

ICES-CH-1955-Near Northern Seas-63

International Council for the  
Exploration of the Sea

C.M. 1955  
Near Northern Seas Com.  
No.

63



EFFECT OF THE DANISH "INDUSTRIAL" FISHERY ON THE  
NORTH SEA COMMERCIAL WHITING FISHERY.

Second Review, 1955

Marine Laboratory  
Aberdeen

Effect of the Danish "industrial" fishery on the North Sea  
Commercial Whiting Fishery.

Second Review, 1955.

(From the Marine Laboratory, Aberdeen)

Introduction

It will perhaps be useful first to review a few points from the Aberdeen paper prepared on this subject for the I.C.E.S. North Sea Committee, and subsequently for the Liaison Committee and the Permanent Commission, in 1953.

1. Attention was drawn to the possibility that fishing might be passing through a historical change whereby fish of sub-legal or even immature size might be regarded in some countries as more valuable than the larger ones. This appears to be true of the Danish industrial fishery in general, as it may well be of some other fisheries. Whereas Denmark has only a very small interest in fishing whiting for human consumption, their industrial fishery in the North Sea, Skagerrak and Kattegat combined developed from about 11,000 tons in 1946 to 129,000 in 1952. One published account estimated that the 1952 catch contained over 43,000 tons of whiting (over 30,000 from the Skagerrak and Kattegat and 5 to 10,000 from the North Sea), but it is understood that the Danish scientists regarded this as a considerable over-estimate - perhaps twice as large as it should have been.

2. In association, the North Sea whiting fishery for human consumption had increased from about 35,000 tons in the "thirties" to a maximum of 73,000 tons in 1951, and for the Scottish fishery (quite the largest) 41,000 tons in 1952.

3. However, the available data on whiting growth in the North Sea showed that the approximate equilibrium yield per recruit for ages at first capture of 0.5, 1, 1.5, etc. years could be expected to increase until at least two years of age, when the whiting would normally be above the minimum legal size of 20 cm. So that scientific evidence alone could not justify exploitation of the whiting stock at any size below the existing minimum landing size, corresponding to an age of about  $1\frac{1}{2}$  years. Indeed, it was pointed out that grounds could be found for increasing the age of first capture.

4. While this point seems quite clear, it was admitted that data on various other aspects of the biology of the whiting and its fishery were inadequate, so that subsequent estimates were necessarily approximate. Whilst it seemed clear that there were three main nursery grounds - in the south-east, in the east and in the north-west - the relative sizes of these is not known with certainty, although the available evidence suggested that they might be comparable. More direct evidence suggests that there is little or no spawning in and beyond the Skagerrak so that the young whiting fished in those waters are considered to drift in as fry and subsequently to return to the North Sea as mature fish. It is quite clear that the principal commercial yield of adults is taken from the north-western North Sea, while the principal yield of immature fish is taken from the Skagerrak and Kattegat. Points on which information is lacking are (a) the quantities of unmarketable fish rejected from the fishery at different times during the present century (although it seems clear that this quantity has diminished considerably since the war, thus partly accounting for the larger commercial catches); (b) the extent to which the relatively pelagic life of the whiting results in over-estimates of the toll exerted on the stocks by conventional methods; and (c) environmental influences.

5. For all that, it remained possible to make a rough estimate

of the probable effects of the industrial fishery upon the adult stocks. The principal immediate effect is exerted within the Skagerrak and Kattegat and might be expected therefore to have greatest influence on the commercial fishery in the eastern North Sea. It was noted that, in contrast to the steadily-increasing fishery in the north-western North Sea, the U.K. fishery for whiting in statistical squares M and N 7-14 had been much less productive after the war than before, although that for plaice, for example, was rather higher. Allowance for growth and an improbably heavy natural mortality suggested that the industrial catch of 0+ and 1+ whiting might be expected to have contributed at least twice their weight as legal-sized recruits; so that recruitment to the commercial stocks as a whole might have been a third higher, with the possibility of a corresponding increase in the commercial yield. Corresponding calculations made by a Danish scientist implied that the effects might have been as low as 5-15 per cent., while those by an English scientist provided an estimate of approximately 50 per cent. Insofar, however, as the estimated weights of whiting taken in the industrial fishery were incorrect, the English and Scottish estimates would in any event have needed to be reduced - perhaps by one-half. But it remains true in more general terms that for the effects of the industrial fishery on the yields from the adult fisheries to be negligible, it would be necessary to assume very high values for natural mortality in the relevant calculations.

7. Finally, a brief review of conventional herring trawling, in which a proportion of immature and mature whiting are taken, was made and suggested that while the quantities concerned were not inappreciable the effects of the Danish fishery were by far the greater.

8. Certain suggestions were made which might ameliorate the effect and one of these (the 10 per cent. minimum of the International Convention) was subsequently adopted.

#### The present position

According to information provided at the recent meeting of the Permanent Commission, the Danish industrial catch is still increasing considerably, although certain changes are taking place. The catch increased from 129,000 tons in 1952 to 152,000 tons in 1953 and 182,000 in 1954. In comparison with 79,000 tons in the first half of 1954, the catch during the first half of 1955 had increased to 99,000, from which an approximate estimate for the whole of 1955 might be of the order of 225,000 tons. The annual increases are appreciable; whereas that between 1950 and 1951 was 48,000 tons it had dropped to 19,000 tons between 1951 and 1952 only to increase to 23,000 tons in the next year, 30,000 tons in the following year and, by inference, the increase in 1955 over 1954 might well be of the order of 40,000 tons. On the other hand, we were informed that sandeels now represent an appreciable proportion of this fishery, having increased from nil in 1952 to nearly 11,000 tons in 1954, with 34,000 tons in the first half of 1955 - so that this represents a considerable proportion of the increase. Further, the proportion of (presumably immature) whiting in the industrial fishery is now said to be 9 per cent. in accordance with the maximum limit of 10 per cent. set by the Convention. Consideration should also be given to (a) evidence from Germany regarding the catching of under-sized fish in their "Oel hering" fishery, where the quantities of whiting are estimated to be well under 5 per cent. (of which under one-third are under-sized) and (b) the Swedish memorandum, concerning investigations in the Højen area, in which evidence was presented for a fairly steady decrease in the proportion of legal-sized whiting from 25 per cent. in January, 1939 down to 7 per cent. in February, 1955. None of the information given in these three memoranda was detailed, and some of the data may be regarded as insubstantial, yet they do seem to provide evidence for real attempts to limit the catch of whiting in the industrial fishery

although there is still ground for appreciable concern. The rate at which the Danish industrial fishery has been increasing is perhaps the most serious of these. Even discounting the quantity of sandeels, it has increased in the two years since 1952 by no less than 40,000 tons, and there is good reason to suppose that it will be appreciably higher in 1955. With its maximum immediate effects within the Skagerrak and Kattegat, effects on local whiting stocks such as those mentioned in the Swedish memorandum should not be surprising. Finally, it should be noted that both the Danish and the German statements refer to the appreciable quantities of legal-sized fish caught by these methods, which, by definition, make use of sub-legal meshes.

While the period since 1952 is all too short for firm conclusions to be drawn, it should certainly be noted that the Scottish whiting catch from the North Sea has fallen heavily in the last two years (from 41,000 tons in 1952 to 33,000 in 1953 and 27,000 in 1954), and the Aberdeen catch per hundred hours trawling has fallen by over one-third (although catch per unit is very variable in this fishery). Meanwhile, the fishery in squares N and M 7-14 has decreased a little further (in contrast to the plaice, which has increased), although it should be noted that there were signs of this decrease as early as 1949. It may not be without significance that (a) the catches of marketable whiting in the regions nearest to the Danish industrial fishery (i.e. the Højen area and along the Danish coast) have fallen most, (b) that the catch for the North Sea as a whole reached its peak in 1951 (as far as we know) and (c) that the Scottish fishery, mainly in the north-western North Sea, attained a peak in 1952 and has since fallen sharply. Further, the decrease in the Scottish fishery, as shown by North Sea statistics, is confined to the trawler landings, taken over a wide area; there has been no corresponding decrease in the seine net landings which are largely from more coastal waters, including the Moray Firth, and thus furthest from the Danish region! There is thus some reason for regarding these data as evidence of an effect which might be "diffusing" as it were, across the North Sea. These statistics should be seen, however, in the knowledge that the Scottish whiting fishery is closely integrated with that for haddock, whiting to some extent being a substitute for the latter. There have been good haddock catches in recent years which may have discouraged any tendency to continue increasing the whiting catches. On the other hand, any such factor would be expected to influence the seine net fishery at least as much as the trawl fishery, if not more so, and it seems significant that it did not do so.

Perhaps one more point should be stressed, i.e. the fact that the equilibrium yield per recruit is not attained until well above the present minimum size of 20 cm. At the time of writing the last report, this minimum size was particularly in mind, but it is very relevant that the best estimate of the age of first capture for the maximum equilibrium yield (fishing mortality rate of 1.0) may be as high as 5 years - i.e. it should not pay to fish whiting below a size of 35-40 cm. In practice, density dependent factors might reduce this to 3-4 years (30 cm.). A representative graph is appended and a table, illustrating the equilibrium yield at different levels of natural mortality and age of first capture (and with the usual assumptions regarding growth and mortality, etc.). No likely alternative growth rate would alter this result appreciably.

In the light of all these results there can be no cause for decreased concern, and it seems essential (a) to discourage positively any further increase in this fishery, and (b) to maintain the 10 per cent. limit.

TABLE I

Statistics relevant to consideration of the Danish industrial fishery ( x 1000 tons)

	Danish Industrial fishery	Total commercial whiting catch in Skagerrak, Kattegat and Belts Sea	Total commercial whiting catch in the North Sea	Total Scottish commercial whiting catch in the North Sea	Scottish trawl whiting catch in the North Sea	Scottish seine whiting catch in the North Sea
1946	11	7	36	18	9	9
1947	24	6	46	23	12	10
1948	41	4	59	27	16	11
1949	41	4	36	14	8	6
1950	62	3	45	16	9	7
1951	110	3	73	34	17	13
1952	129	4	73	41	22	14
1953	152	3	63	33	18	11
1954	182	-	-	27	11	13

TABLE II

Yield per RWC

$T_p^1$	$M$	$A_M$	$F = 0.5$ ( $A_F = 39\%$ )	$F = 1.0$ ( $A_F = 63\%$ )
0.5	0.2	18%	0.05563	0.02381
	0.4	33%	0.02778	0.01480
	0.6	45%	0.01547	0.00969
	0.8	55%	0.00932	0.00661
1.0	0.2		0.07126	0.03889
	0.4		0.03551	0.02406
	0.6		0.01972	0.01566
	0.8		0.01183	0.01062
1.5	0.2		0.08945	0.05951
	0.4		0.04385	0.03581
	0.6		0.02383	0.02252
	0.8		0.01392	0.01468
2.0	0.2		0.10812	0.08315
	0.4		0.05108	0.04731
	0.6		0.02655	0.02803
	0.8		0.01473	0.01712
2.5	0.2		0.12529	0.10586
	0.4		0.05558	0.05164
	0.6		0.02718	0.03070
	0.8		0.01424	0.01757
3.0	0.2		0.14075	0.12808
	0.4		0.05851	0.06256
	0.6		0.02677	0.03167
	0.8		0.01285	0.01647
4.0	0.2		0.15861	0.15805
	0.4		0.05977	0.06471
	0.6		0.02195	0.02743
	0.8		0.00922	0.01183
5.0	0.2		0.16259	0.17053
	0.4		0.04872	0.05792
6.0	0.2		0.15615	0.16916
8.0	0.2		0.12779	0.14272
	0.4		0.02170	0.03200
	0.6		0.00422	0.00521
	0.8		0.00059	0.00084

$M$  = Instantaneous natural mortality rate  
 $F$  = Instantaneous fishing mortality rate  
 $R$  = Recruitment at age 0.5 years  
 $W_\infty$  = Asymptote of Bertalanffy growth curve  
 $T_p^1$  = Age at first capture

The corresponding "annual" rates of fishing and natural mortality, which would represent the proportion of the total numbers dying from each cause, in the absence of the other, is related to the instantaneous rate as follows:-

$$\left. \begin{aligned}
 \text{(Annual fishing mortality rate)} &= A_F = 1 - e^{-F} \\
 \text{(Annual natural mortality rate)} &= A_M = 1 - e^{-M}
 \end{aligned} \right\}$$

EQUILIBRIUM YIELDS OF WHITING AT  
DIFFERENT AGES OF FIRST  
CAPTURE FOR TWO LEVELS OF FISHING  
AND NATURAL MORTALITY

