to causes inherent to the living organism, whilst the causes of irregular or unsettled variations of biological phenomena must be looked for preferably in the less regular play of external conditions of environment.

A corollary of this conclusion, if sound, would be that one of the most variable of external causes of mortality, the action of the fishery, — tremendous as it seems to be, — has not yet been able to affect the normal biological cycle of the herring, and, as yet, is by no means threatening to the fishing industry.

The above explanatory remarks I present as a mere working hypothesis for further investigations and tending simply to show how urgently the solution of certain biological questions is in need of positive data that can only be expected from a continuous survey of the physical and biological conditions in the intermediate region Channel-North Sea.

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