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On the Norwegian Research Work concerning *Pandalus borealis*.

BY

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During the years 1933 to 1936 we have conducted, from the Biological Laboratory, investigations into the deep-sea prawn fishery. The results of these are shown in a paper entitled "Deep-Sea Prawn Fisheries and their Problems", which Professor HJORT and I have written, and which has been published as *Hvalrådets Skrifter* Nr. 17.

In this paper we have reviewed the development of the prawn fisheries from their commencement in 1898 up to, and including, the year 1935, and reported on our own investigations in recent years.

Our studies were based mainly on trawling experiments for the purpose of investigating three different problems connected with present day prawn fishing:

1. Trawlings were first undertaken on the old trawling grounds to enable us to obtain a basis for judging the effect of 35 years of fishing on the size of the prawn stock, and also that we might study the fauna on the grounds as it is revealed in the trawl catches.

2. Furthermore, with the help of experienced prawn trawlers, we carried out a survey of the extent of all known prawn-grounds, and investigated the possibilities of expanding the industry in waters hitherto not fished, namely those of the Norwegian Channel to the north of the Reef off Egersund.

3. As a natural consequence of the experience thus gained, we continued with a series of trawlings with gear of different sizes of mesh, to enable us to determine whether prawn trawling is or is not carried on in a rational manner.

The investigations which HJORT undertook in collaboration with Dr. BIGELOW in the Gulf of Maine in the autumn of 1936 yielded further material of interest for our problems.

The following is a brief summary of our results:

1. Our trawling experiments on the old trawling grounds clearly showed that the yield of the fishery

had declined considerably. For instance in the Oslo-fjord inside Drøbak, the average yield in 1905 to 1906, a few years after the commencement of the fishery, was some 44 kg. per fishing day. In the years 1934 to 1936 the average yield for the trawlers working on a commercial basis was from 8 to 13 kg. per fishing day. And this decrease has taken place in spite of improvement in gear and the increased knowledge of the grounds gained over a period of 30 years.

In the case also of the prawning grounds on the Reef, which were first worked as recently as 1929 and 1930, the latest reports show decreasing catches. This trend in the yield of the fishery is, however, a natural consequence of the fact that an old and accumulated stock is fished when a fishery first commences, whereas, after the lapse of a few years, the yield of the fishery becomes dependent on the annual renewal of the stock.

2. Our survey of the existing and possible new trawling grounds showed that, in southern Norway, there are no possibilities for an expansion of the fishery by extension of the grounds. In the fjords, and in territorial waters, we may assume that practically all possible grounds worth working are known, while in the open waters of the Skagerak, the trawlings on the Reef produced decreasing catches as we moved northwards from the well-known ground off Egersund. From our trawlings in the Norwegian Channel towards Stadt and Tønsen it was evident that a necessary condition for the presence of prawns is a muddy bottom, rich in organic detritus. This was also the experience gained during the trawlings in the Gulf of Maine. The quantity of prawns declines gradually with the disappearance of detritus from the material of the sea bed.

3. Before turning to the results of our trawlings with gear of different sizes of mesh I must mention



that, according to the Norwegian regulations governing the fishing of prawns, the meshes of the prawn-trawl must not exceed 36 knots per Norwegian ell. (Corresponding to a distance between the knots of 1.74 cm. in the dry net.)

Smaller meshes are allowed, and in many cases meshes as small as 44 knots per Norw. ell are in use. The reason for this provision with regard to a maximum mesh is, that the prawn-trawl must conform to a size which entitles it to exemption from the general prohibition against trawl fishing in Norwegian territorial waters.

In considering the question of the effect of the gear on the size of the stock, I must further draw attention to certain facts in the biology of the deep-sea prawn.

When Miss BERKELEY (of British Columbia) took up the study of the biology of different species of *Pandalus* she made the surprising discovery that *Pandalus borealis* and a number of other *Pandalus* species were protandric hermaphrodites. In other words, all individuals first mature as males, and thereafter as females, as which they remain for the rest of their lives.

As long as we believed *Pandalus borealis* to have separate sexes we did not regard the destruction of small prawns in fine meshed gear as a matter of very great importance, since all these small individuals were, without exception, males, and the males did not grow as large as the females. But, knowing, as we do now, that these males will change in a few months into females, their destruction becomes of serious consequence to the renewal of the stock of large prawns, and it is the large prawns which obtain the best price, which form the bulk of the exports, and which make the fishery a paying industry.

In our fishing experiments with gear of different sizes of mesh, we used three equally large trawls, one with a mesh of 32 knots, one with 36 knots and one with 40 knots per Norw. ell. With these trawls we made alternate hauls at different seasons, and our results may be summarized as follows:

Gear with a 32 mesh naturally takes the smallest catches of small prawns, but at all seasons the catch

of large prawns is also considerably less in this gear than in the gear with smaller meshes. Gear with 32 knots to the Norw. ell, therefore, cannot be used for prawn trawling without a marked loss in yield and in the profit of the fishermen. Gear with a 36-mesh net did not make a smaller catch of large prawns than the gear with a 40-mesh net, but the catch of small prawns was considerably less. Even in the 36-mesh trawl, however, a considerable number of small prawns are destroyed, especially in the summer, but at this season of the year a certain destruction of small prawns cannot be avoided. At this time the 32-mesh trawl also takes the small prawns in numbers up to 30 per cent. of the total catch.

As a result of these experiments we drew the conclusion that the mesh with 36 knots to the ell, was best suited for prawn trawling, as it secured a good catch and afforded at least a certain degree of protection to the small prawns. We therefore recommended that this size of mesh should be laid down as a minimum, instead of a maximum size as is the case in the present regulations.

We know that most of the fishermen greatly favour this measure for the preservation of the prawn stock, but in certain localities in east Norway they have felt the need of further measures for the protection of the stock and the industry. They have discussed certain steps which might be taken, e. g., a close season, or a prohibition of canning and export in the summer.

The summer, however, is the season with the best weather conditions for the Reef fishery, and in the fishery on the Reef, Swedish and Danish fishermen also participate. A prohibition of canning and/or of export during the warm season would undoubtedly have the effect of reducing the intensity of the fishing in the summer, but these measures, as well as the question of a close season must be carefully considered in the different districts and in the different countries interested in this industry. In this fishery, as in so many others, international co-operation is a *sine qua non* if the industry is to continue to be lucrative also in the future.