

Such herrings should be branded with the mark "salted at sea". Dr. LISSNER further suggests that State aid should be granted for research voyages to find new fishing grounds, or that the German Herring Fishing-Boat-Owners' Society should undertake this research work at the expense of the companies affiliated to it. Finally he suggests that the herring fishing industry should be lightly treated by the Government as regards taxation and other burdens imposed by the State.

As regards the herring fishing practice he does not consider that the introduction of the Scottish net is essential but he recommends the decrease in the size of mesh in the drift nets used on the German vessels, and he also recommends the use of the English pattern leather buoy. He does not consider that the fishing grounds are always made best use of at the proper times, and he is of the opinion that an extension of the fishing season is both necessary and possible for the German vessels. He considers that an improvement in the organisation for the transmission of news between the herring fishing vessels and the ports would lead to better use being made of the fishing grounds and would lighten the work of the Fishery Protection Vessels. The wireless receiving apparatus as at present in use is regarded as being of little value, and wherever possible wireless telephony should be substituted. Where the cost of this is prohibitive on separate vessels, as is generally the case, the apparatus should be fitted on the leading vessel of a fleet.

Although Dr. LISSNER's paper brings to light little that is new, he has collected much valuable information and gives a clear and concise account of the present position and the needs of the German herring fishery, which will be of considerable use to workers in this field.

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R. SPÄRCK. 1) On the Food Problem in relation to Marine Zoogeography. (Physiol. Papers ded. Prof. Aug. Krogh.) Copenhagen 1926.

2) Studies on the Biology of the Oyster (*Ostrea edulis*). II—IV. Rept. Dan. Biol. Stat. XXXIII. 1927.

1) Hitherto Zoogeography has been considered mainly from a systematic or phylogenetic standpoint. It was Dr. SPÄRCK's aim in writing this paper to stimulate greater interest in the food problem in relation to the Zoogeography of marine bottom animals.

From observations on oysters in aquaria and in tanks he concludes that the difficulties which occur at temperatures above about 20° C. are due to lack of sufficient food under these warm conditions, associated with which are paralysis of the adductor muscle, absence of the crystalline style, and a pale appearance of the digestive gland. Addition to the water of decaying *Zostera* and of glucose appeared to be effective in removing these symptoms.

These observations give rise to considerations of the food supply under natural conditions. SPÄRCK suggests that periodical summer mortalities on oyster beds, and the supplanting of *Ostrea edulis* by *O. angulata* on many of the beds in France, may be due to lack of food during warm periods, or where competition between species or with other genera is an important factor.

He also mentions the difficulty of rearing the larvae of *O. edulis* under conditions where larvae of Annelids and of other Lamellibranchs are able to thrive, suggesting that in natural waters the oyster larva comes off badly when competition for food is severe.

Other instances are given among Lamellibranchs where food supply appears to be the regulating factor in distribution, and where individuals of a species are larger in northern waters than those of the same species in a warm climate.

This short paper serves as a useful reminder of the scarcity of existing information about the natural supply and variations in quantity of food for such animals as the oyster, and the importance of this subject in relation to distribution. The increasing attention which is being given to the physiology of marine animals is likely to provide some basis for estimating food requirements at different temperatures, and advances in the study of Zoogeography may be anticipated in the direction suggested by the author.

2) This paper continues an earlier report, which was recently reviewed in this Journal (Vol. II, No. 1).

The first section deals with the feeding and growth of the pelagic larvae of *Ostrea edulis*. The economic value at the present time of a reliable method of procuring the settlement and growth of oyster spat needs no emphasis.

The author gives results of his experiments made on the rearing of oyster larvae in tanks from 1923—1926, first at Nykøbing, Mors, and later at the Danish Biological Station.

From the outset the main difficulty was recognised as that of feeding the larvae, rather than of inducing the oyster to spawn. Attempts made in tanks with warmed water, with daily renewal of water, and with filtered water proved fruitless. Certain nutrient solutions and emulsions and a culture of the diatom *Nitzschia minutissima* were tried in the laboratory with negative results.

Attention was then given to the value of small green organisms, which were present in open tanks where larvae contrasted favourably in vitality with those in covered tanks.

In July 1925 Dr. SPÆRCK visited some of the Norwegian oyster pools where favourable conditions for production of spat are found, and noted the presence of a small unicellular green alga in considerably greater numbers there than in the Limfjord.

That summer, during a successful experiment by the English Fisheries Department at Conway, a similar alga (*Chlorella*), probably identical, was abundant. He obtained a sample and made cultures from it. The addition of this culture, which later contained other organisms, to the tanks in 1926, though associated with more satisfactory growth than occurred in preceding years, did not result in any settlement of spat. He is of opinion that the food conditions in spite of the measures taken presumably were not good enough, whether from the presence of too many other organisms or too great a growth of bacteria.

It has been noted, however, by the present reviewer during experiments at Conway that a settlement of spat may occur when the appearance of the water is clear and by no means suggestive of any great abundance of organisms. At the same time an excessive growth of a green alga such as

Phaeocystis on the bottom may raise the p_H considerably to a value above that which larvae can stand, viz: about 8.8. Any enrichment of tanks as suggested by SPÄRCK has therefore to be carried out with considerable caution in order to avoid excessive alkalinity.

These experiments form a valuable series, but without any information regarding the p_H of the water, lack of food as the cause of failure must be accepted with reserve.

Section II contains observations on the conditions of the food supply of the oyster. The author mentions how, based on the examination of stomach contents, the view has been held till recently that finely divided particles of organic matter (detritus) must constitute the chief food of the oyster. This material was quantitatively predominant in the localities from which the stomach contents were examined. SPÄRCK noted this predominance in the Limfjord, but his experiments in tanks, which at first appeared to confirm the older hypothesis later indicated that it was not detritus but green organisms especially flagellates on which the oysters fed. His observations in the Norwegian pools during July 1925 showed that stomachs there contained no detritus but almost exclusively green organisms, mainly *Prorocentrum micans*, with numerous smaller green planktonic algae and flagellates. Considering at the same time the recent work of VONK and YONGE on digestion in the oyster, SPÄRCK regards the evidence conclusive that oysters can feed solely on micro-organisms. Data on the extent to which in the Norwegian pools for instance, detritus or diatoms are available at other times of the year, would be of considerable interest.

The fattening of oysters in the French "claires" where diatoms seem to predominate is well known.

The relative value of detritus, however, is at present obscure. It may, as SAVAGE recently found, form at least 90 per cent. of stomach contents, but further work is required to demonstrate how the oyster uses this material as food.

Much work remains to be done on the feeding of the oyster, meanwhile SPÄRCK's observations on the value of micro-organisms are a valuable contribution to the problem.

In his third section the author continues his earlier discussions on fluctuations in the oyster stock in the Limfjord, in which he sought to demonstrate a connection between periodicity of yield and changes in climatic conditions.

He now has available for comparison HAGMEIER's survey of the West Slesvig oyster fishery. The fluctuations there show a marked coincidence with those in the Limfjord. In both localities there were periods of maximum yield round about 1870 and 1915, followed by marked decreases. This is regarded as confirmation of the theory that climate is the most weighty factor in determining good or bad periods, its influence extending over a large area. The importance of natural mortality, varying in extent according to locality is considerable, estimated at not less than 20 per cent. annually in the Limfjord, while fishing accounts for about 8 per cent. Cold is emphasised in connection with winter mortality under open water conditions, and food difficulties, predaceous animals, and overgrowth by competitors for food are presumed to account for summer mortality.

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