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8.

Variation of Year-Classes in an annual Concentration of Fish.

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Variations in the composition of a shoal of fishes depend either on internal agencies affecting the living organism itself, or on certain changes occurring in the environment.

Peculiar conditions observed in the sea may foretell alterations in the normal composition of certain fish concentrations, or, inversely, changes appearing in the composition of a shoal may reveal that, in the past, peculiar conditions must have been prevailing either in the constitution of the organism of the fishes or in their environment.

In fact, the nature and mechanism of the correlation between actions developing in the sea and qualitative or quantitative changes in the composition of shoals of fishes are not always easily detected, as will appear from a few remarks on the work done by us in late years on spent herrings in the intermediate region between the Channel and the North Sea.

In the diagram Fig. 1 are exhibited, in the form called "biological scale", the results of continuous observations made at Ostend during the last eight years on the remarkable concentration of spent herrings that come every winter regularly to the French-Belgian coast to spend there a period of rest without feeding. The step of 1937—1938 in the biological scale is additional to the diagram of the years 1930 to 1937 presented last year to this Committee.

Fluctuation.

The superposition of the annual blocks in the first column on the left side of the scale, Fig. 1, when followed from 1927, above, downwards to 1938, shows the fluctuation in the concentration of three-year-old herrings considered at the time of their first appearance in the wintering station. The same fluctuation is also clearly shown in the linear diagram Fig. 2, first vertical line on the left side. The fluctuation figures for the following years are pointed on the next five vertical lines on the right.

The percentage of the latest class, born in 1934, is rather high: 26 %, which is satisfactory as, in the past years, a high initial proportion has always prognosticated a good percentage in the subsequent years.

Oscillation.

Concerning oscillation, let us first remember that we have proposed the term as indicating the variation of the percentage in the evolution of one and the same generation of fish considered over a series of consecutive years. In the columnar diagram, Fig. 1, the oscillation may be followed from one year to the next by moving one column from left to right as one goes down one step. In the linear diagram, Fig. 2, the oscillation is marked by the dotted lines for each of the seven generations that have been under control since the year 1930.

The two diagrams, Figs. 1 and 2, show the remarkable fact that all year-classes (since the season 1930—1931) in their second appearance on the coast — that is to say at the age of four years — show a higher percentage than at three years. We have tried, last year, to explain this curious fact as follows:

> "The remarkable constancy of this phenomenon leads us to consider it as dependent upon an internal cause, inherent in the physiology of the fish. The fourth year seems to mark the critical age at which mortality in a group of living organisms, being very high immediately after birth and having greatly diminished for a certain period (until the fourth year in the case of herring), again becomes more intense down to the complete extinction of the group."

This year, however, we find for the first time a peculiar feature in the oscillation of one brood of spents, i. e., the young class born in 1933, being now one year older than in the last season ought to have shown a higher percentage than at its first appearance in 1936—1937.

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

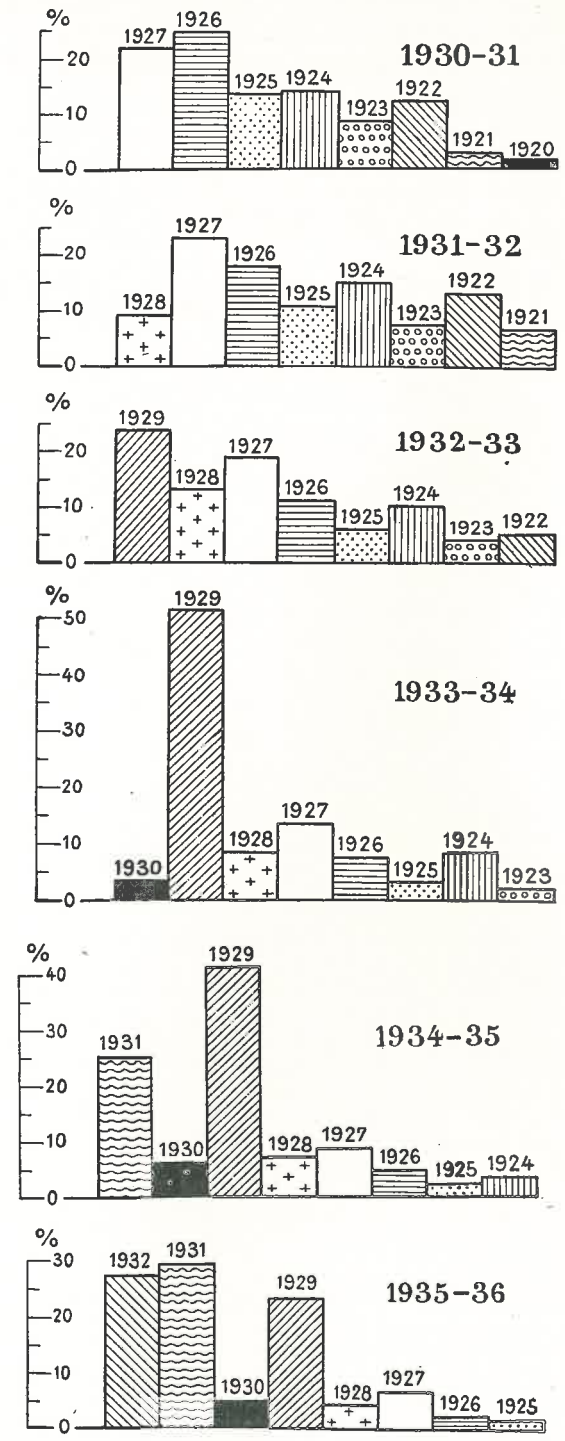
Number of herrings examined	1,479	
Mean weight of a day's capture	7,600	kg.
Total weight landed in the season	7,455,800	kg.
Mean value of 100 kg	75	fr.
Total value of the season	5,577,441	fr.
Number of individuals destroyed	76,861,050	

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	

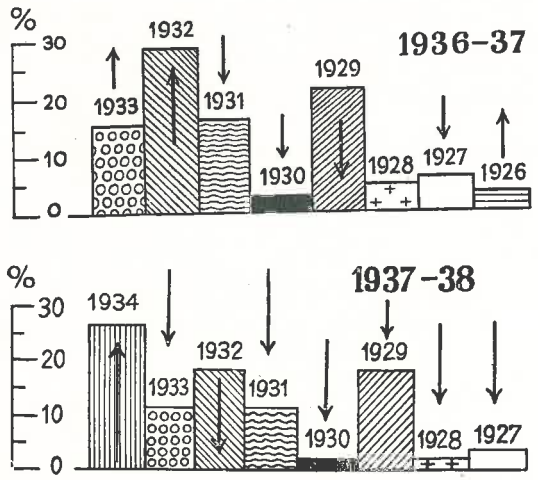
1935—36

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	



Balancing of percentages: number of individuals of each year-class in 100 fishes.

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



Balancing of percentages: number of individuals of each year-class in 100 fishes.

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

1936—37	
Number of herrings examined	625
Mean weight of a day's capture	7,319 kg.
Total weight landed in the season	3,132,460 kg.
Mean value of 100 kg.	72 fr.
Total value of the season	2,258,225 fr.
Number of individuals destroyed	31,211,269

1937—38	
Number of herrings examined	575
Mean weight of a day's capture	5,568 kg.
Total weight landed in the season	807,425 kg.
Mean value of 100 kg.	96 fr.
Total value of the season	774,629 fr.
Number of individuals destroyed	6,892,754

Number of herrings examined in 8 years	8,129

Instead of this we find that its percentage is distinctly lower, it has fallen from 15·5% in 1936—1937 down to 12% in 1937—1938. Its oscillation line in the diagram Fig. 2, instead of bending upwards as might be expected, takes a downward direction.

It will be interesting in future seasons to follow the fate of the class 1933 and to investigate the cause of its low percentage appearing at the very time when an increase was expected and to see whether this reduction is final in the evolution of this class or will be mended next year by a belated addition of herrings then in their fifth year of age?

This seems to show that the rule of an increase of the percentage in a concentration of fishes between their third year of age and the fourth is not an unbreakable law, and that certain accidental causes may interfere with the normal play of hydrographical and biological phenomena.

Peculiar conditions prevailing in the sea may act on the fluctuation of fishes in two different ways:—

1. They may have an influence on the spawning and hatching of the eggs and the welfare of the young larvae, and so affect the abundance of the new generation which will appear in the third subsequent year, as spents, after their first spawning season.

2. They may exert an immediate influence over the then living spent herrings and either drive them in great numbers towards the coast or lead them away from it.

In both cases the fluctuation of the herrings in their usual resting station on the coast will be affected in one way or the other.

The low mean weight of a day's capture in 1937—38 seems to be in correlation with the particular conditions of wind and currents as observed on the "Sandettié" lightship during the period December 1937—February 1938. See the article by Dr. CARRUTHERS in the Appendices.

As to oscillation, we do not see how it could be directly affected by external actions.

Changes in temperature, salinity, pH, wind, motion of water, plankton etc., may very well have an influence on the total shoal of fishes living in a limited region and so affect the fluctuation in a succession of years. But no deviation from the normal play of natural forces could exert a selective action on one particular brood and affect its percentage separately in the composition of the annual concentration: all year-classes in the shoal would be affected at the same time, and their proportion would remain unchanged under the law of the balancing of percentages. The density of the concentration might be altered, but not the percentage of any of the classes: the oscillation line, no other trouble arising, would suffer no deviation.

We may conceive, however, that an entire year-class might be affected by a pathological or congenital predisposition, and so be liable to suffer from an alteration in the environment more deeply than the other

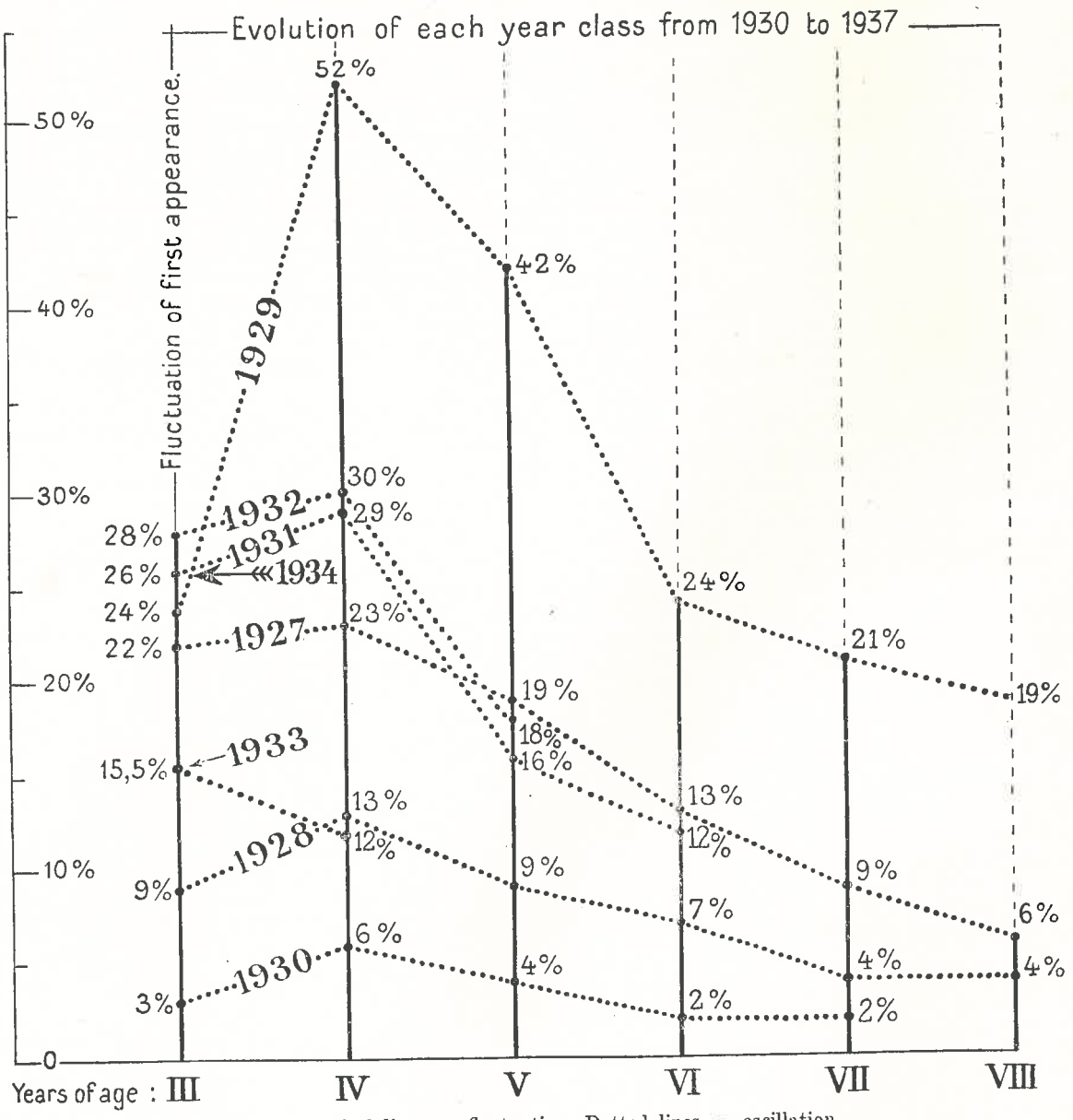


Fig. 2. Vertical lines = fluctuation. Dotted lines = oscillation.

classes in the shoal. But that very sensitiveness would be the effect of internal peculiarities or dispositions and the external actions would be only accessory in the reduction of the number of the units.

These remarks lead us to the conclusion that whilst the fluctuation of a community of fishes may be affected by external actions prevailing in the environment, the oscillation of each particular age-class is dependent on internal organic conditions.

Forecasts.

As predicted in 1937, the concentration of 1937—1938 has shown a still good proportion of herrings of 5 and 6 years, with an important remnant of the remarkable class 1929. Besides that it was expected that the class 1933, just appeared with a passable initial percentage of 15·5% and supposed to be in its augmentative stage, would also supply a passable percentage. In fact, however, this was not the case and the unusual reduction of class 1933 in its 4th year was a surprise.

For the season 1938—1939 it is not possible seriously to draw a forecast, seven of the year-classes being already in their reduction stage, including 1933 that ought to have been in augmentation. We may expect that the remnant of the class 1934, then aged 4 years, will predominate, unless 1933 should show a not less unusual belated enrichment in units.

Quantitatively, there is no sign of a favourable fishing season and we can only wish for the fishermen that favourable meteorological and hydrographical conditions will prevail in the spawning grounds of the SW. and drive plenty of spent herrings towards Gris Nez and Ostend.