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REPORT OF THE IRISH SEA AND BRISTOL CHANNEL WORKING GROUP

Copenhagen, 17 - 25 April 1980

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REPORT OF THE IRISH SEA AND BRISTOL CHANNEL WORKING GROUP

1. INTRODUCTION

1.1 Participation

The following members participated in the 1980 meeting of the Working Group:

R J Boyd	United Kingdom (Northern Ireland)
K M Brander	United Kingdom (England)
A Charuau	France
N Cloet	Belgium
D de G Griffith (Chairman)	Ireland
J Guéguen	France
J P Hillis	Ireland
P Sparre	Denmark
J F de Veen	Netherlands

W Panhorst attended the meeting as ICES Systems Analyst.

It is with sadness that we record the death of Joop de Veen in Copenhagen during the meeting of this Working Group. As a colleague his great contribution to the work of the Group will be missed and as a friend his humour and charm are irreplaceable.

1.2 Terms of Reference (C.Res.1979/2:40)

During the Statutory Meeting in 1979 it was decided that the Irish Sea and Bristol Channel Working Group should meet at ICES headquarters 17-25 April 1980 to:

(1) assess TACs for cod, haddock, whiting, plaice and sole in Divisions VIIa, VIIf and VIIg;

(2) continue the examination of interactions between fisheries.

1.3 Data Shortcomings

The continuing shortage of information on fishing effort, particularly from Ireland, hindered the Working Group in making the assessments requested from them. Biological data are still inadequate in many respects, particularly for the gadoid stocks in the Celtic Sea and the Working Group was unable to meet their terms of reference in this regard.

The availability of the catch data for the first time from the Isle of Man was welcomed by the Working Group. The Isle of Man catch data provided (which were for the year 1979) have been incorporated in the assessments.

In view of the rapid rise in total demersal landings in the Isle of Man (see Table 1.1), efforts should be made to record all landings, rather than only those to processors, and to stipulate the nationality of the vessels involved.

2. IRISH SEA COD

2.1 Catch Trends

There was a rise of 33% in the catch of cod in 1979 to 8 371 tonnes due mainly to increases in Irish and Northern Irish landings (Table 2.1). Landings in the Isle of Man have also been rising rapidly and have been included for the first time (see also Section 1.3).

The catch per unit effort on cod by French trawlers rose by 30% in 1979 and for English and Welsh trawlers by 7%. Applying this to the total catch suggests that fishing mortality may have risen by as much as 24%. The recorded number of hours of directed fishing on cod by Northern Irish trawlers fell by 29%, but in view of the rise in their catch this seems unlikely to represent a decline in the fishing mortality in that fishery.

2.2 Age Compositions and Mean Weights at Age

The 1979 age composition was derived in the way described in the 1978 report. Discards and industrial landings have not been included, but are believed to be small as the industrial fishery ceased early in the year.

The Isle of Man landings have been raised using the English and Welsh age composition. The Northern Irish landings have been raised using the Irish age composition, but this may have led to an overestimate of the number of one and two year olds and an underestimate of the older fish, since the main Northern Irish fishery is on mature, spawning fish.

The values of weight at age remain unchanged from last year and the sum of products check is within 4% of the adult catch in 1979. This has been allowed for in the forecast calculations.

Values of weight at age are given in the text table below.

Age	1	2	3	4	5	6	7
Weight(kg)	0.61	1.66	3.33	5.09	6.19	6.76	8.30

2.3 Virtual Population Analysis

The relationship between catch per effort and number of one year olds (Figure 2.1 of last year's report) was used to estimate the size of the 1977 and 1978 year classes, and terminal F values in the VPA were adjusted accordingly. In order to obtain the number of one year olds of the 1977 year class derived from catch per effort, the terminal F on two year olds would have had to be 1.33, which seems unrealistically high. As mentioned in Section 2.2, the number of two year olds in the catch may be overestimated but, nevertheless, there appears to have been a shift in the exploitation pattern onto one and two year old fish. This has a marked effect on the yield per recruit calculation.

In view of the variability in the exploitation pattern, a constant terminal F of 0.8 was used on ages 3 and older. This gives a rise in mean F of 27% between 1978 and 1979 and is about 30% higher than the level of F during the early 1970s, which is consistent with the overall trends in fishing effort (Section 10). The resulting output is shown in Tables 2.2 to 2.5.

The trends in stock biomass are shown in Figure 2.1 and it appears that the decline in stock biomass has been halted in 1979 as is suggested by all the available catch per effort data. The small numbers of fish older than 7 are not included in the VPA, but have been added in the catch forecast.

2.4 Yield per Recruit

The yield per recruit curve conditional on the 1979 exploitation pattern is shown in Figure 2.2, and it shows a maximum at 40% of the present

level of F. Last year's curve showed a maximum at 50% of the 1978 level of F even though the absolute level of F was then thought to be much higher, at least on older fish. This difference is mainly due to the shift in the exploitation pattern. In view of the variability in the exploitation pattern, the possibility of interactions between species (Section 10) and the possibility of systematic effects of spawning stock on recruit level (see Appendix), it seems particularly undesirable to base a drastic management policy (e.g. severe reductions in TAC) on this yield per recruit curve alone.

2.5 Catch Forecasts

The recommended 1979 TAC was exceeded and fishing mortality may have risen (both last year's forecast and this year's VPA suggest that the rise was about 30%). For the 1981 forecast it is assumed that fishing mortality in 1980 will be the same as in 1979; the catch in 1980 will thus be 7 350 tonnes, leaving a total stock biomass of 15 000 tonnes and a spawning stock biomass of 7 000 tonnes at the beginning of 1981. For 1981 catches were calculated for three options of F as shown below.

Option	F_{1981}	Catch 1981	Stock biomass 1982	
			Total	Spawning stock
1	$= F_{80} = F_{79}$	7 300	15 000	7 000
2	$= 0.8\ F_{1980}$	6 200	17 000	8 000
3	$= F_{max}$	3 600	21 000	11 000

The figures incorporate the 4% discrepancy in the sum of products check. Figure 2.3 shows catches and stock sizes for a range of fishing mortalities in 1981.

At least 50% of these forecast catches consist of one and two year old fish, for which average recruitment (5 574 x 10^3 1 year olds) has been assumed.

There is a 5% joint probability that the two year classes will be as high as 12 068 x 10^3 or as low as 2 574 x 10^3, and the confidence limits which these values generate are shown in Figure 2.3. For Option 1 the catch in 1981 would be 7 300 tonnes, but it could be as high as 11 600 tonnes or as low as 5 300 tonnes. Conversely, if 7 300 tonnes is actually caught in 1981 it could imply an increase of 70 % in F or a decrease of 55%. This once again illustrates that in these circumstances a TAC is not a very precise instrument for regulating fishing mortality.

Several young gadoid surveys have been carried out in 1979 in order to provide early estimates of year class strength and there is good evidence that the 1979 year class is in fact a big one. An abundant 1979 year class (12 068 x 10^3 one year olds) would give a spawning stock biomass in 1982 of 11 400 tonnes under Option 1 and of 18 500 tonnes under Option 3. A comparison of the results of the 1979 United Kingdom groundfish survey with those of the previous three years suggests that the 1979 year class could be around this level of abundance.

2.6 Recommendation

The present level of F is high in relation to the maximum of the yield per recruit curve and the stock biomass is still rather low. The Working Group, therefore, recommends Option 2, a TAC in 1981 of 6 200 tonnes, but would once again stress the uncertainty of such a TAC achieving the desired level of fishing mortality.

3. IRISH SEA WHITING

3.1 Catch Trends

The total catch for 1979 was about 9 900 tonnes (see Table 3.1), which represents a drop of 5% below the 1978 figure but virtually equals the 1979 TAC. There were no major changes in the share of individual countries but for the first time a catch figure for the Isle of Man was provided to the Group. The industrial fishery by Ireland stopped in April 1979. Available information on the Nephrops fishery discards (Section 9) was not adequate to use in the assessment. A significant quantity of whiting may also be discarded in the whitefish fishery.

3.2 Age Compositions and Mean Weight at Age

For 1979 England and Ireland provided catch at age data for the whole year. Northern Ireland provided similar information for the period August to December 1979. The Northern Ireland landings for the rest of the year were converted into age distributions by using an Irish ALK for the first two quarters. English ALKs were used to convert French length compositions into ages. The English catch composition was applied to the Isle of Man catches. The catch composition obtained by these methods represented 97% of the total to which it was then raised. For earlier years figures used were those presented in the 1979 Working Group report.

The weights at age were the same as those used in the 1979 stock assessment (see below). The sum of products check is low by 13%.

Age		1	2	3	4	5	6	7	8	9
Weight at age (kg)	Catch	0.185	0.244	0.295	0.389	0.464	0.530	0.570	0.593	0.608
	Stock	0.070	0.175	0.260	0.342	0.426	0.497	0.550	0.582	0.600

3.3 Virtual Population Analysis

The Working Group assumed that little change in effort had taken place since 1978. Input F values were retained at least year's level. The results are given in Tables 3.2 to 3.5. Neither the 1977 nor the 1978 year classes have been especially strong and the catch has accordingly declined by over 20% since 1977.

Stock biomass remained steady for the third year running at between 15.0 and 15.5 x 10^3 tonnes (see Figure 3.1).

3.4 Yield per Recruit

The yield per recruit and spawning stock biomass per recruit curves conditional on the 1979 exploitation pattern are shown in Figure 3.2. F_{max} falls in the region of 40% of the 1979 F value.

3.5 Catch Forecasts

The number of 1 year old recruits in 1980, 1981 and 1982 was taken as 46×10^6, the geometric mean of the values for the period 1972-76.

Assuming that fishing mortality remains at its 1979 level in 1980, a catch of approximately 10 000 tonnes should be taken, about 1 000 tonnes below the recommended TAC. This will leave a total stock biomass of 17 000 tonnes and a spawning stock biomass of 13 000 tonnes at the beginning of 1981.

For 1981 catches were calculated for 3 options of F as shown below.

Option	F_{1981}	Catch 1981	Stock biomass 1982	
			Total	Spawning stock
1	$= F_{80} = F_{79}$	9 800	16 000	13 000
2	$= 0.8\ F_{80}$	8 400	18 000	15 000
3	$= F_{max}$	5 400	21 000	18 000

The correction to allow for the 13% discrepancy in the sum of products check has been incorporated in these figures.

The results of these forecasts are summarised in Figure 3.3 which also shows the effect at two high and two low recruit levels.

3.6 Recommendation

The current levels of fishing mortality are high in relation to the conditional F_{max} and the Group recommends Option 2, a TAC in 1981 of 8 400 tonnes. If a large amount of discarding has in fact been occurring, the reduction in F represented by this TAC may be much greater than 20%. On the other hand, any continuing use of mesh sizes smaller than 70 mm would tend to counteract this effect.

4. IRISH SEA PLAICE

4.1 Catch Trends

The 1979 catch of 3 390 tonnes showed a slight increase over the figures for the past two years (Table 4.1), and is to be compared with the Working Group's recommended TAC of 3 000 tonnes (later amended to 2 500 tonnes). The 1977 and 1978 catches were approximately 70% and 80% of the respective TACs for those years.

4.2 Age Compositions and Mean Weights at Age

The 1978 age composition was adjusted to take account of new data available from the United Kingdom. For 1979, age distributions were available from Ireland, England and Belgium, accounting for 86% of the landings. The total international age distribution was derived , for males and females (Table 4.2 and Table 4.6) in the same way as in previous years - Irish data raised to Ireland + Northern Ireland catches, English data to England + Wales + Isle of Man + Scotland, and the Belgian age distribution to the sum of Belgian, French and Dutch catches.

Mean weights at age were unchanged from previous years:

Age		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Males	Catch	.06	.173	.20	.27	.33	.37	.40	.43	.44	.45	.46	.46	-	-	-
	Stock	.02	.09	.17	.23	.30	.35	.38	.41	.44	.44	.45	.46	-	-	-
Females	Catch	.06	.14	.25	.37	.50	.63	.75	.86	.97	1.06	1.14	1.21	1.27	1.32	1.36
	Stock	.02	.09	.19	.31	.43	.56	.69	.81	.91	1.02	1.10	1.17	1.24	1.27	1.34

The weights shown are in kg; catch weight at age refers to 1 July and stock weight at age to 1 January. The sum of products check for 1979 was 14% too low, and an adjustment to take account of this has been made in the final catch forecast.

4.3 Virtual Population Analysis

Input Fs were derived by smoothing the mean values for the period 1971-75 given in the 1979 Working Group report. (This takes account of the increasing trend in fishing mortality since 1971, as indicated by the VPA.) The levels of F on 1- and 2 year olds were adjusted to give approximately average (geometric mean) recruit strength in 1978 and 1979. Figure 4.1 shows a geometric mean regression of total stock biomass on United Kingdom cpue. The correlation coefficient is 0.539 ($r = 0.576$ for $p = 0.05$ and 10 d.f.). The regression suggests that the total stock biomass for both the years 1978 and 1979 were among the highest on record, but the increase over 1977 as indicated by the VPA is only marginal (see Figure 4.2). However, the decline in stock biomass seems to have been halted in 1977.

The 1975 year class, which appeared to be very strong in the VPA's run in 1979 and 1978, now appears to have been only about average strength. The apparent strength of the 1976 year class should consequently be treated with reserve.

The results of the VPA are given in Tables 4.3-4.5 and 4.7-4.9.

4.4 Yield per Recruit

The curves of yield per recruit and biomass per recruit, conditional upon the 1979 exploitation pattern are shown in Figure 4.3. The combined male/female curves are weighted by the geometric mean number of recruits (6×10^6 males and 9×10^6 females). The conditional F_{max} is 35% of the peak F in the 1979 exploitation pattern.

4.5 Catch Forecasts

The Working Group assumed that the fishery in 1980 would continue to be effectively unregulated by international agreement, and that the 1979 level of exploitation would continue. The catch for 1980 under these circumstances will be 3 100 tonnes. The total stock biomass in 1981 will be 6 000 tonnes and the spawning stock biomass will be 4 600 tonnes. The 1980 TAC recommended by the Working Group in 1979 was 3 000 tonnes, later amended to 2 500 tonnes by the ACFM.

For 1981, catches were calculated for three options of F, as shown in the following text table:

Options	F_{1981}	Catch 1981	Stock biomass 1982	
			Total	Spawning stock
1	$= F_{80} = F_{79}$	3 000	5 800	4 100
2	$= 0.8\ F_{80}$	2 500	6 300	4 600
3	$= F_{max}$	1 300	7 700	6 000

The correction to allow for the 14% discrepancy in the sums of products check has been incorporated in these figures. It has also been applied to the values in Figure 4.4 which shows the 1981 catches and 1982 biomass corresponding to a range of fishing mortalities in 1981.

4.6 Recommendation

The present level of F is high in relation to the maximum of the conditional yield per recruit curve, and stock biomasses still relatively low. The Working Group therefore recommends Option 2 and a TAC in 1981 of 2 500 tonnes.

5. CELTIC SEA PLAICE (Divisions VIIf and VIIg)

5.1 Catch Trends

The 1979 catch was 863 tonnes, which is about the level of the last six years (Table 5.1). France continues to account for the major proportion of the total landings. Total French fishing effort in the area during 1979 was approximately the same as in 1978, but most of their effort is on roundfish. Belgian fishing hours (in the sole fishery, of which plaice is a by-catch) went down in 1979, but horse-power increased.

5.2 Age Compositions and Mean Weights at Age

The sum of the Belgian age distributions for Divisions VIIf/VIIg and the English age data for Division VIIf were raised to the total international catch (Tables 5.2 and 5.6). These two countries account for only 40% of the total catch.

Mean weights at age used were the same as last year (kg):

Age		1	2	3	4	5	6	7	8	9	10	11
Males	Catch	.1	.236	.281	.305	.340	.380	.428	.519	-	-	-
	Stock	.1	.20	.26	.30	.32	.36	.40	.46	-	-	-
Females	Catch	.1	.286	.374	.467	.548	.705	.838	.949	1.109	1.409	1.600
	Stock	.1	.24	.33	.41	.51	.62	.78	.89	1.03	1.27	1.52

The sum of products check for 1979 agreed with the catch total.

5.3 Virtual Population Analysis

The 1978 values of F were used as input for a trial VPA run. This gave an 18% drop in weighted mean F from 1978 to 1979 which was not in accordance with the available data on fishing effort, and so the levels

of F were raised by 10%; F on 1 year olds was adjusted to give average recruitment. This still resulted in a reduced 1979 exploitation pattern on the younger age groups (3 and 4 year olds) and a 13% reduction in the weighted mean F from 1978 to 1979. This output from the VPA is given in Tables 5.3 to 5.5 (males) and Tables 5.7 to 5.9 (females). The resulting trends in stock biomass and year class strength from 1970 are shown in Figure 5.1. Stock biomass has been declining slowly and now stands at about 60% of the 1970 level. However, the 1975 and 1976 year classes appear to be strong.

5.4 Yield per Recruit

The yield per recruit and spawning stock biomass recruit curves, conditional upon the 1979 exploitation pattern, are shown in Figure 5.2 for males, females and the sexes combined, (weighted by recruit strength). The conditional F_{max} is about 40% of the 1979 peak level of F.

5.5 Catch Forecasts

Recruitment was calculated as the geometric mean for the period 1970-76 i.e. 1.1 x 10^6 males and 1.3 x 10^6 females for 1980, 1981 and 1982. Assuming that fishing mortality remains at its 1979 level in 1980, a 1980 catch of approximately 800 tonnes should be taken - a slight reduction on the 1979 catch and some 100 tonnes (14%) above the 1980 recommended TAC (700 tonnes). This will leave a total stock biomass of 1 900 tonnes and a spawning stock of 1 200 tonnes at the beginning of 1981 (see Figure 5.1). For 1981, catches and stock sizes were calculated for three options of F as shown in the text table below:

Option	F_{1981}	Catch 1981	Stock biomass 1982	
			Total	Spawning stock
1	$= F_{80} = F_{79}$	700	1 800	1 100
2	$= 0.8\ F_{80}$	600	1 900	1 200
3	$= F_{max}$	300	2 200	1 500

The results of these forecasts for a range of fishing mortalities in 1981 are shown in Figure 5.3.

5.6 Recommendation

The present level of F is high in relation to F_{max} and projected stock biomass will decline in 1980 and 1981. The Working Group therefore recommends Option 2 and a 1981 TAC of 600 tonnes.

6. IRISH SEA SOLE

6.1 Catch Trends

The 1979 catch was 1 629 tonnes, including landings from the Isle of Man. The official Irish and Dutch landing figures were amended to incorporate landings in the United Kingdom (Fleetwood). The

1979 catch was substantially 48% higher than in 1978 and in fact the highest since 1971. Catch rates of Belgium, Netherlands and United Kingdom went up by 80%, 32% and 52%, respectively. Belgian effort remained roughly constant (beam trawl effort went up by 17% but otter trawl went down by 45%) and Dutch effort (beam trawl) went up by 5%. Total effort based on Belgian and United Kingdom catch per unit effort declined. The nominal catches in 1970-79 are given in Table 6.1.

6.2 Age Compositions and Mean Weights at Age

The international age composition was calculated by raising the Belgian, Dutch and United Kingdom age distributions accounting for 81% of the total catch, to 100%. The age distribution of the provisional 1978 catch was amended (Tables 6.2 and 6.6) to correspond to the final catch figure to that year. The sum of products check using the weight at age data from last year's assessment shown in the text table was 3% too high. This discrepancy was left during the calculations and was only adjusted in the final catch forecast.

Weight at age (kg)	Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Males	.123	.151	.173	.195	.215	.232	.245	.254	.264	.275	.283	.291	.299	.305
	Females: Catch	.140	.195	.250	.300	.345	.390	.425	.460	.495	.520	.550	.575	.595	.615
	Stock	.120	.170	.220	.270	.310	.360	.410	.440	.480	.510	.530	.560	.580	.600

6.3 Virtual Population Analysis

The age composition of the 1979 international catch is dominated by the 1975 year class, as is also the case in the national catches of Belgium, the Netherlands and United Kingdom. Both in the male and female age compositions, 50% consists of this year class alone.

In last year's assessment the size of the 1975 year class was derived from the geometric mean regression of VPA 2 year old sole on Belgian cpue of 3 year old soles in the beam trawl fishery. The most likely values for the 1975 year class as 2 group were 37 x 10^6 for males and 58 x 10^6 for females (67% of the size of the good 1971 year class at age 2), and the terminal F values for age group 3 in 1978 were adjusted by last year's Working Group to produce these values.

Stock biomass in last year's VPA showed a decline since 1971 which stopped in 1977, followed by a slight increase in 1978. The Belgian cpue correlated well with the stock biomass trend ($r = .79$), but the United Kingdom cpue showed a less good fit ($r = .54$).

This year a trial VPA using last year's terminal F values completely changed the picture ('A' in Figure 6.1). In this VPA, stock in 1977, 1978 and 1979 increased sharply to a level higher than in 1971, which increase is not reflected in the Belgian and the United Kingdom cpue curves. The 1975 year class is in this case about twice the size of the 1971 year class at age 2.

It is possible that fishing effort in 1979 concentrated on the 1975 year class and to study the effects of this, new VPAs were run with amended values for terminal F for age group 4; case B, 1.5 x F_{78} on 4 year olds and case C, 2 x F_{78}. B and C in Figure 6.1 show the resulting stock biomasses and the size of the 1975 year class.

Case B is considered to give the appropriate values of F, stock biomass and recruit strength. The stock of the 1976 year class as 2 year olds agrees with the figure derived from a geometric mean regression of VPA 2 year olds on cpue of 3 year olds one year later in the Belgian beam trawl fishery (Figure 6.2). The correlation coefficient is 0.68 for 7 degrees of freedom which is significant at the 5% level. The input level of F on the 1975 year class in 1979 is in line with the fishing mortality values for that age group in earlier years.

Figure 6.3 shows the trends of stock and recruitment levels derived from this VPA, together with Belgian beam trawl cpue (2nd quarter of each year) and United Kingdom otter trawl cpue (March-September).

6.4 Yield per Recruit

Figure 6.4 shows the curves of yield per recruit and spawning stock biomass per recruit conditional upon the 1979 exploitation pattern. It may be seen that the stock is currently underexploited relative to F_{max}, but increasing the level of exploitation would not bring about any significant rise in the yield per recruit since the curve is flat-topped.

6.5 Catch Forecasts

Recruitment for 1980, 1981 and 1982 was taken as the geometric mean recruitment indicated by the VPA in the period 1970-76. For males this was 2.9×10^6 and for females 3.8×10^6.

It was assumed that as for other Irish Sea stocks, the fishery in 1980 will continue to be unregulated by international agreement and that the 1979 level of exploitation would continue. This will yield a catch in 1980 of 1 600 tonnes, with a total stock biomass of 7 400 tonnes and spawning stock of 6 600 tonnes at the beginning of 1981. This catch compares with the 1980 TAC of 1 300 tonnes recommended by last year's Working Group meeting.

For 1981, catches have been calculated for three options of F in that year, as shown in the text table below. The correction to allow for the 3% sum of products discrepancy has been incorporated.

Option	F_{1981}	Catch 1981	Stock 1982	
			Total	Spawning
1	$F_{81} = F_{80}(=F_{79})$	1 500	7 000	6 200
2	$F_{81} = 0.8\ F_{80}$	1 200	7 300	6 500
3	$F_{81} = 0.4\ F_{80}(=F_{0.1})$	600	7 900	7 000

The levels of catch and stock for a full range of F values are shown in Figure 6.5

6.6 Recommendation

The stock is fully exploited in terms of conditional yield per recruit and there appears to be no justification for a reduction in fishing mortality. The Working Group therefore recommends Option 1 and a 1981 TAC of 1 500 tonnes.

7. CELTIC SEA SOLE (Divisions VIIf and VIIg)

7.1 Catch Trends

The total catch in 1979 rose slightly from its 1978 level of 780 tonnes to 954 tonnes which was 76% of the recommended TAC (1 250 tonnes). Although the 1979 catch represented a decline from the 1976 level of 1 351 tonnes, it was still well below the 1970-73 values, which were in the 1 300 - 1 900 tonnes range. The change in 1979 was due to an increase in the Belgian catch from 506 tonnes in 1978 to 693 tonnes, the catch in France and the United Kingdom showing a very slight decrease (Table 7.1.A).

Total effort (calculated by raising Belgian beam trawl effort corrected for fishing power) showed a slight decline in 1979 (Figure 7.1).

7.2 Age Compositions and Mean Weights at Age

The age distribution for 1978 was the same as that used in the Working Group report for 1979. For 1979 only Belgian age distributions were available, covering 65% of the total international catch. They were raised to the total international catch and the sum of products checks were in good agreement (within 1% of the actual catch).

Mean weights at age in the catch and in the stock were the same as those given in the 1979 Working Group report (see below).

Weight at age (kg)

Age	Catch weight		Stock weight	
	Males	Females	Males	Females
2	.133	.200	.120	.168
3	.187	.282	.174	.258
4	.217	.377	.217	.377
5	.276	.435	.276	.435
6	.305	.516	.305	.516
7	.339	.574	.339	.574
8	.363	.632	.363	.632
9	.388	.690	.388	.690
10	.423	.732	.423	.732
11	.436	.757	.436	.757
12	.448	.787	.448	.787
13	.459	.798	.459	.798
14	.472	.823	.472	.823
15	.484	.835	.484	.835
16	.497	.847	.497	.847

7.3 Virtual Population Analysis

Inputs and outputs are given in Tables 7.2 to 7.9.

The exploitation patterns used as input were the same as those used in last year's report, but with the F values lowered by 10% to take account of the lower fishing effort exerted during 1979 compared with that of 1978 (see Figure 7.1). Although the VPA output (Tables 7.3 and 7.7) shows a slight increase in weighted mean F on the mature age groups in 1979, it corresponds to the 1974 and 1975 levels when fishing effort

was at a similar level to that in 1979, as may be seen from Figure 7.1. The Working Group did not feel that a further reduction in input Fs would be justified.

Although the present VPA indicates that the 1976 year class was not as abundant (as 2 year old recruits) as last year's report suggested, it is still one of the strongest on record and lies on the geometric mean regression line of VPA 3 year olds against cpue of 3 year olds in the Belgian beam trawl fishery ($r = 0.98$ and 0.97, see Figure 7.2). Both correlations are highly significant. The 1977 year class also appears to be strong (Figure 7.2). The steep decline in spawning stock biomass (resulting from the steady disappearance of the strong year classes of 1959, 1960 and 1963) was halted in 1977 (Figure 7.3), although total stock biomass was slightly lower in 1978 than in 1977.

7.4 Yield per Recruit

The yield per recruit curve conditional upon the 1979 exploitation pattern is flat-topped as may be seen in Figure 7.4, which also shows the corresponding curves for spawning stock biomass per recruit. The current level of fishing mortality is around $F_{0.1}$ on the combined male/female yield per recruit curve.

7.5 Catch Forecast

The input data are shown in Table 7.10. Recruitment was calculated as the geometric mean recruitment for the period 1970-76, 1.9×10^6 males and 2.2×10^6 females. It was assumed that the level of fishing mortality would remain unchanged from 1979 through 1980, in which case the 1980 catch will be 1 024 tonnes. This agrees with the recommended 1980 TAC of 1 000 tonnes. The total stock biomass at the beginning of 1981 will have increased to 7 700 tonnes and the spawning stock biomass will have increased to 7 100 tonnes.

TACs for 1981 have been calculated for a range of F values relative to F_{1980}. These may be seen in Figure 7.5, which also shows the resulting biomass for 1982. If fishing mortality in 1981 continues to be at the 1980 level, the catch in 1981 is calculated to be 1 025 tonnes.

7.6 Recommendation

The Working Group recommends that the 1981 TAC should be 1 000 tonnes, on the basis that this stock is optimally exploited in terms of the yield per recruit model.

8. OTHER GADOID STOCKS

8.1 Celtic Sea Cod

Cod catches in 1979 amounted to 3 450 tonnes, which represents an increase of 25% over the 1978 figure. In both years, France accounted for more than 90% of the catch (Table 8.1).

8.2 Celtic Sea Whiting

For the fourth year in succession, catches are of the order of 6 000 tonnes of which 56.9% were landed by France (Table 8.2). In 1978 and earlier years, catches were predominantly from Division VIIf but in 1979 about 62% of the total catch came Division VIIg.

Catch per effort data available for France (82.2 kg/ue in 1979) showed a drop of 35% below the 1978 figure for Division VIIf, whereas there

was no change in Division VIIg (106.8 kg/ue). As explained in last year's report, due to the lack of data for the years prior to 1977, no VPA could be run, but using French effort data, numbers by length group in the French catches for 1978 and 1979, and applying an English age/length key, a first estimate of the Z at age in 1979 was made (see Table 8.3). The Working Group did not feel that the data were adequate to allow an estimate of stock size to be made and hence to recommend a TAC. Nevertheless, the fishing pattern on Celtic Sea whiting being similar to that of the Irish Sea, it may be inferred that the stock would benefit from a reduction in F in 1981.

8.3 Haddock in the Irish Sea and the Celtic Sea

For the second year running, catches originating from Divisions VIIg-k are about 1 000 tonnes, of which France accounted for 95% (Table 8.4). A more detailed split available for France in 1978 showed that only 370 tonnes of her catch was taken from Division VIIg.

No biological information on this species was available to allow the Working Group to make any recommendations. It is unlikely that such information will appear in the future and the Working Group repeats its proposal of last year that haddock in the Irish Sea and the Celtic Sea be omitted from its terms of reference.

9. BY-CATCHES OF PROTECTED SPECIES IN NEPHROPS FISHERIES

9.1 Irish Nephrops Fishery in Division VIIa

There is some evidence that in Division VIIa, Nephrops fisheries continue to catch whiting of a generally smaller size than directed gadoid fisheries (Table 9.1). This is due to several factors, including (1) the effect of Nephrops in the cod end on the selection factor for whiting (Hillis, 1962[x]) and (2) the persistance of some fishing with small-meshed nets in the area. Table 9.1 shows that the age structure of these whiting is generally lower and their length at age markedly lower than that of whiting caught in the directed whitefish fishery. The difference in age structure has not been allowed for in raising the Irish number at age because sampling is incomplete, having been carried out in only one quarter of the year. Examples of length frequencies of whiting catches (landings + discards) from a sector of this fishery believed to be poorly regulated are given in Table 9.2.

Owing to lack of adequate knowledge about the total quantity of whiting taken as by-catch in the Nephrops fishery, the Group was unable to quantify the effect of this by-catch on the whiting stock.

9.2 French Nephrops Fishery

No data are available concerning by-catches in the Nephrops fishery in Division VIIa.

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x) Whiting mesh selection experiments in Irish waters. ICES, C.M.1962, Comparative Fishing Cttee, No.62.

In the Celtic Sea (Division VIIg, mesh size in use 55-60 mm), a continuous sampling programme aboard commercial vessels was initiated in December 1979. Length composition data are given in Table 9.3 (representing 800 hours fishing), from the eight samples taken during the period December 1979 to March 1980.

For Nephrops trawlers from Brittany, protected species make up 20% of the total landings, Nephrops 65% and non-protected species 15%. Amongst protected species, megrim is 6.6%, cod 3.75% and whiting 1.2% of the total landings.

Catches of undersized fish are mainly of megrim on muddy bottoms in the Nephrops areas and to a lesser extent of hake on the Smalls grounds.

At present the sampling programme, which commenced in 1979, has not yielded sufficient information to allow any assessment to be made of the effect of by-catches of the stock of the by-catch species.

9.3 By-Catches of Protected Species in the Shrimp (Crangon) Fishery

Estimates of the numbers of plaice and sole taken as a by-catch in the English and Welsh shrimp fishery in the Irish Sea are available for 1979. They show that about 19 x 10^6 0-group plaice and 1.5 x 10^6 0-group sole were taken in a total shrimp catch of 500 tonnes. These fish are released again during different stages of the sorting process, and studies are in progress to estimate the level of survival. In order to incorporate these figures in the assessment it will also be necessary to estimate the natural mortality on 0-group and 1-group plaice. Catches of other protected species are small.

10. MULTISPECIES MODELLING

10.1 Introduction

The Group considered recent developments in modelling species interactions and technical interactions in order to evaluate their likely importance in generating management advice and to make recommendations on the data which should be compiled. The purpose of the different types of model, their data requirements and the local difficulties in applying them to the Irish Sea are set out below. Present shortcomings in the data base needed for single species assessments should not be overlooked when moving on to these interactive models. In particular, we need better information on all the fishing-induced mortality not accounted for at present (e.g., discard mortality) and on the effort applied in all fisheries.

Ultimately the models which explicitly include species interactions and technical interactions should be used as the basis for fisheries management advice and the Group therefore considers it worthwhile to devote effort to their development in relation to the Irish Sea. Nevertheless, it may be some time before they can be applied and for the present the Working Group has continued with the surplus production model based on the total demersal catch. This is used to recommend the adoption of a total demersal TAC (Section 10.4).

10.2 Species Interaction (Legion Analysis)

Two recent papers (Pope, 1979* and Helgason and Gislason, 1979**) describe similar models which take predation-induced mortality into considera-

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* A modified cohort analysis in which constant natural mortality is replaced by estimates of predation levels (Doc. C.M.1979/H:16).

** VPA analysis with species interaction due to predation (C.M.1979/G:52).

tion. These models are constructed as an extension of ordinary VPA and thus work on historical data. In Sparre, 1980 (to appear as an ICES paper this year) the model (known as legion analysis) is extended to allow for running it in the prognostic mode. To run the legion analysis, a number of additional parameters need to be estimated. and they are:

1) Yearly food intake per individual of each stock and age group assessed.

2) A food suitability matrix(for a definition see Anon., 1980*).

All major fish stocks of the area under consideration should be included in the assessment, including the relevant outputs of the Herring Assessment Working Group. It is especially important that all stocks of fish predators are considered. This condition is difficult to satisfy for the Irish Sea as no age composition data are available for several major fish predators (e.g., hake, dogfish, skates, rays and yellow gurnard).

Before an assessment based on legion analysis is used as the basis for fishery management, a stomach content survey like that suggested for the North Sea (Anon., 1980*) should be implemented for the Irish Sea.

In spite of these difficulties the Group felt that it would be worthwhile to try an assessment based on legion analysis at next year's meeting, even though this will require educated guesses for a number of parameters.

10.3 Technical Interaction

The model by Sparre (1980) also attempts to describe the technical interaction between various components of the fishing fleets, i.e. to allow for the fact that most fisheries are mixed fisheries.

An implication of this approach is that TACs on the various stocks should not be determined independently of each other. By-catches of other species need to be taken into consideration in setting TACs in a mixed fishery.

To model technical interaction (in its simplest form) a number of parameters need to be estimated.

1. A division of the total international fishing fleets into components consisting of uniform vessels. (In this connection a "fleet" is to be considered as a management unit, in country/gear combinations).

2. A by-catch matrix:

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* Report of the ad hoc Working Group on Multispecies Assessment Model Testing. Doc. C.M.1980/G:2 (mimeo.).

Species / Fleet	1	2	....	S
1	b (1,1)	b (1,2)	....	b (1,s)
. . . .	. . . .	. . . .		. . . .
E	b (e,1)	b (e,2)	....	b (e,s)

E = number of fleets considered

S = number of species considered

b(e,s) = (F on species s by fleet e)/(F on target species of fleet e)

For each age group "F on species s by fleet e" is defined as:

$$(\text{Total F on species s}) \times \frac{\text{catch of species s by fleet e}}{\text{total catch of species s}}$$

Total F is derived from VPA.

Thus, the coefficients b(e,s) are derived from species and age group compositions from the various fleets, output from VPA and information on target species.

3. Gear selection curves for each species for each fleet fishing on it. (Mesh sizes, selection factors).

4. Numbers discarded per year at each age group for each fleet and stock.

Technical interaction may well have a greater influence on management strategy than species interaction, and the Group gave the highest priority to modelling technical interactions. It may in any case be easier to estimate the parameters needed for the technical interactions than those for the species interactions and assessments incorporating technical interactions should be attempted next year.

A major difference between the North Sea and the Irish Sea is the relative importance of Nephrops in the latter area. This species must be included in the model of both technical and species interactions in the Irish Sea.

10.4 Total Demersal Production Model

The theoretical background and method of calculation of the total demersal model is given in the 1978 and 1979 Working Group reports. The data for 1977 and 1978 have been corrected and provisional figures for 1979 added to the time series (Table 10.1).

The total demersal catch again declined slightly to 44 700 tonnes and fishing effort was almost unchanged at 13 500 standard units. This level of effort is between 12% and 26% above the level for MSY, depending on whether the linear or the exponential model is preferred (Figure 10.1).

A 10% reduction would bring fishing effort to the MSY point on the Schaefer curve. This corresponds to a total demersal catch in 1981 of about 40 000 tonnes for Divisions VIIa and VIIf, on the assumption that cpue remains at the level of the last four years (3.25 tonnes per standard unit). Out of this total demersal catch 29 000 tonnes should be from Division VIIa.

The Working Group therefore recommends total demersal TACs for 1981 of 29 000 tonnes in Division VIIa and 11 000 tonnes in Division VIIf.

The advantages of using the surplus production model and of adopting a total demersal TAC are:

1. It is a yield model rather than a yield per recruit model. The conclusion from several single species yield per recruit models that fishing mortality should be reduced by large amounts may be misleading because they do not allow for interaction between species or for stock/recruit relationships.

2. The total demersal TAC would be a second-tier TAC, and would include the single species TACs. It thus provides a means of preventing diversion of effort onto non-quota species.

3. Although the present proposal is for a catch limitation rather than an effort limitation it should be seen as an aid to management since it focusses attention on the broad overall pattern and level of fishing required to exploit the available resources. Such an overview tends to get lost in individual species assessments.

The total of the proposed catch levels in Division VIIa in 1981 for the four demersal quota species is 18 500 tonnes which represents 65% of the proposed total demersal TAC.

Table 1.1 Weight of Demersal Fish landed to processors in the Isle of Man

Year	Nominal Weight (tonnes)	
1969	1.9	Estimated
1970	1.5	
1971	29.4	
1972	105.7	
1973	28.5	
1974	15.3	Actual
1975	17.8	
1976	60.3	
1977	348.9	
1978	606.6	
1979	1 376.3	

Table 2.1 Nominal catch (tonnes) of COD in Division VIIa, 1969-1979.

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	272	332	390	348	276	409	282	257	135	144	173
France	563	1 282	2 575[a)]	2 024	2 507	2 601	2 623	1 938	1 370	1 022	1 090
Ireland	2 176	1 574	2 800	2 275	4 224	3 276	3 477	4 815	3 862	3 128	3 746
Netherlands	-	4	148	58	35	113	53	87	32	15	12
UK (Engl.&Wales)	3 445	1 710	2 451	2 856	3 158	2 463	2 132	1 815	1 186	875	980
UK (N. Ireland)	1 380	1 267	1 112	1 522	1 537	1 279	1 153	1 175	1 409	1 064	1 898
UK (Isle of Man)	...	...	...	...	...	...	...	...	...	...	354
UK (Scotland)	131	88	64	90	50	49	70	91	60	79	118
Total	7 967	6 257	9 540	9 173	11 787	10 190	9 790	10 178	8 054	6 328	8 371
Total figures used by Working Group for stock assessment:	7 991	6 426	9 246	9 234	11 819	10 251	9 863	10 247	8 054	6 271	8 371

*) Preliminary

a) Includes Division VIIf

Table 2.2 Irish Sea COD (Division VIIa)

Input catch data in numbers ($x10^3$) for VPA

AGE	1968	1969	1970	1971	1972	1973
1	364	882	1317	2739	789	2263
2	1563	1481	1385	2022	3267	1091
3	1003	1050	352	904	824	1783
4	456	269	204	144	250	430
5	177	186	163	67	58	173
6	28	76	52	39	39	60
7	2	37	19	12	20	21
TOTAL						
	3593	3981	3492	5927	5247	5821
SPAWNING STOCK (AGE >= 3)						
	1666	1618	790	1166	1191	2467

AGE	1974	1975	1976	1977	1978	1979
1	530	1699	1135	816	687	1762
2	3559	642	3007	511	1092	1288
3	557	1407	363	1233	310	608
4	494	294	500	163	311	127
5	131	249	91	218	39	164
6	46	95	79	31	47	38
7	28	22	25	40	18	33
TOTAL						
	5345	4408	5170	3012	2504	4020
SPAWNING STOCK (AGE >= 3)						
	1256	2067	1028	1685	725	970

THE LAST GROUP IS NOT A PLUSGROUP

Table 2.3 Irish Sea COD (Division VIIa)

Fishing mortalities from VPA (M = .20)

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	.11	.19	.22	.27	.23	.25	.25	.23	.56	.24
2	.58	.84	.51	.63	.61	.56	.76	.53	.79	.54
3	.82	1.04	.48	.75	.57	.82	.63	.80	.67	.91
4	.80	.54	.58	.37	.48	.67	.56	.83	.75	.73
5	.68	.93	.76	.38	.25	.73	.45	.63	.40	.91
6	.18	.71	.75	.41	.39	.44	.43	.68	.41	.37
7	.38	.38	.38	.38	.38	.38	.38	.38	.38	.38
MEAN F FOR AGES >= 3 AND <= 7 (WEIGHTED BY STOCK IN NUMBERS)	.76	.87	.56	.63	.51	.76	.56	.76	.64	.85

AGE	1978	1979
1	.22	.46
2	.59	.80
3	.74	.80
4	.62	.80
5	.38	.80
6	.50	.80
7	.38	.80
MEAN F FOR AGES >= 3 AND <= 7 (WEIGHTED BY STOCK IN NUMBERS)	.63	.80

THE LAST GROUP IS NOT A PLUSGROUP

Table 2.4 Irish Sea COD (Division VIIa)

Stock size in numbers ($x10^3$) from VPA

AGE	1968	1969	1970	1971	1972	1973
1	3875	5599	7232	12547	4263	11386
2	3859	2844	3790	4736	7810	2780
3	1948	1761	1009	1862	2070	3473
4	904	701	509	511	718	957
5	393	333	333	234	289	364
6	188	163	108	127	132	184
7	7	128	66	42	69	73
TOTAL	11173	11531	13047	20060	15350	19217
SPAWNING STOCK (AGE >= 3)	3439	3087	2025	2776	3278	5051

AGE	1974	1975	1976	1977	1978	1979
1	2654	9208	2885	4148	3866	5233
2	7286	1696	6010	1346	2662	2547
3	1300	2790	814	2239	645	1202
4	1254	566	1030	342	736	251
5	399	585	202	397	135	334
6	144	210	256	110	131	75
7	97	76	87	139	62	65
TOTAL	13134	15131	11283	8721	8236	9698
SPAWNING STOCK (AGE >= 3)	3194	4227	2388	3227	1708	1918

THE LAST GROUP IS NOT A PLUSGROUP

Table 2.5 Irish Sea COD (Division VIIa)

Stock weight in tonnes from VPA

AGE	1968	1969	1970	1971	1972	1973
1	2364	3415	4411	7654	2600	6945
2	6405	4722	6291	7861	12965	4615
3	6488	5864	3360	6202	6892	11564
4	4600	3569	2592	2600	3656	4871
5	2431	2064	2063	1450	1788	2253
6	1268	1104	727	862	890	1246
7	58	1065	547	345	576	604
TOTAL	23813	21803	19991	26974	29366	32039
SPAWNING STOCK (AGE >= 3)	14844	13666	9289	11459	13801	20539

AGE	1974	1975	1976	1977	1978	1979
1	1619	5617	1769	2530	2358	3192
2	12095	2816	9976	2235	4418	4228
3	4328	9291	2710	7456	2147	4004
4	6383	2881	5242	1741	3745	1278
5	2472	3619	1247	2458	833	2007
6	971	1417	1731	745	886	508
7	806	633	720	1151	518	542
TOTAL	28673	26274	23386	18316	14906	15759
SPAWNING STOCK (AGE >= 3)	14960	17841	11650	13551	8129	8339

THE LAST GROUP IS NOT A PLUSGROUP

Table 3.1 Nominal catch (tonnes) of WHITING in Divisions VIIa, 1970-79
(Data for 1970-78 as officially reported by ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	159	154	38	102	94	99	68	63	51	42
France	1 312	3 172	2 805	3 101	2 700	2 784	2 985	1 952	2 098	1 897
Ireland	1 282	2 306	2 188	3 414	4 184	3 946	5 055	4 821	4 562	3 847
Netherlands	+	23	5	12	52	52	56	24	12	11
UK (England & Wales)	706	810	639	1 224	685	617	635	1 008	1 105	842
UK (N. Ireland	1 314	1 899	1 976	2 437	2 045	2 280	3 290	2 692	3 089	2 946
UK (Scotland)	31	19	29	47	52	54	104	161	152	154
UK (Isle of Man)	...	...	...	....	...	...	...	...	...	372
USSR	-	-	-	-	7	-	-	-	-	-
Total	4 804	8 383	7 680	10 337	9 819	9 832	12 193	10 721	11 069	10 111
Total figures used by the Working Group for assessment purposes:	4 667	6917	7 445	9 972	9 364	9 275	11 651	10 204	10 404	9 892
Industrial catches total (Ireland only):	2 198	2 531	1 231	744	283	353	425	760	927	-

*) Preliminary

Table 3.2 Irish Sea WHITING (Division VIIa)

Input catch data in numbers ($x10^3$) for VPA

AGE	1972	1973	1974	1975	1976	1977
1	4059	17312	8971	17738	4380	23805
2	10841	12619	12888	9822	27386	2880
3	9834	15040	11250	11551	10187	12226
4	3272	2803	1827	1989	3296	1527
5	691	922	642	693	690	909
6	80	327	207	211	535	280
7	107	96	72	73	83	84
8	9	38	20	19	26	13
9	51	11	7	7	11	6
TOTAL	28944	49168	35884	42103	46594	41730
SPAWNING STOCK (AGE >= 2)	24885	31856	26913	24365	42214	17925

AGE	1978	1979
1	7168	9219
2	18443	12084
3	3091	9049
4	4412	909
5	538	1597
6	731	248
7	157	114
8	50	25
9	3	3
TOTAL	34593	33248
SPAWNING STOCK (AGE >= 2)	27425	24029

THE LAST GROUP IS NOT A PLUSGROUP

Table 3.3 Irish Sea WHITING (Division VIIa)

Fishing mortalities from VPA (M = .20)

AGE	1972	1973	1974	1975	1976	1977	1978	1979
1	.10	.34	.25	.24	.35	.44	.18	.22
2	.38	.51	.45	.47	.72	.40	.74	.52
3	1.09	1.45	1.26	.96	1.38	.85	1.03	1.07
4	1.09	1.15	.67	.79	.83	.79	.89	1.03
5	.78	1.14	.93	.59	.72	.58	.74	.99
6	.39	1.15	.88	.97	1.35	.74	1.41	.95
7	.98	1.19	.88	.94	1.51	.81	1.37	.90
8	.34	1.29	.87	.61	1.13	1.13	2.19	.86
9	.90	.90	.90	.90	.90	.90	.90	.90
MEAN F FOR AGES >= 3 AND <= 9 (WEIGHTED BY STOCK IN NUMBERS)								
	1.06	1.38	1.13	.91	1.19	.82	.97	1.05

THE LAST GROUP IS NOT A PLUSGROUP

Table 3.4 Irish Sea WHITING (Division VIIa)

Stock size in numbers ($x10^3$) from VPA

AGE	1972	1973	1974	1975	1976	1977
1	46683	66534	44921	90693	16459	72905
2	37778	34561	38922	28708	58294	9541
3	16081	21198	16992	20311	14700	23279
4	5339	4439	4081	3954	6358	3035
5	1385	1468	1149	1709	1464	2268
6	270	517	384	369	779	582
7	185	150	134	130	115	165
8	34	57	37	45	42	21
9	93	20	13	13	20	11
TOTAL	107851	128944	106634	145933	98230	111807
SPAWNING STOCK (AGE >= 2)	61167	62409	61712	55240	81772	38902

AGE	1978	1979
1	47702	51319
2	38343	32600
3	5227	14934
4	8168	1534
5	1123	2759
6	1044	439
7	227	209
8	60	47
9	5	5
TOTAL	101899	103846
SPAWNING STOCK (AGE >= 2)	54197	52528

THE LAST GROUP IS NOT A PLUSGROUP

Table 3.5 Irish Sea WHITING (Division VIIa)

Stock weight in tonnes from VPA

AGE	1972	1973	1974	1975	1976	1977
1	3268	4657	3145	6349	1152	5103
2	6611	6048	6811	5024	10201	1670
3	4181	5512	4418	5281	3822	6053
4	1826	1518	1396	1352	2174	1038
5	590	625	489	728	624	966
6	134	257	191	184	387	289
7	102	82	74	72	63	91
8	20	33	22	26	24	12
9	56	12	8	8	12	7
TOTAL	16789	18745	16553	19023	18460	15229
SPAWNING STOCK (AGE >= 2)	13521	14087	13408	12674	17308	10125

AGE	1978	1979
1	3339	3592
2	6710	5705
3	1359	3883
4	2783	525
5	478	1175
6	519	218
7	125	115
8	35	27
9	3	3
TOTAL	15362	15244
SPAWNING STOCK (AGE >= 2)	12023	11652

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.1 Nominal catch (tonnes) of PLAICE in Division VIIa, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	305	175	179	221	247	248	136	110	109	142
France	250	-	440	500	132	134	126	141	110	135
Ireland	678	1 080	909	1 079	891	884	1 032	953	1 025	980
Netherlands	8	61	48	42	47	75	73	24	15	18
UK (England & Wales)	1 869	2 744	3 366	3 002	2 240	2 544	1 945	1 422	1 792	1 839
UK (Isle of Man)	...	...	...	...	...	...	...	...	...	52
UK (N. Ireland)	184	132	134	142	104	125	120	165	173	161
UK (Scotland)	58	92	89	73	54	53	52	89	89	106
USSR	-	-	-	-	1	-	-	-	-	-
Total	3 352	4 284	5 165	5 060	3 716	4 063	3 484	2 904	3 313	3 433
Total figures used by Working Group for stock assessment:	3 583	4 232	5 119	5 060	3 715	4 063	3 473	2 904	3 231	3 390

*) Preliminary

Table 4.2 Irish Sea PLAICE male (Division VIIa)
Input catch data in numbers ($x10^3$) for VPA

AGE	1964	1965	1966	1967	1968	1969
1	0	28	0	0	0	59
2	484	511	62	34	108	213
3	399	1172	1679	303	760	883
4	504	1017	1606	2302	1067	1093
5	311	144	889	1962	1459	802
6	455	145	195	232	492	427
7	92	139	53	329	108	136
8	1	169	133	14	5	7
9	1	9	1	39	1	1
10	154	1	1	89	1	43
11	1	1	1	35	1	43
12	1	1	1	30	1	1
TOTAL	2403	3337	4621	5369	4003	3708
SPAWNING STOCK (AGE >= 3)	1919	2798	4559	5335	3895	3436

AGE	1970	1971	1972	1973	1974	1975
1	4	0	0	0	2	16
2	335	175	6	309	408	547
3	1075	1434	1169	1616	717	1887
4	780	1740	2188	1922	1337	760
5	769	637	634	973	923	412
6	356	478	226	277	555	345
7	203	133	37	69	51	56
8	85	36	230	71	16	26
9	4	115	16	47	5	3
10	5	12	1	44	4	14
11	18	32	1	31	11	1
12	40	1	1	16	11	8
TOTAL	3680	4853	4509	5375	4040	4075
SPAWNING STOCK (AGE >= 3)	3341	4678	4503	5066	3630	3512

AGE	1976	1977	1978	1979
1	8	286	4	6
2	788	1314	1591	1216
3	1851	1150	2356	2746
4	1115	623	583	822
5	426	315	175	41
6	226	103	47	38
7	178	64	39	20
8	64	23	11	10
9	19	14	9	14
10	28	1	12	25
11	21	4	1	1
12	6	1	1	1
TOTAL	4730	4504	4829	4940
SPAWNING STOCK (AGE >= 3)	3934	2904	3234	3718

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.3 Irish Sea PLAICE male (Division VIIa)
Fishing mortalities from VPA (M = .150)

AGE	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	.000	.005	.000	.000	.000	.006	.001	.000	.000
2	.055	.055	.013	.007	.028	.039	.044	.026	.001
3	.117	.172	.245	.077	.202	.315	.268	.261	.227
4	.387	.454	.355	.579	.392	.467	.477	.851	.703
5	.565	.171	.870	.918	.857	.542	.665	.861	.841
6	.418	.530	.347	.548	.580	.621	.464	1.133	.827
7	.238	.204	.353	1.616	.503	.292	.671	.297	.212
8	.014	.843	.290	.140	.075	.051	.283	.214	1.163
9	.005	.156	.009	.122	.013	.018	.035	.715	.131
10	3.197	.006	.022	2.682	.004	.976	.114	.133	.011
11	.202	.202	.007	2.157	.202	.215	1.600	2.079	.014
12	.300	.300	.300	.300	.300	.300	.300	.300	.300
MEAN F FOR AGES >= 3 AND <= 12 (WEIGHTED BY STOCK IN NUMBERS)									
	.321	.259	.342	.540	.432	.426	.406	.520	.488

AGE	1973	1974	1975	1976	1977	1978	1979
1	.000	.000	.005	.001	.027	.001	.001
2	.104	.091	.151	.305	.334	.197	.300
3	.474	.349	.704	1.009	.916	.828	.570
4	.664	.868	.716	1.194	1.140	2.055	.740
5	.748	.745	.686	1.134	1.399	1.182	.830
6	1.100	1.317	.656	.983	.901	.762	.850
7	.612	.564	.391	.808	.802	1.029	.830
8	.743	.259	.596	.998	.270	.284	.770
9	.744	.095	.067	1.162	.576	.119	.660
10	.591	.117	.391	1.338	.146	1.457	.520
11	.487	.268	.037	1.724	.636	.202	.390
12	.300	.300	.300	.300	.300	.300	.300
MEAN F FOR AGES >= 3 AND <= 12 (WEIGHTED BY STOCK IN NUMBERS)							
	.618	.691	.681	1.061	.994	.981	.608

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.4 Irish Sea PLAICE male (Division VIIa)
Stock size in numbers ($x10^3$) from VPA

Age	1964	1965	1966	1967	1968	1969
1	11854	6077	6062	4866	6897	9903
2	9763	10203	5205	5218	4188	5936
3	3895	7955	8309	4422	4459	3505
4	1682	2383	5763	5600	3526	3135
5	771	983	1630	3478	2701	2050
6	1426	377	713	588	1195	987
7	466	808	191	434	293	576
8	79	316	567	115	74	152
9	199	67	117	365	86	59
10	167	170	49	100	278	73
11	6	6	145	42	6	239
12	4	4	4	124	4	4
TOTAL	30312	29949	28755	25352	23709	26621
SPAWNING STOCK (AGE >= 3)	8695	13669	17489	15268	12623	10782

AGE	1970	1971	1972	1973	1974	1975
1	8554	6192	3911	5892	4869	3755
2	8469	7359	5329	3367	5071	4189
3	4912	6979	6172	4581	2612	3987
4	2201	3235	4627	4232	2454	1586
5	1692	1176	1188	1972	1875	886
6	1026	749	428	441	803	766
7	457	555	208	161	126	185
8	370	201	355	145	75	62
9	125	240	140	96	59	50
10	50	104	101	105	39	46
11	24	38	78	86	50	30
12	166	4	4	66	46	33
TOTAL	28046	26832	22541	21144	18081	15576
SPAWNING STOCK (AGE >= 3)	11023	13282	13301	11885	8140	7633

AGE	1976	1977	1978	1979
1	8414	11416	5852	6464
2	3217	7235	9561	5034
3	3099	2041	4460	6758
4	1698	973	703	1677
5	667	443	268	77
6	384	185	94	71
7	342	124	65	38
8	108	131	48	20
9	29	34	86	31
10	40	8	17	66
11	27	9	6	3
12	25	4	4	4
TOTAL	18051	22603	21164	20244
SPAWNING STOCK (AGE >= 3)	6420	3952	5751	8746

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.5 Irish Sea PLAICE male (Division VIIa)
Stock weight in tonnes from VPA

AGE	1964	1965	1966	1967	1968	1969
1	237	122	121	97	138	198
2	879	918	468	470	377	534
3	662	1352	1412	752	758	596
4	387	686	1325	1288	811	721
5	231	295	489	1043	810	615
6	499	132	250	206	418	345
7	177	307	73	165	111	219
8	32	130	232	47	30	62
9	87	29	52	161	38	26
10	74	75	22	44	122	32
11	3	3	65	19	3	107
12	2	2	2	57	2	2
TOTAL	3270	4051	4512	4348	3619	3459
SPAWNING STOCK (AGE >= 3)	2154	3011	3922	3782	3104	2727

AGE	1970	1971	1972	1973	1974	1975
1	171	124	78	118	97	75
2	762	662	480	303	456	377
3	835	1186	1049	779	444	678
4	506	744	1064	973	564	365
5	507	353	357	592	563	266
6	359	262	150	154	281	268
7	174	211	79	61	48	70
8	152	82	146	59	31	25
9	55	106	61	42	26	22
10	22	46	44	46	17	20
11	11	17	35	38	23	13
12	76	2	2	30	21	15
TOTAL	3631	3795	3545	3197	2572	2196
SPAWNING STOCK (AGE >= 3)	2697	3009	2987	2776	2018	1744

AGE	1976	1977	1978	1979
1	168	228	117	129
2	290	651	880	453
3	527	347	758	1149
4	391	224	162	386
5	200	133	80	23
6	134	65	33	25
7	130	47	25	14
8	44	54	20	8
9	13	15	38	14
10	18	3	7	29
11	12	4	3	1
12	11	2	2	2
TOTAL	1938	1773	2103	2234
SPAWNING STOCK (AGE >= 3)	1480	894	1127	1651

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.6 Irish Sea PLAICE female (Division VIIa)

Input catch data in numbers ($x10^3$) for VPA

AGE	1964	1965	1966	1967	1968	1969
1	0	0	0	0	0	0
2	513	905	58	130	63	217
3	1512	1983	2624	1174	1201	1434
4	1176	1824	1999	3291	2343	1839
5	135	971	1293	2255	3182	1278
6	396	410	425	763	1119	1800
7	388	170	535	313	211	643
8	139	131	253	253	108	177
9	25	8	180	171	134	57
10	1	19	12	87	23	57
11	29	4	19	51	16	37
12	1	1	6	5	2	21
13	1	1	7	5	4	9
14	1	1	3	6	1	4
15	10	1	6	1	1	1
TOTAL						
	4327	6429	7420	8505	8408	7574
SPAWNING STOCK (AGE >= 3)						
	3814	5524	7362	8375	8345	7357

AGE	1970	1971	1972	1973	1974	1975
1	5	0	0	0	5	2
2	468	252	136	616	792	823
3	1203	1898	2085	2475	1813	2426
4	1399	2142	2948	3311	1357	1142
5	1108	1046	827	1703	1202	746
6	672	893	526	365	490	588
7	690	358	518	276	140	296
8	154	461	397	167	123	93
9	60	129	337	136	51	78
10	24	48	168	194	43	80
11	34	33	54	98	84	46
12	11	35	39	24	29	64
13	20	11	38	14	5	18
14	3	9	19	11	5	16
15	2	1	12	17	5	4
TOTAL						
	5853	7316	8104	9413	6144	6422
SPAWNING STOCK (AGE >= 3)						
	5380	7064	7968	8797	5347	5597

(continued)

Table 4.6 (continued)

AGE	1976	1977	1978	1979
1	15	279	18	6
2	1765	2210	1472	2126
3	2482	1617	2813	2870
4	1310	1847	952	993
5	476	524	367	318
6	337	133	155	147
7	213	86	59	88
8	134	83	43	50
9	40	49	43	53
10	51	20	31	43
11	26	11	9	16
12	16	7	0	4
13	58	8	4	6
14	11	10	4	4
15	5	3	2	6
TOTAL	6939	6887	5980	6730
SPAWNING STOCK (AGE >= 3)	5159	4398	4490	4598

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.7 Irish Sea PLAICE female (Division VIIa)

Fishing mortalities from VPA (M = .100)

AGE	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	.043	.050	.007	.016	.010	.035	.047	.026	.021
3	.235	.207	.180	.159	.183	.278	.243	.243	.273
4	.380	.435	.295	.320	.479	.413	.424	.774	.638
5	.065	.547	.555	.557	.515	.462	.416	.572	.691
6	.329	.254	.435	.661	.526	.546	.418	.615	.560
7	.459	.205	.539	.584	.338	.578	.368	.365	.785
8	.766	.246	.466	.467	.361	.467	.233	.399	.771
9	.295	.076	.548	.585	.429	.293	.253	.278	.503
10	.040	.339	.141	.495	.126	.290	.173	.293	.616
11	.849	.201	.589	1.224	.140	.273	.251	.337	.549
12	.114	.053	.460	.267	.111	.245	.109	.392	.737
13	.048	.143	.539	.769	.315	.866	.346	.136	.852
14	.297	.056	.709	1.118	.297	.525	.709	.231	.326
15	.480	.480	.480	.480	.480	.480	.480	.480	.480
MEAN F FOR AGES >= 3 AND <= 15 (WEIGHTED BY STOCK IN NUMBERS)									
	.279	.302	.285	.355	.401	.419	.345	.437	.491

AGE	1973	1974	1975	1976	1977	1978	1979
1	.000	.001	.000	.002	.034	.003	.001
2	.128	.134	.130	.384	.342	.229	.400
3	.560	.581	.661	.618	.640	.848	.800
4	.796	.607	.793	.817	1.207	.872	.736
5	.846	.670	.707	.816	.819	.726	.723
6	.666	.550	.725	.720	.495	.537	.640
7	.572	.513	.671	.557	.354	.377	.590
8	.555	.478	.677	.650	.388	.268	.560
9	.581	.289	.561	.617	.463	.317	.540
10	.538	.323	.862	.783	.638	.531	.530
11	.795	.417	.596	.677	.334	.588	.510
12	.446	.507	.572	.377	.341	.384	.500
13	.567	.139	.603	1.460	.292	.297	.490
14	.564	.359	.743	.816	1.000	.207	.480
15	.480	.480	.480	.480	.480	.480	.480
MEAN F FOR AGES >= 3 AND <= 15 (WEIGHTED BY STOCK IN NUMBERS)							
	.695	.584	.698	.691	.812	.787	.756

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.8 Irish Sea PLAICE female (Division VIIa)

Stock size in numbers ($x10^3$) from VPA

AGE	1964	1965	1966	1967	1968	1969
1	21415	10275	9372	7634	7395	11793
2	12853	19377	9297	8480	6908	6691
3	7574	11142	16673	8358	7549	6190
4	3897	5418	8200	12595	6447	5691
5	2259	2411	3174	5523	8276	3615
6	1480	1915	1263	1649	2864	4475
7	1103	964	1344	740	770	1532
8	271	630	711	710	373	497
9	103	114	446	404	403	235
10	26	69	96	233	203	237
11	53	23	45	75	129	162
12	10	20	17	22	20	101
13	22	8	18	10	16	16
14	4	19	6	9	4	10
15	27	3	16	3	3	3
TOTAL	51097	52390	50677	46444	41358	41249
SPAWNING STOCK (AGE >= 3)	16829	22738	32008	30330	27056	22765

AGE	1970	1971	1972	1973	1974	1975
1	11471	7529	5969	7321	7832	6413
2	10671	10374	6812	5401	6624	7082
3	5848	9211	9148	6035	4302	5242
4	4241	4150	6533	6299	3118	2177
5	3407	2512	1731	3123	2572	1538
6	2060	2032	1283	785	1212	1191
7	2346	1228	994	663	365	633
8	777	1468	771	410	339	198
9	282	557	892	323	213	190
10	159	198	382	488	163	145
11	161	121	134	187	258	107
12	112	113	78	70	76	154
13	72	91	69	34	40	42
14	6	46	71	27	17	32
15	5	3	33	47	14	11
TOTAL	41617	39633	34901	31211	27146	25152
SPAWNING STOCK (AGE >= 3)	19475	21729	22120	18489	12690	11657

(continued)

Table 4.8 (continued)

AGE	1976	1977	1978	1979
1	8848	8645	7483	6308
2	5801	7932	7557	6754
3	5626	3576	5136	5441
4	2449	2743	1707	1991
5	891	978	743	645
6	686	356	390	325
7	522	302	137	206
8	293	270	192	122
9	91	138	166	133
10	98	44	79	109
11	55	41	21	42
12	53	25	26	11
13	78	33	16	16
14	21	16	22	11
15	14	8	5	16
TOTAL	25525	25169	23740	22131
SPAWNING STOCK (AGE >= 3)	10876	8533	8700	9069

THE LAST GROUP IS NOT A PLUSGROUP

Table 4.9 Irish Sea PLAICE female (Division VIIa)

Stock weight in tonnes from VPA

AGE	1964	1965	1966	1967	1968	1969
1	428	206	187	153	148	236
2	1157	1744	837	763	622	602
3	1439	2117	3168	1588	1434	1176
4	1208	1680	2542	3904	1999	1764
5	971	1037	1365	2375	3559	1554
6	829	1073	707	923	1604	2506
7	761	665	927	510	531	1057
8	220	511	576	575	302	402
9	93	104	406	367	366	214
10	27	71	98	238	207	242
11	58	25	49	83	141	178
12	11	24	20	26	23	118
13	28	10	22	12	19	20
14	5	24	8	12	5	13
15	37	4	22	4	4	4
TOTAL	7273	9293	10933	11533	10965	10088
SPAWNING STOCK (AGE >= 3)	5687	7343	9909	10617	10196	9250

AGE	1970	1971	1972	1973	1974	1975
1	229	151	119	146	157	128
2	960	934	613	486	596	637
3	1111	1750	1738	1147	817	996
4	1315	1286	2025	1953	967	675
5	1465	1080	744	1343	1106	661
6	1154	1138	718	439	679	667
7	1619	847	686	457	252	437
8	630	1189	625	332	274	160
9	256	507	812	294	194	173
10	162	202	390	498	167	147
11	177	133	147	205	284	118
12	131	132	91	82	89	180
13	89	112	86	42	50	52
14	8	58	91	34	22	40
15	7	4	44	63	18	15
TOTAL	9312	9524	8930	7521	5672	5086
SPAWNING STOCK (AGE >= 3)	8122	8440	8197	6888	4919	4320

(continued)

Table 4.9 (continued)

AGE	1976	1977	1978	1979
1	177	173	150	126
2	522	719	680	603
3	1069	679	976	1034
4	759	850	529	617
5	383	421	319	278
6	384	200	219	182
7	360	209	136	142
8	237	219	155	99
9	83	126	151	121
10	100	45	80	112
11	61	45	23	46
12	62	30	31	12
13	97	41	20	20
14	26	21	28	14
15	18	11	7	22
TOTAL	4339	3788	3505	3433
SPAWNING STOCK (AGE >= 3)	3640	2896	2675	2689

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.1.A PLAICE in Divisions VIIf and g. Nominal catches (tonnes) 1970 - 1979.

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	369	326	217	309	270	195	307	214	196	171
France	165	213	320	185	218	413	360	365	527	467
Ireland	19	74	46	39	20	50	49	28	45	49
Netherlands	-	-	-	16	-	2	-	-	-	-
UK (England + Wales)	552	568	413	398	214	227	153	150	152	176
USSR	-	-	-	4	-	1	-	-	-	-
Total	1 105	1 181	996	951	722	888	869	757	920	863

*) Preliminary

Table 5.1.B.

Division	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
VIIg	276	434	372	408	358	419	555	424	528	478
VIIf	829	747	624	539	364	468	314	333	392	385
VIIf + g	1 105	1 181	996	947	722	887	869	757	920	863

*) Preliminary

Table 5.2 Celtic Sea PLAICE male (Divisions VIIf and g)

Input catch data in numbers ($x10^3$) for VPA

AGE	1970	1971	1972	1973	1974	1975
1	0	0	0	0	0	0
2	11	14	70	5	4	30
3	73	220	174	85	155	175
4	276	259	396	319	135	102
5	307	169	72	333	157	140
6	369	104	166	102	71	76
7	147	70	40	4	42	30
8	439	28	29	5	2	2
TOTAL						
	1622	864	947	853	566	555
SPAWNING STOCK (AGE >= 3)						
	1611	850	877	848	562	525

AGE	1976	1977	1978	1979
1	0	0	0	14
2	122	411	444	251
3	340	209	448	392
4	343	216	96	216
5	172	30	54	29
6	64	32	33	25
7	30	18	23	11
8	17	16	5	1
TOTAL				
	1088	932	1098	939
SPAWNING STOCK (AGE >= 3)				
	366	521	654	674

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.3 Celtic Sea PLAICE male (Divisions VIIf and g)

Fishing mortalities from VPA (M = .150)

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	.007	.012	.100	.007	.005	.036	.242	.303	.325
3	.109	.180	.198	.160	.301	.299	.647	.781	.591
4	.500	.638	.529	.622	.385	.312	1.518	1.104	.993
5	.980	.618	.342	1.130	.679	.828	1.240	.457	.885
6	1.325	1.062	3.034	1.091	.738	.789	1.146	.763	.978
7	1.482	.945	1.819	.835	2.670	.767	.799	1.206	2.754
8	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400
MEAN F FOR AGES >= 3 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)	.833	.446	.591	.653	.513	.454	1.028	.893	.714

AGE	1979
1	.015
2	.400
3	.500
4	.600
5	.910
6	1.430
7	1.400
8	1.400
MEAN F FOR AGES >= 3 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)	.571

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.4 Celtic Sea PLAICE male (Divisions VIIf and g)

Stock size in numbers ($x10^3$) from VPA

AGE	1970	1971	1972	1973	1974	1975
1	1424	921	870	987	1066	707
2	1678	1226	792	749	849	918
3	760	1434	1042	617	640	727
4	751	587	1031	736	453	408
5	523	392	267	522	340	265
6	533	169	182	163	145	149
7	201	122	50	8	47	60
8	617	39	41	7	3	3
TOTAL						
	6487	4889	4275	3789	3544	3236
SPAWNING STOCK (AGE >= 3)						
	3385	2742	2612	2054	1628	1611

AGE	1976	1977	1978	1979
1	1961	1992	948	1012
2	609	1688	1715	816
3	762	411	1073	1066
4	464	343	162	512
5	257	88	98	52
6	100	64	48	35
7	58	27	26	15
8	24	22	7	1
TOTAL				
	4235	4637	4077	3510
SPAWNING STOCK (AGE >= 3)				
	1565	956	1414	1681

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.5 Celtic Sea PLAICE male (Divisions VIIf and g)

Stock weight in tonnes from VPA

AGE	1970	1971	1972	1973	1974	1975
1	142	92	87	99	107	71
2	336	245	158	150	170	184
3	198	373	271	160	166	189
4	225	176	309	221	136	122
5	167	125	85	167	109	85
6	192	61	65	59	52	53
7	80	49	20	3	19	24
8	284	18	19	3	1	1
TOTAL	1624	1139	1015	862	760	729
SPAWNING STOCK (AGE >= 3)	1146	802	770	613	483	475

AGE	1976	1977	1978	1979
1	196	199	95	101
2	122	338	343	163
3	198	107	279	277
4	139	103	49	154
5	82	28	31	17
6	36	23	17	13
7	23	11	10	6
8	11	10	3	1
TOTAL	808	819	828	731
SPAWNING STOCK (AGE >= 3)	490	282	390	467

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.6 Celtic Sea PLAICE female (Divisions VIIf and g)

Input catch data in numbers ($x10^3$) for VPA

AGE	1970	1971	1972	1973	1974	1975
1	0	0	0	0	0	0
2	24	5	21	0	14	78
3	132	816	364	362	175	672
4	243	615	578	498	252	304
5	245	218	164	245	260	106
6	85	47	160	42	141	146
7	67	54	43	26	40	63
8	36	60	19	11	24	30
9	3	11	21	32	18	17
10	3	6	6	12	18	11
11	1	3	6	9	4	8
TOTAL						
	839	1835	1382	1237	946	1435
SPAWNING STOCK (AGE >= 3)						
	815	1830	1361	1237	932	1357

AGE	1976	1977	1978	1979
1	0	0	0	20
2	102	502	399	374
3	246	250	623	529
4	296	189	163	375
5	169	77	84	58
6	69	36	49	35
7	42	14	26	22
8	44	34	16	13
9	17	27	21	11
10	19	14	7	8
11	8	7	7	13
TOTAL				
	1012	1150	1395	1458
SPAWNING STOCK (AGE >= 3)				
	910	648	936	1064

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.7 Celtic Sea PLAICE female (Divisions VIIf and g)

Fishing mortalities from VPA (M = .100)

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	.010	.003	.020	.000	.010	.101	.150	.279	.225
3	.109	.448	.253	.469	.227	.773	.461	.575	.581
4	.335	.890	.583	.569	.615	.669	.837	.687	.818
5	.777	.501	.552	.464	.583	.504	.877	.474	.664
6	.366	.288	.747	.235	.471	.675	.636	.403	.555
7	.427	.372	.411	.223	.326	.353	.367	.223	.504
8	.499	.747	.193	.156	.295	.385	.396	.505	.379
9	.101	.247	.563	.503	.363	.312	.348	.400	.595
10	.266	.266	.185	.648	.521	.350	.601	.475	.152
11	.410	.410	.410	.410	.410	.410	.410	.410	.410

MEAN F FOR AGES >= 3 AND <= 11 (WEIGHTED BY STOCK IN NUMBERS)

.317	.553	.436	.473	.431	.652	.619	.544	.599

AGE	1979
1	.015
2	.350
3	.460
4	.740
5	.690
6	.570
7	.460
8	.450
9	.430
10	.420
11	.410

MEAN F FOR AGES >= 3 AND <= 11 (WEIGHTED BY STOCK IN NUMBERS)

.551

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.8 Celtic Sea PLAICE female (Divisions VIIf and g)

Stock size in numbers ($x10^3$) from VPA

AGE	1970	1971	1972	1973	1974	1975
1	2093	1261	1103	1609	941	849
2	2640	1894	1141	998	1456	852
3	1341	2366	1709	1013	903	1304
4	895	1088	1368	1201	573	651
5	473	579	404	690	615	280
6	290	197	318	211	393	311
7	202	182	134	136	151	222
8	96	119	114	80	99	98
9	33	53	51	85	62	66
10	13	27	37	26	46	39
11	3	9	19	28	12	25
TOTAL	8080	7775	6397	6077	5252	4698
SPAWNING STOCK (AGE >= 3)	3347	4620	4152	3470	2855	2997

AGE	1976	1977	1978	1979
1	2389	2297	1467	1411
2	768	2161	2078	1327
3	697	598	1479	1502
4	545	397	305	749
5	302	214	181	122
6	153	114	120	84
7	143	73	69	62
8	141	90	53	38
9	61	86	49	33
10	44	39	52	24
11	25	22	22	40
TOTAL	5267	6090	5875	5393
SPAWNING STOCK (AGE >= 3)	2110	1632	2330	2655

THE LAST GROUP IS NOT A PLUSGROUP

Table 5.9 Celtic Sea PLAICE female (Divisions VIIf and g)

Stock weight in tonnes from VPA

AGE	1970	1971	1972	1973	1974	1975
1	209	126	110	161	94	85
2	634	455	274	240	349	204
3	443	781	564	334	298	430
4	367	446	561	492	235	267
5	241	295	206	352	314	143
6	180	122	197	131	243	193
7	157	142	104	106	118	173
8	85	106	101	71	88	88
9	34	54	53	87	64	68
10	15	30	42	30	52	44
11	5	14	28	43	19	38
TOTAL	2370	2572	2240	2047	1874	1733
SPAWNING STOCK (AGE >= 3)	1527	1991	1856	1646	1431	1444

AGE	1976	1977	1978	1979
1	239	230	147	141
2	184	519	499	318
3	230	197	488	496
4	223	163	125	307
5	154	109	92	62
6	95	70	75	52
7	112	57	54	49
8	125	80	47	33
9	62	88	50	34
10	50	44	59	28
11	38	33	33	62
TOTAL	1513	1590	1669	1582
SPAWNING STOCK (AGE >= 3)	1089	842	1023	1122

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.1 Irish Sea SOLE. Nominal catches (tonnes) 1970 - 1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	1 142	883	561	793	664	805	674	566	453	779
France	115	45	38	12	54	59	72	39	65	32
Ireland	25	45	50	27	28	24	74	84	127	130
Netherlands	235	552	514	281	320	234	381	227	177	280
UK (Engl. & Wales)	267	316	238	258	218	281	195	160	189	290
UK (N. Ireland)	24	40	40	46	23	24	49	49	57	47
UK (Scotland)	1	1	9	11	...	15	18	21	30	38
UK (Isle of Man)	...	...	...	...	...	...	...	...	...	33
Total	1 809	1 882	1 450	1 428	1 307	1 442	1 463	1 146	1 098	1 629

*) Preliminary

Table 6.2 Irish Sea SOLE male (Division VIIa)

Input catch data in numbers ($x10^3$) for VPA

AGE	1970	1971	1972	1973	1974	1975
2	12	27	11	56	24	104
3	488	94	270	178	370	349
4	565	1094	417	1145	239	1085
5	321	660	568	289	654	302
6	571	123	166	349	179	337
7	39	485	68	146	154	63
8	95	132	241	98	132	101
9	260	38	22	185	25	91
10	74	131	16	15	130	58
11	257	264	127	76	33	46
12	46	73	52	83	40	15
13	9	181	31	48	71	19
14	9	15	36	18	82	61
15	4	18	1	32	43	11
TOTAL	2750	3335	2026	2718	2176	2642
SPAWNING STOCK (AGE >= 3)	2738	3308	2015	2662	2152	2538

AGE	1976	1977	1978	1979
2	14	76	19	24
3	107	206	392	439
4	311	654	248	1569
5	384	357	538	457
6	56	504	256	262
7	224	63	337	168
8	70	103	54	93
9	143	58	102	23
10	110	27	6	19
11	11	13	28	15
12	25	2	5	36
13	11	30	15	4
14	1	42	27	3
15	9	2	1	5
TOTAL	1476	2137	2028	3117
SPAWNING STOCK (AGE >= 3)	1462	2061	2009	3093

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.3 Irish Sea SOLE male (Division VIIa)

Fishing mortalities from VPA (M = .100)

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	.007	.007	.008	.013	.008	.031	.005	.012	.005
3	.126	.059	.077	.152	.100	.144	.037	.087	.069
4	.277	.404	.352	.466	.278	.413	.165	.290	.129
5	.435	.531	.336	.391	.470	.592	.223	.258	.364
6	.306	.263	.217	.317	.396	.418	.182	.450	.266
7	.097	.410	.203	.269	.201	.210	.480	.285	.544
8	.290	.476	.326	.443	.367	.176	.338	.376	.373
9	.307	.161	.119	.396	.171	.413	.358	.459	.690
10	.107	.224	.085	.101	.473	.648	1.136	.094	.069
11	.381	.585	.312	.623	.297	.270	.213	.325	.120
12	.085	.158	.191	.308	.699	.191	.206	.049	.179
13	.315	.484	.084	.241	.416	.756	.187	.361	.534
14	.068	1.133	.148	.058	.718	.670	.068	1.926	.566
15	.170	.170	.170	.170	.170	.170	.170	.170	.170
MEAN F FOR AGES >= 4 AND <= 15 (WEIGHTED BY STOCK IN NUMBERS)	.276	.403	.277	.373	.367	.401	.264	.325	.296

AGE	1979
2	.008
3	.130
4	.380
5	.330
6	.270
7	.250
8	.250
9	.240
10	.230
11	.220
12	.200
13	.190
14	.170
15	.170
MEAN F FOR AGES >= 4 AND <= 15 (WEIGHTED BY STOCK IN NUMBERS)	.332

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.4 Irish Sea SOLE male (Division VIIa)

Stock size in numbers ($x10^3$) from VPA

AGE	1970	1971	1972	1973	1974	1975
2	1919	4270	1478	4591	3048	3564
3	4323	1725	3838	1327	4101	2735
4	2446	3448	1471	3216	1031	3359
5	953	1677	2083	936	1825	706
6	2269	558	893	1346	573	1032
7	444	1511	388	650	887	349
8	395	365	908	287	450	657
9	1030	268	205	593	167	282
10	767	686	206	165	361	127
11	850	624	496	171	135	204
12	594	525	314	329	83	91
13	35	494	406	235	219	37
14	143	23	275	338	167	131
15	27	121	7	215	289	74
TOTAL	16194	16294	12969	14399	13336	13347
SPAWNING STOCK (AGE >= 3)	14276	12024	11491	9807	10288	9783

AGE	1976	1977	1978	1979
2	2872	6885	4198	3165
3	3126	2585	6157	3780
4	2143	2726	2143	5199
5	2012	1644	1847	1704
6	353	1456	1149	1161
7	615	267	840	796
8	256	344	182	441
9	498	165	214	113
10	169	315	94	97
11	60	49	260	80
12	141	44	32	208
13	68	104	38	24
14	16	51	65	20
15	60	13	7	34
TOTAL	12388	16648	17225	16822
SPAWNING STOCK (AGE >= 3)	9516	9763	13027	13657

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.5 Irish Sea SOLE male (Division VIIa)

Stock weight in tonnes from VPA

AGE	1970	1971	1972	1973	1974	1975
2	236	525	182	565	375	438
3	653	260	580	200	619	413
4	423	597	255	556	178	581
5	186	327	406	182	356	138
6	488	120	192	289	123	222
7	103	351	90	151	206	81
8	97	89	222	70	110	161
9	262	68	52	151	42	72
10	202	181	54	43	95	34
11	234	171	136	47	37	56
12	168	149	89	93	24	26
13	10	144	118	68	64	11
14	43	7	82	101	50	39
15	8	37	2	66	88	23
TOTAL	3112	3026	2461	2584	2368	2293
SPAWNING STOCK (AGE >= 3)	2876	2501	2279	2019	1993	1855

AGE	1976	1977	1978	1979
2	353	847	516	389
3	472	390	930	571
4	371	472	371	899
5	382	321	360	332
6	76	313	247	250
7	143	62	195	185
8	63	34	44	108
9	127	42	54	29
10	45	83	25	29
11	17	13	71	22
12	40	12	9	59
13	20	30	11	7
14	5	15	29	9
15	18	4	2	19
TOTAL	2140	2689	2856	2893
SPAWNING STOCK (AGE >= 3)	1787	1842	2339	2503

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.6 Irish Sea SOLE female (Division VIIa)

Input catch data in numbers ($x10^3$) for VPA

AGE	1970	1971	1972	1973	1974	1975
2	21	83	22	338	25	150
3	935	319	553	190	797	327
4	763	1082	301	975	326	1252
5	105	538	944	254	782	217
6	730	116	294	425	209	474
7	162	394	150	140	259	22
8	50	18	330	15	124	135
9	299	48	72	148	43	57
10	187	206	45	52	110	26
11	304	99	79	38	18	87
12	60	165	84	66	34	6
13	23	120	188	80	49	4
14	24	34	69	67	44	38
15	51	28	57	39	27	29
TOTAL	3714	3250	3188	2827	2847	2824
SPAWNING STOCK (AGE >= 3)	3693	3167	3166	2489	2822	2674

AGE	1976	1977	1978	1979
2	19	126	51	93
3	218	143	564	599
4	666	637	285	2005
5	1649	415	503	415
6	213	546	203	405
7	393	93	331	170
8	281	107	49	223
9	145	24	117	42
10	56	29	24	62
11	11	30	45	8
12	81	5	30	29
13	34	30	1	5
14	7	6	23	6
15	32	1	7	13
TOTAL	3805	2192	2233	4075
SPAWNING STOCK (AGE >= 3)	3786	2066	2182	3982

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.7 Irish Sea SOLE female (Division VIIa)

Fishing mortalities from VPA (M = .100)

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	.010	.015	.011	.042	.008	.034	.006	.014	.009
3	.194	.180	.119	.116	.117	.115	.057	.054	.071
4	.366	.319	.230	.281	.264	.242	.321	.208	.131
5	.172	.423	.449	.277	.339	.251	.508	.302	.226
6	.341	.260	.382	.331	.342	.315	.371	.278	.212
7	.353	.277	.552	.281	.307	.049	.414	.244	.242
8	.189	.054	.351	.085	.382	.232	1.197	.168	.176
9	.287	.249	.278	.234	.330	.270	.371	.248	.250
10	.245	.292	.346	.295	.244	.303	.410	.105	.372
11	.342	.177	.155	.486	.141	.276	.181	.357	.210
12	.107	.281	.201	.168	.958	.057	.395	.105	.642
13	.049	.286	.524	.267	.163	.236	.460	.222	.025
14	.121	.086	.236	.317	.206	.165	.718	.121	.236
15	.182	.182	.182	.182	.182	.182	.182	.182	.182
MEAN F FOR AGES >= 4 AND <= 15 (WEIGHTED BY STOCK IN NUMBERS)									
	.287	.291	.347	.277	.304	.244	.451	.238	.204

AGE	1979
2	.022
3	.120
4	.342
5	.255
6	.255
7	.246
8	.228
9	.201
10	.182
11	.182
12	.182
13	.182
14	.182
15	.182
MEAN F FOR AGES >= 4 AND <= 15 (WEIGHTED BY STOCK IN NUMBERS)	
	.292

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.8 Irish Sea SOLE female (Division VIIa)

Stock size in numbers ($x10^3$) from VPA

AGE	1970	1971	1972	1973	1974	1975
2	2265	5825	2043	8729	3511	4754
3	5574	2030	5192	1828	7577	3153
4	2606	4156	1534	4172	1473	6099
5	697	1635	2734	1102	2850	1024
6	2649	531	969	1580	756	1838
7	571	1705	370	599	1026	486
8	305	363	1169	193	409	683
9	1257	229	311	745	160	252
10	902	854	161	213	533	104
11	1099	639	577	103	144	378
12	622	706	484	447	58	113
13	503	506	482	358	342	20
14	220	433	344	258	248	263
15	322	177	359	246	170	183
TOTAL	19592	19786	16731	20574	19259	19350
SPAWNING STOCK (AGE >= 3)	17326	13962	14688	11844	15748	14596

AGE	1976	1977	1978	1979
2	3161	9646	6199	4490
3	4159	2842	8608	5561
4	2542	3556	2436	7253
5	4331	1669	2613	1933
6	720	2357	1116	1887
7	1213	450	1615	817
8	419	725	319	1147
9	490	115	555	242
10	174	306	81	391
11	70	105	249	50
12	260	53	66	183
13	96	158	43	32
14	14	55	115	38
15	202	6	44	82
TOTAL	17852	22043	24060	24107
SPAWNING STOCK (AGE >= 3)	14691	12397	17860	19617

THE LAST GROUP IS NOT A PLUSGROUP

Table 6.9 Irish Sea SOLE female (Division VIIa)

Stock weight in tonnes from VPA

AGE	1970	1971	1972	1973	1974	1975
2	272	699	245	1048	421	570
3	948	345	883	311	1288	536
4	573	914	337	918	324	1342
5	188	441	738	298	770	276
6	821	165	301	490	234	570
7	205	614	133	215	370	175
8	125	149	479	79	168	280
9	553	101	137	328	71	111
10	433	410	77	102	256	50
11	560	326	294	53	73	193
12	330	374	257	237	30	60
13	281	283	270	201	191	11
14	128	251	200	150	144	152
15	193	106	216	148	102	110
TOTAL	5611	5178	4567	4576	4443	4437
SPAWNING STOCK (AGE >= 3)	5339	4479	4322	3528	4021	3866

AGE	1976	1977	1978	1979
2	379	1158	744	539
3	707	483	1463	945
4	559	782	536	1596
5	1169	451	705	522
6	223	731	346	585
7	437	162	581	294
8	172	297	131	470
9	216	50	244	106
10	84	147	39	188
11	36	53	127	26
12	138	28	35	97
13	54	89	24	18
14	8	32	67	22
15	121	4	26	49
TOTAL	4303	4467	5069	5457
SPAWNING STOCK (AGE >= 3)	3923	3309	4325	4918

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.1.A Celtic Sea SOLE (Divisions VIIf and VIIg). Nominal catch (tonnes) 1970-1979 by country

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	1 003	989	546	822	914	663	1 054	779	506	693
France	386	731	587	435	75	133	181	80	160	153
Ireland	4	6	4	2	2	5	10	2	2	7
Netherlands	-	-	7	4	15	2	7	7	-	-
UK (Engl. & Wales)	164	135	134	128	99	116	99	93	112	101
Total	1 557	1 861	1 278	1 391	1 105	919	1 351	961	780	954

*) Preliminary

Table 7.1.B Total nominal catch of SOLE (tonnes) in Divisions VIIg and VIIf for 1970-1979.

Division	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
VIIg	727	1 095	730	613	442	354	831	595	436	530
VIIf	830	766	548	778	663	565	520	366	344	424
VIIf + VIIg	1 557	1 861	1 278	1 391	1 105	919	1 351	961	780	954

*) Preliminary

Table 7.2 Celtic Sea SOLE male (Divisions VIIf and g)

Input catch data in numbers ($x10^3$) for VPA

AGE	1970	1971	1972	1973	1974	1975
2	56	333	233	353	84	51
3	895	347	662	1189	262	199
4	367	1191	189	482	615	315
5	352	462	461	174	200	401
6	494	204	179	145	53	181
7	254	151	98	77	89	26
8	149	408	103	52	40	82
9	160	185	165	52	22	31
10	115	27	44	132	65	26
11	53	211	47	34	20	18
12	126	63	14	16	12	13
13	66	68	35	18	32	7
14	13	107	14	36	18	26
15	17	34	12	52	18	5
16	49	1	2	21	1	11
TOTAL						
	3166	3792	2258	2833	1531	1392
SPAWNING STOCK (AGE >= 3)						
	3110	3459	2025	2480	1447	1341

AGE	1976	1977	1978	1979
2	21	245	192	248
3	195	287	526	424
4	369	218	185	609
5	260	129	74	122
6	611	92	68	70
7	81	155	38	95
8	73	39	72	59
9	143	13	36	58
10	31	24	12	6
11	18	13	14	4
12	8	16	5	6
13	42	8	9	5
14	8	32	9	10
15	3	8	5	5
16	21	8	1	2
TOTAL				
	1884	1287	1245	1723
SPAWNING STOCK (AGE >= 3)				
	1863	1042	1054	1475

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.3 Celtic Sea SOLE male (Divisions VIIf and g)

Fishing mortalities from VPA (M = .100)

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	.045	.141	.051	.188	.051	.050	.018	.067	.079
3	.280	.380	.403	.348	.186	.146	.243	.311	.179
4	.283	.643	.327	.509	.272	.316	.389	.415	.300
5	.380	.606	.489	.498	.364	.255	.414	.203	.215
6	.577	.352	.442	.248	.246	.577	.668	.225	.141
7	.214	.307	.254	.307	.212	.164	.488	.311	.122
8	.334	.548	.315	.186	.232	.274	.797	.408	.208
9	.429	.780	.395	.232	.100	.252	.929	.276	.718
10	.196	.106	.373	.558	.446	.148	.381	.336	.391
11	.167	.577	.241	.488	.134	.189	.130	.243	.298
12	.554	.272	.059	.108	.282	.109	.108	.147	.124
13	.201	.582	.213	.091	.291	.236	.527	.135	.104
14	.226	.507	.199	.314	.111	.361	.408	.872	.197
15	1.292	1.292	.086	2.199	.228	.037	.057	.809	.277
16	.190	.190	.190	.190	.190	.190	.190	.190	.190
MEAN F FOR AGES >= 3 AND <= 16 (WEIGHTED BY STOCK IN NUMBERS)									
	.315	.521	.365	.369	.246	.249	.455	.301	.199

AGE	1979
2	.072
3	.223
4	.288
5	.295
6	.288
7	.266
8	.252
9	.230
10	.216
11	.194
12	.180
13	.158
14	.144
15	.144
16	.152
MEAN F FOR AGES >= 3 AND <= 16 (WEIGHTED BY STOCK IN NUMBERS)	
	.257

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.4 Celtic Sea SOLE male (Divisions VIIf and g)

Stock size in numbers ($x10^3$) from VPA

AGE	1970	1971	1972	1973	1974	1975
2	1329	2659	4931	2161	1783	1101
3	3839	1149	2090	4240	1620	1534
4	1559	2624	711	1264	2710	1217
5	1165	1063	1248	464	687	1868
6	1179	721	525	693	255	432
7	1385	599	459	305	489	181
8	550	1012	399	322	203	358
9	480	357	530	264	242	146
10	677	283	148	323	189	198
11	363	503	230	92	167	110
12	310	278	256	164	51	132
13	380	161	192	218	133	35
14	68	281	81	140	180	90
15	24	49	153	60	93	146
16	297	6	12	127	6	67
TOTAL	13605	11746	11965	10837	8809	7614
SPAWNING STOCK (AGE >= 3)	12277	9087	7034	8676	7026	6513

AGE	1976	1977	1978	1979
2	1267	3983	2661	3749
3	947	1127	3372	2225
4	1199	672	747	2551
5	803	735	402	501
6	1310	480	543	293
7	220	608	347	426
8	139	122	403	278
9	246	57	73	296
10	102	88	39	32
11	155	63	57	24
12	82	123	45	38
13	107	67	96	36
14	25	57	53	78
15	57	15	22	39
16	127	48	6	15
TOTAL	6786	8245	8864	10582
SPAWNING STOCK (AGE >= 3)	5519	4262	6203	6833

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.5 Celtic Sea SOLE male (Divisions VIIf and g)

Stock weight in tonnes from VPA

AGE	1970	1971	1972	1973	1974	1975
2	159	319	592	259	214	132
3	668	200	364	738	282	267
4	338	570	154	274	588	264
5	322	293	345	128	190	516
6	360	220	160	211	78	132
7	470	203	156	193	166	61
8	200	367	145	117	74	130
9	186	138	205	102	94	57
10	286	120	63	137	80	84
11	158	219	100	40	73	48
12	139	124	115	73	23	59
13	175	74	88	100	61	16
14	32	133	38	66	85	42
15	12	24	74	29	45	71
16	148	3	6	63	3	33
TOTAL	3652	3008	2604	2442	2055	1911
SPAWNING STOCK (AGE >= 3)	3492	2689	2012	2183	1841	1779

AGE	1976	1977	1978	1979
2	152	478	319	450
3	165	196	587	387
4	260	146	162	554
5	222	203	111	138
6	400	146	166	89
7	74	206	118	145
8	50	44	146	101
9	96	22	28	115
10	43	37	16	14
11	67	28	25	10
12	37	55	20	17
13	49	31	44	16
14	12	27	25	37
15	27	7	10	13
16	63	24	3	7
TOTAL	1718	1650	1780	2099
SPAWNING STOCK (AGE >= 3)	1566	1172	1461	1650

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.6 Celtic Sea SOLE female (Divisions VIIf and g)

Input catch data in numbers ($x10^3$) for VPA

AGE	1970	1971	1972	1973	1974	1975
2	2	182	103	168	63	21
3	246	63	198	693	153	142
4	115	187	137	181	304	124
5	171	139	403	120	230	373
6	124	182	140	226	130	166
7	355	299	89	59	159	82
8	92	258	110	41	55	145
9	83	114	151	64	80	46
10	81	68	74	98	75	37
11	68	100	30	36	92	29
12	26	156	37	23	47	49
13	47	10	100	23	27	24
14	2	2	28	57	35	11
15	15	51	21	34	40	8
16	21	29	5	25	17	29
TOTAL	1448	1840	1626	1848	1507	1286
SPAWNING STOCK (AGE >= 3)	1446	1658	1523	1680	1444	1265

AGE	1976	1977	1978	1979
2	23	153	258	122
3	208	142	267	206
4	125	166	128	228
5	208	153	111	111
6	387	134	79	102
7	226	210	56	126
8	75	87	118	80
9	120	21	42	113
10	42	29	9	49
11	16	32	33	19
12	10	50	9	21
13	65	21	5	1
14	62	42	7	9
15	23	13	14	9
16	57	34	2	4
TOTAL	1647	1287	1144	1200
SPAWNING STOCK (AGE >= 3)	1624	1134	886	1078

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.7 Celtic Sea SOLE female (Divisions VIIf and g)

Fishing mortalities from VPA (M = .100)

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	.001	.069	.023	.084	.032	.013	.017	.052	.089
3	.093	.051	.089	.188	.093	.084	.158	.121	.109
4	.142	.085	.133	.099	.105	.091	.089	.163	.136
5	.147	.228	.239	.148	.158	.163	.194	.135	.140
6	.095	.206	.335	.183	.212	.147	.228	.166	.086
7	.252	.309	.132	.205	.170	.180	.272	.166	.087
8	.148	.262	.160	.075	.268	.206	.222	.143	.119
9	.064	.245	.215	.118	.183	.334	.235	.080	.085
10	.044	.062	.222	.189	.177	.108	.509	.073	.040
11	.058	.064	.032	.144	.243	.086	.056	.815	.120
12	.054	.164	.027	.028	.252	.177	.035	.222	.499
13	.085	.024	.135	.019	.037	.177	.333	.086	.028
14	.014	.004	.078	.096	.033	.017	.798	.331	.034
15	.031	.484	.050	.115	.081	.009	.041	.334	.156
16	.070	.070	.070	.070	.070	.070	.070	.070	.070
MEAN F FOR AGES >= 3 AND <= 16 (WEIGHTED BY STOCK IN NUMBERS)	.104	.139	.134	.131	.125	.119	.177	.147	.107

AGE	1979
2	.043
3	.086
4	.115
5	.151
6	.166
7	.173
8	.155
9	.144
10	.122
11	.101
12	.079
13	.083
14	.058
15	.050
16	.055
MEAN F FOR AGES >= 3 AND <= 16 (WEIGHTED BY STOCK IN NUMBERS)	.120

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.8 Celtic Sea SOLE female (Divisions VIIf and g)

Stock size in numbers ($x10^3$) from VPA

AGE	1970	1971	1972	1973	1974	1975
2	1486	2881	4805	2180	2104	1677
3	2907	1342	2434	4250	1813	1844
4	911	2397	1155	2014	3188	1495
5	1313	715	1991	915	1651	2596
6	1433	1025	515	1419	714	1275
7	1671	1178	755	333	1070	522
8	704	1175	783	599	245	817
9	1406	550	818	604	503	170
10	1963	1194	389	597	486	379
11	1267	1700	1015	282	447	368
12	517	1082	1443	890	221	317
13	603	443	831	1270	784	155
14	156	501	391	657	1128	683
15	514	139	451	328	540	987
16	326	450	78	388	264	450
TOTAL	17176	16772	17855	16726	15156	13737
SPAWNING STOCK (AGE >= 3)	15690	13891	13049	14546	13052	12059

AGE	1976	1977	1978	1979
2	1475	3162	3172	3045
3	1498	1313	2715	2625
4	1533	1158	1053	2203
5	1235	1269	890	831
6	1994	920	1003	700
7	996	1437	705	832
8	395	687	1101	585
9	601	286	539	884
10	110	430	239	448
11	308	60	362	208
12	306	263	24	290
13	241	267	191	13
14	118	156	222	168
15	608	48	101	194
16	885	528	31	79
TOTAL	12303	11984	12348	13105
SPAWNING STOCK (AGE >= 3)	10828	8822	9176	10060

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.9 Celtic Sea SOLE female (Divisions VIIf and g)

Stock weight in tonnes from VPA

AGE	1970	1971	1972	1973	1974	1975
2	250	484	807	366	353	282
3	750	346	628	1097	468	476
4	343	904	435	759	1202	564
5	571	311	866	398	718	1129
6	739	529	266	732	368	658
7	959	676	433	191	614	300
8	445	743	495	378	155	516
9	970	379	565	417	347	117
10	1437	874	285	437	355	277
11	959	1287	769	213	339	279
12	407	851	1135	701	174	250
13	481	354	663	1014	625	124
14	128	412	322	540	928	562
15	429	116	377	274	451	824
16	276	382	66	329	224	382
TOTAL	9145	8647	8112	7846	7321	6739
SPAWNING STOCK (AGE >= 3)	8895	8163	7304	7480	6967	6458

AGE	1976	1977	1978	1979
2	248	531	533	512
3	386	339	701	677
4	578	436	397	831
5	537	552	387	362
6	1029	475	517	361
7	572	825	405	478
8	250	434	636	370
9	415	197	372	610
10	31	315	175	328
11	233	45	274	157
12	240	207	19	228
13	192	213	152	11
14	97	129	182	138
15	508	40	85	162
16	750	447	26	66
TOTAL	6116	5186	4921	5290
SPAWNING STOCK (AGE >= 3)	5868	4655	4388	4779

THE LAST GROUP IS NOT A PLUSGROUP

Table 7.10 Celtic Sea SOLE
Input Data for Catch Forecast

Age	Catch 1979		Catch Weight		Stock Weight		F_{79}	
	Male	Female	Male	Female	Male	Female	Male	Female
2	248	122	.133	.200	.120	.168	.072	.043
3	423	206	.187	.282	.174	.258	.223	.086
4	610	228	.217	.377	.217	.377	.288	.115
5	122	111	.276	.435	.276	.435	.295	.151
6	70	102	.305	.516	.305	.516	.288	.166
7	95	126	.339	.574	.339	.574	.266	.173
8	59	80	.363	.632	.363	.632	.252	.155
9	58	113	.388	.690	.388	.690	.230	.144
10	6.4	49	.423	.732	.423	.732	.216	.122
11	3.6	19	.436	.757	.436	.757	.194	.101
12	5.6	21	.448	.787	.448	.787	.180	.079
13	5.3	.8	.459	.798	.459	.798	.158	.083
14	10.0	8.9	.472	.823	.472	.823	.144	.053
15	4.7	9.0	.484	.835	.484	.835	.144	.050
16	1.5	3.7	.497	.847	.497	.847	.152	.055
17	2.8	.1	.500	.850	.500	.850	.152	.055
18	2.4	1.1	.500	.850	.500	.850	.152	.055
19	1.0	9.2	.500	.850	.500	.850	.152	.055
20	6.0	1.0	.500	.850	.500	.850	.152	.055

M = 0.1

Table 8.1 Nominal catch (tonnes) of COD in Divisions VIIf and VIIg 1971-79

Country	1971	1972	1973	1974	1975	1976	1977	1979	1979*)
Belgium	807	394	524	197	377	226	107	88	170
France	3 330	2 814	2 229	1 770	2 472	3 351	2 088	2 567	3 150
Ireland	28	27	64	24	15	13	17	30	57
Netherlands	-	-	-	-	-	-	-	-	-
UK(Engl.&Wales)	298	328	196	153	127	92	59	67	75
USSR		61	30		30	1			
Total	4 463	3 624	3 043	2 144	3 021	3 683	2 271	2 752	3 452

*) Preliminary

Table 8.2 Nominal catch (tonnes) of WHITING in Divisions VIIf and VIIg 1971-79.

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	194	87	190	72	216	162	97	66	91
France	5 058	5 129	4 514	4 395	4 521	5 881	5 737	6 620	5 690
Ireland	20	58	17	9	23	27	10	12	69
Netherlands	-				1	4	4	2	4
UK(Engl.&Wales)	192	164	208	134	164	130	166	181	146
USSR			15						
Total	5 464	5 438	4 944	4 610	4 925	6 204	6 014	6 881	6 000

*) Preliminary

Table 8.3 Celtic Sea WHITING (Divisions VIIf and VIIg)

Numbers at age landed by France in thousands and effort in 100 hp days

Age	1978	1978	$Z^{*)}$	F
1	2 200	2 344	not fully	
2	7 330	3 840	recruited	
3	6 131	3 847	.59	.39
4	3 347	1 930	1.11	1.09
5	346	786	1.40	1.38
6	221	162	0.71	0.51
7	200	104	0.70	0.50
8	31	45	1.44	1.24
9	-	-		
10	-	4		
French effort	30 920	29 406		

$$*)Z = \log\left(\frac{C_{78,a/effort}}{C_{79,a+1/effort}}\right)$$

Table 8.4 Nominal catch (tonnes) of HADDOCK in Divisions VIIg-k, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	31	23	45	65	35	33	19	13	5	-
France	2 156	2 722	5 590	5 011	4 687	3 463	2 929	1 612	1 001	919
Germany.Fed.Rep.	1	1	-	1	-	+	3	-	-	-
Ireland	535	736	795	1 033	574	314	177	114	69	49
Netherlands	91	66	53	11	1	2	-	-	-	+
Poland	-	3	-	62	143	-	-	-	-	-
Spain	-	-	662	807	998	-	-	265	-	-
UK(Engl.+Wales)	46	25	105	9	8	36	24	14	13	3
USSR	27	136	84	23	125	50	147	-	-	-
Total	2 887	3 712	7 334	7 022	6 571	3 898	3 299	2 018	1 088	971

*) Preliminary.

Table 9.1 Age composition of Irish landed WHITING by-catch in Nephrops fisheries compared with that of directed Irish whitefish fisheries (1 000 , raised to Quarter 3 total).

Age group	July - September 1979			
	White Fish fishery		Nephrops fishery	
	Number	Mean length (cm)	Number	Mean length (cm)
1	925	26.25	944	27.22
2	1 052	31.47	1 571	30.81
3	731	36.08	736	34.30
4	19	36.45	10	33.50
5	127	43.04	70	38.78
6	5	52.67	-	-
7	9	49.20	-	-
≥8	2	53.00	-	-
	2 870		3 331	

Table 9.2 WHITING by-catch samples from Nephrops fisheries - Division VIIa

Length (cm) (mid-point)	July (4 samples)	August (2 samples)
5	-	2
7	-	27
9	-	180
11	-	138
13	1	33
15	8	5
17	46	2
19	138	8
21	173	11
23	127	33
25	58	40
27	13	32
29	11	4
31	2	3
33	3	-
35	-	-
37	1	-
Total	581	518
Weight (kg)	49.9	19.5

Table 9.3 NEPHROPS by-catches by French vessels in Div. VIIg December 1979-March 1980 (length composition data)

Length (cm)	Whiting	Plaice	Sole	Cod	Haddock
18-19			2		
20-21	6		3		
22-23	1	2	6		2
24-25	7	3	43		0
26-27	29	5	106	2	0
28-29	99	24	129	2	2
30-31	155	27	113	3	6
32-33	184	47	81	2	8
34-35	171	28	69	1	13
36-37	131	25	58	3	33
38-39	88	16	41	4	20
40-41	38	8	26	10	19
42-43	21	5	18	8	8
44-45	17	3	7	9	9
46-47	13	4	2	6	5
48-49	6	3		6	6
50-51	2	1		4	6
52-53	5	2		4	10
54-55	3	3		9	3
56-57	0	0		3	6
58-59	0	1		2	4
60-61	1			3	6
62-63				8	9
64-65				11	8
66-67				6	6
68-69				13	4
70-74				35	5
75-79				18	7
80-84				16	1
85-89				18	
90-94				30	
95-99				8	
> 100				9	

Table 10.1 Estimated Catch per Effort and Total International Effort on Total Demersal in Divs. VIIa and VIIf

Year	A	B	C	D
1954	8.6	3 206	27 572	
1955	8.0	3 513	28 104	
1956	8.2	4 046	33 177	3 588
1957	8.8	4 423	38 922	3 994
1958	7.0	5 572	39 004	4 680
1959	5.8	5 887	34 145	5 294
1960	7.5	4 847	36 358	5 435
1961	7.6	4 521	34 356	5 085
1962	6.4	6 650	42 561	5 339
1963	6.2	5 554	34 435	5 575
1964	5.6	8 637	48 366	6 947
1965	5.4	9 165	49 489	7 785
1966	6.1	5 919	36 107	7 907
1967	6.8	6 780	46 106	7 288
1968	5.9	8 306	49 008	7 001
1969	5.1	9 260	47 228	8 115
1970	4.3	10 183	43 786	9 249
1971	4.2	11 724	49 242	10 389
1972	4.5	10 411	46 850	10 772
1973	4.3	13 543	58 237	11 892
1974	4.10	12 312	50 445	12 089
1975	3.61	14 326	51 766	13 394
1976	3.23	16 152	52 235	14 263
1977	3.14	13 761	43 200	14 746
1978*)	3.42	13 450	46 000	14 454
1979*)	3.30	13 540	44 700	13 583

*) Preliminary

A = Catch per effort (from Belgian + E + W otter trawlers - in tonnes/100 hrs of 1954 E + W motor trawlers).

B = Total international effort (in 100 hrs by 1954 motor trawlers).

C = Total demersal catch (in tonnes as reported at Working Group for 1960-1979 and from Bulletin Statistique prior to this).

D = Running 3-year mean of B

Linear model: $A = 9.15 - 4.263 \times 10^{-4} \times D$

$r^2 = .88$

Exponential model: $A = 10.65 \times e^{-8.26 \times 10^{-5} \times D}$

$r^2 = .93$

} 24 observations

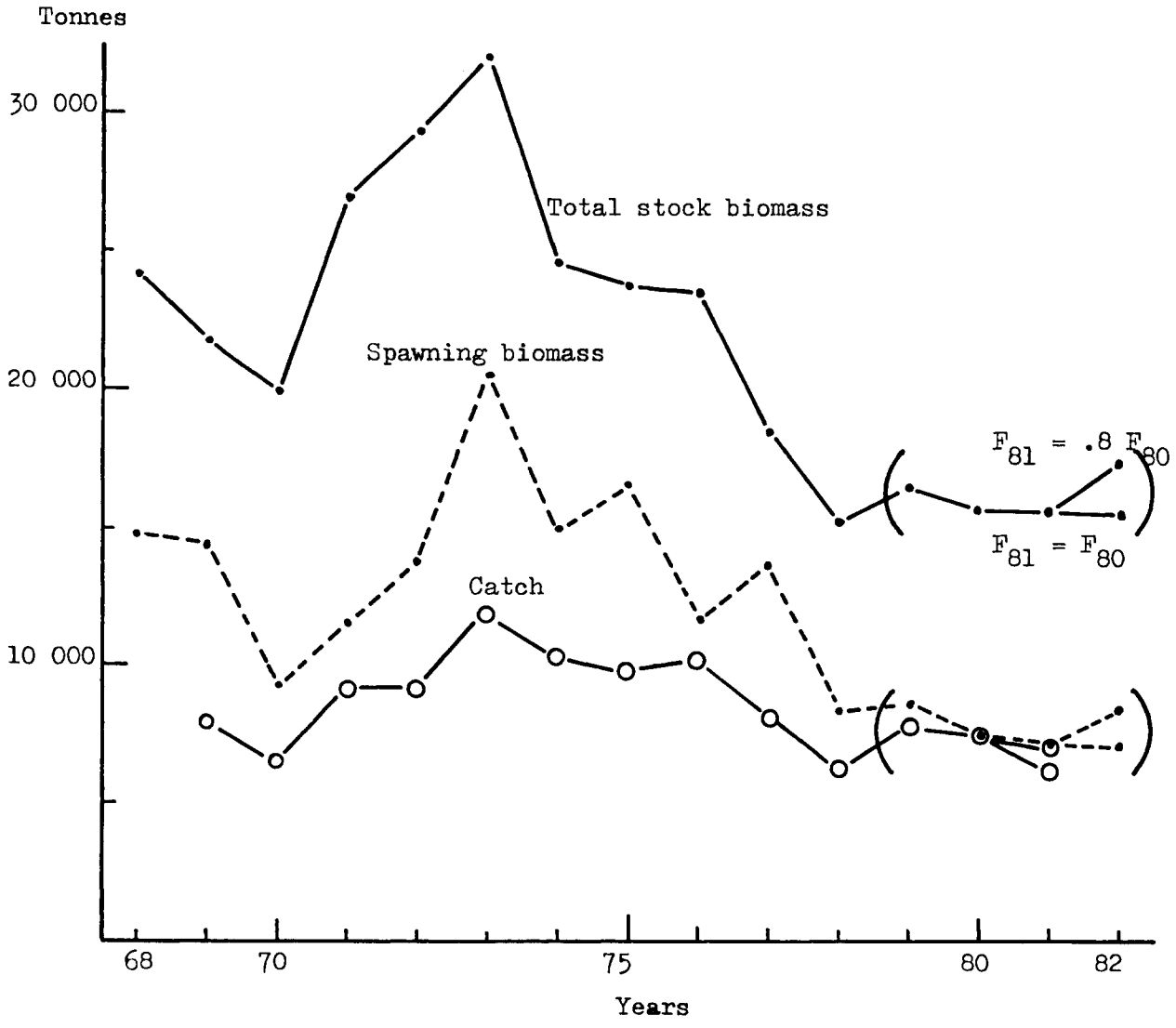
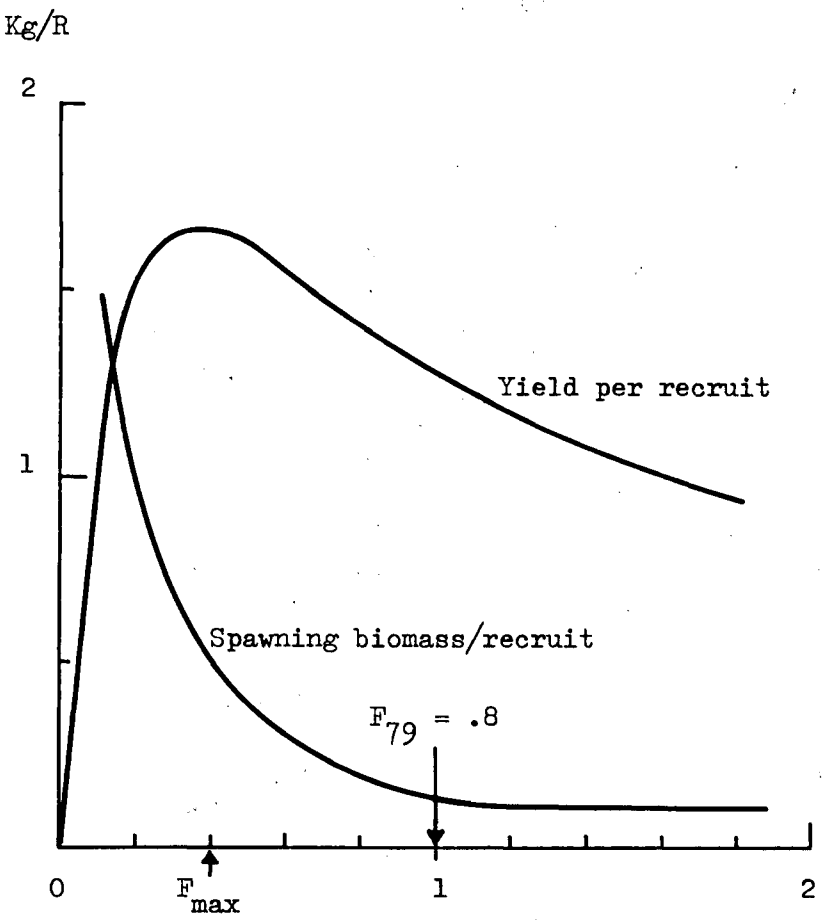


Figure 2.1. Irish Sea COD (Division VIIa).
Trends in catch and stock biomass (tonnes).



F as a multiple of the 1979 exploitation pattern (F on peak = 0.8 in 1979).

Figure 2.2. Irish Sea COD (Division VIIa). Yield per recruit and spawning stock per recruit curves.

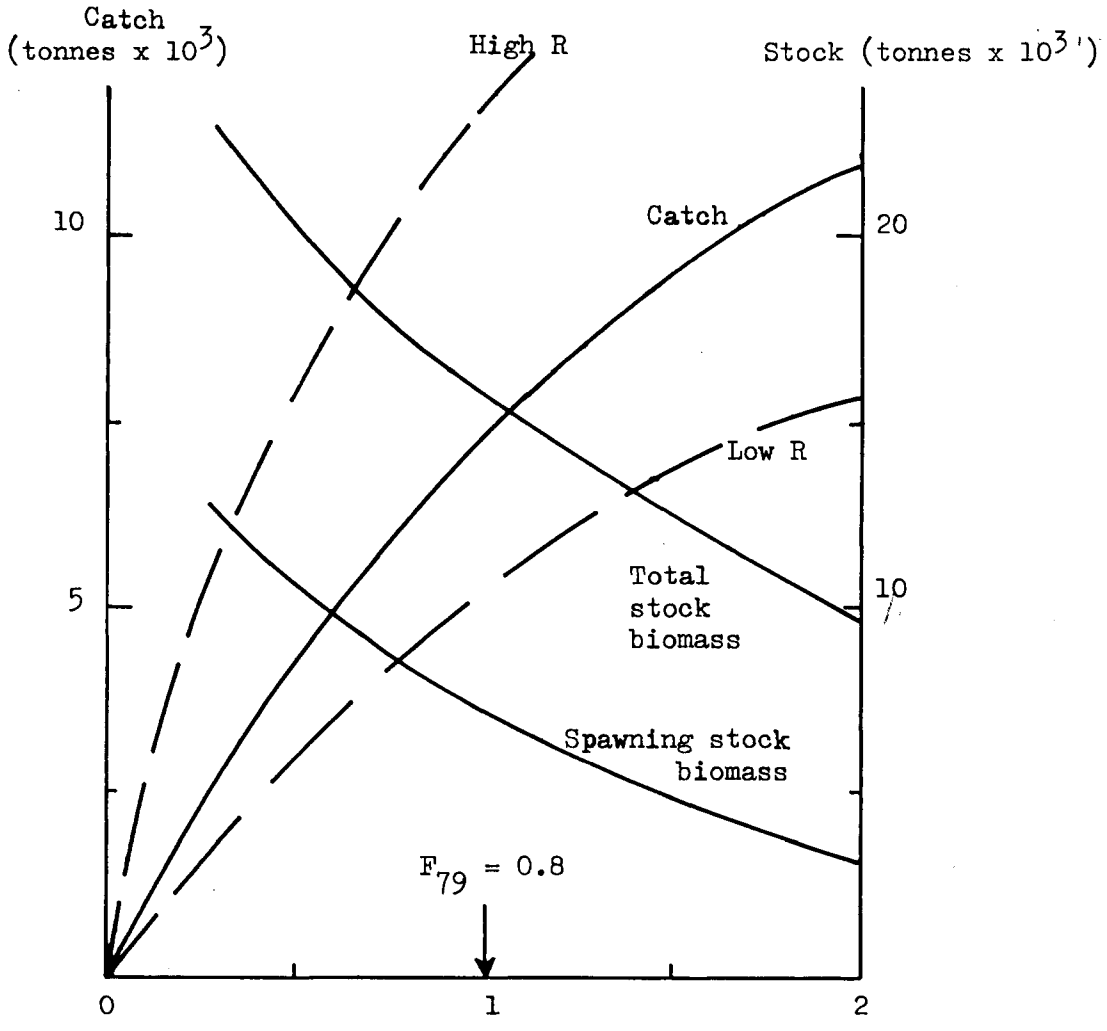


Figure 2.3. Irish Sea COD (Division VIIa). Catch forecasts for 1981 and resulting stock biomass in 1982 for a range of fishing mortalities in 1981. For the catch the 95% confidence interval resulting from two high and two low recruitments is shown.

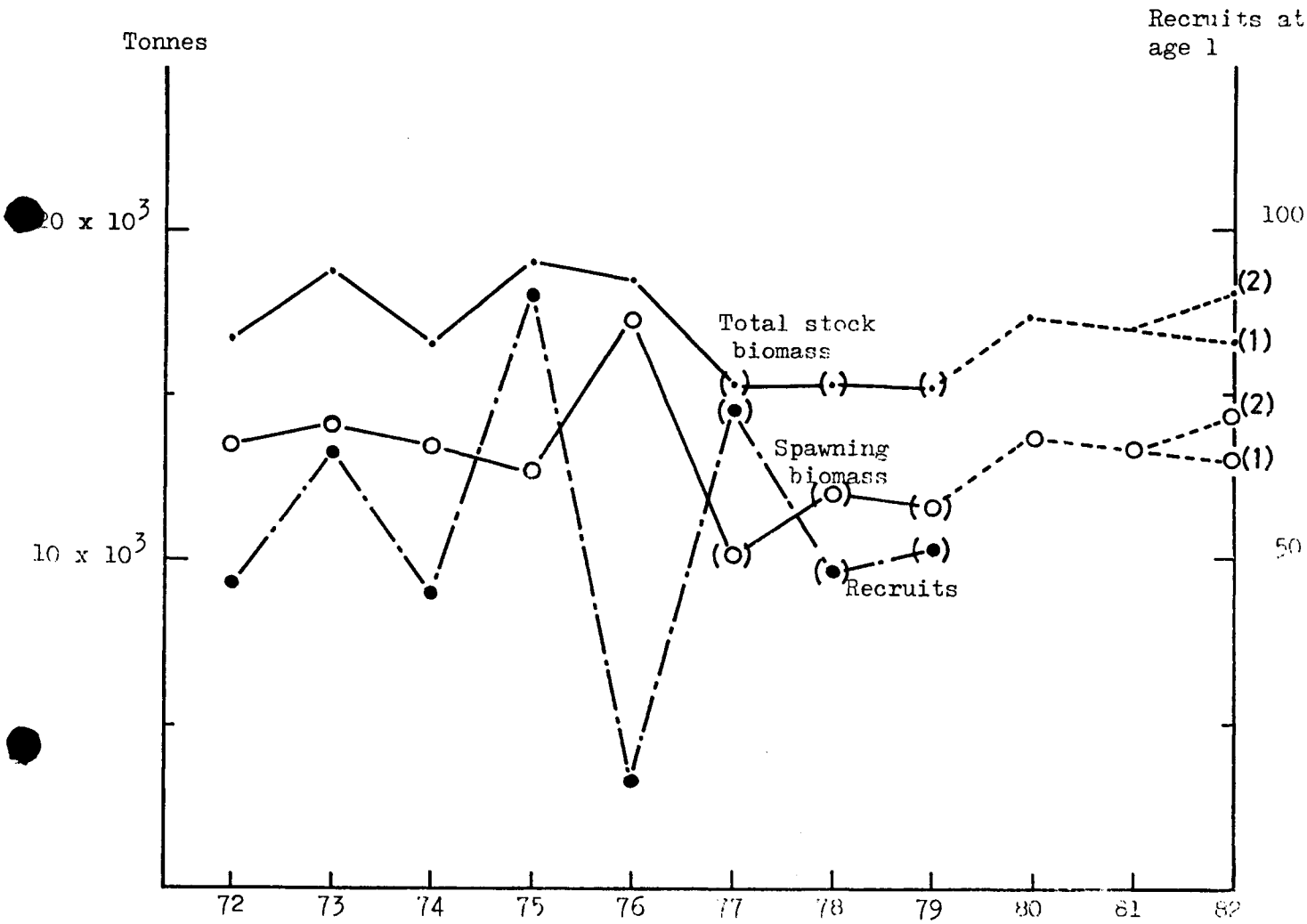


Figure 3.1. Irish Sea WHITING (Division VIIa).
Trends in stock size, stock biomass (both in tonnes) and recruitment at age 1 in numbers (millions).

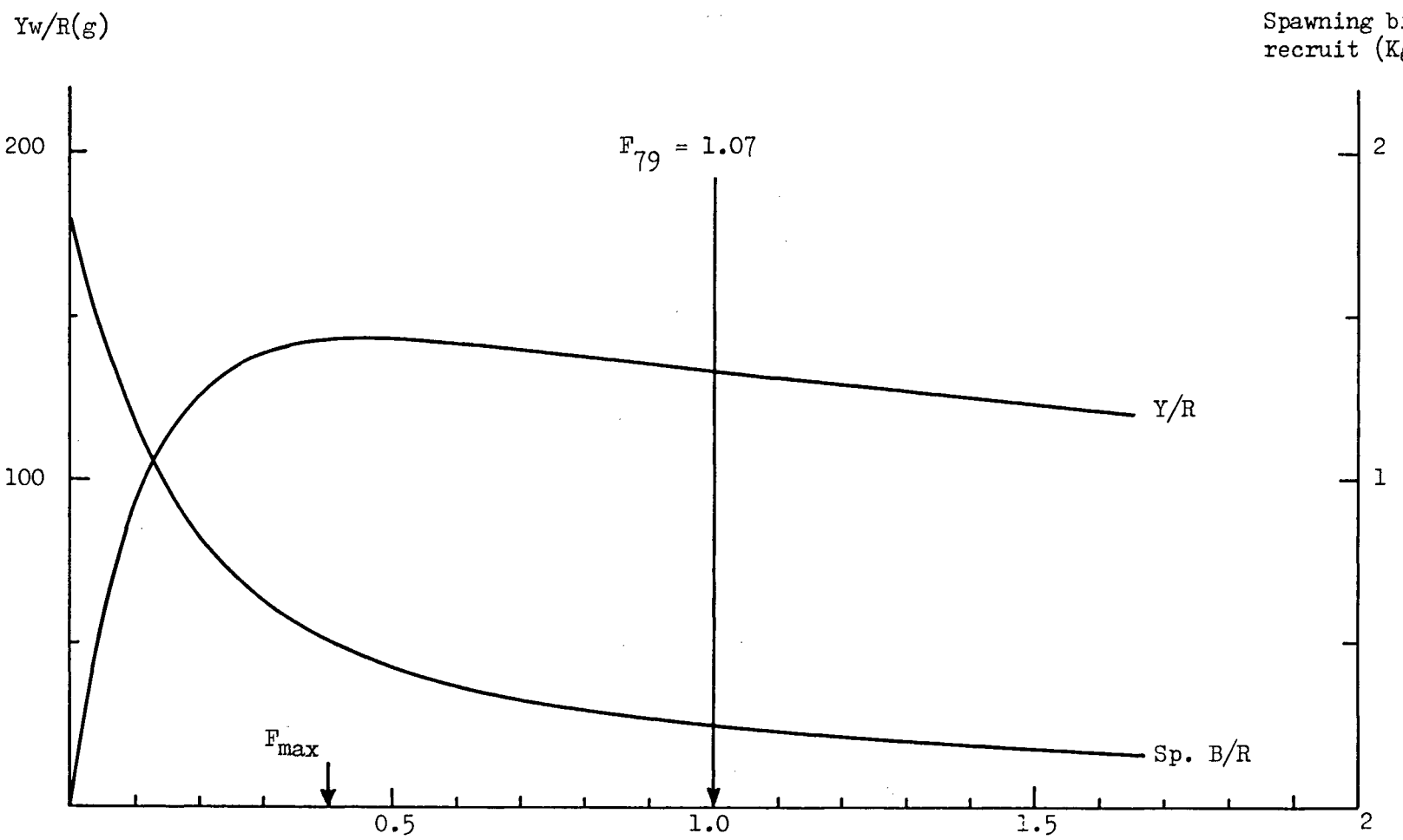


Figure 3.2. Irish Sea WHITING (Division VIIa).
Yield per recruit and spawning stock biomass per recruit curves.

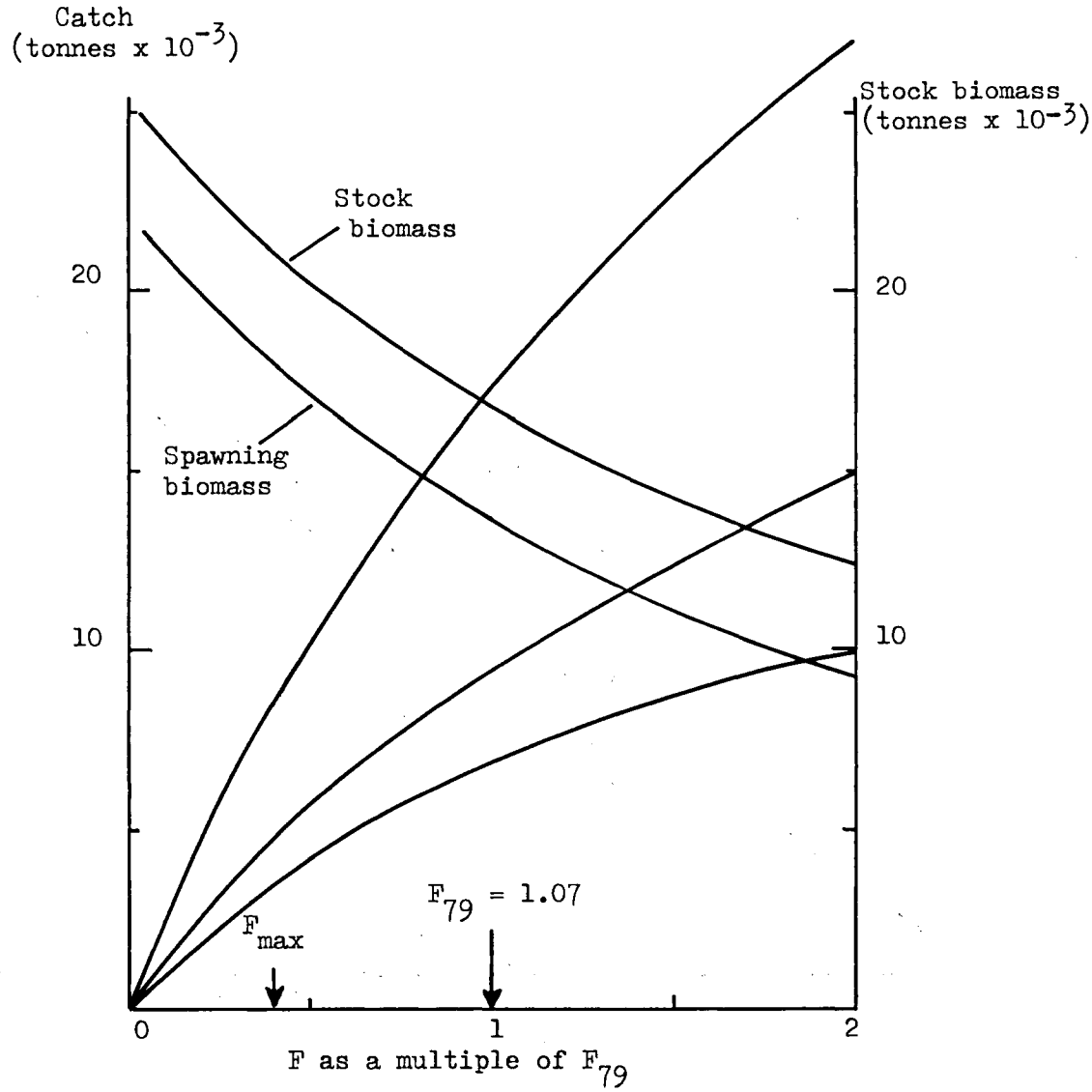


Figure 3.3. Irish Sea WHITING (Division VIIa). Catch forecasts for 1981 and resulting stock biomass in 1982 for a range of fishing mortalities in 1981. For the catch, the 5% confidence interval resulting from two high and two low recruitments is shown.

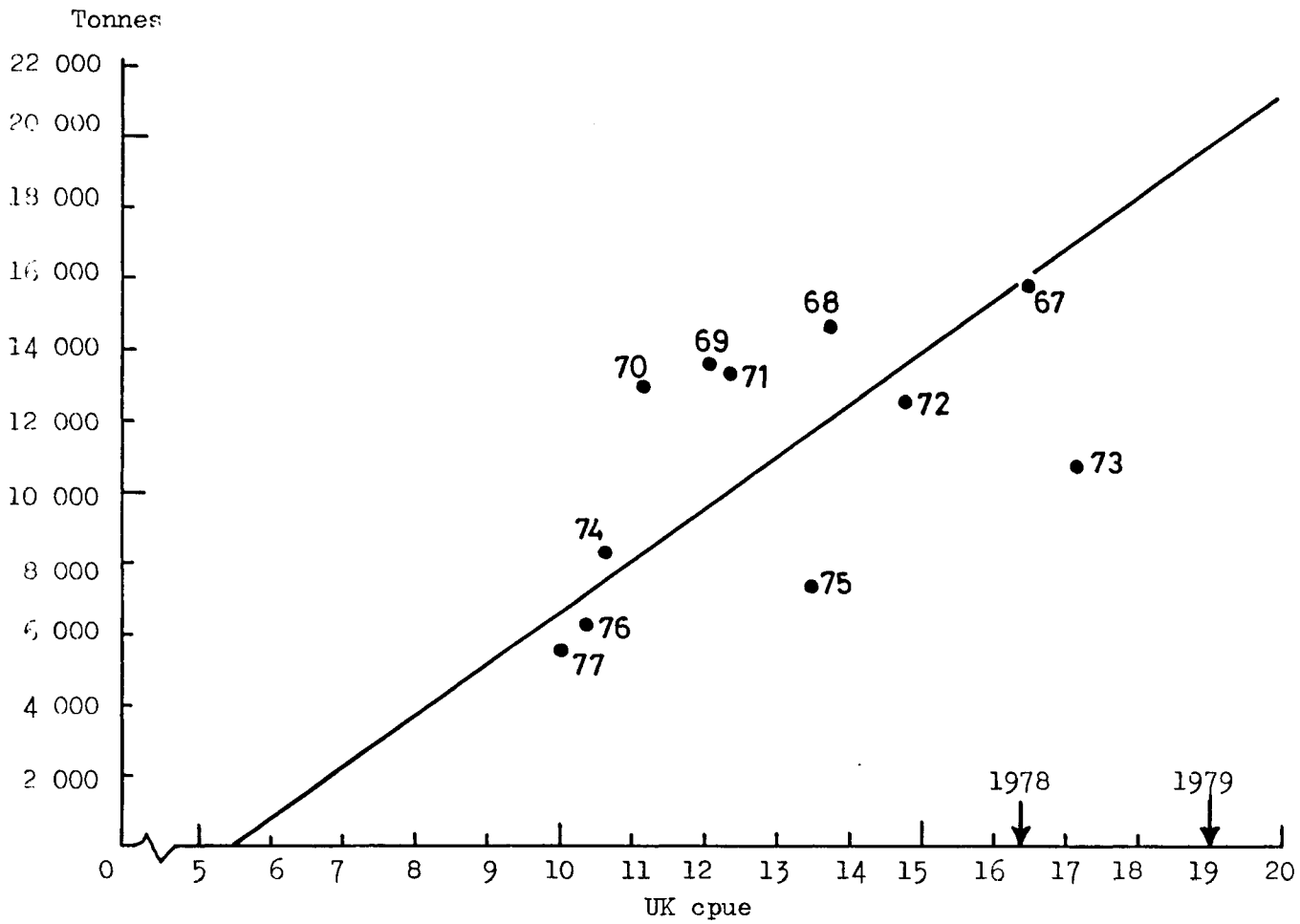


Figure 4.1. Irish Sea PLAICE (Division VIIa).
Regression of total stock biomass (from VPA) against United Kingdom cpue, 1967-77.

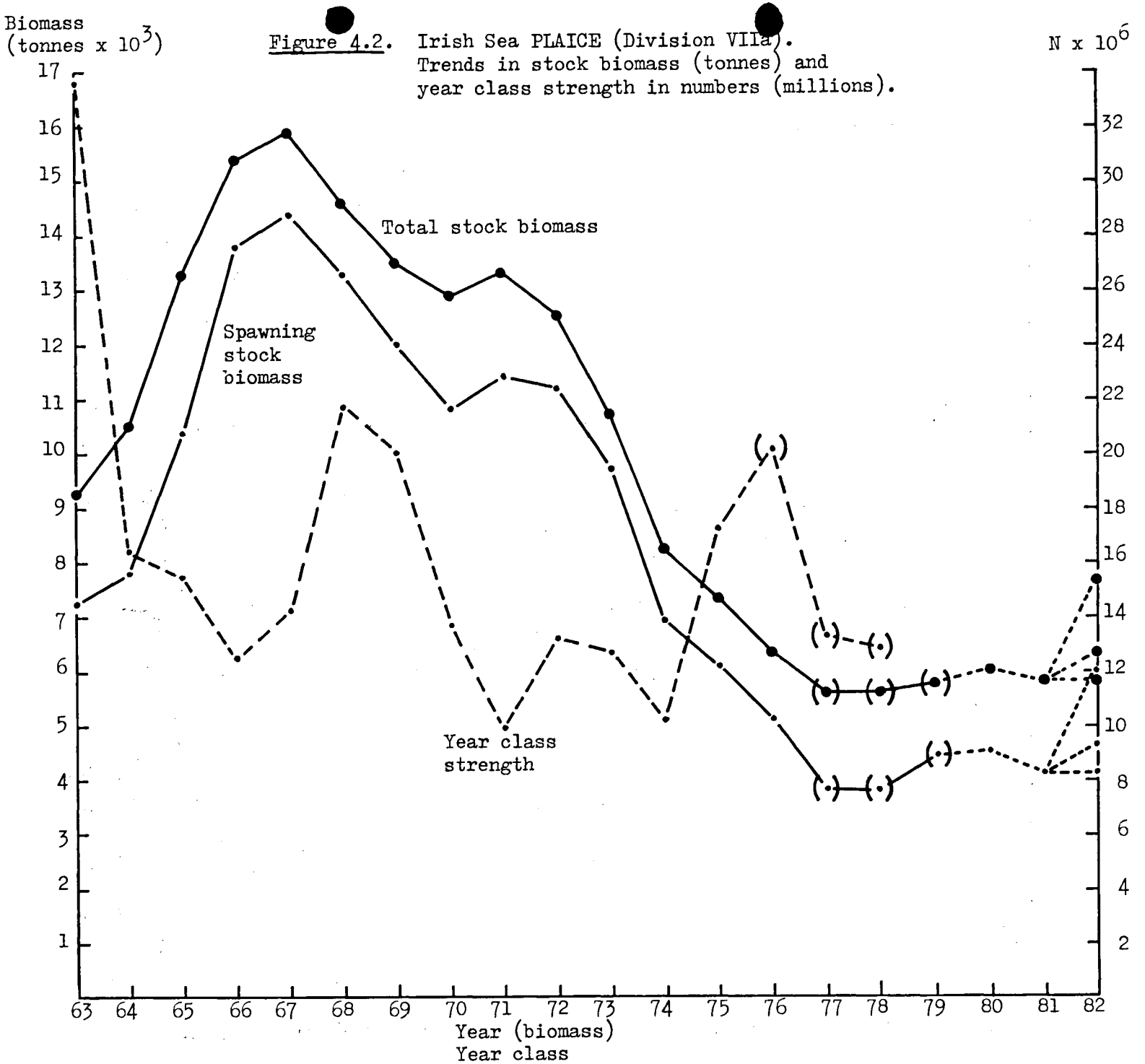
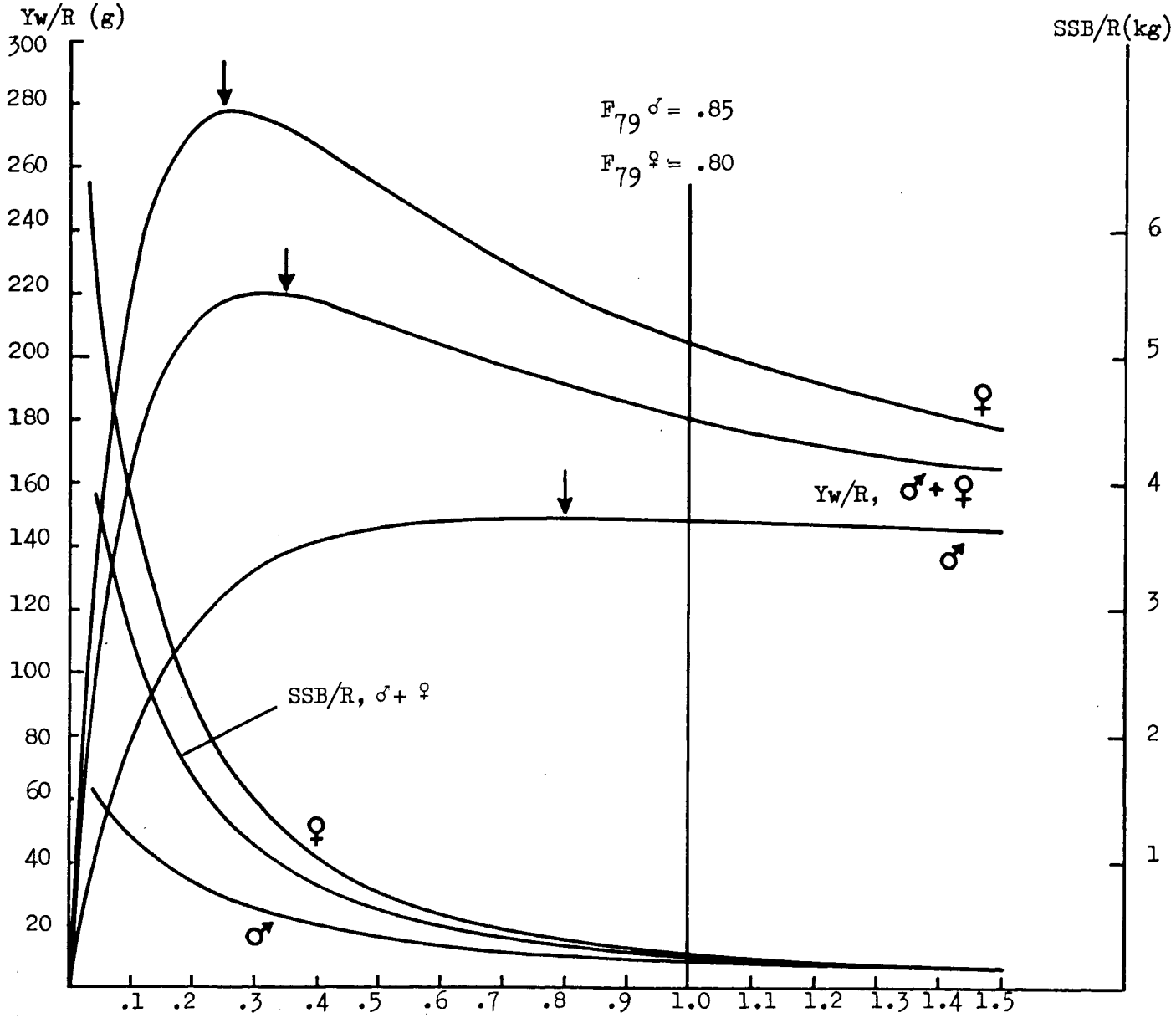


Figure 4.2. Irish Sea PLAICE (Division VIIa). Trends in stock biomass (tonnes) and year class strength in numbers (millions).

Figure 4.3. Irish Sea PLAICE (Division VIIa).
Yield per recruit and spawning stock biomass per recruit curves, conditional on the 1979 exploitation pattern.



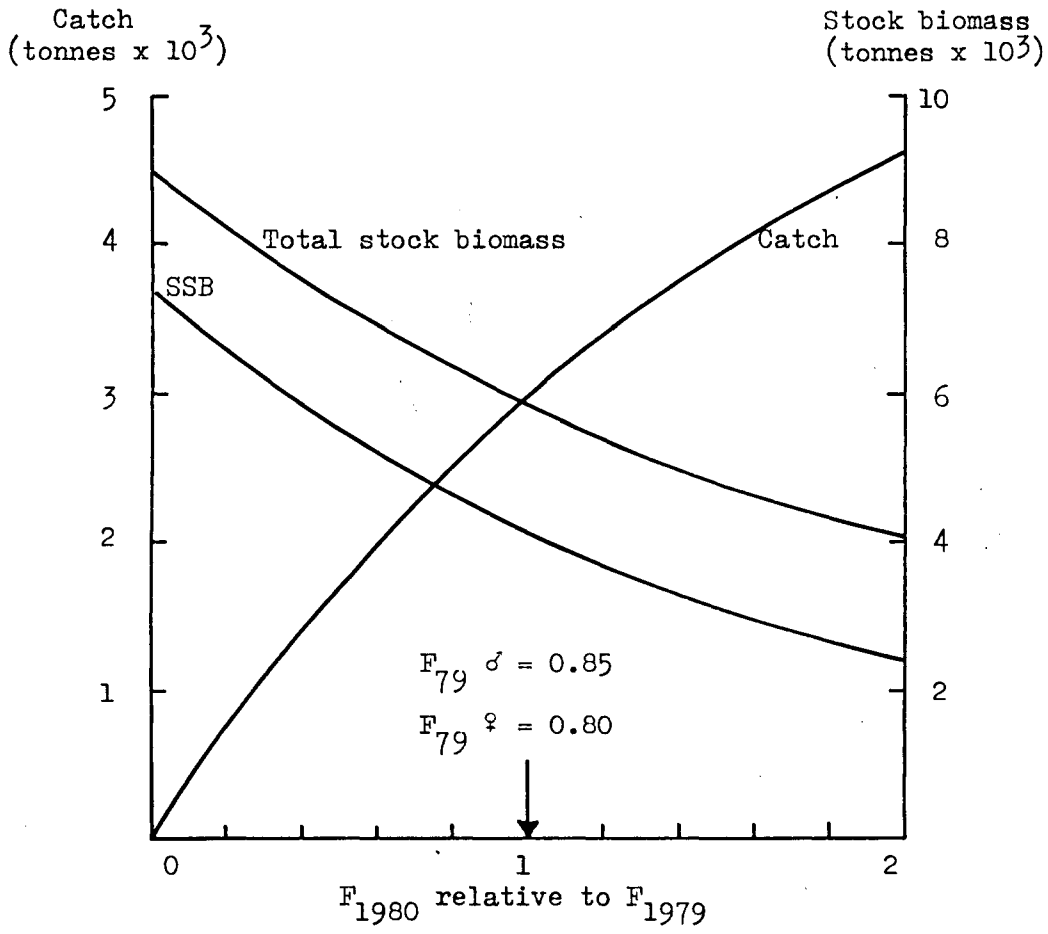


Figure 4.4. Irish Sea PLAICE (Division VIIa).
Catch forecasts for 1981 and resulting stock biomass in 1982 for a range of fishing mortalities in 1981.

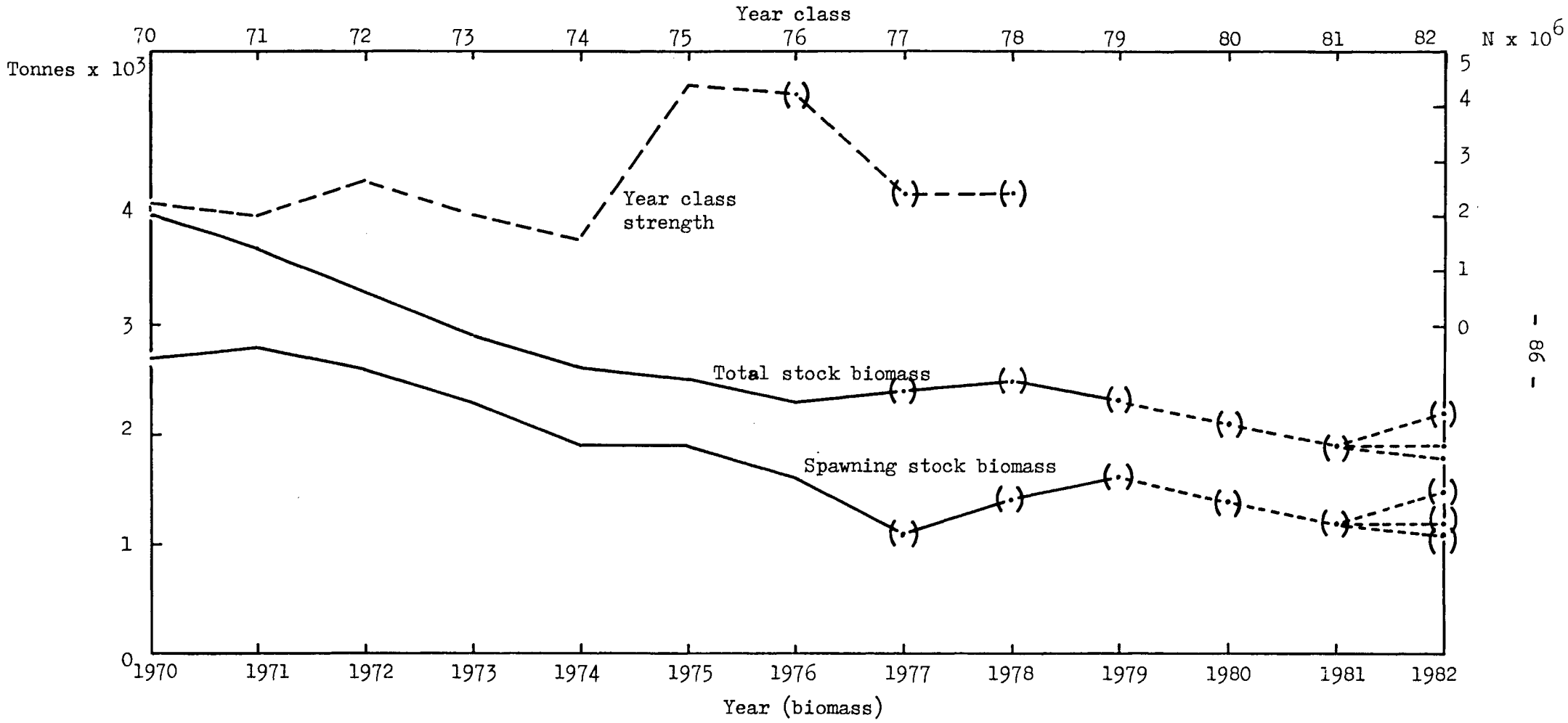


Figure 5.1. Celtic Sea PLAICE (Divisions VIIf and VIIg).
Trends in stock biomass (tonnes) and year class strength (millions).

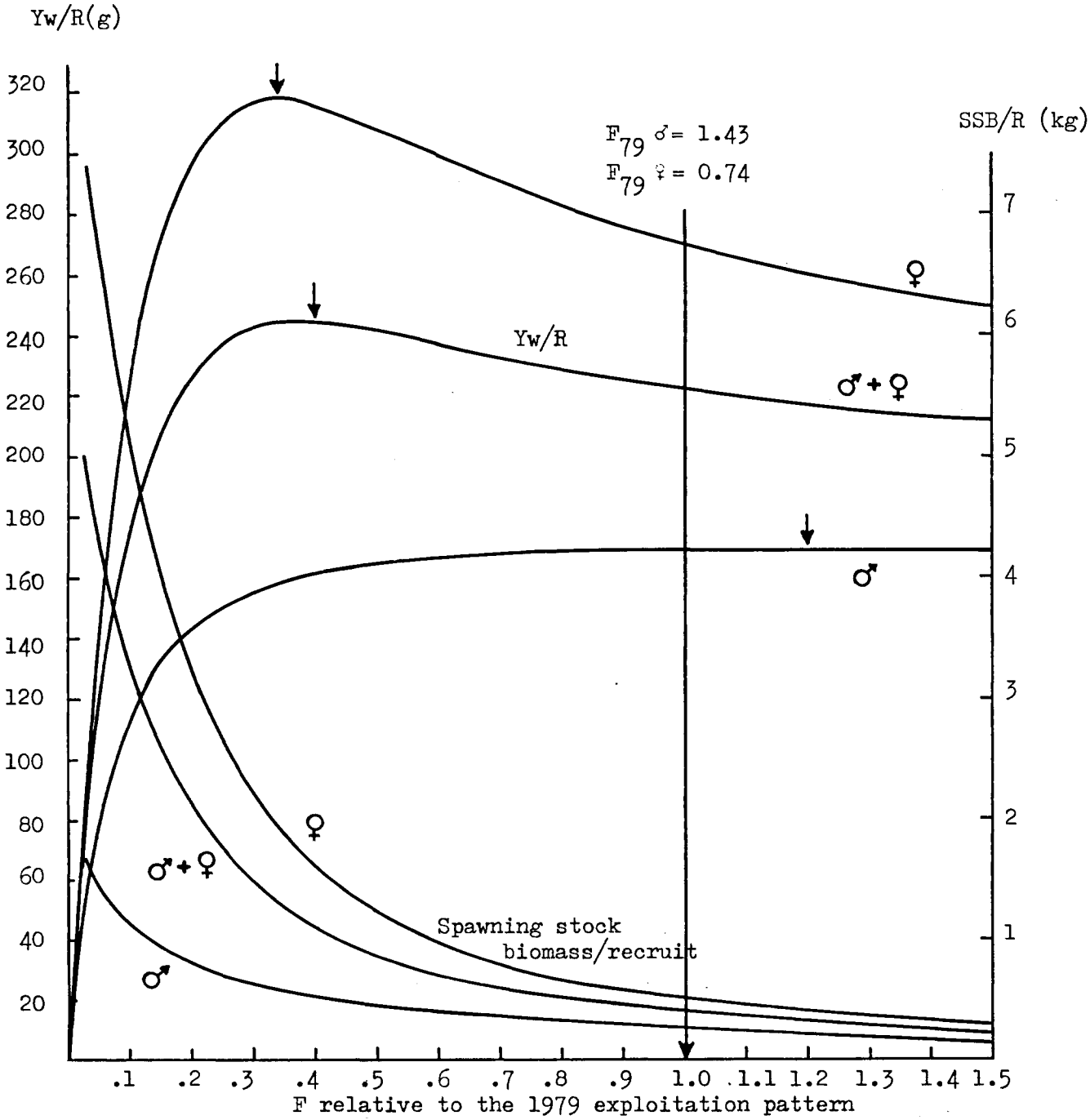


Figure 5.2. Celtic Sea PLAICE (Divisions VIIf and VIIg). Yield per recruit and spawning stock biomass per recruit curves.

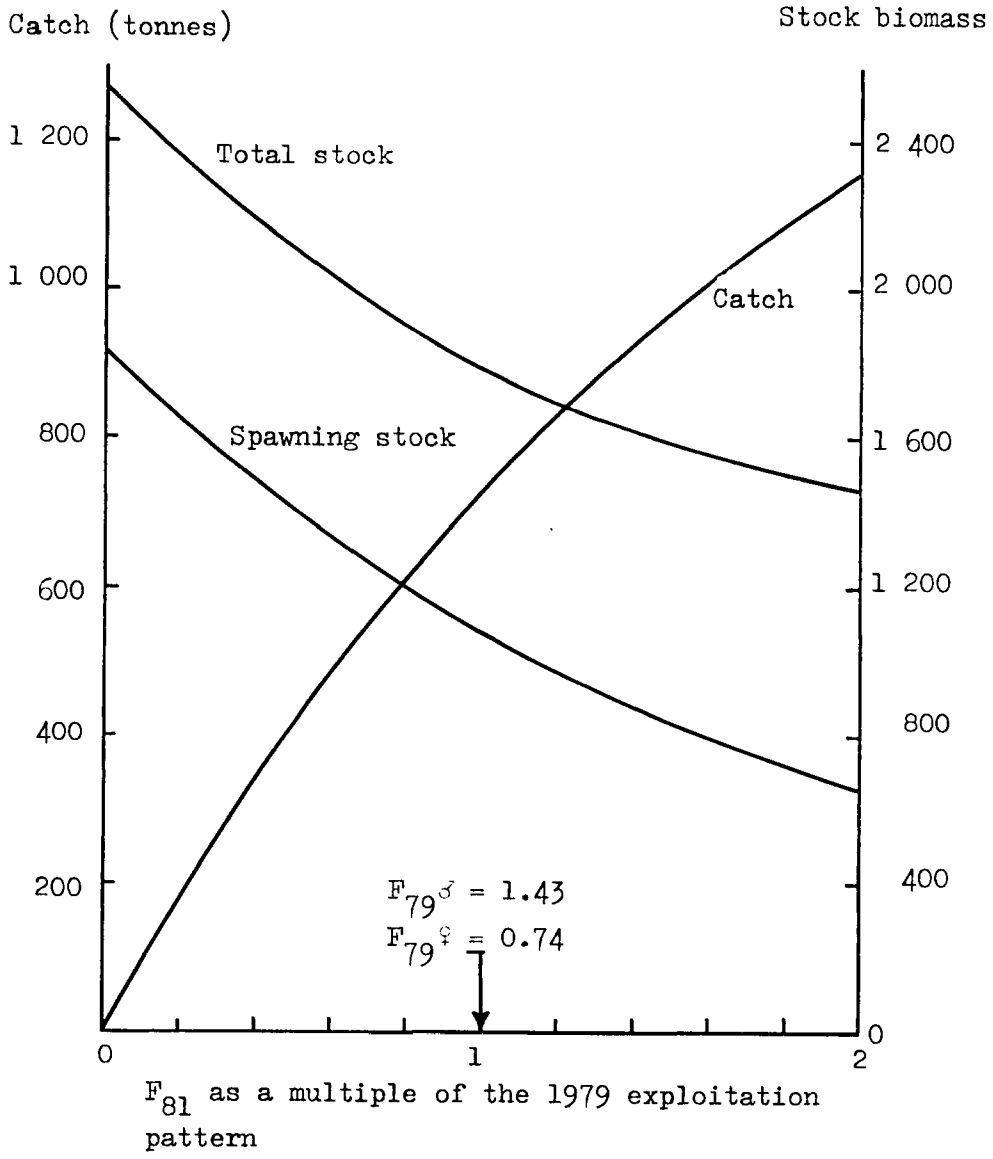


Figure 5.3. Celtic Sea PLAICE (Divisions VIIf and VIIg). Catch forecasts for 1981 and resulting stock biomass in 1982 for a range of fishing mortalities in 1981.

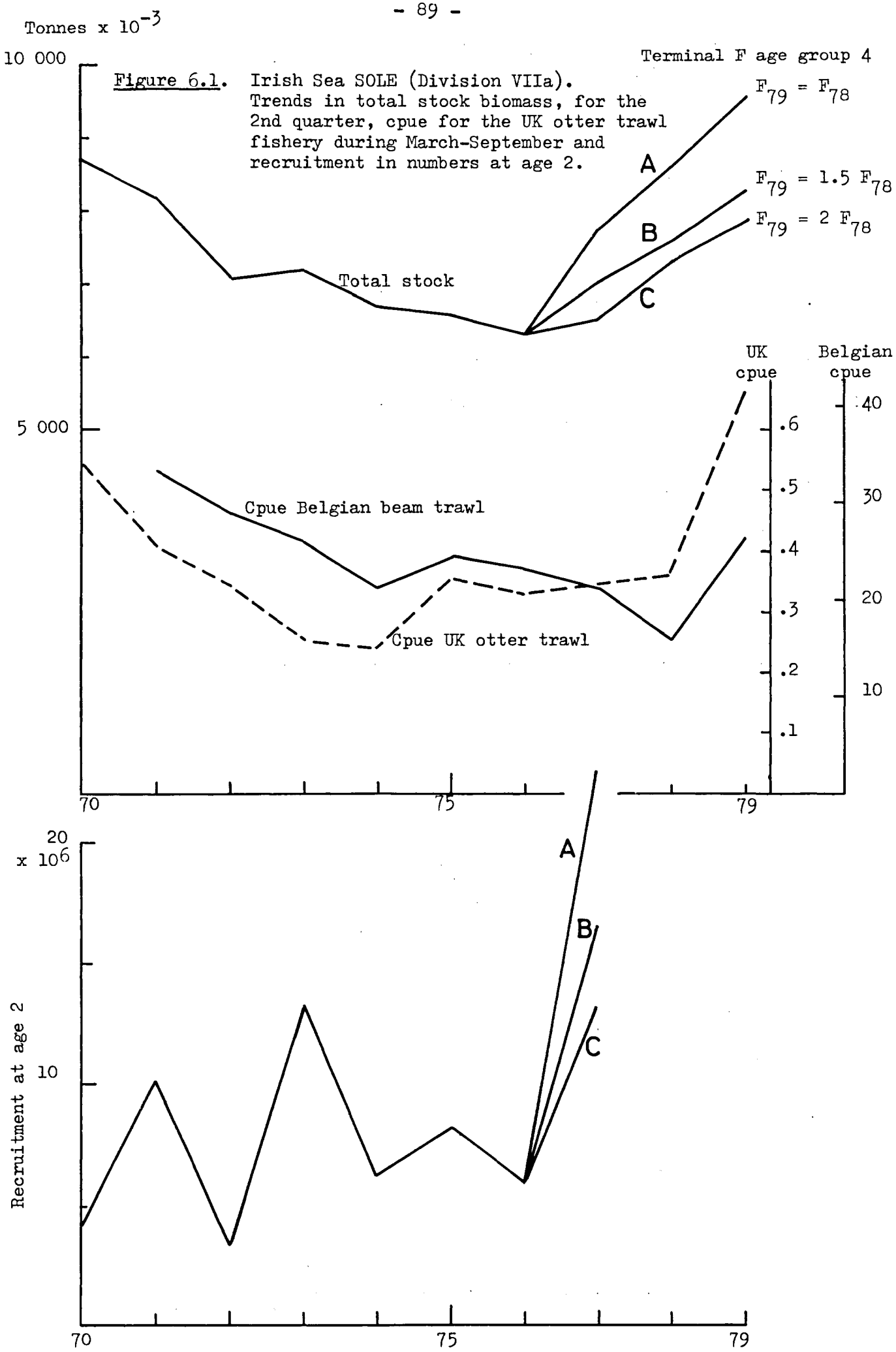


Figure 6.1. Irish Sea SOLE (Division VIIa). Trends in total stock biomass, for the 2nd quarter, cpue for the UK otter trawl fishery during March-September and recruitment in numbers at age 2.

Figure 6.2. Irish Sea SOLE (Division VIIa).
Geometric mean regression of VPA 2-year-olds on cpue of 3-year-olds one year later in the Belgian beam trawl fishery.

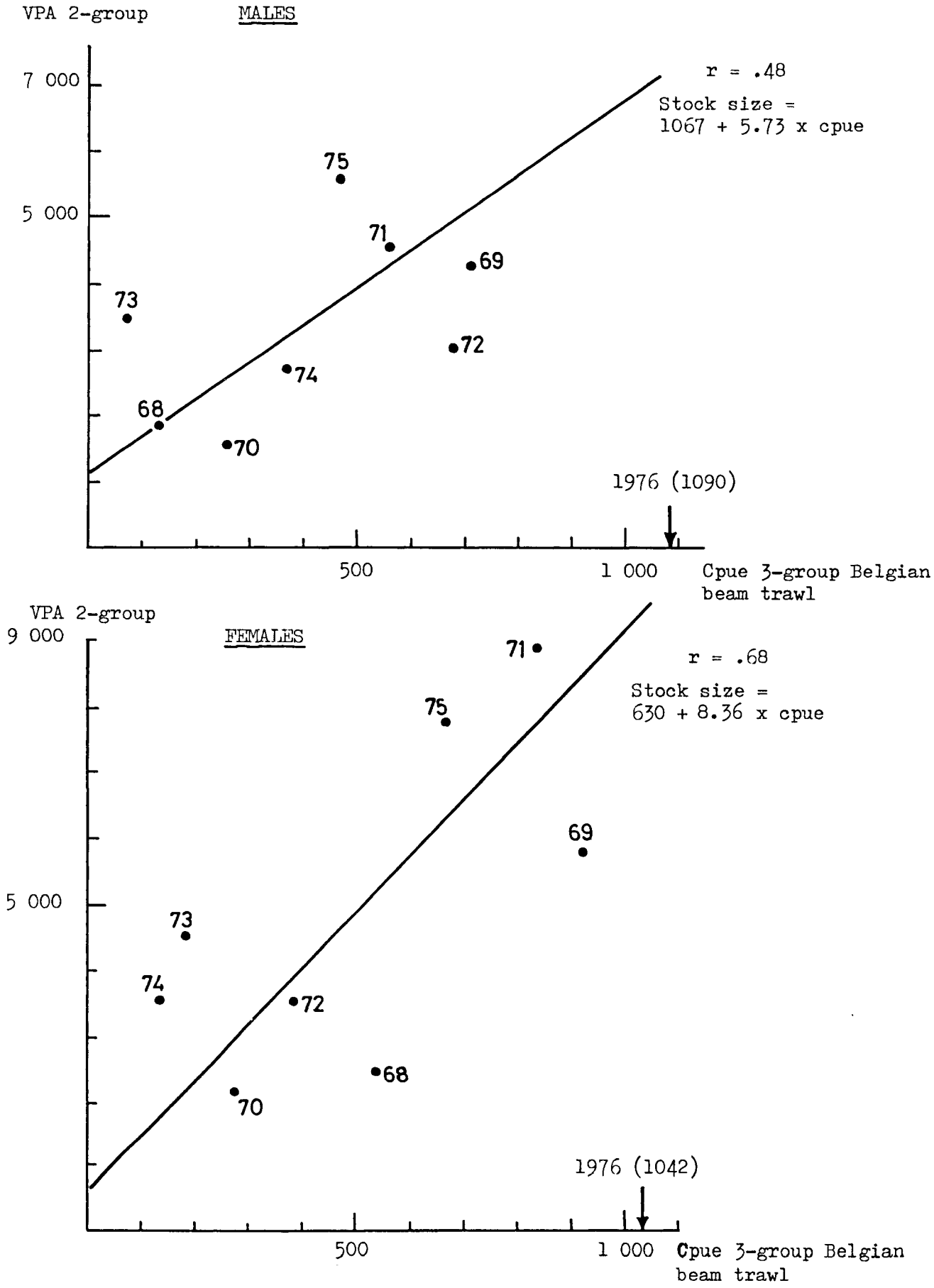


Figure 6.3. Irish Sea SOLE (Division VIIa).
Trends in stock biomass, catch (both in tonnes), recruitment in numbers, Belgian beam trawl cpue for the 2nd quarter and the UK otter trawl cpue during March-September.

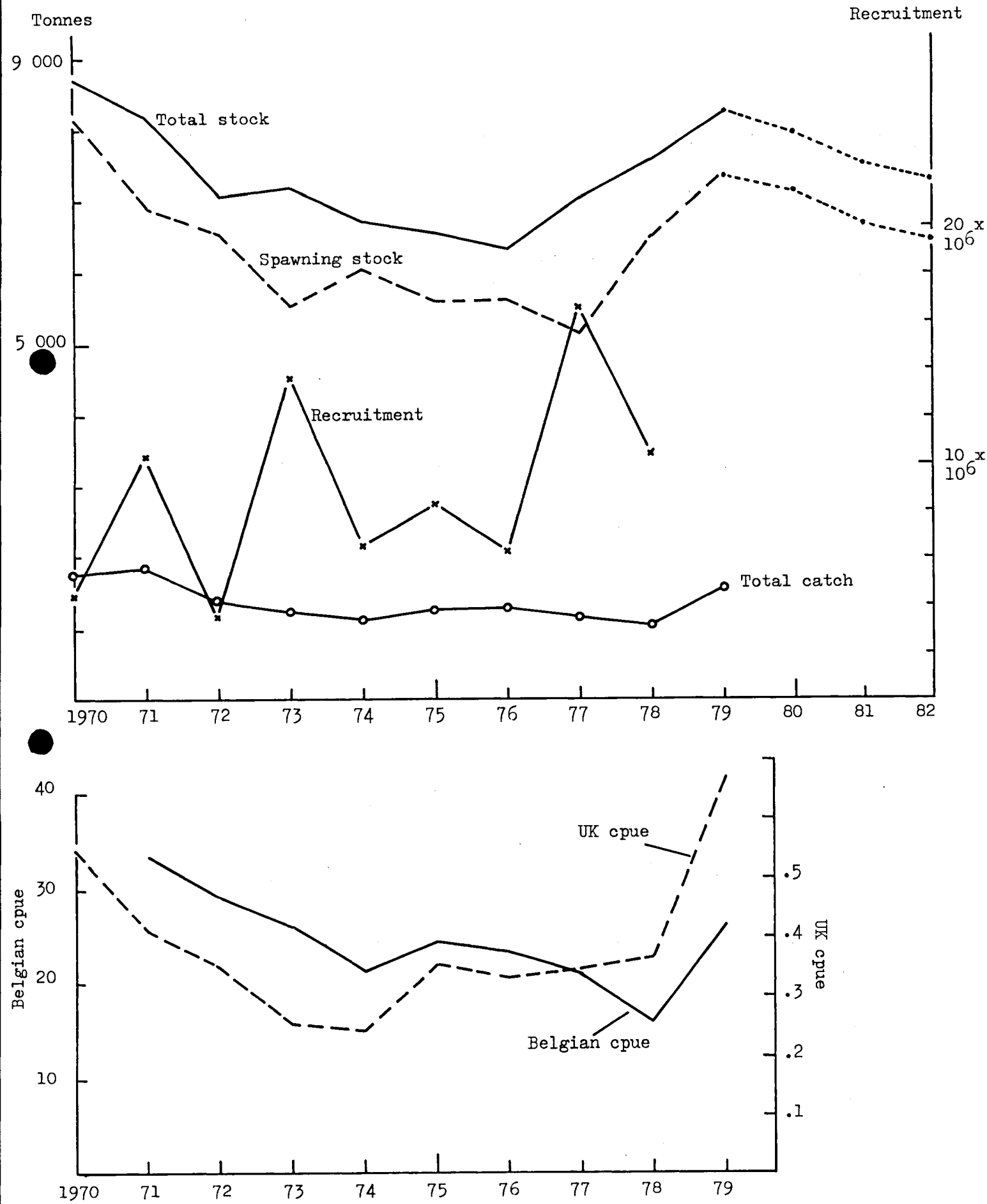
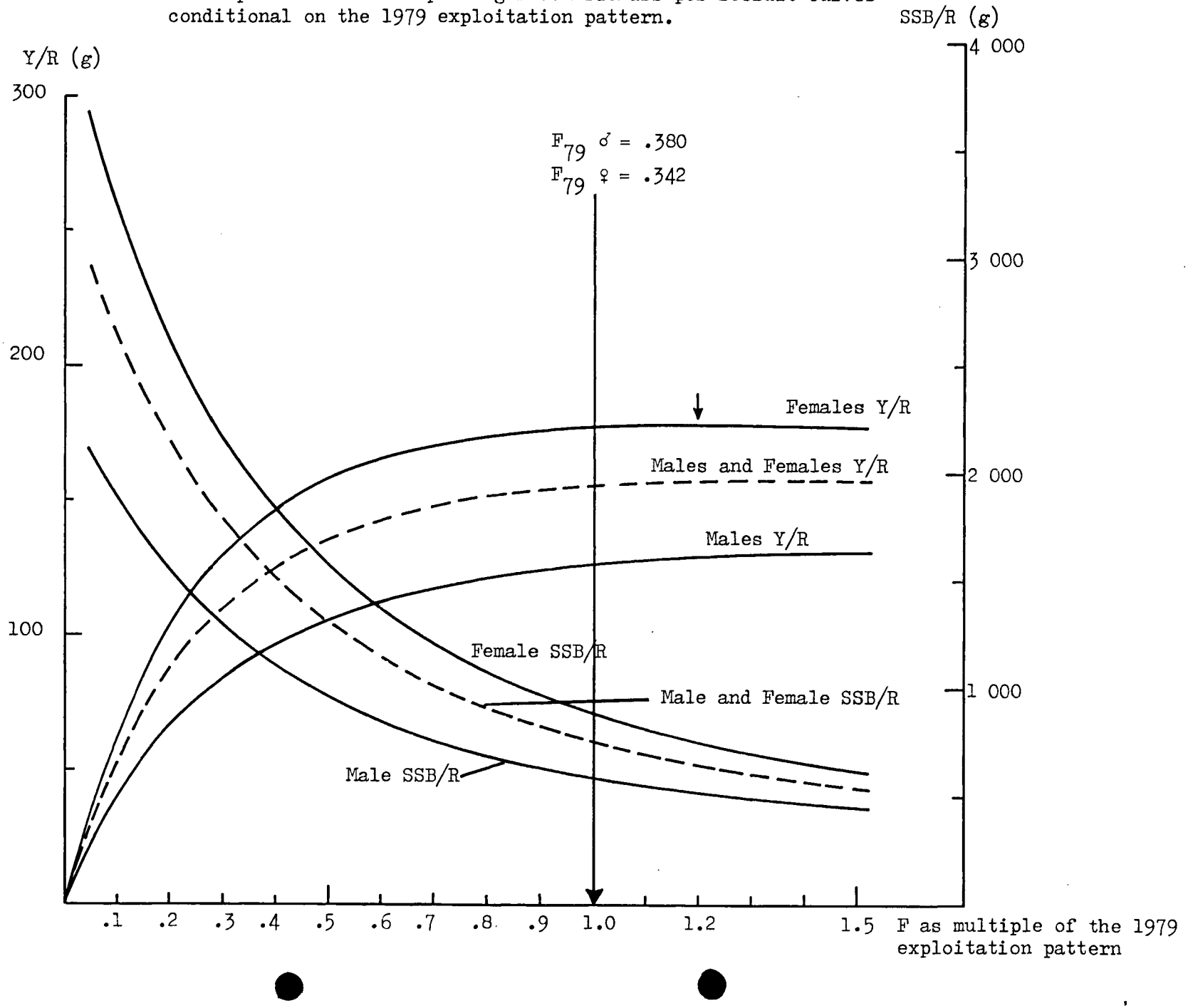


Figure 6.4. Irish Sea SOLE (Division VIIa).
Yield per recruit and spawning stock biomass per recruit curves conditional on the 1979 exploitation pattern.



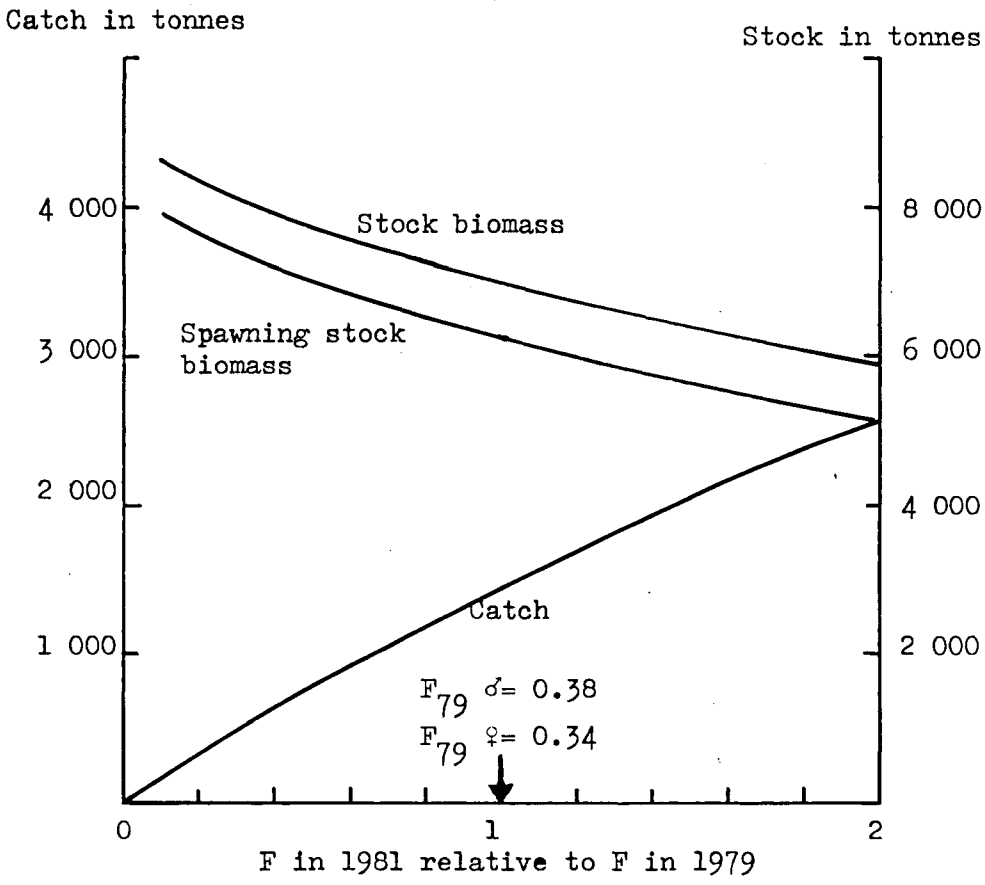


Figure 6.5. Irish Sea SOLE (Division VIIa).
Catch forecasts for 1981 and resulting stock biomass in 1982 for a range of fishing mortalities in 1981.

Figure 7.1. Celtic Sea SOLE (Divisions VIIf and VIIg).
Changes during 1971-79 in total international effort and F values from VPA.

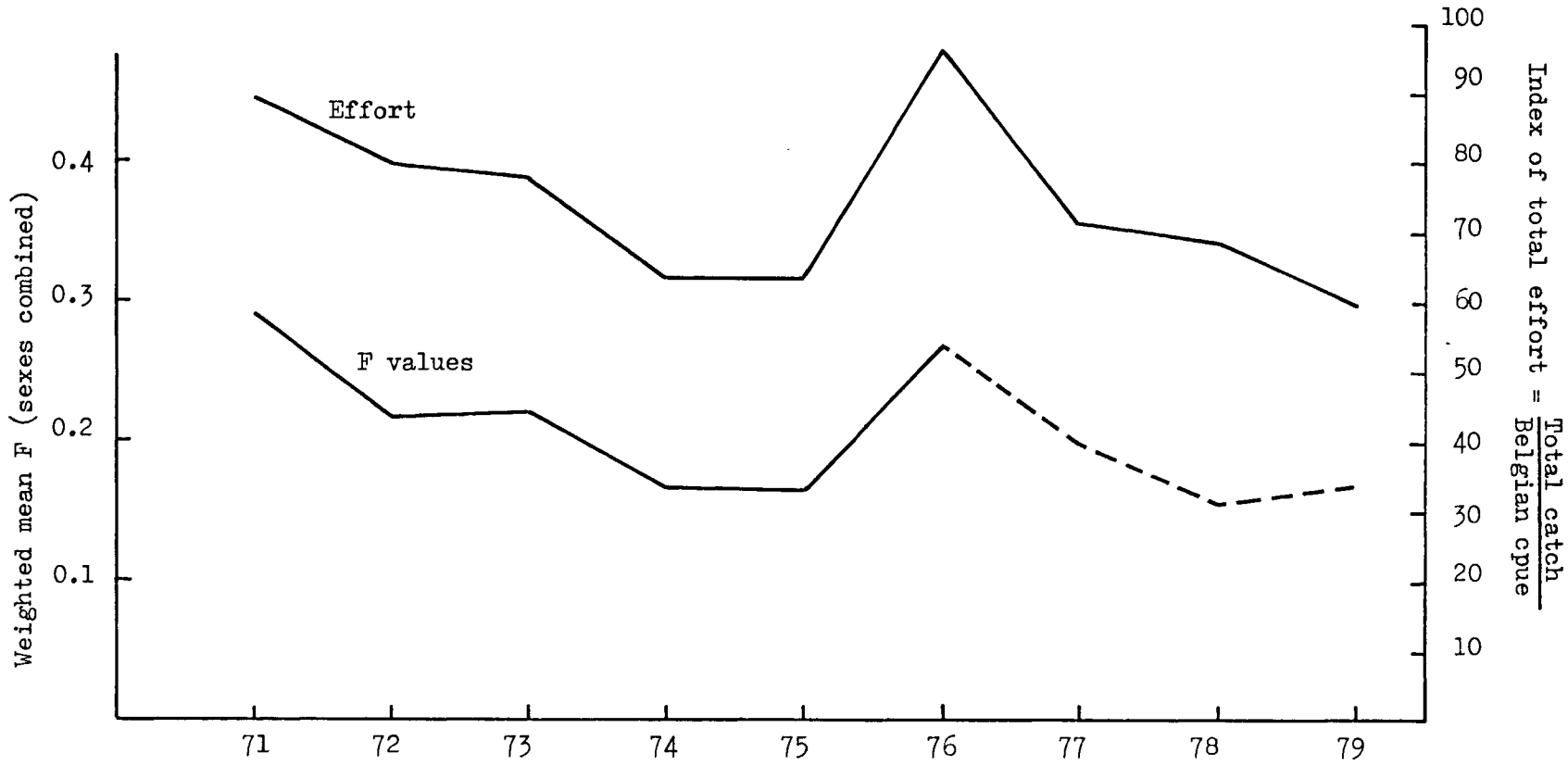
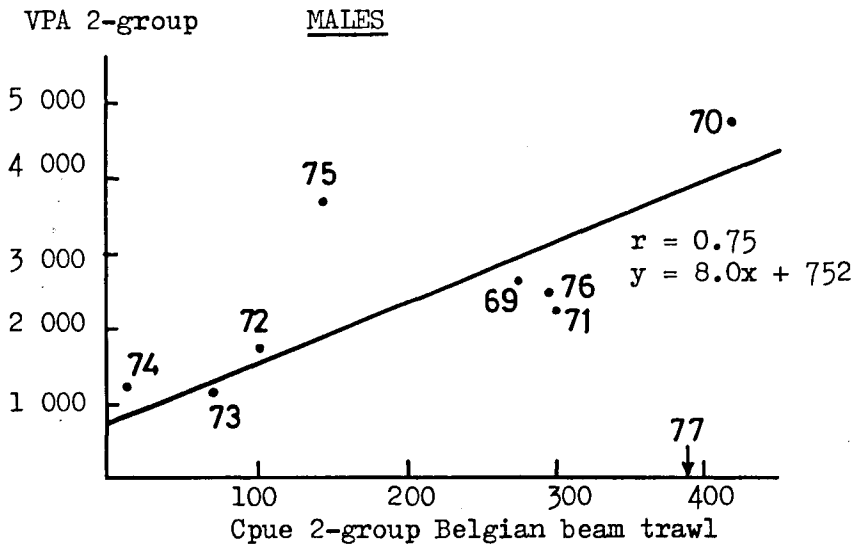
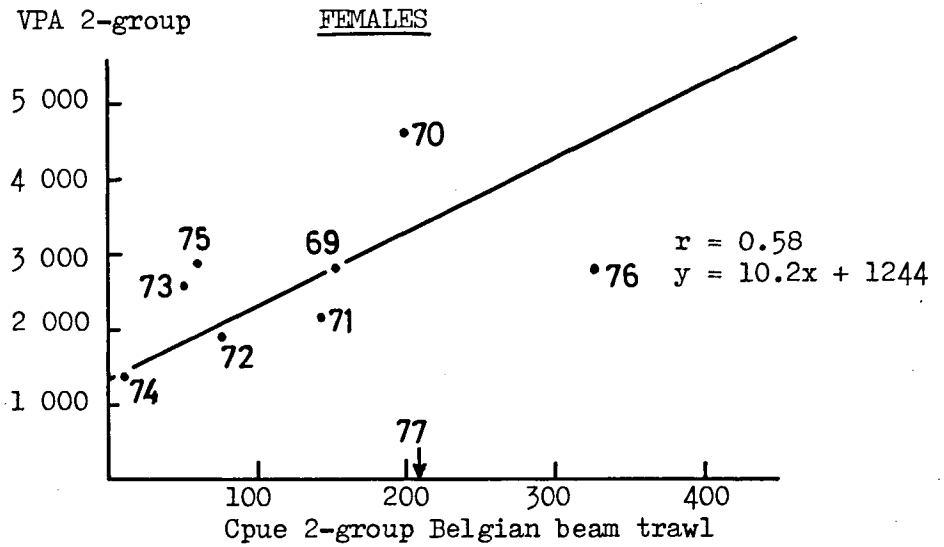
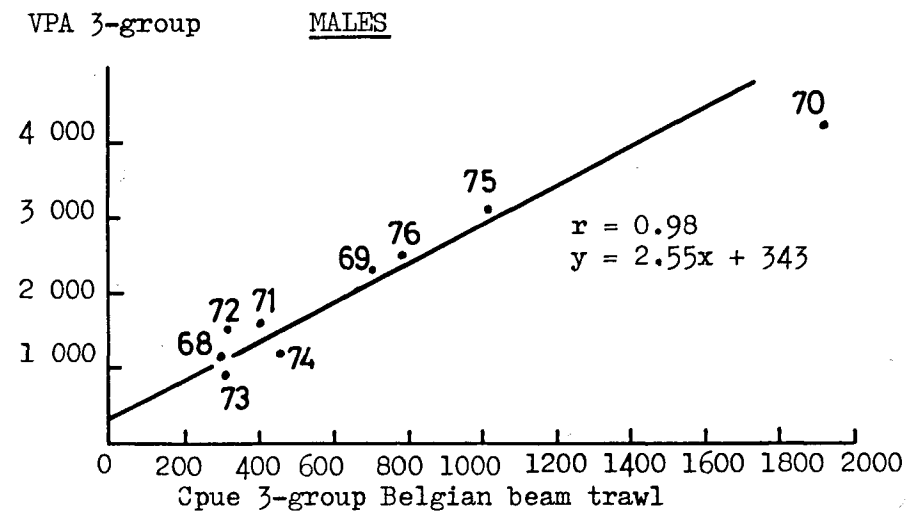
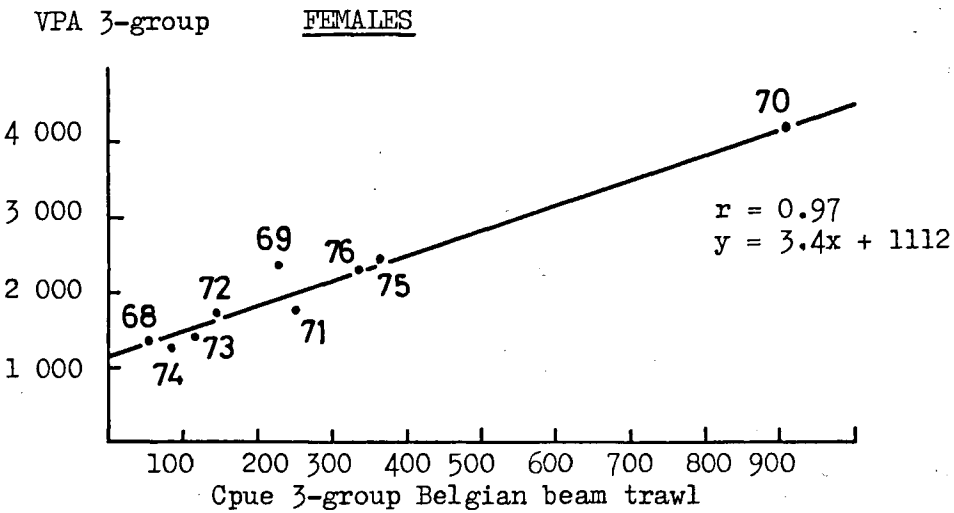


Figure 7.2. Celtic Sea SOLE (Divisions VIIf and VIIg).
Geometric mean regression of VPA estimates and catches of recruiting year classes per unit of effort in the Belgian beam trawl fishery.









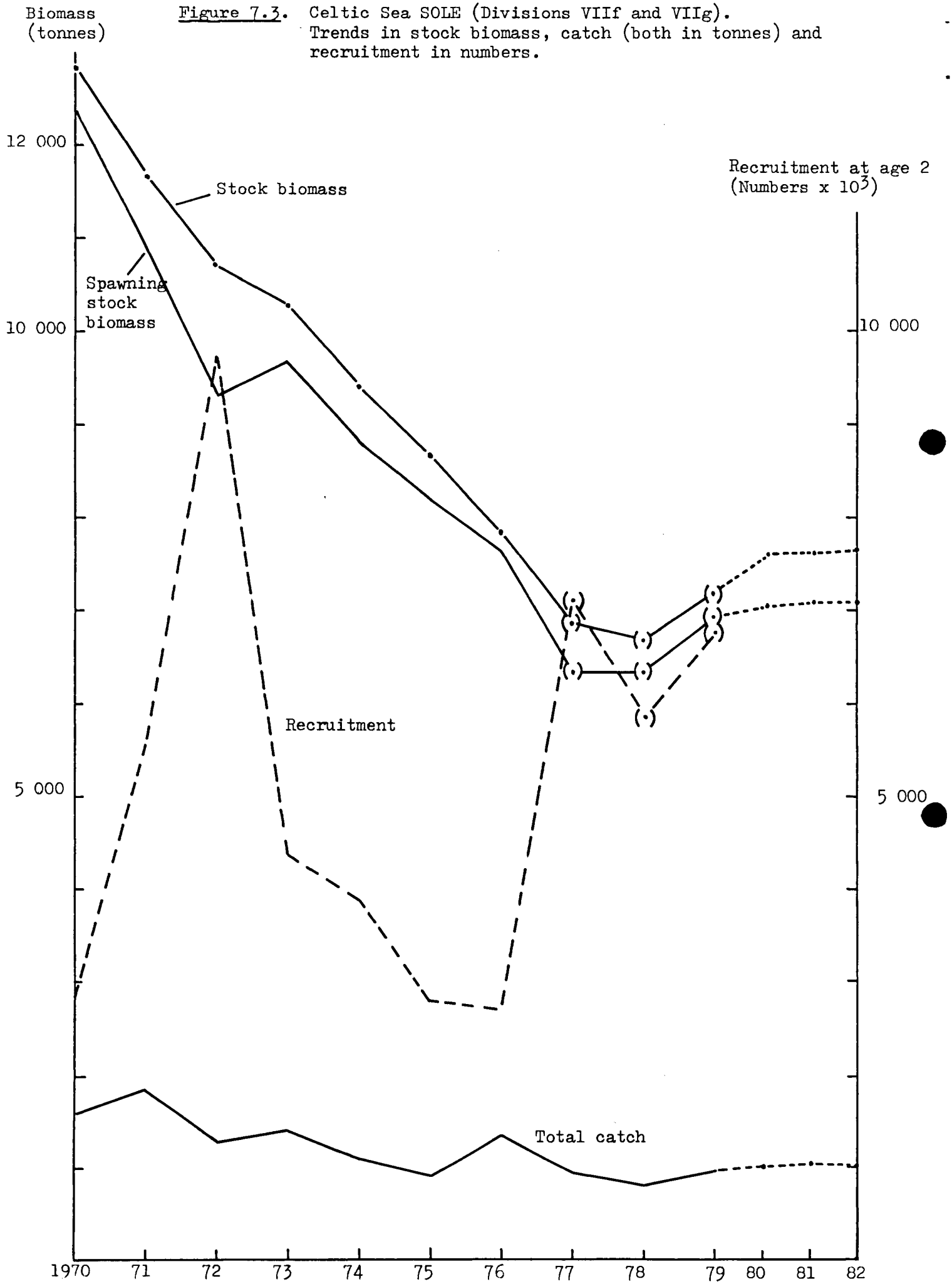
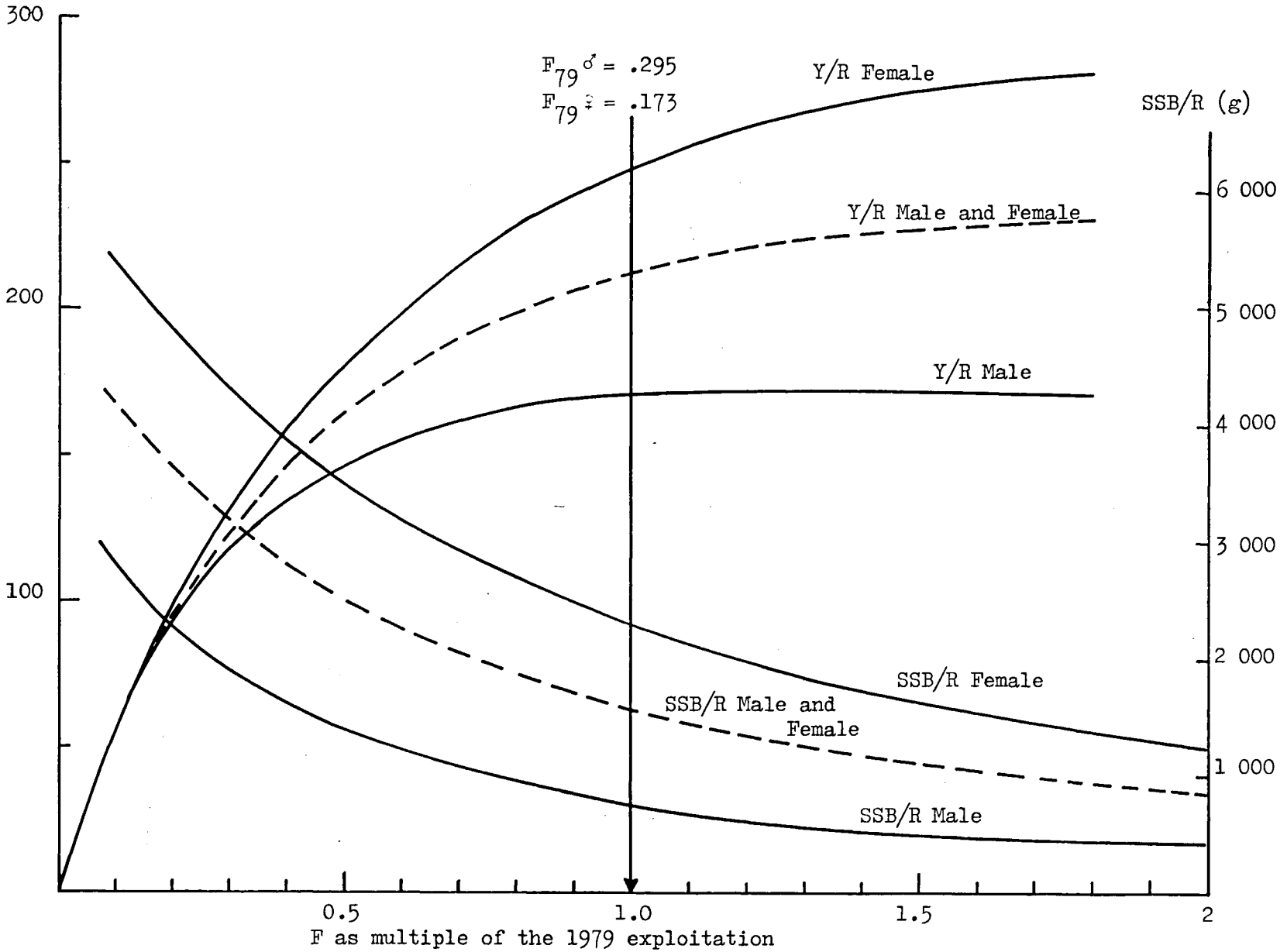


Figure 7.3. Celtic Sea SOLE (Divisions VIIf and VIIg). Trends in stock biomass, catch (both in tonnes) and recruitment in numbers.

Figure 7.4. Celtic Sea SOLE (Divisions VIIf and VIIg).
Yield per recruit and spawning stock per recruit curves conditional on the 1979 exploitation pattern.



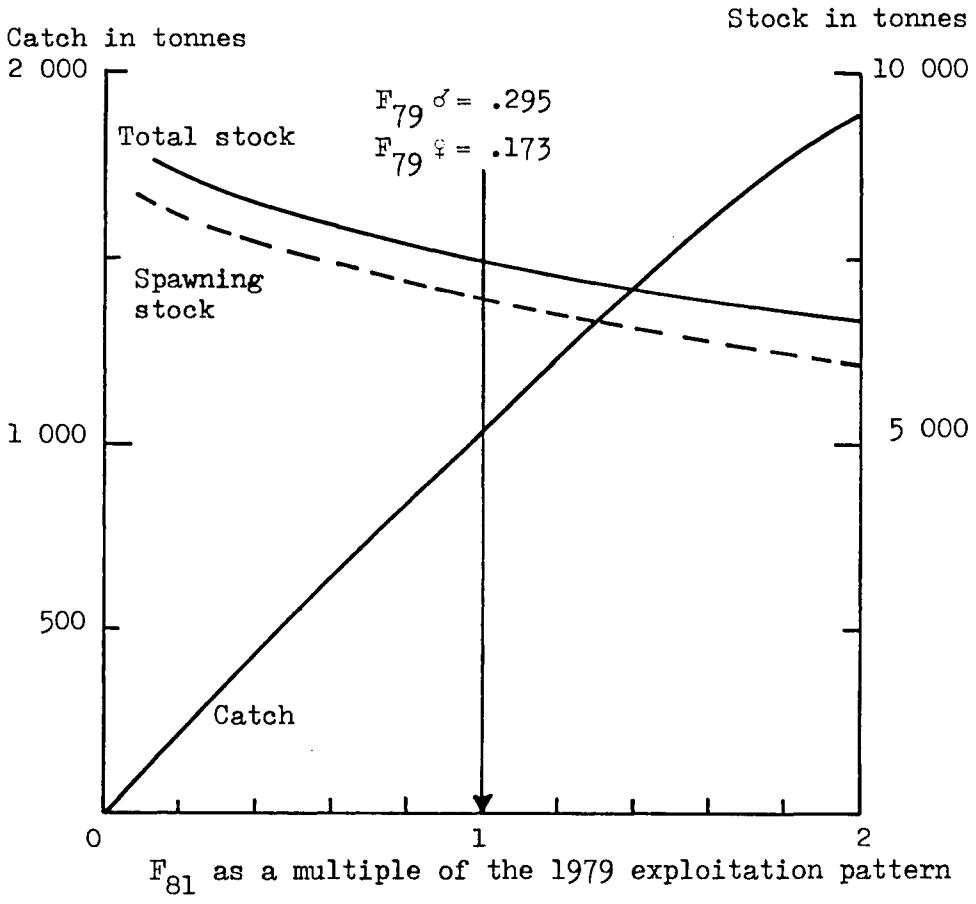


Figure 7.5. Celtic Sea SOLE (Divisions VIIf and VIIg). Catch forecasts for 1981 and resulting stock biomass in 1982 for a range of fishing mortalities in 1981.

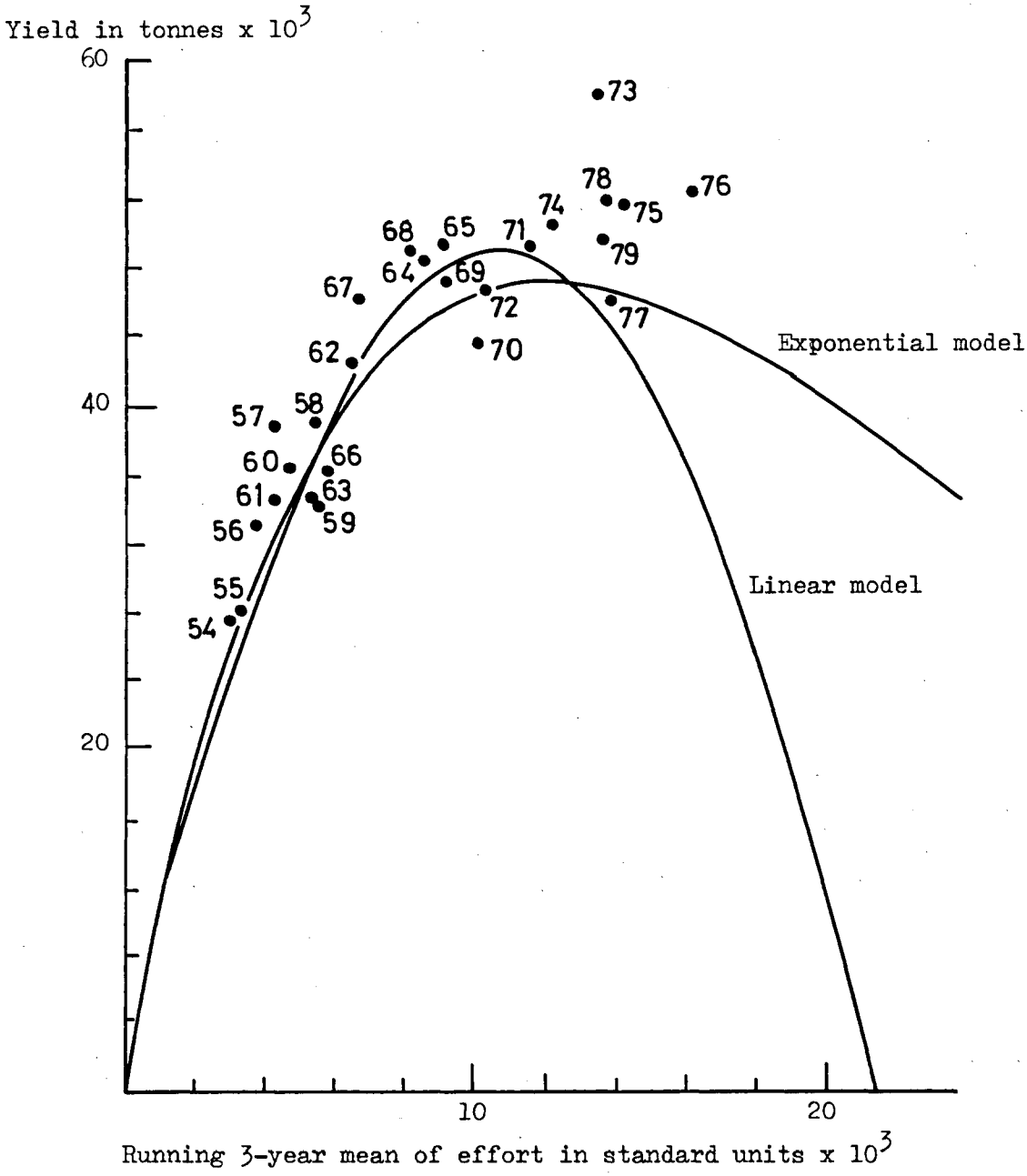


Figure 10.1. Total demersal yield curves for the Irish Sea and Bristol Channel.

N.B. The points shown are annual values. They are not running 3-year means of effort; the caption on the x axis refers to the lines.

APPENDIX: COD RECRUITMENT

by

K M Brander

The available data on spawning stock biomass and number of recruits from the 1979 Working Group report are given in Appendix Table 1 and plotted in Appendix Figure 1. Over the nine-year period covered, the highest recruitment occurred at the lowest spawning stock biomass (in 1970) and the lowest recruitment coincided with highest biomass (in 1973), which suggests a high degree of overcompensation in the stock/recruit relationship. Three curves have been fitted in Appendix Figure 1 using the equation and method described by Shepherd (in press):

$$R = a\,B/\left\{1 + (B/K)^{\beta}\right\}$$

The value of a (1 400 recruits/tonnes) is the slope of the line drawn to the left of the data points and it represents the maximum level of recruitment in the absence of density dependent effects. Conversely, if the biomass per recruit falls below 714 g (= 1/a) then the stock can no longer replace itself and collapses.

The value of K, the so-called 'carrying capacity' parameter, is derived from the average spawning biomass and average recruitment using the equation

$$K = B^*/\left\{(a\,B^*/R^*) - 1\right\}^{1/\beta}$$

This means that all the curves pass through (B^*, R^*), the joint mean and the subsequent yield curves also have a common point. Although K depends on β, the level of F needed to generate K is independent of β.

The value of β represents the degree of compensation and the effect of choosing three different values of β can be seen in Appendix Figure 1. When $\beta = 1$ the curve produced is the Beverton-Holt asymptotic relationship and as β increases the curve becomes increasingly dome-shaped. The choice of a value for β is largely subjective but of the three values chosen here (1, 2, 5) the highest has the lowest sum of squares (125×10^6, 93×10^6, 90×10^6 respectively). A value of β as high as 5 is however unlikely on theoretical grounds.

The fitting of such a stock/recruit relationship is somewhat arbitrary and is liable to criticism on account of the small quantity of data, particularly at low stock levels, and because of the possibility of other systematic effects being present. For example, the reason for the high stock level in 1973 is of course the good recruitment in 1970 and any factor (e.g. temperature variability, slow environmental change) which causes recruitment to show systematic trends may give the mistaken impression that stock is primarily responsible.

An attempt was made to extend the data series back to 1961 using catch per effort instead of VPA. The data are given in Appendix Table 1 and plotted in Appendix Figure 2. The correlation between year class size from VPA and from cpue (number/100 h of 2 year olds) is very good ($r = 0.92$ for 8 df), but the biomass series do not correlate well, mainly because

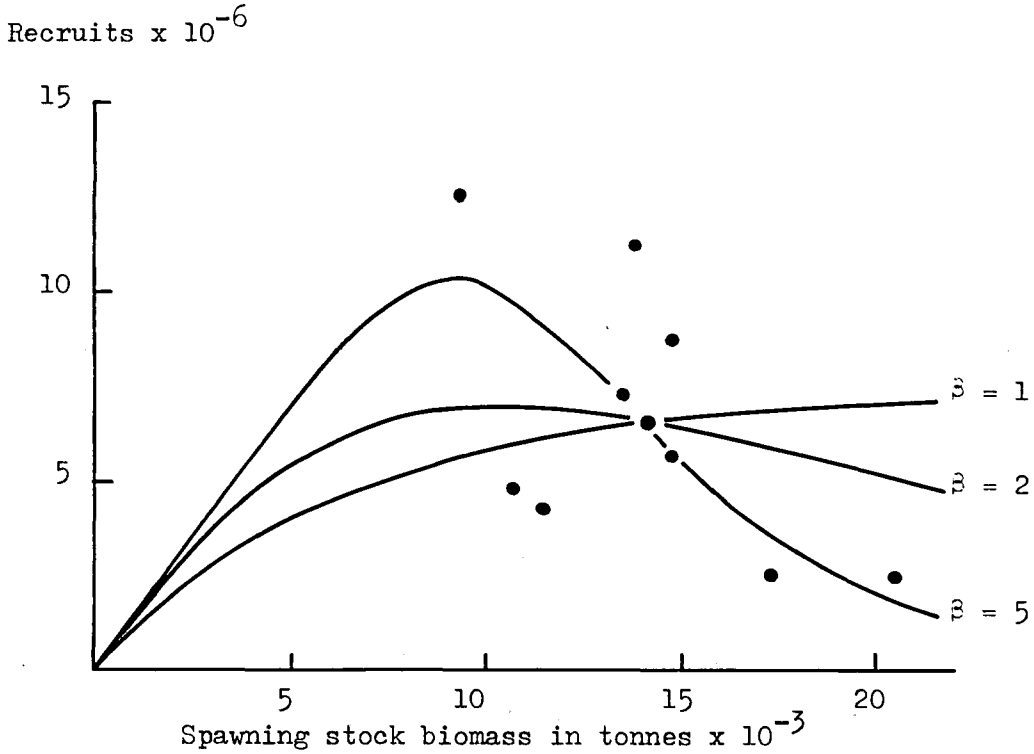
cpue was high in 1968-69 but VPA biomass was not. It is conceivable that cpue is in fact a better indicator of spawning stock biomass than VPA because the cpue data are for the spawning areas during the spawning season only and may therefore more truly reflect the amount of spawning taking place. In any case Appendix Figure 2 shows a relationship between stock and recruitment which is fairly similar to that in Appendix Figure 1. Mean values of recruitment have been calculated for three levels of spawning stock biomass and indicate that recruitment was lower at the low stock levels of 1961-63.

The effect of the three different β values in Appendix Figure 1 on the yield curve is shown in Appendix Figure 3, which also shows the yield per recruit curve multiplied by R^*. This illustrates the enormous effect which the particular shape selected for the stock/recruit relationship may have on the yield curve and hence on the selection of a management objective. Since the available evidence indicates that recruitment may well be higher at intermediate levels of spawning stock, the current management policy of trying to reduce F to 0.5 may be mistaken. On the other hand,recent values of F have approached the level (about 1.4) at which biomass per recruit may fall below the compensation level 357 g = $\frac{1}{2}a$) and should certainly be restrained from going any higher. Even if one accepts the curve for $\beta = 5$, which gives MSY for an F value of 1.8, the population should not be exploited above an F of 1.4 because of loss of resilience and the increased likelihood of stock collapse. The 'compensation F' value of 1.4 is independent of β and therefore fixed whichever shape one chooses for the curve, but it does depend on the slope of a, which is also somewhat arbitrary. The compensation stock biomass also depends on β and has the values 7 026 tonnes, 9 932 tonnes and 12 220 tonnes for $\beta = 1$, 2 and 5 respectively.

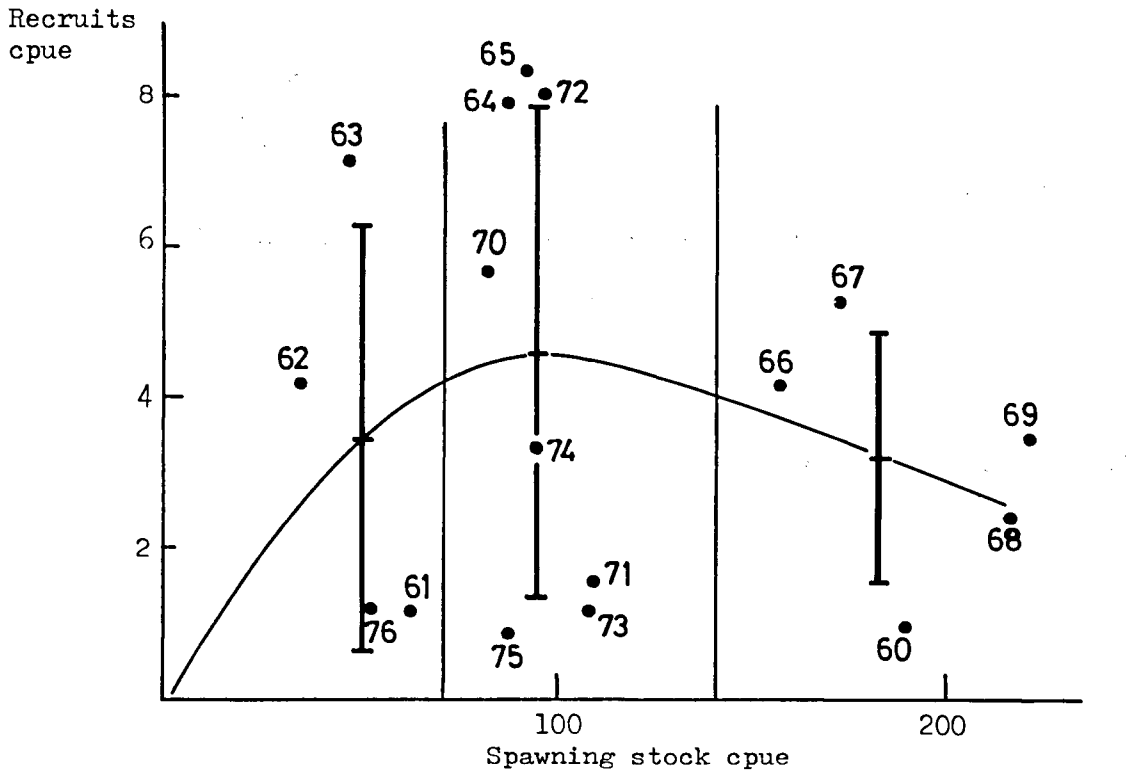
If, as appears possible, the Irish Sea cod do indeed show some degree of overcompensation (i.e. lower recruitment at high stock levels) it is interesting to speculate on the cause of this phenomenon, since extensive sampling of their feeding habits shows no evidence of cannibalism at all.

Appendix Table 1. Irish Sea cod: spawning stock biomass and recruitment.

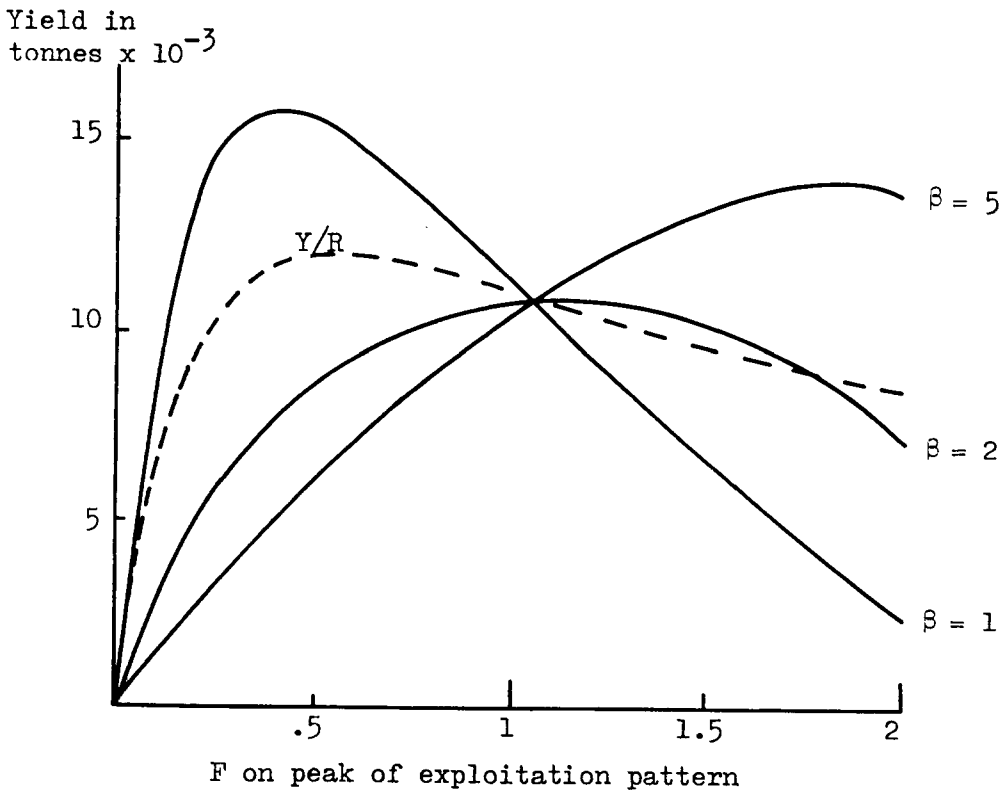
Year	VPA data		Fleetwood catch per effort	
	Spawning biomass tonnes	No. of 1-year-olds x 10^{-3}	Spawning biomass	2-year-old cpue
1960			190	91
1961			62	117
1962			34	419
1963			47	710
1964			88	790
1965			92	833
1966			157	417
1967			173	521
1968	14 844	5 599	217	237
1969	13 666	7 232	221	341
1970	9 289	12 547	82	560
1971	11 459	4 175	109	149
1972	13 801	11 250	96	800
1973	20 539	2 499	109	113
1974	14 765	8 686	94	329
1975	17 300	2 573	87	85
1976	10 699	4 443	52	121
1977			62	
1978			77	
Mean	14 040	6 556		



Appendix Figure 1. Cod stock-recruit data from 1979 report (year classes 1968-76).



Appendix Figure 2. Cod stock-recruit data from catch per effort (year classes 1960-76).



Appendix Figure 3. Cod yield curves