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REPORT OF THE NORTH SEA FLATFISH WORKING GROUP

Charlottenlund, 16-20 February 1976

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Report of the North Sea Flatfish Working Group

1. INTRODUCTION

1.1 The ICES North Sea Flatfish Working Group met in Charlottenlund from 16-20 February 1976 with the following members participating:

D W Armstrong	U.K. (Scotland)
R C A Bannister	U.K. (England)
K Brander	U.K. (England)
R de Clerck	Belgium
D de G Griffith	Ireland
H Lassen	Denmark
G Lefranc	France
E Nielsen	Denmark
T K Pitt	Canada
G Rauck	Germany,(Federal Republic of)
J F de Veen(Chairman)	Netherlands.

1.2 The Group was convened with the following terms of reference (C.Res. 1975/2:21):

"It was decided, that:

the North Sea Flatfish Working Group should meet at Charlottenlund from 16-20 February 1976 in order to assess TACs for 1977 for plaice and sole in the North Sea, Irish Sea, Bristol Channel and English Channel. It is strongly hoped that a representative from France will attend the meeting".

1.3 For North Sea plaice and sole the standard programme for assessment was followed including virtual population analysis and a prognosis programme for arriving at TAC figures.

Since the number of years for which age compositions of total international landings are available has increased to a level where VPA is possible, the standard assessment programme has also applied for the first time for the Irish Sea plaice and sole and the Bristol Channel sole. This was not possible for the Bristol Channel plaice.

As will be clear from Section 4.1, the English Channel plaice and sole fisheries are still difficult to assess. However, progress has been made in understanding the biological problems in the area and some French information was produced enabling the Group to improve on their assessment. When our French colleagues are in position to collect the necessary biological data and when other problems outlined in Section 4.1 are clarified, the assessment in this area can improve considerably.

1.4 The Group had a considerable task to perform and in only half of the time of that in 1975 when it had some extra items on the agenda.

In order to deal properly with its task in the future, an increase in the time allotted to the Group of two days would be greatly appreciated.

2. NORTH SEA SOLE

2.1 Introduction

2.1.1 For calculating a total allowable catch for 1977 a new assessment was made. Since the previous TAC calculations, a year of quota regulation has passed and the predicted trends in catch and stock for 1975 can be compared with what actually happened in that year. The procedure used in the assessment is the same as that followed with the 1975 assessment, which procedure was accepted by the Working Group as standard routine.

2.1.2 At the end of 1975 it became apparent that for a number of reasons the 1975 total catch was considerably higher than the 1975 TAC. Whereas some countries could not fill their quotas, others had no trouble in overshooting their quotas because of difficulties at home in the enforcement of the quota regime. The result is that total international effort in 1975 was at least at the same level as in 1974. However, illegal landings, not reported, have also taken place in the second half of 1975. Though very difficult to assess, these are believed to be of the order of 2 000 - 3 000 tons. It follows that total effort in 1975 in reality has been larger than in 1974, but in the calculations only the official data on landings can be taken into account, and these are given in Table 1.

2.1.3 The preliminary figures for 1974 given in last year's Report (Doc. C.M.1975/F:4) have been replaced by the official data given in the Advance Release of "Bulletin Statistique 1974".

2.2 Age Composition

2.2.1 The <u>1974</u> age composition was based on the updated age compositions per sex for the Netherlands, Belgian and Danish total landings, accounting for 96% of the total landings based on "Bulletin Statistique" nominal weight in metric tons.

2.2.2 The <u>1975</u> age composition was calculated in the same way, but the data for Belgium were preliminary. In addition, the landings data from all other countries are provisional since landings of the last two months have been estimated on the basis of trends in recent years.

As in the previous report no account was made for discarding.

2.3 The Virtual Population Analysis

2.3.1 For male and female sole separately a new virtual population analysis was run. A constant natural mortality of M = 0.10 for both sexes was assumed over the ages 2-14, as had been assumed in the previous VPA.

2.3.2 Terminal F values of 0.14 for males and 0.25 for females were taken for cohorts fully exploited to the age of 14. Last year, the VPA terminal F values for partially exploited cohorts were taken as the average of the 1969-72 F-at-age arrays in the 1974 VPA. This F-at-age array used in the 1975 Report was smoothed to eliminate any minor age to age fluctuations, and used as the new F-at-age array for this year since it could satisfactorily produce the observed 1975 catch composition from that observed in 1974. This F-at-age array per sex, given in Table 2, was taken to be the terminal F values for the partially exploited cohorts in the new VPA.

2.3.3 The resulting fishing mortality at age and the stock in numbers from this VPA were compared with those of the 1975 VPA. For the years prior to 1966 both VPAs gave the same F and stock size results. For that reason the fishing mortalities and stock numbers resulting from the new VPA are only given for the last ten years in Tables 3 and 4. The average F value for ages 2 and older given at the bottom of the F table refer to averages, weighted by stock number at age.

2.3.4 The new VPA gives F values for males slightly higher for the most recent years than in the former VPA, but for females the reverse is true, so that for the combined sexes, the F values are about the same. The new VPA shows that the average fishing mortality over 1972, 1973 and 1974 is at a level of 0.55 compared to 0.40 for the period 1966-71 and to 0.20 for the pre-1966 level.

2.3.5 The abundance of the recruiting year classes (2 year old fish) for the 1955-73 year classes is shown in Table 5.

2.4 Prognosis of Catch and Stock in 1976 and 1977

2.4.1 In the 1975 Report advice on the TAC for 1976 was given on the assumption that the 1975 total catch should not exceed 12 500 tons. The reduction in F from 1974 to 1975 resulting from this should have been 34% and on this basis a TAC of 8 000 tons was recommended, which in the long term would double the stock biomass.

2.4.2 However, the overshooting of the TAC in 1975 resulted in no reduction in F at all. Thus the TAC advice for 1976 should be reconsidered. However, the 1976 TAC has already been officially agreed in NEAFC to be 12 500 tons and national measures are based on the national quota derived from this quantity. Assuming that the 1976 TAC of 12 500 tons will be taken, the catch and stock for several values of the fishing mortality in 1977 were estimated together with the implications for stock recovery.

2.4.3 For the forecast, the relative fishing mortality at age per sex was taken to be the terminal F-at-age array used in the VPA and given in Table 2.

The same weight at age per sex is used as in the 1975 Report and is reproduced in Table 6, in which separate arrays are given for catch (July data) and stock biomass (1st of January data).

2.4.4 The 1975 Report demonstrated that the estimates of the 1973 and 1974 year classes from the Dutch-Belgian-German pre-recruit surveys could be used in the forecast. The 1973 year class, already reasonably abundant as 0- and I-group sole, entered the fishery in the second half of 1975 and from the VPA amounts to 90.3 million soles, which is very close to the figure of 90 million soles predicted in the beginning of 1975 from the pre-recruit surveys.

2.4.5 Since the previous report two extra pre-recruit surveys have been made. These suggest that the 1974 year class will be 40 millions in 1976. For the 1975 year class only the October 1975 pre-recruit survey is available. The first impression is that this year class is below average abundance and similar to the 1974 year class. Therefore a preliminary estimate of the abundance of the 1975 year class when recruiting in 1977 is also 40 millions.

On the other hand, if we disregard this estimate as being only very preliminary, we would take the recruitment for 1977 to be average, i.e. 74 million soles (Doc. C.M.1975/F:4).

2.4.6 The 1977 catch and stock were forecast for several fishing mortalities for a regulated sole fishery in 1976, and for the two recruitment figures for 1977 of 74 million (A) and 40 million soles (B) and are given in Table 7.

2.4.7 The same calculations have been carried out for an unregulated fishery in 1976 (i.e. quota not effective in that year) and for two recruitment levels A and B in 1977. The results are given in Table 8.

2.4.8 The implications of each entry in both tables are given in terms of long-term gain in stock biomass, relative to the expected situation at the beginning of 1977, so that the advice on a TAC can be based on the effect of the possible management strategy on stock recovery.

2.5 Results of the Prognosis

2.5.1 The amount by which the 1975 quota has been exceeded is responsible for a drop in stock biomass of 7.5% (from 39 000 tons to 36 000 tons) compared with the predicted stock biomass given in the 1975 Report. Further, owing to the recruitment of the poor 1974 year class, stock biomass will decline even more. Even if the 1976 catches do not exceed 12 500 tons a natural stop to this decline will only occur if the 1975 year class is of at least average abundance. Since the pre-recruit estimate of this year class is only 40 million soles, this is unlikely.

2.5.2 The present sole fishery is now very dependent on a few young year classes and recruitment largely influences the fishery. Any succession of poor year classes brings the spawning stock to such a level that average recruitment can no longer be maintained.

The present position of recruitment as a function of stock density can be seen in Figure 1 (de Veen, 1975). The strength of the recruiting year classes has been adjusted to the most recent data on year class strength given in Table 5. Both the mean and the variance of the abundance of the most recent year classes have decreased as compared with the pre-1964 year classes, which suggests that the stock has already entered the downward leg of a stock/recruitment relationship.

2.5.3 To escape from this situation, fishery regulation should no longer aim merely at stabilising the stock level at the present position, which was the philosophy of the 1974 and 1975 deliberations at NEAFC, and on the basis of Figure 1 a doubling of stock biomass should move the stock out of the danger area. Therefore, if the 1976 total catch is reduced to 12 500 tons from the 1975 catch level of 17 000 tons, the TAC for 1977 should be 7 000 tons, on the optimistic view of there being average recruitment in 1977 (case A), or 6 700 tons, with predicted 1977 recruitment (case B). In both cases the stock biomass will double in the long term.

2.5.4 The implications of an unregulated fishery in 1976 can be derived from Table 8, where the decline in stock biomass in 1977 will amount to an extra 12%. In this case the TAC for 1977 should be 6 500 tons for case A and 6 200 tons for case B, which will double the biomass in the long term.

Furthermore, if the 1977 TAC were to remain at the same level as the agreed 1976 figure of 12 500 tons, this will have almost no effect in reducing the fishing mortality because from the prognosis the expected catch in 1977 will be either 13 600 tons (case A) or 12 800 tons (case B) and the stock biomass would decline further by 40% long term. With this situation there is a high probability that the stock and the fishery will collapse.

2.6 The Recommendation

2.6.1 In the previous Report (Doc. C.M.1975/F:4) the Group actually recommended a TAC for 1976 of 8 000 tons, but we have shown above that due to the decline in stock biomass owing to the recruitment of the two poor year classes of 1974 and 1975, and the effectively unregulated nature of the fishery in 1975, the 1977 TAC must be lower to achieve the same management objectives as before.

Consequently, a TAC of 6 700 tons must be recommended for 1977. It should be remembered that the present calculations were based only on official statistics of landings.

2.6.2 Rebuilding the stock by a TAC regulation should ultimately make it possible to achieve a sustainable yield of 15 000 tons, if the long-term average recruitment level of 74 million fish materialises. This level of yield is not necessarily the maximum sustainable yield, but conditional upon the present exploitation pattern (mesh size, minimum landing size, F over age relationship) which is far from optimal.

2.6.3 In their 1974 Report (Doc. C.M.1974/F:6) the Working Group gave the short- and long-term effects of increases in mesh size. Increasing the present mesh size to, say, 85 mm could increase the long-term sustainable yield by some 34% and bring it to 20 000 tons. Immediate losses will in this case be about 15%.

It is recommended that the effects of simultaneous enforcement of mesh size increase and effort limitation by TAC should be investigated more thoroughly than was possible during the present meeting.

3. NORTH SEA PLAICE

3.1 The Trend in Catch

The last entries in Table 9 show the most recent catch data for 1974 (based on "Bulletin Statistique", Advance Release) and 1975 (provisional figures based on NEAFC data with some amendments).

The high catch in 1973 has since been followed by two successive reductions of 10% and 5% respectively. The estimated 1975 catch of 116 000 tons was well below the TAC set by NEAFC for that year, in which the fishery was therefore effectively unregulated.

3.2 Age Composition Data

The 1974 age composition, estimated last year, was updated and an estimate made for the 1975 age composition. As last year, data were available for all but the catch taken by France, Norway, Sweden and "Others", but the 1975 data referred mainly to the first three quarters of the year and were raised to the total annual catch. The data are shown in Table 10, columns 2, 3, 8, and 9 and have been added to the historic record in Tables 11 and 12. The most obvious feature of these data is the marked increase in the catch of two and three year old plaice in 1975 over that in 1974. These fish belong to the 1972 and 1973 year classes.

3.3 The Present Mortality Rate and Stock Size

For any latest year N, the mortality and stock composition can normally be estimated by prognosis programme from the catch composition in, say, year N-2. Thus,using appropriate estimates of the recent recruitment, the F-at-age array can be adjusted until a satisfactory estimate is obtained for the observed catches in years N-1 and N. This F array can then be used to initiate a new virtual population analysis, and for predicting the catch and stock for years N+1 and N+2.

In the present situation certain rather arbitrary assumptions were required in order to simulate the unexpectedly high 1975 catch of two and three year old place, which could have arisen either because the 1972 and 1973 year classes were much more abundant than expected, or because of a change in the availability or concentration of these year classes. The Waddensea pre-recruit survey data (see Section 3.8) do not indicate that either of these year classes is very abundant in the continental nurseries as a whole, but that the 1972 year class was locally most abundant in the Horns Reef area ("Annales Biologiques", Vol.30, pp.175-182, 1975).

It is here that the best catches of small plaice were reported to be made by the English, German (Federal Republic) and Netherlands (Figure 2) fleets in 1975. English vessels are reported to have fished more heavily than usual in the area, but for the Dutch fleet, the 1974 and 1975 distributions of fishing effort were not markedly different (Figure 3).

Consequently, it was decided to carry out the check prognosis and VPA runs in such a way as to (i) leave the recruitment of the 1972 and 1973 year classes in line with values indicated by the correlation between the pre-recruit survey (Section 3.8) and last year's VPA; (ii) obtain a temporarily very high value of F on ages 2 and 3 in order to simulate the effect of a localised change in the catchability of these age groups.

The resulting arrays of F at age for 1975 are shown in Table 10, columns 4 and 10. The mean 1971-73 F at age arrays deduced from last year's VPA are also shown for comparison (columns 6 and 12). Except for that on the 2 and 3 year old fish the general level of mortality has not changed because the fishing fleets have contracted slightly of late. There is now very little difference between the male and female rates, and a rather less pronounced change in mortality with age than before.

3.4 Virtual Population Analysis

Using the new 1975 F-at-age array the historical record was brought up to date by VPA, with the results for fishing mortality and stock number at age shown in Tables 11 and 12, for males and females respectively.

3.5 Prognosis

The prognosis programme was used to simulate the trend in catch and stock through to 1977, starting with the 1975 catch, the new F-at-age array, and using the same weight at age data as last year. The weight data are found in Table 13. When applied to the observed 1975 catch composition, these weights at age predict a sum of products which is 10% below the recorded total catch. For 1976 and 1977 the new shape of the new F-at-age array was kept, but the maximal value of 0.9 on age group 3 was reduced to a more normal level of 0.5, which is about the same value as that used in 1974. The 1976 F-at-age array is therefore that shown in Table 10, columns 5 and 11. For 1976 and 1977 the prognosis still allows the fleet to fish on two and three year old plaice rather more heavily than before, but discount the possibility of there being a greatly enhanced catch of four and five year olds in 1977. If the 1972 and 1973 year classes do turn out to be larger than estimated by the pre-recruit surveys, next year's prognosis will have to be amended accordingly.

According to the results of the pre-recruit survey, the 1974 year class is of rather below average abundance. The regression figure suggests that at the beginning of 1976 it will number approximately 214 x 10^6 plaice or, since the male/female sex ratio has averaged about 0.55/0.45 in recent years, 118 x 10^6 male plaice and 96 x 10^6 female plaice. With this recruitment the expected catch predicted for 1976 is 96 300 tons which is consistent with the prognosis for 1976 made last year. At this expected level of catch, the 1976 TAC of 99 900 tons agreed by NEAFC will not achieve any reduction in fishing mortality.

In 1977 the recruits will be of the 1975 year class, which the provisional pre-recruit survey data suggest could be above average. Based on the pre-recruit survey/VPA regression the estimate is 426 x 10^6, or 284 x 10^6 males and 192 x 10^6 females. For the stock present at the beginning of this year, the prognosis programme calculates the catch expected for a range of maximal values of F in the F-at-age array, with the results shown in Table 14, columns 1 and 2.

Assuming the same maximal value of 0.5 in the F-at-age array, i.e. no change in fishing mortality, the expected 1977 catch would be 85 340 tons. The expected stock biomass at the beginning of the year is 203 794 tons.

3.6 The TAC

The choice of TAC required for 1977 depends on the criterion adopted for the management of the stock. Currently these criteria range from attempts to either maximise or optimise yield per recruit, for a particular pattern of fishing, to those which seek to maintain either some arbitrary minimum stock biomass above the level at which recruitment is potentially highly variable, or some enhanced stock level which would optimise or maximise recruitment.

For the present pattern of fishing, the effect of change in the maximal value of F-at-age array on steady state yield per recruit and biomass per recruit has been calculated (Figure 4). This shows that the maximal value on the F-at-age array of 0.5 places the fishery on the flat-topped part of the yield curve, where there can be no further gain in conditional yield per recruit for an increase in mortality, and a very small increase in yield, but a substantial increase in stock, for a reduction in the fishing mortality. A 50% reduction in fishing mortality would bring the fishery to the $F_{0.1}$ level, which a graphical calculation locates at an F value of 0.25 on the axis of maximal F in the F-at-age array.

Figure 5, taken from Bannister (1975), illustrates a possible relationship between an index of stock and estimates of recruitment for the post-war years. If the curve in Figure 5 is accepted, recruitment must tend to decline with any decrease in spawning stock. Even if the curve is not considered acceptable, and a horizontal straight line is preferred, low stock levels are eventually inevitable. From the recruitment point of view, a reasonable, though qualitative, compromise here is to consider that any further decrease in stock size is undesirable and to bear in mind that if stock is increased, recruitment will certainly not decrease and could increase.

The information relating to a TAC for 1977 is presented in Table 15, which is an interpolated version of Table 14 and shows the expected maximum value of the F-at-age array which would arise in 1977 from the range of possible catch values shown, i.e. the table shows the TACs which would be required to achieve these specified levels of fishing mortality in 1977. The major results are:

(i) if the 1977 TAC is left unchanged at 99 000 tons, and this catch is actually realised, the mortality rate must increase and move the fishery to the right along the yield curve;

(ii) a 1977 TAC of 85 000 tons will leave the fishing mortality rate unchanged at its present level;

(iii) a 1977 TAC of 50 000 tons would reduce the maximum value of F on the F-at-age array to 0.25, which is equivalent to the $F_{0.1}$ level.

(iv) intermediate figures of catch lead to the intermediate mortality reductions shown.

Simulation of the long-term steady state situation for the same range of F values, but for average recruitment after 1977, leads to the data for the long-term catch, biomass, and change in biomass from the expected 1977 level, shown in Table 14, columns 4-6. These data confirm the potential long-term value of reducing the mortality to the $F_{0.1}$ level, since at F = 0.25 the catch is 85 000 tons, which is not much less than the optimum of 93 500 tons, but the stock proportional to the catch rate is about 400 000 tons, which is double the expected 1977 level. If the mortality rate were to remain unchanged at the present level of 0.5 for the maximal value in the F-at-age array, average recruitment would allow catch to increase slightly to 93 500 tons, and the stock would equilibrate at about the present level. On the other hand, even with recruitment maintained at an average level, increasing the mortality rate causes the stock to equilibrate at a lower level, i.e. a lower catch rate.

3.7 The Recommendation

The Working Group recommends the following:-

(i) that in no circumstance shall the 1977 TAC be greater than 85 000 tons;

(ii) that the Commission should consider the value of aiming for the $F_{0.1}$ level, which would involve a positive reduction in the fishing mortality but would result in a marked improvement in catch rate. This could be achieved directly in 1977 by means of a TAC of 50 000 tons, or by a phased progression over a period of, say, three years, involving F values of 0.4 in 1977, 0.3 in 1978 and 0.25 in 1979. To begin this progression, the TAC for 1977 would be 71 000 tons with appropriate reductions in the following years, and with any amendments occasioned by marked changes in the recruitment situation.

3.8 Estimation of Recruitment

Last year, an unsuccessful attempt was made to use a short series of data to correlate year class abundance estimates from the 0- and I-group Waddensea surveys with the subsequent virtual population analysis estimates at two years of age. This year, the exercise was repeated using Waddensea survey data for the October surveys instead of the April surveys, with the results shown in Figure 6 and Table 16.

In default of other information it was considered satisfactory to use these data as a guide to the abundance of the 1972-75 year classes. It is of course possible that the change in the result from no correlation to a very good correlation is in some way spurious, and biological investigation of the reason for the change is required.

3.9 Mesh Size

At this meeting, the Working Group had no time to consider how a change in mesh size, and hence age at first capture, would influence the results described here. However, a mesh assessment carried out in 1974 (Doc. C.M.1974/F:6) specified the marked long-term gains to be expected from increases in mesh size up to 90 and 100 mm for this species. With the present F-at-age array these gains may be, if anything, slightly on the conservative side, such that the conclusions outlined then must still stand. It is recommended that the value of increasing the minimum mesh size for the North Sea be constantly borne in mind, for implementation when a suitable occasion arises.

4. THE ENGLISH CHANNEL STOCKS

4.1 Introduction

In previous reports the reason for attempting to include a TAC recommendation for the English Channel flatfish was in the first instance to try and safeguard these stocks against increased exploitation resulting from the diversion of fishing effort from other regulated areas. Not unexpectedly, such data as were discussed last year, suggested that at least some of the stocks in this area could also be in need of management in their own right. However, certain difficulties with catch and biological data, and what appeared to be a lack of published or verifiable information on the distribution and biology of the stocks, prevented the Working Group from making much progress in this direction. Accordingly, the expedient of limiting the TAC recommendation to the average catch of each species for the whole Channel in recent years was eventually retained, although it was fully realised that the solution would very probably be inappropriate, or at best valueless, at the individual stock level.

Discussions at the Working Group and within the national laboratories confirm that the present situation is looked on as being unsatisfactory, both in terms of the rather superficial nature of the advice which has been given, and the lack of detail in the report as to the nature of the problem. As a preliminary to the assessments actually carried out this year, this introductory section therefore seeks to outline the problems by summarising the known and unknown features of the stock structure and the catch data relating thereto; in order to set guidelines for research into the information and methods which will ultimately be necessary to do justice to what is in some respects a rather complex area for assessment purposes.

Recent work conducted by Houghton (personal comm.) was referred to only briefly last year. This work suggests that in the Channel there is a rather complex stock structure, involving coastal populations of both species, plus, for the plaice, a population in the mid-Channel at spawning time. Along the English coast plaice and sole populations occur in Divisions VIId and e and can probably be considered as essentially separate stocks in each division. For sole there is no movement outside the Channel area, but some mature plaice from both the coastal plaice stocks move into the mid-Channel in winter to join a goodly proportion of mature spawning plaice which, from their return to the southern North Sea in summer, must presumably have originated there prior to the winter. These ideas rest largely on the results of English tagging experiments conducted on English coastal and mid-Channel fish. For the plaice, some of the results are included in a recent account of the distribution of plaice eggs in the English Channel (Houghton and Harding, in press).

From discussions with Lefranc as to the location of fishing grounds frequented by French coastal fishermen, it is reasonable to infer that local populations of plaice and sole are also to be found in the Pas-de-Calais and the Bay of Seine. Further, from discussions at this meeting about the distributions of English, Belgian and French fishing and the location of recaptures from the tagging experiments, a reasonable working hypothesis is that:

(i) the English fleet is fishing on the English coastal populations of plaice and sole in Division VIIe; the Channel population of sole in Division VIId, and a mixture of local and spawning plaice in Division VIId at different times of the year;

(ii) the Belgian fleet is fishing mainly on the VIId sole and plaice population but also to some extent in VIIe in the area off Land's End and the deeper waters off Start Point;

(iii) the French fleet is fishing throughout the year on the French coastal populations of plaice and sole, on the mid-Channel spawning population of plaice, and possibly to a small extent on the English coastal populations in Divisions VIId and VIIe at certain times.

While single TACs for the whole Channel will therefore effectively prevent the entry of any additional fishing effort from outside, it is obvious that only fortuitously can they have much relevance to the individual stock components.

At the moment the biological sampling data for the Channel are derived only from Belgian and English fleets. The Belgian data refer principally to VIId. The English data for VIId and e can be looked at separately, but for VIId it is not yet possible to distinguish between data from the local and migratory plaice populations. For catch, there have been major uncertainties as to the validity not only of the total catch reported by France, but also on its allocation between VIId and e. For a variety of reasons the Working Group decided that these problems could not be resolved for the years before 1974. It looked on the 1975 data as giving the first reliable allocation between the East and West Channel, but was still in some doubt about the total French production of both plaice and sole.

This year only the Belgian mortality data could be updated, and the assessments were made by discussing these in conjunction with the English and Belgian catch and catch per effort data, the growth and mortality data reported last year, and some growth data for sole communicated by Houghton. The results of the assessments are described in the following sections.

5. ENGLISH CHANNEL SOLE

5.1 Catch Trends

The published data for France are included, although as mentioned above, probably only the 1975 figure is realistic. Table 17 and Figure 7 show the catches from 1964-75 for the whole area. Figures 8 and 9 show respectively the catch and catch per effort for the two Divisions for Belgium and England.

For the Channel as a whole, the English catch increased steadily since 1964, and the Belgian catch, after being very low between 1964 and 1969, increased somewhat in 1970 and has remained fairly constant since. On the basis of the 1975 figure the French take the major share of the total catch of sole.

On a sub-division basis, the English catch has levelled off in both VIIe and VIId in the last three years, and actually fell rather dramatically in VIId in 1975, possibly as a result both of the TAC enforcement and a fall in effort. For Belgium, the major increase in the catch has been in VIId with, if anything, a slight decline in the very small VIIe catch.

The catch per effort data (Table 19) are not easy to interpret. For VIId, English catch per effort (not corrected for changes in fishing power) increased between 1971 and 1974, but the Belgian value declined very steeply. This may mean that the two fleets are fishing different parts of the stock in this area, although for catch alone the trends for the two fleets were about the same. For VIIe, English catch per effort, corrected for changes in the fishing power of the Brixham fleet (Houghton, personal comm.) declined sharply from 1969 to 1970 but has since remained more or less steady. Stock abundance has therefore probably not changed much recently in VIIe, but shows two opposing trends in VIId, depending on the choice of statistics.

5.2 **Growth**

For VIId Belgian growth parameters have been used, as follows:

VIId	♂:	$K = 0.17$	$W_\infty = 434$ g	$t_0 = -2.8$ yr
	♀:	$K = 0.28$	$W_\infty = 660$ g	$t_0 = -1.1$ yr

These parameters give a growth curve which is quite similar to that for the North Sea. For VIIe, the combined male and female growth parameters calculated by Houghton were used, although the K value looks low, the t_0 value is very highly negative, and the W_∞ is high.

VIIe $K = 0.10$ $L_\infty = 46$ cm $W_\infty = 954$ g $t_0 = -6.6$ yr

5.3 **Yield per Recruit Curves**

For M = 0.1 the growth parameters were used to calculate Beverton and Holt yield per recruit curves for values of $t_c = t_r = 2$ yrs. These curves are shown in Figure 10 for VIId and Figure 11 for VIIe. The curve for VIId has an optimum at F = 0.2, and a fairly moderate fall in yield per recruit with increasing fishing mortality. The curve for VIIe has an optimum between F = 0.1 and 0.2, but a much steeper fall in yield per recruit at the higher F values, because of the difference in the growth parameters. Both curves are similar in general shape to those originally produced in the first North Sea sole assessment (Coop.Res.Rep., Ser.A, No.9, 1969) but because the assumption is that fishing mortality is the same on all the age groups, they may be quite different from the flat-topped type of yield curve produced from an F-at-age array.

5.4 **Mortality**

Based on the average of the 1971-75 Belgian catch per effort estimates, fishing mortality in VIId is estimated as F = 0.26 (♂) and F = 0.42 (♀). For VIIe, the value of F = 0.41 calculated by Houghton and used last year was adopted.

For VIId the present situation appears to be that the fishery is very close to the optimal yield per recruit for male sole, and a little beyond it for female sole, suggesting that the stock is not seriously overexploited at the moment.

For VIIe, however, the shape of the yield curve and the adopted value of fishing mortality are such that the stock in this Division must be considered overexploited. If this assessment is accepted, and there are obviously doubts about the validity of the growth and mortality data used, we have the situation that the western and eastern components of the English Channel sole are in different phases of exploitation and need separate conservation measures.

5.5 **The TAC**

The calculation of valid separate TACs for the eastern and western areas is made difficult by the fact that except for the latest year 1975, the French landings, which comprise 60% of the total, cannot be allocated between the areas. The split in 1975 is 60% from VIId and 40% from VIIe, and if this is used, the total catch in 1975 is 1 005 tons in VIId and 646 tons in VIIe.

For VIId, where the stock appears not to be in immediate danger of overexploitation, a TAC of 1 000 tons for 1977 is reccmmended.

For VIIe the situation described by the available yield curve and mortality data calls for a decrease in fishing mortality of about 32% if the optimum sustainable yield is to be obtained. On this basis, the recommended TAC for 1977 should be 440 tons.

ENGLISH CHANNEL PLAICE

Catch Trends

The recent catch trends are shown for the whole region in Table 18 and for VIId and VIIe separately in Table 12. The separate VIId and and VIIe catch per effort data are shown in Figure 13.
The French data have been included but with the misgivings described previously, although for 1975 the VIId, VIIe allocation is looked on as being accurate.

The Belgian catch of plaice (mainly in VIId) has been steady at a low level since 1970, and has been steady in both VIId and VIIe. The English catch shows several fluctuations but since 1967 the overall trend has been downward. This is especially so in VIIe, but it also true more recently, for VIId where the English catch has fallen rapidly to the same level as that in VIIe. In 1975 in fact, the English fleet was able to catch only 50% of its allowed share of the TAC.

The index of stock abundance in VIIe, based on English catch per effort, corrected for increases in fishing power, fell sharply between 1968 and 1970, and has declined continuously, though less rapidly, since. English catch per effort in VIId has fluctuated markedly but the overall trend is downward in that area too. Belgian catch per effort in VIId also declined from 1971 to 1973 but has since risen very slightly. In summary, therefore, the abundance of plaice fished by the English and Belgian fleets in the English coastal area and in the mid-Channel has been declining in the last few years, although in VIId there have been wide fluctuations about this trend.

Mortality

The low level of catch per effort in those parts of the stock described above corresponds to the high mortality rates which are observed from English and Belgian age composition data. For VIId the most recent Belgian estimate of Z is 0.95 (♂) and 0.59 (♀). For VIIe, the latest figures are not available but the figures for Z given in the last Report are 0.98 (♂) and 0.75 (♀).

In last year's Report it was concluded that with mortality levels of this order, the stocks supporting the English and Belgian fleets must be overexploited. This conclusion was made with reference to unpublished yield per recruit against fishing mortality curves derived from the English coastal population in VIIe. There is no reason to change these conclusions this year.

The TAC

The conclusion that the plaice stocks supporting at least the English and Belgian fleets are overexploited raises the question of what TACs are required for their effective management. On the basis of the working hypothesis described in Section 4.1, the stocks in question are those in the English coastal areas in VIId and VIIe, and in the mid-Channel. We have no knowledge of the state of affairs off the French coast, and the queries raised concerning the true level and sub-division allocation of the French catch obviously seriously complicate this problem. This year, all that the Working Group could do was to retain the expedient of holding exploitation at its present level, but it does recommend that there be separate TACs for VIId and VIIe, and that these should be based on the 1975 catch, as being the only year for which the French catch is reasonably certain. On this basis the Group suggests a TAC for 1977 for VIIe of 450 tons and a TAC for 1977 for VIId of 2 000 tons.

A much more detailed assessment of these plaice stocks which also takes account of the link between the southern North Sea and the mid-Channel spawning population, is recommended for next year.

7. IRISH SEA SOLE

7.1 Catch Trends

The updated 1974 and preliminary 1975 landings of Irish Sea sole are shown in Table 20. The 1975 landings were about the same as those in 1974, which were slightly less than those in the preceding year.

7.2 Age Composition

The international catch at age data in Tables 21 & 22 are derived from Belgian, Dutch and U.K. data for 1971, 1972, 1973 and 1975 and from Belgian and U.K. data only for 1970 and 1974.

7.3 Virtual Population Analysis

VPA carried out on these international catches at age used natural mortalities of 0.1 for both sexes. The terminal fishing mortalities and mortalities on the partially exploited cohorts given in Table 23 were smoothed values derived from a preliminary VPA, for which the results are shown in Tables 21 and 22. Tables 21 and 22 give the stock numbers at the beginning of the year and these are the values used in the prognosis programme. The high number of two year olds in 1975 is derived from the catch of two year olds in 1975 and, judging by the catch per effort of Belgian beam trawlers for two year olds, this 1973 year class is being overestimated by about 25%. The effect of this possible overestimate in the prognosis will be commented on later.

7.4 Growth

The catch weight at age data used in the prognosis were obtained by plotting the mean weights at age derived from the mean lengths at age in Belgian and U.K. catches and fitting a curve by eye.

The length-gutted weight relationships used were calculated by a functional regression from the data given in Table 24 of last year's Report of the Working Group.

Males: $\log_e$ weight (gm) = $\log_e$ length (cm) x 3.5603 - 6.5798

Females: $\log_e$ weight (gm) = $\log_e$ length (cm) x 3.1503 - 5.1452

Confirmation of these weight data was obtained by multiplying the 1975 catch numbers at age by weights at age and checking against the total catch figure, which showed exact correspondence.

7.5 Prognosis

In the absence of any means of estimating the abundance of 1974 and 1975 year classes, the average recruitments for 1970-73 from the VPA (Table 23) were used in the prognosis. The fishing mortalities used for 1975 and 1976 were derived from Belgian and U.K. catch per effort values for 1974/75 and were 0.5 for females and 0.4 for males.

7.6 The Recommendation

The results of the prognosis are given in Table 24 and if the present level of fishing mortality is maintained, the catch in 1977 is expected to be between 1 350 and 1 600 tons. As has been mentioned in paragraph 7.3 the 1973 year class may have been overestimated and the lower of these two values should be taken as more likely. To hold fishing mortality at the present level the TAC for 1977 should be 1 350 tons.

Although it is not possible in this report to relate the present fishing mortality array to the yield per recruit curve given in Figure 3 of last year's Working Group Report, the present level of exploitation is almost certainly very close to the maximum. This means that in the long term almost the same yield could be expected from a very much lower level of exploitation.

8. IRISH SEA PLAICE

8.1 Catch Trends

The nominal catches of plaice in the Irish Sea (VIIa) are given in Table 25 for the period 1960-75. The 1974 figures were revised in accordance with the catches reported to "Bulletin Statistique". Preliminary figures for 1975 were obtained from NEAFC monthly reports (Belgium, Ireland, England and Wales), from preliminary data on the annual catch of selected species reported to ICES in accordance with NEAFC Recommendation 12 (Netherlands, Northern Ireland, Scotland) and from a Working Group participant (France).

The total catch of plaice in the Irish Sea remained at about the same level in 1975 as in 1974 - approximately 3 700 tons.

8.2 Age Composition

For the years 1964-69, the age distribution of the international catch was obtained by raising the age distribution of Fleetwood (U.K.) landings. For the period 1970-74, the age distribution of the Belgian catch and the Fleetwood landings were raised to the international total, but for 1975 only the Belgian age distributions were available. The historical record of age composition data is included in Tables 27 and 28.

8.3 Growth

The 1975 Report of the Working Group (Doc. C.M.1975/F:4) drew attention to the difference in the sizes at age in the English, Belgian and Irish catches and to the younger age at first capture in the Irish fishery compared to that in the English fishery. An examination of the mean length at age of plaice landed at Fleetwood from areas east and west of 5°W showed that growth west of 5°W resembled that found in the Irish catches and thus clearly demonstrates that the difference is due to the area being fished.

In spite of the growth difference a single assessment was carried out using growth data given in Table 26. The bulk of the plaice catch comes from the area east of 5°W but a complete area breakdown of catch within VIIa would be needed in order to carry out separate assessments.

The length/weight relationship was recalculated from Table 20 of last year's Report of the Working Group, using a functional regression. The relationships are:

Male: $\log_e \text{weight (gm)} = \log_e \text{length (cm)} \times 2.8363 - 4.0656$

Female: $\log_e \text{weight (gm)} = \log_e \text{length (cm)} \times 2.8714 - 4.0627$

The mean weights at age calculated from these and used in the prognosis are given in Table 29.

8.4 Virtual Population Analysis

The international age composition data were processed by VPA using M = 0.1 for females and M = 0.15 for males. The terminal F values for partially exploited cohorts are included in Tables 27 and 28 and are the averages for the period 1964-71 obtained from a preliminary VPA. Analyses were started with age 12 (males) and age 15 (females) using terminal F values of 0.3 and 0.25 respectively for fully exploited cohorts. The mortality and stock values calculated by VPA are also shown in Tables 27 and 28. No trend in mortality may be detected from these figures.

The estimates of stock number at two years at age have been taken as minimum estimates of recruitment to the exploited population.

8.5 Prognosis

The fluctuations in recruitment of two year olds for the period 1964-73 were fairly small and the recruitments used in the prognosis for 1976 and 1977 are the averages for that period, excluding the outstanding 1963 year class.

Mean fishing mortalities at age for the period 1964-72 derived from the VPA (Tables 27 and 28) are given in Table 29. The relative mortalities at age derived from these were used in the prognosis. Maximum fishing mortalities for the 1975 and 1976 F-at-age arrays were chosen to give a good fit to the actual catch in 1975. They were 0.5 for females and 0.6 for males, with natural mortalities of 0.1 and 0.15 respectively.

The mortality values calculated by VPA are slightly lower than the mean 1964-72 mortality calculated last year from catch per effort data (Table 30), although the latter do not of course take account of the trend in mortality with age.

The results of the prognosis are given in Table 31 which shows the total stock biomass at the beginning of 1977 (males and females combined) and the F values which would result from different levels of catch being taken in that year. These F values (column 1) are the maxima of the F-at-age array and the figures in column 2 are obtained by multiplying them by the relative F values given in Table 29 and weighting by the catch biomass at age.

If the present level of fishing mortality is maintained (i.e. no change in fishing effort) then the catch in 1977 is expected to be between 3 600 and 4 200 tons. This would be about 27% of the total stock biomass at the beginning of the year and there is no evidence that recruitment would be affected. In order to determine where this level of fishing mortality is on the yield per recruit curve, it is necessary to use the weighted fishing mortality (column 2 of Table 31) which is between 0.33 and 0.4

8.6 The Recommendation

It may be seen from Figure 15 that these values lie close to F_{max} and the TAC for 1977 should therefore be 4 000 tons.

A reduction in effort would affect yield very little in the long term but would increase the catch rate.

9. BRISTOL CHANNEL SOLE

9.1 Catch Trends

The catch in 1975 was close to the average catch for 1962-75, but nevertheless there has been a decline of about 25% between 1970 and 1975 (Table 26).

9.2 Age Composition

The international catch at age data given in Tables 32 and 33 are derived from the Belgian and U.K. data, except for 1975, when only Belgian data were available.

9.3 Virtual Population Analysis

A VPA carried out on these international catches used natural mortalities of 0.1 for both sexes. The terminal fishing mortalities and mortalities on the partially exploited cohorts are given in Tables 32 and 33 and are smoothed values derived from a preliminary VPA. Tables 32 and 33 give the stock numbers at the beginning of the year.

9.4 Growth

The catch weight at age data used in the prognosis are given in Table 34. They were obtained by fitting a by-eye curve to mean weight (gutted) at age data derived from mean lengths at age in Belgian and U.K.catches. (Data forwarded to the Chairman of the Working Group showed that there have been slight changes in the most recent Belgian data, but a check calculation suggests that these changes will in themselves have very little effect on the end result of the current prognosis.

9.5 Mortality

For 1974/75, Belgian catch per effort data give fishing mortality estimates of 0.36 (females) and 0.38 (males). The value for males is very similar to that calculated for the previous year (Doc. C.M.1975/F:4 Figure 4) but that for females is very much higher.

9.6 Recruitment

In principle recruitment at two years of age can here be estimated in two ways, firstly on the basis of the virtual population analysis and secondly using a VPA catch per unit effort regression. For the VPA estimates alone, the average recruitment in 1970-73 was about 1.25 x 10^6 soles, but the 1974 and 1975 recruitments (year classes 1972 and 1973) were well below this. An alternative estimate of recruitment is derived from the data shown in Figure 16 which by agreement of the Group was forwarded to the Chairman for inclusion after the meeting. It is included on the Belgian suggestion that Belgian catch per effort for the last quarter of the year gives the most accurate impression of the abundance of new year classes. If this is the case, and the data in Figure 16 for the 1969-72 year classes are acceptable, the by-eye line predicts a value of some 1.5 x 10^6 soles each for males and females, which is respectively 3.5 and 4.6 times the initial VPA estimate for this year class. The data series in Figure 16 is very short but nevertheless this second estimate of recruitment of the 1973 year class was used as an alternative in the prognosis because of the importance of the 1973 year class in estimating the 1977 stock.

9.7 Prognosis

The prognosis programme was run beginning with the 1975 catch at age data and the smoothed fishing mortality-at-age array. For 1975 and 1976 the maximal values of F in the F-at-age array were taken to be the same as the Belgian catch per effort figures of 0.36 (females) and 0.38 (males). For the 1974 and 1975 year classes, recruiting in 1976 and 1977, the average recruitment for 1970-73 from the VPA was used, viz. 1.25 x 10^6 soles each for males and females. However, as described above, the 1973 year class recruitment in 1975 can be estimated in two ways. Since the prognosis programme actually begins with the 1975 catch, rather than the stock, the two possibilities could only be accounted for in the time available as follows. The lower estimate of the 1976 and 1977 situation was obtained by running the programme from the 1975 catch in the normal way. The upper estimate was then obtained by raising the prediction for age 3 in 1976 and age 4 in 1977 by the factors 3.5 for males and 4.6 for females (see Section 9.6). The results of these calculations for the specified maximal values of F in the F-at-age array are shown in Tables 35 and 36.

9.8 The Recommendation

The recent catch trend has been downward, and for both the upper and lower recruitment situations the expected 1976 catch of 455 or 533 tons is substantially below the 1976 NEAFC TAC of 700 tons, which can therefore have no regulatory effect on the fishery. Further, if the 1977 mortality rate were to be the same as at present the expected catch for both recruitment situations will remain below the 1976 TAC level, at about 400 - 500 tons. To have any regulatory value the 1977 TAC will therefore obviously have to be less than the 1976 figure. Precisely by how much depends on whether it is desirable simply to maintain the present level of fishing, or actually to reduce it.

Last year's report contained Beverton and Holt yield per recruit curves for this species in which optimal yield per recruit corresponds to an F value of about 0.25. These curves assume that F is the same on all age groups. If the mean of the VPA F-at-age array, weighted by the stock number, is assumed to give an equivalent point of entry to these yield curves, the fishery is at about the optimal position on the yield curve for the present pattern of fishing, since the mean F values calculated in this way are 0.20 (females) and 0.29 (males). This means that the fishery will be maintained at its present level of exploitation if the maximal value of F on the F-at-age-array does not exceed 0.38 (males) and 0.36 (females). For these values the expected 1977 catches are 440 tons and 500 tons for the lower and upper recruitment estimates respectively.

There is no way of deciding which figure is actually most representative of the true abundance of the 1973 year class. If a TAC of 500 tons is recommended, and it is in fact the lower estimate of recruitment which turns out to be correct, Table 35 shows that taking the 500 tons in this situation could increase the mortality rate, perhaps by as much as a third. Therefore, biologically the safest situation must be to <u>recommend</u> that the <u>1977 TAC</u> shall be at the lower figure of <u>440 tons</u>, which prevents the fishing mortality from being increased.

10. BRISTOL CHANNEL PLAICE

10.1 Catch Trends

The nominal catch of plaice in the Bristol Channel (VIIf) are shown in Table 25 for the period 1960-75 and are derived from the same sources as indicated for the Irish Sea plaice. The catch in the Bristol Channel in 1975 appeared to increase slightly, from 364 tons to 550 tons, but it is almost certain that the 1974 figure is too low, because it is doubtful if the zero catch reported by France for that year is correct.

10.2 Mortality

Table 30 shows estimates of Z obtained from Belgian and U.K. catch per effort data for the period 1969-74. The U.K. figures were derived from age group 5 onwards (weighted inversely by the variance, except for the 1970-73 calculations), and the Belgian figures from age group 3 onwards. The mean total mortality coefficient over this period was thus 0.68 on females and 1.05 on males (0.87 taking males and females together), compared with 0.53 on females and 0.90 on males (0.72 together), given in the 1975 Report as derived from Belgian data alone.

10.3 Yield Curves

The curves of yields per recruit against F in Figure 17 were constructed from the parameters given in Table 26, and for M = 0.1 and $t_c = t_2 = 1.5$ years. It may be seen that the average value of F on females is somewhat in excess of F_{max} (by a factor of 1.4). The male yield curve is flat-topped, but the combined yield curve shows that although a decrease in F would result in only a negligible gain in yield per recruit, the catch rate could be almost doubled by a reduction in F to 0.4 (assuming M = 0.1).

10.4 The Recommendation

In order to protect this stock from increased fishing effort diverted from other fisheries, it is recommended that the TAC for 1977 should be 500 tons. If fishing effort were to be reduced so that this yield would be taken on the left of the yield per recruit curve rather than beyond the F_{max}, the catch per effort would increase in the long term.

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Table 1. North Sea Sole. Nominal catch (metric tons) for statistical Sub-area IV, 1960-75.

Year	Belgium	Denmark	France	Germany Fed.Rep.	Netherlands	Sweden[b]	U.K.(England and Wales)	U.K. (Scotland)	Total
1960	3 974	1 760	398	1 776	9 274	3	1 444	-	18 629
1961	3 666	2 237	827	2 116	13 488	3	1 617	-	23 954
1962	4 068	2 507	322	1 999	16 287	-	1 694	-	26 877
1963	7 835	350	280	670	13 596	-	3 431	-	26 162
1964	1 071	570	384	277	8 272	-	768	-	11 342
1965	1 621	653	689	371	12 980	-	729	-	17 043
1966	3 586	536	504	1 074	25 192[a]	-	933	-	31 825
1967	4 455	1 593	444	1 094	24 900[a]	-	1 023	-	33 509
1968	3 874	1 590	273	1 138	25 175[a]	...	1 129	-	33 179
1969	2 703	842	364	692	22 032	-	927	-	27 560
1970	1 880	525	265	318	16 024	13	660	1	19 686
1971	2 227	1 149	403	600	18 776	12	485	2	23 654
1972	1 834	671	206	258	17 662	13	449	+	21 093
1973	1 485	957	250	336	15 883	13	387	1	19 312
1974	1 130	705	195	173	15 343	12	340	-	17 898
1975[c]	1 316	636	213	300	14 170	16	407	9	17 067

a) Netherlands - The 1967 and 1968 catches given here include respectively 11 862 tons and 3 779 tons reported originally as "area unknown". Footnote in "Bulletin Statistique" allocate these quantities to "mostly IVb, the rest in IVc". No such explanation is provided for 1 515 tons reported in 1966 as "area unknown", and this quantity has not been included in the 1966 catch given in this table.

b) Sweden - Figures from 1968 onwards include catches made in IIIa. The 1968 catch was included in 148 tons of Various pleuronectiforms.

c) Preliminary figures as reported.

Table 2. North Sea Sole.
Average fishing mortalities and relative fishing mortalities for 1969-73, used as terminal F values in the VPA and the prognosis.

Age	Males		Females	
	Average F	Relative F	Average F	Relative F
2	0.22	0.28	0.28	0.35
3	0.80	1.00	0.80	1.00
4	0.72	0.90	0.66	0.83
5	0.61	0.76	0.66	0.83
6	0.60	0.75	0.66	0.83
7	0.48	0.60	0.60	0.75
8	0.24	0.30	0.40	0.50
9	0.17	0.26	0.35	0.44
10	0.13	0.16	0.29	0.36
11	0.09	0.11	0.21	0.26
12	0.10	0.13	0.16	0.20
13	0.10	0.13	0.16	0.20
14	0.14	0.18	0.25	0.31

Table 3. North Sea Sole.
Age composition of total catch 1966-75 (thousands).

Year / Age	Males									
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	0	0	0	0	557	331	0	113	267	71.7
2	3 929	2 247	4 778	12 637	3 015	17 671	3 411	5 840	9 328	8 311.4
3	60 251	13 983	18 121	10 291	13 170	6 692	23 672	6 500	15 834	11 910.9
4	241	49 210	14 424	2 918	3 936	6 709	3 739	7 643	3 404	4 916.7
5	643	883	28 952	5 631	769	2 462	2 544	1 419	3 447	984.5
6	1 653	216	3 021	8 780	1 290	438	1 116	1 160	1 232	1 673.3
7	319	854	836	0	5 523	694	162	344	821	295.8
8	1 917	635	2 145	66	44	2 647	464	285	421	423.1
9	114	2 769	153	278	32	64	2 269	610	194	243.6
10	189	0	666	3	240	45	51	1 268	211	120.6
11	44	213	30	862	65	162	13	33	808	47.4
12	151	218	169	3	1 022	48	288	194	18	656.3
13	153	104	77	236	98	660	22	161	16	1.1
14	41	110	13	32	220	160	420	27	167	21.3

ctd.

Table 3 (ctd). North Sea Sole.
Fishing mortalities 1966-75.

Males

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975 = F_1
1	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.05
2	0.08	0.08	0.17	0.33	0.16	0.33	0.22	0.18	0.33	0.22
3	0.36	0.39	1.19	0.59	0.58	0.57	0.85	0.70	0.91	0.80
4	0.05	0.49	0.79	0.53	0.41	0.59	0.65	0.65	0.89	0.72
5	0.25	0.22	0.53	0.74	0.23	0.43	0.41	0.48	0.61	0.61
6	0.19	0.11	2.31	0.27	0.32	0.18	0.32	0.30	0.89	0.60
7	0.19	0.12	0.68	0.00	0.24	0.26	0.08	0.14	0.32	0.48
8	0.14	0.63	0.46	0.09	0.18	0.16	0.24	0.18	0.22	0.24
9	0.05	0.26	0.27	0.09	0.05	0.38	0.18	0.51	0.16	0.17
10	0.06	0.00	0.08	0.01	0.09	0.09	0.52	0.13	0.30	0.13
11	0.07	0.08	0.02	0.13	0.17	0.07	0.03	0.68	0.10	0.09
12	0.51	0.47	0.07	0.00	0.21	0.17	0.16	0.67	0.88	0.10
13	0.16	0.70	0.26	0.13	0.07	0.18	0.10	0.11	0.09	0.10
14 = F_1	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Average $F \geq 3$	0.32	0.42	0.70	0.39	0.37	0.37	0.57	0.46	0.66	0.59

ctd.

Table 3 (ctd). North Sea Sole.
Stock in numbers (thousands).

Males

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	35 643	35 210	52 663	23 135	73 777	20 753	40 451	38 502	49 069	1 544
2	53 948	32 251	31 859	47 652	20 934	66 226	18 463	36 602	34 730	44 146
3	209 402	45 080	27 047	24 291	31 134	16 079	43 168	13 469	27 574	22 580
4	5 504	132 356	27 538	7 409	12 242	15 709	8 216	16 708	6 042	10 007
5	3 079	4 751	73 161	11 292	3 942	7 347	7 866	3 898	7 890	2 254
6	10 210	2 176	3 461	38 792	4 896	2 837	4 315	4 707	2 183	3 878
7	1 905	7 669	1 763	309	26 771	3 206	2 151	2 846	3 159	812
8	15 804	1 421	6 128	805	280	18 983	2 243	1 792	2 249	2 080
9	2 304	12 479	685	3 513	666	212	14 663	1 589	1 351	1 635
10	3 470	1 976	8 665	475	2 914	572	131	11 113	860	1 038
11	722	2 960	1 788	7 207	427	2 409	475	70	8 851	578
12	398	612	2 476	1 589	5 703	324	2 026	417	32	7 241
13	1 077	217	347	2 080	1 435	4 190	248	1 560	194	12
14	309	829	98	241	1 658	1 206	3 165	203	1 258	160

Table 4. North Sea sole.
Age composition of total catch 1966-75 (thousands).

Females

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	0	0	0	265	649	185	0	610	410	104.4
2	9 470	2 750	4 624	13 812	4 068	20 731	5 393	7 376	10 207	10 742.9
3	74 396	17 282	13 898	10 086	13 946	7 214	19 772	5 470	12 729	13 741.9
4	358	56 301	10 876	2 174	4 953	6 298	3 795	8 795	2 969	5 545.6
5	402	1 497	21 188	5 083	1 042	1 703	2 905	2 503	3 199	1 201.9
6	1 232	418	2 536	13 408	1 677	584	856	1 208	814	2 099.4
7	464	1 510	1 283	243	7 832	914	282	748	571	416.6
8	3 981	246	2 551	115	168	4 266	567	565	208	592.1
9	435	3 062	529	537	56	79	3 059	684	235	294.5
10	447	475	1 371	193	479	47	47	2 002	206	59.9
11	211	506	259	1 544	74	219	24	188	1 200	212.2
12	339	139	558	154	1 542	0	186	116	48	1 203.7
13	56	418	275	291	85	1 094	26	207	4	20.6
14	62	97	327	96	303	72	658	46	101	68.4

ctd.

Table 4 (ctd). North Sea Sole.
Fishing mortalities 1966-75.

Females

Year / Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975 = F_1
1	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.05
2	0.18	0.11	0.17	0.35	0.20	0.39	0.35	0.23	0.32	0.28
3	0.39	0.50	1.12	0.61	0.63	0.56	0.70	0.62	0.69	0.80
4	0.05	0.50	0.59	0.44	0.61	0.57	0.56	0.69	0.73	0.66
5	0.11	0.30	0.32	0.54	0.35	0.38	0.50	0.80	0.51	0.66
6	0.14	0.15	1.06	0.30	0.30	0.30	0.30	0.36	0.59	0.66
7	0.23	0.22	0.76	0.23	0.26	0.24	0.21	0.42	0.25	0.60
8	0.18	0.17	0.63	0.12	0.22	0.20	0.20	0.71	0.17	0.40
9	0.19	0.19	0.57	0.23	0.07	0.13	0.19	0.36	0.64	0.35
10	0.09	0.30	0.11	0.37	0.29	0.07	0.10	0.16	0.15	0.29
11	0.14	0.12	0.24	0.15	0.21	0.19	0.04	0.61	0.13	0.21
12	0.10	0.11	0.17	0.19	0.20	0.00	0.21	0.27	0.27	0.16
13	0.07	0.15	0.31	0.11	0.14	0.19	0.11	0.34	0.01	0.16
14 = F_1	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.25	0.25	0.25
Average $F \geq 3$	0.34	0.44	0.48	0.37	0.40	0.36	0.48	0.51	0.51	0.62

ctd.

Table 4 (ctd). North Sea Sole.
Stock in numbers (thousands).

Females

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	29 466	33 566	54 193	26 630	74 797	21 489	40 986	44 283	51 399	2 249
2	61 096	26 662	30 371	49 036	23 844	67 062	19 268	37 086	39 489	46 118
3	242 660	46 291	21 512	23 091	31 275	17 714	41 032	12 321	26 557	26 051
4	7 038	149 057	25 521	6 370	11 352	15 107	9 200	18 436	5 974	11 996
5	3 973	6 028	81 562	12 801	3 704	5 586	7 709	4 733	8 366	2 600
6	10 047	3 213	4 035	53 707	6 771	2 364	3 440	4 225	1 918	4 541
7	2 325	7 921	2 510	1 260	35 880	4 536	1 585	2 301	2 678	965
8	25 012	1 664	5 734	1 059	910	25 034	3 237	1 166	1 373	1 881
9	2 584	18 853	1 272	2 775	849	664	18 602	2 391	521	1 045
10	5 590	1 925	14 152	650	2 001	715	525	13 928	1 515	249
11	1 711	4 633	1 291	11 503	405	1 357	602	431	10 702	1 175
12	3 850	1 348	3 712	923	8 942	297	1 020	522	212	8 543
13	867	3 162	1 088	2 829	689	6 627	268	746	363	146
14	467	731	2 464	723	2 283	542	4 958	218	479	324

Table 5. North Sea Sole.
Number of recruits in millions.

Year class	Males	Females	Sexes combined
1955	26.9	44.8	71.7
1956	45.4	67.2	112.6
1957	37.1	70.2	107.3
1958	142.3	200.7	343.0
1959	15.7	24.1	39.8
1960	24.4	33.6	58.0
1961	6.7	8.3	15.0
1962	7.0	9.6	16.6
1963	255.8	296.2	552.0
1964	53.9	60.1	115.0
1965	32.3	26.7	58.9
1966	31.9	30.4	62.2
1967	47.7	49.0	96.7
1968	20.9	23.8	44.8
1969	66.2	67.1	133.3
1970	18.5	19.3	37.7
1971	36.6	37.1	73.7
1972	34.7	39.5	74.2
1973	44.1	46.1	90.3

Table 6. North Sea Sole.
Nominal weight (g) at age, for
catch and stock (average 1969-1973).

Age	Males		Females	
	Biomass	Catch	Biomass	Catch
2	39	90	62	124
3	146	203	199	257
4	231	259	316	377
5	283	302	425	473
6	316	326	507	540
7	339	351	566	585
8	361	371	605	622
9	377	383	639	654
10	387	392	671	684
11	395	395	694	703
12	401	403	713	723
13	404	406	729	735
14	406	407	739	745

Table 7. North Sea Sole.
Prognosis for catch and stock for 1976 and 1977 for a regulated fishery in 1976 (F_{1976} = 0.56).

	Maximal F in F-at-age array ♂	♀	Catch (tons)		Stock biomass (tons) at the beginning of the year		Expected stock biomass long-term increase (%)	
1975	0.80	0.80	17 070		39 405			
1976	0.56	0.56	12 534		36 125			
			A	B	A	B	A	B
1977	0.0		0	0	35 318	33 608	483	508
	0.1		2 505	2 396			296	311
	0.2		4 828	4 616			179	188
	0.3		6 983	6 669			102	108
	0.4		8 984	8 572			53	56
	0.5		10 843	10 336			18	20
Level of 1976	0.6		12 572	11 973			-4	-5
	0.7		14 180	13 492			-21	-22
	0.8		16 277	14 902			-33	-35
	0.9		17 072	15 214			-43	-45
	1.0		18 373	17 434			-50	-52

A - recruitment in 1977 90 000 000 two-year-old soles (available recruitment)
B - " " " 40 000 000 " " (estimate of 1975 year class)

Table 8. North Sea Sole.
Prognosis for catch and stock for 1976 and 1977 for an unregulated fishery in 1976 (F_{1976} = 0.80).

	Maximal F in F-at-age array ♂	Maximal F in F-at-age array ♀	Catch (tons)		Stock biomass (tons) at the beginning of the year		Expected stock biomass long-term increase (%)	
1975	0.80	0.80	17 070		39 405			
1976	0.80	0.80	16 414		36 125			
			A	B	A	B	A	B
1977	0.0		0	0	31 109	29 396	548	580
	0.1		2 165	2 057			337	356
	0.2		4 175	3 962			203	215
	0.3		6 041	5 727			117	124
	0.4		7 775	7 364			61	64
	0.5		9 389	8 883			22	23
	0.6		10 891	10 292			-5	-5
	0.7		12 289	11 601			-24	-25
Level of 1976	0.8		13 594	12 819			-38	-40
	0.9		14 811	13 952			-49	-52
	1.0		15 947	15 007			-56	-60

A - recruitment in 1977 90 000 000 two-year old soles (average recruitment)
B - " " " 40 000 000 " " (estimate of 1975 year class)

Table 9. North Sea Plaice.
Nominal catch (metric tons) for statistical Sub-area IV, 1960-75.

Year	Belgium	Denmark	France	Germany (Fed.Rep.)	Nether-lands	Norway	Sweden[a)]	U.K. (England and Wales)	U.K. (Scot-land)	Others	Total
1960	4 919	33 238	699	4 117	15 213	73	475	23 392	5 366	1	87 493
1961	3 950	32 086	1 341	3 830	15 951	60	497	22 732	5 326	161	85 934
1962	4 535	31 227	464	3 768	19 094	86	472	22 975	5 322	-	87 943
1963	5 662	39 926	501	4 526	23 143	36	438	28 143	5 181	-	107 556
1964	4 339	38 380	1 584	4 390	24 594	30	372	30 773	5 525	-	109 987
1965	3 931	30 560	1 933	4 333	23 271	38	286	26 826	5 534	-	96 712
1966	6 490	29 055	1 986	4 401	25 682	33	148	26 978	5 356	-	100 129
1967	6 778	28 287	1 730	5 290	29 905	35	237	30 974	5 709	-	108 945
1968	5 576	30 369	1 310	5 250	33 236	38	310	29 569	5 810	-	111 468
1969	4 476	35 227	1 330	5 071	39 420	26	309	30 349	4 981	-	121 189
1970	4 360	32 807	1 406	5 519	46 080	22	243	34 839	4 703	-	129 979
1971	5 073	22 278	1 380	3 296	44 502	18	235	32 576	4 210	-	113 568
1972	5 531	24 494	1 062	4 318	52 048	19	250	31 642	3 410	-	122 774
1973	6 133	23 266	1 355	4 976	57 948	15	173	30 400	4 815	399	129 480
1974[b)]	6 202	19 814	519	3 233	54 438	13	172	27 698	4 002	39	116 130
1975[c)]	5 022[e)]	21 864	554	4 000	50 880	8	187	25 146	3 236	271[d)]	109 970

a) Sweden - From 1962 onwards, the figures reported to "Bulletin Statistique" include catches made in IIIa. A note presented to the 12th (1974) meeting of NEAFC by the Swedish Delegation (Agenda Item 7/paper 1) stated that "at present about 40% of the Swedish catch of plaice are caught in the North Sea". This correction has been applied to the Swedish figures for IIIa and IVa in "Bulletin Statistique" for the years 1962 onwards, prior to their inclusion in this table.

b) From Advance Release of "Bulletin Statistique", but U.K. (England and Wales) amended.

c) Preliminary figures as reported and adjusted where possible to the whole year.

d) USSR, Poland.

e) Includes estimate of catches landed in foreign ports.

Table 10. North Sea Plaice.
Catch data for 1974 and 1[redacted] F-at-age arrays for 1971-76, and M-at-age array.

	Males						Females					
Age	Catch 1974	Catch 1975	1975 F-at-age array	1976 F-at-age array	Mean 71-73 F-at-age array	Natural mortality M	Catch 1974	Catch 1975	1975 F-at-age array	1976 F-at age array	Mean 71-73 F-at age array	Natural mortality M
1	890	1 636	0.01	0.01	-	0.25	728	583	0.01			0.20
2	9 832	28 390	0.15	0.15	0.07	0.15	10 456	23 534	0.15	0.15	0.09	0.10
3	30 891	63 822	0.90	0.50	0.21	0.15	29 127	47 556	0.90	0.50	0.27	0.10
4	36 116	19 026	0.40	0.40	0.41	0.15	24 431	18 768	0.40	0.40	0.38	0.10
5	19 987	12 907	0.30	0.30	0.45	0.15	20 248	12 900	0.40	0.40	0.40	0.10
6	8 467	8 771	0.30	0.30	0.41	0.15	10 270	10 023	0.40	0.40	0.39	0.10
7	3 085	4 467	0.30	0.30	0.33	0.15	4 859	5 647	0.40	0.40	0.37	0.10
8	1 904	2 099	0.30	0.30	0.28	0.15	4 450	2 777	0.40	0.40	0.42	0.10
9	1 807	926	0.30	0.30	0.25	0.15	3 941	2 035	0.40	0.40	0.39	0.10
10	1 009	717	0.30	0.30	0.30	0.15	3 152	1 651	0.40	0.40	0.37	0.10
11	2 356	275	0.20	0.20	0.20	0.15	9 661	981	0.40	0.40	0.39	0.10
12	247	922	0.20	0.20	0.28	0.15	1 654	4 532	0.40	0.40	0.38	0.10
13	392	243	0.20	0.20	0.24	0.15	1 659	591	0.30	0.30	0.29	0.10
14	162	131	0.20	0.20	0.54	0.15	1 321	783	0.30	0.30	0.40	0.10
15	354	508					1 258	641	0.30	0.30	0.27	0.10
16							709	634	0.30	0.30	0.24	0.10
17							1 209	263	0.30	0.30	0.40	0.10
18							136	319	0.30	0.30	0.30	0.10
19							54	202	0.20	0.20	0.18	0.10
20							42	90	0.10	0.10	0.10	0.10
21							287	264				
Column numbers 1	2	3	4	5	6	7	8	9	10	11	12	13

Table 11. North Sea Plaice.
Age composition of total catch 1966-75 (thousands).

Males

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	0	0	0	280	1 401	428	1 084	437	890	1 636
2	3 994	4 141	7 247	8 941	13 245	18 886	14 557	13 037	9 832	28 390
3	44 528	17 704	29 209	25 842	27 962	27 438	22 094	35 623	30 891	63 822
4	35 085	116 442	26 674	18 546	31 668	16 385	23 947	46 290	36 116	19 026
5	21 180	29 884	71 530	19 726	23 087	11 357	10 059	21 150	19 987	12 907
6	13 880	16 688	8 597	50 365	18 237	10 351	7 461	5 635	8 467	8 771
7	6 938	12 446	3 530	3 967	37 089	6 189	5 968	2 789	3 085	4 467
8	3 728	3 440	4 620	1 913	2 346	10 683	3 204	3 331	1 904	2 099
9	2 256	2 912	1 007	4 041	1 155	1 408	5 720	1 764	1 807	926
10	831	551	1 621	1 084	1 396	1 180	1 213	4 290	1 009	717
11	363	159	560	939	528	781	856	155	2 356	275
12	552	81	335	686	663	374	736	379	247	922
13	327	231	199	209	307	487	300	276	392	243

ctd.

Table 11 (ctd). North Sea Plaice.
Fishing mortalities 1966-75.

Males

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975 = F_1
1	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01
2	0.03	0.03	0.06	0.08	0.09	0.10	0.08	0.11	0.08	0.15
3	0.09	0.14	0.26	0.28	0.36	0.24	0.15	0.28	0.38	0.90
4	0.41	0.35	0.31	0.25	0.60	0.35	0.32	0.51	0.48	0.40
5	0.41	0.69	0.36	0.37	0.51	0.42	0.36	0.49	0.41	0.30
6	0.32	0.61	0.41	0.44	0.66	0.43	0.50	0.33	0.35	0.30
7	0.43	0.49	0.24	0.32	0.63	0.46	0.44	0.33	0.28	0.30
8	0.24	0.37	0.32	0.18	0.30	0.35	0.44	0.45	0.38	0.30
9	0.34	0.28	0.17	0.48	0.15	0.27	0.30	0.44	0.45	0.30
10	0.29	0.12	0.23	0.26	0.28	0.22	0.38	0.37	0.45	0.30
11	0.21	0.08	0.17	0.19	0.18	0.24	0.23	0.07	0.34	0.20
12	0.32	0.06	0.22	0.30	0.19	0.18	0.35	0.14	0.15	0.20
13 = F_1	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Average F > 1	0.16	0.30	0.27	0.28	0.38	0.23	0.20	0.32	0.31	0.38

ctd.

Table 11 (ctd). North Sea Plaice.
Stock in numbers (thousands).

Males

Year / Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	211 088	181 881	159 814	224 163	277 010	252 214	175 802	184 952	282 303	185 788
2	171 428	164 395	141 649	124 463	174 332	214 503	196 048	135 961	143 656	219 074
3	535 209	143 849	137 660	115 206	98 848	137 786	167 141	155 261	104 955	114 541
4	111 662	419 435	107 432	91 499	75 289	59 278	93 238	123 420	100 733	61 838
5	67 836	63 755	253 558	67 839	61 617	35 666	35 901	58 144	63 596	53 427
6	54 959	38 855	27 412	152 237	40 191	31 771	20 226	21 618	30 561	36 307
7	21 258	34 489	18 092	15 666	84 603	17 827	17 802	10 536	13 405	18 491
8	18 972	11 901	18 219	12 310	9 821	38 709	9 641	9 822	6 494	8 689
9	8 389	12 884	7 069	11 416	8 826	6 287	23 459	5 344	5 383	3 833
10	3 518	5 138	8 400	5 153	6 103	6 528	4 111	14 909	2 974	2 968
11	2 083	2 261	3 913	5 732	3 434	3 963	4 528	2 419	8 874	1 630
12	2 183	1 457	1 799	2 850	4 065	2 467	2 689	3 106	1 939	5 464
13	1 938	1 369	1 179	1 239	1 819	2 886	1 778	1 636	2 323	1 440

Table 12. North Sea Plaice.
Age composition of total catch 1966-75 (thousands).

Females

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	0	0	0	8	770	481	765	723	728	583
2	5 700	3 121	7 033	9 241	9 311	19 676	12 888	12 608	10 456	23 534
3	51 936	21 883	22 698	25 934	27 086	25 283	25 198	33 928	29 127	47 556
4	24 445	63 691	20 257	18 834	28 301	15 825	21 076	41 452	24 431	18 768
5	13 172	18 404	51 274	13 499	16 990	11 499	12 836	19 949	20 248	12 900
6	9 705	11 301	7 476	39 605	13 838	10 296	10 898	7 816	10 270	10 023
7	8 531	8 896	5 122	5 050	34 679	7 023	11 437	6 171	4 859	5 647
8	6 371	4 279	5 833	3 091	4 509	13 864	11 773	6 375	4 450	2 777
9	3 677	5 692	2 494	4 672	2 747	3 210	18 503	5 694	3 941	2 035
10	2 056	2 289	3 178	1 868	3 772	2 471	4 892	12 955	3 152	1 651
11	1 608	1 808	1 309	3 174	1 522	2 303	4 635	2 665	9 661	981
12	1 904	903	1 336	933	2 102	1 536	5 654	2 099	1 654	4 532
13	1 168	1 342	630	990	752	1 424	2 687	1 945	1 659	591
14	1 073	769	840	362	721	627	2 733	2 836	1 321	783
15	589	671	489	687	320	742	1 188	1 150	1 258	641
16	663	322	576	348	373	346	1 475	705	709	634
17	374	504	478	481	291	826	2 459	901	1 209	263
18	305	163	140	179	173	307	618	413	136	319
19	316	139	134	202	95	176	368	289	54	202
20	193	165	113	173	99	88	202	328	42	90

ctd.

Table 12 (ctd). North Sea Plaice.
Fishing mortalities 1966-75.

Females

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975 = F_1
1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01
2	0.04	0.02	0.05	0.09	0.07	0.12	0.10	0.12	0.11	0.15
3	0.13	0.18	0.20	0.26	0.35	0.26	0.20	0.37	0.38	0.90
4	0.29	0.21	0.23	0.23	0.44	0.31	0.31	0.53	0.45	0.40
5	0.22	0.33	0.23	0.21	0.30	0.29	0.40	0.48	0.47	0.40
6	0.16	0.26	0.20	0.25	0.30	0.27	0.42	0.40	0.43	0.40
7	0.22	0.19	0.16	0.18	0.32	0.22	0.48	0.40	0.42	0.40
8	0.19	0.15	0.17	0.12	0.21	0.18	0.60	0.48	0.50	0.40
9	0.20	0.22	0.11	0.18	0.14	0.20	0.35	0.59	0.54	0.40
10	0.13	0.16	0.17	0.10	0.19	0.16	0.47	0.39	0.67	0.40
11	0.14	0.15	0.12	0.23	0.10	0.15	0.44	0.46	0.49	0.40
12	0.21	0.09	0.14	0.10	0.21	0.12	0.58	0.32	0.50	0.40
13	0.11	0.20	0.08	0.13	0.10	0.19	0.29	0.36	0.40	0.30
14	0.15	0.08	0.17	0.05	0.12	0.11	0.58	0.50	0.39	0.30
15	0.19	0.12	0.06	0.18	0.06	0.15	0.27	0.45	0.38	0.30
16	0.23	0.13	0.13	0.05	0.13	0.07	0.44	0.22	0.49	0.30
17	0.13	0.25	0.27	0.14	0.05	0.41	0.86	0.47	0.63	0.30
18	0.17	0.07	0.09	0.14	0.06	0.06	0.54	0.29	0.10	0.30
19	0.15	0.10	0.06	0.16	0.09	0.07	0.09	0.46	0.05	0.20
20 = F_1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Mean $F > 1$	0.15	0.18	0.18	0.20	0.25	0.20	0.29	0.37	0.36	0.39

ctd.

Table 12 (ctd). North Sea Plaice.
Stock in numbers (thousands).

Females

Age \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	178 001	169 883	141 865	170 839	219 422	170 760	147 144	127 042	217 384	64 636
2	159 630	145 735	139 089	116 150	139 864	178 952	139 372	119 780	103 360	177 321
3	448 876	139 022	128 900	119 168	96 316	117 706	143 233	113 865	96 405	83 592
4	100 956	356 831	105 016	95 088	83 222	61 471	82 516	105 684	70 869	59 623
5	71 363	68 162	262 419	75 798	68 166	48 491	40 614	54 676	56 385	40 982
6	68 815	52 070	44 225	188 786	55 771	45 565	32 969	24 585	30 580	31 842
7	45 148	53 051	36 393	32 922	133 241	37 339	31 461	19 506	14 836	17 940
8	39 503	32 755	39 557	28 066	24 995	87 674	27 120	17 636	11 802	8 822
9	21 521	29 695	25 574	30 254	22 459	18 336	66 169	13 401	9 920	6 465
10	17 691	15 982	21 467	20 771	22 940	17 713	13 544	42 329	6 738	5 245
11	13 273	14 054	12 288	16 407	17 020	17 176	13 681	7 622	26 023	3 117
12	10 432	10 483	11 000	9 875	11 833	13 954	13 354	7 988	4 372	14 398
13	12 219	7 632	8 627	8 684	8 049	8 712	11 167	6 733	5 237	2 390
14	7 961	9 946	5 632	7 208	6 917	6 569	6 531	7 556	4 249	3 167
15	3 607	6 185	8 269	4 298	6 178	5 574	5 348	3 323	4 152	2 592
16	3 375	2 704	4 959	7 018	3 237	5 286	4 339	3 712	1 918	2 564
17	3 330	2 424	2 141	3 940	6 019	2 575	4 454	2 529	2 690	1 064
18	2 004	2 658	1 715	1 484	3 108	5 170	1 547	1 708	1 435	1 290
19	2 344	1 524	2 250	1 419	1 173	2 648	4 386	815	1 154	1 169
20	2 129	1 820	1 247	1 909	1 092	971	2 229	3 619	463	993

Table 13. North Sea Plaice.
Mean weight at age per catch and stock.

Age	MALE Gutted weight stock g	MALE Gutted weight catch g	FEMALE Gutted weight stock g	FEMALE Gutted weight catch g
2	65	200	65	215
3	122	260	122	303
4	194	315	194	376
5	282	370	282	451
6	382	413	382	527
7	450	450	490	602
8	485	485	606	676
9	517	517	724	749
10	546	546	819	819
11	573	573	886	886
12	598	598	950	950
13	620	620	1 010	1 010
14	640	640	1 067	1 067
15	694	694	1 120	1 120
16			1 170	1 170
17			1 220	1 220
18			1 260	1 260
19			1 300	1 300

Table 14. North Sea Plaice.
Prognosis for catch and stock in 1976 and 1977
and long-term steady state catch and biomass.

	Maximum F at age value	Prognosis: Catch (tons)	Prognosis: Biomass at beginning of year	Long-term steady state situation: Expected catch (tons)	Long-term steady state situation: Biomass	Long-term steady state situation: Multiple of Biomass in 1977
1975	0.5	109 970	233 960			
1976	0.5	96 300	213 844			
1977			203 794			
	0.0	0			1 462 600	7.18
	0.1	19 570		43 130	818 690	4.02
	0.2	37 800		84 030	509 180	2.50
	0.3	54 770		91 050	346 910	1.70
	0.4	70 590		93 160	254 565	1.25
Present level →	0.5	85 340		93 500	198 060	0.97
	0.6	99 100		93 170	161 280	0.79
	0.7	111 950		92 620	136 100	0.67
	0.8	123 950		92 000	118 120	0.58
	0.9	135 170		91 400	104 830	0.51
	1.0	145 650		90 820	94 715	0.46
Column nos.	1	2	3	4	5	6

Table 15. North Sea Plaice.
Maximal values of the F at age array which would be generated by various catches for 1977.

TAC (tons nominal)	Maximal F value
100 000	0.61
90 000	0.53
80 000	0.46
70 000	0.39
60 000	0.33
50 000	0.26
40 000	0.21
30 000	0.15
20 000	0.10

Table 16. North Sea Plaice.
Recruitment estimates from pre-recruit surveys and virtual population analysis data.

Year class	Abundance at age 2 (from 1975 VPA) millions	Abundance index in 0 - 1 group Waddensea surveys %
1968	340	92
1969	445	137
1970	426	119
1971	370	98
1972	208	50
1973	349*	96
1974	214*	49
1975	426*	123

* Estimated by extrapolation from the regression

Table 17. English Channel Sole.
Nominal catch (metric tons) in statistical Divisions VIId,e, 1964 - 1975 (Bulletin Statistique).

Year	Belgium	France	Netherlands	U.K. (England & Wales)	Total
1964	14	465	-	207	686
1965	43	824	-	175	1 042
1966	8	-	-	216	224
1967	7	816	-	261	1 084
1968	30	520	-	247	797
1969	18	606	-	315	939
1970	137	753	1	353	1 244
1971	160	816	1	406	1 383
1972	153	676	8	523	1 360
1973	128	775	-	485	1 457
1974	165	706	3	490	1 364
1975 1)	135	966	-	550 2)	1 651

1) Preliminary figures as reported. 2) Figure reported to NEAFC.

Table 18. English Channel Plaice.
Nominal catch (metric tons) in statistical Divisions VIId,e, 1964 - 1975 (Bulletin Statistique).

Year	Belgium	France	Netherlands	U.K. (England & Wales)	Total
1964	28	1 393	-	1 038	2 459
1965	33	2 130	-	1 286	3 449
1966	25	2 700 1)	-	1 748	4 473
1967	11	2 905	-	1 805	4 721
1968	30	1 920	-	1 354	3 304
1969	30	1 681	-	1 029	2 740
1970	183	2 161	6	1 517	3 867
1971	180	2 635	-	1 465	4 280
1972	177	1 866	17	1 182	3 242
1973	144	1 735	-	1 256	3 135
1974	152	2 180	-	812	3 144
1975 2)	161	1 748	-	545	2 454

1) Figure from Revue des Travaux de l'Institut des Pêches Maritimes raised to round fresh weight.

2) Preliminary figures as reported.

Table 19. English Channel Sole.
Catch in metric tons per 100 hours fishing for England VIIe (corrected for fishing power) for England VIId and Belgium VIId (both not corrected for fishing power).

		1968	1969	1970	1971	1972	1973	1974	1975
U.K. (England) (Brixham)	VIIe	1.93	1.91	1.01	0.93	1.04	0.8	1.0	
U.K. (England)	VIId	2.08	3.08	2.11	2.08	3.66	3.46	4.08	
Belgium	VIId				18	13	8	10	8

Table 20. Irish Sea Sole and Bristol Channel Sole.
Nominal catch in statistical Divisions VIIa and VIIf, 1960-1975.

Year	Belgium		France		Ire-land	Nether-lands	U.K. (England & Wales)		U.K. (N. Ireland)	U.K. (Scotland)	Total	
	VIIa	VIIf	VIIa	VIIf	VIIa	VIIa	VIIa	VIIf	VIIa	VIIa	VIIa	VIIf
1960	531		90		25	-	756		-	-	1 402	
1961	406		60		25	-	682		-	-	1 173	
1962	40	335	45	45	37	-	464	215	-	-	586	595
1963	64	174	43	61	25	-	323	122	+	-	455	357
1964	938	471	242	77	40	-	380	111	+	-	1 600	659
1965	1 025	498	228	72	29	13	344	75	1	-	1 640	645
1966	407	248	367	150	14	-	288	112	7	-	1 083	510
1967	307	451	361	83	22	-	320	209	12	-	1 022	743
1968	332	292	125	179	23	-	456	127	10	-	946	598
1969	841	289	97	194	34	3	417	168	17	-	1 409	651
1970	1 142	567	115	118	25	235	291	145	24	1	1 833	830
1971	883	595	45	40	45	552	356	131	40	1	1 922	766
1972	561	343	38	82	50	514	278	123	40	9	1 490	548
1973	793	416	12	240	27	281	315	122	46	11	1 485	778
1974	664	545	54	24	28	320	218	94	23	-	1 330	663
1975*	737	417	74	33	22	203	290	147	24	14	1 364	597

* Preliminary figures as reported.

Table 21. Irish Sea Sole.
Age composition of total catch 1970-75 (thousands).

Males

Age \ Year	1970	1971	1972	1973	1974	1975
2	12	27	11	56	24	104
3	488	94	270	178	370	349
4	565	1 094	417	1 145	239	1 085
5	321	660	568	289	654	302
6	571	123	166	349	179	337
7	39	485	68	146	154	63
8	95	132	241	98	132	101
9	260	38	22	185	25	91
10	74	131	16	15	130	58
11	257	264	127	76	33	46
12	46	73	52	83	40	15
13	9	181	31	48	71	19
14	9	15	36	18	82	61
15	4	18	1	32	43	11

ctd.

Table 21 (ctd). Irish Sea Sole.
Fishing mortalities 1970-75.

Males

Year / Age	1970	1971	1972	1973	1974	1975
2	0.01	0.01	0.01	0.01	0.01	0.01
3	0.14	0.07	0.08	0.12	0.09	0.22
4	0.26	0.48	0.41	0.45	0.22	0.38
5	0.35	0.49	0.43	0.50	0.45	0.41
6	0.31	0.20	0.20	0.46	0.58	0.39
7	0.10	0.41	0.14	0.23	0.33	0.37
8	0.22	0.53	0.33	0.28	0.31	0.34
9	0.23	0.12	0.14	0.40	0.10	0.32
10	0.11	0.15	0.06	0.12	0.48	0.30
11	0.44	0.62	0.19	0.38	0.36	0.28
12	0.09	0.19	0.21	0.17	0.32	0.25
13	0.43	0.56	0.10	0.26	0.19	0.22
14	0.09	3.30	0.18	0.07	0.84	0.22
15	0.22	0.22	0.22	0.22	0.22	0.22
Mean $F \geq 4$	0.24	0.35	0.20	0.30	0.35	0.33

ctd.

Table 21 (ctd.) Irish Sea Sole.
Stock in numbers 1970-75.

Males

Age \ Year	1970	1971	1972	1973	1974	1975
2	1 694	4 361	1 794	4 879	2 074	10 982
3	3 843	1 522	3 920	1 612	4 362	1 854
4	2 556	3 014	1 288	3 290	1 290	3 595
5	1 131	1 777	1 691	770	1 893	940
6	2 258	719	982	992	423	1 093
7	412	1 502	534	731	567	213
8	501	336	899	418	523	367
9	1 350	363	179	585	285	348
10	741	975	292	141	354	235
11	760	600	758	249	113	197
12	533	444	294	565	153	71
13	27	439	332	216	433	101
14	115	16	226	271	150	324
15	21	96	1	170	228	58

Table 22. Irish Sea Sole.
Age composition of total catch 1970-75 (thousands).

Females

Age \ Year	1970	1971	1972	1973	1974	1975
2	21	83	22	338	25	150
3	935	319	553	190	797	327
4	763	1 082	301	975	326	1 252
5	105	538	944	254	782	217
6	730	116	294	425	209	474
7	162	394	150	140	259	22
8	50	18	330	15	124	135
9	299	48	72	148	43	57
10	187	206	45	52	110	26
11	304	99	79	38	18	87
12	60	165	84	66	34	6
13	23	120	188	80	49	4
14	24	34	69	67	44	38
15	51	28	57	39	27	29

ctd.

Table 22. (ctd) Irish Sea Sole.
Fishing mortalities 1970-75.

Females

Year / Age	1970	1971	1972	1973	1974	1975
2	0.01	0.02	0.01	0.05	0.01	0.01
3	0.20	0.27	0.13	0.15	0.16	0.22
4	0.38	0.34	0.39	0.32	0.37	0.35
5	0.18	0.45	0.49	0.60	0.41	0.40
6	0.35	0.27	0.42	0.38	1.34	0.41
7	0.51	0.29	0.58	0.32	0.37	0.40
8	0.19	0.09	0.38	0.09	0.47	0.30
9	0.34	0.26	0.51	0.26	0.36	0.36
10	0.28	0.37	0.36	0.75	0.28	0.34
11	0.38	0.21	0.21	0.52	0.55	0.33
12	0.13	0.33	0.25	0.25	1.09	0.32
13	0.07	0.38	0.66	0.36	0.26	0.30
14	0.18	0.13	0.35	0.46	0.30	0.30
15	0.30	0.30	0.30	0.30	0.30	0.30
Mean $F \geq 4$	0.32	0.28	0.40	0.34	0.47	0.36

ctd.

Table 22 (ctd). Irish Sea Sole.
Stock in numbers 1970-75.

Females

Age \ Year	1970	1971	1972	1973	1974	1975
2	1 575	5 284	1 591	6 705	1 946	15 840
3	5 347	1 405	4 702	1 419	5 746	1 737
4	2 515	3 950	969	3 730	1 103	4 442
5	681	1 553	2 548	591	2 450	689
6	2 560	516	895	1 412	295	1 476
7	422	1 624	357	531	875	70
8	299	228	1 096	181	348	546
9	1 076	223	189	679	150	198
10	794	691	156	103	474	95
11	1 007	541	430	99	44	324
12	503	623	395	314	53	23
13	345	398	407	278	221	16
14	150	290	247	191	176	154
15	206	113	231	158	109	117

Table 23. Irish Sea Sole.
Relative fishing mortalities, based on 1970-73 average from VPA.

Age	Male Relative F	Female Relative F
2	0.03	0.05
3	0.55	0.48
4	0.95	0.83
5	1.00	1.00
6	0.98	0.98
7	0.93	0.95
8	0.85	0.90
9	0.80	0.86
10	0.75	0.81
11	0.75	0.79
12	0.75	0.76
13	0.75	0.71
14	0.75	0.71
15	0.75	0.71

Table 24. Irish Sea Sole.
Catch prognosis for 1977.

F	Catch weight (tons)	Catch number $\times 10^{-3}$	
0	0	0	Stock biomass at 6 039 tons beginning of year
1	382	1 686	
2	733	3 239	
3	1 056	4 671	
4	1 354	5 991	Too high by ≈ 150 tons. 1973 year class has been overestimated.
5	1 629	7 209	
6	1 881	8 334	
7	2 115	9 372	
8	2 330	10 331	
9	2 528	11 218	
10	2 712	12 038	

Table 25. Irish Sea Plaice and Bristol Channel Plaice.
Nominal catch in statistical Divisions VIIa and VIIf, 1960-1975.

Year	Belgium		France		Ire-land	Nether-lands	U.K. (England & Wales)		U.K. (N. Ireland)	U.K. (Scotland)	Total	
	VIIa	VIIf	VIIa	VIIf	VIIa	VIIa	VIIa	VIIf	VIIa	VIIa	VIIa	VIIf
1960	140		157		611	-	1 620		34	18	2 580	
1961	82		67		743	-	1 443		22	42	2 399	
1962	11	73	54	4	594	-	1 436	205	28	20	2 143	282
1963	23	55	60	1	545	-	1 141	173	68	29	1 866	229
1964	253	184	147	3	844	-	1 388	204	185	62	2 879	391
1965	150	224	168	10	574	1	2 484	272	225	62	3 664	506
1966	72	113	562	21	782	-	2 527	467	174	151	4 268	601
1967	69	137	1 082	-	819	-	2 866	655	138	85	5 059	792
1968	152	260	40	669	1 449	-	2 764	521	178	112	4 695	1 450
1969	208	202	33	668	1 309	-	2 540	506	216	88	4 394	1 376
1970	305	226	250	102	909	8	1 869	501	184	58	3 583	829
1971	175	202	-	-	1 028	61	2 744	545	132	92	4 232	747
1972	179	137	440	110	863	48	3 366	377	134	89	5 119	624
1973	221	158	500	-	1 079	42	3 002	381	143	73	5 060	539
1974	247	154	132	-	891	47	2 240	210	104	54	3 715	364
1975*	246	126	106	115	842	31	2 377	312	125	51	3 778	553

* Preliminary figures as reported.

Table 26. Irish Sea Plaice and Bristol Channel Plaice.
Growth data - mean lengths (cm) at age, and parameters of von Bertalanffy equation.
Data for age group 0-2 from research vessel samples; data for age group 3 onwards from commercial catch samples.

	Irish Sea (VIIa)							Bristol Channel (VIIf)				
	Female			Male				Female			Male	
Age group	Belgian 1970-74	English & Welsh 1964-74	Irish 1962-66	Age group	Belgian 1970-74	English & Welsh 1964-74	Irish 1962-66	Age group	Belgian 1970-74	English & Welsh 1969,70,73,74	Belgian 1970-74	English & Welsh 1969,70
0		7.3	11.3	0		7.3	11.1	0		9.6		9.5
1		15.3	18.2	1		15.3	18.3	1		17.0		17.1
2		21.0	23.2	2		21.0	22.8	2	29.5	29.6	28.8	28.1
3	31.1	26.8	31.5	3	28.8	26.8	28.9	3	32.4	30.9	30.6	30.2
4	33.8	31.7	34.0	4	31.4	29.7	31.4	4	35.0	32.5	31.5	30.1
5	37.1	33.6	37.7	5	32.4	30.6	33.9	5	37.0	33.8	32.3	31.7
6	39.3	35.9	39.9	6	32.8	31.2	35.6	6	40.4	36.1	32.0	33.3
7	41.5	38.0	43.6	7	35.8	32.0		7	42.9	36.6	35.5	31.1
8	43.7	39.1	45.6	8	36.4	34.8		8	44.8	39.0	38.0	35.0
9	45.3	41.3		9	38.0	34.8		9	47.3	42.9		-
10	46.8	44.1		10+		36.6		10+	51.8	48.1		37.5
11	50.5	45.1										
12	50.6	48.3				Mean age of 10+ = 11.5			Mean age of 10+ = 11.5	Mean age of 10+ = 12.1		Mean age of 10+ = 11.0
13	52.3	47.8										
14	52.5	51.0										
15	51.0	48.6										
16+		53.0										
		Mean age of 16+ = 17.0										
L_∞		53.79				37.13				50.87		35.11
K		0.18				0.35				0.20		0.52
t_o		-0.61				-0.27				-0.85		-0.09

Table 27. Irish Sea Plaice.
Age composition of total catch 1964-75 (thousands).

Males

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	484	489	38	73	105	104	141	219	23	279	500	159
3	399	1 182	1 367	330	672	928	859	1 356	1 268	1 127	845	1 703
4	504	835	1 711	2 241	1 076	1 185	749	1 702	1 953	2 090	1 286	2 139
5	311	246	937	187	1 480	793	1 012	726	670	1 119	897	759
6	455	160	295	357	566	244	495	586	205	337	463	171
7	92	204	73	284	112	188	141	116	147	120	39	27
8	1	157	90	23	10	5	72	55	185	98	10	71
9	1	21	1	72	1	1	5	65	35	41	19	27
10	154	1	1	88	1	33	5	27	1	28	1	71
11	1	1	1	37	1	33	1	5	1	32	1	1
12	1	1	1	23	1	1	59	1	1	26	20	1

ctd.

Table 27 (ctd). Irish Sea Plaice.
Fishing mortalities 1964-75.

Males

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	0.08	0.06	0.01	0.01	0.03	0.02	0.02	0.03	0.00	0.04	0.05	0.02
3	0.11	0.25	0.22	0.08	0.13	0.31	0.20	0.26	0.27	0.28	0.14	0.24
4	0.36	0.33	0.64	0.64	0.40	0.34	0.41	0.73	0.68	0.89	0.55	0.56
5	0.57	0.28	0.70	0.12	1.14	0.54	0.50	0.84	0.67	1.05	1.23	0.70
6	0.35	0.61	0.59	0.59	0.61	0.52	0.74	0.58	0.57	0.81	2.12	0.77
7	0.25	0.24	0.60	2.12	0.35	0.39	0.62	0.35	0.26	0.73	0.19	0.70
8	0.01	0.81	0.15	0.36	0.36	0.02	0.24	0.49	1.48	0.26	0.11	0.56
9	0.01	0.32	0.01	0.16	0.02	0.05	0.03	0.33	0.63	2.06	0.07	0.46
10	3.20	0.01	0.02	2.67	0.00	1.81	0.37	0.18	0.01	1.67	0.22	0.38
11	0.20	0.20	0.01	2.21	0.20	0.12	0.20	0.75	0.01	0.31	0.20	0.34
12	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Mean $F \geq 4$	0.48	0.39	0.34	0.85	0.44	0.37	0.51	0.48	0.50	0.63	0.98	0.59

ctd.

Table 27. (ctd) Irish Sea Plaice.
Stock in numbers 1964-75. (thousands).

Males

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	7 203	9 096	5 188	6 924	4 487	5 937	7 531	6 934	5 811	8 557	10 494	8 645
3	4 164	5 751	7 376	4 430	5 892	3 765	5 014	6 352	5 765	4 980	7 106	8 569
4	1 805	3 214	3 858	5 085	3 508	4 449	2 384	3 521	4 214	3 791	3 246	5 335
5	765	1 088	1 996	1 747	2 316	2 027	2 736	1 361	1 467	1 832	1 346	1 610
6	1 672	372	709	857	1 331	641	1 014	1 422	505	647	553	340
7	450	1 019	173	339	409	625	327	418	685	246	248	57
8	97	302	689	82	35	249	364	151	253	454	102	177
9	153	83	116	510	49	21	209	247	80	49	300	78
10	167	131	52	99	372	42	17	176	153	36	5	241
11	6	6	112	44	6	319	6	10	126	131	6	4
12	4	4	4	95	4	4	244	4	4	108	83	4

Table 28. Irish Sea Plaice.
Age composition of total catch 1964-75 (thousands).

Females

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	513	812	32	166	122	200	268	246	136	486	946	123
3	1 512	2 007	2 004	1 245	1 142	1 258	910	1 658	2 189	1 993	1 762	1 163
4	1 176	1 981	2 194	3 225	2 148	1 946	1 274	2 192	2 749	3 747	1 244	1 129
5	135	1 161	1 522	2 220	3 235	1 317	1 267	1 089	847	1 712	1 225	1 004
6	396	489	480	785	1 239	1 782	850	1 009	508	444	449	771
7	388	124	495	305	256	694	807	390	523	280	154	322
8	139	154	273	259	121	182	221	462	388	188	110	118
9	25	15	197	180	131	62	87	128	347	134	51	95
10	1	33	18	86	26	61	37	52	171	186	43	69
11	29	13	17	60	16	44	56	37	52	99	69	51
12	1	1	5	5	7	21	21	36	44	23	31	59
13	1	1	7	5	4	5	29	12	34	19	7	19
14	1	1	3	7	2	2	5	7	20	13	6	11
15	10	1	2	5	1	1	1	1	14	17	5	1

ctd.

Table 28 (ctd). Irish Sea Plaice.
Fishing mortalities 1964-75.

Females

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	0.04	0.05	0.00	0.02	0.02	0.03	0.03	0.02	0.02	0.08	0.15	0.02
3	0.21	0.20	0.14	0.16	0.16	0.24	0.17	0.21	0.24	0.36	0.38	0.24
4	0.34	0.42	0.30	0.30	0.41	0.39	0.37	0.69	0.57	0.70	0.35	0.40
5	0.06	0.59	0.58	0.50	0.50	0.41	0.41	0.55	0.56	0.75	0.45	0.47
6	0.30	0.29	0.46	0.60	0.51	0.50	0.46	0.60	0.47	0.57	0.39	0.51
7	0.40	0.13	0.48	0.52	0.35	0.53	0.39	0.35	0.64	0.45	0.35	0.48
8	0.64	0.24	0.41	0.44	0.36	0.40	0.28	0.36	0.60	0.44	0.29	0.43
9	0.27	0.11	0.49	0.47	0.36	0.28	0.30	0.24	0.45	0.38	0.18	0.38
10	0.03	0.59	0.17	0.36	0.10	0.26	0.24	0.27	0.50	0.41	0.18	0.35
11	0.75	0.48	0.62	1.16	0.09	0.22	0.35	0.36	0.41	0.54	0.23	0.30
12	0.03	0.04	0.30	0.33	0.33	0.15	0.14	0.36	0.82	0.29	0.28	0.28
13	0.08	0.03	0.42	0.50	0.42	0.37	0.29	0.10	0.59	0.94	0.12	0.25
14	0.18	0.10	0.11	0.87	0.34	0.34	0.69	0.10	0.21	0.42	0.79	0.25
15	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mean F $\geq$ 4	0.36	0.24	0.45	0.53	0.42	0.47	0.38	0.42	0.52	0.47	0.31	0.45

ctd.

Table 28 (ctd). Irish Sea Plaice.
Stock in numbers 1964-75 (thousands).

Females

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	13 647	18 966	9 718	9 266	6 875	6 862	10 288	12 321	7 826	6 931	7 310	6 526
3	8 278	11 860	16 389	8 763	8 227	6 105	6 019	9 054	10 915	6 952	5 810	5 716
4	4 246	6 055	8 826	12 926	6 747	6 359	4 330	4 582	6 619	7 799	4 401	3 587
5	2 377	2 727	3 602	5 906	8 637	4 069	3 910	2 710	2 073	3 388	3 514	2 803
6	1 590	2 023	1 369	1 819	3 241	4 752	2 434	2 337	1 421	1 075	1 447	2 019
7	1 238	1 063	1 366	784	903	1 760	2 612	1 397	1 160	805	552	884
8	309	752	844	768	420	575	935	1 599	894	555	463	354
9	111	148	534	505	449	266	347	637	1 009	442	324	315
10	40	77	120	297	286	282	182	232	455	584	273	245
11	57	36	39	91	187	234	198	129	160	250	352	206
12	38	24	20	19	26	154	170	126	82	96	132	253
13	14	33	21	13	12	17	120	134	80	33	65	90
14	6	12	29	13	7	7	10	81	110	40	12	52
15	47	5	9	24	5	5	5	5	66	81	24	5

Table 29. Irish Sea Plaice.

Mean lengths, and mean weights at age, used in the prognosis.

Age	Male Mean length (cm)	Male Mean weight (g)	Age	Female Mean length (cm)	Female Mean weight (g)
0	8.8	8.3	0	9.7	11.7
1	17.2	58.5	1	17.0	58.7
2	23.1	127.1	2	23.1	140.9
3	27.3	202.9	3	28.1	249.3
4	30.2	270.7	4	32.4	372.8
5	32.3	326.2	5	35.9	501.8
6	33.7	369.4	6	38.8	629.6
7	34.7	401.8	7	41.3	751.0
8	35.4	425.7	8	43.4	863.6
9	35.9	443.0	9	45.1	966.9
10+(11.5)	36.6	467.8	10	46.5	1 055.6
			11	47.7	1 135.8
	W_∞ = 485.9		12	48.7	1 206.2
			13	49.6	1 266.9
			14	50.3	1 319.0
			15	50.8	1 363.2
			16+ (17)	51.7	
				W_∞ = 1 603.7	

Average fishing mortalities (1964-72) and relative F.

Age	Male Mean F 1964-72	Male Relative F	Female Mean F 1964-72	Female Relative F
2	.03	.05	.03	.06
3	.20	.33	.20	.43
4	.50	.83	.42	.89
5	.60	1.00	.46	.98
6	.60	1.00	.47	1.00
7	.57	.95	.44	.94
8	.53	.88	.41	.87
9	.49	.82	.38	.81
10	.45	.75	.36	.77
11	.41	.68	.34	.72
12	.38	.63	.32	.68
13	.35	.58	.30	.64
14			.30	.64
15			.30	.64

Table 30. Irish Sea (VIIa) and Bristol Channel (VIIf) Plaice.
Total mortality estimates from United Kingdom and Belgian catch and effort data and from Irish catch curves.

		1964/5	1965/6	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	
Plaice VIIa												
Female												
England & Wales (Fleetwood)		0.72	0.34	0.86	1.32	0.41	0.47	0.50	0.06	0.81	0.82	
Belgium	Otter Trawl								0.23	1.14	0.73	
	Beam Trawl								0.38	1.01	0.52	
Male												
England & Wales (Fleetwood)		0.20	0.34	0.93	1.61	1.59	0.47	0.63	0.60	0.81	0.60	
Belgium	Otter Trawl								0.43	0.56	1.20	
	Beam Trawl								0.60	0.56	1.10	
Male and Female combined										1973	1974	1975
Ireland										0.70	0.39	0.79
Plaice VIIf												
Female												
England & Wales (Milford Haven)							1.31		0.75		0.91	
Belgium	Otter Trawl								1.11	-0.12	0.63	
	Beam Trawl								0.49	0.53	0.50	
Male												
England & Wales (Milford Haven)							1.64		0.79		1.66	
Belgium	Otter Trawl								1.55	0.19	1.07	
	Beam Trawl								0.80	0.85	0.92	

Table 31. Irish Sea Plaice.
Prognosis for 1977.

	F	Weighted F	Catch weight (tons)	Catch number x 10^{-3}	Stock biomass at beginning of year
	0	0	0	0	
	.1	.07	859	2 085	14 207
	.2	.13	1 651	4 022	
	.3	.20	2 381	5 820	
	.4	.27	3 055	7 491	
	.5	.33	3 677	9 045	
	.6	.40	4 252	10 492	
	.7	.47	4 784	11 841	
	.8	.54	4 885	13 098	
	.9	.60	5 306	14 272	
	1.0	.67	5 697	15 369	
Column numbers	1	2	3	4	5

Table 32. Bristol Channel Sole in Division VIIf.
Age composition of total catch 1970-75 (thousands).

Males

Age \ Year	1970	1971	1972	1973	1974	1975
2	30	137	100	197	50	21
3	476	143	284	664	157	106
4	195	490	81	269	368	161
5	187	190	198	97	120	236
6	263	84	77	81	32	105
7	135	62	42	43	53	19
8	79	168	44	29	24	40
9	85	76	71	29	13	17
10	61	11	19	74	39	17
11	28	87	20	19	12	13
12	67	26	6	9	7	11
13	35	28	15	10	19	5
14	7	44	6	20	11	19
15	9	14	5	29	11	4
16	26	1	1	12	1	9

ctd.

Table 32 (ctd). Bristol Channel Sole in Division VIIf.
Fishing mortalities 1970-75.

Males

Age \ Year	1970	1971	1972	1973	1974	1975
2	0.06	0.11	0.05	0.24	0.11	0.07
3	0.35	0.36	0.31	0.48	0.28	0.33
4	0.34	0.63	0.32	0.47	0.48	0.45
5	0.47	0.56	0.50	0.70	0.35	0.57
6	0.61	0.36	0.42	0.35	0.46	0.52
7	0.25	0.25	0.27	0.38	0.36	0.48
8	0.35	0.49	0.25	0.27	0.34	0.44
9	0.28	0.60	0.35	0.23	0.17	0.38
10	0.30	0.05	0.26	0.66	0.50	0.31
11	0.13	0.79	0.10	0.39	0.18	0.27
12	0.62	0.16	0.10	0.06	0.22	0.23
13	0.19	0.51	0.12	0.21	0.15	0.21
14	0.25	0.33	0.17	0.20	0.33	0.19
15	2.50	1.01	0.05	3.60	0.14	0.17
16	0.15	0.15	0.15	0.15	0.15	0.15
Mean F > 5	0.28	0.39	0.21	0.38	0.27	0.29

ctd.

Table 32 (ctd). Bristol Channel Sole in Division VIIf.
Stock in numbers 1970-75 (thousands).

Males

Year / Age	1970	1971	1972	1973	1974	1975
2	574	1 391	2 110	957	489	326
3	1 709	490	1 128	1 815	679	395
4	714	1 095	308	751	1 013	465
5	518	461	528	202	425	568
6	600	292	237	290	91	271
7	643	294	185	142	186	52
8	278	453	207	127	87	118
9	360	177	251	146	88	56
10	248	245	88	160	104	67
11	236	166	211	62	75	58
12	151	187	68	172	38	56
13	216	74	145	56	147	28
14	33	162	40	117	41	115
15	10	23	105	31	86	27
16	196	1	8	90	1	68

Table 33. Bristol Channel Sole in Division VIIf.
Age composition of total catch 1970-75 (thousands).

Females

Year / Age	1970	1971	1972	1973	1974	1975
2	1	75	44	94	38	16
3	131	26	85	387	93	50
4	61	77	59	101	182	56
5	91	57	173	67	138	200
6	66	75	60	126	78	102
7	189	123	38	33	95	58
8	49	106	47	23	33	102
9	44	47	65	36	48	30
10	43	28	32	55	45	25
11	36	41	13	20	55	20
12	14	64	16	13	28	33
13	25	4	43	13	16	16
14	1	1	12	32	21	9
15	8	21	9	19	24	4
16	11	12	2	14	10	20

ctd.

Table 33 (ctd). Bristol Channel Sole in Division VIIf.
Fishing mortalities 1970-75.

Females

Age \ Year	1970	1971	1972	1973	1974	1975
2	0.00	0.07	0.02	0.15	0.06	0.04
3	0.09	0.04	0.09	0.22	0.19	0.10
4	0.13	0.07	0.11	0.13	0.14	0.15
5	0.20	0.15	0.19	0.16	0.23	0.20
6	0.13	0.22	0.21	0.18	0.25	0.24
7	0.25	0.35	0.15	0.16	0.18	0.26
8	0.14	0.20	0.19	0.11	0.21	0.27
9	0.19	0.17	0.16	0.20	0.33	0.26
10	0.20	0.16	0.15	0.18	0.36	0.25
11	0.05	0.27	0.09	0.12	0.24	0.24
12	0.05	0.10	0.14	0.11	0.21	0.20
13	0.07	0.01	0.08	0.15	0.18	0.16
14	0.00	0.00	0.05	0.07	0.34	0.13
15	0.03	0.44	0.03	0.10	0.06	0.09
16	0.06	0.06	0.06	0.06	0.06	0.06
Mean F > 5	0.12	0.16	0.11	0.12	0.19	0.20

ctd.

Table 33 (ctd). Bristol Channel Sole in Division VIIf. Stock in numbers 1970-75 (thousands).

Females

Age \ Year	1970	1971	1972	1973	1974	1975
2	761	1 250	2 291	722	650	429
3	1 521	688	1 060	2 031	564	552
4	532	1 252	598	878	1 470	422
5	534	423	1 059	485	699	1 157
6	555	397	329	794	375	501
7	883	440	288	241	599	266
8	406	620	281	224	186	452
9	267	321	460	210	181	137
10	245	199	246	355	156	119
11	845	181	154	192	269	98
12	331	730	125	127	155	191
13	379	286	600	98	102	114
14	68	319	255	502	76	77
15	248	62	289	219	424	49
16	198	216	36	252	180	361

Table 34. Bristol Channel Sole.
Gutted weight at age data in grammes
used in the VAP.

Age	Stock	Catch
2	140	140
3	170	170
4	190	190
5	225	225
6	250	250
7	270	270
8	290	290
9	310	310
10	330	330
11	350	350
12	360	360
13	380	380
14	400	400
15	415	415

Table 35. Bristol Channel Sole.
Prognosis for 1977.

F	Catch weight (tons)	Catch number ($x\ 10^{-3}$)	Stock biomass at beginning of year
0	0	0	2 358 t
0.1	134	372	
0.2	259	720	
0.3	374	1 043	
0.4	482	1 346	
0.5	539	1 629	
0.6	624	1 894	
0.7	760	2 141	
0.8	840	2 373	
0.9	915	2 591	
1.0	984	2 795	

Table 36. Bristol Channel Sole.
Prognosis for 1977.

	F ♂	F ♀	Catch weight (tons)	Catch number ($x\ 10^{-3}$)	Stock biomass at beginning of year (tons)
1975	0.38	0.36	544	1 475	2 427
1976	0.38	0.36	533	1 651	2 698
1977	0		0	0	2 589
	0.1		152	480	
	0.2		293	928	
	0.3		422	1 345	
	0.4		543	1 733	
	0.5		656	2 096	
	0.6		761	2 434	
	0.7		857	2 750	
	0.8		947	3 046	
	0.9		1 032	3 322	
	1.0		1 110	3 580	

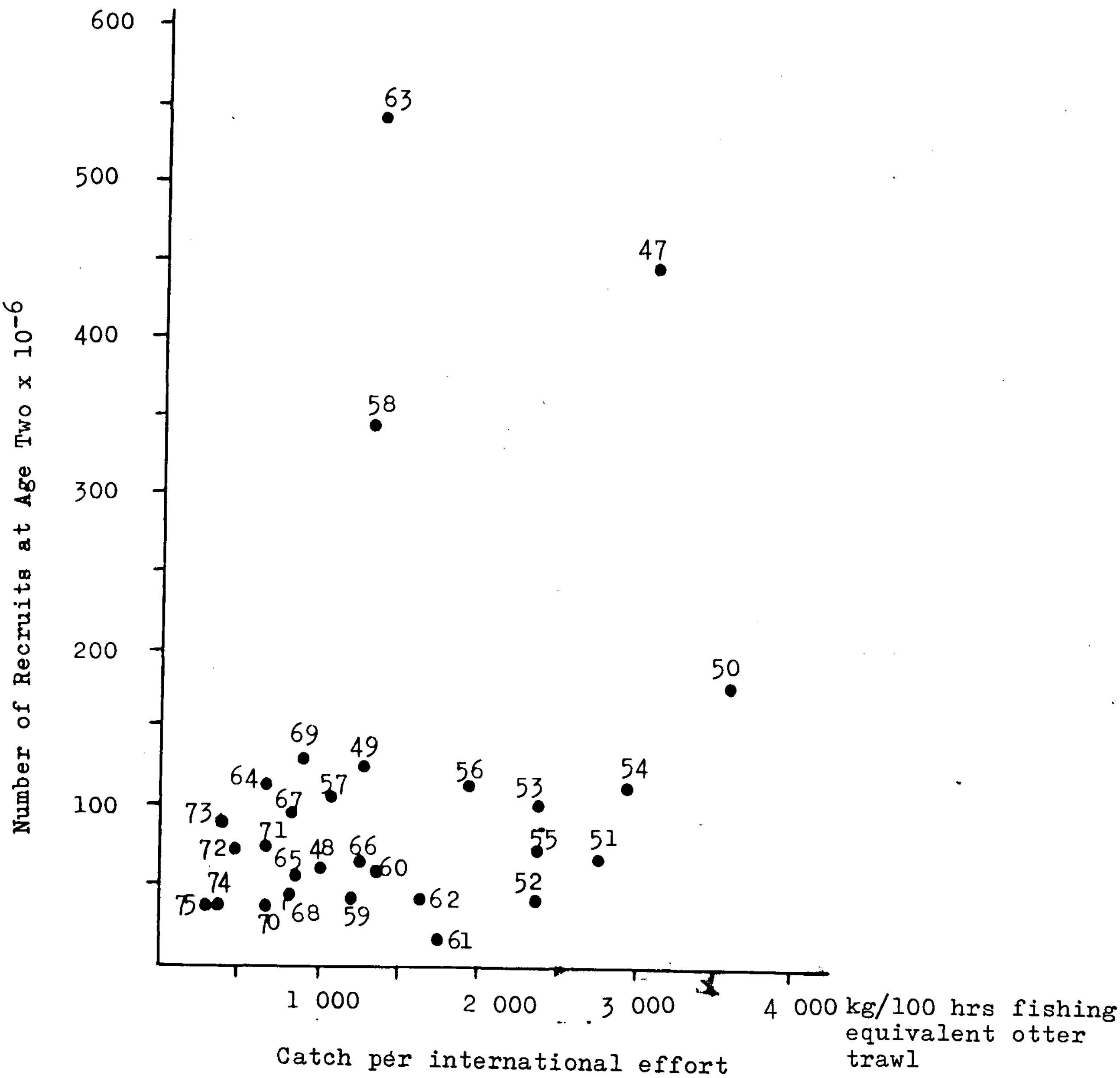


Figure 1. North Sea Sole. Stock/recruitment relationship for post-war year classes.

● year classes

Figure 2.

Catch per 100 hrs. fishing beamtrawl North Sea Plaice 27 - 32 cm

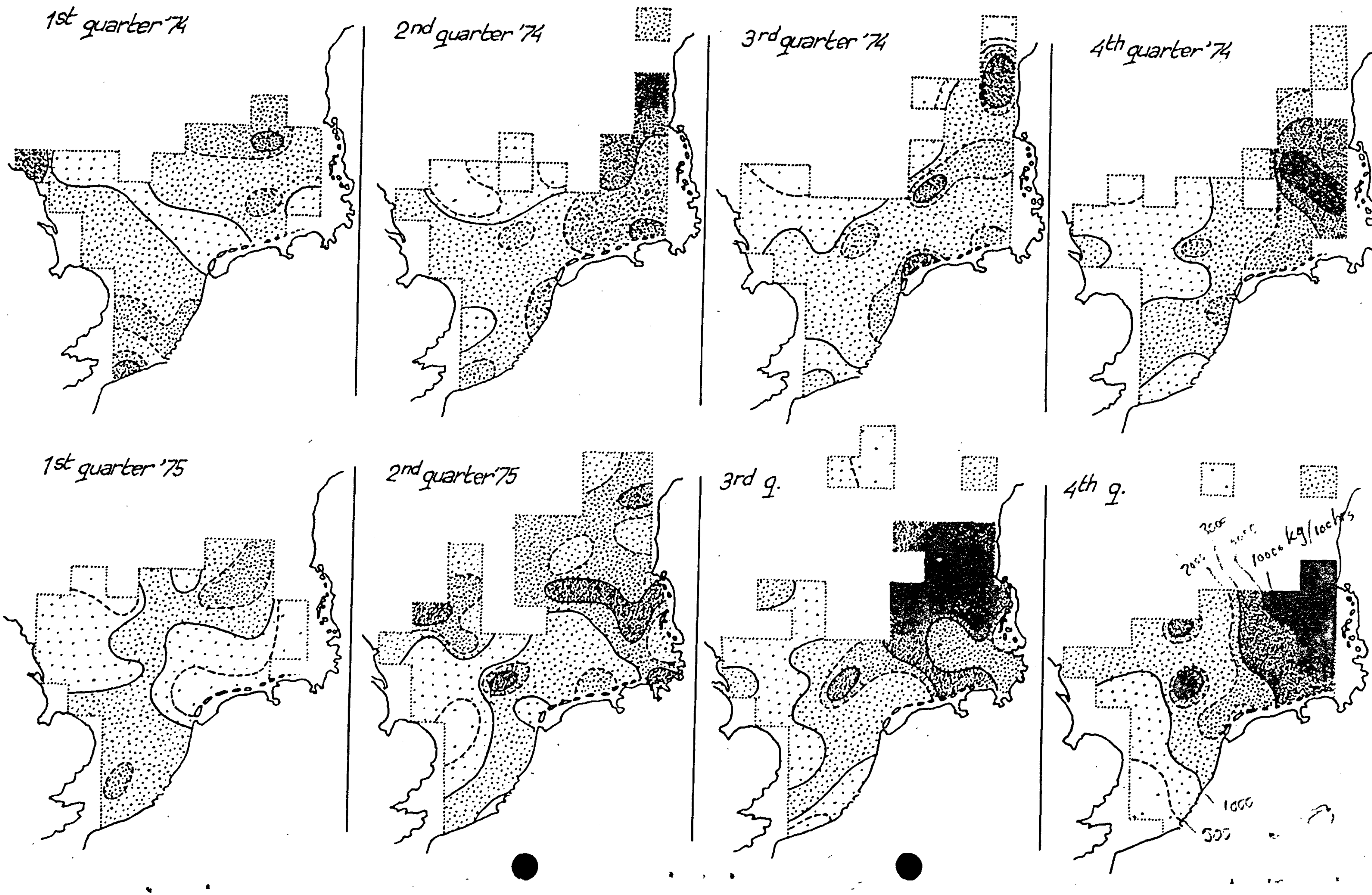


Figure 3. total number of beamtrawl fishing hours per statistical rectangle in the Netherlands

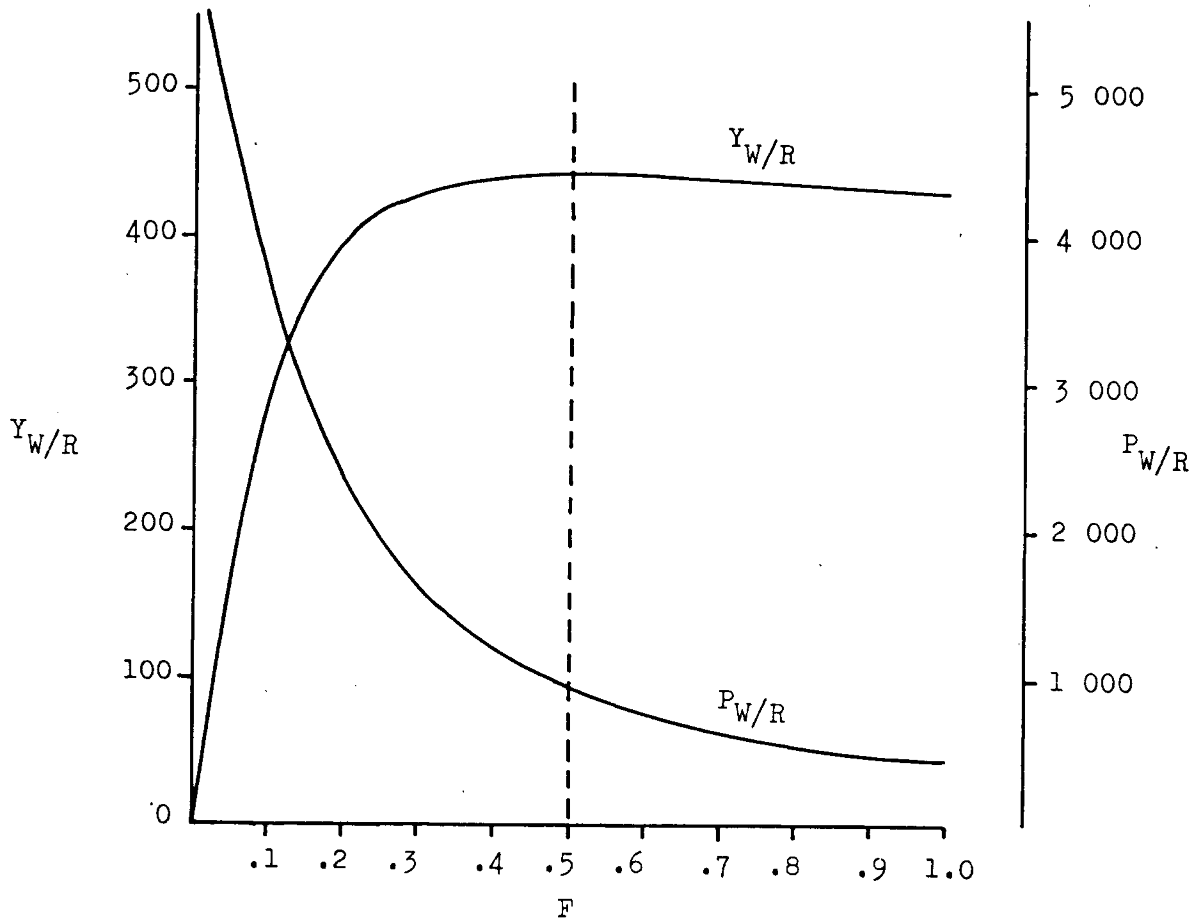


Figure 4. North Sea Plaice.
Curves of steady-state yield per recruit and biomass per recruit against the maximal value of F on the F-at-age array.

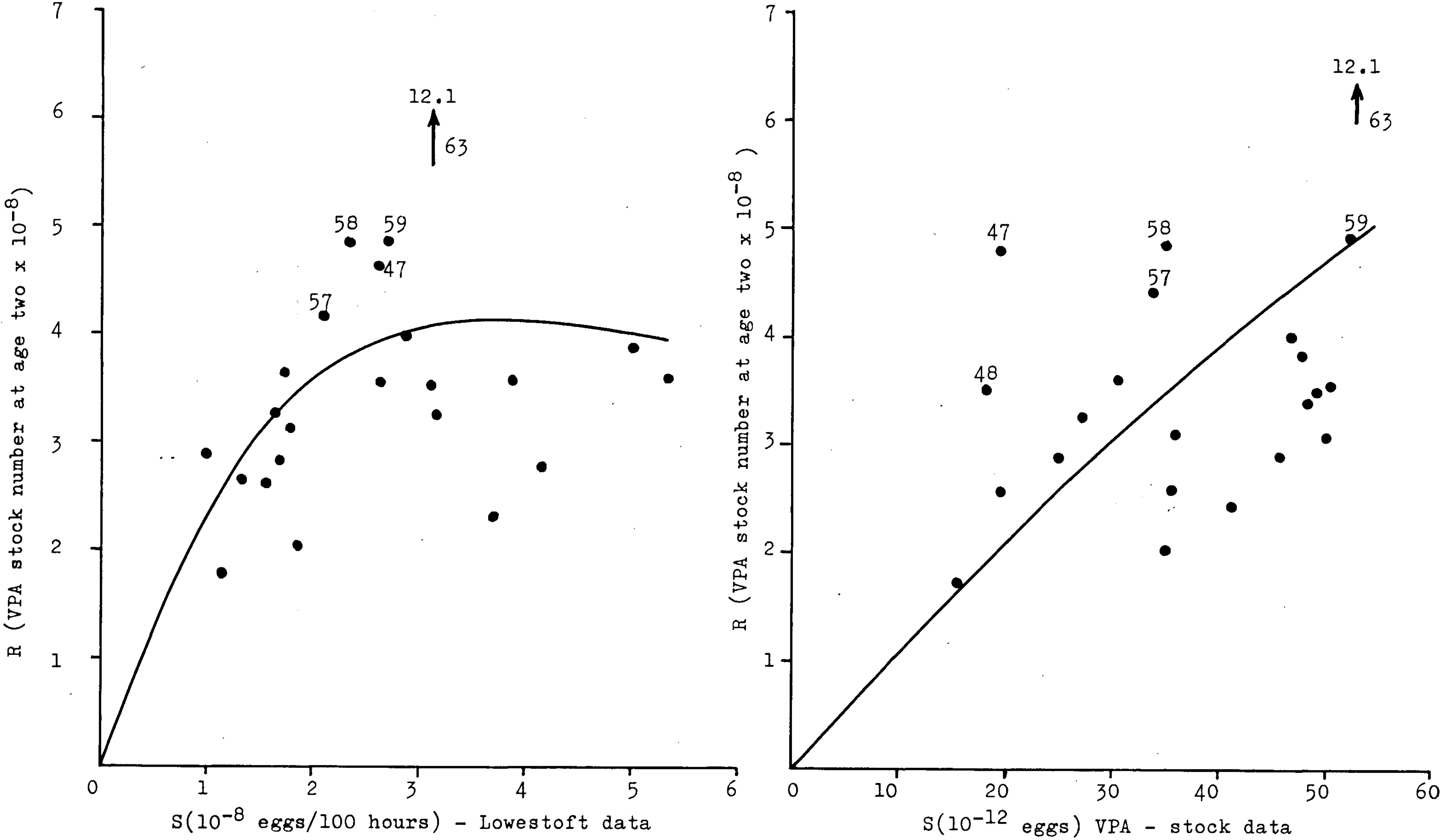


Figure 5. North Sea Plaice. Stock and recruit data.

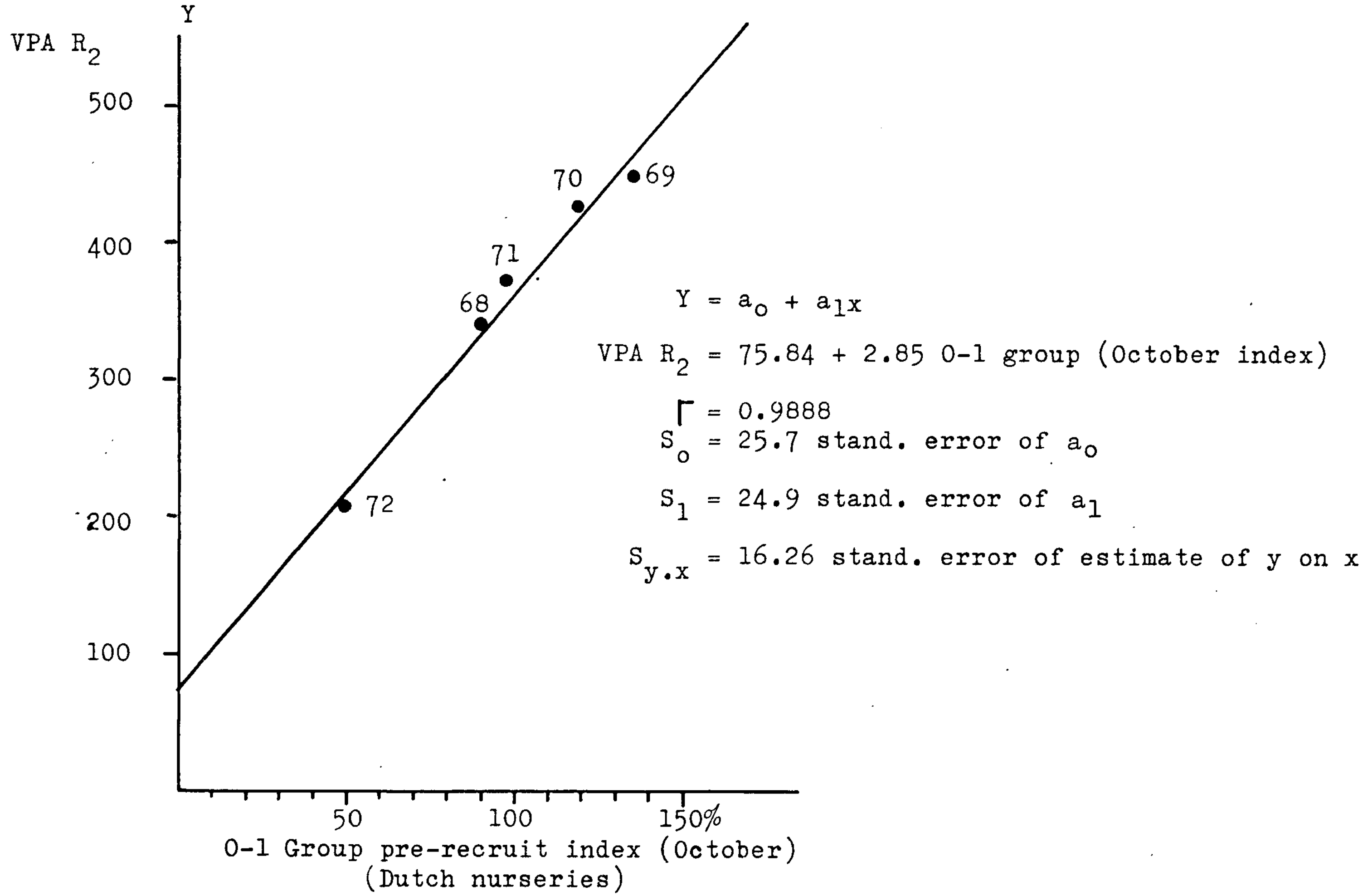


Figure 6. North Sea Plaice.
Relationship between estimates of year class abundance from the VPA and pre-recruit surveys.

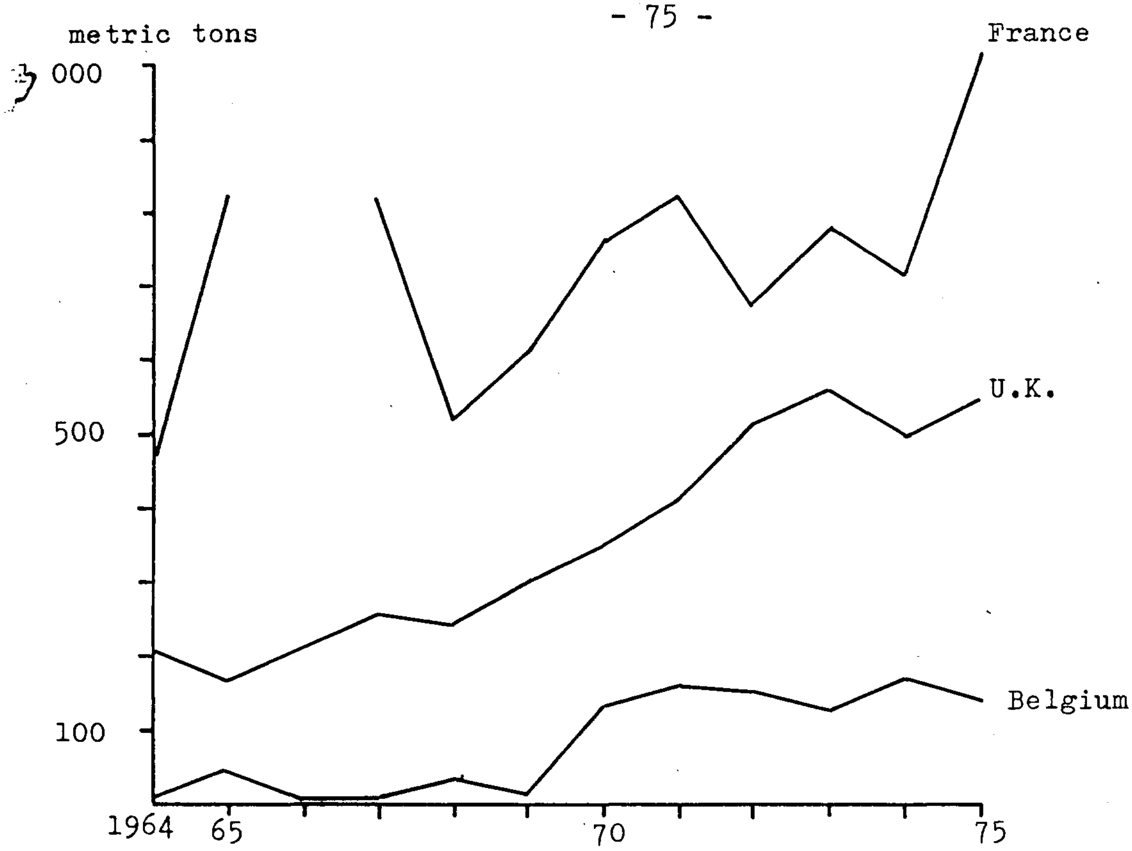


Figure 7. English Channel Sole.
Total annual landings per country.

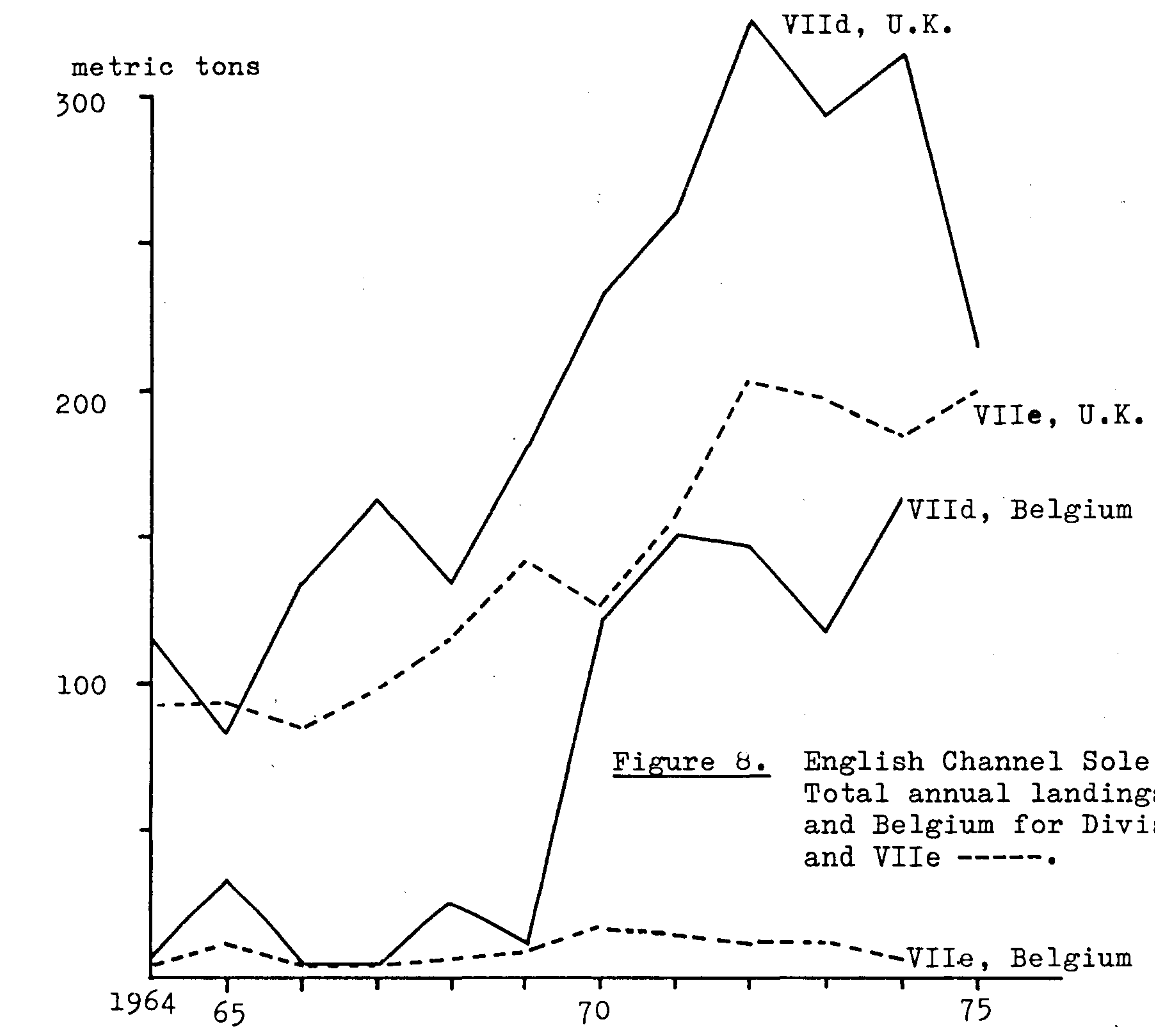
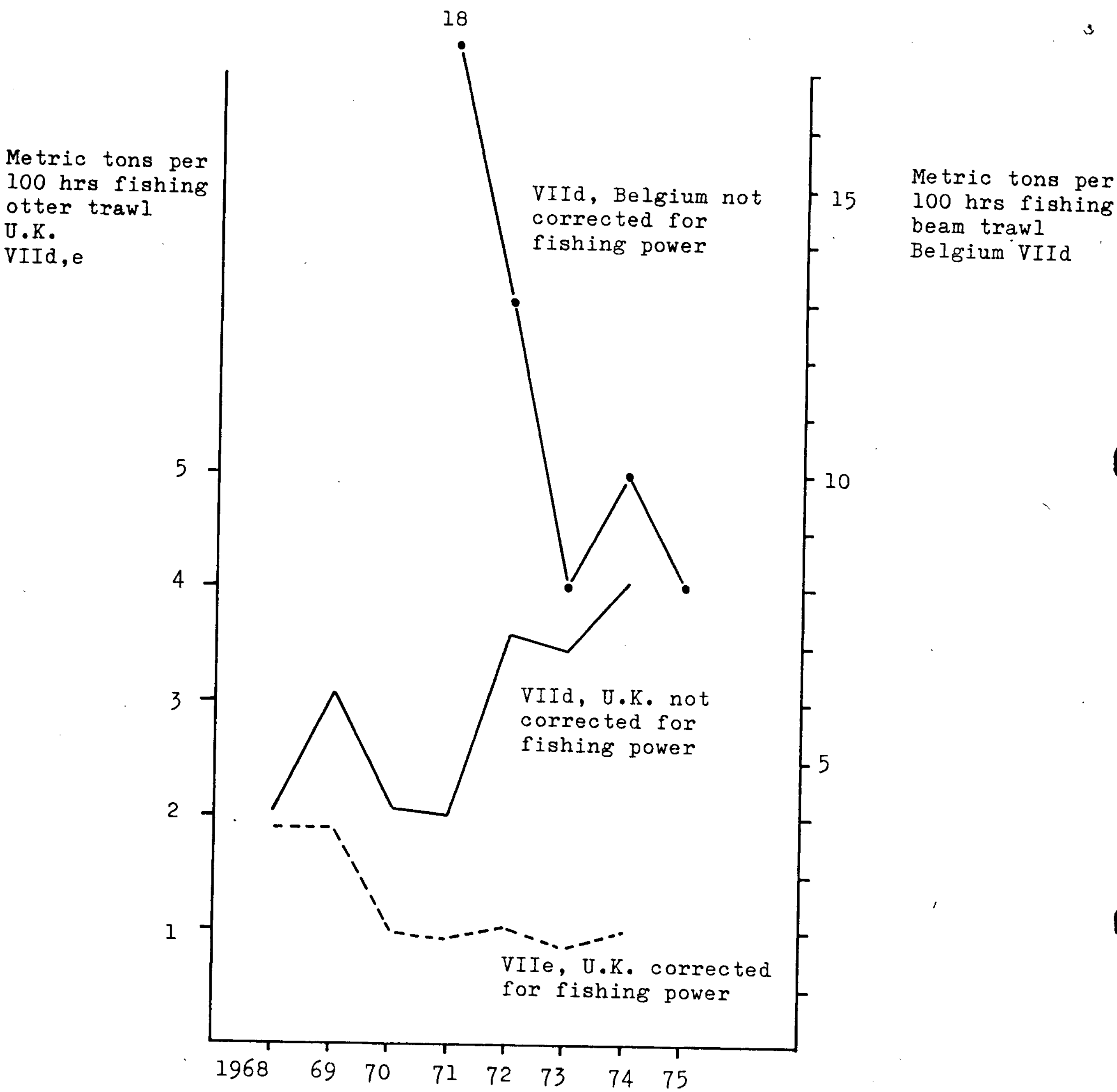


Figure 8. English Channel Sole.
Total annual landings for England and Belgium for Divisions VIId —— and VIIe -----.



<u>Figure 9.</u> Catch per effort for English Channel Sole in Divisions VIId —— and VIIe -----.

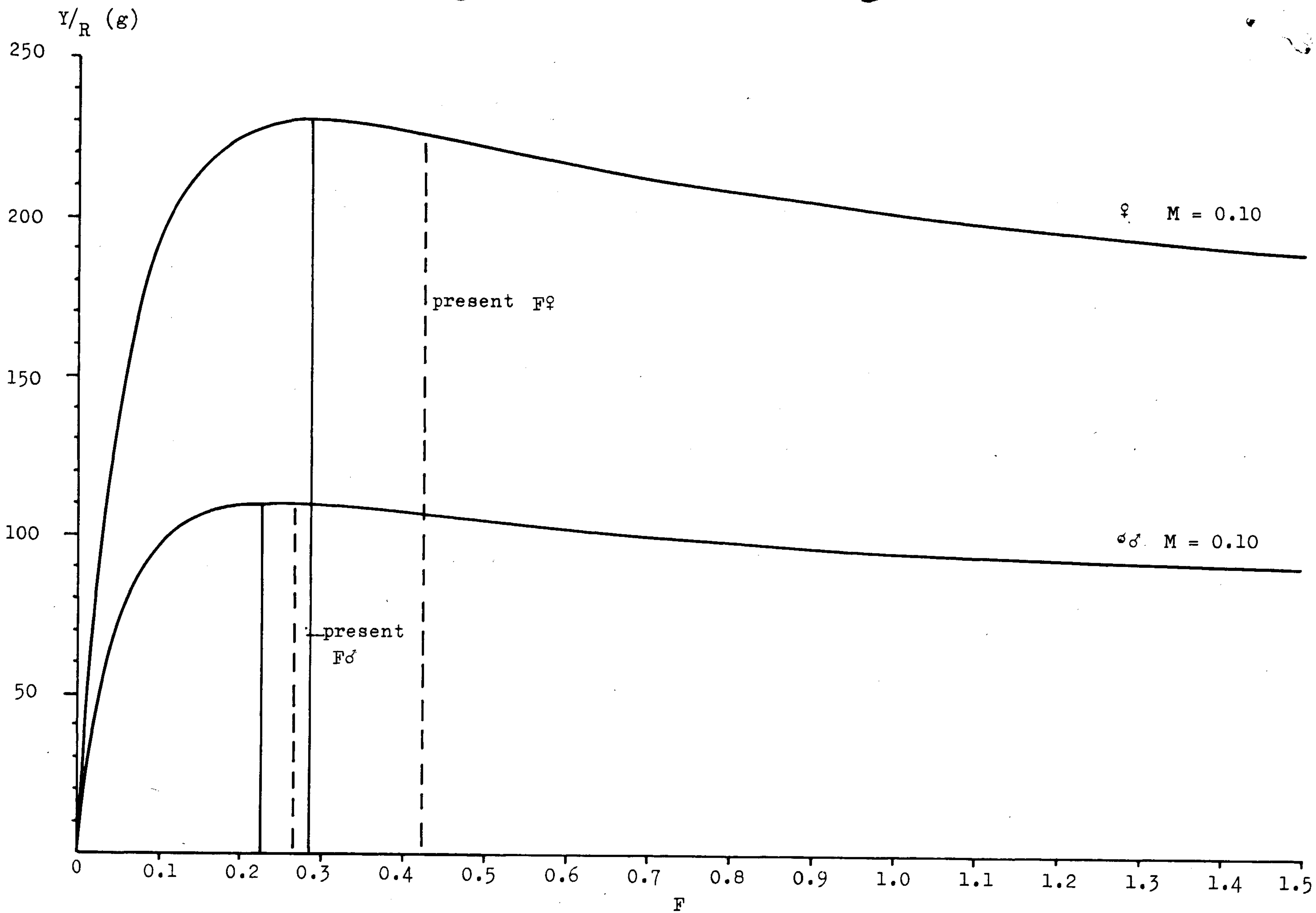
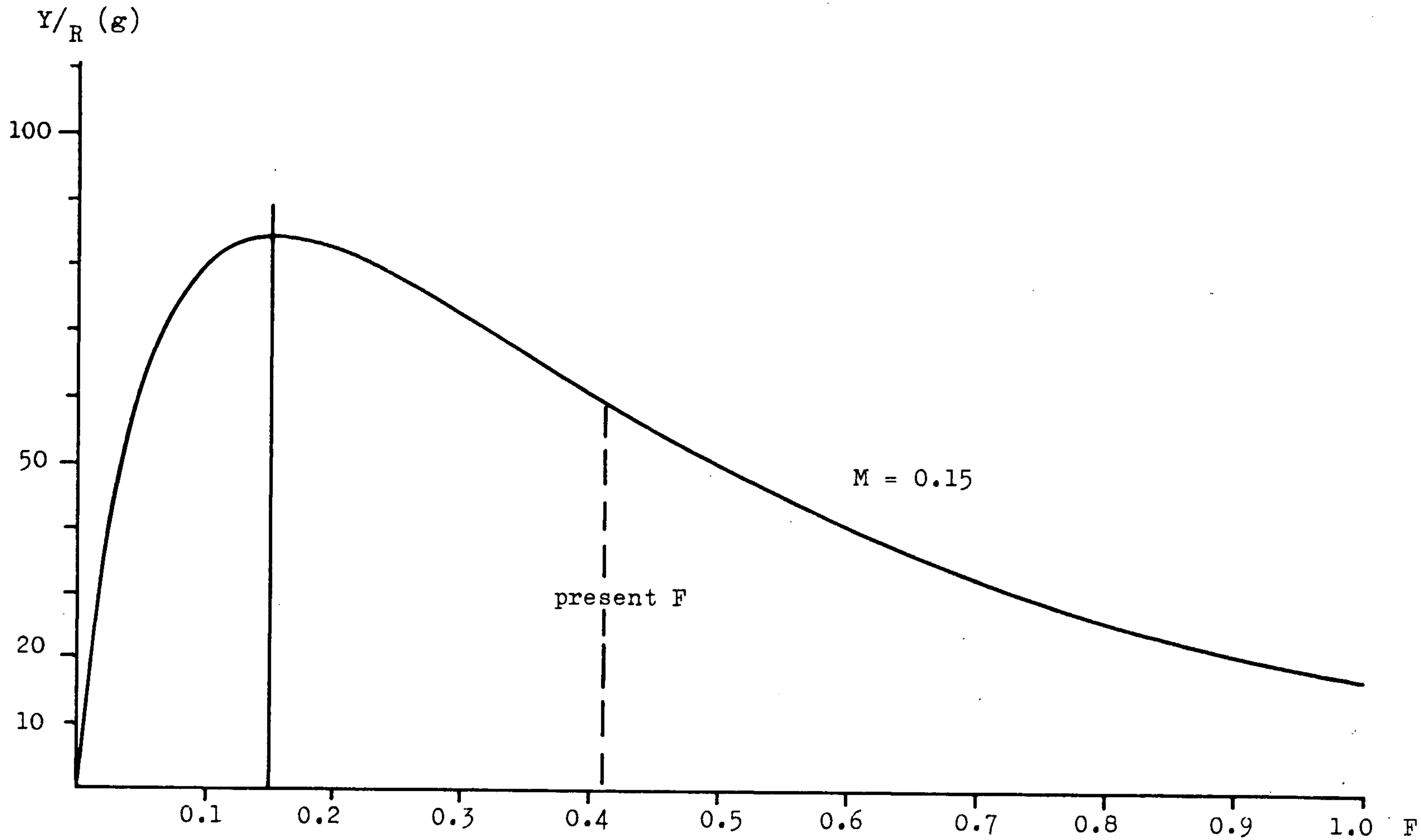


Figure 10. English Channel Sole, Division VIId.
Yield per recruit against fishing mortality for males and females separately.



<u>Figure 11.</u> English Channel Sole, Division VIIe.
Yield per recruit against fishing mortality
for males and females combined.

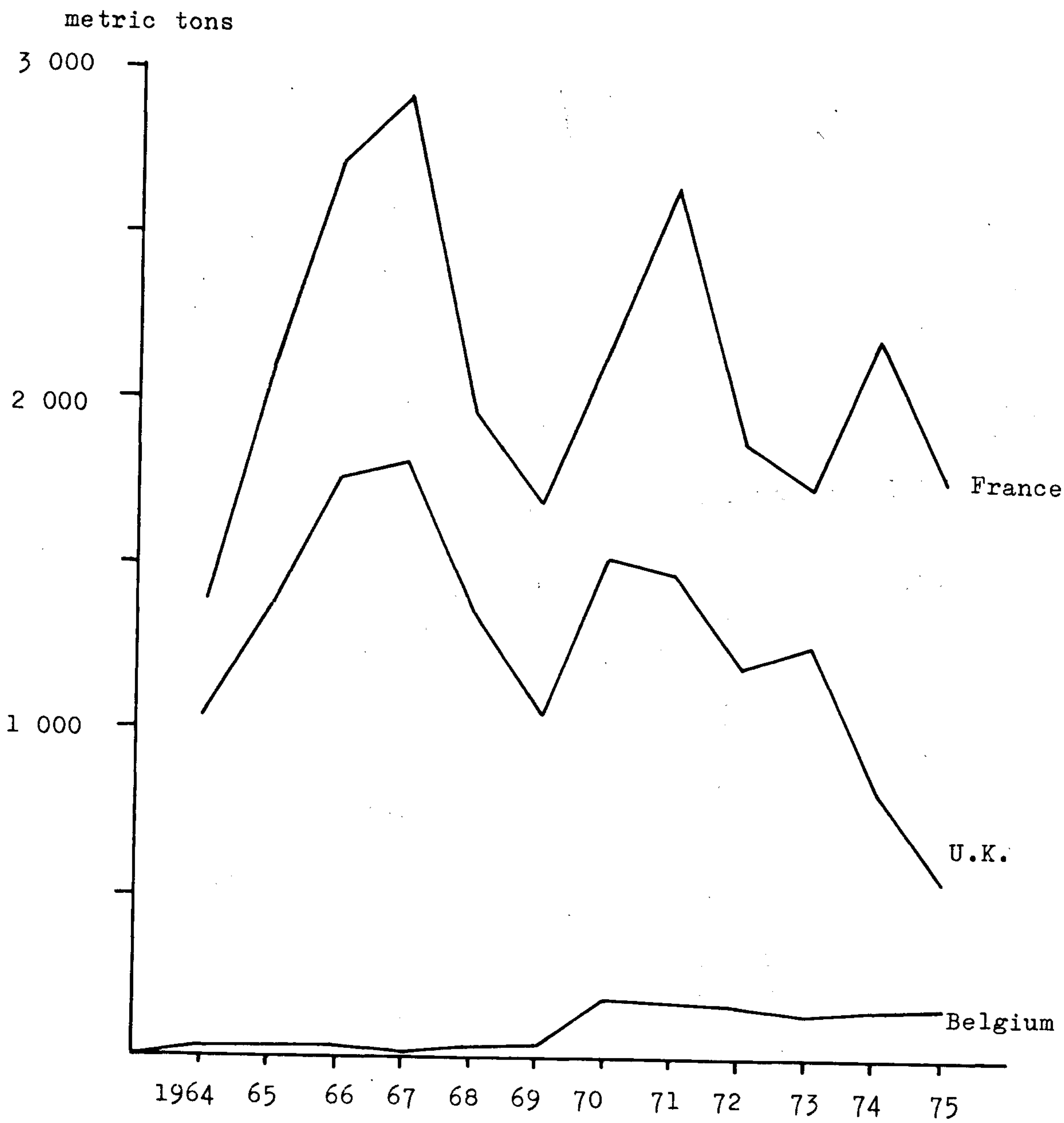


Figure 12. English Channel Plaice.
Total landings per country.

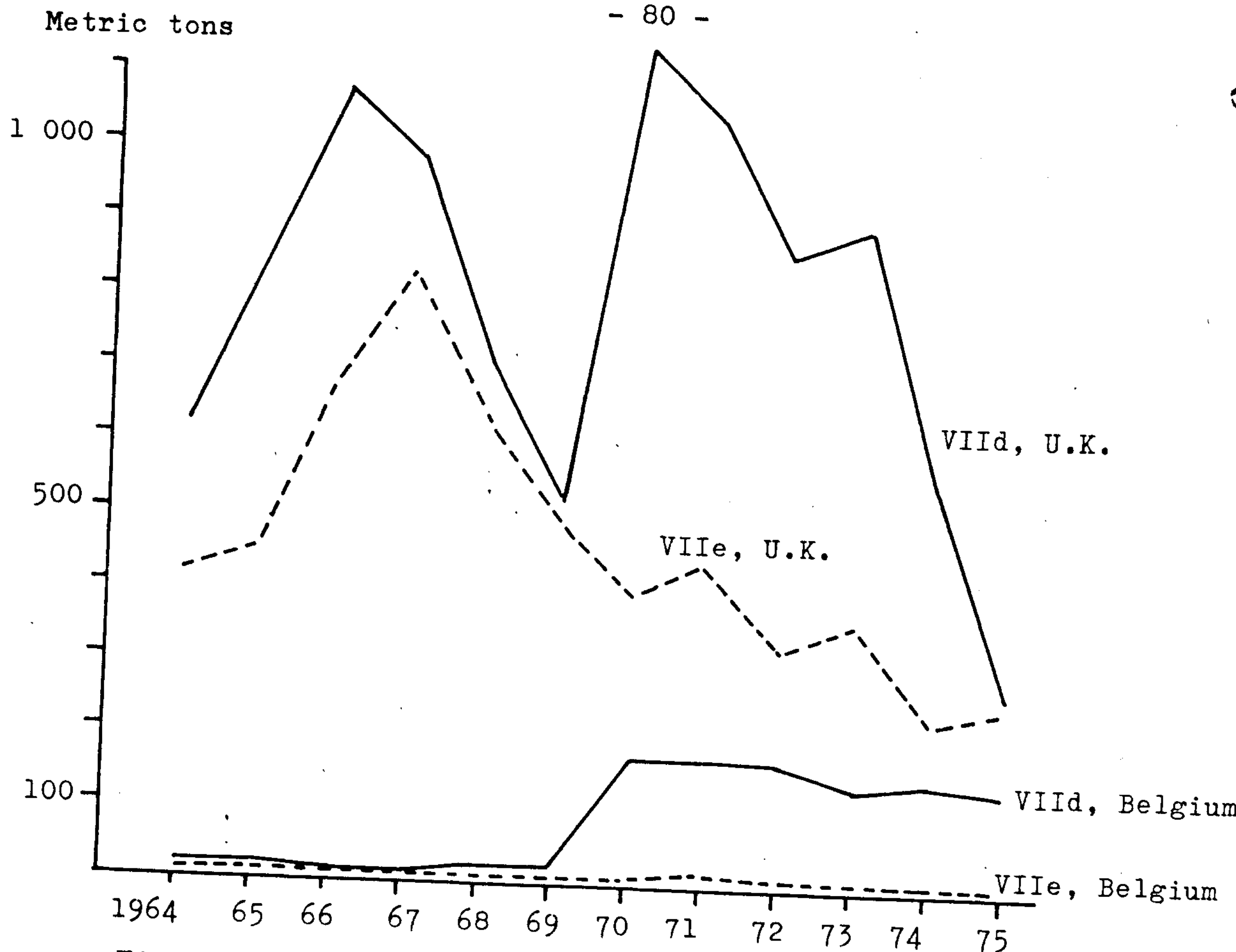


Figure 13. English Channel Plaice.
Total landings for England and Belgium in Divisions VIId ——— and VIIe ------ .

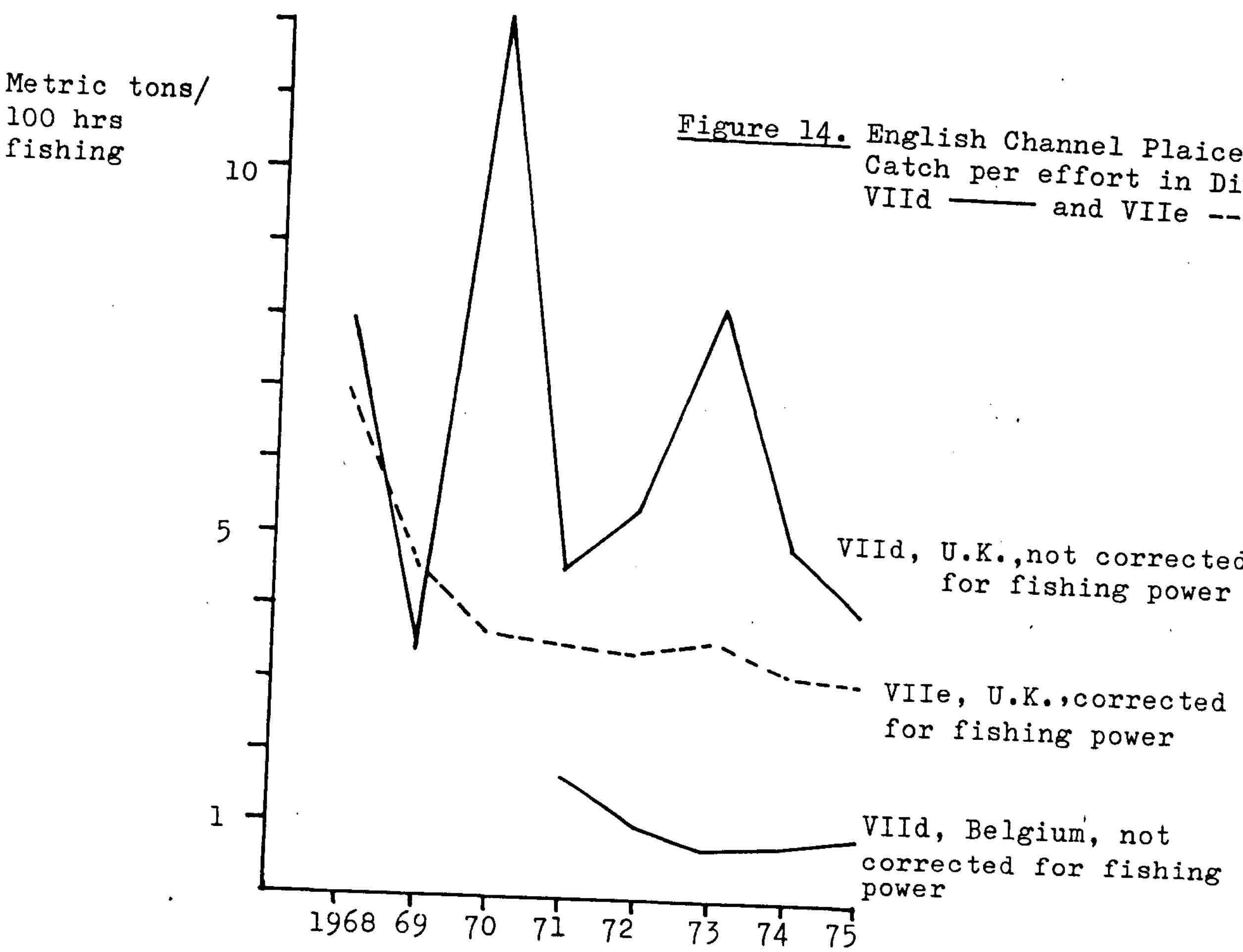
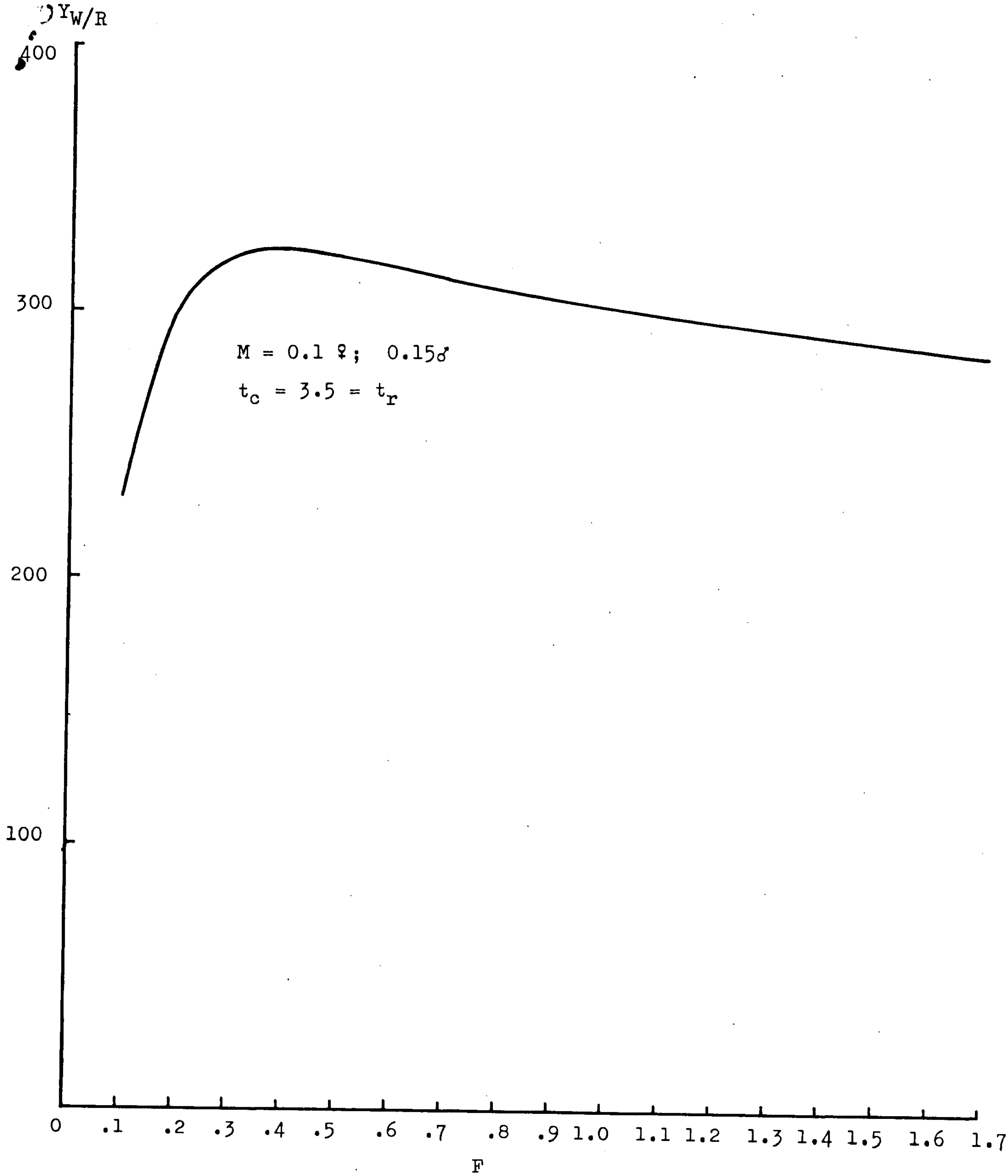


Figure 14. English Channel Plaice.
Catch per effort in Divisions VIId ——— and VIIe ------- .



<u>Figure 15.</u> Irish Sea Plaice.
Yield per recruit against fishing mortality for males and females combined.

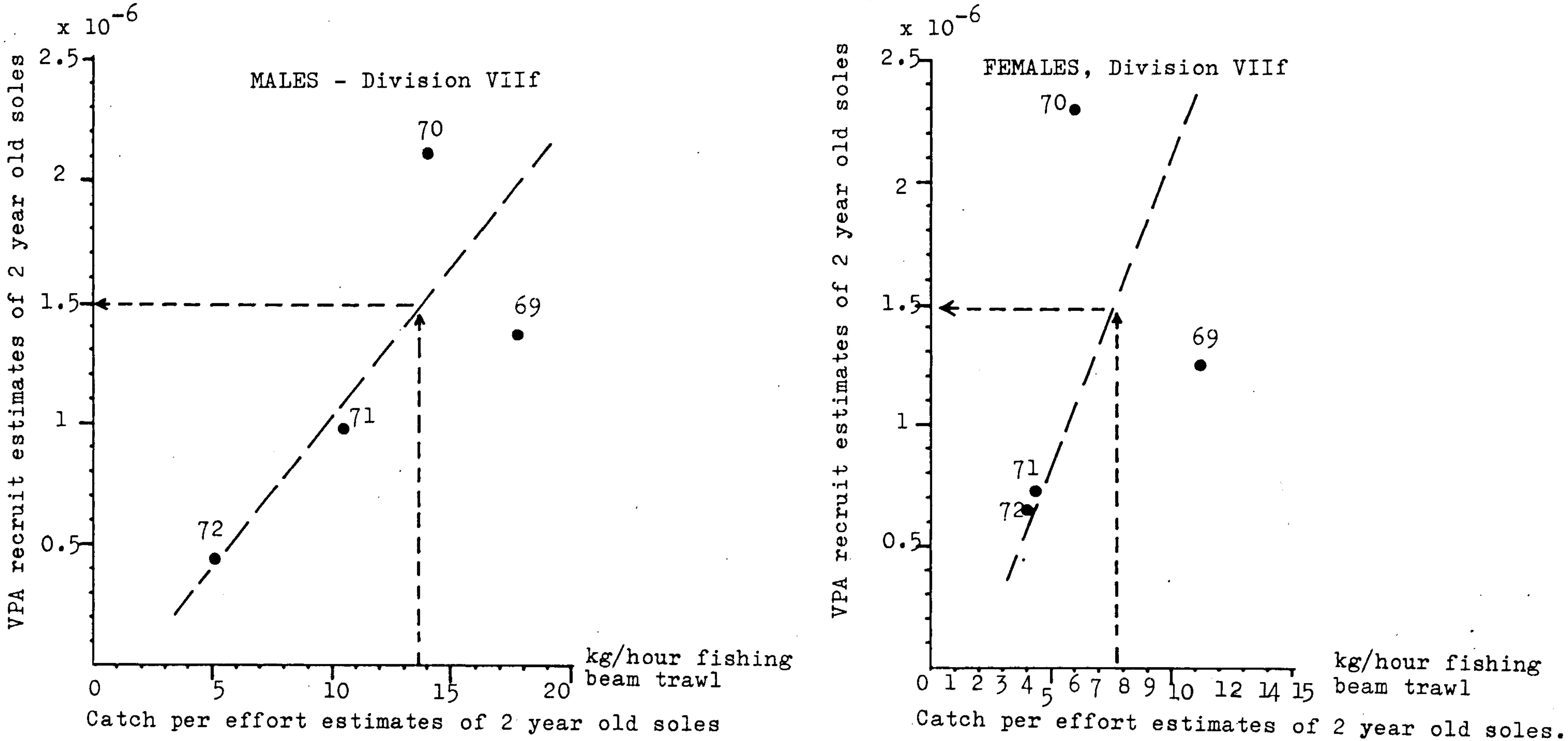


Figure 16. Bristol Channel Sole.
Regression of catch per effort on VPA estimates for 2 year old soles (Belgian data for the 4th quarter of the year).

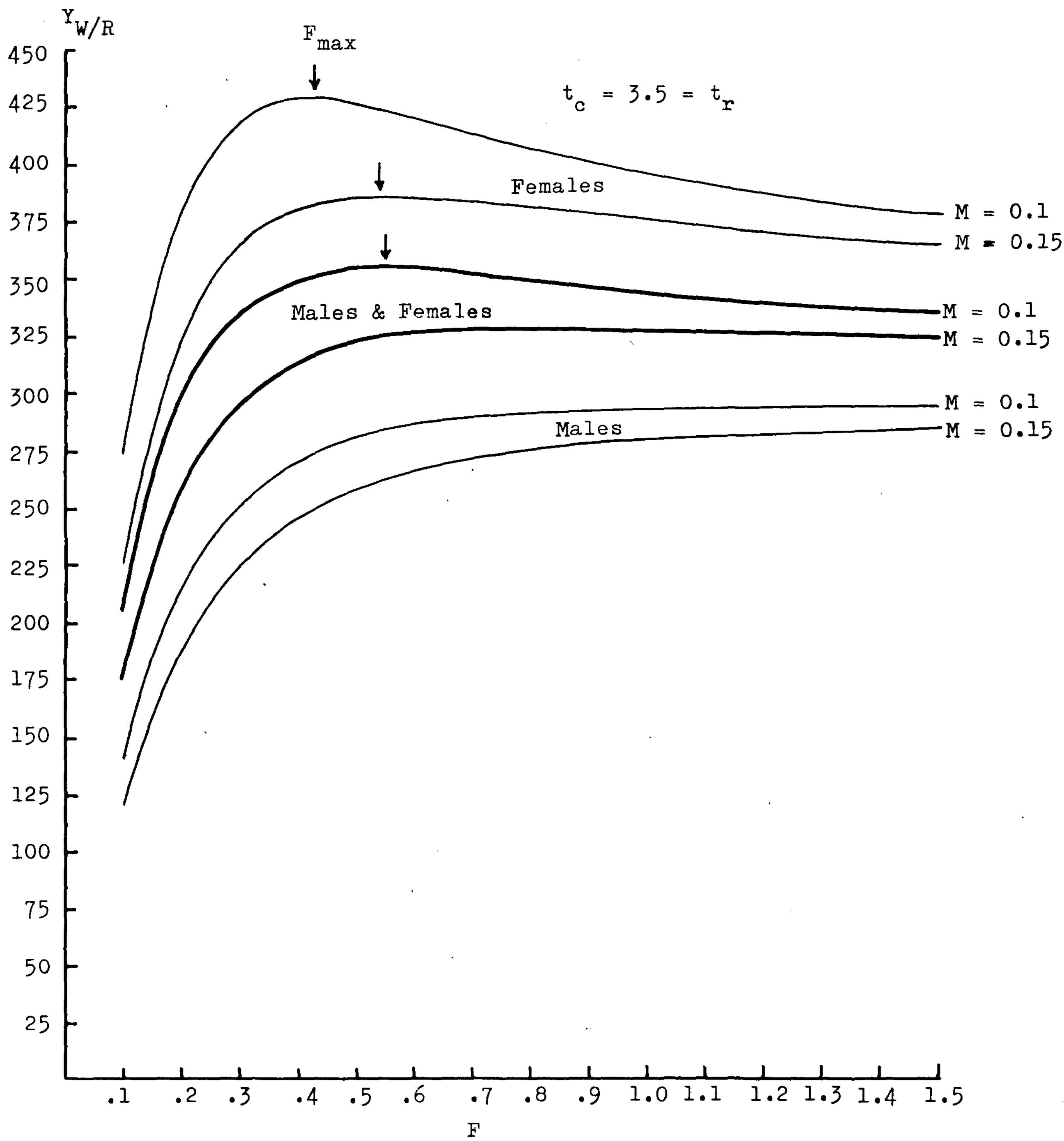


Figure 17. Bristol Channel Plaice.
Yield per recruit against fishing mortality
for sexes separately and for M = 0.10 and 0.15.