International Council for the
Exploration of the Sea

C.M.1983/Assess:1

REPORT OF THE NORTH SEA FLATFISH WORKING GROUP

Copenhagen, 20-25 September 1982

x) General Secretary,
ICES,
Palægade 2-4,
1261 Copenhagen K,
Denmark.

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REPORT OF THE NORTH SEA FLATFISH WORKING GROUP

1. INTRODUCTION

1.1 Participants

The ICES North Sea Flatfish Working Group met at ICES headquarters from 20-25 September 1982, with the following participation:

T Aarup	Denmark
R De Clerck (Chairman)	Belgium
M Giret	France
R Houghton	United Kingdom
T Jakobsen	Norway
R Millner	United Kingdom
E Nielsen	Denmark
A Rijnsdorp	Netherlands
G Rauck	Federal Republic of Germany
F van Beek	Netherlands.

1.2 Terms of Reference

At the 1981 Statutory Meeting, it was decided (C.Res.1981/2:27:16) that the North Sea Flatfish Working Group should meet with the following terms of reference:

"(i) assess TACs for sole and plaice in the North Sea and Channel for 1983,

(ii) continue evaluation of selectivity studies,

(iii) comment on the available by-catch data in fisheries for Crangon and advise if there are areas within 12 mile limits or seasons when a by-catch limit of 10% should be needed,

(iv) specify deficiencies in data required for assessments".

In addition, the Working Group was asked to assess the catch options for sole in the Bay of Biscay.

2. NORTH SEA SOLE

2.1 Landings

In 1981, the total catch was 15 405 tonnes, which was slightly above the 1981 TAC of 15 000 tonnes and 9.5% above the predicted catch in last year's report of 14 053 tonnes. This catch was the lowest since 1964 (11 342 tonnes) after the reduction of the stock in the severe winter of 1962-63. There were no unreported landings. In 1981, 35% of the catch (in weight) or 53% (in numbers) consisted of 2 year old fish (year class 1979).

Table 2.1 summarises the catches for the period 1970-81.

2.2 Data Base, Age Composition and Weight at Age

2.2.1 Data base

In June 1982, the ad hoc North Sea Flatfish Data Base Working Group meeting was held in IJmuiden. In this Working Group, nominal catches, age compositions, weight at age and length at age were evaluated and revised. The new age compositions provided by the different countries were combined and raised to the total nominal catch. This was done

for the sexes separately and for sexes combined and, if possible, on a quarterly basis. Mean weight at age and length at age of the catch were calculated by year from the quarterly values weighted over the catch numbers at age by nation.

In the past, North Sea sole assessments were carried out for sexes separately. Houghton (Doc. C.M.1982/G:13) showed that there were only minor discrepancies between assessments on North Sea sole for sexes separately and sexes combined with the old data base. Therefore, for practical reasons, the Group decided to work out an assessment based on the sexes combined data this year.

In this assessment, the age composition of the new data base was used for the full range of years. For weight at age the data of the new data base were used for the years 1971-81. The weight at age in the years before 1971 are not updated yet. For these years, the values of the old data base were taken (Table 2.5).

The weight at age in the 2nd quarter were used for calculating the stock biomass and the spawning stock biomass. In the years before 1971 the old data published by Houghton and Bannister (Doc. C.M.1979/G:21), based on 2nd quarter data from De Veen (1976 and ICES C.M.1978/G:16), were used. The stock weight at age data for the sexes combined were derived as the mean of the weight of males and females, weighted over the catch numbers (Table 2.6).

2.2.2 Age composition and weight at age in 1981

For 1981 age composition data were available from Belgium, Denmark, Federal Republic of Germany, the Netherlands and the United Kingdom, accounting for 99% of the total landings (Table 2.2). Weight at age data were available for the same countries.

The sum of products check on the total international age composition for 1981 was 3% too low (that is, the correction factor is 1.03). The sum of products discrepancies for the other years are given in Table 2.3.

The values for stock biomass and spawning stock biomass from the VPA and the catch and stock values in the forecast are corrected for the discrepancy between nominal catch and the sum of products.

2.3 Catch per Unit Effort and International Effort

Catch per unit effort data were available from Belgium, the United Kingdom and the Netherlands (Table 2.4 and Figure 2.1).

The United Kingdom cpue are derived from a by-catch fishery in statistical rectangles in which soles were caught. It is a winter cpue corrected for fishing power to a standard vessel 350 GRT. The Belgian and Dutch cpue are derived from a beam-trawl mixed fishery on flatfish more or less directed on sole. These series are new and corrected for HP and fishing speed to a standard vessel of 1 000 HP.

All series show a rapid decline from 1970 until 1974. The United Kingdom and the Dutch cpue are in good agreement for the whole series. For Belgium it agrees until 1979 but then remains at a high level. The United Kingdom cpue declines to a minimum in 1980 and increases again in 1981. This cpue might be biassed for the recent years in which the United Kingdom fleet was reduced considerably and from which it can be assumed that the most experienced skippers remain.

The Dutch cpue declined drastically in 1980 and remained at the same level in 1981. There are indications that in recent years part of the Dutch fleet directed more of its effort to plaice, partly because of the increased market for plaice and the decreased catch rates on

sole in the last 2 years. This cpue might also be biassed for these reasons. The Belgian cpue increased considerably in 1979 and remained at a high level until 1981.

This cpue is based on fishery mainly in the southern part of Division IVc and reflects the situation only in this part of the North Sea. The Belgian cpue suggests a higher stock in the southern part of the North Sea.

International effort was calculated from the cpue series and the total international catch. These are given in Table 2.4 and Figure 2.1.

2.4 Virtual Population Analysis

2.4.1 Exploitation pattern, terminal F and M

From the catches it appears that there is a change in exploitation pattern in the most recent years, more directed to the younger age groups. Therefore, separable VPAs were run on combined data (age of unit selection 3, ages 1 to 15+) on the last 5 years, with a terminal F of .5 and a range of terminal S values of 1.0, .75, .5 and 2.5. All selection patterns obtained show an equally good fit to the catch data. There was no objective way to select one of them as the best one. As it seems unlikely that F would follow an upward trend in the older age groups, a selection pattern with a terminal S of .5 was chosen arbitrarily as in last year's assessment.

Several methods were applied to obtain the present level of F. Correlations of cpue indices (1970-81) against the biomass of the exploited age groups (age 2 and older) show high correlations for the United Kingdom and the Netherlands and also for a relative index of United Kingdom and the Netherlands combined.

	F at age of maximum exploitation				
cpue/biomass	.5	.6	.7	.8	.9
United Kingdom	.78	.78	.76	.75	.73
Netherlands	.78	.82	.83	.83	.82
U.K.+Neth.	.80	.83	.82	.81	.80
Belgium	.58	.49	.40	.36	.32

The United Kingdom series suggests a present F at the age of maximal exploitation of F = .55. The Dutch series suggests an F of about .75. The United Kingdom + Netherlands combined an F of 0.6, and the Belgian series an F below 0.5. As the biomasses for all levels of F showed a good correlation with only minor differences in the correlation coefficients, this method does not give a clear answer.

Correlations of the mean F unweighted for the most exploited age groups $\overline{F(2\text{-}8)u}$ against international effort, calculated from the cpue indices showed lower, but more distinct maximum correlation coefficients. For United Kingdom, a selection pattern with F of 0.6 at the age of maximum exploitation gave the best fit. For the Netherlands, an exploitation pattern with F of .75 gave the best fit. For a correlation with the United Kingdom + Netherlands combined effort series, the best correlation was for F = .7.

F(2-8)u/Int.eff.	F at the age of maximum exploitation .5	.6	.7	.8	.9
United Kingdom	.49	.65	.57	.44	.35
Netherlands	.14	.49	.65	.65	.62
U.K. + Neth.	.31	.59	.65	.59	.53

The cpue against biomass and the F against effort correlations give a range of probable F values between .55 and .75. It was not possible to select a particular value of F with this method.

From plots of indices of international effort and cpue from the Netherlands and United Kingdom against F(2-8)u and biomass, respectively, it appeared that there are non-linear relationships between those sets of data. Therefore log/log regressions were applied to these data excluding the last 3 years (1979 to 1981), which are most influenced by the input F. The plots and correlation coefficients are given in Figure 2.2. From these relationships the expected 1981 values for F(2-8)u and biomass were calculated and the corresponding F at the age of maximum exploitation. The regression of cpue and biomass suggests an F of .6 or .55 for the Dutch and United Kingdom series, respectively. The regression of F(2-8)u and international effort indicates an F of .65 or .6 for the Dutch and United Kingdom series, respectively.

Based on these correlations it was decided to use an exploitation pattern with an F on the age of maximum exploitation of .6 for the final VPA.

Natural mortality was assumed to be .10, with the exception of 1963 when, owing to the effects of the severe winter, additional mortality occurred. A value of .9 for M was taken for 1963 (ICES, C.M.1979/G:10, Flatfish Working Group rep.).

A VPA run, with the selection pattern discussed above, produced a 1979 year class of nearly 180 million recruits. The "Tridens" recruitment surveys estimate this year class as 2.4, 1.8, 1.1 and 1.8 times average recruitment in the time series these surveys were conducted as I- and II-group in spring and autumn, respectively. The mean of this series is 1.8 x average recruitment in the period 1969-80. The input F for this year class has not been changed because the VPA estimate of this year class lies within the confidence limits of the survey estimate of this year class.

The estimate of the 1980 year class from the "Tridens" recruitment surveys is a year class of average strength. Therefore, F at age 1 has been reduced to produce an average year class.

2.4.2 Results of VPA

Tables 2.7, 2.8 and 2.9 give the catch input data, the F values and the stock numbers for ages 1 to 15+. Table 2.10 gives a summary of the VPA results.

The spawning stock biomass decreased continuously since 1967 from 102 000 tonnes to 28 000 tonnes in 1981. This decrease can be explained by the fishing out of the 1963 year class and a considerable increase of effort in the late 1960s, which has since been maintained. In 1978 and 1979 there was an increase of spawning stock biomass due to the 1975 and 1976 year classes, which were above average and recruited to the spawning stock in those years. The rapid decline

in 1980 and 1981 is mainly caused by the low recruitment from the year classes 1977 and 1978 and a high level of fishing effort. In 1982 the spawning stock biomass increased to 43 000 tonnes. It must be noted that almost 57% of this biomass consists of year class 1979, and that the error on the estimate of the size of this year class will have a great influence on the estimate of the present SSB and the expected yields in future.

2.4.3 Recruitment

The recruitment data are given in Table 2.10 and Figure 2.3. The geometric mean recruitment over the years 1957-80 (year classes 1956-1979) was 86 781 million 1 year old recruits. The arithmetic mean recruitment was 129 284 million recruits. These values are lower than in last year's report (101 and 136 million, respectively). These differences are not caused by the combination of the sexes, because no consistent trend between this year's and last year's recruitment estimate exists. These differences must be due to the updating of the data base.

The geometric mean recruitment was used in the short-term prognosis, because it is the best estimate of the expected year class strength in the short term. For the long-term prognosis, the arithmetic mean recruitment was used, because it takes into account the occurrence of extreme year classes.

Figure 2.4 shows a plot of 1 year old recruits against spawning stock biomass at the 1st of January. The big year class 1963 was produced by a low stock as indicated. The high natural mortality in the severe winter of 1962-63 reduced the stock considerably in the first quarter of 1963. This is not reflected in the stock size at the 1st of January.A similar reduction of the stock might also have occurred in 1958. Year classes 1962 and 1978 are reduced considerably in the cold winter of 1963 and 1979, and this might also be the case for year class 1961.

Figure 2.4 shows no indication of a relationship between stock biomass and recruitment at biomass levels observed in the past.

2.5 Catch Predictions

The weight at age data used in the prognosis were smoothed values from the last 5 years. The input data are given in Table 2.11.A and B.

Figure 2.3 shows the expected 1983 catch and the 1984 spawning stock biomass for different levels of fishing mortality with the 1983 exploitation pattern expressed in multiples of the 1981 level.

Table 2.12 summarizes the results of the catch predictions.

The catch in 1982 and 1983 will be 20 400 tonnes and 20 000 tonnes, respectively, assuming an unchanged fishery in those years compared with 1981. The 1979 year class will constitute 58% of the catch in 1982 and 40% of the catch in 1983.

The spawning stock in 1983 and 1984 will then be 42 700 tonnes and 40 600 tonnes, respectively. The 1979 year class will then contribute 43% to the SSB in 1983 and 28% in 1984.

2.6 Equilibrium Yield and Spawning Stock Biomass

Both a deterministic and a stochastic long-term yield and SSB were calculated. The results for the deterministic model are shown in Figure 2.3. The stochastic forecast was very similar and was used to predict the probability of achieving particular levels of the spawning stock.

In the stochastic model it was assumed that the recruitment followed a log normal distribution with $E(\log(R))$ = 11.37 and $v(\log(R))$ = .83.

Both yield curves are very flat-topped and have a maximum at an F which is .7 of the F in 1981.

The expected MSY is 28 000 tonnes in the deterministic model and 26 000 tonnes in the stochastic model. The expected SSB at F_{max} in the deterministic model is 88 000 tonnes and in the stochastic model 81 000 tonnes.

Figures 2.5 and 2.6 show the probability as a function of F for different levels of spawning stock biomass. The probability was calculated as described in Annex 1 for the short term as well as for the long-term prediction. For example, for an unchanged fishing pattern in 1982 and 1983 relative to 1981, the chance of having a stock greater than 40 000 tonnes will be 54%. In the long term, the chance of having a stock greater than 40 000 tonnes will be 72%.

2.7 Management Options

The spawning stock decreased from 39 000 tonnes in 1980 to 28 000 tonnes in 1981, i.e., the lowest level ever recorded. The increase in 1982 to 43 000 tonnes greatly depends on the size of the 1979 year class and the fishing mortality assumed on this year class.

Reportings were received of a concentration of some fleets in the coastal areas in the second half of 1981, concentrating their effort on this year class. This suggests that the fishing mortality on this year class may have been higher than assumed, but, as there was no information available to the Working Group to which extent this occurred, the Group could not take this into account. A lower estimate of the strength of this year class would result in a lower spawning stock biomass and catch in 1982 as predicted.

Accordingly, in the yield models, the F should be reduced to 70% of the present level. This would lead to a catch of about 16 000 tonnes in 1983 and a spawning stock biomass of about 50 000 tonnes in 1984.

3. NORTH SEA PLAICE

3.1 Landings and Effort

The landings used in this assessment are shown in Table 3.1. Some minor revisions have been made (see ad hoc Working Group report). The yield in 1981 remained high at almost 140 000 tonnes and again consisted of a high proportion of unreported landings (45 750 tonnes). The landings of most nations declined.

Catch per unit effort (cpue) data are shown in Table 3.2 and have been plotted in Figure 3.1. Catch rates have continued to increase for most fleets, and the international effort indices have all decreased since 1980 (Figure 3.2).

3.2 Data Base

Revisions have been made to the catch and weight at age data for 1971 onwards. In some years, quite large changes have been made to the age structure. The sums of products are much improved for the period 1971onwards. The catch at age data and SOPs are shown in Table 3.9. Stock weights have been estimated from first quarter catch weights from the new data base (Table 3.8). Catch weights are shown in Table 3.7.

For 1981, age data were available for Belgium, Denmark, Federal Republic of Germany and the United Kingdom; these were added and raised to the total landing (Table 3.3).

It was decided that the assessment should be carried out on the combined sex data. A comparison of combined and separate sex assessments on the old data base showed that there were only small differences in the VPA estimates of stock numbers and biomasses (Appendix 2).

3.3 Terminal F

A terminal S of 0.6 produces a relative F, which is constant on the older ages (Figure 3.3). Four terminal F arrays were obtained for 1981, using the separable VPA on data for 1977 to 1981; these corresponded to maximum F values on age 5 in 1981 of 0.2, 0.3, 0.4 and 0.6. The F values on age 14 for the years 1957-80 were calculated as 0.7 of the mean F on ages 3 to 7. This is equivalent to using a terminal S of 0.6 throughout.

Trial VPAs were carried out using these 4 levels of terminal F and an M of 0.1. The results for F(2-10) and spawning stock biomass are shown in Figure 3.4. Correlations of F(2-10) and international effort and of SSB and cpue for each series of effort data and each terminal F run were calculated for 1970 to 1981. Low correlations were obtained for the Belgian and Federal Republic of Germany data, and these were therefore excluded from further analysis. The United Kingdom first quarter cpue index was also excluded because the fishing power correction was too strongly corrected for BHP according to a recent analysis (Bannister and Large, pers.comm.). The United Kingdom (total year) and Netherlands correlation coefficients were highest for the runs of 0.4 and 0.3, respectively (r = 0.68 and 0.80).

In order to predict F_{81}, the United Kingdom and Netherlands cpue data and effort indices were correlated with SSB and F (2-10) for the period 1970 to 1978. The results are shown in Table 3.4. The SSB-cpue correlation coefficients were higher than those for F-f and were consistent in that the predicted F_{81} values (for the highest r) were similar to the values assumed for 1981. The United Kingdom cpue predicted an F_{81} on age 5 of 0.44, and the Netherlands data gave 0.37. The combined cpue gave a prediction of 0.395 (Figure 3.5).

The cpue indices show an increasing trend in stock from 1975 or 1976 until 1981, and, since the correlations were higher, the SSB-cpue regression was used to predict maximum F_{81} on age 5. The prediction for the combined index was selected and rounded to 0.4 for the final VPA.

3.4 Recruitment

The available indices are shown in Table 3.5. None of the regressions with the VPA recruitments was significant using data up to 1978. The "Tridens" autumn 1-group data showed the best correlation (Table 3.6).

The 1979 year class appears to have been exceptionally large in all areas except for the English coast. The trial VPA with F_{81} = 0.4 estimated a strength of 1053 million, which is in general agreement with the predicted values from the "Tridens" autumn 1-group and the spring 2-group regressions on the VPA (Figure 3.6). The ratio method, shown in Table 3.6, gives values for these two surveys from 1470 to 1082 million, respectively. This is confirmed by the Belgian age 2 cpue for 1971 to 1980, which predicts a value of 1040 million (r = .75). 700 million is predicted by Netherlands catch on age 2 expressed as a proportion of the total catch. Two levels were used in the prediction - 700 and 1053 million.

The 1980 year class was below the recent average in all surveys. The best regression ("Tridens" 1-group autumn) predicts a value of 446.6 million. A strength of 400 million was used. The F on age 1 in 1981 was adjusted to achieve this figure.

All surveys suggest that the 1981 year class is perhaps even larger than the big year class in 1979. Strengths of 1000 and 700 million were therefore assumed for the 1981 year class in the two forecasts, corresponding to the high and low 1979 recruitment runs, respectively.

3.5 Final VPA

The results of the VPA are given in Tables 3.7 to 3.11. They are summarized in Table 3.12 and plotted in Figure 3.7. The average recruitment for the 1956 to 1977 year classes was 391.7 million (GM) or 417.9 million (AM). The 1976 to 1978 year classes were considerably above average, and this has largely caused the recent increases in stock, cpue and yield. Fishing mortality has apparently declined since 1979, and this is in general agreement with the international effort indices.

3.6 Catch Prediction

The catch prediction inputs are given in Table 3.13, the results in Figure 3.7 and Table 3.4. If F remains constant, the yield is expected to be 181 000 tonnes in 1983 for a 1979 year class of 1053 million and 150 000 tonnes for 700 million. The contribution of the 1979 year class to the yield is 26% for the lower recruitment of 700 million and 35% for 1053 million. In either case, it will be a record catch for the plaice stock and is partly the results of the recent series of very good year classes, particularly those of 1976 to 1978, which were all estimated to be in excess of 500 million fish.

The spawning biomass is expected to be 550 000 or 460 000 tonnes in 1984 at the present F, depending upon which 1979 year class strength is used.

3.7 Equilibrium Yield and Biomass

Equilibrium yield and biomass per recruit values were calculated using the same inputs as for the short-term prediction (Table 3.13) except that AM recruitments were used to obtain the total yield and biomass. The results are shown in Figure 3.7. MSY occurs at 0.9 of the 1981 F. The VPA results show no evidence of a decline in recruitment and therefore the Y- and BPR curves can be used with reasonable confidence, that the stock will not collapse at or near the present F.

3.8 Comparison with Previous Assessment

The main difference from the previous result is in the recent level of F. The Working Group is of the opinion that this is not entirely the result of the new data base of the combined sex procedure, but principally due to the way in which we have estimated terminal F. (Note that Table 3.17 from the 1981 Working Group report is not an accurate summary of the old VPA.)

Last year the Working Group estimated the 1980 F(2-10) to be 0.55 on males and 0.41 on females. This was estimated by F-f regressions, using the United Kingdom first quarter cpue's for 1960 to 1976. This series was not used this year, because the fishing power correction was made by dividing the cpue by BHP; this over-compensates for the change in fishing power. A value of 0.327 for 1980 was estimated by this year's assessment, using

SSB-cpue regressions over the period 1970 to 1978. The value for 1981 was 0.288. The disadvantage of the previous method was that it gives a lot of weight to data in the earlier years, which may be poorly corrected for changes in fishing power relative to the recent period. The disadvantage of the present method is that it must use results from the VPA, which are influenced by the assumed terminal F values. However, the various runs predicted similar values for F_{81}, and the Working Group therefore believes that 0.288 is reliable.

3.9 Management Options

The present assessment suggests that the plaice stock is in a healthy state with F close to F_{max} on the Y/R curve and the stock increasing as a result of recent good recruitments.

4. SOLE IN DIVISION VIId

4.1 Landings and Effort

Landings in 1980 were 1 656 tonnes, and provisional landings in 1981 were 2 012 tonnes (Table 4.1). The landings in 1981 are the highest on record and nearly 70% higher than the recommended TAC. However, this recommendation did not take into account the strong 1979 year class, which was the main cause of the increased landings. In 1981, the Working Group assessed a 1981 yield of 1 892 tonnes.

For United Kingdom vessels, the catch per unit effort data were not available for 1981. Table 4.2 gives cpue for Belgian vessels and total international effort (total landings/belgian cpue). Effort in 1980 and 1981 appears to have increased by about 30% compared with the period 1977-79.

4.2 The Data Base

The age composition for 1980 was corrected for changes in landing figures. Belgian and United Kingdom age compositions were available for 1981, and a French length composition was also available; this was converted to an age composition, using the United Kingdom age/length key. Thus, in 1981, 35% of the landings were fully sampled for age, and 100% of the landings were sampled for length.

The data base was constructed using separate male and female data; the sex-combined catch number at age data are shown in Table 4.3.

Weights at age in the catch were calculated by weighting the national values by the national catch numbers for each year. Weights at age for the sexes combined were calculated from these values by taking a weighted mean of the sex separate values (weighting by the total male and female catch by age group) (Table 4.4).

Combined catch and stock weights were obtained by fitting a smooth curve to the catch weights and interpolating to 1 January. The sum of products discrepancy for 1981 was -1%. The smoothed 1981 catch and stock weights were used for the prediction (Table 4.5).

For 1972 the data base is evidently poor. For the age groups 5, 7 and 11, catches were zero, and this had a large effect on the exploitation pattern produced by the separable VPA runs, giving unreasonably low relative F values for these three age groups. It was, therefore, decided to delete 1971 and 1972 from the data base. For 1973 and 1974 the data look more consistent with later years, although French landings are only roughly estimated. For 1975-78, French landings were assumed to have the same age composition as the United Kingdom

landings. Comparison of the data in 1980 and 1981 showed a good correlation ($r = 0.79$ and 0.95, respectively) between the United Kingdom age composition and the estimated French age composition. This indicates that applying the United Kingdom age composition to the French landings in 1975-78 has not produced large errors in the total age composition for those years. However, French age composition data are clearly needed to improve and further evaluate the reliability of the data base.

4.3 Exploitation Pattern and Terminal F

Separable VPAs were calculated for a range of assumptions of terminal S and F for age range 2-14 and years 1973-1981. Figure 4.1 shows the result for the exploitation pattern; the lower figure demonstrates that the terminal F has little influence on the exploitation pattern, and the upper figure shows a range of patterns which fit the data equally well. The patterns are consistent for ages 2 to 5 and exhibit a pronounced peak in S on ages 3 and 4. There is no properly objective way to choose between the exploitation patterns. A value of S of 0.4 was selected, which gives approximately the same levels of F for all the oldest age groups.

Figure 4.2 compares the trend in F for an S of 0.4 with the total international effort trend obtained from the Belgian cpue series. Linear regressions give $r = 0.58$-0.67 over the F range 0.4-0.7 with the best fit for $F = 0.65$.

Figure 4.3 compares the trend in exploited biomass with the Belgian cpue. The best linear regression fit appears to be for an F of approximately 0.75. Thus, the Belgian effort and cpue data seem to indicate an F of about 0.7. However, this value is very high compared with earlier years. The hours fishing by Belgium increased by 20% from 1980 to 1981. This is in reasonable agreement with a terminal $F = 0.4$. The French have increased by 16% in the same period. These two results suggest that fishing mortality increased. It is, therefore, reasonable to suspect that the Belgian data are not representative for the total fishery. Lacking further evidence, the Working Group decided to present a VPA based on $F = 0.4$ as used last year, acknowledging that this is an arbitrary choice.

4.4 Recruitment Survey Estimates

Results of the French young fish surveys carried out on the main nursery grounds in this area were available for the years 1977-81. The results are shown in Table 4.6. The abundance indices obtained for the 1981 year class indicate that it is of average strength.

4.5 Traditional VPA

The exploitation pattern and level of F on age 4 from the separable VPA ($F = 0.4$, $S = 0.3$, unit of selection age 4, years 1973-81) were used to obtain terminal F inputs for the traditional VPA. The results of the VPA are shown in Table 4.7 and Table 4.8, and the biomass and recruitment trends have been plotted in Figure 4.4. Both the total biomass and the spawning stock biomass appear to have increased after 1978.

4.6 Equilibrium Yield and Spawning Stock Biomass

The input data are shown in Table 4.9, and the results in Figure 4.4. The fishery appears to be close to F_{max} at the present level and pattern of fishing mortality.

4.7 Catch Predictions

The input data are shown in Table 4.9. Average recruitment was assumed for the year classes 1980-1982 (7.7 millions at age 1; the geometric mean of the 1973-1978 year classes). The results are given in Table 4.10 and are graphically shown in Figure 4.4.

In 1982 no restrictions have been made on the fisheries, and the forecast was prepared keeping $F_{82} = F_{81}$. At the present level of F, the catch in 1982 is predicted to be 2 330 tonnes. According to this assessment, a TAC of 2 100 tonnes in 1983 will stabilize the fishing mortality at the 1981 level, which, according to the equilibrium yield per recruit curve, was close to F_{max}.

5. SOLE IN DIVISION VIIe

5.1 Landings and Effort

Landings decreased in 1981 to 1 145 tonnes compared with 1 269 tonnes in 1980 (Table 4.1 and Figure 5.1). This was caused by a reduction in French catches, which have fallen for two consecutive years from a peak of 515 tonnes in 1979. The United Kingdom catch of 1 145 tonnes remained at a similar level to that in 1980.

Catch per unit effort was calculated for United Kingdom otter and beam trawlers over 40 feet by averaging over rectangles and months after correcting for fishing power changes due to tonnage (Houghton, 1978) (Table 5.1). Cpue by beam trawlers, who take the bulk of the catch in Division VIIe has changed little since 1977, whilst otter trawl cpue fall steadily for the third consecutive year. An index of total international effort was obtained by dividing the United Kingdom cpue indices into the total landings.

5.2 The Data Base

Age composition data for males and females separately were available from United Kingdom landings for 1969-80; a French length composition was available for 1980 to which the United Kingdom age/length key was applied. The provisional 1980 data were amended.

The validity of using the French data was checked by comparing the numbers landed at age by each country in 1980 and 1981 (Figure 5.2). The relative numbers of each age group caught are in close agreement, and regressions give significant correlations (p less than 0.0) for 1980 and 1981. Male and female data were added to provide the sex-combined data base as in 1980 (Table 5.2). Catch weights for sexes combined (Table 5.3) were calculated from weighted means in each year (weighted by male and female catch numbers) and were smoothed and interpolated for 1 January to provide stock weights (Table 5.4).

Sum of products discrepancies for the separate sex and combined sex data are shown in Table 5.5. A previous discrepancy in 1981, which was due to the omission of Belgian and Irish landings to the weight at age, was amended. Sum of products corrections were not applied to the stock because of their good fit.

5.3 Exploitation Pattern

An assessment was run on the combined sex data as this was shown in 1980 to improve the chances of estimating the most recent level and pattern of fishing mortality using effort data. The exploitation pattern produced, using different assumptions of terminal F and S, are shown in Figure 5.3.

As there is no indication that the exploitation pattern has changed since 1980, the same value of terminal S of 0.4 was used; this gives a relatively constant S from age 8 to 14.

5.4 Terminal F Estimation

Figure 5.4 shows the level of F on age group 4, which was obtained by separable VPA for terminal F values of 0.2, 0.4, 0.5 and 0.6, and a terminal S of 0.4. These can be compared with the total international effective effort indices (Table 5.1). The best agreement with the beam trawl effort is with a terminal F of between 0.4 and 0.5. If the mean F for the ages 3-8 at different levels of terminal F is compared with the international effort for beam and otter trawl separately over the years 1972-81, a significant correlation is obtained (p less than 0.01) and a terminal F between 0.4 and 0.5 gave the highest correlation (Table 5.6).

Another method to estimate terminal F is to consider the F and effort in 1981 compared with the mean F and effort in the period 1972-77. This period was used because the effort data were relatively stable up until 1977. The ratios are shown in Table 5.7. The ratio for beam trawl effort was 2.40 and a ratio of 2.20 was obtained with an F of 0.4 and 2.56 with an F of 0.5. The comparable ratio for otter trawl effort was 3.97, which would require an F of over 0.8. Since the beam effort produces the major part of the landings, the otter trawl effort was excluded from the comparison. These results confirm that the value for terminal F lies close to 0.5, and this was therefore chosen, together with an exploitation pattern defined by an S of 0.4.

5.5 Final VPA

Natural mortality was assumed to be 0.1.

Terminal F values were calculated from the levels of F in age 4 and the exploitation pattern obtained from a separable VPA using F4 = 0.5 and S14 = 0.4. The results are shown in Tables 5.8 and 5.9 and are based on the combined sex data. Spawning stock biomass is plotted in Figure 5.5, along with the landings and the estimated recruitment at age 1.

5.6 Recruitment

The pattern of recruitment of 1 year olds estimated from the VPA is shown in Figure 5.5. The 1969-78 average was 3140 million and the individual year classes vary by less than a factor of two around this level. The 1979 year class was average, although it had been estimated in 1980 as 1.5 times the average strength. No information was available on the strength of the 1981 and 1982 year classes, which were assumed to be average.

5.7 Equilibrium Yield and Spawning Stock Biomass

Fishing mortality has increased since 1977 (Figure 5.5) and with a steeply declining recruitment, this has resulted in a fall in spawning stock biomass to its lowest level since 1971 (Figure 5.5). The fall in SSB is reflected in the declining yield and also in the cpue indices for both beam and otter trawl (Figure 5.1).

At the present level of F the stock is being exploited beyond maximum sustainable yield. For an average recruitment of 3.3 million fish, the spawning stock will equilibrate at about 1 900 tonnes and give a long-term yield of nearly 700 tonnes.

5.8 Catch Prediction

The input data are shown in Table 5.10 and the results in Table 5.11. If the 1981 level of F is maintained, a yield of 850 tonnes would be expected in 1983. However, the same fishing mortality will reduce the SSB to about 2 800 tonnes from its present level of nearly 4 000 tonnes.

5.9 Management Options

Spawning stock biomass increased considerably over the period 1977-79, mainly as a result of the recruitment to the stock of the large 1975 year class. However, since 1977, F has nearly doubled and in the absence of further good year classes, the SSB has begun to decline steeply. It is necessary to reduce the fishing mortality in order to prevent a falling yield per recruit and to maintain the SSB at a satisfactory level.

6. ENGLISH CHANNEL PLAICE (Divisions VIId and VIIe)

6.1 Landings (Table 6.1)

The catch in 1981 was the highest on record (6 212 tonnes). In the period between 1962 and 1980, the catch fluctuated around a mean of 3 500 tonnes. The 1981 increase in the catch was observed.

6.2 Age Composition (Tables 6.2 and 6.3)

As in previous years, age compositions were available for English and Belgian catches. Again the French data base was limited to a length distribution for sexes combined. The English age/length key and sex ratio were used to transform the French data. As last year, the Working Group felt that this approach had a major influence on the total international age composition as the French catch data accounted in 1981 also for more than half of the total international catch.

6.3 Analytical Assessment

For the same reasons spelled out in the 1981 report, the Working Group considered that no analytical assessment could be carried out for this stock.

7. MESH SELECTION EXPERIMENTS IN THE SOLE FISHERY

7.1 Introduction

In Table 7 of the previous Flatfish Working Group report (ICES, C.M. 1982/Assess:3) the results of 49 sole selection experiments conducted by Belgium, Federal Republic of Germany and the Netherlands were presented. As a conclusion from the Dutch and Belgian experiments, the figures indicated that the rigging of the gear, HP, towing speed, towing duration on 'clean' or 'dirty' ground had no significant influence on the selection factor for sole. Federal Republic of Germany experiments conducted on board low HP vessels resulted in rather low selection factors of about 3.0, compared with an average of 3.3 found for the Dutch and Belgian vessels.

7.2 New Selectivity Experiments

164 additional hauls were conducted by the Federal Republic of Germany in 1982, using mesh sizes between 62.0 and 90.4 mm (Bohl and Rauck, 1982). However, the values of 3.0 found in 1981 were confirmed. The possible reasons for the low selection factors given in the paper were the very dense epibenthos population in the Federal Republic of Germany coastal waters, the relatively long beams of 6 to 8 m used, the continuous reduction of towing speed, sometimes up to a complete stand-still, and the higher proportion of smaller soles in the catches, compared to other experiments. As a consequence of the continuously reduced towing speed, the water flow through the trawl net is more and more impeded, sand is increasingly retained and the meshes are closed to such an extent, that there is little chance for the soles, particularly the small ones, to escape from the cod end.

The results of a new series of Dutch mesh selection experiments on sole were published in 1982 (van Beek et al., 1982). A total of 233 successful hauls directed on sole were carried out on board commercial vessels of 1015 and 1310 BHP, using mesh sizes between 65 and 90 mm. The tow duration was set between 15 and 120 minutes in order to examine the effect of towing time on the selection factor. In addition, short hauls with initial cod-end filling of 100-200 kg of debris were conducted to study the effect of different cod-end fillings on the selection process.

It could be shown that the selection factor and the selection range of soles are dependent of the amount and volume of the catch. It was also demonstrated that within the Dutch experiments, the selection range goes up, and the selection factor goes down, with increasing HP (in the range of 950-1700). The values derived from the Belgian and Federal Republic of Germany experiments, however, do not fit with this relationship.

The conclusion is that under different conditions, the selection factor can vary, but that the modern beam trawl is similar to that of the otter trawl fleet of the 1960s, and that 3.3 is suitable for mesh assessments.

7.3 Mesh Assessment for Sole in Sub-area IV

In the 1981 Working Group report, a mesh assessment was made for sole in Sub-area IV. Two major shortcomings of this assessment were that discards were not included and that the effective mesh size currently used was not known. This year, a paper by van Beek (C.M.1982/B:39) was presented with mesh assessments including both discards and various assumptions about the current effective mesh size. The paper also gives a more detailed account of the short-term and long-term effects of a mesh increase, especially in relation to recruitment levels. Otherwise, the method used was the same as the one used in the 1981 Flatfish Working Group. The main results of the new assessment are given in Tables 7.1 and 7.2.

Discarding in Dutch sole fisheries in 1978-80 was about 8% by numbers, and this corresponds to an underestimate of the recruitment of about 7%.

The problem of the effective mesh size currently in use is important only in relation to an increase to 80 mm mesh. However, the possible error in estimates of the long-term yield for 80 mm mesh is not larger than 4%. With an increase to 90 mm, the current effective mesh size is of very little significance to the calculations.

The long-term gain in yield by increasing the mesh size to 80 mm and 90 mm is estimated to be 6-10% and 15%, respectively. With an average recruitment of 100 million at age 1, this means an increase in long-term yield of 1 500 - 2 000 tonnes for 80 mm mesh and 3 200 - 3 300 tonnes for 90 mm mesh.

Increasing the mesh size to 80 mm from 1 January 1981 is estimated to give a short-term loss of 14-22% in yield. The loss will be reduced to 5-7% in 1982. In 1983, there will be a gain of 2-3% and for 1984 a gain of 5-7% is estimated. An increase to 90 mm from 1981 would have given a loss of about 40% in 1981, 30% in 1982, and 9% in 1983. In 1984, a gain of 4% would be expected. After introducing 80 mm mesh, however, an increase to 90 mm will give smaller short-term losses. The losses will be more important, if the mesh increase coincides with a strong year class. The main benefit of an increase to 80 or 90 mm would be to increase the spawning stock.

8. BY-CATCH DATA IN THE FISHERIES FOR CRANGON

The Working Group took note of the internal EEC report "Problem of the by-catches in the fisheries for shrimps". This report was presented by an EEC member country as a result of a specific contract for scientific research on this topic. The period of investigation was fixed for a whole year cycle starting on 1 April 1981.

The aim of this study was to obtain information on the by-catch rates of commercially sized fish species in the shrimp fishery in the Southern Bight. This was done by daily recordings in the fishing ports of Belgium (Zeebrügge, Oostende and Nieuwpoort) and of the Netherlands (Breskens and Colijnsplaat). Detailed information was also available from the Channel fishery in the Baie de Somme.

The results of the by-catch rates are given in Table 8.1. In nearly all cases, this by-catch level is beyond the proposed 10% limit. There seems to be a difference in the fish species' composition in relation to the season (Table 8.2). In the period May to September the by-catch consisted mainly of flatfish species, viz., sole and plaice. From October to April, roundfish species as whiting and cod became more dominant in the shrimp catches. The total estimated by-catch of sole, plaice, whiting and cod from the catches in the area are summarized in Table 8.3 for the period April 1981 to February 1982. In addition, the total North Sea and English Channel of the directed fishery for the year 1981 is also given in the table, in order to illustrate the relative importance of the by-catch of the shrimp fishery.

The Working Group does still not have available an estimate of the total catch of undersized plaice and sole in the shrimp fishery, which is what is needed to assess its full effect on the assessments.

9. CATCH OPTIONS FOR SOLE IN THE BAY OF BISCAY

The nominal catch of the sole catches is given in Table 9.1, from which it is seen that the catch level did not change very much over the last four years.

No additional information was made available to the Group. The Group, therefore, took note of the most recent publications on this stock (Guillou et al., 1980, Rev.Trav.Inst.Pêches marit.44(4) and Guillou et al, ICES, Annls biol., Vol.37 and 38 (in print).

From these publications it appeared that cpue declined from 1970 to 1978 with a factor of about 35%. However, information on the most recent years was lacking, and the Group was, therefore, not able to make further evaluations.

The only information on the total age distribution was derived from the 1981 catches. This distribution showed that 80% of the 1981 catches consisted of ages 1-4. The amount of the ages older than 8 years fluctuated between 1 and 2% for each year class up till the age of 19.

The Working Group finally agreed that the available information was insufficient for indicating any catch options for 1983.

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Table 2.1 Nominal Catch (tonnes) of SOLE in Sub-area IV.

Country \ Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Belgium	1 880	2 226*	1 833	1 483*	1 130	1 392*	1 456	1 671*	1 727*	2 044*	1 378	1 363
Denmark	525	1 149	671	957	705	682	574	348	465	313*	710*	720
France	265	403	206	250	195	297	598	308	346	309*	232*	
Germany, Fed.Rep.	318	600	258	336	173	233	192	310	467	242*	338*	346
Netherlands	16 024	18 776	17 662	15 883	15 434*	15 242	11 044	10 873	6 749	7 646*	12 695*	12 400
United Kingdom (Engl.+Wales)	660	484*	443*	386*	340	426	455	491*	625*	649	452*	381
Other countries	13	14	13	14	12	-	7	2	1	40	2	-
Total	19 685	23 652	21 086	19 309	17 989							
Unreported landings						2 500	3 000	4 000	9 900	11 354		
Grand Total						20 772	17 326	18 003	20 281	22 597	15 807	15 405

* Figure revised by Ad hoc Flatfish Working Group 1982, otherwise from Bulletin Statistique.

Table 2.2 North Sea SOLE. Age composition of the catch in 1981.

Country	Belgium	Denmark	Germany, Fed.Rep.	Netherlands	England	TOTAL*
Gear	All gears	Gill net	All gears	All gears	Otter trawl	
Age						
1	24.2		1.9	391.2		422.6
2	2 173.1		281.9	26 036.0	359.9	29 220.6
3	320.8	3.8	26.8	2 756.0	110.8	3 259.5
4	241.2	521.7	169.0	5 720.5	127.2	6 866.5
5	1 113.8	472.0	151.0	6 094.5	288.6	8 223.9
6	590.6	542.7	79.1	2 265.5	137.6	3 661.8
7	179.8	89.8	25.2	586.6	55.0	948.4
8	182.3	68.8	43.6	531.3	49.0	886.3
9	91.5	133.8	59.5	439.4	32.5	766.4
10	27.5	49.2	10.5	98.9	8.8	197.4
11	62.0	11.5	5.2	15.3	12.0	107.3
12	27.4	7.6	12.5	102.4	8.0	159.9
13	22.1		5.4	56.9	6.3	91.8
14	7.8	3.8	2.0	4.4	2.5	20.7
15	10.8	3.8	1.3	2.3	48.3+	331.4+
16	10.7		2.1	8.5		
17	6.4		1.7	1.4		
18	34.1		10.6	116.5		
19	0.8					
20	7.7		1.3	13.6		
21	13.1+		1.0+	31.2+		
SOP	1 418.2	719.1	345.6	11 946.7	380.3	14 999.7
NOMC	1 363.4	720.0	345.6	12 400.0	381.0	15 404.9

* The sum of the age compositions is raised to the total international catch with a factor 1.01281

Table 2.3 North Sea SOLE. Sum of Product discrepancies of the catch.

Year	SOP (A)	Nominal Catch (B)	A/B
1957	9 137	12 067	132
1958	11 326	14 287	126
1959	13 695	13 832	101
1960	19 029	18 620	98
1961	24 825	23 566	95
1962	24 878	26 877	108
1963	24 863	26 162	105
1964	10 132	11 342	112
1965	12 634	17 043	135
1966	33 157	33 340	101
1967	30 334	33 439	110
1968	29 742	33 179	112
1969	28 889	27 560	95
1970	21 237	19 685	93
1971	22 599	23 652	105
1972	22 318	21 086	94
1973	18 560	19 309	104
1974	18 237	17 989	99
1975	20 559	20 773	101
1976	16 959	17 326	102
1977	17 672	18 003	102
1978	20 371	20 280	100
1979	22 322	22 595	101
1980	15 496	15 807	102
1981	15 012	15 405	103

Table 2.4 Belgian, Dutch and United Kingdom cpue indices for North Sea SOLE (tonnes/1000 kg) and estimates of total international effort based on these indices

Year	Yield ($tx10^3$)	Netherlands[1] beam trawl cpue	United Kingdom[1] winter cpue	Belgium[1] beam trawl cpue 2. quarter	Belgium[1] beam trawl cpue wh.y.	International effort based on		
						Netherl.	United Kingdom	Belgium
1970	19 685	51	1 704	-	-	3 810	1 903	-
1971	23 652	51	1 592	84	48	4 630	1 486	4 968
1972	21 086	43	1 059	49	39	4 904	1 991	5 401
1973	19 309	28	863	50	34	6 997	2 231	5 679
1974	17 989	22	644	31	24	8 177	2 574	7 415
1975	20 773	22	929	32	26	9 442	2 236	7 990
1976	17 326	25	904	29	24	6 930	1 761	2 219
1977	18 003	22	791	34	27	9 193	2 276	6 660
1978	20 280	28	952	36	26	7 234	2 130	2 800
1979	22 598	30	1 052	44	39	7 533	2 148	5 794
1980	15 807	18	643	58	32	8 782	2 281	4 940
1981	15 405	18	826	43	36	8 558	1 865	4 278
1982	-	-	-	71	-	-	-	-

1) For deviation of indices see para. 2.3.

Table 2.5. North Sea SOLE (Males and Females) in Sub-Area IV. Mean weight (kg) at age in the catch.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.042	0.000
2	0.099	0.096	0.099	0.096	0.091	0.101	0.097	0.068	0.086
3	0.149	0.154	0.155	0.151	0.149	0.143	0.150	0.142	0.158
4	0.207	0.195	0.208	0.208	0.216	0.197	0.205	0.205	0.196
5	0.250	0.245	0.246	0.245	0.256	0.252	0.245	0.242	0.236
6	0.287	0.285	0.282	0.277	0.279	0.271	0.303	0.280	0.275
7	0.304	0.292	0.296	0.277	0.320	0.312	0.324	0.329	0.309
8	0.337	0.307	0.302	0.304	0.329	0.349	0.336	0.297	0.366
9	0.340	0.353	0.372	0.368	0.373	0.369	0.345	0.394	0.381
10	0.395	0.360	0.391	0.372	0.406	0.377	0.404	0.451	0.385
11	0.408	0.424	0.426	0.419	0.417	0.396	0.422	0.466	0.480
12	0.393	0.592	0.422	0.427	0.476	0.444	0.417	0.454	0.414
13	0.461	0.393	0.447	0.436	0.545	0.495	0.518	0.456	0.502
14	0.641	0.642	0.511	0.471	0.510	0.399	0.509	0.488	0.501
15+	0.571	0.571	0.571	0.571	0.571	0.571	0.571	0.573	0.504

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.000	0.000	0.000	0.000	0.082	0.108	0.160	0.115	0.164
2	0.117	0.110	0.108	0.131	0.133	0.179	0.202	0.191	0.192
3	0.178	0.176	0.166	0.212	0.210	0.229	0.224	0.236	0.233
4	0.257	0.230	0.219	0.277	0.294	0.314	0.323	0.332	0.338
5	0.282	0.296	0.267	0.337	0.354	0.358	0.425	0.402	0.418
6	0.306	0.346	0.311	0.411	0.405	0.420	0.432	0.444	0.449
7	0.369	0.378	0.372	0.545	0.450	0.440	0.506	0.530	0.520
8	0.422	0.333	0.392	0.495	0.534	0.505	0.496	0.540	0.559
9	0.468	0.426	0.483	0.551	0.523	0.506	0.574	0.456	0.609
10	0.495	0.573	0.487	0.648	0.560	0.484	0.582	0.609	0.602
11	0.555	0.521	0.573	0.581	0.549	0.496	0.441	0.681	0.661
12	0.543	0.458	0.564	0.705	0.598	0.485	0.669	0.489	0.678
13	0.441	0.595	0.589	0.599	0.572	0.610	0.609	0.592	0.532
14	0.558	0.518	0.664	0.675	0.621	0.618	0.646	0.618	0.582
15+	0.515	0.581	0.700	0.698	0.689	0.531	0.689	0.607	0.679

	1975	1976	1977	1978	1979	1980	1981
1	0.129	0.143	0.147	0.152	0.137	0.141	0.143
2	0.182	0.190	0.186	0.196	0.208	0.199	0.187
3	0.225	0.222	0.236	0.231	0.246	0.244	0.226
4	0.320	0.306	0.307	0.314	0.323	0.331	0.324
5	0.406	0.389	0.369	0.370	0.391	0.371	0.378
6	0.456	0.441	0.424	0.426	0.448	0.418	0.424
7	0.529	0.512	0.430	0.466	0.534	0.499	0.442
8	0.595	0.562	0.526	0.417	0.544	0.556	0.516
9	0.629	0.667	0.562	0.572	0.609	0.598	0.542
10	0.560	0.658	0.622	0.471	0.657	0.544	0.553
11	0.648	0.538	0.731	0.604	0.728	0.658	0.403
12	0.633	0.736	0.607	0.711	0.774	0.684	0.665
13	0.620	0.668	0.605	0.588	0.806	0.674	0.565
14	0.645	0.593	0.643	0.830	0.839	0.661	0.721
15+	0.678	0.684	0.581	0.716	0.815	0.717	0.745

Table 2.6. North Sea SOLE (Males and Females) in Sub-Area IV. Mean weight (kg) at age of the stock.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
2	0.071	0.070	0.070	0.067	0.065	0.072	0.069	0.063	0.063
3	0.120	0.121	0.123	0.095	0.121	0.120	0.125	0.115	0.127
4	0.179	0.169	0.176	0.175	0.182	0.171	0.179	0.177	0.157
5	0.223	0.223	0.220	0.217	0.229	0.225	0.219	0.217	0.211
6	0.271	0.250	0.266	0.256	0.263	0.256	0.265	0.264	0.260
7	0.287	0.276	0.280	0.281	0.302	0.296	0.310	0.304	0.292
8	0.320	0.292	0.287	0.289	0.332	0.330	0.304	0.283	0.340
9	0.332	0.343	0.355	0.352	0.357	0.352	0.367	0.380	0.364
10	0.360	0.346	0.378	0.358	0.385	0.362	0.388	0.434	0.370
11	0.395	0.415	0.413	0.406	0.392	0.384	0.409	0.452	0.465
12	0.577	0.576	0.469	0.414	0.454	0.431	0.366	0.441	0.402
13	0.448	0.377	0.435	0.424	0.526	0.432	0.510	0.444	0.488
14	0.629	0.631	0.502	0.464	0.486	0.394	0.498	0.480	0.493
15+	0.561	0.561	0.561	0.561	0.561	0.561	0.561	0.562	0.495

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.028	0.028	0.028	0.023	0.033	0.034	0.038	0.039	0.035
2	0.083	0.079	0.077	0.095	0.096	0.117	0.131	0.146	0.146
3	0.142	0.142	0.134	0.170	0.171	0.218	0.218	0.230	0.218
4	0.210	0.204	0.194	0.240	0.253	0.312	0.323	0.326	0.329
5	0.238	0.269	0.243	0.310	0.325	0.347	0.430	0.389	0.408
6	0.286	0.322	0.291	0.335	0.378	0.410	0.438	0.432	0.429
7	0.353	0.362	0.355	0.414	0.428	0.446	0.456	0.505	0.499
8	0.406	0.321	0.378	0.477	0.515	0.497	0.464	0.474	0.565
9	0.470	0.406	0.466	0.514	0.509	0.504	0.547	0.403	0.542
10	0.482	0.559	0.474	0.628	0.545	0.412	0.351	0.562	0.594
11	0.543	0.509	0.562	0.569	0.538	0.454	0.335	0.707	0.632
12	0.533	0.441	0.554	0.639	0.579	0.399	0.624	0.505	0.594
13	0.433	0.587	0.582	0.585	0.558	0.595	0.643	0.550	0.650
14	0.548	0.509	0.654	0.665	0.612	0.414	0.618	0.603	0.540
15+	0.508	0.574	0.693	0.694	0.685	0.506	0.696	0.628	0.623

	1975	1976	1977	1978	1979	1980	1981
1	0.035	0.035	0.035	0.035	0.045	0.039	0.068
2	0.148	0.142	0.147	0.139	0.148	0.157	0.137
3	0.206	0.201	0.202	0.211	0.211	0.200	0.200
4	0.311	0.301	0.291	0.290	0.300	0.304	0.305
5	0.403	0.379	0.365	0.365	0.352	0.345	0.364
6	0.446	0.458	0.409	0.429	0.429	0.394	0.402
7	0.508	0.508	0.478	0.427	0.521	0.489	0.454
8	0.582	0.517	0.487	0.385	0.562	0.537	0.522
9	0.580	0.644	0.531	0.542	0.567	0.579	0.561
10	0.617	0.697	0.617	0.428	0.656	0.549	0.520
11	0.615	0.614	0.661	0.570	0.712	0.664	0.409
12	0.647	0.736	0.656	0.675	0.716	0.676	0.713
13	0.650	0.648	0.678	0.589	0.787	0.638	0.533
14	0.705	0.628	0.632	0.860	0.815	0.657	0.822
15+	0.669	0.679	0.665	0.697	0.791	0.638	0.720

Table 2.7. North Sea SOLE (Males and Females) in Sub-Area IV.
Input catch in numbers ('000) for VPA.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0	0	0	0	0	0	0	75	0
2	1160	1997	3855	12832	4389	1620	570	201	47152
3	8516	8342	13244	15052	55063	5965	8006	2469	878
4	10255	11923	12154	13920	26065	56884	8648	5835	1428
5	2807	7064	9861	10357	10632	13913	47017	3784	5162
6	2209	3063	6845	9302	6297	9602	7760	16218	2514
7	4714	2896	3961	5846	4140	4236	6326	3037	11849
8	1233	3659	2401	1814	3383	3954	2124	1719	1426
9	676	1525	2761	1169	1459	2196	3335	776	1440
10	4782	751	1504	3209	1046	677	1548	777	401
11	114	4242	773	1331	1573	1375	751	425	668
12	99	95	3215	574	1019	932	704	177	352
13	47	241	93	3604	587	990	2008	420	409
14	68	65	105	195	2252	450	411	350	223
15+	208	276	304	319	455	1958	2365	557	1028
TOTAL	36947	46139	57715	84805	118358	104752	91577	36819	74930

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0	0	1114	289	1181	453	1	724	101
2	13749	3961	19100	28911	6932	35329	8206	13125	15380
3	138516	26370	13510	22825	27518	13601	41218	11934	21540
4	621	85825	27632	5911	9435	12886	7609	16527	5487
5	1120	1924	53042	12771	1976	4360	5409	3916	7061
6	3364	601	503	25778	3486	1346	1710	2407	1923
7	908	2186	437	353	13590	2257	533	1129	1585
8	3815	791	1586	246	243	6969	1332	838	658
9	663	5100	386	927	117	161	5504	1254	401
10	897	523	4942	293	769	223	130	3323	609
11	284	632	284	2765	163	507	103	220	2364
12	528	305	826	247	2554	271	506	312	104
13	215	436	90	583	191	1606	128	369	32
14	108	174	446	158	522	424	1037	82	305
15+	561	630	539	708	1138	1174	974	1377	1401
TOTAL	170328	129503	126440	102765	69864	81587	74400	57536	58949

	1975	1976	1977	1978	1979	1980	1981
1	264	1041	1747	27	9	637	423
2	22954	3543	22328	25031	8180	1209	29221
3	24536	27966	12073	29292	41170	12512	3260
4	11717	14013	15307	6129	16061	17781	6807
5	2088	4819	7440	0639	2996	7297	8224
6	3830	966	1779	4250	3227	1450	3662
7	791	1909	319	1730	1747	2197	948
8	908	551	1112	611	817	1409	886
9	508	425	256	646	242	367	766
10	234	204	211	192	393	54	197
11	252	195	94	235	154	415	107
12	1905	132	122	123	117	52	169
13	25	1320	108	106	103	52	92
14	84	39	852	68	73	32	21
15+	945	773	729	879	687	598	331
TOTAL	75039	57895	64476	75967	75968	46062	55164

Table 2.8. North Sea SOLE (Males and Females) in Sub-Area IV.
Fishing mortalities from VPA (M = 0.10).

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.016	0.016	0.031	0.027	0.025	0.017	0.033	0.024	0.160
3	0.098	0.133	0.123	0.146	0.138	0.124	0.144	0.284	0.127
4	0.202	0.173	0.261	0.231	0.358	0.136	0.353	0.215	0.235
5	0.158	0.182	0.190	0.329	0.176	0.293	0.305	0.390	0.267
6	0.099	0.196	0.217	0.246	0.304	0.214	0.350	0.241	0.431
7	0.149	0.162	0.130	0.297	0.147	0.307	0.262	0.337	0.249
8	0.061	0.148	0.176	0.196	0.250	0.183	0.331	0.167	0.233
9	0.059	0.090	0.143	0.110	0.214	0.224	0.208	0.286	0.184
10	0.093	0.077	0.094	0.219	0.122	0.191	0.283	0.198	0.210
11	0.058	0.100	0.095	0.119	0.143	0.208	0.278	0.197	0.177
12	0.060	0.036	0.093	0.086	0.111	0.106	0.206	0.140	0.223
13	0.060	0.181	0.040	0.138	0.106	0.135	0.464	0.269	0.484
14	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.200	0.200
15+	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.200	0.200
F(2- 8),U	0.109	0.145	0.161	0.216	0.207	0.189	0.257	0.237	0.235

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.000	0.000	0.011	0.006	0.008	0.012	0.000	0.007	0.001
2	0.132	0.108	0.319	0.374	0.172	0.329	0.264	0.216	0.185
3	0.419	0.356	0.676	0.642	0.645	0.520	0.694	0.662	0.573
4	0.112	0.440	0.686	0.524	0.592	0.633	0.547	0.587	0.649
5	0.261	0.517	0.474	0.687	0.294	0.532	0.528	0.534	0.474
6	0.250	0.195	0.218	0.394	0.355	0.297	0.363	0.419	0.484
7	0.243	0.227	0.190	0.210	0.331	0.364	0.165	0.385	0.475
8	0.264	0.307	0.229	0.140	0.195	0.252	0.337	0.372	0.361
9	0.145	0.215	0.216	0.182	0.082	0.195	0.288	0.539	0.272
10	0.150	0.147	0.297	0.226	0.202	0.198	0.188	0.251	0.483
11	0.202	0.146	0.101	0.240	0.169	0.178	0.118	0.486	0.255
12	0.186	0.308	0.236	0.106	0.325	0.413	0.243	0.544	0.398
13	0.184	0.206	0.126	0.233	0.101	0.310	0.311	0.250	0.085
14	0.200	0.200	0.300	0.300	0.300	0.300	0.300	0.300	0.300
15+	0.200	0.200	0.300	0.300	0.300	0.300	0.300	0.300	0.300
F(2- 8),U	0.240	0.307	0.396	0.430	0.369	0.418	0.414	0.454	0.457

	1975	1976	1977	1978	1979	1980	1981
1	0.007	0.009	0.013	0.001	0.001	0.004	0.005
2	0.279	0.105	0.244	0.228	0.220	0.142	0.210
3	0.536	0.565	0.537	0.523	0.625	0.535	0.600
4	0.624	0.486	0.614	0.509	0.538	0.536	0.560
5	0.486	0.502	0.458	0.523	0.445	0.443	0.450
6	0.452	0.386	0.310	0.457	0.460	0.356	0.370
7	0.333	0.373	0.189	0.496	0.306	0.578	0.370
8	0.466	0.382	0.350	0.577	0.406	0.383	0.430
9	0.463	0.391	0.254	0.314	0.417	0.287	0.350
10	0.225	0.302	0.305	0.273	0.285	0.138	0.220
11	0.334	0.264	0.198	0.578	0.327	0.486	0.390
12	0.299	0.262	0.234	0.381	0.561	0.157	0.310
13	0.140	0.310	0.316	0.294	0.559	0.463	0.400
14	0.300	0.300	0.300	0.300	0.300	0.300	0.300
15+	0.300	0.300	0.300	0.300	0.300	0.300	0.300
F(2- 8),U	0.456	0.398	0.387	0.473	0.428	0.425	0.427

Table 2.9. North Sea SOLE (Male and Females) in Sub-Area IV.
Stock size in numbers ('000) from VPA at 1 January.
Biomass unit: tonnes.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	149051	146405	561267	70723	111515	29446	21553	572663	128733
2	78670	134367	132473	507855	63993	100903	26644	8763	518096
3	95894	70081	120135	116201	447328	53732	89760	10482	7738
4	58915	73678	55486	96122	90849	352463	42753	31609	7143
5	22923	43574	59870	53676	69019	57493	264917	12267	23063
6	24715	16676	32721	44812	25174	52357	38825	79359	7513
7	35794	20264	13444	23835	31720	16806	38260	11121	56417
8	21794	27912	15592	10631	16019	24771	11190	11735	7184
9	12490	18549	21781	11829	7943	11285	18660	3262	8986
10	50038	10660	15335	17086	9592	5802	8127	5576	2222
11	3247	40678	8931	12636	12415	7686	4606	2490	4308
12	1794	2630	38205	7347	10151	9740	5650	1419	1850
13	847	1530	2470	31515	6103	3217	7927	1870	1116
14	754	717	1155	2147	24846	4965	6496	2026	1293
15+	2958	3056	3349	3514	5023	21602	37420	3225	5947
TOTAL No.	560451	623885	1062215	994976	931689	757266	622986	757873	781607
SSB No.	338730	342613	338470	416490	756182	626918	574790	176448	134778
Total Biom.	90312	96072	112062	127571	148273	145348	148439	58721	74148
SSB	81596	83557	91003	92059	141772	137465	146148	46143	38805

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	44875	81674	108553	51233	147309	41434	78337	106478	109489
2	116483	40605	73358	97163	46082	132163	37060	70882	95657
3	423995	92339	32977	48263	60512	35115	86090	25748	51679
4	6168	252395	58551	15173	22089	28726	18897	38929	12012
5	5108	4990	147667	26852	8133	11059	13804	9896	19586
6	15970	3560	2693	82835	12222	5485	5878	7369	5243
7	4416	11259	2651	1960	50521	7754	3086	3698	4387
8	39805	3134	8118	1984	1438	32827	4876	2827	2276
9	5147	27654	2086	5841	1561	1071	23091	3149	1765
10	6763	4023	20183	1521	4405	1302	797	15672	1663
11	1630	5268	3148	13573	1098	3255	966	598	11028
12	3264	1205	4119	2575	9657	839	2465	777	332
13	1340	2452	601	2944	2096	6317	503	1750	408
14	622	1008	1805	639	2110	1715	4192	333	1234
15+	3133	3648	2178	7862	4805	4749	3940	5569	5667
TOTAL No.	678719	534618	468288	355417	374038	313816	284582	293678	322431
SSB No.	517361	412940	286377	207022	180646	140214	109185	110318	117284
Total Biom.	106746	98395	82742	82012	69977	69073	65585	58909	60307
SSB	95822	92917	74054	71603	60692	52201	57754	44407	42509

	1975	1976	1977	1978	1979	1980	1981	1982
1	41509	118934	143974	48108	10638	179514	89035	**********
2	98974	37308	100626	128612	43504	9617	161826	80160
3	71953	67781	30393	75293	92618	31601	7554	118691
4	26376	38093	34363	16072	40395	44860	16750	3751
5	5680	12783	21198	17065	8739	21348	23759	8657
6	11635	3162	7003	12133	9156	5070	12404	13708
7	2927	6357	1946	4649	6952	5232	3213	7753
8	2469	1899	3942	1458	2561	4634	2655	2008
9	1436	1374	1197	2512	741	1544	2857	1563
10	1217	813	841	840	1661	442	1048	1859
11	928	379	547	561	578	1130	348	761
12	7736	601	611	406	285	377	629	213
13	202	5193	419	437	251	147	292	417
14	339	159	3447	276	295	130	84	177
15+	3824	3126	2950	3555	2777	2419	1340	955
TOTAL No.	276605	298468	359955	311979	221151	308064	323794	
SSB No.	136121	142225	109355	135258	167010	118933	72934	
Total Biom.	59349	53110	56768	59377	55404	46742	55252	
SSB	43248	43649	36055	39816	48486	38231	27027	

The biomasses in this table are not corrected for SOP discrepancies.

Table 2.10 Summary of the VPA results for North Sea SOLE

Year	F(2-8)U	Spawning stock[⌘] biomass (tonnes)	Stock[⌘] biomass (tonnes)	Recruitment age 1 (thousands)
1957	.109	107 707	119 212	149 051
1958	.145	105 282	121 051	146 405
1959	.161	91 913	113 183	561 267
1960	.210	92 018	125 020	70 723
1961	.207	134 683	140 859	111 515
1962	.189	148 462	156 976	29 446
1963	.257	153 455	155 861	21 553
1964	.237	51 680	65 768	572 663
1965	.235	52 387	100 100	128 733
1966	.240	96 780	107 813	44 875
1967	.307	102 209	108 235	81 074
1968	.398	82 940	92 671	108 553
1969	.430	68 023	77 911	51 233
1970	.369	56 444	65 079	147 309
1971	.418	54 811	72 527	41 434
1972	.414	54 289	61 650	78 337
1973	.454	46 183	61 265	106 478
1974	.457	42 084	59 704	109 489
1975	.456	43 680	59 942	41 509
1976	.398	44 522	54 172	118 934
1977	.387	36 776	57 903	143 974
1978	.473	39 816	59 377	48 108
1979	.428	48 971	55 958	10 638
1980	.425	38 996	47 677	179 514
1981	.427	27 838	56 910	-

[⌘] Corrected for SOP discrepancies

Table 2.11.A North Sea SOLE input data for catch predictions

Age	Stock at 1981	Catch weight	Stock weight	F at age
1	86 781	.143	.068	.005
2	161 826	.187	.137	.210
3	7 554	.226	.200	.600
4	16 750	.324	.305	.560
5	23 759	.378	.364	.450
6	12 404	.424	.402	.370
7	3 213	.442	.454	.370
8	2 655	.516	.522	.430
9	2 857	.542	.561	.330
10	1 048	.553	.520	.220
11	348	.403	.409	.390
12	629	.665	.713	.310
13	292	.565	.533	.400
14	84	.721	.822	.300
15	1 340	.745	.720	.300

Table 2.11.B. North Sea SOLE.
Input data for long-term yield.

LIST OF INPUT VARIABLES BY AGE GROUP:

AGE	1981 STOCK SIZE	F-PATTERN	M	MATURITY OGIVE	WEIGHT IN THE CATCH	WEIGHT IN THE STOCK
1	86781.00	0.0050	0.100	0.0000	0.1100	0.0740
2	161826.00	0.2100	0.100	0.0000	0.1900	0.1460
3	7554.00	0.6000	0.100	1.0000	0.2500	0.2050
4	16750.00	0.5600	0.100	1.0000	0.3100	0.2980
5	23759.00	0.4500	0.100	1.0000	0.3600	0.3580
6	12404.00	0.3700	0.100	1.0000	0.4100	0.4130
7	3213.00	0.3700	0.100	1.0000	0.4600	0.4600
8	2655.00	0.4300	0.100	1.0000	0.5000	0.6000
9	2857.00	0.3300	0.100	1.0000	0.5400	0.5400
10	1048.00	0.2200	0.100	1.0000	0.5800	0.5800
11	348.00	0.3900	0.100	1.0000	0.6100	0.6100
12	629.00	0.3100	0.100	1.0000	0.6500	0.6400
13	292.00	0.4000	0.100	1.0000	0.6800	0.6700
14	84.00	0.3000	0.100	1.0000	0.7200	0.7000
15+	1340.00	0.3000	0.100	1.0000	0.7400	0.7200

Table 2.12 North Sea SOLE results of the catch predictions

Year	F	Catch in tonnes x 10^3	Year	Spawning biomass in tonnes x 10^3
1981	F_{81}	15 460	1982	27 838
1982	F_{81}	20 403	1983	42 718
1983	.2 x F_{81}	6 672	1984	75 665
1983	.4	11 722	1984	64 319
1983	.6	15 498	1984	54 938
1983	.8	18 274	1984	47 160
1983	1.0	20 269	1984	40 691
1983	1.2	21 658	1984	35 296
1983	1.4	22 575	1984	30 782
1983	1.6	23 131	1984	26 991

Table 3.1 North Sea PLAICE. Nominal catch (tonnes) in Sub-area IV.
* = figure revised by ad hoc Flatfish Working Group 1982, otherwise from Bulletin Statistique.

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981[1]
Belgium	4 360	5 102*	5 350*	6 111*	6 198*	6 162*	5 286*	7 321*	6 231*	7 687*	7 005*	6 346*
Denmark	32 807	22 278	24 494	23 266	19 814	22 731	25 612	20 900	21 285	27 497	27 057	22 026
Faroe Islands	-	-	-	1	-	1	-	1	-	-	-	-
France	1 406	1 380	1 062	1 355	519	536	497	598	750	856	711*	586*
Federal Republic of Germany	5 519	3 290*	4 287*	5 734*	3 231*	4 041*	3 649*	5 414*	4 595*	4 315*	4 319*	3 449*
Ireland	-	-	-	-	-	-	-	-	-	19	-	+
Netherlands	46 080	44 503*	52 048	57 948	54 438	51 293	46 457	42 307	28 219	38 295	39 782	40 049
Norway	22	18	19	15	13	13	20	16	13	13	15	18
Poland	-	-	-	1	-	153	40	-	-	-	-	-
Sweden	608	588	626	432	431	35	28	-	-	7	7	3
UK (Engl.&Wales)	34 839	32 576	31 597*	30 354*	23 855*	20 291*	23 772*	27 625*	27 862	25 825	18 687*	17 129*
UK (Scotland)	4 703	4 210	3 410	4 815	4 002	3 230	3 310	3 622	3 877	4 126	4 345	4 390
USSR	-	-	-	397	39	50	-	-	-	-	-	-
Total	130 344	113 945	122 893	130 429	112 540	108 536	108 671	107 804	92 832	108 640	101 928	93 996
Unreported catches	-	-	-	-	-	-	4 999	11 384	21 152	36 707	38 023	45 751
GRAND TOTAL	130 344	113 945	122 893	130 429	112 540	108 536	113 670	119 188	113 984	145 347	139 951	139 747

1) Preliminary

Table 3.2 North Sea PLAICE. Nominal catch and different indices for catch per unit effort and total international effort.

Year	Nominal catch (tonnes)	Catch per unit effort						Total international effort				
		UK Q1*	UK whole year*	Nether-lands*	Belgium**	Federal*** Republic of Germany	Mean relativ index of UK whole year and Netherlands	UK Q1 1)	UK whole year 1)	Belgium 2)	Nether-lands 1)	Federal 3) Republic of Germany
1957	70 562	6.26	2.136					11.27	33.03			
1958	73 346	5.37	1.971					13.67	37.21			
1959	79 284	4.91	2.127					16.14	37.28			
1960	87 493	5.23	2.160					16.73	40.51			
1961	89 534	4.39	2.058					20.39	43.51			
1962	87 943	4.02	2.277					21.89	38.62			
1963	107 556	6.15	2.971					17.49	36.20			
1964	109 987	6.56	3.004					16.77	35.80			
1965	96 712	4.89	2.847					19.78	33.97			
1966	100 129	7.67	3.771			400.0		13.05	26.55			25.03
1967	108 945	6.71	4.077			443.3		16.24	26.72			25.55
1968	111 934	6.07	3.846			408.0		18.44	29.10			27.43
1969	121 652	6.92	4.186			421.5		17.58	29.06			28.86
1970	130 344	6.26	4.336	10.96		517.8	1.170	20.82	30.06	11.89		25.17
1971	113 945	7.81	4.240	9.28	49.9	411.0	1.069	14.59	26.87	12.28	22.83	27.72
1972	122 893	5.73	3.793	10.08	51.4	608.5	1.049	21.45	29.76	12.19	23.91	20.20
1973	130 429	6.08	3.833	8.89	61.5	535.0	0.992	21.45	34.03	14.67	21.21	24.38
1974	112 540	3.86	2.918	7.23	60.1	438.0	0.779	29.16	38.57	15.57	18.72	25.69
1975	108 536	3.55	2.808	6.30	45.4	423.5	0.716	30.57	37.21	17.23	25.01	25.63
1976	113 670	3.24	3.187	9.09	34.3	433.5	0.914	35.08	35.67	12.50	33.14	26.22
1977	119 188	3.75	3.328	7.95	43.8	798.2	0.874	31.78	35.81	14.99	27.21	14.93
1978	113 984	4.56	3.879	8.14	39.8	710.7	0.959	25.00	29.38	14.00	28.64	16.04
1979	145 347	4.90	4.090	11.82	45.5	829.0	1.181	29.66	35.54	12.30	31.94	17.55
1980	139 951	4.68	3.394	11.56	50.8	766.2	1.074	29.90	41.23	12.11	27.55	18.27
1981	139 747	5.41	3.997	12.96	58.3	-	1.228	25.83	34.96	10.78	23.97	-

* tonnes/ 100 hrs ** kg/hr *** kg/day 1) hours x 10^{-5} 2) hours x 10^{-8} 3) days x 10^{-4}

UK Q1: corrected by dividing CPUE by BHP

UK year: corrected by dividing CPUE by Fishing Power ($FP = 0.077 \times BHP^{0.364}$)

Table 3.3 North Sea PLAICE. Age composition for different Fleets in 1981. PLAICE sexes combined whole year. (Divs.VIb+c)

AD HOC Working Group, June 1982

Country: / Gear:	Belgium All gears	Denmark All gears	Fed.Rep. of Germany All gears	Netherlands All gears	England Otter trawl	England Seine	TOTAL ⁎
Age							
1	107.5	14.0		122.0			252.6
2	4.351.6	17.446.0	188.0	74.461.7	477.3	393.8	100.927.1
3	6.029.0	20.212.0	2.323.0	79.996.2	4.821.8	4.541.3	122.296.2
4	4.471.4	15.956.0	1.388.0	25.008.9	6.008.8	2.711.6	57.604.3
5	1.313.5	6.074.0	1.747.0	19.061.8	5.060.2	1.210.1	35.744.7
6	426.2	2.280.0	723.0	6.615.2	1.714.6	211.5	12.414.3
7	131.0	1.601.0	522.0	5.223.6	1.577.0	167.3	9.563.9
8	80.7	595.0	445.0	4.203.2	2.270.2	208.5	8.091.9
9	68.7	197.0	230.0	2.372.4	1.683.3	148.5	4.874.3
10	38.2	15.0	73.0	974.6	203.9	50.8	1.405.8
11	28.8	8.0	55.0	688.7	249.1	28.1	1.096.9
12	38.4	8.0	26.0	356.3	316.2	55.1	829.6
13	21.3		17.0	276.9	431.0	21.1	795.0
14	28.5	3.0	18.0	207.9	176.1	18.0	468.2
15	4.4	1.0	7.0	67.8	656.3+	72.0+	1.305.7+
16	11.9		8.0	159.9			
17			2.0				
18	32.2		1.0	227.0			
19							
20	8.0						
21				0.6+			
22							
23							
24							
25							
26							
27							
28							
29							
30							
SOP	7.095 4	0.0	3.402.6	82.907.4	12.256.8	4.584.4	137.279.1
NOMC	6.345.8	22.026.0	3.449.0	85.800.0	12.470.0	4.659.0	139.747.0

⁎ The sum of the age compositions is raised to the total international catch with a factor 1 03709

Table 3.4 North Sea PLAICE. Correlations of SSB on cpue and $\bar{F}_{2-10}$ on effort for 1970-78 with predicted values for 1981.

		SSB ON CPUE			
	Trial $_{81}F_5$ =	0.2	0.3	0.4	0.6
UK (year)	r	0.578	0.840	0.808	0.751
	pred.SSB_{81}	432.7	401.8	391.1	382.1
	pred.$_{81}F_5$	0.40	0.44	0.45	0.46
NETHERLANDS	r	0.501	0.867	0.876	0.840
	pred. SSB_{81}	499.5	468.3	470.2	477.7
	pred.$_{81}F_5$	0.345	0.370	0.370	0.365
UK + NETHERLANDS relative	r	0.568	0.898	0.886	0.836
	pred. SSB_{81}	468.6	437.6	433.5	433.5
	pred.$_{81}F_5$	0.365	0.395	0.40	0.40
		$\bar{F}_{2-10}$ ON EFFORT			
UK (year)	r	0.145	0.374	0.556	0.725
	pred.$_{81}\bar{F}_{2-10}$	0.312	0.333	0.347	0.364
	pred. $_{81}F_5$	0.430	0.457	0.475	0.495
NETHERLANDS	r	0.101	0.350	0.567	0.798
	pred.$_{81}\bar{F}_{2-10}$	0.206	0.251	0.276	0.298
	pred.$_{81}F_5$	0.295	0.355	0.385	0.412

Table 3.5 North Sea PLAICE. Pre-recruit Survey Data.

Year Class	"Tridens" Surveys					UK-Surveys		French Surveys		VPA x 10^{-3}
	0-Group Autumn	I-Group Spring	I-Group Autumn	II-Group Spring	II-Group Autumn	0-Group Autumn	I-Group Autumn	0-Group Autumn	I-Group Autumn	(1-year-olds)
1968	-	-	-	7 708	9 449	-	-	-	-	334.1
1969	-	8 641	8 033	-	23 848	-	-	-	-	374.6
1970	3 678	-	8 100	16 452	9 584	-	-	-	-	287.6
1971	6 705	10 888	6 436	(8 736)	4 191	-	-	-	-	233.3
1972	4 912	(32 979)	57 238	43 774	17 905	-	-	-	-	553.1
1973	5 450	5 835	15 648	15 583	9 171	38.7	6.8	-	-	427.8
1974	2 193	3 902	9 781	4 996	2 274	46.8	8.3	-	-	345.2
1975	1 151	1 739	12 637	3 424	2 899	19.0	3.3	-	-	328.9
1976	11 543	8 344	19 119	27 634	12 713	43.0	3.6	-	781.1	504.6
1977	4 370	5 054	13 924	7 039	9 540	32.2	6.4	62.2	141.3	508.9
1978	3 349	6 922	21 681	10 778	12 083	25.2	6.4	299.3	492.0	684.3
1979	27 835	16 567	59 672	37 466	16 106	10.9	3.6	884.9	543.2	(1 053.1)
1980	4 039	2 594	19 611	11 132	-	16.5	3.3	74.9	199.1	-
1981	31 542	20 251	-	-	-	60.6	-	986.3	-	-

Table 3.6 North Sea PLAICE. Year class strength estimation.

		"Tridens" Surveys					UK Surveys		French Surveys	
		0-Group Autumn	I-Group Spring	I-Group Autumn	II-Group Spring	II-Group Spring	0-Group	I-Group	0-Group	I-Group
RATIO METHOD	Survey mean to 1978	4 817	6 416	17 259	15 265	10 332	34.2	5.8	180.8	471.5
	Ratio:1979/mean	5.78	2.58	3.46	2.45	1.56	0.16	0.62	4.90	1.15
	1980/mean	0.84	0.40	1.14	0.73	-	0.48	0.57	0.41	0.42
	1981/mean	6.55	3.16	-	-	-	10.45	-	5.46	-
	VPA mean to 1978	430.4	426.0	424.8	441.6	416.6	466.6	466.6	596.6	565.9
	Prediction: 1979	2 488	1 099	1 470	1 082	650	75	289	2 923	651
	1980	362	170	484	322	-	224	266	245	239
	1981	2 819	1 346	-	-	-	4 876	-	3 257	-
REGRESSION METHOD	r	.139	-.053	.594	.386	.419	-.188	.058	-	-
	n	9	8	10	9	11	6	6	2	3
	GM Slope v	.0479	-.0478	0092	.0517	.0209	-12.24	67.11	-	-
	GM Intercept u	199.6	732.6	265.3	-347.7	201.1	884.8	77.40	-	-
	Prediction: 1979	1 532.9	-	816.9	1 589.5	537.7	-	319.0	-	-
	1980	323.9	-	446.6	227.9	-	-	298.9	-	-
	1981	1 710.5	-	-	-	-	-	-	-	-

Table 3.7. North Sea PLAICE (Males and Females).
Mean weight (kg) at age in the catch.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.000	0.000	0.000	[illegible]	0.000	[illegible]	[illegible]	[illegible]	0.000
2	0.225	0.224	0.226	0.226	0.224	0.222	0.225	0.229	0.232
3	0.220	0.226	0.259	0.259	0.261	0.266	0.259	0.270	0.270
4	0.267	0.263	0.334	0.339	0.341	0.334	0.334	0.335	0.336
5	0.335	0.335	0.446	0.441	0.447	0.447	0.439	0.435	0.437
6	0.415	0.420	0.547	0.555	0.553	0.552	0.553	0.543	0.553
7	0.476	0.435	0.634	0.637	0.626	0.652	0.621	0.634	0.638
8	0.567	0.579	0.708	0.730	0.715	0.736	0.715	0.682	0.694
9	0.657	0.660	0.604	0.329	0.816	0.864	0.327	0.748	0.781
10	0.813	0.819	0.925	0.936	0.927	0.992	0.971	0.877	0.833
11	0.957	0.929	1.032	1.077	1.066	1.056	1.091	0.932	0.881
12	1.107	1.122	1.149	1.236	1.140	0.977	1.273	1.015	1.035
13	1.236	1.244	1.280	1.219	1.241	1.283	1.251	1.049	1.068
14	1.291	1.311	1.460	1.475	1.474	1.421	1.443	1.111	0.957
15+	1.363	1.396	1.530	1.563	1.574	1.539	1.454	1.234	1.281

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.000	0.000	0.000	0.224	0.213	0.200	0.270	0.311	0.271
2	0.252	0.235	0.234	0.277	0.275	0.336	0.310	0.335	0.316
3	0.271	0.271	0.269	0.322	0.321	0.370	0.363	0.347	0.353
4	0.337	0.334	0.330	0.391	0.389	0.413	0.433	0.407	0.407
5	0.439	0.439	0.442	0.457	0.459	0.459	0.496	0.494	0.478
6	0.547	0.546	0.554	0.503	0.502	0.521	0.545	0.570	0.546
7	0.630	0.612	0.643	0.591	0.578	0.552	0.582	0.649	0.618
8	0.700	0.681	0.682	0.634	0.659	0.613	0.656	0.667	0.707
9	0.748	0.762	0.779	0.716	0.747	0.706	0.665	0.722	0.742
10	0.854	0.836	0.838	0.755	0.793	0.730	0.800	0.763	0.795
11	0.930	0.957	0.899	0.850	0.837	0.803	0.872	1.042	0.811
12	0.991	1.051	1.001	0.837	0.900	0.885	0.913	0.990	1.005
13	1.017	1.051	1.007	1.002	0.949	0.980	0.935	0.984	0.972
14	1.131	1.074	1.095	0.917	1.021	1.085	0.982	1.075	1.058
15+	1.214	1.275	1.249	1.155	1.120	1.111	1.197	1.161	1.259

	1975	1976	1977	1978	1979	1980	1981
1	0.265	0.273	0.254	0.244	0.235	0.236	0.237
2	0.318	0.318	0.323	0.315	0.311	0.286	0.274
3	0.337	0.351	0.353	0.369	0.349	0.344	0.329
4	0.430	0.389	0.380	0.397	0.388	0.401	0.416
5	0.494	0.505	0.416	0.438	0.429	0.473	0.505
6	0.582	0.575	0.556	0.491	0.474	0.545	0.558
7	0.641	0.634	0.647	0.609	0.550	0.588	0.604
8	0.717	0.708	0.721	0.687	0.675	0.662	0.642
9	0.807	0.758	0.715	0.776	0.796	0.772	0.725
10	0.832	0.841	0.791	0.781	0.871	0.931	0.869
11	0.944	0.895	0.896	0.886	0.816	0.943	0.956
12	1.031	0.962	0.970	0.933	0.894	0.848	0.931
13	0.965	1.014	0.855	1.039	1.083	1.015	0.933
14	1.174	1.023	1.063	0.933	1.044	1.308	1.179
15+	1.317	1.198	1.165	1.094	1.115	1.246	1.236

Table 3.8. North Sea PLAICE (Males and Females).
Mean weight at age of the stock (kg).

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141
2	0.185	0.136	0.198	0.198	0.197	0.195	0.197	0.195	0.197
3	0.215	0.215	0.225	0.225	0.224	0.225	0.223	0.235	0.238
4	0.239	0.239	0.234	0.235	0.285	0.284	0.264	0.293	0.299
5	0.299	0.299	0.397	0.394	0.395	0.396	0.393	0.303	0.389
6	0.407	0.410	0.500	0.515	0.477	0.511	0.512	0.514	0.523
7	0.496	0.510	0.600	0.555	0.575	0.597	0.565	0.604	0.608
8	0.577	0.546	0.699	0.724	0.711	0.729	0.711	0.659	0.671
9	0.658	0.632	0.811	0.829	0.815	0.856	0.828	0.632	0.712
10	0.809	0.851	0.914	0.969	0.910	0.975	0.956	0.826	0.773
11	1.041	1.077	1.077	1.053	1.043	1.033	1.006	0.873	0.830
12	1.155	1.171	1.110	1.201	1.100	0.952	1.259	0.943	0.972
13	1.464	1.413	1.240	1.134	1.205	1.245	1.215	1.016	1.037
14	1.376	1.397	1.410	1.426	1.425	1.367	1.391	1.102	0.971
15+	1.349	1.362	1.470	1.504	1.500	1.469	1.405	1.221	1.266

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.141	0.141	0.141	0.178	0.150	0.175	0.175	0.175	0.160
2	0.197	0.200	0.199	0.212	0.219	0.270	0.264	0.270	0.246
3	0.239	0.238	0.238	0.265	0.265	0.319	0.331	0.318	0.310
4	0.299	0.298	0.300	0.344	0.343	0.373	0.409	0.368	0.378
5	0.390	0.390	0.392	0.419	0.420	0.425	0.476	0.469	0.442
6	0.517	0.517	0.524	0.475	0.474	0.494	0.539	0.541	0.519
7	0.606	0.584	0.613	0.570	0.558	0.520	0.521	0.593	0.559
8	0.677	0.657	0.658	0.641	0.647	0.590	0.617	0.601	0.640
9	0.682	0.695	0.710	0.677	0.716	0.687	0.665	0.642	0.666
10	0.801	0.835	0.783	0.757	0.784	0.704	0.772	0.722	0.716
11	0.872	0.895	0.845	0.819	0.819	0.796	0.813	0.922	0.802
12	0.930	0.987	0.940	0.852	0.896	0.931	0.949	0.932	0.976
13	0.986	1.020	0.970	0.958	0.914	1.026	0.931	1.017	1.096
14	1.127	1.070	1.094	0.908	1.011	0.933	0.978	0.998	0.988
15+	1.199	1.264	1.272	1.137	1.113	1.127	1.299	1.133	1.193

	1975	1976	1977	1978	1979	1980	1981
1	0.160	0.160	0.160	0.150	0.150	0.150	0.150
2	0.266	0.238	0.250	0.242	0.243	0.229	0.250
3	0.310	0.306	0.309	0.336	0.303	0.307	0.282
4	0.394	0.359	0.364	0.367	0.363	0.372	0.378
5	0.452	0.467	0.465	0.411	0.414	0.444	0.473
6	0.538	0.542	0.551	0.467	0.459	0.524	0.536
7	0.580	0.573	0.627	0.547	0.543	0.582	0.570
8	0.660	0.663	0.690	0.630	0.667	0.651	0.624
9	0.704	0.701	0.667	0.704	0.764	0.776	0.707
10	0.767	0.776	0.759	0.773	0.826	1.025	0.849
11	0.860	0.801	0.818	0.848	0.894	0.947	0.710
12	0.953	0.930	0.909	0.939	0.880	0.838	0.866
13	0.864	1.066	0.836	0.959	1.127	1.209	1.114
14	1.055	1.163	1.055	1.024	1.041	1.194	1.218
15+	1.223	1.159	1.110	1.119	1.255	1.310	1.324

Table 3.9. North Sea PLAICE (Males and Females).
Input catch in numbers ('000) for VPA.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	10194.0	3118.0	26726.0	7901.0	3750.0	3498.0	11171.0	21853.0	17206.0
3	40776.0	23725.0	38238.0	80089.0	40512.0	58587.0	35546.0	47713.0	51067.0
4	44117.0	58128.0	20484.0	45026.0	73378.0	81047.0	121918.0	70524.0	57734.0
5	29151.0	29960.0	28516.0	17473.0	72594.0	61793.0	77257.0	65064.0	47770.0
6	12757.0	16332.0	16764.0	22013.0	12515.0	24534.0	35420.0	36169.0	32552.0
7	11226.0	6200.0	11756.0	11574.0	12858.0	11394.0	15870.0	12982.0	17215.0
8	8625.0	6291.0	4713.0	6485.0	6200.0	9954.0	7035.0	4992.0	8544.0
9	4596.0	4915.0	5135.0	5250.0	5316.0	4647.0	5065.0	3220.0	3983.0
10	3962.0	3549.0	4471.0	3715.0	3214.0	3642.0	4052.0	3171.0	3222.0
11	2594.0	3731.0	2912.0	2500.0	2727.0	2078.0	3313.0	2543.0	3243.0
12	1478.0	1539.0	2352.0	1882.0	2712.0	2282.0	2029.0	1565.0	2045.0
13	954.0	772.0	1564.0	1510.0	1057.0	1577.0	1706.0	1278.0	1009.0
14	641.0	513.0	682.0	651.0	1147.0	1280.0	1221.0	986.0	1504.0
15+	907.0	919.0	1205.0	1095.0	1207.0	1141.0	2198.0	3561.0	4167.0
TOTAL	165870.0	164592.0	180016.0	205945.0	202763.0	267449.0	322235.0	275621.0	252001.0

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.0	0.0	0.0	238.0	2171.0	443.4	2517.5	974.4	2223.0
2	9694.0	7262.0	14260.0	16162.0	22556.0	29877.4	37171.5	31189.4	23120.0
3	96464.0	39587.0	51907.0	51776.0	55643.0	46817.9	61461.0	65417.5	55547.9
4	59530.0	180133.0	46951.0	57380.0	59969.0	33367.8	52296.2	73159.1	42124.9
5	34352.0	48288.0	172814.0	53225.0	40077.0	25298.5	23456.1	40235.1	41075.2
6	23585.0	27989.0	10070.0	59970.0	37075.0	22747.4	17084.8	13016.2	19665.9
7	15469.0	21342.0	8652.0	9007.0	71768.0	16691.9	14310.3	6517.5	8015.3
8	10099.0	7719.0	10453.0	5004.0	6855.0	29077.0	10959.7	9749.4	6320.9
9	5933.0	8604.0	3501.0	8713.0	3902.0	6485.3	18362.4	6245.6	5563.4
10	2387.0	2340.0	4799.0	2957.0	5168.0	4643.6	3393.1	14019.1	3930.9
11	1971.0	1967.0	1369.0	4113.0	2650.0	3505.6	3017.9	2194.3	10118.4
12	2456.0	984.0	1071.0	1619.0	2765.0	2225.1	2874.2	2529.0	1633.8
13	1495.0	1573.0	829.0	1199.0	1059.0	2012.4	1612.2	1738.9	1085.7
14	1169.0	949.0	989.0	579.0	841.0	946.7	1617.4	1701.3	1242.1
15+	3798.0	3344.0	2835.0	2441.0	1713.0	3932.2	3540.8	3724.3	3369.2
TOTAL	268902.0	352581.0	287590.0	266458.0	308017.0	230060.4	253662.1	274863.1	225631.6

	1975	1976	1977	1978	1979	1980	1981
1	981.3	2819.8	3220.4	1147.9	1318.4	979.1	252.6
2	26123.9	33643.3	50968.9	60577.7	58030.6	64898.0	100927.1
3	61623.4	77649.3	43289.0	62343.1	118803.0	133729.0	122296.2
4	31262.0	96397.9	66012.6	54540.8	48961.6	77516.8	57604.3
5	25418.9	13778.9	43704.6	50101.5	47885.6	24971.7	35744.7
6	21137.5	9904.3	9142.2	35509.7	39931.7	17980.6	12414.3
7	11873.0	9119.8	5911.7	5939.5	24227.7	13760.0	9563.9
8	5972.9	6390.8	5022.2	3352.2	4101.1	8457.6	3091.9
9	4106.1	2947.2	4061.1	2419.3	2807.0	1863.6	4874.3
10	3337.3	2020.1	1927.2	2175.3	2332.6	1326.3	1405.8
11	1740.8	2111.3	1301.2	1145.0	1849.2	952.1	1090.9
12	7935.3	910.7	1357.1	603.4	1112.5	1172.8	829.6
13	1082.4	4478.1	489.2	639.3	707.3	432.8	795.8
14	1424.0	388.1	2239.7	330.1	707.0	284.3	463.2
15+	4177.5	2643.6	1327.2	2524.1	2578.7	1218.7	1305.7
TOTAL	210194.3	265203.2	236524.3	263194.9	355474.6	349533.4	357671.3

Table 3.10. North Sea PLAICE (Males and Females).
Fishing mortalities from VPA (M = 0.10).

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.059	0.055	0.065	0.038	0.017	0.011	0.035	0.024	0.018
3	0.164	0.166	0.191	0.233	0.127	0.100	0.121	0.098	0.221
4	0.305	0.329	0.278	0.365	0.344	0.262	0.367	0.331	0.356
5	0.297	0.311	0.330	0.246	0.309	0.481	0.463	0.474	0.345
6	0.234	0.242	0.291	0.316	0.249	0.421	0.496	0.364	0.425
7	0.235	0.155	0.245	0.251	0.248	0.334	0.395	0.302	0.263
8	0.264	0.196	0.156	0.130	0.266	0.275	0.317	0.214	0.297
9	0.189	0.205	0.220	0.152	0.204	0.212	0.222	0.206	0.236
10	0.182	0.135	0.259	0.221	0.167	0.188	0.258	0.167	0.295
11	0.275	0.233	0.214	0.202	0.222	0.140	0.253	0.228	0.231
12	0.222	0.233	0.251	0.179	0.247	0.261	0.179	0.148	0.259
13	0.232	0.200	0.290	0.156	0.222	0.250	0.253	0.144	0.208
14	0.174	0.169	0.138	0.194	0.179	0.238	0.278	0.235	0.225
15+	0.174	0.169	0.188	0.194	0.179	0.238	0.278	0.235	0.225
F(2-10),U	0.267	0.267	0.277	0.215	0.214	0.265	0.313	0.259	0.272

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.000	0.000	0.000	0.001	0.000	0.002	0.001	0.002	0.005
2	0.035	0.027	0.053	0.037	0.082	0.193	0.103	0.171	0.050
3	0.117	0.175	0.239	0.275	0.360	0.227	0.265	0.420	0.454
4	0.382	0.297	0.284	0.242	0.512	0.343	0.359	0.519	0.464
5	0.523	0.538	0.302	0.297	0.392	0.385	0.342	0.437	0.331
6	0.255	0.421	0.365	0.335	0.461	0.256	0.419	0.336	0.376
7	0.326	0.345	0.197	0.230	0.432	0.410	0.355	0.338	0.316
8	0.217	0.239	0.251	0.151	0.272	0.278	0.458	0.388	0.406
9	0.308	0.259	0.140	0.345	0.150	0.396	0.253	0.456	0.355
10	0.240	0.272	0.201	0.158	0.266	0.239	0.351	0.292	0.514
11	0.264	0.225	0.160	0.236	0.141	0.200	0.215	0.327	0.300
12	0.245	0.133	0.270	0.221	0.221	0.201	0.312	0.229	0.384
13	0.272	0.210	0.207	0.290	0.197	0.222	0.193	0.291	0.231
14	0.197	0.243	0.180	0.195	0.302	0.242	0.249	0.288	0.300
15+	0.197	0.243	0.180	0.195	0.302	0.242	0.249	0.288	0.300
F(2-10),U	0.245	0.279	0.221	0.243	0.325	0.304	0.332	0.374	0.385

	1975	1976	1977	1978	1979	1980	1981
1	0.003	0.009	0.007	0.002	0.002	0.001	0.001
2	0.072	0.120	0.220	0.151	0.142	0.117	0.118
3	0.183	0.253	0.201	0.367	0.435	0.491	0.298
4	0.442	0.365	0.325	0.368	0.485	0.499	0.366
5	0.300	0.317	0.367	0.345	0.566	0.433	0.400
6	0.510	0.328	0.326	0.419	0.533	0.381	0.354
7	0.304	0.381	0.290	0.316	0.497	0.315	0.318
8	0.363	0.302	0.332	0.245	0.334	0.246	0.273
9	0.435	0.275	0.285	0.235	0.294	0.223	0.237
10	0.332	0.352	0.266	0.217	0.332	0.197	0.233
11	0.399	0.322	0.357	0.317	0.259	0.195	0.222
12	0.361	0.333	0.315	0.249	0.342	0.232	0.233
13	0.418	0.316	0.268	0.233	0.455	0.164	0.218
14	0.277	0.231	0.236	0.261	0.352	0.296	0.260
15+	0.277	0.231	0.236	0.268	0.352	0.296	0.260
F(2-10),U	0.354	0.306	0.316	0.306	0.463	0.327	0.288

Table 3.11. North Sea PLAICE (Males and Females).
Stock size in numbers ('000) from VPA at 1 January.
Biomass unit: tonnes.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	291059	491062	509036	511991	415024	351414	350116	1130797	331424
2	158427	265361	443427	400597	403274	306481	317057	322171	1020106
3	283014	160510	251077	375031	409197	416192	328281	276315	271764
4	175993	217362	122970	172425	204672	326067	320007	203275	204728
5	118050	117403	141557	84251	112746	109369	218105	174894	171340
6	64106	79804	77817	71565	59634	74099	94779	124244	96521
7	51272	45399	50712	52613	61413	42114	44525	52174	78133
8	37713	50089	35644	40160	36814	43359	27275	27134	34896
9	28031	27335	27225	27536	30181	25531	29790	17979	19859
10	24945	21001	20521	19761	21874	22265	10091	21560	13212
11	11317	18310	15025	14326	14555	16741	16107	13049	10516
12	7777	7730	13479	11553	10589	10490	13174	11955	9411
13	4327	5034	5579	9491	6743	7483	7246	9974	9331
14	4212	3402	4175	3754	7343	6330	5274	4938	7829
15+	5959	6207	7365	6515	7777	5650	9103	17833	21692
TOTAL NO.	1297500	1502111	1712014	1662423	1912979	1683182	1806920	2473923	2314029
SSB NO.	771520	779964	865974	952713	1071720	1141491	1128174	1038371	1334940
TOTAL BIOM	368121	402131	495983	534670	555961	505719	502210	658599	655909
SSB BIOM.	279699	292043	354589	374530	407390	434180	444106	414080	475824

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	321083	294262	254243	334132	374623	287623	233291	553183	472776
2	298980	290526	260259	250049	302061	330908	259030	208097	499524
3	913908	261314	255977	227351	191881	251883	270462	199817	159222
4	196511	735502	198859	162359	150594	120529	131592	191841	118807
5	130519	121386	494409	135410	129533	84911	77422	114733	104315
6	109748	85513	64124	330936	91016	79223	52264	47671	65703
7	58312	76920	50855	42781	214132	51972	50118	31119	30927
8	54304	38035	49370	37302	30154	125758	31209	31787	20082
9	23471	39605	27136	34753	29453	20781	86206	17857	19517
10	14109	15611	27675	21229	23182	22944	12059	60579	10242
11	8898	10101	11430	21484	16415	16073	16354	8237	40947
12	11806	6181	7272	8568	14632	12397	11218	11933	5372
13	6575	8407	4659	4995	6216	11615	9558	7427	8588
14	6859	4531	6114	3429	3332	4619	7695	7127	5023
15+	22284	15966	17525	14455	6888	19185	16846	15612	13626
TOTAL NO.	2177548	2003717	1735960	1628736	1569151	1445922	1322741	1507646	1574669
SSB NO.	1250021	1433534	1221604	1065905	968058	863904	821304	750311	772520
TOTAL BIOM	647312	631739	591463	581783	547675	557128	520145	511772	492155
SSB BIOM.	463834	530099	498060	407793	430867	400125	396009	354039	350390

	1975	1976	1977	1978	1979	1980	1981	1982
1	345201	328886	514569	508925	684281	1153172	399906	**********
2	425072	311418	294907	453491	459406	617910	951928	301064
3	430013	358439	249825	212777	352818	300577	497401	705471
4	91451	330577	250654	184959	133430	206621	199026	354125
5	67611	53132	217730	164202	115846	74365	113556	126021
6	55503	37098	35008	108736	101039	59503	43030	68875
7	40809	30160	24176	23007	64744	53668	36797	27718
8	20392	25670	18646	16268	15185	35641	35512	24726
9	12180	12836	17166	12111	11539	9794	24226	24456
10	12360	7131	8619	11680	8001	7778	7094	17295
11	5545	8038	4537	6151	8514	5625	5779	5085
12	27453	3368	5271	2872	4479	5940	4166	4188
13	3312	17318	2184	3482	2120	2997	4262	3011
14	6171	1973	11423	1512	2497	1163	2301	3101
15+	13102	13442	9110	11563	9116	4945	6418	6216
TOTAL NO.	1561786	1539487	1644030	1721730	1973002	2499801	2332741	
SSB NO.	788743	875672	867102	879671	883213	957285	1218081	
TOTAL BIOM	515920	494758	505039	509851	553082	643046	582033	
SSB BIOM.	337422	350230	348847	342893	341171	358985	432905	

The biomasses in this table are not corrected for SOP discrepancies.

Table 3.12. North Sea PLAICE.
Summary of results from the final VPA. Biomasses corrected for SOPs.

Year	SOP Discrepancy	Spawning Stock (t x 10-3)	Total Stock (t x 10-3)	Recruits Age 1 (x 10-6)	$\bar{F}_{2-10}$
1957	1.18	330.0	434.4	291.1	0.207
1958	1.22	356.3	490.6	490.1	0.202
1959	0.95	336.9	471.2	509.0	0.227
1960	1.02	382.5	545.4	512.0	0.215
1961	1.00	407.4	556.0	405.0	0.214
1962	0.75	325.6	424.3	350.4	0.265
1963	0.76	337.6	427.3	356.1	0.313
1964	0.95	393.4	606.7	1 136.3	0.259
1965	0.86	409.2	564.1	330.4	0.272
1966	0.89	412.8	576.1	321.1	0.245
1967	0.74	392.3	467.5	294.3	0.279
1968	0.90	448.8	532.3	254.2	0.220
1969	0.99	463.1	576.0	334.1	0.233
1970	0.91	392.1	498.4	374.6	0.325
1971	1.01	404.1	542.5	287.6	0.304
1972	1.01	400.6	525.3	233.3	0.332
1973	1.00	354.0	510.8	553.1	0.374
1974	1.03	340.3	506.9	472.8	0.385
1975	1.04	350.9	536.6	345.2	0.354
1976	1.00	350.2	494.8	328.9	0.300
1977	1.00	348.8	505.0	504.6	0.310
1978	0.96	329.2	489.5	508.9	0.300
1979	1.00	341.2	553.1	684.3	0.403
1980	1.01	362.6	649.5	1 053.1	0.327
1981	1.02	441.6	695.7	(400.0)	0.288

Table 3.13. North Sea PLAICE.
Input data for long-term yield.

LIST OF INPUT VARIABLES BY AGE GROUP:

AGE	STOCK SIZE	F-PATTERN	M	MATURITY OGIVE	WEIGHT IN THE CATCH	WEIGHT IN THE STOCK
1	1000000.00[1]	0.0010	0.100	0.0000	0.2370	0.1500
2	361863.00	0.1130	0.100	0.5000	0.2740	0.2500
3	765470.00[2]	0.2980	0.100	0.5000	0.3290	0.2820
4	534725.00	0.3600	0.100	1.0000	0.4160	0.3780
5	126021.00	0.4000	0.100	1.0000	0.5050	0.4730
6	68375.00	0.3540	0.100	1.0000	0.5530	0.5360
7	27703.00	0.3130	0.100	1.0000	0.6040	0.5700
8	24226.00	0.2730	0.100	1.0000	0.6420	0.6240
9	24456.00	0.2570	0.100	1.0000	0.7250	0.7070
10	17295.00	0.2330	0.100	1.0000	0.8690	0.8490
11	5035.00	0.2220	0.100	1.0000	0.9500	0.9100
12	4138.00	0.2330	0.100	1.0000	0.9310	0.8860
13	3001.00	0.2138	0.100	1.0000	0.9330	1.1140
14	3101.00	0.2460	0.100	1.0000	1.1790	1.2180
15+	6202.00	0.2400	0.100	1.0000	1.2360	1.3240

1) 700 000 in the low 1979 year class run.
2) 476 345 in the low 1979 year class run.

Table 3.14. North Sea PLAICE.
Results of short-term catch prediction (corrected for the 1981 SOP discrepancy of 1.02 = Landings/SOP). Catches and biomasses in tonnes.

	Low Recruitment	High Recruitment
1979 year class =	700×10^6	$1\,053 \times 10^6$
1980 year class =	400×10^6	400×10^6
1981 year class = (at age 1)	700×10^6	$1\,000 \times 10^6$
1981 Catch =	139 700	139 700
Total Stock =	614 400	695 700
Sp. Stock =	400 700	441 600
$\bar{F}_{2-10}$ =	.295	.288
1982 Catch =	142 000	165 900
Total Stock =	652 400	780 900
Sp. Stock =	430 100	471 700
$\bar{F}_{2-10}$ =	.288	.288
1983		
Total Stock =	665 900	809 900
Sp. Stock =	483 400	592 900

F/F_{81}	1983 Yield	1984 Sp. Stock	1983 Yield	1984 Sp. Stock
0	0	605 900	0	725 900
0.2	33 740	572 900	40 870	686 250
0.4	65 441	542 000	79 300	649 100
0.6	95 240	513 100	115 430	614 300
0.8	123 250	486 000	149 400	581 700
1.0	149 600	460 700	181 400	551 200
1.2	174 390	436 900	211 500	522 600
1.4	197 700	414 700	239 900	495 800

Table 4.1 English Channel SOLE.
Nominal catch (in tonnes) in Divisions VIId and VIIe, 1969-81.

Year	Belgium		Denmark	France		Netherl.	Ireland	U.K.		Total	
	VIId	VIIe	VIIe	VIId	VIIe	VIId,e	VIIe	VIId	VIIe	VIId	VIIe
1969	10	8	-	606		-	-	177	138	939	(353)
1970	127	10	-	753		1	-	228	125	1 244	(391)
1971	157	3	-	816		1	-	254	152	(953) 1 383	(432)
1972	147	6	-	676		8	-	322	201	(921) 1 360	(437)
1973	126	2	-	775		-	-	360	194	(1 000) 1 457	(459)
1974	159	6	-	706		3	-	309	181	(940) 1 364	(427)
1975	132	3	-	464	271	1	-	244	217	841	491
1976	203	4	-	599	352	-	-	404	260	1 206	616
1977	225	3	-	737	331	-	-	315	272	1 277	606
1978	241	4	20	782	384	-	-	366	453	1 389	861
1979	311	1	-	1 129	515	-	-	402	665	1 842	1 181
1980	302[2]	45	-	1 075[2]	447[2]	-	13	279[2]	764	1 656[2]	1 269[2]
1981	491	16		1 311	345	-	-	210[1]	784	2 012	1 145

Figures for 1981 supplied by Working Group members

1) Official figure + 50 tonnes unreported, estimated by the English Working Group members

2) Revised from Bull.Stat.

Table 4.2 SOLE in Division VIId.
Effort and catch per unit effort.

Year	Total landings	Belgian cpue t/1 000 h	Total int. effort 1 000 h
1972	921	8.1	113.7
1973	1 000	8.2	122.0
1974	940	9.5	98.9
1975	841	7.9	106.5
1976	1 206	11.3	106.7
1977	1 277	9.8	130.3
1978	1 389	9.4	147.8
1979	1 842	15.0	122.8
1980	1 656	9.7	170.7
1981	2 012	11.8	170.5

Table 4.3. SOLE in Division VIId (Males and Females combined). Input catch in numbers ('000) for VPA.

	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0	0	6	33	45	271	517	72	0
2	487	540	21	600	1031	1813	896	1163	2183
3	318	551	764	1208	762	2362	3676	843	1909
4	756	516	417	712	837	550	1579	2213	494
5	258	434	135	240	235	316	406	753	1583
6	45	75	407	84	105	299	218	213	737
7	77	99	113	272	46	91	178	179	167
8	63	16	51	62	96	54	49	52	164
9	172	41	16	37	45	57	28	123	136
10	203	56	26	12	28	36	59	25	18
11	66	15	26	8	22	28	19	59	27
12	84	45	171	20	12	19	24	16	61
13	116	8	22	200	32	12	8	22	13
14	32	53	30	5	115	34	27	17	18
15+	125	157	184	154	107	128	142	136	191
TOTAL	2682	2595	2582	3640	4165	6170	7026	5903	7701

Table 4.4. SOLE in Division VIId (Males and Females combined). Mean weight (kg) at age in the catch.

	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.105	0.080
2	0.190	0.190	0.190	0.190	0.190	0.190	0.190	0.175	0.142
3	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.234	0.210
4	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.297	0.276
5	0.355	0.355	0.355	0.355	0.355	0.355	0.355	0.345	0.315
6	0.410	0.410	0.410	0.410	0.410	0.410	0.410	0.390	0.362
7	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.427	0.402
8	0.493	0.493	0.493	0.493	0.493	0.493	0.493	0.465	0.450
9	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.497	0.495
10	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.530	0.532
11	0.565	0.565	0.565	0.565	0.565	0.565	0.565	0.557	0.568
12	0.573	0.573	0.573	0.573	0.573	0.573	0.573	0.562	0.590
13	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.608	0.611
14	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.635	0.631
15+	0.620	0.620	0.620	0.620	0.620	0.620	0.620	0.655	0.650

Table 4.5 SOLE in Division VIId.
Biomass and recruitment.

Year	Recruits at age 1 x 1000	Total biomass*	Spawning stock* biomass	SOP correction
1973	5 505	6 311	5 636	.93
1974	6 085	7 479	6 420	1.06
1975	4 703	6 564	5 651	.95
1976	14 348	7 581	6 028	1.04
1977	19 733	8 987	5 858	1.09
1978	4 624	7 486	5 446	.86
1979	9 552	8 481	7 505	.88
1980	20 850	9 522	7 041	.95
1981	7 687	9 092	7 046	.99

* Corrected for SOP discrepancies in each year

Average correction factor = .97

Mean recruitment at age 1 = 9 166 over years 1973-1978

= 5 229 excluding 1975 and 1976 year classes

Table 4.6 SOLE in Division VIId. French pre-recruit survey results (standard deviation given in brackets)

Year of survey	0-Group	1-Group	2-Group
1977	33.7 (23.7)	170.8 (93.8)	55.9 (23.2)
1978	67.5 (37.5)	57.1 (20.7	4.5 (4.5)
1979	501.5 (183.4)	114.4 (30.2)	11.1 (3.8)
1980	98.5 (35.6)	1 163.5 (364.5)	73.6 (16.4)
1981	133.0 (29.3)	352.4 (61.3)	77.5 (15.2)

Table 4.7. SOLE in Division VIId (Males and Females).
Fishing mortalities from VPA (M = 0.10).

	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.19	0.12	0.00	0.16	0.15	0.11	0.28	0.16	0.13
3	0.22	0.30	0.22	0.29	0.24	0.28	0.31	0.41	0.37
4	0.25	0.32	0.35	0.30	0.30	0.30	0.27	0.28	0.40
5	0.30	0.22	0.19	0.31	0.14	0.16	0.33	0.18	0.29
6	0.07	0.12	0.20	0.12	0.19	0.23	0.14	0.26	0.24
7	0.18	0.15	0.24	0.25	0.10	0.22	0.19	0.15	0.30
8	0.11	0.03	0.12	0.18	0.12	0.15	0.16	0.07	0.18
9	0.24	0.09	0.05	0.10	0.17	0.08	0.18	0.07	0.23
10	0.12	0.18	0.07	0.05	0.10	0.18	0.11	0.11	0.17
11	0.38	0.05	0.00	0.02	0.10	0.12	0.12	0.13	0.15
12	0.19	0.42	0.10	0.06	0.04	0.11	0.13	0.13	0.18
13	0.16	0.02	0.33	0.15	0.09	0.05	0.06	0.15	0.13
14	0.14	0.09	0.10	0.11	0.11	0.12	0.13	0.14	0.16
15+	0.14	0.09	0.10	0.11	0.11	0.12	0.13	0.14	0.16
F(3- 6),W	0.22	0.24	0.24	0.28	0.23	0.20	0.23	0.25	0.31
F(3- 6),U	0.19	0.19	0.23	0.24	0.19	0.22	0.23	0.22	0.30

	1973-1981
1	0.01
2	0.15
3	0.30
4	0.31
5	0.24
6	0.18
7	0.20
8	0.12
9	0.19
10	0.11
11	0.13
12	0.15
13	0.13
14	0.12
15+	0.12

Table 4.8. SOLE in Division VIId (Males and Females).
Stock size in numbers ('000) from VPA at 1 January.
Biomass unit: tonnes.
(Biomass estimates are not corrected for SOP discrepancies.)

	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	5505	6035	4763	14343	19733	4024	9552	2 7850	0
2	2965	4931	5560	4256	12951	17812	3832	8342	16797
3	1699	2226	3994	4967	3775	11172	14595	2617	6425
4	1033	1226	1486	2991	3344	2241	6913	9539	1569
5	1037	2569	969	956	1939	2232	1563	4732	6537
6	751	894	1460	615	632	1532	1771	978	3594
7	464	636	557	1502	436	472	1103	1347	833
8	657	565	482	397	921	396	541	529	1149
9	661	517	326	346	506	742	567	702	766
10	2721	816	429	275	316	229	619	252	121
11	220	2195	505	363	257	266	173	503	204
12	498	157	1634	432	321	194	209	133	399
13	651	571	61	1497	566	286	158	166	116
14	254	647	328	53	1164	342	241	135	179
15+	1661	1918	2032	1503	1091	1149	1256	1031	1358
TOTAL NO.	23 658	25172	24932	34219	47076	42535	42319	51831	41670
SSB NO.	14618	14198	14723	15615	14392	20149	26935	22609	22873
TOTAL BIOM.	6736	7656	6918	7219	6245	8705	9657	10023	9164
SSB BIOM.	6066	6157	6944	5796	5574	6333	6528	7412	7117

	1982
1	**********
2	0
3	14955
4	4003
5	952
6	4410
7	2553
8	460
9	793
10	504
11	92
12	159
13	303
14	87
15+	1147

Table 4.9. SOLE in Division VIId.
Input data for catch predictions.

LIST OF F-FACTORS AND RECRUITMENT BY YEAR:

YEAR	F-FACTOR	RECRUITMENT
82	0.4000	**********
83	0.4000	7687.00
84	0.4000	7687.00

PROPORTION OF F BEFORE THE SPAWNING SEASON: 0.0000
PROPORTION OF M BEFORE THE SPAWNING SEASON: 0.0000

LIST OF INPUT VARIABLES BY AGE GROUP:

AGE	STOCK SIZE	F-PATTERN	M	MATURITY OGIVE	WEIGHT IN THE CATCH	WEIGHT IN THE STOCK
1	7687.00	0.0000	0.100	0.0000	0.0000	0.0100
2	6956.00	0.1300	0.100	0.0000	0.1420	0.1100
3	14935.00	0.3700	0.100	1.0000	0.2100	0.1780
4	4003.00	0.4000	0.100	1.0000	0.2700	0.2400
5	952.00	0.2900	0.100	1.0000	0.3150	0.2950
6	4410.00	0.2400	0.100	1.0000	0.3620	0.3400
7	2553.00	0.3000	0.100	1.0000	0.4020	0.3840
8	460.00	0.1800	0.100	1.0000	0.4500	0.4150
9	793.00	0.2300	0.100	1.0000	0.4950	0.4700
10	504.00	0.1700	0.100	1.0000	0.5320	0.5120
11	92.00	0.1500	0.100	1.0000	0.5680	0.5500
12	159.00	0.1600	0.100	1.0000	0.5900	0.5800
13	303.00	0.1300	0.100	1.0000	0.6110	0.6020
14	87.00	0.1600	0.100	1.0000	0.6310	0.6220
15+	1147.00	0.1600	0.100	1.0000	0.6500	0.6400

Table 4.10 SOLE in Division VIId. Results of catch predictions. Geometric mean recruitment (1973-1978) was assumed for 1982 and 1983.

1981	Total catch	2 012
	Total stock biomass	9 139
	Spawning stock biomass	7 082
1982	Total catch	2 325
$F_{82} = F_{81}$	Total stock biomass	9 112
	Spawning stock biomass	8 274
1983	Total stock biomass	2 135
	Spawning stock biomass	7 576

$_{83}F_{(3-8)}$	F_{83}/F_{81}	Catch 1983	Spawning stock biomass in 1984
0.0	0.0	0	9 088
0.059	0.2	482	8 590
.119	4	934	8 123
.178	6	1 360	7 685
.237	8	1 759	7 273
.297	1.0	2 135	6 886
.356	1.2	2 490	6 524
.415	1.4	2 822	6 181
.475	1.6	3 135	5 861
.534	1.8	3 431	5 559
.593	2.0	3 709	5 275

Table 5.1 Effort and catch per effort for Division VIIe SOLE.

Year	U.K. >40' beam		U.K. >40' otter		Cpue[1] (whole wt:kg/h)		Total landings t (whole weight)	International effort	
	Hours	t (gutted)	Hours	t (gutted)	Beam	Otter		Beam h x 10^{-4}	Otter h x 10^{-5}
1972	7 809	83.84	77 671	82.48	13 880	1 503	437	3 148	2 908
1973	14 410	84.69	81 679	78.87	8 530	1 135	459	5 381	4 044
1974	14 076	101.50	57 891	53.07	8 997	1 641	427	4 746	2 602
1975	14 256	94.13	66 410	68.97	7 141	1 360	491	6 876	3 610
1976	8 150	87.79	68 461	80.27	12 020	1 946	616	5 125	3 165
1977	11 311	112.69	68 762	68.12	10 570	1 327	506	5 733	4 567
1978	22 029	217.04	55 991	64.94	10 700	1 876	861	8 047	4 614
1979	38 273	421.20	60 176	70.70	10 650	1 455	1 181	11 089	8 173
1980	58 231	568.47	59 948	62.83	9 584	1 144	1 305	13 616	11 407
1981	59 496	568.06	58 635	44.76	9 242	832	1 145	12 389	13 762

1) These indices are obtained by averaging over rectangles within months, then by averaging over months; hours corrected for fishing power, including all rectangles in which fishing took place.

Table 5.2. SOLE in Division VIIe (Males and Females combined). Input catch in numbers ('000) for VPA.

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	0.0	0.0	0.5	0.0	0.0	0.4	5.6	5.0	1.9
2	88.8	53.4	50.6	145.8	71.1	44.6	61.0	134.3	297.1
3	321.6	231.9	200.5	411.7	596.2	349.1	519.9	350.2	371.5
4	79.7	322.2	245.8	167.2	433.1	220.0	172.7	439.3	362.9
5	148.5	89.5	198.1	115.4	88.9	177.8	225.3	148.3	220.3
6	209.7	82.7	65.1	112.5	98.7	71.2	119.3	171.9	106.2
7	21.2	112.3	80.0	14.3	119.8	79.5	17.7	95.7	90.3
8	49.6	12.8	155.5	24.7	16.6	42.7	71.6	35.2	95.3
9	25.5	34.7	9.8	133.5	51.6	32.0	26.6	61.9	10.6
10	20.1	52.1	34.6	38.5	30.1	24.4	21.0	56.8	28.1
11	8.9	21.9	54.5	53.6	4.1	54.9	26.6	13.0	35.1
12	10.6	15.2	15.1	24.3	30.0	12.7	33.3	17.7	12.9
13	9.4	41.1	21.4	15.0	40.3	16.9	18.8	65.6	17.7
14	16.4	11.0	24.1	5.1	4.4	12.5	25.2	17.6	41.6
15+	26.6	45.8	52.2	61.7	61.4	64.0	82.1	148.4	90.7
TOTAL	1036.6	1126.6	1207.8	1523.3	1446.3	1202.7	1428.7	1761.4	1782.2

	1978	1979	1980	1981
1	0.0	0.0	0.0	0.0
2	227.8	209.3	175.8	170.3
3	1120.8	766.3	561.4	655.4
4	383.5	688.9	589.8	565.7
5	207.7	174.8	611.8	453.7
6	197.2	325.5	143.0	365.6
7	102.4	192.6	165.2	173.7
8	85.8	78.6	132.9	124.3
9	73.0	111.2	70.7	69.9
10	37.1	106.1	63.5	53.8
11	25.1	20.8	136.2	51.6
12	19.3	28.0	38.0	39.8
13	11.9	58.9	22.6	9.9
14	11.5	7.1	38.8	13.4
15+	144.4	240.9	219.8	147.8
TOTAL	2647.5	3009.0	2989.5	2894.9

Table 5.3. SOLE in Division VIIe (Males and Females).
Mean weight (kg) at age in the catch (not smoothed).

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
2	0.186	0.186	0.186	0.186	0.186	0.186	0.186	0.186	0.186
3	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230
4	0.299	0.299	0.299	0.299	0.299	0.299	0.299	0.299	0.299
5	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
6	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403
7	0.433	0.433	0.433	0.433	0.433	0.433	0.433	0.433	0.433
8	0.474	0.474	0.474	0.474	0.474	0.474	0.474	0.474	0.474
9	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508
10	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530
11	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545
12	0.560	0.560	0.560	0.560	0.560	0.560	0.560	0.560	0.560
13	0.570	0.570	0.570	0.570	0.570	0.570	0.570	0.570	0.570
14	0.580	0.580	0.580	0.580	0.580	0.580	0.580	0.580	0.580
15+	0.721	0.721	0.721	0.721	0.721	0.721	0.721	0.721	0.721

	1978	1979	1980	1981
1	0.132	0.132	0.000	0.000
2	0.186	0.186	0.190	0.171
3	0.230	0.230	0.250	0.234
4	0.299	0.299	0.334	0.333
5	0.358	0.358	0.385	0.392
6	0.403	0.403	0.516	0.495
7	0.433	0.433	0.549	0.540
8	0.474	0.474	0.615	0.541
9	0.508	0.508	0.602	0.617
10	0.530	0.530	0.587	0.639
11	0.545	0.545	0.573	0.683
12	0.560	0.560	0.740	0.639
13	0.570	0.570	0.590	0.776
14	0.580	0.580	0.860	0.815
15+	0.721	0.721	0.780	0.658

Table 5.4. SOLE in Division VIIe (Males and Females).
Mean weight (kg) at age of the stock.

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
2	0.162	0.162	0.162	0.162	0.162	0.162	0.162	0.162	0.162
3	0.223	0.223	0.223	0.223	0.223	0.223	0.223	0.223	0.223
4	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.265
5	0.323	0.323	0.323	0.323	0.323	0.323	0.323	0.323	0.323
6	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380
7	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420
8	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455
9	0.492	0.492	0.492	0.492	0.492	0.492	0.492	0.492	0.492
10	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520
11	0.543	0.543	0.543	0.543	0.543	0.543	0.543	0.543	0.543
12	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555
13	0.565	0.565	0.565	0.565	0.565	0.565	0.565	0.565	0.565
14	0.570	0.570	0.570	0.570	0.570	0.570	0.570	0.570	0.570
15+	0.721	0.721	0.721	0.721	0.721	0.721	0.721	0.721	0.721

	1978	1979	1980	1981
1	0.008	0.008	0.010	0.010
2	0.162	0.162	0.120	0.107
3	0.223	0.223	0.190	0.200
4	0.265	0.265	0.280	0.285
5	0.323	0.323	0.380	0.357
6	0.380	0.380	0.470	0.430
7	0.420	0.420	0.540	0.485
8	0.455	0.455	0.580	0.533
9	0.492	0.492	0.620	0.579
10	0.520	0.520	0.650	0.612
11	0.543	0.543	0.670	0.648
12	0.555	0.555	0.690	0.680
13	0.565	0.565	0.700	0.708
14	0.570	0.570	0.710	0.729
15+	0.721	0.721	0.720	0.742

Table 5.5 SOLE in Division VIIe.
Sum of products discrepancies.

Year	Combined male and female
1969	100
1970	95.8
1971	94.0
1972	94.3
1973	92.5
1974	99.2
1975	98.9
1976	94.7
1977	100.8
1978	101.0
1979	108.7
1980	100.1
1981	100.0

Table 5.6 SOLE in Division VIIe.

Year	Reference $\bar{F}$ (ages 3-8) from separable VPA						International effort	
	F_4=0.3	F_4=0.4	F_4=0.5	F_4=0.6	F_4=0.7	F_4=0.8	Beam trawl	Otter trawl
1972	.107	.116	.123	.128	.146	.150	3.15	2.91
1973	.133	.146	.156	.163	.188	.194	5.38	4.04
1974	.120	.133	.143	.151	.173	.179	4.75	2.60
1975	.117	.131	.142	.150	.150	.157	6.88	3.61
1976	.131	.148	.161	.171	.186	.195	5.13	3.17
1977	.130	.149	.164	.175	.193	.204	5.73	4.57
1978	.169	.197	.220	.238	.269	.286	8.05	4.61
1979	.199	.240	.273	.300	.341	.366	11.09	8.17
1980	.217	.273	.322	.366	.413	.451	13.62	11.41
1981	.267	.360	.453	.546	.677	.764	12.39	13.76
Correlation of F on effort								
beam	.81*	.91*	.89*	.87*	.84*	.84*		
otter	.97*	.97*	.97*	.97*	.96*	.96*		

* $P < 0.01$

Table 5.7 SOLE in Division VIIe.
Ratios of F and effort in 1981 to the mean F and effort for the period 1972-1977.

$_4F_{81}$	Ratio	Ratio $\frac{\text{Beam effort'81}}{\text{Beam effort'72-77}}$	$\frac{\text{Other effort'81}}{\text{Other effort'72-77}}$
.3	1.85	2.40	3.97
.4	2.20		
.5	2.56		
.6	2.94		
.7	3.31		
.8	3.76		

Table 5.8. SOLE in Division VIIe (Males and Females).
Fishing mortalities from VPA (M = 0.1).

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.05	0.05	0.02	0.06	0.04	0.02	0.02	0.05	0.06
3	0.14	0.16	0.22	0.16	0.19	0.22	0.22	0.14	0.18
4	0.14	0.19	0.22	0.26	0.23	0.14	0.15	0.26	0.19
5	0.18	0.21	0.15	0.14	0.19	0.13	0.18	0.17	0.18
6	0.10	0.13	0.20	0.11	0.15	0.21	0.11	0.18	0.15
7	0.04	0.07	0.16	0.06	0.14	0.16	0.06	0.10	0.13
8	0.05	0.03	0.11	0.06	0.08	0.06	0.19	0.16	0.13
9	0.04	0.04	0.02	0.12	0.16	0.19	0.05	0.22	0.06
10	0.11	0.11	0.05	0.11	0.03	0.10	0.16	0.12	0.13
11	0.07	0.15	0.14	0.09	0.01	0.07	0.14	0.13	0.09
12	0.02	0.14	0.13	0.08	0.06	0.05	0.05	0.11	0.17
13	0.05	0.11	0.26	0.17	0.16	0.04	0.09	0.12	0.14
14	0.05	0.07	0.08	0.08	0.06	0.06	0.07	0.10	0.09
15+	0.05	0.07	0.08	0.08	0.06	0.06	0.07	0.10	0.09
F(3- 8),U	0.11	0.13	0.18	0.13	0.16	0.15	0.15	0.17	0.16
F(2-10),U	0.10	0.11	0.13	0.12	0.14	0.13	0.13	0.16	0.13

	1978	1979	1980	1981	1972-1977
1	0.00	0.00	0.00	0.00	0.00
2	0.06	0.08	0.09	0.10	0.04
3	0.31	0.28	0.30	0.48	0.19
4	0.25	0.28	0.33	0.50	0.20
5	0.14	0.16	0.38	0.40	0.16
6	0.21	0.31	0.17	0.36	0.15
7	0.19	0.29	0.26	0.28	0.11
8	0.15	0.20	0.30	0.25	0.11
9	0.12	0.27	0.25	0.23	0.13
10	0.27	0.24	0.21	0.27	0.11
11	0.15	0.21	0.48	0.24	0.09
12	0.06	0.22	0.64	0.22	0.09
13	0.20	0.22	0.24	0.30	0.12
14	0.11	0.16	0.20	0.20	0.08
15+	0.11	0.16	0.20	0.20	0.08
F(3- 8),U	0.21	0.25	0.29	0.38	
F(2-10),U	0.19	0.23	0.25	0.32	

Table 5.9. SOLE in Division VIIe (Males and Females).
Stock size in numbers ('000) from VPA at 1 January.
Biomass unit: tonnes.
(Biomass estimates are not corrected for SOP discrepancies.)

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	1358.1	3536.0	3106.0	2304.3	3408.2	3462.4	3060.5	5805.0	4232.2
2	1939.3	1228.9	3199.5	2810.0	2085.0	3138.1	3132.5	2764.0	5247.8
3	2531.5	1670.4	1061.2	2846.9	2404.0	1819.0	2797.1	2776.4	2373.3
4	637.9	1985.2	1291.2	769.9	2185.0	1799.1	1314.6	2037.4	2179.6
5	930.9	501.5	1490.4	935.1	538.0	1566.1	1418.9	1025.5	1426.7
6	2213.3	701.3	368.8	1160.4	736.5	402.4	1248.2	1070.0	786.6
7	559.7	1803.4	556.0	271.9	943.1	572.7	296.5	1016.1	805.0
8	1002.3	486.3	1525.1	427.2	232.5	739.6	442.7	251.5	828.4
9	626.3	859.8	427.8	1232.2	363.0	194.6	628.6	332.6	194.1
10	205.5	542.5	745.0	377.8	988.2	279.5	145.7	543.5	242.2
11	148.4	166.8	441.4	641.2	305.3	865.5	229.7	111.9	437.8
12	460.9	125.8	130.2	347.6	529.3	272.3	731.0	130.7	88.9
13	198.7	408.9	99.4	103.4	291.4	450.4	234.4	629.8	146.7
14	353.2	170.9	329.2	69.7	79.4	225.4	391.5	194.2	507.5
15+	572.9	711.5	713.0	842.7	1107.4	1154.3	1275.4	1637.3	1106.5
TOTAL NO.	13739.0	14897.2	15484.2	15140.4	16256.2	16941.4	17347.2	20375.8	20603.5
SSB NO.	10441.6	10132.4	9178.7	10026.1	10703.0	10340.9	11154.2	11806.8	11123.4
TOTAL BIOM	4369.5	4239.0	4338.7	4413.7	4596.5	4731.7	4953.2	5186.6	5144.1
SSB BIOM.	4044.5	4011.6	3795.5	3940.0	4230.9	4195.6	4421.2	4692.4	4260.1

	1978	1979	1980	1981	1982
1	2992.6	2401.9	2076.6	0.0	**********
2	3827.7	2707.8	2173.3	1879.0	0.0
3	4436.1	3246.9	2291.3	1799.5	1538.4
4	1794.7	2978.1	2211.0	1504.6	1007.5
5	1627.7	1260.1	2041.1	1441.3	825.7
6	1081.8	1275.5	974.2	1267.0	874.2
7	610.9	791.7	845.4	745.7	799.8
8	642.6	455.6	533.6	589.3	509.9
9	659.1	500.0	337.6	356.8	415.3
10	165.6	527.0	346.9	238.4	256.5
11	192.4	114.6	376.2	253.6	164.7
12	362.8	150.3	84.0	211.4	180.5
13	68.2	309.9	109.4	40.0	153.5
14	115.9	50.4	224.6	77.6	26.8
15+	1455.4	1709.8	1272.1	855.4	691.1
TOTAL NO.	20063.4	18479.6	15857.3	11259.4	
SSB NO.	13243.2	13369.9	11607.4	9380.5	
TOTAL BIOM	5471.5	5504.9	5224.6	4105.0	
SSB BIOM.	4827.5	5047.1	4943.1	3903.9	

Table 5.10. SOLE in Division VIIe.
Input data for catch predictions.

LIST OF F-FACTORS AND RECRUITMENT BY YEAR:

YEAR	F-FACTOR	RECRUITMENT
82	0.2000	**********
83	0.2000	3139.60
84	0.2000	3139.60

PROPORTION OF F BEFORE THE SPAWNING SEASON: 0.0000
PROPORTION OF M BEFORE THE SPAWNING SEASON: 0.0000

LIST OF INPUT VARIABLES BY AGE GROUP:

AGE	STOCK SIZE	F-PATTERN	M	MATURITY OGIVE	WEIGHT IN THE CATCH	WEIGHT IN THE STOCK
1	3139.60	0.0000	0.100	0.0000	0.0000	0.0100
2	2840.80	0.1000	0.100	0.0000	0.1710	0.1070
3	1522.40	0.4800	0.100	1.0000	0.2340	0.2000
4	1012.30	0.5000	0.100	1.0000	0.3330	0.2850
5	825.70	0.4000	0.100	1.0000	0.3920	0.3570
6	876.90	0.3600	0.100	1.0000	0.4950	0.4300
7	791.90	0.2800	0.100	1.0000	0.5400	0.4850
8	516.30	0.2500	0.100	1.0000	0.5410	0.5330
9	419.00	0.2300	0.100	1.0000	0.6170	0.5790
10	251.60	0.2700	0.100	1.0000	0.6390	0.6120
11	167.50	0.2400	0.100	1.0000	0.6830	0.6480
12	179.70	0.2200	0.100	1.0000	0.6390	0.6800
13	151.20	0.3000	0.100	1.0000	0.7760	0.7080
14	26.80	0.2000	0.100	1.0000	0.8150	0.7290
15+	691.10	0.2000	0.100	1.0000	0.6580	0.7420

Table 5.11 Division VIIe SOLE.
Catch predictions, average recruitment 1981 and 1982 year classes.

1981	Catch weight	1 145
	Total stock	4 104
(F_4=0.5)	Spawning stock	3 904
1982	Catch weight	929
	Total stock	3 526
(F_4=0.5)	Spawning stock	3 191
1983	Total stock	3 164
	Spawning stock	2 828

F_{max}	F_{83}/F_{81}	Catch weight 1983	Spawning stock 1984
0.0	0.0	0	3 448
0.1	0.2	193	3 249
0.2	0.4	373	3 062
0.3	0.6	542	2 889
0.4	0.8	699	2 727
0.5	1.0	846	2 576
0.6	1.2	984	2 436
0.7	1.4	1 113	2 304
0.8	1.6	1 233	2 181
0.9	1.8	1 346	2 066
1.0	2.0	1 452	1 958

Table 6.1 English Channel PLAICE
Nominal catch (tonnes) in Divisions VIId and VIIe, 1962-1981.

Year	Belgium		Denmark		France		Netherlands	U.K. (England & Wales)		Total	
	VIId	VIIe	VIId	VIIe	VIId	VIIe	VIId,VIIe	VIId	VIIe	VIId	VIIe
1962		24	-	-		874	-	545	373		1 816
1963		32	-	-		1 162	-	472	506		2 172
1964		20	-	-		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	147	5	1[2]	-	1 439	323	-	376	312	1 963	640
1977	149	3	81[2]	-	1 714	336	-	302	363	2 246	702
1978	161	3	-	156[3]	1 810	314	-	349	467	2 320	940
1979	217	2	28	-	2 094	458	-	278	515	2 617	975
1980	435	22	-	-	2 346	440	-	※517	606	3 298	1 068
1981	850		-	-	3 719			1 643		6 212	

※ Raised for under-reporting
1) Figure from Révue des Travaux de l'Institut des Pêches maritimes raised to round fresh weight
2) Includes VIIe
3) Includes VIId

Note! All combined VIId,e figures and the 1975-79 data are from Bulletin Statistique
All others from national statistics

Table 6.2. PLAICE in Divisions VIId+e (Males).
Age composition of total catch 1971-81 ('000).

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0	21	3	29	3	324	46	133	138
2	465	348	133	81	1445	452	2057	1401	1538
3	2211	1919	844	324	1048	1016	521	1906	1315
4	872	721	2501	382	537	288	563	145	600
5	532	315	782	150	302	129	119	82	127
6	362	443	165	57	66	68	112	51	70
7	228	173	99	35	34	72	37	44	61
8	205	28	8	18	38	25	53	16	30
9	157	57	5	3	18	17	12	15	11
10	8	6	40	1	46	14	25	2	8
11	1	28	3	41	25	14	17	3	6
12+	13	2	0	0	22	11	4	10	6
TOTAL	5054	4061	4583	1101	3584	2430	3566	3808	3910

	1980	1981
1	222	361
2	3286	4448
3	1590	6182
4	367	710
5	183	116
6	41	61
7	23	16
8	46	35
9	35	8
10	5	2
11	16	-
12+	6	11
TOTAL	5820	11950

Table 6.3. PLAICE in Divisions VIId+e (Females).
Age composition of total catch 1971-81 ('000).

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	[illegible]	2	1	9	1	190	51	35	43
2	198	253	68	470	945	355	1754	639	891
3	851	717	679	1716	994	1441	616	1578	1293
4	330	406	681	794	402	475	554	164	1017
5	244	215	484	1384	316	230	271	192	117
6	316	340	203	330	235	105	81	81	130
7	109	51	74	223	66	136	47	65	112
8	174	221	17	65	66	70	63	69	79
9	153	134	111	99	32	51	52	46	78
10	280	65	102	193	66	42	23	20	68
11	142	35	12	110	15	17	26	25	33
12+	142	105	24	82	83	24	12	7	23
TOTAL	3659	2558	2652	5419	3257	2918	3674	2891	3889

	1980	1981
1	285	88
2	2 004	1125
3	1437	3436
4	496	1041
5	445	196
6	92	193
7	54	53
8	45	43
9	21	31
10	56	32
11	36	15
12+	27	71
TOTAL	5052	6567

Table 7.1 North Sea SOLE. Long-term forecast (unchanged situation is 100). (The first figure is the Yield, the second figure is the SSB)

Assumed old mesh size	New mesh size			
	60 mm	75 mm	80 mm	90 mm
60 mm	100 100	107 116	110 125	115 187
75 mm		100 100	106 119	115 183

Table 7.2 North Sea SOLE. Short term forecast (in brackets the percentage change to the situation when the old mesh size was maintained)
Recruitment year class 1979: 180 million
- - - 1980: 130 million
Other year classes 100 million. Mesh size going from 60 mm to 60, 75, 80 and 90 mm.

Old/new mesh size	Catch 1981 SP. stock 1982	Catch 1982 SP. stock 1983	Catch 1983 SP.stock 1984	Catch 1984 SP.stock 1985
60 mm/60 mm	14 869 (100)	23 839 (100)	24 823 (100)	22 910 (100)
present situation	37 658 (100)	41 647 (100)	39 637 (100)	38 197 (100)
60 mm/75 mm	12 795 (-14)	23 348 (-2)	25 906 (+4)	24 195 (+6)
	39 611 (+5)	45 899 (+10)	44 492 (+12)	43 328 (+13)
60 mm/80 mm	11 421 (-22)	22 123 (-7)	25 245 (+2)	24 597 (+7)
	40 981 (+9)	47 881 (+15)	48 478 (+22)	47 563 (+25)
60 mm/90 mm	8 633 (-42)	16 110 (-32)	22 521 (-9)	23 775 (+4)
	43 693 (+16)	58 844 (+41)	63 182 (+59)	64 623 (+69)
Mesh size going from 75 mm to 75, 80 and 90 mm				
75 mm/75 mm	14 869 (100)	23 839 (100)	24 823 (100)	22 910 (100)
present situation	37 658 (100)	41 647 (100)	39 637 (100)	38 197 (100)
75 mm/80 mm	12 853 (-14)	22 762 (-5)	25 447 (+3)	24 009 (+5)
	39 607 (+5)	46 305 (+11)	45 270 (+14)	44 211 (+16)
75 mm/90 mm	9 022 (-39)	16 491 (-31)	22 590 (-9)	23 733 (+4)
	43 320 (+15)	57 948 (+39)	62 049 (+57)	63 382 (+66)

Table 8.1 Monthly by-catch rates according to fish ports (percentage of sized fish to toal catch)

Year / Month		Oostende	Zeebrugge	Nieuwport	Breskens	Colijns-plaat
1981	March	(-)	26	(-)	17	14
	April	(-)	19	(-)	15	11
	May	33	22	(-)	32	14
	June	9	17	4	22	10
	July	12	21	1	7	13
	August	15	17	10	6	43
	September	19	8	24	8	27
	October	30	15	(-)	11	16
	November	29	14	(-)	14	22
	December	36	24	(-)	25	9
1982	January	40	24	(-)	33	30
	February	48	25	(-)	22	23

(-) No date

Table 8.2 Total landings of shrimps and by-catch per month in tonnes for the ports ZEEBRUGGE and COLIJNSPLAAT

Year / Month	ZEEBRUGGE					COLIJNSPLAAT				
	Shrimp	Sole	Plaice	Whiting	Cod	Shrimp	Sole	Plaice	Whiting	Cod
1981 March	15.6	0.3	0.4	0.2	1.8	24.0	+	-	+	3.3
April	25.2	0.5	2.1	0.2	0.8	12.4	0.6	0.1	0.1	0.6
May	31.3	0.9	1.3	0.5	+	11.6	0.1	0.2	0.1	0.3
June	43.1	1.3	0.4	0.3	-	14.6	0.5	0.3	+	-
July	67.3	1.7	3.5	+	-	13.0	0.8	0.9	-	+
August	82.6	2.6	7.2	+	-	8.8	1.9	4.3	-	-
September	122.5	3.1	3.5	-	-	30.8	2.0	8.3	0.1	0.2
October	71.6	0.9	5.4	1.1	3.4	91.3	1.1	6.1	2.4	7.6
November	44.8	+	0.4	2.4	2.7	29.3	+	2.6	1.0	4.8
December	34.1	+	0.5	0.6	4.7	80.9	-	0.1	0.7	4.9
1982 January	17.6	-	0.3	0.1	0.9	59.4	+	1.0	0.4	5.6
February	21.5	+	0.3	0.5	1.2	64.6	-	1.3	1.4	3.3

Table 8.3 Total by-catch in tonnes of SOLE, PLAICE, WHITING and COD in the Belgian and Dutch shrimp fishery of the Southern Bight (period March 1981-February 1982) and in the French shrimp fishery of the eastern Channel (period 1980 and 1981)

	Sole	Plaice	Whiting	Cod	Shrimp
Belgian shrimp fleet	16.5	41.4	26.5	30.4	809.9
Dutch shrimp fleet	14.7	34.6	13.1	49.5	794.9
Total (1981) international North Sea cth.	15 404	135 336	194 185	272 856	
French shrimp fleet 1980	115.7	166.8	36.6	59.0	457.7
1981	107.3	260.0	46.2	59.4	528.5
Total international VII d and e (1981)	3 157	6 211	8 271	5 036	

Table 9.1 Nominal catch (tonnes) of SOLE in Sub-area VIII, 1971-1981. (Data for 1971-1980 by separate countries from Bulletin Statistique).

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Belgium	-	-	-	-	-	26	64	30	-	33	4
Denmark	-	-	-	-	-	-	-	-	5	-	-
France	1 661	1 683	2 250	2 856	2 821	2 968	1 959	2 308	2 376	2 549	2 446
Netherlands	-	-	-	-	39	74	6	2	-	-	13
Spain	2 062	125	116	106	98	171	241	283	62	107	22
United Kingdom (England and Wales)	-	-	-	-	-	-	-	-	-	-	+
TOTAL	3 723	1 808	2 366	2 962	2 958	3 239	2 270	2 623	2 443	2 689	2 485

Figure 2.1. North Sea SOLE.
Cpue on relative scale for United Kingdom, Belgium and Netherlands, and international effort based on these indices.

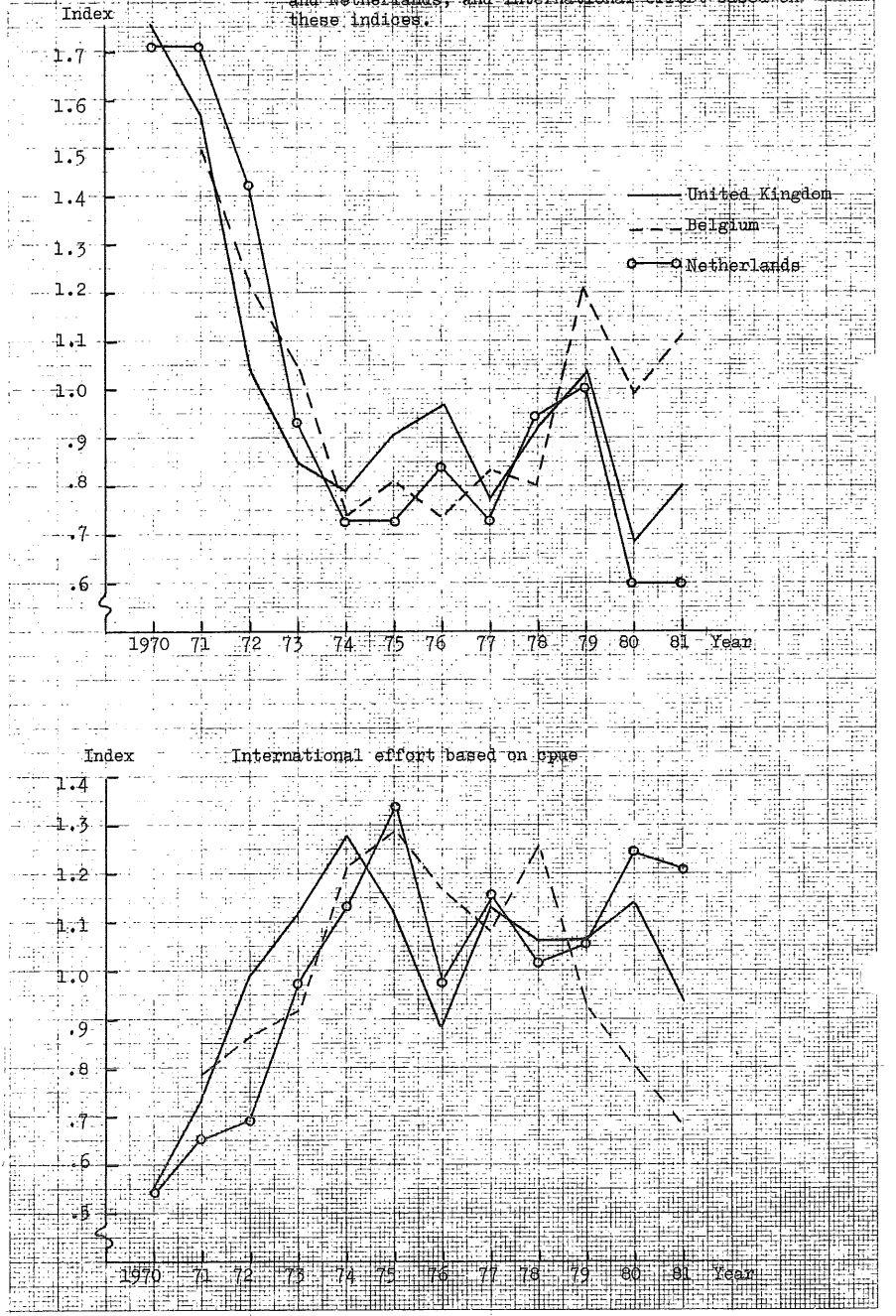
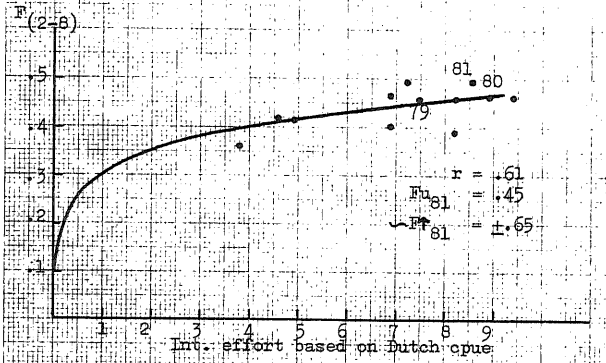
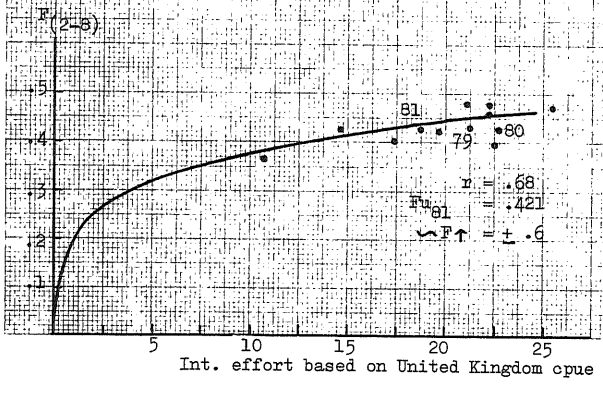
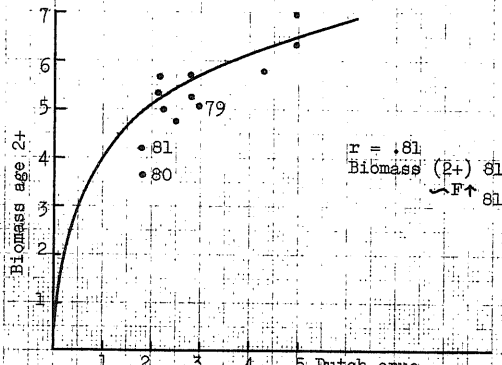


Figure 2.2. North Sea SOLE.
Log-log regression between $F_{(2-8)}$ and effort indices for the years 1970-78.
($F\uparrow$ = F at age of maximum exploitation)





Log-log regression between biomass of age 2 and older and cpue indices for the years 1970-78



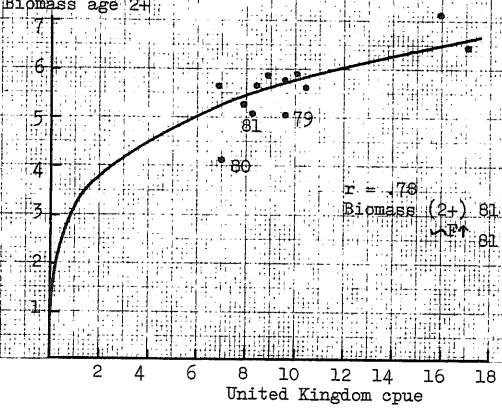


Figure 2.3. North Sea SOLE.
Summary figures.

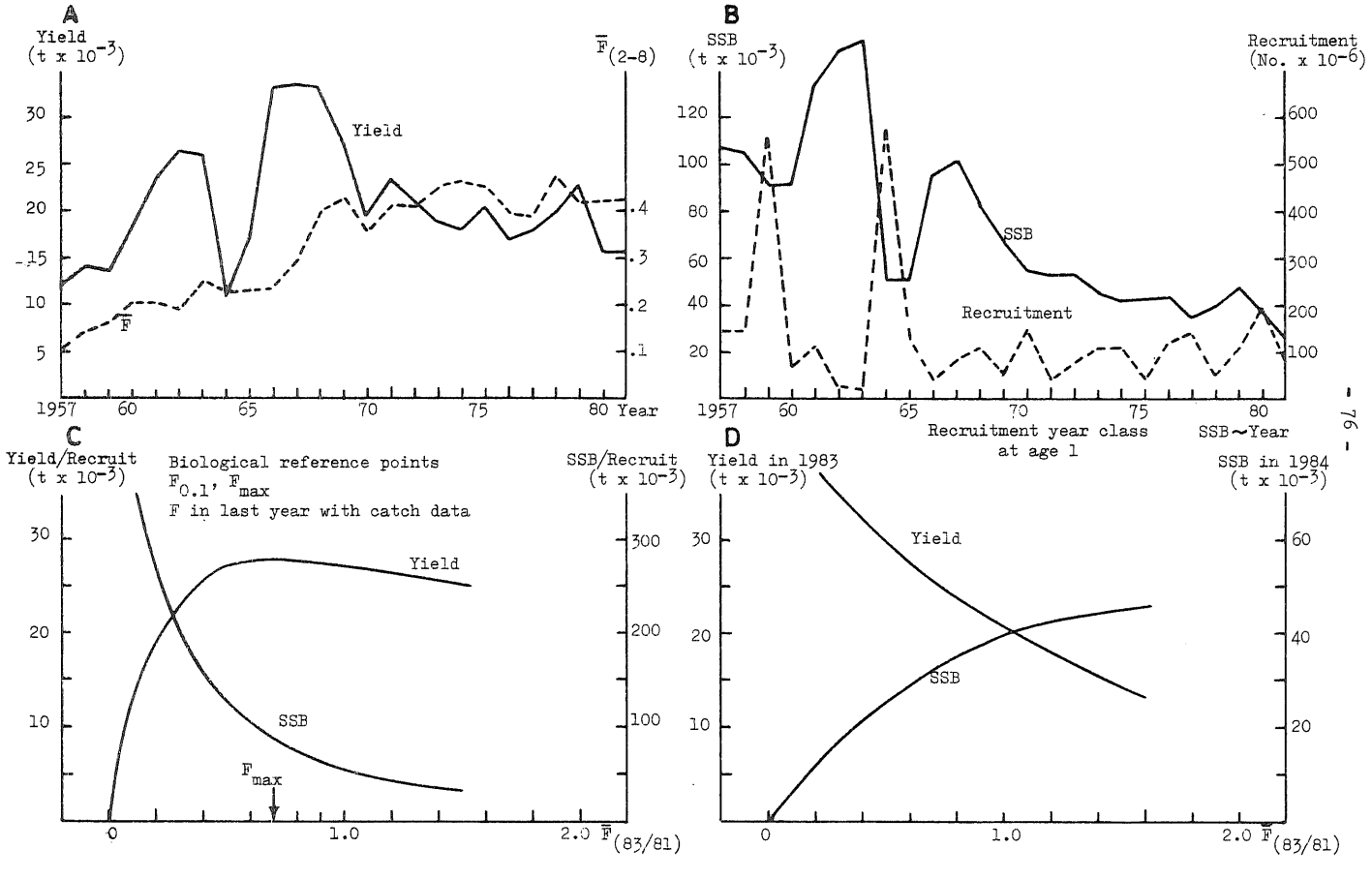


Figure 2.4. North Sea SOLE.
Stock-recruitment plot.

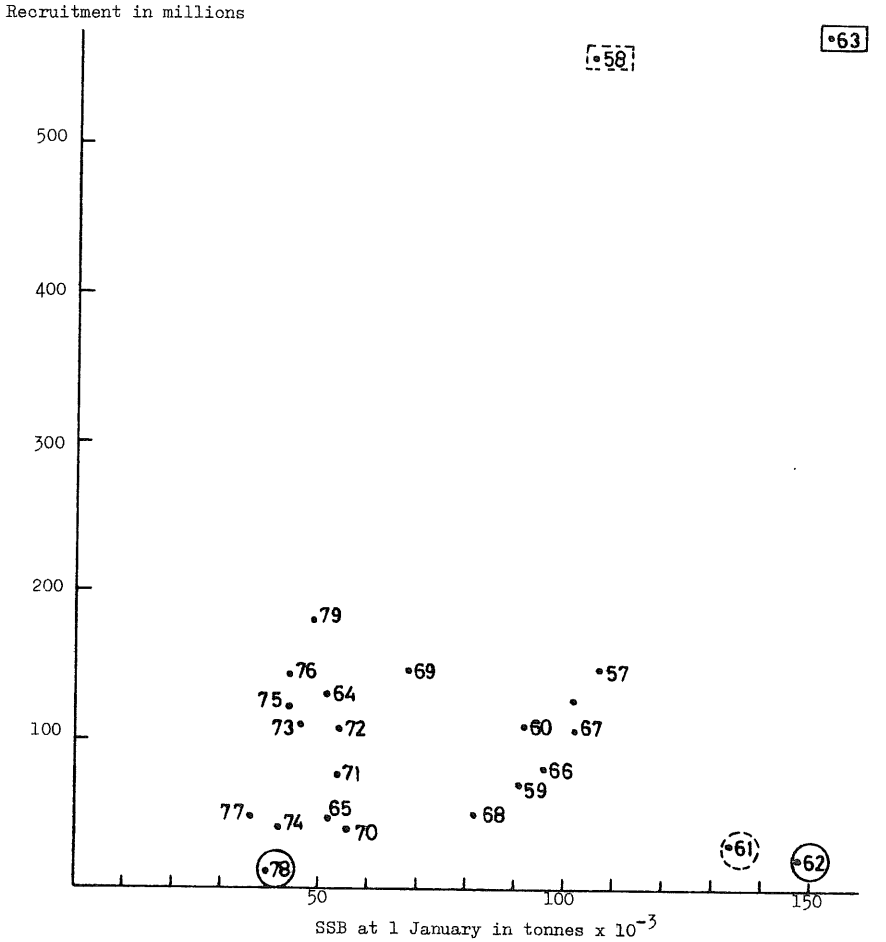


Figure 2.5. The probability as a function of F_{rel} for a spawning stock level greater than 60 000, 50 000, 40 000 and 30 000 tonnes in 1984.

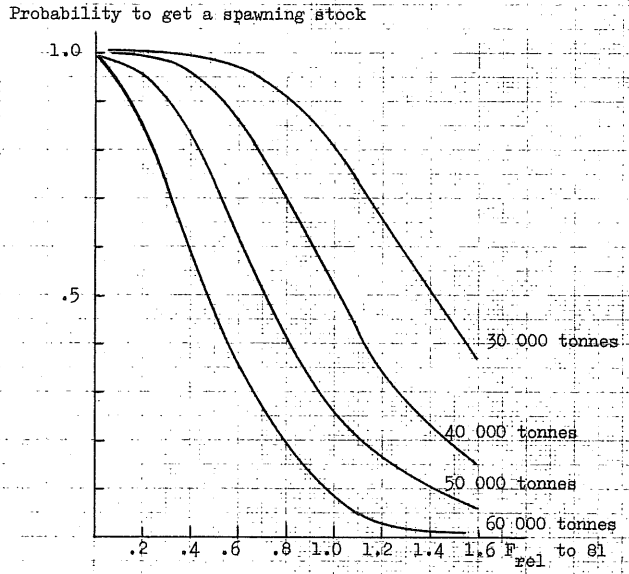


Figure 2.6. The probability as a function of $\bar{F}_{rel}$ for a spawning stock level greater than 30 000, 40 000, 50 000 and 60 000 tonnes in the long term and yield equal or greater than 25 000 tonnes.

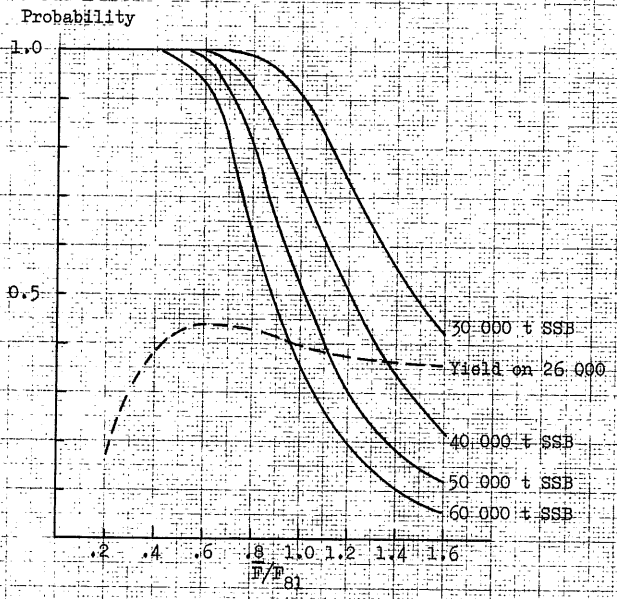


Figure 3.1. North Sea PLAICE.
Catch per unit effort indices.

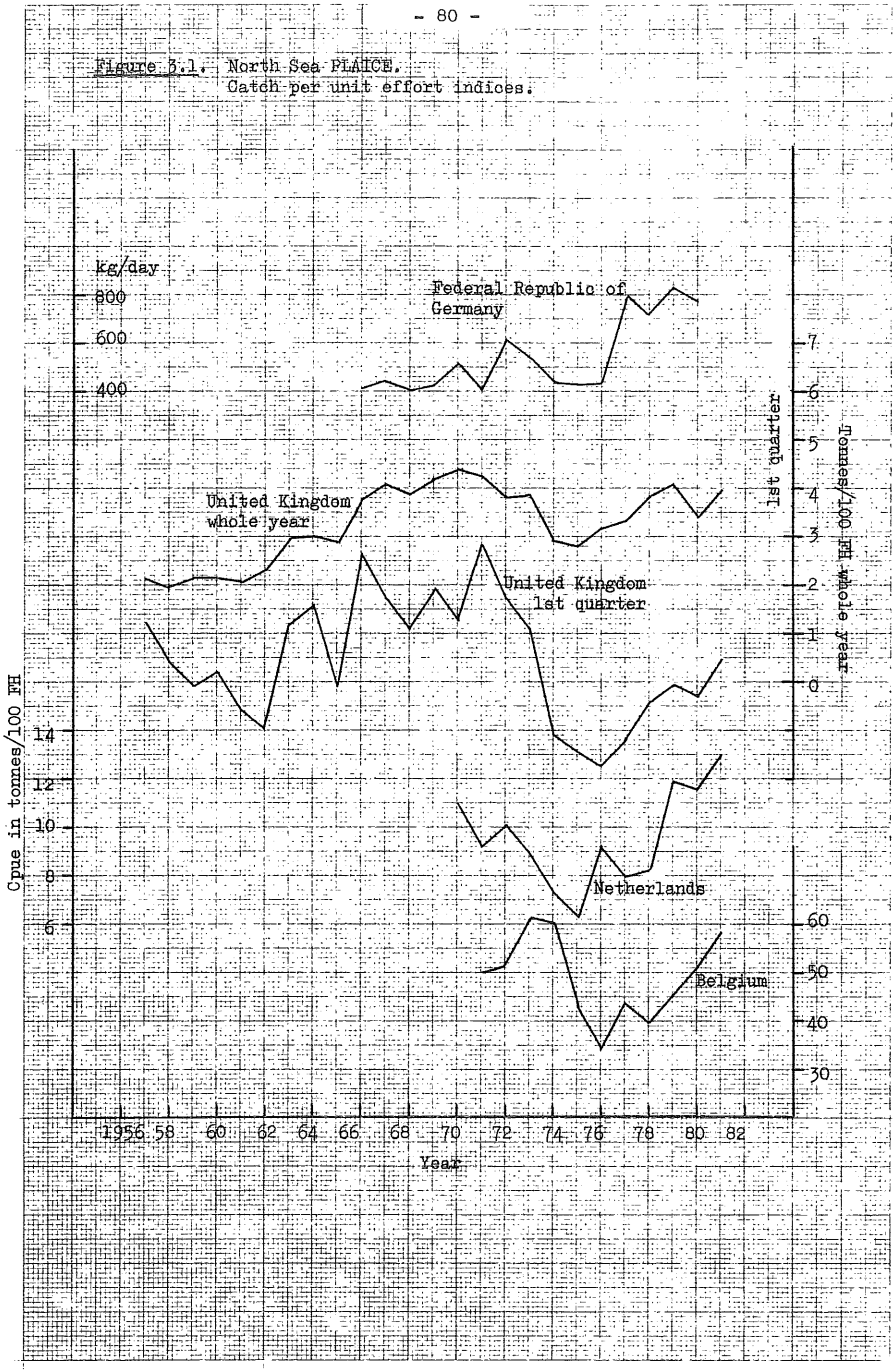


Figure 3.2. North Sea PLAICE.
International effort indicated by the different indices.

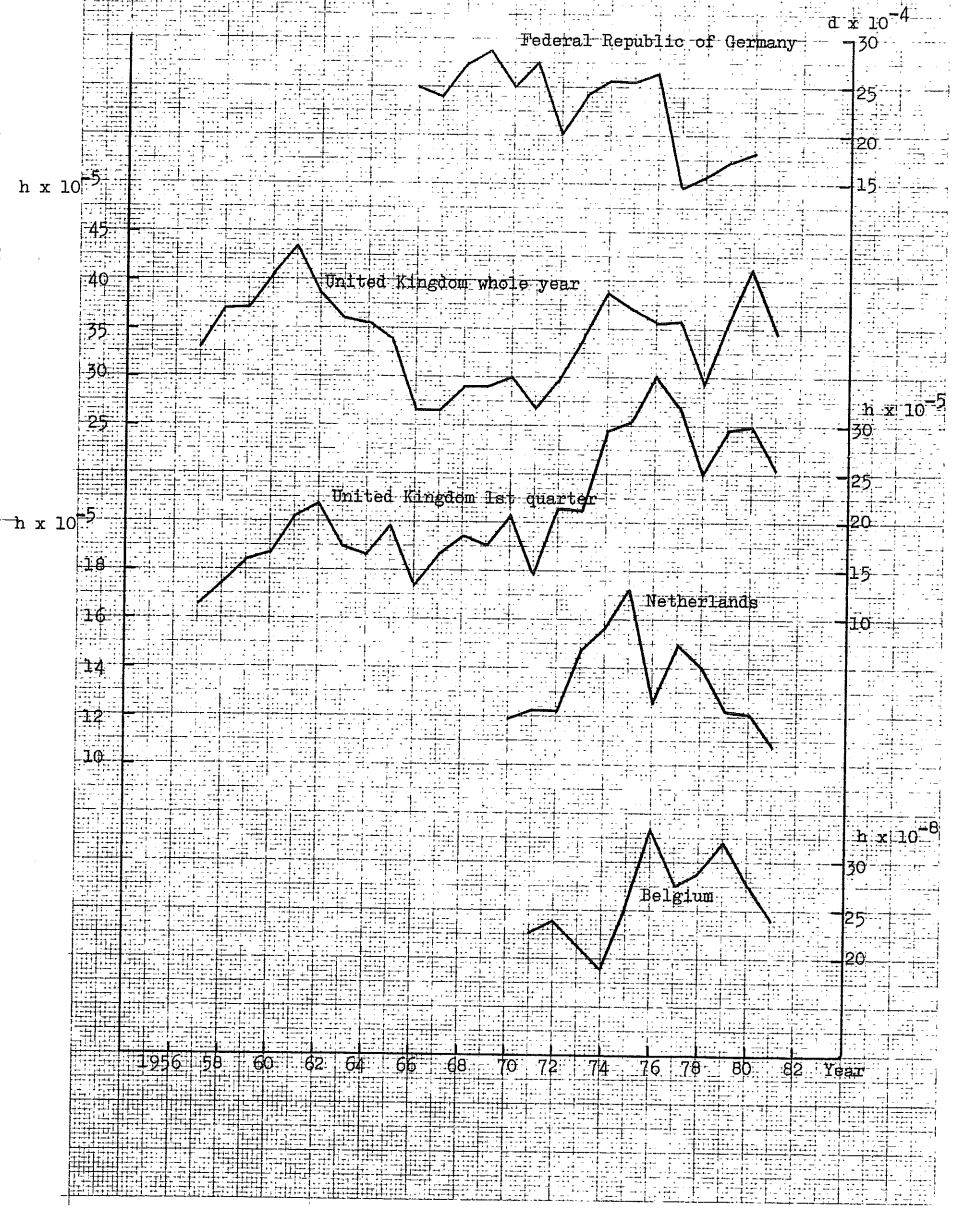
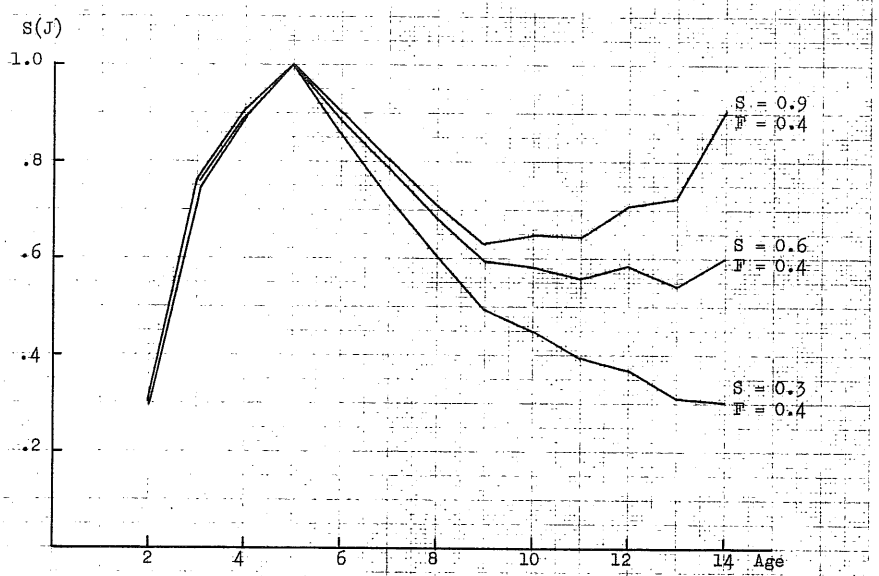


Figure 3.3. North Sea PLAICE.
Selection patterns for different options of S and F values from separable VPA analysis.



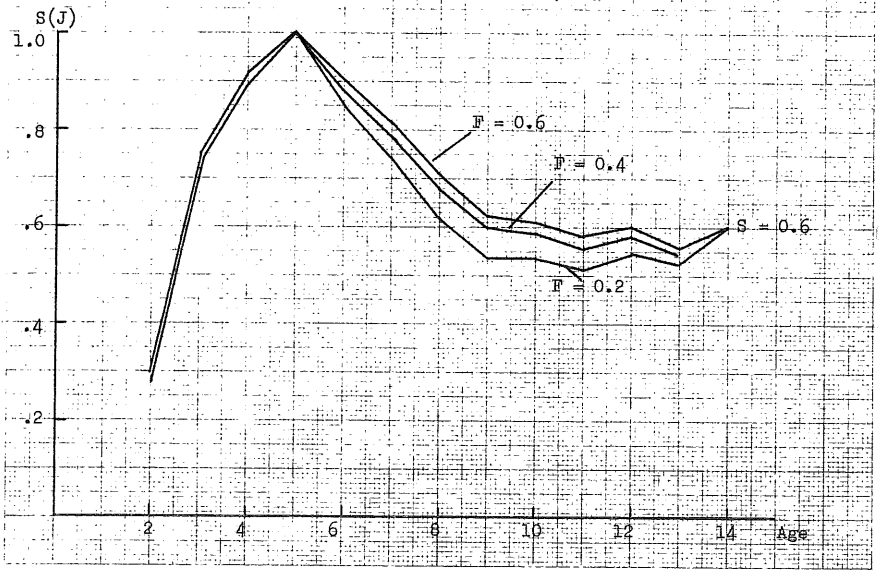
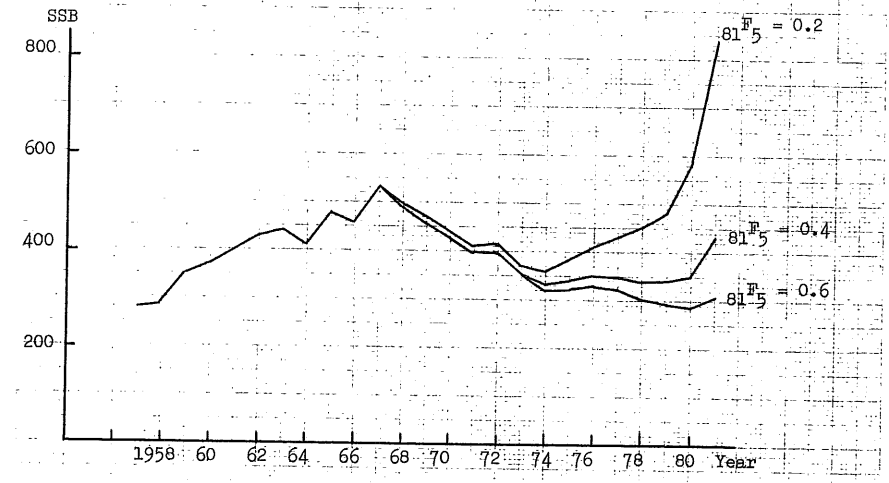


Figure 3.4. North Sea PLAICE.
Spawning stock biomass and $\bar{F}_{2-10}$ from trial VPAs with terminal F values (F in year 1981 for age 5) of 0.2, 0.4 and 0.6.



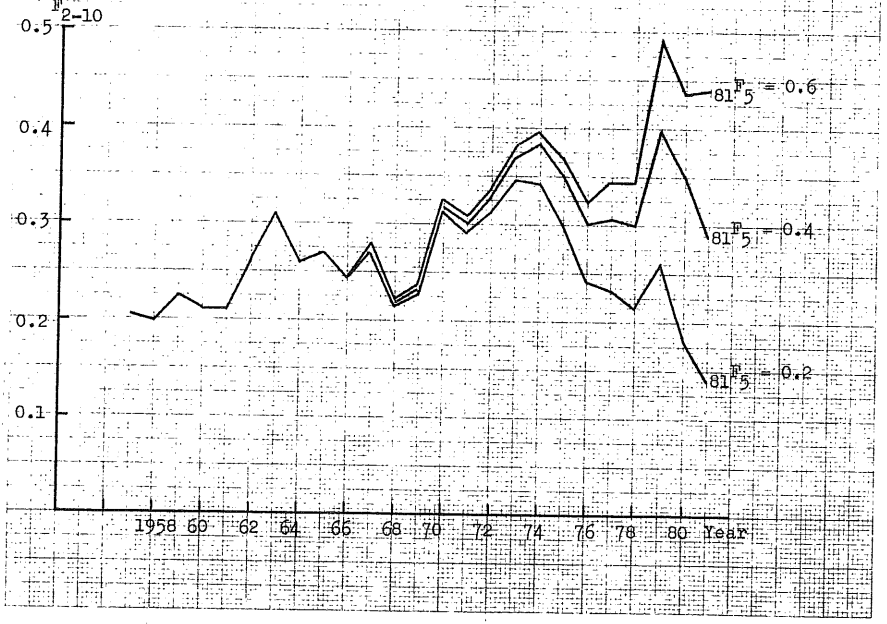


Figure 3.5. North Sea PLAICE.
Geometric mean regression of spawning stock biomass against the relative cpue index based on the United Kingdom whole year and Netherlands' whole year index for the period 1970-78 from the VPA with $\bar{F}_{81}^{5}$ = 0.4.

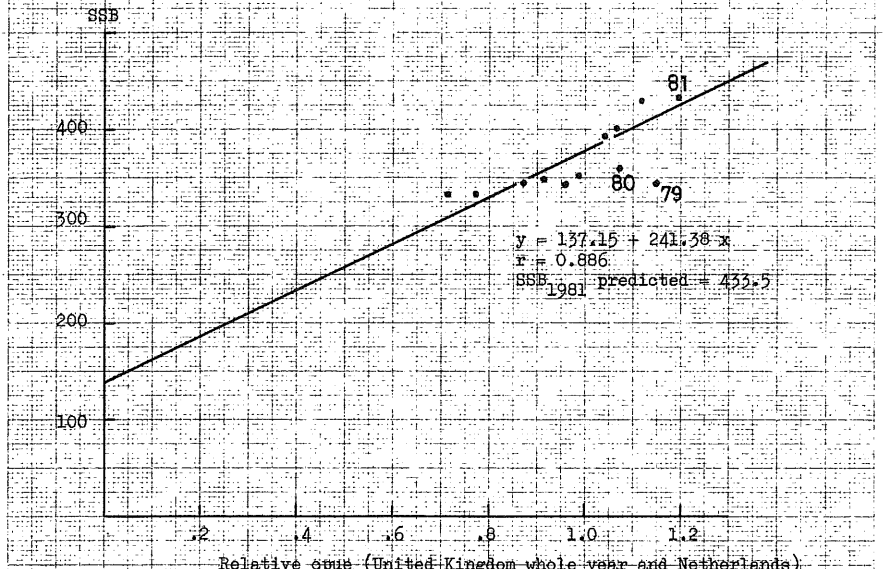
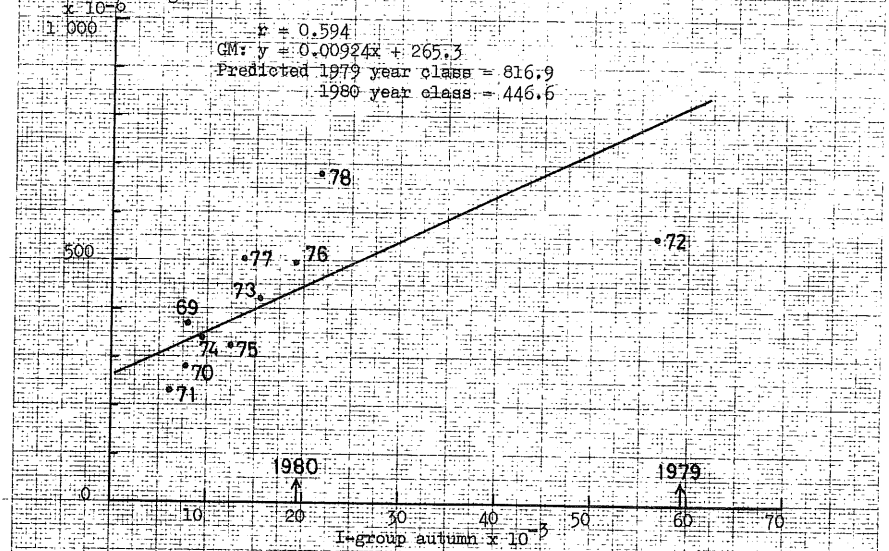


Figure 3.6. North Sea PLAICE.
Regressions of VPA estimate of recruitment on pre-recruit survey indices.



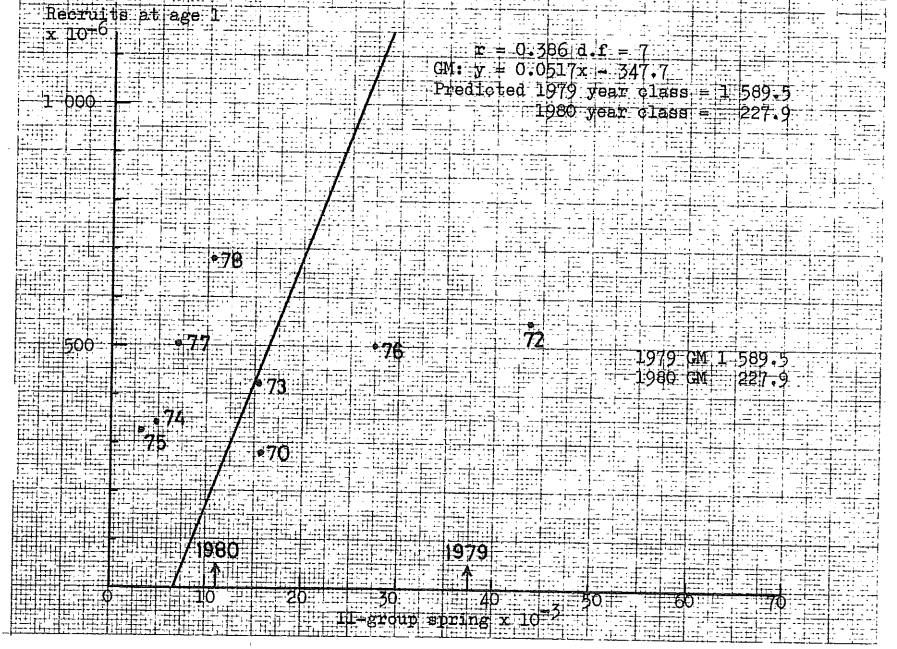


Figure 3.7. North Sea PLAICE.
Summary figures.

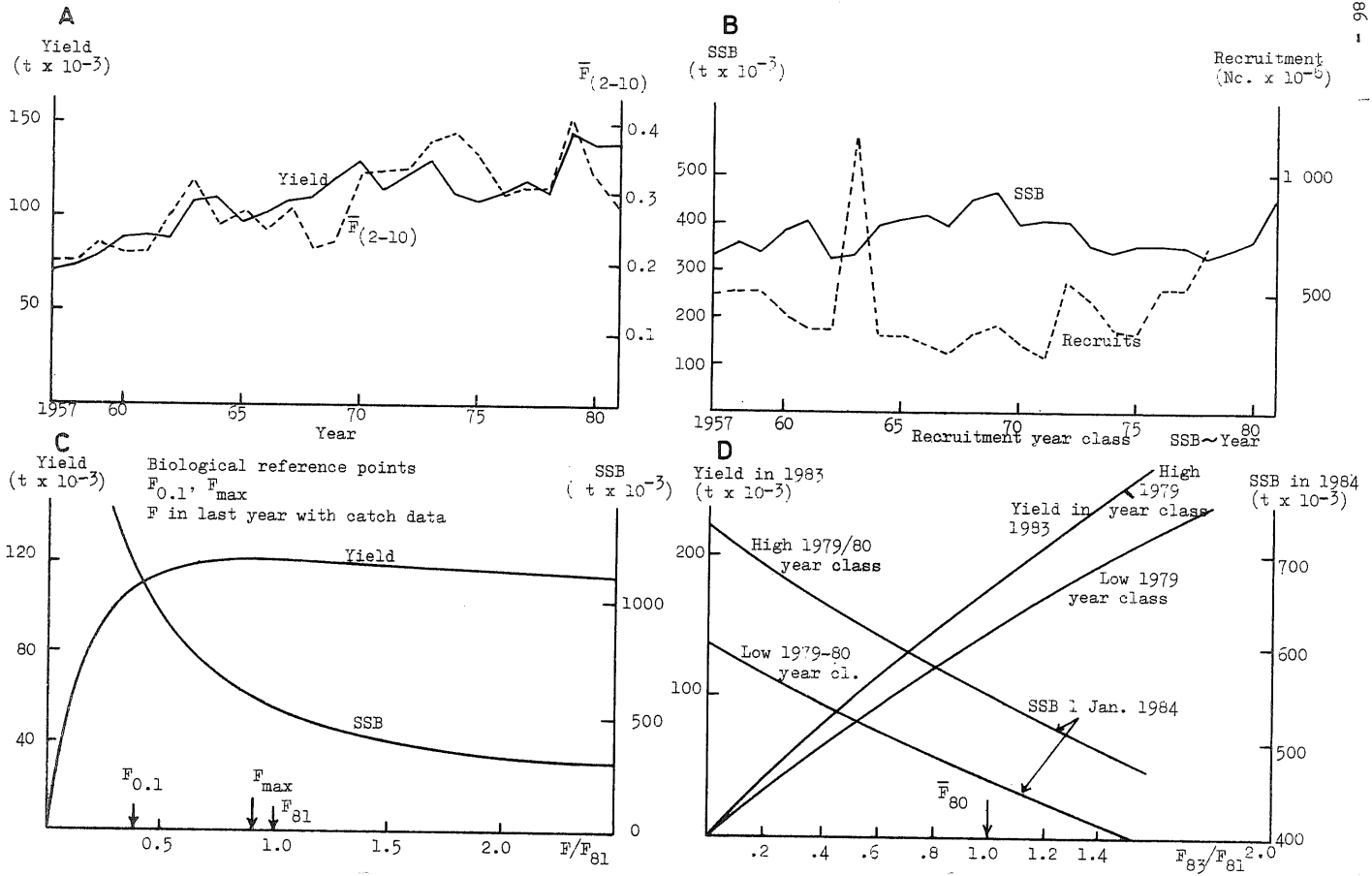


Figure 4.1. SOLE in Division VIId.
Trial separable VPA (sexes combined).

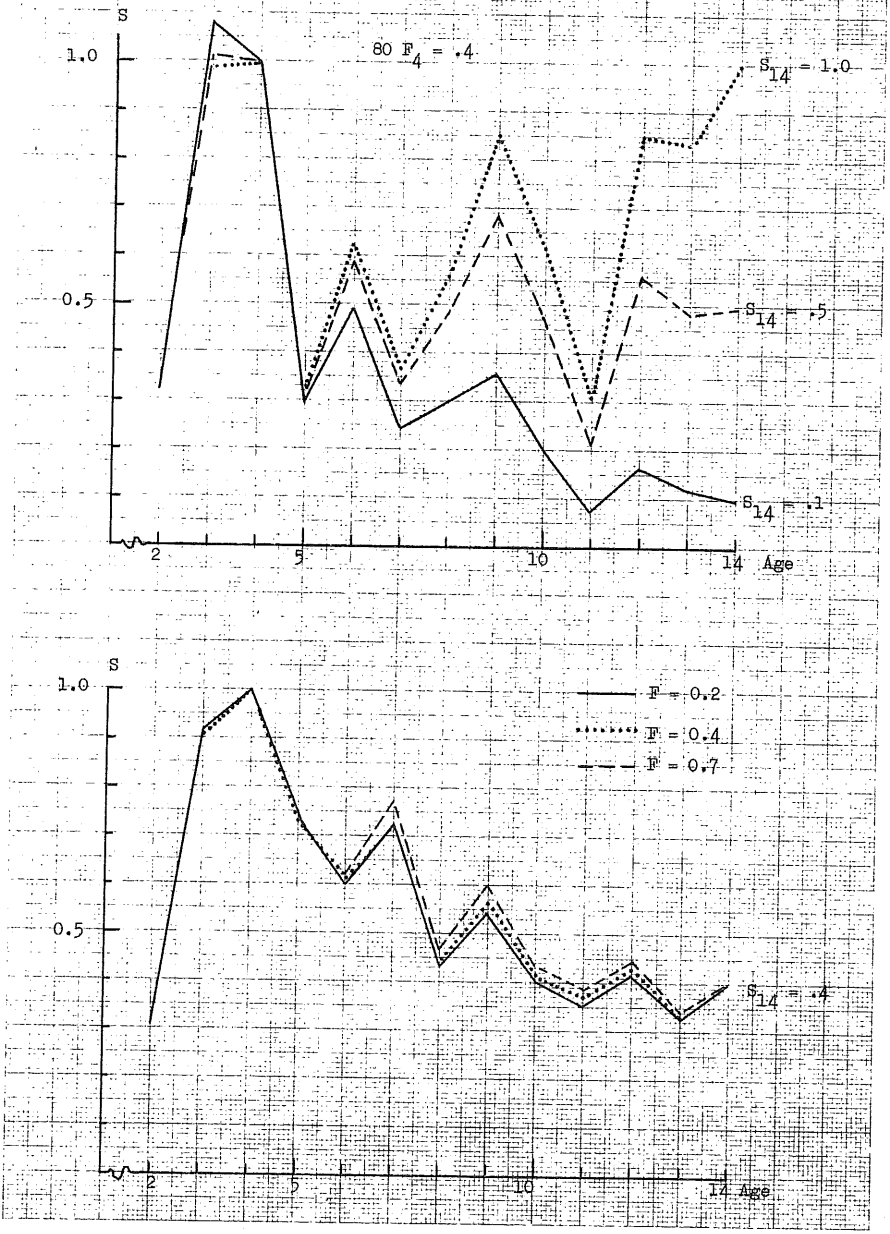


Figure 4.2. SOLE in Division VIId.

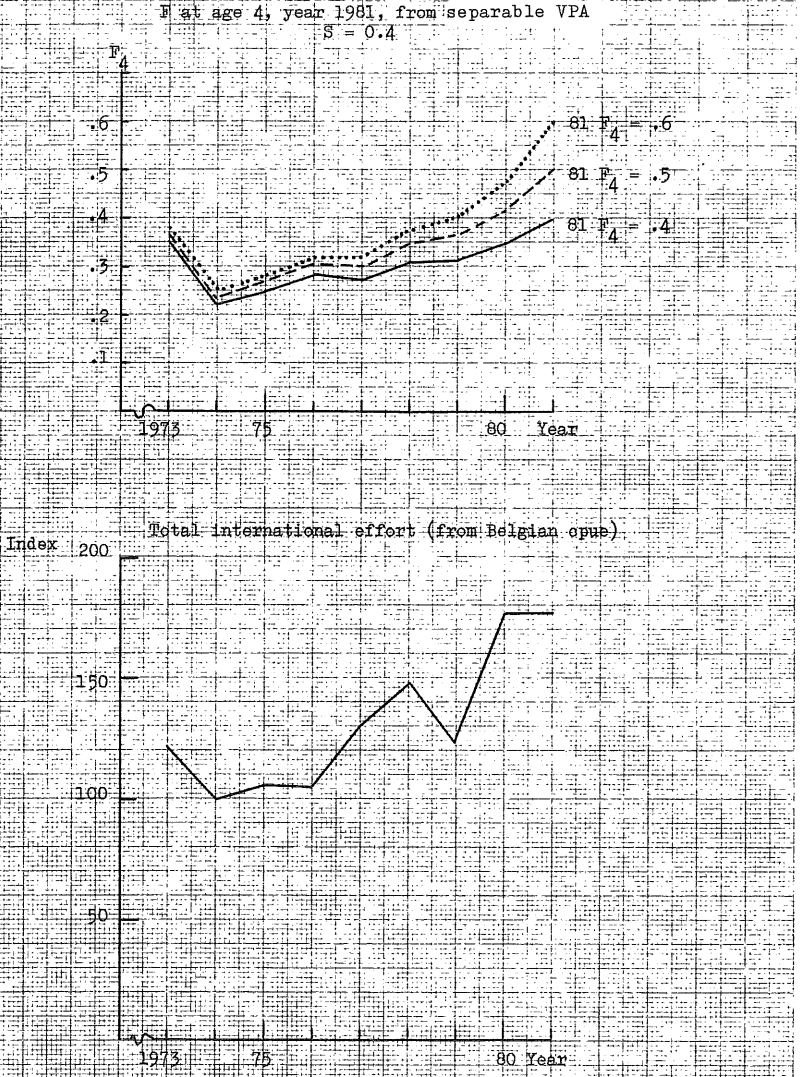


Figure 4.3. SOLE in Division VIId.

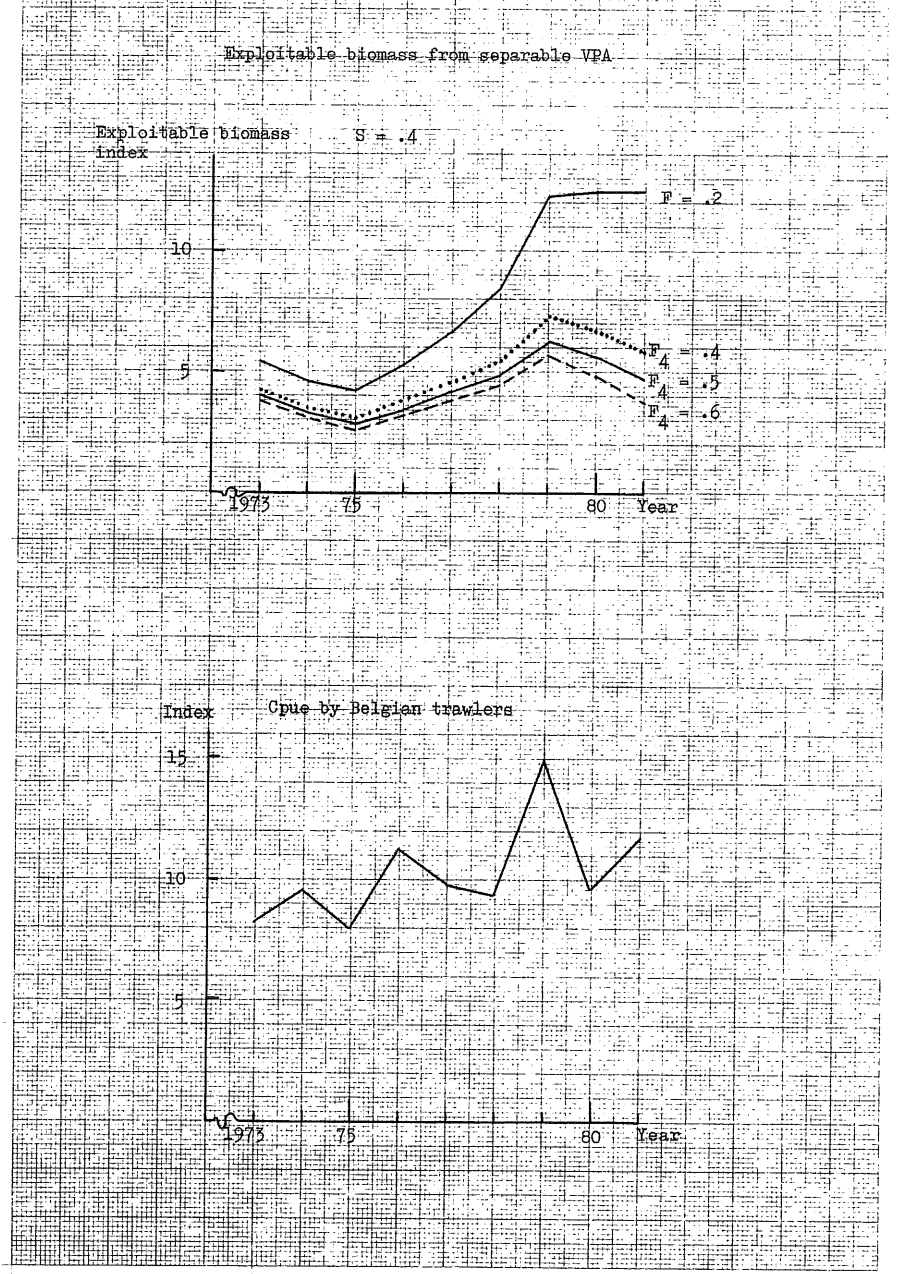


Figure 4.4. SOLE in Division VIId.
Summary figures.

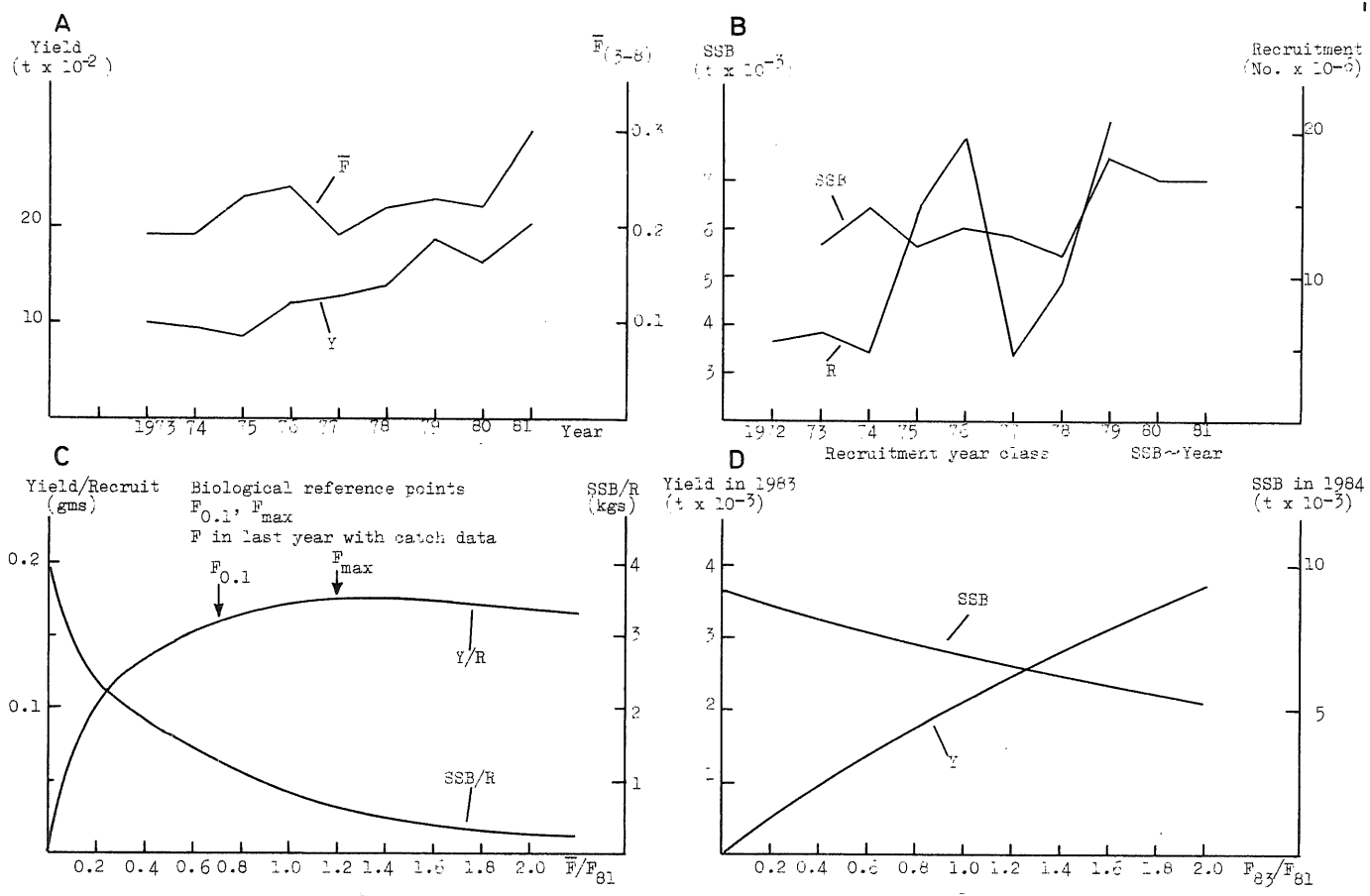


Figure 5.1. SOLE in Division VIIe.

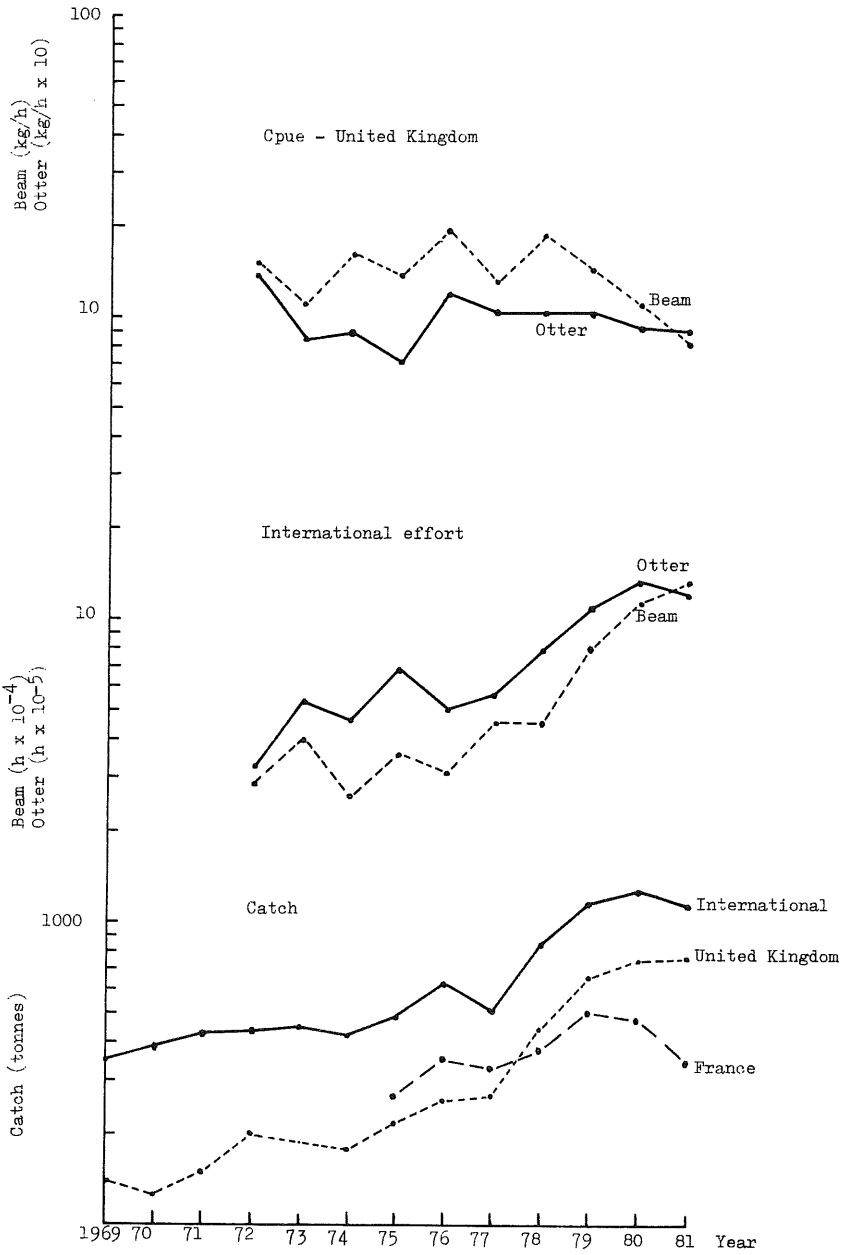


Figure 5.2. SOLE in Division VIIe.
Catch in numbers at age.

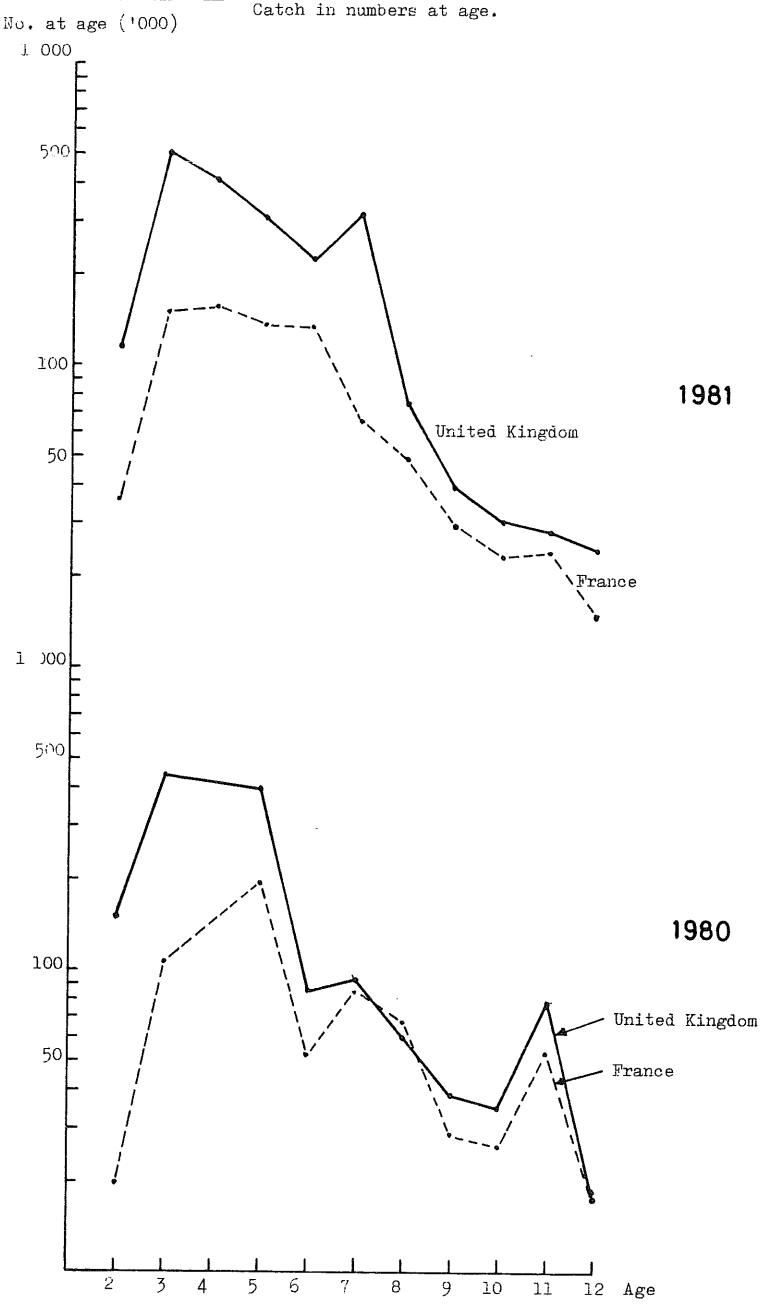


Figure 5.3. SOLE in Division VIIe.
Separable VPA results.
81 F_4 = 0.4

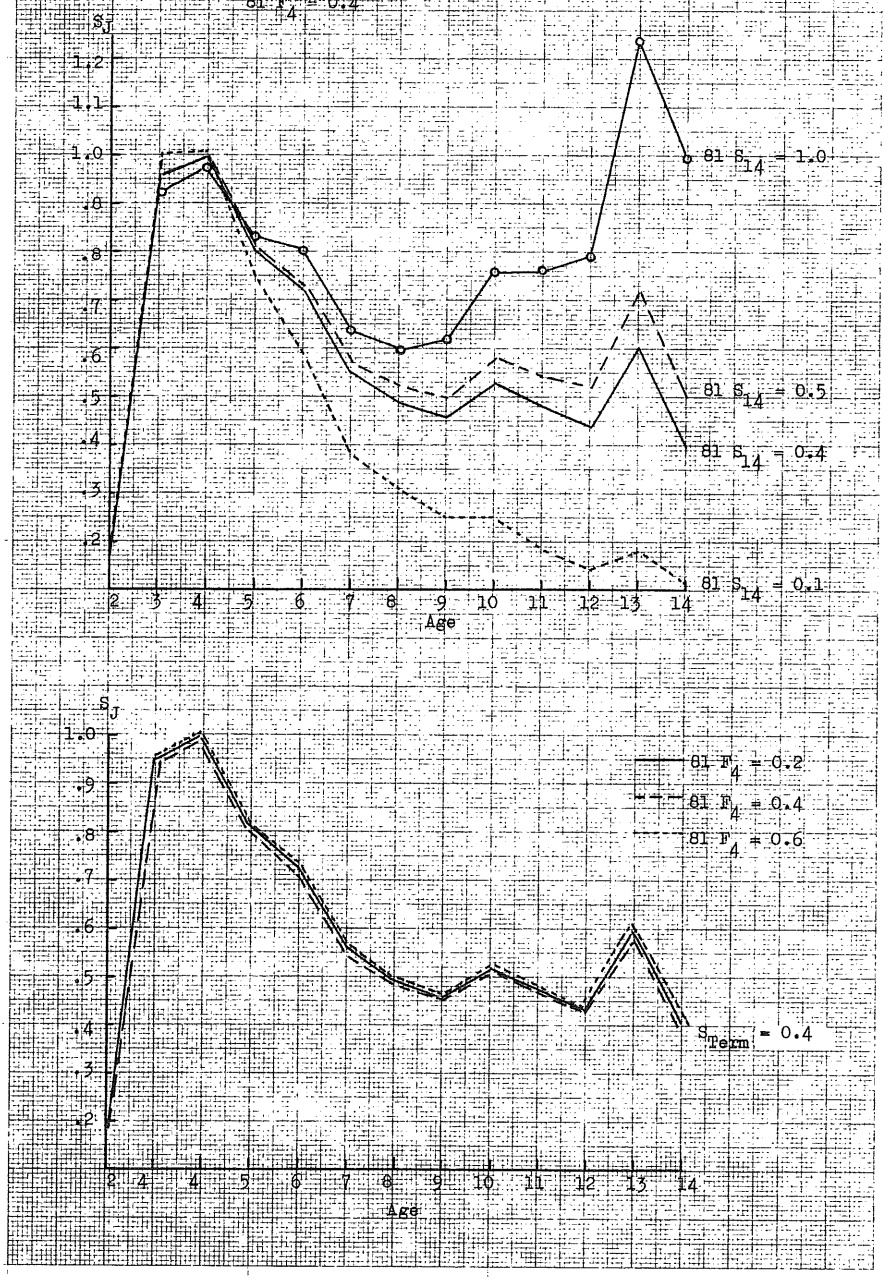
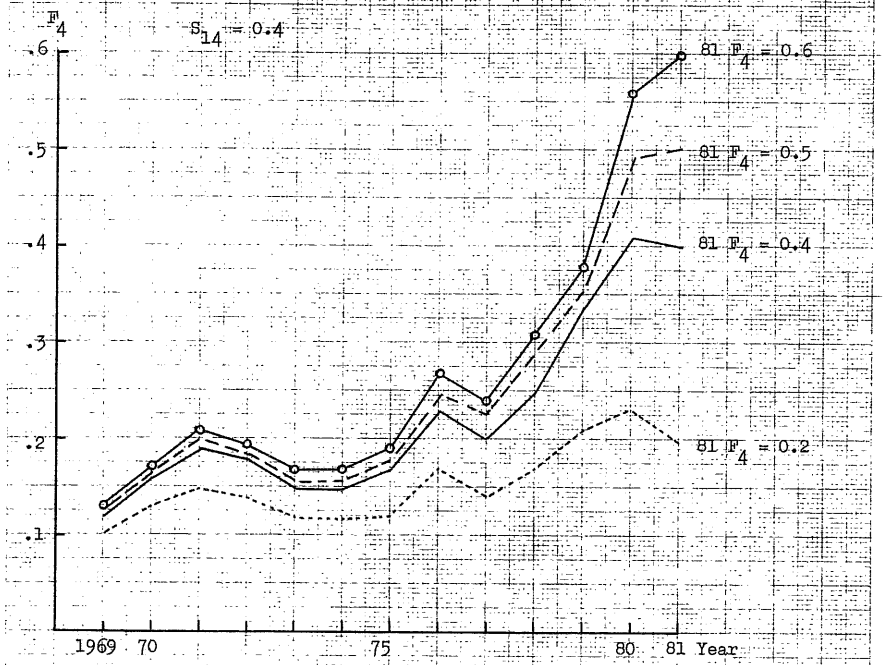


Figure 5.4. SOLE in Division VIIe.
Separable VPA results - fishing mortality and effort.



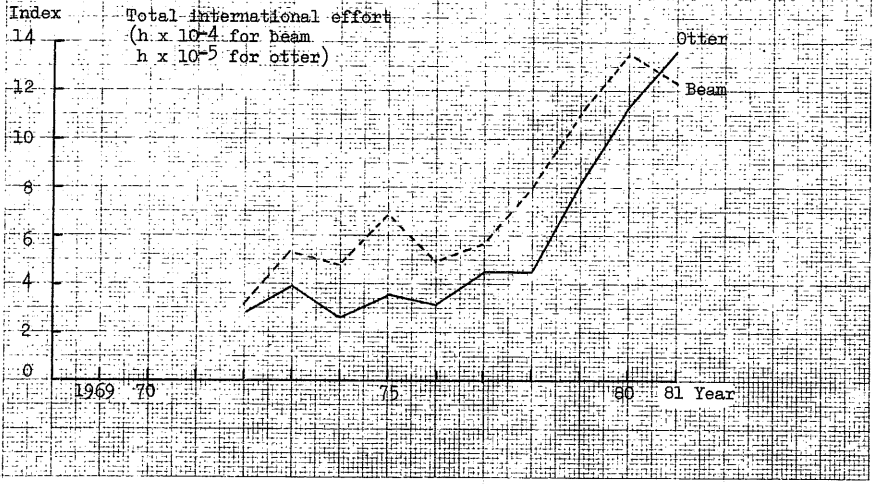
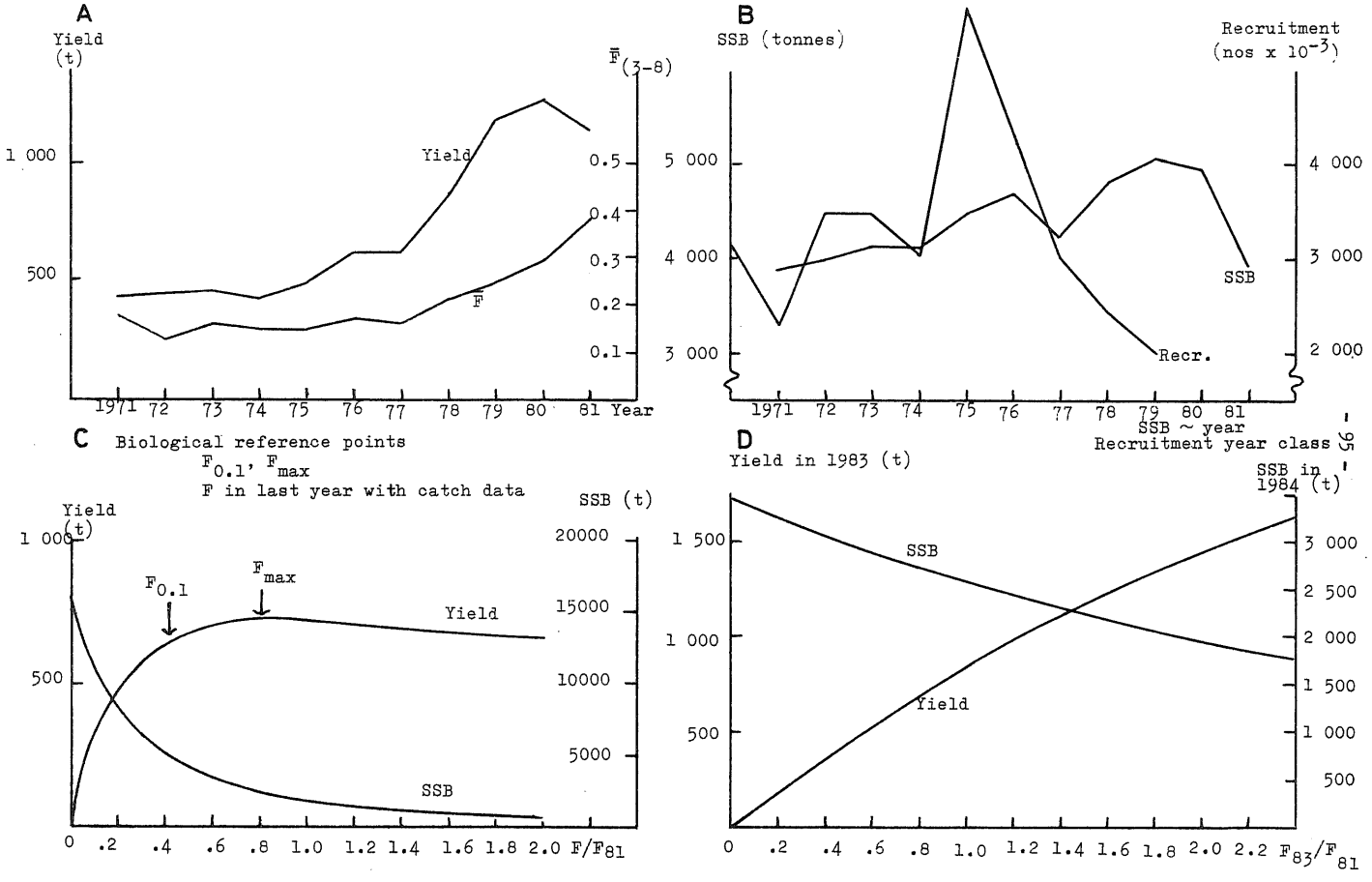


Figure 5.5. SOLE in Division VIIe.
Summary figures.



APPENDIX 1

SIMULATION RUNS OF THE STOCHASTIC MODEL

In the stochastic model (Nielsen, 1980), one assumes that the recruitment, R, can be described by a log-normal-distribution, LN(A,B**2).

From the definition of the log-normal distribution, it follows that

$$R - LN(A,B**2)$$

is equivalent to

$$LOG(R) - N(A,B**2)$$

where N(A,B**2) is the normal distribution.

From the theory about the log-normal distribution, it follows that there is a connection between the parameters A and B**2, and the mean value and variance of R.

Let E(R) denote the mean of R and V(R) denote the variance of R, then

$$A = LOG(E(R)) - 0.5*LOG(V(R)/(E(R)**2) + 1) \qquad (1)$$

$$B**2 = LOG(V(R)/(E(R)**2) + 1)$$

In the stochastic model (Nielsen, 1980), it has been shown that if the recruitment follows a log-normal distribution, then the spawning stock and the yield will also follow a log-normal distribution (assuming unchanged exploitation pattern during the years).

Based on these facts, a number of simulation runs were made (in this case, 100 runs). The mean and variance of the spawning stock and yield were calculated, whereafter it was possible to calculate the 1% and 99% fractiles of the SSB and the yield, using the formula (1).

EXAMPLE

Assume that E(SSB) = 500 and V(SSB) = 100, we calculate the values A and B**2 for the SSB. We have

$$A = LOG(500) - 0.5*LOG(100/250000 + 1) = 6.2136091$$

$$B**2 = LOG(100/250000 + 1) = 0.001998.$$

We now have, according to the assumption that

$$LOG(SSB) - N(6.2136091, 0.001998).$$

If we normalize, we have

$$(LOG(SSB) - 6.2136091)/SQRT(0.001998) - N(0,1)$$

For the 1% fractile, we then have to solve the equation

$$(LOG(SSB) - 6.190231)/SQRT(0.001998) = -2.32$$

which gives

$$SSB = EXP(-2.32*SQRT(0.001998) + 6.2136091).$$

When the distribution of the SSB is given, it is then possible to calculate the probability of getting an SSB greater than a decided value, SSBO. That is done in almost the same way.

We have that

$$P(SSB < SSBO) - N(A,B**2)$$

$$<=>$$

$$P(SSB >= SSBO) - 1-N(A,B**2).$$

Normalizing gives

$$(LOG(SSBO) - A)/SQRT(B**2) - N(0,1)$$

whereafter, the probability can be found in a table.

EXAMPLE

If we use the values from the previous example, we can calculate the probability of getting an SSB > 550.

We have that

$$(LOG(550) - 6.2136091)/SQRT(0.001998) = 2.1546163$$

The probability P(SSB >= 550) is 1 - 0.98422 = 0.01578.

The programs for making the simulation runs, based on a log-normal distribution of the recruitment, have been added as a new option to Kjarton Hoydal's NEWPRED program.

FOOTNOTE: All equations are given in semi-computer language.

APPENDIX 2

COMBINED SEX ASSESSMENT FOR NORTH SEA PLAICE

by R G Houghton

1. The attached tables and figures show the results of a comparison of the separate and combined sex assessments for North Sea plaice. This was carried out in the same way as for North Sea sole (Houghton ICES CM 1982/G:13) and it used the old database from the 1981 Working Group.

2. The coefficients of variation (CV) from the separate VPA (Table 1) are higher for males than for females but, when the catch at age data are combined, the CVs are not reduced below that for females as was the case for sole. However, the combined CVs are only slightly higher than those for females.

3. The exploitation patterns used by the 1981 Working Group were different for each sex; that for males was thought to be more peaked than that for females (S = 0.5 for males, = 0.8 for females). However, after a number of separate VPA trials, it became clear that there was no firm evidence of different problems between the two sexes. Similar patterns can be obtained from the separable VPA which are equally good fits to the catch-at-age data as are the different patterns assumed last year (Figure 1).

4. Estimates of total stock number and recruit numbers at age 1 from the combined VPA are within 2.2 and 6.9 per cent of the separate sex VPAs (excluding 1980) and most of the values are in closer agreement (Table 2).

5. Fishing mortalities from the separate sex VPAs are greater for males than for females and this is reflected in large discrepancies in the arithmetic mean F from the separate and combined VPAs (Table 3). When weighted for stock numbers, the mean F values are in close agreement (-2.4% is the largest difference).

6. Total stock and spawning stock biomasses are in fairly good agreement; the extreme discrepancy ranges are -4.2 to +0.4 and -18.4 to +12.4% respectively. The larger discrepancies for spawning stock are probably due to values used for the proportion mature; in the separate sex assessment males were assumed to become mature at age 2 and females at age 4 (1981 WG); in the combined assessment they were assumed to become mature at age 3. Closer agreement would have been achieved if it had been possible to vary the proportion mature with age in the Lowestoft VPA program (ie 0.5 on age 2 and 3, 1.0 on age 4 and older).

7. There appear to be no important differences between the separate sex and combined VPAs for North Sea plaice. Even though there are differences in the fishing mortalities between males and females this is not important because the trends in F are similar. The F values estimated by the combined VPA are equivalent to the F values of the separate sex VPA weighted by the stock numbers of males and females.

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Appendix 2, Table 1. Separable VPA results for North Sea PLAICE: coefficients of variation (%) of log catch ratios (obs-fitted). Age range 2-14 (males) 2-16 (females), 2-14 (combined). Terminal F = 0.6, S = 0.5 in each case. Reference age = 4.

	Male	Female	Combined
1966-70	43.1	16.6	21.6
1971-75	33.4	28.1	29.0
1976-80	27.6	16.7	17.7
1966-80	32.3	21.5	22.8

Appendix 2, Table 2. Comparison of separate sex and combined VPAs for North Sea PLAICE: stock and recruit numbers (in millions of fish).

	Total stock numbers			Recruits at age 1		
	Separate	Combined	Ratio (comb/sep)	Separate	Combined	Ratio (comb/sep)
1951	1345.2	1347.3	1.002	307.8	300.0	0.975
2	1283.4	1287.4	1.003	242.7	246.3	1.015
3	1278.6	1280.7	1.002	291.2	289.7	0.995
4	1260.0	1262.2	1.002	293.5	294.2	1.002
5	1331.0	1331.6	1.000	352.2	352.4	1.001
6	1268.5	1263.3	0.996	211.0	206.5	0.979
7	1311.6	1285.6	0.980	310.9	289.3	0.931
8	1520.0	1486.9	0.978	493.6	484.8	0.982
9	1730.2	1708.5	0.987	510.4	517.9	1.015
1960	1912.4	1892.8	0.990	524.5	524.7	1.000
1	1953.5	1931.0	0.988	418.8	413.4	0.987
2	1920.8	1902.0	0.990	346.6	350.0	1.010
3	1845.8	1828.6	0.991	359.0	359.2	1.001
4	2526.6	2502.9	0.991	1153.6	1147.4	0.995
5	2363.2	2344.0	0.992	334.1	333.9	0.999
6	2219.9	2203.6	0.999	322.2	322.8	1.002
7	2054.8	2039.4	0.992	301.2	301.6	1.001
8	1771.4	1758.3	0.993	247.9	248.2	1.001
9	1649.3	1638.2	0.993	321.6	321.3	0.999
1970	1616.9	1605.5	0.993	380.2	380.3	1.000
1	1477.2	1467.4	0.993	301.4	300.7	0.998
2	1378.4	1374.8	0.997	247.9	247.3	0.998
3	1613.0	1605.4	0.995	609.0	605.8	0.995
4	1678.6	1667.8	0.994	501.6	498.9	0.995
5	1635.6	1628.6	0.996	349.0	347.9	0.997
6	1504.8	1496.0	0.994	287.1	287.1	1.000
7	1527.4	1521.1	0.996	485.3	486.6	1.003
8	1733.4	1729.7	0.998	632.3	633.8	1.002
9	1921.1	1894.3	0.991	617.7	602.5	0.975
1980	1686.4	1585.0	0.940	296.6	210.9	0.711

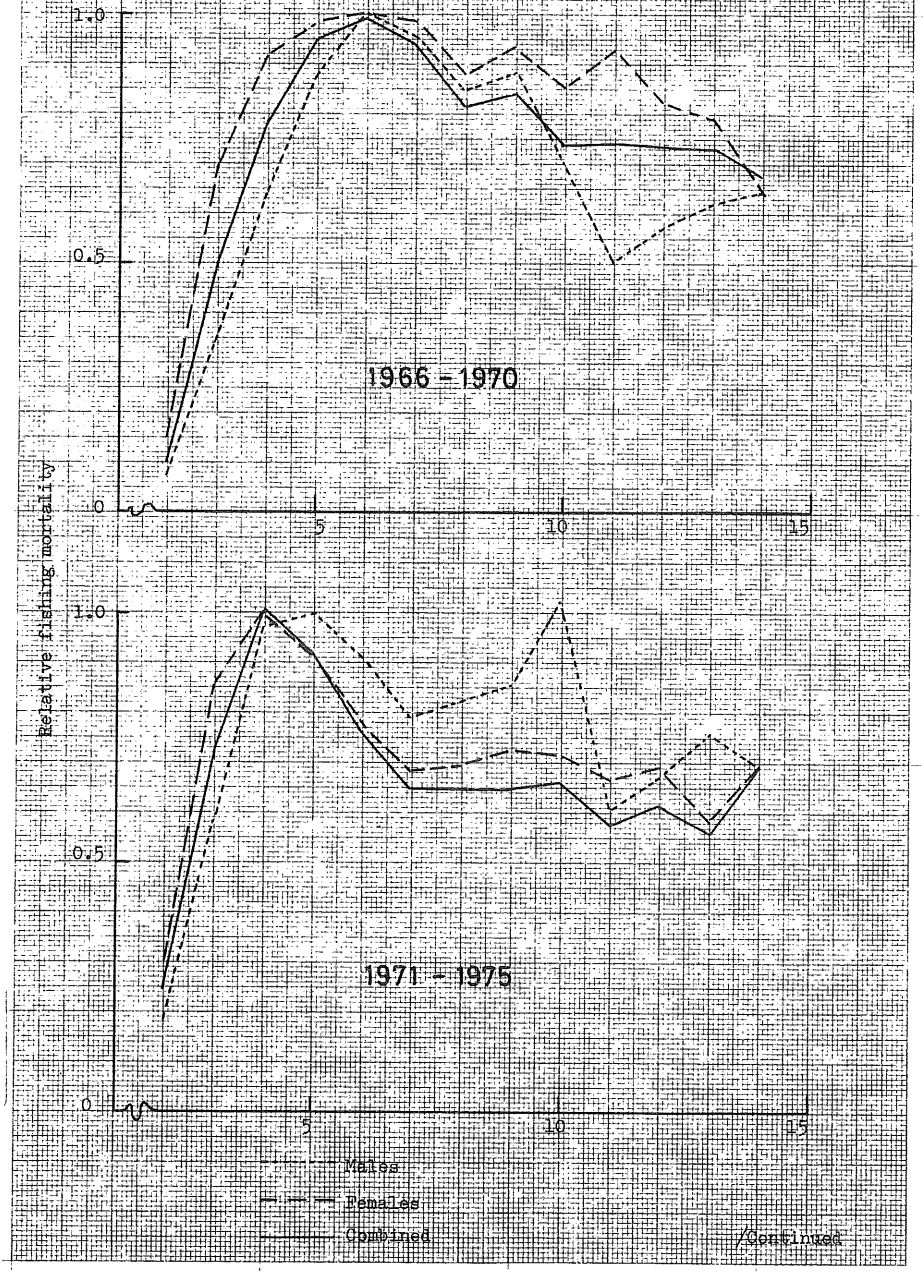
Appendix 2, Table 3. Comparison of separate sex and combined VPAs for North Sea PLAICE - arithmetic mean and mean weighted by stock numbers on age groups 2 to 10.

	Arithmetic $\bar{F}_{2-10}$					Weighted $\bar{F}_{2-10}$		
	Separate							
	Male	Female	Average	Comb	Ratio	Sep	Comb	Ratio
1951	.388	.176	.282	.222	.787	.204	.200	.980
2	.416	.191	.303	.242	.799	.213	.210	.986
3	.514	.215	.364	.279	.766	.250	.245	.980
4	.481	.190	.335	.245	.731	.210	.206	.981
5	.401	.176	.288	.226	.903	.187	.184	.984
6	.382	.159	.271	.210	.775	.174	.171	.983
7	.349	.162	.255	.208	.816	.199	.197	.990
8	.299	.165	.232	.201	.866	.190	.193	1.016
9	.378	.169	.273	.226	.828	.179	.182	1.017
1960	.293	.173	.233	.217	.931	.177	.179	1.011
1	.333	.168	.250	.216	.864	.157	.157	1.000
2	.337	.217	.277	.268	.968	.209	.211	1.010
3	.422	.238	.330	.314	.952	.282	.281	.996
4	.374	.185	.280	.258	.921	.251	.247	.984
5	.384	.194	.289	.270	.934	.149	.148	.993
6	.366	.172	.269	.241	.896	.166	.166	1.000
7	.432	.190	.311	.270	.868	.254	.248	.976
8	.329	.161	.245	.209	.853	.229	.226	.987
9	.369	.167	.268	.221	.825	.245	.242	.988
1970	.488	.236	.362	.314	.867	.329	.321	.976
1	.406	.203	.304	.254	.836	.232	.229	.987
2	.441	.328	.385	.358	.930	.261	.260	.996
3	.488	.352	.420	.394	.938	.386	.384	.995
4	.517	.353	.435	.408	.938	.270	.267	.989
5	.449	.415	.432	.423	.979	.258	.259	1.004
6	.560	.370	.465	.439	.944	.351	.349	.994
7	.460	.305	.382	.359	.940	.354	.355	1.003
8	.517	.344	.431	.404	.937	.334	.334	1.000
9	.706	.503	.605	.567	.937	.370	.370	1.000
1980	.534	.407	.471	.471	1.000	.316	.319	1.009

Appendix 2, Table 4. Comparison of separate sex and combined VPAs for North Sea PLAICE - stock biomasses in thousands of tonnes.

	Total stock			Spawning stock		
	Sep	Comb	Ratio	Sep	Comb	Ratio
1951	421.9	423.4	1.004	302.7	308.5	1.019
2	418.5	418.5	1.000	303.3	311.3	1.026
3	416.9	415.2	0.996	304.5	313.8	1.031
4	400.7	396.8	0.990	295.1	294.2	0.997
5	420.9	414.0	0.984	297.6	299.7	1.007
6	436.1	424.8	0.974	327.2	319.7	0.977
7	438.3	423.9	0.967	325.7	336.4	1.033
8	496.7	481.3	0.969	355.2	340.5	0.959
9	485.5	468.9	0.966	341.4	316.3	0.926
1960	557.2	543.8	0.976	387.8	373.7	0.964
1	573.8	555.7	0.968	420.6	403.8	0.960
2	443.7	429.0	0.967	342.7	336.9	0.983
3	445.8	431.6	0.968	354.2	345.9	0.977
4	635.8	610.8	0.961	420.9	397.8	0.945
5	591.9	571.9	0.966	435.6	355.3	0.816
6	605.3	585.0	0.966	437.1	491.1	1.124
7	500.0	480.7	0.961	421.6	405.5	0.962
8	561.0	538.8	0.960	474.6	458.6	0.966
9	598.3	584.3	0.977	494.7	480.8	0.972
1970	529.0	510.7	0.965	428.9	398.6	0.929
1	592.8	567.9	0.958	466.9	437.3	0.937
2	482.0	477.5	0.991	386.0	386.8	1.002
3	475.0	461.1	0.975	340.8	336.1	0.986
4	475.5	465.4	0.979	333.4	286.2	0.858
5	422.9	420.8	0.995	286.6	294.1	1.026
6	367.7	361.3	0.983	274.2	276.3	1.008
7	437.9	429.5	0.981	314.2	309.5	0.985
8	437.6	431.4	0.986	294.9	262.7	0.891
9	516.9	508.2	0.983	310.7	267.8	0.862
1980	489.2	474.6	0.970	342.8	328.2	0.957

Appendix 2, Figure 1. North Sea PLAICE.
Separable VPA results.



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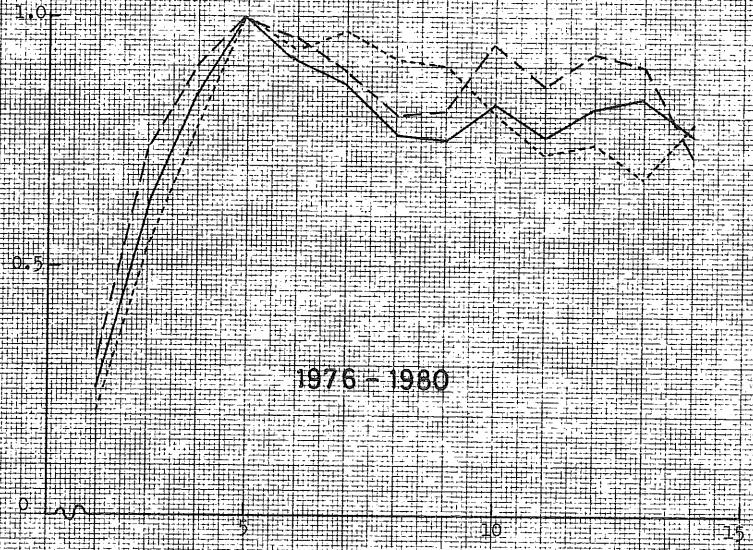
Appendix 2, Figure 1 (Continued).



Original reference age = 4 years in each case
terminal F = 0.6 years in each case

Original terminal S:	Males	Females	Combined
1966-70	1.00	0.70	0.85
1971-75	0.70	0.70	0.70
1976-80	1.00	0.80	0.90

"S" patterns renormalised to age of F_{max} in each case.