

A study of seasonal variations shows that there is a definite period of poor fishing in February-March, and that there are three maxima, in January, April-May, and August-October. It is deeply interesting to see that the fishery shows a monthly variation, the catches being better at new than at full moon.

A painstaking account of the monthly distribution of the bream on the fishing grounds is then given, illustrated by charts. These are based on the records in the skippers' log-books mentioned above. The region of best fishing apparently moves north from lat.  $49^{\circ}$  in December-January to lat.  $54^{\circ}$  in September, and then moves south again. It is necessary to recognise two distinct regions, separated by the 49th parallel of latitude.

In the far more important northern region, the author notes that the time of best fishing falls later in the year as one goes from south to north, and that the two maxima in the fishery, which occur in December and April in latitude  $49^{\circ}$  N, approach each other as one moves north, until in lat.  $54^{\circ}$  N. they are confounded in one maximum of large amplitude in September.

He explains the period of poor fishing in February-March thus: the second concentration of fish (or improvement in the fishing) in April-May, occurs in shallower water than the first (December-January), and this arrival in the shallower water takes place progressively later from south to north. The time between the two concentrations is spent in midwater, out of the reach of the trawl. The dates of this vertical migration are consonant with the dates of the advance of warmer and more saline water on to the Continental shelf, and the bream may remain in midwater in these more favourable water-layers. Further north, this vertical migration becomes less marked, and disappears to the west of Ireland.

The author has made the best of his available data. But the bream (unless there has been a drastic change recently) is not a fish primarily sought for; it is an important by-product of the hake fishery. In such a case, where the seasonal changes in the depth and localities fished by the fleets bear no relation to the concentrations of the fish being studied, but to those of another species, obviously data on a very large scale and from a very wide area are essential. Had the author had the good luck to possess such ideal data, many of his difficulties might have vanished, and some of his hypotheses have proved unnecessary.

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**Gérard Belloc.** "Contribution à l'étude de la sardine des côtes françaises de l'Atlantique (entre Loire et Gironde)." *Rev. des Trav. de l'Off. des Pêches Mar.* Tome V, Fasc. 2, No. 18. Paris, 1932.

In September, 1930, a committee of experts met at Lisbon for the purpose of discussing and deciding upon uniform methods to be adopted by all workers engaged in any ichthyometrical study of the sardine. At the conclusion of the meeting it was agreed that the schemes of work which had been drawn up<sup>1)</sup> should be set on foot as early as possible in all the various regions where sardine fishing is carried on to any great extent. The task envisaged by the committee is the comprehensive study (by many workers in different places) of the entire sardine population along the western shores of Europe, as it is not to be expected that the separate contribution of an isolated investigator in a restricted locality will, by itself, supply anything like

<sup>1)</sup> See the *Rapp. Atl.*, 1930, for full details.

complete solutions to all the many problems which remain still unsolved in the life-history of this fish.

The paper under review embodies the results of researches undertaken by the author in accordance with the recommendations of the above-mentioned committee. The investigations were carried out during the 1931 sardine season over a region lying between Loire and Gironde, on the Atlantic seaboard of France. Along that part of the coast sardines regularly appear inshore between May and October. They move away from the land and descend into deep water during the winter months.

The first part of the report describes the vessels and explains the methods normally employed in the sardine fishery carried on from the main ports within the area — La Rochelle, Les Sables d'Olonne, Saint Gilles, Port Breton, and l'Herbaudière. Motor pinnaces are mostly used, these having largely replaced the older and less efficient motor-auxiliary sailing craft. Every pinnace carries from 4 to 8 small "dories" each of which is set afloat on the fishing ground and, handled by one man, it fishes in the vicinity of the parent vessel. The nets used, generally tinted blue to make them less discernible in the water, are usually from 40 to 50 m. in length and have a depth of from 7 to 9 m. The meshes are of such size that the distance between 5 knots when the meshes are diagonally extended — the "moule" — normally falls between 48 and 60 mm.

In the main body of the report are set forth the ichthyometrical data obtained by examination of numerous samples of sardines drawn mainly from three different fishing localities within the area studied. Information has been collected concerning the size of the fish, the proportions of the sexes, the number of vertebrae, age and growth, sexual development, and the chief food organisms; and the results obtained have been compared with those previously recorded from the same area.

From the constancy of their morphological characters the author concludes that the sardines which inhabit the whole region between Loire and Gironde constitute a single homogeneous population which is characterised by the mean vertebral number  $52.24 \pm 0.18$ . The mean length of the fish examined in 1931 was, however, greater than that of the 1929 samples; this is correlated with the fact that the bulk of the 1931 samples consisted of considerably older fish. Throughout the area females are distinctly less numerous than males but they reach a larger size. Hermaphrodite individuals occasionally are found but do not exceed about 2 % of the population. Examination of stomach contents revealed that, as a general rule, most of the captured fish are gorged with eggs from the roes which are used by the fishermen to attract them. But there are also to be found in the stomachs other food remains, which indicate clearly that at the beginning of the fishing season the sardines (mean length 13—14 cm.) feed mainly upon phytoplanktonic Diatoms and Peridinians (*Navicula*, *Ceratium*, *Peridinium*, etc.) which are at that time plentiful in the sea. Towards the end of the season the fish (mean length 16—19 cm.) feed mainly upon zooplanktonic organisms such as Copepods, Schizopods, and *Sagitta*.

Up to the present the author has been able to obtain no definite information concerning the spawning period (or periods) of the sardines in his area, or concerning the distribution of their eggs and larvae. He expresses the intention, however, of investigating these problems in subsequent seasons. His colleagues working in other localities will look forward with interest, therefore, to the publication of further reports embodying the results of his continued researches.

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