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Preliminary results on long period changes in the stocks of some North Sea commercial fish species

by
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For a long time it has seemed desirable to me, to obtain a nearer knowledge on what has occurred in the North Sea since the early times of fishes. I should like to contribute to this question as I have got a rather large statistical material on the German North sea fishery since about eighteen-ninety. By adding all available data from other sources I have tried to extend the outlook as far back as possible, although in the early times the informations were more or less incomplete and incorrect.

I have not been able to finish this work until now and have not taken into consideration the more biological aspects as well as the pure statistics. Therefore I can only now give some preliminary remarks on what seems to be the result.

For the time being I can only dispose of the statistical results for the long-line fishery for haddock of small coastal vessels and for the trawl fishery of sailing vessels which later changed over to motor cutters, all in the German Bight.

As the unit for the calculation of the catches I have taken the fishing trip, which means one day in the case for the long-liners and about one week for the small trawlers. There is not much variation in this respect. But difficulties for the comparability of the catches throughout the whole time of 8 decennaries arise only for the trawlers firstly from the extension of the old seasonal fishery beginning in spring and ending in autumn to the winter months, and secondly from the strongly increased fishing efficiency of the sailers in being converted to motor vessels.

I hope that I shall later be in a position to report also on the results of the steam trawler statistics and possibly to add some new knowledge to what is given now.

In dealing with the development of the stocks and catches of the different commercial fish species concerned, I have devided them into three groups:

The first with increasing yields,
the second with decreasing yields,
the third, the yields of which first decreased and then increased again.

To begin with the first group it seems to me, that most of the increasing species are of no further interest. They are less marketable fish such as dab, flounder, cod and whiting, which in earlier time probably have not been utilized to the full extent or did not appear on the markets or were statistically not separated clearly from other species. Therefore there is no evidence at all that the increase is a real one.

Among this group the plaice is the only one of interest (Fig. 1). This fish has given yields which became higher by several steps corresponding to the fishing efficiency of vessel and gear:

The first step is the beam trawl fishery with sailing vessels with about 200 kg per trip;
the second is the otter trawl fishery with the more seaworthy sailing cutters after the turn of the century with about 400 kg;
then after the first world war the completely motorised vessels rose to about 1000 kg;
and the last step is the fleet of larger motor vessels with stronger machines after the second war with about 2000 kg. per trip.

This narrow relation between the technical efficiency and the yield to be expected therefrom to the yield practically reached of course does in no way support the suspicion of any overfishing. Indeed comparisons of the fishing efficiency result in an increase to about the tenfold, beginning with the sailing vessels and the beam-trawl of the last century and ending with the large motor-cutters of the present time with modern otter trawls. If the later yields on this base are reduced to those of the fishing vessel of the nineties, the curve probably does not show

neither an increase nor a decrease of the stock. In this connection the three peaks of the curve are of no special interest. For the first one I have no clear explanation and I only have to remark, that this peak falls into the same year as when the sole and some other fish declined for the first time; therefore possibly the high yields of plaice can be due to an increased effort to catch plaice instead of the sole. The two later peaks of course result from the interruption of fishing and the corresponding conservation of the plaice population during the two wars. In the years between these peaks a slight decline occurred and probably has to be considered as a result of steady increase in fishing intensity and in the corresponding total mortality.

The second group, that of declining species, has to be divided into two parts. Firstly there are the rays the curve of which (Fig. 2) falls rather evenly during the whole time, interrupted only by slight rises in consequence of the recovery during war times. It seems to me, that the rays offer a nearly ideal example of a really overfished population. And I think the cause will be that the rays produce a rather small number of eggs, the development of which is comparatively very well secured. Therefore the amount of recruits other than in the case of most of our commercial fish species directly depends on the size of the parent stock; recruitment is rather small but independent from outer ecological mortality factors. The stock decreasing by a high fishing mortality produces therefore a number of brood the decrease of which exactly corresponds to that of the parents. Even if the fishing intensity remains on an even level under such circumstances the consequence will be a steady decline of the population and of the catches as described by the curve.

As far as this investigation can show, the rays are the only example of this kind, that is to say of a true overfishing, resulting in a real depletion of the population. And the conclusion may be drawn from this statement, that for all the other species of commercial fish the question of recruitment in dealing with the effect of fishing upon the stocks may be left out of consideration, as it is done in most cases.

Similar curves only seem to be found for the crab Cancer pagurus with a slower decline and for the oyster, the recruitment of which in the open North Sea is quite at random and therefore completely insufficient to compensate for the heavy depletion of the fishery. Therefore the stock of North Sea oyster disappeared very quickly after such a fishery had set in.

The haddock as the representative of the second group of declining species (Fig. 3) offers a basically different picture. Firstly there are strong fluctuations resulting obviously from rich and poor year-classes independent of the size of the parent stock. And the decline itself was not a steady one, but more of the kind of a sudden event within a distinct space of time.

The first sign of decreasing catches occurred when the rise, in the open waters of the German Bight about 1890, did not reach the coastal waters. So it can be seen that on the German coast the haddock fishery since 1886 began to decline, more offshore (Helgoland) since 1890; and after a short rise about 1895 the haddock catches in this whole area declined to almost zero at the turn of the century. The coastal long-line fishery at that time came completely to an end; for the sailing trawlers the haddock became quite unimportant and was more and more substituted by cod and whiting. There were only some short periods of much higher catches during or immediately after the wars, and in smaller degree - obviously corresponding to rich year classes - at other times. The very high peak about 1920 was probably reached by the coincidence of war conservation and rich recruitment.

There can be no doubt at all, that the intensified fishery was active in depleting the stock of haddock, but for two reasons I do not think that overfishing was the only or the main cause for that decline:

First of all the average size of the haddock with the decline of the catch did not decrease - as it should have in the case of overfishing - but it increased, - from about 500 - 1000 grams to 1500 - 2000 grams, that will say to the double and in terms of length from an average of about 40 cm. or a little more to nearly 50 cm.

Secondly in the beginning of the decrease only the autumn fishery declined and ceased almost completely before 1900. But not until that year became the spring fishery also shorter ending in june instead of in august, and this fishery declined and ceased some years later than the autumn fishery.

So it seems clear, that the haddock fishery not merely declined by lack of fish, but that depending on outer influences the structure and seasons of the migration changed.

I think the steam trawler statistics will furnish some additional knowledge in this direction. It seems, that the fishery on the Great Fisher Bank in these early years was mainly carried out during the winter and spring, whereas later on it became a summer and autumn fishery. If that is true, perhaps this area originally was a more important spawning place than in later years. So it might seem possible, that in the last century the migration of a haddock stock which spawned on the Great Fisher Bank touched the German coasts regulary each year. But then, when the haddock withdrew more to the northern part of the North Sea, the migration did no longer extend much to the German Bight.

Some of the first results of steam trawler statistics are shown in Fig. 5 and 6. They reveal that the decline in the German coastal waters was indeed less pronounded in the offshore areas of the German Bight and did not occur at all in the region of the Dogger Bank. On the contrary here the migrating haddock seem rather to have accumulated after they no longer approached the coast. And also the peak of the catches on Great Fisher Bank in the spring, that is about the time of spawning, disappeared in later years and was substituted by a peak in the second half of the year at the time of the feeding migration.

In this connection there is still another point of view, when the German Bight did no longer allow for a paying haddock fishery, owing to the changes decribed, the steamers turned to the middle North Sea grounds. There they were fishing in the area of distribution of the spawners as well as in that of the young fish, and therefore the percentage of small haddock suddenly increased largely. That was indeed the case in the nineties, and this fact was then taken as a sign of overfishing - which perhaps may not be quite correct, at least not in full extension, but could be a secondary effect of the supposed natural change in the North Sea haddock stock and the resulting displacement of fishing activity.

In summarizing all these preliminary observations, the result might be, that although in no way the facts of overfishing can be denied, it was by no means the only cause of the changes. Perhaps a natural narrowing of the area of distribution and of the migration of the haddock simultaneously with an intensifying fishery resulted in the decline of the haddock fishery in the North Sea. Quite generally the question arises whether natural causes or overfishing are active, and obviously cannot in all cases be answered in a distinctive way, but the interaction of both is possibly far more common than it is thought until now.

The third group, represented mainly by the sole, is highly interesting (Fig. 4). For here the catches first decreased similar to the haddock and the rays; but after the minimum point was reached about 1910, a rise began again.

It is not quite clear, whether the catches become smaller already since the seventies and whether the peak some years after 1890, was caused by secondary influence or if it was a reality at all. (Possibly there is an interrelation between the changes in the stock of haddock, plaice and sole, in the corresponding yields of these species and the relative amount of fishing for each of them.) But most probably the main decline in this group occurred some years later than that of the haddock and was less steep, continuing rather steadily from about 1895 to about 1910, and then an equally steady rise began again.

The data immediately taken from the statistics show that the sole at present time is fished about 3 times as nummerous per fishing trip than it was at the beginning of the fishery and 20 times as much compared with the minimum about 1910. If it is correct, that the fishing efficiency has increased tenfold, then the amended curve would show an increase of almost tenfold since the minimum, and the present size of the stock would be about one quarter or a little more of that 80 years ago. That means that, the real decrease would have diminished the stock to not more than 5% of its initial strength as far as it is known and then would have risen again to the fivefold of the minimum. What has been the influence of the fishery in these events of decrease and increase and how the development of the sole population would have been without being disturbed by the fishery cannot be estimated.

Several other species show a curve of catches very similar to that of the sole: in the first line the turbot and further the brill, but this latter species does not increase beyond 1938. Also the gurnard seem to belong to this group, although their increase did not begin until the outbreak of the second world war and therefore is also somewhat similar to that of the rays. However they did not decrease so steadly as the rays, but more suddenly equal to the other species of this group, and recently these occurred also a very much stronger increase than there did for the rays.

Apparently this whole group is one of the southern and warm water species, and that is the first point of special interest. It would be quite reasonable to suppose, that the increase during the last forty years has been caused by rising water temperatures. And as a consequence the decline during the decennaries before would then be supposed to be the effect of a cooling down of the water - but I did not find any clear proof of that.

The second point of special interest is, that here we see several commercial fish stocks without any doubt rise in spite of an equally undoubtable intensification of the fishery. At least the sole is the object of a special fishery branch and could therefore in no way escape any damage - if such a one would result from an intensified fishery. So in my opinion the sole and the fact of its increase is an example which could apply also to other commercial fish species and to the problem of the effect of the fishery to the stocks generally, and therefore should be taken as a warning not to overestimate the effect of overfishing

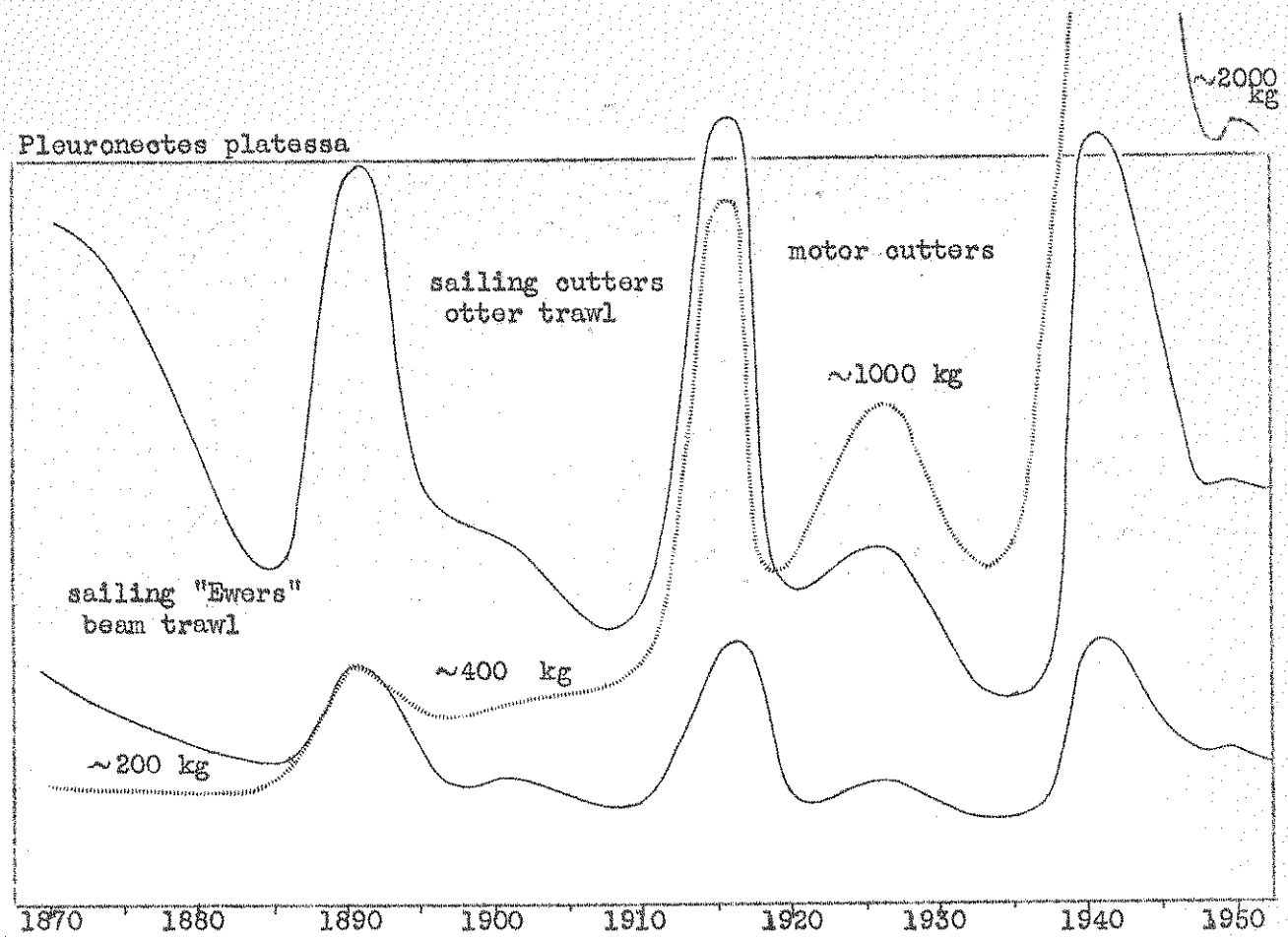

Fig. 1. Curves of the catches of plaice per fishing trip of German sailing and motor cutters (trawl) in German Bight. Heavy lines: after the original statistics, fine lines: corrected on the base of an estimated 1 : 10 improvement of the fishing efficiency. For unity the peaks of most curves is set = 100 (height of the frame line).

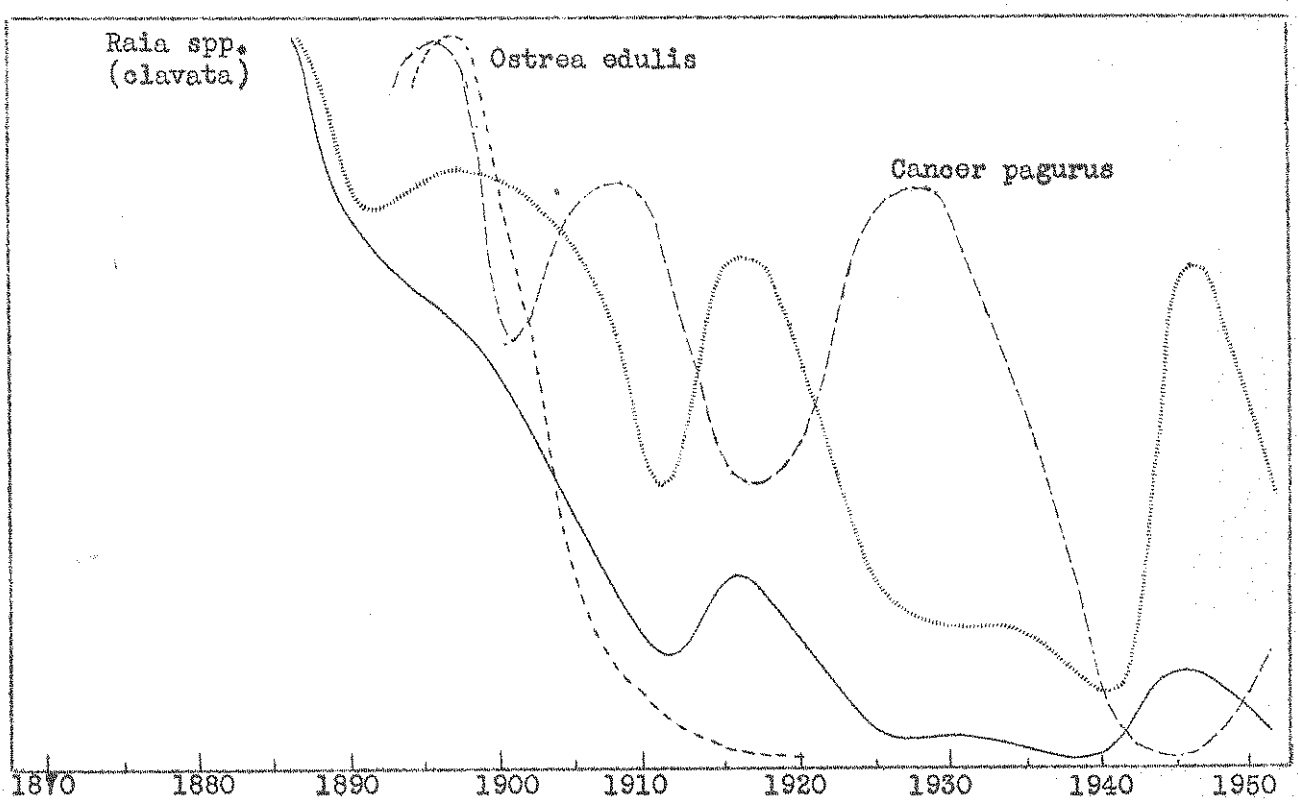

Fig. 2. Curves of the catches per fishing trip of German sailing and motor cutters (trawl) in the German Bight: decreasing species. Further comment as in Fig. 1.

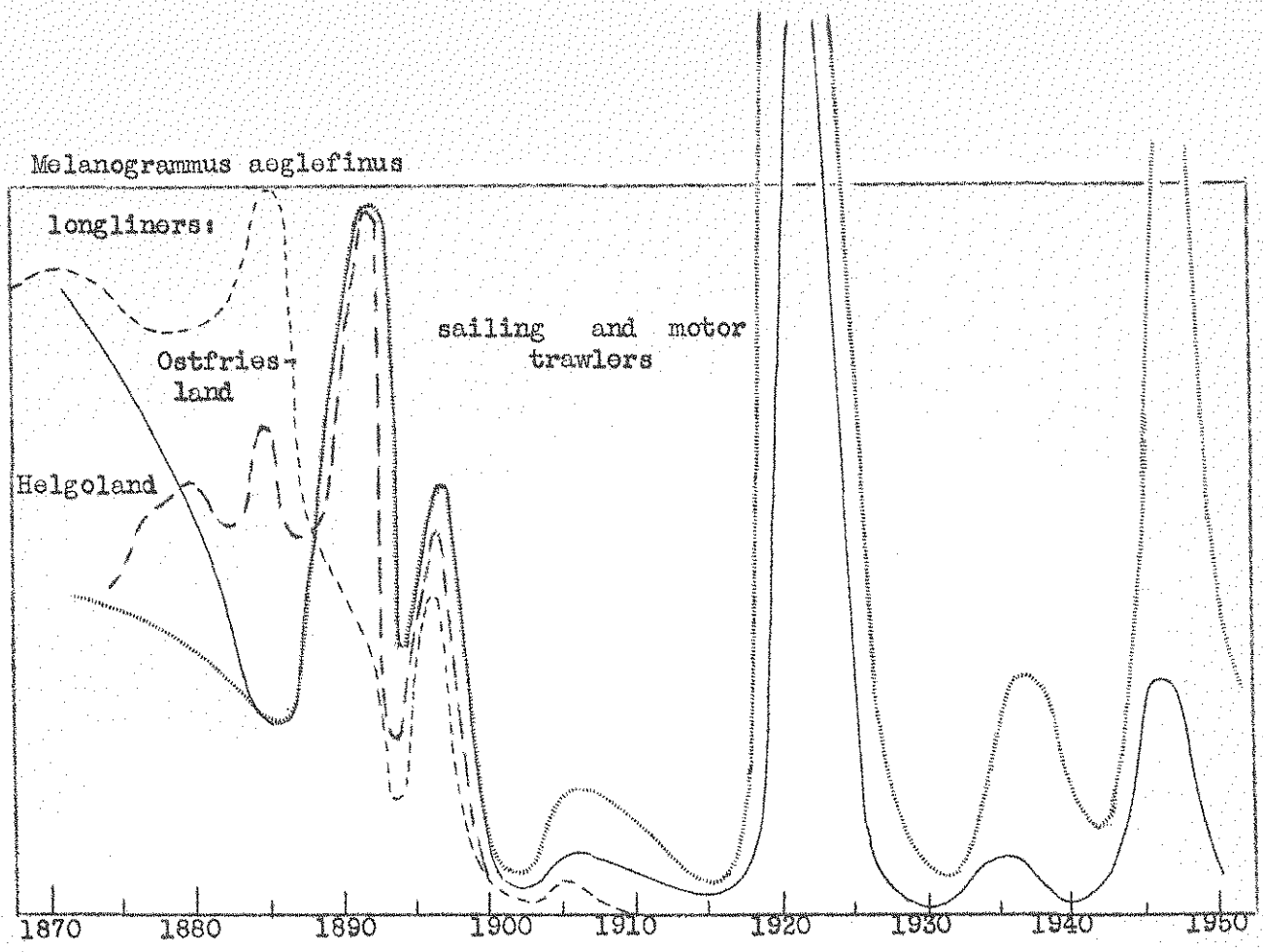

Fig. 3. Curves of the catches of haddock per fishing trip of German sailing and motor cutters (trawl) and of coastal long-liners in the German Bight. Further comment as in Fig. 1.

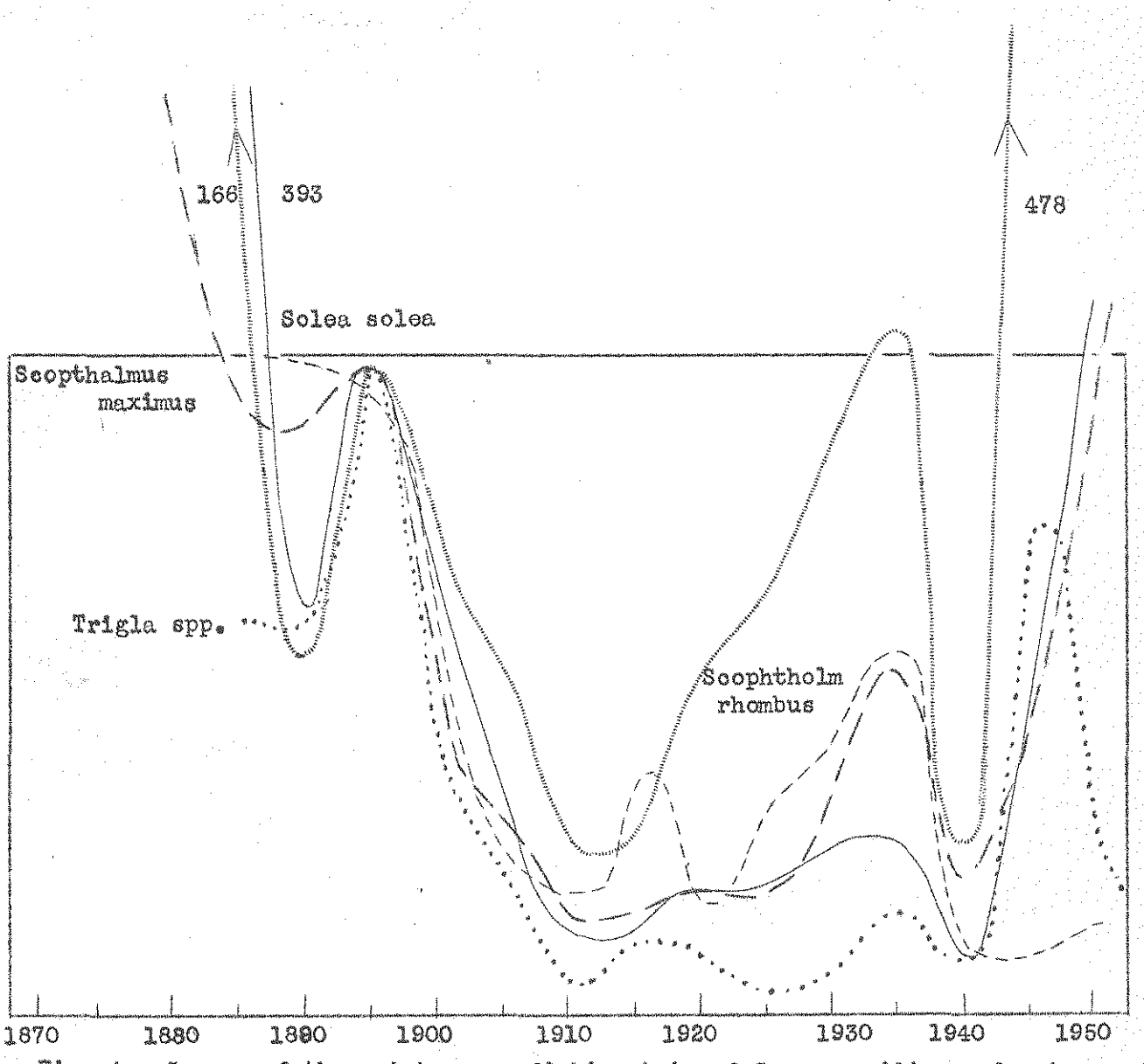

Fig. 4. Curves of the catches per fishing trip of German sailing and motor cutters (trawl) in the German Bight: species decreasing and the increasing again. Further comment as in Fig. 1.

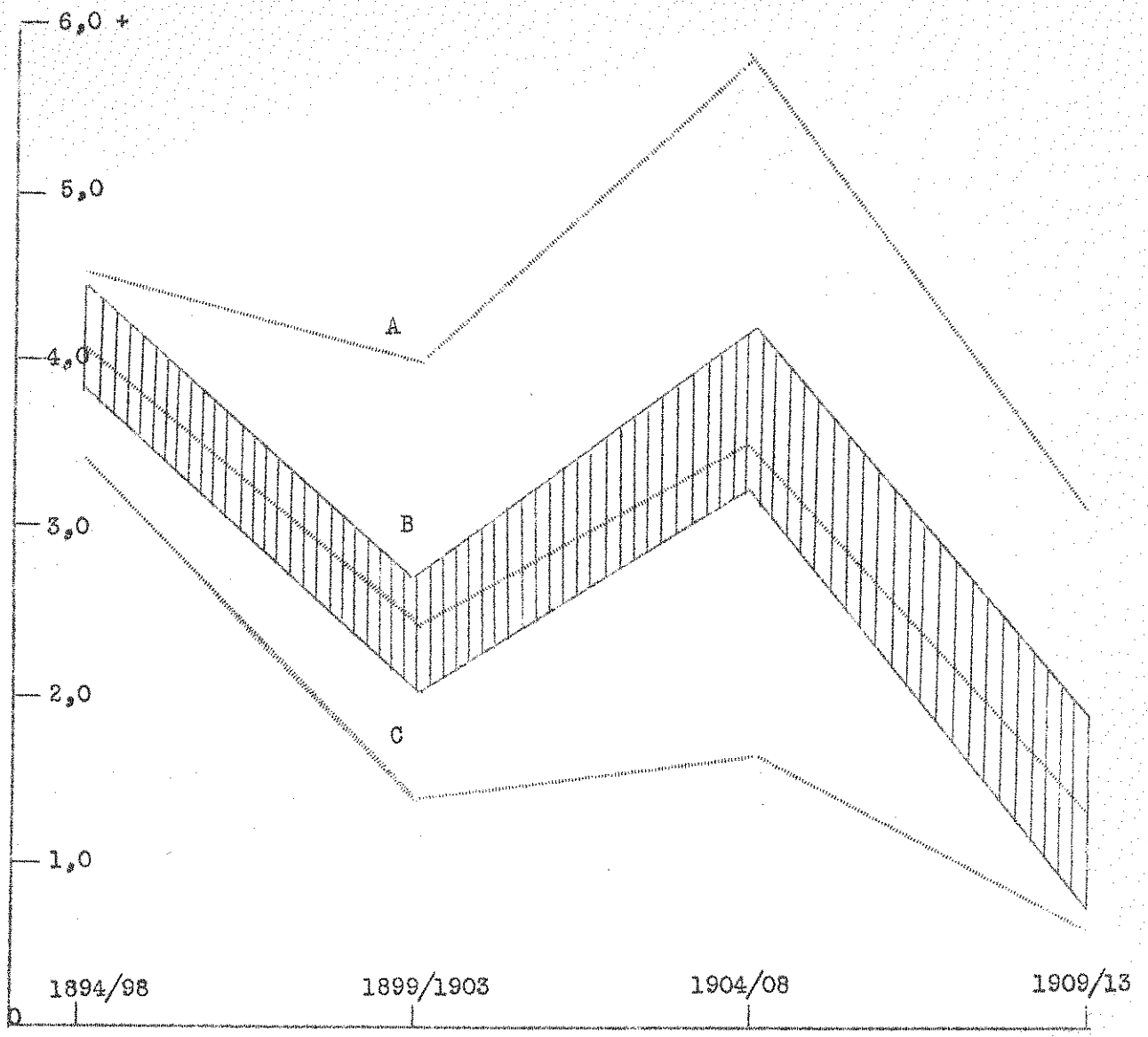

Fig. 5. Average catch of haddock per fishing trip of steam trawlers
A Doggerbank,
B Outer German Bight (with limits of variation between fishing places),
C Inner German Bight.

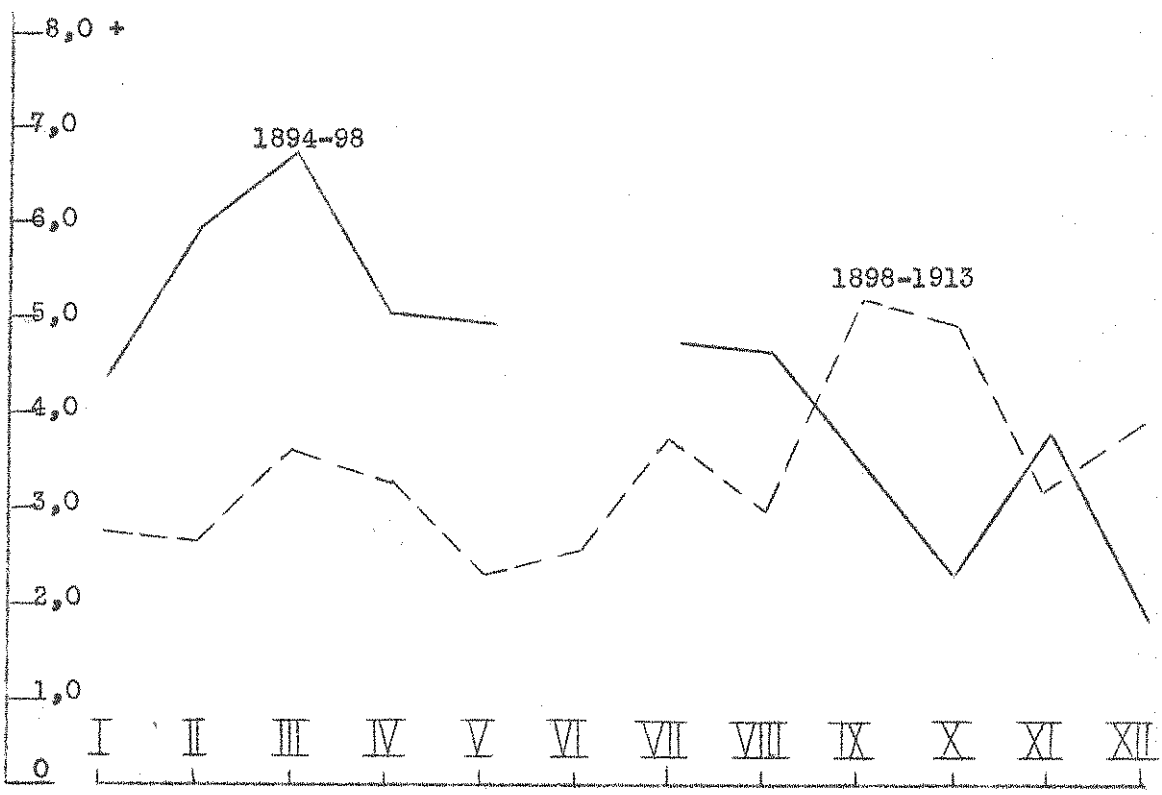

Fig. 6. Monthly average catch of haddock per fishing trip of steam trawlers on the Great Fisher Bank during and after the decline of the haddock in the German Bight.