

Report of the North Sea Working Group

The North Sea Working Group was set up at the request of the Liaison Committee at the 1967 Council Meeting.

The meeting was held in Copenhagen from April 25th - May 3rd 1968, and the following members participated:-

E. Bertelsen	Denmark	(Chairman)
J. Møller Christensen	Denmark	
E. Ursin	Denmark	
H. Knudsen	Denmark	
A. Hysten	Norway	
D. Danielsen	Norway	
G. Rauck	Germany	
P. Hovart	Belgium	
G. Lefranc	France	
J. P. de Veen	Netherlands	
R. Jones	United Kingdom	
M. J. Holden	United Kingdom	

The objectives of the Group were to produce, for each of the stocks of cod, haddock, whiting, plaice and sole:-

- (a) a historical review of the fishery, and
- (b) an assessment of the present stage of these stocks with particular reference to the effects of changes in mesh-size and fishing effort.

In view of the magnitude of the task and the relatively short time available the Group decided to make mesh-assessments their primary objective and to devote such time as remained to the historical review and to effort assessments.

Historical Review

Statistics of total landings are tabulated in Tables 1-3 and plotted in Figures 1-3 and 5 and 7.

No statistics are available for measuring total effort directly and so only indirect estimates can be given. These have been obtained by dividing the total landings by all countries by the landings per unit effort in the same year by various classes of vessel. On the assumption that the landings of the selected vessels are representative of the landings of all vessels, this technique provides estimates of total effort in units of effort of the vessels used.

In general, the results are satisfactory, but there are instances when very different results are obtained, according to which class of vessel is used (e.g. effort in English and Scottish trawler hours for cod, 1966). This sort of difference is significant, if only because it illustrates the difficulty of obtaining reliable estimates of total effort by this method. These estimates, being based on the ratios of landings to landings per unit effort, rest on the assumption that the landings per unit effort come from vessels whose operations are representative of those of all vessels. In general this may be so but instances can occur in which an unrepresentatively low landing per unit effort can lead to an exceptionally high total effort, or vice versa.

A further point of difficulty in interpreting such data arises due to the undoubted increase in gear efficiency that has taken place with time. Where this is not allowed for, post-war landings per unit effort will, for example, be artificially high in relation to pre-war landings. In that case also, post-war effort estimates will be artificially low in relation to pre-war effort. These limitations of the data should be borne in mind when interpreting long-term trends in the effort data.

Cod

Landings (Tables 1 and 4; Figure 1)

Before the war the total landings by all countries showed a decline. From 1920 to 1938 in fact, landings declined from 156,000 tons to 71,000 tons. After the war, there was a decline for a few years but then, from 1950 onwards, landings increased. From 1962 onwards the rate of increase was particularly large and by 1966, total landings had reached the record value of 228,000 tons.

Available data show that the largest quantities of cod come from areas IVa and IVb and suggest, on the basis of incomplete statistics, that the quantity coming from IVb is greater than that coming from IVa.

From year to year, landings fluctuated considerably, but this was largely due to fluctuation in year-class strength. In recent years several good year-classes have been known to contribute to the increase in landings. South of the Dogger Bank there was a good year-class in 1963 and this has caused landings from IVc to increase in 1965 and 1966. North of the Dogger there have been good year-classes in 1961, 1964 and 1965 and these account for the recent increase in landings from areas IVa and IVb. Only in the case of landings from Norway has the effect of these good year-classes not been experienced. This was because most of the Norwegian landings have come from close to the Norwegian coast from a stock of cod separated by deep water from the rest of the North Sea and apparently not part of the main North Sea cod stock.

Landings per unit effort (Tables 5 and 6; Figure 1)

In general, landings per unit effort exhibited the same trends as were shown by the total landings. In particular, landings per unit effort were higher after the war than before the war. Also, since the war, the tendency has been for landings per unit effort to increase rather than decrease.

Effort (Tables 5 and 9; Figure 4)

Comparisons of pre- and post-war levels of effort gave somewhat different results according to whether English or Scottish trawler hours were used. Effort in English trawler hours, appeared to be lower after than before the war. In Scottish trawler hours effort was also lower after the war, although to a smaller extent, but it then appears to have increased to a level greater than that pre-war. The two methods gave very different results for 1966 in particular. In this instance, however, it seems reasonable to suppose that the estimate based on Scottish steam and motor trawl hours is more likely to be correct. In 1966 there would have been few English steam trawlers left. As already pointed out, this sort of difference serves to emphasize the difficulty of interpreting effort data calculated in this way.

Haddock

Landings (Tables 2 and 4; Figure 2)

Before the war total landings of haddock were cyclical. They decreased from 1907-1917. Then they increased until 1920 and then decreased to an all time minimum in 1935. From 1947-1963 they fluctuated about a level of 80,000 tons, the fluctuations being readily explainable in terms of good and bad year-classes (Jones, 1966). In 1964 the landings rose and continued to rise to reach 272,000 tons in 1966. This was due to the effect of the 1962 year-class which was the strongest year-class recorded in the North Sea.

Haddock come mainly from areas IVa and IVb, the percentage coming from area IVc being of the order of 1% or less. Haddock landings since 1963 require special comment. These rose due to the 1962 year-class which according to sampling by Scottish research vessels must have been about 15 times as great as the four or five preceding year-classes. This augmented the catches of all countries except those of Norway which, as in the case of cod came from a separate stock of coastal fish. Particularly striking were the landings by Denmark in 1964, and by the USSR in 1966.

Danish landings increased from 2,700 tons in 1963 to 72,000 tons in 1964. This occurred because in 1964 the haddock of the 1962 year-class had reached marketable size in the eastern half of areas IVa and IVb and the vessels engaged in the Danish industrial fishery changed to fishing for haddock as a protected species. About 98% of these haddock were landed for fish meal.

Also striking is the value of 86,000 tons recorded for the USSR in 1966.

Landings per unit effort (Tables 5 and 6; Figure 2)

The long-term trend in the landings per unit effort by English trawlers shows a decline from 1926 to 1962. These vessels fished mainly in areas IVb and IVc. Landings per unit effort by Scottish trawlers fishing mainly in areas IVa and IVb showed no such decrease, but tended to increase, rather than decrease, in the long term.

Effort (Tables 5 and 9; Figure 4)

In English trawler hours, effort appeared to be as high as or higher after the war than before. In Scottish trawler hours it appeared to be lower after the war than before.

Whiting

Landings (Tables 3 and 4; Figure 3)

Whiting landings have tended to increase since 1906. From 1906 to 1914 landings were around 20-30,000 tons. From 1929 to 1938 they were around 40,000 tons. Post-war they have continued to increase from about 50,000 tons after the war to 158,000 tons in 1966.

Whiting are landed from sub-areas IVa, b and c in more nearly equal quantities than either cod or haddock.

An important feature of the whiting landings is that some countries catch whiting using small mesh nets for industrial purposes. The quantities caught in this way by Denmark have increased from about 9,000 annually in 1956-62 to about 35,000 tons annually in 1963-66. Germany and France also take whiting in this way but exact statistics of the total amounts taken by these vessels were not available.

Whiting parallels haddock in recent years since the whiting class of 1962 was also very good, although not so good as that of haddock. This year-class, along with the good class of 1961, has caused landings to increase considerably in recent years. Danish landings in particular increased very greatly from 1963 onward, due to these year-classes. These were taken by the vessels that normally engage in the Danish industrial fishery, but which were temporarily fishing for haddock and whiting as protected species.

Landings per unit effort (Tables 5 and 6; Figure 3)

Landings per unit effort by English trawlers, fishing mainly in sub-areas IVb and IVc show a long-term decrease. Those by Scottish trawlers, fishing mainly in sub-areas IVa and IVb, show a long-term increase.

Effort (Tables 5 and 9; Figure 4)

The exceptionally high effort shown for 1966 is unlikely to be representative of the real relative effort in that year. It occurs because in that year the landings per unit effort by English and Scottish trawlers were quite unrepresentative of the landings per unit effort by other vessels and particularly of those by Danish vessels.

Plaice

Landings (Figure 5)

In the inter-war period landings initially fell but started to rise in 1923 as the result of the industrial plaice fishery by the Dutch. In 1924 the Danish seine-net fishery began and landings increased still further until 1929 when they started to decline, mainly as a result of the drop in Dutch and English landings. This fall was partly due to decreases in stock abundance and partly to the prevalent economic conditions.

After the 1939-45 war, catches were high but decreased as stock abundance fell, until 1954 when they started to rise again, surpassing the immediate post-war total in 1963. The marked rise in Danish landings in 1959 resulted from a switch from fishing for sandeels to trawling for plaice, and the increase since 1961 in the Dutch landings resulted from the introduction of the beam-trawl.

Landings per unit effort (Table 7; Figure 6)

A. All North Sea

From 1930 to 1960 English steam trawlers provide the best and most continuous unit of effort (Gulland, 1968). Although the same type of vessel was operating prior to 1930 the introduction of Vigneron-Dahl gear improved their efficiency. Normally a factor of 1.42 has been used to allow for this, based on comparison of the catches of haddock by standard otter trawls and by Vigneron-Dahl trawls (Bowman, 1932), but a comparison of sailing and steam trawlers working in ICES area IVc in the period 1926-30 showed that the increased efficiency may have been as high as 1.85; this factor has been used to raise landings per effort in the period 1909-25, steadily decreasing over the period 1926-30 to unity.

Similar calculations have been made to allow for the increased efficiency of motor trawlers compared with steam trawlers; subsequent to 1960 landings per unit effort by motor trawlers, divided by a factor of 1.2, has been used in Figure 6, because steam trawler landings per effort are unreliable after this year.

The introduction of echo-sounders around 1950 and of Decca Navigators in 1953-56 also increased the efficiency of the boats by allowing them to find their grounds more accurately and fish areas which were previously too rough to be worked without the accurate positioning Decca Navigators permit.

Pre 1914-18 landings per unit effort were low and falling; immediately post-war they were very high (although this may be an over-estimate, depending upon the extent to which the correction factor for V.D.gear is right) but fell almost continuously as effort increased. A similar sequence of events followed the 1939-45 war until 1951 although the landings per unit effort did not fall to the extent which they did in the inter-war period because fishing effort was lower. In this respect the North Sea stocks showed the classic response of declining landings per unit effort in response to increased fishing effort.

However in 1952, landings per unit effort started to rise and have increased almost continuously since, with minor fluctuations. Even allowing for a 10-15% increase in efficiency due to echo-sounders and Decca navigators, landings per unit effort have still increased. Gulland (1968) attributes the increase to a shift of the English fleet away from grounds on which small plaice predominate to the grounds north-west and east of the Dogger Bank on which larger fish predominate. He concludes that this

has effectively resulted in an increase in mesh-size, the expected result of which would be a rise in landings per unit effort.

The English fleet is now fishing mainly upon the German Bight stock of plaice whereas pre-war fishing was concentrated mainly upon the Southern Bight stock. De Veen (1962) presented data which suggested that the growth^{rate} of plaice in the post-war years is higher than pre-war; the Working Group examined these data to determine whether the recent increase in landings per unit effort could partly be attributed to changes in growth rates but found that they were insufficient to state whether there has been any change in the growth parameters given by Beverton and Holt (1957). Data given in Table 26 also indicate changes in the growth rate of the stocks fished by English trawlers but the pre-war data are insufficient to obtain estimates of K and L_{∞} . It is difficult to obtain truly comparable data for these studies because the offshore migration of plaice is size-dependent and also because the technique of age-determination has improved recently, using the burning technique of Møller Christensen (1964); the age of large fish was probably underestimated until this technique was adopted. The data given by Beverton and Holt (1957) are also of little use for comparative studies because they combined data from both sexes which leads to an overestimate of L_{∞} and an underestimate of K depending upon the ratio of males to females in the sample. The Working Group could not determine whether changes in the growth rate had occurred and this subject requires more study. The effect of an increase in K from .095 to 0.15 would be to increase catch per unit effort by approximately 25% at present fishing effort (Figure 13).

B. By sub-areas

The landings per unit effort of plaice by 5-year means from the three sub-areas is shown in Table 7. The higher landings per unit effort in the post-war years, the result of the lower fishing effort, has occurred in ICES areas IVb and IVc, but there is no evidence that landings per unit effort have increased in ICES area IVc over the last 5-year period as they have done in ICES area IVb, as shown by the English steam trawler data. Both the Belgian and English data indicate that there has been a decline in the abundance of plaice in ICES area IVa.

Effort (Figure 6)

Total effort rose rapidly from 1919 to 1930 and then declined due to economic factors. It remained much higher than in any of the post 1939-45 war years, during which total effort has fluctuated around 3.8×10^6 hours fishing (English steam trawler units). The decrease in effort between 1953 and 1959 was mainly due to the Danish fleet switching to fishing for sandeels.

Soles

Landings (Figure 7)

Total landings have increased almost continuously since 1924. The main fluctuations have been caused by the cold winters of 1924, 1929, 1947, 1950, 1958 and 1963; during these winters above average numbers of soles were caught as a consequence of which stock abundance was reduced. The cold winters were usually followed immediately by an above-average year-class which resulted in higher landings as it recruited to the fishery as 3-year-olds. This sequence of events was most marked with the 1924, 1929, 1947 and 1963 winters. If it had not been for the 1963 winter reducing the abundance of soles to one quarter of that in the preceding years landings would probably have risen considerably from 1961 onwards following the introduction of the beam trawl.

Landings per unit effort (Table 8; Figure 8)

It is difficult to obtain a good index of the landings per unit effort for the sole fisheries. English steam trawlers provide the most continuous record, although they are not always fishing primarily for soles. The Working Group also examined other indices which did not provide a continuous record (Dutch steam trawlers, Dutch motor cutters, Belgian motor cutters); it found that these gave almost the same results as the English steam-trawler data which have therefore been used (Figure 8).

A. All North Sea

Landings per unit effort mirrors almost entirely total landings, except immediately after the 1939-45 war, when stock abundance was high, and except after 1963 (Figure 8). Since 1963 the stock of soles has been so low that the English steam trawlers have not followed the traditional East Bank fishery in spring, and their landings per unit effort has in consequence been low. In contrast that by Dutch motor cutters using either otter or beam trawls, and fishing for small soles, has been increasing since 1964-65.

B. By sub-areas

It was not considered appropriate to use landings per unit effort for the whole of each sub-area, but only for selected rectangles for selected periods, because sole fisheries are seasonal and because the grounds upon which they occur are restricted. The results are shown in Table 8. In selected rectangles of ICES area IVc landings per unit effort rose from 1923 to 1938 but have altered little since. In ICES area IVb they rose to a maximum in the period 1953-57 and appears to have fallen since; the rise appears more marked in rectangles I8 and I9 than in rectangles F6, F7, G6 and G7 but the difference may be due to an increase in trawler size which permitted the more distant grounds to be worked more efficiently. In ICES area IVa landings per unit effort also rose from 1923, to a maximum in 1948-52. The Working Group concluded that there has been a long-term increase in the abundance of soles, particularly in ICES area IVb and to some extent in area IVa, but that it is now decreasing again. The increase in landings from 1924 onwards was attributed to this increase in abundance, which in its turn was attributed to long-term climatic changes. The decrease in abundance since corresponds almost exactly to that to be expected from the increase in fishing effort from 0.3 to 0.6 (Figure 16).

Effort (Figure 7)

Total effort, in terms of hours fishing by British steam trawlers, declined slightly from 1925 to 1938. The post-war effort was similar until 1955 when it started to rise rapidly and has increased even more rapidly since 1963. This increase is a result of the expanding Dutch fisheries for soles and the introduction of the beam-trawl.

Mesh Assessments

Mesh assessments were made using the method of Gulland (1961). This provides for each species an estimate of the immediate loss that would result from an increase in mesh-size. It also provides a means of estimating what proportion and weight of the fish so released would eventually be caught by using the larger mesh. The data required for the application of the method are:

- 1) length-composition data
- 2) Selectivity data
- 3) Mortality estimates
 - (a) of marketable fish
 - (b) of fish within the selection ranges of the mesh-sizes concerned
- 4) Discard data.

Length-composition data

Length compositions have been tabulated in the form of numbers actually landed at each age in selected length groups. The roundfish data available are tabulated in Tables 10-22.

Plaice length compositions for English trawler and seiner landings, and for Netherlands otter and beam trawler landings are shown in Table 23. Data were only available for Denmark for 1960 and 1961 but were estimated for other years on the assumption that the ratio of the number of fish in each 5-cm length group in the Danish landings to that in the Dutch landings was the same in each year. Numbers of soles landed in the Danish, Dutch and English trawl fisheries are given in Table 24.

Selectivity Data

Data relating to cod-end materials, mesh-sizes in use, and selection factors for each species are tabulated in Table 26. The sources from which these data were obtained are given at the foot of the Table.

For the purposes of calculation appropriate values had to be chosen for the selection characteristics and the mesh-sizes in use and the values actually used for this purpose are detailed in Table 27. These were taken from Table 26 except in the case of English seiners. These vessels were reported to be using mesh-sizes of 98 mm. This was thought to be true for boats fishing for cod and plaice, but in the case of haddock and whiting, the length compositions of the fish landed by English seiners suggested that a much smaller mesh-size than this was in use. For these species a mesh-size of 70 mm was adopted.

On the right-hand half of Table 27 are shown the 50% retention lengths for each species, gear and mesh-size. For each mesh-size above that in use at present, the mesh-size specified refers to the manila equivalent of the mesh-size that may actually be in use, i.e. for a 90 mm cod-end the 50% retention length for haddock is given as 31 cm. Haddock assessments for an increase in mesh-size to "90 mm" are therefore applicable to an increase in the mesh-size of each gear to mesh-sizes that would retain 50% of the haddock 31 cm in length.

Further selectivity data required in the calculations are shown in Table 28. These show the 50% ages corresponding to each of the 50% lengths given in Table 27. These were determined using the appropriate age/length relationship for each species. Also the differences from the present 50% ages are shown for each species in the right-hand half of the Table. These show for each species and mesh-size the length of time (in years) that it would take for a fish to grow from the 50% length of a present mesh-size to the 50% length of a given larger mesh-size.

Mortality estimates

(a) Mortality rates of marketable fish

Published and unpublished values of Z, the total instantaneous mortality rate, are given in Table 29.

For the calculations, values of E, were required, this being the expectation of eventual capture of a fish that has been released and has survived to the 50% age of the larger mesh. With constant mortality throughout the exploitable phase, $E = F/Z$, the ratio of the fishing to the total mortality rate. No estimates were available of F and this had to be evaluated by assuming a suitable range of values for M, the natural mortality rate. For cod, haddock and whiting this was assumed to lie between 0.10 and 0.25. For plaice a range of 0.1 to 0.2 was assumed and for soles a range of 0.035 to 0.105 was used, the lower value for each of these species being the most probable. Using the values of Z in Table 29, E can be readily calculated from the ratio F/Z . For roundfish the values were of the order 0.75 - 0.85. For plaice the range was 0.62 to 0.81 and for sole the range was 0.82 - 0.94.

To allow for possible variations in mortality with age, some estimates of E were also made for roundfish by using the method described in the Appendix to the Report of the North-Western Working Group (1967). These were made using estimates of the numbers of fish landed at each age in the Scottish trawl and seine fisheries (Tables 30-32). The values of E obtained, using values of M of 0.10 and 0.25 ranged from 0.7-0.9 for cod, haddock and whiting.

(b) Mortality rates of fish within the selection range of the mesh-sizes concerned

Also necessary for the calculations were estimates of the mortality rate during the period in which the fish grew from the 50% age of the present mesh-size to the 50% age of a larger mesh-size. This was necessary in order to take account of the loss that would occur due to the deaths of fish, released by increasing the mesh-size, during the period in which they grew to a size at which they could be exploited by the larger mesh. Mortality during this phase could be partly due to natural mortality and partly due to the activities of vessels fishing for Article 6 species.

Data on the by-catch of Annex II species in Article 6 fisheries are given in the report of the Lienesch Committee (1960) and in the report of the Liaison Committee for 1968. From these some idea can be obtained of the order of magnitude of the mortality on young fish due to these fisheries.

For cod, plaice and soles, mortality due to Article 6 fisheries appears to be very small, and therefore only the effect of natural mortality has been taken into account for these species. This has been assumed to lie within the same ranges as were assumed for older fish.

In the case of haddock it was noted that the landings by Danish vessels normally fishing for Article 6 species have increased enormously in recent years. This increase could be attributed to the effect of the outstanding 1962 year-class and it was considered that once this year-class had disappeared from the North Sea, the haddock by-catch in Danish and other Article 6 fisheries would return to its previous level. That being so, the data indicated that the mortality on young haddock due to the Article 6 fisheries would not be large and could reasonably be taken into account by assuming that the mortality due to it plus natural mortality would be in the range 0.10-0.25.

Only in the case of whiting was it considered that the mortality of young fish due to Article 6 fisheries was large enough to make the total mortality appreciably greater than that due to natural mortality alone. In particular, the by-catch of whiting in the Danish fishery for processing is now rather large. Estimates of the total mortality rate of whiting less than 3.0 years of age (this being the age at which 50% are retained by the present mesh-size) have been made by Knudsen (1968) as being of the order 0.4 - 0.6. These values have therefore been used as values of the total mortality of whiting over the selection ranges of the nets concerned.

The values used in the calculations for E, and for the mortality rates over the selection phase, are summarised below.

	<u>E (over exploitable phase)</u>	<u>Mortality rate (over selection phase)</u>
Cod and haddock)	0.90 and 0.70	0.10 0.25
Whiting))	0.90 and 0.70	0.40 0.60
Plaice	0.6 - 0.8	0.1 - 0.2
Sole	0.82 - 0.94	0.035 - 0.105

Discards

Some data, mostly unpublished, were available to the Group on the quantities of fish discarded at sea. Scottish data did however show that haddock and whiting were discarded in very variable amounts. After examining these data it was decided to treat the whiting landings as though 10% of the catch (by numbers) had been discarded and to treat the haddock landings as though either 10 or 25% of the catch (by numbers) had been discarded. Cod landings were treated as if no discarding had taken place.

Discard data for the English plaice fishery in 1966-67 show that it was less than 5%. This was during the period when the 1963 year-class was present on the grounds in large numbers as small fish. For the Dutch fisheries discard data may be between 10 and 25%. In the Dutch sole fishery they are less than 5% and in Danish sole and plaice fisheries negligible.

Immediate Losses (Tables 33 and 35)

Cod

Immediate losses were very small, even with an increase to a 100 mm mesh these were unlikely to exceed 5%. For this reason, separate estimates for English and Scottish trawl and seine are not given in the Table.

Haddock

Immediate losses were different for the different components of the U.K. fleet. They were smallest for English trawl and largest for Scottish seine. For all gears combined they ranged from 10% with an 85 mm mesh to 44% with a 100 mm mesh.

Whiting

As for haddock, the immediate losses were smallest for English trawlers and largest for Scottish seiners. For all gears combined, values ranged from 11% with an 80 mm mesh to 80% with a 100 mm mesh.

Plaice

An increase in mesh-size would result in the release of very few fish which are at present being caught because the selection factor for plaice is low.

Soles

Immediate losses could be large, even for small increases in mesh-size (Table 35).

Long-Term Gains (Tables 34 and 35)

Cod

For cod the long-term gains were very similar for each gear and alternative assessment, and the results have been combined for all U.K. trawl and seine. The mean values were 3% with a 90 mm mesh and 7% with a 100 mm mesh. No attempt was made to determine the mesh-size that would give the maximum benefits for cod.

Haddock

Values are given for two combinations of E and M and for two levels of discarding. Gains were highest for English trawlers and lowest for Scottish seiners. For all gears combined, maximum gains (of the order of 6-27%) were predicted with approximately an 85 mm mesh.

Whiting

Values are given for two combinations of E and M and for one level of discarding. As for haddock, gains were highest for English trawlers and lowest for Scottish seiners. For all gears combined maximum gains (of the order of 4-9%) were predicted with approximately an 80 mm mesh.

Plaice

Increasing the mesh-size to 100 mm would result in negligible long-term gains. The reason for this is that few small fish occur in the landings because the major fisheries occur on grounds on which fish larger than the 50% selection point for a 100 mm mesh occur.

Soles

Theoretically, long-term gains would be registered by all fleets, even with an increase up to 100 mm mesh (Table 35) but raising the mesh-size to this level could have other repercussions. Soles are severely affected by extremely cold conditions such as occurred in the winters of 1924, 1929, 1947, 1950, 1958 and 1963. Subsequent to these years landings per unit effort fell as a consequence of the mortality caused by the low temperatures, and additional fishing mortality resulting from the increased availability of soles. Over the period 1924-63 this has occurred on average every eight years, and between 1947 and 1963 every five years. Raising the mesh-size to 100 mm would raise the 50% age to 6.3 years (Table 28). In consequence there would be a serious possibility that year-classes would be reduced considerably by low temperatures before they recruited to the fisheries; for example, if a 100 mm mesh had been in force since 1924, all the year-classes from 1924 to 1928 and all those subsequent to 1947 would have been adversely affected by low-temperature winters before recruiting to the fisheries, with the exception of those of 1950 and 1951. Thus it would be unlikely that the theoretical gain from raising the mesh-size would be realised. A more detailed study is necessary to estimate at what mesh-size the greatest long-term gain for all countries might be achieved and how this would be divided on the different fleets.

Comparison with the assessments given in the report of the Ad Hoc Committee

Previously, mesh assessments for North Sea species have been given in the report of the ad hoc Committee (1955).

Assessments of immediate losses for cod, haddock, whiting and plaice in this report are of the same order of magnitude as those obtained in the report of the ad hoc Committee. For soles, larger immediate losses are predicted in this report. The long-term assessments are also comparable for cod, whiting and plaice. For haddock, the assessments in this report lead to a smaller optimum mesh-size than was obtained in the previous report. This is due to the adoption of a larger selection factor for haddock here.

The results obtained for sole agree with those given in the Liaison Committee Report 1963. Any differences can be attributed to taking the present mesh-size in the Dutch and Danish fisheries as 68 mm, instead of 75 mm, and the increased total mortality rate due mainly to the beam-trawl fishery (0.6 instead of 0.3).

Effort Assessments

In order to assess the probable relationship between fishing effort and yield, theoretical curves were plotted, for each species (Figures 9-16). These were constructed on the basis of the Beverton & Holt constant parameter model, and curves are given for

- (a) yield per recruit against fishing mortality rate, and
- (b) catch per unit effort per recruit against fishing mortality rate.

Each of these relationships is plotted for each species for two values of natural mortality. Only in the case of whiting was allowance made for the operations of Article 6 fisheries. This was done by adopting a total mortality rate of 0.4 between the ages of 1.4 and 3.0 years. For whiting it was then possible to make assessments of the effects of changes

- (a) in the fishing effort by all fisheries,
- (b) in the fishing effort by fisheries for Annex II species only with the fishing effort by fisheries for Article 6 species kept constant.

The parameters necessary for calculating the yield/effort curves using either the original formula of Beverton & Holt or its modified form in Beverton and Holt (1964) are given in Table 36.

Results

For all species, a reduction in fishing mortality rate (i.e. a reduction in fishing effort) from its present level should lead to a progressive increase in catches per unit effort.

The effect of a reduction in fishing effort on total yield is different for different species.

Cod (Figure 9)

A reduction in fishing effort should lead to an increase in yield whichever of the two values of natural mortality are adopted.

Haddock (Figure 10)

A reduction in fishing effort should increase the yield for $M = 0.10$ but would have little effect on it if $M = 0.25$.

Whiting (Figures 11 and 12)

The curves in Figures 11 and 12 show the whiting yields, and catches per unit effort per recruit, in the fisheries for Annex II species only. To allow for the effect of the Article 6 fisheries the curves have been plotted as weights per recruit of 1.4 years of age. Figure 11 shows what happens to Annex II catches when effort is varied by proportionately the same amount in both the fisheries for Annex II and Article 6 fisheries. Figure 12 shows what happens to the Annex II catches when the effort is varied in the fisheries for Annex II species only. Naturally, when effort is reduced in all fisheries, the gains to the Annex II fisheries are greater than when effort is reduced in the Annex II fisheries alone.

When effort is reduced in all fisheries, the yield per recruit in the Annex II fisheries increases whichever value of M is adopted (Figure 11). When effort is reduced only in the Annex II fisheries, the yield per recruit increases if $M = 0.10$ but scarcely changes if $M = 0.25$ (Figure 12).

In the time available to the Group it was not possible to calculate the effect of changes in effort on the whiting yield from the Article 6 fisheries or from both fisheries combined.

Plaice (Figures 13 and 14)

The two curves were constructed using the parameters given by Beverton & Holt (1957); additional curves were constructed using a natural mortality rate (M) of 0.20 (Figures 13 and 14). At the lower level of natural mortality, yield per recruit would increase with a reduction in fishing mortality rate to 0.125 but at the higher level there would be little gain. The increased abundance of plaice during the last war did not result in any observable decrease in the growth rate and it is, therefore, unlikely that this would result if density increased as the result of less fishing.

Sole (Figures 15 and 16)

A reduction in effort would result in a theoretical increase in yield per recruit (Figure 15) but this would raise the average age of the stock to greater than ten years and the effect of cold winters, discussed under mesh assessments, would be felt. A reduction in fishing mortality rate to 0.35-0.40 would probably produce the maximum benefit. At this level changes in stock abundance (Figure 16) are unlikely to be reflected in decreased growth rates.

Overall effort assessments

Using the detailed curves in Figures 9-16 it would be possible to make quite precise statements of the percentage changes in yield and catch per unit effort that might be expected to result from a given change in fishing effort. The Group noticed however that from some curves in particular, the point of maximum yield/recruit was associated with a relatively very high catch per unit effort. For cod, using a value of $M = 0.10$ for example, the maximum yield/recruit occurs, when $F = 0.10$ and the catch per unit effort is 9.5 times its present level. Any tendency to increase the weight of the exploitable part of the stock by this amount could easily be offset by density-dependent changes in growth or natural mortality. It would be dangerous therefore to accept these curves as they stand over a wide range of fishing mortalities. Instead it seems safer to use them to indicate the probable direction of change of yield and catch per unit effort for a small change in fishing effort from its present level.

It would appear safe to conclude that a small reduction in effort from its present level should be associated with

- (a) an increase in catch per unit effort for all species, and
- (b) no decrease in yield per recruit for any species and with an increase for some.

Recommendation

The Group recommended that every effort should be made by countries, that do not already do so, to collect data from which the numbers of fish landed, by length and by age, can be estimated.

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Table 1. Landings of cod by all vessels fishing in the North Sea (metric tons).
From Bulletin Statistique -corrected for whole weight.

Year	Belgium	Denmark	England	Faroe & Iceland	France	Germany	Nether-lands	Norway ¹⁰⁾	Poland	Scotland	Sweden	USSR	Total
1906	365	515	48,055	-	-	2,784	2,877	4,494	-	29,674	-	-	88,764
1907	405	1,260	44,290	-	-	2,873	2,558	6,105	-	27,990	-	-	85,481
1908	988	852	43,608	-	-	4,361	2,974	8,194	-	32,988	-	-	93,965
1909	710	876	57,291	-	-	5,401	3,937	8,013 ¹⁾	-	38,496	-	-	114,724
1910	498	987	59,125	-	-	6,368	4,126	5,805	-	38,013	-	-	114,921
1911	612	1,304	56,487	-	-	7,652	5,046	8,047	-	39,280	-	-	119,028
1912	526	1,623	53,649	-	-	9,783	7,685	17,298	-	39,031	-	-	129,595
1913	Not Av.	1,280	53,780	-	-	8,865	6,970	22,145	-	36,186	-	-	129,226
1914	"	1,740	47,560	-	-	5,568	7,538	35,041	-	63,743	181	-	161,371
1915	"	3,877	31,166	-	-	3,512	14,080	39,111	-	14,983	109	-	106,838
1916	"	3,619	18,066	-	-	221	11,344	34,445	-	13,785	160	-	81,640
1917	"	1,930	15,981	-	-	669	4,360	21,844	-	13,669	664	-	59,117
1918	"	4,636	20,812	-	-	2,917	3,070	18,362	-	14,738	677	-	65,212
1919	"	3,154	37,364	-	-	11,741	7,125	24,276	-	25,643	362	-	109,665
1920	294 ²⁾	1,658	63,107	-	-	11,234	4,124	36,779	-	38,220	421	-	155,837
1921	-	3,760	56,635	-	-	9,571	5,385	32,204	-	34,994	172	-	142,721
1922	-	1,444	52,237	-	-	5,882	5,494	35,401	-	30,266	575	-	131,299
1923	-	1,596	34,633	-	-	2,183	4,753	23,346	-	19,259	559	-	86,349
1924	-	2,244	33,040	-	-	3,083	3,989	19,845	-	19,236	242	-	81,679
1925	-	2,857	38,631	-	78	3,978	5,614	10,142	-	23,688	335	-	85,323
1926	-	2,973	40,526	-	198	3,673	7,114	21,998	-	22,144	428 ³⁾	-	99,054
1927	-	4,537	44,358	-	1,108	3,664	7,547	10,325	-	24,827	409 ³⁾	-	96,775
1928	30	3,902	34,469	-	163	4,010	6,769	6,537	-	22,255	372	-	78,507
1929	565	3,184	35,096	-	216	2,257	7,371	5,784	-	19,875	242	-	74,590
1930	415	4,003	39,706 ⁴⁾	-	165	3,253	9,583	6,900	-	19,431	894 ⁵⁾	-	84,350
1931	271	5,012	31,866 ⁴⁾	-	312	3,274	8,447	6,204	-	17,775	708 ⁵⁾	-	73,869
1932	454	5,865	34,870	-	198	2,878	5,818	6,191	-	20,923	1,120	-	78,317
1933	887	8,067	47,000	2	233	3,234	3,974	6,217	-	22,353	1,727	-	92,696
1934	639	5,923	40,599	9	244	3,547	5,846	6,722	-	21,454	2,012	-	86,995
1935	863	4,297	30,088	-	227	2,501	4,695	6,448	-	22,043	2,368	-	73,530
1936	1,143	3,687	24,696	35	215	1,993	4,824	6,571	-	19,704	1,137	-	64,005
1937	985	4,181	26,307	1	179	2,366	4,825	6,085	14	21,562	917	-	67,424
1938	1,337	4,243	25,713	24	170	3,165	6,096	6,449	(14)	22,897	975	-	71,083
1939	893	6,717	Not Av.	(24)	Not Av.	3,159	4,551	7,527	+	21,545	1,080	-	45,496

The Table is continued on the next page

Table 1. Continued.

Year	Belgium	Denmark	England	Faroe & Iceland	France	Germany	Nether-lands	Norway ¹⁰⁾	Poland	Scotland	Sweden	USSR	Total
1940	Not Av.	4,857	Not Av.	Not Av.	Not Av.	223	1,179	4,638	-	11,766	51	-	22,714
1941	+ 28	9,500	"	"	"	570	71	5,153	-	10,143	-	-	25,437
1942	106	11,128	"	"	"	11,600	140	3,346	-	11,408	-	-	37,650
1943	4	16,565	"	"	"	3,196	375	4,308	-	14,699	-	-	39,249
1944	814	14,186	"	"	"	1,837	403	3,488	-	15,561	-	-	35,479
1945	3,991	8,058	"	"	"	Not Av.	2,838	6,522	-	19,926	703	-	38,861
1946	4,192	20,268	48,739	"	"	9,048	8,012	6,844	-	32,068	2,090	-	131,060
1947	4,117	20,950	37,128	-	1,081	4,714	11,634	5,383	-	24,882	2,396	-	112,360
1948	4,770	11,559	33,857	-	3,395	3,376	2,908	4,172	-	19,053	2,586	-	85,023
1949	3,230	9,048	32,412	-	3,490	13,875	5,108	4,597	-	20,812	2,617	-	96,729
1950	3,158	9,587	28,226	-	2,578	3,501	3,549	5,682	-	20,182	4,279	-	80,814
1951	3,204	8,794	22,456	-	1,880	2,358	3,425	3,597	-	17,322	2,450	-	65,446
1952	3,398	12,942	24,722	-	2,630	2,805	4,682	3,529	-	24,618	2,480	-	81,612
1953	3,497	15,199	25,053	-	2,718	3,571	5,601	2,258	-	27,129	1,775	-	86,702
1954	3,890	14,977	22,957	-	2,608	4,173	5,987	2,625	-	26,878	1,943	-	85,645
1955	3,296	16,742	20,881	+	3,210	4,397	5,263	4,277	1,257	24,531	2,263	463	87,174
1956	2,708	16,430	20,812	-	3,598	4,325	5,076	5,154	1,327	22,788	2,622	768	86,196
1957	3,064	18,320	25,592	5	3,882	4,679	5,983	5,547	1,889	28,533	2,621	699	100,458
1958	4,496	17,605	27,955	12	5,833	4,637	8,043	5,577	2,059	29,991	2,211	4,378	109,365
1959	5,101	18,205	31,936	2	6,974 ⁶⁾	4,742	6,520	6,921	1,745	31,284	2,169	653	115,647
1960	6,464	21,448	34,204	15	1,188 ⁷⁾	4,253	8,274	4,558	1,691	25,890	2,187	888	109,697
1961	5,523	18,758	31,007	-	6,592 ⁸⁾	5,448	8,102	4,651	1,577	22,903	2,851	-	108,353
1962	5,151	14,787	22,621	-	767 ⁹⁾	5,636	7,680	4,954	2,094	26,227	Not Av.	250	90,589
1963	6,082	21,289	26,335	-	4,086	5,838	7,630	4,311	1,604	33,845	"	150	110,239
1964	12,783	20,472	25,505	-	8,366	5,136	9,857	5,743	2,764	29,481	11,219 ⁹⁾	571	125,196
1965	15,562	29,634	36,900	-	14,784	13,313	20,588	6,144	2,918	30,214	12,686 ⁹⁾	1,658	181,622
1966		37,406	49,374	-	17,317	19,002	22,417	4,360	13,356	32,832	14,489 ⁹⁾	2,360	228,477

Footnotes

- 1) Includes Swedish fishery in North Sea.
- 2) Ostende only.
- 3) Includes herring fishery Iceland and seining Irish Sea and Clyde.
- 4) Includes British landings in Holland.
- 5) Includes west coast of Scotland.
- 6) Not accounted for 126,214 all areas.
- 7) Includes Norwegian Sea, Spitzbergen and Bear Island.
- 8) Not accounted for 5,141.
- 9) Includes Kattegat and Skagerak.
- 10) Most of Norwegian catches since the war are from close to the Norwegian coast. These do not strictly belong to the North Sea.

Table 2. Landings of haddock by all vessels fishing in the North Sea (metric tons).
From Bulletin Statistique - corrected for whole weight.

Year	Belgium	Denmark	England	France	Germany	Nether-lands	Norway ⁹⁾	Scotland	Sweden	Others	Total
1906	1,718	1,974	118,915	-	12,055	12,090	-	52,529	-	-	199,281
1907	1,210	2,858	123,087	-	14,006	10,469	-	58,085	-	-	209,715
1908	1,056	3,413	101,582	-	12,649	9,603	1,606	52,853	-	-	182,762
1909	663	3,778	84,386	-	11,790	7,350	1,324	47,374	-	-	156,665
1910	226	1,806	75,283	-	11,501	8,445	1,216	41,877	-	-	140,354
1911	429	1,823	80,437	-	12,600	7,621	986	51,762	-	-	155,658
1912	553	1,321	75,160	-	13,006	10,936	1,077	43,440	-	-	145,493
1913	-	1,015	53,935	-	13,910	7,318	1,686	31,245	-	-	109,109
1914	-	1,595	50,972	-	7,785	12,335	1,040	34,690	-	-	108,417
1915	-	3,904	51,406	-	7,411	35,518	861	28,249	-	-	127,349
1916	-	25,148	16,831	-	195	36,999	980	20,864	-	-	101,017
1917	-	10,266	35,397	-	782	11,759	1,020	20,258	7	-	9,489
1918	-	11,385	58,930	-	3,612	14,949	792	28,728	-	-	118,396
1919	-	26,891	89,700	-	42,271	30,433	2,068	41,855	2	-	233,220
1920	310 ¹⁾	11,197	114,138	-	40,348	13,873	1,765	57,783	-	-	239,414
1921	-	12,107	94,841	-	23,837	13,075	3,151	48,261	-	-	195,272
1922	-	5,946	107,520	-	16,570	15,650	2,068	40,335	386	-	188,475
1923	-	10,604	77,681	-	5,442	11,181	1,895	34,577	127	-	141,507
1924	-	9,675	57,961	-	6,040	8,719	1,538	37,531	80	-	121,544
1925	-	6,946	88,726	9	10,636	13,453	1,337	46,517	50	-	167,674
1926	-	6,717	72,772	-	11,010	11,496	1,378	44,821	148 ²⁾	-	148,342
1927	-	9,803	61,905	-	10,351	10,815	1,601	47,993	286 ²⁾	-	142,754
1928	16	5,500	57,612	-	7,739	10,888	1,475	47,315	206	-	130,751
1929	408	4,351	53,937	9	5,668	10,725	1,614	45,559	556	-	122,827
1930	400	5,945	64,051 ³⁾	5	5,535	15,947	1,376	53,031	1,202 ⁴⁾	-	147,492
1931	455	6,501	44,577 ³⁾	38	6,383	12,936	1,832	51,982	575 ⁴⁾	-	125,279
1932	707	4,790	39,319	7	5,999	7,372	2,131	50,210	1,086	15	111,621
1933	743	3,684	45,389	-	6,068	6,173	2,432	54,931	3,719	9	123,154
1934	277	1,797	29,207	2	4,814	7,554	2,324	47,592	4,456	-	98,032
1935	448	1,236	19,460	-	2,714	6,303	2,270	40,390	3,933	20	76,754
1936	675	930	15,763	-	1,508	5,650	2,259	33,801	3,925	33	64,531
1937	1,021	2,087	17,574	-	1,659	9,030	2,037	50,078	3,232	39	86,751
1938	564	933	15,297	-	1,754	8,197	2,031	48,214	4,455	29	81,484
1939	243	1,099	Not Av.	Not Av.	1,297	6,752	2,674	37,891	3,102	-	53,081

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Table 2. Continued.

Year	Belgium	Denmark	England	France	Germany	Nether-lands	Norway ⁹⁾	Scotland	Sweden	Others	Total
1940	Not Av.	1,052	Not Av.	Not Av.	2	1,724	1,596	23,164	75	Not Av.	27,613
1941	"	2,525	"	"	21	+	2,426	17,162	-	"	22,134
1942	"	1,378	"	"	13	+	1,738	16,737	-	"	19,866
1943	"	2,997	"	"	46	+	1,424	12,915	-	"	17,382
1944	"	11,371	"	"	-	+	1,536	14,737	-	"	27,644
1945	568	3,166	"	"	-	2,327	1,279	39,329	7,766	"	54,435
1946	1,707	8,932	16,401	"	10,967	5,138	1,768	65,136	13,983	"	124,032
1947	1,268	3,184	13,825	"	3,946	9,068	2,421	63,039	9,978	"	106,729
1948	1,669	4,541	9,408	597	2,409	4,545	1,886	47,593	8,136	"	80,784
1949	1,041	3,203	6,192	318	840	5,236	1,446	36,042	8,499	"	62,817
1950	945	1,842	8,721	466	752	4,710	1,399	37,948	7,412	"	64,195
1951	853	1,183	5,925	988	654	4,547	861	36,299	7,043	"	58,353
1952	781	1,404	5,641	1,398	564	5,188	1,186	32,566	5,518	"	54,246
1953	800	1,039	7,883	1,202	779	6,675	1,147	36,958	5,962	"	62,445
1954	1,451	570	7,522	4,357	1,260	9,705	1,111	41,315	5,446	"	72,737
1955	1,731	838	7,270	5,177	2,129	12,909	3,498	50,701	7,012	6	91,271
1956	1,925	831	8,117	5,451	1,808	13,306	4,340	53,201	8,979	-	97,958
1957	1,101	675	11,131	6,170	1,791	14,158	3,301	61,207	7,981	15	107,530
1958	972	920	8,122	5,233	3,419	11,477	1,854	59,125	6,900	-	98,022
1959	997	1,545	7,659	5,7745)	1,652	9,072	1,514	47,076	6,231	-	81,520
1960	595	1,932	5,968	1655)	1,057	8,542	896	42,268	6,092	-	67,539
1961	868	2,261	6,485	7,524	890	7,642	934	35,840	6,6176)	24	69,090
1962	783	2,157	5,485	189	543	6,592	960	31,924	4,469	29	53,109
1963	68	2,722	7,262	131	979	9,384	1,116	36,189	Not Av ⁶⁾	7	59,551
1964	4,219	72,223	19,208	14,248	2,095	16,918	2,134	63,784	6,7076)	67)	201,542
1965	2,508	65,077	14,672	14,565	3,134	27,983	1,249	81,466	7,978)	5,9898)	224,621
1966	1,705	48,189	12,679	12,540	2,635	19,355	1,135	76,468	11,800	85,580)	272,086

Footnotes

- 1) Ostende only.
- 2) Includes herring fishery at Iceland and seine fishery Irish Sea and Clyde.
- 3) Includes British landings in Holland.
- 4) Includes west coast of Scotland.
- 5) 6,029, probably North Sea (not definite).
- 6) Includes Kattegat and Skagerak.
- 7) Includes 5,883 by USSR.
- 8) Includes 84,364 by USSR.
- 9) Most of Norwegian catches since the war are from close to the Norwegian coast. These do not strictly belong to the North Sea.

Table 3. Landings of whiting by all vessels fishing in the North Sea (metric tons).
From Bulletin Statistique - corrected for whole weight.

Year	Belgium	Denmark	England	France	Germany	Nether-lands	Norway	Scotland	Sweden	Poland	USSR	Total
1906	390	Not Av.	11,961	-	125	1,078	-	8,048	-	-	-	21,610
1907	303	-	10,968	-	279	1,061	-	7,633	-	-	-	20,244
1908	306	-	13,044	-	3,934	1,188	17	7,981	-	-	-	26,470
1909	342	10	14,135	-	5,021	1,236	22	6,908	-	-	-	27,674
1910	369	-	15,426	-	6,199	1,944	18	7,953	-	-	-	31,909
1911	327	-	13,771	-	7,600	2,022	14	7,632	-	-	-	31,366
1912	317	-	19,528	-	9,148	2,785	14	9,272	-	-	-	41,064
1913	-	+	21,549	-	3,307	2,475	5	12,160	-	-	-	39,496
1914	-	-	17,493	-	3,732	3,228	10	12,872	-	-	-	37,362
1915	-	27	8,919	-	614	2,802	9	6,295	-	-	-	18,661
1916	-	22	5,363	-	30	4,217	17	5,993	-	-	-	15,789
1917	-	169	3,197	-	724	2,220	19	3,342	-	-	-	9,541
1918	-	39	5,137	-	814	1,930	25	4,269	-	-	-	12,176
1919	-	1	10,723	-	1,972	2,597	27	4,446	-	-	-	19,770
1920	-	5	16,686	-	2,204	1,282	114	8,605	-	-	-	29,136
1921	244	1	14,563	-	6,063	1,955	103	9,859	-	-	-	32,548
1922	-	5	12,555	-	7,035	2,596	65	8,288	7	-	-	30,554
1923	-	8	13,275	-	3,808	2,645	30	7,995	1	-	-	27,772
1924	-	18	14,325	-	6,301	2,435	32	10,986	2	-	-	34,446
1925	-	365	11,409	1,912	5,000	2,359	41	8,503	15	-	-	29,442
1926	-	203	11,708	1,865	4,448	2,778	15	8,431	93	-	-	29,402
1927	-	64	12,289	3,537	5,254	2,848	15	10,658	2	-	-	34,719
1928	-	116	12,937	6,606	5,128	2,625	21	10,772	3	-	-	38,307
1929	41	174	15,517	8,450	5,898	3,477	42	13,011	30	-	-	48,572
1930	1,960	187	11,650	6,430	5,357	2,413	49	12,934	22	-	-	40,863
1931	1,916	92	12,009	6,640	5,968	2,288	52	14,070	56	-	-	42,687
1932	1,537	67	13,291	7,372	5,402	2,216	47	17,619	146	-	-	48,094
1933	1,839	162	10,862	8,151	4,930	1,178	40	14,364	372	-	-	41,343
1934	1,422	24	10,374	7,411	4,633	1,708	59	16,644	1,251	-	-	43,529
1935	1,444	5	10,444	8,760	4,608	1,919	64	21,003	1,449	-	-	47,834
1936	1,577	10	7,503	3,688	4,112	2,532	76	17,278	1,438	-	-	38,629
1937	1,969	33	6,719	6,140	3,588	2,432	67	12,737	1,556	-	-	35,233
1938	1,955	39	7,728	6,858	3,818	3,264	67	15,982	1,831	-	-	41,715
1939	2,164	3	Not Av.	Not Av.	3,918	3,203	116	18,161	1,187	-	-	28,347
	1,759	3										

Table to be continued

Table 3. Continued

Year	Belgium	Denmark	England	France	Germany	Nether-lands	Norway	Scotland	Sweden	Poland	USSR	Total
1940	--	34	Not Av.	Not Av.	315	2,502	38	6,971	72	-	-	9,932
1941	135	41	"	"	144	4,443	58	9,091	Not Av.	-	-	13,912
1942	235	18	"	"	66	2,941	78	13,053	"	-	-	16,391
1943	185	13	"	"	43	1,738	202	11,433	"	-	-	13,614
1944	28	-	"	"	27	217	124	10,326	"	-	-	10,722
1945	1,119	+	"	"	-	2,847	103	10,393	190	-	-	14,652
1946	3,540	1	6,153	"	3,352	6,448	59	20,627	441	-	-	40,621
1947	2,932	1	5,121	7,027	2,825	7,234	149	25,734	741	-	-	51,764
1948	2,773	17	4,496	19,589	3,203	4,011	55	31,187	1,624	-	-	66,955
1949	1,977	13	3,404	11,613	1,814	3,843	41	16,219	1,489	-	-	40,413
1950	2,286	11	4,973	17,590	1,126	5,716	39	18,536	1,205	-	-	51,482
1951	3,063	14	6,443	24,553	854	7,820	16	33,631	1,295	-	-	77,689
1952	2,255	131	5,882	16,153	730	9,077	22	40,985	1,497	-	-	16,732
1953	1,595	92	4,565	16,381	880	7,567	46	33,095	1,569	-	-	65,790
1954	1,713	8,060	4,141	20,372	841	5,513	26	27,327	1,133	-	-	69,126
1955	1,938	7,466	4,145	22,000	629	6,368	73	33,212	1,157	-	-	16,988
1956	1,903	2,730	4,398	24,194	1,183	6,741	41	36,739	1,314	-	-	19,243
1957	1,760	19,424	3,580	23,690	957	5,474	14	33,785	1,056	-	-	89,740
1958	2,087	2,752	3,045	25,861	693	7,162	21	37,666	1,953	-	-	81,241
1959	2,369	7,359	3,259	22,573	1,084	10,157	1,308	35,005	1,384	-	-	84,498
1960	2,393	7,641	2,529	2,358	1,075	9,225	243	28,009	1,034	1	-	54,508
1961	3,385	16,359	3,378	15,103	1,489	10,228	67	34,057	1,216	19	-	85,301
1962	3,866	8,878	3,147	2,560	1,276	11,898	111	32,643	-	16	-	64,395
1963	3,860	41,786	4,127	2,290	1,115	12,318	130	31,594	-	-	1,730	98,950
1964	2,074	26,279	4,321	15,179	2,703	7,155	42	27,376	2,174	-	361	87,664
1965	2,426	21,985	5,061	25,104	542	9,695	39	35,467	2,207	131	7,396	110,053
1966	2,771	51,164	4,391	19,872	1,292	10,244	100	38,879	2,638	71	26,507	157,929

Table 4. Landings of cod, haddock and whiting by all vessels fishing in the North Sea, from ICES sub-areas. Metric tons not corrected to whole weight (from Bulletin Statistique).

Year	COD 00's tons				HADDOCK 00's tons				WHITING 00's tons						
	IVa	IVb	IVc	Not Split	Total	IVa	IVb	IVc	Not Split	Total	IVa	IVb	IVc	Not Split	Total
1956	196	482	20	105	803	450	226	11	252	939	322	229	103	95	749
1957	243	397	22	288	950	455	338	14	246	1,053	247	187	175	234	843
1958	313	492	43	189	1,037	687	236	15	24	962	447	202	101	25	775
1959	305	508	58	224	1,095	474	231	10	82	797	417	199	113	76	905
1960	226	632	78	108	1,044	390	199	1	74	664	275	125	43	88	531
1961	198	504	49	307	1,058	321	195	1	155	672	296	171	59	307	833
1962	288	436	41	191	896	255	199	0.3	70	524	311	157	83	90	641
1963	332	466	42	249	1,089	324	230	3	37	594	315	145	90	437	987
1964	333	431	98	347	1,209	499	556	8	924	1,987	228	174	38	415	855
1965	257	726	255	517	1,755	829	453	5	930	2,217	285	202	46	534	1,067
1966	417	931	317	552	2,217	906	231	4	1,549	2,690	296	215	64	977	1,552

Table 5. Annual landings of Cod, Haddock and Whiting by British trawlers from sub-areas of the North Sea - by selected periods.

Years	Cod (00's tons)				Haddock (00's tons)				Whiting (00's tons)			
	IVa	IVb	IVc	Total	IVa	IVb	IVc	Total	IVa	IVb	IVc	Total
1923 - 1930	80 ¹⁾	255 ¹⁾	16 ¹⁾	342 ¹⁾	221	517	5.0	743	66	94	8.8	169
1935 - 1938	72	180	20	273	244	152	0.75	396	88	69	5.2	162
1956 - 1963	53	120	8.1	181	124	80	0.55	204	53	27	1.2	81
1964	85	98	3.1	186	128	147	1.6	277	32	32	0.4	64
1965	55	157	7.1	219	136	129	1.3	266	19	37	0.4	66

Effort (000's hours)

All Species

Years	IVa	IVb	IVc	Total
1925 - 1930	481	1,589	310	2,380
1923 - 1930	461	1,618	329	2,408
1935 - 1938	580	1,250	331	2,160
1956 - 1963	166	517	43	726
1964	170	662	26	858
1965	128	651	33	812

Landings per unit effort (tons/thousand hours)

Years	Cod				Haddock				Whiting			
	IVa	IVb	IVc	Total	IVa	IVb	IVc	Total	IVa	IVb	IVc	Total
1923 - 1930	17 ¹⁾	16 ¹⁾	5 ¹⁾	13 ¹⁾	48	32	1.5	31	15	6	3	8
1935 - 1938	12	15	6	11	42	12	0.2	18	15	6	2	76
1956 - 1963	32	23	19	25	75	16	1.3	28	37	6	3	155
1964	50	15	12	26	77	22	6.0	32	19	48	15	74
1965	43	24	21	29	106	20	3.9	33	15	57	13	7

1) For period 1925 - 1930

Table 6. Landings of Cod, Haddock and Whiting in cwt per hundred hours fishing by Scottish and English trawlers.

Years	C O D			H A D D O C K			W H I T I N G		
	Scotland Steam & Motor	England Steam Motor		Scotland Steam & Motor	England Steam Motor		Scotland Steam & Motor	England Steam Motor	
1914	47.0			54.3			33.1		
1915	26.4			89.8			24.4		
1916	25.5			85.0			31.7		
1917	31.0			92.9			24.7		
1918	40.4			123.9			35.2		
1919	91.7			209.5			24.2		
1920	86.8			157.7			25.9		
1921	68.4			108.3			24.7		
1922	45.2			80.6			21.1		
1923	32.7			86.8			24.9		
1924	35.5	20.6		79.7	39.0		32.3	10.6	
1925	43.9	26.2		79.3	68.0		21.8	8.6	
1926	49.0	32.1		102.2	68.3		22.9	10.9	
1927	50.8	31.0		94.8	50.5		26.0	10.0	
1928	41.4	24.8		87.4	50.1		24.2	11.2	
1929	37.2	26.1		76.5	46.6		29.4	13.4	
1930	31.4	29.4		85.6	55.6		26.3	10.1	
1931	32.2	24.7		102.0	41.7		30.4	11.3	
1932	36.0	29.8		90.9	40.2		36.4	13.5	
1933	36.4	37.4		98.4	40.0		26.4	9.5	
1934	31.1	29.2		87.4	25.2		27.9	9.0	
1935	28.0	23.6		69.5	18.5		33.0	10.0	
1936	25.9	20.7		55.4	16.1		30.6	7.5	
1937	35.8	23.9		88.9	18.7		22.2	7.0	
1938	35.9	27.0		100.7	19.5		27.6	9.8	
1939	40.0			89.7			42.6		
1940	51.0			131.7			33.7		
1941	60.9			200.7			46.5		
1942	69.2			209.2			63.7		
1943	96.4			156.1			61.4		
1944	120.6			157.4			58.8		
1945	119.0			221.6			27.4		
1946	122.5	108.1		195.1	38.6		42.2	13.7	
1947	70.9	71.7		155.1	28.6		47.2	10.0	
1948	45.8	62.5		107.4	19.7		58.5	8.1	
1949	48.5	56.9		83.5	13.0		26.3	5.7	
1950	55.4	51.3		97.5	19.1		24.7	7.9	
1951	42.2	41.9		99.1	13.6		51.1	10.6	
1952	49.2	47.3		75.9	13.4		68.9	9.9	
1953	62.2	48.9		83.8	18.7		67.0	7.3	
1954	61.1	48.9		(112.7)	19.4		(72.2)	6.7	
1955	60.0	47.1		141.7	19.5		77.4	6.5	
1956	54.1	46.4		144.4	23.3		86.4	6.1	
1957	71.3	55.7		189.1	29.8		66.8	5.4	
1958	66.7	56.8	34.3	169.3	21.1	15.0	65.6	5.1	6.1
1959	64.5	63.0	38.0	142.5	18.2	12.0	61.3	4.8	4.6
1960	55.3	63.6	42.3	134.9	14.5	9.3	39.3	3.8	3.4
1961	50.5	46.6	39.1	121.2	15.2	11.5	52.5	3.9	4.0
1962	54.7	27.2	29.7	119.3	8.1	10.9	54.0	3.6	3.9
1963	81.3	53.0	31.8	117.6	31.4	12.7	60.9	9.3	4.0
1964	78.4	94.6	31.0	171.3	109.0	27.6	48.2	6.9	3.5
1965	63.3	178.2	46.5	159.8	86.9	24.1	37.6	4.5	5.5
1966	70.7	516.0	63.7	211.5	44.1	19.5	40.1	2.3	4.2

Table 7. Landings of Plaice per unit fishing effort by British and Belgian trawlers from ICES sub-areas.

Years	British Trawlers (tons per hundred hours fishing)						Belgian Trawlers (tons per hours fishing)		
	IVa		IVb		IVc		IVa	IVb	IVc
	Steam	Motor	Steam	Motor	Steam	Motor	Motor	Motor	Motor
1924-28	0.65	ND	0.82	ND	1.46	ND	ND	ND	ND
1929-33	0.30	ND	0.86	ND	1.48	ND	ND	ND	ND
1934-38	0.37	ND	0.84	ND	1.53	ND	ND	ND	ND
1947-51 ^x	0.27	ND	2.50	2.12	2.73	2.32	ND	ND	ND
1952-56 ^x	0.47	ND	2.27	2.25	2.42	2.23	0.08	4.49	2.47
1957-61 ^x	ND	0.23	2.43	2.63	2.19	1.94	0.05	1.15	3.16
1962-66 ^x	ND	0.24	ND	3.72	ND	1.78	0.04	1.07	2.91

^x Grimsby and Lowestoft trawlers only

ND = no data

Table 8. Landings of Soles per unit fishing effort by British and Belgian trawlers from various areas.

Years	British Trawlers (tons per 1,000 hours fishing)							Belgian Trawlers (tons per 100 hours fishing per 100 horse power)		
	IVa ^x		IVb				IVc		IVb	IVc
	Steam	Motor	F6,F7	G6,G7	L8	L9	Steam	Motor	Motor	Motor
1923-26	0.28	ND	0.64	ND	1.36	ND	1.79	ND	ND	ND
1929-32	0.30	ND	1.54	ND	2.20	ND	1.74	ND	ND	ND
1935-38	0.68	ND	1.48	ND	4.23	ND	2.28	ND	ND	ND
1948-51	1.89	ND	4.19	ND	6.35	ND	2.11	ND	ND	ND
1952-55	0.88	ND	6.65	ND	21.10	ND	2.31	ND	3.62	1.47
1956-59	0.49	ND	3.06	ND	7.84	ND	1.40	ND	1.29	1.67
1960-62	ND	1.92	3.33	2.28	4.75	6.03	ND	2.22	1.85	1.73
1964-66	ND	7.52	ND	2.75	ND	2.02	ND	1.93	0.38	1.39
Period	All year		Jan.-Apr.		Mar.-Apr.		May - Sept.			

^x Catch per effort for those rectangles in which soles are caught

ND = No data

Table 9. Estimates of total fishing effort (in millions of hours) in the North Sea for Cod, Haddock and Whiting. (Trawlers).

Years	C O D			H A D D O C K			W H I T I N G		
	Scotland ¹⁾	England		Scotland ¹⁾	England		Scotland ¹⁾	England	
	Steam & Motor	Steam	Motor	Steam & Motor	Steam	Motor	Steam & Motor	Steam	Motor
1914	5.63			3.50			1.98		
1915	6.64			2.49			1.34		
1916	5.25			2.08			0.87		
1917	3.14			1.50			0.68		
1918	2.66			1.68			0.61		
1919	1.99			1.95			1.43		
1920	2.96			2.66			1.97		
1921	3.44			3.16			2.31		
1922	4.80			4.10			2.54		
1923	4.34			2.86			1.96		
1924	3.78	6.51		2.68	5.47		1.87	5.70	
1925	3.19	5.35		3.71	4.33		2.37	6.01	
1926	3.32	5.06		2.55	3.81		2.25	4.73	
1927	3.13	5.12		2.64	4.96		2.34	6.09	
1928	3.11	5.19		2.62	4.58		2.78	6.00	
1929	3.30	4.70		2.82	4.62		2.90	6.36	
1930	4.42	4.72		3.02	4.65		2.73	7.10	
1931	3.77	4.91		2.15	5.27		2.46	6.63	
1932	3.57	4.31		2.15	4.87		2.32	6.25	
1933	4.17	4.06		2.20	5.40		2.75	7.63	
1934	4.59	4.88		1.97	6.82		2.74	8.49	
1935	4.30	5.11		1.94	7.28		2.54	8.39	
1936	4.05	5.07		2.04	7.03		2.21	9.04	
1937	3.09	4.63		1.71	8.14		2.78	8.83	
1938	3.19	4.24		1.42	7.33		2.65	7.47	
1939-46									
1947	2.62	2.59		1.21	6.56		1.94	9.15	
1948	3.08	2.25		1.32	7.22		2.02	14.59	
1949	3.30	2.81		1.32	8.50		2.71	12.52	
1950	2.41	2.61		1.16	5.91		3.68	11.50	
1951	2.91	2.93		1.14	8.31		2.87	13.86	
1952	3.10	3.23		1.38	7.82		2.13	14.82	
1953	2.61	3.32		1.44	6.46		1.87	17.13	
1954	2.64	3.30		1.24	7.23		1.80	19.35	
1955	2.78	3.54		1.24	8.99		1.87	22.29	
1956	2.97	3.46		1.30	8.06		1.77	24.51	
1957	2.66	3.41		1.11	7.07		2.52	31.23	
1958	3.11	3.65	6.05	1.14	9.12	12.83	2.36	30.39	25.40
1959	3.39	3.48	5.76	1.12	8.75	13.28	2.63	33.54	35.00
1960	3.78	3.28	4.94	0.98	9.16	14.28	2.70	27.96	31.25
1961	4.19	4.54	5.41	1.11	8.85	11.69	3.17	42.71	41.64
1962	3.27	6.59	6.03	0.88	12.94	9.62	2.55	38.32	35.37
1963	2.67	4.10	6.84	1.01	3.78	9.35	3.24	21.22	49.33
1964	3.08	2.55	7.78	2.32	3.65	14.40	3.80	26.53	52.30
1965	5.55	1.97	7.55	2.77	5.10	18.40	5.68	47.42	38.80
1966	6.28	0.86	6.97	2.54	12.20	27.59	7.74	134.92	73.88

1) Based on Aberdeen trawler catches per hundred hours fishing until 1954 and thereafter based on total Scottish trawl catches per hundred hours fishing

Table 10.

ENGLAND

Cod - trawl

Numbers landed (thousands)

Length	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
25-29	2	6	0.3	3	0.7	0.9		0.6	10	2	1	27	2
30-34	150	404	204	162	204	108	100	116	344	432	535	2759	251
35-39	726	1784	1102	908	1454	627	529	621	1005	1708	2041	12505	1137
40-44	1200	1992	1569	1418	2517	1163	1035	943	1243	2230	2229	17539	1595
45-49	872	1514	1439	1399	2362	1143	1120	1005	825	2226	2208	16113	1465
50-54	646	1118	1175	1205	1904	1166	853	904	619	1846	2037	13473	1225
55-59	397	710	870	885	1253	1037	652	572	507	1352	1624	9859	896
60-64	299	508	718	685	827	864	529	448	388	651	1328	7245	659
65-69	267	286	520	452	616	615	347	321	304	324	1021	5073	461
70-74	272	211	381	433	510	404	381	260	279	233	794	4158	378
75-79	185	145	237	372	282	228	283	197	217	161	411	2718	247
80-84	168	132	177	330	162	193	237	214	183	168	219	2183	198
85-89	148	128	112	223	109	161	171	161	132	138	114	1597	145
90-94	157	152	109	184	134	120	185	147	141	127	105	1561	142
95-99	129	122	90	136	88	123	138	107	119	82	99	1233	112
100-104	94	78	76	97	74	82	108	84	79	64	66	902	82
105-109	18	26	33	39	18	35	40	34	32	27	35	337	31
110-114	8	10	8	13	7	20	15	16	16	11	12	136	12
115+	2	0.8	3	3	4	9	4	6	10	3	9	54	5
T o t a l	5740	9327	8823	8947	12526	8099	6727	6157	6453	11785	14888	99472	9043
Corresponding wt landed 000's cwt	215	260	272	323	352	293	269	235	216	303	439	3177	289

Table 11.

ENGLAND

Cod - seine

Numbers landed (thousands)

Length	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
25-29	2	6	2	2	3	0	110	0.7	4		0.7	21	2
30-34	121	242	61	96	198	85	110	54	353	118	136	1574	143
35-39	247	319	114	240	370	311	496	202	572	706	655	4232	385
40-44	288	302	203	335	483	505	589	308	493	1289	896	5691	517
45-49	185	322	292	315	603	588	486	339	482	1212	750	5574	507
50-54	137	318	181	277	533	537	348	323	316	969	830	4769	434
55-59	100	191	156	241	297	391	218	309	200	574	657	3334	303
60-64	111	151	113	185	219	275	168	200	225	432	600	2679	244
65-69	88	91	65	133	154	253	129	138	200	155	577	1983	180
70-74	73	76	56	128	174	212	105	129	155	122	495	1725	157
75-79	52	65	40	109	139	168	82	105	110	112	297	1279	116
80-84	80	95	50	117	124	172	112	178	142	134	207	1411	128
85-89	102	134	86	84	138	143	115	197	199	157	120	1475	134
90-94	116	214	143	102	201	150	118	228	204	146	148	1770	161
95-99	125	165	141	94	126	117	92	156	195	102	154	1467	133
100-104	68	96	98	86	101	61	72	131	80	72	82	947	86
105-109	42	47	32	30	38	20	26	54	43	30	47	409	37
110-114	14	15	8	16	13	5	12	18	16	13	19	149	14
115+	2	4	0.4	7	0.7	3	0.9	10	7	2	4	41	4
Total	1953	2853	1841	2597	3915	3996	3279	3080	3996	6345	6675	40530	3685
Corresponding wt landed 000's cwt	105	142	103	121	166	170	126	183	178	204	264	1762	160

Table 12. SCOTLAND

Cod - Trawl

Numbers landed (thousands)

	1963	1964	1965	1966	Total	Mean
< 30	44	41	64	87	236	59
30 - 34	637	460	783	1,040	2,920	730
35 - 39	1,300	590	940	1,500	4,330	1,083
40 - 44	1,520	600	621	1,320	4,061	1,015
45 - 49	1,260	590	479	1,020	3,349	837
50 - 54	960	590	372	720	2,642	661
55 - 59	479	600	326	476	1,881	470
60 - 64	393	700	401	318	1,812	453
65 - 69	217	574	275	215	1,281	320
70 - 74	182	329	246	188	945	236
^x 75 - 77	75	146	159	113	493	123
78 - 80	50	80	140	91	361	90
81 - 83	34	63	160	79	336	84
84 - 86	23	45	82	84	234	59
87 - 89	17	28	51	70	166	42
90 - 92	15	23	39	59	136	34
93 - 95	14	19	47	54	134	34
96 - 98	12	12	22	31	77	19
99 - 101	8	9	21	28	66	16
≥ 102	18	13	28	20	79	20
Total	7,258	5,512	5,256	7,513	25,539	6,385
Corresponding weight landed 000's cwt.	158	175	161	187	681	170

^x Note change in grouping

Table 13. SCOTLAND

Cod - Seine

Numbers landed (thousands)

	1963	1964	1965	1966	Total	Mean
< 30	180	20	89	57	346	86
30 - 34	2,580	670	1,900	2,100	7,250	1,813
35 - 39	4,150	1,100	2,260	3,500	11,010	2,753
40 - 44	3,330	910	1,200	2,740	8,180	2,045
45 - 49	2,330	760	780	1,680	5,550	1,388
50 - 54	1,550	900	740	1,280	4,470	1,118
55 - 59	960	1,020	770	770	3,520	880
60 - 64	556	820	619	454	2,449	612
65 - 69	347	548	509	294	1,698	424
70 - 74	276	380	378	211	1,245	311
^x 75 - 77	160	175	219	110	664	166
78 - 80	120	190	190	110	610	152
81 - 83	86	160	190	96	532	133
84 - 86	60	100	130	130	420	105
87 - 89	47	70	97	88	302	76
90 - 92	54	37	84	84	259	65
93 - 95	45	44	79	56	224	56
96 - 98	27	16	46	48	137	34
99 - 101	21	21	30	28	100	25
≥ 102	37	28	59	61	185	46
Total	16,916	7,969	10,369	13,897	49,151	12,288
Corresponding weight landed 000's cwt.	324	250	290	300	1,164	291

^x Note change in grouping

Table 14.

ENGLAND

Haddock - Trawl

Numbers landed (thousands)

Length	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
20-24	-	-	0.5	0.5	0.5	0.1	0.9	-	-	2.0	0.3
25-29	284	461	546	554	332	456	600	18	7	3258	362
30-34	3267	2059	3772	4742	2445	3338	8298	59	339	28319	3147
35-39	4399	2810	2748	4022	2137	3138	8906	5855	1709	35724	3969
40-44	2711	2370	1475	1407	1308	1259	2925	4971	2885	21311	2368
45-49	893	1048	495	433	463	675	786	2032	2592	9417	1046
50-54	285	404	245	180	156	302	306	546	1229	3653	406
55-59	51	192	106	62	54	111	106	215	299	1196	133
60-64	22	50	44	28	19	30	51	60	64	368	41
65-69	3	11	10	14	7	6	26	10	16	103	12
70+	0.6	3	2	4	5	4	8	4	8	39	4
Total	11916	9408	9444	11446	6926	9319	22013	13770	9148	103390	11488
Corresponding wt landed 000's cwt	107	97	79	89	68	83	180	157	133	993	110

Table 15.

ENGLAND

Haddock - Seine.
Numbers landed (thousands).

Length	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
20 - 24	0.3	-	-	-	0.6	-	0.3	-	-	1	0.1
25 - 29	101	1147	777	164	904	1907	1885	5	1	6891	766
30 - 34	981	670	1884	1286	3106	2076	13516	549	146	24214	2690
35 - 39	808	332	402	844	2307	1046	4985	2665	684	14073	1564
40 - 44	196	231	246	248	1404	344	456	1349	1438	5912	657
45 - 49	38	86	81	101	489	129	118	389	1153	2584	287
50 - 54	10	52	13	51	162	54	48	64	282	736	82
55 - 59	3	18	1	19	54	13	8	25	70	211	23
60 - 64	0.5	3	2	7	20	3	4	5	23	68	8
65 - 69	0.3	0.1	-	2	7	-	0.3	0.8	8	19	2
70+	0.5	0.6	-	-	5	-	-	-	0.6	7	1
Total	2139	2540	3406	2722	8459	5572	21021	5052	3805	54716	6080
Corresponding wt. landed 000's cwt.	15	16	20	20	19	32	125	47	50	344	38

Table 16.

SCOTLAND

Haddock - Trawl
Numbers landed (thousands)

Length	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
20 - 24	0	49)	3,676	8,650	5,743	6,106	415	874	37,055	4632
25 - 29	4,704	6,838)	12,836	12,900	14,600	34,900	19,400	9,200	140,066	17508
30 - 34	17,134	19,096	10,343	7,600	8,600	14,700	24,700	32,800	131,457	16432
35 - 39	21,531	11,183	4,526	4,080	3,590	4,120	7,130	14,100	53,055	6632
40 - 44	10,429	5,080	1,363	1,420	1,400	1,480	1,550	3,610	16,056	2007
45 - 49	3,357	1,876	532	438	406	420	383	796	4,368	546
50 - 54	760	633	191	140	113	128	101	158	1,190	149
55 - 59	183	176	58)	11	34	41	39	53)	380	47
60 - 64	55	46	11)							
65 - 69	14	9	3)							
70+	3	3								
Total	58,170	44,989	33,539	35,239	34,486	61,895	53,718	61,591	383,627	47953
Average weight landed 000's cwt.	458	309	277	234	229	381	407	559	2,854	357

Table 17. SCOTLAND

Haddock - Seine
Numbers landed (Thousands).

Length	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
20 - 24	3	29,274 ²⁾	14,184	23,388	28,400	36,550	8,912	1,498 ³⁾	152375	19047
25 - 29	10,164	45,751	26,937	19,700	32,600	78,800	90,000	23,500	337512	42189
30 - 34	20,224	7,060	9,645	8,200	10,000	15,100	50,000	46,300	161106	20138
35 - 39	14,601	2,978	3,088	3,990	3,700	4,620	9,490	16,100	49689	6211
40 - 44	5,723	937	963	1,410	1,240	1,660	1,960	3,970	13585	1698
45 - 49	1,445	176	285	370	387	380	429	990	3368	421
50 - 54	351	34	122	103	102	88	142	189	819	103
55 - 59	39	13	34 ³⁾	38	29	33	62	34 ³⁾	274	34
60 - 64	11	4	3							
65 - 69	2	1	3							
70+	7									
Total	52,570	86,230	55,464	57,199	76,458	137,231	160,995	92,581	718728	89841
Average weight landed 000's cwt.	355	420	339	311	390	713	1,008	770	4306	538

Table 18.

ENGLAND

Whiting - Trawl

Numbers landed (thousands)

Length cm	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
20	1	3	0.1	1	0.1	0.2	1	0.1		-	00.7	7	0.6
21	1	3	0.2	0.3	0.1	0.2	2	3		-	00.9	8	0.7
22	4	2	0.7	3	3	4	4	24		-	7	40	4
23	23	11	4	11	7	23	24	89		00.2		226	21
24										3			
25	66	61	19	38	30	121	94	88	204	16	25	762	69
26	137	128	51	98	101	279	246	129	629	69	59	1926	175
27	250	185	112	152	171	390	356	250	767	225	119	2977	271
28	321	250	205	277	251	501	454	369	893	399	196	4116	374
29	507	317	340	340	336	581	486	413	1262	592	240	5414	492
30	616	420	499	469	359	612	540	482	1371	659	342	6369	579
31	678	421	584	557	409	599	511	466	790	928	508	6451	586
32	733	472	622	567	402	637	490	710	658	902	465	6658	605
33	735	494	616	525	348	490	424	412	546	853	527	5970	543
34	641	422	553	520	374	467	376	432	454	612	511	5362	488
35	562	383	451	435	315	340	278	342	332	469	400	4307	392
36	398	350	392	348	264	217	210	287	303	331	372	3472	316
37	285	300	297	327	229	186	169	249	232	260	298	2832	258
38	231	225	251	249	193	143	136	200	172	245	235	2280	207
39	151	203	160	185	147	103	84	157	145	149	165	1649	150
40-44	274	505	429	397	325	210	154	322	315	552	359	3842	349
45-49	47	116	101	70	70	32	14	51	59	40	131	731	66
50-54	12	15	14	16	10	21	4	5	8	3	24	132	12
55-59	2	0.2	00.6	2	1	7	00.2	2	0.6	2	7	25	2
60+	-	-	0.2	0.1	-	0.2	-	-	-	-	-	0.5	0.05
Total	6675	5286	5702	5587	4345	5964	5057	5393	9246	7309	4992	65556	5960
Corre- sponding wt landed 000's cwt	36	31	33	31	24	29	24	27	23	35	28	321	29

Table 19.

ENGLAND

Whiting - seine

Numbers landed (thousands)

Length cm	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
20	-	-	-	-	-	-	-	-	-	-	-	-	-
21	0.1	-	-	-	1	-	-	-	-	-	-	1	0.1
22	4	1	-	-	0.5	-	-	-	-	-	-	5	0.5
23	1	0.3	0.7	0.7	10	3	4	-	-	-	-	20	2
24	11	4	1	9	144	60	28	21	1	-	5	284	26
25	35	68	6	75	253	217	175	45	20	4	14	912	83
26	110	273	74	254	431	373	370	138	88	33	37	2181	198
27	177	475	182	369	554	597	545	571	361	76	86	3993	363
28	282	498	310	540	547	816	734	836	1155	118	168	6004	546
29	341	443	372	706	536	755	687	1220	2095	155	235	7545	686
30	529	412	431	668	431	738	676	1303	1720	222	287	7417	674
31	569	419	471	610	414	648	767	1478	1615	283	469	7743	704
32	585	458	614	486	288	501	715	1015	1180	240	367	6449	586
33	529	342	421	427	194	378	524	746	712	190	336	4799	436
34	513	390	313	321	161	295	454	562	522	188	291	4010	365
35	393	242	228	226	110	210	305	401	392	170	184	2861	260
36	284	218	138	169	74	127	256	338	169	83	185	2041	186
37	234	178	82	134	57	70	135	214	141	56	130	1431	130
38	98	182	52	75	48	60	90	151	130	57	105	1048	95
39	120	111	53	73	29	33	80	128	81	37	72	817	74
40-44	358	184	90	134	69	75	85	246	180	76	122	1619	147
45-49	54	28	21	25	22	7	6	24	35	13	20	255	23
50-54	38	2	3	6	4	7	-	2	2	2	0.3	66	6
55-59	-	2	0.4	-	-	-	-	-	0.4	2	-	5	0.4
60+	1	-	-	-	-	-	-	-	-	-	-	1	0.1
Total	5266	4930	3863	5308	4378	5970	6636	9439	10599	2005	3113	61507	5591
Corresponding wt landed 000's cwt	28	24	18	23	17	24	28	42	47	10	12	273	25

Table 20.

SCOTLAND

Whiting - Trawl
Numbers landed (thousands)

Length	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
< 24	13	63	58	-	130	16	28	2	4	314	35
24	49	154	181	-	290	76	88	6	20	864	96
25	93	335	419	1012	770	300	170	51	43	3193	355
26	244	741	804	1367	1100	740	480	170	120	5766	641
27	530	1438	1278	2243	1600	1500	1000	490	280	10359	1151
28	1013	1988	1593	2887	2100	2100	1800	950	610	15041	1671
29	1823	2890	1804	3293	2400	2600	2300	1500	1300	19910	2212
30	2815	3735	1948	3250	2500	2800	2500	1900	1800	23248	2583
31	3451	3985	1905	2948	2400	2600	2400	2300	2300	24289	2699
32	4003	3981	1678	2443	2300	2300	2100	2200	2300	23305	2589
33	4011	3828	1545	1766	1800	2100	1900	2000	2300	21250	2361
34	3487	3239	1184	1392	1600	1800	1500	1700	2000	17902	1989
35	2639	2624	995	1039	1200	1300	1100	1300	1500	13697	1522
36	2230	2149	793	804	880	1200	960	1000	1200	11216	1246
37	1732	1698	610	592	620	880	740	710	920	8502	945
38	1348	1210	452	440	450	660	610	480	630	6280	698
39	996	888	383	329	350	500	470	390	440	4746	527
40-44	2533	1870	765	702	671	112	112	828	973	8566	952
45-49	638	345	170	124	98	183	222	173	158	2121	236
50-54	87	41	26	20	18	31	32	31	31	317	35
55-59	4	2	0.1	0.2	1	2	0.5	5	5	20	2
60+	-	-	-	-	-	-	-	-	-	-	-
Total	33739	37204	18591	26661	23278	23800	20513	18186	18934	220906	24545
Corresponding wt landed 000's cwt	212	197	90	120	106	118	107	96	106	1152	128

Table 21.

SCOTLAND

Whiting - Seine

Numbers landed (thousands)

Length	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
<24	28	85	175	-	410	11	64	6	10	789	88
24	156	297	561	-	1500	350	390	65	56	3375	375
25	508	1338	2392	9068	6100	1800	2100	600	460	24366	2707
26	1664	3478	8016	13637	11000	4400	5300	3000	1200	51695	5744
27	5147	6579	11303	19045	14000	1900	10000	8600	3700	80274	8919
28	9214	9871	13572	20941	16000	10000	13000	15000	8600	116198	12911
29	12863	12869	13552	19941	16000	12000	13000	19000	14000	132225	14803
30	15213	14905	13253	16908	15000	12000	11000	20000	18000	136279	15142
31	14517	12832	11017	12585	12000	11000	8600	18000	19000	119551	13283
32	12412	10717	8879	8323	9400	9800	6300	14000	16000	95831	10648
33	9411	8500	6627	5176	6800	7900	4900	9100	12000	70414	7824
34	6480	6501	4732	3195	4600	6600	3900	6200	9100	51308	5701
35	4023	4683	3339	1962	3100	4100	2800	4000	5300	34307	3812
36	2859	3341	2225	1223	2300	3400	2300	2600	4500	24748	2750
37	1878	2156	1596	792	1400	2500	1700	1800	3000	16822	1869
38	1253	1326	1274	502	1000	1800	1200	1300	1800	11455	1273
39	946	880	872	318	630	1500	960	910	1400	8416	935
40-44	1735	1301	1676	592	1190	2740	2110	2230	2030	15604	1734
45-49	290	169	203	90	170	397	510	429	330	2588	288
50-54	56	8	24	14	18	212	458	78	56	904	100
55-59	4	-	4	0.3	0.9	2	2	9	8	30	3
60+	-	-	-	-	-	-	-	-	-	-	-
Total	100637	101836	105292	134312	122619	94412	90594	126927	121550	998179	110909
Corre- sponding wt landed 000's cwt	446	413	398	474	462	430	365	518	558	4064	452

Table 22. Numbers (thousands) of whiting landed for processing from the North Sea by Danish vessels (based on the length distribution of fish landed for processing at Esbjerg).

Length cm	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
7						411	211					622	57
8		316				1,916	211					2127	193
9		316				6,297	106					6719	611
10						10,540	634					14246	1295
11			259			17,384	211	527				23031	2094
12			518			20,669	846	2,107				44416	4038
13			1,167			15,605	2,009	13,694				66325	6030
14			1,167			12,026	3,489	10,007				60456	5496
15			2,722			8,761	4,547	18,434				72576	6598
16			3,889	656		7,666	4,335	10,007				66575	6052
17			2,592	1,312		5,065	7,507	9,481				75831	6894
18			2,333	2,623		5,749	10,045	13,167				77302	7027
19			1,685	5,247		3,285	13,323	12,641				82256	7478
20			2,333	5,903		9,034	8,776	25,281				159441	14495
21			907	10,494		13,141	7,719	43,716				184087	16735
22			1,037	7,215		15,057	6,556	63,204				225645	20513
23			907	8,526		13,415	3,701	51,616				187484	17044
24			518	10,494		13,962	3,807	52,143				175698	15973
25			1,037	3,279		11,909	3,595	35,815				134039	12185
26			648	1,312		13,141	4,124	20,541				113302	10300
27			778	1,312		7,802	2,749	15,274				86628	7875
28			648	1,968		5,065	2,749	7,900				64646	5877
29			648	656		2,464	2,115	8,427				48064	4369
30			518	656		2,053	846	5,794				33941	3086
31			130	656		958	740	2,107				27121	2466
32			130	656		274	634	1,053				13094	1190
33			130	656		137	423	1,053				11421	1038
34			130	656		137	317	1,053				6633	603
35	139						317					2655	241
36							106					786	71
37							106					106	10
38							106					1149	104
40							106					1776	161
Total	47,128	187,169	26,703	69,522	101,450	223,942	96,857	423,990	335,460	147,965	410,013	2070199	188200
									Corresponding weight landed			(metric tons)	185670

Table 23. Plaice

Numbers landed (thousands)

Country	Denmark	England	England	Netherlands	Netherlands
Gear	Otter trawl	Otter trawl	Seine	Otter trawl	Beam trawl
Year	1958-66 ^x	1956-67	1956-67	1958-66	1962-66
cm					
20-4	2,885	458	81	3,227	605
25-9	407,935	61,958	5,463	192,505	36,223
30-4	241,804	153,998	33,615	135,354	38,261
35-9	26,838	121,576	31,595	44,577	10,816
40-4	5,894	65,214	16,946	18,667	3,309
45-9	1,132	25,764	6,758	6,817	989
50-4	684	10,867	3,264	2,045	284
55-9	339	3,164	1,065	505	31
60-4	78	670	232	82	1
65-9	0	98	23	9	0
Total	687,589	443,767	99,042	403,788	90,519

^xData for all years except 1960-61 based on comparison with Dutch data - see text

Table 24. Soles

Numbers landed (thousands)

Length cm	Netherlands		Length cm	Denmark		England	
	Otter trawl 1958-66	Beam trawl 1962-66		Otter trawl 1960-66	Otter trawl 1958-66		
20.5		1	20-1	2		5	
22.5	2,353	1,625	22-3	865		168	
24.5	63,953	39,438	24-4	5,493		1,567	
26.5	90,639	47,564	26-7	4,139		3,882	
28.5	69,307	28,323	28-9	2,897		6,433	
30.5	50,705	20,730	30-1	2,227		7,737	
32.5	33,832	8,627	32-3	1,316		6,624	
34.5	20,058	4,868	34-5	787		4,593	
36.5	14,472	2,976	36-7	351		2,826	
38.5	5,165	1,383	38-9	201		1,739	
40.5	2,490	581	40-1	97		970	
42.5	1,137	240	42-3	41		498	
44.5	458	92	44-5	26		198	
46.5	146	32	46-7	21		90	
48.5	23	5	48-9	2		23	
50.5	2	0	50+	0		11	
Total	354,740	156,485	Total	18,465		37,364	

Table 25. Mean lengths (cm) for age of female plaice landed at Lowestoft in 1928-29 and at Grimsby and Lowestoft in 1967.

Age (years)	2	3	4	5	6	7	8	9	10
1928-29 ¹⁾	24.1	26.0	28.0	30.4	33.1	35.3	37.8	40.0	42.6
1967 ²⁾	27.5	30.1	31.5	37.7	39.9	40.4	42.8	43.3	44.7

Plaice of up to 27 years-old occurred in the 1967 samples

1) From Thursby-Pelham, 1932 Table 24. 2) From unpublished data.

Table 26. Selectivity data relating to North Sea species.

Gear	Species	Material in Use 1)	Mesh-size in Use 2)	Selection Factor 3)	Minimum Landings Size 4)
Trawl	Cod	PE + PP → (England Scotland All countr.)	72,2 - 82,2 76,4 54,9 - 82,2	3.4	30
	Haddock	PE + PP (England Scotland All countr.)	"	3.4	27
	Whiting	PE + PP "	"	3.8	23
	Plaice	PE+PP+PA → (England Holland All countr.)	72,2 - 82,2 73,1 54,9 - 82,2	2.2	25
	Sole	PE+PP+PA → (Denmark England Holland All countr.)	- 72,2 - 82,2 72,1 - 73,1 54,9 - 82,2	3.3	24
Seine	Cod	PE + PP → (England Scotland All countr.)	97,9 66,0 66,0 - 97,9	3.4	30
	Haddock	PE + PP → (England Scotland All countr.)	"	3.9	27
	Whiting	PE + PP (England Scotland All countr.)	"	4.1	23
	Plaice	PE+PP+PA → (England Holland All countr.)	97,9 66,0 - 97,9	2.2	25
	Sole	" (England Denmark All countr.)	97,9 66,0 - 97,9	3.3	24

PE = Polyethylene. PP = Polypropylene. PA = Polyamide.

1) Procès-Verbal de la Réunion 1967, pp.61.

2) The Liaison Committee's Report to NEAFC for 1968

3) Co-opted Members' Report to the Liaison Committee. Coop.Res.Rep. 1964, Series B:26-31.

4) North-East Atlantic Fisheries Commission, May 1967, page 74, 1968.

Also Note

1) Coop.Res.Report 1964. Series B. 1st paragraph on page 31.

2) Coop.Res.Report 1965. Series B. 1st, 2nd and 3rd paragraphs on page 81.

3) Coop.Res.Report 1966. Series B. Item "Mesh selection and differentials" on page 61 and 62.

Table 27. Selectivity data used in the calculations.

		Present Mesh-size	Selection Factor	Selection Range (cm)	50% Length (cm)				
					Present Mesh-size	80 mm	85 mm	90 mm	100 mm
Cod	Trawl	75	3.4	6	25	-	-	31	34
	Seine Scotland Seine England	70) 98)	3.4	6	34	-	-	34	34
Haddock	Trawl	75	3.4	6)	26	-	29	31	34
	Seine	70	3.9	6)					
Whiting	Trawl	75	3.8	6)	29	30	32	34	38
	Seine	70	4.1	6)					
Sole	Trawl England	75	3.3	4	25	26	28	30	33
	Beam-) Trawl) & Denmark)	68		4	22				
Plaice	Trawl England	75	2.2	1.6	17)			20	22
	Holland)	68			15)				
	Denmark)								
	Seine England)	98		1.6	22)				
	Denmark)								

Table 28. Showing the 50% ages used in the calculations.

		50% Ages corresponding to different mesh-sizes					Differences from present 50% ages corresponding to different mesh-sizes					
		Present Mesh	75	80	85	90	100	75	80	85	90	100
Cod	Trawl) Scottish Seine)	1.2	-	-	-	1.5	1.8	-	-	-	0.3	0.6
	English Seine	1.8	-	-	-	1.8	1.8	-	-	-	0	0
Haddock	Trawl) Seine)	2.0	-	=	2.4	2.8	3.4	-	-	0.4	0.8	1.6
Whiting	Trawl) Seine)	3.0	-	3.4	4.0	5.0	∞	-	0.4	1.0	2.0	∞
Sole	Trawl: Denmark) Holland)	2.5	3.1	3.5	4.1	4.7	6.3	0.6	1.0	1.6	2.2	3.8
	Trawl: England	3.1	3.1	3.5	4.1	4.7	6.3	0	0.4	1.0	1.6	3.2
Plaice	Denmark) Holland)	1.8	2.1	-	-	2.8	3.3	0.3	-	-	1.0	1.5
	Trawl: England	2.1	-	-	-	2.8	3.3	0	-	-	0.7	1.2
	Seine: England	2.8	-	-	-	-	3.3	-	-	-	-	0.5

Table 29. Total instantaneous mortality rate (Z) over the range of ages exploited by Annex II fisheries.

Cod	Haddock	Whiting	Sole	Plaice
1.1 ¹⁾	1.0 ²⁾	1.0 ⁴⁾	0.6 ⁷⁾	0.53 ⁸⁾
	1.1 ³⁾	1.2 ⁵⁾		
		1.3-2.4 ⁶⁾		

- | | |
|-----------------------------------|---|
| 1) From Baitt & Symonds (1967) | 5) From Jones (1964) |
| 2) From Parrish & Jones (1952) | 6) From Knudsen (1968) |
| 3) From unpublished Scottish data | 7) From unpublished Dutch and Danish data |
| 4) From Ellis & Jones (1956) | 8) From Gulland (1968) |

Table 30. Numbers of Cod (millions) landed in Scotland by trawl and seine.

Age \ Year	1963	1964	1965	1966	Total	Mean
1	1.5	0.50	4.7	4.7	11.4	2.8
2	20	5.1	4.2	12	41.3	10.3
3	2.2	6.5	3.5	2.6	14.8	3.7
4	0.74	1.0	2.5	1.2	5.4	1.4
5	0.29	0.27	0.35	0.79	1.7	0.43
6	0.14	0.10	0.17	0.14	0.55	0.14
7	0.032	0.026	0.039	0.056	0.15	0.038
8	0.027	0.0068	0.028	0.036	0.098	0.024
9	0.0042	0.0028	0.010	0.0081	0.025	0.0063
10	0.0011	0.0029	0.0082	0.023	0.035	0.0088
Total	25	13	15	22	75	19
Corresponding weight landed (000's cwt)	482	424	451	487	1844	461

Table 31. Numbers of haddock (millions) landed in Scotland by trawl and seine.

Age	Year	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total	Mean
1	1958	2.2	26.4	16.6	11.6	16.7	18.7	0.024	2.3	7.2	131	14.6
2	1958	2.4	12.1	78.3	36.5	14.9	76.1	171.5	1.5	3.4	396.7	44.1
3	1958	118.6	6.1	6.0	43.3	14.1	7.0	25.2	202.6	2.5	425.4	47.3
4	1958	21.6	59.5	5.1	1.9	14.0	6.0	2.1	6.8	141.8	258.8	28.8
5	1958	18.3	10.5	13.4	1.4	0.65	4.0	1.5	0.78	1.8	42.3	4.7
6	1958	3.6	3.6	1.9	5.5	0.44	0.31	0.77	0.47	0.17	16.8	1.9
7	1958	0.46	1.1	0.58	0.43	1.9	0.15	0.066	0.13	0.073	4.9	0.54
8 and older	1958	0.049	0.19	0.16	0.18	0.20	0.49	0.16	0.07	0.037	1.5	0.17
Total		157	119	122	101	93	113	201	215	157	1278	142
Corresponding wt landed 000's cwt		1024	813	730	616	545	619	1094	1415	1329	8185	909

Table 32. Numbers of Whiting (millions) landed in Scotland by trawl and seine.

Age \ Year	1962	1963	1964	1965	1966	Total	Mean
1	33	5.0	0.9	5.2	5.3	49.4	9.9
2	51	68	53	4.8	22	198.8	39.8
3	46	32	45	110	8.2	241.2	48.2
4	11	16	7.7	21	96	151.7	30.3
5	3.4	4.1	3.6	2.8	9.0	22.9	4.6
6	0.05	1.1	0.97	1.1	0.98	4.20	0.84
7	0.35	0.0074	0.24	0.23	0.39	1.2	0.24
8	0.024	0.10	0.0024	0.069	0.039	0.23	0.047
9	0.014	0.011	0.025	0.00045	0.023	0.07	0.015
10	0.00041	0.0011	0.0056	0.0053	0.0004	0.01	0.0026
Total	145	126	111	145	142	670	134
Corresponding weight landed (000's cwt)	568	549	472	613	664	2866	573

Table 33. Mesh assessments - Roundfish.

Immediate losses %

		Mesh Size			
		80	85	90	100
Cod	- U.K. trawl and seine	-	-	1	3
Haddock	- England trawl	-	4	8	18
	- England seine	-	9	17	32
	- Scotland trawl	-	7	14	28
	- Scotland seine	-	12	24	41
	- U.K. trawl and seine	-	10	18	44
Whiting	- England trawl	8	25	41	69
	- England seine	11	32	51	79
	- Scotland trawl	9	27	45	73
	- Scotland seine	12	36	56	83
	- U.K. trawl and seine	11	34	55	80

Table 34. Mesh assessments - Roundfish.

Long-term gains %

	% Discarded	E 1)	M 2)	Mesh Size			
				80	85	90	100
Cod - U.K. trawl and seine	0	.9	.1			4	7
		.7	.25			3	6
Haddock - England trawl	10	.9	.1		18	22	22
		.7	.25		13	13	9
	25	.9	.1		34	38	35
		.7	.25		25	25	18
England seine	10	.9	.1		13	11	1
		.7	.25		8	4	- 9
	25	.9	.1		28	25	12
		.7	.25		19	14	- 2
Scotland trawl	10	.9	.1		14	14	6
		.7	.25		9	7	- 8
	25	.9	.1		30	28	17
		.7	.25		21	17	3
Scotland seine	10	.9	.1		8	2	-14
		.7	.25		3	- 5	-23
	25	.9	.1		23	15	- 5
		.7	.25		14	5	-17
U.K. trawl and seine	10	.9	.1		12	9	- 3
		.7	.25		6	2	-13
	25	.9	.1		27	22	8
		.7	.25		18	11	- 6
Whiting - England trawl	10	.9	.4	13	21	25	
		.7	.6	8	11	1	
England seine	10	.9	.4	10	9	3	
		.7	.6	4	-3	-17	
Scotland trawl	10	.9	.4	12	17	17	
		.7	.6	7	4	- 5	
Scotland seine	10	.9	.4	8	3	- 8	
		.7	.6	2	-9	-26	
U.K. trawl and seine combined	10	.9	.4	9	7	- 1	
		.7	.6	4	-5	-20	

1) Values of E over the exploitable phase. 2) Values of total mortality over the selection phase.

Table 35. Mesh assessments - Sole

Immediate losses %

Mean size (mm)	75	80	85	90	100
Denmark otter trawl	14	26	39	52	73
England otter trawl	11	21	34	46	70
Netherlands otter trawl	15	28	44	57	80
Netherlands beam trawl	0	56	14	24	34
All countries combined	11	22	36	49	71

Long-term gains %

for $Z = 0.6$

Mesh size (mm)		75	80	85	90	100
Denmark otter trawl	M					
	0.035	6	12	20	29	49
England otter trawl	0.105	3	6	10	13	17
	0.035	-	3	8	12	13
Netherlands otter trawl	0.105	-	2	4	6	4
	0.035	5	10	16	23	43
Netherlands beam trawl	0.105	3	5	8	9	13
	0.035	4	9	16	23	49
All countries	0.105	2	4	6	8	15
	0.035	4	9	16	22	40
	0.105	3	5	7	9	12

Table 36. Parameters used in the calculation of the yield effort curves.

	50% Age (1c)	50% Length (1c)	Growth Parameters			Range of M
			to	K	L_{∞}	
Cod	1.2	25	+0.39	0.20	132	.10-.25
Haddock	2.0	26	-0.76	0.26	53	.10-.25
Whiting	3.0	29	+0.27	0.26	42	.10-.25 ²⁾
Sole	2.5	22	-0.76	0.26	39.2	.035-.105
Plaice	3.7 ¹⁾	24 ¹⁾	-0.8	{ 0.095 0.15	68.5	0.1-0.2

1) Assumes fishing occurs on grounds where the larger fish occur.

2) For 3.0 year and older fish.

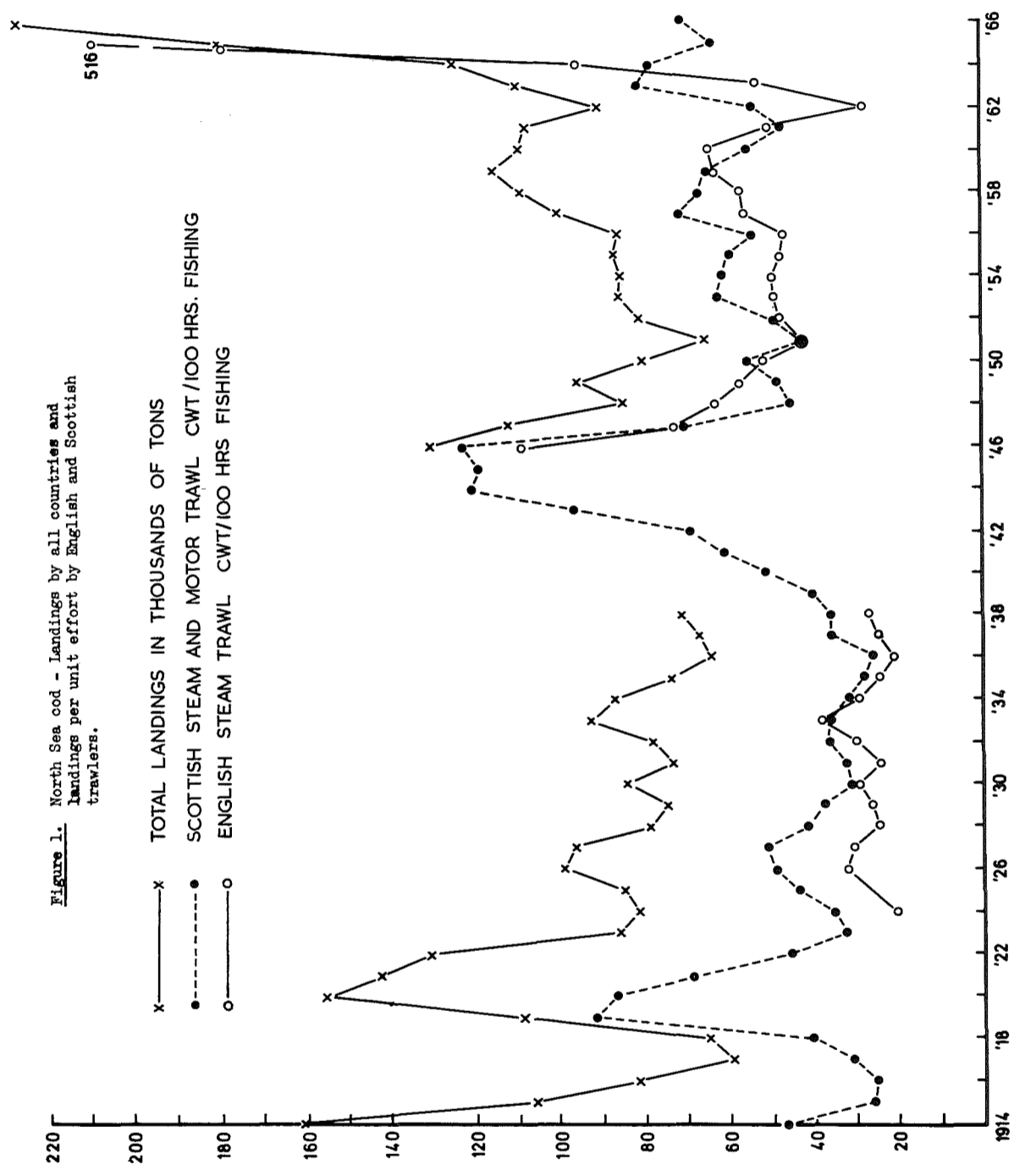


Figure 1. North Sea cod - Landings by all countries and landings per unit effort by English and Scottish trawlers.

x — TOTAL LANDINGS IN THOUSANDS OF TONS
 ● — SCOTTISH STEAM AND MOTOR TRAWL CWT/100 HRS. FISHING
 ○ — ENGLISH STEAM TRAWL CWT/100 HRS FISHING

Figure 2. North Sea haddock - Landings by all countries and landings per unit effort by English and Scottish trawlers.

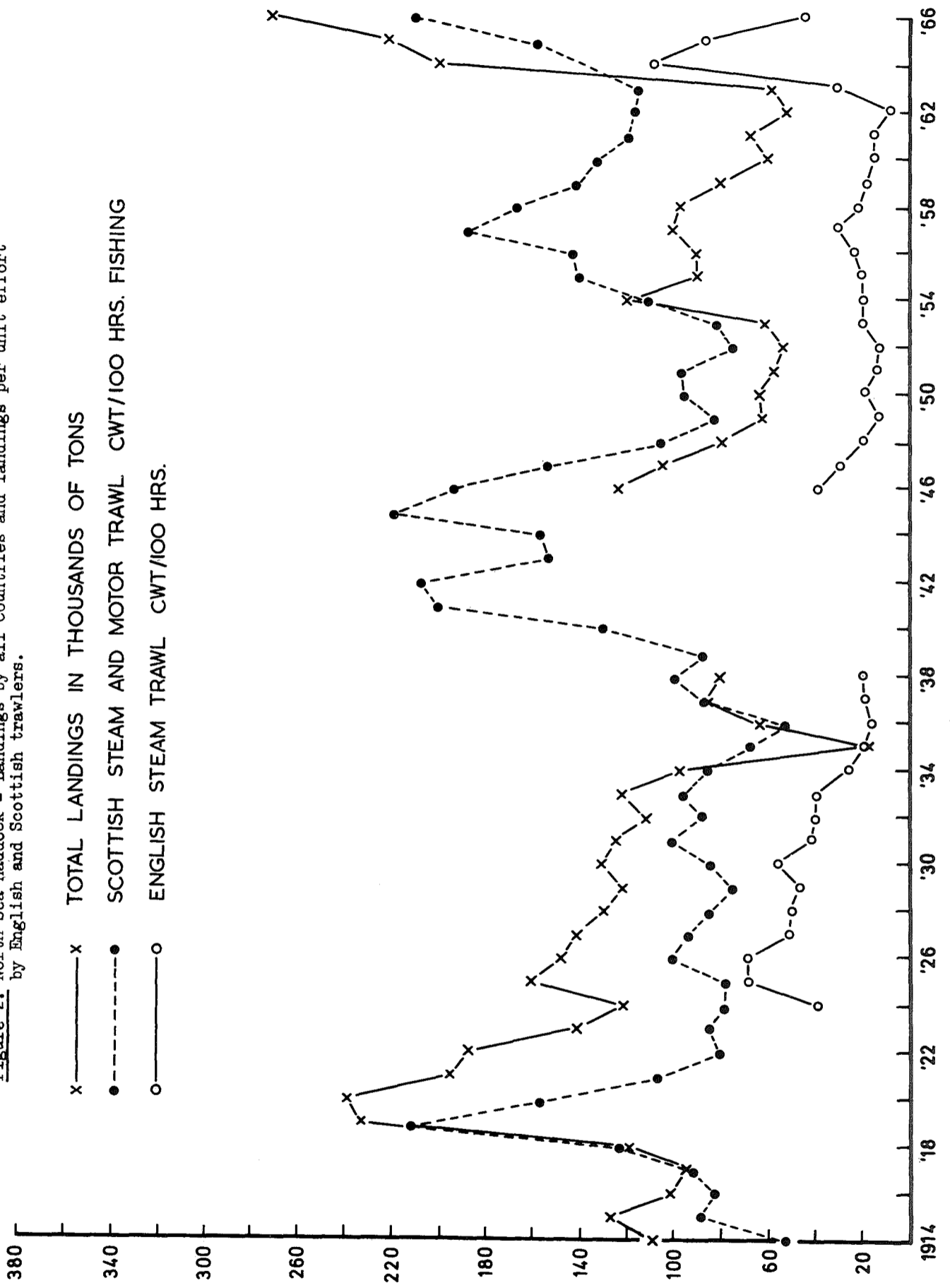


Figure 3. North Sea whiting - Landings by all countries and landings per unit effort by English and Scottish trawlers.

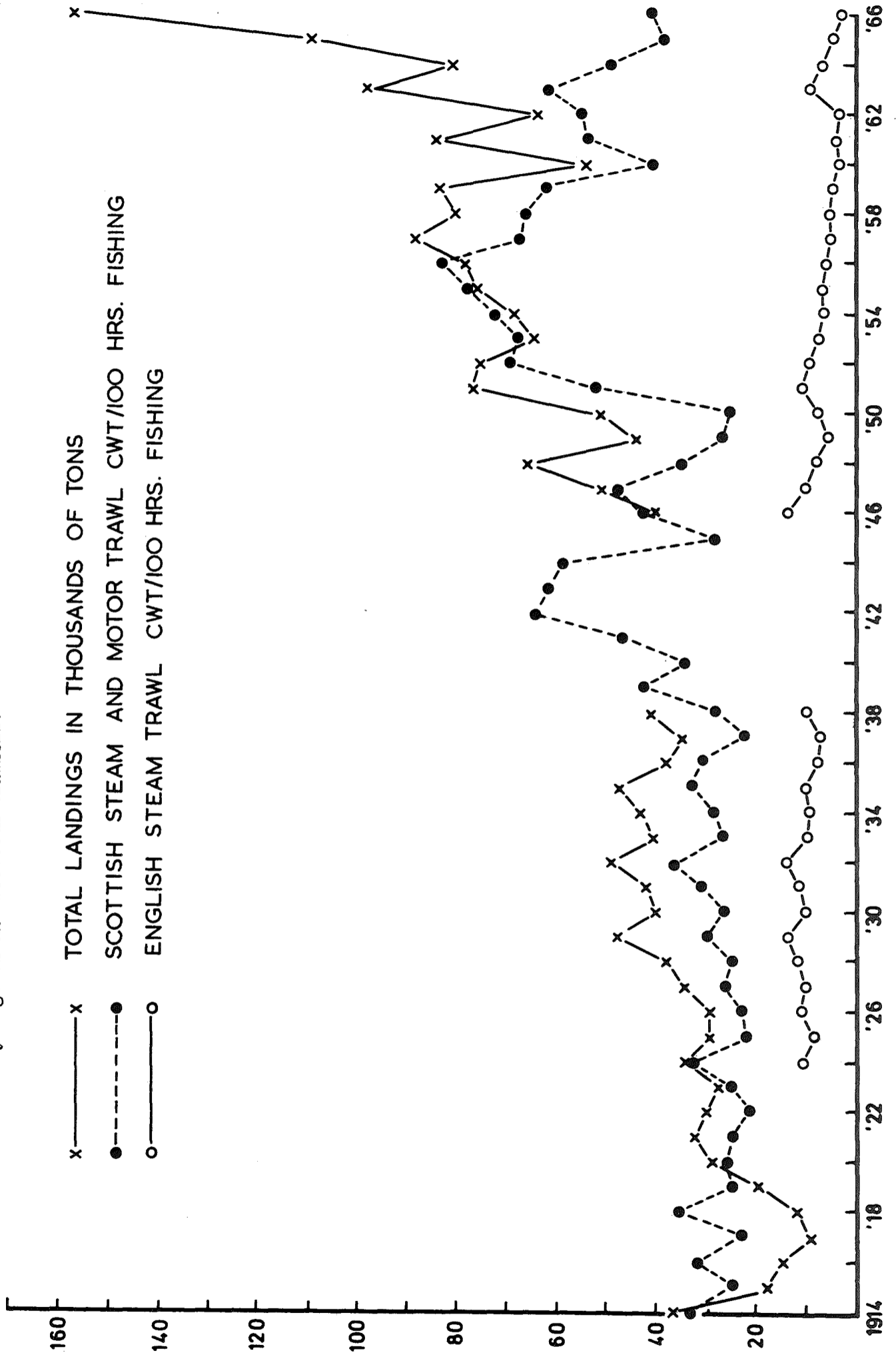
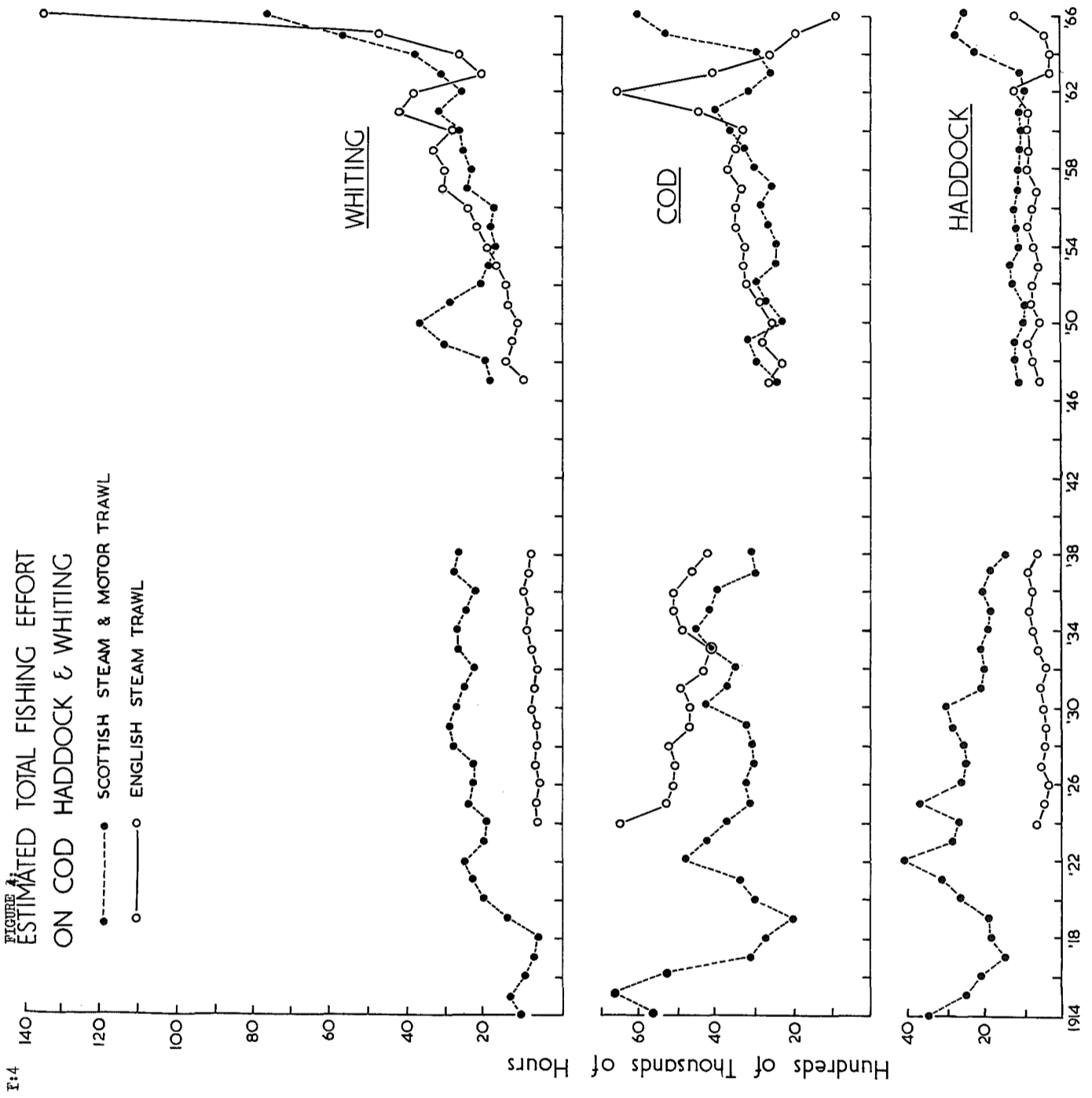


FIGURE 4
 ESTIMATED TOTAL FISHING EFFORT
 ON COD HADDOCK & WHITING



F:4

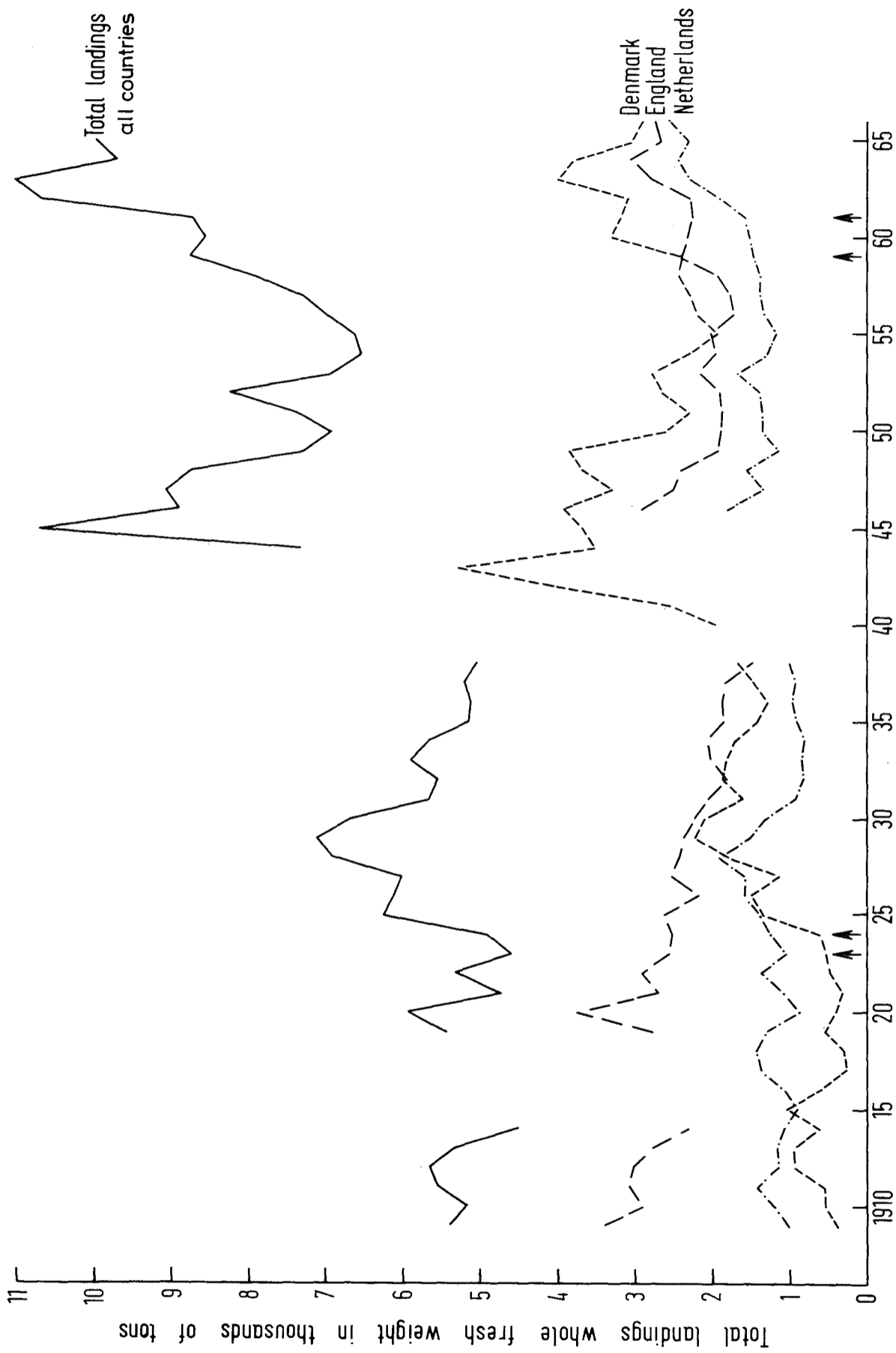


FIGURE 5. NORTH SEA PLAICE - LANDINGS BY ALL AND VARIOUS COUNTRIES. ARROWS INDICATE START OF DUTCH INDUSTRIAL FISHERY (1923), START OF DANISH SEINE NET FISHERY (1924), CHANGE FROM SANDEEL TO PLAICE FISHING BY DANES (1929) AND START OF DUTCH BEAM TRAWL FISHERY (1961).

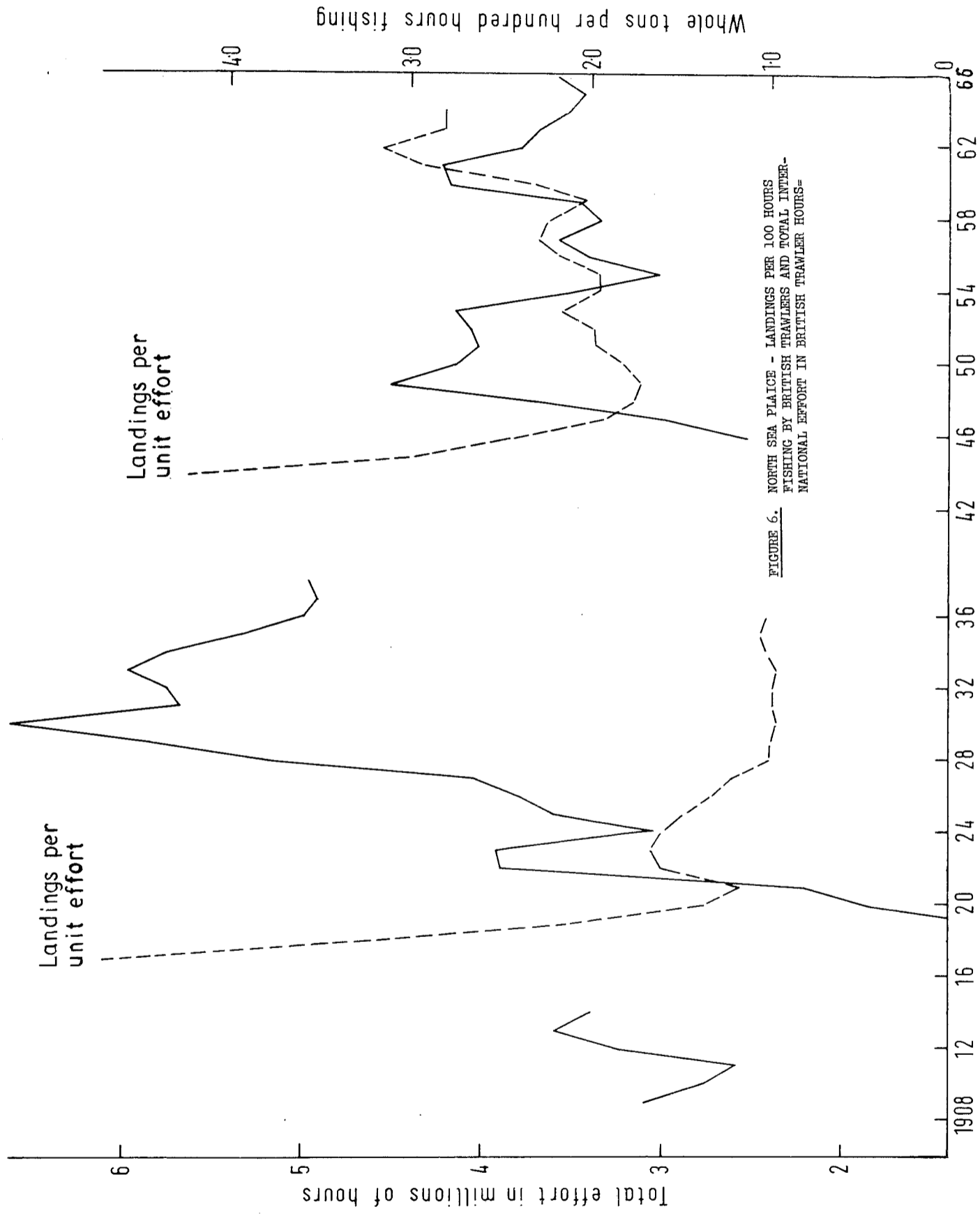
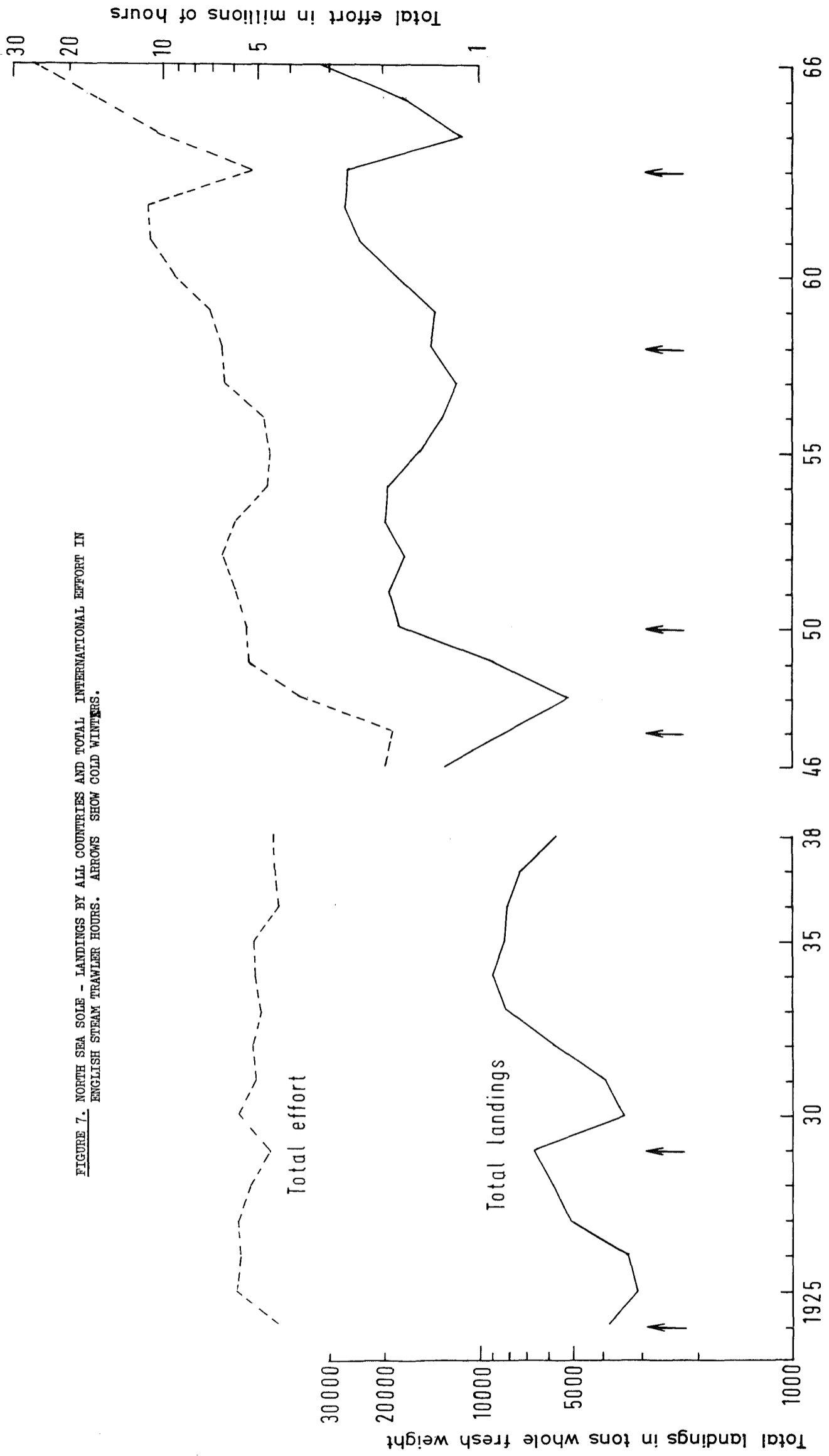


FIGURE 6. NORTH SEA PLAICE - LANDINGS PER 100 HOURS FISHING BY BRITISH TRAWLERS AND TOTAL INTER-NATIONAL EFFORT IN BRITISH TRAWLER HOURS.

FIGURE 7. NORTH SEA SOLE - LANDINGS BY ALL COUNTRIES AND TOTAL INTERNATIONAL EFFORT IN ENGLISH STEAM TRAWLER HOURS. ARROWS SHOW COLD WINTERS.



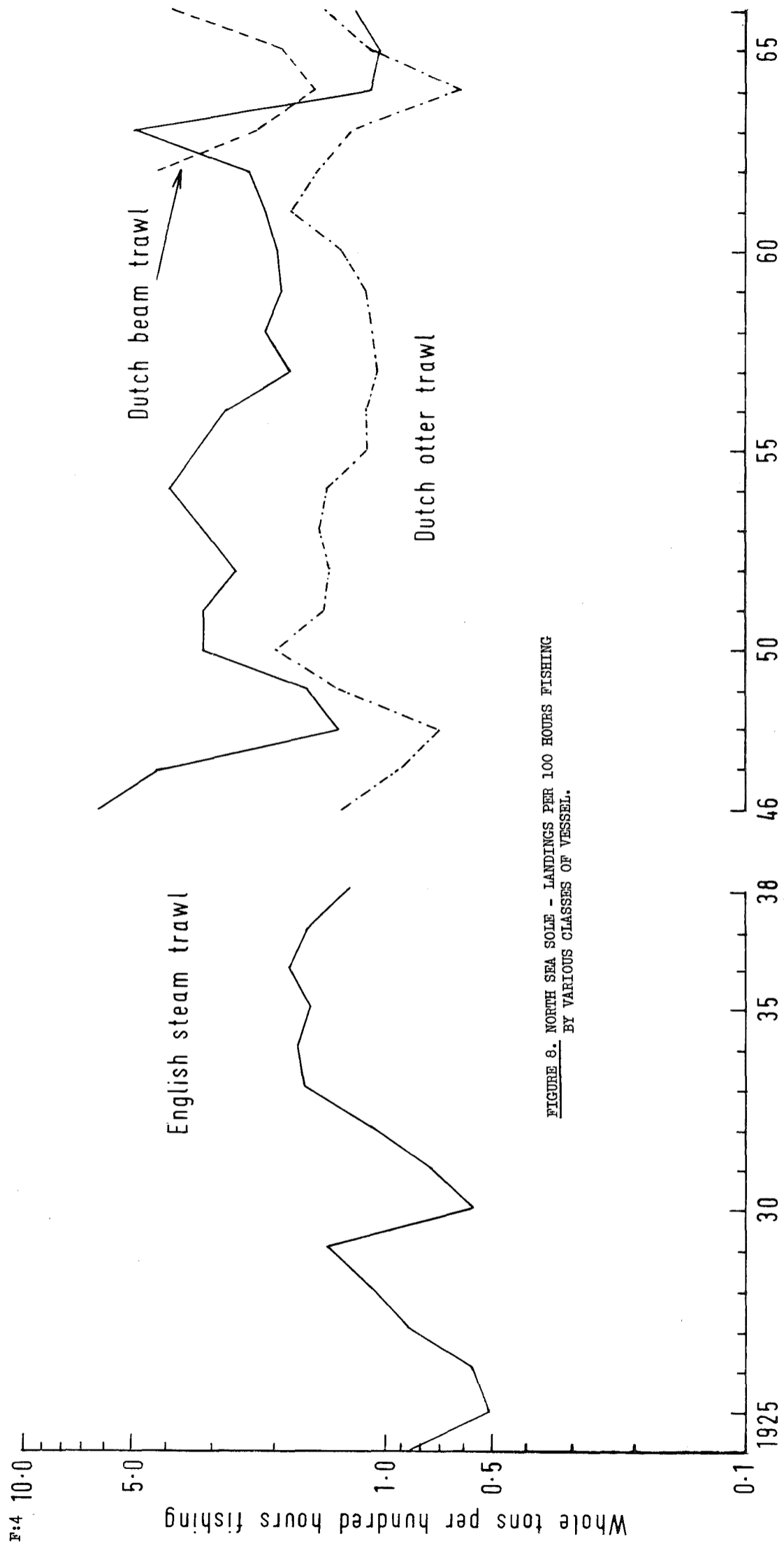


FIGURE 8. NORTH SEA SOLE - LANDINGS PER 100 HOURS FISHING BY VARIOUS CLASSES OF VESSEL.

NORTH SEA COD

YIELD PER RECRUIT AND CATCH PER UNIT EFFORT PER RECRUIT PLOTTED AGAINST F.

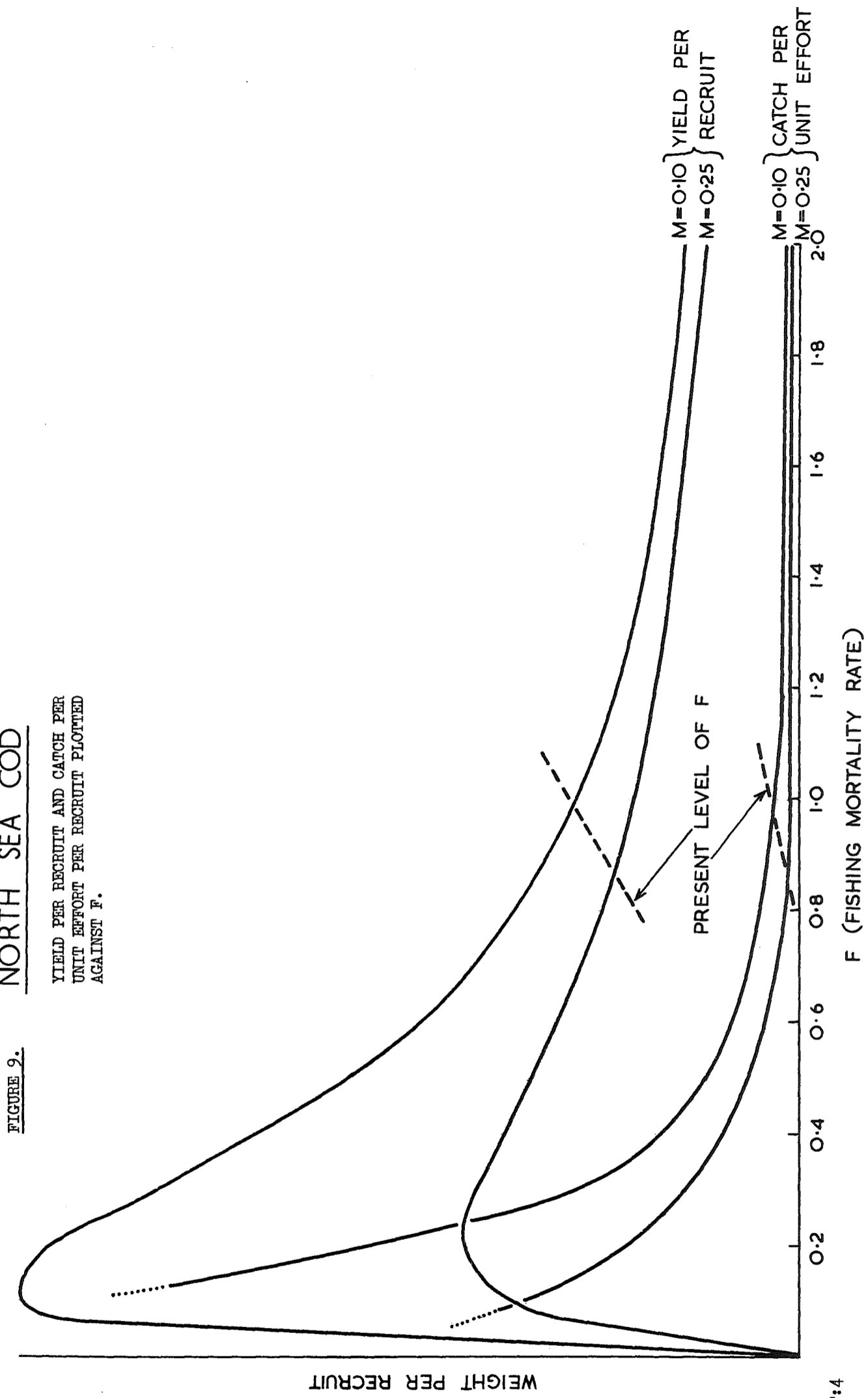


FIGURE 9.

FIGURE 10. NORTH SEA HADDOCK

YIELD PER RECRUIT AND CATCH PER UNIT EFFORT PER RECRUIT PLOTTED AGAINST F.

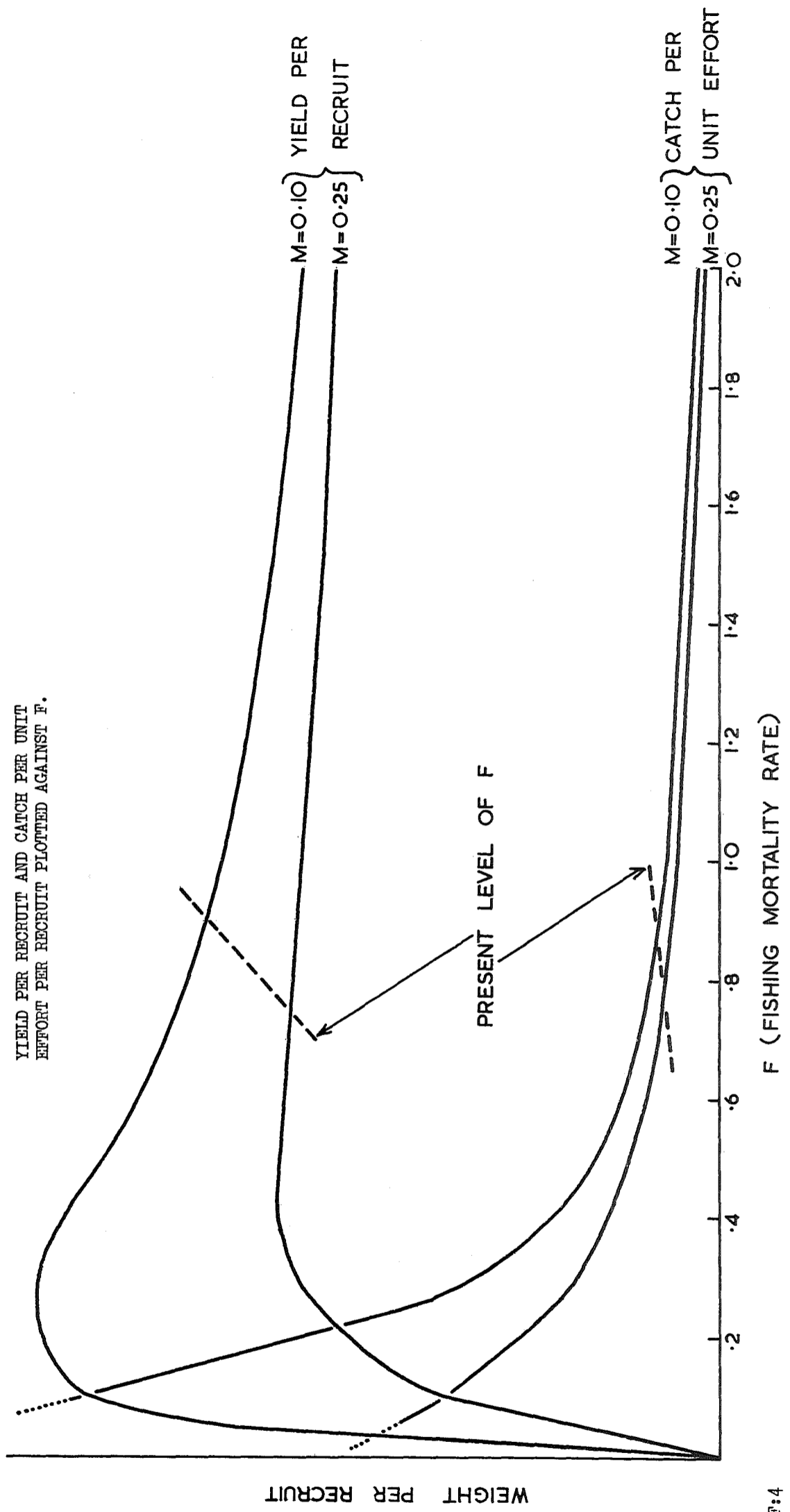


FIGURE 11. NORTH SEA WHITING

EFFORT VARIED IN ANNEX II & ARTICLE 6 FISHERIES

YIELD PER UNIT EFFORT PER RECRUIT PLOTTED AGAINST F DUE TO ANNEX II FISHERIES.

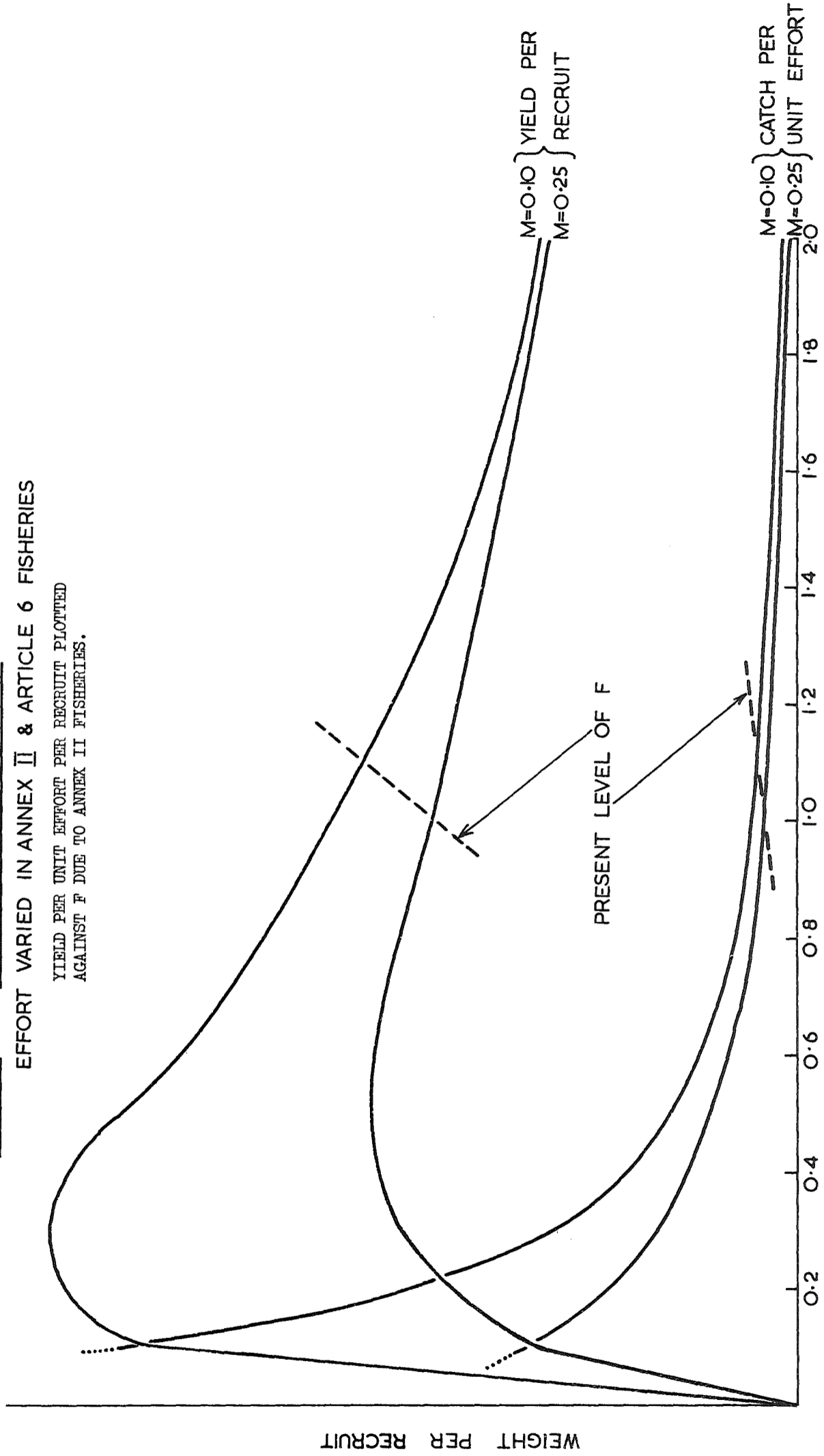
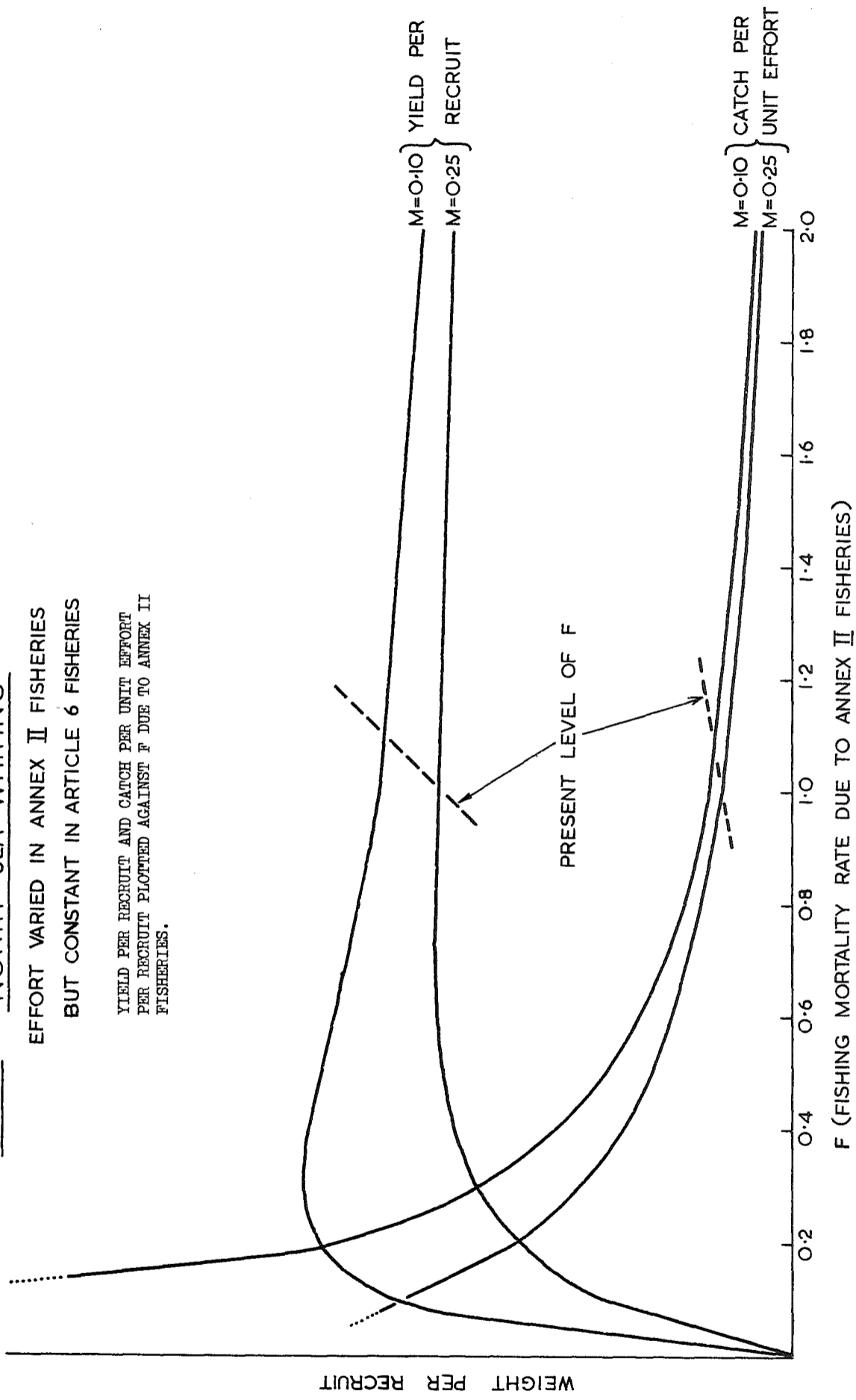


FIGURE 12. NORTH SEA WHITING

EFFORT VARIED IN ANNEX II FISHERIES
BUT CONSTANT IN ARTICLE 6 FISHERIES

YIELD PER RECRUIT AND CATCH PER UNIT EFFORT
PER RECRUIT PLOTTED AGAINST F DUE TO ANNEX II
FISHERIES.



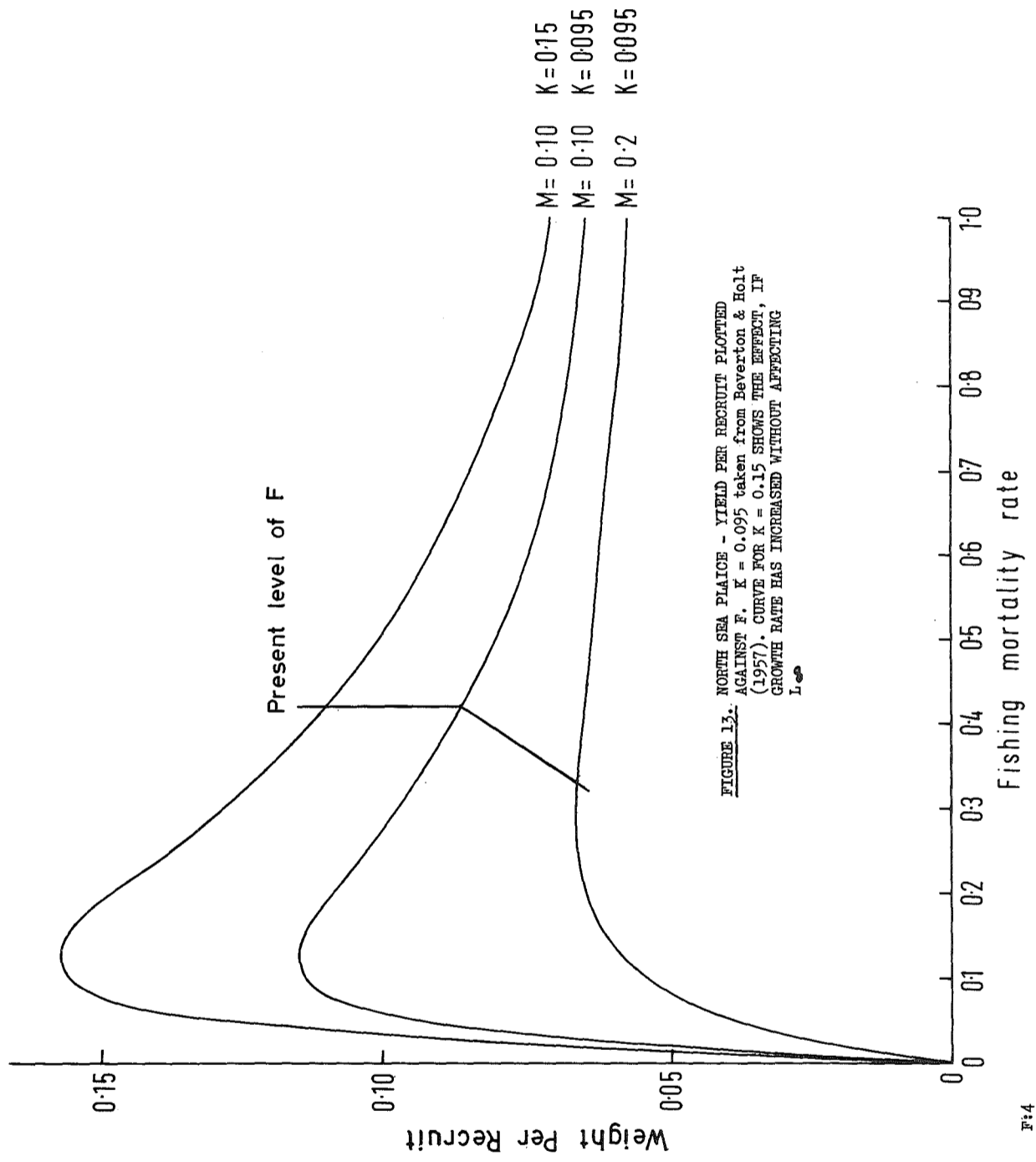


FIGURE 13. NORTH SEA PLAICE - YIELD PER RECRUIT PLOTTED AGAINST F. $K = 0.095$ taken from Beverton & Holt (1957). CURVE FOR $K = 0.15$ SHOWS THE EFFECT, IF GROWTH RATE HAS INCREASED WITHOUT AFFECTING L_{∞}

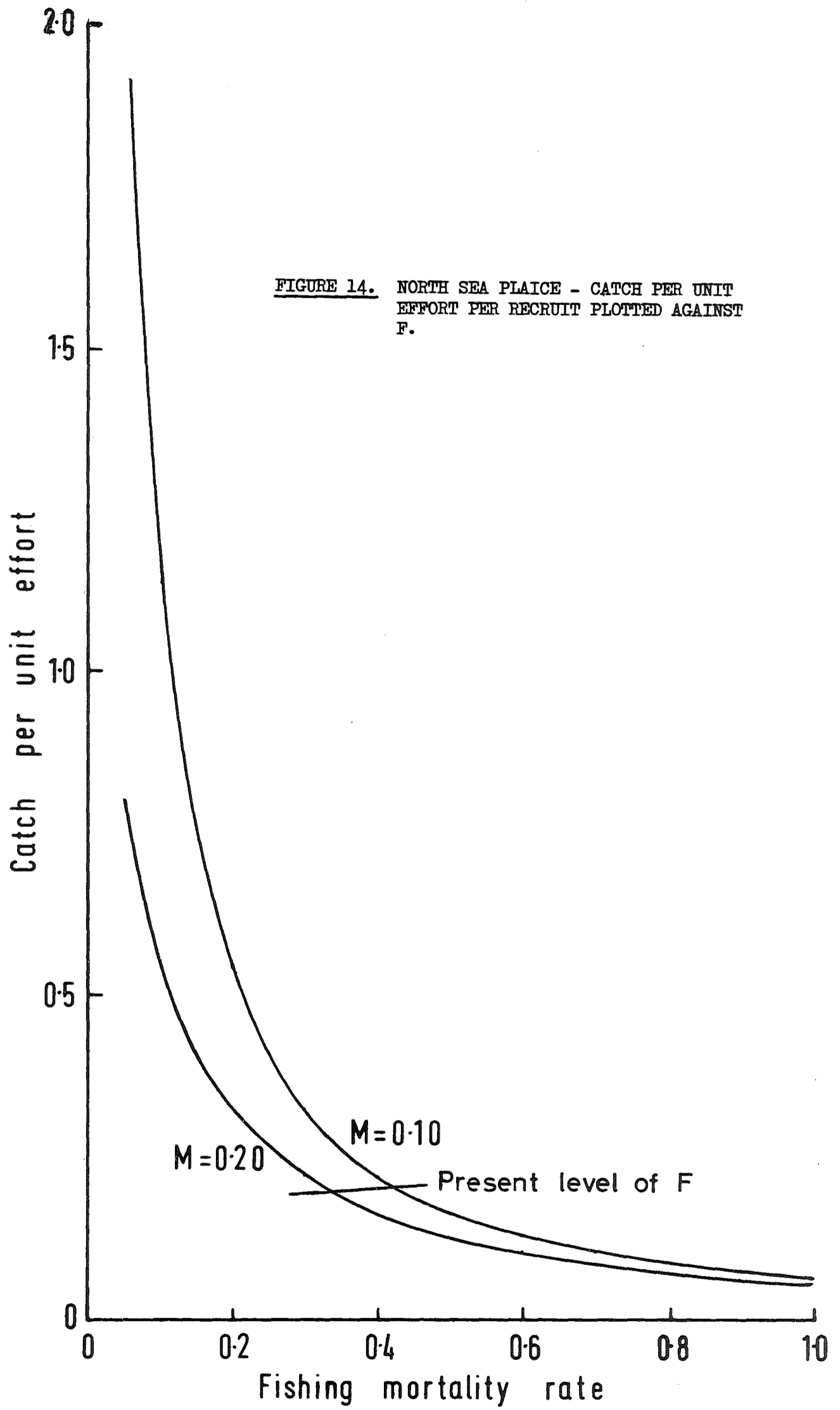
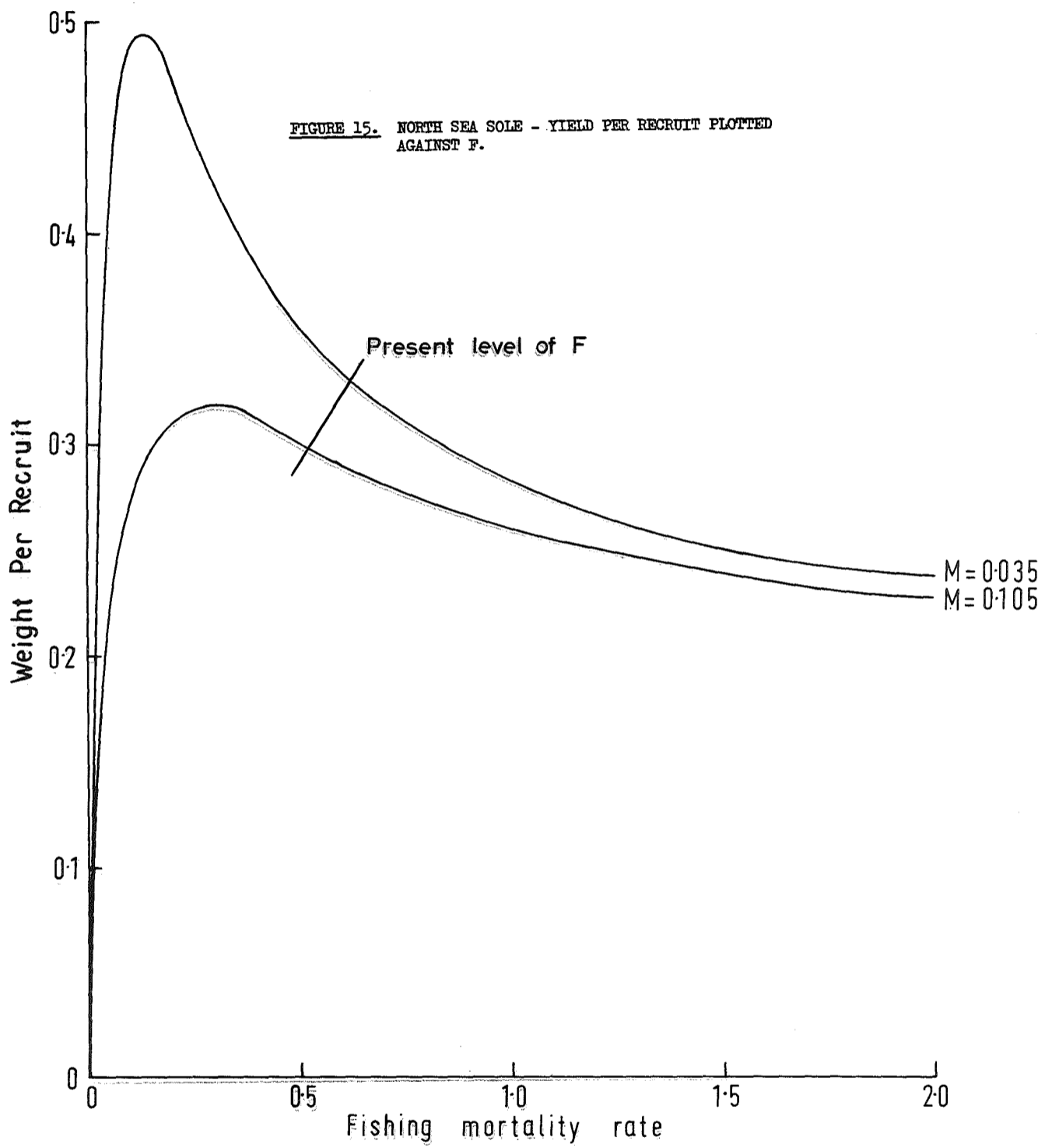


FIGURE 14. NORTH SEA PLAICE - CATCH PER UNIT EFFORT PER RECRUIT PLOTTED AGAINST F.



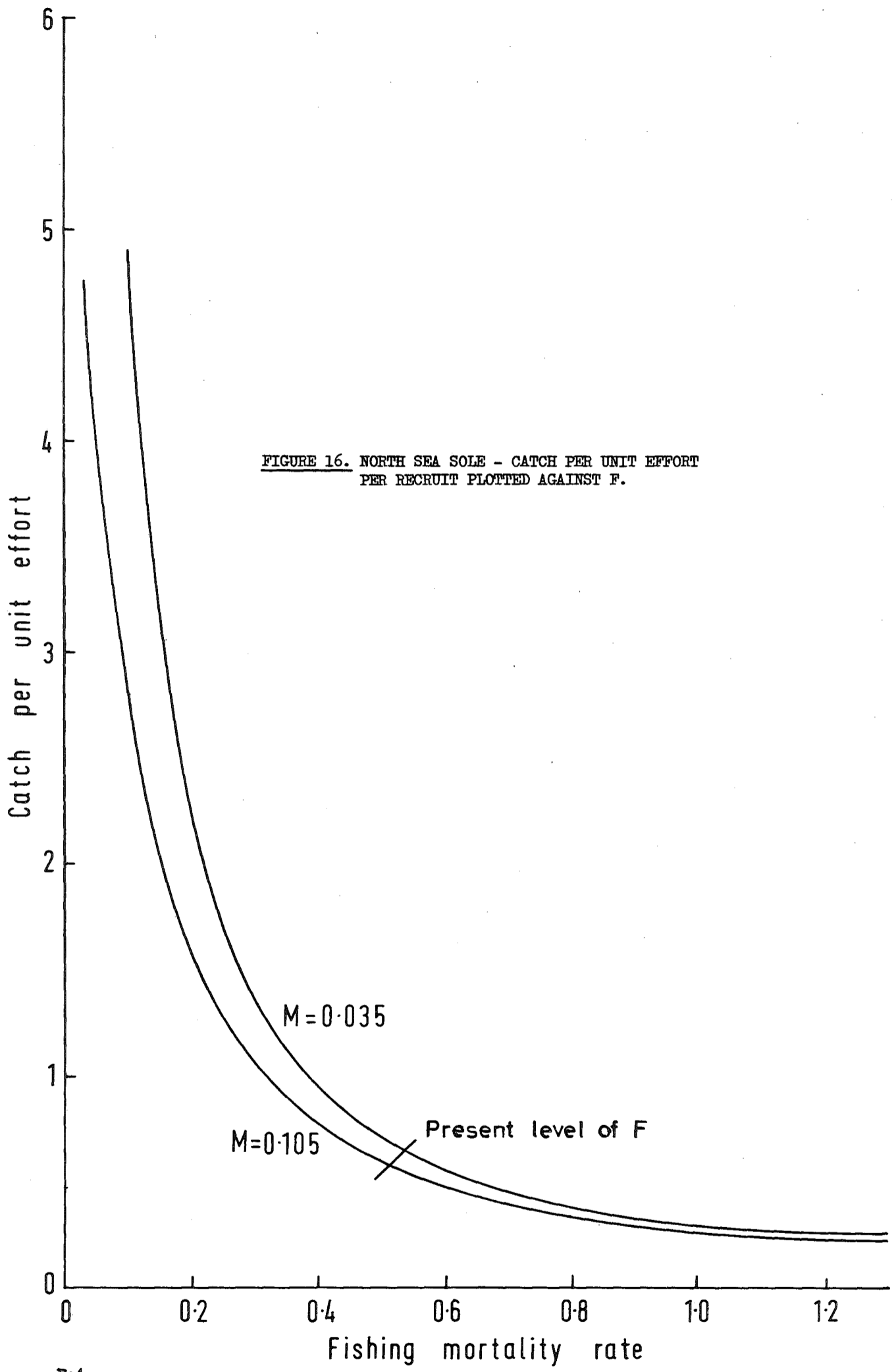


FIGURE 16. NORTH SEA SOLE - CATCH PER UNIT EFFORT PER RECRUIT PLOTTED AGAINST F.