



REPORT OF THE NORTH SEA FLATFISH WORKING GROUP

- Page 8 4th line from top to read: "from 1969 to 1971"
- " " 5.1.2, 2nd para., 4th line to read: "... catches show that 41% of the..."
- Page 10 6.1, 4th line to read: "United Kingdom and France did not..." delete Ireland.
- Page 11 2nd para. to read: "From the yield per recruit curve at an F at age array (Figure 6.1), the situation of the actual maximum yield is a little below F_{max} for the females and close to F_{max} for the males for Case B. For Case A...." (Changes underlined)
- " " 7.2.1, the line above the table to read: "The weight at age relationships..."
- Page 13 8.4, 2nd para., 7th line to read: "... and 0.6 (males) and 0.45 (females)..."
- Page 23 Table 3.4: the year classes below the heading should read: "1946-65" instead of 1964-65, and "1966-75" instead of 1966-76. and under the heading: Class interval (millions), the last amount should read: "400 - 849" instead of 800-849.
- Page 86 Figure 5.2, the Age indicated under the Figure should read:
"IV
III
II"
instead of I, II and III.
- Page 90 Virtual Population Analysis paragraph: 5th line should read: "compared to levels in 1975"
- " " Biomass Curves paragraph: last but one line in 1st para, in bracket: to read "(Table Annex I.2.B)"
- Page 104 Figure Annex I.1: in the Figure above the broken line the text to read:
"stock biomass based on 1956-64 F-at-age array"
- Page 106 Table Annex II.1:
Under NEW ESTIMATES the column: New 1975-76 F-at-age array to be replaced as follows:
- | |
|------|
| 0.01 |
| 0.26 |
| 0.36 |
| 0.49 |
| 0.57 |
| 0.45 |
| 0.32 |
| 0.28 |
| 0.22 |
| 0.20 |
| 0.18 |
| 0.18 |
| 0.18 |
| 0.20 |

This Report not to be cited without prior reference to the Council^x

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Ref. Statistics Cttee

REPORT OF THE NORTH SEA FLATFISH WORKING GROUP

Charlottenlund, 8-23 February 1977

This Report has not yet been approved by the International Council for the Exploration of the Sea; it has therefore at present the status of an internal document and does not represent advice given on behalf of the Council. The proviso that it shall not be cited without the consent of the Council should be strictly observed.

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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 8-23 February 1977 with the following members participating:

D W Armstrong	U.K. (Scotland)
R C A Bannister	U.K. (England)
R De Clerck	Belgium
D de G Griffith	Ireland
R G Houghton	U.K. (England)
H Lassen	Denmark
G Lefranc	France
E Nielsen	Denmark
T K Pitt	Canada
G Rauck	Germany (Federal Republic of)
W Weber	Germany (Federal Republic of)

The ICES Systems Analyst W L Panhorst acted as Rapporteur.

- 1.2 The Group was convened with the following terms of reference (C.Res.1976/2:29):

"It was decided, that the North Sea Flatfish Working Group should meet at Charlottenlund from 8-23 February 1977 in order to assess TACs for 1978 for plaice and sole in the North Sea, Irish Sea, Bristol Channel and English Channel."

In addition, following the NEAFC request from the November Mid-Term Meeting, the Working Group was requested by the Chairman of the Liaison Committee to provide description of life histories, fisheries and distribution of the stocks in relation to zones under national fisheries jurisdiction for:

Common Sole, Megrin and Turbot in Division IIIa, Sub-areas IV, VI, VII, VIII and IX;

Plaice, Brill and Common Dab in Division IIIa, Sub-areas IV, VI, VII and VIII;

European Flounder in Division IIIa, Sub-areas IV, VI and VII;

Halibut and Witch in Division IIIa, Sub-areas IV and VI;

Lemon Sole in Division IIIa and Sub-area IV.

- 1.3 Table 1 summarizes the Working Group's advice on the 1978 TACs for plaice and sole in the various areas together with the Group's TACs advices for 1977 and 1976. In addition, the NEAFC TACs for 1977 and 1976 and the preliminary landings in 1976 are given, to enable comparison with previous years' advices.

2. NORTH SEA SOLE

2.1 Catch trends

The official catch for 1976 was 13 922 tons which was lower than the official 1975 catch of 17 067 tons. In last year's report, however, the Group guessed that landings of about 2 000 - 3 000 tons had not been reported in 1975. The best guess of non-reported landings in 1976 is of the order of 3 000 tons.

Regardless of whether non-reported landings are included or not, the total catch in both 1975 and 1976 exceeded the TACs for those years as set by NEAFC. This has occurred despite attempts, especially in the Netherlands, to enforce the quotas in 1976.

2.2 Assessment of current stock situation

Because it is known that large quantities of sole have not been included in the official catch statistics for 1975 and 1976, the Group felt that an assessment based on the official catch statistics would be erroneous. The Group also felt that, for obvious reasons, their guesses at the levels of non-reported landings would probably be incorrect. Any assessment based on these values would therefore be influenced accordingly. The Group decided to carry out two assessments of the sole stock, one based on official figures and one based on figures including its best guesses of non-reported landings in 1975 and 1976. These assessments are presented in Annex I.

2.3 Total allowable catch

As in former reports the objective of the TAC recommendations is to double the current stock biomass in the long run. This will however now achieve only about half of what would have been achievable in 1973.

Prognoses of the catch in 1977 and evaluation of the TAC in 1978 are also described in Annex I. By carrying out these calculations, the Group has worked out the TAC which would have to be recommended in 1978 according to each of two assumptions:

- Case A - that the official figures are correct
- Case B - that illegal landings in 1975 and 1976 were 2 000 and 3 000 tons respectively.

The TACs evaluated are in both cases 8 000 tons although they correspond to different maximum F values. Because of the inadequacy of the landings data, the Group feels that it cannot have much confidence in the absolute value obtained in Case B.

However, this assessment still clearly shows that the 1977 TAC of 12 500 tons will decrease the size of the stock by about 30% in that year and that a similar TAC in 1978 would have no conservation effect whatever.

On this basis, the Group recommends that the TAC for 1978 must be far below the level of 12 500 tons and in the present context a TAC in 1978 of 8 000 tons would have some conservatory effect.

2.4 The effects of continued poor statistics of catch

The Group is of the opinion that it is imperative that the validity of the sole catch statistics should be restored to its pre-1975 level as soon as possible. If this is not done, it will be absolutely impossible to evaluate a TAC for 1979 and the sole fishery will then remain in a virtually unregulated state. This has very serious implications for the future survival of the North Sea sole stock, and under these circumstances the Group will have no option other than to recommend a zero TAC for 1979.

3. NORTH SEA PLAICE

3.1 The trend in catch

3.1.1 Table 3.1 shows the recent catch data. Last year's figure for 1975 has been corrected, and a preliminary estimate made for the 1976 catch. The latter is based on the latest reports, either to NEAFC or national statistical offices, and includes estimates of the last months' catch derived from previous years' performance. The estimate for the Netherlands has been raised by 10% to allow for any landings not officially reported.

- 3.1.2 The 1976 catch appears to have been about the same as the latest figure for 1975, which is now rather lower than the original estimate. Despite being higher than the Working Group recommendation of 85 000 tons, the 1976 NEAFC TAC of 99 900 tons was exceeded by at least 9%.
- 3.2 Age composition data
The 1975 age composition has been updated and that for 1976 estimated. 97% of the 1976 catch is accounted for directly by sampling. The 1975 readjustment involved an increase in the catch of older female plaice, noticeably in the final Netherlands figures. In 1976, the importance of the 1973 and especially the 1972 year classes in the landings was maintained.
- 3.3 Virtual population analysis
- 3.3.1 Tables 3.2 and 3.3 show the results of the VPA using the latest catch at age data, the assumed natural mortality at age (Annex Tables 1 and 2, column a), and the terminal F at age arrays assessed as in Annex II. The male catch data have been truncated at age 14 to prevent difficulties with zero values. For the female arrays the age twenty data were used as such, with no account being taken of plus groups.
- 3.3.2 Looking at individual year classes, the 1972 and 1973 year classes are estimated as being about one half of the abundance of the outstanding 1963 year class, which throws doubt on the original estimate for these year classes made in the pre-recruit survey and discussed last year. Last year the assumption was made that the relatively high catch of two and three year old plaice in 1975 was attributable to a concentration of fishing effort close to the eastern nursery grounds, rather than to an especially high abundance of these year classes. The assumption was made because of circumstantial evidence about the distribution of the fishing fleets, and because, for the Waddensea as a whole, pre-recruit surveys suggested only average abundance for the year classes, except in the Horns Reef area. In order to work on a "fail-safe" basis with regard to stock therefore, the mortality on three and four year old plaice was last year increased substantially as a result of the initial test simulations, although in the prognoses for 1976 and 1977, F was reduced somewhat on the hypothesis that in 1976 the effect would be less marked.
- 3.3.3 These assumptions seem to have been inappropriate. High catches of these year classes have been maintained, and considerable adjustment of last year's F at age array has been necessary in order to get reasonably close to the observed 1976 catch number at age array, especially when starting from the updated 1975 catch number array. Indeed the male adjustments are still unsatisfactory, and for both sexes there have been additional difficulties with the 1971 year class abundance. However, adjustments were taken to the point at which the F at age array for 1976 are rather similar to the mean 1967-70 arrays, which iterations show are relatively unaffected in the VPA by variation in the 1976 terminal F at age input. If the unavoidably arbitrary nature of these testing procedures are accepted, the conclusion is that fishing mortality is probably not at present substantially different from that of 1967 to 1970, and that after a prolonged decline beginning in 1967, stock has increased of late with the advent of the good 1972 and 1973 year classes. The trend in stock number and in weighted mean fishing mortality at age in the last years is shown in Figure 3.1.
- 3.3.4 The long-term frequency distribution of recruitment estimated at age one is shown in Table 3.4. Looking at the frequency distribution of year classes, the majority lies in the range $150-249 \times 10^6$ with several in the $250-399 \times 10^6$ range, and one of 800×10^6 , per sex. The distribution of the most recent year classes is similar to that in previous years, with a similar proportion in the modal class intervals.

3.3.5 The 1974 and 1975 year classes are suggested as being of average and below average abundance, respectively.

3.4 Prognosis for 1978

3.4.1 The catch prognosis for 1977 and 1978 depends on the following input data:

- (i) Estimated 1976 catch number at age
- (ii) 1976 M and F at age array
- (iii) Estimates of the 1975 and 1976 recruitment at two years of age
- (iv) Mean weights at age data.

3.4.2 The 1976 catch number at age, and the M and F at age arrays are given in Annex II, Tables 1 and 2.

3.4.3 The recruitment data have been estimated using preliminary estimates of surveys on the nursery grounds by the research vessel "Tridens" (de Veen, pers.comm.). The surveys indicate that the 1975 year class is about average, and the 1976 year class a little less than twice average abundance. If, valid, these indicate recruitments per sex of the order of respectively 190×10^6 and 340×10^6 for the 1974 and 1975 year classes, equivalent to roughly 150×10^6 and 270×10^6 at age two. One year old fish are not dealt with in the prognosis programmes because of the small number being caught.

3.4.4 Use of the previous year's catch weight at age array in the normal way leads, in the prognosis check runs for 1976, to a 20% overestimate of the observed 1976 catch weight. This discrepancy could arise from the presence in 1976 of the very high numbers of the 1972 and 1973 year class fish, since the quotient of total catch weight and total catch number decreases from 392 g in 1972 to 332 g in 1976, a fall of 15%. Accordingly, although the prognosis has been run normally, using the gutted weight at age data presented in the previous report (Doc. C.M.1976/F:4, Table 13) which were raised to nominal weight, a separate calculation for weight was also carried out. This involved grossing up the total predicted catch number (summed across all age groups and both sexes) by the 1976 catch mean weight per fish of 332 g whole weight. Since this latter figure has been derived from the most recent data, it was decided to base the recommendation in this value.

3.5 Prognosis results

3.5.1 It is not expected that there will be any substantial change in plaice fishing mortality in the North Sea in 1977. The expected catch in 1977, assuming no change in mortality, and the predicted catch in 1978 for a range of the maximal value in the F at age array are shown in Tables 3.5 and 3.6.

3.5.2 The expected 1977 catch is 94 000 tons (whole weight) compared to the 1977 NEAFC TAC of 99 900 tons. However, if the conventional weight at age data are used the expected catch, raised to whole weight, is 123 000 tons. The conclusion seems to be that within the range of these two figures the 1977 NEAFC TAC will not make necessary any adjustment to the 1977 mortality rate. This being so, the expected 1978 catch for the same mortality rate is 95 000 and 117 000 tons for the two weight estimates. This is again of the same order as the present NEAFC TAC.

3.6 Recommendation

- 3.6.1 Previous yield per recruit calculations based on a variety of F at age arrays used in previous reports have all identified the recent mortality level as being in the region where increased fishing no longer generates an increase in sustainable yield. With the present VPA mortality rate similar to that in the 1967-70 period, there seems to be no reason to change this assessment of the state of the stock.
- 3.6.2 Similarly, although as discussed last year, the interpretation of stock and recruit data for North Sea plaice depends on the point of view taken, there is currently no reason to suppose that the spawning stock is in danger.
- 3.6.3 From the foregoing, the Working Group recommendation is to maintain the status quo in this fishery. On the basis of the prognosis made using the more likely mean weight in the catch, the Working Group recommends that the 1978 TAC should be 95 000 tons whole weight.

4. ENGLISH CHANNEL SOLE

It was felt that at the very least separate assessments for the two Divisions (VIIe and VIId) were necessary, and from the evidence of recent United Kingdom tagging experiments and the localisation of the English and French coastal fisheries (Houghton and Lefranc, pers. comm.), a further breakdown is necessary on biological grounds. The data are insufficient to enable this to be done and so the simple VIId, VIIe split was maintained.

Catch data from Bulletin Statistique and also the national statistics of Belgium, France and the United Kingdom are assembled in Table 4.1 for the period 1962 to 1976. These may be underestimates.

4.1 Division VIIe sole

4.1.1 Catch and effort data

It was assumed that the proportion of the total French catch in VIId, VIIe which was taken in VIIe had not changed since 1969. The total catch of sole in Division VIIe was estimated for the years 1969-74 on this basis (Table 4.2).

Total catch has increased rapidly since 1969 mainly due to increases in the United Kingdom catch. This was caused by the change from otter trawl to twin-beam trawling since 1967 at Brixham. The catch per effort of the remaining Brixham otter trawlers (corrected for their fishing power changes) had declined to one third of the 1969 value by 1974 but has increased since then. As indices of sole abundance in Division VIIe these data are doubtful because they arise from a small area (statistical squares 29E5 and 29E6) and represent only a small proportion of the total catch.

The final column of Table 4.2 is an estimate of total fishing effort (f in $F = qf$) obtained by dividing total catch in column 2 by c.p.u.e. in column 3. This increased sharply between 1969 and 1974 and has decreased since then.

4.1.2 Virtual population analysis

United Kingdom compositions were available for the period 1969-76. The samples between 1969 and 1974 were taken only from Brixham landings in Division VIIe; in 1975 the sampling programme was modified to include all United Kingdom landings from the Division. These were raised to the total international catch shown in Table 4.2 and the resulting age compositions were used as input for the VPA. A constant

of $M = 0.1$ was assumed for all ages and both sexes. The results of the VPA are shown in Tables 4.3 and 4.4.

Despite the variability in fishing mortality (F) it was clear that the average F between ages 3 to 6 in each year increased between 1969 and 1972 for each sex almost regardless of the input terminal F values in the VPA. Accordingly the final VPA run was carried out using terminal F s which maintained this upward trend. This VPA is consistent with a doubling of effective fishing effort between 1969 and 1974 and also with the steady increase in proportion of small fish observed in the English length:composition data over the same period. The 1976 max F for females is 0.45 at age 5 and 0.21 at ages 3 and 4 for males. This unusual reversal of the ratio of F between the sexes could not be explained.

The final VPAs provide an estimate of average recruitment, as one year old fish for the 1968 to 1974 year classes, which is approximately 2.10^6 fish (sexes combined). The 1963 year class was stronger than any other year class represented in age composition data.

4.1.3 Yield per recruit calculations

A yield per recruit curve was calculated for each sex using the relative F at age used in the final VPAs (Tables 4.3 and 4.4). Weight at age data were obtained from United Kingdom samples taken between 1969 and 1975 (Table 4.5). Natural mortality was assumed constant at 0.1. The resulting yields per recruit are shown in Table 4.6 and have an F max of about 0.5. Currently the average fishing mortality is 0.33 suggesting that the stock is not overexploited. Until further information becomes available, however, the Group recommends that fishing mortality should not be allowed to increase.

4.1.4 Total allowable catch

Catch predictions were made on the basis of the 1976 catch at age, the relative F and the max F in 1976 from the VPA, the observed weights at age and recruitments of 1.10^6 fish per sex. Max F was held constant at 0.45 for females and 0.21 for males during 1977 and 1978. The catch prediction for 1977 was 400 tons and for 1978 was 350 tons at that level of F . The TAC for 1978 should therefore be 350 tons.

4.2 Division VIIId sole

4.2.1 Catch and effort data

The catch of sole in Division VIIId was estimated from the sum of the known catches of Belgium and the United Kingdom added to a proportion (0.64) of the French catch from Divisions VIIId+e. The proportion was estimated from the 1975 and 1976 French data (Table 4.7). The catch of sole approximately doubled between 1969 and 1971 and has since remained fairly steady. The quota for 1976 had some effect on Belgian effort which was concentrated in the first quarter. Even so the Belgian quota for Divisions VIIId+e was exceeded. The quota had no effect on the United Kingdom catch which increased substantially in 1976. The French catch also increased.

4.2.2 Virtual population analysis

Belgian age compositions for the English Channel (mainly Division VIIId) are from 1971. United Kingdom age compositions were available for both the trawl and trammel net fishery for 1975 and 1976. These were added to the corresponding Belgian data and the sum raised to the estimated total international catches in 1975 and 1976. This was an unsatisfactory procedure since the United Kingdom and Belgium account for only half of the total landings. The estimated catch at age data were used as input for the VPA. The results of the VPA are shown in Tables 4.8 and 4.9.

An M of 0.1 was assumed for each sex. The terminal Fs were estimated as the smoothed mean values of F at age for the years 1971-73 from trial VPAs.

The catch at age data were poor between 1971 and 1973 and no great reliance can be placed on the results of these VPAs although they produced no evidence that fishing mortality had changed between 1971 and 1976. The maximum F at age on females was estimated to be approximately 0.27 (ages 3 to 9) and on males was about 0.26 (age 3) in 1976. The exploitation pattern for the males differed markedly from that for females.

In last year's report c.p.u.e. Fs were reported (assuming M = 0.1) which for females were higher (0.42) than the present estimate (0.27).

4.2.3 Yield per recruit calculations

Sums of products (Belgian weight at age x numbers at age) for 1975 and 1976 were in good agreement with the total international catches for these years (Table 4.10). Yield per recruit values were calculated using the relative F at age of the input terminal Fs of the VPAs. M of 0.1 was again assumed. The maximum sustainable yield corresponds to an F of ca. 0.35 (Table 4.11). In contrast to Division VIIe sole the yield curves of both sexes have well-defined peaks. One may judge from this that Division VIId sole are therefore almost fully exploited at the present level of fishing mortality (assuming $F_d = F_f$).

4.2.4 Total allowable catch

Catch predictions based on the 1976 F values used in the VPAs are shown in Table 4.12. It was assumed that no change in F will occur in 1977 and this implies a 1977 catch of 1 230 tons. The Working Group recommends a 1978 TAC of 1 150 tons which will maintain the current level of fishing mortality.

5. ENGLISH CHANNEL PLAICE

Reference was made last year to the complicated stock structure of the English Channel plaice. For the present migration between the Channel and the North Sea still cannot be taken into account in the assessment work which this year concentrated on making separate assessment for Divisions VIId and VIIe populations, which was made possible by the new French statistics.

Catch data from Bulletin Statistique and national statistics are assembled in Table 5.1 for the period 1962-76 for each Division separately, as far as they are known.

5.1 Division VIIe plaice

5.1.1 Catch and effort data

Division VIIe catches are shown in Table 5.1 from United Kingdom statistics from 1962 to 1976, from Belgian statistics from 1969 and from French statistics for 1975 and 1976. It was considered that the proportion of total French catch in Divisions VIId+e taken in Division VIIe had not changed appreciably from 1969 to 1976, an assumption which allowed the total Division VIIe catch for the 1969 to 1976 period to be estimated (Table 5.2). This shows a fairly steady decline to about two-thirds of the 1969-71 level by 1976. Table 5.2 also shows the estimated c.p.u.e. of United Kingdom otter trawlers at Brixham corrected for horse power changes. These vessels fish mainly in ICES statistical rectangles 29E5 and 29E6 and have experienced a severe decline in c.p.u.e. since 1969. During the same period the use of beam trawls increased in the United Kingdom fishery.

The values of effective effort (i.e. f in $F = qf$) in column 7 of Table 5.2 were calculated by dividing the total estimated catch in column 2 by the c.p.u.e. of Brixham's otter trawlers in column 3. A doubling in the total estimated fishing effort from 1969 to 1976 can be seen. Since then it has fluctuated without trend.

5.1.2

Virtual population analysis

Age composition data were available for Brixham (U.K.) landings from 1969 to 1974 and for the total United Kingdom landings in 1975 to 1976. The sampling programme was modified in 1975 to include ports other than Brixham and also an area stratified statistical sampling scheme.

English tagging data have shown a low rate of migration out of the northern part of Division VIIe (north of 50°N) even to other parts of Division VIIe south of this line (Houghton, pers.comm.). The French data on 1976 catches show that two-thirds of the French catch is taken in the south of Division VIIe (Lefranc, pers.comm.).

Despite this evidence for a localisation of the stocks, homogeneity of this population was assumed. The United Kingdom age composition data were applied to the total estimated international catch. The resultant catch at age array was used as input for the VPA. Using an assumed value of $M = 0.1$ for females and 0.15 for males, VPAs were carried out on these data (excluding plus groups). The results of the final VPAs are shown in Tables 5.3 and 5.4.

Because of the variation in individual F at age, no trend in F could really be detected in the early years. The 1971 F is the highest value in both sexes, which corresponds with the estimated fishing effort (Table 5.2). Because no trend in F was observed in the later years, the final VPA was calculated using a terminal F at age calculated from 1969-74 averages. Peak F values are found in age group 4 for males and age groups 3 to 6 for females. F declines to about half the maximum value at age 8+ for males and 13+ for females. The average F over the age range 3 to 6 and between 1969 and 1975 was 0.36 for females and 0.46 for males with no evidence of a trend.

In the last report values of Z were given which were based on United Kingdom c.p.u.e. data in Division VIIe. These were much higher than the results of the present analysis. The most likely explanation lies in the variation of F at age found from this year's VPA. Catch per unit effort are biased if F varies with age and are overestimated if F decreases with age as in this case. The present maximum F in the exploitation pattern is therefore about 0.4 for females of age groups 3 to 6 and 0.6 for males of age group 4.

5.1.3

Yield per recruit calculations

Yield per recruit curves were calculated from the relative F at age array used in the final VPA runs. Weight and age data were derived from the United Kingdom samples in Division VIIe for 1969 to 1975. The resulting weights at age (Table 5.5) were applied to age compositions from data 1969 to 1975 and the resulting total weights were found to agree with the observed weights to within an average of 2% (+). These weights seemed sufficiently close to the real values to be used in calculating the variation in yield per recruit with fishing mortality. The Y_w/R curves are shown in Table 5.6 against the maximum F s for each sex and a combined curve calculated by assuming a 1:1 sex ratio and a constant relation between F_f and F_m of 0.6 to 0.4. The combined Y_w/R curve was then to be used with the average F between the sexes. Since the current average F on the fully exploited groups is ~0.5 the Y_w/R curve demonstrates that the fishery is taking the maximum weight per recruit from the stock at the present level of F . Improvements in catch rates alone would be expected if F were reduced.

5.1.4 Recruitment

The VPA runs gave an average recruitment of 1 year olds between 1969 and 1976 of approximately 10^6 fish per sex. Figure 5.1 shows the trend in recruitment over this period from the VPA. There is perhaps some downward trend in these results although the year class of 1973 is the largest of the series.

After calculating the stock data shown in Tables 5.3 and 5.4 further backwards it was found that the 1963 year class at recruitment probably was about 15×10^6 fish in total. To examine recruitment further the length composition data of 1962 to 1976 were used. Firstly, it was calculated that, if all year classes are of average strength, the 25-29.9 cm length group of females would contain 46, 39 and 8 per cent of age groups 2, 3 and 4 respectively and the same group of males would contain 38, 41 and 11 per cent of age groups 2, 3 and 4 (Figure 5.2). These figures were estimated from United Kingdom length at age data 1969-75. It was reasoned that plotting the c.p.u.e. of this length group as a time series would give some indication of the variation in recruitment over the period 1968 to 1974. Table 5.7 shows the basic data which are plotted in Figure 5.2. Every year class since 1969 seems to have been somewhat lower than the average of 1965 to 1968. Before 1965 the 1963 year class was not represented in the catch of 25-29.9 cm fish and hence we can say that the recruitment in the period between 1958 and 1962 was perhaps on average higher than the level from 1965 to 1968. It seems that recruitment has declined fairly steadily from the 1958 year class to the present level of 2×10^6 1-year-old fish. This gives some cause for concern and should be examined carefully in the future. It was not possible to look at a stock and recruitment relationship. One would expect that recruitment would be dependent on the spawning stock in Divisions VIIe, VIIId and IVC (Houghton and Harding, Doc.C.M.1976/F:21).

5.1.5 Total allowable catch

The $\frac{Y}{W/R}$ curve shows full exploitation and no reduction in F is recommended for obtaining the MSY position. Despite the concern over recruitment it was felt that insufficient information were available to estimate a minimum spawning stock size in the stock or any stock/recruitment relationship.

The TAC for Division VIIe plaice in 1978 should therefore be 600 tons which is just less than the most recent catch level and takes into account the recent poor recruitment. Further reduction in the TAC is to be expected for 1979 on the basis of the recent recruitments.

5.2 Division VIIId Plaice

5.2.1 Catch and effort data

Only Belgium, France and the United Kingdom catch plaice in Division VIIId. In 1975 the total estimated catch was 2 248 tons and in 1976 it was 1 873 tons. No reliable index of abundance was available for any period.

5.2.2 ^{938M} Biological data in the area of the North Sea and the North Sea to the west of the British Isles were calculated by raising the sum of the Belgian and United Kingdom age compositions to the total landings. These data are given in Table 5.8. The 1963 year class was good in this area and it also seems that the 1973 year class was better than the recent average. The United Kingdom catch in 1976, which is taken inshore, included some one year old fish which did not appear in the 1975 age compositions at all. United Kingdom fishermen reported unusually high catch rates of undersized plaice in 1976. The Group, therefore, had some evidence to suggest that the 1975 year class in this area was exceptionally high.

It was judged likely that the values of Z given in last year's report were incorrect since they were obtained from catch per unit effort estimates which can be shown to be biased if F varies with age. If this stock demonstrates the usual flatfish variation in F with age then these Z values will be overestimated. The age composition data are more consistent with a lower mortality rate than last year.

5.2.3 Total allowable catch

No predictions could be made for this population on the basis of the data which were available to the Group. Treatment of this population as a self-contained unit is, in any case, totally inappropriate because of the problem of fish migrating between the North Sea and the English Channel which was referred to in last year's report and which has again been confirmed by United Kingdom tagging experiment (Houghton, Doc. C.M.1976/F:21).

However, the Working Group felt that there was no reason for concern about the present levels of fishing mortality or recruitment, and recommended a TAC of 2 500 tons for 1978. This figure was based on the average catch between 1975 and 1976 multiplied by 1.25 to allow exploitation of the recent good year classes.

6. BRISTOL CHANNEL SOLE

6.1 Catch trends

The decline of the total catch observed during 1975 was continued in 1976 (Table 6.1). The Belgians, who take 80% of the total international catch, stopped their fishery in this area in 1975 in the fourth quarter of the year and in 1976 in the 3rd quarter. United Kingdom, France and Ireland did not fulfil their quotas. The catch per unit effort calculated from the Belgian data (80% of the international catch) increased in 1976. The effort was only half the one of 1975 (Table 6.2).

6.2 Age composition

The international catch at age data given in Tables 6.3 and 6.4 were amended for 1975 by adding the English data. For 1976 the Belgian and English data were available, covering 96% of the international catch, and raised to the total catch.

6.3 Virtual population analysis

The international age composition was processed by a VPA using natural mortality of 0.1 for both sexes. The terminal fishing mortalities were derived from the smoothed mean values for the period 1970-72 obtained from a preliminary VPA. Results of the VPA are shown in Tables 6.3 and 6.4. Due to the cessation of the Belgian fishery from June 1976 onwards, no reliable estimate of 2 year old recruits was possible since recruitment occurs in the last quarter.

6.4 Prognosis

Due to the absence of pre-recruit surveys in this area, the average recruitment was obtained as the mean number of the 3-year-olds over the period 1970-75 and calculating the corresponding 2-year-old fish with the F values from the VPA. From this calculation, an average recruitment of 1.5×10^6 males and 1.3×10^6 females was obtained.

Starting with the 1976 catch at age data and the corresponding terminal F at age array two prognoses were calculated, one with a catch in 1977 equal to the quota of 700 tons (Case A) and one with a 1977 catch of about the same level as 1976, i.e. 520 tons (Case B). For Case A the

the maximum F for the 1977 catches raised to 0.65 for the males and to 0.50 for the females. For the other possibility, the maximum F in Case B should be 0.55 for the males and 0.35 for the females. The corresponding stock in the beginning of 1978 should then be 3 000 tons in Case A and 3 150 tons in Case B (Tables 6.5 and 6.6).

From the yield per recruit curve at an F at age array (Figure 6.1), the situation of the actual F_{max} is a little below the maximum yield for the females and close to maximum yield for the males for Case B. For Case A the stock will become slightly overexploited. Case B conclusion is similar to the one made in the previous report (Doc. C.M.1976/F:4).

6.5 Recommendation

The previous studies indicate a decline in the fishing effort in the area and a present level of exploitation almost certainly very close to the maximum of the yield per recruit curve. The catch prognosis is 630 tons for Case A and 670 tons for Case B. As Case B might be the most probable one, a TAC for 1978 of 670 tons is recommended.

7. BRISTOL CHANNEL PLAICE

7.1 Catch trends

Catches by all countries in 1976 were lower than in 1975 (Table 7.1), the 1976 preliminary total being 303 tons compared with 468 tons in the previous year. This continues the steady downward trend from the peak of 1 450 tons in 1968 which had been achieved following a similarly steady annual increase from around 300 tons in 1962. Belgium, France and England are the only nations participating in this fishery.

7.2 Data

7.2.1 Weight-at-age

In the absence of new weight data, mean weights-at-age were derived by applying the Irish Sea length/weight relationship given on p.14 of the 1976 report to the Belgian mean length-at-age data in the same report (Doc. C.M.1976/F:4).

The length/weight relationships are as follows:

Age group	2	3	4	5	6	7	8	9	10	11
Males(kg)	.236	.281	.305	.340	.380	.428	.519	.600	-	-
Females(kg)	.286	.374	.467	.548	.705	.838	.949	1.109	1.439	1.600

7.2.2 Age composition

The age composition of the Belgian landings were available for the period 1970-76. Corresponding data from the British fishery were available only for 1976, and there was no information on the age distribution of the French landings. The Belgian figures were therefore used in the following way to derive the landings in numbers per age group for the total international catch for the years 1970-76.

Sums of products (Belgian no./age x Belgian w/age) were checked against the annual catch data published in Bulletin Statistique and the Belgian age distribution adjusted where necessary. A similar exercise (English no./age x Belgian w/age) was carried out on the 1976 English age frequency.

Belgian age frequencies were raised directly to Belgian plus French annual landings. The age distribution of English catches for the years 1970-75 were derived from Belgian age frequencies by the method described in Annex III.

7.3

Virtual Population Analysis

Input F_s for 1976 were calculated as the mean of F_s at each age for the period 1970-73 as obtained from trial VPAs. The fishing mortality on the two youngest age groups in 1976 was then adjusted to give average recruitment (as numbers of 2 year old fish) in 1975 and 1976. The output from the VPA for males and females is given in Tables 7.2 and 7.3. Natural mortality on males was taken to be 0.15, and 0.1 for females.

Maximum levels of F in the exploitation patterns were 1.0 for males (age group 6 and older), and 0.7 for females (age groups 4 and 5); terminal F for females was 0.43. No trends were observed in the levels of F throughout the period.

7.4

Yield per recruit curves

Using the mean weights-at-age derived in Section 7.2.1, and the relative F values given in Table 7.4, yield per recruit curves were constructed for males and females respectively. The female curve had an F_{max} of 0.25, while the male curve was flat-topped.

7.5

Total allowable catch

Assuming average recruitment during 1977 and 1978 (600 000 males and 900 000 females annually), and assuming that the current exploitation pattern remains unchanged (see relative F_s in Table 7.4), several prognoses may be made for these two years (Table 7.5).

If the 1977 NEAFC TAC of 640 tons is reached, and if the females continue to make up approximately 70% of the catch by weight, the level of F on females will have been increased to 1.6 from its 1976 value of 0.7. The corresponding fishing mortality on males (derived from a functional regression of F_f on F_m) will be 1.82 compared with 1.0 during 1976. The Working Group is of the opinion that this TAC (640 tons) cannot be caught in full, and that any increase in F will be more likely to be around 40%. This implies an F_f of 1.0 in 1977 and F_m of 1.12, and the total yield would then be 467 tons. If the 1976 levels of F are maintained throughout 1977 and 1978, the predicted catches will be 381 tons and 424 tons respectively.

The yield per recruit curves, however, indicate that the fishing mortalities corresponding to the MSY point are 0.25 for females and (derived from the functional regression of F_f on F_m) 0.24 for males. Reducing F to these levels would mean a TAC in 1978 of 117 tons if the 1977 NEAFC TAC is taken in full, or 147 tons if mortalities in 1977 are increased by 40%.

An attempt to get back to the MSY point in 1978 would thus involve a reduction of about 50% in present catch levels, and this is considered to be too great a cutback to recommend. The Working Group therefore recommends a TAC for 1978 of 380 tons, which is the catch predicted by a 40% increase in F during 1977 followed by a return to the 1976 levels in 1978.

8.

IRISH SEA SOLE

8.1

Catch trends

The international catch maintained the same level during the period 1972-76 (Table 8.1). The TAC was not fulfilled in 1975 nor in 1976, when it was set at 1 700 tons and 1 670 tons respectively. In the case of the Belgian beam trawlers the catch per unit effort did not show substantial changes (Table 8.2).

8.2

Age composition

The international catch at age data for 1976 given in Tables 8.3 and 8.4 are derived from the Belgian, United Kingdom and Dutch data, covering 87% of the total catch which was raised to 100%. Due to the cessation of the Belgian and Dutch fisheries in the last half of the year no reliable estimate of the two year old soles could be made.

8.3

Virtual population analysis

A VPA was carried out on the catch figures for the period 1970-76 the results of which are shown in Tables 8.3 and 8.4. The terminal F values were obtained from a preliminary run, taking the smoothed values of the F values of the period 1970-72. The catch data show that there have been several good year classes (1971, 1969, 1967, 1966, 1964 and 1961) whose survivors are still present in the stock. The stock is not therefore dependent on only one or two recent year classes, as is the case in the North Sea sole.

8.4

Prognoses

The average recruitment was calculated on the same basis as in the Bristol Channel and amounted to 5 000 000 for the females and 2 900 000 for the males.

As the quota for 1975 and 1976 has not been fulfilled, two possibilities have been used in the prognosis runs. For Case A it was assumed that the 1977 catch should be equal to the 1977 TAC set up by NEAFC. Case B is the most probable one, having a 1977 catch equal to the 1976 catch. In both cases the max F for both sexes has been used for the 1977 catches, resulting in a value of 0.8 (males) and 0.55 (females) in Case A, and 0.6 (females) and 0.45 (males) in Case B. The resulting biomass of the spawning stock for 1978 would be 5 114 tons for Case A and 5 398 tons for Case B (Tables 8.5 and 8.6). From the yield per recruit for F varying with age, max F is for both sexes close to the maximum on the yield per recruit curves, shown in Figure 8.1. This was similar to the conclusion of the previous report. On the long-term yield for F varying with age, there seems to be a maximum from F = 0.4 to F = 0.7, and an F value of 0.55 is recommended. In Case A this should be equivalent to a TAC of 1 280 tons, and in Case B of 1 380 tons. Taking Case B as the most probable situation, a TAC of 1 380 tons should be recommended.

9.

IRISH SEA PLAICE

9.1

Catch trends

The reported preliminary catch for 1976 (3 300 tons) is slightly lower than the 1975 nominal catch of 4 000 tons, but the annual figure for the last 10 years has fluctuated around an average of 4 000 tons (Table 9.1). Catches have in fact been rather stable since the mid-1960s, as the following 5-year averages indicate:

1962-66	2 964
1967-71	4 393
1972-76	4 246

9.2

Age compositions and mean weight-at-age

The age distribution of the landings for 1975 was adjusted to agree with the updated landing figures for that year.

Age distributions for 1976 were available from Belgium, Ireland and England and the sums of products (numbers landed x mean weight) were adjusted to correspond with the preliminary data on 1976 landings. Belgian age distributions were raised to the sum of the Belgian, French and Netherlands landings, Irish age frequencies to the sum of Irish and Northern Irish landings, and English data to the sum of the landings in England and Scotland. The age distribution of the total international landings is shown in Tables 9.2 and 9.3.

The mean weights-at-age were the same as those used in the 1976 report of the Working Group (C.M.1976/F:4) and were as follows:

Age group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Males(kg)	.06	.13	.20	.27	.33	.37	.40	.43	.44	.45	.46	.46	--	--	--
Females(kg)	.06	.14	.25	.37	.50	.63	.75	.86	.97	1.06	1.14	1.21	1.27	1.32	1.36

9.3 Virtual population analysis

Input F_s were calculated as the mean of F_s at each age for the period 1964-72 as obtained from trial VPAs, and M was taken as 0.15 for males and 0.1 for females. The VPA output is reproduced in Tables 9.2 and 9.3.

No clear trends in fishing mortality throughout the period are evident from the VPA. Maximum levels of F in the 1976 exploitation pattern were 0.6 for males and 0.48 for females. The fishing mortality on the two youngest age groups in 1976 was then adjusted to give approximately average recruitment (as numbers of 1 year old fish) in 1975 and in 1976.

9.4 Yield per recruit curves

Using the mean weights-at-age given in Section 9.2.1 and the relative fishing mortalities in Table 9.4, yield per recruit curves were constructed for males and females separately. The female curve had an F_{max} of 0.25, and the male curve was flat-topped.

9.5 Total allowable catch

Recruitment for 1977 and 1978 was calculated as the mean of 1 year old fish in the stock for the years 1964-72 as obtained from the VPA - 7.6×10^6 males and 10.3×10^6 females. Prognoses of catch and stock biomass are given in Figure 9.1 for two levels of F for 1978-85. Maintaining the levels of fishing mortality at those corresponding to the 1977 TAC (4 150 tons) will give reasonably steady annual yields of around 4 000 tons and a stock biomass stable at about 15 000 tons. Bringing the fishing mortality back to the MSY point (0.25 for females and 0.24 for males as derived from a regression of F_f on F_m 1964-71) in 1978 and keeping it at that level would correspond to a catch of 2 500 tons in 1978. The maintenance of such a strategy would allow catches to rise to their present level (approximately 4 000 tons) by 1985, with a corresponding increase in stock biomass of 50%.

At present there would not appear to be any biological evidence that such an increase in stock size is required, especially in view of the fact that to achieve this increase the short-term yields would have to be considerably reduced and that long-term yields would be no higher than at present.

The Group therefore recommends that the 1978 TAC should be 4 400 tons.

10. NORTH SEA PLAICE TRIAL RUN WITH THE NEW FISHDAT SYSTEM

The Group had the opportunity to use the terminal connected to the RECKU-computer to test the user's language of the newly developed FISHDAT system for ICES assessment Working Groups. At the 1976 meeting of the ADP Working Group it was decided to use North Sea plaice data provided by members of the Flatfish Working Group from the first quarter of 1974. During the present trial run no plaice data could be loaded in the database and only a limited load of herring data was present, preventing us from considering the effect of a full load of the database on response time. It is expected that full loading will greatly increase response time which renders the system ineffective during meetings of assessment groups.

The Group found that the user's language commands and the new system worked satisfactorily. However before another trial run is contemplated the system must work on a short response time with the full load of the plaice data.

Table 1. Summary of the Working Group's advice on the 1978 TAC for plaice and sole in the various areas, the Group's advice on TAC for 1977 and the NEAFC TAC for 1977, the Group's advice for TAC in 1976, the NEAFC TAC for 1976 and the provisional landings in 1976, all in metric tons nominal weight.

Area	Species	Working Group TAC 1978	Working Group TAC 1977	NEAFC TAC 1977	Working Group TAC 1976	NEAFC TAC 1976	Provisional landings 1976
IVa,b,c North Sea	Plaice	<u>95 000</u>	71 000	99 900	85 000	99 900	109 386
	Sole	<12 500 (~8 000)	6 700	12 500	8 000	12 500	13 922 17 000*
VIIId,e English Channel	Plaice	VIIId <u>2 500</u> VIIe <u>600</u>	VIIId 2 000 VIIe 1 000	3 340	?	3 340	2 572
	Sole	VIIId <u>1 150</u> VIIe <u>350</u>	VIIId 450 VIIe 440	1 450	1 300	1 450	1 685
VIIIf Bristol Channel	Plaice	<u>380</u>	500	640	500	640	303
	Sole	<u>670</u>	440	700	720	700	518
VIIa Irish Sea	Plaice	<u>4 400</u>	4 000	4 150	4 000	4 150	3 284
	Sole	<u>1 380</u>	1 350	1 670	1 600	1 670	1 383

* the Working Group's guess of total catch including non-reported sole landings.

Table 3.1 Nominal catch (metric tons) of Plaice in Sub-area IV, 1966-76.

(Data for 1966-74 from Bulletin Statistique;
Data for 1975 and 1976 from national offices).

Year	Belgium	Denmark	Faroe Isls.	France	Germany (F.R.)	Nether- lands	Norway	Poland	Sweden ^{a)}	U.K. (England and Wales)	U.K. (Scot- land)	USSR	Total
1966	6 490	29 055	-	1 765	4 401	25 682	33	-	370	26 978	5 356	-	100 130
1967	6 778	28 287	-	1 730	5 290	29 905	35	-	593	30 974	5 709	-	109 301
1968	5 576	30 369	-	1 310	5 250	33 236	38	-	776	29 569	5 810	-	111 934
1969	4 476	35 227	-	1 330	5 071	39 420	26	-	772	30 349	4 981	-	121 652
1970	4 360	32 807	-	1 406	5 519	46 080	22	-	608	34 839	4 703	-	130 344
1971	5 073	22 278	-	1 380	3 296	44 502	18	-	588	32 576	4 210	-	113 921
1972	5 531	24 494	-	1 062	4 318	52 048	19	-	626	31 642	3 410	-	123 150
1973	6 133	23 266	1	1 355	5 451	57 948	15	1	432	30 400	4 815	397	130 214
1974	6 202	19 814	-	519	3 233	54 438	13	-	431	23 854	4 002	39	112 545
1975	6 154	22 731	-	536	4 040	51 293	13	-	35	20 085	3 266	154	108 307
1976*	3 238	23 724		399	3 515	51 630	27		53	23 465	3 258	77	109 386

* Preliminary.

a) 1965-74 includes Division IIIa.

Table 3.2 North Sea Plaice.
Age composition of total catch 1967-76 (thousands).

Males

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	280	1 401	428	1 084	437	890	981	2 715
2	4 141	7 247	8 941	13 245	18 886	14 557	13 037	9 832	21 743	18 800
3	17 704	29 209	25 842	27 962	27 438	22 094	35 623	30 891	59 986	51 130
4	116 442	26 674	18 546	31 668	16 385	23 947	46 290	36 116	15 709	79 304
5	29 884	71 530	19 726	23 087	11 357	10 059	21 150	19 987	11 399	18 787
6	16 688	8 597	50 365	18 237	10 351	7 461	5 635	8 467	7 457	5 255
7	12 446	3 530	3 967	37 089	6 189	5 968	2 789	3 085	4 166	3 703
8	3 440	4 620	1 913	2 346	10 683	3 204	3 331	1 904	2 037	2 329
9	2 912	1 007	4 041	1 155	1 408	5 720	1 764	1 807	1 430	1 216
10	551	1 621	1 084	1 396	1 180	1 213	4 290	1 009	866	719
11	159	560	939	528	781	856	155	2 356	264	573
12	81	335	686	663	374	736	379	247	892	141
13	231	199	209	307	487	300	276	392	181	571
14	180	149	217	120	183	345	261	162	110	97

ctd.

Table 3.2 (ctd) North Sea Plaice.
Fishing mortalities 1967-76.

Males

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01
2	0.03	0.05	0.08	0.09	0.11	0.10	0.10	0.03	0.11	0.26
3	0.14	0.24	0.26	0.35	0.25	0.17	0.37	0.34	0.23	0.36
4	0.35	0.31	0.23	0.54	0.34	0.34	0.61	0.74	0.27	0.49
5	0.73	0.36	0.38	0.46	0.36	0.34	0.53	0.55	0.52	0.57
6	0.70	0.44	0.44	0.68	0.37	0.40	0.30	0.39	0.39	0.45
7	0.50	0.29	0.36	0.64	0.48	0.35	0.24	0.25	0.32	0.32
8	0.35	0.33	0.23	0.35	0.35	0.47	0.32	0.24	0.25	0.28
9	0.28	0.15	0.50	0.20	0.34	0.31	0.48	0.27	0.27	0.22
10	0.13	0.23	0.23	0.30	0.31	0.52	0.38	0.52	0.19	0.20
11	0.09	0.18	0.19	0.16	0.26	0.37	0.11	0.34	0.23	0.18
12	0.04	0.26	0.34	0.19	0.15	0.39	0.26	0.24	0.20	0.18
13	0.22	0.13	0.24	0.23	0.20	0.17	0.24	0.44	0.26	0.18
14	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Mean F ≥ 1	0.25	0.22	0.21	0.26	0.18	0.17	0.18	0.16	0.18	0.27

ctd.

Table 3.2 (ctd) North Sea Plaice.
Stock in numbers (thousands), 1967-76.

Males

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	191 726	163 575	218 330	249 993	205 241	190 979	489 976	301 512	114 285	308 288
2	172 140	149 316	127 393	169 789	193 462	159 465	147 781	381 209	234 035	88 142
3	142 917	144 325	121 805	101 369	133 876	149 034	123 778	115 127	319 000	181 309
4	418 833	106 629	97 232	80 964	61 445	89 875	107 840	73 670	70 580	219 123
5	61 797	253 040	67 149	66 547	40 530	37 763	55 253	50 239	30 238	46 238
6	35 550	25 738	151 792	39 598	36 002	24 405	23 218	28 082	24 843	15 528
7	33 933	15 263	14 228	84 221	17 320	21 437	14 124	14 781	16 360	14 504
8	12 626	17 742	9 877	8 585	38 382	9 205	12 944	9 580	9 872	10 235
9	12 907	7 693	11 006	6 733	5 224	23 178	4 971	8 066	6 486	6 614
10	4 777	8 420	5 690	5 750	4 727	3 197	14 668	2 653	5 273	4 261
11	2 007	3 602	5 749	3 895	3 660	2 979	1 635	8 667	1 354	3 738
12	2 072	1 580	2 582	4 080	2 864	2 429	1 774	1 264	5 285	922
13	1 274	1 708	1 051	1 590	2 898	2 119	1 412	1 177	859	3 724
14	1 067	883	1 286	711	1 084	2 044	1 547	960	652	572

Table 3.3 North Sea Plaice.
Age composition of total catch 1967-76 (thousands).

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	8	770	481	765	723	728	269	1 037
2	3 121	7 033	9 241	9 311	19 676	12 888	12 608	10 456	18 210	14 522
3	21 883	22 698	25 934	27 086	25 283	25 198	33 928	29 127	46 396	35 487
4	63 691	20 257	18 834	28 301	15 825	21 076	41 452	24 431	18 884	51 327
5	18 404	51 274	13 499	16 990	11 499	12 836	19 949	20 248	14 398	8 663
6	11 301	7 473	39 605	13 838	10 296	10 898	7 816	10 270	13 806	6 601
7	8 896	5 122	5 050	34 679	7 023	11 437	6 171	4 859	7 270	6 673
8	4 279	5 833	3 091	4 509	13 864	11 773	6 375	4 450	3 993	4 440
9	5 692	2 494	4 672	2 747	3 210	18 503	5 694	3 941	6 223	2 464
10	2 289	3 178	1 868	3 772	2 471	4 892	12 955	3 152	3 024	2 117
11	1 808	1 309	3 174	1 522	2 303	4 635	2 665	9 661	1 593	1 988
12	903	1 336	933	2 102	1 536	5 654	2 099	1 654	8 071	897
13	1 342	630	990	752	1 424	2 687	1 945	1 659	1 017	7 326
14	769	840	362	721	627	2 733	2 836	1 321	1 374	344
15	671	489	687	320	742	1 188	1 150	1 258	1 435	546
16	322	576	348	373	346	1 475	705	709	1 166	541
17	504	478	481	291	826	2 459	901	1 209	431	668
18	163	140	179	173	307	618	413	136	1 168	267
19	139	134	202	95	176	368	289	54	132	307
20	165	113	173	99	88	202	328	42	25	43

ctd.

Table 3.2 (ctd) North Sea Plaice.
Fishing mortalities 1967-76.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
2	0.02	0.05	0.07	0.06	0.10	0.09	0.10	0.04	0.08	0.10
3	0.17	0.17	0.21	0.28	0.20	0.16	0.31	0.31	0.19	0.20
4	0.16	0.21	0.19	0.33	0.24	0.23	0.38	0.34	0.31	0.30
5	0.32	0.17	0.19	0.23	0.19	0.28	0.32	0.29	0.31	0.20
6	0.24	0.19	0.17	0.26	0.19	0.25	0.24	0.24	0.29	0.20
7	0.17	0.14	0.17	0.20	0.18	0.30	0.20	0.21	0.24	0.20
8	0.12	0.15	0.11	0.20	0.10	0.47	0.25	0.19	0.24	0.20
9	0.21	0.09	0.15	0.12	0.19	0.17	0.39	0.21	0.39	0.20
10	0.13	0.15	0.08	0.16	0.14	0.43	0.16	0.34	0.22	0.20
11	0.17	0.09	0.20	0.08	0.12	0.36	0.39	0.15	0.26	0.20
12	0.12	0.16	0.08	0.18	0.09	0.44	0.24	0.39	0.17	0.20
13	0.22	0.10	0.15	0.07	0.16	0.21	0.24	0.28	0.40	0.20
14	0.13	0.18	0.07	0.14	0.07	0.44	0.31	0.23	0.35	0.20
15	0.17	0.10	0.20	0.07	0.19	0.17	0.30	0.20	0.36	0.20
16	0.18	0.20	0.09	0.14	0.10	0.63	0.13	0.27	0.25	0.20
17	0.37	0.40	0.22	0.09	0.48	1.49	0.88	0.31	0.23	0.20
18	0.12	0.15	0.23	0.11	0.11	0.71	1.03	0.27	0.48	0.20
19	0.18	0.12	0.29	0.16	0.13	0.17	0.75	0.30	0.40	0.20
20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Mean F ≥1	0.13	0.13	0.13	0.15	0.13	0.18	0.17	0.13	0.16	0.18

ctd.

Table 3.3 (ctd) North Sea Plaice.
Stock in numbers (thousands), 1967-76.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	203 465	166 717	207 371	265 689	197 741	170 408	389 596	301 393	196 001	115 014
2	169 533	166 583	136 497	169 774	216 832	161 463	138 827	318 321	246 102	160 229
3	148 643	150 433	144 046	114 726	144 769	177 505	133 852	113 638	278 090	205 379
4	448 219	113 719	114 566	105 722	78 115	106 993	136 686	88 937	75 201	207 582
5	70 121	345 087	83 669	85 784	68 826	55 664	76 810	84 390	57 309	50 134
6	56 018	45 996	263 563	62 892	61 497	51 360	38 190	50 582	57 153	38 200
7	58 350	39 963	34 524	200 878	43 778	45 871	36 132	27 139	36 023	38 618
8	39 293	44 351	31 296	26 443	148 843	32 944	30 658	26 836	19 945	25 696
9	32 149	31 489	34 591	25 381	19 647	121 507	18 659	21 692	20 057	14 257
10	20 213	23 687	26 123	26 863	20 356	14 730	92 377	11 486	15 887	12 251
11	12 366	16 116	18 415	21 862	20 725	16 072	8 693	71 284	7 405	11 505
12	8 569	9 473	13 338	13 649	18 335	16 565	10 149	5 340	55 326	5 188
13	7 184	6 896	7 303	11 182	10 355	15 131	9 632	7 191	3 264	42 398
14	6 810	5 227	5 641	5 668	9 404	8 017	11 141	6 870	4 933	1 990
15	4 436	5 431	3 932	4 760	4 444	7 913	4 665	7 391	4 962	3 161
16	2 015	3 377	4 450	2 906	4 003	3 316	6 032	3 130	5 493	3 130
17	1 722	1 517	2 509	3 696	2 275	3 293	1 605	4 788	2 160	3 864
18	1 549	1 081	920	1 814	3 068	1 276	670	602	3 186	1 545
19	869	1 247	845	663	1 477	2 484	570	217	416	1 777
20	955	654	1 001	573	509	1 169	1 898	243	145	251

Table 3.4 North Sea Plaice.
Frequency distributions of recruitment
at Age 1 as estimated by Virtual Population
Analysis.

Class interval (millions)	Year classes			
	1964-65		1966-76	
	♂	♀	♂	♀
50 - 99	0	0	0	0
100 - 149	1	0	1	1
150 - 199	7	5	3	4
200 - 249	7	10	3	2
250 - 299	0	3	0	1
300 - 349	2	1	2	1
350 - 399	2	0	0	1
800 - 849	1	1	1	0
	20	20	10	10

Table 3.5 North Sea Plaice.
 Prognosis results for 1977 and 1978.
 Catch number and weight as a function of maximum F
 in the F at age array

Year	Maximum F	Catch number (thousands)		Catch weight (tons whole weights)	
		♂	♀	♂	♀
1977	♂ = 0.57 ♀ = 0.30	150 075	132 694	53 421	69 216
1978	0.1	30 030	46 333	9 893	23 627
	0.2	58 190	89 654	19 134	45 708
	0.3	84 610	130 192	27 768	66 301
	0.4	109 409	168 128	35 842	88 229
	0.5	132 696	203 652	43 395	103 486
	0.6	154 574	236 932	50 463	120 265
	0.7	175 138	268 123	57 081	135 944
	0.8	194 475	297 371	63 281	150 603
	0.9	212 666	324 809	69 093	164 310

* Corresponding weight as 282 769 x 0.332 kg = 94 000 tons.

Table 3.6 North Sea Plaice.
Prognosis results for 1978.

Catch number and weight for various
multiples of the maximum value of the
F at age array.

Multiple of maximum F	Corresponding actual maximum value		Catch ('000)	Weight ♂ + ♀	Weight as number x 332 g ♂ + ♀
	♂	♀			
0.5	0.29	0.15	146 000	60 000	48 500
0.75	0.43	0.23	213 000	92 000	71 000
1.0	0.57	0.30	286 000	117 000	95 000
1.25	0.71	0.38	337 000	138 000	112 000
1.50	0.86	0.45	389 000	161 000	130 000

Note: In all cases, stock biomass at the beginning of 1978
is estimated as 363 000 tons whole weight.

Table 4.1 English Channel Sole.
 Nominal catch (metric tons) in statistical
 Divisions VIId-e, 1962-76.

Year	Belgium		France		Netherlands		U.K. England & Wales		Total	
	VIIId	VIIe	VIIId	VIIe	VIIId	VIIe	VIIId	VIIe	VIIId	VIIe
1962	30		610		-		138	127		905
1963	28		629		-		195	113		965
1964	14		465		-		116	91		686
1965	43		824		-		83	92		1 042
1966	8		-		-		132	84		224
1967	7		816		-		162	99		1 084
1968	30		520		-		133	114		797
1969	10	8	606		-		177	138		939
1970	127	10	753		1		228	125		1 244
1971	157	3	816		1		254	152		1 383
1972	147	6	676		8		322	201		1 360
1973	126	2	775		-		360	194 ²⁾		1 457
1974	159	6	706		3		309	181		1 364
1975	132	3	464	271	1		244	217	841	491
1976 ¹⁾	202	5	541	274	-		407	256	1 150	535

1) Preliminary figures as reported to NEAFC.

2) Figures amended from 1976 Working Group Report.

3) Mainly Division VIId.

Note: Catches for Divisions VIId and VIIe combined were taken from Bulletin Statistique as were the separate catches in 1975. The VIId and VIIe separate catches were obtained from national statistics.

Table 4.2 Division VIIe Sole.
Estimated catch (in metric tons) for 1969-76.
and catch per effort based on Brixham (U.K.)
otter trawl catches.

Year	Total International Catch (A)	Brixham c.p.u.e (otter units) (B)	Brixham Otter trawl catch	Total catch c.p.u.e Effective effort (A/B)
1969	353	1.89	74	186.8
1970	391	1.02	46	383.0
1971	432	0.94	37	460.6
1972	437	1.02	48	427.6
1973	459	0.80	33	573.8
1974	427	0.68	31	627.9
1975	491	1.24	42	395.0
1976 ¹⁾	535	1.12	?	477.7

1) Estimated values.

Table 4.3 Division VIIe Sole.
Age composition of total catch 1969-76 (thousands).

Males

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	0	0	0	.8	4.5	.1
2	43.5	10.5	24	57.5	58.4	45.8	50.2	41.3
3	62.4	99.9	99.7	138.7	136.2	132.2	235.6	174.7
4	29.4	127.1	76.6	90.2	166.2	88.9	56.6	163.6
5	35.6	27	28.4	32.4	50.1	42.8	91.1	68.3
6	51.4	30.7	14	17.3	29	17.5	69	58.6
7	0	21	34.3	0	8.6	18.8	17.5	32.8
8	14.9	6.1	39	6	22.9	19.2	38.8	21.9
9	16.1	29.2	6.8	78.2	8.6	16.8	6.1	30.6
10	0	13.4	0	21.9	0	6.9	5.2	35.3
11	0	10.6	35.5	16.4	0	28.4	17.8	4.8
12	2.6	4.8	2	7.8	8.6	7	17.2	13.9
13	6.6	6.1	7.8	10.8	11.3	10.5	3.6	23

NB. The last group is not a plus group.

ctd.

Table 4.3 (ctd). Division VIIe Sole.
Fishing mortalities 1969-76.

Males

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976	Relative F in 1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.05
2	0.05	0.01	0.02	0.05	0.06	0.03	0.05	0.06	0.18
3	0.07	0.13	0.17	0.17	0.14	0.15	0.22	0.21	1.00
4	0.13	0.17	0.12	0.21	0.28	0.11	0.08	0.21	1.00
5	0.09	0.16	0.05	0.06	0.15	0.09	0.15	0.12	0.57
6	0.07	0.09	0.10	0.03	0.06	0.07	0.19	0.12	0.57
7	0.00	0.04	0.13	0.00	0.02	0.05	0.08	0.12	0.57
8	0.07	0.06	0.08	0.03	0.25	0.05	0.12	0.12	0.57
9	0.07	0.16	0.08	0.20	0.04	0.26	0.02	0.12	0.57
10	0.00	0.07	0.00	0.35	0.00	0.04	0.11	0.12	0.57
11	0.00	0.09	0.24	0.13	0.00	0.10	0.12	0.12	0.57
12	0.04	0.06	0.02	0.07	0.08	0.18	0.07	0.12	0.57
13	0.10	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.57
Mean F \geq 3	0.07	0.11	0.11	0.12	0.12	0.10	0.14	0.16	
\bar{F}_{3-6}	.09	0.14	.11	.12	.16	.11	.16	(.17)	

ctd.

Table 4.3 (ctd) Division VIIe Sole.
Stock in numbers (thousands) 1969-76.

Males

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976
1	819	1 182	1 407	1 263	1 578	1 241	828	11
2	1 030	741	1 070	1 273	1 143	1 428	1 122	745
3	992	891	661	945	1 097	979	1 248	968
4	245	839	711	503	723	863	760	906
5	445	193	638	571	370	497	697	634
6	751	369	149	550	485	287	409	544
7	120	631	304	122	482	412	243	305
8	247	108	551	243	110	428	355	203
9	245	209	92	461	214	78	369	284
10	150	207	162	77	343	186	55	328
11	94	136	174	146	49	311	161	45
12	65	85	113	124	117	44	254	129
13	73	57	72	100	105	97	33	214

Table 4.4 Division VIIe Sole.
Age composition of total catch 1969-76 (thousands).

Females

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976
1	0 0	0 0	.6	0 0	0 0	.2	0	1
2	25.9	24.8	20.6	60.5	42.8	42.6	19	28.1
3	190.2	130.1	110.8	265.4	201.8	209.3	277	162.1
4	64.8	170.2	156.5	91	279.8	109.6	121.3	243.9
5	98.8	44.9	146.5	126.3	74.2	113.1	122.3	81.1
6	147.9	80.8	45.3	102.3	70.4	52.9	50.8	58.8
7	16	97.1	47.1	21.9	118.9	28.1	10	47.6
8	32.1	13.9	140.2	20.2	2.6	31.6	36.3	9.2
9	9.2	16.1	7.3	65.4	21.7	21.9	20.1	25.5
10	16.5	33.2	31.3	20.9	31.4	21.2	18.5	21.4
11	13.2	15.6	18.1	31.4	5.8	16.1	10.7	10.7
12	6.6	10.7	20	14.2	19	13.3	19.6	3.8
13	1.5	17	13.6	3.3	6.9	10.5	14.1	33.4
14	14.5	8.1	13.6	2.9	4.4	7.2	16.6	4.2
15	5	15.4	7.6	14.7	4.6	9.3	8.3	12.1
16	4.5	4.3	4.8	7.8	3.3	6.2	5.5	7.9
17	7.7	0	2.1	3.1	.5	3	9.9	14.5
18	1.2	.9	2.3	5.5	12.3	7	11.6	3.3
19	3	3	8.7	1.7	.5	6.4	2.7	16.4
20	.2	1.7	3.7	2.9	1.1	2.5	2.5	3.3

NB. The last group is not a plus group.

ctd.

Table 4.4 (ctd) Division VIIe Sole.
Fishing mortalities 1969-76.

Females

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976	Relative F in 1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.001	0.002
2	0.03	0.05	0.02	0.07	0.06	0.03	0.03	0.10	0.22
3	0.17	0.15	0.27	0.28	0.33	0.41	0.29	0.35	0.78
4	0.18	0.21	0.25	0.33	0.46	0.27	0.40	0.40	0.89
5	0.28	0.16	0.25	0.29	0.43	0.30	0.48	0.45	1.00
6	0.16	0.35	0.22	0.24	0.24	0.54	0.19	0.40	0.89
7	0.10	0.14	0.31	0.14	0.43	0.12	0.16	0.25	0.56
8	0.10	0.10	0.26	0.19	0.02	0.17	0.21	0.20	0.44
9	0.04	0.06	0.07	0.17	0.29	0.21	0.14	0.20	0.44
10	0.07	0.20	0.14	0.24	0.10	0.45	0.25	0.20	0.44
11	0.12	0.07	0.14	0.18	0.09	0.06	0.38	0.20	0.44
12	0.02	0.12	0.12	0.14	0.14	0.26	0.09	0.20	0.44
13	0.02	0.07	0.20	0.02	0.09	0.10	0.44	0.20	0.44
14	0.16	0.11	0.07	0.05	0.03	0.11	0.20	0.20	0.44
15	0.12	0.24	0.13	0.09	0.10	0.09	0.16	0.20	0.44
16	0.24	0.13	0.10	0.18	0.02	0.17	0.06	0.20	0.44
17	0.18	0.00	0.08	0.07	0.01	0.02	0.40	0.20	0.44
18	0.03	0.03	0.18	0.27	0.41	0.24	0.11	0.20	0.44
19	0.14	0.10	0.32	0.18	0.03	0.35	0.13	0.20	0.44
20	0.10	0.10	0.15	0.15	0.15	0.20	0.20	0.20	0.44
Mean F ≥ 9	0.07	0.10	0.12	0.14	0.11	0.14	0.16	0.20	
\bar{F}_{3-6}	.20	.22	.25	.29	.37	.38	.34	(.40)	

ctd.

Table 4.4 (ctd) Division VIIe Sole.
Stock in numbers (thousands) 1969-76.

Females

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976
1	633	1 435	983	838	1 450	725	343	1 051
2	1 083	573	1 298	889	759	1 312	656	310
3	1 258	955	495	1 155	747	646	1 147	575
4	411	957	741	342	794	485	386	775
5	421	310	705	522	224	453	334	234
6	1 044	287	238	499	352	132	303	187
7	180	804	184	173	354	252	69	226
8	358	147	635	121	135	208	201	53
9	223	293	120	442	91	120	158	148
10	268	193	250	102	338	61	88	124
11	123	227	143	196	72	276	36	62
12	289	99	191	112	148	60	234	22
13	88	255	79	153	88	116	42	193
14	100	78	214	59	136	73	95	24
15	45	77	63	181	50	119	59	70
16	22	36	55	50	150	41	99	46
17	50	16	29	45	38	133	31	84
18	39	38	15	24	38	34	117	19
19	24	34	33	11	17	23	24	95
20	2	19	28	22	8	14	14	19

Table 4.5 Weight at age (g) used in yield calculations for Division VIIe Sole.

Age	Females	Males
1	-	139
2	184	162
3	234	197
4	299	250
5	371	267
6	410	287
7	463	312
8	500	343
9	550	346
10	575	355
11	613	377
12	645	467
13	675	394
14	700	
15	725	
16	750	
17	770	
18	785	
19	800	
20	812	

Table 4.6 Yield per recruit for Division VIIe Sole in grams. Combined yield calculated assuming that the ratio between F^{δ} and F^{φ} is always 0.21 : 0.45.

F_{\max}	Yield of males per recruit	Yield of females per recruit	Yield of $\delta + \varphi$
0.05	64	101	75
0.1	100	156	123
0.15	121	187	150
0.2	134	205	161
0.25	142	216	176
0.3	148	221	182
0.4	154	226	189
0.6	157	224	191
0.8	156	218	188
1.0	155	213	186
1.2	154	209	183
1.5	152	205	

Table 4.7 Estimated total international catch in nominal metric tons of Division VIIId Sole and catcy per effort (c.p.u.e) of Belgian twin-beam trawlers in the first quarter of the year (metric tons per 1 000 horse-power hours).

Year	Total catch (A)	C.p.u.e. (B)	Belgian beam-trawl catch in the 1st quarter of the year	Effective effort (A/B)
1969	575	-	-	-
1970	836	-	-	-
1971	953	0.58	83	1 609
1972	921	0.48	5	1 879
1973	1 000	0.35	42	2 806
1974	940	0.32	50	2 872
1975	840	0.21	42	4 000
1976 ¹⁾	1 150	0.28	127	4 107

1) Preliminary figure.

Table 4.8 Division VIIId Sole.
Age composition of total catch 1971-76 (thousands).

Males

Age \ Year	1971	1972	1973	1974	1975	1976
2	91	34.7	147.6	186.1	4.7	145.6
3	222.2	215.8	189.1	187.3	291.1	408.9
4	11	185.4	389.4	191.3	223.8	254.4
5	0	0	137.5	213.5	78.7	56.8
6	15.3	45.3	14.8	32	226.4	8.8
7	63.5	0	30.5	11.4	73.8	71.1
8	447.5	45.3	12.5	0	33.8	18.6
9	15.3	510.5	100.8	30.2	9.3	16.2
10	21.4	41	130.5	9.7	18.2	3.9
11	51.9	28.5	38.3	47.4	10	41.8
12	34.8	0	24.2	45.1	95.6	227.5
13	108.1	162.5	52.3	0	9.1	42.3
14	220.4	28.5	76.6	22.3	105.3	45.9

ctd.

Table 4.8 (ctd) Division VIIId Sole.
Fishing mortalities 1971-76.

Males

Age \ Year	1971	1972	1973	1974	1975	1976	Relative F in 1976
2	0.04	0.05	0.14	0.09	0.00	0.08	0.31
3	0.26	0.12	0.40	0.24	0.19	0.26	1
4	0.04	0.33	0.29	0.79	0.44	0.22	0.85
5	0.00	0.00	0.38	0.23	0.78	0.17	0.65
6	0.03	0.41	0.07	0.13	0.35	0.16	0.62
7	0.02	0.00	0.48	0.06	0.43	0.16	0.62
8	0.27	0.02	0.03	0.00	0.23	0.16	0.62
9	0.05	0.50	0.04	0.08	0.26	0.15	0.58
10	0.07	0.17	0.20	0.00	0.05	0.15	0.58
11	0.38	0.11	0.22	0.09	0.01	0.15	0.58
12	0.10	0.00	0.11	0.37	0.25	0.15	0.58
13	1.15	0.79	0.85	0.00	0.11	0.15	0.58
14	0.15	0.15	0.15	0.15	0.15	0.15	0.58

ctd.

Table 4.8 (ctd) Division VIIId Sole.
Stock in numbers (thousands), 1971-76.

Males

Age \ Year	1971	1972	1973	1974	1975	1976
2	2 333	703	1 173	2 183	2 075	1 989
3	1 002	2 024	603	921	1 799	1 873
4	301	696	1 627	367	656	1 351
5	154	262	454	1 102	151	381
6	623	140	237	280	795	62
7	3 104	549	83	200	223	505
8	1 969	2 748	497	47	170	132
9	317	1 357	2 444	438	42	122
10	348	272	745	2 115	367	29
11	171	295	207	550	1 905	315
12	380	106	240	151	452	1 714
13	165	311	96	194	94	319
14	367	47	128	37	176	76

Table 4.9 Division VIIId Sole.
Age composition of total catch 1971-76 (thousands)

Females

Age \ Year	1971	1972	1973	1974	1975	1976
2	0	0	339.8	354.6	16.9	215.1
3	249.1	294.6	128.9	364.8	484.9	799.9
4	42.7	28.5	367.2	127.3	205.2	505.6
5	45.2	0	120.3	270.6	60.7	212.8
6	0	0	30.5	43.4	209.1	71.4
7	21.4	0	46.9	87.9	23.3	232.1
8	327.9	0	50	10.3	12.3	38.6
9	20.8	310.7	71.1	10.8	9	15.6
10	0	226.4	152.3	46.2	4.9	9.8
11	47	0	28.1	111.3	16.7	3.6
12	70.2	0	58.6	0	70.7	4.1
13	48.8	24.8	63.3	8.6	7.6	139.7
14	73.3	57.7	18	41.1	6	1
15	0	0	26.6	21.1	9	10.9
16	28.7	39.1	21.1	6.3	11.1	24.9
17	0	0	0	36	43.3	10.6
18	0	9.3	0	25.7	9.4	12.4
19	0	0	0	9.7	25.6	13.7
20	97.1	8.1	0	17.1	7.1	4.8
21	26.3	38.5	14.1	30.8	8.9	30.7

ctd.

Table 4.9 (ctd) Division VIIId Sole.
Fishing mortalities 1971-76.

Females

Age \ Year	1971	1972	1973	1974	1975	1976	Relative F in 1976
2	0.00	0.00	0.17	0.11	0.00	0.06	0.22
3	0.38	0.11	0.19	0.24	0.19	0.27	1.00
4	0.14	0.06	0.18	0.26	0.19	0.27	1.00
5	0.26	0.00	0.34	0.17	0.17	0.27	1.00
6	0.00	0.00	0.14	0.18	0.18	0.27	1.00
7	0.10	0.00	0.46	0.66	0.12	0.27	1.00
8	0.16	0.00	0.81	0.15	0.16	0.27	1.00
9	0.07	0.20	0.55	0.36	0.17	0.27	1.00
10	0.00	1.85	0.13	0.74	0.24	0.26	0.96
11	0.12	0.00	1.35	0.12	0.58	0.25	0.93
12	0.32	0.00	0.49	0.00	0.09	0.24	0.89
13	0.16	0.16	0.25	0.11	2.70	0.23	0.85
14	0.31	0.27	0.15	0.22	0.09	0.23	0.85
15	0.00	0.00	0.17	0.24	0.06	0.22	0.81
16	0.27	0.32	0.14	0.05	0.17	0.22	0.81
17	0.00	0.00	0.00	0.32	0.48	0.22	0.81
18	0.00	0.22	0.00	0.37	0.12	0.22	0.81
19	0.00	0.00	0.00	0.15	0.67	0.22	0.81
20	0.97	0.32	0.00	0.81	0.14	0.22	0.81
21	0.22	0.22	0.22	0.22	0.22	0.22	0.81

ctd.

Table 4.9 (ctd) Division VIIId Sole.
Stock in numbers (thousands) 1971-76.

Females

Age \ Year	1971	1972	1973	1974	1975	1976
2	3 219	870	2 315	3 671	3 935	3 879
3	828	2 912	788	1 772	2 985	3 544
4	341	513	2 355	590	1 257	2 240
5	210	268	437	1 783	413	943
6	115	147	243	281	1 356	316
7	238	104	133	191	213	1 028
8	2 344	195	94	76	89	171
9	329	1 809	176	38	59	69
10	192	278	1 342	92	24	45
11	421	174	39	1 070	40	17
12	265	336	157	9	862	20
13	337	174	304	87	8	713
14	290	259	134	215	70	1
15	164	192	179	104	156	58
16	129	148	174	137	74	132
17	54	89	97	138	118	56
18	60	49	81	88	90	66
19	34	55	36	73	55	73
20	163	31	50	32	57	25
21	38	56	21	45	13	45

Table 4.10 Weight at age (g) for Division VIIId
Sole based on Belgian weight at age data
(gutted weight x 1.08). Female weights
at age 14+ estimated by extrapolation
of the curve of weight at age.

Age	Males	Females
2	97	135
3	178	243
4	221	346
5	270	410
6	302	475
7	335	524
8	362	567
9	378	594
10	400	621
11	416	648
12	427	670
13	437	680
14	443	(693)
15	448	(700)
16		(704)
17		(708)
18		(712)
19		(713)
20		(713)

Table 4.11 Yield per recruit for Division VIIId Sole (g).
Combined curve calculated assuming equality
of the sexes in number and fishing mortality.

F	$Y_{W/R}$		$Y_{W/R}$
	♂	♀	♂ + ♀
0.05	68	135	102
0.10	104	191	147
0.15	123	216	170
0.20	135	227	181
0.25	141	231	186
0.30	144	232	188
0.40	147	229	188
0.60	144	218	181
0.80	139	208	174
1.00	134	199	167
1.20	130	192	161
1.50	125	184	154

where F is the maximum F at age in the F at age array (i.e.
age 3 for ♂♂ and ages 3-9 for ♀♀).

Table 4.12 Catch predictions and TACs for
Division VIIId Sole. (In tons, whole weight).

Year	Sex	F	Catch	Total
1976	♀	0.27		
	♂	0.26		1 150
1977	♀	0.27	896	
	♂	0.26	334	1 230
1978	♀	0.27	851	
	♂	0.26	302	1 153

Table 5.1 English Channel Plaice.

Nominal catch (metric tons) in statistical Divisions VIId-e, 1962-76.

Year	Belgium		France		Nether- lands		U.K. (England & Wales)		Total	
	VIIId	VIIe	VIIId	VIIe	VIIId	VIIe	VIIId	VIIe	VIIId	VIIe
1962	24		874		-		545	373	1 816	
1963	32		1 162		-		472	506	2 172	
1964	28		1 393		-		616	422	2 459	
1965	33		2 130		-		841	445	3 449	
1966	25		2 700 ¹⁾		-		1 067	681	4 473	
1967	11		2 905		-		976	829	4 721	
1968	30		1 920		-		713	641	3 304	
1969	18	12	1 681		-		521	508	2 740	
1970	170	13	2 161		6		1 126	391	3 867	
1971	175	4	2 635		-		1 025	440	4 279	
1972	163	14	1 866		17		855	327	3 242	
1973	139	5	1 735		-		889	367	3 135	
1974	148	4	2 180		13		564	248	3 157	
1975	153	8	1 802	288	-		293	279	2 248	575
1976*	146	5	1 349	388	-		378	306	1 873	699

*) Preliminary figures as reported.

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

NB. All combined VIId,e figures, and the 1975 data, are from Bulletin Statistique. All others are from national statistics.

Table 5.2 Division VIIe Plaice.
Nominal catch (metric tons) and catch per
effort (metric tons per 1 000 fishing hours).

1	2	3	4	5	6	7
	Estimated ¹⁾ total catch (A)	U.K. (Brixham) c.p.u.e. (B)	U.K. total catch	Brixham catch	Brixham otter trawl catch	A/B = f
1969	814	5.17	508	294	282	157.4
1970	793	3.70	391	222	204	214.3
1971	918	2.74	440	218	173	335.0
1972	677	2.34	327	211	131	289.3
1973	684	1.98	367	237	105	345.5
1974	644	2.01	248	170	70	320.4
1975	575	1.95	279	278	63	294.9
1976	699	1.84 ¹⁾	306 ¹⁾	162 ¹⁾	?	380.9 ¹⁾

¹⁾ Estimated - see text.

Table 5.3 Division VIIe Plaice.
Age composition of total catch 1969-76 (thousands).

Males

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976
1	20.3	38.5	.4	20.9	3	29	2.9	11.6
2	86	187.6	299	155.6	132.5	80.7	244.3	63.8
3	335.2	365	534	393.1	248.4	202.7	159.9	390.3
4	238.2	174.8	192.2	148.4	263.6	153.9	64.3	80.4
5	68.7	46.6	122.7	72.6	64.3	89.5	31.5	40.4
6	246.2	40	37	21.3	50.1	36.9	21.1	27
7	27.7	132.6	12.2	11.9	19.3	35.4	26.1	30.5
8	11.4	11.9	117.4	7.3	7.5	18.2	15.3	22.8
9	4.2	13.7	1.8	30.6	4.5	3	6.4	9.1
10	11.1	5.3	8.1	6.3	40	.7	4.2	5.6
11	12	1.3	1.4	6.5	2.5	40.5	2.5	2.7
12	.4	4.2	12.5	1.8	1	.4	22.2	.1

NB. The last group is not a plus group.

ctd.

Table 5.3 (ctd) Division VIIe Plaice.
Fishing mortalities 1969-76.

Males

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976	Relative F in 1976
1	0.01	0.02	0.00	0.03	0.01	0.02	0.01	0.01	0.02
2	0.08	0.14	0.22	0.20	0.23	0.17	0.19	0.20	0.33
3	0.47	0.49	0.68	0.47	0.54	0.61	0.57	0.50	0.83
4	0.83	0.46	0.48	0.37	0.64	0.71	0.37	0.60	1.00
5	0.56	0.35	0.64	0.32	0.26	0.44	0.29	0.40	0.67
6	0.29	0.71	0.49	0.20	0.36	0.22	0.16	0.40	0.67
7	0.60	0.24	0.46	0.27	0.26	0.43	0.23	0.35	0.58
8	0.23	0.52	0.32	0.52	0.26	0.40	0.32	0.30	0.5
9	0.20	0.45	0.13	0.12	0.67	0.15	0.23	0.30	0.5
10	0.15	0.39	0.49	0.82	0.22	0.19	0.30	0.30	0.5
11	0.49	0.02	0.16	0.89	0.87	0.34	1.87	0.30	0.5
12	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.5
Mean F ≥ 7	0.33	0.25	0.33	0.21	0.26	0.37	0.28	0.32	
F ₃₋₆	.54	.50	.57	.34	.45	.50	.35	.48	

ctd.

Table 5.3 (ctd) Division VIIe Plaice.
Stock in numbers (thousands), 1969-76.

Males

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976
1	1 824	1 919	1 058	828	633	1 769	442	1 255
2	1 272	1 551	1 616	911	693	542	1 496	378
3	951	1 016	1 161	1 115	640	474	392	1 062
4	450	510	538	509	597	322	221	190
5	171	169	278	286	301	272	136	131
6	1 047	84	102	126	179	200	151	88
7	66	674	35	54	89	108	138	111
8	59	31	458	19	35	59	60	94
9	25	41	16	286	10	24	34	38
10	83	17	22	12	217	4	17	23
11	33	62	10	12	5	150	3	11
12	2	17	52	7	4	2	92	0

Table 5.4 Division VIIe Plaice.
Age composition of total catch 1969-76 (thousands).

Females

Year Age \	1969	1970	1971	1972	1973	1974	1975	1976
1	7.7	20.4	.2	2.4	.8	9.2	.7	4.2
2	53.2	120.4	117.4	60.9	67.9	70.3	126.3	46.2
3	286	228.2	322.2	241.7	170.8	182.6	118.9	344.6
4	121.1	144.6	136.7	118.2	204.5	157.3	95.5	105
5	46.7	62.1	76.8	60	62.1	72.7	53.1	90.6
6	251.1	41.6	42.8	50.4	30.6	33.9	56.4	38.4
7	36.6	145.7	24.6	24.1	19.1	42.6	28.5	35.3
8	14.1	27.7	108.3	22.5	13.7	14.3	16.7	22.7
9	34.1	18.4	7.5	55.3	6.6	21.2	6.3	7.1
10	23.7	13.1	14.3	6.7	48.7	9.1	9.8	8.2
11	5.1	6.1	7.8	3.9	4.9	28	4.3	6.6
12	1.8	11.2	10	6.8	6.1	3.1	24.9	4.3
13	2.7	3.9	5.2	4.8	4.3	1.6	3	20.2
14	4	3.9	1.5	7.4	3.7	1.4	4.4	6.5
15	2	.2	.7	3.9	1.1	3	5.9	1
16	.8	.5	1	1.4	.5	1.4	2.7	2.6
17	.7	.5	.5	.1	.5	3.3	3.9	2.8
18	.4	1.2	.9	.8	.5	.2	.7	3.1
19	.1	1.2	.8	.7	.3	.4	.4	1.6
20	.2	.9	.6	1.4	.6	.3	1.1	.6

NB. The last age group is not a plus group.

ctd.

Table 5.4 (ctd.) Division VIIe Plaice.
Fishing mortalities 1969-76.

Females

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976	Relative F in 1976
1	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.01	0.02
2	0.07	0.13	0.12	0.09	0.09	0.13	0.10	0.10	0.25
3	0.49	0.45	0.55	0.35	0.36	0.35	0.29	0.40	1.0
4	0.36	0.44	0.46	0.35	0.51	0.58	0.27	0.40	1.0
5	0.24	0.28	0.39	0.34	0.28	0.30	0.35	0.40	1.0
6	0.29	0.31	0.29	0.43	0.26	0.22	0.36	0.40	1.0
7	0.23	0.24	0.27	0.23	0.25	0.60	0.26	0.35	0.87
8	0.17	0.25	0.25	0.38	0.18	0.27	0.44	0.30	0.75
9	0.35	0.32	0.09	0.18	0.16	0.41	0.17	0.30	0.75
10	0.28	0.20	0.39	0.10	0.21	0.31	0.30	0.30	0.75
11	0.07	0.10	0.15	0.16	0.08	0.16	0.21	0.30	0.75
12	0.05	0.18	0.21	0.17	0.35	0.06	0.18	0.30	0.75
13	0.16	0.13	0.11	0.13	0.14	0.13	0.07	0.20	0.5
14	0.25	0.32	0.06	0.20	0.13	0.06	0.54	0.20	0.5
15	0.31	0.02	0.08	0.19	0.04	0.13	0.32	0.20	0.5
16	0.10	0.11	0.09	0.20	0.03	0.05	0.15	0.20	0.5
17	0.05	0.08	0.13	0.01	0.09	0.25	0.19	0.20	0.5
18	0.07	0.11	0.17	0.29	0.06	0.04	0.07	0.20	0.5
19	0.02	0.28	0.09	0.18	0.15	0.06	0.10	0.20	0.5
20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.5
Mean F ≥ 10	0.16	0.16	0.18	0.15	0.17	0.14	0.20	0.23	
\bar{F}_{3-6}	.35	.37	.42	.37	.35	.36	.32	.40	

ctd.

Table 5.4 (ctd) Division VIIe Plaice.
Stock in numbers (thousands), 1969-76.

Females

Age \ Year	1969	1970	1971	1972	1973	1974	1975	1976
1	1 122	1 195	796	880	685	1 493	564	444
2	791	1 008	1 062	720	794	619	1 342	510
3	770	665	797	849	593	654	493	1 095
4	418	425	385	417	539	375	418	334
5	230	264	248	219	265	294	190	288
6	1 057	164	180	152	141	181	198	122
7	184	718	109	122	89	99	131	125
8	92	132	511	75	87	63	49	92
9	121	70	93	360	46	66	43	29
10	100	77	46	77	273	36	40	33
11	83	68	58	28	63	201	24	27
12	40	70	56	45	22	53	155	17
13	19	35	53	41	34	14	45	117
14	19	15	28	43	33	27	11	38
15	8	13	10	24	32	26	23	6
16	9	5	12	8	18	28	21	15
17	14	7	4	10	6	16	24	16
18	6	12	6	3	9	5	11	18
19	6	5	10	5	2	7	4	9
20	1	5	3	8	3	2	6	3

Table 5.5 Length and weight at age of
Division VIIe Plaice based on U.K.(Brixham)
samples 1969 to 1975. Figures in brackets
achieved by extrapolation

Age	Males		Females	
	Length (cm)	Weight (g)	Length (cm)	Weight (g)
1	28.15	235	27.96	230
2	30.12	286	30.82	308
3	31.89	339	33.95	411
4	33.06	377	36.44	506
5	34.08	412	38.20	584
6	35.03	447	40.12	677
7	35.81	477	41.37	743
8	37.07	528	42.53	808
9	38.07	578	44.32	914
10	38.07	572	45.21	971
11	38.26	580	47.31	1 112
12	39.50	638	48.50	1 199
13	39.50	546	48.19	1 179
14	39.26	626	50.65	1 368
15	40.62	692	51.80	1 464
16	41.13	718	53.89	1 648
17	-	(728)	52.79	1 551
18	42.50	792	53.76	1 642
19	-	(751)	53.98	1 665
20	-	(760)	53.49	1 624

NB. a in $W = al^3$ = 0.010238

Table 5.6 Yield per recruit for Division VIIe Plaice
for the sexes separate and combined (g)

\bar{F}	$Y_{W/R}$ corresponding to $F\sigma$ or $F\varphi$		Implied F		$Y_{N/R}$ corresponding to \bar{F}			$\sigma + \varphi$
	σ	φ	σ	φ	σ	φ		
0.05	73	211	.06	.04	75	165		134
0.1	122	307	.12	.08	120	245		204
0.15	156	351	.18	.12	155	290		249
0.2	181	372	.24	.16	175	315		274
0.25	199	381	.3	.2	190	330		291
0.3	213	383	.36	.24	205	340		305
0.4	232	382	.48	.32	225	345		319
0.6	251	373	.72	.48	230	340		319
0.8	260	364	.96	.64	235	330		316
1.0	264	357	1.2	.8	240	325		316
1.2	267	352	1.44	.96	240	320		314
1.5	269	345	1.8	1.2	242	315		312

NB. $F\sigma = 1.2 \bar{F}$, $F\varphi = 0.8 \bar{F}$

where $F\sigma$ and $F\varphi$ correspond to the maximum Fs in the F at age arrays for males and females, respectively at age 4 and at ages 3 to 6.

Table 5.7 Division VIIe Plaice.

Variation in recruitment from 1962 to 1976 as indicated by the c.p.u.e of the length group 25-29.9 cm.

Year	25-29.9 cm U.K. catch in thousands		U.K. catch Brixham cpue	c.p.u.e	
	♀	♂		♀	♂
1962	121	126	112.6	1.075	1.119
1963	126	212	88.1	1.430	2.406
1964	135	233	76.0	1.776	3.066
1965	260	316	65.1	3.993	4.854
1966	190	579	64.5	2.946	8.977
1967	114	610	64.4	1.770	9.472
1968	64	205	57.6	1.111	3.559
1969	46	147	98.3	0.468	1.495
1970	43	143	105.7	0.407	1.353
1971	43	176	160.6	0.268	1.096
1972	37	114	139.7	0.265	0.816
1973	16	47	185.4	0.086	0.254
1974	12	27	123.4	0.097	0.219
1975	24	67	143.1	0.168	0.468
1976	48	16	166.3	0.289	0.096

Table 5.8 Division VIIId Plaice.
Catch at age in thousands.

Age	Male		Female	
	1975	1976	1975	1976
1	0	139.3	0	86.7
2	1 200.6	346.4	857.1	223.5
3	888.0	644.4	875.3	782.5
4	472.6	310.3	306.3	449.2
5	270.1	122.8	263.0	253.6
6	44.5	48.3	178.4	179.3
7	7.8	42.3	57.0	154.0
8	22.4	4.1	49.0	90.9
9	11.2	9.2	26.3	22.0
10	41.7	7.8	28.4	53.8
11+/11	22.4	30.7	13.4	16.8
12			60.5	36.6
13			11.8	78.6
14			16.0	16.7
15			4.1	26.2
16			20.8	8.7
17			5.4	13.7
18			2.4	4.7
19			0	6.4
20			6.1	0.7
21+			15.6	8.8

Table 6.1 Bristol Channel Sole in Division VIIIf.
Nominal catch 1962-76.

Year	Belgium	France	U.K. England & Wales	Total
1962	335	45	215	595
1963	174	61	122	357
1964	471	77	111	659
1965	498	72	75	645
1966	248	150	112	510
1967	451	83	209	743
1968	292	179	127	598
1969	289	194	168	651
1970	567	118	145	830
1971	595	40	131	766
1972	343	82	123	548
1973	416	240	122	778
1974	545	24	94	663
1975	453	20	92	565
1976*	412	20	86	518

* Preliminary figures as reported.

Table 6.2 Effort and catch per unit effort of
the Belgian sole landings by the beam
trawl in the Bristol Channel
(period 1971-76).

Year	Hours fishing	Catch per hour fishing
1971	42 238	16.8
1972	30 738	13.8
1973	27 657	17.9
1974	34 927	18.3
1975	41 978	15.4
1976	28 979	18.5

Table 6.3 Bristol Channel Sole in Division VIIId.
Age composition of total catch 1970-76 (thousands).

Males

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	30	137	100	197	50	31	8
3	476	143	284	664	157	122	75
4	195	490	81	269	368	193	142
5	187	190	198	97	120	246	100
6	263	84	77	81	32	111	235
7	135	62	42	43	53	16	31
8	79	168	44	29	24	50	28
9	85	76	71	29	13	19	55
10	61	11	19	74	39	16	12
11	28	87	20	19	12	11	7
12	67	26	6	9	7	8	3
13	35	28	15	10	19	4	16
14	7	44	6	20	11	16	3
15	9	14	5	29	11	3	1
16	26	0.1	1	12	0.1	7	8

ctd.

Table 6.3 (ctd) Bristol Channel Sole in Division VIIIf.
Landing mortalities in 1970-76.

Males

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	0.05	0.12	0.04	0.23	0.07	0.09	0.10
3	0.30	0.30	0.33	0.36	0.25	0.23	0.30
4	0.32	0.49	0.25	0.53	0.30	0.50	0.41
5	0.51	0.53	0.34	0.46	0.43	0.30	0.46
6	0.69	0.40	0.37	0.20	0.24	0.78	0.47
7	0.22	0.30	0.31	0.32	0.18	0.16	0.46
8	0.37	0.42	0.33	0.33	0.27	0.22	0.42
9	0.60	0.64	0.28	0.33	0.22	0.32	0.36
10	0.25	0.12	0.29	0.46	0.86	0.40	0.30
11	0.17	0.60	0.31	0.45	0.11	0.55	0.27
12	0.63	0.21	0.07	0.20	0.27	0.09	0.25
13	0.23	0.52	0.17	0.13	0.72	0.21	0.23
14	0.28	0.44	0.18	0.31	0.19	3.37	0.22
15	2.82	1.25	0.07	6.43	0.25	0.06	0.22
16	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Mean F ≥ 5	0.45	0.46	0.23	2.05	0.27	0.29	0.34

ctd.

Table 6.3 (ctd) Bristol Channel Sole in Division VIIIf.
Stock in numbers (thousands), 1970-76.

Males

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	672	1 304	2 672	1 019	734	368	88
3	1 951	579	1 050	2 322	735	617	303
4	742	1 313	388	681	1 472	516	442
5	492	487	724	275	361	983	284
6	550	268	260	468	157	213	656
7	713	249	163	163	346	111	88
8	269	517	166	108	106	263	85
9	198	168	309	109	70	74	191
10	286	98	80	212	71	51	49
11	186	201	79	55	122	27	31
12	1 838	141	100	52	31	99	14
13	180	887	103	84	39	22	82
14	30	130	478	79	67	17	16
15	10	20	76	362	53	50	1
16	1	1	5	64	1	37	42

Table 6.4 Bristol Channel Sole in Division VIIIf.
Age composition of total catch 1970-76 (thousands).

Females

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	1	75	44	94	38	13	9
3	131	26	85	387	93	87	80
4	61	77	59	101	182	76	48
5	91	57	173	67	138	229	80
6	66	75	60	126	78	102	149
7	189	123	38	33	95	50	87
8	49	106	47	23	33	89	29
9	44	47	65	36	48	28	46
10	43	28	32	55	45	23	16
11	36	41	13	20	55	18	6
12	14	64	16	13	28	30	4
13	25	4	43	13	16	15	25
14	1	1	12	32	21	7	24
15	8	21	9	19	24	5	9
16	11	12	2	14	10	18	22

ctd.

Table 6.4 (ctd) Bristol Channel Sole in Division VIIIf.
Fishing mortalities 1970-76.

Females

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	0.00	0.06	0.02	0.11	0.06	0.01	0.03
3	0.08	0.04	0.08	0.25	0.13	0.17	0.08
4	0.09	0.06	0.11	0.12	0.16	0.14	0.13
5	0.18	0.10	0.15	0.15	0.21	0.27	0.19
6	0.13	0.20	0.13	0.14	0.23	0.22	0.25
7	0.13	0.33	0.13	0.09	0.14	0.21	0.26
8	0.04	0.09	0.18	0.10	0.11	0.17	0.16
9	0.10	0.05	0.07	0.18	0.28	0.11	0.11
10	0.04	0.07	0.04	0.07	0.32	0.18	0.08
11	0.04	0.05	0.04	0.03	0.08	0.18	0.06
12	0.04	0.09	0.02	0.05	0.04	0.05	0.05
13	0.06	0.01	0.07	0.02	0.07	0.03	0.05
14	0.00	0.00	0.04	0.06	0.04	0.03	0.05
15	0.03	0.38	0.03	0.08	0.06	0.01	0.05
16	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Mean F \geq 5	0.07	0.09	0.06	0.06	0.09	0.08	0.09

ctd.

Table 6.4 (ctd) Bristol Channel Sole in Division VIIIf.
Stock in numbers (thousands), 1970-76.

Females

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	784	3 319	2 106	959	640	1 221	320
3	1 775	710	1 122	1 864	778	543	1 093
4	752	1 481	617	935	1 319	616	413
5	576	623	1 267	503	750	1 021	485
6	581	435	509	982	391	547	706
7	1 602	463	322	404	769	280	398
8	1 187	1 270	303	255	334	606	206
9	504	1 028	1 048	229	209	271	464
10	1 037	414	885	887	173	144	219
11	889	897	348	771	750	114	108
12	383	771	773	303	678	627	86
13	445	333	636	684	262	587	538
14	77	379	298	535	607	222	517
15	294	70	343	258	454	529	194
16	237	258	43	302	215	388	474

Table 6.5 Bristol Channel Sole. Prognosis for catch and stock in 1977 and 1978 and long-term increase in stock biomass for Case A (Catch₁₉₇₇ = TAC₁₉₇₇)

Prognosis				Long-term steady state situation	
Year	Maximum Fat age	Catch in tons	Stock at the beginning of the year in tons	Expected catch in tons	
	♂ ♀	♂ + ♀			
1976	0.47 0.26	520	3 804		
1977	0.65 0.50	687	3 321		Average recruitment =
1978	0.0	-	2 999		2.8×10^6
	0.1	121		362	
	0.2	234		502	
	0.3	340		559	
	0.4	440		583	
	0.5	537		589	
max → yield	0.6	628		590	
	0.7	714		588	
	0.8	796		582	
	0.9	871		575	
	1.0	945		570	

Table 6.6 Bristol Channel Sole. Prognosis for catch and stock in 1977 and 1978 and long-term increase in stock biomass for Case B (Catch₁₉₇₇ = Catch₁₉₇₆)

Prognosis				Long-term steady state situation	
Year	Maximum Fat age	Catch in tons	Stock at the beginning of the year in tons	Expected catch in tons	
	♂ ♀	♂ + ♀			
1976	0.47 0.26	520	3 804		
1977	0.55 0.35	524	3 321		Average recruitment =
1978	0.0	0	3 151		2.8×10^6
	0.1	128		362	
	0.2	250		502	
	0.3	364		559	
	0.4	473		583	
	0.5	574		589	
max → yield	0.6	671		590	
	0.7	764		588	
	0.8	842		582	
	0.9	931		575	
	1.0	1 009		570	

Table 7.1 Bristol Channel Plaice.
Nominal catch in Division VIIf, 1962-76.

Year	Belgium	France	U.K. (England & Wales)	Total
1962	73	4	205	282
1963	55	1	173	229
1964	184	3	204	391
1965	224	10	272	506
1966	113	21	467	601
1967	137	-	655	792
1968	260	669	521	1 450
1969	202	668	506	1 376
1970	226	102	501	829
1971	202	-	545	747
1972	137	110	377	624
1973	158	-	381	539
1974	154	-	210	364
1975	137	147	184	468
1976*	78	97	134	303

* Preliminary figures as reported.

Table 7.2 Bristol Channel Plaice.
Age composition of total catch, 1970-76 (thousands).

Males

Year Age \	1970	1971	1972	1973	1974	1975	1976
2	8.3	9.4	43.8	3.4	2.5	15.6	41
3	55.5	138.7	109	48	78.2	92.2	115.1
4	206.7	164.5	247.7	181.3	68.1	54.4	116.4
5	229.7	107	44.6	189.3	79	74.5	58.1
6	277.2	65.9	104	58.5	36.1	40.5	21.6
7	109.7	44.5	25.3	1.6	21.5	15.6	10.2
8	329.4	18.4	18.5	3.1	1	1.4	5.7

ctd.

Table 7.2 (ctd) Bristol Channel Plaice.
Fishing mortalities 1970-76.

Males

Year Age \	1970	1971	1972	1973	1974	1975	1976
2	0.01	0.02	0.13	0.01	0.01	0.03	0.07
3	0.14	0.20	0.24	0.19	0.33	0.28	0.28
4	0.57	0.68	0.59	0.72	0.42	0.38	0.64
5	1.08	0.63	0.37	1.24	0.77	1.06	0.83
6	1.39	1.04	3.27	1.14	0.79	1.15	1.00
7	1.44	0.84	1.69	0.63	2.22	0.91	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mean F ≥ 2	1.02	0.74	0.93	0.96	0.69	0.74	0.74

ctd.

Table 7.2 (ctd) Bristol Channel Plaice.
Stock in numbers (thousands), 1970-76.

Males

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	983	654	396	352	473	604	653
3	472	839	554	300	300	405	506
4	506	355	594	376	214	186	263
5	370	245	154	283	157	121	110
6	391	108	112	92	71	63	36
7	152	84	33	4	25	28	17
8	554	31	31	5	2	2	10

Table 7.3 Bristol Channel Plaice.
Age composition of total catch, 1970-76 (thousands).

Females

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	18	2.7	13	0	6.8	41.2	35
3	98.8	515.8	228.4	205	88.1	354.1	82.9
4	181.9	388.7	362.1	282.1	126.8	160.5	99.9
5	184	137.7	103	138.9	131.3	56.3	57.4
6	64.4	29.7	100.2	24.2	70.8	76.9	23.7
7	50.2	34.5	27.5	14.8	19.9	32.8	14.2
8	27.1	38	11.9	6.2	11.7	16.2	15.4
9	1.6	6.9	12.7	18.3	9.1	9.4	5.9
10	1.6	3.8	4.3	7.5	9	6.2	6.7
11	.9	1.6	4.3	5.5	2.2	4.4	2.5

ctd..

Table 7.3 (ctd.) Bristol Channel Plaice.
Fishing mortalities 1970-76.

Females

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	0.01	0.00	0.02	0.00	0.01	0.05	0.04
3	0.14	0.51	0.31	0.53	0.25	0.96	0.12
4	0.41	1.01	0.71	0.68	0.66	0.82	0.70
5	0.97	0.54	0.72	0.58	0.69	0.61	0.70
6	0.46	0.35	0.87	0.32	0.58	1.02	0.50
7	0.50	0.42	0.56	0.26	0.42	0.52	0.45
8	0.58	0.79	0.22	0.21	0.30	0.62	0.44
9	0.08	0.25	0.58	0.54	0.46	0.37	0.43
10	0.28	0.25	0.22	0.73	0.50	0.58	0.43
11	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Mean F ≥ 2	0.56	0.74	0.69	0.58	0.61	0.74	0.61

ctd.

Table 7.3 (ctd) Bristol Channel Plaice.
Stock in numbers (thousands), 1970-76.

Females

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	1 523	1 000	586	468	668	894	938
3	808	1 361	902	518	423	598	770
4	569	638	743	600	275	299	207
5	309	343	210	330	276	129	119
6	184	106	180	93	167	125	63
7	133	106	68	68	61	84	41
8	64	73	63	35	48	36	45
9	22	32	30	46	26	32	18
10	7	18	23	15	24	15	20
11	3	5	13	16	7	13	7

Table 7.4 Bristol Channel Plaice.
Relative fishing mortalities in
1976, used in yield per recruit
calculations and catch prognoses.

Age	Males	Females
2	.07	.06
3	.28	.17
4	.64	1.0
5	.83	1.0
6	1.0	.71
7	1.0	.64
8	1.0	.63
9		.61
10		.61
11		.61

Table 7.5

Bristol Channel Plaice.
 Prognoses of catch and biomass (metric tons)
 in 1977 and 1978 for different management
 strategies.

Year	Females			Males			Total		Remarks
	F	Catch	Biomass	F	Catch	Biomass	Catch	Biomass	
1976	0.7	186	900	1.0	117	440	303	1 340	
1977	1.6	446	909	1.82	184	610	630	1 519	1977 TAC reached
1978	1.6	364	862	1.82	149	374	738	1 236	$F_{1978} = F_{1977}$
1977	1.0	334	1 032	1.12	133	445	467	1 477	Assume F_{1977} increases 40%
1978	1.0	338	1 024	1.12	132	439	470	1 463	$F_{1978} = F_{1977}$
1977	0.7	259	1 114	1.0	122	456	381	1 570	$F_{1977} = F_{1976}$
1978	0.7	297	1 159	1.0	127	454	424	1 613	$F_{1978} = F_{1976, 1977}$
1978	0.25	89	1 172	0.24	28	496	117	1 668	1977 TAC reached, $F_{1978} = \text{MSY}$
1978	0.7	262	1 109	1.0	122	450	384	1 559	Assume F_{1977} increases 40% $F_{1978} = F_{1976}$
1978	0.25	111	1 280	0.24	36	537	147	1 817	Assume F_{1977} increases 40% $F_{1978} = \text{MSY}$

Table 8.1 Irish Sea Sole.
Nominal catch (metric tons) in Division VIIa, 1962-76.

Year	Belgium	France	Ireland	Netherlands	U.K.			Total
					England & Wales	N.Ireland	Scotland	
1962	40	45	37	-	464	-	-	586
1963	64	43	25	-	323	+	-	455
1964	938	242	40	-	380	+	-	1 600
1965	1 025	228	29	13	344	1	-	1 640
1966	407	367	14	-	288	7	-	1 083
1967	307	361	22	-	320	12	-	1 022
1968	332	125	23	-	456	10	-	946
1969	841	97	34	3	417	17	-	1 409
1970	1 142	115	25	235	291	24	1	1 833
1971	883	45	45	552	356	40	1	1 922
1972	561	38	50	514	278	40	9	1 490
1973	793	12	27	281	315	46	11	1 485
1974	664	54	28	320	218	23	-	1 330
1975	805	59	24	234	281	24	15	1 442
1976*	671	63	92	278	250	46	3	1 383

* Preliminary figures as reported.

N.B. +: catch less than 1 ton.

Table 8.2 Catch per unit effort
(kg/h.p.) of the Belgian beam-trawl catches during the second quarter over the period 1971-76.

Year	kg/h.p.
1971	26.7
1972	25.9
1973	25.3
1974	21.1
1975	24.1
1976	25.2

Table 8.3 Irish Sea Sole.
Age composition of total catch
(thousands), 1970-76.

Year Age \	1970	1971	1972	1973	1974	1975	1976
2	12	27	11	56	24	104	17
3	488	94	270	178	370	349	108
4	565	1 094	417	1 145	239	1 085	267
5	321	660	568	289	654	302	335
6	571	123	166	349	179	337	52
7	39	485	68	146	154	63	211
8	95	132	241	98	132	101	70
9	260	38	22	185	25	91	140
10	74	131	16	15	130	58	40
11	257	264	127	76	33	46	9
12	46	73	52	83	40	15	25
13	9	181	31	48	71	19	8
14	9	15	36	18	82	61	-
15	4	18	1	32	43	11	10

ctd.

Table 8.3 (ctd) Irish Sea Sole.
Fishing mortalities 1970-76.

Males

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	0.01	0.01	0.01	0.02	0.02	0.06	0.01
3	0.12	0.06	0.07	0.19	0.15	0.29	0.08
4	0.28	0.40	0.35	0.43	0.37	0.72	0.34
5	0.46	0.54	0.33	0.38	0.42	0.96	0.45
6	0.32	0.29	0.22	0.30	0.38	0.35	0.37
7	0.11	0.43	0.23	0.28	0.19	0.20	0.34
8	0.31	0.58	0.35	0.52	0.38	0.16	0.32
9	0.31	0.17	0.16	0.44	0.21	0.44	0.32
10	0.11	0.23	0.09	0.14	0.55	0.92	0.31
11	0.42	0.60	0.32	0.71	0.44	0.34	0.30
12	0.09	0.18	0.20	0.31	0.92	0.33	0.28
13	0.33	0.53	0.10	0.26	0.42	1.53	0.26
14	0.08	1.24	0.17	0.07	0.80	0.69	0.24
15	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Mean F \geq 4	0.26	0.39	0.24	0.32	0.36	0.34	0.32

NB. The last group is not a plus group.

ctd.

Table 8.3 (ctd) Irish Sea Sole.
Stock in numbers (thousands), 1970-76.

Males

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	1 941	4 522	1 212	3 179	1 615	1 740	-
3	4 392	1 745	4 066	1 086	2 823	1 439	1 475
4	2 425	3 510	1 489	3 423	814	2 203	971
5	909	1 658	2 139	952	2 012	510	968
6	2 207	519	875	1 397	588	1 201	176
7	387	1 456	353	635	933	362	767
8	375	313	858	255	436	698	268
9	1 026	249	159	548	138	269	536
10	750	682	189	123	320	101	157
11	790	608	492	156	97	167	36
12	554	472	301	325	70	56	107
13	34	457	357	223	215	25	37
14	125	22	242	294	156	128	5
15	23	104	6	185	249	64	58

Table 8.4 Irish Sea Sole.
Age composition of total catch 1970-76 (thousands).

Females

<u>Age</u> <u>Year</u>	1970	1971	1972	1973	1974	1975	1976
2	21	83	22	338	25	150	24
3	935	319	553	190	797	327	238
4	763	1 082	301	975	326	1 252	607
5	105	538	944	254	782	217	1 508
6	730	116	294	425	209	474	187
7	162	394	150	140	259	22	358
8	50	18	330	15	124	135	72
9	299	48	72	148	43	57	129
10	187	206	45	52	110	26	50
11	304	99	79	38	18	87	8
12	60	165	84	66	34	6	78
13	23	120	188	80	49	4	27
14	24	34	69	67	44	38	7
15	51	28	57	39	27	29	31

ctd.

Table 8.4 (ctd) Irish Sea Sole.
Fishing mortalities 1970-76.

Females

Age \ Year	1970	1971	1972	1973	1974	1975	1976
2	0.01	0.01	0.01	0.04	0.01	0.09	0.02
3	0.19	0.21	0.12	0.12	0.10	0.12	0.17
4	0.35	0.31	0.27	0.27	0.28	0.20	0.31
5	0.19	0.39	0.42	0.34	0.32	0.27	0.35
6	0.31	0.29	0.34	0.31	0.46	0.30	0.35
7	0.32	0.25	0.67	0.24	0.28	0.07	0.34
8	0.17	0.05	0.30	0.11	0.31	0.20	0.31
9	0.32	0.22	0.24	0.19	0.46	0.21	0.27
10	0.27	0.33	0.29	0.24	0.19	0.50	0.25
11	0.37	0.20	0.18	0.37	0.11	0.20	0.25
12	0.12	0.31	0.23	0.21	0.58	0.04	0.25
13	0.06	0.34	0.61	0.32	0.21	0.11	0.25
14	0.16	0.11	0.30	0.40	0.27	0.22	0.25
15	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mean F ≥ 4	0.28	0.25	0.33	0.26	0.29	0.23	0.31

NB. The last group is not a plus group.

ctd.

Table 8.4 (ctd) Irish Sea Sole.
Stock in numbers (thousands), 1970-76.

Females

Year Age \	1970	1971	1972	1973	1974	1975	1976
2	2 017	5 971	1 958	10 107	3 321	1 923	-
3	5 723	1 805	5 324	1 751	8 823	2 981	1 597
4	2 721	4 291	1 331	4 292	1 404	7 227	2 387
5	638	1 739	2 856	918	2 958	961	5 350
6	2 850	478	1 063	1 690	590	1 935	663
7	628	1 887	322	683	1 126	336	1 302
8	340	415	1 333	150	486	773	283
9	1 157	260	358	893	121	322	572
10	827	763	190	256	668	69	237
11	1 035	571	495	129	182	500	38
12	540	649	423	373	81	148	370
13	394	431	430	303	275	41	128
14	172	334	277	212	198	202	33
15	242	133	270	185	128	137	147

Table 8.5 Irish Sea Sole.
 Prognosis for catch and stock in 1977 and 1978
 and long-term increase in stock biomass for Case A
 $(\text{Catch}_{1977} = \text{TAC}_{1977})$.

Year	Prognosis				Long-term steady state situation	
	Max. F at age		Catch in tons		Stock at the beginning of the year in tons	Expected catch in tons
	♂	♀	♂	+ ♀		
1976	0.45	0.35		1 504	5 850	
1977	0.80	0.55		1 728	5 664	
1978	0.0			-	5 114	
max. yield	0.1			275		967
	0.2			529		1 211
	0.3			763		1 279
	{ 0.4			980		1 294
	{ 0.5			1 182		1 286
	{ 0.6			1 370		1 278
	0.7			1 543		1 270
	0.8			1 703		1 252
	0.9			1 583		1 240
	1.0			1 991		1 227

Average recruitment = 7.9×10^6

Table 8.6 Irish Sea Sole.
 Prognosis for catch and stock in 1977 and 1978 and
 long-term increase in stock biomass for Case B
 (Catch₁₉₇₇ = Catch₁₉₇₆).

Year	Prognosis				Long-term steady state situation	
	Maximum F at age		Catch in tons	Stock at the beginning of the year in tons	Expected catch in tons	
	♂	♀	♂ + ♀			
1976	0.45	0.35	1 504	5 850		
1977	0.6	0.45	1 449	5 664		
1978	0.0		-	5 398		
	0.1		297		967	
	0.2		572		1 211	
	0.3		826		1 279	
max. yield	{ 0.4		1 060		1 294	
	{ 0.5		1 277		1 286	
	{ 0.6		1 478		1 278	
	0.7		1 663		1 270	
	0.8		1 835		1 252	
	0.9		1 996		1 240	
	1.0		2 144		1 227	

Table 9.1 Irish Sea Plaice.
Nominal catch (metric tons), 1962-76.

Year	Belgium	France	Ireland	Netherlands	U.K. (England & Wales)	U.K. (N.Ireland)	U.K. (Scotland)	Total
1962	11	54	594	-	1 436	28	20	2 143
1963	23	60	545	-	1 141	68	29	1 866
1964	253	147	844	-	1 388	185	62	2 879
1965	150	168	574	1	2 484	225	62	3 664
1966	72	562	782	-	2 527	174	151	4 268
1967	69	1 082	819	-	2 866	138	85	5 059
1968	152	40	1 449	-	2 764	178	112	4 695
1969	208	33	1 309	-	2 540	216	88	4 394
1970	305	250	909	8	1 869	184	58	3 583
1971	175	-	1 028	61	2 744	132	92	4 232
1972	179	440	863	48	3 366	134	89	5 119
1973	221	500	1 079	42	3 002	143	73	5 060
1974	247	132	891	47	2 240	104	54	3 715
1975	248	134	884	75	2 544	125	53	4 063
1976	135	110	866	73	1 934	120	46	3 284

Table 9.2 Irish Sea Plaice.
Age composition of total catch, 1964-76 (thousands).

Males

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	0	0	0	0	0	0	0	0	0	0	23
2	484	489	38	73	105	104	141	219	23	279	500	.171	715
3	399	1 182	1 367	330	672	928	859	1 356	1 268	1 127	845	1 832	1 795
4	504	835	1 711	2 241	1 076	1 185	749	1 702	1 953	2 090	1 286	2 300	1 112
5	311	246	937	187	1 480	793	1 012	726	670	1 119	897	816	412
6	455	160	295	357	566	244	495	586	205	337	463	184	221
7	92	204	73	284	112	188	141	116	147	120	39	29	171
8	1	157	90	23	10	5	72	55	185	98	10	76	72
9	1	21	1	72	1	1	5	65	35	41	19	29	15
10	154	1	1	88	1	33	5	27	1	28	1	76	26
11	1	1	1	37	1	33	1	5	1	32	1	1	16
12	1	1	1	23	1	1	59	1	1	26	20	1	6

ctd.

Table 9.2 (ctd) Irish Sea Plaice.
Fishing mortalities 1964-76.

Males

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.003
2	0.08	0.06	0.01	0.01	0.02	0.02	0.02	0.03	0.00	0.05	0.08	0.01	0.10
3	0.11	0.25	0.22	0.08	0.14	0.30	0.21	0.24	0.24	0.29	0.20	0.44	0.20
4	0.36	0.33	0.64	0.64	0.39	0.36	0.39	0.75	0.60	0.74	0.58	1.15	0.50
5	0.57	0.28	0.70	0.12	1.14	0.52	0.56	0.76	0.71	0.80	0.79	0.87	0.60
6	0.35	0.61	0.59	0.59	0.61	0.52	0.68	0.69	0.47	0.93	0.88	0.34	0.58
7	0.25	0.24	0.60	2.12	0.35	0.39	0.62	0.31	0.35	0.52	0.23	0.11	0.58
8	0.01	0.81	0.15	0.36	0.36	0.02	0.24	0.49	1.09	0.38	0.07	0.89	0.40
9	0.01	0.32	0.01	0.16	0.02	0.05	0.03	0.33	0.63	0.72	0.11	0.28	0.40
10	3.20	0.01	0.02	2.67	0.00	1.81	0.37	0.18	0.01	1.67	0.03	0.79	0.40
11	0.20	0.20	0.01	2.21	0.20	0.12	0.20	0.75	0.01	0.31	0.20	0.04	0.35
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	0.30

ctd.

Table 9.2 (ctd) Irish Sea Plaice.
Stock in numbers (thousands), 1964-76.

Males

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	10 568	6 152	7 684	5 386	6 782	9 379	8 791	6 538	7 183	8 017	14 572	9 389	8 268
2	7 203	9 096	5 295	6 614	4 636	5 838	8 073	7 567	5 627	6 183	6 900	12 543	8 081
3	4 164	5 751	7 376	4 522	5 625	3 893	4 928	6 818	6 310	4 822	5 063	5 476	10 637
4	1 805	3 214	3 858	5 085	3 587	4 220	2 493	3 448	4 615	4 259	3 110	3 576	3 025
5	765	1 088	1 996	1 747	2 316	2 095	2 538	1 455	1 404	2 175	1 747	1 493	976
6	1 672	372	709	857	1 331	641	1 072	1 253	586	593	845	680	537
7	450	1 019	173	339	409	625	327	468	540	315	202	303	415
8	97	302	689	82	35	249	364	151	296	329	161	138	234
9	153	83	116	510	49	21	209	247	80	85	193	129	49
10	167	131	52	99	372	42	17	176	153	36	36	149	85
11	6	6	112	44	6	319	6	10	126	131	6	30	58
12	4	4	4	95	4	4	244	4	4	108	83	4	25

Table 9.3 Irish Sea Plaice.
Age composition of total catch, 1964-76 (thousands).

Females

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	0	0	0	0	0	0	0	0	0	0	30
2	513	812	32	166	122	200	268	246	136	486	946	132	1 618
3	1 512	2 007	2 004	1 245	1 142	1 258	910	1 658	2 189	1 993	762	1 251	2 390
4	1 176	1 981	2 194	3 225	2 148	1 946	1 274	2 192	2 749	3 747	1 244	1 214	1 264
5	135	1 161	1 522	2 220	3 235	1 317	1 267	1 089	847	1 712	1 225	1 080	447
6	396	489	480	785	1 239	1 782	850	1 009	508	444	449	829	312
7	388	124	495	305	256	694	807	390	523	280	154	346	194
8	139	154	273	259	121	182	221	462	388	188	110	127	119
9	25	15	197	180	131	62	87	128	347	134	51	102	37
10	1	33	18	86	26	61	37	52	171	186	43	74	39
11	29	13	17	60	16	44	56	37	52	99	69	55	24
12	1	1	5	5	7	21	21	36	44	23	31	63	18
13	1	1	7	5	4	5	29	12	34	19	7	20	47
14	1	1	3	7	2	2	5	7	20	13	6	12	8
15	10	1	2	5	1	1	1	1	14	17	5	1	5

ctd.

Table 9.3 (ctd) Irish Sea Plaice.
Fishing mortalities 1964-76.

Females

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.003
2	0.04	0.05	0.00	0.02	0.02	0.03	0.03	0.02	0.02	0.12	0.15	0.01	0.18
3	0.21	0.20	0.14	0.16	0.16	0.25	0.18	0.22	0.25	0.42	0.24	0.26	0.20
4	0.34	0.42	0.31	0.30	0.42	0.39	0.37	0.72	0.59	0.79	0.45	0.66	0.40
5	0.06	0.59	0.59	0.51	0.49	0.43	0.43	0.56	0.59	0.81	0.57	0.78	0.48
6	0.30	0.29	0.46	0.61	0.53	0.49	0.48	0.63	0.49	0.63	0.45	0.86	0.48
7	0.40	0.13	0.48	0.52	0.37	0.56	0.38	0.38	0.71	0.48	0.41	0.65	0.44
8	0.64	0.24	0.41	0.44	0.36	0.43	0.31	0.35	0.70	0.53	0.32	0.63	0.43
9	0.27	0.11	0.49	0.47	0.36	0.28	0.33	0.26	0.43	0.50	0.23	0.48	0.33
10	0.03	0.59	0.17	0.36	0.10	0.26	0.24	0.30	0.57	0.38	0.26	0.54	0.30
11	0.75	0.48	0.62	1.16	0.09	0.22	0.35	0.36	0.48	0.69	0.21	0.54	0.30
12	0.03	0.04	0.30	0.33	0.33	0.15	0.14	0.36	0.82	0.36	0.42	0.27	0.30
13	0.08	0.03	0.42	0.50	0.42	0.37	0.29	0.10	0.59	0.94	0.16	0.46	0.30
14	0.18	0.10	0.11	0.87	0.34	0.34	0.69	0.10	0.21	0.42	0.79	0.39	0.30
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	0.25

ctd.

Table 9.3 (ctd) Irish Sea Plaice.
Stock in numbers (thousands), 1964-76.

Females

Age \ Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	21 030	10 552	10 091	7 522	7 444	11 134	12 747	7 559	5 083	8 120	17 048	11 390	10 524
2	13 545	19 028	9 548	9 131	6 806	6 736	10 074	11 534	6 840	4 600	7 347	15 425	10 306
3	8 237	11 768	16 446	8 609	8 104	6 043	5 905	8 861	10 202	6 060	3 700	5 750	13 832
4	4 246	6 018	8 743	12 977	6 607	6 248	4 274	4 479	6 444	7 155	3 595	2 625	4 016
5	2 377	2 727	3 569	5 830	8 684	3 943	3 810	2 660	1 981	3 230	2 934	2 074	1 227
6	1 590	2 023	1 369	1 789	3 173	4 794	2 320	2 247	1 376	991	1 305	1 496	857
7	1 238	1 063	1 366	784	876	1 698	2 650	1 295	1 078	764	476	756	571
8	309	752	844	768	420	550	880	1 633	802	481	426	285	357
9	111	148	534	505	449	266	325	587	1 040	359	258	281	138
10	40	77	120	297	286	282	182	212	409	612	198	185	158
11	57	36	39	91	187	234	198	129	142	209	378	138	97
12	38	24	20	19	26	154	170	126	82	80	95	276	73
13	14	33	21	13	12	17	120	134	80	33	50	57	190
14	6	12	29	13	7	7	10	81	110	40	12	39	32
15	47	5	9	24	5	5	5	5	66	81	24	5	24

Table 9.4 Irish Sea Plaice.

Relative fishing mortalities in 1976,
used in yield per recruit calculation and
prognoses.

Age	Males	Females
1	.005	.006
2	.17	.38
3	.33	.42
4	.83	.83
5	1.0	1.0
6	.97	1.0
7	.97	.92
8	.67	.90
9	.67	.69
10	.67	.63
11	.58	.63
12	.50	.63
13		.63
14		.63
15		.52

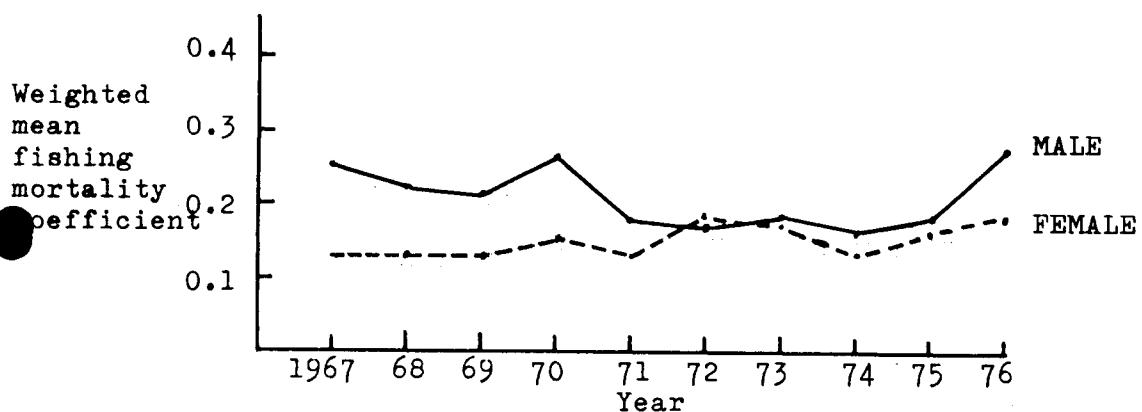
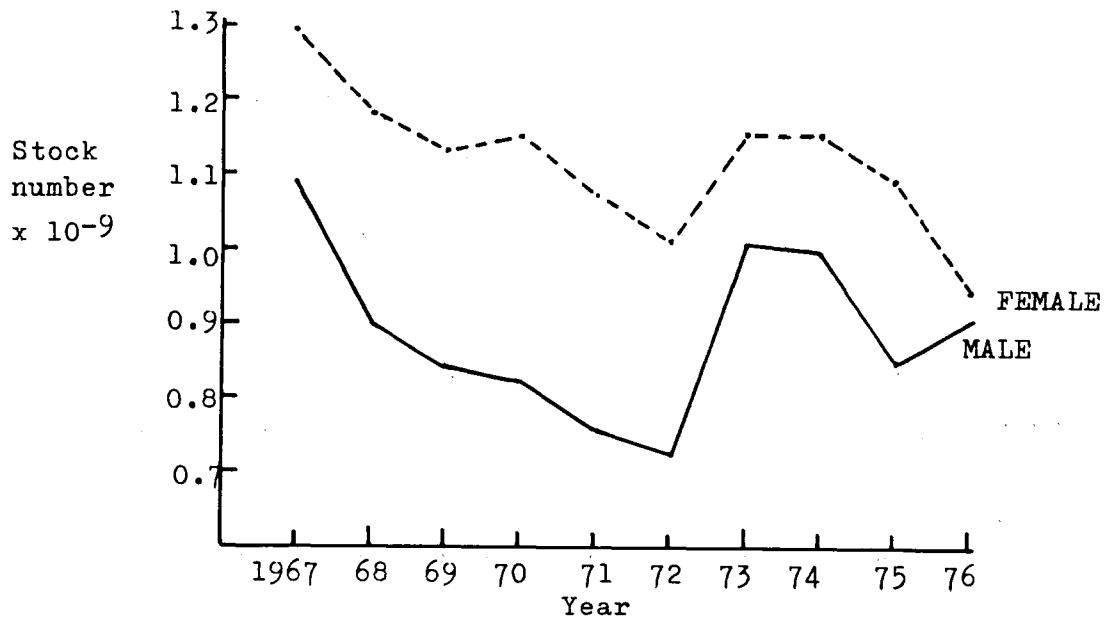


Figure 3.1 North Sea Plaice.

Trend in total stock number, and weighted mean fishing mortality coefficient with time, 1967-76.

Figure 5.1 Stock size of one year old plaice during 1962-76 according to VPA calculations.

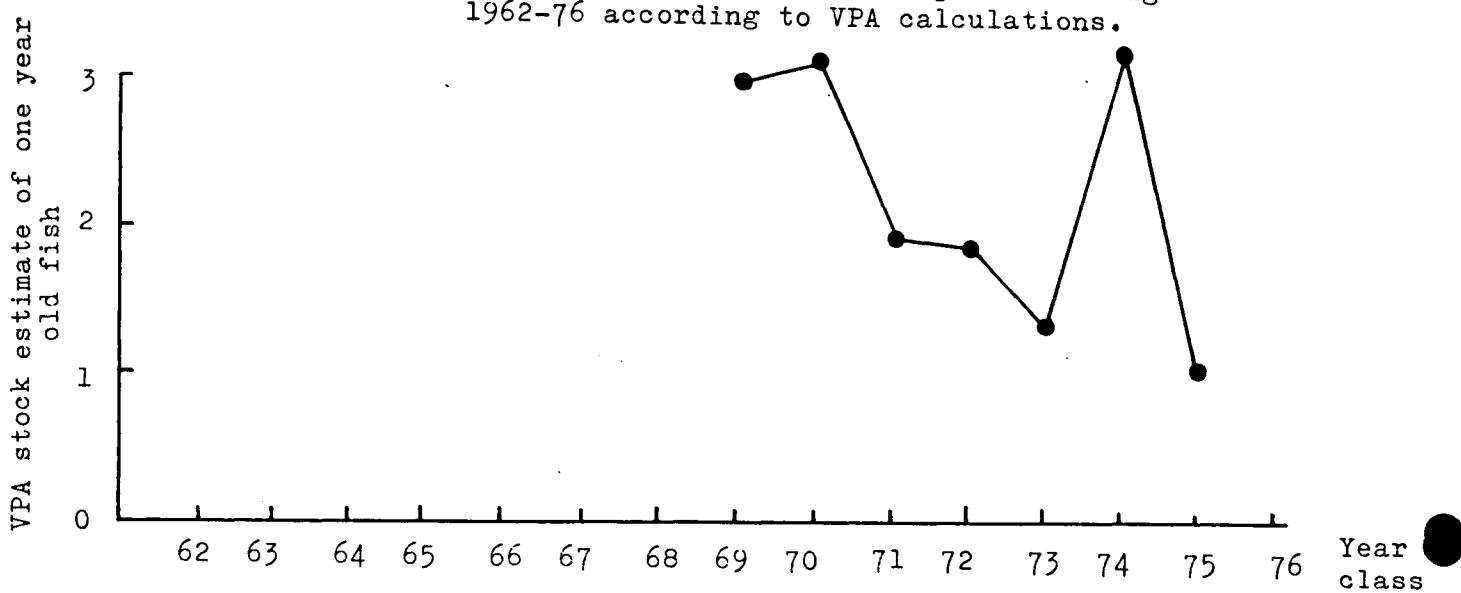
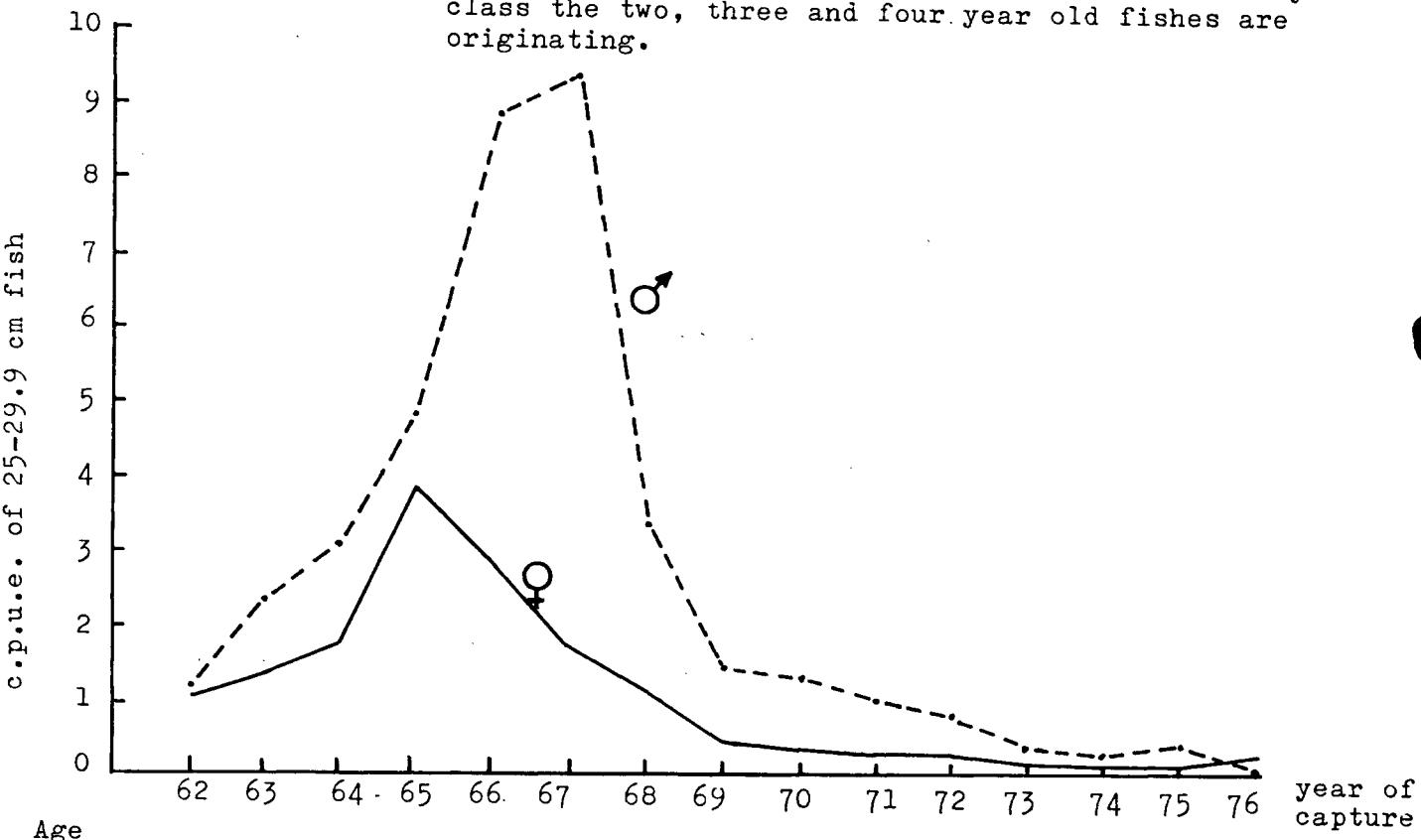


Figure 5.2 c.p.u.e. of plaice with size 25-29.9 cm during 1962-76, with for each year indicated from which year class the two, three and four year old fishes are originating.



Age	I	II	III												
	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74

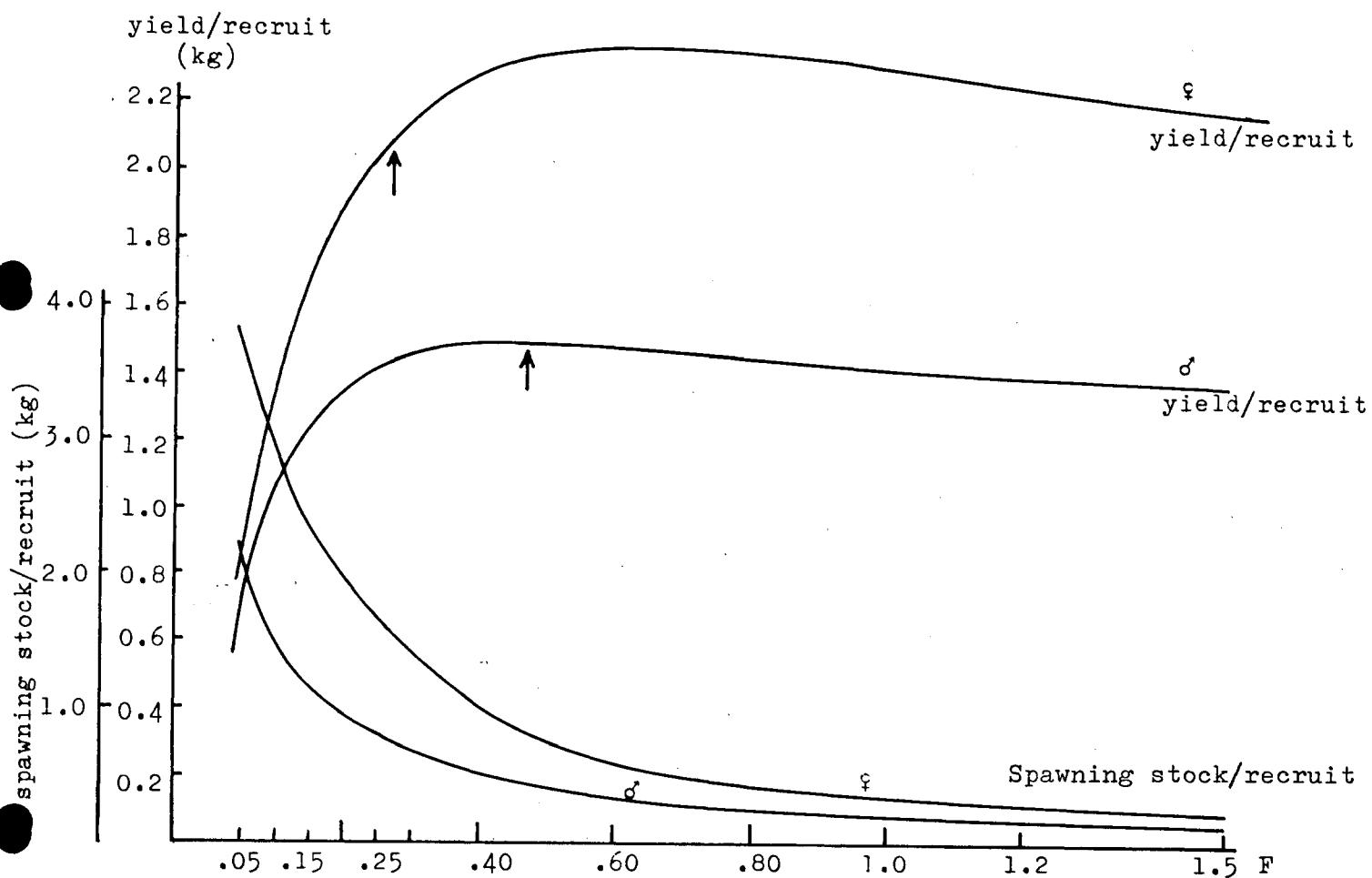


Figure 6.1 Bristol Channel Sole.
Yield per recruit and spawning stock biomass
per recruit curves.

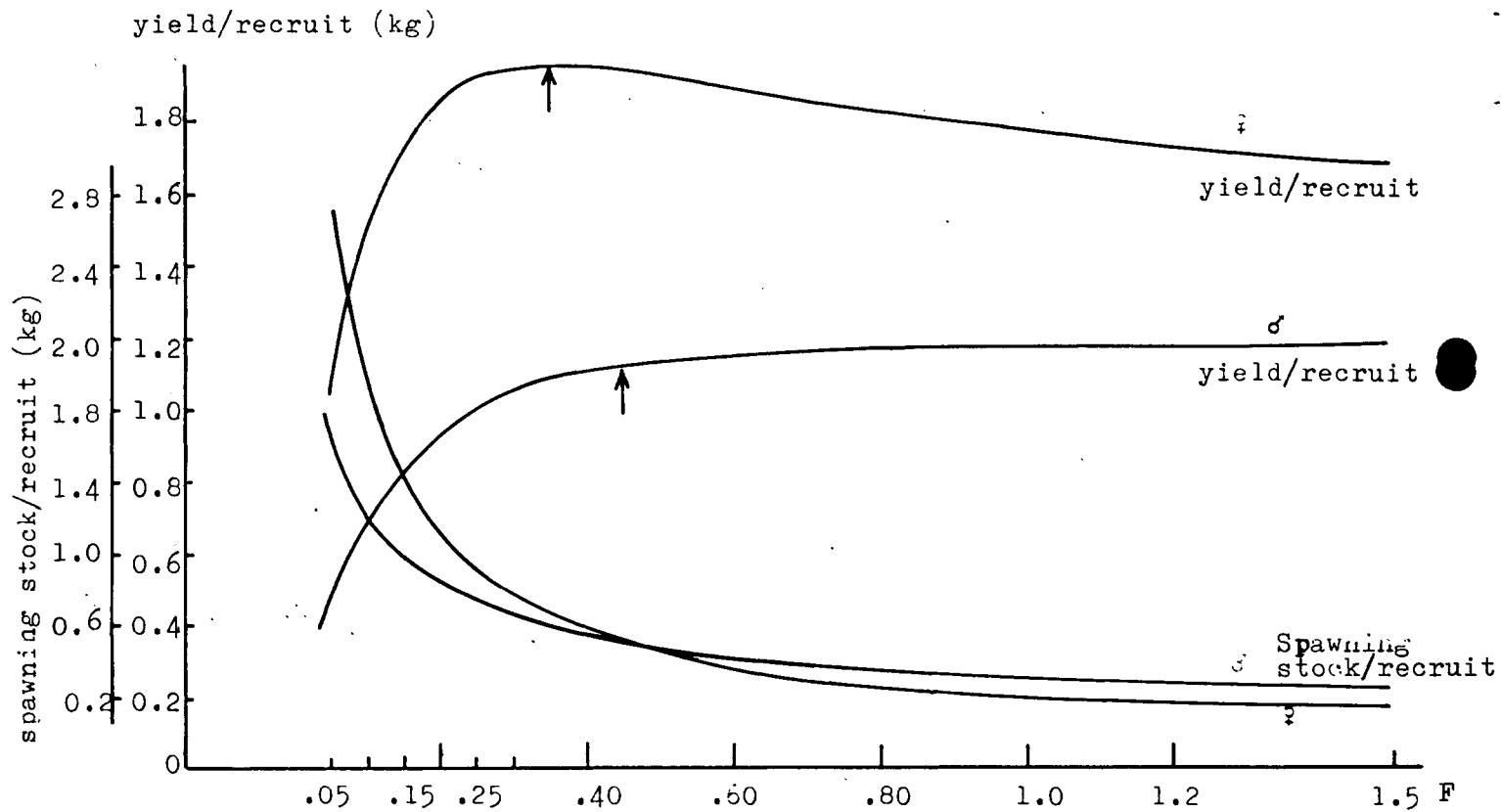
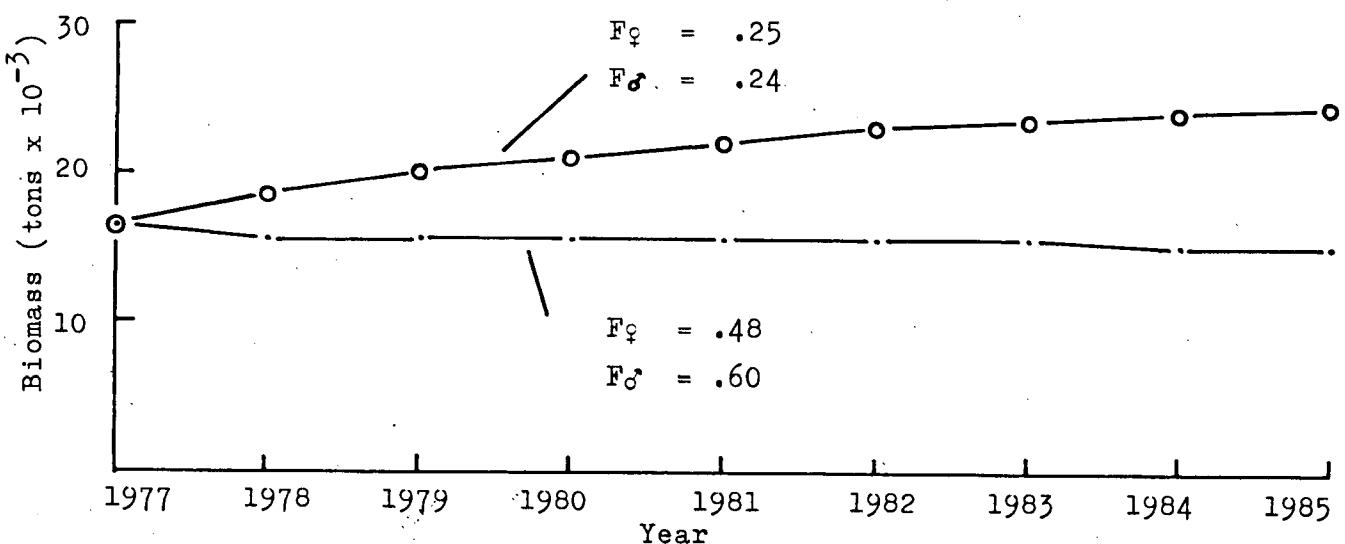
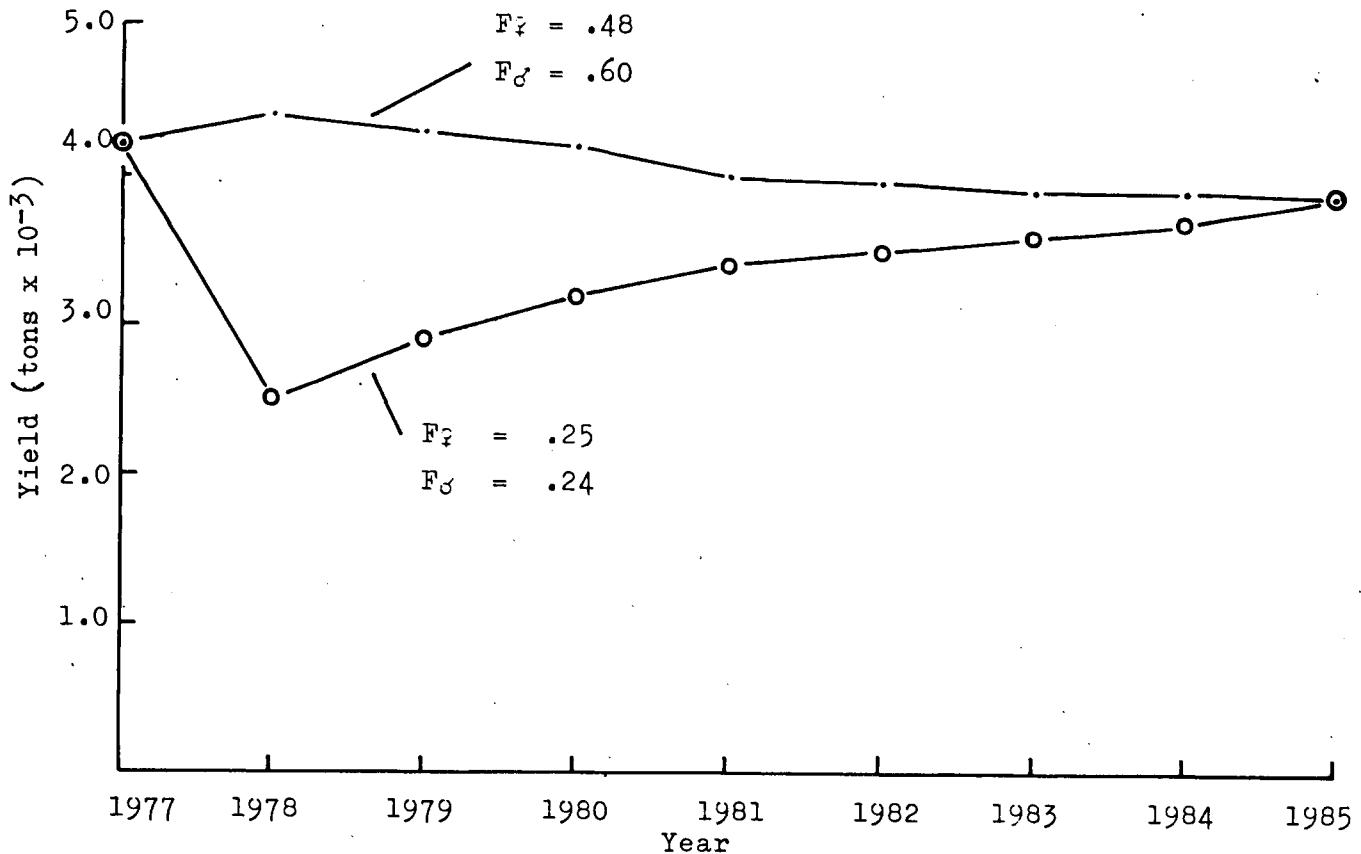


Figure 8.1 Irish Sea Sole (Division VIIa).
Yield per recruit and spawning stock biomass
per recruit curves.

Figure 9.1 Irish Sea Plaice.
Predicted catch and stock biomass 1977-85.



ANNEX I

NORTH SEA SOLE

Assessment Case A (This assessment is based on official catch data given in Table Annex I.1).

Data

Age composition data for 1976 were available from Belgium, Denmark, Federal Republic of Germany and the Netherlands. These accounted for 95% of the official catch data. These age frequencies were summed and raised directly to the official total catch.

The preliminary 1975 age compositions used in the 1976 assessment were adjusted to agree with final official catch data. The effects of doing this were very small.

Virtual Population Analysis

Choice of terminal F-at-age-array

Measures taken by the Netherlands to enforce their quota in 1976 resulted in a decrease in the total horse-power of the Dutch fleet of about 10%. Because Dutch official landings represent most of the total landings (80%) in 1976, it was assumed that, in that year, fishing mortality levels were reduced by about 10% as compared to levels in 1976.

On this basis the values of terminal F at age array used in the 1976 assessment were reduced by 10% and were used to initiate this year's VPA ($M = 0.1$ for both sexes). These terminal F values are given in Table Annex I.2, and the results of the VPA are given in Table Annex I.3 (males) and Table Annex I.4 (females).

Biomass Curves

A combined male and female biomass curve was constructed using the terminal F-at-age values referred to above; weight at age values as shown in Table Annex I.7 and an average recruitment of 74 million soles. This curve, in isolation, cannot be used to predict accurately changes in biomass when maximum F decreases. This is because, on the basis of pre-existing evidence, the shape of the F-at-age array changes as maximum F decreases in such a way that maximum F occurs at progressively higher ages. For this reason a second biomass curve was constructed using a maximum F of 0.4 and a relative F-at-age array appropriate to this value. This relative F-at-age was estimated from VPA data for the years 1956-64, when maximum F was about 0.4 (Table Annex I.2.). The present maximum F is estimated to be 0.72.

The trajectory of long-term stock size gives a reduction of F to 0.4 in 1978 which lies between the lines defined by these two limiting situations. It can be seen from Figure Annex I.1 that a reduction of maximum F to 0.4 in 1978, this value being sustained thereafter, should double the stock size in the long term.

Prognoses

The first stage of the prognoses to be described subsequently was to predict the expected catch in 1977. It was assumed that effort will not increase in 1977. On this basis maximum $F_{77} = \text{maximum } F_{76} = 0.72$ implying a 1977 catch of 10 800 tons.

Prognoses were then carried out for the catch in 1978, assuming various levels of maximum F in that year. The results of these are shown in Table Annex I.8. The stated objective is to achieve a value of maximum F of 0.4 in 1978 since at this level of F biomass will double in the long term. This implies a catch of about 8 000 tons in 1978. 1978 TAC of 12 500 tons would require a maximum F of 0.64. If such a level of F were to be maintained then the long-term biomass would not increase.

Assessment Case B (This assessment is based on the Group's best interpretations of the true catches in 1975 and 1976).

Data

The Group assumed that the non-reported soles had the same relative % age distributions as for the reported soles in 1975 and 1976. Accordingly, age composition data available to the Group for those years were raised to the amended total catch of 19 560 tons in 1975 and 16 900 tons in 1976.

Virtual Population Analysis

Choice of terminal F-at-age array

Lacking evidence to assess the maximum F in 1976, the Group took the value of maximum F used in last year's report (0.8) and applied this in conjunction with the associated relative F-at-age array (Table Annex I.2) to the 1976 data to initiate the VPA.

The results of this VPA can be found in Table Annex I.5 (males) and Annex I.6 (females).

Biomass Curves

Biomass curves were constructed corresponding to those for Case A (Figure Annex I.1). These indicated that to double the biomass in the long term a value of maximum F of 0.35 would be required.

Prognoses

As for Case A, a prediction was made of the catch in 1977 assuming no change in maximum F (Table Annex I.9). The predicted catch is 12 700 tons.

To achieve the level of maximum F = 0.35 in 1978 the catch must be reduced to 8 000 tons. A 1978 TAC of 12 500 tons implies a level of a maximum F of 0.6. This represents a reduction of 17% in maximum F compared to the estimated 1976 position. No increase in stock biomass in the long term can therefore be expected.

Recommended TACs

The outcome of both Case A and Case B is that the TAC in 1978 should be about 8 000 tons. However, it should be stressed that conclusions reached from studying Case A are definitely incorrect and that the Group is by no means sure that Case B represents the true situation. Thus the agreement between the TACs evaluated in such cases may be purely fortuitous. For this reason the Group feels unable to give valid advice on a TAC for 1978 except to say that the TAC must be far below 12 500 tons and that in the present context a 1978 TAC of 8 000 tons would have some conservatory effect.

Table Annex I.1 North Sea Sole.
Nominal catch (metric tons) for statistical Sub-area IV, 1960-76.

Year	Belgium	Denmark	France	Germany (F.R.)	Nether- lands	Poland	Spain	Sweden ^{b)}	U.K.		Total
									England & Wales	Scotland	
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	1 383	682	297	233	15 242	-	-	+	426	9	18 263
1976 ^{c)}	1 303	565	206	204	11 171	5	8	+	460	-	13 922

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 Annex I.2 A.North Sea Sole.

Terminal F values used in the VPA and in the prognosis
for Cases A and B based on the 1975 F-at-age array.

Age	Case A max F = .72				Case B max F = .80			
	Males		Females		Males		Females	
	F	rel.F	F	rel.F	F	rel.F	F	rel.F
2	0.20	0.28	0.26	0.35	0.22	0.28	0.28	0.35
3	0.72	1.00	0.72	1.00	0.80	1.00	0.80	1.00
4	0.66	0.90	0.60	0.83	0.72	0.90	0.66	0.83
5	0.56	0.76	0.60	0.83	0.61	0.76	0.66	0.83
6	0.55	0.75	0.60	0.83	0.60	0.75	0.66	0.83
7	0.44	0.60	0.55	0.75	0.48	0.60	0.60	0.75
8	0.22	0.30	0.37	0.50	0.24	0.30	0.40	0.50
9	0.16	0.21	0.32	0.44	0.17	0.21	0.35	0.44
10	0.12	0.16	0.27	0.36	0.13	0.16	0.29	0.36
11	0.08	0.11	0.19	0.26	0.09	0.11	0.21	0.26
12	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
13	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
14	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
15	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
16	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
17	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
18	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
19	0.09	0.13	0.15	0.20	0.10	0.13	0.16	0.20
20	0.15	0.19	0.25	0.31	0.15	0.19	0.25	0.31

see also Table Annex I.2.B

Table Annex I.2.B North Sea Sole.

Terminal F values used in the prognosis for calculating long-term catch and stock biomass based on the 1956-64 F-at-age array.

Age	Males		Females	
	F	rel.F	F	rel.F
2	0.02	0.07	0.06	0.15
3	0.15	0.43	0.22	0.58
4	0.27	0.78	0.38	1.00
5	0.34	1.00	0.34	0.87
6	0.33	0.97	0.30	0.78
7	0.32	0.93	0.27	0.69
8	0.30	0.88	0.24	0.61
9	0.29	0.85	0.21	0.55
10	0.24	0.71	0.19	0.50
11	0.22	0.63	0.18	0.46
12	0.20	0.59	0.16	0.42
13	0.19	0.54	0.16	0.42
14	0.17	0.50	0.16	0.41
15	0.17	0.49	0.16	0.41
16	0.16	0.47	0.16	0.41
17	0.16	0.46	0.16	0.41
18	0.15	0.44	0.16	0.40
19	0.15	0.44	0.16	0.40
20	0.15	0.44	0.25	0.65

Table Annex I.3 North Sea Sole.
Age composition of total catch 1967-76 (thousands), Case A.

Males

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	0	557	331	0	113	267	71.7	321.1
2	2 247	4 778	12 637	3 015	17 671	3 411	5 840	9 328	8 311.4	1 170.5
3	13 983	18 121	10 291	13 170	6 692	23 672	6 500	15 834	11 910.9	9 387.7
4	49 210	14 424	2 918	3 936	6 709	3 739	7 643	3 404	4 916.7	5 771.5
5	883	28 952	5 631	769	2 462	2 544	1 419	3 447	984.5	2 289.6
6	216	3 021	8 780	1 290	438	1 116	1 160	1 232	1 673.3	545.7
7	854	836	0	5 523	694	162	344	821	295.8	897.5
8	635	2 145	66	44	2 647	464	285	421	423.1	200.6
9	2 769	153	278	32	64	2 269	610	194	243.6	184.8
10	0	666	3	240	45	51	1 268	211	120.6	83.6
11	213	30	862	65	162	13	33	808	47.4	112.1
12	218	169	3	1 022	48	288	194	18	656.3	47.7
13	104	77	236	98	660	22	161	16	1.1	482.4
14	110	13	32	220	160	420	27	167	21.3	23.4

ctd.

Table Annex I.3 (ctd) North Sea Sole.
Fishing mortalities 1967-76, Case A.

Males

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.01	0.05
2	0.07	0.18	0.33	0.15	0.32	0.21	0.17	0.29	0.35	0.20
3	0.39	1.08	0.62	0.59	0.53	0.82	0.68	0.84	0.64	0.72
4	0.49	0.78	0.42	0.45	0.61	0.56	0.60	0.82	0.61	0.66
5	0.20	0.54	0.72	0.17	0.50	0.43	0.38	0.53	0.53	0.56
6	0.11	1.68	0.27	0.31	0.12	0.39	0.32	0.58	0.47	0.55
7	0.12	0.68	0.00	0.24	0.24	0.05	0.18	0.34	0.23	0.44
8	0.63	0.46	0.09	0.08	0.16	0.23	0.12	0.31	0.27	0.22
9	0.26	0.27	0.09	0.05	0.15	0.18	0.46	0.10	0.26	0.16
10	0.00	0.08	0.01	0.09	0.09	0.15	0.13	0.25	0.07	0.12
11	0.08	0.02	0.13	0.17	0.07	0.03	0.12	0.10	0.07	0.08
12	0.47	0.07	0.00	0.21	0.17	0.16	0.67	0.08	0.10	0.09
13	0.70	0.26	0.13	0.07	0.18	0.10	0.11	0.09	0.01	0.09
14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Mean F ≥3	0.42	0.67	0.39	0.37	0.37	0.55	0.44	0.60	0.49	0.54

ctd.

Table Annex I.3 (ctd)

North Sea Sole.

Stock in numbers (thousands), 1967-76, Case A.

Males

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	34 039	52 284	24 381	75 097	21 156	42 226	42 985	33 242	7 562	6 916
2	34 012	30 800	47 309	22 060	67 421	18 828	38 208	38 787	29 825	6 774
3	45 339	28 640	23 332	30 824	17 098	44 248	13 798	29 027	26 248	19 107
4	132 250	27 772	8 835	11 377	15 429	9 136	17 680	6 339	11 313	12 485
5	5 176	73 065	11 503	5 229	6 566	7 614	4 728	8 766	2 521	5 585
6	2 176	3 846	38 705	5 085	4 002	3 609	4 479	2 933	4 669	1 349
7	7 669	1 763	645	26 692	3 378	3 205	2 208	2 953	1 488	2 640
8	1 421	6 128	805	584	18 911	2 398	2 746	1 672	1 893	1 065
9	12 479	685	3 513	666	487	14 598	1 729	2 214	1 113	1 312
10	1 976	8 665	475	2 914	572	379	11 055	987	1 819	776
11	2 960	1 788	7 207	427	2 409	475	295	8 798	693	1 531
12	612	2 476	1 589	5 703	324	2 026	417	236	7 193	582
13	217	347	2 080	1 435	4 190	248	1 560	194	196	5 885
14	829	98	241	1 658	1 206	3 165	203	1 258	160	176

Table Annex I.4 North Sea Sole.

Age composition of total catch 1967-76 (thousands), Case A.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	265	649	185	0	610	410	104.4	320
2	2 750	4 624	13 812	4 068	20 731	5 393	7 376	10 207	10 742.9	1 300.2
3	17 282	13 898	10 086	13 946	7 214	19 772	5 470	12 729	13 741.9	8 821.2
4	56 301	10 876	2 174	4 953	6 298	3 795	8 795	2 969	5 545.6	6 619.2
5	1 497	21 188	5 083	1 042	1 703	2 905	2 503	3 199	1 201.9	2 507.9
6	418	2 536	13 408	1 677	584	856	1 208	814	2 099.4	613
7	1 510	1 283	243	7 832	914	282	748	571	416.6	1 206.6
8	246	2 551	115	168	4 266	567	565	208	592.1	376.1
9	3 062	529	537	56	79	3 059	684	235	294.5	361.9
10	475	1 371	193	479	47	47	2 002	206	59.9	224.1
11	506	259	1 544	74	219	24	188	1 200	212.2	138.2
12	139	558	154	1 542	0	186	116	48	1 203.7	114.6
13	418	275	291	85	1 094	26	207	4	20.6	1 274.9
14	97	327	96	303	72	658	46	101	68.4	32.9

ctd.

Table Annex I.4 (ctd) North Sea Sole.
Fishing mortalities, 1967-76, Case A.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.05
2	0.11	0.17	0.35	0.18	0.38	0.34	0.23	0.27	0.45	0.26
3	0.50	0.99	0.59	0.62	0.51	0.67	0.60	0.69	0.61	0.72
4	0.47	0.59	0.35	0.57	0.55	0.48	0.63	0.69	0.64	0.60
5	0.28	0.29	0.54	0.25	0.34	0.47	0.60	0.44	0.59	0.60
6	0.13	0.94	0.27	0.30	0.19	0.26	0.33	0.35	0.51	0.60
7	0.21	0.62	0.18	0.22	0.24	0.12	0.34	0.22	0.27	0.55
8	0.15	0.56	0.09	0.17	0.16	0.20	0.34	0.13	0.34	0.37
9	0.19	0.47	0.19	0.05	0.10	0.15	0.36	0.20	0.25	0.32
10	0.30	0.11	0.27	0.23	0.05	0.07	0.12	0.15	0.07	0.27
11	0.12	0.24	0.15	0.14	0.14	0.03	0.39	0.09	0.21	0.19
12	0.11	0.17	0.19	0.20	0.00	0.15	0.18	0.14	0.11	0.15
13	0.15	0.31	0.11	0.14	0.19	0.07	0.23	0.01	0.08	0.15
14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Mean F ≥ 3	0.42	0.44	0.34	0.37	0.32	0.43	0.43	0.44	0.48	0.53

ctd.

Table Annex I.4 (ctd) North Sea Sole.
Stock in numbers (thousands), 1967-76, Case A.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	34 377	54 743	28 250	76 384	21 830	41 290	50 723	34 789	6 691	6 892
2	28 333	31 106	49 533	25 310	68 498	19 577	37 361	45 317	31 089	5 955
3	46 294	23 024	23 755	31 724	19 039	42 330	12 601	26 806	31 321	17 954
4	156 517	25 524	7 725	11 951	15 512	10 396	19 606	6 226	12 220	15 340
5	6 365	88 299	12 804	4 929	6 126	8 075	5 813	9 421	2 827	5 812
6	3 641	4 339	59 798	6 774	3 471	3 929	4 555	2 892	5 494	1 421
7	8 492	2 897	1 533	41 387	4 539	2 586	2 743	2 976	1 845	2 984
8	1 899	6 251	1 408	1 157	30 016	3 240	2 072	1 772	2 151	1 274
9	18 853	1 484	3 241	1 164	887	23 108	2 393	1 340	1 406	1 385
10	1 925	14 152		842	2 423	1 000	728	18 004	1 517	989
11	4 633	1 291	11 503	579	1 738	861	614	14 389	1 177	838
12	1 348	3 712	923	8 942	454	1 365	756	377	11 880	863
13	3 162	1 088	2 829	689	6 627	410	1 058	574	296	9 606
14	731	2 464	723	2 283	542	4 958	347	761	515	248

Table Annex I.5 North Sea Sole.
Age composition of total catch 1967-76 (thousands), Case B.

Males

Year Age \	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	0	557	331	0	113	267	232.9	384.6
2	2 247	4 778	12 637	3 015	17 671	3 411	5 840	9 328	10 140.8	1 401.8
3	13 983	18 121	10 291	13 170	6 692	23 672	6 500	15 834	14 916.5	11 243.1
4	49 210	14 424	2 918	3 936	6 709	3 739	7 643	3 404	5 318.5	6 912.2
5	883	28 952	5 631	769	2 462	2 544	1 419	3 447	912.6	2 742.1
6	216	3 021	8 780	1 290	438	1 116	1 160	1 232	1 708.9	653.5
7	854	836	0	5 523	694	162	344	821	229.8	1 074.9
8	635	2 145	66	44	2 647	464	285	421	283.7	240.2
9	2 769	153	278	32	64	2 269	610	194	170.9	221.3
10	0	666	3	240	45	51	1 268	211	114.8	100
11	213	30	862	65	162	13	33	808	56.7	134.2
12	218	169	3	1 022	48	288	194	18	696.8	57.1
13	104	77	236	98	660	22	161	16	5.9	577.7
14	110	13	32	220	160	420	27	167	26.9	28

ctd.

Table Annex I.5 (ctd) North Sea Sole.
Fishing mortalities 1967-76, Case B.

Males

Year Age \	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.03	0.05
2	0.07	0.18	0.33	0.15	0.32	0.21	0.17	0.25	0.37	0.22
3	0.39	1.06	0.62	0.59	0.52	0.80	0.67	0.79	0.69	0.80
4	0.49	0.78	0.41	0.45	0.60	0.55	0.58	0.80	0.59	0.72
5	0.19	0.52	0.71	0.16	0.50	0.43	0.37	0.50	0.45	0.61
6	0.11	1.59	0.26	0.30	0.12	0.39	0.31	0.56	0.44	0.60
7	0.12	0.64	0.00	0.24	0.24	0.05	0.18	0.34	0.17	0.48
8	0.63	0.46	0.08	0.07	0.15	0.22	0.11	0.30	0.17	0.24
9	0.26	0.27	0.09	0.05	0.13	0.17	0.44	0.09	0.17	0.17
10	0.00	0.08	0.01	0.09	0.08	0.13	0.12	0.24	0.06	0.13
11	0.08	0.02	0.13	0.17	0.07	0.03	0.10	0.09	0.08	0.09
12	0.47	0.07	0.00	0.21	0.17	0.16	0.57	0.07	0.10	0.10
13	0.70	0.26	0.13	0.07	0.18	0.10	0.11	0.07	0.03	0.10
14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Mean F ≥ 3	0.42	0.65	0.38	0.36	0.36	0.54	0.42	0.56	0.51	0.60

ctd.

Table Annex I.5 (ctd) North Sea Sole.
Stock in numbers (thousands), 1967-76, Case B.

Males

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	34 079	52 378	24 487	75 734	21 318	43 838	48 955	38 054	8 473	8 283
2	34 262	30 836	47 394	22 157	67 998	18 975	39 666	44 189	34 179	7 446
3	45 482	28 866	23 365	30 901	17 186	44 769	13 931	30 346	31 133	21 314
4	133 554	27 901	9 038	11 406	15 498	9 215	18 149	6 459	12 500	14 068
5	5 275	74 243	11 618	5 413	6 592	7 676	4 799	9 189	2 629	6 278
6	2 270	3 935	39 768	5 189	4 168	3 634	4 535	2 997	5 051	1 514
7	7 669	1 849	724	27 654	3 472	3 355	2 230	3 004	1 546	2 951
8	1 421	6 128	882	655	19 781	2 483	2 882	1 691	1 939	1 181
9	12 479	685	3 513	736	551	15 385	1 806	2 337	1 131	1 485
10	1 976	8 665	475	2 914	635	438	11 766	1 057	1 930	861
11	2 960	1 788	7 207	427	2 409	532	348	9 442	756	1 637
12	612	2 476	1 589	5 703	324	2 026	469	283	7 776	630
13	217	347	2 080	1 435	4 190	248	1 560	241	239	6 374
14	829	98	241	1 658	1 206	3 165	203	1 258	203	211

Table Annex I.6 North Sea Sole.
Age composition of total catch, 1967-76 (thousands), Case B.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0	1 265	649	185	0	610	410	50.8	395.7
2	2 750	4 624	13 812	4 068	20 731	533	7 376	10 207	14 391.2	1 557.1
3	17 282	13 898	10 086	13 946	7 214	19 772	5 470	12 729	15 291.7	10 564.3
4	56 301	10 876	2 174	4 953	6 298	3 795	8 795	2 969	6 152.7	7 927.1
5	1 497	21 188	5 083	1 042	1 703	2 905	2 503	3 199	1 083.2	3 003.4
6	418	2 536	13 403	1 677	584	856	1 208	814	2 014.2	733
7	1 510	1 283	243	7 832	914	282	748	571	399.8	1 445
8	246	2 551	115	168	4 266	567	565	208	466.7	450.4
9	3 062	529	537	56	79	3 059	684	235	229.2	433.4
10	475	1 371	193	479	47	47	2 002	206	103.8	268.4
11	506	259	1 544	74	219	24	188	1 200	176	165.5
12	139	558	154	1 542	0	186	116	48	1 307.4	137.2
13	418	275	291	85	1 094	26	207	4	20.7	1 526.7
14	97	327	96	303	72	658	46	101	62.4	39.4

ctd.

Table Annex I.6 (ctd) North Sea Sole.
Fishing mortalities, 1967-76, Case B.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.05
2	0.11	0.17	0.34	0.18	0.38	0.04	0.22	0.24	0.52	0.28
3	0.49	0.97	0.58	0.61	0.50	0.66	0.60	0.63	0.61	0.80
4	0.46	0.58	0.34	0.56	0.55	0.47	0.62	0.68	0.64	0.66
5	0.29	0.28	0.53	0.24	0.34	0.47	0.57	0.42	0.50	0.66
6	0.15	0.99	0.25	0.29	0.18	0.25	0.32	0.33	0.45	0.66
7	0.22	0.79	0.20	0.21	0.23	0.11	0.32	0.22	0.24	0.60
8	0.17	0.63	0.13	0.18	0.15	0.20	0.31	0.13	0.25	0.40
9	0.19	0.57	0.23	0.08	0.11	0.14	0.34	0.18	0.18	0.35
10	0.30	0.11	0.37	0.29	0.08	0.08	0.11	0.14	0.10	0.29
11	0.12	0.24	0.15	0.21	0.19	0.05	0.46	0.08	0.16	0.21
12	0.11	0.17	0.19	0.20	0.00	0.21	0.29	0.18	0.11	0.16
13	0.15	0.31	0.11	0.14	0.19	0.11	0.34	0.01	0.10	0.16
14	0.15	0.15	0.15	0.15	0.15	0.15	0.25	0.25	0.25	0.25
Mean F ≥ 3	0.41	0.43	0.33	0.36	0.31	0.42	0.42	0.42	0.47	0.58

ctd.
100

Table Annex I.6 (ctd) North Sea Sole.
Stock in numbers (thousands), 1967-76, Case B.

Females

Age \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	34 533	54 819	28 536	76 910	16 292	43 176	55 145	41 534	7 441	8 522
2	28 632	31 247	49 603	25 568	68 974	14 566	39 067	49 318	37 192	6 684
3	46 483	23 295	23 883	31 787	19 273	42 760	12 673	28 349	34 939	20 027
4	159 798	25 695	7 968	12 066	15 569	10 608	19 993	6 292	13 611	17 147
5	6 213	91 262	12 958	5 149	6 230	8 126	6 004	9 771	2 886	6 497
6	3 149	4 202	62 478	6 913	3 670	4 023	4 601	3 064	5 810	1 586
7	7 921	2 453	1 410	43 810	4 664	2 766	2 828	3 018	2 000	3 349
8	1 664	5 734	1 007	1 045	32 207	3 353	2 235	1 849	2 189	1 431
9	18 853	1 272	2 775	802	786	25 091	2 496	1 486	1 476	1 538
10	1 925	14 152	650	2 001	673	636	19 798	1 610	1 122	1 118
11	4 633	1 291	11 503	405	1 357	564	531	16 012	1 261	917
12	1 348	3 712	923	8 942	297	1 020	488	303	13 348	974
13	3 162	1 088	2 829	689	6 627	268	746	331	228	10 836
14	731	2 464	723	2 283	542	4 958	218	479	296	187

Table Annex I.7 North Sea Sole.
 Nominal weight (g) at age for
 stock and catch (average 1969-73).

Age	Males		Females	
	Biomass	Catch	Biomass	Catch
1	10		10	
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
15	410	410	742	750
16	410	410	748	750
17	410	410	752	750
18	410	410	758	750
19	410	410	760	750
20	410	410	760	750

Table Annex I.8 North Sea Sole.
 Prognosis for catch and stock in 1977
 and 1978 and long-term increase in stock
 biomass for Case A.

Year	Prognosis			Long-term steady state situation			
	Maximum F at age ♂ ♀	Catch in tons	Stock at beginning of the year in tons	Stock based on 1975 F at age in tons	Stock based on 1957-64 F at age in tons	Expected stock long-term % increase	
1976	0.72 0.72	14 610	42 194	(I)	(II)	(I)	(II)
1977	0.72 0.72	10 849	34 454				
1978	0.0	0	35 062				
	0.1	2 318			122 730	+250	
	0.2	4 468			89 170	+154	
	0.3	6 463			69 560	+98	
	0.4	8 317		51 000	58 000	+45	+65
	0.5	10 040		39 480	48 650	+13	+39
	0.6	11 644		32 500		-1	
	0.7	13 138					
	0.8	14 531		27 560		-21	
	0.9	15 832		23 900		-32	
	1.0	17 047					
Present F level →					→		

Table Annex I.9 North Sea Sole.
 Prognosis for catch and stock in 1977
 and 1978 and long-term increase in stock
 biomass for Case B.

Year	Prognosis			Long-term steady state situation		
	Maximum F at age	Catch in tons	Stock at beginning of the year in tons	Stock based on 1975 F at age in tons	Stock based on 1957-64 F at age in tons	Expected stock long-term % increase
♂	♀					
1976	0.72	0.72	17 420	51 301	(I)	(II)
1977	0.72	0.72	12 687	41 276		
1978	0.0	0	40 010			
	0.1	2 501			122 730	+207
	0.2	4 824			89 170	+123
	0.3	6 982			69 560	+74
	0.4	8 990			51 000	+27
	0.5	10 859			58 000	+45
	0.6	12 601			39 480	-1
	0.7	14 226			48 650	+22
Present F level	→				32 500	-19
	0.8	15 743			27 560	-31
	0.9	17 162			23 900	-40
	1.0	18 489				

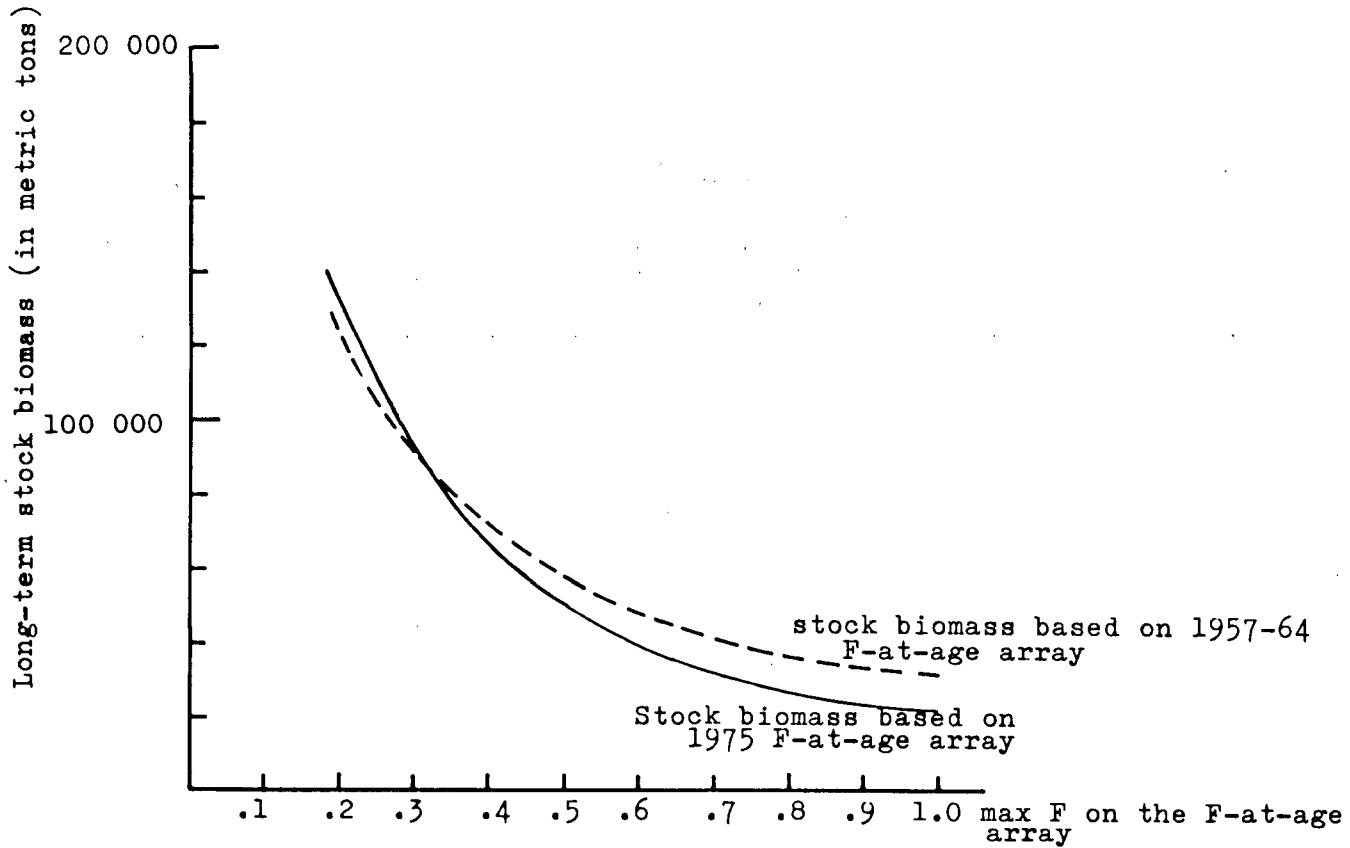


Figure Annex I.1 North Sea Sole.
Sexes combined. Long-term stock biomass.

ANNEX II

NORTH SEA PLAICE. - ESTIMATION OF TERMINAL F-AT-AGE ARRAYS

- AII.1 Over the last few years the custom has been to use the new age composition data to make a preliminary estimate of the fishing mortality at age by VPA, if necessary with several runs to examine the effect of varying terminal F input for the last year. The resulting F-at-age array is then available for use in a prognosis programme, but to a certain degree it is rather arbitrarily defined. Accordingly, last year, a new element was added to the procedure. The prediction of the previous year's prognosis (1974) was tested against the observed catch number at age array for the latest year (1975) and adjusted until a reasonable representation was obtained. The adjusted F-at-age array, which of course involves certain assumptions about its shape, and the F on the recruiting age groups, was then compared with previous estimates and then used to run a new prognosis for the evaluation. Use of the adjusted F-at-age array in a new VPA gives a check on the latest estimate of stock number, and the frequency distribution of recruitments. This procedure was adopted again this year.
- AII.2 The inputs and outputs of the testing procedure are shown in Tables Annex II.1 and Annex II.2 for male and female plaice respectively. The original 1975 catch number at age array, and the 1975 and 1976 F-at-age array calculated for use in last year's prognosis, are at columns 3, 4 and 5 respectively, with the resulting catch prediction for 1976 at column 6. The updated 1975 catch at age is at column 8, and this was used with the F-at-age array to re-simulate the 1976 catch number at age. The observed 1976 estimate, for comparison, is at column 7. Columns 9 and 10 show the best adjustment that could be made to last year's 1976 F-at-age array in the time available, and column 10 shows the 1976 prediction which it achieves.
- AII.3 Though not perfect, especially for males, in which the 2-4 age groups are still unsatisfactorily estimated, the result is better than for the F-at-age array used last year, especially for females. For comparison column 11 shows the mean 1967-70 F-at-age array from recent VPA print-outs.
- AII.4 It is not claimed that these testing and checking procedures provide either indisputable or independent evidence of the current stock status. For example, Figure 3.1 merely says what the pre-1970 mortality level was; it does not itself allow us to distinguish between terminal F inputs and hence possible mortality rates differing by a factor of two. On the other hand, the "adjustment-by-prognosis" procedure does attempt the important task of achieving some measure of consistency and overlap between assessments in successive years. For this year, the procedure ended with a judgement; namely, that mortality is probably now no higher than it was a few years ago, and that recruitment has increased. This is exactly opposite to the judgement made last year.

Table Annex II.1 North Sea Plaice.
Catch and F-at-age array data for recent simulations.

Males

ORIGINAL ESTIMATES

NEW ESTIMATES

Age	Natural mortality	1975 catch array	1975 F at age array	1976 F at age array	Predicted 1976 catch array	Estimated observed 1976 catch array	Updated 1975 catch array	New 1975-76 F at age array	Re-run of 1976 prediction	Mean 1967-70 F at age array
1	0.25	1 636	0.01	0.01	-	2 715	981	0.01	-	0.01
2	0.15	28 390	0.15	0.15	14 588	18 800	21 743	0.06	6 088	0.07
3	0.15	63 822	0.90	0.50	62 546	51 130	59 986	0.26	72 866	0.26
4	0.15	19 026	0.40	0.40	18 398	79 304	15 709	0.36	52 634	0.37
5	0.15	12 907	0.30	0.30	8 619	18 787	11 399	0.49	12 106	0.49
6	0.15	8 771	0.30	0.30	8 230	5 255	7 457	0.57	6 748	0.57
7	0.15	4 467	0.30	0.30	5 593	3 703	4 166	0.45	3 023	0.45
8	0.15	2 099	0.30	0.30	2 848	2 329	2 037	0.32	1 725	0.33
9	0.15	926	0.30	0.30	1 338	1 216	1 430	0.28	1 135	0.29
10	0.15	717	0.30	0.30	590	719	866	0.22	752	0.24
11	0.15	275	0.20	0.20	319	573	264	0.20	549	0.18
12	0.15	922	0.20	0.20	194	141	892	0.18	169	0.24
13	0.15	243	0.20	0.20	650	571	181	0.18	641	0.24
14	0.15	131	0.20	0.20	171	97	110	0.18	130	0.31
15		(508)			(304)	(385)	(258)		(263)	0.17
Col-										
umn No.										
1	2	3	4	5	6	7	8	9	10	11

Notes: All catch numbers in thousands

Figures in brackets represent plus groups (not necessarily used as such in calculation)

One-year-old fish are not estimated by prognosis.

Table Annex II.2 North Sea Plaice.

Catch and F-at-age array data for
recent simulations.

ORIGINAL ESTIMATESNEW ESTIMATESFemales

Age	Natural mortality	1975 catch array	1975 F at age array	1976 F at age array	Predicted 1976 catch array	Estimated observed 1976 catch array	Updated 1975 catch array	New 1975-76 F at age array	Re-run of 1976 prediction	Mean 1967-70 F at age array
1	0.20	583	0.01	0.01	-	1 037	269	0.01	-	0.01
2	0.10	23 534	0.15	0.15	12 150	14 522	18 210	0.10	10 695	0.06
3	0.10	47 556	0.90	0.50	54 450	35 487	46 396	0.20	28 423	0.23
4	0.10	18 768	0.40	0.40	14 441	51 327	18 884	0.30	49 185	0.24
5	0.10	12 900	0.40	0.40	11 383	8 663	14 398	0.20	10 029	0.25
6	0.10	10 023	0.40	0.40	7 824	6 600	13 806	0.20	9 130	0.23
7	0.10	5 647	0.40	0.40	6 079	6 673	7 270	0.20	10 228	0.18
8	0.10	2 777	0.40	0.40	3 425	4 440	3 993	0.20	5 386	0.16
9	0.10	2 035	0.40	0.40	1 684	2 464	6 223	0.20	2 958	0.15
10	0.10	1 651	0.40	0.40	1 234	2 117	3 024	0.20	4 610	0.14
11	0.10	981	0.40	0.40	1 001	1 988	1 593	0.20	2 240	0.14
12	0.10	4 532	0.40	0.40	595	897	8 071	0.20	1 180	0.13
13	0.10	591	0.30	0.30	2 159	7 326	1 017	0.20	5 979	0.13
14	0.10	783	0.30	0.30	396	344	1 374	0.20	753	0.11
15	0.10	641	0.30	0.30	525	546	1 435	0.20	1 018	0.09
16	0.10	634	0.30	0.30	430	541	1 166	0.20	1 063	0.11
17	0.10	263	0.30	0.30	425	668	431	0.20	864	0.12
18	0.10	319	0.30	0.30	176	267	1 168	0.20	319	0.09
19	0.10	202	0.20	0.20	149	307	132	0.20	865	0.10
20	0.10	(354)	0.10	0.10	78	(284)	(133)	0.20	98	0.10
Col. No.					118 606	146 496			145 024	
1	2	3	4	5	6	7	8	9	10	11

Notes: All catch numbers in thousands

Figures in brackets represent plus groups (not necessarily used as such in calculation)
One-year-old fish are not estimated by prognosis.

ANNEX III. DERIVATION OF ENGLISH AGE FREQUENCIES FROM BELGIAN AGE FREQUENCIES
FOR BRISTOL CHANNEL PLAICE

Determination of ratio of numbers-at-age per ton landed.

English catch in 1976: Belgian catch in 1976.

Age	Males			Females		
	England 1976 No/ton	Belgium 1976 No/ton	$\frac{\text{England}}{\text{Belgium}} = K_t$	England 1976 No/ton	Belgium 1976 No/ton	$\frac{\text{England}}{\text{Belgium}} = K_t$
2	.080	.586	.14 (.1)	.099	.242	.41 (.4)
3	.452	1.446	.31 (.5)	.625	.294	2.13 (2.1)
4	1.181	.839	1.41 (1.2)	.714	.382	1.87 (1.9)
5	.724	.303	2.38 (1.9)	.331	.276	1.20 (1.2)
6	.263	.118	2.23 (2.9)	.106	.136	.78 (.8)
7	.098	.079	1.24 (4.0)	.010	.120	.08 (.7)
8	.089	.014	6.36 (5.3)	.066	.090	.73 (.6)
9	.106	.018	5.89 (6.5)	.029	.032	.91 (.4)
10	-			.011	.052	.21 (.4)
11	-			.004	.020	.20 (.4)
12+	-			.011	.040	.28 (.4)

The England : Belgium ratios (K_t) were plotted and smoothed values estimated. The latter are shown in brackets in the table and were used in subsequent calculations.

Assuming that the ratios calculated above do not vary between years, the number of fish landed at each age by English vessels in each year were calculated using the relationship:

$$C_{t,i} = K_t \cdot c_{t,i} \cdot \frac{Y_i}{y_i}$$

where $C_{t,i}$ = catch in number by England of age group t in year i

$i = (1970 \dots 1975)$

$c_{t,i}$ = Catch in number by Belgium of age group t in year i

Y_i = Total catch in weight by England in year i

y_i = Total catch in weight by Belgium in year i

The estimated English figures were then adjusted by the sums of product techniques so as to agree with the total English landings. For the years 1971-75 the sums of products were within 20% of the reported landings, but in 1970 a discrepancy of 90% was observed.