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REPORT OF THE NORTH SEA FLATFISH WORKING GROUP

Copenhagen, 21-26 September 1981

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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 21-26 September 1981, with the following participation:

R C A Bannister	United Kingdom
R De Clerck (Chairman)	Belgium
H Gislason	Denmark
R G Houghton	United Kingdom
T Jakobsen	Norway
B Mesnil	France
E Nielsen	Denmark
T K Pitt	Canada
A Rijnsdorp	Netherlands
G Rauck	Federal Republic of Germany
F van Beek	Netherlands.

1.2 Terms of Reference

At the 1980 Statutory Meeting it was decided (C.Res.1980/2:6/15) 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 1982,

(ii) collate the results of mesh selection experiments using beam trawls carried out in 1980 and comment on the effects of the results on ICES' previous advice on this topic,

(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.

1.3 Working Procedures

Separable VPAs (Pope and Shepherd, in prep.) were used in all assessments to investigate the range of assumptions about terminal F which could fit the catch at age data. The following values had to be defined for each run:

1. the age of unit selection, or age on which fishing mortality is at a maximum,
2. the level of F on the unit selection age in the last year,
3. the relative F on the otolith age group referenced to the unit selection age (the same value applies to each year).

The goodness of fit to the separable model (i.e., that the F values can be explained by a level of F in each year and a single exploitation pattern applying throughout the period) is tested by examining the sums of squares of the residuals between the observed and expected log catch-ratios. High ssq's may be explained by poor sampling or by changes in the exploitation pattern.

Exploitation patterns can be extracted from the data and a choice made as to the most likely one. The levels of F can be directly correlated with effort indices to predict the level of F in the last year.

2. NORTH SEA SOLE

2.1 Landings

In 1980, the total catch was 15 827 tonnes, which is slightly above the 1980 TAC of 15 000 tonnes. There were no unreported landings this year. Compared with 1979, the catch decreased by 30%. The main reason for this decrease was a failing recruitment of the 1977 and 1978 year classes. In the years 1975-78, 41% of the catches (in weight) consisted of 2 and 3 year olds. In 1980, this percentage was only 22%. Also, the higher catchability in the first quarter of 1979, due to the hard winter of 1978-79, contributed to the high 1979 catch. In the years 1978-80, the year class 1976 made a substantial contribution to the total landings (18, 47 and 37%, respectively, of the total catch).

Table 2.1 summarizes the catches reported for the period 1969-80.

2.2 Age Composition and Weight at Age

2.2.1 Age composition

No amendments were made to the 1979 age composition. For the 1975 age composition, the catch figures for males at ages 9, 13 and 14, and for females at age 10, were amended as a consequence of the recalculation of the basic data. For 1980, age composition data were available from Belgium, Denmark, the Federal Republic of Germany, the Netherlands and the United Kingdom, accounting for 98.5% of the total landings. The United Kingdom age composition was derived from a United Kingdom length composition and Dutch age/length keys.

The sums of products check on the national age composition with the national weight at age was +2.6% for Belgium, +0.3% for Denmark, 0.09% for the Federal Republic of Germany, and -2.7% for the Netherlands. The SOP check for the United Kingdom age distribution, using Dutch gutted weight at age data, was -0.5%.

2.2 Weight at age

For 1980, weight at age data were available from Belgium, Denmark, the Federal Republic of Germany and the Netherlands, all based on 1980 market sampling (Table 2.2). The Netherlands data show lower values than those of the Federal Republic of Germany. The Belgian and Danish values showed even lower values for all age groups.

A combined catch weight at age for 1980 was calculated from weighting the national data by numbers (Table 2.2). The smoothed values are also given in that table.

The sums of products check on the total international age composition of 1980 with the smoothed catch weight at age was 1% too low.

For calculating spawning stock biomass in the VPA, nominal weight at age values for the catch and stock for the years 1957-78 were taken from Houghton and Bannister (1979), in which annual data on changing growth in North Sea sole were grouped and smoothed (Tables 2.4, 2.5, 2.9 and 2.10). The catch and stock weight at age for 1979 were taken from the report of the Working Group in 1980.

The values for stock biomass from the VPA and the catch and stock values in the forecast are corrected for the discrepancies between nominal catches and the sums of products (Table 2.14).

A better estimate for the stock weight at age is the first quarter weight at age. These data were only available for a few years. From these data it appears that stock weight at age is higher than catch weight. This was also shown by De Clerck (1981). The interpolated stock weight at age data are always lower than the catch weight at age.

Since the first quarter weight at age data were not available for all years, interpolated stock weight at age were used in the calculations for all years to obtain comparable biomasses. The absolute biomasses of the stock estimates will be subsequently higher.

2.3 Catch per Unit Effort

Catch per unit effort data were available from Belgium, the United Kingdom and the Netherlands (Table 2.3, Figure 2.5). The Dutch cpue is a beam trawler cpue from a more or less directed fishery on sole, corrected for fishing speed and fishing power. The United Kingdom cpue series are derived from a by-catch fishery in statistical rectangles in which soles were caught. Nevertheless, the patterns over a long series of years are in quite good agreement.

The cpue in both series in the years 1973-77 remained more or less constant, but increased in 1978 and again in 1979. This was caused by the good 1975 and 1976 year classes recruiting to the fisheries. In the first quarter of 1979 also the catchability of sole increased considerably; this was caused by the concentration of soles in deeper areas during the severe 1978-79 winter. The Belgian series is an uncorrected second quarter beam trawl cpue, which remained more or less constant during the whole period from 1971 until 1981. All cpue series do not show the consistently decreasing trend in the stock biomass.

2.4 Virtual Population Analysis

2.4.1 Exploitation pattern, terminal F and M

Separable VPAs were run on combined male plus female catch data and also on the separate sex data (years 1967-80, ages 2 to 14, age of unit selection 3). The combined data fit the separable model better than the separate sex data. The sums of squares and coefficients of variation are given below:

	SSQ	CV %
Combined	44.3	34.9
Female	182.7	70.9
Male	380.2	102.2

This, perhaps, suggests that the assessment should be carried out on the combined data, but for this important stock it was felt that this approach should be examined in detail before using it in the Working Group. Consequently, the assessment was carried out with the separate sex data.

However, for simplicity, the combined data were used to investigate the effect of various assumptions of F and S. Separate VPAs were run using a range of terminal F at 0.3, 0.6 and 0.9, and a range of terminal S of 0.2, 0.5 and 0.8. The results show that the exploitation patterns are relatively uninfluenced by the choice

of terminal Fs (Figure 2.1). A consistent peak in S is obtained on age group 3, followed by a decline to about 50% of the peak at age 7. Thereafter, the exploitation patterns diverge. An S greater than 0.5 seems unlikely because this produces an upward trend in the older age groups. The selection pattern obtained with a terminal S of 0.5 was thought to be the most likely, since this generates an exploitation pattern which is relatively constant on the older ages.

Separable VPAs were run for males and females separately using terminal F and S values of 0.5. The exploitation patterns obtained in this way (Figure 2.2) were smoothed and used in all subsequent traditional VPA runs.

The present level of F was derived from regressions between indices of total international effort from the Dutch cpue and terminal F values in trial traditional VPAs. In these trial VPAs the level of the unweighted mean F on age groups 2-8 was kept on the .5, 1.0 and 1.5 times the level of last year's terminal F. The correlations (for 1962 to 1977, excluding 1968) are shown below.

$\bar{F}$ unweighted, ages 2-8, 1980	Correlation coefficient	$\bar{F}$ 1980 from regression and international effort data from Dutch cpue
Males		
Opt. 1 ($.5\ F_{79}$)	.66	.4542
Opt. 2 (F_{79})	.79	.4814
Opt. 3 ($1.5\ F_{79}$)	.80	.5092
Females		
Opt. 1	.83	.4228
Opt. 2	.89	.4543
Opt. 3	.90	.4815

It appears that the choice of terminal F hardly affects the estimate of the level of input F for 1980 and Option 2 was chosen for the final VPA (Figures 2.3 and 2.4). In the final exploitation patterns, Fs on age group 1 were adapted to produce a 1979 stock in the VPA in accordance with the "Tridens" estimate of that year class from the 1980 autumn survey and the regression with VPA given by Van Beek and Van Leeuwen (1980).

Natural mortality was assumed to be 0.10, with the exception of 1963 when, owing to the effects of the severe winter, additional mortality occurred. A value of 0.9 for M was taken for 1963 (see doc. C.M.1979/G:10, Flatfish WG report).

2.4.2 Results of the VPA

Tables 2.6, 2.7, 2.8 and 2.11, 2.12, 2.13 give the catch input data, the F values and stocks numbers per sex for ages 1-15+. Spawning stock biomasses are given in Table 2.15 and Figure 2.5.

The spawning stock decreased continuously since 1966 from 104 000 tonnes to 35 600 tonnes in 1977. This decrease was caused by fishing out the extremely strong 1963 year class (6 x average) and by a considerable increase in effort in that period. Thereafter, the spawning stock increased in 1978 and 1979 to 40 100 tonnes and 45 000 tonnes, respectively, due to the 1975 and 1976 year classes which recruited to the spawning stock and both year classes were above average strength. In 1980 the spawning stock decreased again considerably to a level of 34 000 tonnes due to the poor recruitment of the 1977 year class and the increased catchability of the mature fish in the first quarter of 1979. When fishing mortality is at the presently assumed level, the stock is further decreased to 23 000 tonnes in 1981, the lowest level ever recorded in the spawning stock. The main reasons for this decrease are the 1978 year class, which was recorded as a good one in the 0-group recruitment surveys but was reduced considerably in the severe 1978/79 winter and now seems to be the lowest ever recorded, and a continuously too high level of fishing mortality.

2.5 Catch Predictions

2.5.1 Recruitment

Figure 2.6 shows a plot of 1 year old recruits against spawning stock biomass. The picture shows no indication of any relation between stock and recruitment at biomass levels observed in the past. Therefore, a mean recruitment was assumed in 1981 for all catch predictions, i.e., 46 709 x 10^3 for males and 54 675 x 10^3 for females. These averages are geometric means for the years 1957-77.

However, it is likely that if the spawning stock continues to decrease, the recruitment will fall. Since there is no evidence of at what stock level this would occur, the Working Group did not take this into account in catch predictions and yields.

The 1979 year class is assumed to be above average. The recruitment value for the 1979 year class was taken from the 1 group autumn "Tridens" VPA regression. Runs were also made with the upper and lower limits of the estimate of this year class to show the effect of this year class on the expected catch and stock biomass.

2.5.2 Prognosis

The input data for the prognosis are given in Table 2.16. Figure 2.7 shows the expected 1982 catch and 1983 spawning stock for different values of fishing mortality, with the 1982 exploitation pattern, expressed as multiples of the 1980 level. Table 2.17 summarizes the results of the prognosis.

Taking into account the upper and lower limits of the estimate for the 1979 year class from the "Tridens" survey, the catch in 1981 will lie between 13 000 tonnes and 15 000 tonnes, assuming that $F_{82} = F_{81} = F_{80}$. The catch in 1982 will then lie between 18 000 tonnes and 23 000 tonnes. The spawning stock in 1982 will then lie between 30 000 tonnes and 38 000 tonnes and will lie between 33 000 tonnes and 39 000 tonnes in 1983.

2.6 Equilibrium Yield and Spawning Biomass

Equilibrium total yield curves were calculated in several different ways (stochastic model, Nielsen, 1980; deterministic model with density-dependent growth, Houghton and Bannister,1979; deterministic model with constant growth using both arithmetic and geometric areas recruitments). The differences in levels between the obtained results

could not be resolved; but each method indicated a maximum in yield in the range from 0.62 to 0.75 of the F in 1980.

The results for the traditional deterministic model are shown in Figure 2.8, using the same inputs as for the catch forecast (Table 2.16). These are plotted as yield and spawning biomass per recruit.

The stochastic model showed that there was a 50% probability of obtaining yields 25% greater or 30% less than the equilibrium yield at the present F. There was a 50% probability of obtaining spawning stock biomasses 30% greater or less than the equilibrium level at the present F.

This model allows for the range of variation in year class strength to be expected and shows that, compared with the increment in yield per recruit expected from a return to F_{max}, there is a good chance of obtaining the same increased yield at the present level of F. However, for the spawning stock, the increment in spawning biomass per recruit from a return to F_{max} is about 85% and, therefore, this would be the main benefit from reducing F to the F_{max} level.

2.7 Management Options

In the period 1973-80 the stock has varied between 35 000 tonnes and 50 000 tonnes. In that situation catches and spawning stock depended greatly on the level of recruitment of the most recent incoming year classes.

In this stock, recruitment fluctuates considerably. When recruitment fails for two successive years, as happened in 1978 and 1979, this will be immediately reflected in the catches and bring the stock to an even more dangerous level. This means that recruitment may fall.

In 1980 the spawning stock decreased from 35 000 tonnes to 23 000 tonnes in 1981, i.e., the lowest level ever recorded.

Under the assumptions that the present F will be maintained in 1981 and 1982, the spawning stock will increase in 1982 to 34 000 tonnes due to the effect of one good incoming year class (1979) only, and will increase again in 1983, provided that recruitment from the 1980 year class will not fail.

The consistent trend of declining biomass indicates that fishing mortality on this stock is too high. Also, the yield models indicate that the present F is beyond the point of optimal exploitation.

According to the yield models the F should be reduced to 60% of the present level. This would lead to a TAC in 1982 between 12 000 and 15 500 tonnes, depending on the size of the 1979 year class. However, in the short term the spawning stock biomass would still be at a dangerous level between 39 000 tonnes and 46 500 tonnes.

At previous Working Group meetings a spawning stock of 50 000 tonnes was assumed to be a safe level at which mean recruitment will not fall. The recent period showed that spawning stocks below 50 000 tonnes can also produce good year classes. However, also from a management point of view, a spawning stock lower than 50 000 tonnes would not be preferable, because situations as we are in now would be regularly repeated, which would mean that the TACs will fluctuate considerably, and this is not desirable for good management.

When a spawning stock biomass of 50 000 tonnes is a target in the short term, this could be achieved by a TAC for 1982 between 0 and 11 000 tonnes, provided that the 1979 year class is of the presently presumed strength. It is obvious that this year class is of crucial importance to the fishery and to the stock in the near future.

3. NORTH SEA PLAICE

3.1 Landings

The 1979 data on landings were amended where necessary, and provisional 1980 data were assembled (Table 3.1). Data were based on "Bulletin Statistique" and on figures estimated by national experts. In 1980, landings by most countries were similar to those in 1979, but a decline of 30% in the catch of the United Kingdom (England and Wales) led to a slight decrease in the estimated total landing. Unreported landings were estimated at 38 023 tonnes.

3.2 Catch at Age

The 1977 and 1979 catch at age distributions were amended, the former arising from a change in the English catch at age data, and the latter from changes in the landings and catch at age data for several countries. The new 1980 data are based on age data for five countries representing 96% of the total landings. The total catch at age distribution tables have been updated (Tables 3.2 and 3.5). It has not been possible to make any corrections for discarding. A feature of the last two years is a very large increase in the catch of 3 year old plaice by the Netherlands, when compared to earlier years.

3.3 Weight at Age

Weight at age data have been assembled as in previous years, using a mean of various national data, weighted by their catch at age numbers. Catch weight represents the mean of four quarters and stock weight the first quarter data. Data were converted to whole weight first, so that individual national factors could be accommodated. For 1979, the data were reworked to take account of the new numbers. The final sets are in Table 3.8. Sums of products checks (Table 3.9) were good (2-3% too low).

For the prognosis, the catch and stock weights were smoothed averages of the 1979 and 1980 data for stock (Figure 3.8) and straightforward average of the 1979 and 1980 data for catch weight.

3.4 Catch per Effort and Effort

The index of effort adopted last year was derived from English motor trawl catch per unit effort. Data were averaged over 12 months for statistical rectangles where plaice were caught, corrected for fishing power changes, using the annual mean BHP of Lowestoft otter trawlers, and divided into international catch. Seasonally, the primary data show a regular pattern in which a first quarter peak predominates throughout the period 1960-80, with an additional late summer peak arising in the last three or four years, suggesting a slight change in the distribution of the fishery. The winter peak corresponds to the

spawning fishery, which is relatively constant, and this year the mean January-March catch per 100 hours x BHP (hereafter called cpue Index 1)has been adopted as an index of stock corrected for fishing power and independent of distributional or directivity changes. The mean of August to November data has also been extracted as a second index (cpue Index 2) for comparative purposes. The temporal trend in these indices is shown in Figure 3.2 and in Table 3.10, which also shows international catch and the corresponding estimate of total estimated effort. These are the data used later for comparison with fishing mortality coefficients. The trends in estimated total effort are shown in Figure 3.2.

Other indices of catch per unit effort were also examined with a view to determining the broad trend in stock (Table 3.11 and Figure 3.3). These were:

1. English motor trawl cpue, 1st quarter, different spawning grounds.
2. Belgian beam trawl cpue (from 1971 only).
3. Netherlands total catch divided by corrected beam trawl hours (from 1970).

All were fishing power corrected, using mean annual horse power or an equivalent index. Except for Flamborough and Southern Bight data, the broad trend is a high stock in the period 1966-73, a decline in 1974 and 1975, and an increase in 1978-80. Unfortunately, Netherlands data cannot be used to provide a total effort index, since in the years before 1970 the available data need to be corrected for the declining otter trawl component, whilst in recent years Dutch fishermen are reported to have switched from sole to plaice, which probably distorts the index. There is also an indication that the power correction for sole is too strong for plaice.

3.5 Terminal F

The international effort estimate suggests that fishing mortality has been increasing in recent years. The separable VPA was, therefore, used as a tool to determine what combinations of exploitation patterns and maximal fishing mortality might be appropriate to this trend.

The three factors, which can be varied in this analysis, are the age of unit selection (A), the terminal selection (S) and the maximal fishing mortality (F). Values for A which reproduced the exploitation pattern observed previously were A = 5 for males, and A = 4 for females, although trials showed that output was relatively independent of this parameter in this case only. Tables 3.12 and 3.13 and Figures 3.4 and 3.5 show the results of output for different combinations of F and S. This output is the combination of parameters which satisfy the given catch at age matrix, with the tabulated residual sum of squares. These residuals are very low for North Sea plaice, and the log catch ratio residuals are evenly distributed, indicating that North Sea plaice catch at age variation can be explained by the model. In all cases is the trend in annual F (mean of ages 2-10) independent of the choice of S, and the exploitation pattern relatively independent of changes in F.

For males, the exploitation pattern was essentially parabolic in the age range 1-11, for both S =0.5 and S = 1.0, and it seems reasonable to propose that for fish of age 11 and older, fishing mortality is unlikely to depart from this configuation. A value of S = 0.5 for males was, therefore, selected to determine the exploitation pattern.

For females, the exploitation pattern shows a slow decline in mortality at age after age 5 for S = 0.5. For S = 1.0, mortality at age declines then increases on older fish. There is at present no biological or fishery reason to suspect an increase in mortality on older plaice, and a value of S = 0.8, producing an intermediate exploitation pattern, was adopted.

For terminal F itself, Figures 3.4 and 3.5 show, on the basis of the separable analysis, that for S = 0.5 (males) and S = 0.8 (females), the mean fishing mortality (ages 2-10) in the period 1970-75 was at least 0.5 - 0.6 for males, and 0.4 - 0.5 for females, independently of terminal F, and that maximal F values of 0.7 (males) and 0.5 (females) would produce an increase in F in recent years. A trial VPA was carried out with these values, and compared with the results using a low F and a high F run. (Table 3.14 shows the input data.). These outputs have been evaluated by testing the correlation between mean fishing mortality and total effort. (Figures 3.6 and 3.7, Tables 3.15 and 3.16.)

It is important to be clear about the nature of these results. The trials are based on the separable VPA exploitation pattern for S = 0.5 (males) and S = 0.8 (females), and the given maximal F values, which generate the terminal F at age arrays as shown in Table 3.14. The corresponding outputs in Table 3.15 are mean values of F, averaged for the age range 2-10, which is unaffected by the choice of S.

It is these mean values which have been used in the effort correlations, which cover the years 1970-76 and are, therefore, independent of terminal F. This is shown by the fact that the prediction for the 1980 F_{2-10} for the estimated 1980 effort of 31.8 units is more or less independent of the trial input F at age, being 0.4 for females and 0.55 for males (Table 3.16).

The VPA is, therefore, based on the chosen exploitation pattern and a value of maximal F which achieves mean values of F for 1980 of 0.4 (females) and 0.55 (males). To achieve this, maximal F values of F = 0.5 (females) and F = 0.7 (males) are required. As last year, the natural mortality used is 0.1 for both sexes.

3.6 Pre-Recruit Surveys' Data

Autumn I-group and spring II-group estimates of year class strength from the Netherlands "Tridens" surveys are shown in Table 3.18 and compared with the combined male and female stock number of 1 year olds from the basic VPA. For year classes 1968-76, unaffected by the terminal F input, the data are significantly correlated at the 1% level. The correlation is not significant when the 1977 point is included. The 1968-76 regression has been used to predict the strengths of the 1977, 1978, 1979 and 1980 year classes from the more recent "Tridens" estimates, as shown in Table 3.18. Prediction is by G.M. regression for sexes combined. The proportions of the two sexes in the VPA in the 1968-76 year classes are 0.518 males and 0.482 females, and these have been used to partition the recruitment predictions.

3.7 VPA

The results of the chosen VPA are given in Tables 3.3, 3.4, 3.6 and 3.7, and the biomass and recruitment data are summarized in Table 3.17, where the sum of products corrections, shown in Table 3.9, have been applied. The correlation between the spawning

stock biomass and English cpue (Index 1) for 1960-80 is 0.8, which is significant.

Inspection of these results might suggest a problem with the choice of exploitation pattern.

Although representing the best average for the years 1971-80, and although justified on the basis of the mean F effort correlation for 1960-76, it creates a very large 1977 year class (half the size of the 1963 year class) when applied to the very high catch of 3 year olds in 1980. Such a year class is not expected on the basis of the "Tridens" I- and II-group survey data (Table 3.18).

One view is that the 3 year old catch in 1978-80 could result from a change in directivity by the Dutch fleet, which is switching away from sole. An alternative approach to the data would be to predict the 1977-79 year classes from the "Tridens" surveys and adjust the 1980 F values accordingly. However, two items of evidence suggest that the VPA output is valid. The first is an increase in catch per unit effort by the Belgian beam trawl fleet for the 1977 year class, which in 1980 and 1981 was 1.18 and 1.47 times the 1976 year class. English catch at age data suggest the same. Table 3.19 shows the cpue on age group 3 from Lowestoft motor trawl data for 1970-80, and the VPA estimates of age group 1. The cpue is adjusted for changes in fishing power. These data are correlated and the cpue index suggests that the 1977 year class is of the same order as the 1972 year class. The evidence suggests that the VPA results can be accepted.

3.8 Catch Predictions

Catch forecasts were made, using the input data presented in Table 3.20. Recruitment of the 1980 and 1981 year classes was taken as the geometric mean of 1 year olds of the 1959 to 1975 year classes, which gave an equal sex ratio for the first time. Weights at age data were derived as described in Section 3.3. The results are shown in Figure 3.9. The effect of the good year class is that for $F_{81} = F_{80}$ the catch in 1981 is now expected to be 148 000 tonnes and the 1982 catch 145 000 tonnes. Because of the difference in the age of maturity, the male spawning stock will be lower in 1983 while the female spawning stock will increase slightly.

3.9 Stock and Recruitment

Figure 3.10 and Table 3.17 show combined male and female age 1 recruits and spawning stock from 1960 to the period corresponding to the effort-fishing mortality, and the cpue stock biomass correlations.

Figure 3.11 shows the corresponding plot for total recruits against female spawning stock. Neither plot shows an indication of a decline in recruitment in recent years, the overall plot confirming previous conclusions that recruitment has until now been independent of spawning stock.

3.10 Yield per Recruit

Long-term yield and biomass per recruit were calculated from the input data used in the short-term forecast for both terminal F options (Table 3.21 and Figure 3.12). The yield per recruit curve shows that, as last year, the plaice fishery is close at F_{max} on the curve for males, but well beyond F_{max} for females.

3.11 Management Options

Fishing mortality on plaice has increased of late, and the general trend in stock has been downwards since the peak level of 1970. At the moment the stock is increasing because of the effect of the 1972 year class (now declining), and the 1979 and possibly also now the 1977 and 1978 year classes which are larger than previously anticipated. The stock and recruitment diagram does not suggest that an immediate stock biomass problem will occur. However, the diagnosis of the equilibrium yield per recruit curve is that the fishery is well beyond F_{max} for the current exploitation pattern. One should not, therefore, be too complacent about the state of the plaice stock in the North Sea. The worry is that the plaice fishery appears to be responding to changes in the sole fishery, which may further increase fishing mortality on plaice.

4. SOLE IN DIVISION VIId

4.1 Landings and Effort

In the Flatfish Working Group report of 1980 it was suggested that significant under-reporting takes place for this stock. For the United Kingdom, the principal cause of this was thought to be landings by part-time fishermen. A field and questionnaire survey in 1980 showed that, despite the large number of small vessels on the United Kingdom coast (2 000 in Sussex, for example) only about 200 part-time fishermen were fishing regularly. These vessels are all less than 10 m in length, and the majority is less than 5 m. The survey results indicate that they were responsible for a total landing of approximately 10 tonnes in 1980.

Inspection of the data record for the United Kingdom landings from Division VIId showed that full time fishermen's landings were probably fully recorded in the period 1971-79. In 1980, however, due to staffing problems, the landings at three ports were not recorded for most of the year. Comparison with previous years and adjacent ports indicated that approximately 110 tonnes were missed in this way. The official United Kingdom figure in 1980 of 158 tonnes was amended by adding to it the total under-reported landings (110 plus 10).

The provisional French landing figures of 880 tonnes in 1980, which excluded several months' data, was amended to 970 tonnes.

The series of landings data up to 1980 has, therefore, been corrected for under-reporting, and it is thought that these figures are an accurate reflection of the total landings (Table 4.1). Landings reached a peak of 1 842 tonnes in 1979; in 1980 the landings decreased to 1 553 tonnes (Figure 4.6). These can be compared with TACs of 1 840 tonnes in 1979 and 1 380 tonnes in 1980 (the latter was based on the average catch).

Table 4.2 shows the catch per effort data from Belgian and United Kingdom vessels. The Belgian catch per effort peaked in 1979 and declined in 1980. The United Kingdom data show a decrease in catch per effort in 1980 and approximately confirm the trend shown by the Belgian data. Total international effort (total landings/ Belgian cpue) appears to have increased by about 40% since 1973. The United Kingdom cpue data were used only for general confirmation of the trend in cpue, because the fishery is limited to the United Kingdom inshore area.

4.2 The Data Base

The age composition data for 1971-79 were fully checked and amended, as necessary. The 1971-74 data are based on Belgian samples, 1975-77 on Belgian and United Kingdom samples, and 1978-79 on Belgian, United Kingdom and French samples.

Belgian and United Kingdom age compositions were available for 1980, and a French length composition was also available; this was converted to an age composition using the United Kingdom age/length key. Thus, in 1980, 38% 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. No consistent trend was detectable, and unweighted averages were calculated for the period 1971-80 for the separate sexes. 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 from 1971-80). (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 sums of products discrepancies for the combined data are shown in Table 4.5.

4.3 Sexes Combined or Separate?

Separable VPAs were calculated for males and females separately and on the combined data. Figure 4.1 compares the exploitation patterns and F levels obtained. The sums of squares and coefficients of variation (ages 2 to 14, years 1973-80) are shown below:

	SSQ	CV%
Combined sexes	36.7	38.5
Females	171.7	90.9
Males	201.4	98.4

These results indicate that the separate sex data are extremely variable. The variation and deviations from the separable model are reduced markedly when the separate sex data are combined, and it was decided that the assessment should be based on the combined data (as for Division VIIe sole, see Section 5 for further discussion).

4.4 Exploitation Pattern and Terminal F

Separable VPAs were calculated for a range of assumptions of terminal S and F for age range 2 to 14 and years 1971-80.

Figure 4.2 shows the result for the exploitation pattern; the lower figure demonstrates that the terminal F has little influence on the 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. The pattern generated by an S of 1.0 seems unlikely because of the double peaks; and the patterns for terminal S values of 0.5 and 0.1 probably encompass the feasible range of patterns for this stock. There is no properly objective way to choose between these,

but, as there is some argument for choosing a value of 0.4 for Division VIIe sole, a value of S of 0.3 was selected for Division VIId sole which is intermediate in the likely range.

Figure 4.3 shows the effect of the two levels of S, which describe the range and terminal F values of 0.2 and 0.5 on the trend in fishing mortality and exploited biomass. The S of 0.1 has a marked effect on both trends, and it is thus particularly important to find an objective way of establishing the correct value. The rather erratic behaviour of F and exploited biomass in 1972 is due to the sparse sampling in that year.

Figure 4.4 compares the trend in F for an S of 0.3 with the total international effort trend obtained from Belgian cpue series. This increased by 40% between 1973 and 1980 (from the fitted straight line). A terminal F of 0.4 generates a similar, proportional increase in fishing mortality.

Figure 4.5 compares the trend in exploited biomass with the Belgian cpue. A terminal F of 0.4 again produces a proportional change in exploited biomass.

4.5 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 1977-80. The results are shown in Table 4.6. The abundance indices obtained for the 1979 year class indicate that this is extremely numerous (10 times the 1978 year class and 20 times the 1977 year class). The 0- and 1-group estimates agree as to the relative strengths of these three year classes. (It is not surprising that the 2-group index does not agree, since the survey takes place in inshore areas and the 2 year olds are distributed further offshore.)

The series is too short to allow for an accurate prediction of the strength of the 1979 year class, which is not so numerous on the United Kingdom coast (the United Kingdom tagging programme in 1981 did not succeed in catching many 2 year olds).

Thus, as a conservative approach, the abundance of this year class was set at a level 25% higher than the good 1976 year class to be roughly in agreement with the estimates from the North Sea.

4.6 Traditional VPA

The exploitation pattern and level of F on age 4 from the separable VPA (F = 0.4, S = 0.3, unit selection age 4, years 1971-80) were used to obtain terminal F inputs for the traditional VPA. The exploitation pattern was smoothed to produce a steady outline in F from age 4 onwards. The F on age 2 in 1980 was increased to reduce the 1978 year class to the level indicated by the French surveys (approximately twice the 1977 year class strength). The F on age 1 was adjusted to give a 1979 year class strength of roughly 20 million fish, which is 25% higher than the VPA estimate for the 1976 year class.

The results of the VPA are shown in Tables 4.7 and 4.8, and the biomass and recruitment trends have been plotted in Figure 4.6. The total biomass has been relatively stable since 1971, and the spawning stock biomass has declined from 7 800 tonnes in 1971 to 6 027 tonnes in 1980.

4.7 Equilibrium Yield and Spawning Stock Biomass

The input data are shown in Table 4.9, and the results in Figure 4.7.a. The fishery appears to be close to F_{max} at the

present level and pattern of fishing mortality (F on age 4 = 0.4). However, on the basis of average recruitment (6.8 million, 1971 to 1979 including the strong 1975 and 1976 year classes), a decline in the total spawning stock biomass is to be expected at the present level of fishing mortality (equilibrium spawning stock biomass = 4 900 tonnes, compared with the 1980 level of 6 027 tonnes). The equilibrium yield will also be less than the recent yields (1 312 compared with yields in excess of 1 500 tonnes).

4.8 Catch Predictions

The input data are shown in Table 4.9. Average recruitment was assumed for the 1980 and 1981 year classes (4.8 million at age 1; the mean of the 1970 to 1978 year classes excluding the strong 1975 and 1976 year classes). The results are given in Table 4.10 and are graphically shown in Figure 4.7.b.

The TAC in 1981 is 1 200 tonnes; this requires a reduction in F of 29% (0.71 of the F_{80}). This is unlikely to be achieved, and so the forecast was prepared keeping $F_{81} = F_{80}$. At the present level of F, the catch in 1982 is predicted to be 2 092 tonnes, of which 1 033 tonnes are due to the 1979 year class (49%). The spawning stock biomass will be 7 039 tonnes in 1983 of which 2 235 tonnes are from the 1979 year class (32%). The value assumed for this year class was a conservative estimate according to the French pre-recruit survey.

According to this assessment a TAC of 2 100 tonnes for 1982 will stabilize the fishing mortality at the 1980 level which, according to equilibrium yield per recruit curve, was close to F_{max}.

5. SOLE IN DIVISION VIIe

5.1 Landings and Effort

Landings increased in 1980 to 1 305 tonnes compared with 1 181 tonnes in 1979 (Table 4.1). As far as is known, no under-reporting takes place for this stock. Since 1969 the landings have risen by a factor of 3.7, attributable mainly to the United Kingdom but also to landings in France.

Effort data were available for the United Kingdom otter and beam trawlers over 40 feet (Table 5.1). A remarkable increase in beam trawl fishing hours has occurred since 1977 and has been the principal cause of the higher United Kingdom landings.

Catch per effort indices were calculated by averaging over rectangles and months after correcting for fishing power changes due to tonnage, using the regression equation: FP = (.0072 x GRT) + 0.6017, obtained by Houghton (1976). Dividing these indices into the total landings provides an index of total international effort; this has increased by a factor of 3 from the 1972-77 mean to 1980 (Table 5.1).

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 entire data base was checked and recalculated using quarterly age compositions for United Kingdom landings (as opposed to the annual age compositions which were used formerly), and the provisional 1979 data were amended. Male and female data were added to provide the sex combined data base (Table 5.2), as explained in Section 5.3.

Equivalent weights at age data were calculated for each year (weighted mean of quarterly values; also weighted by catch numbers between nations in 1980). No trend in the catch weights was observed in the period 1969-80, and so simple averages were calculated to represent the catch weights for the period 1969-80. These were smoothed by eye and stock weights interpolated for 1 January to apply to each sex.

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 at a later stage and interpolated to provide catch and stock weights.

Sums of products discrepancies for the separate sex and combined sex data are shown in Table 5.4. The discrepancy increases from 1969-80, indicating, perhaps, that the growth rate increased in this period. Sums of products corrections were not applied to this stock because of doubts about their true explanation.

5.3 Sexes Separate or Combined?

Separable VPAs were run on the separate and combined sex data for a range of values of terminal F and S. Natural mortality was assumed to be 0.1. Deviations from the separable model were considerably greater for the separate sex data than for the combined data, and there was no systematic pattern in the deviations. This indicates that the data are consistent with a single exploitation pattern, and that compensating errors occur between males and females probably as a result of sparse sampling (the sexes split using the length stratified sample taken for age determination). The deviations are given below:

	Ages	SSQs	CV (%)
Combined data	2-14	37.3	34.6
Females	2-14	64.4	45.4
Males	2-14	640.8	143.3
Males	2-13	522.1	134.6

The exploitation patterns and F levels obtained for separate and combined data are compared in Figure 5.1. The patterns and trends are more erratic in the case of separate sex data (particularly the males) than would be expected if the deviations were due to sparse sampling.

These results suggest that the assessment should be conducted on the combined male plus female data, and that this would improve the chances of estimating the most recent level and pattern of fishing mortality using effort data. There is little to suggest from the earlier VPAs that the males and females experience different fishing mortalities or that they have different exploitation patterns, which is the further support for combining the data.

Male and female growth rates are, of course, different, and this creates a problem in combining them. The effect of this is tested in the assessment by comparing the combined and separate estimates of biomass in the past (see Section 5.6).

5.4 Exploitation Pattern

Exploitation patterns obtained from combined data using different assumptions of terminal F and S are shown in Figure 5.2. The lower

Figure demonstrates that S is fairly insensitive to the input F in 1980. The upper Figure shows the equally good fits to the model that are obtained for a wide range of terminal S values. The peak in S occurs consistently on age 3 or 4, and a rapid decline to about 50% of the highest level occurs up to age 7. The patterns diverge thereafter. An S of 1.0 seems unlikely, since this produces a double peak (ages 4 and 14). The likely range for terminal S is, therefore, 0.5 to 0.1; there appears to be no objective way of choosing between these values. However, as will be described later, an S of 0.1 produces a decline in stock biomass from the VPA over a range of terminal F values (0.2 to 0.8), and this is not reflected in the catch per effort data which have fluctuated with a steady trend since 1972.

On this basis it was decided that the exploitation pattern was more likely to be one in which the terminal S was about 0.4, which produces a relatively constant S from age 8 to 14.

5.5 Terminal F Estimation

Figure 5.3 shows the level of F on age group 4, which was obtained by separable VPA for terminal F values of 0.2 and 0.5 and S values of 0.4 and 0.1. The lower part of the Figure shows the equivalent estimates of exploited biomass. The F and biomass values in the early part of the period are sensitive to the input S (particularly low values, 0.1). However, it was suggested that low S values could be rejected because the biomass trend obtained was not in agreement with the catch per effort data.

The trends in F obtained (with an S of 0.4) are shown in Figure 5.4 and may be compared with the total international effective effort indices (Table 5.1). Fishing mortality and effort were plotted against each other for different terminal F assumptions but each plot gave a line through the origin with a similar value of the correlation coefficient. Only the 1978 to 1980 points influence the location of the line and, therefore, this technique cannot be used to estimate the terminal F. An alternative approach was adopted - by comparing the ratios of the 1972-77 means with the 1980 value for F and effort. The mean ratio for effort (beam and otter) was 2.95, and this ratio is obtained with a terminal F of about 0.55.

Figure 5.5 shows the exploited biomasses calculated for a range of terminal F values which can be compared with the United Kingdom cpue indices below (again $S_{14} = 0.4$). The peaks and troughs in the exploited biomass trend coincide with those in the beam trawl cpue. By eye, the best agreement with the beam trawl data would be obtained with a terminal F in the range 0.4 to 0.5, probably at about 0.45. The trend is similar to the otter trawl catch per effort.

Both methods agree in indicating a terminal F on age 4 in 1980 of about 0.5 (the mean 0.45 and 0.55). This value was, therefore, chosen for terminal F estimations with an exploitation pattern defined by an S of 0.4 obtained from the separable VPA.

5.6 Final VPA

Natural mortality was assumed to be 0.1.

Terminal F values were calculated from the levels of F on age 4 and the exploitation pattern obtained from a separable VPA using $_{80}F_4 = 0.5$ and $S_{14} = 0.4$. The results are shown in Tables 5.5 and 5.6 and are based on the combined sex data. Total biomass and spawning stock biomass are plotted in Figure 5.6 along with the landings and the estimated recruitment at age 1.

Traditional VPAs were carried out on males and females separately, using the same terminal F values as those used for the combined data. The biomass, obtained by summation of the separate sex data, are also plotted in Figure 5.6. This demonstrates that the mean weights at age for the combined VPA did not introduce any major problems. The recruitment estimates from the separate VPAs are, of course, the same as from the combined VPA.

5.7 Recruitment

The trend is shown in Figure 5.6. The 1969-78 average number of 1 year olds was 3 294 million fish, with good year classes in 1969 and 1975.

The 1979 year class is above average in most areas (North Sea, Eastern Channel and the Irish Sea). No indpendent pre-recruit data exist for Division VIIe sole and so a recruitment of 1.5 times average was assumed for the 1979 year class (4.9 million fish at age 1). No information exists as to the strength of the 1980 or 1981 year classes, and these have been assumed to be of average strength, and the range of error was estimated in the forecast by using the observed range (1 800 to 5 700 tonnes).

5.8 Equilibrium Yield and Biomasses per Recruit

The input data are shown in Table 5.7 and the results in Figure 5.7. It appears that the recent increase in fishing mortality has brought this stock to F_{max}. For an average recruitment of 3.3 million fish this indicates that the spawning stock will equilibrate at about 2 000 tonnes, giving a long-term yield of 660 tonnes at the 1980 level of F.

5.9 Catch Predictions

The United Kingdom landings for January to April 1981 were 172.4 tonnes. Landings in this period have averaged 29% of the annual total. These figures suggest that the 1981 total international landings will be 1 100 tonnes compared with the TAC of 1 000 tonnes. The forecast was calculated with a yield constraint of 1 100 tonnes ($F_{81} = 1.18\ F_{80}$). The input data are shown in Table 5.7 and the results in Table 5.8 and Figure 5.8.

The 1980 and 1981 year classes do not affect the predicted yield in 1982; the results are shown for a range of 1980 and 1981 year classes (1.8, 3.3 and 5.7 million at age 1, representing the estimated range observed and the mean for the years 1969-78). Taking the 1979 year class at 1.5 times average indicates a yield of 900 tonnes in 1982. This would stabilise F at F_{80} at F_{max}. However, the 1979 year class contributes one quarter of this yield. Also shown in Figure 5.8 are the forecast results for an average 1979 year class; in this case the TAC to stabilize F should be 800 tonnes.

5.10 Management Options

The stock has experienced a dramatic increase in fishing mortality since 1977 and appeared to be fully exploited (in relation to F_{max}) in 1980. It is likely that the F will continue to increase in 1981, and it may be that F is already too high. It is necessary to stabilise the fishing mortality at the 1980 level. The TAC to achieve this should be 900 tonnes, or less if the 1979 year class is only of average strength.

6. ENGLISH CHANNEL PLAICE (Divisions VIId and VIIe)

6.1 Landings (Table 6.1)

Updated 1979 and provisional 1980 landings were added to Table 6.1. For 1980 the English landings were raised by 1.7 to allow for under-reporting of landings for Divisions VIId and VIIe combined.

6.2 Age Composition

The 1979 age composition for Divisions VIId and VIIe combined was amended and a new age composition calculated for 1980. In both years this was based on the English and Belgian age compositions, but since French length compositions were available, these were just split into males and females on the basis of the English sex ratio according to the English age/length key. Since the French landings are such a large proportion of the total, this procedure had a major influence on the age compositions. In previous years, the French landings were accounted for by raising the English age data directly. The outcome (Tables 6.2 and 6.3) is a very large number of 2 and 3 year old fish in 1980.

6.3 Weight at Age (Table 6.4)

Up to 1979 weight at age data used were the constant set derived at the 1979 meeting of the Working Group. For 1980 a new catch weight at age set was derived. English weights at age were used together with a set based on a French mean length at age obtained via the English age/length keys, and a mean condition factor calculated from the French length composition. The sum of products check was almost exact. Stock weight at age data for 1980 were obtained by interpolation.

6.4 Terminal F and Exploitation Pattern

In the past it has been felt that the English Channel plaice data were poor because only part of the landings were sampled for age. Despite the inclusion of a French length distribution, the situation has not effectively changed. Various trials were undertaken with the age composition series using the separable VPA. Rather high residual sums of squares were obtained, and although it was possible to make tentative conclusions about the exploitation pattern, which is probably best fitted in both sexes by a terminal S of 0.1-0.2, it was not considered advisable to proceed further with this assessment until the data base had been re-examined, and the problem of determining terminal S and F had been given further consideration.

6.5 Catch Predictions

For the above reasons, no catch predictions were carried out for the stock. There would be no gain at present from including the English Channel data with the North Sea age compositions, because of the very small numbers involved relative to those in the North Sea. A mixed model, involving local stocks and migrating components, was considered, but no data were available to input to it.

6.6 Recruitment

The conclusion for the North Sea plaice is that the 1977 and 1978 year classes are large. A short series of French 0-group survey data off the French coast indicates that for the English Channel

this may also be true for the 1977 year class, but not necessarily so for the 1978 year class. The 1980 Belgian beam trawl catch per unit of effort was substantially higher than in 1979 (13.5 kg/hour fishing against 9.1 kg/hour fishing), and 3 year olds featured very highly in the catch at age data.

6.7 Management Objectives

Because of the difficulties with the data, the current decision has been to recommend a TAC based on the average catch, with the object to prevent a major expansion of effort on the Channel stocks by diversion from elsewhere. On the basis of the relatively high F values suggested by previous assessments, it still seems worthwhile to maintain effort at the present level, although an average catch recommendation may not be very practical in the light of the recruiting large year classes.

7. MESH SELECTION EXPERIMENTS IN THE SOLE FISHERY AND MESH ASSESSMENT

7.1 Introduction

Since the last mesh assessment made by the Flatfish Working Group in 1974, drastic changes have taken place in the structure of fleets fishing for sole, particularly in the Dutch fleet. It was suggested that the increasing ship size and the corresponding increase in HP and weight of the gear might lead to a different selectivity rate for sole on all fishing grounds.

For these reasons, and in the light of the consequences of the proposed increase of a minimum mesh size to 90 mm in the North Sea in 1982, it seemed necessary to repeat mesh selection experiments.

7.2 Selectivity Experiments

From October 1979 up to August 1981, more than 50 sole selectivity experiments have been carried out by Belgium, the Federal Republic of Germany, the Netherlands and the United Kingdom (latest United Kingdom data not published and not included) (Table 7.1). The range of mesh openings varied from 64.5 mm to 101.3 mm. In all countries the experiments were carried out aboard commercial beam trawlers of different HP in order to achieve a representative selectivity picture of the present beam trawl fleet. The HP of the chartered vessels ranged from 250-1700 BHP.

During the experiments two different methods with minor modifications were applied: the "parallel method", using two different mesh openings on each side of the vessel, and the "whole cover method", using whole cod end covers pulled over two cod ends of different mesh openings. In order to keep the cod end cover off the main cod end, in several experiments three rows of 3 floats (4 litres) were fixed to the topside of the cod end cover. The rigging of the gear with chains and the size of the beam were left unchanged from the commercial fishing conditions.

The Dutch and Belgian experiments indicate that selection factor and selection range are largely independent of riggings, HP, towing speed, towing duration, and on "clean" and "dirty" ground. The mean selection factor was 3.3 and mean selection range was 3.8 cm, which both are close to results of earlier experiments.

The latest United Kingdom data (unpubl.) seem to indicate that minor amendments to the net (stripping of blinders, changing from "topside cover" to "whole cover") lead to a higher selectivity rate.

The selection factor derived from the Federal Republic of Germany experiment, carried out in shallow water off the North Frisian coast with a 250 HP charter vessel, resulted in a mean selection factor of 3.0. Since the reasons for the lower values are difficult to explain at present, further experiments are planned to be carried out in 1982.

7.3 Mesh Assessment for Sole in Sub-area IV

Mesh assessments for North Sea sole have been carried out in 1968 and 1974 (Anon., 1969, 1974). More recent selection experiments do not indicate that the selectivity in the North Sea sole fisheries has changed significantly after 1974, and a new mesh assessment would, therefore, be expected to give results similar to those obtained from the 1974 mesh assessment. However, the minimum legal mesh size for trawls in the North Sea was increased to 80 mm from 1 December 1980 and will be further increased to 90 mm from 1 October 1982. The Working Group, therefore, decided to make a new mesh assessment to estimate the effects of these increases in mesh size.

The selection factor and selection range used in the mesh assessment were 3.3 and 3.8, respectively, which represent the averages from the recent Belgian and Dutch mesh selection experiments with beam trawls (Table 7.1). The selection factor is the same as used in 1968 and 1974, and the selection range is slightly lower than the value of 4.0 used in 1974. The range of 3.8 was applied only to 80 mm mesh and was assumed to be proportional to mesh size. The resulting selection curves for 75, 80 and 90 mm mesh sizes are shown in Figure 7.1.

The mesh assessment was made for the sexes separately and was based on the age compositions of the 1980 landings. Mean length at age in 1980 was available from the Netherlands. From Belgium and the Federal Republic of Germany, mean weight at age in 1980 was available and the mean length at age was estimated using the length/weight relationship given in Table 6 in the 1974 Working Group report. This procedure gives a slight overestimate (probably about 0.1 - 0.3 cm) of the mean length at age. For all three countries, the series of length at age were smoothed. The resulting lengths are given in Table 7.2 for the age groups that will be affected by the increase in mesh size. For France and the United Kingdom, it was assumed that length at age was the same as in the Belgian and Dutch fishery, respectively. The Danish fishery is presently only with gill nets.

The mean lengths and the selection curves were used to estimate the reduction of F resulting from an increase in the mesh size. If the percentage of fish retained for a given length is reduced from "a" to "b" by increasing the mesh size, F for the corresponding age group was assumed to be reduced by the factor $\frac{b}{a}$. This was worked out separately for each country after first having split the Fs in 1980 according to the catch at age ratios. The resultant Fs were finally added together to produce new exploitation patterns corresponding to 80 mm and 90 mm mesh size (Table 7.3). The present exploitation pattern was assumed to represent 75 mm mesh size.

The exploitation patterns were used to make three catch predictions which were run 20 years beyond 1983. The assumptions about mesh sizes were: 1) 75 mm from 1981 onwards, 2) 80 mm from 1981 onwards, 3) 80 mm in 1981 and 1982, and 90 mm from 1983 onwards. The latter

option will be the one corresponding most closely to the changes in legal minimum mesh size. The results of the predictions for 1983 should give an indication of the immediate losses resulting from the increase in mesh size and the predictions for the ultimate year should represent the long-term average yields at the present level of effort.

The results for the total fishery are summarized in Table 7.4 and Figure 7.2. The immediate loss by increasing the mesh from 80 mm to 90 mm in 1983 is about 27%, which is somewhat higher than the values of 15-20% indicated by Table 7 in the 1974 Working Group report. The long-term gain of a mesh increase from 80 mm to 90 mm is about 5%, compared to about 15% in the former assessment.

The discrepancies seem even larger when the change from 75 mm to 80 mm mesh is considered, although a direct comparison cannot be made because in the 1974 assessment, 73 mm mesh was used as a basis for the calculations. Compared with the 1968 assessment, the long-term gains from increasing the mesh from 80 mm to 90 mm are virtually identical. The immediate losses were on average somewhat higher than those of the present assessment. For the spawning stock biomass, increase in mesh from 80 mm to 90 mm will give an increase of about 40% in the long term.

One significant difference from the 1974 assessment is that discards were not included. Age compositions of discards were not available, but the present level of discarding appears to be low.

Immediate losses and long-term gains for the Federal Republic of Germany, Belgian and Dutch fisheries are given in Table 7.4. Immediate losses are highest for the Dutch fishery, nearly 30%, and the Belgian fishery will have losses of about 20%. Losses for the Federal Republic of Germany will be about 5%. The long-term gains for the Netherlands are very small. The table indicates considerable gains for the Belgian and the Federal Republic of Germany fisheries. If released fish are not fully distributed their national gains will be overestimates, and they should therefore be treated with caution.

The French fishery is likely to be affected in a similar way as the Belgian fishery, and the United Kingdom fishery may be but compared with the Dutch. The Danish gill net fishery is likely to get some benefit from an increased mesh size.

One major problem concerning the mesh assessment is the effective mesh size currently used. If this is significantly lower than the legal mesh size, the present assessment would be incorrect. Another problem is that an increase in mesh size will make the fleets move to other fishing grounds, and the resulting exploitation patterns may, therefore, be different from those estimated which may change both immediate losses and long-term gains.

8. BY-CATCH DATA IN THE FISHERIES FOR CRANGON

The Working Group took notice of the EEC request to ICES dated 10.10.1980. However, in the meantime a contract for scientific research on this topic was made between the Commission and a member country. This contract started on 1 April 1981 and is planned until the end of March 1982. It consists of the following research:

a) Regular sampling on board or in the ports of the composition of the total catch, including shrimps and length measurements of commercial by-catch species.

b) Calculation of the percentages of the by-catch per port and per month.

c) Calculation of the total weight of the by-catch species individually per month.

d) Evaluation through length and age samples of the numbers per age group of the by-catch species under quota regulation and comparison of this quantity with the respective numbers caught in the directed fishery over the same period.

e) The area involved is situated in the coastal area from the Baie de Somme (France) to Colijnsplaat (Netherlands).

It is envisaged that the final report on the first period of the contract will be available to the Commission at 1 December 1981. The preliminary results will be available at 1 October 1981 and could not, therefore, be discussed during the time of the Working Group meeting.

9. INTERNATIONAL TAGGING PROGRAMME ON JUVENILE SOLES

The Working Group decided to undertake a joint tagging programme on juvenile soles in 1981. Apart from the results of an international tagging programme on adult soles (Coop.Res.Rep., No.5), some individual and separate taggings were carried out in the past. In the light of research on the distribution of the nurseries and also the recruitment to the several sub-stocks, a coordinated tagging programme was set up between several members of the Working Group. Figure 9.1 shows the distribution of the release positions and the respective numbers tagged. It is the intention of the Working Group to hold a special meeting on the migration of juvenile soles when sufficient recaptures over a period of two years will be available.

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Table 2.1 Nominal catch (tonnes) of SOLE in Sub-area IV, 1969-80.
(Data for 1969-1979 by separate countries from Bulletin Statistique)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980*
Belgium	2 703	1 880	2 227	1 834	1 485	1 130	1 383	1 456	1 673	1 728	2 043	1 378
Denmark	842	525	1 149	671	957	705	682	574	348	465	279	754
France	364	265	403	206	250	195	297	598	308	346	309	232
Germany, Fed.Rep.	692	318	600	258	336	173	233	192	316	467	242	338
Netherlands	22 032	16 024	18 776	17 662	15 883	15 343	15 242	11 044	10 873	6 749	7 646	12 695
Poland	-	-	-	-	-	-	-	5	-	-	-	-
Sweden[a]	-	13	12	13	13	12	+	-	-	-	-	-
U.K. (Engl.+Wales)	927	660	485	449	387	340	426	455	492	626	600	430
U.K. (Scotland)	-	1	2	+	1	...	-	2	2	1	+	-
Total	27 560	19 686	23 654	21 093	19 312	17 898	18 263	14 326	14 012	10 382	11 119	15 827
Unreported landings							2 500	3 000	4 000	9 900	11 354	-
Grand Total							20 763	17 326	18 012	20 282	22 473	15 827

*) National landings as determined by the Working Group

a) Figures include catches made in Division IIIa.

Table 2.2 North Sea SOLE, nominal weight at age of the annual catch in 1980, in grammes

Male									Female						
Year class	Age	Belgium	Denmark	Germany Fed.Rep.	Netherl.	U.K. o	Weighted mean	Smoothed	Belgium	Denmark	Germany Fed.Rep.	Netherl.	U.K. o	Weighted mean	Smoothed
1979	1	131		133	139	141	136	135	145		120	143	145	143	140
1978	2	165		157	182	184	178	170	214		207	216	219	216	210
1977	3	199	171	196	194	197	194	205	361	176	318	280	284	282	300
1976	4	227	266	267	253	257	250	245	350	297	460	414	419	402	400
1975	5	263	339	338	290	294	292	285	463	320	555	499	506	459	475
1974	6	251	374	445	301	305	299	315	554	393	659	574	582	553	550
1973	7	323	405	426	371	376	369	345	598	374	721	671	680	652	630
1972	8	349	371	476	390	395	390	375	655	585	769	678	687	675	700
1971	9	350	417	502	409	415	408	405	638	848	821	769	780	768	750
1970	10	500	325	598	571	578	439	430	602	724	890	506	513	620	790
1969	11	437	367	411	441	447	439	445	737	885	905	883	894	865	830
1968	12	470		497	540	547	507	460	726	887	1 038	822	833	799	850
1967	13	262	725	622	511	518	500	475	758		1 047	949	862	930	870
1966	14			502	440	446	445	490		1 012	1 057	1 245	1 261	1 140	880
1965	15	585			789	799	496 ⌘	500 ⌘	872	729	1 208	823	833	885 ⌘	885 ⌘
1964	16	354		716					729		1 086	1 127	1 142		
1963	17	425		644	474	480			811	999	1 053	895	908		
1962	18			578					738						
1961	19								943						
1960	20														
1959	21											895	907		
1958	22											829	840		
1957	23														
1956	24											1 253	1 270		
1955	25											986	999		
1954	26														
1953	27														
1952	28														
1951	29											944	957		

⌘ 15+ group weight

o Dutch gutted weight at age raised with United Kingdom conversion factor

Conversion factors: Belgium 1.08, Denmark 1.11, France 1.12, Germany,Fed.Rep. 1.11, Netherl. 1.11, United Kingdom 1.125 nominal/gutted

Table 2.3 Belgian, Dutch and United Kingdom cpue indices for North Sea SOLE (tonnes/1 000 hours) and estimates of total international effort based on these indices

Year	Yield ($t \times 10^3$)	Neth.⌘ beam trawl cpue	U.K.⌘ winter cpue	Belgium beam trawl cpue 2nd quarter	International effort based on		
					Neth.	U.K.	Bel.
1962	26.9	34.08	3.767		7.89	7.14	
1963	26.2	20.32	6.761		12.88	3.88	
1964	11.3	14.49	1.554		7.83	7.27	
1965	17.0	17.51	1.776		9.73	9.57	
1966	31.8	31.15	1.945		10.22	16.35	
1967	32.5	40.07	2.377		8.36	13.67	
1968	33.2	21.81	2.402		15.21	13.82	
1969	27.6	20.87	1.784		13.21	15.47	
1970	19.7	12.76	1.592		15.43	12.37	
1971	23.6	11.92	1.079	11.7	19.84	21.87	20.17
1972	21.1	10.68	1.059	9.3	19.75	19.92	22.69
1973	19.3	7.84	0.863	9.9	24.63	22.36	19.49
1974	17.9	7.33	0.699	7.7	24.42	25.61	23.25
1975	20.8	7.94	0.929	8.9	26.15	22.39	23.37
1976	17.3	6.42	0.984	8.6	24.99	17.58	20.12
1977	18.0	7.47	0.791	8.5	24.11	22.76	21.18
1978	20.3	9.93	0.952	9.1	20.42	21.32	22.31
1979	22.5	10.24	1.052	9.3	21.95	21.39	24.19
1980	15.8	6.08⊠	.693⊠	11.0 ⊠	26.03	22.80	14.36
1981				8.2 ⊠			

⌘ corrected for fishing power

⊠ provisional

Table 2.4. North Sea SOLE (Males).
Mean weight (kg) at age in the catch.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
2	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
3	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109
4	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146
5	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180
6	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202
7	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225
8	0.244	0.244	0.244	0.244	0.244	0.244	0.244	0.244	0.244
9	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264
10	0.285	0.285	0.285	0.285	0.285	0.285	0.285	0.285	0.285
11	0.304	0.304	0.304	0.304	0.304	0.304	0.304	0.304	0.304
12	0.323	0.323	0.323	0.323	0.323	0.323	0.323	0.323	0.323
13	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342
14	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354
15+	0.385	0.385	0.385	0.385	0.385	0.385	0.385	0.385	0.385

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.048	0.048	0.048	0.056	0.056	0.056	0.068	0.068	0.058
2	0.087	0.087	0.087	0.115	0.115	0.115	0.132	0.132	0.114
3	0.130	0.130	0.130	0.177	0.177	0.177	0.205	0.205	0.176
4	0.172	0.172	0.172	0.224	0.224	0.224	0.264	0.264	0.234
5	0.207	0.207	0.207	0.261	0.261	0.261	0.307	0.307	0.280
6	0.232	0.232	0.232	0.292	0.292	0.292	0.341	0.341	0.316
7	0.252	0.252	0.252	0.315	0.315	0.315	0.362	0.362	0.344
8	0.270	0.270	0.270	0.338	0.338	0.338	0.381	0.381	0.366
9	0.288	0.288	0.288	0.360	0.360	0.360	0.400	0.400	0.384
10	0.309	0.309	0.309	0.377	0.377	0.377	0.418	0.418	0.399
11	0.327	0.327	0.327	0.394	0.394	0.394	0.439	0.439	0.414
12	0.348	0.348	0.348	0.411	0.411	0.411	0.452	0.452	0.430
13	0.364	0.364	0.364	0.428	0.428	0.428	0.465	0.465	0.446
14	0.380	0.380	0.380	0.439	0.439	0.439	0.477	0.477	0.460
15+	0.413	0.413	0.413	0.467	0.467	0.467	0.502	0.502	0.483

	1975	1976	1977	1978	1979	1980
1	0.058	0.058	0.058	0.058	0.100	0.135
2	0.114	0.114	0.114	0.114	0.179	0.170
3	0.176	0.176	0.176	0.176	0.215	0.205
4	0.234	0.234	0.234	0.234	0.251	0.245
5	0.280	0.280	0.280	0.280	0.288	0.285
6	0.316	0.316	0.316	0.316	0.319	0.315
7	0.344	0.344	0.344	0.344	0.351	0.345
8	0.366	0.366	0.366	0.366	0.385	0.375
9	0.384	0.384	0.384	0.384	0.413	0.405
10	0.399	0.399	0.399	0.399	0.442	0.430
11	0.414	0.414	0.414	0.414	0.469	0.445
12	0.430	0.430	0.430	0.430	0.495	0.460
13	0.446	0.446	0.446	0.446	0.520	0.475
14	0.460	0.460	0.460	0.460	0.540	0.490
15+	0.483	0.483	0.483	0.483	0.590	0.500

Table 2.5. North Sea SOLE (Males).
Mean weight (kg) at age of the stock.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
2	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
3	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
4	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129
5	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
6	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192
7	0.215	0.215	0.215	0.215	0.215	0.215	0.215	0.215	0.215
8	0.235	0.235	0.235	0.235	0.235	0.235	0.235	0.235	0.235
9	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255
10	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275
11	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295
12	0.313	0.313	0.313	0.313	0.313	0.313	0.313	0.313	0.313
13	0.332	0.332	0.332	0.332	0.332	0.332	0.332	0.332	0.332
14	0.350	0.350	0.350	0.350	0.350	0.350	0.350	0.350	0.350
15+	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.027	0.027	0.027	0.035	0.035	0.035	0.036	0.036	0.035
2	0.065	0.065	0.065	0.085	0.085	0.085	0.090	0.090	0.085
3	0.107	0.107	0.107	0.145	0.145	0.145	0.172	0.172	0.145
4	0.151	0.151	0.151	0.198	0.198	0.198	0.235	0.235	0.205
5	0.190	0.190	0.190	0.240	0.240	0.240	0.288	0.288	0.256
6	0.220	0.220	0.220	0.276	0.276	0.276	0.328	0.328	0.300
7	0.241	0.241	0.241	0.304	0.304	0.304	0.353	0.353	0.330
8	0.262	0.262	0.262	0.325	0.325	0.325	0.371	0.371	0.357
9	0.280	0.280	0.280	0.349	0.349	0.349	0.390	0.390	0.375
10	0.298	0.298	0.298	0.370	0.370	0.370	0.410	0.410	0.393
11	0.318	0.318	0.318	0.387	0.387	0.387	0.428	0.428	0.406
12	0.337	0.337	0.337	0.403	0.403	0.403	0.445	0.445	0.420
13	0.355	0.355	0.355	0.420	0.420	0.420	0.460	0.460	0.438
14	0.371	0.371	0.371	0.433	0.433	0.433	0.473	0.473	0.453
15+	0.405	0.405	0.405	0.458	0.458	0.458	0.497	0.497	0.480

	1975	1976	1977	1978	1979	1980
1	0.035	0.035	0.035	0.035	0.010	0.035
2	0.085	0.085	0.085	0.085	0.100	0.100
3	0.145	0.145	0.145	0.145	0.165	0.150
4	0.205	0.205	0.205	0.205	0.215	0.225
5	0.256	0.256	0.256	0.256	0.260	0.265
6	0.300	0.300	0.300	0.300	0.305	0.300
7	0.330	0.330	0.330	0.330	0.340	0.330
8	0.357	0.357	0.357	0.357	0.370	0.360
9	0.375	0.375	0.375	0.375	0.400	0.390
10	0.393	0.393	0.393	0.393	0.425	0.415
11	0.406	0.406	0.406	0.406	0.455	0.440
12	0.420	0.420	0.420	0.420	0.480	0.455
13	0.438	0.438	0.438	0.438	0.505	0.470
14	0.453	0.453	0.453	0.453	0.530	0.485
15+	0.480	0.480	0.480	0.480	0.590	0.500

Table 2.6. North Sea SOLE (Males).
Input catch in numbers ('000) for VPA.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0	0	0	0	0	0	0	7	0
2	86	259	278	4338	1640	0	84	98	25195
3	2940	2184	3814	5535	18720	2163	1828	1163	168
4	3376	5582	3552	7301	7752	25792	2919	2535	892
5	1272	3113	4928	5108	4116	6133	22873	1907	2656
6	863	1728	2455	5654	3117	5241	2473	7656	1220
7	2584	1837	819	3431	1901	2087	2443	1303	5729
8	624	2463	1802	1249	1945	1902	592	2145	557
9	440	850	1279	696	738	1197	1533	303	631
10	2180	498	594	2181	567	416	705	254	210
11	75	1941	435	888	1003	937	596	169	218
12	0	0	1992	298	480	526	531	92	241
13	26	190	15	2569	177	469	732	259	186
14	1	1	73	119	1087	400	195	199	201
15+	343	343	343	343	343	343	343	190	520
TOTAL	14810	20989	22379	39710	43586	47606	37647	18280	36624

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0	0	0	0	557	331	0	113	267
2	3929	2247	4778	12637	3015	17671	3411	5840	9328
3	60251	13983	18121	10291	13170	6692	23672	6500	15834
4	241	49210	14424	2918	3936	6709	3739	7643	3404
5	643	883	28952	5631	769	2462	2544	1419	3447
6	1653	216	3021	8780	1290	438	1116	1160	1232
7	319	854	836	0	5523	694	102	344	821
8	1917	635	2145	66	44	2647	464	285	421
9	114	2769	153	278	32	64	2269	610	194
10	189	0	666	3	240	45	51	1268	211
11	44	213	30	862	65	162	13	33	808
12	151	218	169	3	1022	48	288	194	18
13	153	104	77	236	98	660	22	161	16
14	41	110	13	32	220	160	420	27	167
15+	262	403	33	93	357	481	485	568	384
TOTAL	69907	71845	73418	41830	30338	39264	38656	26165	36552

	1975	1976	1977	1978	1979	1980
1	233	394	817	27	1	188
2	10141	1435	9776	11428	3193	631
3	14917	11512	5544	13879	20111	5758
4	5319	7077	8202	3042	7118	8516
5	913	2808	4304	3634	1354	3535
6	1709	669	1078	2323	1649	731
7	230	1101	212	1103	703	1011
8	284	246	557	360	380	578
9	158	227	121	284	92	164
10	115	102	92	136	125	15
11	57	137	23	92	39	197
12	697	59	53	44	30	18
13	7	592	55	48	33	30
14	30	29	402	4	11	20
15+	369	355	316	272	153	221
TOTAL	35179	26743	31552	36676	34992	21610

Table 2.7. North Sea SOLE (Males).
Fishing mortalities from VPA.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0030	0.0045	0.0063	0.0217	0.0681	0.0000	0.0087	0.0139	0.1043
3	0.0836	0.0869	0.0763	0.1499	0.1104	0.1083	0.0644	0.2297	0.0269
4	0.1305	0.2018	0.1780	0.1834	0.2876	0.1956	0.2765	0.1717	0.2470
5	0.1202	0.1532	0.2459	0.3699	0.1341	0.3443	0.3542	0.4472	0.2443
6	0.0539	0.2126	0.1559	0.4354	0.3594	0.2254	0.3002	0.2854	0.5084
7	0.1168	0.1395	0.1326	0.3014	0.2270	0.3855	0.2052	0.5861	0.3189
8	0.0623	0.1398	0.1771	0.2727	0.2490	0.3306	0.2555	0.4227	0.2522
9	0.0495	0.1018	0.0901	0.0864	0.2292	0.2137	0.6570	0.2681	0.1880
10	0.0833	0.0655	0.0864	0.1953	0.0847	0.1750	0.2486	0.3208	0.2685
11	0.0430	0.0894	0.0676	0.1613	0.1162	0.1759	0.3338	0.1248	0.4437
12	0.0000	0.0000	0.1121	0.0544	0.1105	0.0741	0.1884	0.1750	0.2347
13	1.1692	0.2021	0.0108	0.1851	0.0374	0.1349	0.1846	0.1917	0.55[illegible]
14	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.2000
15+	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.2000
F(2- 8),U	0.0815	0.1340	0.1389	0.2478	0.2051	0.2271	0.2064	0.2795	0.2431

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.0000	0.0000	0.0000	0.0000	0.0076	0.0163	0.0000	0.0021	0.0053
2	0.0810	0.0792	0.1848	0.3412	0.1603	0.3114	0.2070	0.1632	0.2147
3	0.3780	0.4017	1.2981	0.6564	0.6296	0.5537	0.7738	0.6590	0.7520
4	0.0441	0.5345	0.8245	0.6467	0.4987	0.6802	0.6097	0.5406	0.7753
5	0.2525	0.2013	0.6146	0.8045	0.3087	0.5918	0.5256	0.4351	0.4426
6	0.2112	0.1129	1.7880	0.3357	0.3768	0.2584	0.5186	0.4288	0.7377
7	0.2131	0.1443	0.7109	0.0000	0.3249	0.3177	0.1286	0.2640	0.5420
8	0.1498	0.7346	0.5609	0.0952	0.0940	0.2275	0.3234	0.3098	0.5239
9	0.0672	0.2979	0.3421	0.1145	0.0550	0.1724	0.2770	0.8043	0.3190
10	0.0710	0.0000	0.0969	0.0089	0.1229	0.0920	0.1812	0.2197	0.6402
11	0.0741	0.0961	0.0226	0.1573	0.2405	0.1027	0.0313	0.1532	0.1900
12	0.5571	0.5441	0.0926	0.0025	0.2523	0.2508	0.2586	0.7358	0.1052
13	0.2055	0.8352	0.3324	0.1621	0.0958	0.2293	0.1561	0.1822	0.1049
14	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2600	0.2600
15+	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2600	0.2600
F(2- 8),U	0.1899	0.3155	0.8546	0.4114	0.3419	0.4201	0.4410	0.4001	0.5697

	1975	1976	1977	1978	1979	1980
1	0.0131	0.0078	0.0135	0.0016	0.0003	0.0028
2	0.2538	0.0942	0.2398	0.2360	0.2319	0.2200
3	0.5483	0.4493	0.5452	0.5519	0.7250	0.7300
4	0.5395	0.4832	0.5908	0.5789	0.5404	0.6900
5	0.4280	0.5400	0.5401	0.5021	0.4878	0.5000
6	0.3642	0.5658	0.3627	0.5571	0.3965	0.4700
7	0.2562	0.3752	0.3106	0.6795	0.2876	0.4000
8	0.3223	0.4226	0.2940	1.1366	0.4638	0.3600
9	0.3369	0.4090	0.3370	0.2140	0.9131	0.3300
10	0.2827	0.3366	0.2570	0.6860	0.1235	0.3100
11	0.3126	0.5606	0.1053	0.3909	0.3757	0.2600
12	0.2224	0.5431	0.3884	0.2671	0.1895	0.2600
13	0.0489	0.2662	1.3413	0.6425	0.2927	0.2600
14	0.2600	0.2600	0.2600	0.2600	0.2600	0.2600
15+	0.2600	0.2600	0.2600	0.2600	0.2600	0.2600
F(2- 8),U	0.3875	0.4186	0.4119	0.6060	0.4476	0.4814

Natural mortality is 0.1 for all years and age groups except for 1963 where it is 0.9 for all age groups.

Table 2.8. North Sea SOLE (Males).
Stock size in numbers ('000) from VPA at 1 January.

Age of first maturity: 3 years

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	66891	51304	234619	28917	54029	16298	18362	271856	58636
2	30540	60526	46422	212292	26165	48888	14747	7465	243978
3	38512	27552	54519	41740	187966	22117	44235	5944	6662
4	28959	32053	22855	45707	32511	152295	17957	16863	4275
5	11794	22997	23704	17307	34426	22064	113318	5537	12851
6	17269	9463	17852	16772	10818	27241	14149	32329	3204
7	24616	14806	6923	13822	9819	6834	19674	4261	21990
8	10846	19819	11652	5486	9252	7080	4205	6515	2621
9	9574	9221	15594	8832	3779	6526	4603	1351	3863
10	28626	8245	7536	12895	7331	2719	4769	970	935
11	1870	23831	6987	6254	9597	6094	2065	1512	637
12	1204	1621	19719	5909	4816	7731	4625	601	1208
13	39	1089	1467	15950	5065	3902	6496	1557	457
14	11	11	805	1313	11993	4413	3085	2196	1163
15+	3784	3784	3784	3784	3784	3784	5426	2096	3009
TOTAL	274537	286322	474439	436981	411351	337987	277717	361054	367488
SPAWN. ST.	177106	174493	193397	195772	331157	272800	244608	81733	62874

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	34269	32836	50028	23606	77093	21494	44986	56087	52705
2	53056	31008	29712	45811	21360	69227	19154	40705	50642
3	200535	44273	25922	22348	29469	16464	45880	14075	31286
4	5868	124341	26809	6404	10489	14207	8564	19148	6589
5	3022	5081	65924	10635	3035	5764	6511	4211	10091
6	9108	2124	5759	52261	4305	2017	2886	3483	2466
7	1743	6672	1717	569	20866	2672	1409	1555	2053
8	14464	1275	5226	763	515	13643	1760	1121	1080
9	1843	11267	553	2699	628	424	9833	1152	744
10	2896	1559	7569	356	2178	537	323	6744	466
11	647	2441	1411	6216	319	1743	444	244	4899
12	370	543	2006	1248	4806	227	1423	389	189
13	864	192	285	1655	1126	3379	160	1014	169
14	237	637	75	185	1273	926	2431	124	765
15+	1516	2332	191	538	2066	2784	2807	2601	1759
TOTAL	330438	266582	221787	155294	179527	155507	148549	152655	165904
SPAWN. ST.	243113	202738	141447	85877	81074	64787	84429	55863	62557

	1975	1976	1977	1978	1979	1980	1981
1	18765	53554	63860	17908	3707	70616	**********
2	47436	16758	48083	57006	16178	3353	63717
3	36969	33299	13800	34230	40736	11608	2435
4	13346	19332	19225	7239	17836	17852	5062
5	2746	7041	10790	9635	3671	9401	8102
6	5865	1619	3712	5689	5277	2040	5159
7	1067	3687	832	2337	2949	3212	1153
8	1080	747	2293	552	1072	2001	1948
9	579	708	443	1546	160	610	1203
10	490	374	426	286	1129	58	397
11	223	334	242	298	130	903	39
12	3666	147	172	197	182	81	630
13	154	2655	77	106	136	136	57
14	137	133	1841	18	50	92	95
15+	1690	1626	1447	1246	701	1011	770
TOTAL	134213	142015	167243	138292	93916	122974	
SPAWN. ST.	68012	71703	55300	63378	74031	49005	

Table 2.9. North Sea SOLE (Females).
Mean weight (kg) at age in the catch.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
2	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101
3	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
4	0.236	0.236	0.236	0.236	0.236	0.236	0.236	0.236	0.236
5	0.304	0.304	0.304	0.304	0.304	0.304	0.304	0.304	0.304
6	0.349	0.349	0.349	0.349	0.349	0.349	0.349	0.349	0.349
7	0.394	0.394	0.394	0.394	0.394	0.394	0.394	0.394	0.394
8	0.439	0.439	0.439	0.439	0.439	0.439	0.439	0.439	0.439
9	0.484	0.484	0.484	0.484	0.484	0.484	0.484	0.484	0.484
10	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529
11	0.563	0.563	0.563	0.563	0.563	0.563	0.563	0.563	0.563
12	0.596	0.596	0.596	0.596	0.596	0.596	0.596	0.596	0.596
13	0.624	0.624	0.624	0.624	0.624	0.624	0.624	0.624	0.624
14	0.647	0.647	0.647	0.647	0.647	0.647	0.647	0.647	0.647
15+	0.686	0.686	0.686	0.686	0.686	0.686	0.686	0.686	0.686

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.056	0.056	0.056	0.068	0.068	0.068	0.073	0.073	0.070
2	0.129	0.129	0.129	0.146	0.146	0.146	0.163	0.163	0.140
3	0.214	0.214	0.214	0.248	0.248	0.248	0.270	0.270	0.235
4	0.281	0.281	0.281	0.349	0.349	0.349	0.399	0.399	0.360
5	0.349	0.349	0.349	0.422	0.422	0.422	0.495	0.495	0.475
6	0.405	0.405	0.405	0.489	0.489	0.489	0.574	0.574	0.560
7	0.450	0.450	0.450	0.546	0.546	0.546	0.641	0.641	0.635
8	0.495	0.495	0.495	0.585	0.585	0.585	0.686	0.686	0.675
9	0.540	0.540	0.540	0.619	0.619	0.619	0.726	0.726	0.710
10	0.574	0.574	0.574	0.652	0.652	0.652	0.759	0.759	0.745
11	0.602	0.602	0.602	0.686	0.686	0.686	0.788	0.788	0.770
12	0.630	0.630	0.630	0.709	0.709	0.709	0.810	0.810	0.790
13	0.652	0.652	0.652	0.737	0.737	0.737	0.827	0.827	0.810
14	0.675	0.675	0.675	0.754	0.754	0.754	0.844	0.844	0.820
15+	0.712	0.712	0.712	0.782	0.782	0.782	0.866	0.866	0.838

	1975	1976	1977	1978	1979	1980
1	0.070	0.070	0.070	0.070	0.100	0.140
2	0.140	0.140	0.140	0.140	0.220	0.210
3	0.235	0.235	0.235	0.235	0.340	0.300
4	0.360	0.360	0.360	0.360	0.445	0.400
5	0.475	0.475	0.475	0.475	0.540	0.475
6	0.560	0.560	0.560	0.560	0.615	0.550
7	0.635	0.635	0.635	0.635	0.680	0.630
8	0.675	0.675	0.675	0.675	0.730	0.700
9	0.710	0.710	0.710	0.710	0.775	0.750
10	0.745	0.745	0.745	0.745	0.820	0.790
11	0.770	0.770	0.770	0.770	0.855	0.830
12	0.790	0.790	0.790	0.790	0.885	0.850
13	0.810	0.810	0.810	0.810	0.910	0.870
14	0.820	0.820	0.820	0.820	0.930	0.880
15+	0.838	0.838	0.838	0.838	0.980	0.885

Table 2.10. North Sea SOLE (Females).
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	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072
3	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135
4	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203
5	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
6	0.328	0.328	0.328	0.328	0.328	0.328	0.328	0.328	0.328
7	0.370	0.370	0.370	0.370	0.370	0.370	0.370	0.370	0.370
8	0.412	0.412	0.412	0.412	0.412	0.412	0.412	0.412	0.412
9	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
10	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508
11	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545
12	0.580	0.580	0.580	0.580	0.580	0.580	0.580	0.580	0.580
13	0.607	0.607	0.607	0.607	0.607	0.607	0.607	0.607	0.607
14	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635
15+	0.673	0.673	0.673	0.673	0.673	0.673	0.673	0.673	0.673

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.029	0.029	0.029	0.032	0.032	0.032	0.040	0.040	0.035
2	0.090	0.090	0.090	0.105	0.105	0.105	0.117	0.117	0.100
3	0.170	0.170	0.170	0.195	0.195	0.195	0.215	0.215	0.180
4	0.250	0.250	0.250	0.297	0.297	0.297	0.340	0.340	0.295
5	0.315	0.315	0.315	0.387	0.387	0.387	0.450	0.450	0.423
6	0.375	0.375	0.375	0.456	0.456	0.456	0.535	0.535	0.522
7	0.430	0.430	0.430	0.515	0.515	0.515	0.610	0.610	0.600
8	0.475	0.475	0.475	0.565	0.565	0.565	0.670	0.670	0.660
9	0.520	0.520	0.520	0.600	0.600	0.600	0.705	0.705	0.695
10	0.560	0.560	0.560	0.632	0.632	0.632	0.742	0.742	0.730
11	0.590	0.590	0.590	0.670	0.670	0.670	0.772	0.772	0.757
12	0.620	0.620	0.620	0.695	0.695	0.695	0.800	0.800	0.782
13	0.645	0.645	0.645	0.718	0.718	0.718	0.817	0.817	0.800
14	0.665	0.665	0.665	0.742	0.742	0.742	0.835	0.835	0.812
15+	0.705	0.705	0.705	0.780	0.780	0.780	0.860	0.860	0.833

	1975	1976	1977	1978	1979	1980
1	0.035	0.035	0.035	0.035	0.050	0.040
2	0.100	0.100	0.100	0.100	0.160	0.120
3	0.180	0.180	0.180	0.180	0.285	0.230
4	0.295	0.295	0.295	0.295	0.395	0.340
5	0.423	0.423	0.423	0.423	0.500	0.435
6	0.522	0.522	0.522	0.522	0.580	0.500
7	0.600	0.600	0.600	0.600	0.645	0.590
8	0.660	0.660	0.660	0.660	0.705	0.675
9	0.695	0.695	0.695	0.695	0.755	0.720
10	0.730	0.730	0.730	0.730	0.795	0.770
11	0.757	0.757	0.757	0.757	0.835	0.810
12	0.782	0.782	0.782	0.782	0.870	0.840
13	0.800	0.800	0.800	0.800	0.897	0.865
14	0.812	0.812	0.812	0.812	0.920	0.880
15+	0.833	0.833	0.833	0.833	0.980	0.885

Table 2.11. North Sea SOLE (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	71	0
2	1199	1890	3900	9148	3158	1729	537	119	26685
3	5925	6622	10057	9983	38429	4053	6582	1457	756
4	7248	6548	9156	11560	19004	33036	5949	4721	551
5	1624	3953	5173	4475	6603	8477	24975	1934	2196
6	1192	1304	3671	3875	3436	4651	5432	8626	1213
7	2260	1201	707	2621	2434	2280	3856	1753	5719
8	573	1170	622	633	1504	2224	1580	796	812
9	263	633	1411	475	730	1083	1864	470	712
10	1801	219	614	995	508	250	668	544	145
11	50	1783	341	500	634	516	331	283	464
12	77	63	1063	278	536	419	130	85	121
13	19	37	85	1272	427	559	1210	177	244
14	49	63	22	44	995	73	170	168	203
15+	556	556	556	556	556	556	556	315	341
TOTAL	22836	26042	37378	46415	78954	59906	53840	21519	40162

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0	0	0	265	649	185	0	610	410
2	9470	2750	4624	13812	4068	20731	533	7376	10207
3	74396	17282	13898	10086	13946	7214	19772	5470	12729
4	358	56301	10876	2174	4953	6298	3795	8795	2969
5	402	1497	21188	5083	1042	1703	2905	2503	3199
6	1232	418	2536	13408	1677	584	856	1208	814
7	464	1510	1283	243	7832	914	282	748	571
8	3981	246	2551	115	168	4266	567	565	208
9	435	3062	529	537	56	79	3059	684	235
10	447	475	1371	193	479	47	47	2002	206
11	211	506	259	1544	74	219	24	188	1200
12	339	139	558	154	1542	0	186	116	48
13	56	418	275	291	85	1094	26	207	4
14	62	97	327	96	303	72	658	46	101
15+	136	518	801	256	856	579	410	920	746
TOTAL	91989	85219	61076	48257	37730	43985	33120	31438	35647

	1975	1976	1977	1978	1979	1980
1	51	405	1109	2	7	440
2	14391	1594	15036	14016	4986	649
3	15292	10817	7975	15818	21079	6811
4	6153	8116	9114	3118	8991	9189
5	1083	3075	4305	3075	1671	3741
6	2014	751	1135	1975	1606	721
7	400	1480	180	657	1084	1148
8	467	461	724	242	482	809
9	229	444	199	369	153	200
10	100	275	158	61	275	39
11	176	170	88	142	114	213
12	1307	141	88	80	91	35
13	21	1563	70	62	74	25
14	62	40	551	56	62	11
15+	644	668	528	539	507	370
TOTAL	42390	30000	41260	40212	41182	24401

Table 2.12. North Sea SOLE (Females).
Fishing mortalities from VPA.

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
2	0.0247	0.0236	0.0496	0.0335	0.0916	0.0274	0.0453	0.0129	0.1020
3	0.1078	0.1653	0.1513	0.1551	0.1721	0.1462	0.1820	0.2414	0.0954
4	0.2682	0.1496	0.3206	0.2324	0.4340	0.1965	0.4420	0.2834	0.1213
5	0.1416	0.2052	0.1518	0.2286	0.1806	0.3122	0.2965	0.3814	0.1846
6	0.0717	0.1450	0.2661	0.1459	0.2458	0.1674	0.4515	0.2322	0.3883
7	0.1247	0.0864	0.0982	0.2751	0.1155	0.2286	0.2699	0.3905	0.2126
8	0.0652	0.0790	0.0530	0.1077	0.2243	0.1319	0.3253	0.1177	0.2808
9	0.0859	0.0858	0.1161	0.0471	0.1564	0.2233	0.2056	0.2222	0.1318
10	0.0839	0.0861	0.1009	0.1009	0.0586	0.0663	0.2766	0.1223	0.0887
11	0.0608	0.1006	0.1680	0.1004	0.0777	0.0702	0.1545	0.2669	0.1309
12	0.2135	0.0914	0.0723	0.1801	0.1337	0.0608	0.0296	0.0768	0.1563
13	0.0257	0.1352	0.1538	0.1044	0.4071	0.1801	0.3314	0.0724	0.2914
14	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
15+	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
F(2- 8),U	0.1148	0.1220	0.1558	0.1683	0.2091	0.1729	0.2875	0.2371	0.1979

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.0000	0.0000	0.0000	0.0100	0.0087	0.0118	0.0000	0.0105	0.0074
2	0.1810	0.1085	0.1752	0.3528	0.1871	0.3676	0.0387	0.2159	0.2174
3	0.4005	0.5092	1.0090	0.6158	0.6368	0.5145	0.6298	0.5889	0.6129
4	0.0538	0.5302	0.6188	0.3608	0.6198	0.5880	0.4963	0.5647	0.6555
5	0.1098	0.2945	0.3443	0.5845	0.2618	0.3958	0.5247	0.6310	0.3647
6	0.1344	0.1431	1.0146	0.3389	0.3427	0.2052	0.3145	0.3819	0.3809
7	0.2242	0.2165	0.7326	0.2075	0.3018	0.2828	0.1296	0.4410	0.2786
8	0.2012	0.1594	0.5978	0.1138	0.1939	0.2385	0.2538	0.3652	0.1872
9	0.2132	0.2100	0.5268	0.2119	0.0671	0.1180	0.2401	0.4852	0.2267
10	0.1029	0.3376	0.1230	0.3287	0.2647	0.0665	0.0859	0.2185	0.2335
11	0.1615	0.1457	0.2772	0.1777	0.1804	0.1664	0.0396	0.5030	0.1766
12	0.1198	0.1366	0.2119	0.2357	0.2415	0.0000	0.1862	0.2427	0.2045
13	0.0906	0.1904	0.3847	0.1463	0.1770	0.2411	0.0887	0.2896	0.0105
14	0.1000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
15+	0.1000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
F(2- 8),U	0.1864	0.2802	0.6418	0.3678	0.3634	0.3703	0.3411	0.4555	0.3853

	1975	1976	1977	1978	1979	1980
1	0.0024	0.0065	0.0162	0.0001	0.0019	0.0057
2	0.3386	0.0854	0.3110	0.2589	0.2810	0.2200
3	0.5126	0.4073	0.6743	0.5505	0.6722	0.6700
4	0.6012	0.4989	0.6297	0.5385	0.6178	0.6200
5	0.4682	0.6075	0.4769	0.3970	0.5492	0.5000
6	0.3656	0.6108	0.4177	0.3712	0.3306	0.4300
7	0.2903	0.4435	0.2532	0.4031	0.3185	0.3700
8	0.3428	0.5588	0.3595	0.5569	0.5144	0.3700
9	0.2880	0.5601	0.4424	0.2795	0.7340	0.3700
10	0.1276	0.5831	0.3507	0.2093	0.3086	0.3700
11	0.2854	0.2947	0.3292	0.5388	0.6523	0.3700
12	0.2643	0.3457	0.2184	0.4962	0.7031	0.3700
13	0.1163	0.5093	0.2572	0.2108	1.0610	0.3700
14	0.2000	0.3000	0.3000	0.3000	0.3000	0.3700
15+	0.2000	0.3000	0.3000	0.3000	0.3000	0.3700
F(2- 8),U	0.4170	0.4589	0.4460	0.4394	0.4691	0.4543

Natural mortality is 0.1 for all years and age groups except for 1963 where it is 0.9 for all age groups.

Table 2.13. North Sea SOLE (Females).
Stock size in numbers ('000) from VPA at 1 January.

Age at first maturity: 3 years

	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	94002	93614	322168	41866	74291	20263	24019	319430	66334
2	51667	85057	84705	291510	37882	67222	18335	9765	288964
3	60898	45610	75166	72937	255073	31277	59181	7124	8723
4	32305	49474	34982	58462	56516	194312	24451	20057	5064
5	12913	22355	38548	22970	41928	33133	144460	6389	13670
6	18092	10141	16475	29967	16538	31669	21940	43665	3948
7	20239	15237	7938	11424	23435	11703	24239	5679	31323
8	9539	16167	12646	6511	7851	18893	8426	7524	3477
9	3356	8087	13516	10852	5290	5676	14982	2474	6052
10	23504	2787	6716	10890	9367	4093	4108	4959	1793
11	890	19556	2314	5493	8908	7993	3466	1267	3971
12	420	758	16001	1770	4496	7458	6742	1207	878
13	788	307	626	13468	1337	3559	6350	2661	1012
14	541	695	243	485	10978	805	2689	1854	2240
15+	6135	6135	6135	6135	6135	6135	8796	3475	3762
TOTAL	335289	375979	638177	584740	560025	444191	372185	437531	441210
SPAWN. ST.	189620	197309	231305	251365	447852	356705	329831	108336	85912

	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	31033	33375	53797	27918	78710	16512	44027	61207	58457
2	60021	28080	30199	48678	25009	70603	14765	39837	54802
3	236114	45319	22795	22934	30951	18767	44232	12853	29045
4	7174	143140	24643	7520	11210	14814	10151	21320	6454
5	4059	6151	76219	12009	4743	5458	7445	5591	10967
6	10284	3291	4146	48877	6056	3303	3324	3987	2692
7	2423	8135	2580	1360	31513	3890	2434	2196	2462
8	22914	1752	5928	1122	1000	21086	2653	1935	1279
9	2376	16955	1352	2950	906	745	15031	1862	1215
10	4800	1737	12435	722	2160	767	599	10698	1037
11	1484	3918	1121	9949	470	1500	649	498	7779
12	3152	1143	3065	769	7536	355	1149	565	272
13	679	2530	902	2243	550	5356	322	863	401
14	684	561	1892	556	1754	417	3808	266	585
15+	1501	2998	4636	1482	4954	3351	2373	5324	4317
TOTAL	388698	299084	245710	189089	207522	166924	152962	169002	181765
SPAWN. ST.	297644	237630	161714	112493	103803	79809	94170	67958	68506

	1975	1976	1977	1978	1979	1980	1981
1	22657	65585	72379	23583	3814	81418	**********
2	52504	20452	58959	64437	21336	3444	73252
3	39899	33863	16991	39088	45006	14576	2501
4	14239	21623	20390	7834	20396	20792	6749
5	3032	7062	11880	9829	4137	9950	10120
6	6891	1718	3481	6673	5979	2161	5461
7	1664	4326	844	2074	4165	3887	1272
8	1686	1126	2512	593	1254	2741	2430
9	959	1083	583	1587	307	678	1713
10	877	651	560	339	1086	133	424
11	743	698	329	357	249	722	83
12	5900	505	470	214	188	117	451
13	201	4098	324	342	118	84	73
14	359	162	2228	226	251	37	53
15+	3727	2702	2135	2180	2050	1253	806
TOTAL	155338	165655	194065	159354	110338	141996	
SPAWN. ST.	80177	79618	62728	71335	85187	57133	

Table 2.14 North Sea SOLE, Sum of Product discrepancies of the catch (the stock biomasses in Figure 2.5 A. and Table 2.17 are corrected for these discrepancies)

Year	SOP Males	SOP Females	SOP $\frac{\text{Males}}{\text{Females}}$ (A)	Nominal catch (B)	SOP $\frac{B}{A}$ discr.
1957	2858.14	6463.68	9321.82	12.067	1.29
1958	4149.41	7407.83	11557.24	14.287	1.24
1959	4407.15	9941.69	14348.84	13.832	.96
1960	7348.53	11719.63	19118.16	18.629	.97
1961	6958.58	18714.21	25672.79	23.954	.93
1962	8421.05	16705.06	25126.11	26.877	1.07
1963	7291.33	17037.44	24328.77	26.162	1.08
1964	3676.26	7174.62	10850.88	11.342	1.05
1965	4696.75	7925.85	12622.6	17.043	1.35
1966	9668.13	21068.89	30737.02	31.825	1.04
1967	12286.03	24391.83	36677.86	33.509	.91
1968	13101.18	19439.02	32540.20	33.179	1.02
1969	8584.71	16309.77	24894.48	27.560	1.11
1970	6775.57	13911.11	20686.68	19.686	.95
1971	7322.68	12568.40	19891.08	23.654	1.19
1972	9205.94	12796.56	22009.50	21.093	.96
1973	6442.20	12297.30	18739.50	19.312	1.03
1974	7223.53	9989.63	17213.16	17.898	1.04
1975	6643.39	12051.16	18694.55	20.763	1.11
1976	5993.79	11462.44	17462.23	17.326	.99
1977	6356.98	11968.57	18325.55	18.012	.98
1978	7096.62	10977.06	18073.68	20.282	1.12
1979	8230.92	16388.42	24619.34	22.473	.91
1980	5505.15	10126.12	15631.27	15.827	1.01

Table 2.15 North Sea Sole, spawning stock biomass at 1 January from VPA corrected for SOP discrepancies

Year	Males	Females	Total
1957	42 587	70 667	113 254
1958	42 165	72 975	115 140
1959	34 476	63 399	97 875
1960	35 579	69 657	105 235
1961	44 551	94 045	138 596
1962	47 639	101 957	149 596
1963	45 989	105 682	151 671
1964	16 379	38 284	54 663
1965	17 171	42 053	59 223
1966	33 123	70 406	103 529
1967	29 771	61 806	91 577
1968	26 213	55 959	82 172
1969	23 743	52 815	76 558
1970	18 841	41 589	60 430
1971	19 747	41 112	60 859
1972	20 433	37 729	58 162
1973	16 018	33 882	49 899
1974	14 632	28 704	43 336
1975	15 847	31 554	47 401
1976	15 025	27 250	42 275
1977	12 718	22 904	35 622
1978	14 713	25 431	40 144
1979	14 304	30 781	45 085
1980	12 072	22 713	34 784

Table 2.16 North Sea SOLE, input data for catch prognosis and yield

Age	Males				Females			
	Stock at 1-1-81 (x 10^3)	Catch weight	Stock weight	F at age	Stock at 1-1-81 (x 10^3)	Catch weight	Stock weight	F at age
1	46 709*	.135	.035	.0028	54 675*	.140	.040	.0057
2	63 717**	.170	.100	.22	73 252**	.210	.120	.22
3	2 435	.205	.150	.73	2 501	.300	.230	.67
4	5 062	.245	.225	.69	6 749	.400	.340	.62
5	8 102	.285	.265	.50	10 120	.475	.435	.50
6	5 159	.315	.300	.47	5 461	.550	.500	.43
7	1 153	.345	.340	.40	1 272	.630	.590	.37
8	1 948	.375	.360	.36	2 430	.700	.675	.37
9	1 263	.405	.390	.33	1 713	.750	.720	.37
10	397	.430	.415	.31	424	.790	.770	.37
11	39	.445	.440	.26	83	.830	.810	.37
12	630	.460	.455	.26	451	.850	.840	.37
13	57	.475	.470	.26	73	.870	.865	.37
14	95	.490	.485	.26	53	.880	.820	.37
15^+	770	.500	.500	.26	806	.885	.885	.37

* average mean (GM) recruitment 1957-77

** "Tridens" estimate year class 1979 (mean) lower limit 48908 x 10^3 ♂ 57327 x 10^3 ♀

upper limit 75541 x 10^3 ♂ 88422 x 10^3 ♀

Table 2.17 North Sea SOLE, results of the prognosis, corrected for SOP discrepancies ⁎

		Catch tonnes x 10^3				Spawning stock biomass tonnes x 10^3		
Year	F	Lower 1979 estimate	Mean	Upper 1979 estimate	Year	Lower 1979 estimate	Mean	Upper 1979 estimate
1980	F_{80}		15.827		1981		23.151	
1981	F_{80}	12.939	14.053	15.041	1982	30.050	34.355	38.215
1982	0 x F_{80}	0	0	0	1983	51.464	57.269	62.456
1982	.2 F_{80}	4.373	5.110	5.739	1983	46.949	52.002	56.522
1982	.4	8.365	9.689	10.867	1983	42.904	47.301	51.237
1982	.6	11.935	13.797	15.454	1983	39.268	43.009	46.528
1982	.8	15.159	17.489	19.565	1983	36.001	39.337	42.324
1982	1.0	18.070	20.812	23.253	1983	33.060	35.964	38.567
1982	1.2	20.709	23.809	26.569	1983	30.408	32.937	35.205
1982	1.4	23.101	26.514	29.554	1983	28.013	30.215	32.191
1982	1.6	25.275	28.961	32.245	1983	25.847	27.764	29.485
1982	1.8	27.253	31.178	34.676	1983	23.884	25.554	27.053
1982	2.0	29.057	33.191	36.875	1983	22.103	23.557	24.863

⁎ SOP corrections + 1%

⁎ Options for 1979 year class from "Tridens" survey with lower and upper limit

Table 3.1 North Sea PLAICE.
Nominal catch (tonnes) in Sub-area IV, 1969-1980 (data for 1969-1979 broken down by countries are from Bulletin Statistique)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980*
Belgium	4 476	4 360	5 073	5 531	6 133	6 202	6 154	4 574	6 547	6 036	7 687	7 006
Denmark	35 227	32 807	22 278	24 494	23 266	19 814	22 731	25 612	20 900	21 285	27 497	25 879
Faroe Islands	-	-	-	-	1	-	1	-	1	-	-	-
France	1 330	1 406	1 380	1 062	1 355	519	536	497	598	750	856	711
Germany, Fed.Rep.	5 071	5 519	3 296	4 318	5 451	3 233	4 040	3 654	5 423	4 674	4 315	4 550
Netherlands	39 420	46 080	44 502	52 048	57 948	54 438	51 293	46 457	42 307	28 219	38 295	39 782
Norway	26	22	18	19	15	13	13	20	16	13	13	13
Poland	-	-	-	-	1	-	153	40	-	-	-	-
Sweden[a]	772	608	588	626	432	431	35	28	-	-	7	6
UK (England) and Wales	30 349	34 839	32 576	31 642	30 400	23 854	20 290	23 789	27 623	27 862	25 825	18 687
UK (Scotland)	4 981	4 703	4 210	3 410	4 815	4 002	3 266	3 310	3 622	3 877	4 126	4 336
USSR	-	-	-	-	397	39	-	-	-	-	-	-
Total	121 652	130 344	113 921	123 150	130 214	112 545	108 512	107 981	107 037	92 716	108 621	100 970
Unreported landings[b]								5 000	11 384	21 150	36 705	38 023
Grand Total								112 981	118 421	113 866	145 326	138 993

*) Preliminary
a) 1969-74 includes Division IIIa
b) Estimated by the Working Group

Table 3.2. North Sea PLAICE (Males).
Input catch in numbers ('000) for VPA.

	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	0	0	0	0	0	0	0	0	0
2	3241	1675	2266	5390	5551	7427	3994	4141	7247
3	38948	18091	26154	17209	24448	26468	44528	17704	29209
4	25707	39245	49281	72995	43948	34481	35085	116442	20674
5	10361	16586	32518	47327	41645	30706	21180	29884	71530
6	11185	7046	12598	17947	22433	17681	13880	16688	8597
7	4976	6104	5252	7027	5568	7522	6958	12446	3530
8	2186	3208	3138	2766	2189	3337	3728	3440	4620
9	906	1788	790	1604	1227	1119	2256	2912	1007
10	661	1057	587	879	697	1127	831	551	1621
11	406	496	419	453	448	1186	563	159	560
12	129	447	300	45	302	243	552	81	335
13	215	219	114	201	194	186	527	231	199
14	10	19	119	75	120	615	96	180	149
15+	20	2	49	328	765	573	916	503	365
TOTAL	98951	96583	134185	174246	149535	132671	134674	205362	155643

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	280	1401	428	1084	437	890	981	3027	1719
2	9941	13245	14886	14557	13037	9832	21743	19178	27610
3	25842	27962	27438	22094	35623	30891	59986	51915	40298
4	18546	31068	16385	23947	46290	36116	15709	79941	47829
5	19726	23087	11357	10059	21150	19987	11599	19126	34461
6	50305	18237	10351	7461	5635	8467	7457	5353	3856
7	3967	37089	6189	5968	2789	3085	4166	3744	2258
8	1913	2346	10083	3204	3331	1904	2037	2351	1800
9	4041	1155	1408	5720	1764	1807	1430	1225	1475
10	1084	1396	1180	1213	4290	1009	806	723	618
11	959	528	781	856	155	2356	264	579	320
12	686	663	574	736	379	247	892	143	264
13	209	307	487	300	276	392	181	574	139
14	217	120	183	345	261	162	110	98	377
15+	371	362	449	477	524	340	258	296	281
TOTAL	137127	159586	106579	98021	135941	117485	127479	188273	163305

	1978	1979	1980
1	860	734	456
2	33503	29160	36946
3	28382	61154	76291
4	29842	26371	44089
5	33725	27034	13630
6	22361	21931	9911
7	3248	10096	6701
8	1271	1566	2060
9	751	735	472
10	798	523	135
11	295	520	186
12	92	320	323
13	122	41	95
14	101	154	10
15+	475	438	170
TOTAL	155806	180777	192681

Table 3.3. North Sea PLAICE (Males).
Fishing mortalities from VPA (M = 0.1).

	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0150	0.0073	0.0125	0.0373	0.0580	0.0155	0.0503	0.0523	0.0655
3	0.2584	0.0979	0.1359	0.1112	0.2112	0.2277	0.1089	0.1634	0.2947
4	0.4004	0.3974	0.3695	0.5928	0.4024	0.4554	0.4683	0.4051	0.5496
5	0.3359	0.4324	0.5989	0.6413	0.7127	0.4817	0.4967	0.8222	0.4111
6	0.4684	0.3936	0.6040	0.6753	0.6366	0.6692	0.5702	0.8180	0.5218
7	0.4398	0.4469	0.4556	0.7132	0.4388	0.4012	0.5558	0.5856	0.3525
8	0.3719	0.4999	0.3861	0.4096	0.4469	0.4163	0.5154	0.4889	0.3961
9	0.1285	0.5222	0.1948	0.3098	0.2856	0.3835	0.4870	0.3856	0.2287
10	0.2173	0.1944	0.2867	0.3067	0.1918	0.4082	0.4833	0.1861	0.3419
11	0.3106	0.2247	0.0928	0.3328	0.2201	0.5052	0.1982	0.1413	0.2608
12	0.1342	0.6017	0.6999	0.0124	0.3438	0.1650	0.4130	0.0556	0.4347
13	1.1780	0.3135	0.2656	0.2890	0.0613	0.3275	0.5160	0.2702	0.1686
14	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
15+	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
F(2-10),U	0.2928	0.3324	0.3573	0.4221	0.3738	0.3843	0.3660	0.4317	0.3291

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	0.0019	0.0084	0.0030	0.0091	0.0014	0.0034	0.0053	0.0213	0.0069
2	0.0970	0.1046	0.1538	0.1196	0.1287	0.0357	0.0956	0.1230	0.2441
3	0.3093	0.4325	0.2903	0.2045	0.4198	0.4441	0.2808	0.3069	0.5613
4	0.2751	0.6724	0.4315	0.3925	0.7405	0.8733	0.5775	0.6462	0.4545
5	0.4184	0.5703	0.4792	0.4557	0.6315	0.7411	0.8681	0.9525	0.5674
6	0.5031	0.7537	0.4801	0.5904	0.4423	0.4942	0.6040	0.6797	0.4404
7	0.4302	0.7573	0.5492	0.4985	0.4049	0.4105	0.4274	0.6165	0.6052
8	0.2920	0.4328	0.4485	0.5425	0.5085	0.4722	0.4624	0.4044	0.6033
9	0.6329	0.2506	0.4450	0.4079	0.5765	0.5065	0.6933	0.4953	0.4239
10	0.3643	0.4121	0.4004	0.7690	0.5397	0.6794	0.4300	0.8173	0.4425
11	0.3025	0.2702	0.3789	0.5015	0.7762	0.5694	0.3306	0.5053	0.9618
12	0.5151	0.3224	0.2282	0.6515	0.3842	0.4134	0.3819	0.2674	0.4029
13	0.4705	0.4057	0.3692	0.3343	0.4800	0.7630	0.5348	0.4109	0.5990
14	0.2500	0.4800	0.4000	0.4300	0.4800	0.5100	0.4400	0.5500	0.4600
15+	0.2500	0.4800	0.4000	0.4300	0.4800	0.5100	0.4400	0.5500	0.4600
F(2-10),U	0.3692	0.4881	0.4064	0.4413	0.4880	0.5173	0.4488	0.5602	0.4603

	1978	1979	1980
1	0.0026	0.0039	0.0014
2	0.1617	0.1007	0.2435
3	0.3706	0.4359	0.3650
4	0.4399	0.6322	0.5810
5	0.5940	0.8021	0.7600
6	0.7912	0.8717	0.6910
7	0.7214	0.9192	0.6360
8	0.7274	0.8276	0.5800
9	0.4654	1.1439	0.5020
10	0.3795	0.6310	0.5730
11	0.3480	0.4039	0.4250
12	0.7227	0.6882	0.4180
13	0.2925	0.7382	0.3940
14	0.5000	0.6400	0.3500
15+	0.5000	0.6400	0.3500
F(2-10),U	0.5175	0.7072	0.5479

Table 3.4. North Sea PLAICE (Males).
Stock size in numbers ('000) from VPA at 1 January.

	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	265861	212258	170781	172943	561901	155197	151351	132752	112219
2	228529	240561	192059	154529	156485	508429	140428	136930	120119
3	179364	203700	216076	171628	134700	136317	452984	123267	119963
4	81603	125540	167127	170673	138947	98677	98224	367575	94725
5	38060	47475	78219	104507	85362	84077	56024	55646	222245
6	31305	24613	29052	38197	49798	37873	46996	31179	22126
7	14041	17732	15625	14369	17591	23840	17349	29366	12451
8	7373	8533	10262	8620	6359	10263	14443	9311	14795
9	7389	4599	4683	6312	5178	3680	6124	9533	5167
10	3550	6277	2469	3488	4190	3522	2269	3405	5866
11	1508	2585	4677	1677	2322	3129	2119	1266	2558
12	1078	1034	1868	3834	1088	1676	1709	1572	995
13	523	853	512	839	3426	698	1286	1023	1346
14	47	90	564	356	569	2916	455	853	706
15+	95	9	232	1555	3627	2716	4343	2385	1730
TOTAL	861286	897661	891608	853524	1171544	1073008	996883	906065	737011
SPAWN. ST.	595425	685403	720827	680582	609643	917812	845552	773312	624793

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	155104	176453	150232	126416	325660	277679	193346	151908	262034
2	101540	140077	158529	135529	113355	294234	250409	174014	135669
3	101801	83382	114164	125324	108804	90185	256906	205921	139237
4	80841	67604	48954	77273	92425	64697	52338	173552	137087
5	60421	55554	31226	28772	47223	39882	24446	32467	85238
6	133312	35979	28418	17498	16505	22724	17198	11340	11533
7	11881	72935	15322	15910	8773	9596	12543	8506	5200
8	7919	6992	30948	8005	8745	5295	5759	7402	4155
9	9008	5351	4104	17883	4211	4759	2988	3282	4470
10	3720	4329	3746	2380	10761	2141	2595	1352	1810
11	3771	2338	2594	2271	1007	5676	983	1527	540
12	1783	2521	1615	1607	1245	764	2906	639	834
13	583	964	1653	1106	758	767	457	1784	442
14	1029	329	581	1054	717	424	324	242	1070
15+	1759	994	1426	1429	1439	891	759	732	798
TOTAL	674472	655804	593313	502437	741627	819733	823955	775669	785918
SPAWN. ST.	519368	479351	443080	436021	415967	542053	630610	624761	525884

	1978	1979	1980	1981
1	353973	198903	342507	**********
2	235404	319470	179277	309480
3	94749	181243	261365	127158
4	97785	58830	106058	164173
5	78735	51160	28288	53677
6	42703	39332	20756	12710
7	6002	17515	14885	9410
8	2569	2904	6321	7130
9	2057	1123	1148	3202
10	2047	1168	324	592
11	1052	1639	563	165
12	187	672	990	333
13	504	82	306	590
14	269	341	35	186
15+	1263	969	624	421
TOTAL	910558	875352	965447	
SPAWN. ST.	556585	676448	620940	

Table 3.5. North Sea PLAICE (Females).
Input catch in numbers ('000) for VPA.

	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	0	0	0	0	0	0	0	0	0
2	4720	1581	1232	5731	16302	9859	5700	3121	7033
3	41141	28411	52428	18337	25265	24619	51936	21883	22698
4	17921	34133	31766	48921	20576	23253	24445	63691	20257
5	7132	12008	29275	29950	21419	17064	13172	18404	51274
6	11428	4869	11956	17473	13736	14871	9705	11301	7473
7	6598	6754	6142	6799	7014	9693	8551	8896	5122
8	4299	4992	6816	4299	2803	5207	6371	4279	5833
9	2344	3528	3857	4059	1993	2864	3677	5692	2494
10	3054	2157	3055	3173	2474	2095	2056	2289	3178
11	2094	2231	1659	2860	2095	2057	1608	1808	1309
12	1673	1765	1382	1984	1263	1802	1904	903	1336
13	1095	1438	1463	1505	1084	1483	1168	1342	630
14	621	1128	1161	1146	866	889	1073	769	840
15	508	607	545	673	527	872	589	671	489
16	195	255	324	456	505	633	663	322	576
17+	372	343	223	641	1764	2089	1630	1848	1405
TOTAL	106995	106200	133264	147987	123686	119330	134228	147219	131947

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	8	770	481	765	723	728	269	1076	1149
2	9241	9311	19676	12888	12608	10456	18210	14735	20783
3	25934	27086	25283	25198	33928	29127	46596	36246	27744
4	18854	28301	15825	21076	41452	24431	18884	51867	31682
5	13499	16996	11499	12836	19949	20248	14598	8750	27529
6	39605	13838	10276	10898	7816	10270	13806	6677	4528
7	5050	34079	7023	11437	6171	4859	7270	6753	2995
8	3091	4509	13864	11773	6375	4450	3993	4518	2674
9	4672	2747	3210	18503	5694	3941	6223	2498	2180
10	1868	5772	2471	4892	12955	3152	3024	2145	1103
11	3174	1522	2303	4635	2665	9661	1593	2025	826
12	933	2102	1536	5654	2099	1654	8071	909	915
13	990	752	1424	2687	1945	1659	1017	1374	314
14	362	721	627	2735	2836	1321	1574	372	1587
15	687	320	742	1188	1150	1258	1435	559	197
16	348	373	546	1475	705	709	1166	552	246
17+	1035	658	1397	3647	1931	1441	1864	1544	923
TOTAL	129331	148451	117983	152285	161002	129365	148993	148600	133375

	1978	1979	1980
1	307	604	944
2	26920	29072	28486
3	25638	58908	57207
4	23363	22818	32127
5	25659	21602	10026
6	18541	18476	7702
7	3154	14442	6912
8	2144	2665	5721
9	1771	2114	1358
10	2008	1834	1196
11	872	1330	789
12	535	805	844
13	582	673	326
14	226	557	270
15	1130	185	196
16	115	1113	80
17+	815	843	743
TOTAL	133780	178041	154927

Table 3.6. North Sea PLAICE (Females).
Fishing mortalities from VPA (M = 0.1).

	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0215	0.0071	0.0069	0.0385	0.1070	0.0195	0.0376	0.0214	0.0496
3	0.2436	0.1556	0.1764	0.1216	0.1934	0.2086	0.1217	0.1773	0.1906
4	0.2204	0.2914	0.2331	0.3872	0.2319	0.2686	0.2936	0.1929	0.2212
5	0.1690	0.1795	0.3862	0.3190	0.2601	0.2049	0.2144	0.3338	0.2097
6	0.2324	0.1496	0.2431	0.3725	0.2117	0.2587	0.1543	0.2570	0.1961
7	0.1928	0.1875	0.2545	0.1904	0.2238	0.2032	0.2074	0.1851	0.1589
8	0.1520	0.2626	0.2612	0.2538	0.1005	0.2303	0.1787	0.1368	0.1595
9	0.1469	0.1612	0.2128	0.2186	0.1604	0.1271	0.2258	0.2147	0.0992
10	0.1790	0.1754	0.1831	0.2428	0.1801	0.2256	0.1138	0.1916	0.1600
11	0.1630	0.1723	0.1779	0.2330	0.2239	0.2000	0.2416	0.1245	0.1433
12	0.1884	0.1802	0.1379	0.2972	0.1372	0.2723	0.2506	0.1860	0.1146
13	0.1876	0.2192	0.1996	0.1958	0.2346	0.2115	0.2539	0.2586	0.1715
14	0.1969	0.2076	0.2468	0.2122	0.1480	0.2739	0.2087	0.2362	0.2285
15	0.2826	0.2678	0.1790	0.1977	0.1291	0.1953	0.2623	0.1749	0.2074
16	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
17+	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
F(2-10),U	0.1731	0.1678	0.2175	0.2383	0.1854	0.1941	0.1719	0.1901	0.1605

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	0.0001	0.0040	0.0033	0.0066	0.0027	0.0034	0.0018	0.0083	0.0054
2	0.0822	0.0670	0.1193	0.1045	0.1291	0.0438	0.0995	0.1165	0.2606
3	0.2319	0.3244	0.2528	0.1974	0.3852	0.4324	0.2473	0.2611	0.2967
4	0.2138	0.3775	0.2844	0.2763	0.3039	0.4679	0.4900	0.4248	0.3398
5	0.2013	0.2712	0.2309	0.3492	0.4043	0.4368	0.4918	0.3917	0.3720
6	0.2221	0.2910	0.2336	0.3172	0.3303	0.3336	0.3318	0.3943	0.3207
7	0.1765	0.2751	0.2102	0.3905	0.2662	0.3133	0.3707	0.4775	0.2742
8	0.1220	0.2112	0.1509	0.3657	0.3487	0.2785	0.4063	0.3684	0.3123
9	0.1661	0.1363	0.2047	0.2744	0.5221	0.3356	0.6825	0.4755	0.2715
10	0.0903	0.1758	0.1569	0.4807	0.2801	0.5437	0.4124	0.4676	0.2998
11	0.2124	0.0889	0.1389	0.4328	0.4646	0.3098	0.5167	0.4742	0.2932
12	0.1294	0.1903	0.1095	0.3160	0.3165	0.5199	0.4080	0.5560	0.3614
13	0.1048	0.1313	0.1707	0.2529	0.2973	0.3931	0.6217	0.7080	0.3347
14	0.1205	0.0931	0.1385	0.3004	0.4082	0.3010	0.5799	0.4293	0.2822
15	0.2639	0.1413	0.1177	0.3717	0.3600	0.2842	0.5460	0.4366	0.3768
16	0.2000	0.2000	0.2000	0.3200	0.3500	0.3500	0.4100	0.3700	0.3100
17+	0.2000	0.2000	0.2000	0.3200	0.3500	0.3500	0.4100	0.3700	0.3100
F(2-10),U	0.1674	0.2366	0.2026	0.3284	0.3522	0.3539	0.4147	0.3697	0.3053

	1978	1979	1980
1	0.0011	0.0034	0.0032
2	0.1517	0.1264	0.1970
3	0.3779	0.5025	0.3460
4	0.3875	0.5993	0.5600
5	0.4491	0.6589	0.5090
6	0.4084	0.5996	0.4590
7	0.3439	0.5686	0.4150
8	0.2871	0.4826	0.4090
9	0.3123	0.4493	0.4300
10	0.3815	0.5427	0.4380
11	0.3643	0.4154	0.4200
12	0.2795	0.5934	0.4480
13	0.3652	0.5928	0.4510
14	0.3799	0.6260	0.4450
15	0.2964	0.5405	0.4140
16	0.3500	0.4700	0.4200
17+	0.3500	0.4700	0.4200
F(2-10),U	0.3444	0.5032	0.4114

Table 3.7. North Sea PLAICE (Females).
Stock size in numbers ('000) from VPA at 1 January.

	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	258847	206708	176207	186426	592419	179210	171242	168673	135859
2	233628	234214	187037	159439	168685	536045	162156	154946	152622
3	199598	206908	210423	168066	134818	137145	475677	141306	137234
4	105659	141564	160239	159609	134655	105521	100726	381077	107082
5	49142	75697	95715	114844	98054	96620	71609	67953	284349
6	57796	36795	57998	58259	75531	68401	71228	52292	44036
7	38278	41451	28664	41152	36695	55306	47782	35234	36593
8	31998	23562	31095	20119	30731	26546	40842	35137	41532
9	18006	24871	21105	21669	14116	25189	19078	30906	27729
10	19351	14067	19154	15436	15754	10880	20072	13773	22562
11	14607	14791	10680	14431	10956	11906	7856	16208	10290
12	10223	11228	11265	8038	10543	7925	8321	5583	12949
13	6717	7061	8484	8880	5437	8159	5401	6175	4194
14	5045	5038	5568	6288	6097	3891	5975	3833	4314
15	2104	2739	3488	3936	4602	5135	2077	4388	2739
16	1129	1476	1875	2639	2923	3663	3857	1864	3334
17+	2153	1985	1291	3710	10209	12090	9434	10695	8131
TOTAL	1052141	1056719	1030286	993581	1356585	1291651	1224413	1150045	1035549
SPAWN. ST.	361067	404888	459620	479650	456663	439254	415397	385119	409833

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	166751	203844	151259	121550	284144	223890	155730	136413	223066
2	122931	150875	183714	136407	109255	256416	201892	140655	122409
3	131413	102452	127669	147541	111182	80883	222077	165379	113272
4	102626	94296	87617	91526	109581	68444	51019	156918	113251
5	77666	74934	58497	45628	62822	59902	38790	28281	92841
6	208620	57461	51729	42017	29116	37935	35019	21464	17297
7	32751	151178	38866	37055	27684	18934	24590	18617	13093
8	28247	24839	103892	28501	22689	19194	12524	13359	10449
9	32041	32623	14196	80839	14647	14486	13146	7548	9615
10	22721	24555	17861	13417	55593	7862	9370	6011	4463
11	17598	18734	18637	13815	7507	38013	4121	5613	3408
12	8007	12729	13551	14676	8109	4269	25233	2229	3161
13	10447	6413	9522	12612	7927	5346	2297	15193	1157
14	3197	8513	5089	7264	8862	5328	3265	1116	6768
15	3106	2549	7018	4009	5935	5331	3568	1654	657
16	2014	2155	2002	5645	2501	2516	3630	1870	967
17+	5990	5808	8085	13957	6851	5113	5804	5230	3629
TOTAL	975986	962061	884603	816459	872454	859866	812085	729541	741503
SPAWN. ST.	554891	504891	421962	410961	367873	292677	232386	287094	282757

	1978	1979	1980	1981
1	284364	185346	310484	**********
2	200746	257012	167133	280040
3	85349	156078	204940	124187
4	76178	52926	85446	131199
5	74243	46785	26300	46894
6	57911	42871	21905	14305
7	11357	34830	21311	12525
8	9006	7286	17848	12733
9	6919	6115	4669	10729
10	6631	4581	3531	2395
11	2992	4097	2409	2062
12	2300	1881	2447	1432
13	1993	1574	940	1415
14	749	1251	787	542
15	4618	464	605	456
16	408	3107	244	362
17+	2892	2353	2269	1494
TOTAL	828657	808556	872669	
SPAWN. ST.	258198	210121	190112	

Table 3.8 North Sea PLAICE
Weight and age data for 1979 and 1980

	Male					Female			
	Catch		Stock			Catch		Stock	
Age	1979	1980	1979	1980	Age	1979	1980	1979	1980
1	.201	.239	.182	.130	1	.179	.230	.139	.100
2	.267	.281	.277	.214	2	.298	.290	.235	.233
3	.315	.326	.306	.305	3	.388	.369	.307	.310
4	.342	.364	.339	.360	4	.442	.457	.367	.441
5	.383	.427	.367	.440	5	.524	.538	.423	.565
6	.408	.470	.406	.469	6	.581	.647	.495	.612
7	.432	.472	.435	.470	7	.658	.644	.559	.690
8	.504	.498	.467	.488	8	.797	.727	.617	.717
9	.524	.530	.488	.536	9	.889	.861	.682	.852
10	.566	.596	.532	.690	10	.943	.876	.754	1.028
11	.504	.575	.548	.536	11	.917	1.055	.809	1.076
12	.530	.540	.559	.526	12	1.030	.980	.876	.932
13	.635	.507	.570	.673	13	1.123	1.187	.949	1.230
14	.544	.733	.587	.715	14	1.102	1.327	1.018	1.224
15^+	.595	.644	.673	.668	15	1.072	1.356	1.070	1.347
					16	1.283	1.301	1.097	1.449
					17^+	1.128	1.409	1.044	1.371

Units are kilogramme, fresh weight

Table 3.9 North Sea PLAICE
SOP check (males and females)

Year	Nominal catch	SOP	Ratio nom.catch/sop (%)
1960	87 493	85 791	102.0
1961	89 543	89 476	100.1
1962	87 943	116 789	75.3
1963	107 556	141 805	75.8
1964	109 987	116 191	94.7
1965	96 712	112 328	86.1
1966	100 129	111 927	89.5
1967	108 945	146 320	74.5
1968	111 934	124 718	89.7
1969	121 652	123 124	98.8
1970	130 344	142 996	91.2
1971	113 921	101 298	112.5
1972	123 150	130 227	94.6
1973	130 214	136 499	95.4
1974	112 545	116 517	96.6
1975	108 512	123 846	87.6
1976	112 981	141 997	79.6
1977	118 421	119 465	99.1
1978	113 866	121 851	93.4
1979	144 582	131 664	109.8
1980	138 992	136 671	101.7

Table 3.10 North Sea PLAICE
English catch per effort and estimated total effort 1960-1980

Year	Total catch (tonnes)	English Motor Trawl cpue[1]		Estimated Total Effort[x]	
		Jan.-March	Aug.-Nov.	Index 1 (Jan.-March)	Index 2 (Aug.-Nov.)
1960	84 493	5.23	3.20	16.7	27.3
1961	89 543	4.39	3.13	20.4	28.6
1962	87 943	4.02	3.67	21.9	24.0
1963	107 556	6.15	4.51	17.5	23.8
1964	109 987	6.56	4.49	16.8	24.5
1965	96 712	4.89	4.35	19.8	22.2
1966	100 129	7.67	5.19	13.1	19.3
1967	108 245	6.71	6.25	16.2	17.4
1968	111 934	6.07	5.14	18.4	21.8
1969	121 652	6.92	4.66	17.6	26.1
1970	130 344	6.26	4.99	20.8	26.1
1971	113 921	7.81	4.05	14.6	28.1
1972	123 150	5.73	3.88	21.5	31.7
1973	130 214	6.08	3.63	21.4	35.9
1974	112 545	3.86	2.80	29.2	40.2
1975	108 512	3.55	2.85	30.6	38.1
1976	112 981	3.24	3.43	34.9	32.9
1977	118 421	3.75	3.35	31.6	35.3
1978	113 866	4.56	3.85	25.0	29.6
1979	144 582	4.93	3.82	29.3	37.8
1980	138 992	4.37	2.97	31.8	46.8

1) Tonnes / (100 hours x BHP)
x) (Total catch ÷ tonnes/100 hours x BHP) x 1000

Table 3.11 North Sea PLAICE
Various indices of catch per unit effort

Year	English Motor Trawl. Mean 1st Quarter[1]					Belgium beam trawl[2]	Netherlands beam trawl[3]
	White Bank	P Buoys	Transition area	Flamborô	Southern Bight		
1960	12.6	10.9	10.1	7.1	6.3		
1961	10.7	10.5	8.3	3.1	4.6		
1962	9.2	9.1	7.1	4.9	4.9		
1963	14.1	10.5	6.6	5.5	4.5		
1964	13.8	14.4	7.9	8.2	5.2		
1965	11.5	10.9	8.8	9.9	4.7		
1966	14.9	12.0	9.1	6.3	2.0		
1967	13.7	11.3	11.1	7.7	3.4		
1968	9.3	10.7	11.2	6.3	3.4		
1969	12.7	(46.9)	10.1	6.5	6.0		
1970	17.0	17.0	13.5	4.4	2.9		5.0
1971	16.1	16.2	10.9	5.6	1.5	6.3	4.07
1972	15.5	14.4	11.1	3.2	2.2	6.4	4.74
1973	15.5	11.8	8.7	2.6	0.9	7.5	4.47
1974	12.2	8.4	6.2	2.4	2.4	7.2	4.06
1975	8.9	5.8	5.1	2.6	1.9	5.1	3.59
1976	9.0	11.0	6.0	1.4	2.7	4.0	3.68
1977	14.8	12.2	2.1	2.0	0.4	5.1	4.15
1978	13.3	15.5	11.1	1.3	1.9	4.7	4.51
1979	12.7	12.2	10.3	1.8	4.5	5.3	6.32
1980	12.9	13.3	10.9	0.6	1.1	5.5	5.82

1) (Tonnes/(100 hours x BHP)) x 1000

2) (Kg/(100 hours x BHP)) x 100

3) Total Netherlands catch ÷ corrected beam trawl hours Tonnes/(100 hours x fishing power)

Table 3.12 North Sea PLAICE
Output from separarable VPA analysis

	Male								Female				
	F_t=0.2		F_t=0.5		F_t=0.7		F_t=2.0		F_t=0.3		F_t = 0.5		F_t = 0.5
Trend in mean F_{2-10}	S=0.5	S=1.0	S=0.5	S=1.0	S=0.5	S=1.0	S=0.5	S=1.0	S=0.5	S=1.0	S=0.5	S=1.0	S=0.8
1970	.568	.569	.568	.576	.566	.577	.558	.577	.236	.243	.240	.248	
1971	.498	.500	.505	.500	.504	.513	.499	.514	.225	.227	.230	.233	.223
1972	.561	.564	.579	.583	.580	.586	.578	.591	.419	.420	.433	.435	.418
1973	.516	.521	.546	.549	.551	.554	.553	.562	.406	.407	.427	.428	.412
1974	.576	.585	.634	.636	.644	.646	.657	.663	.376	.377	.404	.403	.390
1975	.496	.509	.579	.580	.596	.596	.622	.623	.467	.471	.519	.518	.503
1976	.525	.543	.666	.669	.701	.699	.758	.753	.433	.441	.506	.507	.495
1977	.417	.434	.595	.598	.646	.645	.744	.734	.305	.311	.377	.377	.372
1978	.333	.346	.548	.550	.624	.619	.795	.773	.295	.297	.387	.384	.384
1979	.342	.350	.681	.683	.840	.835	1.340	1.296	.412	.413	.596	.592	.552
1980	.200	.200	.500	.500	.700	.700	2.000	2.000	.300	.300	.500	.500	.500
Exploitation Pattern													
Age 1	.009	.009	.009	.009	.009	.009	.009		.010	.009	.010	.010	.010
2	.138	.135	.160	.159	.168	.167	.190	.189	.270	.266	.282	.279	.306
3	.478	.470	.511	.507	.522	.518	.549	.546	.770	.763	.779	.774	.693
4	.805	.797	.824	.820	.830	.827	.844	.842	1.000	1.000	1.000	1.000	1.000
5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.003	1.016	.996	1.005	1.017
6	1.017	1.035	.995	1.004	.988	.995	.969	.972	.900	.923	.903	.918	.918
7	.915	.951	.911	.931	.909	.925	.902	.910	.794	.827	.803	.825	.830
8	.819	.876	.827	.862	.828	.857	.830	.846	.731	.777	.741	.773	.818
9	.781	.872	.799	.859	.803	.850	.813	.844	.746	.812	.758	.807	.860
10	.778	.923	.808	.915	.818	.913	.844	.908	.750	.845	.765	.838	.876
11	.571	.735	.598	.730	.608	.728	.633	.724	.682	.804	.697	.795	.840
12	.567	.806	.589	.794	.597	.791	.620	.780	.710	.886	.727	.875	.896
13	.545	.891	.558	.878	.563	.874	.578	.861	.665	.898	.682	.887	.903
14	.500	1.000	.500	1.000	.500	1.000	.500	1.000	.613	.916	.627	.907	.890
15									.544	.924	.552	.917	.828
16									.500	1.000	.500	1.000	.800
Residual ssq	22.639	23.052	20.141	20.228	19.416	19.395	17.898	17.465	15.655	15.499	15.200	14.884	15.79

Table 3.13 North Sea PLAICE.
Output from separarable VPA analysis
Exploitable Biomass (plus groups excluded)

Year	Male							Female				
	F = 0.2		F = 0.5		F = 0.7	F = 2.0		F = 0.3		F = 0.5		
	S = .5	S = 1.0	S = .5	S = 1.0	S = .5	S = .5	S = 1.0	S = .5	S = 1.0	S = .5	S = .8	S = 1.0
1970	128.1	122.8	125.5	121.6	125.0	124.2	121.1	318.4	304.6	309.6		299.7
1971	97.8	92.9	94.8	91.4	94.2	93.3	90.7	277.6	266.3	268.4	261.5	260.7
1972	84.4	78.9	80.5	76.8	79.7	78.5	75.9	269.1	255.5	257.5	249.3	248.5
1973	102.3	96.3	95.9	92.3	94.6	92.7	90.6	235.0	224.2	221.8	215.6	215.4
1974	91.5	85.4	82.8	79.5	81.2	78.7	76.9	207.1	196.2	191.0	184.9	184.5
1975	156.0	98.7	91.5	88.3	88.8	84.8	83.7	197.4	186.8	170.7	171.0	171.0
1976	147.6	136.6	117.6	113.4	112.3	104.2	103.3	218.2	206.0	187.1	180.7	180.7
1977	179.5	166.2	126.5	122.3	117.1	103.4	102.6	223.3	213.4	183.4	179.5	178.8
1978	202.1	187.8	121.4	117.6	107.2	86.5	86.0	221.0	211.7	170.3	164.7	166.5
1979	254.4	286.9	118.3	114.2	94.3	59.0	58.6	206.8	198.8	141.8	122.9	139.0
1980	497.2	474.7	181.8	178.2	125.7	40.8	41.1	258.3	249.6	151.4	149.9	149.1

Table 3.14 North Sea PLAICE
Exploitation pattern and terminal F for VPA trials

	Male				Female			
Age	E.P.	F_t for max F of 0.7	F_t for max F of 0.35	F_t for max F of 1.0	E.P.	F_t for max F of 0.5	F_t for max F of 0.22	F_t for max F of 0.80
1	.0094	.01	.00	.01	.0098	0.00	0.00	.01
2	.1683	.12	.06	.17	.3064	0.15	.06	.26
3	.5218	.37	.21	.50	.6929	0.35	.15	.56
4	.8300	.58	.35	.80	1.000	0.500	.22	.80
5	1.000	.70	.44	1.00	1.017	0.51	.22	.80
6	.9877	.69	.44	.98	.9179	0.46	.20	.73
7	.9090	.64	.41	.92	.8299	0.41	.18	.66
8	.8283	.58	.40	.90	.8175	0.41	.18	.65
9	.8033	.56	.39	.90	.8602	0.43	.19	.68
10	.8180	.57	.38	.89	.8762	0.44	.20	.70
11	.6075	.42	.28	.65	.8402	0.42	.19	.67
12	.5970	.42	.27	.63	.8958	0.45	.20	.71
13	.5630	.39	.25	.58	.9027	0.45	.20	.72
14	.5000	.35	.22	.50	.8898	0.44	.20	.72
15	.5000	.35	.22	.50	.8281	0.41	.18	.66
16					.8000	0.42	.18	.64
17					.8000	0.42	.18	.64
Mean F2-10 1980		.53	.34	.78		0.41	.18	.65

Table 3.15 North Sea PLAICE.
Comparison between total effort and mean F_{2-10} for trial VPA runs.

Year	Total effort index	Basic run		High run		Low run	
		Males	Females	Males	Females	Males	Females
1960	16.7	.29	.17	.29	.17	.29	.17
1961	20.4	.33	.16	.33	.17	.33	.17
1962	21.9	.33	.21	.34	.22	.34	.22
1963	17.5	.41	.23	.42	.24	.42	.24
1964	16.8	.36	.18	.37	.29	.37	.18
1965	19.8	.37	.18	.38	.20	.38	.19
1966	13.1	.34	.16	.36	.17	.36	.17
1967	16.2	.41	.18	.43	.19	.43	.19
1968	18.4	.31	.15	.33	.16	.33	.16
1969	17.6	.35	.16	.37	.17	.37	.16
1970	20.8	.47	.23	.49	.24	.49	.23
1971	14.6	.39	.20	.41	.20	.40	.20
1972	21.5	.42	.32	.44	.33	.44	.31
1973	21.4	.48	.35	.49	.36	.48	.33
1974	29.2	.51	.35	.52	.36	.51	.32
1975	30.6	.44	.41	.46	.44	.43	.36
1976	34.9	.56	.37	.58	.40	.54	.30
1977	31.6	.46	.31	.49	.34	.42	.23
1978	25.0	.52	.35	.57	.41	.46	.23
1979	29.3	.71	.47	.85	.61	.56	.26
1980	31.8	.53	.41	.78	.65	.34	.18

Table 3.16 North Sea PLAICE.
Total effort - fishing mortality correlation data.

Run 1				
Males	$\bar{F}_{2-10}$ = 0.53	y = 0.1333 + 0.1286b,	r = 0.719 ⁂	1980 F → 0.54
Females	$\bar{F}_{2-10}$ = 0.41	y = -0.0726+0.0149b,	r = 0.829 ⁂⁂	1980 F → 0
Run 2				
Males	$\bar{F}_{2-10}$ = 0.78	y = 0.1381 + 0.0132b	r = 0.703⁂	1980 F → 0.56
Females	$\bar{F}_{2-10}$ = 0.65	y = -0.0700+0.0157b,	r = 0.812 ⁂⁂	1980 F → 0.43
Run 3				
Males	$\bar{F}_{2-10}$ = 0.34	y = 0.1587 + 0.0120b,	r = 0.641⁂	1980 F → 0.54
Females	$\bar{F}_{2-10}$ = 0.18	y = -0.0105+0.0116b,	r = 0.759 ⁂⁂	1980 F → 0.36

Table 3.17 North Sea PLAICE. Summary of output data from the VPA.

Year	Spawning stock biomass in tonnes			Total biomass in tonnes	Recruitment age 1		$\bar{F}_{(2-10)}$	
	♂	♀	Total	♂ + ♀	♂	♀	♂	♀
1960	157.7	234.0	391.7	566.3			.29	.17
1961	179.0	248.4	424.7	585.6	212.3	206.7	.33	.16
1962	147.0	203.2	350.2	454.4	170.8	176.2	.33	.21
1963	147.5	217.7	365.2	453.6	172.9	186.4	.41	.23
1964	176.4	261.6	438.0	656.2	561.9	592.4	.36	.18
1965	212.2	240.7	452.9	611.9	155.2	179.2	.37	.18
1966	214.4	241.8	456.3	627.5	151.3	171.2	.34	.16
1967	173.5	267.0	440.5	519.0	132.8	168.7	.41	.18
1968	180.5	316.7	497.2	583.6	112.2	135.9	.31	.15
1969	182.2	337.1	519.3	622.9	155.1	166.7	.35	.16
1970	153.2	298.7	451.9	522.2	176.5	203.8	.47	.23
1971	163.9	330.2	494.1	620.2	150.2	151.3	.39	.20
1972	132.9	283.9	416.8	512.8	126.4	121.6	.42	.32
1973	128.8	235.2	364.0	498.4	325.7	284.1	.48	.35
1974	152.1	199.8	351.9	494.1	277.6	223.9	.51	.35
1975	152.9	149.9	302.8	439.1	193.4	155.7	.44	.41
1976	148.5	136.1	284.6	378.2	150.9	136.4	.56	.37
1977	163.5	159.4	322.9	439.8	262.2	172.0	.46	.31
1978	159.9	141.2	301.1	435.6	350.4	284.4	.52	.35
1979	232.2	123.4	355.6	573.3	379.8	233.5	.71	.47
1980	230.9	113.9	344.8	488.7	48.2	198.9	.53	.41

Table 3.18 North Sea PLAICE.
Comparison between "Tridens" pre-recruit survey data and VPA recruitment estimates.

Year class	I Group autumn	II Group spring	VPA ♂ + ♀ x 10^{-3}
1968			321817
1969	8033	16452	380297
1970	8100	8736	301491
1971	6436	43774	247966
1972	57238	15583	609804
1973	15648	4993	501569
1974	9781	3424	349076
1975	12637	27634	287321
1976	19119	7039	485100
1977	13924	10778	638337
1978	21681	37466	384249
1979	59672		652991
1980	19611		

Regression I group 1969-76: $y = 7.47x + 267369$

II group 1968-76: $y = 9.36x + 237869$

Prediction values:

	1977 year class	1978 year class	1979 year class	1980 year class
From I group	371427	429397	713314	413927
From II group	303772	338739	588646	

Sex ratio period 1968-76: $^{\text{Males}}/_{\text{Females}} = 0.518$

Table 3.19 North Sea PLAICE.
Comparison between VPA index of 1 year old recruits and Lowestoft catch per effort of age group 3 for 1970-80

Year class	Cpue index x)		VPA index age 1 (10^6)	
	♂	♀	♂	♀
1967	12.98	9.15	112.2	135.9
1968	16.52	10.17	155.1	166.7
1969	8.93	10.75	176.5	203.8
1970	11.73	13.48	150.2	151.3
1971	11.76	12.90	126.4	121.6
1972	36.37	26.15	325.6	284.1
1973	17.53	17.81	272.6	223.9
1974	3.62	7.15	193.4	155.7
1975	8.62	9.81	150.9	136.4
1976	17.51	17.48	262.2	172.0
1977	20.7	25.6	350.4	284.4

More or less comparable to 1972 year class.

x) Catch in thousands $\div[(\text{hours} \times \text{BHP}) \div 1 \times 10^6]$

Males: $y = 110.995 + 6.553b$, $r = 0.701$ ⁎

Females: $y = 73.928 + 7.620b$, $r = 0.861$ ⁎⁎⁎

Table 3.20 North Sea PLAICE.
Input data for catch prognosis. Males: F = 0.7 Females: F = 0.509
Last group is a plus group.

Age	MALES				FEMALES			
	No. x 10^3	Exploitation pattern	Catch weight	Stock weight	No. x 10^3	Exploitation pattern	Catch weight	Stock weight
1	342 507	.002	.220	.156	310 484	0.006	.204	.120
2	179 277	.348	.274	.245	167 133	0.387	.294	.234
3	261 365	.522	.320	.306	204 940	0.680	.379	.309
4	106 058	.830	.351	.350	85 446	0.982	.450	.401
5	28 288	1.000	.405	.390	26 300	1.000	.531	.494
6	20 756	.988	.439	.430	21 905	0.902	.614	.560
7	14 885	.909	.452	.465	21 311	0.815	.651	.640
8	6 321	.828	.501	.495	17 848	0.804	.762	.710
9	1 148	.803	.527	.525	4 069	0.845	.875	.780
10	324	.818	.581	.550	3 531	0.861	.910	.850
11	563	.608	.540	.575	2 409	0.825	.986	.925
12	990	.597	.535	.600	2 447	0.880	1.005	.990
13	306	.563	.571	.620	940	0.886	1.155	1.060
14	35	.500	.639	.640	787	0.874	1.244	1.120
15	624	.500	.620	.670	605	0.813	1.214	1.180
16					244	0.825	1.292	1.240
17					2 269	0.825	1.269	1.300
Recruitment								
1980	342 507				310 484			
1981	214 414				199 513			
1982	187 600				189 700			
1983	187 600				189 700			

Table 3.21 North Sea PLAICE.
Input data for yield and spawning stock biomass per recruit calculations.

		Catch weight		Spawning stock	
		Males	Females	Males	Females
Average pattern	.0	.000	.000	4.723	6.987
	.1	.159	.265	2.568	2.855
	.2	.211	.312	1.782	1.573
	.3	.232	.319	1.321	1.009
	.5	.245	.314	.949	.409
	1.0	.249	.297	.648	.187
	1.5	.248	.287	.535	.090
	2.0	.247	.281	.471	.048
	2.5	.246	.276	.429	.028
Changed pattern	.0	.000	.000	4.723	6.988
	.1	.086	.232	3.509	3.371
	.2	.140	.293	2.696	1.956
	.3	.175	.300	2.132	1.261
	.5	.213	.311	1.440	.629
	1.0	.242	.297	.760	.184
	1.5	.247	.288	.544	.072
	2.0	.248	.282	.455	.032
	2.5	.248	.278	.409	.015

Table 4.1 English Channel SOLE.
Nominal catch (in tonnes) in Divisions VIId and VIIe, 1969-80.

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	304	45	-	970[1]	483[1]	-	13	278[2]	764	1 553	1 305

1) Figures supplied by French Working Group member.

2) Official figure + 120 tonnes unreported, estimated by the English Working Group member.

Bracketed figures are those used in the assessments.

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	cpue by U.K. vessels < 40'			
				Hastings trawl	Hastings trammel	Rye trawl	Eastbourne trammel
1972	921	8.1	113.7	8.45	-	5.32	10.73
1973	1 000	8.2	122.0	8.38	-	4.53	19.65
1974	940	9.5	98.9	8.04	-	7.59	11.42
1975	841	7.9	106.5	8.84	12.84	6.60	7.23
1976	1 206	11.3	106.7	8.56	10.98	9.86	8.56
1977	1 277	9.8	130.3	8.85	9.66	5.98	7.21
1978	1 389	9.4	147.8	10.30	13.71	9.04	8.37
1979	1 842	15.0	122.8	9.45	11.95	8.34	12.29
1980	1 553	9.7	160.1	7.23	8.74	-	-

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

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.0	0.0	0.0	0.0	0.0	33.4	44.7	371.0	317.1
2	90.7	37.7	487.3	539.7	21.3	606.1	1681.2	1812.7	896.0
3	802.9	545.1	317.5	551.0	763.6	1208.2	761.8	2362.2	3675.8
4	52.5	226.5	756.4	518.1	416.7	711.7	836.8	550.1	1579.1
5	41.1	0.0	257.9	483.6	134.6	240.0	234.6	317.9	405.6
6	11.4	48.3	45.3	75.1	407.1	64.0	105.0	298.9	217.9
7	82.1	0.0	77.0	99.3	112.5	271.6	46.1	90.5	178.1
8	744.7	48.3	62.7	10.1	50.6	62.2	95.6	53.9	49.0
9	35.4	875.7	172.2	40.8	15.8	36.6	45.2	56.7	27.6
10	17.7	24.1	282.6	55.6	26.2	12.4	27.7	35.8	59.0
11	94.2	0.0	65.9	158.4	26.1	8.0	21.6	27.8	19.0
12	99.9	43.8	84.1	44.9	171.3	25.5	11.6	18.5	24.4
13	152.3	57.3	115.9	8.3	21.9	200.4	31.6	12.4	8.3
14	187.7	61.9	31.8	52.6	29.7	5.4	114.5	33.5	27.4
15+	246.0	303.5	125.4	157.2	184.2	154.3	107.3	127.6	142.0
TOTAL	2658.6	2272.2	2882.0	2594.7	2381.6	3639.8	4165.3	6169.5	7626.3

	1980
1	72.6
2	1153.1
3	804.8
4	2059.7
5	710.4
6	198.4
7	163.2
8	48.2
9	110.1
10	25.2
11	52.7
12	16.0
13	20.5
14	15.6
15+	130.3
TOTAL	5580.8

Table 4.4 SOLE in Division VIId. Estimates of catch weights at age

Age	Average 1971-80			
	Male	Female	Sexes combined	
			weighted average	smoothed
1	.140	.180	.119	.119
2	.157	.174	.192	.190
3	.198	.275	.241	.245
4	.243	.355	.304	.302
5	.285	.461	.342	.355
6	.309	.516	.413	.410
7	.328	.557	.461	.455
8	.323	.606	.498	.493
9	.336	.624	.546	.525
10	.363	.731	.531	.550
11	.415	.627	.552	.565
12	.394	.673	.533	.578
13	.448	.740	.621	.590
14	.387	.679	.580	.595
15+	.454	.747	.649	.620

Table 4.5 SOLE in Division VIId.
Biomass and recruitment

Year	Recruits at age 1 x 1000	Total biomass*	Spawning stock* biomass	SOP correction
1971	1955	8425	7800	.83
1972	4542	8335	7861	.91
1973	4564	6685	5949	.93
1974	5350	7581	6698	1.06
1975	4985	6878	6018	.95
1976	12265	7834	6402	1.04
1977	15684	8770	6186	1.09
1978	4550	7079	5406	.86
1979	7708	7530	6684	.87
1980	19599	7968	6027	.92

* Corrected for SOP discrepancies in each year
Average correction factor = .94

Mean recruitment at age 1 = 6845 over years 1971-79
= 4807 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)

Table 4.7. SOLE in Division VIId.
Fishing mortalities from VPA (M = 0.1)

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.089	0.044
2	0.018	0.023	0.133	0.148	0.005	0.152	0.174	0.144	0.287
3	0.417	0.128	0.239	0.195	0.285	0.343	0.259	0.348	0.427
4	0.050	0.176	0.235	0.355	0.199	0.415	0.376	0.269	0.368
5	0.057	0.000	0.278	0.207	0.223	0.151	0.208	0.213	0.289
6	0.013	0.079	0.056	0.109	0.241	0.141	0.082	0.393	0.198
7	0.067	0.000	0.156	0.150	0.211	0.224	0.128	0.085	0.382
8	0.160	0.046	0.092	0.025	0.096	0.155	0.103	0.194	0.055
9	0.114	0.254	0.205	0.072	0.044	0.084	0.145	0.074	0.129
10	0.030	0.095	0.109	0.085	0.054	0.040	0.076	0.147	0.092
11	0.096	0.000	0.358	0.074	0.047	0.019	0.082	0.092	0.097
12	0.232	0.053	0.195	0.392	0.096	0.053	0.051	0.085	0.098
13	0.192	0.181	0.174	0.024	0.299	0.140	0.078	0.038	0.045
14	0.100	0.100	0.130	0.100	0.100	0.100	0.100	0.100	0.100
15+	0.100	0.100	0.130	0.100	0.100	0.100	0.100	0.100	0.100
F(3- 8),U	0.127	0.072	0.176	0.174	0.209	0.238	0.193	0.250	0.286

	1980
1	0.004
2	0.200
3	0.400
4	0.400
5	0.250
6	0.200
7	0.200
8	0.150
9	0.150
10	0.150
11	0.100
12	0.100
13	0.100
14	0.100
15+	0.100
F(3- 8),U	0.267

Table 4.8. SOLE in Division VIId.
Stock size in numbers ('000) from VPA at 1 January.

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	1955.3	4542.1	4564.4	5349.8	4984.7	12265.2	15683.6	4550.5	7708.5
2	5358.9	1769.2	4109.9	4130.1	4840.7	4510.4	11066.3	14148.6	3765.0
3	2464.5	4762.7	1565.0	3255.9	3224.5	4359.8	3505.6	8416.9	11080.6
4	1121.7	1469.2	3791.7	1114.8	2423.0	2193.3	2799.3	2449.2	5376.4
5	781.7	965.1	1114.3	2713.1	707.1	1796.9	1310.2	1739.7	1694.2
6	926.4	668.2	873.2	763.6	1995.8	512.1	1398.0	962.8	1272.4
7	1331.6	827.4	558.8	747.1	619.6	1419.6	402.6	1165.2	587.9
8	5300.4	1126.9	748.7	432.5	581.7	453.9	1026.7	320.5	968.3
9	345.4	4088.8	973.7	617.8	381.7	478.2	351.6	838.2	238.8
10	627.0	278.9	2868.8	717.6	520.3	330.4	398.0	275.2	704.6
11	1081.7	550.5	229.5	2327.3	596.5	445.9	287.1	333.8	215.0
12	505.7	889.3	498.1	145.2	1955.3	514.9	395.8	239.3	275.6
13	914.6	362.7	763.0	370.9	88.8	1606.5	441.7	347.1	198.9
14	2071.0	683.0	273.8	580.4	327.7	59.6	1265.3	369.6	302.3
15+	2714.2	3348.6	1079.8	1734.4	2032.3	1702.4	1185.9	1407.9	1566.7
TOTAL	27499.9	26332.6	24012.7	25000.4	25279.8	32649.0	41513.6	37564.4	35955.2
SPAWN. ST.	20185.7	20021.2	15338.4	15520.6	15454.4	15873.4	14763.8	18865.4	24481.8

	1980	1981
1	19110.2	**********
2	6673.5	17222.6
3	2556.7	4943.9
4	6543.4	1550.7
5	3367.8	3968.8
6	1148.2	2373.3
7	944.5	850.6
8	363.2	699.7
9	829.6	282.8
10	189.9	646.1
11	581.5	147.9
12	176.5	476.1
13	226.2	144.5
14	172.1	185.2
15+	1437.6	1318.0
TOTAL	44320.9	
SPAWN. ST.	18537.3	

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

LIST OF F-FACTORS AND RECRUITMENT BY YEAR:

YEAR	F-FACTOR	RECRUITMENT
80	0.4000	**********
81	0.4000	4800.00
82	0.0000	4800.00
83	0.0000	4800.00

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	20000.00	0.0010	0.100	0.0000	0.1190	0.0700
2	6673.50	0.5000	0.100	0.0000	0.1900	0.1150
3	2556.70	1.0000	0.100	1.0000	0.2450	0.2170
4	6543.40	1.0000	0.100	1.0000	0.3020	0.2750
5	3367.80	0.6250	0.100	1.0000	0.3550	0.3290
6	1148.20	0.5000	0.100	1.0000	0.4100	0.3820
7	944.50	0.5000	0.100	1.0000	0.4550	0.4320
8	363.20	0.3750	0.100	1.0000	0.4930	0.4760
9	829.60	0.3750	0.100	1.0000	0.5250	0.5080
10	189.90	0.3750	0.100	1.0000	0.5500	0.5340
11	581.50	0.2500	0.100	1.0000	0.5650	0.5580
12	176.50	0.2500	0.100	1.0000	0.5780	0.5720
13	226.20	0.2500	0.100	1.0000	0.5900	0.5830
14	172.10	0.2500	0.100	1.0000	0.5950	0.5920
15+	1437.60	0.2500	0.100	1.0000	0.6200	0.6200

Table 4.10 SOLE in Division VIId.
Results of catch predictions.

1980	Total landings	1 684 t	
	Total stock biomass	8 723 t	
	Spawning stock biomass	6 555 t	
1981	Total landings	1 892 t	(TAC = 1 200 t)
	Total stock biomass	8 683 t	
$F_{81} = F_{80}$	Spawning stock biomass	6 267 t	
1982	Total stock biomass	8 810 t	
	Spawning stock biomass	7 975 t	

F_{82}	$F_{82/80}$	Landings 1982	Spawning stock biomass 1983
0.	0.	0.	9 209
0.08	0.2	472.6	8 717
0.16	0.4	916.2	8 256
0.24	0.6	1 332.7	7 824
0.32	0.8	1 724.0	7 419
0.40	1.0	2 091.8	7 039
0.48	1.2	2 437.8	6 682
0.56	1.4	2 763.3	6 346
0.64	1.6	3 069.7	6 031
0.72	1.8	3 358.4	5 735
0.80	2.0	3 630.4	5 457

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

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 [illegible] (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	396.2	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	148.8	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	28.6	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	1323.3	1446.3	1202.7	1428.7	1761.4	1782.2

	1978	1979	1980
1	0.0	0.0	0.0
2	227.8	209.3	175.4
3	1120.8	766.3	563.7
4	383.5	688.9	595.2
5	207.7	174.8	620.9
6	197.2	325.5	145.6
7	102.4	192.6	190.1
8	85.8	78.6	136.8
9	73.0	111.2	72.3
10	37.1	106.1	65.4
11	25.1	20.8	139.1
12	19.3	28.0	39.1
13	11.9	58.9	23.2
14	11.5	7.1	39.7
15+	144.4	240.9	225.6
TOTAL	2647.5	3009.0	3032.1

Table 5.3 SOLE in Division VIIe.
Weight at age in the catch; averages of the 1969 to 1980 values, weighted for catch number in the case of the combined values; not smoothed.

Age	Males	Females	Combined
1	.147	.114	.132
2	.172	.199	.186
3	.210	.248	.230
4	.258	.322	.299
5	.283	.392	.358
6	.310	.446	.403
7	.339	.513	.433
8	.379	.543	.474
9	.377	.604	.508
10	.372	.595	.511
11	.414	.654	.530
12	.493	.704	.623
13	.438	.680	.554
14	.498	.707	.721

Table 5.4 Sums of products discrepancies for Division VIIe SOLE (landing -SOP x 100).

Year	Summed male + female	Combined male + female
1969	96.8	100.0
1970	94.4	98.8
1971	93.4	93.9
1972	96.1	94.3
1973	93.2	92.5
1974	98.2	99.1
1975	100.6	98.8
1976	97.8	94.6
1977	102.9	100.7
1978	103.4	101.0
1979	110.8	108.7
1980	110.8	113.7

Table 5.5. SOLE in Division VIIe.
Fishing mortalities from VPA (M = 0.1).

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.001	0.001
2	0.051	0.035	0.013	0.057	0.034	0.013	0.020	0.071	0.062
3	0.142	0.162	0.162	0.122	0.193	0.209	0.192	0.137	0.253
4	0.140	0.185	0.231	0.176	0.163	0.140	0.136	0.220	0.184
5	0.186	0.206	0.149	0.145	0.120	0.084	0.187	0.150	0.147
6	0.106	0.134	0.204	0.106	0.160	0.120	0.067	0.190	0.136
7	0.041	0.068	0.167	0.056	0.141	0.167	0.036	0.064	0.129
8	0.055	0.029	0.115	0.064	0.077	0.062	0.200	0.083	0.075
9	0.047	0.045	0.025	0.123	0.165	0.188	0.045	0.237	0.029
10	0.115	0.114	0.052	0.116	0.033	0.099	0.162	0.114	0.144
11	0.063	0.158	0.150	0.096	0.015	0.070	0.144	0.129	0.086
12	0.025	0.132	0.140	0.083	0.065	0.051	0.050	0.112	0.163
13	0.051	0.115	0.248	0.180	0.173	0.042	0.090	0.118	0.141
14	0.052	0.070	0.082	0.077	0.066	0.067	0.074	0.103	0.092
15+	0.052	0.070	0.082	0.077	0.066	0.067	0.074	0.103	0.092
F(3- 8),U	0.112	0.131	0.171	0.112	0.143	0.130	0.136	0.141	0.154

	1978	1979	1980
1	0.000	0.000	0.000
2	0.081	0.122	0.100
3	0.309	0.378	0.484
4	0.397	0.283	0.500
5	0.137	0.282	0.393
6	0.170	0.293	0.356
7	0.169	0.223	0.248
8	0.157	0.170	0.218
9	0.068	0.278	0.208
10	0.122	0.120	0.234
11	0.166	0.084	0.205
12	0.056	0.252	0.201
13	0.199	0.218	0.305
14	0.115	0.157	0.200
15+	0.115	0.157	0.200
F(3- 8),U	0.223	0.271	0.367

Table 5.6. SOLE in Division VIIe.
Stock size in numbers ('000) from VPA at 1 January.

	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	1783.3	4654.6	3061.3	2452.0	3869.5	3575.8	2292.9	5745.3	3383.7
2	1888.4	1613.6	4211.6	2769.5	2218.7	3501.2	3235.2	2069.3	5193.8
3	2547.2	1624.3	1409.3	3762.7	2367.4	1940.0	3125.7	2869.3	1744.8
4	640.3	1999.3	1249.5	1084.8	3013.6	1766.0	1424.0	2334.7	2263.6
5	919.1	503.7	1503.2	897.4	822.8	2315.6	1389.0	1124.5	1695.5
6	2189.8	690.7	370.8	1172.0	702.4	660.1	1926.3	1042.9	876.1
7	548.9	1782.2	546.4	273.7	953.6	541.8	529.6	1629.6	780.5
8	965.1	476.5	1505.9	418.5	234.1	749.1	414.8	462.4	1383.6
9	588.6	826.1	419.0	1214.8	355.2	196.0	637.2	307.3	384.9
10	195.0	508.4	714.5	369.8	972.4	272.4	147.0	551.3	219.3
11	151.9	157.4	410.5	613.6	298.0	851.3	223.3	113.1	444.9
12	451.5	129.0	121.6	319.7	504.3	265.8	718.1	174.9	90.0
13	198.7	398.4	102.3	95.7	266.2	427.8	228.4	618.1	141.4
14	340.0	170.9	321.5	72.3	72.4	202.6	371.0	188.8	497.0
15+	551.4	711.5	696.3	874.3	1009.7	1037.2	1208.8	1592.0	1083.5
TOTAL	13959.2	16246.5	16643.6	16390.8	17660.1	18302.5	17871.1	20823.4	20182.7
SPAWN. ST.	10287.5	9978.3	9370.7	11169.3	11571.9	11225.5	12343.0	13008.7	11605.2

	1978	1979	1980	1981	1969-1978
1	2120.9	2138.8	0.0	**********	3293.9
2	3059.9	1919.1	1935.2	0.0	2976.1
3	4417.2	2552.2	1537.7	1584.4	2580.8
4	1226.3	2933.9	1583.0	857.5	1700.2
5	1703.7	746.1	2001.2	868.8	1287.4
6	1325.0	1344.3	509.3	1222.3	1095.6
7	691.9	1011.6	907.6	522.8	827.8
8	620.4	528.8	732.6	640.9	723.0
9	1161.3	479.9	403.9	533.0	609.1
10	338.2	981.4	328.8	296.8	428.8
11	171.8	270.8	787.3	235.4	343.6
12	369.2	131.6	225.3	580.3	314.4
13	69.2	315.7	92.5	166.7	254.6
14	111.1	51.3	229.8	61.7	234.7
15+	1395.5	1740.0	1305.6	1137.5	1016.0
TOTAL	18781.6	17145.7	12579.7		
SPAWN. ST.	13600.8	13087.8	10644.5		

Table 5.7. SOLE in Division VIIe.
Input data for catch predictions.

LIST OF F-FACTORS AND RECRUITMENT BY YEAR:

YEAR	F-FACTOR	MAXIMUM RECRUITMENT	AVERAGE RECRUITMENT	MINIMUM RECRUITMENT
80	0.5000	**********		
81	0.5878	5700.00	3300.00	1800.00
82	1.0000	5700.00	3300.00	1800.00

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	4900.00	0.0010	0.100	0.0000	0.1320	0.0080
2	1935.20	0.2010	0.100	0.0000	0.1860	0.1620
3	1537.70	0.9690	0.100	1.0000	0.2300	0.2230
4	1583.00	1.0000	0.100	1.0000	0.2990	0.2650
5	2001.20	0.7860	0.100	1.0000	0.3580	0.3230
6	509.30	0.7120	0.100	1.0000	0.4030	0.3800
7	907.60	0.4970	0.100	1.0000	0.4330	0.4200
8	732.60	0.4360	0.100	1.0000	0.4740	0.4550
9	403.90	0.4160	0.100	1.0000	0.5080	0.4920
10	328.80	0.4690	0.100	1.0000	0.5300	0.5200
11	787.30	0.4100	0.100	1.0000	0.5450	0.5430
12	225.30	0.4030	0.100	1.0000	0.5600	0.5550
13	92.50	0.6100	0.100	1.0000	0.5700	0.5650
14	229.80	0.4000	0.100	1.0000	0.5800	0.5700
15+	1305.60	0.4000	0.100	1.0000	0.7210	0.7210

Table 5.8 Division VIIe SOLE.
Catch predictions; average recruitment 1980 and 1981 year classes, 1979 year class 1.5 times average.

1980	Catch weight	1 137	
	Total stock	4 716	
(F_4 = 0.5)	Spawning stock	4 364	
1981	Catch weight	1 100	(constraint)
	Total stock	4 312	
(F_4 = .5878)	Spawning stock	3 568	
1982	Total stock	3 785	
	Spawning stock	3 275	

F_{max}	F_{82}/F_{80}	Catch weight 1982	Spawning stock 1983
0.	0.	0.	3 853
0.1	0.2	211.5	3 635
0.2	0.4	408.9	3 432
0.3	0.6	593.1	3 243
0.4	0.8	765.2	3 066
0.5	1.0	926.1	2 902
0.6	1.2	1 076.7	2 748
0.7	1.4	1 217.7	2 604
0.8	1.6	1 349.9	2 470
0.9	1.8	1 473.8	2 344
1.0	2.0	1 590.1	2 226

Table 6.1 English Channel PLAICE
Nominal catch (tonnes) in Divisions VIId and VIIe, 1962-1980

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

※ 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 statis

Table 6.2. PLAICE in Divisions VIId+e (Males).
Age composition of total catch 1971-80 ('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	363	145	600
5	532	315	782	150	302	129	119	82	127
6	362	443	165	37	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	3366	3808	3910

	1980
1	222
2	3286
3	1590
4	367
5	183
6	41
7	23
8	46
9	35
10	5
11	16
12+	6
TOTAL	5820

Table 6.3. PLAICE in Divisions VIId+e (Females).
Age composition of total catch in 1971-80 ('000).

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0	2	1	9	1	196	51	35	48
2	198	253	68	476	983	355	1964	639	891
3	851	717	679	1716	994	1040	616	1578	1293
4	330	400	861	794	402	475	584	164	1017
5	344	215	480	1324	316	286	271	192	117
6	316	340	203	336	235	185	81	61	130
7	309	51	74	223	86	188	47	65	112
8	574	221	17	65	66	70	83	69	79
9	153	134	111	99	33	30	52	36	78
10	280	85	102	183	38	42	23	20	68
11	142	35	12	106	18	17	26	25	33
12+	142	105	24	88	85	24	12	7	23
TOTAL	3639	2558	2632	5419	3257	2908	3810	2891	3889

	1980
1	285
2	2064
3	1437
4	490
5	445
6	92
7	54
8	45
9	21
10	36
11	36
12+	27
TOTAL	5032

Table 6.4 PLAICE in Divisions VIId and VIIe.
Catch weight at age data for 1980 (whole weight).

Age	MALES				FEMALES			
	U.K.	France	Belgium	Total catch mean weight	U.K.	France	Belgium	Total catch mean weight
1	283.8	191.3	207.4	199.5	350.9	218.3	290.6	230.5
2	313.5	269.9	316.4	279.3	361.4	298.5	456.8	314.5
3	385.9	357.3	329.4	355.3	535.1	464.2	543.2	488.5
4	481.6	402.5	329.4	425.9	705.7	585.4	853.2	631.2
5	694.8	563.7	423.4	601.6	835.5	650.6	945.0	726.2
6	912.8	584.5	460.1	742.1	1 063.5	806.2	1 072.4	888.2
7	677.3	591.0		635.0	1 236.2	956.7	1 008.7	1 118.0
8	610.3	593.0		595.0	1 389.6	999.7	1 359.7	1 164.2
9	865.2	694.0		698.0	1 392.3	1 141.0	1 047.6	1 194.1
10	621.2	517.0		566.1	1 503.7	1 073.9	1 131.4	1 265.8
11	818.2	694.0		723.4	1 309.0	1 008.4	1 681.6	1 279.2
12	517.3	513.0		514.7	1 512.1	1 525.5	1 236.6	1 437.7
13	1 127.8	1 080.0		1 099.7	1 781.8	1 652.4	1 642.7	1 709.1
14	-				1 774.4	1 083.5	989.3	1 294.0
15	725.0	602.0		651.1	1 669.9	1 291.8	1 293.8	1 458.0
16	879.8	694.0		780.8	1 857.1	1 453.0	934.2	1 684.9
17	905.2	694.0		767.9	1 756.3	1 686.8	1 327.3	1 712.3
18	604.2	477.0		534.9	1 993.9	1 491.0		1 917.1

Table 7.1 SOLE SELECTIVITY EXPERIMENTS - NORTH SEA

Country	Year	Month	Area surveyed	Method	No. of hauls	Mean tow duration (min.)	HP of vessel	Mesh opening (mm)	Sel. factor	Sel. range	50% ret.length	No. of soles caught	No. of soles in sel.range
Netherl.	1979	Nov.	South.Bight	Parallel haul	26	52	1235	80.1	3.2	2.7	25.4	644	61
"	"	"	"	"	19	123	"	80.3	3.2	4.6	26.0	772	149
"	"	Oct.	N. of Ameland	"	12	23	"	81.0	3.2	5.0	25.6	346	115
"	"	Nov.	South.Bight	"	16	75	"	82.9	3.0	4.2	24.9	593	57
"	"	Dec.	"	"	15	60	"	83.9	3.3	3.6	27.9	350	86
"	"	Dec.	Engl. east coast	"	17	113	"	86.5	3.4	4.3	29.1	1 458	585
"	"	Nov.	South.Bight	"	15	74	"	101.3	3.0	4.1	30.1	557	184
								Mean:	3.2	4.1			
							IRISH SEA						
Netherl.	1980	Aug-Sep	SE Irish B.	Whole cover	23	132	1015	72.0	3.3	4.3	23.4	3 180	1 335
"	"	"	"	"	20	125	"	80.4	3.4	3.6	27.2	3 118	1 411
"	"	"	"	Parallel haul	6	111	"	82.0	3.6	3.0	29.4	992	193
"	"	"	"	Whole cover	12	124	"	85.1	3.4	3.2	29.3	1 832	326
								Mean:	3.4	3.5			
Netherl.	1980	Oct.	SE Irish B.	Whole cover	8	107	1700	65.3	3.4	-	22.4	5 476	-
"	"	"	"	"	16	124	"	76.0	3.2	6.3	24.0	14 486	10 457
"	"	"	"	"	12	108	"	84.6	3.1	6.1	26.2	9 459	6 557
"	"	"	"	"	2	120	"	85.3	3.3	4.9	27.9	2 017	816
								Mean:	3.3	5.8			
							NORTH SEA						
Netherl.	1981	Aug.	8-14 n.m. off IJmuiden	Whole cover	8	119	1015	68.9	3.4	3.5	23.6	931	418
"	"	"	"	"	12	65	"	69.2	3.5	3.6	23.9	454	262
"	"	"	"	"	13	64	"	81.7	3.4	3.0	28.1	677	371
"	"	"	25 n.m. NW off IJmuiden	"	19	127	"	81.4	3.6	3.2	29.0	1 883	576
"	"	"	"	"	11	133	"	93.7	3.5	0.9	33.0	600	17
								Mean:	3.5	2.6			

Table 7.1 NORTH SEA (ctd)

Country	Year	Month	Area surveyed	Method	No. of hauls	Mean tow duration (min.)	HP of vessel	Mesh opening (mm)	Sel. factor	Sel. range	50% ret.length	No. of soles caught	No. of soles in sel.range
Netherl.	1981	Aug.	W of Black Bank (South.B.)	Whole cover	10	93	1310	64.5	3.5	3.6	22.5	1 346	466
"	"	"	"	"	14	64	"	64.9	3.4	3.9	22.0	927	273
"	"	"	"	"	11	93	"	78.9	3.4	4.7	27.3	1 477	836
"	"	"	"	"	20	63	"	78.9	3.4	3.9	26.9	2 228	1 532
"	"	"	"	"	10	122	"	79.7	3.4	3.5	27.4	2 296	939
"	"	"	"	"	5	63	"	80.3	3.3	3.0	26.8	234	157
"	"	"	"	"	7	64	"	92.3	3.3	2.4	30.5	1 329	69
"	"	"	"	"	10	122	"	93.4	3.4	3.6	32.5	2 410	225
"	"	"	"	"	5	63	"	93.8	3.2	0.9	30.1	1 399	827
								Mean:	3.4	3.3			
Germany Fed.Rep.	1981	May	5-12 n.m. off N.Frisian Islands	Whole cover	38	approx. 50	250	69.2	3.0	5.3	20.6	2 862	2 352
"	"	"	"	"	"	"	"	69.5	2.9	5.8	19.9	1 498	1 160
"	"	June	5-20 m depth	"	32	"	"	79.3	3.0	4.0	23.5	3 339	938
"	"	"	"	"	"	"	"	90.3	3.2	-	28.5	1 620	-
								Mean:	3.0	5.0			
Belgium	1980	June	South.Bight	Whole cover	35	120	285	78.5	3.2	3.1	24.5	3 575	252
"	"	Nov.	East coast of England	"	17	150	420	77.4	3.3	3.4	25.2	1 881	258
"	1981	Jan.	South.Bight	"	30	150	420	76.9	3.4	2.8	25.9	4 784	429
"	1980	Oct.	"	"	39	130	1 320	75.9	3.2	3.7	24.2	4 566	200
								Mean:	3.3	3.3			

Table 7.1 NORTH SEA (ctd.)

Country	Year	Month	Area surveyed	Method	No. of hauls	Mean tow duration (min)	HP of vessel	Mesh opening (mm)	Sel. factor	Sel. range	50% ret. length	No. of soles caught	No. of soles in sel.range
Belgium	1980	June	South.Bight	Whole cover	40	120	285	81.8	3.2	2.9	26.3	3 753	853
"	"	Nov.	East coast of England	"	29	150	420	81.0	3.3	4.0	27.1	4 162	1 027
"	1981	Jan.	South.Bight	"	36	150	420	80.7	3.4	3.4	27.1	6 104	666
"	1980	Oct.	"	"	64	130	1 320	79.3	3.3	4.1	26.0	5 289	1 103
								Mean:	3.3	3.6			
Belgium	1980	June	South.Bight	"	35	120	285	87.3	3.2	4.0	27.5	2 938	629
"	"	Nov.	East coast of England	"	17	150	420	85.9	3.1	4.1	26.5	1 876	979
"	1981	Jan.	South.Bight	"	30	150	420	85.6	3.2	3.5	27.5	4 570	488
"	1980	Oct.	"	"	39	130	1 320	85.0	3.1	4.7	27.8	4 748	792
								Mean:	3.2	4.1			
Belgium	1980	June	South.Bight	"	40	120	285	90.3	3.1	3.6	28.1	3 231	1 208
"	"	Nov.	East coast of England	"	29	150	420	90.2	3.4	3.4	30.4	3 373	1 038
"	1981	Jan.	South.Bight	"	36	150	420	89.8	3.2	4.0	28.9	5 622	739
"	1980	Oct.	"	"	64	130	1 320	88.6	3.1	4.9	27.8	5 007	507
								Mean:	3.2	4.0			

Table 7.2 North Sea SOLE
Mean length at age used in the mesh assessment

	Males				Females		
Age	Belgium	Germany Fed.Rep.	Netherlands	Age	Belgium	Germany Fed.Rep.	Netherlands
1	20.9	23.1	24.4	1	23.7	23.7	24.4
2	24.1	25.9	26.4	2	27.6	27.6	28.0
3	26.8	28.5	28.1	3	31.2	31.2	31.0
4	28.8	30.2	29.7	4	33.8	33.8	33.5
5	30.5	32.3	31.1				
6	31.9	33.8	32.3				
7	33.1	35.2	33.4				
8	34.0		34.4				
9			35.3				

Table 7.3 North Sea SOLE.
Exploitation patterns used in the mesh assessment.

Age	Males			Females		
	75mm	80mm	90mm	75mm	80mm	90mm
1	.0028	.0011	.0001	.0057	.0025	.0004
2	.220	.140	.037	.221	.174	.072
3	.730	.593	.257	.671	.651	.454
4	.690	.619	.383	.621	.621	.565
5	.500	.480	.341	.497	.497	.497
6	.470	.470	.373	.434	.434	.434
7	.400	.400	.362	.371	.371	.371
8	.360	.360	.345	.367	.367	.367
9	.330	.330	.330	.367	.367	.367
10	.310	.310	.310	.367	.367	.367
11	.260	.260	.260	.367	.367	.367
12	.260	.260	.260	.367	.367	.367
13	.260	.260	.260	.367	.367	.367
14	.260	.260	.260	.367	.367	.367
15+	.260	.260	.260	.367	.367	.367

Table 7.4 North Sea SOLE
Results of the mesh assessment*

	Immediate losses (1983) %				Long-term gains %			
Mesh increase	Belgium	Germany Fed.Rep.	Netherlands	Total all countries	Belgium	Germany Fed.Rep.	Netherlands	Total all countries
75 - 80	8	2	+	1	13	6	2	2
75 - 90	25	6	28	27	24	49	2	6
80 - 90	18	5	28	26	10	41	1	5

* There may be some discrepancy between the losses and gains from individual countries and those of the total for the whole fishery. This is caused by variation in the weight at age sets

Figure 2.1 North Sea SOLE. Selection pattern from separable VPA, sexes combined.

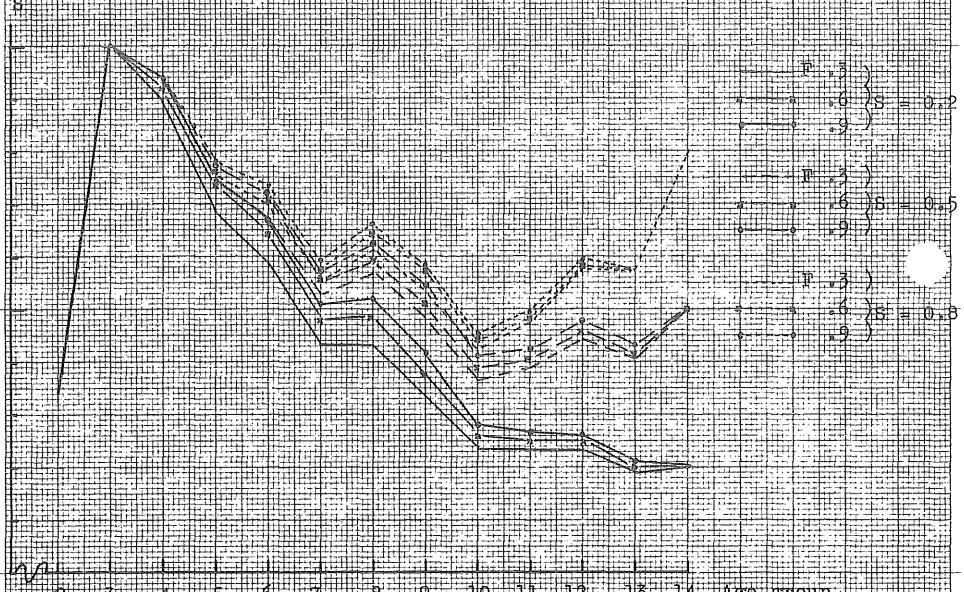
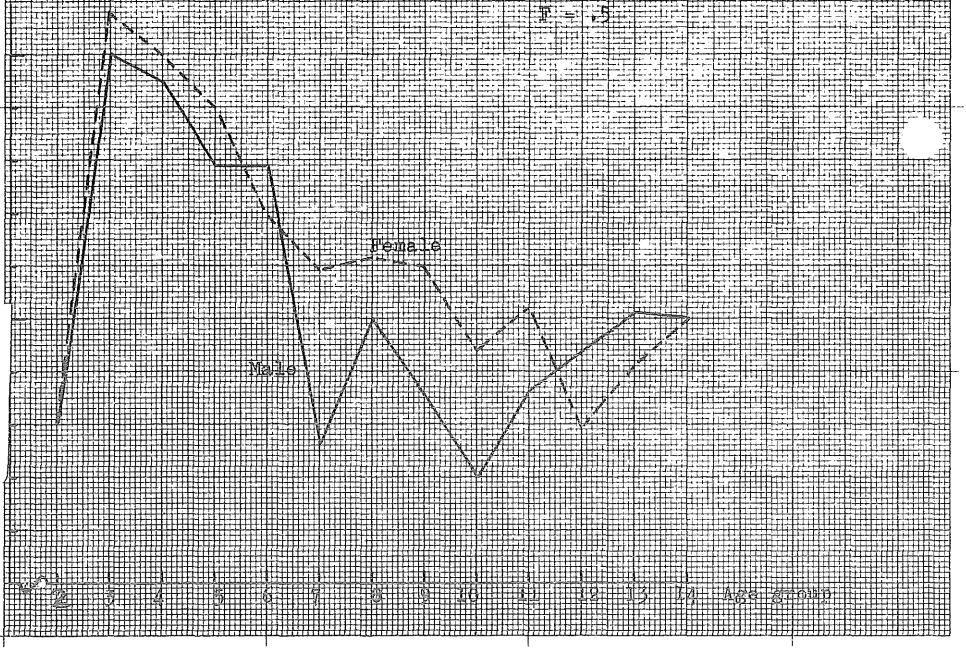


Figure 2.2 North Sea SOLE. Selection pattern from separable VPA, sexes separate.



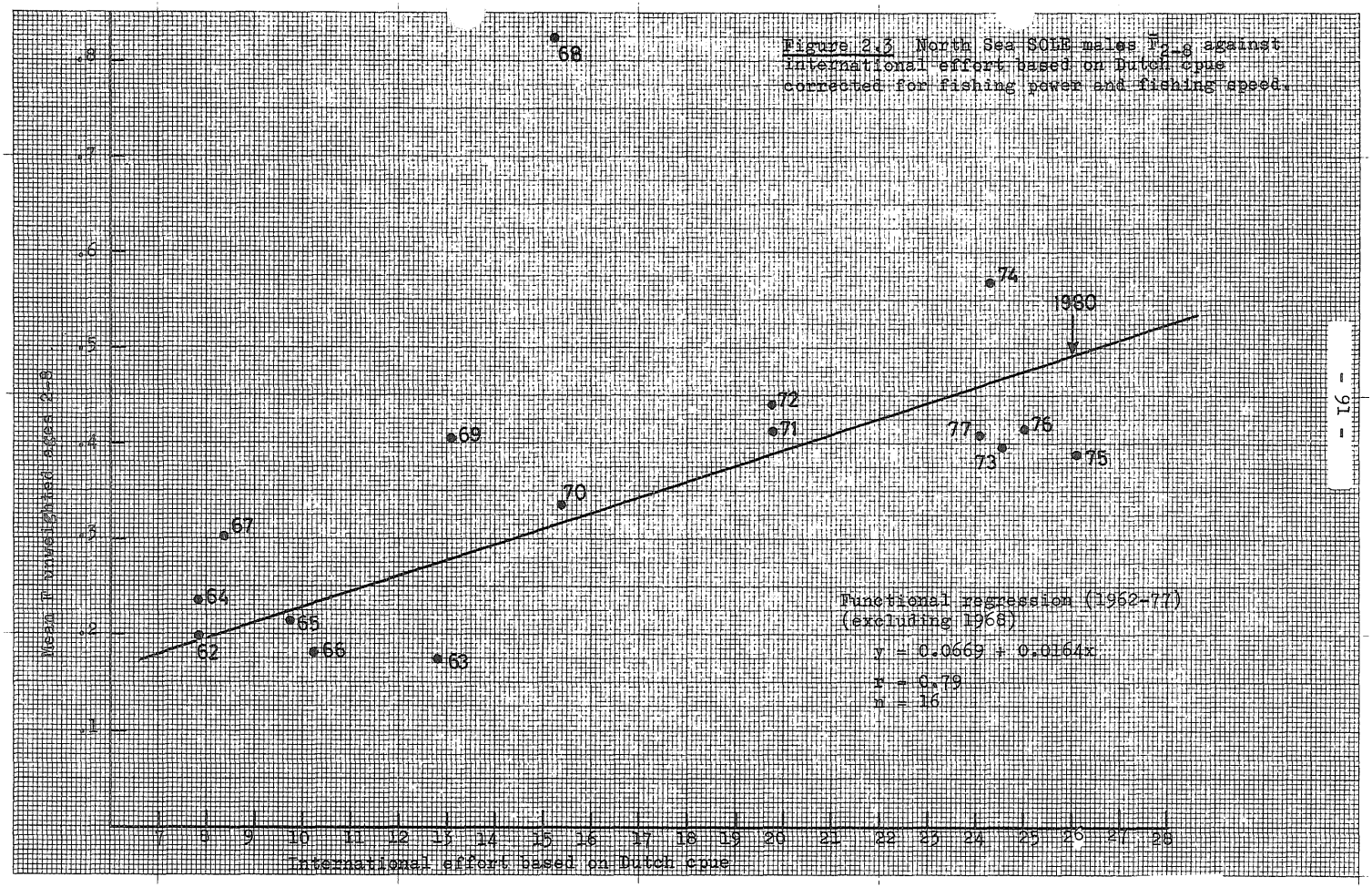


Figure 2.3 North Sea SOLE males $\bar{F}_{2-8}$ against International effort based on Dutch cpue corrected for fishing power and fishing speed.

Functional regression (1962-77) (excluding 1968)

$y = 0.0669 + 0.0164x$

$r = 0.79$

$n = 16$

Figure 2.4 North Sea SOLE females F_{2-8} against international effort based on Dutch cpue corrected for fishing power and fishing speed.

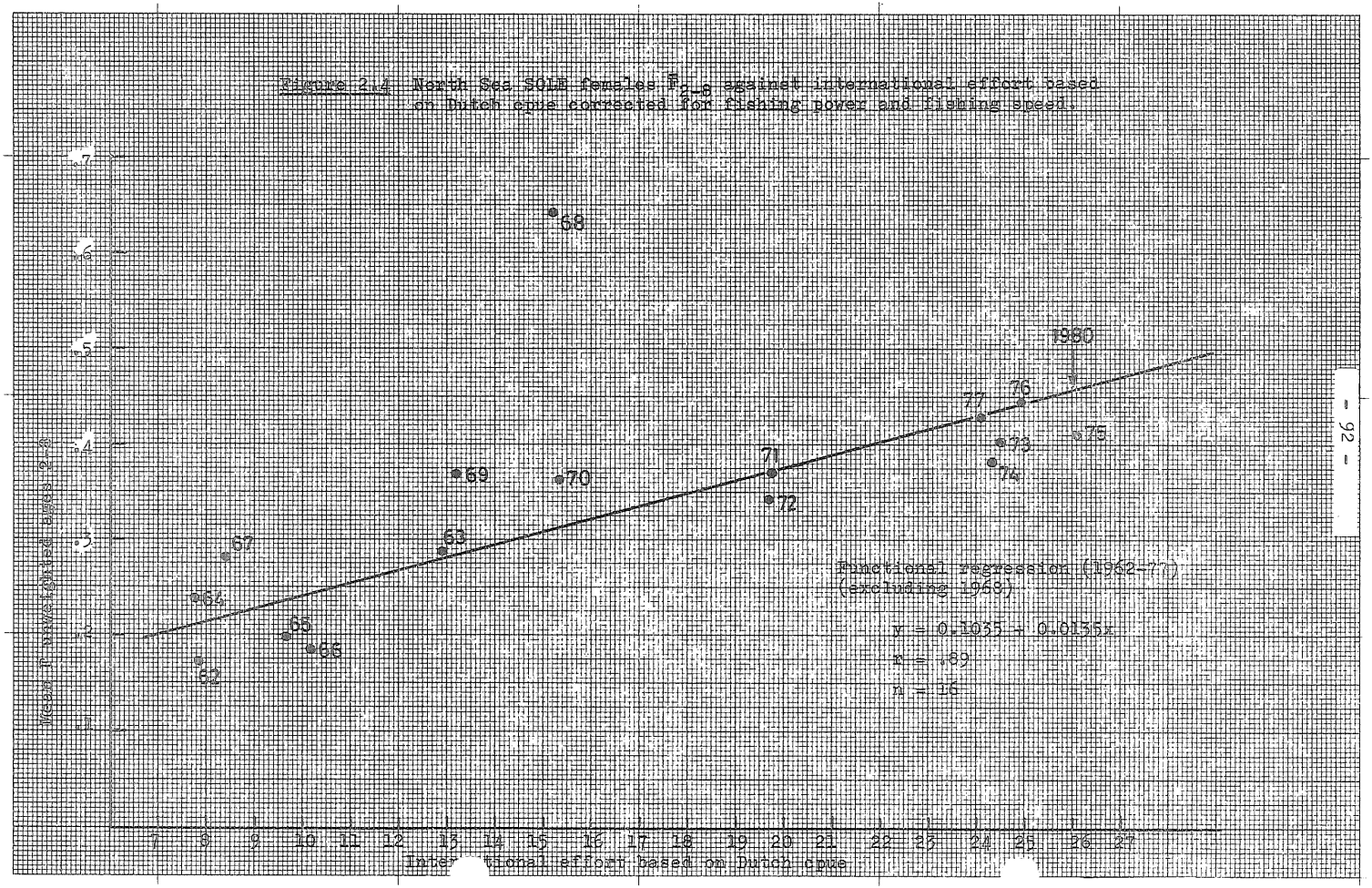


Figure 2.5 North Sea SOLE.

A Total stock and spawning stock biomass, nominal catch

B Belgian, Dutch and United Kingdom cpue

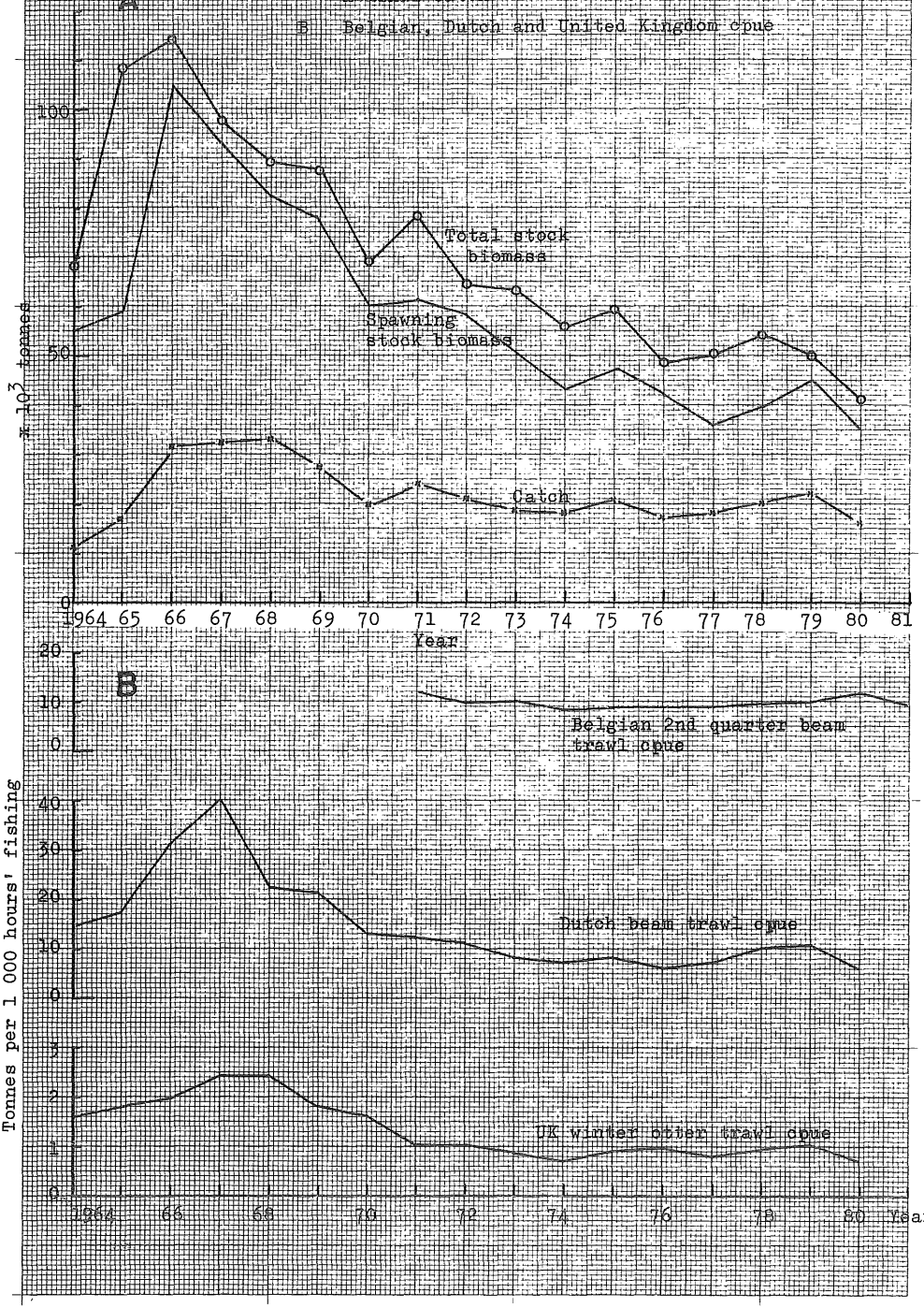


Figure 2.6 North Sea SOLE. Spawning stock/recruitment plot.

(Year classes 1962 and 1978 reduced as 0-group by severe winters; year class 1979 "Tridens" estimate)

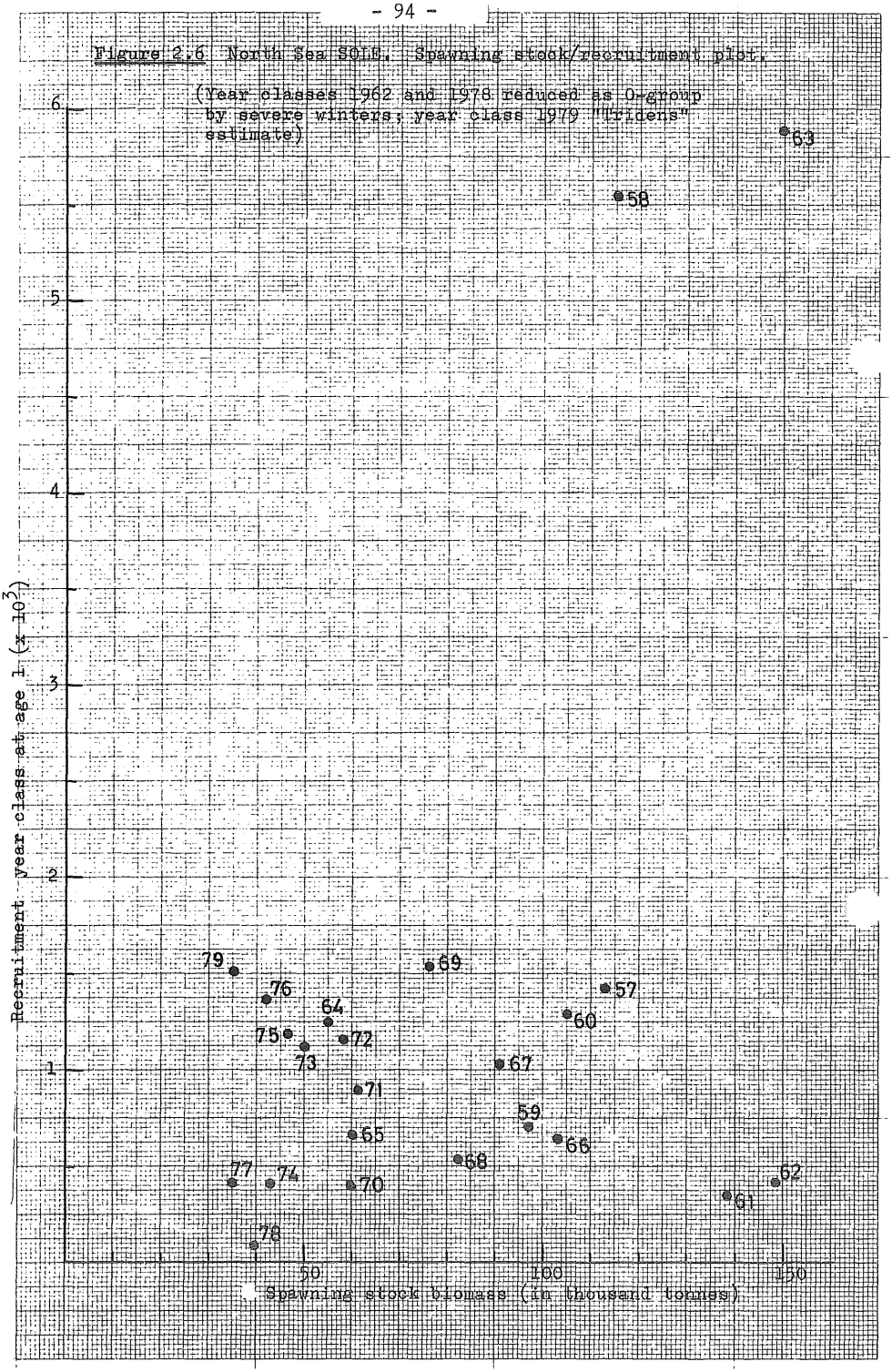
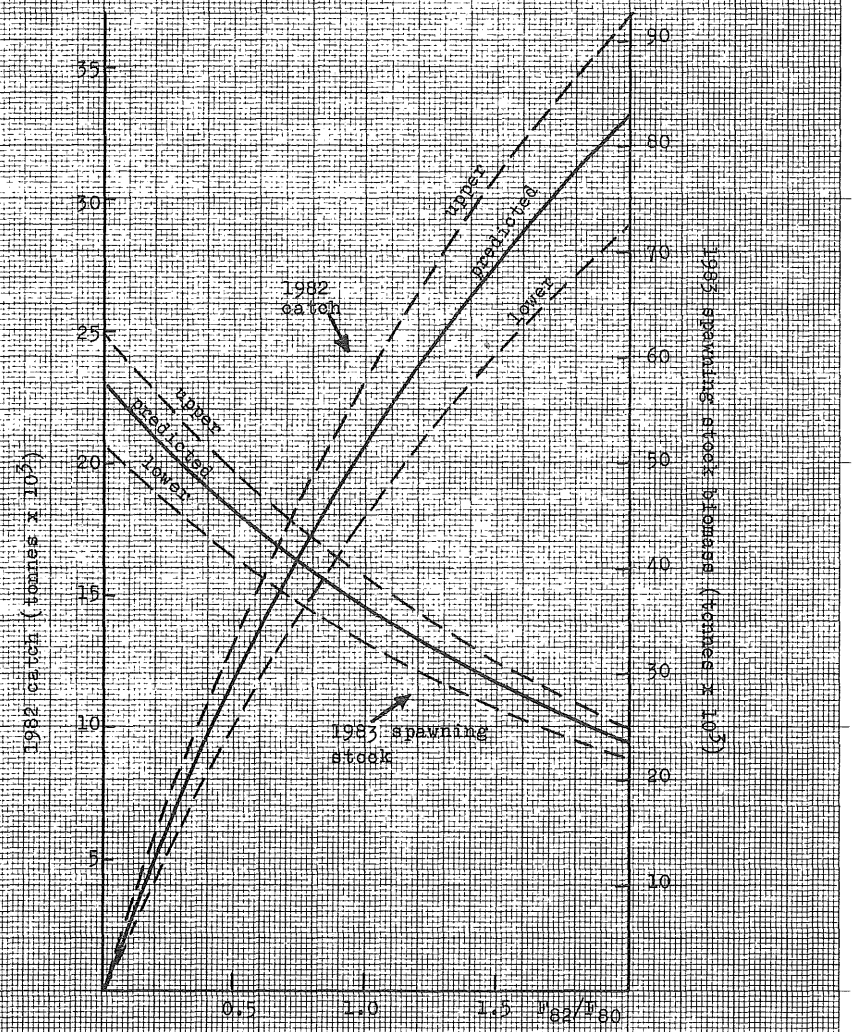


Figure 2.7 North Sea SOLE.
Results of catch prognosis using a range of values for the 1979 year class.



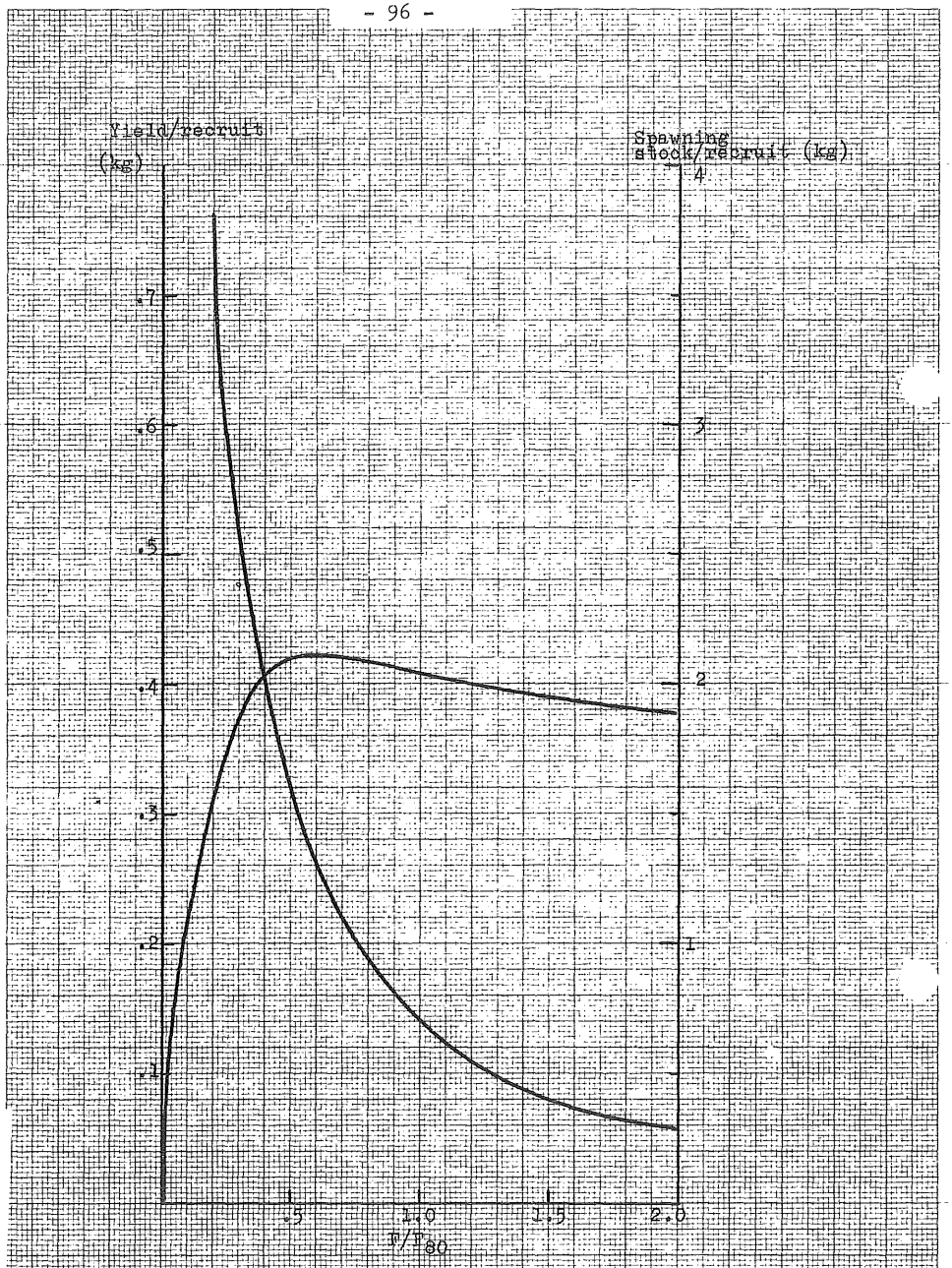


Figure 2.8 North Sea SOLE.
Equilibrium yield and spawning stock biomass per recruit.

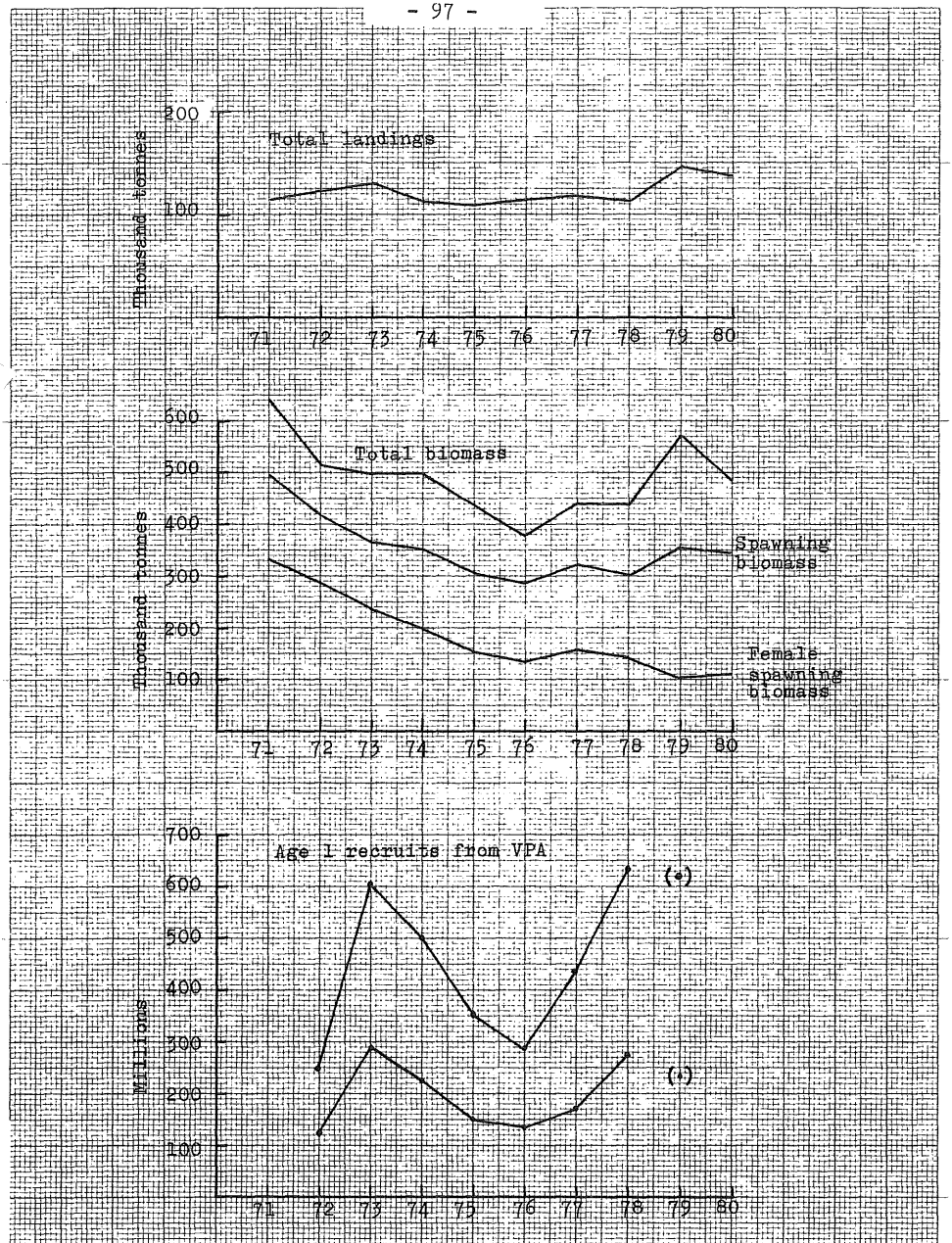


Figure 3.1 North Sea PLAICE.
Trend in landings, biomass, spawning biomass and recruitment.

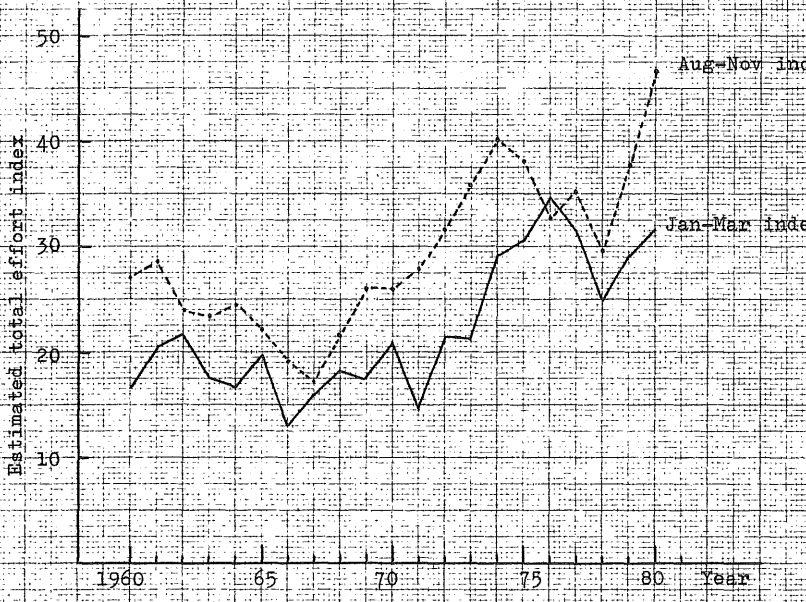
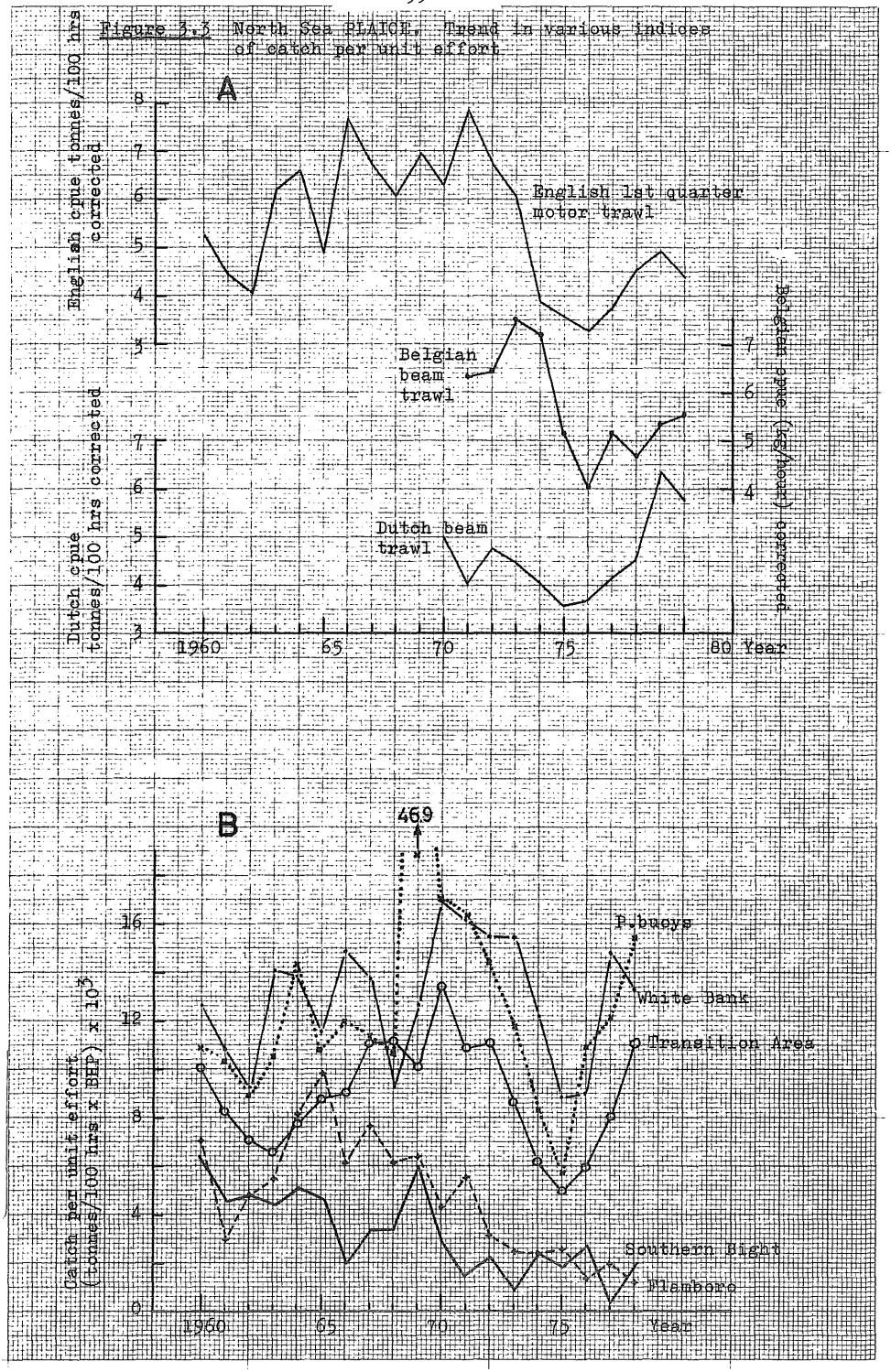


Figure 3.2 North Sea PLAICE.
Trends in estimated total effort based on English motor trawl data from Table 3.10.

Figure 3.3 North Sea PLAICE. Trend in various indices of catch per unit effort



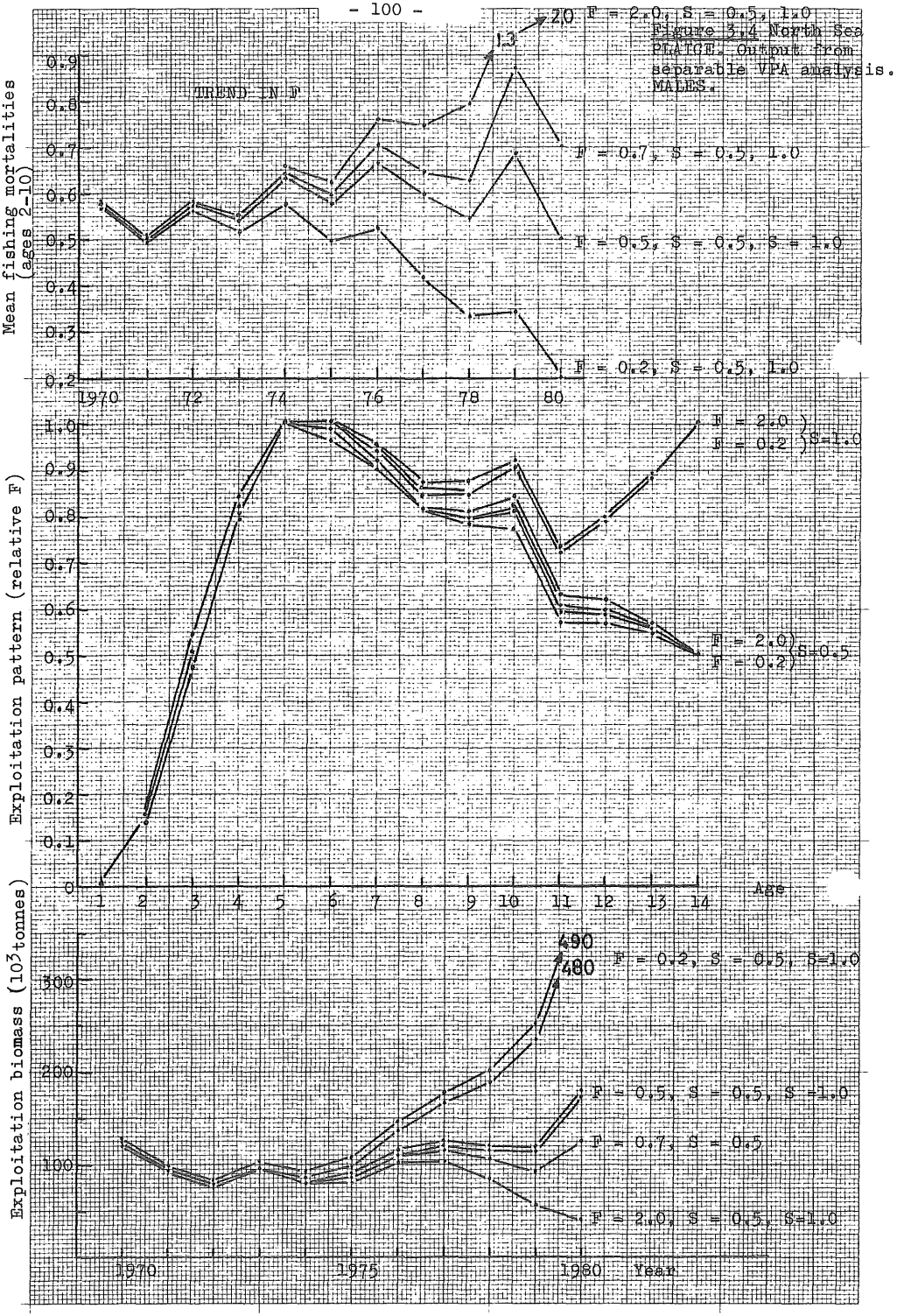


Figure 3.4 North Sea PLAICE. Output from separable VPA analysis. MALES.

Figure 3.5 North Sea PLAICE. Output from separable VPA analysis. FEMALES.

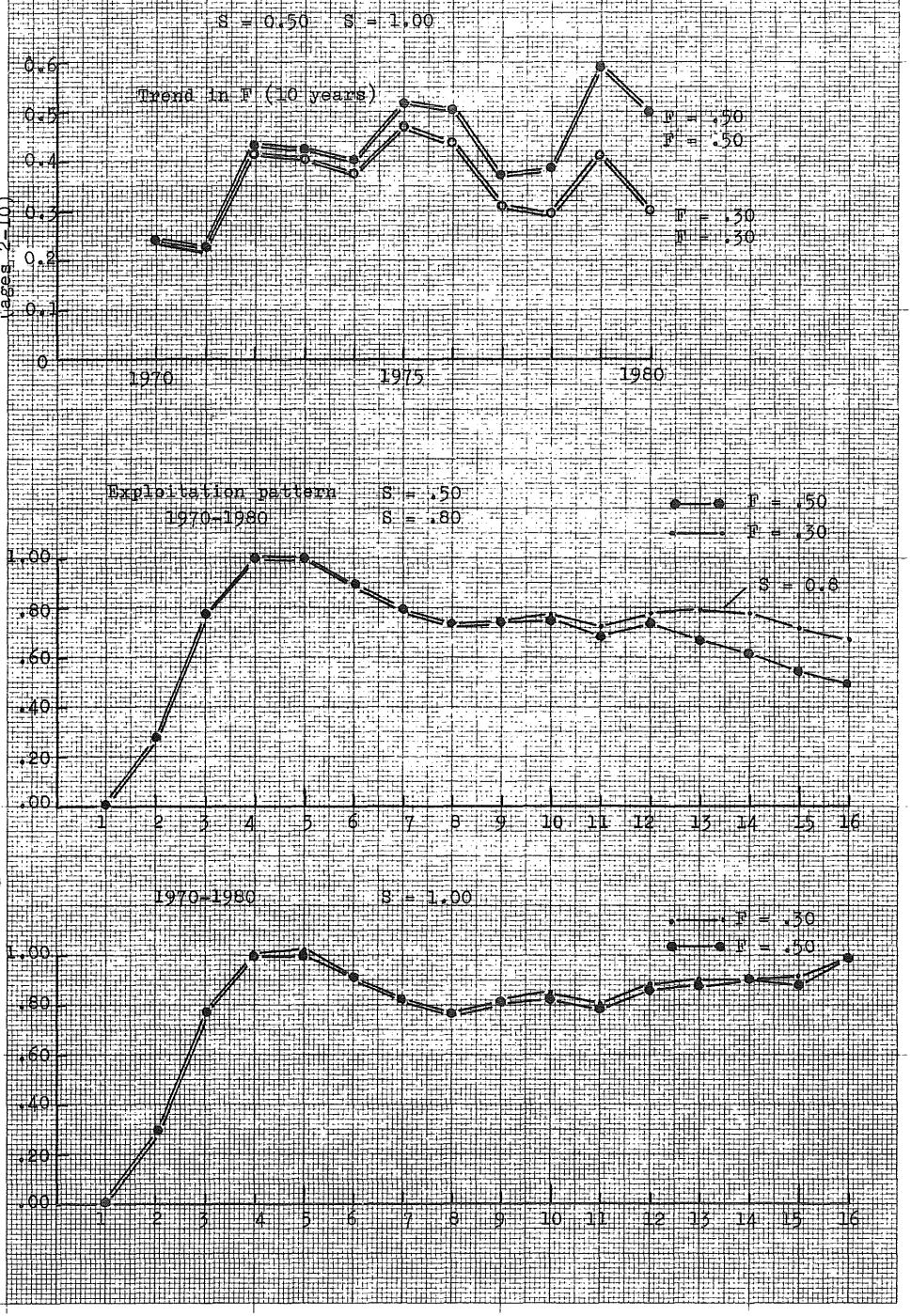


Figure 3.6 North Sea PLAICE. Males.
Correlation between mean fishing mortality and fishing effort. Mean unweighted fishing mortality for ages 2-10. against total international effort, 1960-76, expressed in English motor trawler units.

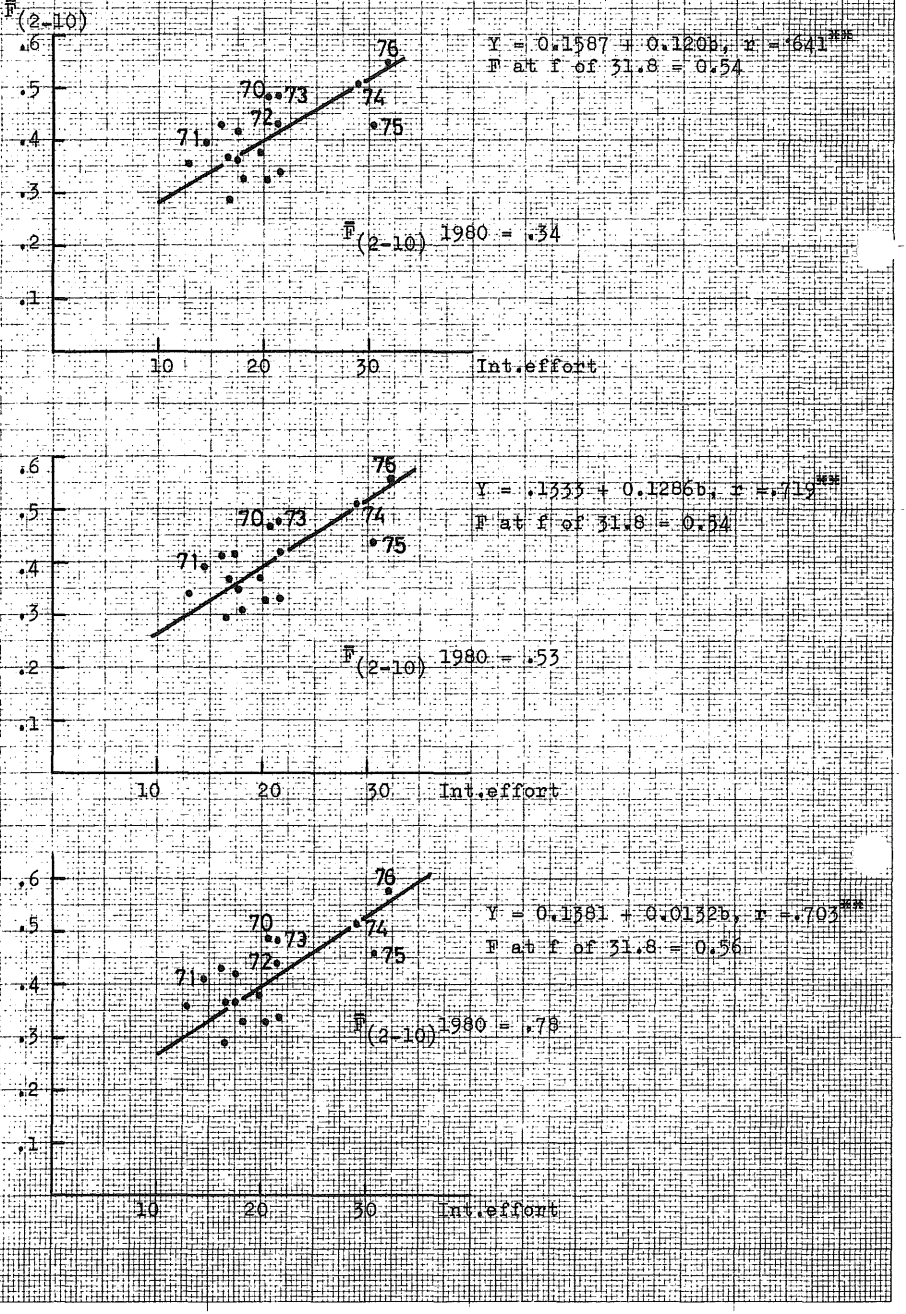
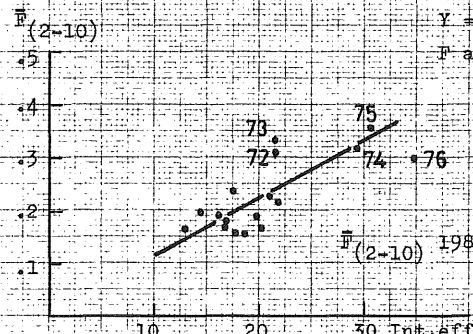
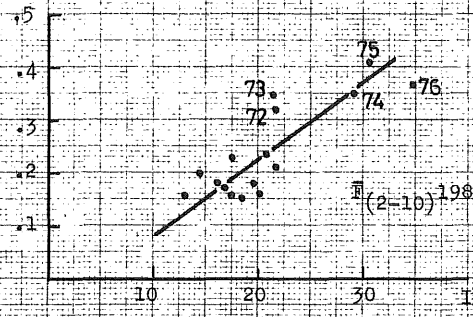


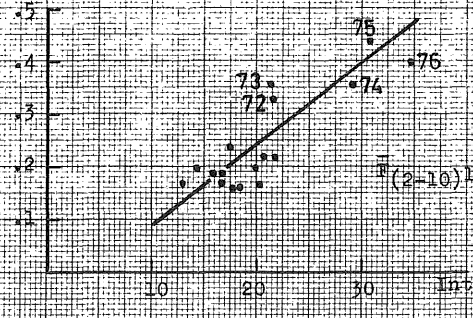
Figure 3.7 North Sea PLAICE. Females.
Mean unweighed fishing mortality for ages 2 to 10 against total international effort expressed in English motor trawler units.



Y = -0.0105 + 0.0116b, r = .759***
F at f of 31.8 = .36



Y = -0.0726 + 0.0149b, r = .829***
F at f of 31.8 = 0.40



Y = -0.070 + 0.0157b, r = .812***
F at f of 31.8 = 0.43

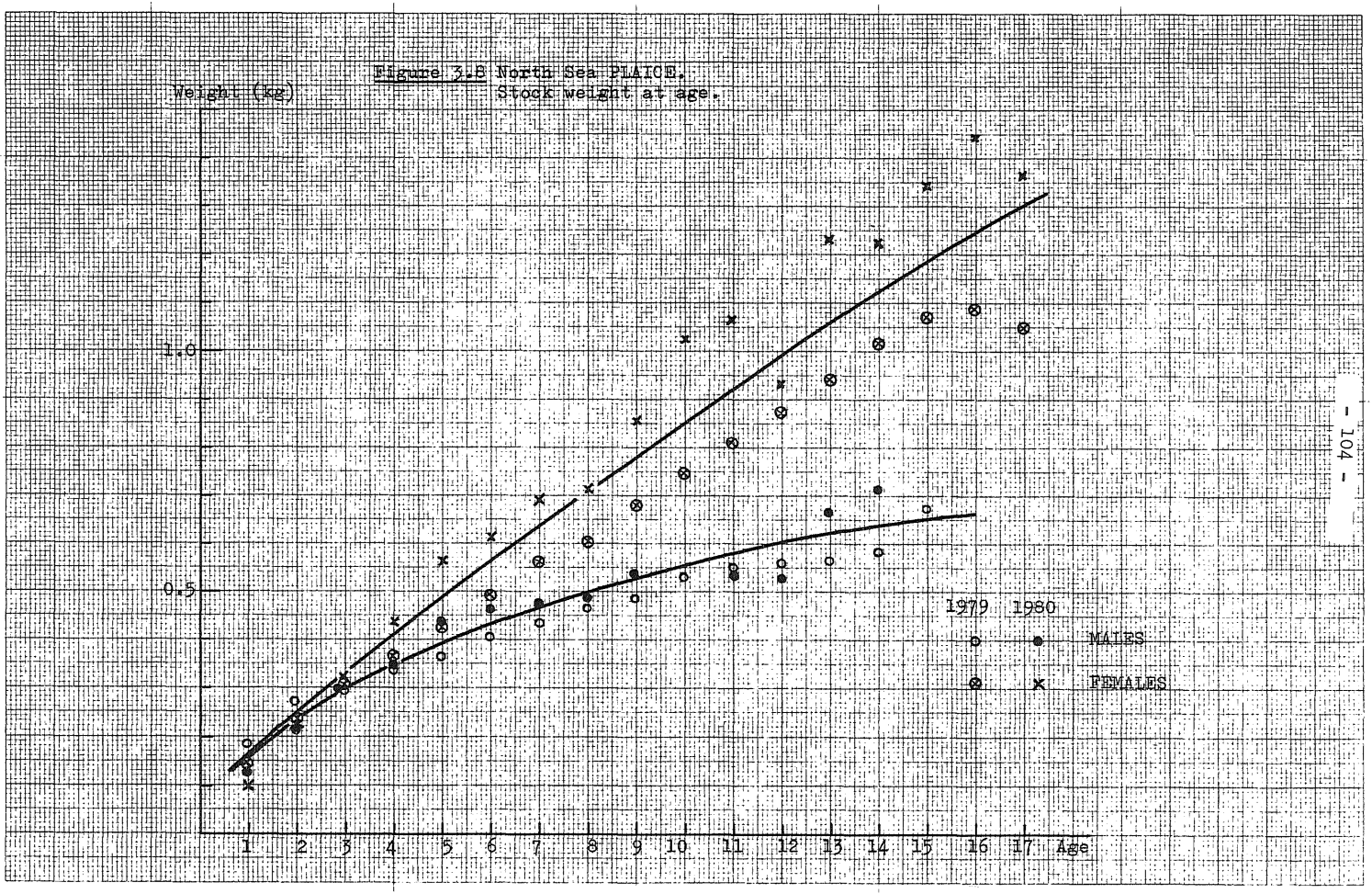


Figure 3.8 North Sea PLAICE.
Stock weight at age.
Weight (kg)
1.0
0.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 Age
1979 1980
MALES
FEMALES

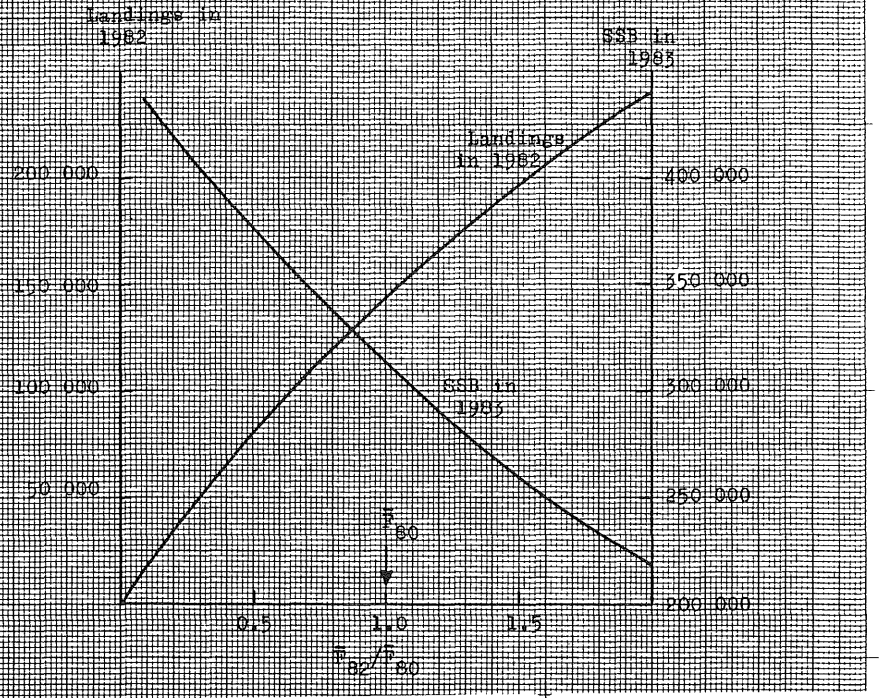


Figure 3.9 North Sea PLAICE. Predictions for landings in 1982 and spawning stock biomass in 1983.

Figure 3.10 North Sea PLAICE.
Stock and recruitment plot.

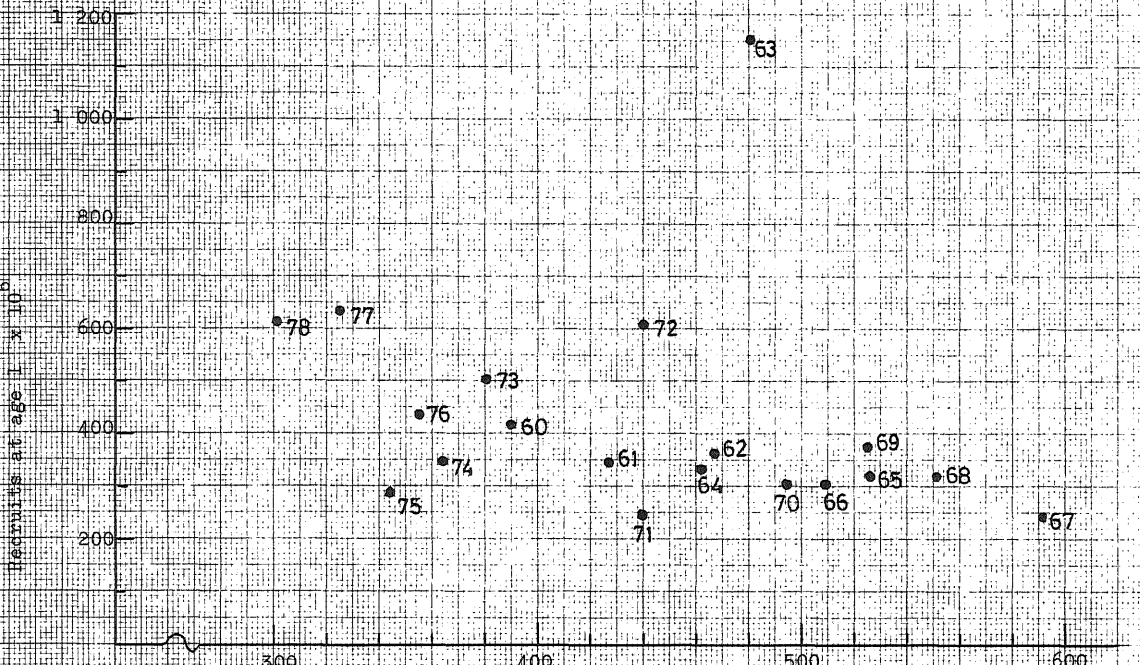


Figure 3.11 North Sea PLAICE.
Stock and recruitment plot.

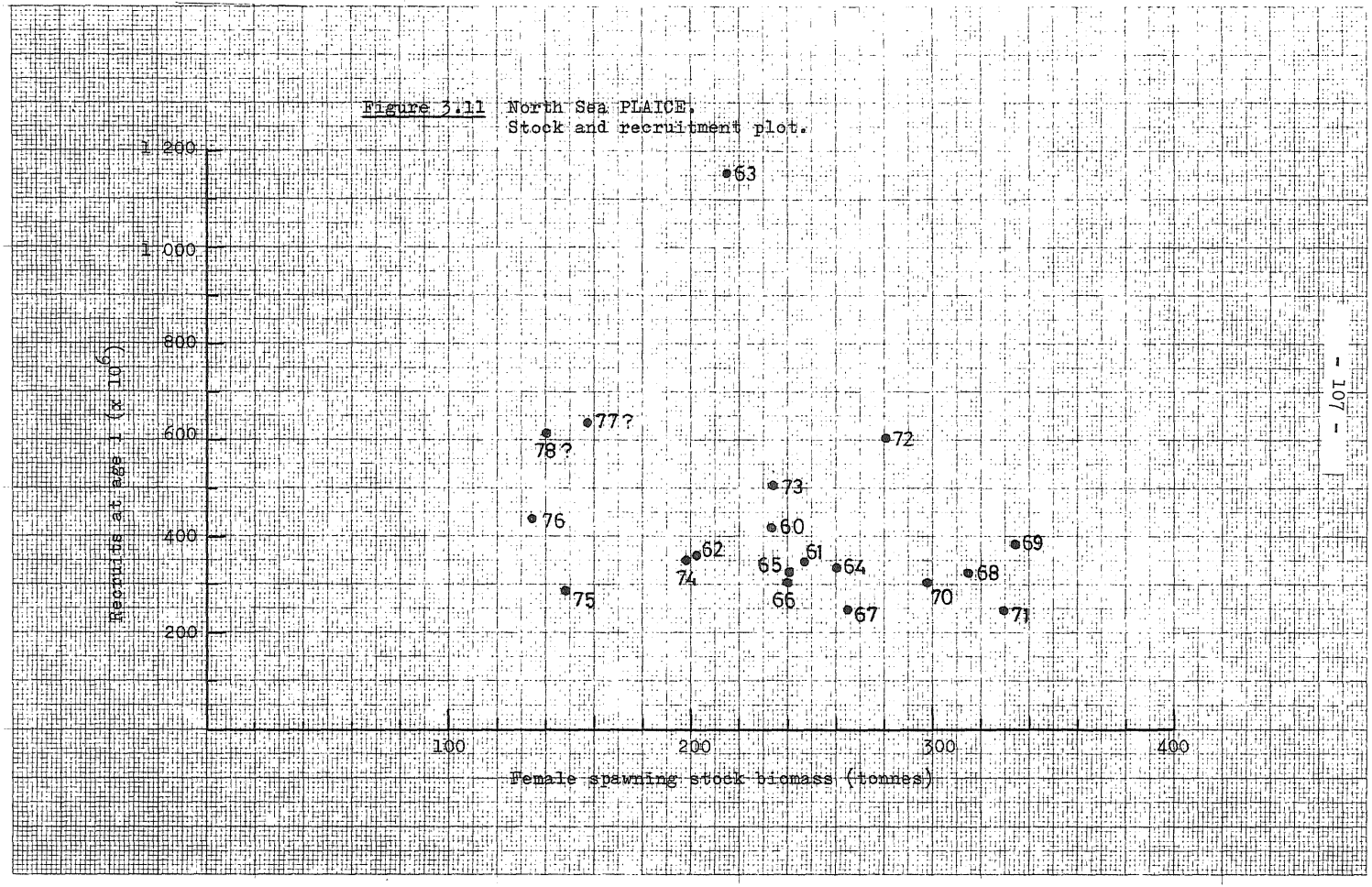


Figure 3.12 North Sea PLAICE.
Yield per recruit and spawning stock biomass per recruit for two exploitation patterns.

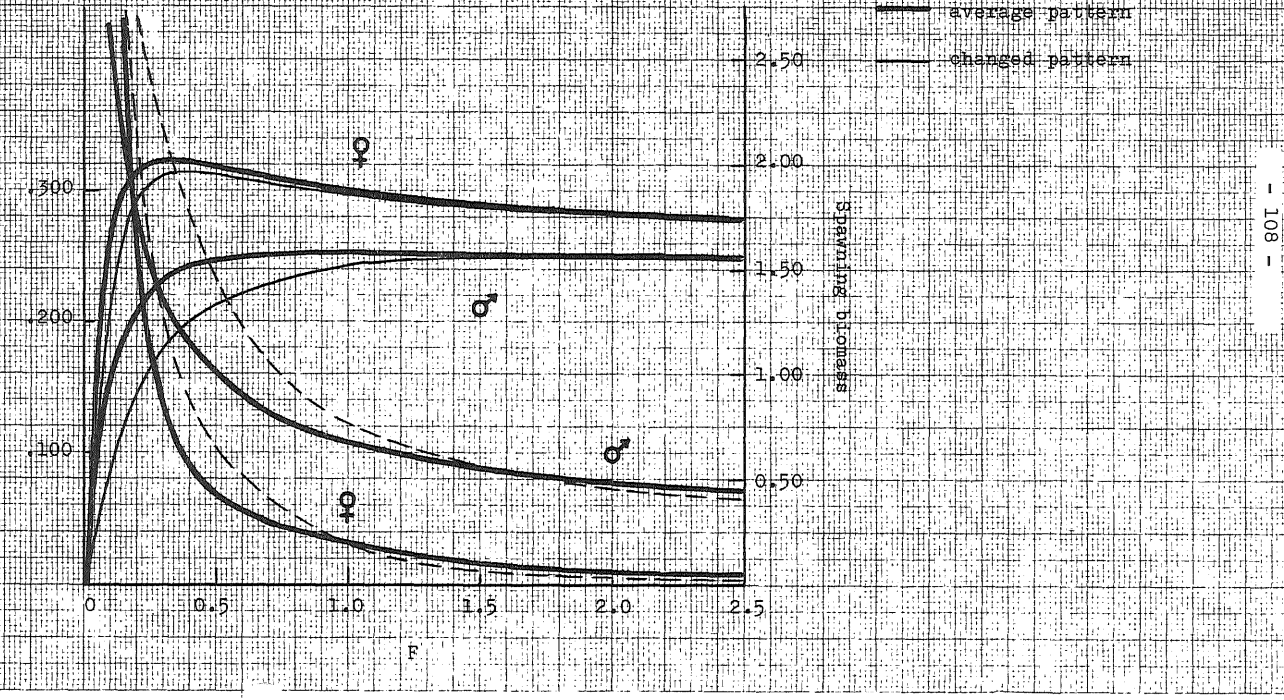


Figure 4.1 SOLE in Division VIId.
Total separable VPA.

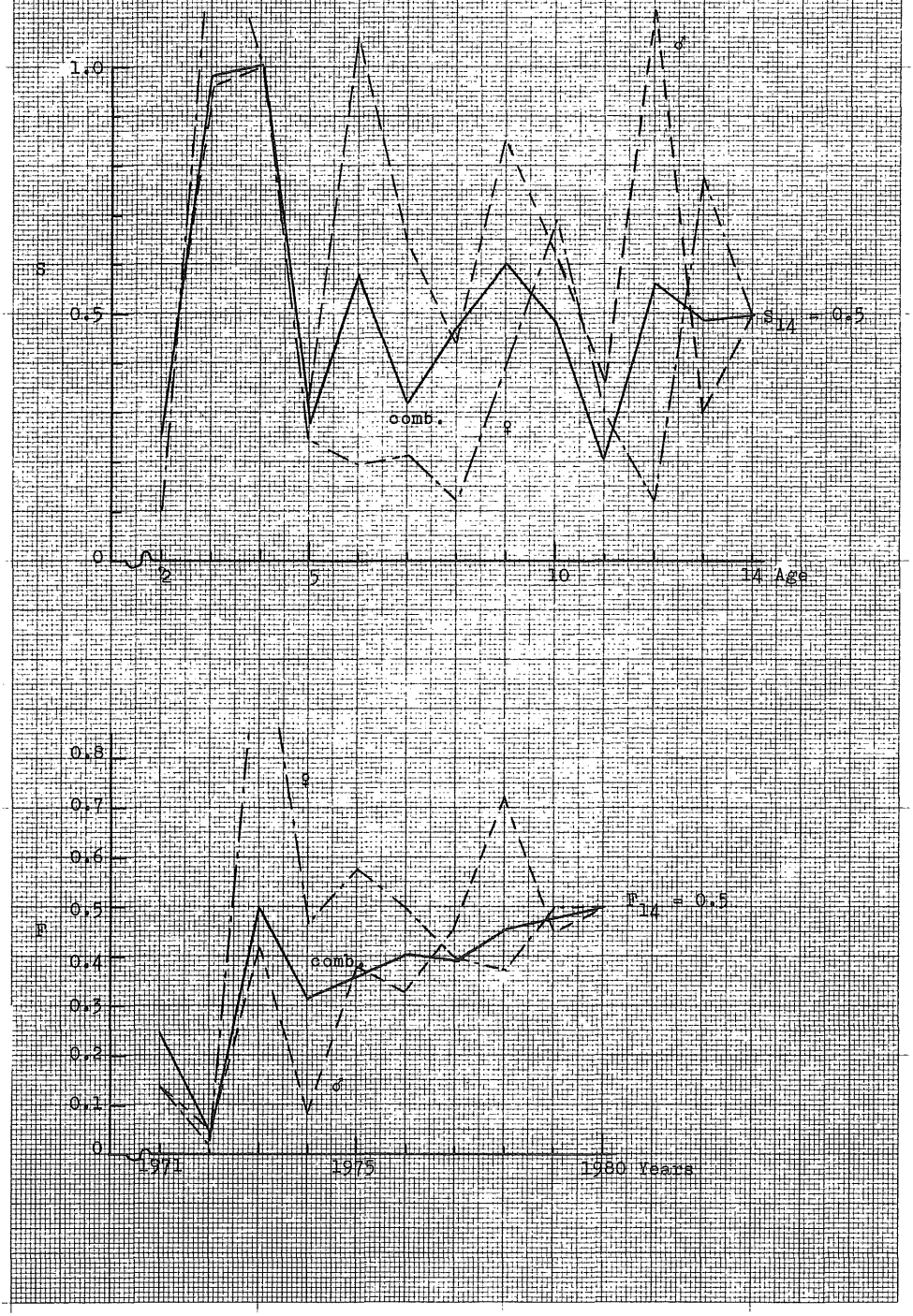


Figura 4.2 SOLE in Division VIId.
Trial separable VPA. Sexes combined.

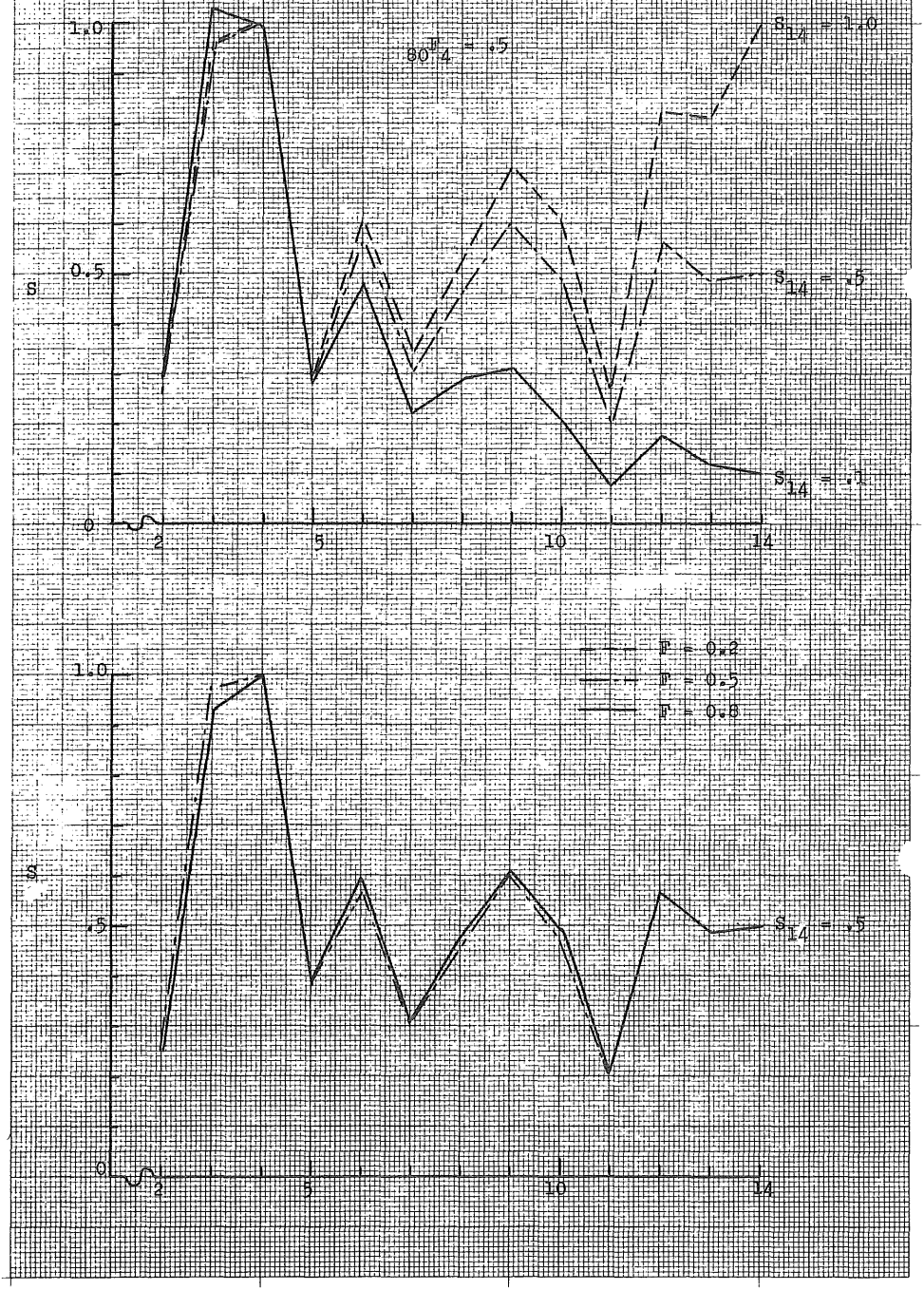


Figure 4.3 SOLE in Division VIId. Trial separable VPA. Sexes combined.

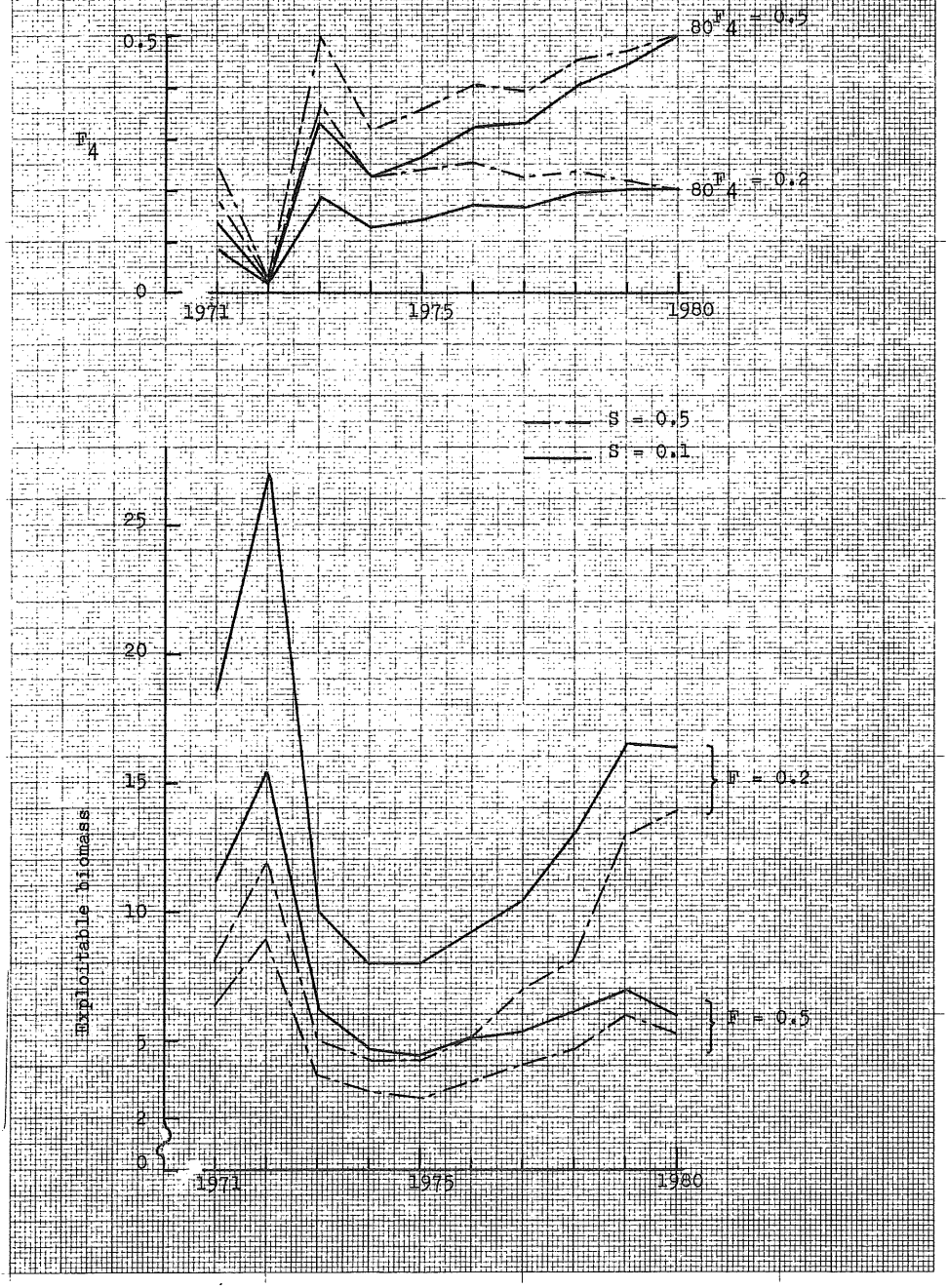
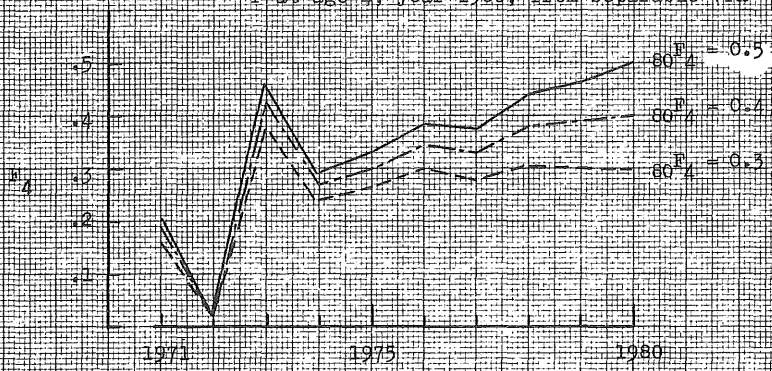


Figure 4.4 SOLE in Division VIId.

S = 0.3

F at age 4, year 1980, from separable VPA



Total international effort (from Belgian cpue)

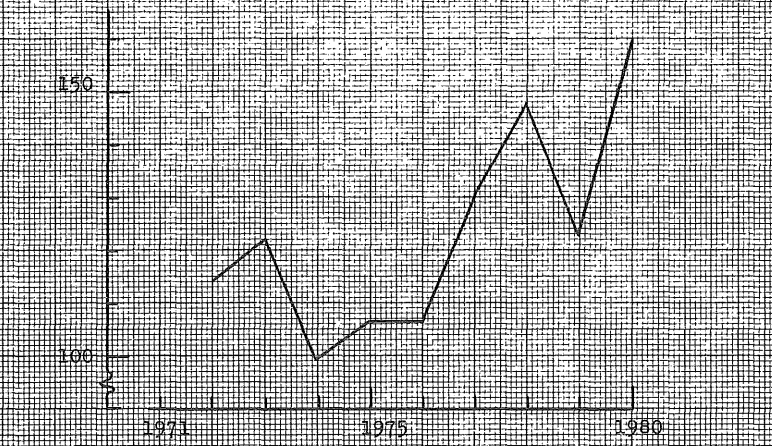
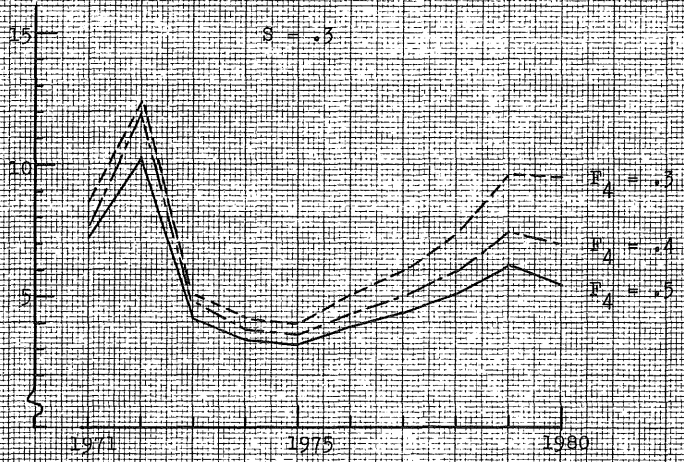


Figure 4.5 SOLE in Division VIId.

Exploitable biomass from separable VPA



cpue by Belgian trawlers

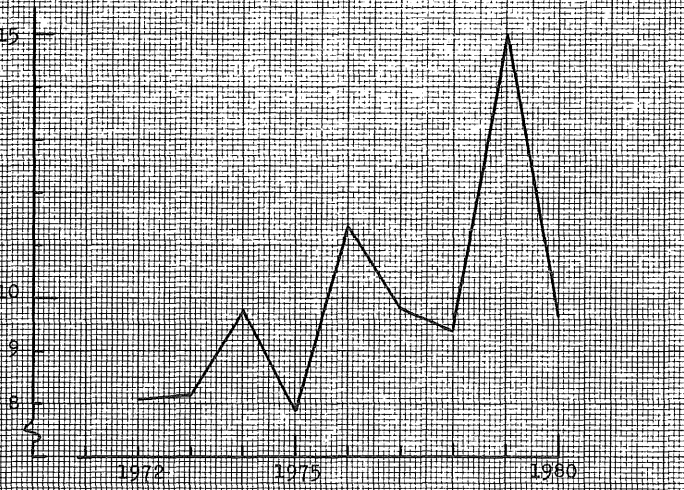


Figure 4.6 SOLE in Division VIId.

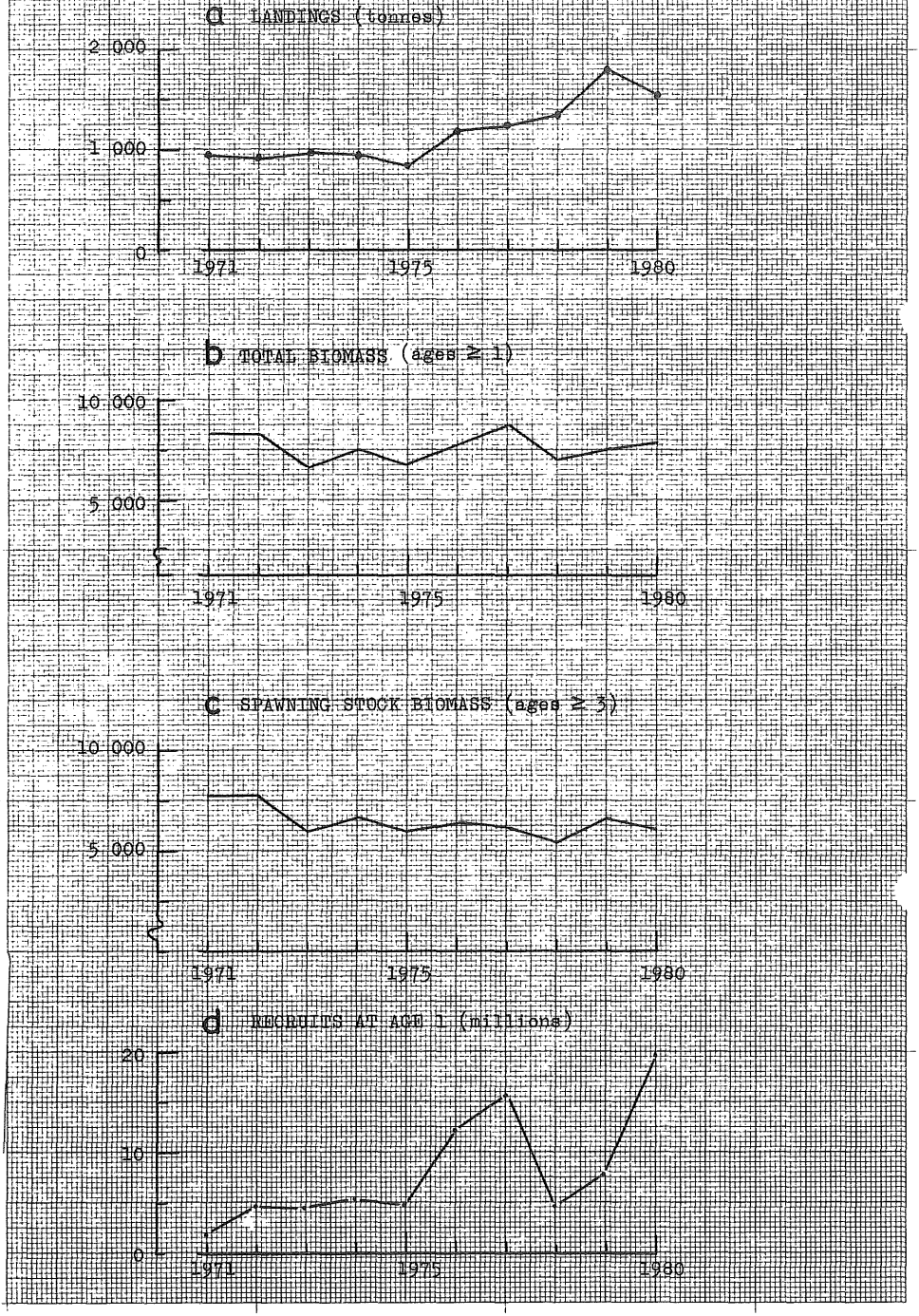


Figure 4.7 SOLE in Division VIId.

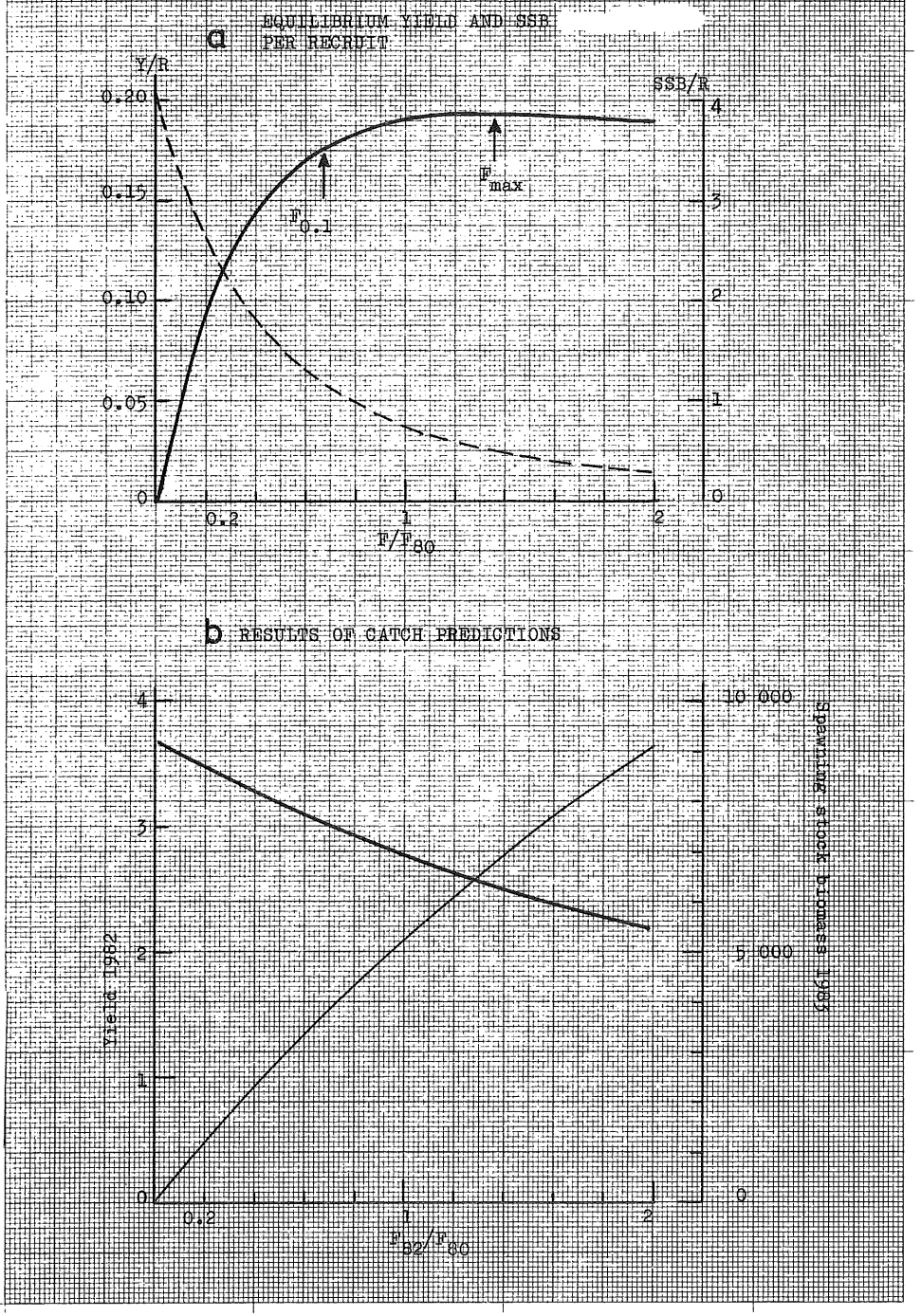


Figure 5.1 SOLE in Division VIIe.
Comparison of separable VPA results for sex separate and combined data.

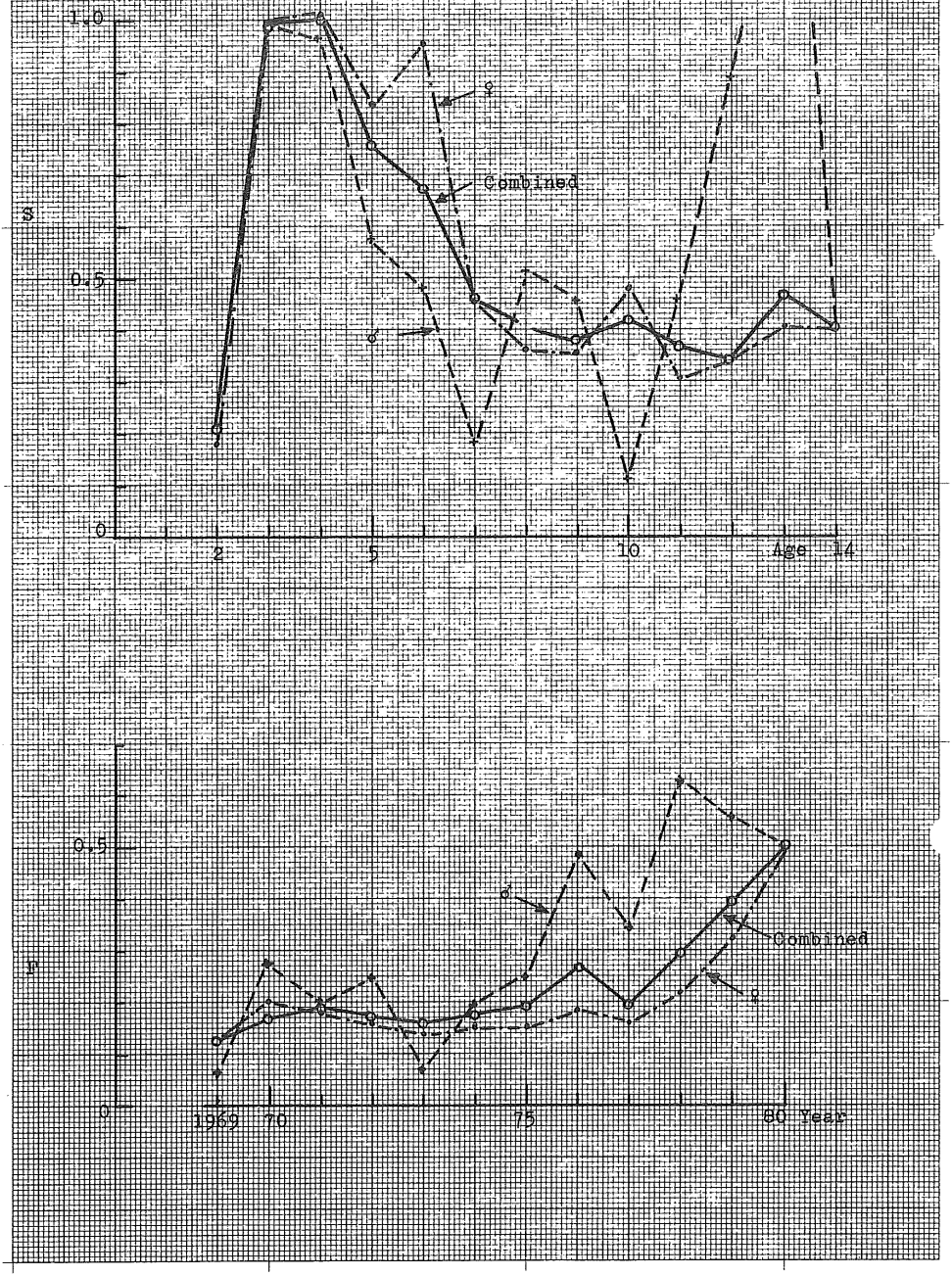


Figure 5.2 SOLE in Division VIIe.
Separable VPA results using combined data-exploitation patterns.

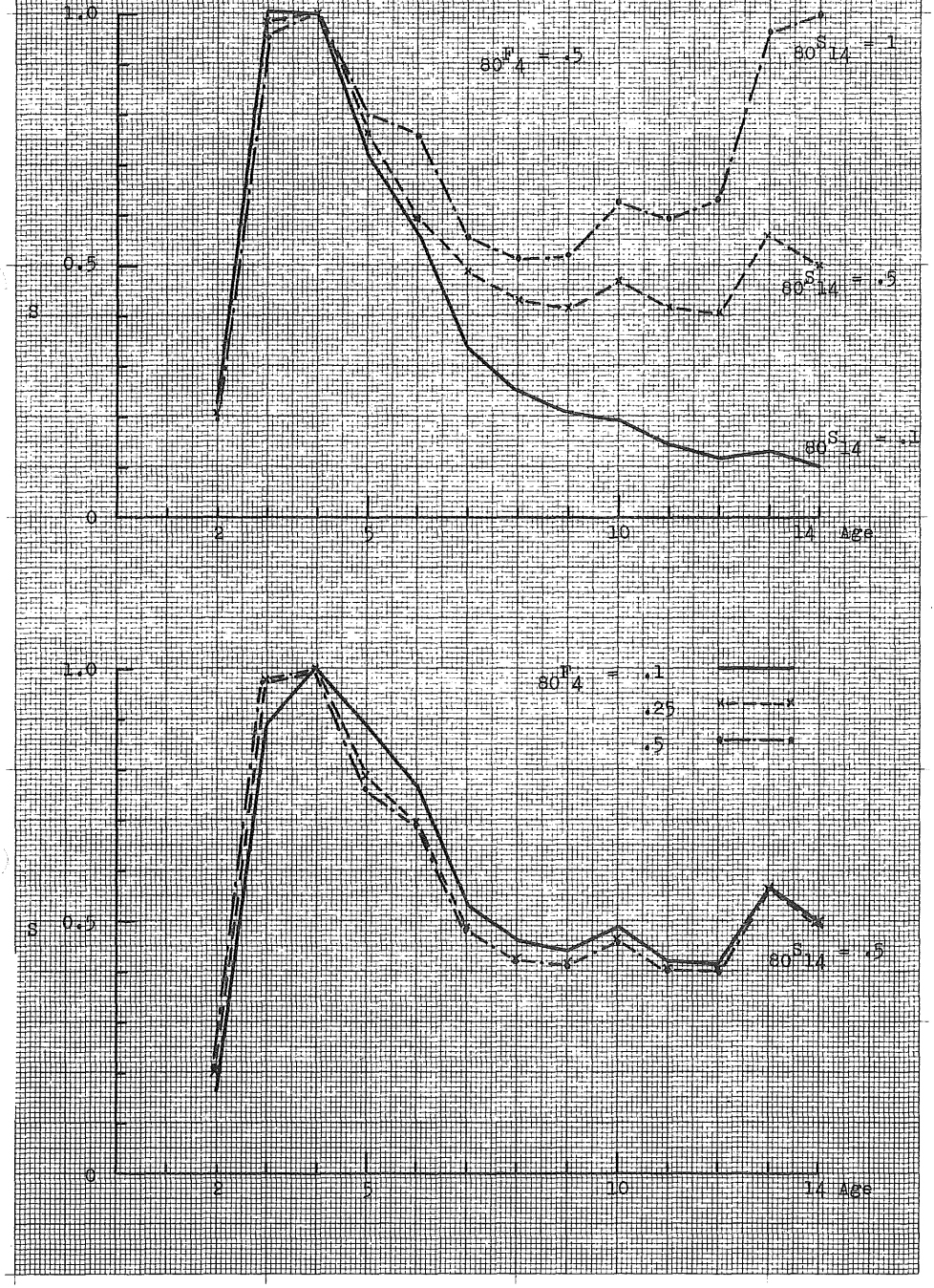


Figure 5.3 SOLE in Division VIIe. Separable VPA results using combined data-trends in F and biomass.

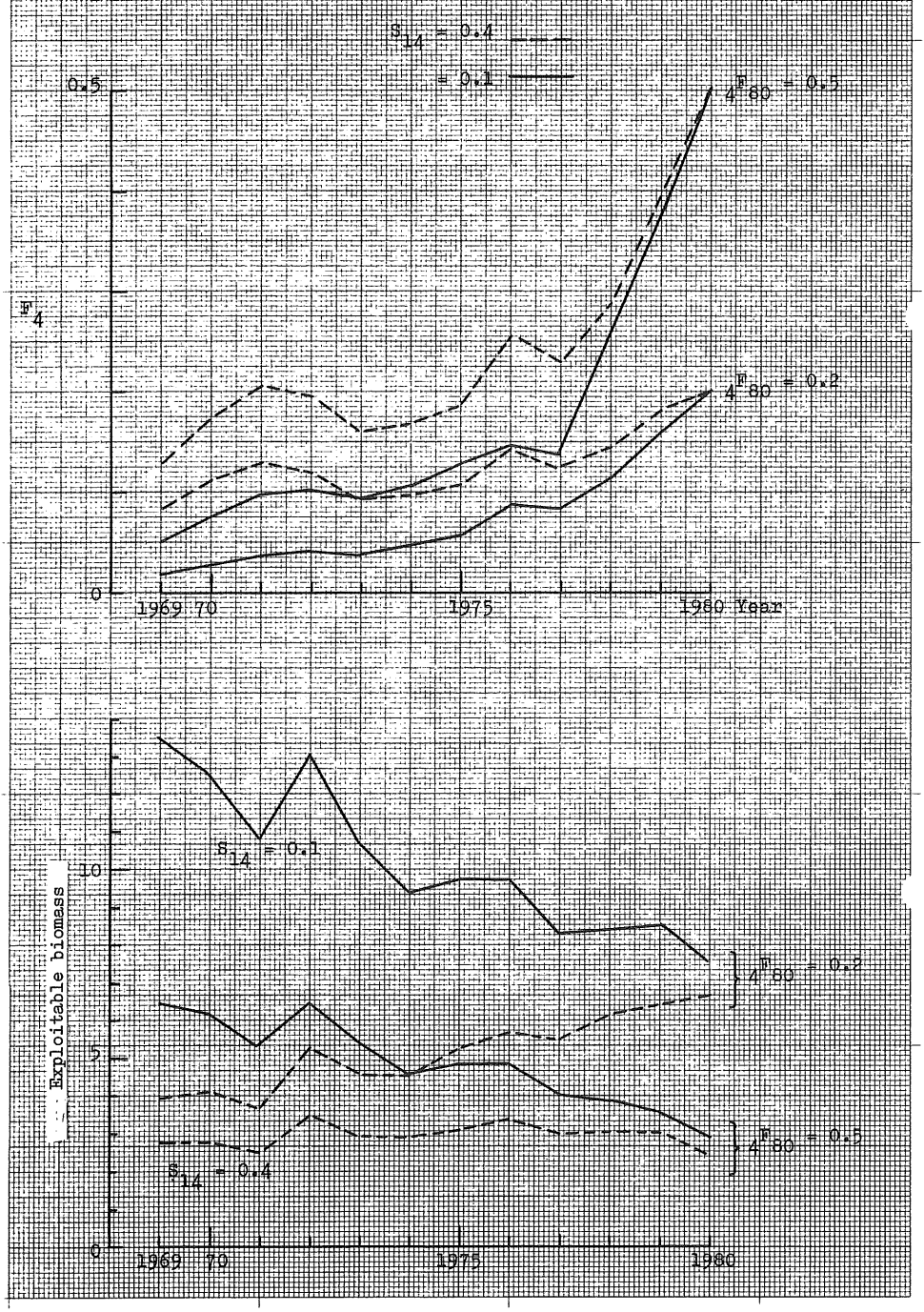


Figure 5.4 SOLE in Division VIIe. Separable VPA results using combined data - fishing mortality and effort.

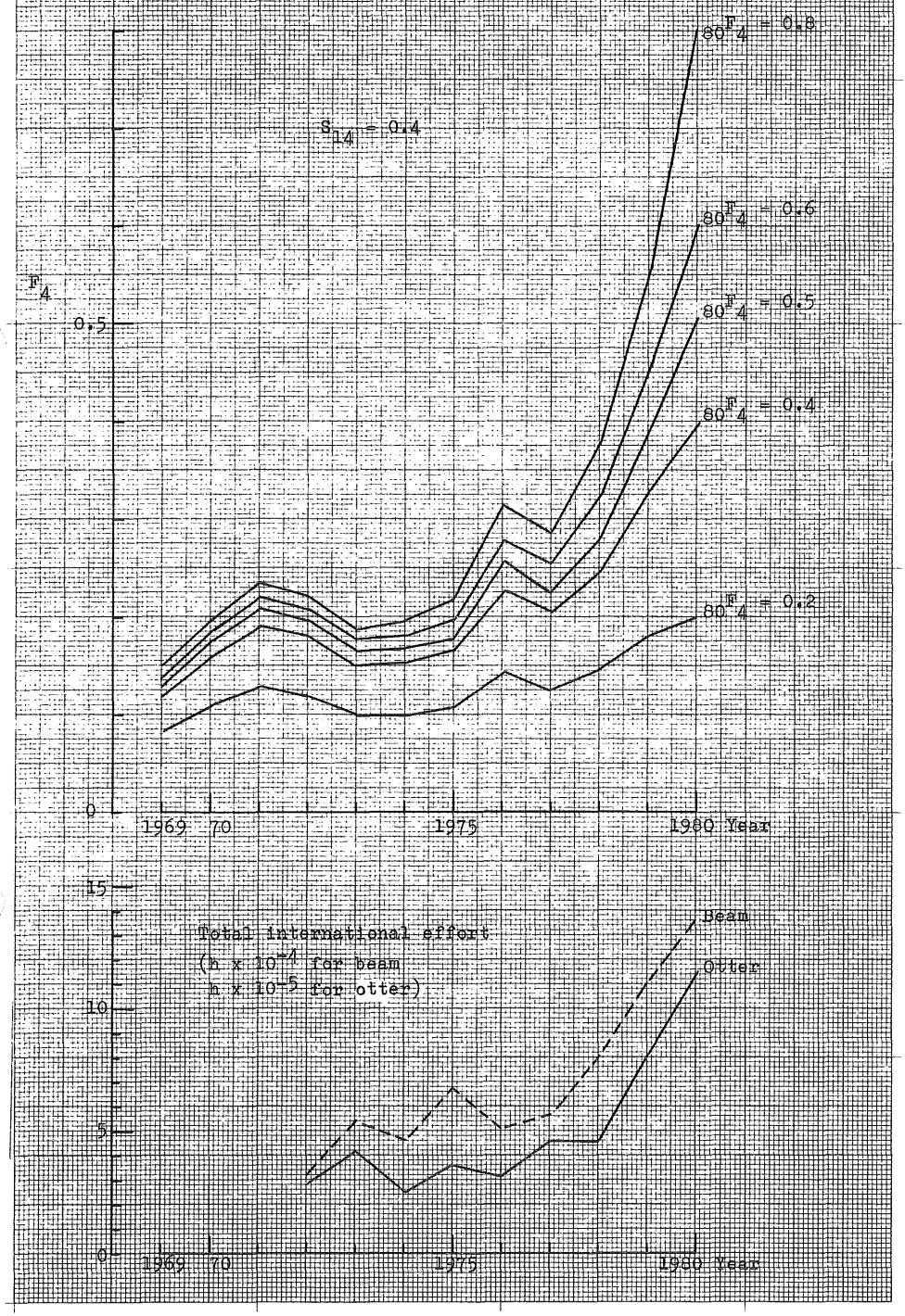


Figure 5.5 SOLE in Division VIIe. Separable VPA results - exploited biomass and catch per effort.

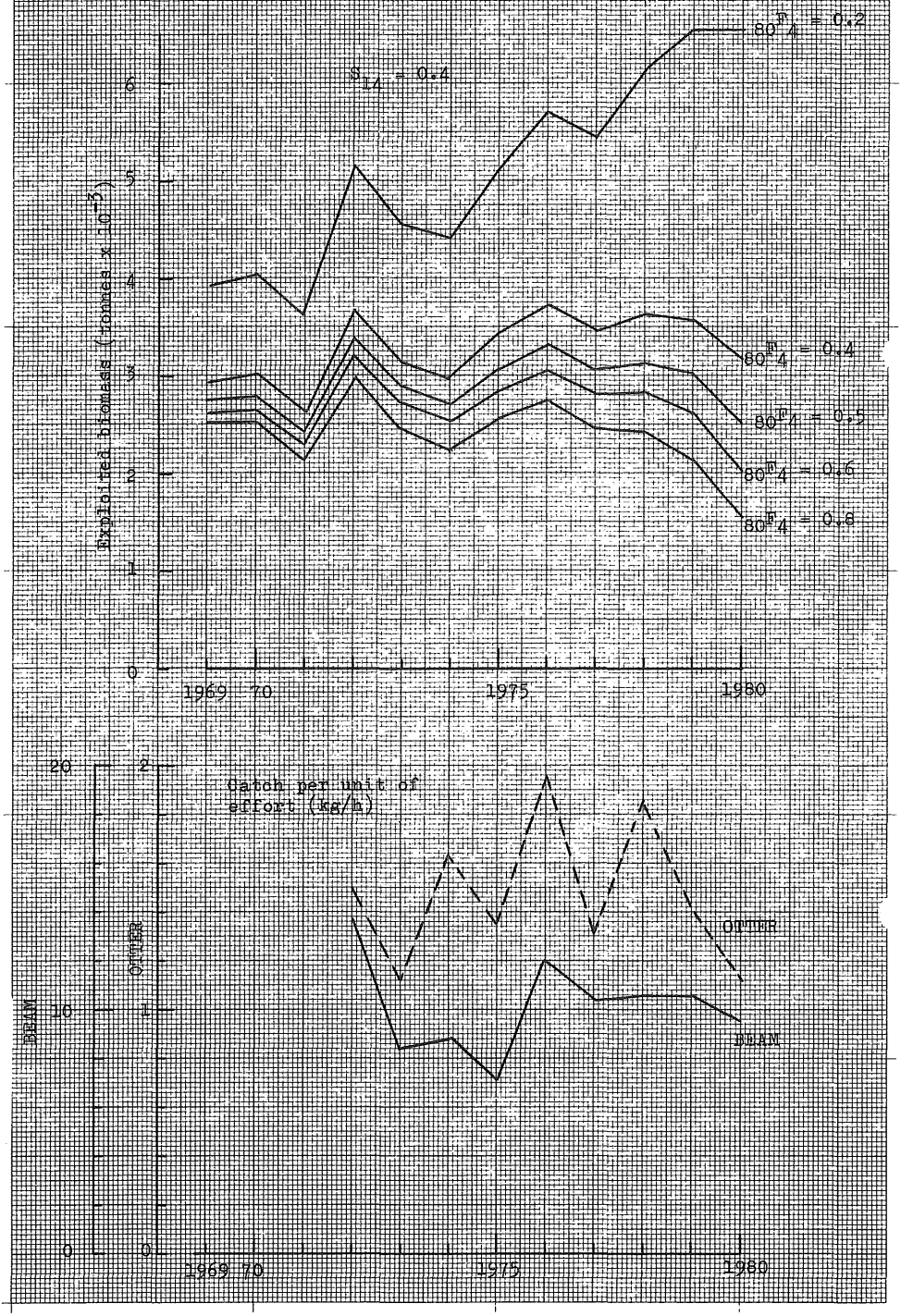


Figure 5.6 Sole in Division VIIe.

a) Total biomass (TB), spawning stock biomass (SSB) and landings (L).

b) Recruits at age 1.

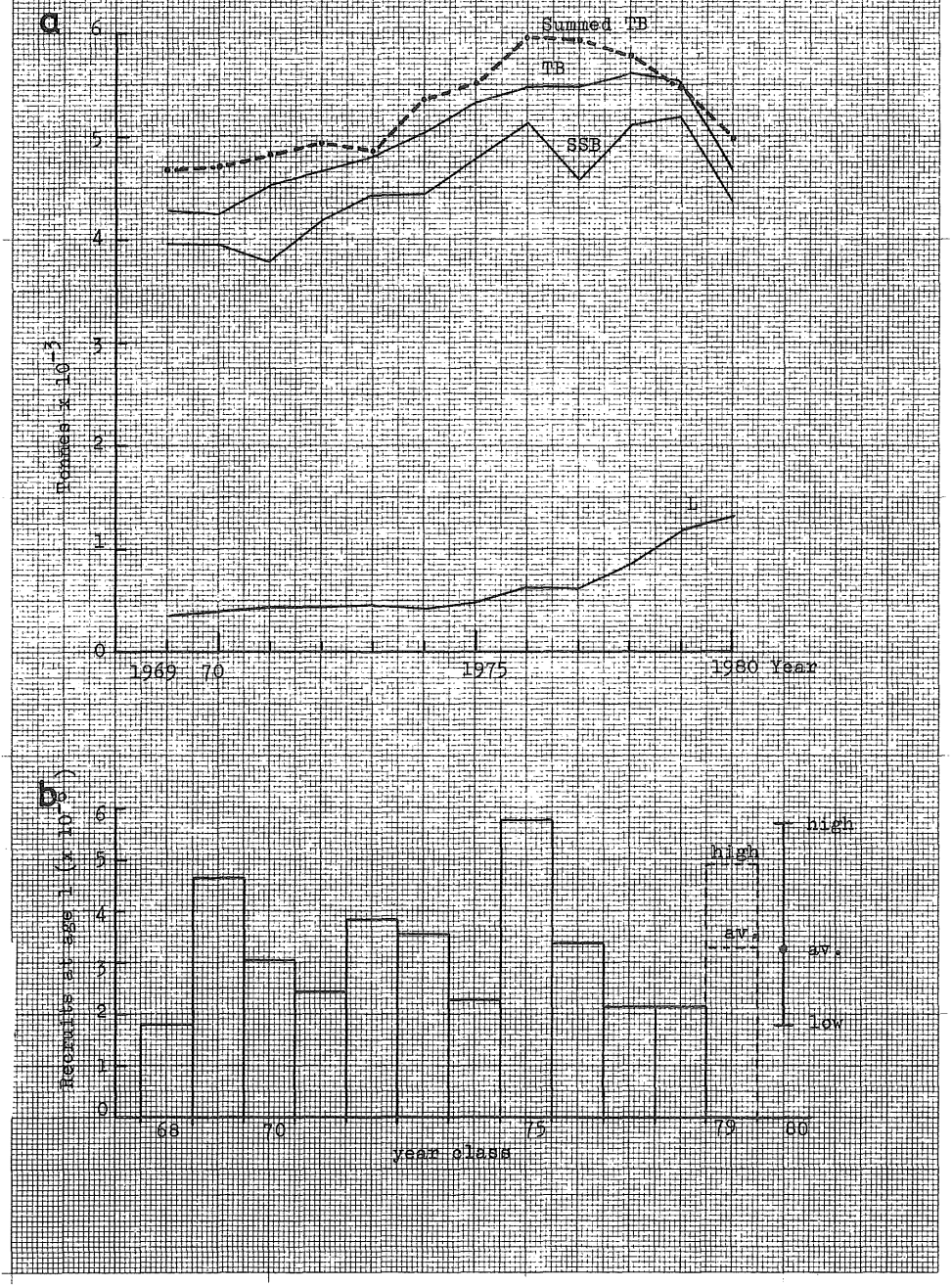
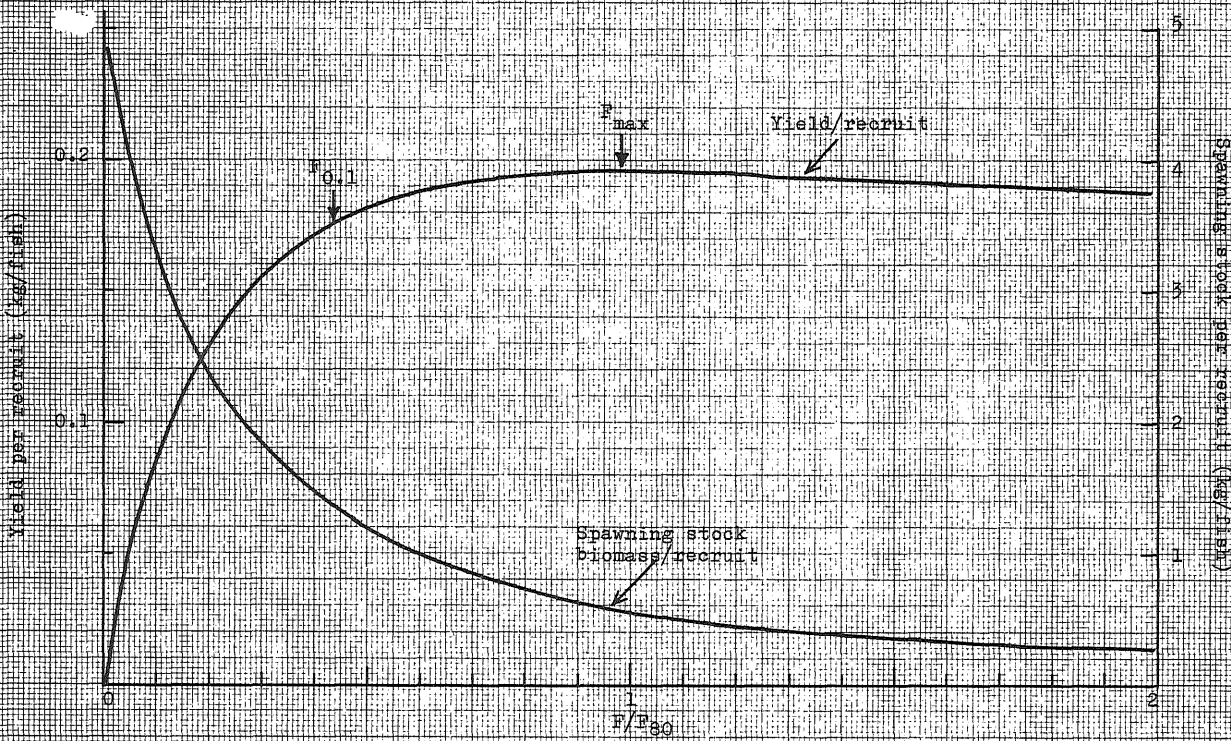


Figure 5.7 SOLE in Division VIIe. Equilibrium yield per recruit and spawning stock biomass per recruit curves.



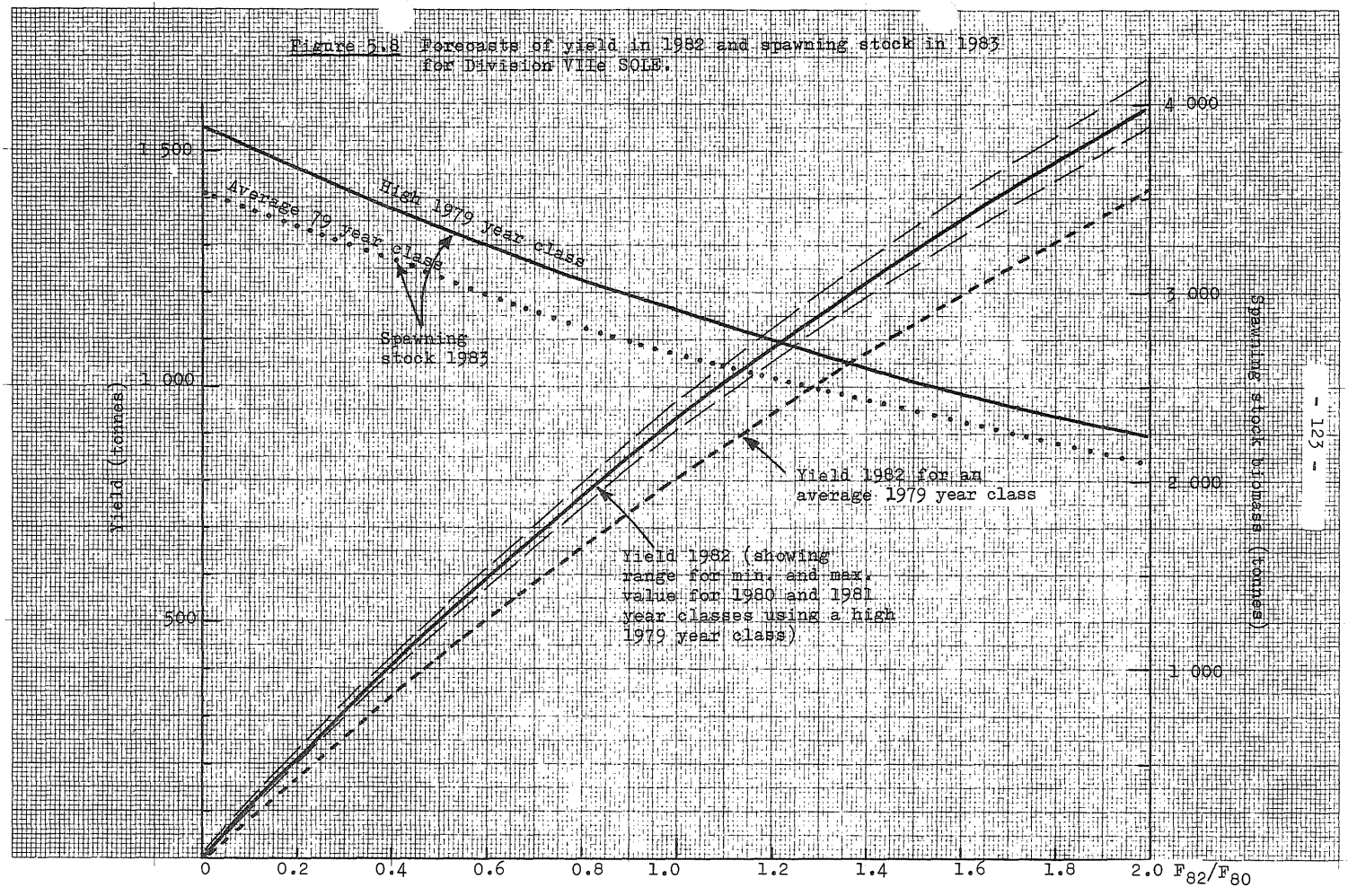


Figure 5.8 Forecasts of yield in 1982 and spawning stock in 1983 for Division VIIe SOLE.
Yield (tonnes)
Spawning stock biomass (tonnes)
F_{82}/F_{80}
1 500
1 000
500
4 000
3 000
2 000
1 000
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Average 79 year class
High 1979 year class
Spawning stock 1983
Yield 1982 for an average 1979 year class
Yield 1982 (showing range for min. and max. value for 1980 and 1981 year classes using a high 1979 year class)

Figure 7.1 Selection curves for 75 mm, 80 mm and 90 mm mesh size.

S.f. = 3.5

S.r = 3.8 at 80 mm mesh, proportional to mesh size

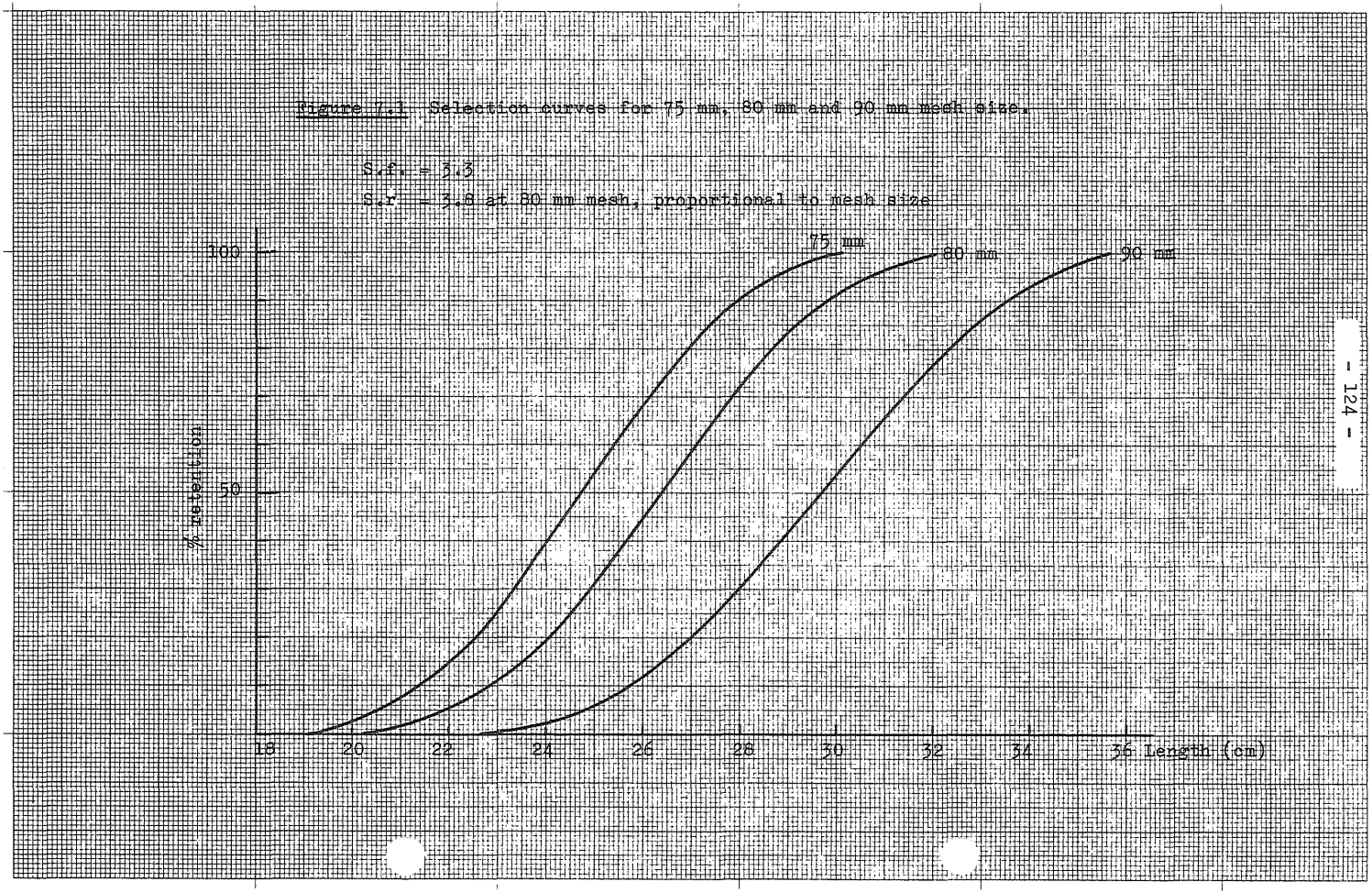
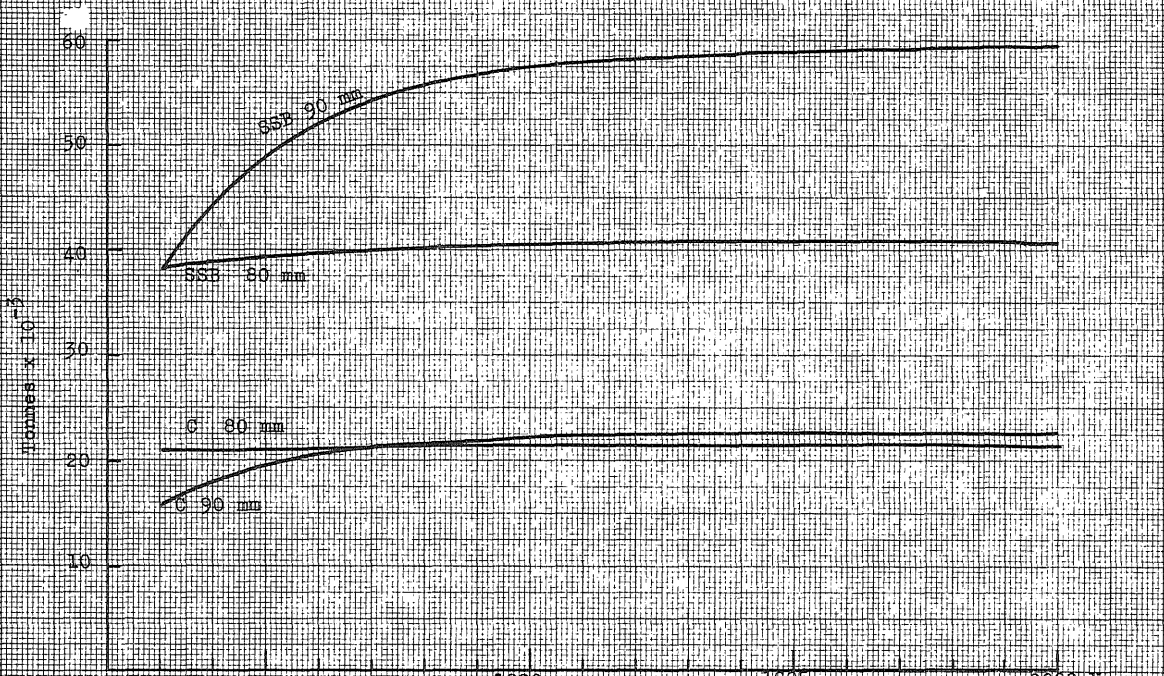


Figure 7.2 North Sea SOLE. Development of catch and spawning stock biomass from 1983 onwards for 80 mm and 90 mm mesh size.



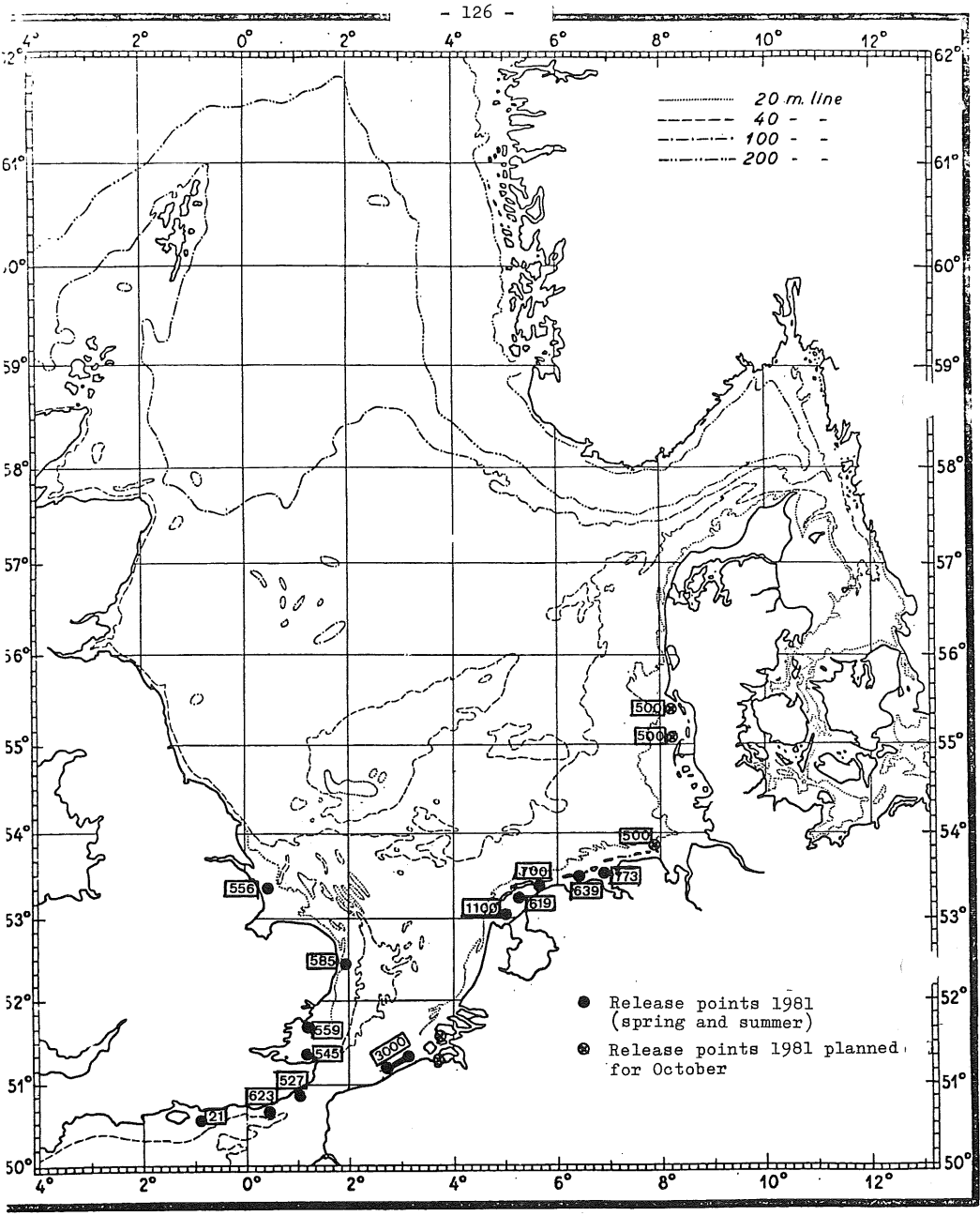


Figure 9.1 Release positions of international juvenile SOLE tagging experiment during 1981.