

## Reviews.

### Essay-Review.

On Works concerning the Valuation of the Southern North Sea

by

C. G. JOH. PETERSEN. Ph. D., LL. D., D. Sc.

In 1914 I published in Rep. Dan. Biol. Station XXII a hypothetical chart of the animal communities of the North Sea, based exclusively upon fauna-lists in the literature at hand. In this chart an area along the coasts was shown as inhabited by a "*Macoma baltica*" community, while the rest of the Southern North Sea was designated as a "*Venus*" community, excepting only a small part of the central area which, with a query, was indicated as a "*Brissoopsis*" community. As the method used of course could not give reliable results I was very glad to learn that the English Ministry of Agriculture and Fisheries in 1921 decided to start investigations with my "Grab" in the North Sea. In July 1921 the first attempt was made to find out, which animal communities really are to be found in the Southern North Sea, a series of bottom samples being taken from the research vessel "George Bligh" during its voyage from Lowestoft to Esbjerg. The assistant of the Danish Biological Station, Dr. H. BLEGGVAD, accompanied the English naturalists during this voyage; he has in Proc. Zool. Soc. London, April 1922, given a short account of the results. He found 1) in the harbour of Lowestoft a "*Macoma*" community, 2) from the English coast outwards a poor "*Venus*" community, 3) following thereafter an "*Amphiura*" community, 4) nearer the coast of Jutland again a "*Venus*" community, and 5) at Horns Reef a community with "*Syndosmya alba*"; all these are communities which, though containing some few new species, exactly correspond to those found by us in the Kattegat at lesser depths; in deeper water several other communities are found in the Kattegat.

In 1923 the first Report on the "Grab" work carried out by F. M. DAVIS, of Lowestoft, during the years 1921—23 was published under the title of "Quantitative Studies on the Fauna of the Sea Bottom, Part I" (Ministry of Agriculture and Fisheries. Fishery Investigations Ser. II. Vol. VI. No. 2). It gives the results of an investigation of the Dogger Bank, which was found to be inhabited by a quantitatively very rich fauna; especially the two species *Spisula subtruncata* and *Macra stultorum* occurred in big "patches" or "beds", some of these being 700 sq. miles in extension and containing a population of abt. 4,500 Millions of young *Spisula*. DAVIS found the general fauna to agree with my "*Venus*" or "*Deep-Venus*"

community; only towards the edges, and in the deep water off it, it seemed gradually to change into my "*Echinocardium-Filiformis*" community.

During the years 1922—24 similar investigations were carried out by Dr. A. HAGMEIER from the "Biologische Anstalt" of Heligoland (Berichte d. Deutschen wiss. Komm. f. Meeresforschung. N. F. Bd. I. 1919—23) between Esbjerg and the coast of Holland. He found the same communities as BLEGVAD; he could, however, based upon his much more extended investigations, give more detailed information on their geographical distribution and their contents, — for one thing on the occurrence of *Syndosmya alba* in the North Sea. He found this bivalve in numbers round Heligoland from the outer limit of the "*Macoma*" community, where a pure "*Syndosmya*" community, was found, to far out West of Heligoland in the "*Echinocardium-Filiformis*" community; also transitions between the "*Venus*" and the "*Echinocardium-Filiformis*" communities were found here, as could be expected in waters with evenly increasing depths where the transitions from one community to another must play a greater part than in the Kattegat. It is certainly possible to divide the communities in the North Sea into more subdivisions than we find it convenient in the Kattegat; how far one may go in this direction, becomes a question to settle for each separate area of investigation. But in the main lines the best agreement, as to the main communities, was found to exist between the shallower parts of the Kattegat and the South-eastern North Sea, excepting only with respect to *Syndosmya alba*. How this last named fact is to be understood, must for the present remain doubtful; these investigations still are in their beginning.

In 1925 No. 2 of the "Quantitative Studies on the Fauna of the Sea Bottom" by F. M. DAVIS was published (Min. Agr. Fish. Fishery Investigations Ser. II. Vol. VIII. No. 4). In this paper all the work carried out with the "Petersen Grab" during the years 1921—24 has been treated, but in another way than that used in his first paper. Thus DAVIS makes no attempt first of all to get a general view, accompanied by a chart, of the distribution of the different communities in the North Sea; he takes another way, trying to orientate himself by making the texture of the soil, the inorganic particles or at any rate the non-living material, the basis of the classification of the existing associations of animals. Although it may sometimes be possible by this method roughly to follow up the occurrences of the communities, still there will be so many exceptions from the rule, that the method seems to me to be very dangerous. If anyone intended, as I from the beginning did, to get knowledge as to which areas of a sea have identical faunas, his obvious course would have been to examine the animals themselves, and not to make a circuit, which is known to be impossible to employ with respect to several species, thus for instance absolutely not in the case of the "*Macoma*" community.

DAVIS refers to the fact that the characteristic of the communities of the Kattegat does not appear to be adequate to the whole of the North Sea; this is very probable, it is just the thing which has to be investigated. But if the Kattegat communities do not agree with the conditions in the North Sea, then some other communities must be set up on the basis of the new investigations. DAVIS himself says page 16 that "communities do undoubtedly exist".

I understand, however, very well the difficulties connected with these investigations in the North Sea in many places, for the fauna is often poor as compared with that of the Kattegat, and the bottom conditions are often "patchy" or "a mosaic of soils"; furthermore so few characteristic communities are to be found in the Southern North Sea that we easily may lose the general view of the conditions there, with the many gradual transitions between the communities. But I believe that we still more will lose the general view if we do not stick to the living animals but proceed to set up some different sorts of "soils", in which the different communities then have to appear. I understand quite well that DAVIS wishes to remove any subjective estimate from these investigations, and it may, especially where the fauna is poor, be difficult to class single bottom samples with certainty among definite communities; but then more samples must be taken. DAVIS therefore has tried in a quantitative manner to classify the material of the sea bottom in different groups, according to the size of its particles and suggests thus to exclude his own subjective estimate, but has he thereby hit the opinion of the animals about the matter? Several of them do not ask about the size of the sand particles but about other factors, we do not know which, and they are asking about many factors. One of these, and an essential one, is persecution from carnivorous animals, another is food competition. The answer of the animals themselves, here can I live, and there I cannot, seems to me to be the fundamental fact in this matter. Experience will show how far we can get by taking "soils" as a basis for orientation among the animals of the sea bottom; the work of DAVIS is in its very beginning, and it is difficult for the reader to orientate himself in the results; a synoptic chart is not given. One thing, at any rate, is certain:— the Danish animal communities cannot be forced into frames determined exclusively by the nature of the soil.

However, whether it may be chosen to work in one way or another, we will surely in the course of time get valuable information on the fauna of the North Sea and, especially, on its importance as a fish food; in this respect DAVIS has already rendered good work. But examinations of fish stomachs must be carried out side by side with the Grab work; DAVIS, too, wishes this to be done in the future.

In his two papers DAVIS has given much valuable information on the biology of some of the bottom animals, especially with respect to the rate of growth, breeding, spatfall and mortality of *Spisula subtruncata*, a species which is of the greatest importance as a fish food in the Southern North Sea. Thus it is shown that the growth in the first year is of the order of 12—15 mm., that in the second year of 2—4 mm., and that in the third of 1—2 mm. Breeding takes place from the beginning of June to the end of September, the animals being sexually mature by the end of their first year. The mortality has been shown to be especially heavy for the 0 group, thus in one case amounting to 33 per cent. in 49 days. As to the various causes of this mortality, DAVIS by an examination of the dead valves comes to the result that 87 per cent. of the mortality was due to fish, 9 per cent. to Natica and only 4 per cent. to "other factors". The growth of *Maetra stultorum* was shown to be very rapid during the first months of life; DAVIS found an increase of 7.55 mm. in mean length in 63 days, from August till October, or an increase of 167 per cent. during this period. The mor-

tality in the same period was 70 per cent. The two above named bivalves, *Spisula subtruncata* and *Maetra stultorum*, have proved to be the dominant species of the Dogger area, therefore this information about their life history is of the greatest value.

It has been a great pleasure for me to see that quantitative bottom work has now been adopted by the countries bordering the North Sea. for its importance is great for the understanding of the fisheries and their fluctuations. That the different investigators have different opinions on the principles upon which the investigations in the different seas shall be based, was to be expected beforehand. In the course of time the most adequate principles surely will be followed during the continuation of these investigations.

OSCAR SUND. Merking av sei i Nordland Sommeren 1921. Report on Norwegian Fishery and Marine Investigations. Vol. III. No. 5. pp. 18. Tables 4. Plates 3. English Summary. Bergen 1925.

The Norwegian Fishery Department is to be congratulated on this large-scale marking-experiment on *Gadus virens*. Over 2000 fish were liberated, 1000 young fish (3—5 years old) at Gildeskaal near latitude 67° N., and 1119 large fish near the Lofoten Islands.

In the four years that have elapsed since the experiment between 6 and 7 per cent. have been recaptured; 116 or 6 per cent. within a year of marking, 19 or 1 per cent. in the second year, and 3 fish in the third year. This is the usual experience in marking round fish, and the reduction in the percentage of returns in the second and subsequent years reminds us of the necessity of improving the technique. This is important if we are to investigate the relation of the young immature populations with the spawning shoals. In this experiment the Norwegian "silver-coin" mark was used for the small fish, and PETERSEN'S bone and brass label for the larger. Both types were attached to the operculum.

All Dr. SUND'S recaptures were in Norwegian waters, although the experiment was widely advertised in other countries. The Lofoten and Gildeskaal fish intermingled. One of the Lofoten (large) fish went North as far as Tromsø, but two migrated to southern Norway. None of the small fish migrated any long distance to Southward, but two went far to the Northward, one as far as Arnö, another to Finmarken.

Dr. SUND wisely refrains from being led by this difference into the tempting conclusion that the small fish work to the Northward and the large to the Southward. The numbers do not warrant it.

Altogether 112 out of 139 recaptures were from within 20 kilometers of the place of liberation, and Dr. SUND concludes that, in spite of the interesting cases of long-distance migrations, it is "very remarkable how many have stayed for many months in the vicinity of the place where they were set free". Of course to find a fish after an interval even within a mile of the position of liberation is not conclusive evidence that it has remained there all the time. It has been shewn that 6 almost certainly mature cod liberated on the rocks at Flamborough Head before the spawn-