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

International Council for the
Exploration of the Sea

https://doi.org/10.17895/ices.pub.9402

C.M.1978/G:6

Demersal Fish Committee

REPORT OF THE IRISH SEA AND BRISTOL CHANNEL WORKING GROUP

Lowestoft, 13 - 17 March 1978

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

x) General Secretary,
ICES,
Charlottenlund Slot,
DK-2920 Charlottenlund,
Denmark

LIST OF CONTENTS

List of Contents (ctd) Page

REPORT OF THE IRISH SEA AND BRISTOL CHANNEL WORKING GROUP

1.0 INTRODUCTION

1.1 The Working Group met at Lowestoft, UK, from 13-17 March with the following terms of reference (C. Res. 1977/2:8):

> "In view of the importance of making assessments so as to take account of interaction between fisheries, a Working Group, to be called 'The Irish Sea and Bristol Channel Working Group' to be convened by Mr David de G Griffith, should meet for 5 days at Lowestoft to assess TACs for cod, haddock, whiting, plaice and sole in Divisions VIIa and VIIf. The Working Group should also identify and specify in detail shortcomings and gaps in data required for stock assessment purposes."

1.2 In December 1977, the Chairman of the Advisory Committee on Fishery Management asked the Working Group to examine the applicability of mesh assessments (based on North Sea data) to other parts of NEAFC Region 2, and also to make recommendations on minimum landing sizes. This was in response to the following request from the EEC (Director General of Fisheries) to ICES.

> "This year the Liaison Committee report recommended an increase in mesh size in Region II. Mesh assessments have been carried out for North Sea species, but not as far as we are aware for ICES sub-areas VI, VII and VIII. In view of the questions raised by special interest groups in these areas we think it would be useful to extend the mesh assessment work to these areas. Furthermore the North Sea Roundfish mesh assessments suffer from certain difficulties with regard to the distinction between catch and landings and over the fact that the two different methods used were not necessarily giving the same results. It would also be useful to have a firm proposal on minimum landing sizes in relation to the proposed mesh changes (perhaps on the basis of adopting the 90% retention length) and a judgement about whether gill nets and purse seines should be included in mesh proposals."

1.3 Participation was as follows:

K M Brander	UK (England)
R De Clerck	Belgium
D de G Griffith	Ireland (Chairman)
J Gueguen	France
J P Hillis	Ireland
H T Hutley	UK (Northern Ireland)
M Sissenwine	USA
J F de Veen	Netherlands

2.0 IRISH SEA COD

2.1 Catch trends

The catch of cod in 1977 fell to 7994 tons (provisional figure) from 10,247 in 1976 (Table 2.1). This is the lowest level since 1970 and appears to have been due to both a fall in catch rate (shown by French and UK statistics) and possibly a slight decline in the fishing effort on cod, at least by Ireland.

2.2 Age composition of the catch

The international age composition is shown in Table 2.2. For the years up to but not including 1974 the data are taken from the 1977 Report of the North Sea Roundfish Working Group (CM 1977/F:8). For the 1974-76 the numbers have been adjusted to the new catch data reported. For 1977 the method was as follows:

i UK numbers at age were available.

ii French quarterly length distributions were converted to age distributions using UK age/length keys.

iii The Irish age distributions were raised to include the Northern Irish catch.

iv The sum of all of these, which make up the bulk of the catch, were raised to the total international catch.

By catch, discards, and industrial landings, which are all one-year-old or younger, were not included in the VPA.

2.3 Recruitment

A plot of the relationship between UK catch per effort of one-year-old cod in the fourth quarter and the latest VPA values of one-year-old numbers is given in Figure 2.1 (for the method see Brander, 1975). As predicted by this relationship, the 1975 yearclass is below average, but the 1976 yearclass should be average. The 1977 and 78 yearclasses have also been assumed to be average (6.8×10^6 one-year-olds) and the effect of this assumption on the forecast will be examined later. There are no marked trends in recruitment and the spawning stock biomass is high.

2.4 Weight at age

Values of weight at age are given in Table 2.2 and are the same as those used last year. The sum of products of numbers in the catch in 1977 and weight at age is within 1% of the actual catch and the check for 1975 and 1976 is also very close. For years prior to 1975 the sum of products is considerably higher than the actual weight and this is because the data were raised from the UK catch only, in which weight at age is lower.

2.5 Mortality

The value of natural mortality used was 0.2. The terminal F used was the mean of the VPA values for 1968-74. This was judged to be reasonable because it gave slightly lower F values on the abundant ages (2- and 3-year-olds) than in 1977 and a slight drop in biomass, such as might be expected from the decline in catch per effort and effort. These terminal F values also give estimates of the 1975 and 1976 yearclasses which are consistent with the values expected from Figure 2.2. The results of the VPA are shown in Tables 2.3 and 2.4.

2.6 Catch forecast for 1979

The catch forecast for 1979, assuming no change in the fishing mortality and exploitation pattern in 1978 (ie no increase in mesh size) is shown in Table 2.5. If the fishing mortality and exploitation pattern are unchanged then the catch will be 8636 tons, but almost half of this is accounted for by the two yearclasses (1977 and 1978) for which we have assumed average recruitment. The relationship between F in 1979, the catch in 1979 and the total stock biomass at the beginning of 1980 is given in Figure 2.2. Figures 2.3 shows the trends in catch and stock biomass since 1968 and the projected figures.

2.7 Yield per recruit

The yield per recruit curve, conditional on the present exploitation pattern, is shown in Figure 2.4. It has a peak at a level of F which is about 50% of the present level, and although the increase in yield per recruit from going down to this level is only 9%, there would be a consequent increase in total stock biomass of about 85%. Greater improvements in yield could probably be obtained by reducing the mortality on pre-recruit cod in the small-mesh fisheries and by reducing the mortality on one-year-old cod. The 1975 yearclass in particular appears to have suffered very heavy mortality as one year olds in the Irish fishery. An increase in mesh size to 80 mm single twine (90 mm double) would have little effect since even the larger mesh size only just raises the mean selection length above the present 30 cm minimum landing size regulation. It may be necessary to consider restricting the directed fisheries for codling during the latter part of the year, but the Working Group did not have time to consider this option in detail.

2.8 Evaluation of options

2.8.1 The spawning stock biomass is in a healthy state (see Figure 2.3) and likely to remain so if fishing mortality does not rise. Although the pre-recruit cod are being overfished in the sense that they form part of the by-catch in the small mesh fisheries there is no evidence of so-called "recruit overfishing".

2.8.2 Although the yield per recruit curve indicates some benefit to be gained from reducing F to the level needed for conditional MYR, the corresponding increase in yield per recruit is small. Continuing with the present level of F would therefore seem a reasonable course of action and this would give a catch of 8,636 tons in 1979. THE WORKING GROUP THEREFORE RECOMMENDS A TAC OF 8,600 TONS IN 1979.

2.8.3 Since these values depend heavily on the size of incoming yearclasses it may be possible to allow a higher TAC if recruitment is good. On the other hand if recruitment is poor then the catch should fall in any case, provided the fishing mortality is not allowed to rise (ie effort restriction or second tier quota in force).

3.0 IRISH SEA WHITING

3.1 Catch trends

The revised figures of international landings in the last decade are given in Table 3.1 taking into account the latest national amendments. After the minimum of 6,900 t in 1970, annual landings have not shown marked trend: they fluctuated between 8,700 and 12,100 t. France, Ireland and Northern Ireland accounted for about 88% of the total and the share of Ireland alone represents more than 40%. In the last few years the part taken for industrial purposes tended to decline from more than 2,000 t in the early seventies to 760 t in 1977 (Table 3.1, part B).

3.2 Input data for stock assessment

Age composition of catches was available for the period 1969-1977 for England and Wales. France provided length distributions for the last 5 years; these were converted into age distributions by using English age/length keys for the corresponding years. Irish data concerning catches for human consumption were also presented for 1976 and 1977. In order to run a VPA, the age structure for the 4 earlier years was reconstructed for each age group separately by multiplying the summed numbers for France, England and Wales by the mean factor $N_{I + NI}/N_{EW + F}$ for 1976 and 1977 (where $N_{I + NI}$ represents the number at age in Irish and Northern Irish catches and $N_{EW + F}$ the number at age in English, Welsh and French catches). The values of this factor were as follows:

Age group:	1	8.241
	2	2.004
	3	1.739
	4	1.215
	5	0.485
	6	0.235

(Irish samples contained no fish older than 6).

The total numbers were adjusted so that the sum of products of number x weight at age corresponded to the total weight landed. In this way allowance could be made for the younger age structure of Irish catches whilst any yearclass dominance present in the English, Welsh and French data was preserved. Information about the numbers of whiting caught in the Irish industrial fishery is given in section 10.1.

3.3 Mean weight at age

Mean weight at age for English data was calculated by use of the parameters given in the 1973 Whiting Working Group Report (CM 1973/F:2). For Irish data the mean of values obtained from length-weight relationships at different seasons in 1976 was used. The overall weight at age values were a mean of Irish data weighted by the numbers of fish at each age landed in Ireland and Northern Ireland, and English data weighted by the rest of the catch (see Table 3.2).

3.4 Virtual population analysis

The stock value of M used was 0.2.

Terminal values of F for 1977 were derived from a hand-smoothed plot of the means 1972-1974. For age group 9 they were based on a mean of values for age groups 8 and 7 during 1972-74.

The exploitation pattern appeared to involve Irish boats in a concentrated fishery on whiting mainly of groups, 1, 2 and 3, whereas French catches showed an older age composition and that for English/Welsh catches was still older.

The exploitation pattern appeared to have little trend with time, weighted mean F values oscillating between 0.95 and 1.25. The exploitation pattern, averaged over the period 1972-74, showed that the greatest levels of F fell on the 3-year-old and 7-year-old fish.

3.5 Prognosis

To predict catches in 1979, parameters used for 1977 were applied unchanged to 1978. Recruitment of numbers of age one-year-old fish was taken to be 60×10^6.

The 1979 catch was predicted using values of F differing from those of 1977 by factors of from 0.5 to 2.0. The resulting values are shown in Table 3.5. Predictions for 1978 and 1979 are strongly influenced by the unusual strength of the 1976 yearclass as judged from the 1977 catch by one-year-olds, which should make the catch increase in both 1978 and 1979 at unchanged rate of exploitation. The biomass at the end of the year should rise from 17,500 tons in 1976 to 22,535 tons in 1977 and

23,065 in 1978 but should fall to 20,492 tons in 1979. A reduction of F in 1979 to 0.9 of the 1977 value would maintain the catch at its 1977 level and the close of year biomass would be slightly higher. Such a reduction in F values would transfer the benefit of the 1976 yearclass from the 1979 catch to the spawning stock, but of course the 1977 and 1978 yearclasses (which are expected to contribute about 40% of the 1979 catch) are of unknown size.

In view of the uncertainty which also surrounds the size of the 1976 yearclass, the Working Group felt unable to recommend a TAC based on the foregoing VPA and prognosis. A TAC of 10,000 tons for the human consumption fishery is therefore recommended for 1979, which is close to the annual catch levels of recent years.

4.0 IRISH SEA PLAICE

4.1 Catch trends

At 2,840 tons the 1977 catch was approximately 600 tons (18%) down in comparison with the 1976 catch of 3,467 tons (Table 4.1), thus continuing the gradual decline from 4,000 tons in 1975. Five-year averages are:

1963-67	3,537
1968-72	4,405
1973-77	3,829

The total 1977 catch thus amounts to only 68% of the TAC of 4,150 tons. None of the five participating countries (except the Netherlands) reached their 1977 quota.

4.2 Age compositions and mean weight at age

The age distribution of the 1976 landings were adjusted to agree with the updated landing figures for that year.

Age distributions for 1977 were available from Ireland, England/Wales and Belgium, accounting for 85% of the total landings. Irish age distributions were raised to the sum of Irish and Northern Irish landings, English data to the sum of the landings in England, Wales and Scotland, and Belgian age distributions to the sum of Belgian, French and Dutch landings. This procedure follows that of the 1977 North Sea Flatfish Working Group Report (CM 1977/F:5). The age compositions of the total landings for the period 1964-77 are shown in Tables 4.2 and 4.5 for males and females respectively, together with mean weights-at-age for fish in the catch (1 July) and in the stock (1 January).

4.3 Virtual population analysis

In the opinion of the Working Group (see section 6), a significant decrease in fishing effort occurred in the Irish Sea in 1977. Input Fs were calculated so as to take account of the general decrease in effort, and to show a 20% decrease compared with the mean 1976 level of F on the fully recruited age groups. The VPA output is reproduced in Tables 4.2 to 4.7; M = 0.15 for males and 0.1 for females. Mean weights at age are the same as those used in the 1977 assessment (CM 1977/F:5).

Recruitment as one-year-old fish has fluctuated about a mean of 7.0 x 10^6 for males and 9.5 x 10^6 for females during the years 1967 to 1977.

4.4 Yield per recruit curves

Conditional Y/R curves were calculated using the mean weights-at-age given in Tables 4.2 and 4.5. These indicated that the 1977 levels of F (1.02 for males and 0.82 for females) exceeded F_{max} by a factor of 1.7 for males and 3.3 for females.

4.5 Total allowable catch

Catch levels in 1979, and stock biomass at 1 January 1980, were calculated for a range of Fs. The results are shown in Figure 4.1.

Maintaining the 1977 level of F through 1978 and 1979, and assuming average recruitment, will give a total catch of 3,300 tons in 1979. A reduction of F to F_{max} in 1979 (0.6 for males and 0.2 for females) would correspond to a total catch of 1,480 tons in that year (a decrease of 55%).

Since there is no evidence to suggest that the stock is in need of such radical conservation measures, the Working Group RECOMMENDS A TAC in 1979 OF 3,000 TONS.

5.0 BRISTOL CHANNEL PLAICE

5.1 Catch trends

The 1977 catch (316 tons) was at the same level as that of 1976 (Table 5.1). Thus only half the TAC of 640 tons was taken in either year.

5.2 Age composition and mean weight at age

Belgian and UK age distributions (accounting for 65% of the total catch) were raised to the total international catch (Belgium, France and UK). The weights at age for fish in the catch (1 July) were the same as those used in the 1977 assessment; these weights and the weights at age of fish in the stock (1 January) are shown in Tables 5.2 and 5.5.

5.3 Virtual population analysis

Input Fs used were the means for the period 1970-74, calculated from trial VPAs. This gave an F on the recruiting age group (2-year-olds) of .03 (males) and .01 (females) in 1977, which implied a numerical strength of this yearclass one order of magnitude higher than the mean annual recruitment since 1970. By increasing the 1977 level of fishing mortality on 2-year-olds to 0.2 for males and 0.15 for females, the recruitment in that year was calculated as 1.0×10^6 males and 1.6×10^6 females, about twice the 1970-74 mean. Throughout the period, mean F on the fully exploited age groups has fluctuated without trend. The VPA outputs are shown in Tables 5.2 to 5.7; M = 0.15 for males and 0.1 for females.

5.4 Prognosis

Maintaining the 1977 level of F through 1978 and 1979 should give total catches of 620 tons and 840 tons respectively. These yields, and the increased catch rates which they imply, are based on the strong 1975 yearclass.

In Y/R terms, however, the current level of F on females (0.69) exceeds F_{max} by a factor of two. The male Y/R curve is flat-topped.

The Working Group recommends that advantage should be taken of the 1975 yearclass, and that THE TAC FOR 1979 SHOULD BE 600 TONS.

6.0 IRISH SEA SOLE

6.1 Catch trends

The total 1977 catch was 1,163 tons (preliminary figure) which was considerably lower than the 1975 and 1976 levels and also lower than the 1977 TAC of 1,670 tons. With the low 1977 catch rates, effort would have had to increase for the TAC to be met, and this did not occur. In the case of the Belgian fishery, part of the potential effort was diverted to the North Sea where catch rates of sole in 1977 were higher than expected. The mean horse-power of the Belgian fleet in the Irish Sea was lower in 1977 than in previous years, and catch rates were also somewhat reduced (see Table 6.2).

6.2 Age composition

The international age composition of the catch was calculated by raising the data from Belgium, Holland and the UK (accounting for 86% of the total catch) to 100%. The age distributions of 1974 and 1976 were amended to include the Dutch 1974 and adjusted 1976 age distribution. Tables 6.3 and 6.7 give the total age composition by sexes. The Belgian and Dutch fishery was mainly concentrated in the second quarter.

6.3 Virtual population analysis

A VPA was carried out on the catch figures for the years 1970-77 and the results of this analysis are given in Tables 6.3 to 6.8.

In the 1977 Report of the North Sea Flatfish Working Group (CM 1977/F:5), a TAC of 1,380 tons for 1978 was recommended assuming that the 1977 catch would be equal to the 1976 catch of 1,463 tons. This would have given an F value close to the optimum in the yield per recruit curves.

The fact that the actual 1977 catch of 1,163 tons was 20% lower than the expected catch of 1,449 tons implies that a reduction in effort had taken place for reasons explained under catch trends. Thus the terminal F values for the new VPA are those used in the 1977 assessment (CM 1977/F:5), lowered by 20%. A natural mortality rate of 0.10 was taken for both sexes.

The catch data show that in 1977 a yearclass (1975) of about the strength of the good 1971 yearclass recruited to the fishery. Together with the remainder of the 1969, 1967, 1966 and 1964 yearclasses. this makes the stock less dependent on a few yearclasses than are other sole stocks.

6.4 Prognosis

Recruitment was taken as the average value of the two-year-old soles in the VPA and amounted to 3.9×10^6 males and 4.2×10^6 females.

For 1978 a TAC of 1,380 tons has been recommended, although at present no TAC has been adopted. The Working Group therefore had to consider which catch level is likely to be achieved in 1978. It is plausible to assume that the effort level in 1977 will be maintained, together with the 1977 exploitation pattern. A prognosis was carried out starting with the calculated stock for 1977 and the exploitation pattern as given by the terminal F array in the VPA. The weight-at-age data are given for catch and stock in Tables 6.3 and 6.6. Table 6.9 summarizes the results of this prognosis. The expected catch for 1978 will be 1,200 tons, a rise of 7½% over the 1977 level. This is the result of the good 1975 yearclass being fully exploited, giving a rise of 4.3% in the stock biomass and 21.9% in the spawning stock biomass. For 1979 Table 6.9 gives an array of possible fishery strategies also shown in Figure 6.1. An obvious choice is to assume fishing effort in 1979 will remain constant, which will result in a catch of 1,370 tons. This is a rise of 14% over the expected 1978 level. Predicted stock biomass and spawning stock biomass will both increase 3% over their 1978 values.

Conditional yield per recruit curves are shown in Figure 6.2, in which the position of current levels of F are indicated.

It is necessary to stabilize the present situation and keep F constant, at the same time letting total stock and spawning stock increase. Thus the catch figure of 1,370 tons expected in 1979 for an unchanged exploitation pattern should be taken to the TAC. A rounded figure of 1,400 TONS IS RECOMMENDED AS THE TAC FOR 1979.

7.0 BRISTOL CHANNEL SOLE

7.1 Catch trends

The total catch in 1977 dropped substantially from the 1975-76 level to 352 tons. Only 50% of the TAC set for 1977 was fished. The reason for this drop is a decrease in effort of 10,000 h fishing of all gears of the Belgian fleet catching about 70% of the total catch, owing to the better than expected catch-rate in the North Sea sole fishery.

The catch-rate of the Belgian beam trawlers (see Table 7.2) declined as compared with the 1976 situation. However, considering the whole period 1971-77 no definite trend can be observed.

7.2 Age composition

The international catch at age data are given in Tables 7.3 and 7.6. For 1977 the Belgian and English data were available covering 97% of the international catch and were raised to the total catch.

7.3 Virtual population analysis

The international age composition was processed by a VPA using natural mortality of .10 for both sexes.

The 1977 assessment recommended a TAC of 670 tons for 1978 assuming constant effort and an expected 1977 catch of 520 tons. The actual catch in 1977 turned out to be 352 tons, being 62% of the expected catch. For this reason the terminal F values used in last year's VPA has been lowered by 38% for the new VPA. The results of this VPA are shown in Tables 7.3 and 7.8. The decline in stock observed since 1970 has levelled off in 1977.

Judging by the catch of 2-year-olds in 1977, the 1975 yearclass appears to be about the same strength as the 1970 yearclass which was the highest on record.

7.4 Prognosis

An average recruitment of 1.1 x 10^6 males and 0.9 x 10^6 females was calculated from the VPA stock sizes of the 2-year-old soles. It is not likely that effort in 1978 will increase to the 1976 level and it may be assumed that with the present situation in the North Sea sole fishery, fishing effort in the Bristol Channel will remain constant.

A prognosis was carried out based on the stock composition in 1977 and using the terminal F values in the present VPA. Tables 7.3 and 7.6 give the weight at age data for catch and stock. These are based on revised Belgian data for the period 1970-77 and are whole weights. The results of this prognosis are given in Table 7.9 and shown in Figure 7.1. The expected catch for 1978 will be 350 tons being the same as the observed 1977 catch. The recruitment of the good 1975 yearclass will put an end to the gradual decline in stock level which began in 1970 (as indicated by VPA).

Table 7.9 gives an array of fishery strategies. If fishing effort does not change, a catch of 372 tons will be achieved in 1979, accompanied by a slight increase (2.5%) in the spawning stock biomass.

The present maximum F level is below the maximum on the conditional yield per recruit curve given in Figure 7.2 for both sexes. A slight increase in the allowable catch will bring the fishery somewhat closer to F_{max}. For that reason A TAC FOR 1979 of 400 TONS IS RECOMMENDED, but the Working Group draws attention to the reservations expressed in section 13.0 about the area basis for this assessment.

8.0 HADDOCK

Although the recommendation of a TAC for haddock was included in the Working Group's terms of reference, no data were available to enable this to be done. The group included haddock in the total demersal production discussed in section 10 of this report.

9.0 MINIMUM MESH SIZES

Constant F at age seldom occurs and the Gulland method could therefore not be used, since the observed F at age relationship should be taken into consideration. The difficulty is that the exploitation pattern is a result of a number of factors such as fleet deployment over the area, varying distribution of the fish with age and the current mesh size.

It is not possible to assess the precise form of the exploitation pattern where the mesh size changes. This uncertainty will increase with larger changes in mesh size.

It is reasonable to expect as a first approximation that an increase in mesh size with the consequence of a shift in the 50% selection age will force the exploitation pattern to move to older ages while conserving its shape at the same time. The amount of the shift can be read off from the length at age curves showing the 50% length for the various mesh sizes considered.

9.1 Irish Sea sole

Figure 9.1 shows the length at age curves for male and female sole and the 50% lengths for the 75 mm, 80 mm and 90 mm mesh for double twine, used in the directed fishery for soles with the beam trawl by Belgium and the Netherlands (see Table 9.1). The selection factor of 3.3 used in the 1974 mesh assessment by the North Sea Flatfish Working Group was adopted.

Figure 9.2 gives the current exploitation pattern for the 75 mm mesh taken from the VPA in section 6.

Figure 9.3 shows the exploitation patterns for the 80 mm and 90 mm mesh for males and females and Table 9.2 gives the corresponding F at age values.

For the mesh assessment a prognosis was carried out based on the stock composition at the beginning of 1977 and using the 75 mm exploitation pattern for 1977 and 1978. Unchanged fishing mortality over the years 1977-1989 has been assumed. The predicted stock composition at the beginning of 1979 was then used together with the exploitation pattern for the 80 mm mesh to predict catch and stock for 1979 and 1980. To conclude, the predicted stock composition at the beginning of 1981 was used with the exploitation pattern for the 90 mm mesh to predict catch and stock for 1981-1989. Table 9.3 and Figure 9.4 give the results of these predictions.

From 1977 to 1978 the catch will increase by 7%. The introduction of the 80 mm mesh size on 1 January 1979 will cause the catch in 1979 to drop by 19%, but in 1980 the catch will increase 15% over the 1979 level and be only 7% less than the 1978 catch.

The introduction of the 90 mm mesh size at the beginning of 1981 would result in a drop of 48%, a heavy immediate loss. In the succeeding years this drop in catch level will diminish and in 1986, five years after the proposed introduction of the 90 mm mesh, the catch will reach the 1980 level again. The long-term gain is negligible.

The stock and the catch-rate will benefit from the mesh increase and will be roughly doubled in 10 years' time, Figure 9.5. However, the severe short-term losses which will not in the long run lead to any gain makes an increase in mesh size to 90 mm unrealistic.

The proposal for Region 2, which is based on North Sea data, is thus not applicable to the Irish Sea sole because of the lower growth rate in the latter area.

9.2 Bristol Channel sole

The same method has been applied as in the Irish Sea sole. Figure 9.6 gives the length at age curves together with the 50% lengths and ages for 75, 80 and 90 mm mesh double twine (Table 9.4).

Figure 9.7 gives the current exploitation pattern for the 75 mm mesh taken from the VPA in section 6.3.

Figure 9.8 gives the exploitation pattern for the 80 mm and 90 mm mesh for males and females and Table 9.5 gives the corresponding F at age arrays. Again, unchanged fishing mortality has been applied and, as in the case of the Irish Sea sole, catch and stock was predicted for 1977-89 for an increase in mesh size to 80 mm in 1979 and 1980 and to 90 mm from 1981 onwards.

Table 9.6 and Figure 9.9 and 9.10 give the results of this prognosis. The catch will decline from 1977 to 1978 (see section 7.4) and the introduction of the 80 mm mesh in 1979 would reduce catches in 1979 by a further 9%. The 1980 catch will increase by 5% over the preceding year's catch, but the introduction of the 90 mm mesh would lead to a 29% drop in the catch in 1981. The catch will then rise and reach the 1977 level in 1985, four years after the introduction of the 90 mm mesh (Figure 9.9). The catch will then continue to rise and will in 1989 be 87% higher than the 1981 catch.

Short-term losses would be less severe than in the Irish Sea sole and the long-term gains will exceed the short-term losses considerably. Stock biomass will increase by some 40% (Figure 9.10).

Contrary to the situation in the Irish Sea sole an increase in mesh size to 90 mm would be beneficial both to the long-term catch and stock situation. This is because the growth rate in the Bristol Channel resembles that of the North Sea.

9.3 Whiting

Gulland's method was used to estimate the influence of an increase in the mesh size to 90 mm (double). The worksheet is reproduced in Table 9.7. Using the mean age distribution of the international catch over the period 1973-77 and the length/weight/age relationship used in the VPA, it was calculated that an increase in mesh size from 70 mm single twine to 90 mm double twine would result in a short-term loss of 36%. The calculation used the selectivity data from Table 26 of the 1974 Report of the North Sea Roundfish Working Group (CM 1974/F:5) which had consolidated the data presented in the 1969 ICES Co-operative Research Report. These data were based on nets of double synthetic twine, and agreed closely with the results of Hillis (1968) for the Irish whiting fishery.

The mesh assessment indicates that no long-term gain would accrue in the Irish Sea if the proposed increase to 90 mm double (80 mm single) were implemented. The reason for this difference from the North Sea mesh assessment is the lower growth rate of Irish Sea whiting.

This assessment takes account of only the human consumption fishery, but the small-mesh fisheries are discussed in section 10 of this report.

10.0 SMALL MESH FISHERIES IN THE IRISH SEA AND THEIR EFFECTS ON WHITEFISH FOR HUMAN CONSUMPTION

The Irish Sea has traditionally been subject to several fisheries with small mesh nets and these have caused considerable mortality of juvenile whitefish of several species. The 60 mm mesh concession for whiting (within the so-called "whiting box") has been repeated, but three small mesh fisheries still continue.

The industrial fishery landing at Mornington in Ireland.

The Nephrops fishery by Northern Irish, Irish, French and recently English vessels.

The English and Welsh shrimp fishery.

Some data are available on the whitefish by-catches for all three fisheries and an attempt has been made to assess the mortality on juvenile whiting in particular, since that is the species most affected. More routinely collected data are needed on the whitefish by-catches from these small mesh fisheries and also on the discard rates in the large mesh (NEAFC Recommendation 4) fisheries. This would enable a full assessment to be made of the effects of reducing mortality in the small mesh fisheries and of increasing the whitefish mesh size. Nevertheless the data available do allow firm conclusions to be drawn about the relative importance of the two measures currently proposed for regulating the Nephrops fishery, namely an increase in the mesh size to 70 mm and a minimum landing size of 100 mm total length.

10.1 The industrial fishery

The estimated quantities of whitefish species landed as a by-catch in the Irish industrial fishery are given in Table 10.1. The quantities of whiting are comparable to the quantities discarded in the Northern Irish Nephrops fishery and the numbers involved are therefore likely to be of the same order (see rows 2 and 3 of Table 10.2). From the length frequency data it is clear that these are mostly 0-group fish and the bulk are caught during the autumn (Report of the Irish Sea Working Group, ICES CM 1973/F:2).

10.2 The Nephrops fisheries

The quantities of whiting taken as a by-catch in the small mesh Nephrops fisheries are given in Table 10.2. No data were available for Ireland and only 1975 data were available for France. The UK only entered the small mesh fishery in 1977. For Northern Ireland, estimates of the quantity discarded were available and data for 1972 and 1973 enabled an estimate to be made of the numbers of whiting (mainly I and 0-groups) discarded. Even allowing for a fairly high natural mortality on these pre-recruit fish it is clear that the quantities discarded in the Nephrops fishery are comparable to the number recruiting to the human consumption fishery (see Table 3.4). By-catch data for other species show that they are less affected by the Nephrops fishery but more data are needed to carry out an assessment.

The proposed increase in mesh size for Nephrops would have a very beneficial effect on recruitment of whiting as well as giving the benefits for Nephrops which are outlined in the report of the 1977 Nephrops Working Group (ICES CM 1977/K:2). It would also have smaller but noticeable effects on recruitment of other species such as cod. The proposed minimum landing size of 100 mm for Nephrops will not affect whitefish recruitment and its effects on Nephrops have not been assessed. The Working Group therefore recommends that priority should be given to implementing the proposal on the increase in mesh size to 70 mm for Nephrops. The proposal to increase the minimum landing size should be considered elsewhere.

10.3 The shrimp (*Crangon crangon*) fisheries

As in the North Sea, these cause high mortalities on juvenile flatfish, but no estimates are available of the quantities involved, the survival of the rejected by-catch or the effect on flatfish recruitment. Studies directed at this problem have been started and should be encouraged.

It is clear from Table 10.2 that there are considerable gaps in our data on by-catches and discarding and any further data should be made available to allow a full assessment of the small mesh fisheries.

11.0 FISHERY AND BIOLOGICAL INTERACTION RELATIVE TO FISHERIES MANAGEMENT OF THE IRISH SEA AND BRISTOL CHANNEL

Currently fish stocks are assessed and managed in isolation. Fisheries for each stock interact with other fisheries and stocks as follows:

i Fishing effort necessary to capture any particular species also generates fishing mortality on other species (fishery interaction).

ii The three factors that determine surplus yield of stock (recruitment, growth and natural mortality) are all potentially affected by competition and/or predation-prey interactions with other stocks (biological interactions).

11.1 Fishery interactions

Fishing effort should be categorized as directed toward specific species or non-directed (mixed) for each country. The long-term goal should be to determine the specific fishing mortality generated for each species by a unit of fishing effort of each category. With this information, for a desired catch or fishing mortality for each species, the optimum set of national TACs by species could be determined. It is unlikely that such a task will be completed in the near future, but numerous useful intermediate results may stem from a rigorous consideration of non-directed fishing mortality in the Irish Sea and Bristol Channel.

11.2 Biological interactions

Two approaches to multispecies research and management should be considered. Production by individual populations can be modelled empirically, based on observed fluctuations in production and abundance of potentially interacting species and environmental factors. Such models may have predictive values useful for management purposes, but generally empirical models should be tested on a set of data not used to fit the model parameters and the model structure should be supported by biological evidence of the existence of interactions.

Another approach is the development of process oriented multispecies models. Such models relate production of each species to a mass or energy balance equation: assimilated consumption equals growth plus metabolism plus reproductive material. It will be many years before such models have adequate predictive ability to be used directly in fisheries management, but programs designed to collect some of the data necessary for process oriented models may provide immediate biological support for empirical models. The general data requirements for process-oriented models are already well known, but the Working Group did not have time to specify in sufficient detail either the subjects to be included or the design of the systems to collect this information. The Working Group did, however, compile an agreed revised set of catch data for all species and brought together all available data on nominal fishing effort and factors affecting fishing power.

The simplest approach to multispecies management, is application of a surplus production model (Schaefer 1954, 1957; Pella and Tomlinson 1969; Fox 1970) to a group of species together. This family of models has been widely applied to single species fishery management and recently ICNAF applied such a model to management of the total finfish and squid biomass of the Atlantic continental shelf of the USA north of Cape Hatteras.

Surplus production models relate production in excess of that required to maintain the population at its current level to population biomass. These models are an extremely simplified representation of a biological system. One of the weaknesses of surplus production models is that they ignore age structure. When applied to several species together, they also ignore species composition, but since most variability in production is effected by fluctuations in recruitment and the early life stages of many species may compete together, application of a surplus yield model to several species may be as meaningful as application to a single species. Because of their simplified nature, surplus production models are probably inadequate for predicting the short-term effect of a particular level of fishing, but they may be a useful indicator of long-term potential impact.

12.0 TOTAL DEMERSAL PRODUCTION MODEL

Total demersal production of the Irish Sea and Bristol Channel was modelled by Brander (1977). Fox's (1970) exponential model was fitted to time series of total demersal catch and total units of standardized fishing effort for 1954-1973. Fox's (1970) model assumes that catch per unit of effort declines exponentially as effort increases for a population at equilibrium.

The calculation of standardized fishing effort is described by Brander. The Working Group updated the total demersal production model for three additional years of catch and effort data (1974-1976) and adjusted the total international effort data to take account of the revised total demersal catch data supplied to the Group (Table 12.1). In addition to the exponential model, the Schaefer model was also fitted to the data. For the Schaefer model, a linear relationship between catch per unit of fishing effort and effort is assumed at equilibrium.

In order to approximate observations at equilibrium, three-year running averages of effort were considered (Gulland 1961). The linear and exponential relationships between catch per unit effort and three-year running average of effort are shown in Figure 12.1. The corresponding production models are shown in Figure 12.2. The deviations between observed and predicted points of catch and effort cannot be used to judge the validity of the models since the models indicate the equilibrium catch associated with each level of effort whereas the data points are clearly not representative of the equilibrium situation. On the other hand, the functions plotted in Figures 12.1 and 12.2 should explain most of the variability in the data points to which they were fitted since the application of running averages of effort was intended to correct for non-equilibrium conditions. The correlation coefficients of the linear and exponential models are 0.90 and 0.92 respectively.

Since both models fit the available data almost equally well, both sets of results are considered. According to the linear model, MSY is about 52,000 tons corresponding to 11,200 standard units of effort. For the exponential model, MSY is about 54,000 tons corresponding to 14,000 standard units of effort.

If in fact the exponential model is correct, but effort were restricted to 11,200 units, the equilibrium catch would be 90% of MSY with a 12% higher catch rate than at MSY. On the other hand if 14,000 units of effort is allowed and the linear model were in fact valid, only 82% of MSY would be caught at equilibrium with a 35% lower catch rate than corresponds to MSY. Thus the adverse impact of erroneously accepting the exponential model is more severe than would result from erroneously accepting the linear model. Furthermore, recent work in ICNAF (Doubleday 1976, Sisenwine 1977) and by Beddington and May (1977) indicate that for a system with random fluctuations in production (which is clearly the case), fishing mortality should be restricted below the MSY level in order to reduce variability in population size and catch and in order to avoid severe reductions in biomass that might threaten future productivity. In ICES (Shepherd 1977), some of these conclusions have been challenged, but nevertheless from a conservation point of view, according to the total demersal production model, catch and effort should be limited to 52,000 tons and 11,200 standard units. These levels of catch and effort approximately correspond to the current situation. At the same time most countries have not taken their entire allowable catch of several species. Thus, a total demersal TAC of 52,000 tons would not allow substantial increase in catch of any particular species without a corresponding decrease in catch of some other species. A major departure from the past observed pattern of relative fishing mortality (by species) may invalidate the total demersal production model, therefore single species catch restrictions are also necessary. It is also noteworthy that the implementation of mesh size increases will probably decrease mortality on young fish and have a positive effect on MSY, but the magnitude of the effect cannot be evaluated at present.

The conclusion from the multispecies assessment is that total demersal fishing effort should not be allowed to rise above its present level, but the Working Group did not have time to consider this result in relation to the single species assessments carried out. The Group does not, therefore, feel able to make a recommendation on a second tier total demersal TAC, or effort restriction, at present.

13.0 VALIDITY OF THE AREAS USED IN ASSESSMENT AND MANAGEMENT

The present area basis for assessment and quota management, using the Bristol Channel (VIIf) as a unit is unsatisfactory because the populations in VIIf are not separate stocks and because the fishing grounds, particularly off

Trevose Head, are split between VIIf and VIIg. The Working Group did not have time to discuss the situation in detail, but noted that separate assessments of the VIIf populations are unrealistic if they do not include a consideration of the situation in VIIg. The Working Group feel that the areas for which assessments are required and for which TACs are set should be redefined to take account of the distribution of stocks and the pattern of fishing.

14.0 REFERENCES

ANON, 1973. Report of the Working Group on Irish Sea whiting. ICES CM 1973/F:2.

ANON, 1974. Report of the North Sea Roundfish Working Group. ICES CM 1974/F:5, 37 pp, mimeo.

ANON, 1977. Report of the North Sea Flatfish Working Group. ICES CM 1977/F:5.

BEDDINGTON, J. R. and MAY, R. M., 1977. Harvesting natural populations in a randomly fluctuating environment. Science 197: 463-465.

BRANDER, K. M., 1975. A yield assessment of Irish Sea *Nephrops* and the effect of a mesh change. ICES CM 1975/K:30, 4 pp, mimeo.

BRANDER, K. M., 1977. The management of Irish Sea fisheries - a review. Lab. Leafl. MAFF Direct. Fish Res., Lowestoft, (36), 40 pp.

DOUBLEDAY, W. G., 1976. Environmental fluctuations and fisheries management. ICNAF Selected Papers No. 1: 141-150.

FOX, W. W., 1970. An exponential surplus yield model for optimizing exploited fish populations. Trans Am. Fish Soc. 99 (1): 80-88.

GULLAND, J. A. Fishing and the stocks of fish at Iceland. Fishery Invest., Lond., Ser. 2, 23 (4), 52 pp.

HILLIS, P., 1968. The Whiting fishery off countries Dublin and South on the east coast of Ireland. Irish Fish. Invest. No. 4, Series B, 40 pp.

PELLA, J. J. and TOMLINSON, P. K., 1969. A generalized stock production model. Latin-Amer Trop. Tuna Commission Bull. 13 (3): 421-496.

SCHAEFER, M. B., 1954. Some aspects of the dynamics of populations important to the management of commercial marine fisheries. Inter-Amer. Tropical Tuna Commission Bull. 1 (2).

SCHAEFER, M. B., 1957. A study of the dynamics of the fishery for yellowfin tuna on the eastern tropical Pacific Ocean. Inter-American Tropical Tuna Commission Bull. 11 (6).

SHEPHERD, J. G., 1977. The sensitivity of exploited populations to environmental "noise", and the implication for management. ICES CM 1977/F:27.

SISSENWINE, M. P., 1977. The effect of random fluctuations on a hypothetical fishery. ICNAF Selected Papers, 2: 137-147.

TABLE 2.1 Nominal catch (metric tons) of cod in Division VIIa, 1967-1977

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	251	211	272	332	390	348	276	409	282	257	135
France	989	1044	563	1282	2229	2024	2507	2601	2623	1938	1410
Ireland	1611	2126	2200	1743	2852	2336	4256	3337	3550	4903	3798
Netherlands	2	1	-	4	148	58	35	113	53	87	38
UK (England & Wales)	3310	3730	3445	1710	2451	2856	3158	2463	2132	1815	1154
UK (N Ireland)	1177	1389	1380	1267	1112	1522	1537	1279	1153	1171	1409
UK (Scotland)	11	40	131	88	64	90	50	49	76	91	50
Total	7351	8541	7991	6426	9246	9234	11819	10251	9863	10247	7994

*Preliminary

Table 2.2

IRISH SEA COD
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 68	69	70	71	72	73	74	75	76	77	INDIVIDUAL WT IN KG CATCH	STOCK
1	364	882	905	2762	777	2258	467	939	1960	845	.610	.610
2	1563	1481	1710	2200	3241	1064	4364	761	3154	507	1.660	1.660
3	1003	1050	344	824	832	1792	570	1636	521	1213	3.330	3.330
4	456	269	211	179	247	437	398	277	390	160	5.090	5.090
5	177	186	229	76	61	172	61	152	43	214	6.190	6.190
6	28	76	44	49	39	63	43	33	61	31	6.760	6.760
7	2	37	18	19	13	30	16	16	17	40	8.300	8.300
CHECK WT (NOS*WT)	9779	9834	7475	9951	10631	13075	12254	9991	10971	8077		

Table 2.3

IRISH SEA COD
FISHING MORTALITY (M=.20)

AGE	YEAR 68	69	70	71	72	73	74	75	76	77	MEAN OF 68-74
1	.11	.18	.16	.29	.23	.22	.18	.12	.94	.19	.20
2	.56	.86	.64	.74	.65	.58	.82	.51	.76	.68	.69
3	.78	.95	.50	.74	.71	.96	.72	.88	.81	.76	.76
4	.76	.49	.50	.52	.52	1.08	.58	.97	.53	.76	.76
5	.69	.83	1.06	.34	.34	.85	.41	.46	.37	.64	.64
6	.18	.74	.47	.68	.29	.70	.53	.41	.33	.64	.64
7	.38	.38	.38	.38	.38	.38	.38	.38	.38	.51	.51
										.38	.38
WEIGHTED MEAN F>3	.73	.80	.59	.65	.61	.95	.62	.83	.62	.71	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 2.4

IRISH SEA COD
STOCK IN NUMBERS (* 1000)

AGE	YEAR 68	69	70	71	72	73	74	75	76	77	MEAN OF 68-74
1	3807	5812	6585	12057	4085	12815	3050	8937	3498	5371	6887
2	3975	2788	3964	4576	7392	2646	8460	2077	6470	1121	4829
3	2021	1856	964	1717	1783	3155	1214	3037	1019	2483	1816
4	936	760	586	481	670	717	991	485	1030	370	734
5	387	360	381	291	233	327	199	455	151	494	311
6	188	159	129	109	170	137	115	108	236	85	144
7	7	128	62	66	45	104	55	55	59	139	67
STOCK BIOMASS	24139	22587	20535	26196	27079	30177	27458	25489	24530	20071	

TABLE 2.5 Summary of results of catch forecast for Irish Sea cod in 1979. Biomass and catch weights are in tonnes, F values are multiples of 1977 exploitation pattern

F	Catch wt	Total biomass	Biomass in 1980
0	0	22153	37074
.2	2179	22153	33735
.4	4102	22153	30793
.6	5801	22153	28198
.8	7304	22153	25906
1.0	8636	22153	23879
1.2	9818	22153	22084
1.4	10868	22153	20492
1.6	11802	22153	19078
1.8	12634	22153	17820
2.0	13376	22153	16698

TABLE 3.1 Nominal catch (metric tons) of whiting in Division VIIa, 1968-77

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
A: FOR HUMAN CONSUMPTION										
Belgium	103	115	159	154	38	102	94	99	68	63
France	4285	3148	1312	1952	2805	3102	2700	2784	2985	1968
Ireland [1]	3007	2421	1145	2059	1953	3048	3736	3389	4513	4202
Netherlands	+	0	+	23	5	12	52	52	56	28
UK (England & Wales)	1536	1251	706	810	639	1224	685	617	635	953
UK (N Ireland)	3548	2391	1314	1899	1976	2437	2045	2280	3290	2692
UK (Scotland)	35	107	31	19	29	47	52	54	104	160
Total	12514	9443	4667	6917	7445	9972	9364	9275	11651	10066
B: FISHMEAL										
Total (Ireland only)	na	707	2198	2531	1231	744	283	353	425	760

1 = Catches reduced from those previously published by a factor of 1.12

*Preliminary

Table 3.2

IRISH SEA WHITING
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 72	73	74	75	76	77	78	79	80	81	INDIVIDUAL WT IN KG CATCH	STOCK
1	5617	11973	8945	14834	3940	23029	0	0	0	0	.185	.070
2	11553	9774	12978	8713	24638	2882	0	0	0	0	.244	.175
3	7601	11826	11344	10328	9168	12152	0	0	0	0	.295	.260
4	2193	2295	1849	1817	2965	1521	0	0	0	0	.389	.342
5	510	829	658	669	621	918	0	0	0	0	.464	.426
6	57	311	215	209	481	288	0	0	0	0	.530	.497
7	96	97	74	76	75	86	0	0	0	0	.570	.550
8	7	39	20	20	23	13	0	0	0	0	.593	.582
9	37	11	7	7	10	3	0	0	0	0	.608	.600
CHECK WT (NOS*WT)	7302	9616	9365	9104	11204	9777	0	0	0	0		

Table 3.3

IRISH SEA WHITING
FISHING MORTALITY (M=.20)

AGE	YEAR 72	73	74	75	76	77	78	79	80	81	MEAN OF 72-74
1	.15	.26	.27	.23	.37	.22	.00	.00	.00	.00	.23
2	.46	.42	.51	.47	.74	.52	.00	.00	.00	.00	.47
3	1.00	1.29	1.34	1.02	1.42	1.07	.00	.00	.00	.00	1.21
4	.89	1.02	.71	.81	.98	1.03	.00	.00	.00	.00	.87
5	.65	1.08	.96	.61	.74	.99	.00	.00	.00	.00	.89
6	.29	1.12	.95	.98	1.31	.95	.00	.00	.00	.00	.79
7	.91	1.19	.91	1.14	1.31	.90	.00	.00	.00	.00	1.00
8	.27	1.31	.87	.68	1.55	.86	.00	.00	.00	.00	.82
9	.90	.90	.90	.90	.90	.90	.00	.00	.00	.00	.90
WEIGHTED MEAN F>3	.95	1.23	1.20	.96	1.26	1.06	.00	.00	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 3.4

IRISH SEA WHITING
STOCK IN NUMBERS (* 1000)

AGE	YEAR 72	73	74	75	76	77	78	79	80	81	MEAN OF 72-74
1	44038	56573	40894	79022	13817	128194	0	0	0	0	47168
2	34187	30994	35561	25447	51356	7775	0	0	0	0	33580
3	13006	17632	16608	17488	13024	20056	0	0	0	0	15749
4	4050	3900	3972	3567	5154	2567	0	0	0	0	3974
5	1169	1364	1157	1601	1300	1586	0	0	0	0	1230
6	247	501	381	362	712	510	0	0	0	0	376
7	175	151	134	121	111	158	0	0	0	0	153
8	32	58	37	44	31	25	0	0	0	0	43
9	68	20	13	13	18	5	0	0	0	0	34
STOCK BIOMASS	14608	16261	15548	16713	16102	17460	0	0	0	0	

TABLE 3.5 Catch and surviving biomass in tonnes 1976-79

	$\frac{F}{F_{1977}}$	Catch	Biomass at beginning of following year
1976	...	11697	17460
1977	1	10049	22535
1978	1	12003	23065
1979	.5	8147	25859
	.6	9036	24610
	.7	10621	23456
	.8	11727	22391
	.9	12757	21405
	1.0	13715	20492
	1.1	14609	19646
	1.2	15433	18860
	1.3	16223	18130
	1.4	16953	17451
	1.5	17637	16818
	2.0	20487	14227

TABLE 4.1 Nominal catch (metric tons) of plaice in Division VIIa, 1967-77

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	69	152	208	305	175	179	221	247	248	136	110
France	1082	40	33	250	-	440	500	132	134	126	140
Ireland	819	1449	1309	909	1028	863	1079	891	884	1032	914
Netherlands	-	-	-	8	61	48	42	47	75	73	28
UK (England & Wales)	2866	2764	2540	1869	2744	3366	3002	2240	2544	1937	1391
UK (N Ireland)	138	178	216	184	132	134	143	104	125	117	165
UK (Scotland)	85	112	88	58	92	89	73	54	53	52	99
Total	5059	4695	4394	3583	4232	5119	5060	3715	4063	3473	2847

*Preliminary

Table 4.2

IRISH SEA PLAICE MALE
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 64	65	66	67	68	69	70	71	72	73	INDIVIDUAL WT IN KG CATCH	STOCK
1	0	0	0	0	0	0	0	0	0	0	.060	.020
2	484	489	38	73	105	104	141	219	23	279	.173	.090
3	399	1182	1367	330	672	928	859	1356	1268	1127	.200	.170
4	504	835	1711	2241	1076	1185	749	1702	1953	2090	.270	.230
5	311	246	937	187	1480	795	1012	726	670	1119	.330	.300
6	455	160	295	357	566	244	495	586	205	337	.370	.350
7	92	204	73	284	112	188	141	116	147	120	.400	.380
8	1	157	90	23	10	5	72	55	185	98	.430	.410
9	1	21	1	72	1	1	5	65	35	41	.440	.440
10	154	1	1	88	1	33	5	27	1	28	.450	.440
11	1	1	1	37	1	33	1	5	1	32	.460	.450
12	1	1	1	23	1	1	59	1	1	26	.460	.460
CHECK WT (NOS*WT)	678	847	1230	1100	1192	984	1035	1339	1237	1479		

IRISH SEA PLAICE MALE
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 74	75	76	77	78	79	80	81	82	83	INDIVIDUAL WT IN KG CATCH	STOCK
1	0	0	24	280	0	0	0	0	0	0	.060	.020
2	500	171	759	1730	0	0	0	0	0	0	.173	.090
3	845	1832	1906	1170	0	0	0	0	0	0	.200	.170
4	1286	2300	1180	687	0	0	0	0	0	0	.270	.230
5	897	816	437	356	0	0	0	0	0	0	.330	.300
6	463	184	235	109	0	0	0	0	0	0	.370	.350
7	39	29	182	42	0	0	0	0	0	0	.400	.380
8	10	76	76	22	0	0	0	0	0	0	.430	.410
9	19	29	16	43	0	0	0	0	0	0	.440	.440
10	1	76	28	5	0	0	0	0	0	0	.450	.440
11	1	1	17	6	0	0	0	0	0	0	.460	.450
12	20	1	6	5	0	0	0	0	0	0	.460	.460
CHECK WT (NOS*WT)	1108	1447	1199	946	0	0	0	0	0	0		

Table 4.3

IRISH SEA PLAICE MALE
FISHING MORTALITY (M=.15)

AGE	YEAR 64	65	66	67	68	69	70	71	72	73	MEAN OF 64- 74
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.08	.06	.01	.01	.03	.02	.02	.03	.00	.05	.04
3	.11	.25	.22	.08	.14	.30	.21	.24	.26	.31	.21
4	.36	.34	.67	.64	.39	.37	.41	.76	.62	.82	.55
5	.57	.28	.76	.13	1.14	.53	.57	.83	.74	.84	.67
6	.41	.62	.59	.69	.66	.53	.70	.74	.55	1.01	.68
7	.25	.30	.61	2.19	.46	.44	.63	.32	.38	.70	.60
8	.01	.82	.20	.37	.40	.03	.29	.50	1.21	.45	.40
9	.01	.33	.01	.23	.02	.06	.04	.42	.66	.94	.26
10	3.52	.01	.02	2.99	.00	2.10	.44	.27	.01	1.96	1.03
11	.30	.30	.01	2.60	.30	.18	.30	1.00	.01	.44	.52
12	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51
WEIGHTED MEAN F>3	.32	.31	.42	.43	.43	.38	.39	.48	.46	.63	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

IRISH SEA PLAICE MALE
FISHING MORTALITY (M=.15)

AGE	YEAR 74	75	76	77	78	79	80	81	82	83	MEAN OF 64- 74
1	.00	.00	.00	.04	.00	.00	.00	.00	.00	.00	.00
2	.10	.04	.25	.17	.00	.00	.00	.00	.00	.00	.04
3	.22	.62	.86	.70	.00	.00	.00	.00	.00	.00	.21
4	.67	1.41	1.04	.85	.00	.00	.00	.00	.00	.00	.55
5	.99	1.18	1.15	1.02	.00	.00	.00	.00	.00	.00	.67
6	.99	.52	1.39	.99	.00	.00	.00	.00	.00	.00	.68
7	.27	.13	1.50	.99	.00	.00	.00	.00	.00	.00	.60
8	.10	1.21	.56	.68	.00	.00	.00	.00	.00	.00	.40
9	.14	.45	.86	.68	.00	.00	.00	.00	.00	.00	.26
10	.04	1.12	1.02	.68	.00	.00	.00	.00	.00	.00	1.03
11	.30	.06	.77	.59	.00	.00	.00	.00	.00	.00	.52
12	.51	.51	.51	.51	.00	.00	.00	.00	.00	.00	.51
WEIGHTED MEAN F>3	.51	.95	.98	.79	.00	.00	.00	.00	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 4.4

IRISH SEA PLAICE MALE
STOCK IN NUMBERS (* 1000)

AGE	YEAR 64	65	66	67	68	69	70	71	72	73	MEAN OF 64- 74
1	10559	6107	7572	5232	6713	9244	8362	6091	6629	6314	7071
2	7068	9088	5257	6517	4503	5778	7956	7197	5243	5705	6341
3	4011	5635	7370	4489	5542	3780	4878	6718	5995	4491	5233
4	1799	3083	3760	5000	3558	4148	2398	3405	4531	3990	3507
5	761	1083	1885	1663	2312	2070	2477	1373	1368	2103	1692
6	1459	369	706	762	1258	637	1050	1201	516	562	846
7	446	836	170	336	328	562	323	449	495	255	398
8	94	299	531	79	32	179	311	149	279	291	214
9	100	80	113	374	47	19	150	201	77	71	127
10	165	85	50	97	256	40	15	124	113	34	91
11	4	4	73	42	4	219	4	8	82	97	49
12	3	3	3	62	3	3	158	3	3	70	33
STOCK BIOMASS	3010	3577	3943	3803	3708	3558	3772	3907	3681	3487	

IRISH SEA PLAICE MALE
STOCK IN NUMBERS (* 1000)

AGE	YEAR 74	75	76	77	78	79	80	81	82	83	MEAN OF 64- 74
1	4955	4295	13842	7686	0	0	0	0	0	0	7071
2	5435	4265	3697	11891	0	0	0	0	0	0	6341
3	4652	4215	3516	2481	0	0	0	0	0	0	5233
4	2828	3224	1943	1279	0	0	0	0	0	0	3507
5	1516	1251	678	592	0	0	0	0	0	0	1692
6	784	485	332	185	0	0	0	0	0	0	846
7	175	251	248	71	0	0	0	0	0	0	398
8	110	115	189	48	0	0	0	0	0	0	214
9	160	85	30	93	0	0	0	0	0	0	127
10	24	120	46	11	0	0	0	0	0	0	91
11	4	20	34	14	0	0	0	0	0	0	49
12	54	3	16	13	0	0	0	0	0	0	33
STOCK BIOMASS	2978	2716	2201	2287	0	0	0	0	0	0	

Table 4.5

IRISH SEA PLAICE (FEMALE)
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 64	65	66	67	68	69	70	71	72	73	INDIVIDUAL WT IN KG CATCH	STOCK
1	0	0	0	0	0	0	0	0	0	0	.060	.020
2	513	812	32	166	122	200	268	246	136	486	.140	.090
3	1512	2007	2004	1245	1142	1258	910	1658	2189	1993	.250	.190
4	1176	1981	2194	3225	2148	1946	1274	2192	2749	3747	.370	.310
5	135	1161	1522	2220	3235	1317	1267	1089	847	1712	.500	.430
6	396	489	480	785	1239	1782	850	1009	508	444	.630	.560
7	388	124	495	305	256	694	807	390	523	280	.750	.690
8	139	154	273	259	121	182	221	462	388	188	.860	.810
9	25	15	197	180	131	62	87	128	347	134	.970	.910
10	1	33	18	86	26	61	37	52	171	186	1.060	1.020
11	29	13	17	60	16	44	56	37	52	99	1.140	1.100
12	1	1	5	5	7	21	21	36	44	23	1.210	1.170
13	1	1	7	5	4	5	29	12	34	19	1.520	1.240
14	1	1	3	7	2	2	5	7	20	13	1.272	1.270
15	10	1	2	5	1	1	1	1	14	17	1.360	1.340
CHECK WT (NOS*WT)	1688	2532	3239	3947	3983	3733	2965	3423	3779	3996		

AGE	YEAR 74	75	76	77	78	79	80	81	82	83	INDIVIDUAL WT IN KG CATCH	STOCK
1	0	0	32	274	0	0	0	0	0	0	.060	.020
2	946	132	1718	2069	0	0	0	0	0	0	.140	.090
3	762	1251	2537	1605	0	0	0	0	0	0	.250	.190
4	1244	1214	1342	1862	0	0	0	0	0	0	.370	.310
5	1225	1080	475	552	0	0	0	0	0	0	.500	.430
6	449	829	331	142	0	0	0	0	0	0	.630	.560
7	154	346	206	94	0	0	0	0	0	0	.750	.690
8	110	127	126	76	0	0	0	0	0	0	.860	.810
9	51	102	39	48	0	0	0	0	0	0	.970	.910
10	43	74	41	20	0	0	0	0	0	0	1.060	1.020
11	69	55	25	10	0	0	0	0	0	0	1.140	1.100
12	31	63	19	9	0	0	0	0	0	0	1.210	1.170
13	7	20	50	7	0	0	0	0	0	0	1.520	1.240
14	6	12	8	8	0	0	0	0	0	0	1.272	1.270
15	5	1	5	3	0	0	0	0	0	0	1.360	1.340
CHECK WT (NOS*WT)	2125	2575	2308	2013	0	0	0	0	0	0		

Table 4.6

IRISH SEA PLAICE (FEMALE)
FISHING MORTALITY (M=.10)

AGE	YEAR 64	65	66	67	68	69	70	71	72	73	MEAN OF 64- 74
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.04	.05	.00	.02	.02	.03	.03	.02	.02	.14	.05
3	.21	.20	.14	.17	.16	.25	.18	.22	.26	.46	.23
4	.34	.42	.31	.31	.42	.40	.39	.73	.61	.84	.48
5	.06	.59	.60	.51	.51	.44	.44	.60	.62	.86	.53
6	.32	.30	.46	.62	.53	.52	.50	.67	.56	.69	.52
7	.42	.14	.49	.53	.38	.57	.42	.40	.78	.60	.47
8	.65	.26	.45	.45	.36	.44	.32	.40	.77	.63	.47
9	.28	.12	.55	.54	.38	.28	.35	.27	.52	.59	.38
10	.03	.62	.18	.43	.12	.27	.24	.32	.62	.52	.34
11	.81	.53	.68	1.22	.12	.28	.38	.37	.55	.79	.55
12	.04	.05	.35	.38	.37	.20	.19	.40	.86	.44	.35
13	.12	.05	.49	.63	.53	.44	.41	.14	.73	1.06	.44
14	.27	.15	.17	1.16	.49	.49	.94	.15	.32	.60	.53
15	.43	.43	.43	.43	.43	.43	.43	.43	.43	.43	.43
WEIGHTED MEAN F>3	.26	.31	.28	.34	.38	.40	.35	.44	.47	.69	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

AGE	YEAR 74	75	76	77	78	79	80	81	82	83	MEAN OF 64- 74
1	.00	.00	.00	.03	.00	.00	.00	.00	.00	.00	.00
2	.20	.02	.25	.31	.00	.00	.00	.00	.00	.00	.05
3	.29	.38	.48	.34	.00	.00	.00	.00	.00	.00	.23
4	.52	.90	.80	.68	.00	.00	.00	.00	.00	.00	.48
5	.64	1.05	.99	.82	.00	.00	.00	.00	.00	.00	.53
6	.50	1.11	.99	.82	.00	.00	.00	.00	.00	.00	.52
7	.48	.82	.82	.75	.00	.00	.00	.00	.00	.00	.47
8	.45	.82	.71	.74	.00	.00	.00	.00	.00	.00	.47
9	.31	.85	.57	.57	.00	.00	.00	.00	.00	.00	.38
10	.34	.85	.92	.57	.00	.00	.00	.00	.00	.00	.34
11	.33	.83	.70	.52	.00	.00	.00	.00	.00	.00	.55
12	.54	.50	.69	.52	.00	.00	.00	.00	.00	.00	.35
13	.21	.71	.85	.52	.00	.00	.00	.00	.00	.00	.44
14	1.06	.56	.61	.27	.00	.00	.00	.00	.00	.00	.53
15	.43	.43	.43	.43	.00	.00	.00	.00	.00	.00	.43
WEIGHTED MEAN F>3	.47	.74	.63	.52	.00	.00	.00	.00	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 4.7

IRISH SEA PLAICE (FEMALE)
STOCK IN NUMBERS (* 1000)

AGE	YEAR 64	65	66	67	68	69	70	71	72	73	MEAN OF 64- 74
1	20663	10450	9963	7303	7340	10927	12388	7048	4420	6123	9577
2	13476	18697	9456	9015	6608	6642	9887	11210	6377	4000	9173
3	8207	11716	16163	8526	8001	5864	5823	8695	9912	5643	8337
4	4240	5992	8697	12722	6532	6155	4114	4405	6296	6895	6297
5	2352	2722	3544	5794	8461	3876	3725	2515	1914	3096	3700
6	1515	2000	1364	1767	3140	4593	2259	2170	1246	931	2015
7	1183	996	1347	780	856	1669	2469	1239	1010	646	1147
8	305	702	784	750	417	532	853	1469	752	420	664
9	108	145	490	450	433	262	309	563	891	314	379
10	38	74	117	257	237	268	179	197	388	478	217
11	55	33	36	88	151	190	184	127	129	189	131
12	26	22	18	16	24	121	130	114	79	68	63
13	10	23	19	11	10	15	90	98	69	30	38
14	4	8	20	11	5	5	9	54	77	30	21
15	30	3	6	15	3	3	3	3	42	51	16
STOCK BIOMASS	7708	9833	11351	11983	11465	10551	9725	9689	9005	7535	

AGE	YEAR 74	75	76	77	78	79	80	81	82	83	MEAN OF 64- 74
1	8719	9115	9025	9740	0	0	0	0	0	0	9577
2	5541	7889	8248	8136	0	0	0	0	0	0	9173
3	3158	4116	7014	5835	0	0	0	0	0	0	8337
4	3218	2136	2538	3944	0	0	0	0	0	0	6297
5	2702	1734	788	1030	0	0	0	0	0	0	3700
6	1186	1286	551	265	0	0	0	0	0	0	2015
7	422	648	383	186	0	0	0	0	0	0	1147
8	320	236	259	152	0	0	0	0	0	0	664
9	202	185	94	116	0	0	0	0	0	0	379
10	157	134	71	48	0	0	0	0	0	0	217
11	256	101	52	26	0	0	0	0	0	0	131
12	78	167	40	23	0	0	0	0	0	0	63
13	40	41	91	18	0	0	0	0	0	0	38
14	10	29	18	35	0	0	0	0	0	0	21
15	15	3	15	9	0	0	0	0	0	0	16
STOCK BIOMASS	5445	5145	4582	4390	0	0	0	0	0	0	

TABLE 5.1 Nominal catch (metric tons) of plaice in Division VIIf, 1967-77

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	137	260	202	226	202	137	158	154	137	79	71
France	-	669	668	102	-	110	-	-	147	98	110
UK (England & Wales)	655	521	506	501	545	377	381	210	184	137	135
Total	792	1450	1376	829	747	624	539	364	468	314	316

*Preliminary

Table 5.2

BRISTOL CHANNEL PLAICE (MALE)
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	INDIVIDUAL WT IN KG CATCH	STOCK
2	8	9	44	3	2	16	44	172	0	0	.236	.200
3	55	139	109	48	78	92	123	87	0	0	.281	.260
4	207	164	248	181	68	54	124	90	0	0	.305	.300
5	230	107	45	189	79	74	62	12	0	0	.340	.320
6	277	66	104	58	36	40	23	13	0	0	.380	.360
7	110	44	25	2	21	16	11	8	0	0	.428	.400
8	329	18	18	3	1	1	6	7	0	0	.519	.460
CHECK WT (NOS*WT)	482	181	192	158	94	94	121	109	0	0		

Table 5.3

BRISTOL CHANNEL PLAICE (MALE)
FISHING MORTALITY (M=.15)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	.01	.01	.13	.01	.01	.03	.08	.03	.00	.00	.03
3	.14	.20	.23	.19	.36	.43	.40	.22	.00	.00	.22
4	.57	.68	.59	.68	.41	.44	1.79	.54	.00	.00	.59
5	1.08	.63	.37	1.23	.69	1.01	1.29	.82	.00	.00	.80
6	1.40	1.04	3.27	1.14	.77	.88	.99	1.06	.00	.00	1.52
7	1.44	.83	1.69	.63	2.22	.87	.59	1.15	.00	.00	1.36
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.00	.00	1.00
WEIGHTED MEAN F>3	1.02	.74	.93	.94	.66	.74	1.43	.64	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 5.4

BRISTOL CHANNEL PLAICE (MALE)
STOCK IN NUMBERS (* 1000)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	985	673	401	323	330	481	597	6272	0	0	542
3	472	840	571	304	274	282	399	473	0	0	492
4	506	355	595	391	218	164	158	230	0	0	413
5	370	245	154	284	170	124	91	23	0	0	245
6	390	108	112	92	72	73	39	22	0	0	155
7	152	83	33	4	25	29	26	12	0	0	59
8	554	31	31	5	2	2	10	12	0	0	125
STOCK BIOMASS	1046	624	524	389	294	297	329	1472	0	0	

Table 5.5

BRISTOL CHANNEL PLAICE (FEMALE)
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	INDIVIDUAL WT IN KG CATCH	STOCK
2	18	3	13	0	7	41	37	210	0	0	.286	.240
3	99	516	228	205	88	354	89	104	0	0	.374	.330
4	182	389	362	282	127	160	107	79	0	0	.467	.410
5	184	138	103	139	131	56	61	32	0	0	.548	.510
6	64	30	100	24	71	77	25	15	0	0	.705	.620
7	50	34	27	15	20	33	15	6	0	0	.838	.780
8	27	38	12	6	12	16	16	14	0	0	.949	.890
9	2	7	13	18	9	9	6	11	0	0	1.109	1.030
10	2	4	4	7	9	6	7	6	0	0	1.409	1.270
11	1	2	4	5	2	4	3	3	0	0	1.600	1.520
CHECK WT (NOS*WT)	347	552	447	360	270	373	195	207	0	0		

Table 5.6

BRISTOL CHANNEL PLAICE (FEMALE)
FISHING MORTALITY (M=.10)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	.01	.00	.02	.00	.01	.13	.09	.15	.00	.00	.01
3	.13	.50	.29	.56	.26	1.03	.41	.35	.00	.00	.35
4	.41	.97	.69	.63	.73	.89	.91	.69	.00	.00	.69
5	.96	.55	.65	.55	.60	.75	.93	.67	.00	.00	.66
6	.45	.34	.88	.27	.54	.75	.81	.52	.00	.00	.50
7	.50	.41	.54	.26	.34	.45	.28	.42	.00	.00	.41
8	.57	.78	.22	.20	.31	.45	.38	.40	.00	.00	.41
9	.08	.24	.57	.53	.43	.38	.28	.40	.00	.00	.37
10	.26	.23	.21	.70	.48	.52	.50	.40	.00	.00	.38
11	.40	.40	.40	.40	.40	.40	.40	.40	.00	.00	.40
WEIGHTED MEAN F>3	.56	.72	.67	.54	.58	.72	.71	.58	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 5.7

BRISTOL CHANNEL PLAICE (FEMALE)
STOCK IN NUMBERS (* 1000)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	1540	1039	563	449	642	347	446	1582	0	0	847
3	825	1376	937	497	406	575	275	368	0	0	809
4	568	653	757	632	256	284	186	165	0	0	573
5	310	341	225	343	305	112	106	68	0	0	305
6	186	108	178	106	179	152	48	38	0	0	151
7	134	107	69	67	73	95	65	19	0	0	90
8	65	73	64	37	46	47	55	44	0	0	57
9	23	34	30	47	27	31	27	34	0	0	32
10	7	19	24	16	25	16	19	19	0	0	18
11	3	5	14	17	7	14	9	10	0	0	9
STOCK BIOMASS	1347	1427	1173	950	828	730	522	5695	0	0	

TABLE 6.1 Nominal catch (metric tons) of sole in Division VIIa, 1967-1977 (data for 1967-1976 from Bulletin Statistique)

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	307	332	841	1142	883	561	793	664	805	674	566
France	361	125	97	115	45	38	12	54	59	72	55
Ireland	22	23	34	25	45	50	27	28	24	74	53
Netherlands	-	-	3	235	552	514	281	320	234	381	273
UK (England & Wales)	308	446	400	267	316	238	258	218	281	195	167
UK (N Ireland)	12	10	17	24	40	40	46	23	24	49	49
UK (Scotland)	-	-	-	1	1	9	11	...	15	18	-
Total	1010	936	1392	1809	1882	1450	1428	1307	1442	1463	1163

*Preliminary

TABLE 6.2 Irish Sea sole. Catch per unit of effort (kg/hr) of Belgian beam trawlers during the second quarter over the period 1971-77

Year	Kg/hr
1971	26.7
1972	25.9
1973	25.3
1974	21.1
1975	24.1
1976	25.2
1977	22.2

Table 6.3

IRISH SEA SOLE (MALE)
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	INDIVIDUAL WT IN KG CATCH	STOCK
2	12	27	11	56	17	104	14	77	0	0	.123	.123
3	488	94	270	178	465	349	107	209	0	0	.151	.151
4	565	1094	417	1145	263	1085	311	664	0	0	.173	.173
5	321	660	568	289	674	302	384	362	0	0	.195	.195
6	571	123	166	349	196	337	56	511	0	0	.215	.215
7	39	485	68	146	158	63	224	64	0	0	.232	.232
8	95	132	241	98	132	101	70	105	0	0	.245	.245
9	260	38	22	185	38	91	143	59	0	0	.254	.254
10	74	131	16	15	164	58	110	27	0	0	.264	.264
11	257	264	127	76	38	46	11	13	0	0	.275	.275
12	46	73	52	83	37	15	25	2	0	0	.283	.283
13	9	181	31	48	70	19	11	30	0	0	.291	.291
14	9	15	36	18	80	61	1	43	0	0	.299	.299
15	4	18	1	32	46	11	9	2	0	0	.305	.305
CHECK WT (NOS*WT)	566	707	415	546	493	506	309	425	0	0		

Table 6.4

IRISH SEA SOLE (MALE)
FISHING MORTALITY (M=.10)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	.01	.01	.01	.01	.01	.03	.00	.01	.00	.00	.01
3	.14	.05	.07	.15	.10	.18	.03	.06	.00	.00	.10
4	.27	.46	.30	.43	.29	.32	.21	.27	.00	.00	.35
5	.46	.52	.41	.32	.43	.57	.16	.36	.00	.00	.43
6	.28	.29	.21	.42	.33	.36	.17	.30	.00	.00	.30
7	.05	.36	.23	.26	.30	.15	.38	.27	.00	.00	.24
8	.29	.20	.27	.52	.35	.28	.22	.27	.00	.00	.33
9	.31	.16	.04	.31	.35	.38	.72	.26	.00	.00	.23
10	.11	.22	.09	.03	.44	1.21	.96	.25	.00	.00	.18
11	.37	.59	.31	.64	.10	.19	.68	.24	.00	.00	.40
12	.08	.15	.19	.31	.66	.05	.13	.22	.00	.00	.28
13	.31	.48	.08	.24	.41	.76	.04	.21	.00	.00	.31
14	.07	1.13	.15	.05	.71	.67	.07	.19	.00	.00	.42
15	.17	.17	.17	.17	.17	.17	.17	.17	.00	.00	.17
WEIGHTED MEAN F>3	.26	.39	.26	.35	.36	.34	.24	.29	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 6.5

IRISH SEA SOLE (MALE)
STOCK IN NUMBERS (* 1000)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	2154	4520	1535	5609	2514	3824	4181	8131	0	0	3267
3	3948	1938	4064	1379	5023	2259	3362	3769	0	0	3270
4	2474	3109	1664	3421	1079	4103	1712	2942	0	0	2349
5	905	1704	1777	1111	2011	727	2687	1255	0	0	1501
6	2446	515	917	1070	732	1181	372	2067	0	0	1136
7	873	1673	349	672	637	477	749	284	0	0	841
8	391	753	1054	252	470	427	372	465	0	0	584
9	1027	263	556	725	135	300	291	270	0	0	541
10	764	684	202	483	481	86	185	128	0	0	523
11	880	621	494	168	423	280	23	64	0	0	517
12	594	552	312	327	80	346	210	11	0	0	373
13	35	494	431	233	218	37	299	166	0	0	282
14	143	23	275	360	165	131	16	261	0	0	193
15	27	121	7	215	309	74	60	13	0	0	136
STOCK BIOMASS	3223	3164	2602	2846	2574	2479	2486	3200	0	0	

Table 6.6

IRISH SEA SOLE (FEMALE)
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	INDIVIDUAL WT IN KG CATCH	STOCK
2	21	83	22	338	18	150	19	128	0	0	.140	.120
3	935	319	553	190	263	327	218	145	0	0	.195	.170
4	763	1082	301	975	295	1252	666	646	0	0	.250	.220
5	105	538	944	254	843	217	1649	421	0	0	.300	.270
6	730	116	294	425	195	474	213	554	0	0	.345	.310
7	162	394	150	140	272	22	393	94	0	0	.390	.360
8	50	18	330	15	105	135	281	109	0	0	.425	.410
9	299	48	72	148	48	57	145	24	0	0	.460	.440
10	187	206	45	52	80	26	56	29	0	0	.495	.480
11	304	99	79	38	24	87	11	30	0	0	.520	.510
12	60	165	84	66	25	6	81	5	0	0	.550	.530
13	23	120	188	80	50	4	34	30	0	0	.575	.560
14	24	34	69	67	33	38	7	6	0	0	.595	.580
15	51	28	57	39	65	29	32	1	0	0	.615	.600
CHECK WT (NOS*WT)	1224	1080	1096	872	775	823	1241	673	0	0		

Table 6.7

IRISH SEA SOLE (FEMALE)
FISHING MORTALITY (M=.10)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	.01	.02	.01	.04	.01	.04	.02	.02	.00	.00	.02
3	.20	.18	.13	.12	.04	.11	.07	.14	.00	.00	.13
4	.35	.34	.23	.30	.25	.24	.30	.25	.00	.00	.29
5	.18	.39	.50	.28	.41	.26	.50	.28	.00	.00	.35
6	.34	.28	.34	.39	.31	.38	.40	.28	.00	.00	.33
7	.38	.28	.63	.24	.41	.05	.54	.27	.00	.00	.39
8	.20	.06	.36	.10	.26	.32	1.12	.25	.00	.00	.19
9	.29	.27	.31	.24	.47	.20	.60	.22	.00	.00	.32
10	.26	.30	.38	.34	.18	.45	.27	.20	.00	.00	.29
11	.26	.19	.16	.56	.23	.26	.31	.20	.00	.00	.28
12	.11	.19	.22	.18	.80	.07	.37	.20	.00	.00	.30
13	.05	.30	.31	.30	.18	.24	.66	.20	.00	.00	.23
14	.13	.09	.25	.16	.17	.18	.76	.20	.00	.00	.16
15	.20	.20	.20	.20	.20	.20	.20	.20	.00	.00	.20
WEIGHTED MEAN F>3	.28	.29	.35	.29	.32	.25	.46	.26	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 6.8

IRISH SEA SOLE (FEMALE)
STOCK IN NUMBERS (* 1000)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	2268	5525	1947	8126	3688	4148	1307	6792	0	0	4311
3	5313	2032	4921	1741	7038	3320	3614	1165	0	0	4209
4	2715	3920	1536	3928	1395	6123	2694	3063	0	0	2699
5	656	1734	2521	1104	2631	982	4354	1807	0	0	1729
6	2632	494	1059	1387	759	1582	683	2378	0	0	1266
7	539	1689	337	679	852	502	982	417	0	0	819
8	290	334	1155	163	482	514	433	517	0	0	485
9	1227	215	285	733	133	337	337	127	0	0	519
10	859	827	149	190	523	75	251	168	0	0	510
11	1406	600	554	92	122	397	43	174	0	0	555
12	595	984	449	426	47	88	277	29	0	0	500
13	467	481	734	327	323	19	74	174	0	0	466
14	204	400	322	486	220	245	14	35	0	0	326
15	295	162	330	226	376	168	185	6	0	0	278
STOCK BIOMASS	5620	5155	4525	4461	4327	4243	3880	3635	0	0	

TABLE 6.9 Summary of results of catch forecast for Irish Sea sole in 1979. Biomass and catch weights are in tonnes. F values are multiples of 1977 exploitation pattern.

	F	Catch	Stock at beginning of year	Spawning stock
1977	1	1142.0	6848	5032.4
1978	1	1213.9	7126	6139.7
				(At 1/1/1980)
1979	.1	155.0	7294	7546.6
	.2	306.0		7389.0
	.3	453.1		7238.2
	.4	596.7		7091.5
	.5	736.2		6948.6
	.6	872.2		6809.3
	.7	1004.9		6673.6
	.8	1134.1		6541.6
	.9	1260.1		6412.8
	1.0	1382.9		6287.5
	1.1	1502.5		6165.3
	1.2	1619.2		6076.3
	1.3	1732.8		5930.3
	1.4	1843.7		5817.3
	1.5	1951.7		5707.2
	1.6	2057.0		5600.0
	1.7	2159.7		5495.3
	1.8	2259.9		5393.0
	1.9	2357.6		5294.1
	2.0	2452.7		5197.3

TABLE 7.1 Nominal catch (metric tons) of sole in Division VIIf, 1967-1977 (data for 1967-1976 from Bulletin Statistique)

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	451	292	289	567	595	343	416	545	453	416	253
France	83	179	194	118	40	82	240	24	20	16	11
UK (England & Wales)	209	127	168	145	131	123	122	94	92	88	88
Total	743	598	651	830	766	548	778	663	565	520	352

*Preliminary

TABLE 7.2 Bristol Channel sole. Effort and catch per unit effort by beam trawlers in the Bristol Channel (period 1971-1977)

Year	Hours fishing	kg per hours fishing
1971	19 664	16.8
1972	13 064	13.8
1973	19 147	17.9
1974	22 516	18.3
1975	23 218	15.4
1976	17 869	18.5
1977	13 961	15.7

Table 7.3

BRISTOL CHANNEL SOLE (MALE)
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	INDIVIDUAL WT IN KG CATCH	STOCK
2	30	137	100	197	50	31	8	89	0	0	.133	.120
3	476	143	284	664	157	122	75	105	0	0	.187	.174
4	195	490	81	269	368	193	142	80	0	0	.217	.217
5	187	190	198	97	120	246	100	47	0	0	.276	.276
6	263	84	77	81	32	111	235	34	0	0	.305	.305
7	135	62	42	43	53	16	31	57	0	0	.339	.339
8	79	168	44	29	24	50	28	14	0	0	.363	.363
9	85	76	71	29	13	19	55	5	0	0	.388	.388
10	61	11	19	74	39	16	12	9	0	0	.423	.423
11	28	87	20	19	12	11	7	5	0	0	.436	.436
12	67	26	6	9	7	8	3	6	0	0	.448	.448
13	35	28	15	10	19	4	16	3	0	0	.459	.459
14	7	44	6	20	11	16	3	12	0	0	.472	.472
15	9	14	5	29	11	3	1	3	0	0	.484	.484
16	26	0	1	12	0	7	8	3	0	0	.497	.497
CHECK WT (NOS*WT)	479	436	252	374	235	231	210	117	0	0		

Table 7.4

BRISTOL CHANNEL SOLE (MALE)
FISHING MORTALITY (M=.10)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	.05	.11	.04	.23	.09	.06	.01	.06	.00	.00	.11
3	.32	.33	.32	.40	.26	.28	.17	.19	.00	.00	.33
4	.32	.56	.28	.51	.35	.53	.52	.25	.00	.00	.41
5	.46	.52	.41	.56	.40	.38	.51	.29	.00	.00	.47
6	.65	.34	.37	.26	.32	.70	.66	.29	.00	.00	.39
7	.20	.27	.25	.32	.24	.23	.38	.29	.00	.00	.26
8	.33	.36	.28	.25	.27	.34	.69	.26	.00	.00	.30
9	.44	.54	.22	.27	.15	.31	.67	.22	.00	.00	.32
10	.22	.08	.22	.34	.60	.25	.29	.19	.00	.00	.29
11	.15	.48	.19	.32	.08	.30	.15	.17	.00	.00	.24
12	.62	.18	.05	.11	.16	.06	.11	.16	.00	.00	.22
13	.18	.51	.13	.10	.32	.12	.15	.14	.00	.00	.25
14	.25	.32	.17	.23	.13	.44	.11	.14	.00	.00	.22
15	2.44	.97	.05	3.54	.17	.04	.04	.14	.00	.00	1.43
16	.14	.14	.14	.14	.14	.14	.14	.14	.00	.00	.14
WEIGHTED MEAN F>3	.35	44	.27	.39	.31	.39	.49	.25	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 7.5

BRISTOL CHANNEL SOLE (MALE)
STOCK IN NUMBERS (* 1000)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	621	1329	2448	987	639	583	712	1605	0	0	1205
3	1815	534	1072	2122	706	531	498	637	0	0	1250
4	743	1193	348	702	1291	491	365	379	0	0	855
5	535	488	615	238	380	819	261	196	0	0	451
6	578	307	262	369	124	230	508	142	0	0	328
7	789	274	198	164	257	82	103	237	0	0	336
8	294	586	189	139	108	183	59	64	0	0	263
9	248	191	371	130	99	75	118	27	0	0	208
10	326	144	101	268	90	77	50	55	0	0	186
11	217	237	120	73	173	44	54	34	0	0	164
12	151	170	132	89	48	145	30	43	0	0	118
13	224	74	129	114	72	37	123	24	0	0	123
14	33	170	40	102	93	47	30	96	0	0	88
15	10	23	112	31	74	74	28	24	0	0	50
16	209	1	8	96	1	56	64	24	0	0	63
STOCK BIOMASS	1873	1485	1375	1323	1035	908	754	734	0	0	

Table 7.6

BRISTOL CHANNEL SOLE (FEMALE)
CATCH IN NUMBERS (* 1000) INPUT FOR VPA AND FORECAST

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	INDIVIDUAL WT IN KG CATCH	STOCK
2	1	75	44	94	38	13	9	56	0	0	.200	.168
3	131	26	85	387	93	87	80	52	0	0	.382	.258
4	61	77	59	101	182	76	48	61	0	0	.377	.377
5	91	57	173	67	138	229	80	56	0	0	.435	.435
6	66	75	60	126	78	102	149	49	0	0	.516	.516
7	189	123	38	33	95	50	87	77	0	0	.574	.574
8	49	106	47	23	33	89	29	32	0	0	.632	.632
9	44	47	65	36	48	28	46	8	0	0	.690	.690
10	43	28	32	55	45	23	16	11	0	0	.732	.732
11	36	41	13	20	55	18	6	12	0	0	.757	.757
12	14	64	16	13	28	30	4	18	0	0	.787	.787
13	25	4	43	13	16	15	25	8	0	0	.798	.798
14	1	1	12	32	21	7	24	15	0	0	.823	.823
15	8	21	9	19	24	5	9	5	0	0	.835	.835
16	11	12	2	14	10	18	22	13	0	0	.847	.847
CHECK WT (NOS*WT)	423	421	365	487	476	412	347	239	0	0		

Table 7.7

BRISTOL CHANNEL SOLE (FEMALE)
FISHING MORTALITY (M=.10)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	.00	.07	.03	.16	.08	.03	.02	.04	.00	.00	.07
3	.12	.05	.10	.32	.21	.24	.19	.11	.00	.00	.16
4	.10	.08	.15	.15	.22	.24	.18	.20	.00	.00	.14
5	.11	.11	.25	.23	.28	.41	.38	.29	.00	.00	.14
6	.11	.11	.15	.26	.40	.31	.45	.38	.00	.00	.20
7	.19	.26	.07	.10	.28	.42	.42	.39	.00	.00	.18
8	.12	.14	.14	.05	.13	.40	.41	.24	.00	.00	.11
9	.08	.15	.11	.13	.12	.14	.33	.17	.00	.00	.12
10	.06	.06	.13	.11	.22	.07	.10	.11	.00	.00	.12
11	.05	.07	.03	.10	.14	.11	.02	.09	.00	.00	.08
12	.05	.12	.03	.04	.18	.10	.03	.07	.00	.00	.08
13	.08	.02	.10	.03	.06	.12	.10	.07	.00	.00	.06
14	.02	.00	.06	.09	.05	.03	.26	.07	.00	.00	.04
15	.04	.49	.04	.11	.08	.01	.04	.07	.00	.00	.15
16	.07	.07	.07	.07	.07	.07	.07	.07	.00	.00	.07
WEIGHTED MEAN F>3	.10	.11	.11	.12	.18	.20	.21	.18	.00	.00	

THE WEIGHTING USES THE NO. AT EACH AGE IN THE STOCK

Table 7.8

BRISTOL CHANNEL SOLE (FEMALE)
STOCK IN NUMBERS (* 1000)

AGE	YEAR 70	71	72	73	74	75	76	77	78	79	MEAN OF 70-74
2	573	1098	1694	659	517	537	589	1500	0	0	908
3	1239	518	922	1491	507	432	474	524	0	0	935
4	679	997	444	753	983	371	308	353	0	0	771
5	953	557	829	346	586	717	263	233	0	0	654
6	682	776	450	586	249	399	432	162	0	0	548
7	1138	555	630	350	411	152	265	250	0	0	617
8	447	850	385	534	285	282	90	157	0	0	500
9	574	358	668	304	462	227	171	54	0	0	473
10	795	477	279	543	241	373	179	111	0	0	467
11	711	679	405	222	439	175	315	146	0	0	491
12	293	609	575	355	182	345	141	280	0	0	403
13	332	252	491	506	309	138	284	124	0	0	378
14	63	277	224	403	445	264	111	233	0	0	283
15	214	56	250	192	334	383	232	78	0	0	209
16	171	186	31	217	155	280	342	202	0	0	152
STOCK BIOMASS	4762	4416	4124	3905	3382	2842	2283	1924	0	0	

TABLE 7.9 Summary of results of catch forecast for Bristol Channel sole in 1979. Biomass and catch weights are in tonnes. F values are multiples of 1977 exploitation pattern

		Catch	Stock at beginning of year	Spawning stock
1977	1	358.4	2657.3	2428.6
1978	1	349.3	2646.2	2373.8
				(At 1/1/1980)
1979	.1	40.7	2711.5	2788.6
	.2	80.6		2746.6
	.3	119.7		2705.7
	.4	158.0		2665.6
	.5	195.6		2626.3
	.6	232.4		2587.7
	.7	268.5		2550.1
	.8	303.8		2513.2
	.9	338.4		2477.0
	1.0	372.4		2441.4
	1.1	405.7		2406.7
	1.2	438.5		2372.6
	1.3	470.5		2339.3
	1.4	501.8		2306.5
	1.5	532.7		2274.5
	1.6	562.9		2243.0
	1.7	592.5		2212.1
	1.8	621.7		2181.9
	1.9	650.3		2152.2
	2.0	678.3		2123.2

TABLE 9.1 Irish Sea sole

Mesh	50% retention length		50% retention age		Shift in years	
	♂	♀	♂	♀	♂	♀
75 mm	24.8 cm		3.7 years	2.5 years		
80 mm	26.7 cm		4.8 years	3.1 years	+ 1.4 years	+ 0.6 years
90 mm	29.7 cm		10 years	4.3 years	+ 6.6 years	+ 1.8 years

TABLE 9.2 Exploitation patterns for mesh assessment of Irish Sea sole

	Males			Females		
Mesh size (mm)	75	80	90	75	80	90
Years	1977, 78	1979, 80	1981	1977, 78	1979, 80	1981
Age						
2	.01	.00	.00	.02	.01	.00
3	.06	.00	.00	.14	.05	.00
4	.27	.03	.00	.25	.19	.04
5	.36	.13	.00	.28	.27	.16
6	.30	.36	.00	.28	.29	.26
7	.27	.33	.00	.27	.28	.29
8	.27	.28	.03	.25	.27	.28
9	.26	.27	.12	.22	.25	.27
10	.25	.27	.36	.20	.22	.24
11	.24	.26	.34	.20	.20	.21
12	.22	.25	.28	.20	.20	.20
13	.21	.24	.27	.20	.20	.20
14	.19	.22	.27	.20	.20	.20
15	.17	.21	.26	.20	.20	.20

TABLE 9.3 Results of the mesh assessment on Irish Sea sole (weights in tonnes)

Mesh size (mm)	Year	Catch	Stock	Spawning stock
75	1977	1139	7086	5271
75	1978	1219	7371	6386
80	1979	989	7534	6549
80	1980	1138	7931	6946
90	1981	588	8323	7338
90	1982	686	8714	7729
90	1983	762	9398	8413
90	1984	861	9986	9001
90	1985	999	10435	9450
90	1986	1149	10733	9748
90	1987	1169	10870	9885
90	1988	1180	10973	9988
90	1989	1196	11061	10076

TABLE 9.4 Bristol Channel sole

Mesh	50% retention length		50% retention age		Shift in years	
	♂	♀	♂	♀	♂	♀
75 mm	24.8 cm		2.5 years	2.0 years		
80 mm	26.7 cm		3.3 years	2.3 years	+ 0.8 years	+ 0.3 years
90 mm	29.7 cm		5.5 years	3.2 years	+ 3.0 years	+ 1.2 years

TABLE 9.5 Exploitation patterns for mesh assessment of Bristol Channel sole

	Males			Females		
Mesh size (mm)	75	80	90	75	80	90
Years	1977, 78	1979, 80	1981	1977, 78	1979, 80	1981
Age						
2	.06		.00	0.04	0.02	0.00
3	.19	.10	.00	.11	0.08	0.02
4	.25	.21	.00	.20	0.16	0.10
5	.29	.26	.01	.29	0.25	0.18
6	.29	.29	.12	.38	0.36	0.25
7	.29	.29	.22	.39	0.39	0.35
8	.26	.28	.26	.24	0.28	0.39
9	.22	.25	.29	.17	0.18	0.25
10	.19	.22	.29	.11	0.14	0.18
11	.17	.18	.28	.09	0.09	0.12
12	.16	.16	.24	.07	0.07	0.08
13	.14	.15	.20	.07	0.07	0.07
14	.14	.14	.18	.07	0.07	0.07
15	.14	.14	.16	.07	0.07	0.07
16	.14	.14	.14	.07	0.07	0.07

TABLE 9.6 Results of the mesh assessment on Bristol Channel sole (weights in tonnes)

Mesh size (mm)	Year	Catch	Stock	Spawning stock
75	1977	358	2657	2403
75	1978	349	2676	2359
80	1979	316	2648	2360
80	1980	331	2749	2462
90	1981	237	2731	2444
90	1982	242	2925	2638
90	1983	273	3114	2826
90	1984	315	3294	3006
90	1985	366	3431	3144
90	1986	400	3516	3228
90	1987	414	3566	3278
90	1988	427	3604	3316
90	1989	435	3627	3338

TABLE 9.7 Irish Sea whiting. Gulland estimate. Actual mesh to 90 mm (double twine)

	$\bar{C}$ 73-77 C_1	l_t	W_t	S_1 1977	S_2	$\frac{S_2}{S_1}$	$C_K = C_1 \cdot \frac{S_2}{S_1}$	NR $C_1 - C_K$	NRe^{-M_t} M = .2	$NRe^{-M_t} \times \frac{F}{Z}$ F = .9
0										
1	12544	29.5	.185	.21	.14	0.67	8404	4140	3257	2665
2	11797	32.3	.244	.49	.36	.73	8612	3185	2505	2050
3	10964	34.4	.295	1.0	.51	.51	5592	5372	4226	3458
4	2089	37.6	.389	.26	.76	.79	1650	439	345	282
5	739	39.9	.464	.23	.23	1.	687	52	41	33
6	301	41.7	.53	.88	1.0	1.	301	0		
7	82	42.7	.57	.86	1.0	1.	82	0		
8	23	43.2	.593	.85	1.0	1.	23	0		
9	8	43.6	.608	.84	1.0	1.	8	0		

TABLE 10.1 Ireland VIIA. Industrial landings

	Total amount of each species (tonnes)								
	1969	1970	1971	1972	1973	1974	1975	1976	1977
Whiting	707	2198	2531	1231	744	283	353	425	760
Hake					6				
Haddock		90							
Cod	24	169	52	61	32	61	51	88	28
Dab	66	159	188	54	19	54	12	54	33
Plaice	36	199	220	41	32	34	51	41	19
Megrim		10							
Mackerel	18	30		14					28
Herring	2579	3750	1767	2830	2143	4480	1562	1215	1348
Sprat	2174	3113	3524	240	3258	1705	1849	4833	2421
Others	435	229	2145*	170	69	115	47	95	109

*Mostly sandeel

TABLE 10.2 Estimated quantities of whiting landed in the industrial and *Nephrops* fisheries and quantities discarded

	68	69	70	71	72	73	74	75	76	77
INDUSTRIAL										
Irish		707	2198	2531	1231	744	283	353	425	760
NEPHROPS FISHERY										
1 Quantity landed (tonnes)										
N Ireland	784	710	450	833	1145	1442	1056	1307	1941	2029
France	na	na	na	na	na	na	na	278	na	na
Ireland	na	na	na	na	na	na	na	na	na	na
UK										na
2 Quantity discarded (tonnes)										
N Ireland	385	342	214	407	535	728	514	642	942	984
3 No x 10^{-6} discarded										
N Ireland	18	16	10	19	25	34	24	30	44	46

For N Ireland the quantities (tonnes) and numbers of discards are estimated using 1972/73 data from Watson and Parsons (1974, ICES CM 1974/F:29) and from ICES CM 1973/F:2

TABLE 12.1 Estimated catch per effort and total international effort on total demersal in VIIa + VIIf

	A	B	C	D
1954	8.6	3206	27572	
55	8.0	3513	28104	
56	8.2	4046	33177	3588
57	8.8	4423	38922	3994
58	7.0	5572	39004	4680
59	5.8	5887	34145	5294
60	7.5	4847	36358	5435
61	7.6	4521	34356	5085
62	6.4	6650	42561	5339
63	6.2	5554	34435	5575
64	5.6	8637	48366	6947
65	5.4	9165	49489	7785
66	6.1	5919	36107	7907
67	6.8	6780	46106	7288
68	5.9	8306	49008	7001
69	5.1	9260	47228	8115
70	4.3	10183	43786	9249
71	4.2	11724	49242	10389
72	4.5	10411	46850	10772
73	4.3	13543	58237	11892
74	4.8	10509	50445	11487
75	4.1	12983	51766	12345
76	3.9	14118	52235	12536

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

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

C = Total demersal catch (in tons as reported at WG for 1960-76 and from Bull. Stat. prior to this)

D = Running 3 year mean of B

Linear model: $A = 9.30 - 4.476 \times 10^{-4} \times D$

$r^2 = .81$

Exponential model: $A = 10.39 \times e^{-7.814 \times 10^{-5} \times D}$

$r^2 = .85$

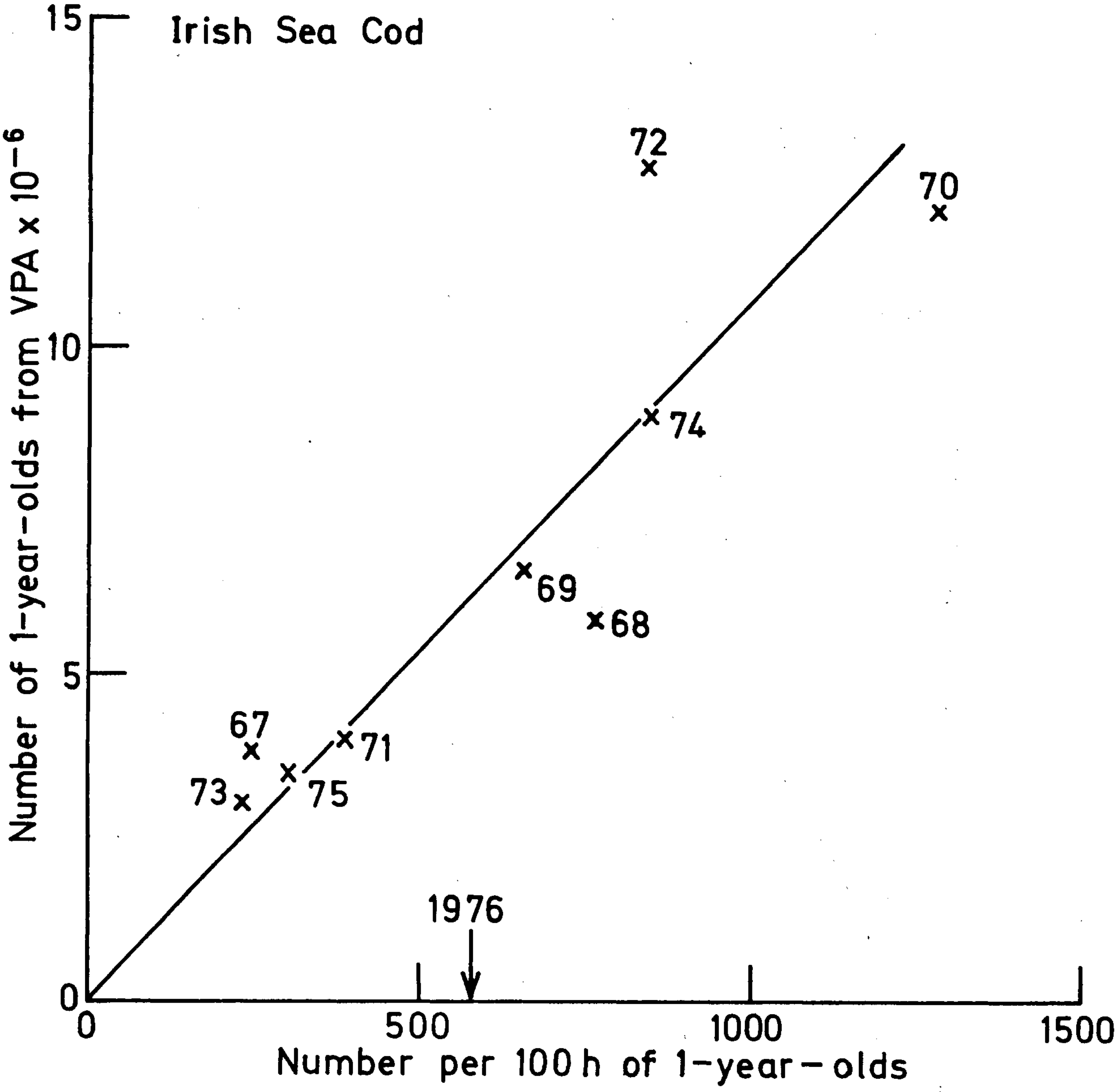


Figure 2.1 Abundance of 1-year-old cod from VPA plotted against catch per effort of 1-year-olds in U.K. 4th quarter catch.

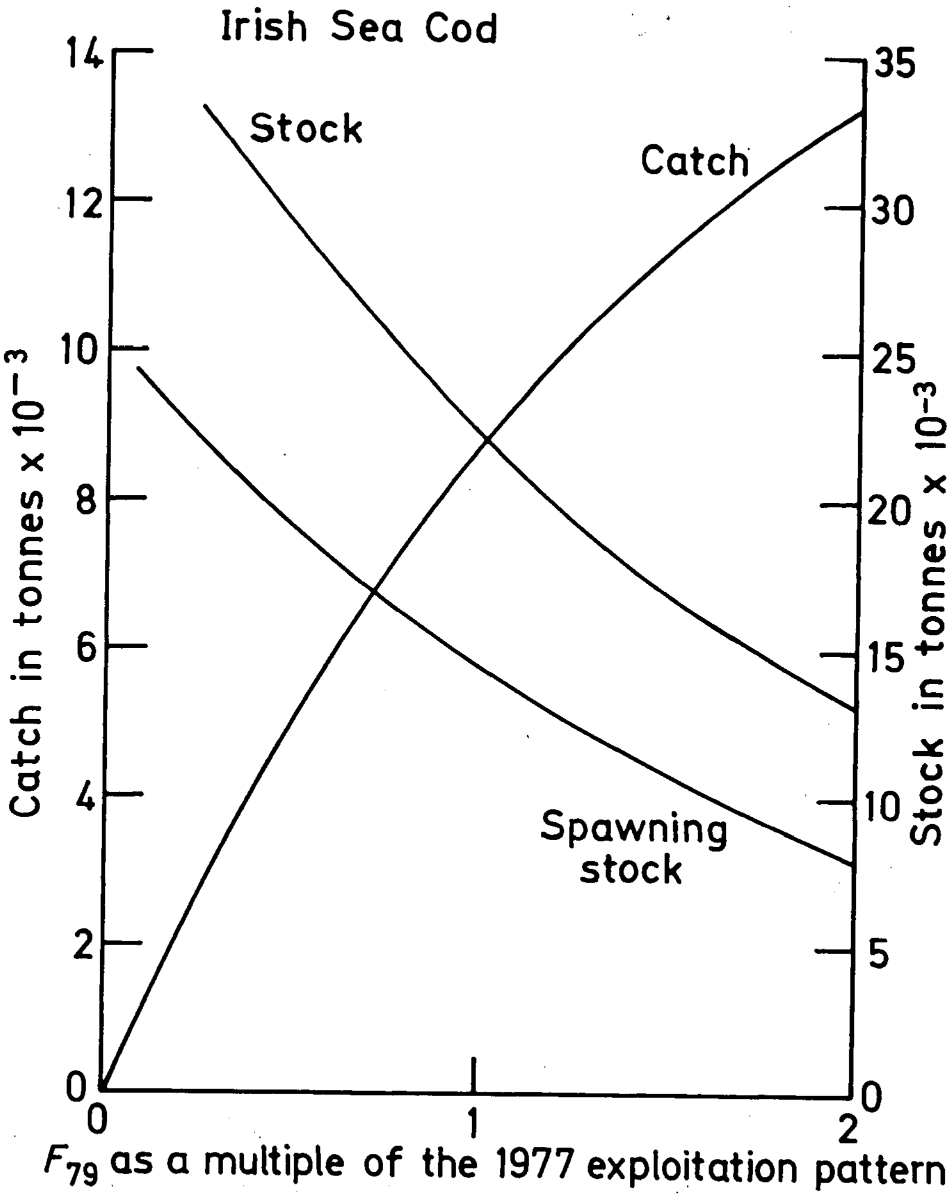


Figure 2.2 Relationship between F and catch in 1979 and stock in 1980.

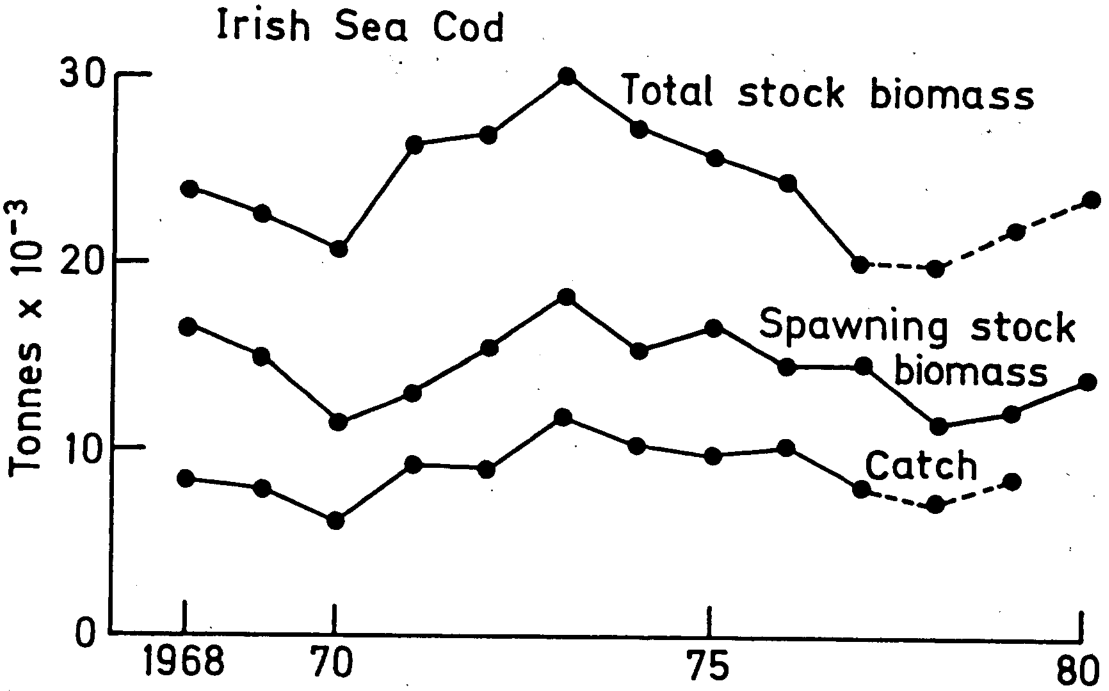
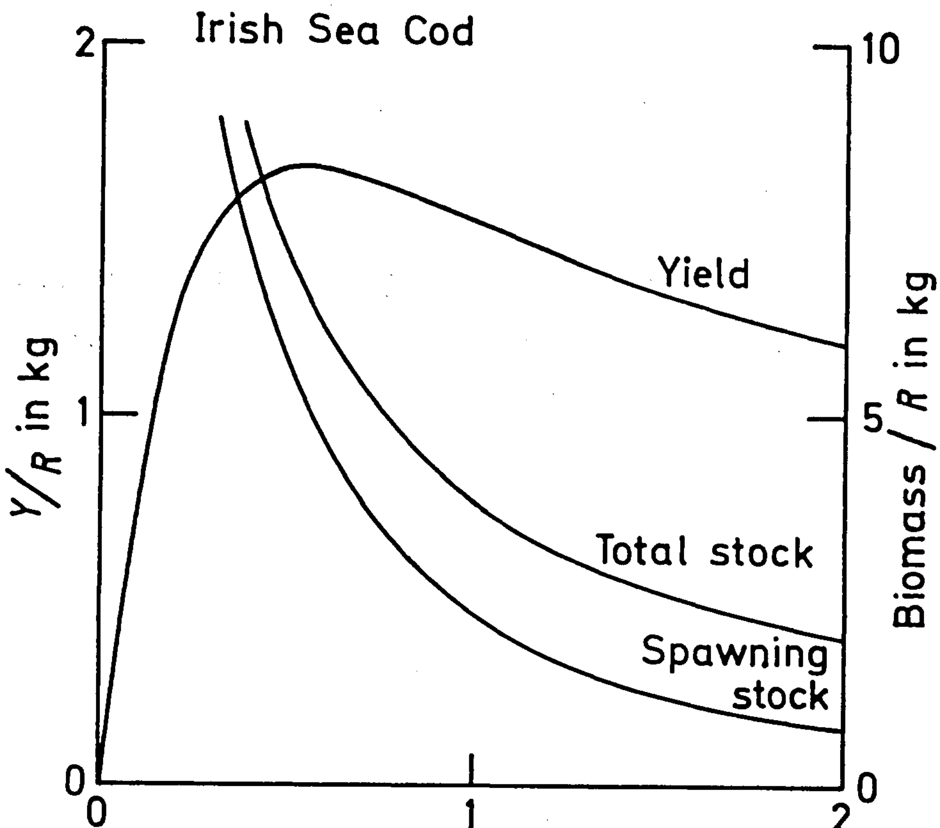


Figure 2.3 Actual and projected trends in catch and biomass.



F as multiple of 1977 exploitation pattern

Figure 2.4 Yield per recruit conditional on 1977 exploitation pattern.

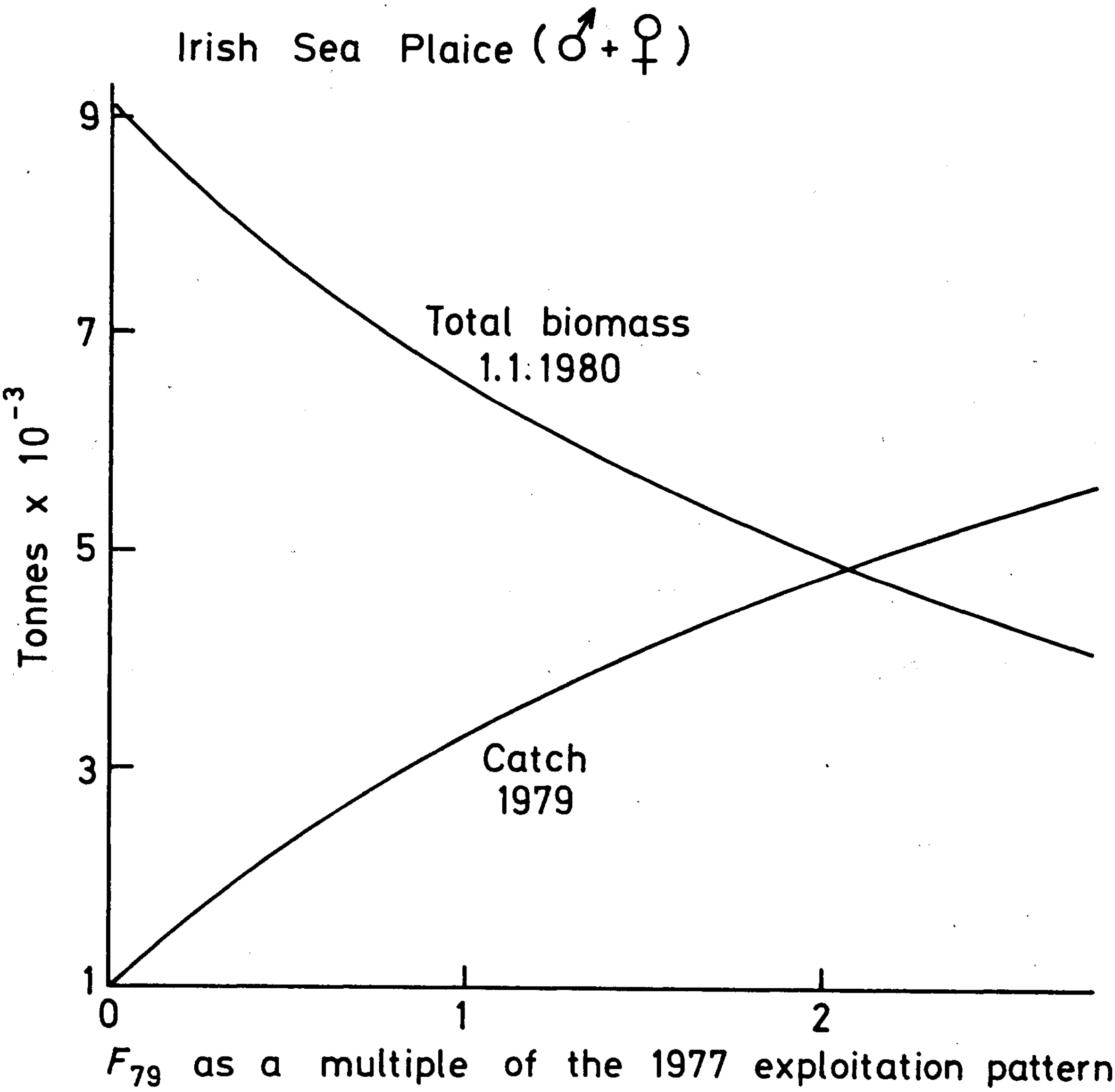


Figure 4.1 Relationship between F and catch in 1979 and stock in 1980.

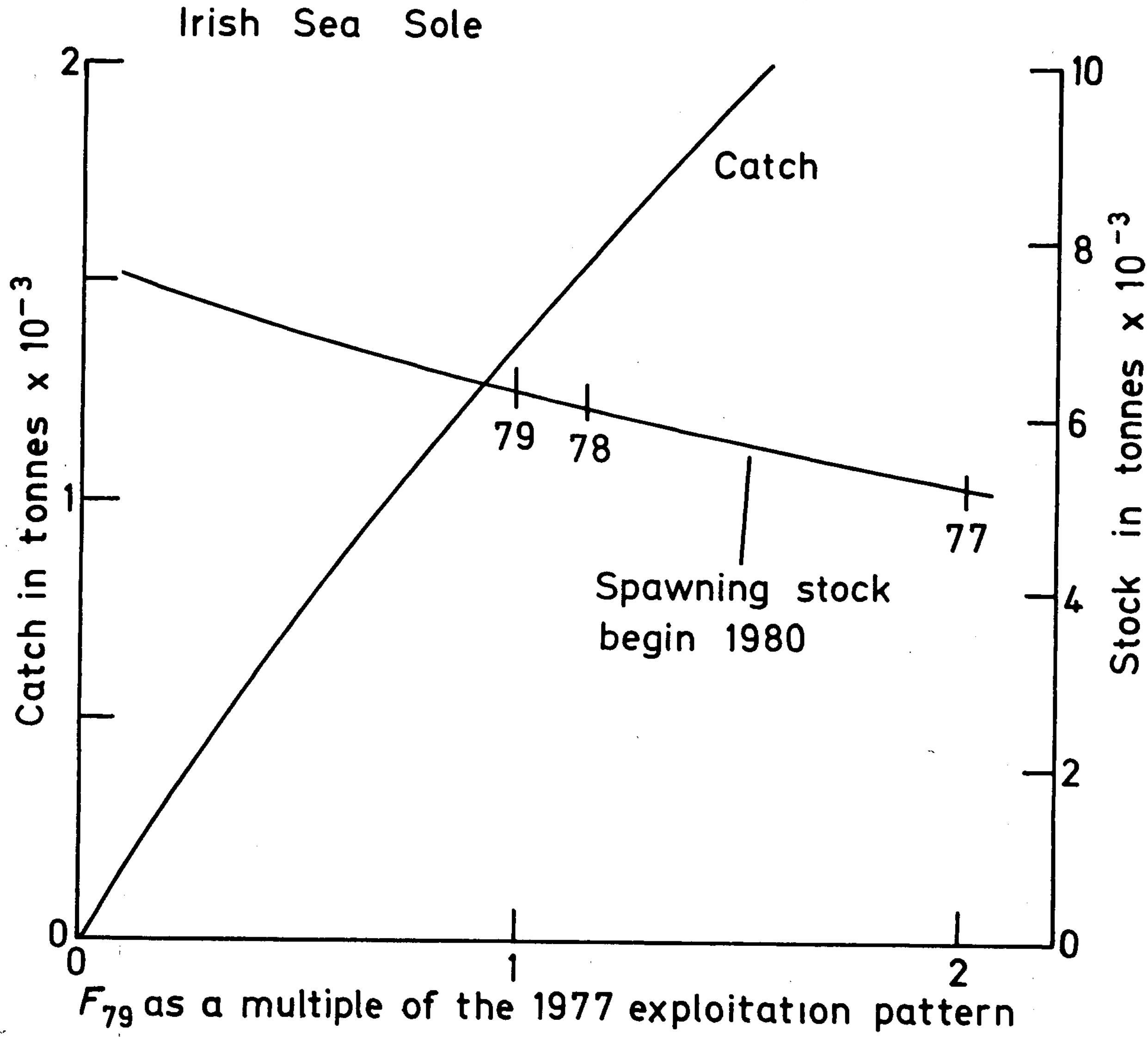


Figure 6.1. Relationship between F and catch in 1979 and spawning stock biomass in 1980.

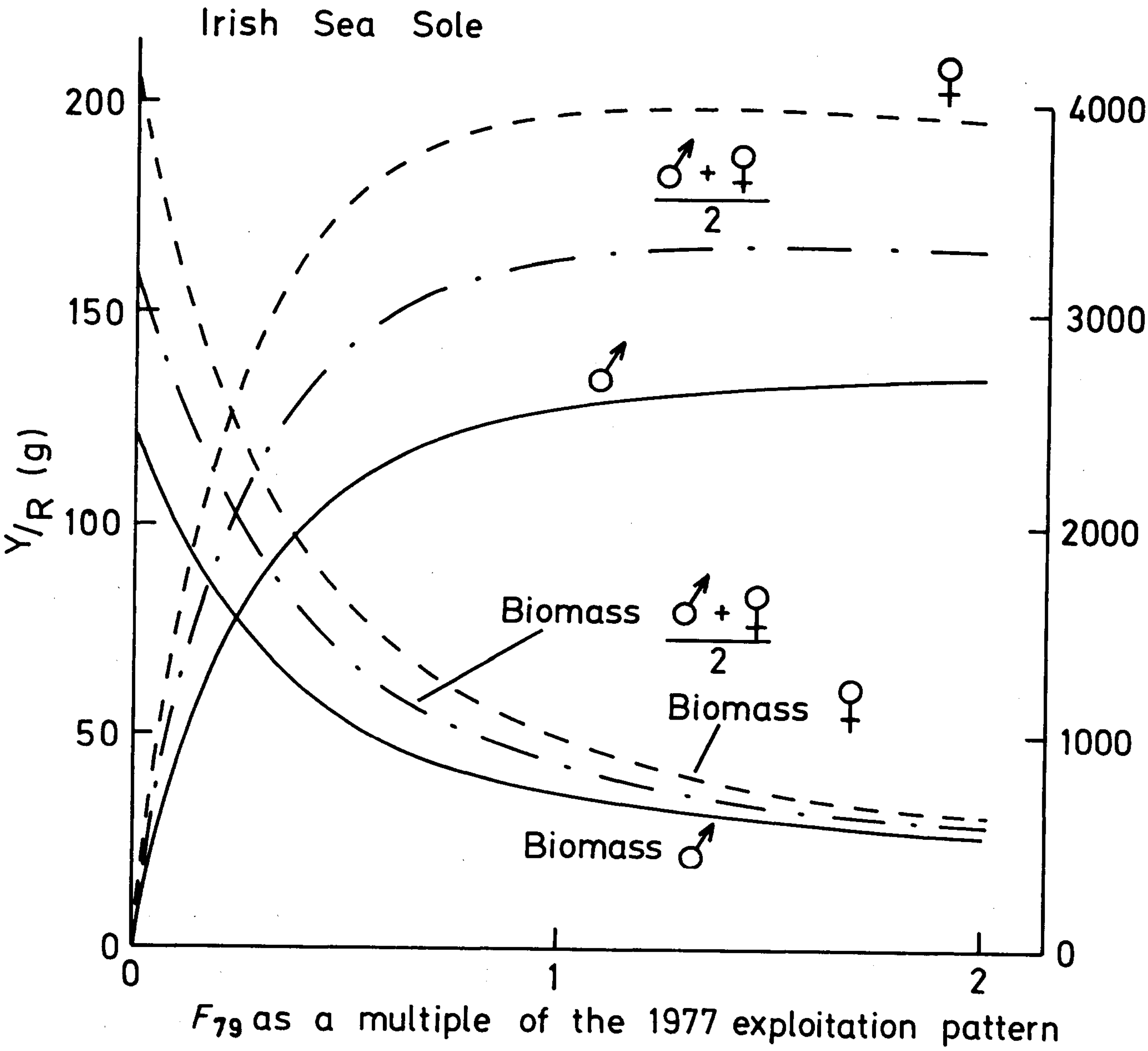


Figure 6.2 Yield per recruit conditional on the 1977 exploitation pattern.

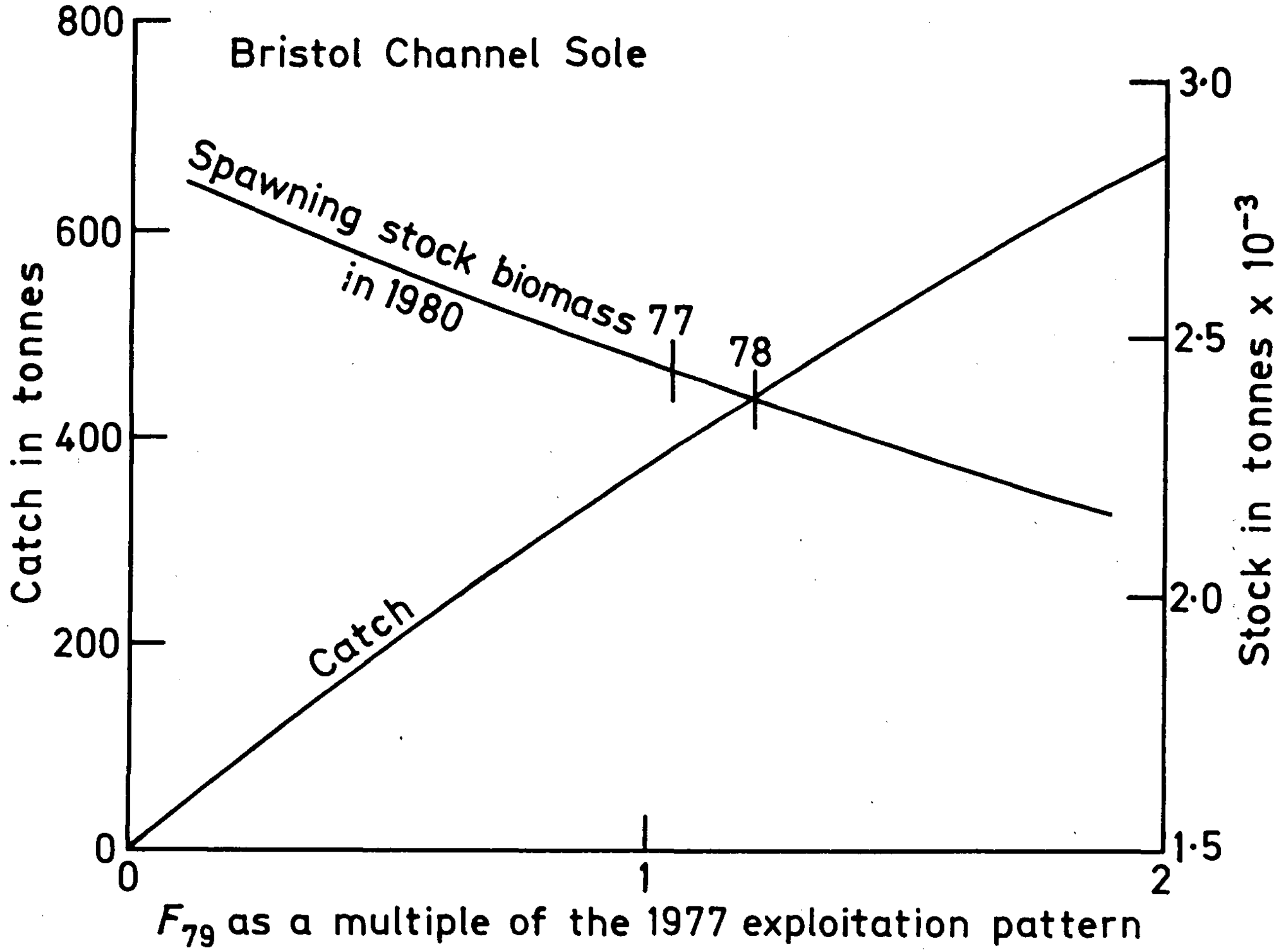


Figure 7.1. Relationship between F and catch in 1979 and spawning stock in 1980

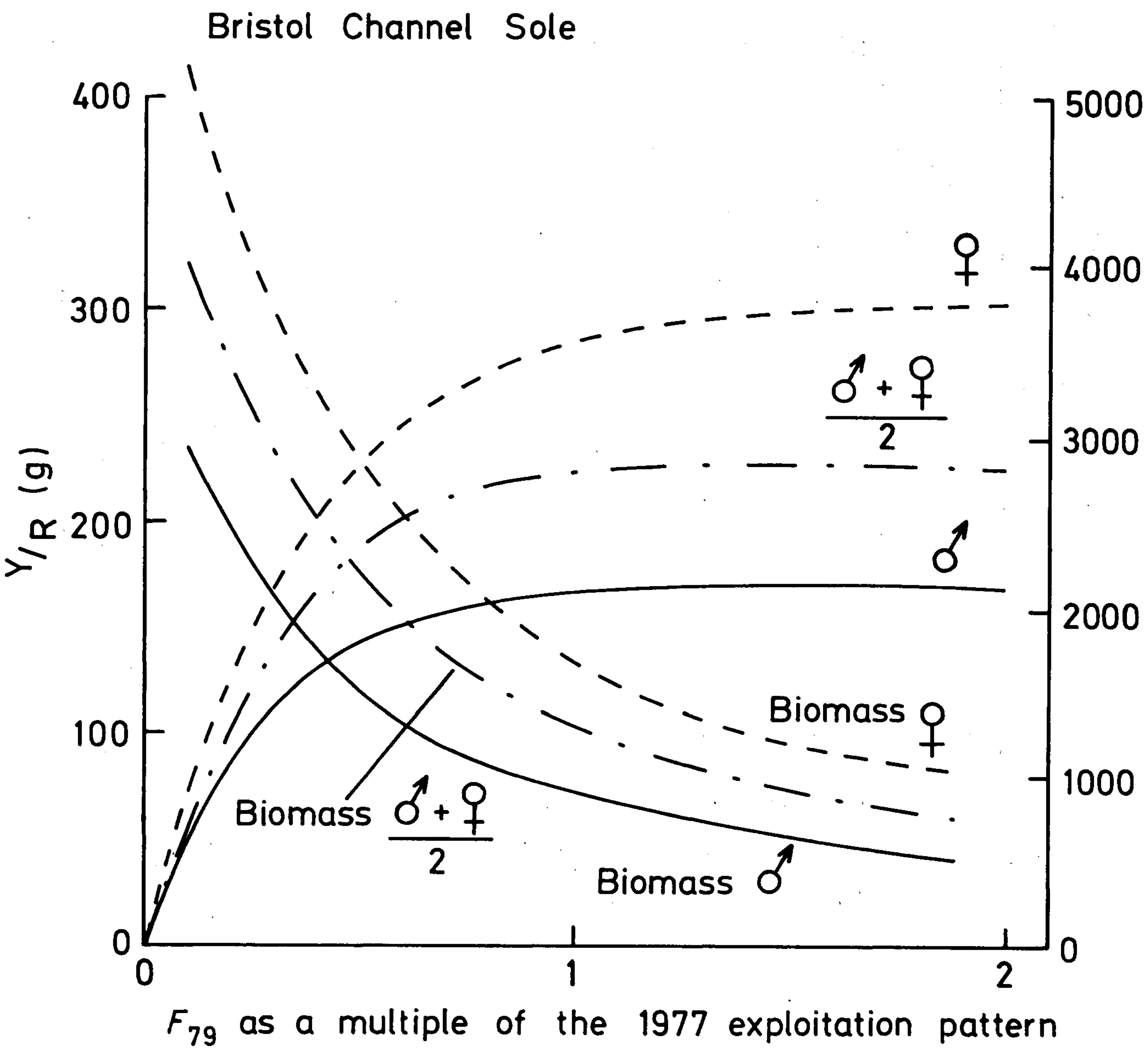


Figure 7.2 Yield per recruit conditional on 1977 exploitation pattern.

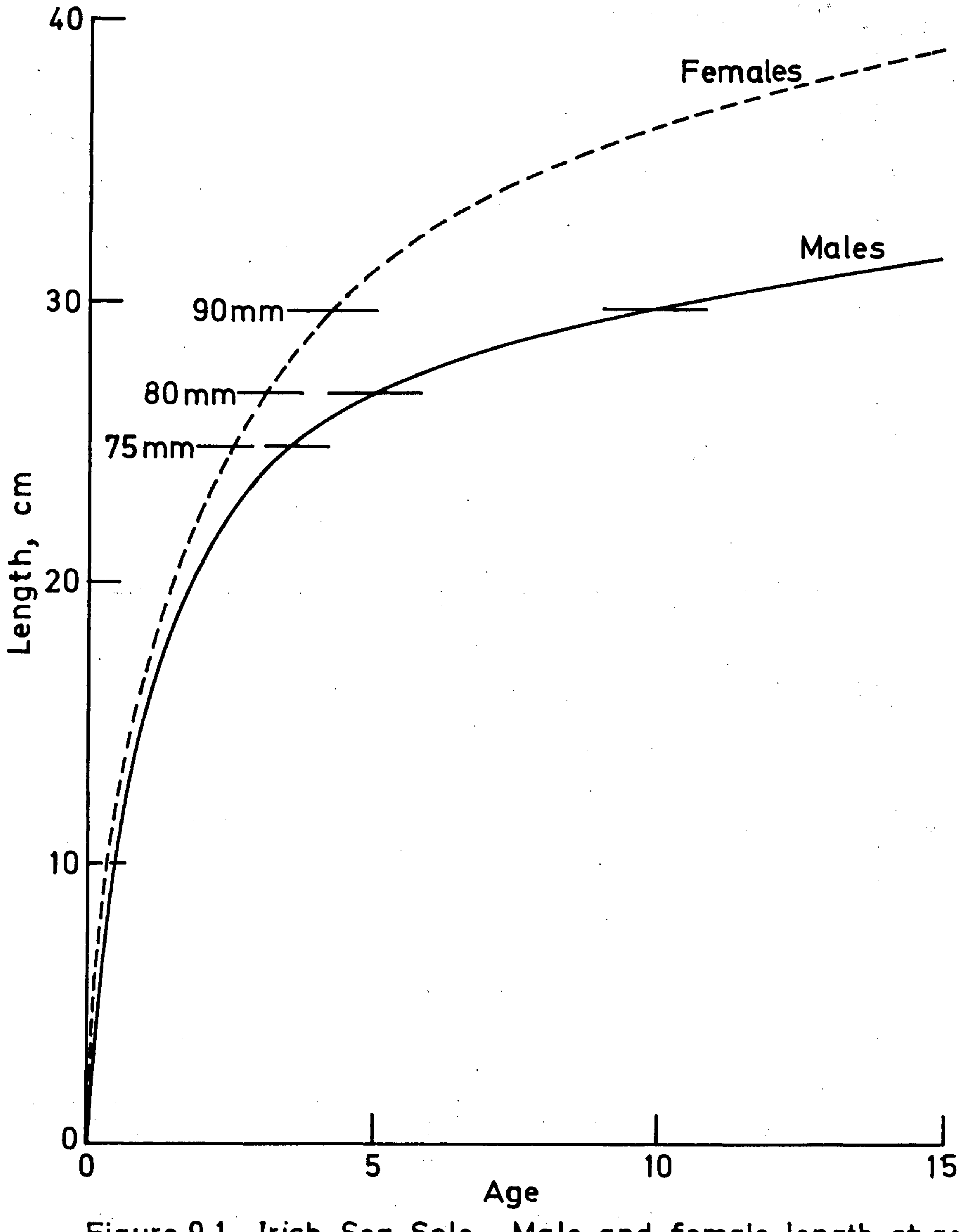


Figure 9.1 Irish Sea Sole. Male and female length at age

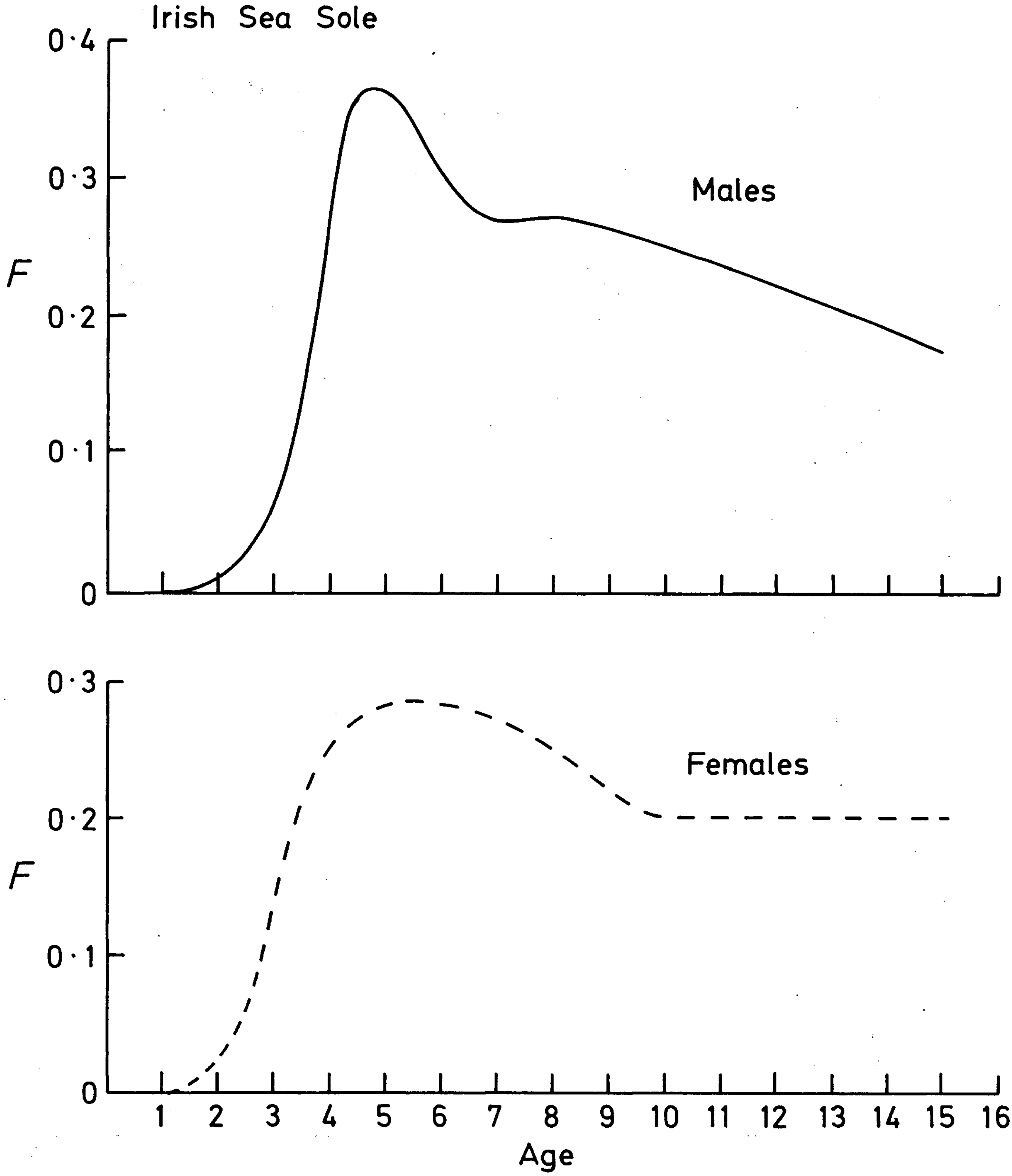


Figure 9.2 Exploitation patterns for 75 mm mesh. (double synthetic)

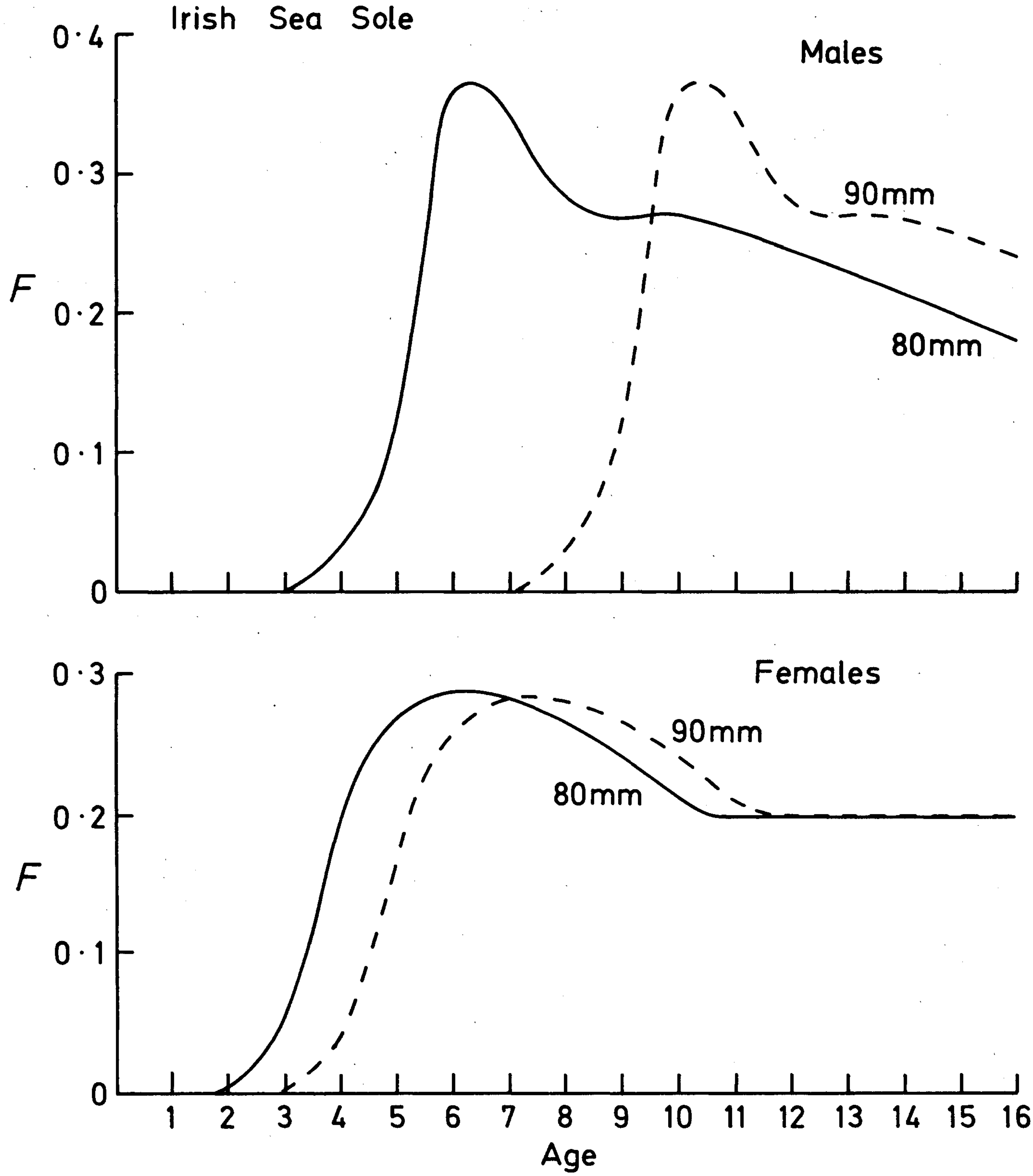


Figure 9·3 Exploitation patterns for 80 mm & 90 mm mesh (double synthetic)

Irish Sea Sole. Mesh assessment

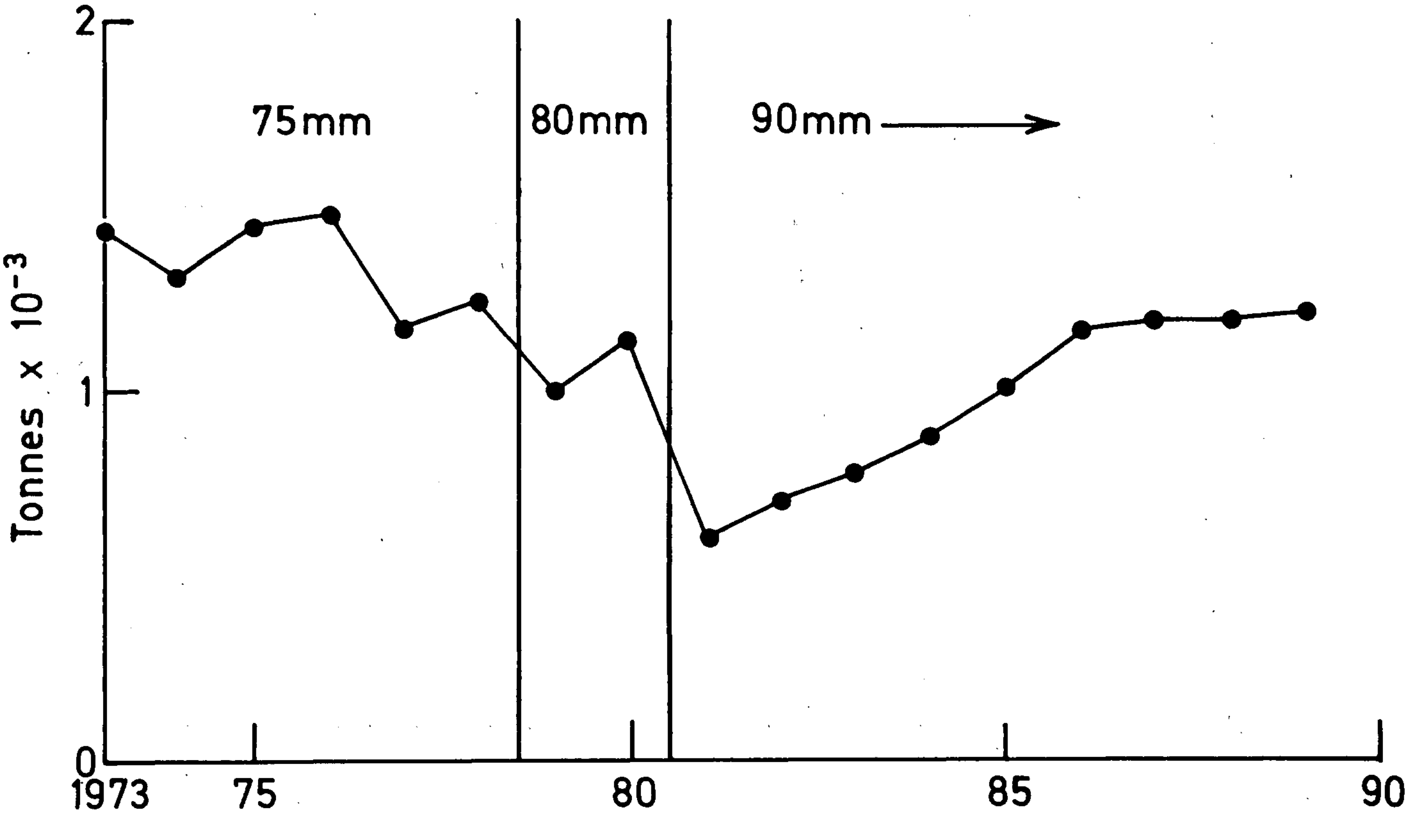


Figure 9.4

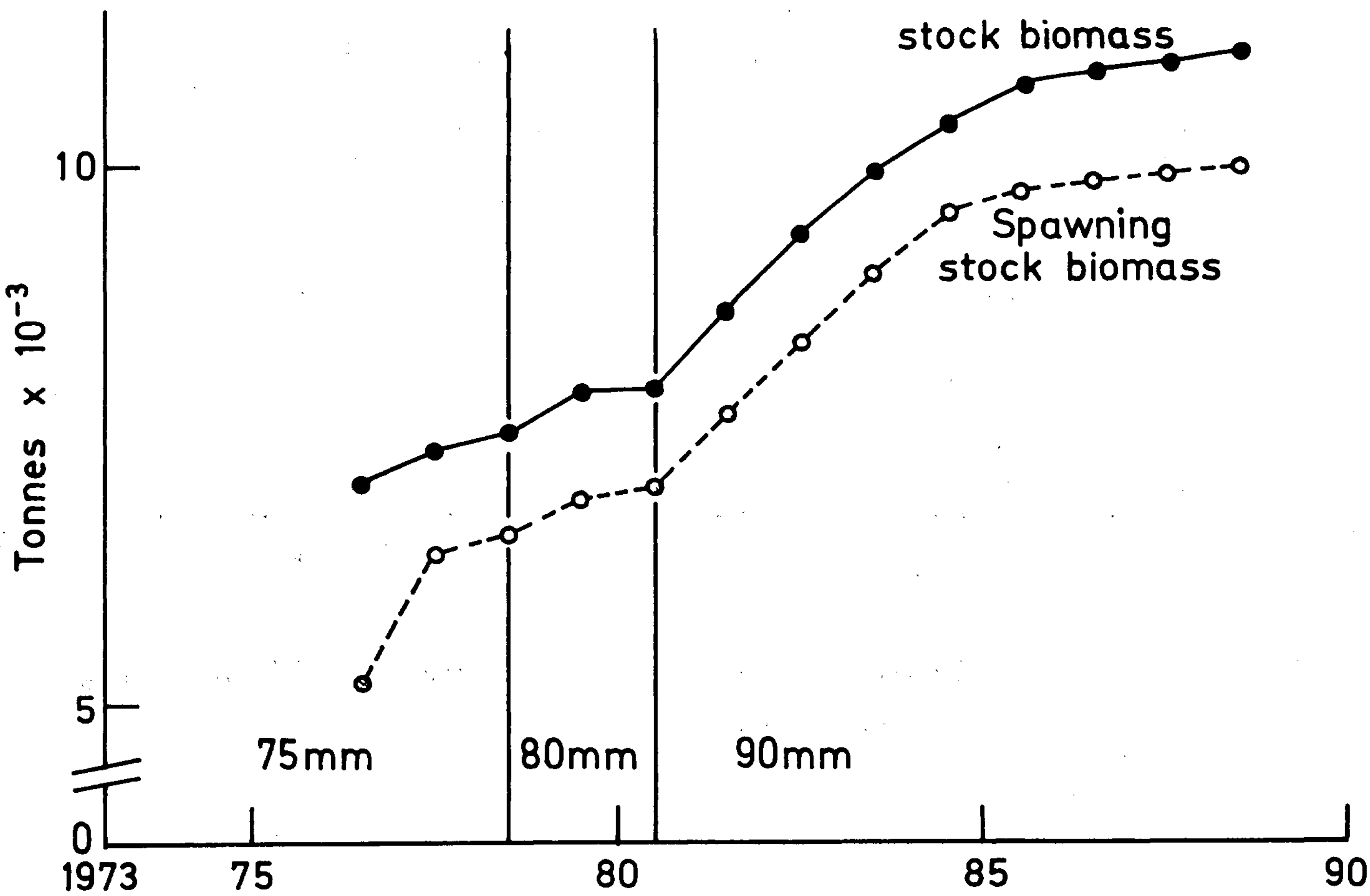


Figure 9.5

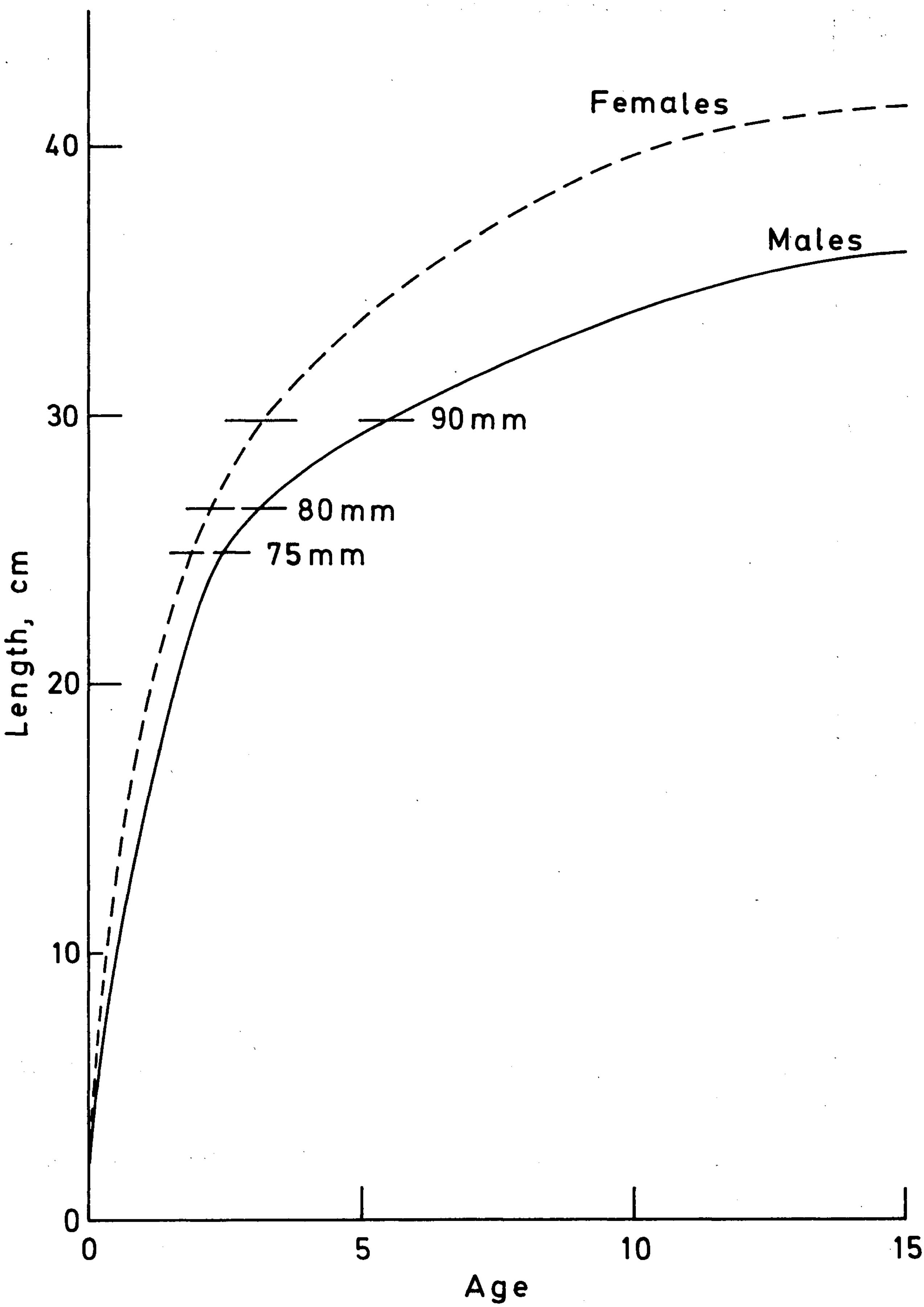


Figure 9.6 Bristol Channel Sole. Male and female length at age

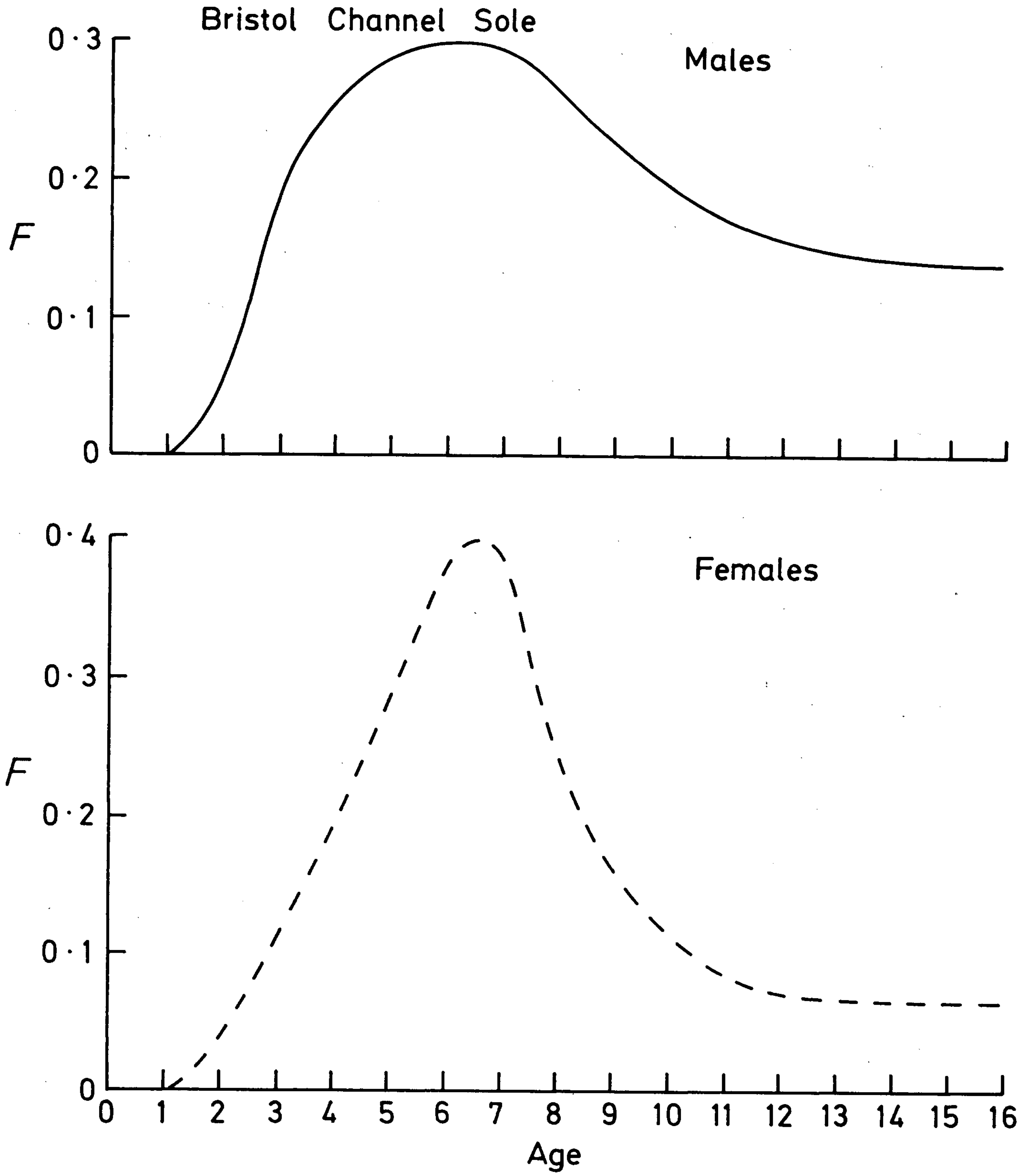


Figure 9.7 Exploitation patterns for 75 mm mesh (double synthetic)

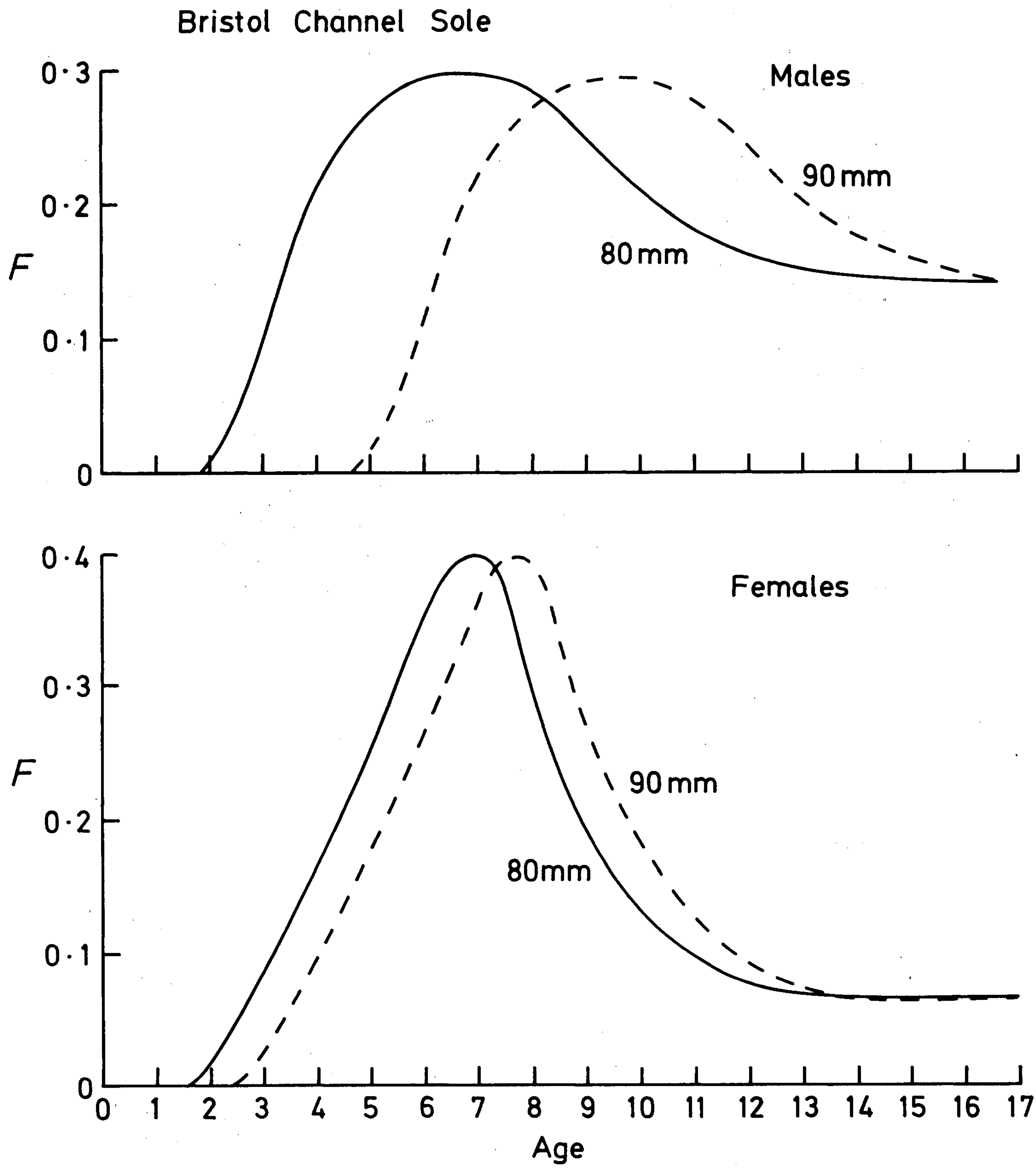


Figure 9.8 Exploitation pattern for 80 & 90 mm mesh.

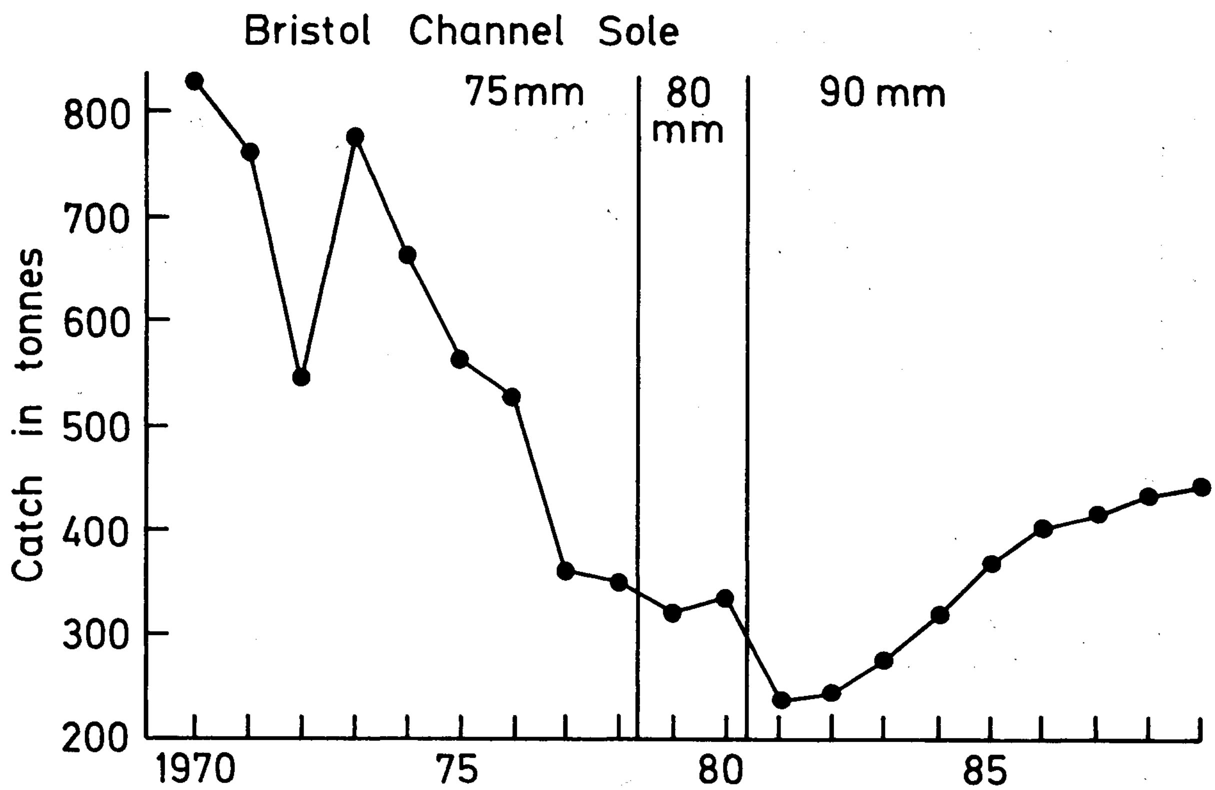


Figure 9.9 Mesh assessment

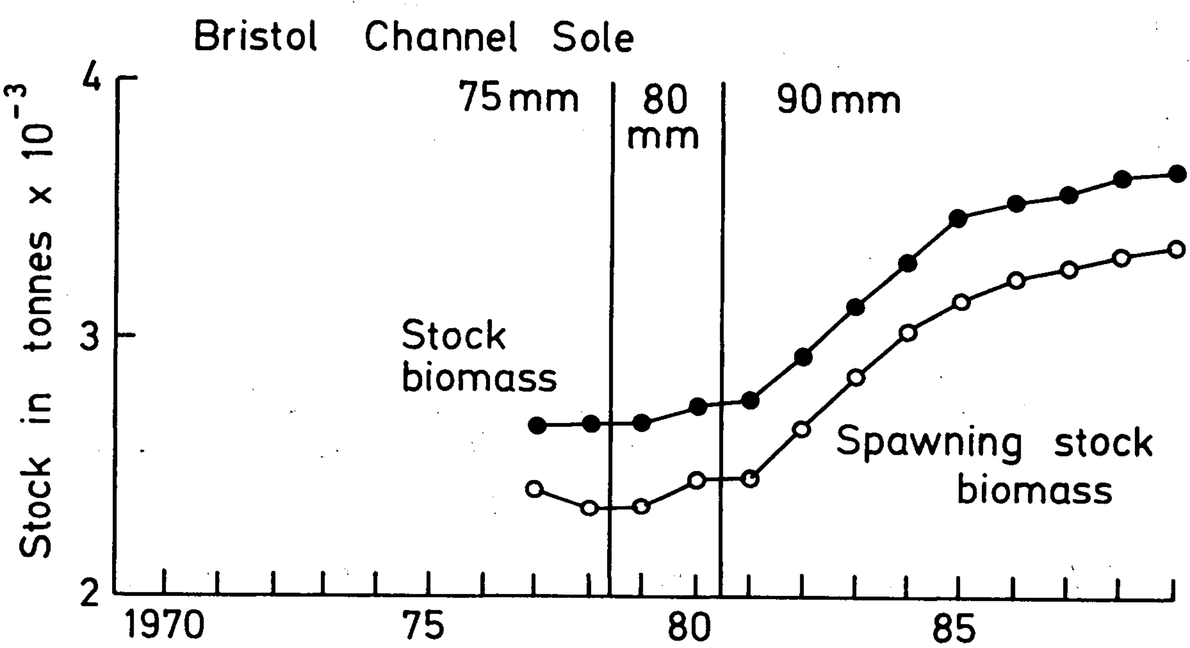


Figure 9.10 Mesh assessment

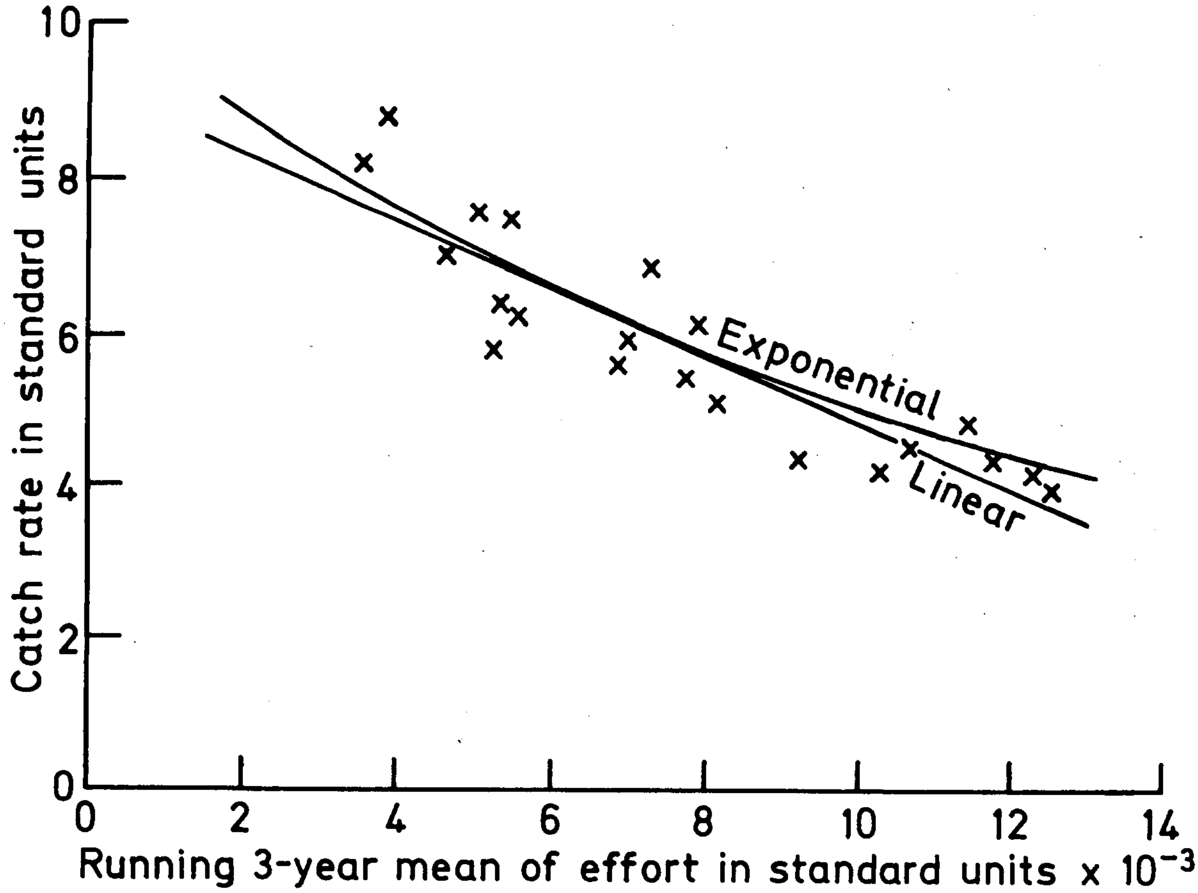


Figure 12.1. Relationship between total demersal catch rate and total demersal effort for the Irish Sea and Bristol Channel.

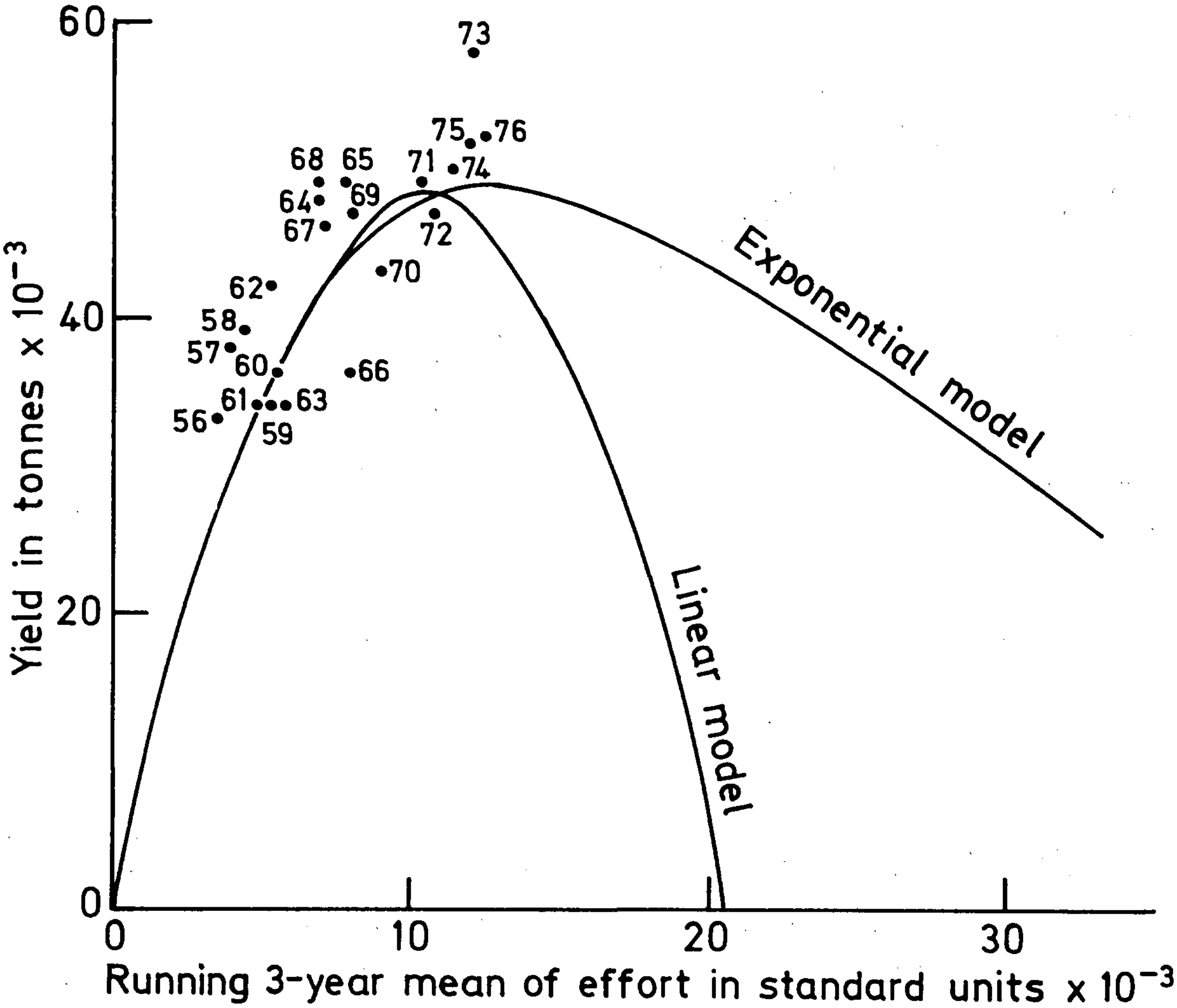


Figure 12.2 Total demersal yield curves for the Irish Sea and Bristol Channel.