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International Council for the
Exploration of the Sea

C.M.1976/H:2
Pelagic Fish (Northern) Committee

REPORT OF THE HERRING ASSESSMENT WORKING GROUP

FOR THE AREA SOUTH OF 62°N

Charlottenlund, 26 February - 6 March 1976

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 an advice given on behalf of the Council. The proviso that it shall not be cited without prior reference to the Council should be strictly observed.

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Report of the Herring Assessment Working Group for the Area South of 62°N

1. Introduction and Participation

1.1 The Herring Assessment Working Group for the Area South of 62°N met at Charlottenlund in the period 26th February - 6th March 1976 to report to the Liaison Committee meeting in April 1976 on the following subjects:

(a) reassessment of the state of, and appropriate levels of TAC for, North Sea and Skagerak herring in 1976 and 1977;

(b) the TAC level for Celtic Sea herring in the period 1 April 1977 - 31 March 1978;

(c) the appropriate level of TAC for Division VIa herring in 1977;

(d) assessment of the herring population in the Northern Irish Sea (Division VIIa), and the provision of advice on the TAC level, if required;

(e) reassessment of North Sea sprat, and the appropriate TAC level for 1977;

(f) assessment of the state of the sprat stock in Division IIIa and advice on the need for regulatory action.

The Working Group was also asked to provide further advice on a minimum landing size for North Sea herring.

1.2 Member countries were represented by the following scientists:

Dr H Ackefors	Sweden
Dr R S Bailey	U.K. (Scotland)
Mr A Bowers	U.K. (England)
Mr E Bakken	Norway
Mr A Corten	Netherlands
Dr S Fedorov	U.S.S.R.
Mr J Jakobsson	Iceland
Dr A Lindquist	Sweden
Mr M Liwoch	Poland
Dr A Malkov	U.S.S.R.
M A Maucorps	France
Mr J Molloy	Ireland
Mrs E Nielsen	Denmark
Mr K Popp Madsen	Denmark
Mr K H Postuma	Netherlands
Mr A Saville (Chairman)	U.K. (Scotland)
Dr A Schumacher	Federal Republic of Germany
Mr G Speiser	Federal Republic of Germany
Mr Ø Ulltang	Norway
Mr K Vickers	U.K. (Northern Ireland)
Mr R J Wood	U.K. (England)
Mr O J Østvedt	Norway.

1.3 During the course of the meeting the Working Group had the opportunity to discuss with the Chairman of the ICES ADP Working Group, and with members of the Danish Institute for Fisheries and Marine Research concerned with the development of the ADP system, recent refinements in the programme for handling herring data. Comments on this system are given in Section 8.

2. North Sea

2.1 The fishery in 1975

2.1.1 In Table 2.1 catch data for the years 1966-75 are given (preliminary for 1975). The total North Sea catch in 1975, excluding Skagerak, amounted to 302 567 tons which is about 27 000 tons higher than in 1974. Thus, the catches of the two last years are the lowest on record, with the exception of the war years 1915-17 and 1941-42.

2.1.2 In previous years the preliminary estimates have increased by about 10% when the final catch data have become available. It is, however, expected that for 1975 the change will be considerably less but even with such an increase the catch for 1975 will be less than 340 000 tons. The Skagerak catch decreased from 55 512 tons in 1974 to 52 129 tons in 1975 (Table 2.2).

2.1.3 Tables 2.3-2.7 give the catch data for the sub-divisions of the area used in the previous reports. In area IVaE the catches in 1975 decreased to 9 014 from 15 377 tons in 1974. In area IVaW the catch in 1975 increased to 99 679 tons from the very low 1974 catch of 84 174 tons. In Division IVb the total catch in 1975 was 177 810 tons which is about 10 000 tons higher than in 1974. The socalled adult fishery (for human consumption) decreased from 116 000 tons in 1974 to about 88 000 tons in 1975 (Table 2.5) whereas there was a corresponding increase in the young herring fisheries (for industrial purposes including by-catches) from about 52 000 tons in 1974 to about 90 000 tons in 1975. In Division IVc and Division VIId the catch in 1975 increased to about 23 000 tons from 7 383 tons in 1974.

2.1.4 The numbers of herring at each age in the catches in each area are given in Table 2.8 and those for the total North Sea are summarised in the text table below. Annual catches in numbers per age group in each of the last ten years are given in Table 2.10.

Millions of herring caught per age group (winter rings)

Year \ Age	0	1	2	3	4	5 and older	Total
1971	684	4 378	1 147	622	208	97	7 177
1972	750	3 341	1 441	344	131	40	6 047
1973	289	2 368	1 344	659	150	96	4 906
1974	992	838	718	327	114	79	3 069
1975	261	2 436	528	254	139	88	3 706

2.1.5 The catches of 0-group herring in 1975 have decreased sharply from the very high 1974 level, whereas the catches of the 1-group have almost trebled. Catches of 2-ringers, and older were at an even lower level than in 1974.

2.1.6 The catch in numbers was calculated for the Skagerak catches for the second year running (Table 2.9) and the 1974 figures were updated according to the final catch figures. In 1975 there was a sharp decrease in 0-group catches as compared with 1974, whereas the catch in numbers of older age groups increased.

2.2 Fishing mortality in 1975

2.2.1 Fishing mortality on adults (year class 1972 and older)

Few direct estimates for $F_{adults\ 1975}$ were available. The total mortality rate calculated from Dutch catch per unit effort data in the central North Sea was 1.89. This is probably an overestimate, due to fluctuations in availability. The mean figure of 0.92 for the last three years may be a more reliable estimate.

In the absence of any other direct information on the $F_{adults\ 1975}$, a value of 0.90 was used as the estimate for $F_{adults\ 1975}$. The catch prediction and the VPA have been based on this figure.

2.2.2 Fishing mortality on 1-ringers (year class 1973)

No direct estimate for $F_{1\text{-ringers}\ 1975}$ was available. However, there is an estimate of the stock of 1-ringers at the beginning of 1975 derived from the Young Herring Survey. This year class was estimated at 4.9×10^9 (para. 2.4.3). The catch of $2\ 436 \times 10^6$ 1-ringers in 1975 then corresponds to an $F_{1\text{-ringers}\ 1975} = 0.73$.

As the stock estimate from YHS may not be very accurate, it was considered unwise to base the $F_{1\text{-ringers}\ 1975}$ exclusively on the YHS estimate. A second estimate, derived from catch per unit effort data from the young herring fisheries in the central North Sea, indicated a year class strength of the 1973 year class as 0-group of 6.3×10^9 and corresponding to 4.76×10^9 1-group in 1975. This estimate is very close to that obtained from the Young Herring Survey and would indicate an F for 1-ringers in 1975 of 0.8. A third indication of $F_{1\text{-ringers}\ 1975}$ was based on the results of the VPA (Section 2.3). The mean value for $F_{1\text{-ringers}}$ over the period 1967-70 was about 0.5, but it increased to about 0.95 in 1971-73 and has probably remained about this level in subsequent years.

In the light of the above information a value of 0.90 was used as the best estimate for $F_{1\text{-ringers}\ 1975}$.

2.2.3 Fishing mortality on 0-group (year class 1974)

No direct estimate for $F_{0\text{-group}\ 1975}$ was available. Preliminary data from the YHS in 1976 indicate a year class strength of $2\ 051 \times 10^6$ as 1-ringers in the beginning of 1976 (Section 2.4.4). A catch of 261×10^6 0-group in 1975 would then have corresponded to an $F_{0\text{-group}} = 0.11$.

In view of the possible errors in the YHS estimates, the Working Group decided to base its estimate of $F_{0\text{-group}\ 1975}$ on VPA results for the period 1971-73. Values of $F_{0\text{-group}}$ over this period ranged from 0.11 to 0.17 with a mean of 0.14.

A third indication of $F_{0\text{-group}\ 1975}$ may be derived from the development of the sprat fishery in the central North Sea. As most of the 0-group herring are caught as by-catch in this fishery, a change in the effort will affect $F_{0\text{-group}}$ in herring. The average effort in 1971-73 of 42.7 thousand hours increased in 1975 to 55.9 thousands hours or by 30%. Applying this increase to the average $F_{0\text{-group}}$ in 1971-73 of 0.14, as stated above one arrives at an $F_{0\text{-group}\ 1975}$ of 0.18.

In the light of the above information, a figure of 0.18 was used as the estimate for $F_{0\text{-group}\ 1975}$.

2.3 Results from VPA

2.3.1 Calculated fishing mortalities and stock sizes for the period 1966-74 are given in Tables 2.11 and 2.12. It should be noted that the estimates of fishing mortality and stock size for 1974 are highly dependent on the input F's for 1975 and too much reliance should not be placed on them.

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2.3.2 The VPA results presented in the previous report (Doc. C.M.1975/H:2) indicated that fishing mortality on 1-ringers in 1971 had increased sharply from about 0.5 to about 0.95. The VPA results presented in Table 2.11 confirm that in 1971 the fishing mortality on 1-ringers was in fact at this high level. The table further indicates that this high fishing mortality on 1-ringers has been continued in later years.

2.3.3 The fishing mortalities on adult fish in the period 1968-73 has remained at a level of about 1.0 which is more than twice the level giving the maximum yield per recruit.

2.3.4 It should be noted that the changes in fishing mortalities in 1972 and 1971 due to the new input data for 1975 are very small giving only slightly lower mortalities in 1971-72 than in the previous assessment. Calculated stock size biomass for 1971 and 1972 are slightly higher than those given in the previous report (C.M.1975/H:2).

2.3.5 The year class 1972 has now been estimated for the first time from VPA. The figure of 2.42×10^9 still depends to some extent on the input of F in 1975 but it would indicate that the 1972 year class is about 31% of the long-term mean (1962-69 (C.M.1972/H:13, p.13)). The year classes 1970 and 1971 are now estimated at 7.2×10^9 and 5.1×10^9 as 0-group respectively.

2.4 Recruitment

2.4.1 Methods for estimating recruitment

The first estimate of a new year class is normally based on two sources of information. One of them is the results of the ICES Young Herring Survey, which in recent years have been available at the time of the Working Group meeting. The YHS gives an estimate of the stock of 1-ringers at the beginning of the year. From the number of 0-group caught during the previous year and the assumed natural mortality rate one can estimate the initial year class strength.

The other estimate of year class strength is obtained from catches of 0-group, and an assumption of $F_{0\text{-group}}$ in the previous year. $F_{0\text{-group}}$ is estimated from past estimates from VPA, and from information on subsequent developments of fishing effort.

One year later, a second estimate of the same year class is derived from the catch of 1-ringers and an assumption of $F_{1\text{-ringers}}$. Each subsequent year the estimate of that year class becomes more precise.

The first estimate of a year class may contain considerable errors, as is evident from the table below, giving estimated values from earlier reports from the Working Group.

Estimates of year class strength as 0-group in No's $\times 10^{-9}$

Year class	First estimate made by Working Group	Second Working Group estimate	Third Working Group estimate based on catch 1-ringers	Most recent estimate from VPA
1970	11.8	11.8	-	7.2
1971	7.9[2]	7.9[2]	6.2	5.1
1972	7.9[2]	5.6[1]	2.8	2.4
1973	6.0	6.0	5.8	-
1974	2.5	1.7	-	-

1) Not available during Working Group meeting 1974.

2) For 1971 year class these estimates were based on indications from these sources that this year class was of average strength. For the 1972 year class no data were available and the year class was assumed to be average.

The year classes 1970 and 1971 are now estimated at 7.2×10^9 and 5.1×10^9 respectively. This means that they were originally overestimated by some 60%.

2.4.2 Year class 1972

The best estimate for year class 1972 now available is 2.4×10^9. It should be noted that this year class was overestimated in the Young Herring Survey by 175%. A much more accurate estimate of this year class was given in February 1975, when both the catches of 0- and 1-ringers were taken into account. The serious overestimation of this year class was one of the main causes of the overoptimistic assessment of the North Sea stock during the Working Group meeting in 1974.

2.4.3 Year class 1973

A first estimate of year class 1973 was available for the YHS in 1975. The regression of VPA stock size on YHS estimates, given in C.M.1975/H:9 was re-calculated, inserting the updated estimate for the 1971 year class and the preliminary estimate for the 1972 year class (Table 2.12). The new regression formula calculated is $Y = 0.00238 \times 1.34$. This gives an estimate of 4.9×10^9 1-ringers in 1975, and consequently an initial year class strength of 6.0×10^9 as 0-group.

A second estimate for year class 1973 was derived from VPA, assuming $F_{1\text{-ringers } 1975}$ to have been 0.90 (Section 2.2.2). This corresponds to a year class of 5.8×10^9 as 0-group. This figure was accepted as the best estimate for year class 1973 available, but is not completely independent.

2.4.4 Year class 1974

A first estimate on year class 1974 was available from preliminary data on the YHS in 1976. Using the regression formula given in 2.2.3, this year class would be estimated at 2.1×10^9 1-ringers in 1976. A catch of 261×10^6 0-group would then correspond to a stock of 2.5×10^9 0-group at the beginning of 1975.

A second estimate for year class 1974 was derived from VPA, assuming an $F_{0\text{-group } 1975}$ of 0.18 (Section 2.2.3). This corresponds to a year class of 1.7×10^9 as 0-group. This figure was accepted as the best available estimate for the year class 1974.

2.5 Estimates of relative spawning stock biomass from herring larval surveys

2.5.1 Provisional abundance estimates were calculated for the 1975/76 spawning season from the data obtained during the international surveys of herring larvae in the North Sea and adjacent waters. A comparison was made of the abundance estimates for herring larvae < 10 mm in length, and total herring larvae, between surveys made in 1975/76 and comparable surveys carried out during 1974/75. The results are given in Table 2.5.1, together with the percentage decrease or increase between the 1974 and 1975 estimates. The estimates were adjusted, where necessary, to take account of any significant differences in the distribution of sampling stations between the two years.

North Sea

2.5.2 There was a good coverage of the Orkney/Shetland area during the period 3-25 September 1975. Compared with roughly the same period in 1974 there was a decrease of over 60% in both the abundance estimate of the smallest larvae (< 10 mm), and of total larvae of all length groups. The survey between 20-25 September 1975 showed a reduction of 88% in larvae < 10 mm compared with a survey in 1974 covering a longer time period, but the total

number of all sizes of larvae showed a reduction of only 24%. These surveys, which covered the major spawning area in the northern North Sea suggest an overall decrease in herring larval production in 1975 of approximately 50%.

2.5.3 Central North Sea

Three extensive surveys were made in 1975 and abundance estimates for all of these were low compared with those of recent years. Due to the very poor coverage of this area in 1974 it was only possible to make one comparison between that survey and the corresponding one in 1975. Because the survey in 1975 was made a few days later than the one in 1974, it is more reasonable to compare the abundance estimates for all sizes of larvae rather than the estimates for only the smallest ones. A decrease of 52% is indicated for 1975.

2.5.4 Southern North Sea/Eastern Channel

Two surveys can be compared in this area, one in December and the other in January. The abundance estimates for both are extremely low, although low production has been a feature of this area for several years. Discounting the estimate for larvae <10 mm in the December survey, an overall decrease in production in 1975 of the order of 50% is indicated.

2.5.5 Decrease in the size of the spawning stock

There was a decrease in herring larval production in all spawning areas of the North Sea in 1975/76 of roughly 50% compared with 1974. In the southern North Sea, an area which has contributed only an insignificant proportion of the total North Sea larval production in recent years, there was a substantial increase in the herring catch during the spawning season, probably indicating an increase in the number of herring in the area. The very low numbers of larvae subsequently caught, however, may indicate that a high proportion of these herring were caught before they were able to spawn. The total population of adult North Sea, 3 years and older, from the stock prognosis shows a reduction, both in the number of potential spawners, and in stock biomass of 45% in 1975 from the 1974 levels. This estimate of the reduction in the size of the stock of spawning herring in the North Sea in 1975 is therefore in very close agreement with that deduced independently from the reduction in larval production, estimated from the international survey of herring larvae.

2.6 TACs for 1976 and 1977

In the report of the Liaison Committee in October 1975 the Working Group advised that, in the light of the evidence of the very low spawning stock size for North Sea herring and the dangers in this situation of continued low recruitment, it was imperative that action should be taken to rebuild the stock as quickly as possible. Accordingly, it advised a complete prohibition of a directed fishery for North Sea herring and more rigid restrictions on by-catch of herring in the mixed fisheries. With the new data available to the 1976 meeting the spawning stock size as at 1 September 1976 was estimated at 249 000 tons. This is 100 000 tons greater than the estimated spawning stock for 1975, due to the recruitment of the 1973 year class, which appears to be appreciably stronger than that of 1972. This estimate was based on the assumption that the TAC of 87 000 tons agreed by NEAFC for the period 1 January - 30 June 1976 would be taken, and that there would be no fishing after 30 June 1976.

However, a spawning stock of 249 000 tons is much less than that required to ensure optimal recruitment. In Figure 1 the relationship between spawning stock size, and the recruitment which that spawning stock produced over the period 1952-74, is shown. This suggests that there is a relationship between stock size and recruitment at stock sizes below about

800 000 tons. The low spawning stock sizes in the period 1968 to 1974 have produced, on average, recruitments well below the long-term mean. The value of about 800 000 tons is about 30% of the spawning stock biomass in the late 1940s, when this stock was only lightly exploited.

The relation between the lightly exploited spawning stock size and that at which recruitment failed was examined for other herring stocks in the ICES area. In the Atlanto-Scandian herring it is rather difficult, because of the wide annual variations in recruitment to judge at what spawning stock size the sustained decline in recruitment occurred; but this would appear to have been at a level of $\frac{1}{2}$ - $\frac{1}{4}$ of the lightly exploited stock (Dragesund and Ulltang, 1975). Similarly for Icelandic spring and summer spawners the data presented by Jakobsson (1973) would suggest that in these stocks the recruitment decline started at a spawning stock biomass of about 1/3 and 1/2 of the lightly exploited stock respectively. The relative consistency of these values might suggest that when no stock/recruitment relationship can be demonstrated, a value of about 1/3 of the lightly exploited stock might be taken as being a realistic value at which to take measures to rebuild the spawning stock for herring.

In this situation the Working Group can only reiterate their advice that it is imperative to rebuild the spawning stock as quickly as possible. In the light of the stock/recruitment relationship shown in Figure 1, it was decided that the initial objective should be to attain a spawning stock size of about 800 000 tons as quickly as possible. A prognosis was carried out of the time which will be necessary to achieve this on the assumption of (i) a complete ban on a directed herring fishery; (ii) with two options of exploitation resulting from the by-catch in other Recommendation 2 fisheries, and (iii) recruitment estimated from the stock/recruitment relationship given in Figure 1. One of these options (F for 1-group = 0.8, F for 0-group = 0.15) is at approximately the level of the fishing mortality rates on these age groups in recent years. The alternative option is at half these fishing mortality rates to give a measure of the likely effect of restrictions on the fisheries which produce these by-catches. The results are shown in the text table below.

Year / Mixed fishery F's		1975	1976	1977	1978	1979	1980
$F_{0\text{-group}} = 0.15$	A	146	249	351	494	696	930
$F_{1\text{-group}} = 0.80$	B	3	4.4	5.3	6.5	7.4	8.0
$F_{0\text{-group}} = 0.075$	A	146	249	381	599	922	-
$F_{1\text{-group}} = 0.40$	B	3	4.4	5.6	7.2	7.9	-

A = spawning stock biomass in thousand ton units.

B = recruitment produced by that spawning stock as 0-group x 10^{-9} (from Figure 1).

This shows that even with a complete ban on directed fisheries for herring after 30 June 1976, the stock will not reach the requisite level of 800 000 tons until September 1980, if the current level of exploitation of juvenile herring continues. If the current level of exploitation of juvenile herring in the mixed fisheries is halved, this stock level will be reached one year earlier, in September 1979.

It must be stressed that these results are highly dependent on the estimates of recruitment for the 1975 and subsequent year classes which were obtained from Figure 1. As there is considerable variability of the annual values about this line, the requisite stock level could be obtained somewhat earlier or somewhat later. As the estimate of the current stock level, however, is very close to the origin of the stock/recruitment curve, there is a considerable risk that two successive years of below average recruitment for these stock levels could reduce the stock to the point where recovery might be very much retarded or may not take place. In these circumstances further restriction of by-catches of those year classes which are already in the stock is highly desirable.

The low level of recruitment, estimated from Figure 1, from the spawning stock size in 1975, is supported by the low abundance of large herring larvae found in surveys carried out in February 1976 in the Dutch coastal area and in the Skagerak. The Working Group must stress that the current situation of this stock is so serious that no further directed fishery should be considered in 1976 and 1977 and that every effort should be made to reduce the by-catch in the mixed fisheries. The spawning stock in 1977 is very dependent on the estimated strength of the 1973 year class in that year. This estimate is largely controlled by the assumption that there will be no directed fishery after 1 July 1976. If a TAC is agreed for the whole of 1976 higher than that at present set for the first six months of 1976, the spawning stock in 1977 will have been overestimated and the recovery of the stock thereafter will be very much slower and might never take place. This situation will be reviewed in 1977, but on present data it seems highly unlikely that any relaxation of these restrictions can be advocated before 1979. Attainment of a spawning stock size of about 800 000 tons must be considered as only an initial objective, which must be reached as quickly as possible if the future of this herring stock is to be assured. In the longer term, although some fishing may be permissible, this should be restricted, to permit a further increase in spawning stock size, with the aim of ultimately attaining a value of about 1.5 million tons, corresponding to a total stock biomass of about 2 million tons. Such a stock level will give a better prospect of optimal recruitment, will give more stable annual catches and will give a major increase in catch per unit effort.

3. Celtic Sea

3.1 Catch data

The catch data for the period 1965-75 from the Celtic Sea are given in Table 3.1. The figures for 1975 are provisional and the 1974 figures, which had been estimated in the previous report (C.M.1975/H:2), have been revised and slightly altered. The total catch of 16 000 tons in 1975 is the lowest recorded since 1965. The decline is particularly noticeable in the catches by the Irish fleet.

In previous reports, stock assessment of Celtic Sea herring was based on a fishing season extending from 1 March - 28 February. However, the NEAFC quota system was based on a period 1 April - 31 March. It was, therefore, decided to rearrange the Working Group data according to the NEAFC quota season and the catches by countries per season on this basis are given in Table 3.2. For both the 1974/75 and 1975/76 seasons the total recorded catches were much lower than the TAC set by NEAFC of 32 000 and 25 000 tons respectively.

3.2 Racial composition of the Celtic Sea herring stock

The Celtic Sea herring stock has been considered by previous Working Groups to be a self-contained winter spawning stock. The existence of an autumn spawning stock in the area had been noticed (Wood and Foster, 1966) in the late fifties, but since this stock did not constitute an important part of

the total landings, it was ignored in any stock assessments made at that time. During the 1974/75 season, herring identified by their maturity stages and low vertebral counts as autumn spawners constituted about 5% by weight of the total Irish catch. During 1975/76 these autumn spawners constituted over 35% of the total weight of the Irish catch. It is not known whether these herring represent an influx of a new component into the Celtic Sea or whether they are the result of a change in the spawning time of the main winter spawning race. For the purpose of stock assessment in this report, they have been considered to belong to the Celtic Sea stock. However, it must be pointed out that if they are a separate stock, then the total size of the Celtic Sea stock will be overestimated.

3.3 Catch in numbers per year class

The age composition of the total catch in 1975/76 was calculated from Irish and Dutch age data using the same procedure adopted in previous reports. There is, however, a scarcity of age composition data for the catches for the early part of the season and only two samples (100 otoliths) were available to cover the period 1 April to 31 August when 30% of the total catch was taken. Because of the revised catches for 1974/75 and the change to the new season (i.e. starting from 1 April), some slight changes were made in the previously calculated age compositions of the catches. The new age compositions of the total catches from 1965/66 - 1975/76 are shown in Table 3.3.

3.4 Mean weight at age

3.4.1 At the previous Working Group meeting, no accurate data were available of mean weight at age for Celtic Sea herring. In order to make a catch prognosis, mean weights at age in previous assessments were estimated from the von Bertalanffy parameters for Celtic Sea herring.

3.4.2 During the 1975/76 season, mean weights at age were measured from Irish catches. These mean weights are somewhat higher than those estimated during the previous meeting (Table 3.4). The figures derived from the Irish catches 1975/76 are now considered to be the best data on mean weight at age. Consequently, these mean weights have been used in the following prognosis of catch and stock size in 1976/77. The new values used have increased the estimated stock biomasses by approximately 10%.

3.5 Estimates of fishing mortality in the 1975/76 season

The only direct mortality estimates for Celtic Sea herring are derived from Irish catch/effort data. Using these data the total mortality rate for 1975/76 was estimated at 1.29. When the values from catch per effort data are compared with those obtained from VPA it can be seen that those from c.p.e. data vary considerably in the last 3 years (Table 3.5). However, as the effort in the last three seasons has been very constant, it was decided that the mean value of Z for this period from Irish c.p.e. data would be the best estimate of total mortality for 1975/76. Assuming a natural mortality of 0.10 this resulted in a value of F = 0.82 and this value was subsequently used in the calculation of stock size in 1976 and as an input value for VPA.

3.6 Estimates of fishing mortalities in previous seasons

Fishing mortalities and stock sizes in previous seasons have been calculated by VPA using the catch compositions in Table 3.3 and assuming an F_{adult} of 0.82 in the season 1975/76. The results of this analysis are presented in Tables 3.6 and 3.7.

Fishing mortality on 1-ringers has in the past only been a small fraction of the adult fishing mortality. Over the period 1970-74, $F_{1\text{-ringers}}$ have been on average 15% of F_{adults}.

3.7 Recruitment

The 1972/73 year class, which recruited to the fishery in 1975/76, appears to be of very low strength. Assuming an F_{adults} of 0.82 over the last fishing season, the strength of this year class as 1-ringers is estimated at 32 million (Table 3.7). The modal value for year class strength in the Celtic Sea stock is 100 million 1-ringers (Doc. C.M.1975/H:2).

The 1973/74 year class seems to be better than the preceding one, although only a preliminary estimate can be made of this year class, based on the catch of 1-ringers in the 1975/76 season. If an $F_{1\text{-ringer}}$ of 0.12 is assumed (= 15% F_{adults} which is the same proportion as in the five previous years), the stock size at the beginning of the season is estimated at 109 million 1-ringers.

An industrial fishery exists in the Irish Sea which exploits quantities of 0- and 1-group herring. Molloy and Corten (1975) concluded that some recruits to the Celtic Sea may come from that part of the Irish Sea where this fishery takes place. It may therefore have some effect on the recruitment level to the Celtic Sea stock although the extent is not yet known (see para. 5.2 of this report dealing with the Irish Sea stock).

3.8 TAC for 1977/78

The stock size at 1 April 1976 was calculated from the catch composition in the season 1975/76, using the following assumptions:

$M = 0.10$

$F_{adults\ 1975/76} = 0.82$ (see above)

$F_{1\text{-ringers}\ 1975/76} = 0.12$ (see above).

Recruitment of year class 1974 will be of modal strength (100 million of 1-ringers).

Estimated stock size at 1 April 1976

Age in rings	1	2	3	4	5	6	7	8	8+
Numbers x 10^{-3}	100 000	87 441	9 958	11 962	5 253	4 601	2 476	966	734

For the 1976/77 fishing season, NEAFC has agreed a TAC of 16 800 tons for the Celtic Sea. In order to take this TAC, a fishing mortality of 0.87 will have to be applied to the adult stock (Table 3.8). This will leave an adult stock of only 10 200 tons by the end of this fishing season. This is a dangerously low spawning stock level being about 17% of the spawning stock in the period 1965-70 (Figure 2). Furthermore, it should be stressed that the figure of 10 200 tons depends to a large extent on the assumption of $F_{1\text{-ringers}\ 1975} = 0.12$. If fishing mortality on 1-ringers in 1975 has been more than 0.12, the year class 1973/74 will be weaker than estimated, and the stock of adults left by the end of the 1976/77 season will be even lower.

There is no information available at present on the contribution that year class 1974/75 will make to the adult stock in 1977. In this situation, the Working Group can only recommend a closure of the entire fishery from 1st April 1977, until the spawning stock has recovered to a sufficiently high

level. The Working Group considers this level to be at least 1/3 of the stock size in a period of light exploitation (see para. 2.5). The estimated stock during the period of light exploitation is about 120 000; therefore, the minimum spawning stock should be set at 40 000 tons (Figure 2).

Provided year classes 1974 and 1975 are of modal strength, a closure of the fishery during two seasons would be sufficient to bring the spawning stock to the requisite level.

3.9 Additional conservation measures

In paragraph 3.8 it is estimated that the spawning stock in 1976/77 will be at a very low level, if the TAC for the season is taken in full. This situation is largely due to the TAC for 1976/77 having been set at a level which will require a fishing mortality rate about twice that giving the maximum yield per recruit (para. 3.8) and about 50% above the level recommended for this stock in the last report of the Working Group.

As an appreciable part of the annual catch is taken on the spawning grounds, which are entirely within Irish fishery jurisdiction, a considerable contribution to improving the size of the spawning stock in 1976/77, and to improving the prospects for recovery of this stock in subsequent years, could be made if the spawning grounds were closed to fishing in December 1976 and January 1977, when the main part of the catch in this area is normally taken.

4. Herring in Division VIa

4.1 Total catches and the fisheries in Division VIa

The total catch reported by each country in Division VIa for each of the years 1966-74 is given in Table 4.1 together with preliminary estimates of the catches taken in 1975. Estimates of the weight of herring taken in each year in the Moray Firth young herring and sprat fisheries are also given. The final figure of total catch in Division VIa in 1974 shows an increase of about 4 000 tons over the preliminary figure for that year in the last report of the Working Group. The preliminary 1975 figure of 128 240 tons shows a decrease of about 81 000 tons (40%) compared with the final 1974 figure and a decrease of about 119 000 tons (48%) compared with 1973. The provisional catch figures for 1975 indicate that only 83% of the TAC of 155 200 tons have been taken. This decrease in total catch is partly a result of a quota regulation introduced by NEAFC for 1975 and partly low abundance in the area mainly fished by purse seiners.

The catches by Norway, Faroes and Iceland show a drastic decline from a total for these countries of 41 155 tons in 1974 to only 3 152 tons in 1975. In spite of considerable time spent for searching for herring in the area north of Scotland and west of the Hebrides normally fished by purse seiners, few schools of herring were found in 1975. In contrast, countries fishing with trawls further south in Division VIa were able to maintain their catch at about the same level as in 1974 (Netherlands, Ireland) or even to increase their catch (France).

4.2 Catch in numbers in Division VIa

4.2.1 Estimates of the numbers of autumn spawning herring per age group caught in Division VIa in each of the years 1966-75 are given in Table 4.2, and in the Moray Firth in Table 4.3. The estimates for the period 1966-72 are taken from Saville and Morrison (1973), and from unpublished Scottish data on the catch in number in the Moray Firth fishery.

4.2.2 Estimates of the numbers of autumn spawning herring caught in 1974 have been corrected according to the revised catch figures. The numbers per age group for 1975 are compiled from national reports. Catches in number per age group for countries for which no age composition data were available were raised by using age data from other countries, taking into account the seasonality of the fisheries.

4.2.3 As in the preceding 5 years, the 1969 year class provided a considerable component of the fishery, accounting in 1975 for 26% of the numbers caught in Division VIa and contributing in 1975 to the fishery in about the same proportion as the recruiting year class 1972 (29%).

4.3 Stock and mortality estimates

4.3.1 The estimated fishing mortalities, and stock in numbers per age group in the period 1965-73, calculated by VPA, are given in Tables 4.4 and 4.5. The result of this type of analysis is critically dependent on the estimated fishing mortality in the most recent year. In the previous report fishing mortality was estimated on the basis of catch per unit effort data of the Scottish Minch fishery. Since national and international regulations have been introduced in this fishery, catch per unit effort data for 1975 do not provide an estimate of F in this year. Calculation of F from stock sizes obtained from VPA for the beginning of 1975 and corresponding catches in 1975 resulted in an estimated F of about 30% lower than in the previous year as outlined above (0.7) giving an F of 0.5 for 1975.

4.3.2 The stock in number data (Table 4.5) confirm the estimate of the strength of the 1970 year class given in the previous report. The number of 1-ringers from this year class (1 186 x 10^6) is of the same order as the long-term average over the period 1957-73, i.e. 1 054 x 10^6, but only 75% of the 1965-73 average, i.e. 1 568 x 10^6. The 1971 year class (537 x 10^6), however, is very much weaker being only 45% of the strength of the 1970 year class. The sizes of the 1972 and 1973 year classes (1 546 x 10^6 and 1 600 x 10^6 respectively) are estimated from Scottish catch per landing data, using a regression presented in the 1974 report of this Group (C.M.1974/H:4). It should be noted, however, that in 1975 the landing of small herring in Scottish ports was restricted by national and international regulations and therefore the estimate of the 1973 year class has to be considered as a minimal estimate.

4.4 Catch prognosis for 1976 and 1977

4.4.1 A prediction has been made of the catch which could be taken in 1977. The basic age composition at 1 January 1975 was calculated from the catch in numbers per age group in 1975 by using the F = 0.5 in 1975 given in paragraph 4.3.1.

4.4.2 The mean weights per age group calculated for 1975 are not very different from those calculated for 1974.

Mean weights per age in grammes

Age in rings	1	2	3	4	5	6	7	8	≥9
1974	88	124	163	171	190	212	218	220	220
1975	91	118	152	179	182	199	217	228	228

This shows that the relatively low weights of the 4-ringers in 1974 and of the 5-ringers in 1975 belonged to the 1969 year class, which is the largest year class which has ever been observed in the stock. For the catch prediction and estimation of biomass the mean of 1974 and 1975 weights were used.

4.4.3 As in the calculation of the 1976 TAC the recruiting year classes (1974 and 1975) for which no information is available were taken as equal to the most frequent recruitment in the period 1957-73 (650×10^6). This level is about 40% below the average over the same period and will therefore reduce the probability of overestimating the stock sizes, and the corresponding catches calculated on this basis.

4.4.4 The number of 2-ringed herring recruiting to the fishery in Division VIa is affected by the Moray Firth sprat and herring fisheries on 1-ringers. In order to account for these catches in estimating the number of 2-ringers in the following year an F of 0.13 was applied. This value corresponds to the 1969-73 average F. The catch of 1-ringers in Division VIa was calculated by using an F which is 10% of the F applied to the older age groups. As in the previous assessments the F applied to the 2-ringers was taken as 50% of the F for 3-ringers and older.

4.4.5 The basic parameters used to calculate the TAC for 1977 are given below:

Age (rings)	Number per age group at 1 Jan.1977 ($\times 10^{-6}$)	Average weight per age group in grammes
1	650.0	90
2	516.4	121
3	891.4	158
4	423.4	175
5	74.7	186
6	59.7	206
7	166.3	218
8	28.6	224
≥9	48.7	224

4.4.6 The stock size at the beginning of 1977 was calculated on the assumption that in 1976 the TAC of 136 000 tons will be taken, which implies a fishing mortality of 0.51 on adults (3-ringers and older) in that year. The remaining biomass will be at about the same level as in the beginning of 1975 and slightly below that of 1976 (Figure 3).

4.4.7 Predicted catch figures together with the corresponding values for F and the biomass of the adult component of the stock are given in the table below (weight in 1 000 tons):

1975	1976			1977			1978
Biomass	Biomass	F	Catch	Biomass	F	Catch	Biomass
					0.18 ($F_{0.1}$)	52	370
368	416	0.51	136	357	0.30	83	339
					0.60 (F_{max})	146	275

4.5 Advice on TAC

In advising on the TAC the Working Group followed the guidelines worked out at the ICES "Ad hoc Meeting on the Provision of Advice on the Biological Basis for Fisheries Management" (Doc. C.M.1976/Gen:3).

4.5.1 The TAC for 1977 corresponding to $F_{0.1}$ = 0.18 was calculated as 52 000 tons.

4.5.2 This result was then considered in relation to minimum stock size levels. The level of stock size which would produce the most desirable level of recruitment for the herring stock in Division VIa cannot at present be defined from a stock/recruitment curve. Therefore, estimates of the relevant adult stock size have to be made on the basis of the history of the stock and the fishery.

4.5.3 In the period prior to 1965 the size of the stock was at an average level of 205 000 tons, with only minor fluctuations, supporting a relatively stable fishery of about 60 000 tons per year (Figure 3). The average recruitment during this period was about 440 x 10^6 1-ringers. After 1965 the level of recruitment increased considerably, the average over the 1965-72 period being about 1 700 x 10^6 1-ringers and, excluding the two outstanding year classes 1963 and 1969, about 1 100 x 10^6 1-ringed herring. This leads to the conclusion that a stock size of 200-250 000 tons will be sufficient to prevent recruitment failure due to low spawning potential and that an annual catch of about 30% of the fishable biomass does not reduce the stock below the required minimum level.

4.5.4 At the level of stock size estimated for the beginning of 1977, fishing at $F_{0.1}$ would allow a catch of only 15% of the stock. This would result in an increase in stock size of only 4% by January 1978, but would require a reduction of about 62% from the 1976 TAC level. Since fishing at $F_{0.1}$ is intended to serve as a long-term objective rather than an immediate step, this sharp reduction in TAC seems to be an unnecessary rigid measure in the present situation.

4.5.5 Fishing at F_{max}, however, would increase the TAC for 1977 above that for 1976 by 7%, but would decrease the size of the stock by 23%. This is undesirable particularly as fishing at this level would remove 41% of the stock present at the beginning of 1977.

4.5.6 The flat top of the yield per recruit curve (Figure 4) begins at F = 0.3. In the range between F = 0.3 and F_{max} = 0.6 the increase in yield per recruit is only 4%. Considering the points set out in 4.5.4 it seems advisable to apply an F = 0.3 as an intermediate step in the light of the actual fishing situation. This gives a TAC of 83 000 tons in 1977 and would result in a biomass of 339 000 tons at the beginning of 1978. This level is only 5% below that of 1975 but about 50% above the minimum stock size suggested in paragraph 4.5.3. The TAC for 1977 would be 23% of the biomass at the beginning of 1977.

4.5.7 It should also be borne in mind that in Division VIa steps have been taken to optimise the exploitation pattern. A minimum landing size of 20 cm has been introduced for herring in this area and the 10% herring by-catch regulation enforced since 1 February 1976 in the Moray Firth sprat fishery should reduce the exploitation of 0- and 1-group recruits to this stock considerably.

5. Irish Sea Herring (Division VIIa)

5.1 Introduction

5.1.1 Herring fishing in the North Irish Sea is supported by two autumn spawning stocks called the Mourne stock and the Manx stock. They have distinct spawning grounds which are shown in Figure 6 but for management purposes they may be considered together. The need for management was appreciated following a considerable increase in catch, effort and estimated F on the Manx stock from 1970 onwards. Since most of the herring were taken in the area of United Kingdom fisheries jurisdiction first steps in management were taken on a national basis.

5.1.2 In 1972 a Working Party of United Kingdom fishery scientists recommended a prohibition from 1 October to 17 November in each year from 1973 of fishing for herring within 12 miles of the Isle of Man and a shorter prohibition within 12 miles of the coast of Northern Ireland, South of 54°10'N to a line SE from Haulbowline Rock. The prohibition was expected to reduce effort at a time when the shoals of herring were concentrated for spawning. In fact, there was a decrease of F on the Manx stock from 0.62 in 1972 to 0.47 in 1973. A closure of the Mourne fishery for 2 weeks in October 1973 was not followed by a decrease in the estimated F from the 1972 level of = 0.80.

5.1.3 In 1974 effort and catch rose sharply despite the continuation of the prohibition of fishing mentioned in 5.1.2. Consequently the United Kingdom Working Party recommended a TAC of about 12 000 tons for 1975 for the Manx stock. The basis for this recommendation was reported to ICES (Doc. C.M. 1975/H:40). The TAC was in fact set at 18 000 tons for U.K. fishermen. The actual catch by U.K. vessels was 15 408 tons, and by those of other nations 3 727 tons, giving a total of 19 135 tons. No TAC was set for the Mourne herring but a $3\frac{1}{2}$ day fishing week was introduced. The prohibitions of fishing for herring of both stocks remained in force in the periods mentioned above.

5.2 Catch and effort

Annual catch data from 1964 to 1975 are given in Tables 5.2.1 and 5.2.2. Most of the catch until 1974, other than that taken by Ireland, was taken in the months of May to October inclusive with more than half the annual catch taken in September.

In 1974 and 1975 there was some catch in each month of the year, but most was of pre-spawning or spawning herring in July and October. The Irish catch on the Mourne stock from 1969 included an industrial fishery on 0- and 1-ring herring (Table 5.3.1 (b))

Most of the herring is caught by trawling. Available statistics on effort (expressed as trawler landings, i.e. one day's fishing) are given in Table 5.2.3. The very large increase in effort in 1974 was in part due to the catches made in winter and spring but was mainly the result of the deployment of a larger number of boats.

5.3 Age composition of the stock

5.3.1 Total catches of Manx herring were converted to catches in numbers using data from samples taken of landings in the Isle of Man, England, N.Ireland and Ireland supplemented in 1974 and 1975 by French and Dutch samples.

Catches of Mourne herring were similarly treated, though available sampling data were more limited. Most of the data are from Irish sampling.

From Tables 5.3.1(a) and (b) it can be seen that 2- and 3-ring fish are the most numerous age groups in the catches of Manx stock, and 0- and 1-ring fish in those of the Mourne stock.

5.3.2 Tables 5.3.2(a) and (b) show annual stock sizes at 1 January each year estimated by VPA with input values of M = 0.1, F = 0.7 for both stocks.

It should be noted that 1-ring fish are only partially recruited to the fishery on Manx stock. Full recruitment takes place as 2-group fish. Recruitment was high in 1969, 71, 72 and 74. All available evidence suggests that it was average in 1975.

Stock estimates of the Mourne herring show that the stock size has decreased considerably since 1971.

5.3.3 Industrial fishery

Since 1969 an industrial fishery has been carried out in the northern part of the Irish Sea. Sampling of the catches has enabled estimates of the weight of young herring landed to be made. These were as follows:

Year	1969	1970	1971	1972	1973	1974	1975
Tons	2 210	3 796	2 715	2 251	1 913	2 190	1 573

Examination of otoliths has shown that 0-group herring are first taken during June/July when they are approximately 10 cm long. These young herring remain in the catches for approximately one year until they migrate offshore as 1-group, at which time they are approximately 18-20 cm long. They appear to be most abundant during the winter months. The total catch of herring in this fishery expressed as numbers per age class is shown in Table 5.3.3 for the period 1969 to 1975. During this period the average annual number per age group taken was as follows:

Age group	0	1	2	3	Total
Numbers (10^{-6})	73.9	24.5	6.9	0.7	106.0

Catches of this size must have some effect on the level of recruitment to the adult stock to which they would have recruited. The appearance of the strong 1969 year class as 1-ring fish in the Mourne stock was preceded by high catches of 0-group fish in the industrial fishery and in general catches of 0-group herring in the industrial fishery would seem to give an index of the recruitment level to the Mourne fishery. In addition, there is a very strong similarity between the vertebral counts of the Mourne stock and of the herring taken in the industrial fishery.

5.4 Management

Predictions of the stocks in 1977 were calculated and are given in the table below:

Stocks	Biomass 1975	1976			1977 Biomass
		Biomass	F	Catch	
Manx	42 951	36 736	0.4	11 573	39 148
Mourne	14 196	13 166	0.74	6 594	14 924

5.4.1 For the Manx stock a value of M = 0.1 was used throughout. F = 0.65 for 1975 was estimated from the regression of F on effort for a long series of data. Recruitment of 83 x 10^6 2-ring fish was assumed for 1976 and 1977; this is the average value from VPA for the years 1964-73. It is likely that the 1976 catch estimated at 11 000 tons in the light of U.K. national restrictions will generate an F of 0.4 in that year. This value has been used for 1976 in the calculations but it must be stressed that it will be

unrealistic if there is a major diversion of fishing effort to this area by other countries. The yield per recruit curve for this stock is shown in Figure 7; it can be seen that values of F = 0.4 in 1976 and F = 0.3 in 1977 represent progressive steps from the 1975 value of F = 0.65 towards the $F_{0.1}$ = 0.16, in accordance with the recommendation given by the ICES "Ad hoc Meeting on the Provision of Advice on the Biological Basis for Fisheries Management" (Doc. C.M.1976/Gen:3). Estimates of recent recruitment to the Manx stock indicate that there is no need at present for concern about the level of spawning stock size. On these considerations an F = 0.3 was taken as the appropriate level for 1977. This would entail a TAC for 1977 of 10 000 tons for the Manx stock.

5.4.2 For the Mourne stock a value of M = 0.1 was also used. Mean F on the 0-group for the years 1969-73 from VPA was F = 0.74. The spawning stock biomass has shown a considerable decrease over the years for which estimates are available. It was considered that F on adults in 1975 was at much the same level as in the preceding 2 years. F on the 1-ring and older fish from VPA in 1973 was F = 0.77 and in 1974 for Northern Ireland trawl c.p.e. data was F = 0.80. It was decided to use a value of F = 0.74 on all age groups in both 1975 and 1976 in the calculation of stock sizes. Recruitment of 0-group fish for 1976 and 1977 was estimated at 75% of the mean recruitment 1969-73 (from VPA) to allow for the possibility that some of the 0-group fish taken in the industrial catch could have been from some stock other than the Mourne one. The Mourne 0-group recruitment value used was therefore 128×10^6 fish. In calculating the TAC for this stock in 1977 an F = 0.3 was used as in the Manx stock. This would allow a build up of the stock and would produce a yield for 1977 of 3 000 tons. This TAC is calculated on the assumption that the recommendation regarding a minimum landing size in paragraph 5.4.4 is implemented in 1977.

5.5 TAC for 1977 in Division VIIa

As discussed in paragraphs 5.4.1 and 5.4.2 fishing at an F of 0.3 would appear to be an allowable intermediate step in approaching the $F_{0.1}$ value for these stocks. This gives a TAC for the whole North Irish Sea area of 13 000 tons in 1977.

5.5.1 Minimum landing size

In Section 7 it is explained that the introduction of a minimum landing size of 20 cm would result in an appreciable increase in the yield per recruit for North Sea herring. Advice on this topic given to the November 1975 meeting of NEAFC also stressed that this measure would result in a considerable increase in spawning stock biomass.

This measure would have similar effects in other areas where herring have similar growth curves and where there is exploitation of fish below this size. Although a detailed comparison between the growth curves between Irish Sea and North Sea herring was not made, it was possible to show that the average weight/age was very similar for adult fish but that the Irish Sea stocks appeared to grow slightly faster in the younger age groups. This would indicate that the introduction of a minimum landing size of 20 cm would have a similar beneficial effect on the yield/recruit and spawning stock biomass for Irish Sea herring.

6. Sprat Assessment for the North Sea and Skagerak

6.1 Introduction

At its meeting in 1975 the Working Group considered the recent increase in catches of sprat in the North Sea. In the absence of adequate biological data the Working Group was unable to do more than advise a precautionary TAC, which it was suggested should be at the level of catch in 1974, i.e. 300 000 tons. With a further sharp increase in catches in 1975 in both the North Sea and Skagerak, the Working Group asked for more detailed information for its 1976 meeting.

Since the populations of sprat in the North Sea and Skagerak appear to be more or less distinct, the Group decided that the two stocks should be treated separately for assessment purposes. The catches from the Norwegian fjords (ICES Division IVa East) are considered to be from, and were included in, the Skagerak stock.

Owing to some confusion in the past, the Group agreed on a set of definitions for the age of sprat. Peak spawning in the North Sea and Skagerak occurs from about May-July. Fish born in this period are termed 0-group until 31 December of that year, and then for the whole of the next year they are 1-group. Over the winter period sprat in their first year of life are termed 0/1-group, and similarly for the older age groups.

6.2 North Sea sprat

6.2.1 The North Sea fishery in 1975

In Table 6.1 catch data for the years 1966-74 and preliminary catch data for 1975 are given for each sub-division of the North Sea. The total North Sea catch in 1975, excluding the Norwegian fjord catch, amounted to 635 300 tons, the highest catch on record and more than double that taken in 1974. The increased catch in 1975 came almost exclusively from ICES Division IVb and was taken by two countries, Denmark and Norway. In Division IVb the catch of Denmark increased from 159 400 tons in 1974 to 321 800 tons in 1975, and the catch of Norway from 9 500 tons in 1974 to 145 700 tons in 1975.

The annual age compositions for Sub-divisions IVb east and IVb west which were included in the previous report were updated (Table 6.2). Although Danish and Norwegian data exist for Sub-divison IVb west for 1974 and 1975, to provide an age composition for the 1974-75 season which is comparable with the earlier ones, the percentage age compositions given in Table 6.2 are based only on English data from the North Shields winter fishery, this being the only available source of data prior to 1974. Those for Sub-division IVb east are based on Danish data from the summer fishery.

The catch in number per age group was calculated by the Working Group from the national data for age compositions of catches in 1974 and 1975. These are given for each region in Table 6.3. It is clear that the high catches in both 1974 and 1975 were due to the strength of the 1973 year class which made the major contribution to the catches as 1-year old fish in 1974 and as 2-year old fish in 1975. The 1974 year class appears to be much weaker than the 1973 year class in the North Sea sprat population.

6.2.2 Biological parameters of the North Sea sprat

The weight at age of sprat in the North Sea landings was estimated from data provided from both the inshore and offshore fisheries. Only the larger members of the 0-group are taken in the winter fisheries and so for this age group the mean weight in the catches is probably higher than that for the population in sea. Values for all age groups are given for January 1974 and for January and July 1975 in the text table below. The values were rather different in 1974 and 1975, so the means of the two sets of estimates have been used in the assessment of North Sea sprat.

Mean weight (g)

Age	January 1974	January 1975	Mean	1 July 1975
0	-	-	-	0
1	2.3	3.1	2.7	4.6
2	9.0	10.4	9.7	14.1
3	15.3	17.3	16.3	20.0
4	19.9	25.6	22.7	29.0
5	28.4	29.8	29.1	-

The estimate of natural mortality (M) of North Sea sprat used is that of 0.8 made by Johnson (1970). The only other available estimate of the natural mortality rate is that of 1.05 for the Gullmar Fjord in the Skagerak area made by Lindquist (1974).

Sprat first spawn at an age of about 2 years. The spawning stock is therefore considered to consist of the 2-group fish and older.

6.2.3 Fishing mortality and stock size

The recent increase in the total annual catches of sprat from the North Sea is very large. To understand its effect on the stock, estimates of fishing mortality or stock size are required. The Working Group considered a number of methods of obtaining such estimates.

a) Virtual Population Analysis

VPA is of doubtful validity for short-lived species like sprat because the estimates of F and stock size obtained are highly dependent on the accuracy of the values of M and the fishing mortality assumed for the oldest age groups and in the last year of the analysis. With this reservation in mind, the Working Group carried out VPAs on two sets of data:

1. the annual catch in numbers of each age group for the whole North Sea from 1967-75 on a fishing season basis (i.e. July-June). The estimates of catch composition up to 1973-74 had been prepared prior to the meeting using samples from the English and Scottish commercial landings for the inshore fisheries, research vessel samples taken mainly during the International Young Herring Surveys for the offshore fisheries and all other available age data. The data for 1974-75 were calculated by the Working Group. The input data are given in Table 6.4.
2. the quarterly catch in numbers per age group for the whole North Sea from January 1974 - December 1975, estimated by the Working Group from catch and age composition data supplied by participants. The input data are given in Table 6.5.

The VPAs were carried out using a natural mortality coefficient of 0.8 and input values of the final fishing mortalities given in Tables 6.6 and 6.7. To give reasonable input values it was assumed that F had been at a rather low level in the period 1967-73 and that it doubled in 1974 and again in 1975. In the quarterly VPA it was assumed that M is evenly distributed throughout the year.

The values of fishing mortality estimated from the VPAs are given in Tables 6.6 and 6.7, and the estimated stock size and recruitment on 1 July of each year in Table 6.8.

The stock size appears to have fluctuated considerably as a result of an increase in recruitment from 1972-75 and in stock size in 1974 (Table 6.8). The increased catches taken from 1974-75 may therefore in part be due to an increase in stock. The fishing mortality appears to have been low up to 1971-72 and to have increased since then.

This analysis suggests that the catches of sprat taken in 1974 and 1975 represent a considerable proportion of the average total stock in the North Sea and that catches at this level may only be sustainable at the higher level of recruitment from 1972 to 1975.

The level of recruitment in 1975 cannot yet be measured quantitatively but age compositions in that year (Tables 6.2 and 6.3) suggest that it was not as high as in 1974. The poor catches in the British coastal fisheries in

the last three months of 1975, moreover, indicate that the 1975 year class may be substantially weaker than either of the two preceding ones. It can only be assumed, therefore, that there will be a return to the earlier recruitment levels and that this is likely to result in a considerable decrease in catch in 1976, if fishing effort remains at the same level as in 1975.

b) Catch per unit effort

The VPA indicates rather low levels of F prior to 1972 and an increase to about 0.2 by 1974 (Tables 6.6 and 6.7). Independent estimates of total mortality (Z) between late 1974 and late 1975 were made from catch-per-unit effort data supplied by the Soviet Union and by Denmark for the off-shore fisheries (Table 6.9). The two estimates of Z obtained (1.20 and 1.32) indicate values of F in that year of about 0.4 - 0.5. As these are estimates of fishing mortality rate in 1975, and the catch in that year was about twice that of 1974, these estimates are in reasonable agreement with that from VPA.

c) Estimates independent of catch and effort data

In addition to the above estimates of fishing mortality, the Working Group considered other ways of obtaining estimates of the stock size in the North Sea. Egg and larval surveys carried out in 1972 by Johnson and Dawson (1975) indicate a stock of about 0.5 million tons in that part of the North Sea south of 57°N. Although this cannot be taken as a precise estimate it was calculated making conservative assumptions and so is probably not unreasonable as a minimum estimate, since spawning also occurs to the north-east of Scotland. The stock size calculated by this means is of the same order as that from VPA.

The estimates from these different methods are therefore in some agreement but, in view of the reservations about their accuracy, the Working Group considers it essential that other methods for estimating stock size and recruitment estimates be investigated. In particular, the possibility of carrying out coordinated acoustic surveys and egg and larval surveys should be considered.

6.2.4 The effect of fishing mortality on yield per recruit and stock size

Yield per recruit curves were prepared using an M of 0.8 and weight at age values given above (Figure 8). Three patterns of exploitation were considered:

a) F in the first year of life (F_o) at about the present level, i.e. about 1/6 of the F on the older age group (F_{adult});

b) $F_o = F_{adult}$;

c) F_o = zero.

All three yield per recruit curves rise steeply with increase in F up to a level of fishing mortality of about 0.6. With the same level of exploitation in the first year as in older fish; the curve then reaches an asymptote, but the yield per recruit continues to rise with low or zero exploitation in the first year. These curves are typical of those for short-lived, fast-growing species of fish, and suggest that with yield as the only criterion, the most efficient form of exploitation is to catch the fish when they are young. At the present estimated levels of

fishing mortality, there is also little likelihood that selective restriction of 0-group exploitation would result in any significant gain in yield per recruit.

Although no gain in yield per recruit is likely to accrue from reducing fishing mortality, heavy exploitation would seriously depress the spawning stock size. The effects of different patterns of exploitation, and of increasing values of F, on the spawning stock were also considered (Figure 9). Reduction of the spawning stock to about 1/3 of the unexploited level is estimated to occur with an F of about 0.54. Reduction of the current rate of exploitation in the first year would have only a marginal effect on the spawning stock size. On the other hand, if the exploitation rate in the first year increased disproportionately, a considerable reduction in spawning stock would occur. Any regulation that prevents an increase of exploitation on the 0-group is therefore desirable.

6.2.5 Calculation of TAC for 1977

Although the output of the VPA must be treated with reserve, the Working Group decided that the absence of more reliable estimates the results should be used to calculate a Total Allowable Catch for 1977. The following basis was used for the calculation:

a) Since there are indications that the strength of the 1975 is below those of the three preceding year classes and since there is no way of predicting the strength of the 1976 year class in 1977, it was assumed that recruitment of these year classes will be at the mean for the years 1967-74 of 181 x 10^9 fish (Table 6.8).

b) In the absence of information on the relationship between stock and recruitment, it was decided that it would be undesirable to reduce the spawning stock below 1/3 of the unexploited level as had been done for herring (paragraph 2.6). With the present exploitation pattern, this would occur with a fishing mortality of 0.57, that is about the same level as in 1974-75. At this F the spawning stock per recruit is 2.19 g (Figure 8).

The predicted long-term annual catch calculated on this basis is 396 000 tons. Thus it is estimated that a fishing mortality not substantially different from that in 1975 will result in a catch in 1977 considerably lower than that taken in 1975. This situation is the result of a lower level of recruitment and it must be borne in mind that, with a short life-span species such as sprat, there will inevitably be major fluctuations in annual catch due to recruitment variation.

A rather cautious approach is also necessary because, if recruitment in 1977 is below average and the TAC is, as a result, set at too high a level, then the F generated will be much higher than 0.57 and concentrated on the older age groups. The spawning stock will then be reduced to a level much lower than that advocated, greatly increasing the risk of reaching the level at which a stock/recruitment relationship occurs. It must also be borne in mind that any increase in F in the sprat fishery will result in a heavier fishing mortality rate of immature herring caught as by-catch in the sprat fishery.

Taking all the above factors into consideration, the Working Group recommends that the TAC for sprat in the North Sea for 1977 should be set no higher than 400 000 tons.

6.2.6 Protection of 0/1-group sprat

In paragraph 6.2.4 attention was drawn to the desirability of protecting 0/1-group sprat from too heavy an exploitation rate. In the last report of the Working Group experiments were discussed which gave selection factors

for sprat from which it was deduced that a 20 mm mesh size in sprat trawls would be the appropriate size to give almost complete protection to 0/1-group sprat. In the light of possible problems from meshing, using trawls of this mesh size, NEAFC introduced a 16 mm mesh size for sprat trawls at its mid-term meeting in November 1975.

Further experiments have been carried out on the problems of meshing and selection, using Scottish commercial sprat trawlers fishing by normal commercial practice for the Scottish fleet, but using trawls of 16 mm and 20 mm mesh sizes. A total of 27 trawl hauls were carried out in which catches up to 10 tons were taken, and covering a sprat population with a size range from 3.5 to 13.5 cm.

These results suggested that, under the conditions of these experiments, meshing was not a problem with either 16 mm or 20 mm mesh sizes. They also gave selection factors somewhat lower than those stated in the previous report - suggesting 50% selection lengths of 5.7 cm for a 16 mm mesh size, and 7.3 cm for a 20 mm mesh size. In view of the differences between these new results and those previously reported, and the possibility that selection by sprat trawls may vary appreciably from one national fishery to another, depending on factors such as towing speed and net design, it is recommended that further experiments be done under the normal commercial practice of national fleets fishing North Sea sprat.

In the western North Sea 0/1-group sprat may be largely confined to areas close to the coast. This age group can form a major proportion of the catches of the U.K fishery in coastal areas, but does not contribute appreciably to the catches of other fisheries further offshore. The differences in the age composition of the stocks in coastal and more offshore waters may also be a factor in influencing the applicability of the selection experiments mentioned above to fleets of other countries, as these experiments were carried out in a coastal area.

6.3 Sprat in Division IIIa and the Norwegian Fjords

The sprat population in areas III and IVa east (the Norwegian west coast fjords) can be considered as a single stock which is largely independent of the population in other areas of the North Sea. This population spawns in a well-defined area between Denmark and Sweden from May to August. From the spawning area the larvae drift either to the Skagerak and Kattegat coastal areas or to the Norwegian coastal areas. As in the North Sea, most Skagerak sprat become sexually mature at an age of 2 years, with a small proportion spawning at an age of one year.

6.3.1 The sprat fishery

The fishery for sprat has the following structure: in the coastal areas of Norway and Sweden there have been purse-seine fisheries for more than a century, with little annual fluctuations in the yield. The catch is used for human consumption only. In addition, there are trawl fisheries for sprat by Denmark and Sweden, the greatest landings being taken from summer to early winter. The Danish landings remained at a constant level until 1972. There was a major increase in these landings from 1973 onwards. The total landings from these trawl fisheries in 1975 were at a level of about 100 000 tons. Catches in this area for the period 1966-75 are given in Table 6.10.

6.3.2 Biological data

Biological observations on the sprat in Divs. IIIa/IVa east exist for a considerable time. The percentage age compositions, excluding the 0/1-group, and the mean age in samples from the purse-seine catches from the coastal area, and in trawl samples from the open sea, are given in Table 6.11. These do not show any long-term trends.

The percentage in numbers of 0/1-group sprat in Swedish samples for the period 1966-75 does not show any significant trend (Table 6.12). It is apparent, however, that the proportion of 0/1-group sprat in the trawl catches is consistently higher than in the purse-seine catches.

There are no effort data available which would permit an evaluation of stock size changes from catch per unit effort in Division IIIa. Since, however, the fishing effort has not changed in the Norwegian and Swedish coastal fisheries, and since the catches have not increased appreciably, it would appear that there has not been any major increase in stock abundance in Division IIIa. The large increase in total catch from the open sea fishery therefore must have at least largely been due to an increase in fishing effort.

6.3.3 Stock assessment

The features of the population dynamics of North Sea sprat described in the report of the Working Group last year (Doc. C.M.1975/H:2) apply also to the sprat in Division IIIa.

No age data are available in a suitable form to carry out a VPA for the Skagerak stock. The Working Group was, therefore, not able to estimate a TAC on any precise basis. Any further increase of the fishing effort, however, might have the effect of reducing recruitment, and of bringing about a collapse of the stocks and the fisheries, before appropriate conservation action could be taken. Moreover, with regulation of sprat and herring fisheries in the North Sea, there is likely to be a major diversion of fishing effort to Skagerak sprat unless some control is introduced in that area. In 1977 the landings should therefore not be allowed to exceed the level of 1975. This would mean a total allowable catch for Division IIIa and the Norwegian fjords of 100 000 tons.

To improve the ability to advise on regulation of Division IIIa sprat, methods are required to measure the strength of the recruiting year classes. Such methods may include 0-group surveys.

7. Minimum Landing Size for North Sea Herring

7.1 In a previous report (Doc. C.M.1975/H:2) selection experiments for sprat indicated that the selection factor was in the range 3.5 - 4.5. Information now available from Scottish selection experiments carried out on commercial pair trawlers suggest roughly similar values (para. 6.2.6). According to these results, the 50% retention length of sprat, corresponding to the 16 mm minimum mesh size introduced by NEAFC is between 5.5 and 7.2 cm, or close to the mean length of the 0-group sprat.

7.2 No mesh selection experiments were available for that size range of herring but the Working Group considered it unlikely that selection factors for herring would differ appreciably from those found for sprat. Setting a minimum landing size for North Sea herring corresponding to 50% retention length of the 16 mm mesh (i.e. minimum landing size of about 6 cm) would be absurd as it would achieve nothing and would be unenforcable. As explained in the report of the Liaison Committee (Doc. C.M.1975/Li:9) prepared at the Montreal Meeting in October 1975, a 20 cm minimum landing size for North Sea herring has been introduced in Division VIa and the yield per recruit curves for herring in the two areas are very similar. It would therefore be appropriate to have uniformity in minimum landing sizes between the two areas and any other areas where similar conditions apply.

8. Application of the ICES "FISHDAT" System

During the present meeting Working Group members were introduced to recent developments in the ICES data processing system for North Sea herring.

A trial run using input data from the 1972 herring fisheries was already made in 1974 and reported on by the ADP Working Group (Doc. C.M.1975/D:2). The output was in general agreement with the results obtained by the Herring Assessment Working Group using the same data but slightly different assumptions on e.g. allocation of unallocated catch data.

Since then further development has taken place and handling made much easier for the user by the introduction of a direct data-base management system.

The present Working Group endorsed that the "FISHDAT" System contains important assets to the assessment work:

(i) It will almost completely cut out the very appreciable time hitherto spent on tedious calculations and preparation of basic tables thus giving the Group more time for their main object, which should be the scientific appraisal of the material and of the conclusions based thereon.

(ii) It necessitates a steady inflow of data in a uniform format from the laboratories involved. At present, Working Groups are frequently presented with untreated data in a more or less suitable form for processing.

(iii) Working the ADP System requires a higher degree of explicit and consistent assumptions than are perhaps applied at present by Working Groups, especially on a year-to-year basis.

The Working Group recommends that steps be taken to bring the ADP System into full operation.

9. Summary

9.1 The new data available for North Sea herring suggest that there will be some increase in the size of the adult stock in 1976, due to the recruitment in that year of the 1973 year class. However, the spawning stock in 1976 will still be at a very low level of about 1/10 of that in the immediate post-war years. There is now some evidence that, at a spawning stock biomass below 800 000 tons, recruitment becomes dependent on spawning stock biomass for this population. It is therefore imperative that firm action be taken to rebuild the stock to this level as quickly as possible.

9.2 In the light of this position it is strongly recommended that directed fisheries on North Sea herring should be prohibited from 1 July 1976, and every attempt should be made to further restrict the by-catches of herring in the mixed fisheries, until the spawning stock recovers to 800 000 tons. It is difficult to predict with any precision how long this will take, but with the best assumptions which can be made, this may not be achieved before 1980 with the present exploitation rate in the mixed fisheries or before 1979 if some further restrictions are introduced on these.

9.3 The rapid decline in the Celtic Sea herring stock has continued. It is estimated that if the agreed 1976/77 TAC is taken in full, the adult stock biomass at the end of that season will be below 10% of the level under conditions of light exploitation. It is considered essential to rebuild this adult stock to a level of 40 000 tons as quickly as possible.

9.4 It is therefore recommended that there should be no fishery on this stock in 1977/78 and that consideration should be given to closing the fishery within Irish fishing jurisdiction, on the spawning grounds in December-January 1976/77. If these measures are implemented and recruitment is not below average some fishing might be permissible in 1979/80.

9.5 The state of the herring stock in Division VIa is not as serious as in the stocks mentioned above. If the agreed TAC for 1976 is taken in full, the remaining stock biomass will be about the same level in 1977 as in 1975 and 1976. There are indications of recruitment of a 1973 year class considerably above the modal value used in forecasting recruitment when no indications are available. There is no evidence of the stock biomass in this population being at the level where recruitment will be affected. The 1977 TAC recommended for this stock is 83 000 tons.

9.6 An assessment has been made of the herring stock in Division VIIa. In this area there would appear to be two distinct spawning stocks - one in the area around the Isle of Man and one in the Mourne area. However, there is probably some mixing of them during part of the year, and for practical reasons it would be advisable to treat them as a single management unit. There is clear evidence of a rapid increase in exploitation of these stocks in recent years which has been partially controlled by unilateral regulatory action by the United Kingdom. International control now appears highly desirable and it is recommended that a TAC of 13 000 tons be brought in force in 1977.

There is a considerable fishery in the northern part of Division VIIa of juvenile herring used for industrial purposes. It is recommended that in Division VIIa a minimum landing size for herring of 20 cm be introduced, in conformity with that currently in force in Division VIa.

9.7 Advances have been made in the assessment of North Sea sprat which have permitted the recommendation of a TAC for this species, in that area, on a firmer basis. It is recommended that in 1977 the TAC for North Sea sprat, excluding the Norwegian fjords, should be set at a level not higher than 400 000 tons.

9.8 Few data are available to permit the calculation of a permissible catch level for the sprat stock in Division IIIa and in the Norwegian fjords. However, catches in this area have been increasing very rapidly in recent years and this can be expected to continue as a result of more stringent restrictions on both sprat and herring fishing in the North Sea. It is therefore recommended that in these areas the catch of sprat in 1977 shall not be allowed to exceed the catch level in 1975. This would entail a TAC of 100 000 tons.

10. References

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Table 2.1. Herring. Catch in tons 1966-1975.
North Sea (Sub-area IV and Divisions VIId and e) by country.
Skagerak (Division IIIa) total catch.

Country \ Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Belgium	391	410	134	468	1 200	681	1 337	2 160	603	2 361
Denmark	105 900	135 000	163 100	180 260	133 331	185 393	213 738	174 254[a]	61 728	113 411
Faroe Isl.	1 491	35 993	49 995	40 640	58 365	45 524	48 444	54 935[b]	26 161[b]	29 384
France	10 711	11 478	12 852	15 307	11 482	11 408	12 901	22 235	12 548	19 710
Germany, D.R.	-	-	-	-	290	475	127	1 728	3 268	2 607
Germany, F.R.	54 157	32 312	21 216	12 798	7 150	3 570	3 065	10 634[c]	12 470	5 738
Iceland	1 047	5 684	44 489	19 997	22 951	37 171	31 998	23 742[d]	29 017	16 289
Netherlands	56 668	37 270	22 306	29 769	46 218	32 479	24 829	34 070	35 106	35 938
Norway	424 462	240 032	211 904	114 938	193 102	125 842	117 501	99 739	40 975	30 714
Poland	74 071	37 816	11 954	9 221	5 057	2 031	2 235	5 738	9 850	7 069
Sweden	121 970	121 591	88 061	33 109	34 670	36 880	7 366	4 222[e]	3 561	3 500
U.K. (England)	10 716	8 215	5 128	6 666	9 702	4 113	394	2 268	5 699	6 475
U.K. (Scotland)[f]	17 557	18 138	16 477	22 053	21 885	25 073	17 227	16 012	15 034	8 862
USSR	16 442	11 660	70 029	61 549	18 078	9 500	16 386	30 735	18 096	20 509
Total N. Sea	895 583	695 599	717 645	546 775	563 481	520 140	497 548	484 012	275 116	302 567
Skagerak	144 655	279 744	280 036	113 279	71 071	61 570	67 021	84 566	55 512	52 129
Grand Total	1 040 238	975 343	997 681	660 054	634 552	581 710	564 569	568 578	330 628	354 696

Footnotes:

a) Total includes 2 107 tons for human consumption unspecified to area.

b) Supplied by Fiskirannsóknarstovan.

c) From Federal Republic of Germany national statistics compiled by Federal Research Board of Fisheries, Hamburg.

d) Excludes 15 938 tons caught on Skagerak border and allocated to that area on the basis of age analysis.

e) Swedish catches in Danish ports reported by area (North Sea, Skagerak) used for area allocation of Swedish landings reported as Skagerak and North Sea in Swedish statistics.

f) Catches from Moray Firth not included.

Table 2.2. Herring. Total catch in tons.
Skagerak (Division IIIa excl. Kattegat).

Year	Denmark	Faroe Islands	Germany Fed.Rep.	Iceland	Nether-lands	Norway	Poland	Sweden	U.S.S.R.	Total
1966	75 200	-	432	-	74	30 438	511	38 000	-	144 655
1967	100 400	-	466	2 151	-	95 039	127	66 000	15 561	279 744
1968	143 600	-	2	695	36	71 865	42	45 000	18 796	280 036
1969	57 965	-	-	-	-	13 957	-	41 357	-	113 279
1970	30 107	-	-	6 453	-	7 581	-	26 930	-	71 071
1971	26 985	5 636	-	3 066	-	6 120	-	19 763	-	61 570
1972	34 900	4 115	-	7 317	-	1 045	-	19 644	-	67 021
1973	42 098	5 265[a]	-	15 938[a]	-	836	-	20 429[a]	-	84 566
1974	35 732	7 132	36	231	-	698	-	11 683	-	55 512
1975[*]	29 944	8 342	108	1 209	-	196	-	12 348	-	52 129

[*] Preliminary figures.

[a] See Table 2.1 footnote under relevant country.

Table 2.3. Herring. Total catch in tons.
North Sea, Northeast (Division IVa east of 2°E).

Year	Belgium	Denmark	Faroe Islands	France	German Dem.Rep.	Germany Fed.Rep.	Iceland	Nether-lands	Norway	Poland	U.K. Scotland	Sweden	U.S.S.R.	Total
1971	-	6 219	239	-	-	-	-	167	10 720	-	-	-	-	17 345
1972	-	19 711	979	-	-	9	1 943	40	50	-	-	-	-	22 732
1973	-	686	12 776[a]	-	637	-	-	331	236	-	-	-	-	14 666
1974	-	12 284	532	-	55	-	2 460	46	-	-	-	-	-	15 377
1975	-	7 436	-	-	-	-	1 502	24	52	-	-	-	-	9 014

[a] See Table 2.1. footnote under relevant country.

Table 2.4. Herring. Total catch in tons.
North Sea. Northwest (Division IVa west of 2°E).

Year	Denmark	Faroe Islands	Finland	France	German Dem.Rep.	Germany Fed.Rep.	Iceland	Netherlands	Norway	Poland	U.K. England	U.K. Scotland	Sweden	USSR	Total
1971	44 500	45 095	-	514	-	389	36 992	5 755	115 108	1 288	-	24 711	4 954	9 500	288 806
1972	29 711	37 004	-	888	-	100	29 721	1 967	100 408	1 620	74	17 227	-	16 386	235 106
1973	41 341	42 159[a)]	1 540	209	1 057	2 624	23 742	4 615	62 749	5 547	-	15 430	4 222	30 735	247 697
1974	3 475	16 676	-	414	40	1 431	22 421	2 139	14 393	9 187	-	10 473	-	3 525	84 174
1975	12 982	19 722	-	595	-	1 459	7 679	2 238	23 497	6 310	-	6 633	-	11 562	99 679

a) See footnote under relevant country.

Table 2.5. Herring. Total catch in tons.
North Sea central (Division IVB). Adult herring fisheries.

Year	Denmark	Faroe Islands	France	German Dem.Rep.	Germany Fed.Rep.	Iceland	Netherlands	Norway	Poland	U.K. England	U.K. Scotland	Sweden	USSR	Total
1971[a)]	2 488	429	4 734	-	-	179	10 172	14	743	4 113	362	1 926	-	25 168
1972	1 589	10 460	2 014	-	21	334	11 372	17 043	615	271	-	4 068	-	47 787
1973	-	-	8 259	34	115	-	17 370	29 027	191	2 175	582	-	-	57 753
1974	2 067	8 953	8 561	3 173	3 832	4 136	31 229	26 582	662	5 658	41	2 416	14 566	116 396
1975	4 348	9 662	4 958	2 607	2 104	7 108	28 267	7 215	759	6 403	2 229	3 500	8 822	87 980

a) In 1971 Belgium caught 8 tons included in the Total.

Table 2.5.1. Provisional Estimates of the abundance of herring larvae in the North Sea in 1975/76, and comparable estimates for 1974/75.

Area and date of survey	Numbers of larvae <10mm x 10^{-9}	% Reduction 1974→1975	Numbers of larvae of all size groups	% Reduction 1974→1975
Orkney Shetland Area				
7 - 19/9/74	1 164		2 147	
3 - 25/9/75	425	63%	744	65%
23/9 - 2/10/74	225		996	
20 - 25/9/75	26	88%	761	24%
Central North Sea				
2 - 9/10/74	1 271		1 699	
8 - 14/10/75	79	94%	822	52%
Southern North Sea/ Eastern Channel				
9 - 16/12/74	1		11	
8 - 19/12/75	3		8	27%
7 - 16/1/75	15		22	
7 - 19/1/76	3	80%	9	69%

Table 2.6. Herring. Total catch in tons.
North Sea central (Division IVb).

Year	Young herring fisheries				Total young and adult fisheries (Tables 2.5 and 2.6)
	Denmark	Germany, Fed.Rep.	Sweden	Total	
1971	132 161	3 055	30 000	165 216	190 209
1972	162 671	2 823	3 298	168 792	216 579
1973	129 988	5 638	-	135 626	193 379
1974	43 866	6 761	1 145	51 772	168 168
1975	87 661	2 169	-	89 830	177 810

Table 2.7. Herring. Total catch in tons.
North Sea, South and English Channel, East and West (Divisions IVc and VIId and e).

Year	Belgium	Denmark	France	Germany Fed.Rep.	Netherlands	Poland	U.K. England	USSR	Total
1971	673	25	6 160	126	16 385	-	82	-	23 451
1972	1 337	57	9 999	112	11 450	-	49	-	23 004
1973	2 160	132	13 767	2 257	11 754	-	93	-	30 163
1974	603	36	4 573	432	1 692	1	41	5	7 383
1975	2 361	984	14 157	6	5 411	-	72	125	23 116

Table 2.8. North Sea catch in millions of fish by age.

Year	Area	Age in winter rings										Total
		0	1	2	3	4	5	6	7	8	>8	
1972	IVaW of 2°E	-	338.9	830.1	176.8	88.6	19.3	4.1	-	0.5	0.4	1 458.7
	IVaE of 2°E	-	75.1	91.0	17.8	5.8	0.7	0.1	-	-	-	190.5
	IVb	-	25.2	46.4	98.8	20.5	6.7	0.6	0.2	0.6	-	199.0
	IVbYH	750.4	2 896.6	337.9	21.1	6.4	1.2	0.2	-	-	-	4 013.8
	IVc+VIId,e	-	4.8	135.1	29.3	9.3	5.0	-	-	-	-	183.5
	Total NS	750.4	3 340.6	1 440.5	343.8	130.6	32.9	5.0	0.2	1.1	0.4	6 045.5
1973	IVaW of 2°E	-	52.5	742.1	452.6	58.0	39.5	20.3	2.6	0.5	0.6	1 368.7
	IVaE of 2°E	-	0.3	16.2	23.1	6.3	7.2	1.0	0.3	0.8	-	55.2
	IVb	-	242.5	180.1	39.0	28.3	4.7	7.2	-	-	-	501.8
	IVbYH	289.4	2 070.5	362.5	29.4	2.6	0.5	0.2	0.3	-	-	2 755.4
	IVc+VIId,e	-	2.2	43.3	115.1	55.0	7.4	1.9	0.5	0.1	0.0	225.5
	Total NS	289.4	2 368.0	1 344.2	659.2	150.2	59.3	30.6	3.7	1.4	0.6	4 906.6
1974	IVaW of 2°E	65.3	162.9	98.5	112.9	97.1	36.0	18.6	4.5	1.5	1.0	598.3
	IVaE of 2°E	5.7	131.8	24.2	10.8	1.0	-	-	-	0.1	-	173.6
	IVb(adult)		54.0	493.7	212.3	19.5	18.9	3.6	0.3	0.4	0.1	802.8
	IVbYH	925.1	493.5	132.1	5.7							1 556.4
	IVc+VIId		3.9	24.1	20.3	8.4	1.2	0.1	0.2			58.2
	Total NS	996.1	846.1	772.6	362.0	126.0	56.1	22.3	5.0	2.0	1.1	3 189.3
1975	IVaW of 2°E		277.9	124.9	71.8	51.0	41.8	10.2	6.6	3.0	1.1	588.3
	IVaE of 2°E		77.0	7.7	6.5	2.2	0.4	0.1	0.1	-	-	94.0
	IVb(adult)		259.6	142.0	119.9	78.4	14.3	5.6	2.6	0.5	0.3	623.2
	IVbYH	260.1	1 799.7	137.8	19.6	2.6	-	0.4				2 220.2
	IVc+VIId	0.9	21.8	115.2	35.9	4.8	1.6	-				180.2
	Total NS	261.0	2 436.0	527.6	253.7	139.0	58.1	16.3	9.3	3.5	1.4	3 705.9

Table 2.9. Skagerak catch in millions of fish by age.

Age in winter rings	0	1	2	3	4	5	6	7	8	>8	Total
1974	632.2	292.3	92.1	46.4	14.5	5.8	1.1	0.8	-	-	1 085.2
1975	76.2	380.7	38.0	36.2	49.1	13.3	5.4	0.6	0.6	-	600.1

Table 2.10. Millions of herring caught annually per age group (winter rings) in the North Sea over the last 10 years.

Year \ Winter rings	0	1	2	3	4	5	6	7	8	>8	Total	
1966	374.5	1 383.1	2 569.1	741.2	450.1	889.8	45.3	64.8	35.5	236.3	6 850.3	
1967	645.4	1 674.3	1 171.5	1 364.7	371.5	297.8	393.1	67.9	81.6	172.8	6 240.6	
1968	839.3	2 425.0	1 795.2	1 494.3	621.4	157.1	145.0	163.4	13.7	91.8	7 746.2	
1969	112.0	2 503.3	1 883.0	296.3	133.1	190.8	49.9	42.7	27.4	25.1	5 263.6	
1970	898.1	1 196.2	2 002.8	883.6	125.2	50.3	61.0	7.9	12.0	12.2	5 249.3	
1971	684.0	4 378.5	1 146.8	662.5	208.3	26.9	30.5	26.8	-	12.4	7 176.7	967.4
1972	750.4	3 340.6	1 440.5	343.8	130.6	32.9	5.0	0.2	1.1	0.4	6 045.5	574.0
1973	289.4	2 368.0	1 344.2	659.2	150.2	59.3	30.6	3.7	1.4	0.6	4 906.6	905.0
1974	996.1	846.1	772.6	362.0	126.0	56.1	22.3	5.0	2.0	1.1	3 189.3	574.5
1975	261.0	2 436.0	527.6	253.7	139.0	58.1	16.3	9.3	3.5	1.4	3 705.9	481.3

Table 2.11. Total North Sea. Calculated fishing mortality.

Winter rings \ Years	1966	1967	1968	1969	1970	1971	1972	1973	1974[1]	1975
0	0.08	0.09	0.12	0.03	0.11	0.11	0.17	0.13	0.20	?
1	0.34	0.50	0.52	0.56	0.47	0.96	0.91	1.00	0.63	0.9*)
2	0.68	0.47	1.47	0.88	1.08	0.99	0.89	1.09	1.00	0.9*)
3	0.71	0.84	1.92	0.94	1.30	1.24	0.82	1.27	0.88	0.9*)
4	0.56	0.84	1.07	0.86	1.29	1.20	0.77	0.95	0.78	0.9*)
5	0.82	0.80	0.96	1.05	0.84	0.98	0.52	0.86	1.05	0.9*)
6	0.37	0.90	1.06	0.83	1.07	2.10	0.42	1.22	0.79	0.9*)
7	0.36	1.30	1.31	0.96	0.26	2.48	0.06	0.55	0.57	0.9*)
8	0.69	0.90	0.90	0.70	0.70	0.70	0.70	0.55	0.57	0.9*)
$\bar{F}_w \geq 2$	0.68	0.70	1.50	0.89	1.13	1.11	0.86	1.12	0.94	

1) Inefficient estimates. *) Assumed values.

Table 2.12. Total North Sea. Calculated stock in numbers x 10^{-9} and stock biomass.

Winter rings \ Years	1966	1967	1968	1969	1970	1971	1972	1973	1974[1]
0	5.34	7.63	7.69	3.85	9.18	7.20	5.13	2.42	5.78
1	5.06	4.47	6.29	6.16	3.38	7.45	5.87	3.93	1.91
2	5.46	3.26	2.45	3.39	3.19	1.92	2.58	2.13	1.31
3	1.53	2.51	1.84	0.51	1.27	0.98	0.65	0.96	0.65
4	1.10	0.68	0.99	0.24	0.18	0.31	0.26	0.26	0.25
5	1.67	0.57	0.27	0.31	0.09	0.05	0.09	0.11	0.09
6	0.16	0.67	0.23	0.09	0.10	0.04	0.02	0.05	0.04
7	0.23	0.10	0.23	0.07	0.04	0.03	0.00	0.01	0.01
8	0.20	0.14	0.02	0.06	0.03	0.03	0.00	0.00	0.00
Σ_{0+1} Juveniles	10.40	12.10	13.98	10.01	12.56	14.65	11.00	6.35	7.69
Σ_{2-8} Adults	10.35	7.93	6.03	4.67	4.90	3.36	3.60	3.52	2.35
Biomass (tons x 10^{-3})	1 599	[illegible]313	1 064	682	651	607	[illegible]536	524	348

1) Inefficient estimates.

Tubby

	67/68	68/69	69/70	70/71
0/1	1967 2319	1968 324	1969 2881	1970 5003
1/2	1966 2841	1967 1424	1968 3003	1969 2068
2/3	1965 2176	1966 1956	1967 1100	1968 1564
3/4	472	721	1966 730	1967 828
4/5	11	137	300	1966 385

	67	68		69		70		
	1160×2	1160	162	162	1440	1440	2502	
	1420×2	1420	712	712	1504	1504	1034	
	1088×2	1088	978	978	550	550	782	
	236×2	236	361	361	365	365	414	
	6×2	5	69	69	150	150	193	
0	0	0		0		0		71 0
1	2341	2319+713631		524+1503 1827		2881+1034 3915		5003+?
2	2106	1421+977 2399		712+550 1262		1503+782 2285		517+
3	472+383	1078+360 1438		978+361 1343		550+414 964		1671
4+	11	236+68+6 310	174	361+150+69 580	522	365+192+150 707		

Herring F

	66 Mod WG76		67 mod WG		68	69		70		71	72 WG76	73
Prior #												
0	.06	.08	.08	.09	.10	.12	.04	.03	.05	.11	.17	.13
1	.35	.34	.42	.50	.50	.52	.51	.56	.51	.47	.96 .91	1.00
2	.59	.68	.53	.47	1.26	1.47	.84	.88	.97	1.08	.99 .89	1.09
3+	.64	[.68]	.70	[.70]	1.47	[1.50]	.88	.89	1.19	1.13	1.11 .86	1.12
		/ 2+ mean										

Age	Season 1968-69	Work i 1968	Work i 1969
1968	324	0	324
67	1424	712	712
66	1956	978	978
65	721	360	361
64	137	69	68

	Season 1969-70	i 1969	i 1970
1969	2881	0	2881
68	3007	1503	1504
67	1100	550	550
66	730	365	365
65	300	150	150

	Season 1970-71	i 1970	i 1971
1970	5003	0	5003
69	2067	1034	1034
68	1564	782	782
67	828	414	414
66	385	192	193

	Season 1969-70	i 1969	i 1968
1969	2319	0	2319
68	2841	1420	1421
67	2176	1088	1088
66	722	360	361
65	11	5	6

	Season 1971-72	i 1967 1	i 1972
1971	2805	0	2805
70	5688	2844	2844
69	1534	767	767
68	775	387	388
67	438	219	219

	Season 1972-73	i 1972	i 1973
72	6901	0	6901
71	6470	3235	3235
70	3615	1807	1808
69	752	376	376
68	214	107	107

	Season 1973-74	i 1973	i 1974
73	10709	0	
72	15285	7642	
71	2912	1456	
70	885	442	
69	255	228	

Army	Jack i 1969
1969	0
68	324+503
67	712+550
66	978+365
65	361+150 } 1922
64	68

	Jack i 1970
1970	0
69	2881+1034
68	1504+782
67	550+414
66	365+192
65	150

	Jack i 1971	
1971	0	
70	5003+2844	
69	1034+767	
68	782+387	1169
67	414+219	
66	193	

	Jack i 1972	
72	0	
71	2805+3235	6040
70	2844+1807	4651
69	767+376	1143
68	388+107	495
67	219	219

	Jack i 1973
1973	0
72	6901+7642
71	3235+1456
70	1808+442
69	376+228
68	107

	Jack i 1967
1967	0
66	1420+[illegible]
65	1088+( )
64	360+( )
63	5+( )

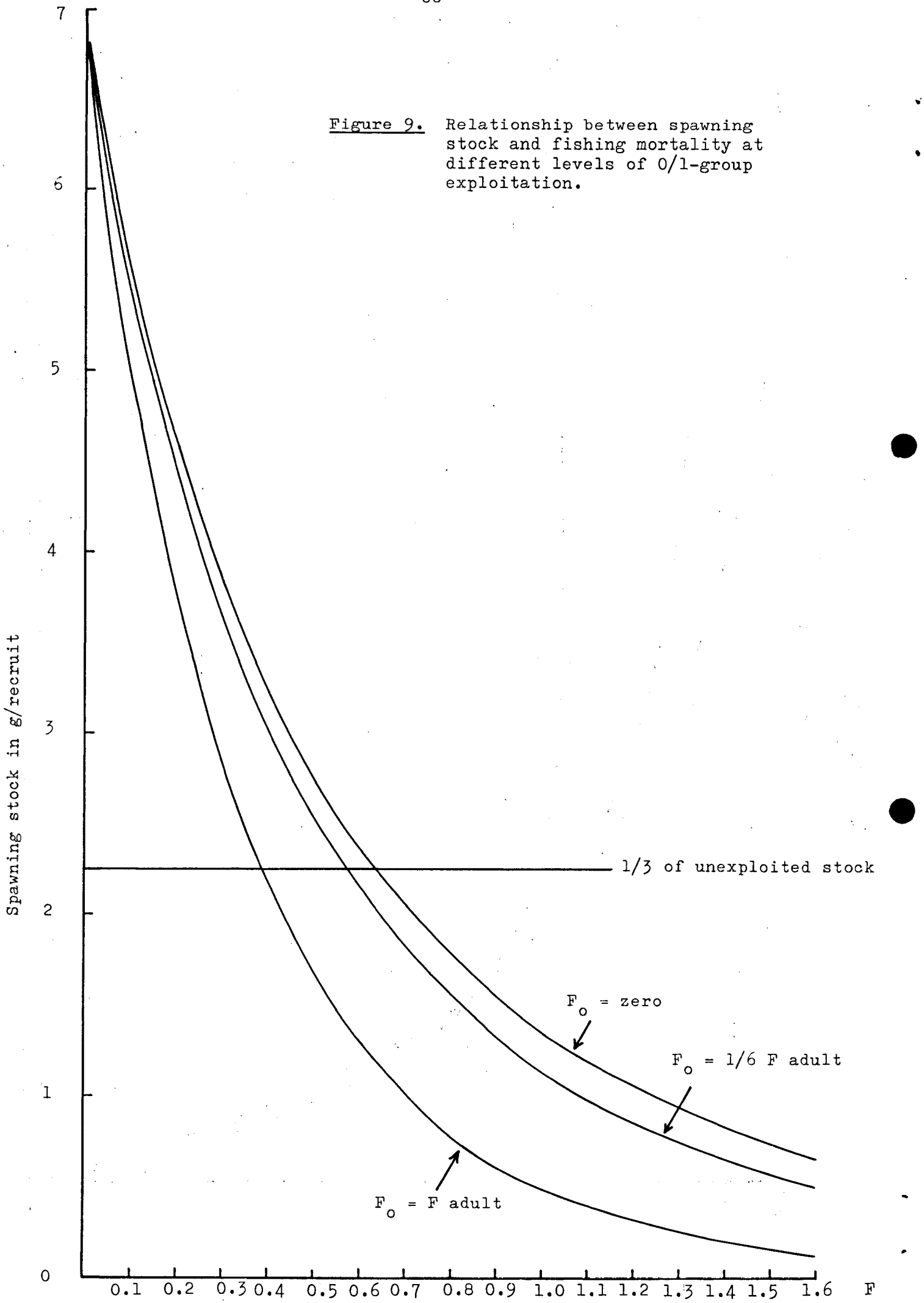


Figure 9. Relationship between spawning stock and fishing mortality at different levels of 0/1-group exploitation.

Figure 8. Yield per recruit curves for North Sea sprat at different intensities of 0-group exploitation.

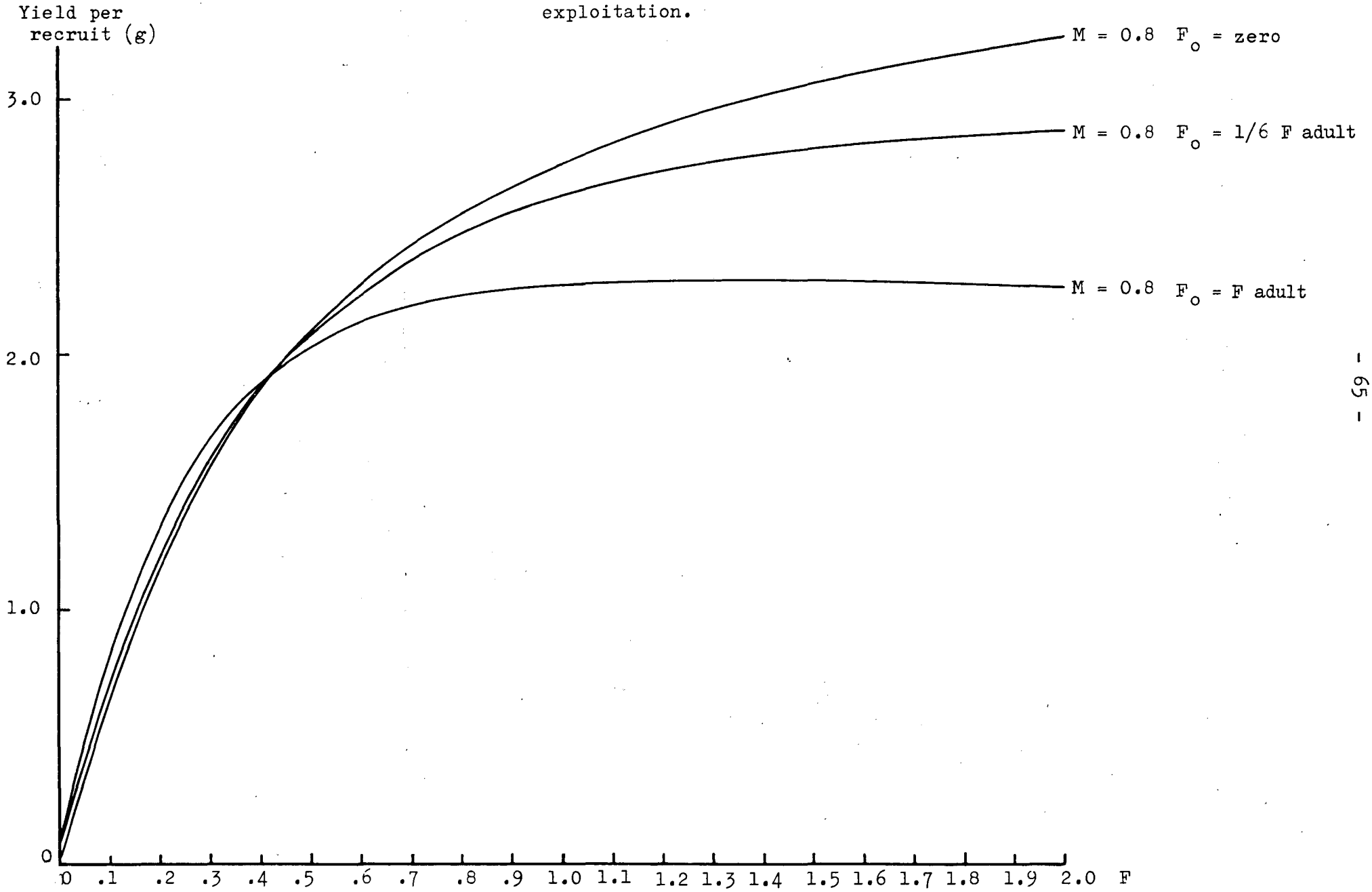
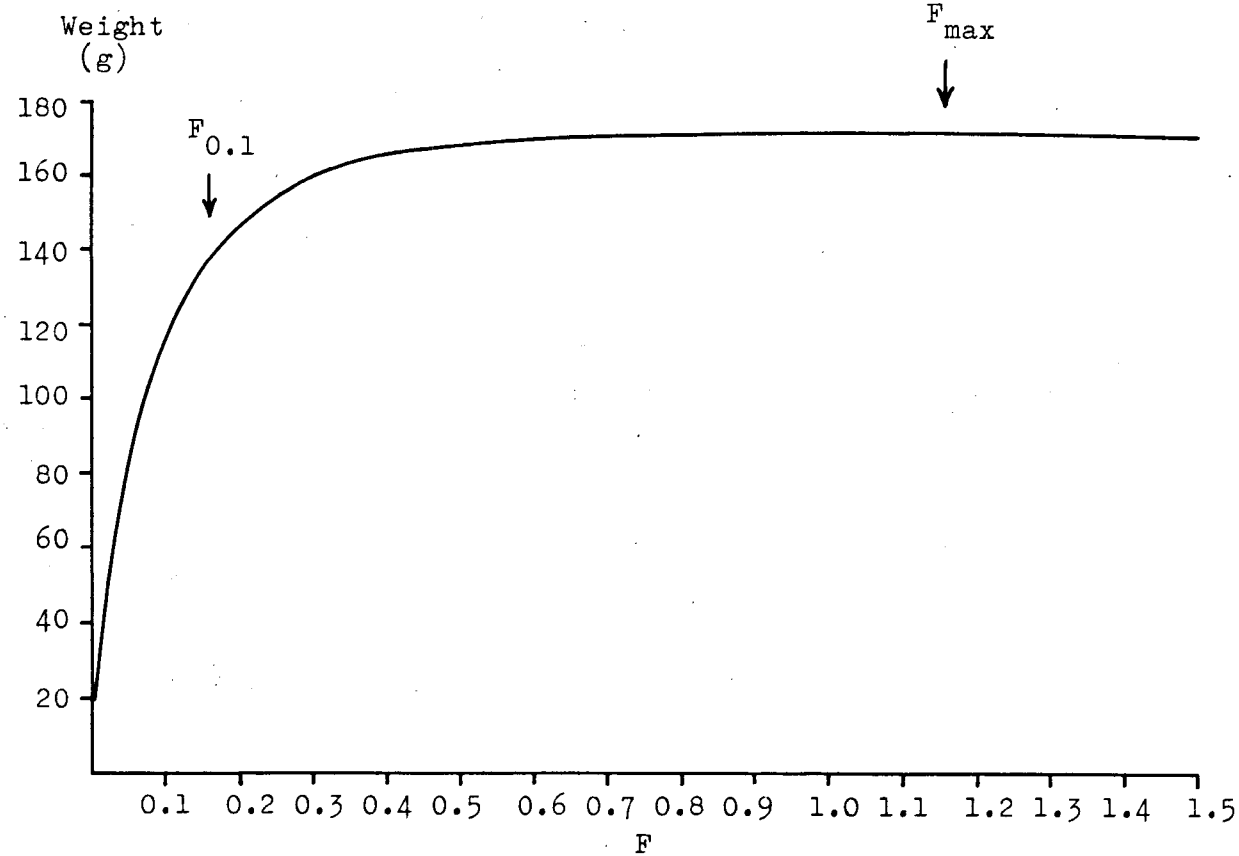


Figure 7. Yield per recruit curve for Manx herring stock.



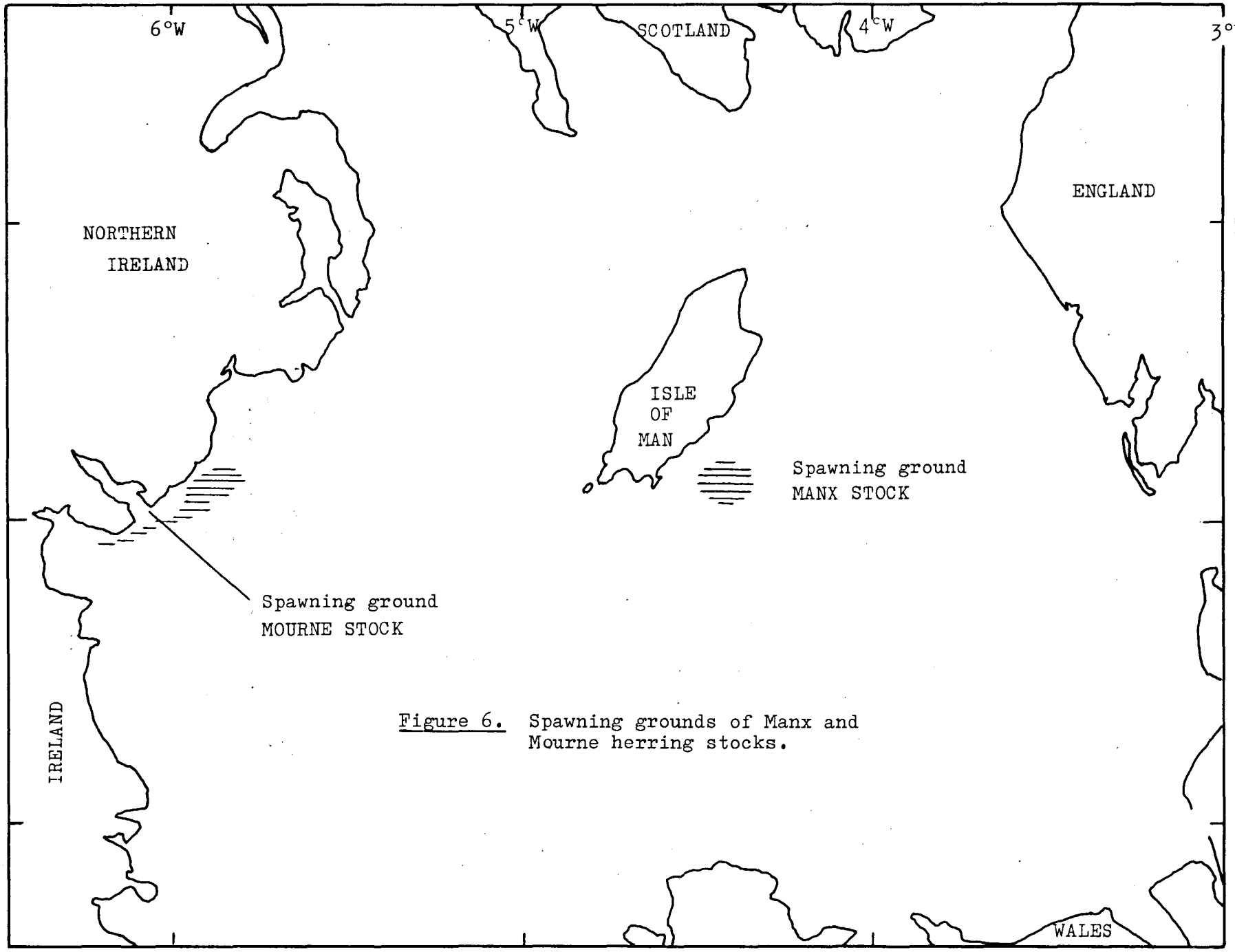
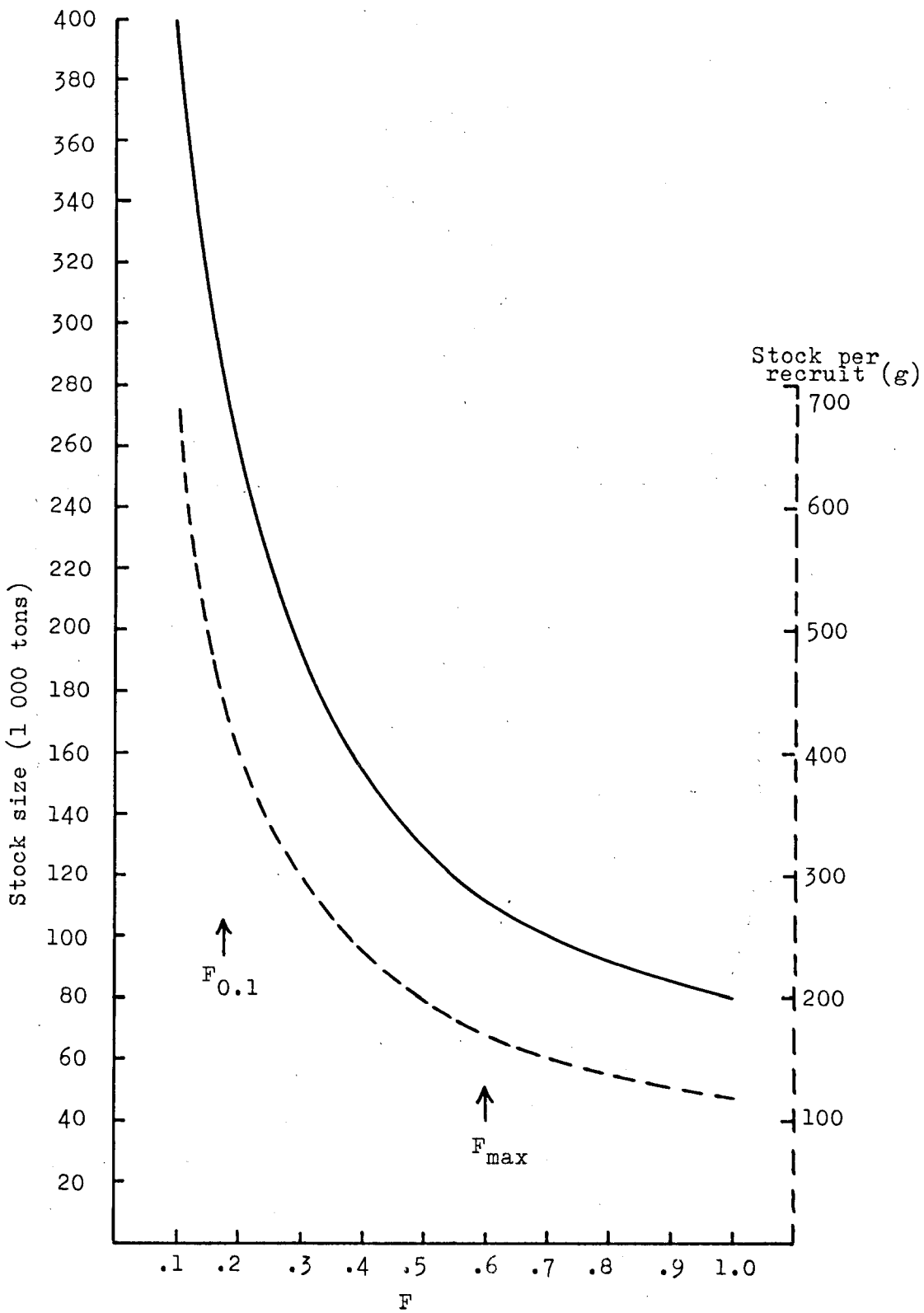


Figure 6. Spawning grounds of Manx and Mourne herring stocks.

Figure 5. VIa herring.
Stock size per recruit in grams (broken line) and corresponding stock size in 1 000 tons (solid line) assuming constant modal recruitment (650 x 10^6 1-ringers) and equilibrium situation for different values of F.



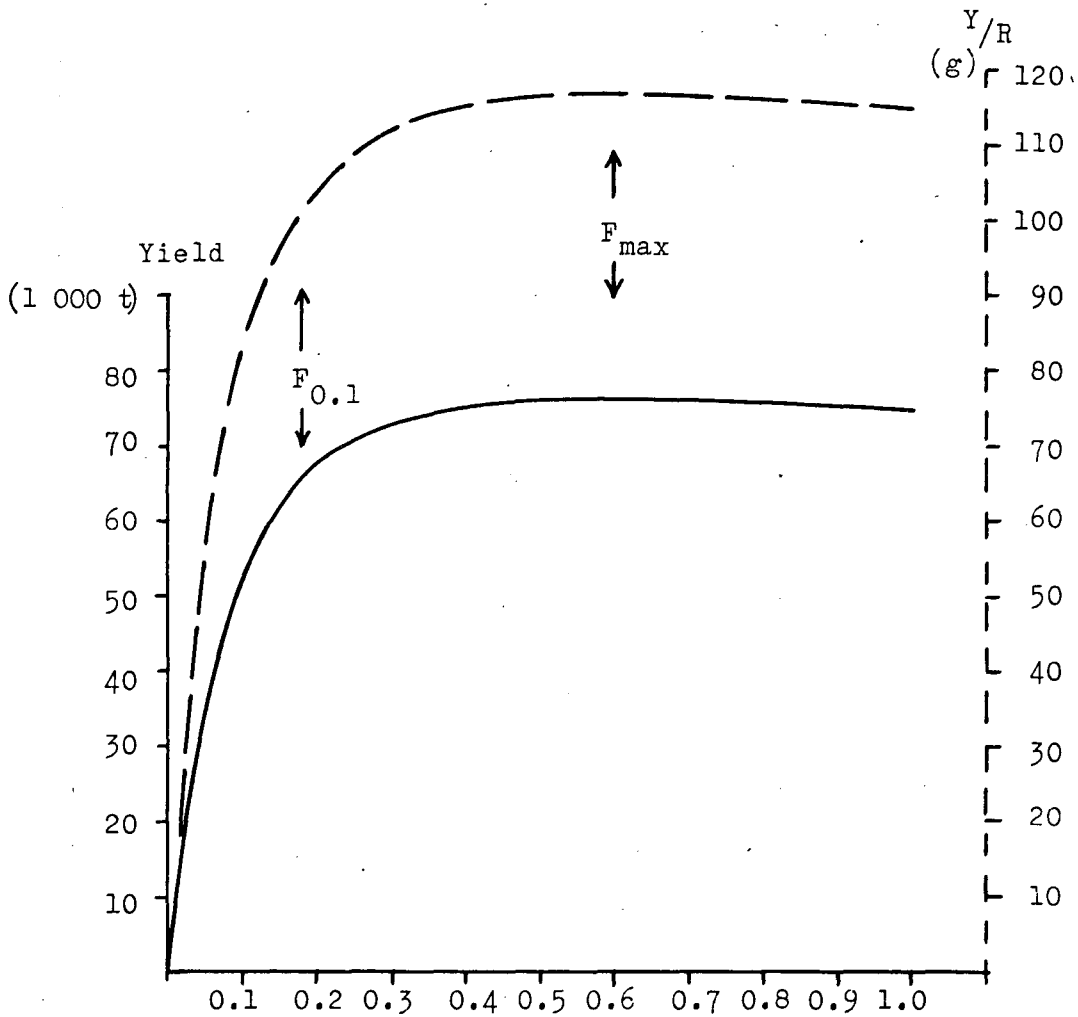


Figure 4. VIa herring.

Yield per recruit in grams (broken line) and yield in 1 000 tons (solid line) assuming constant modal recruitment (650×10^6 1-ringers) and equilibrium situation for different values of F.

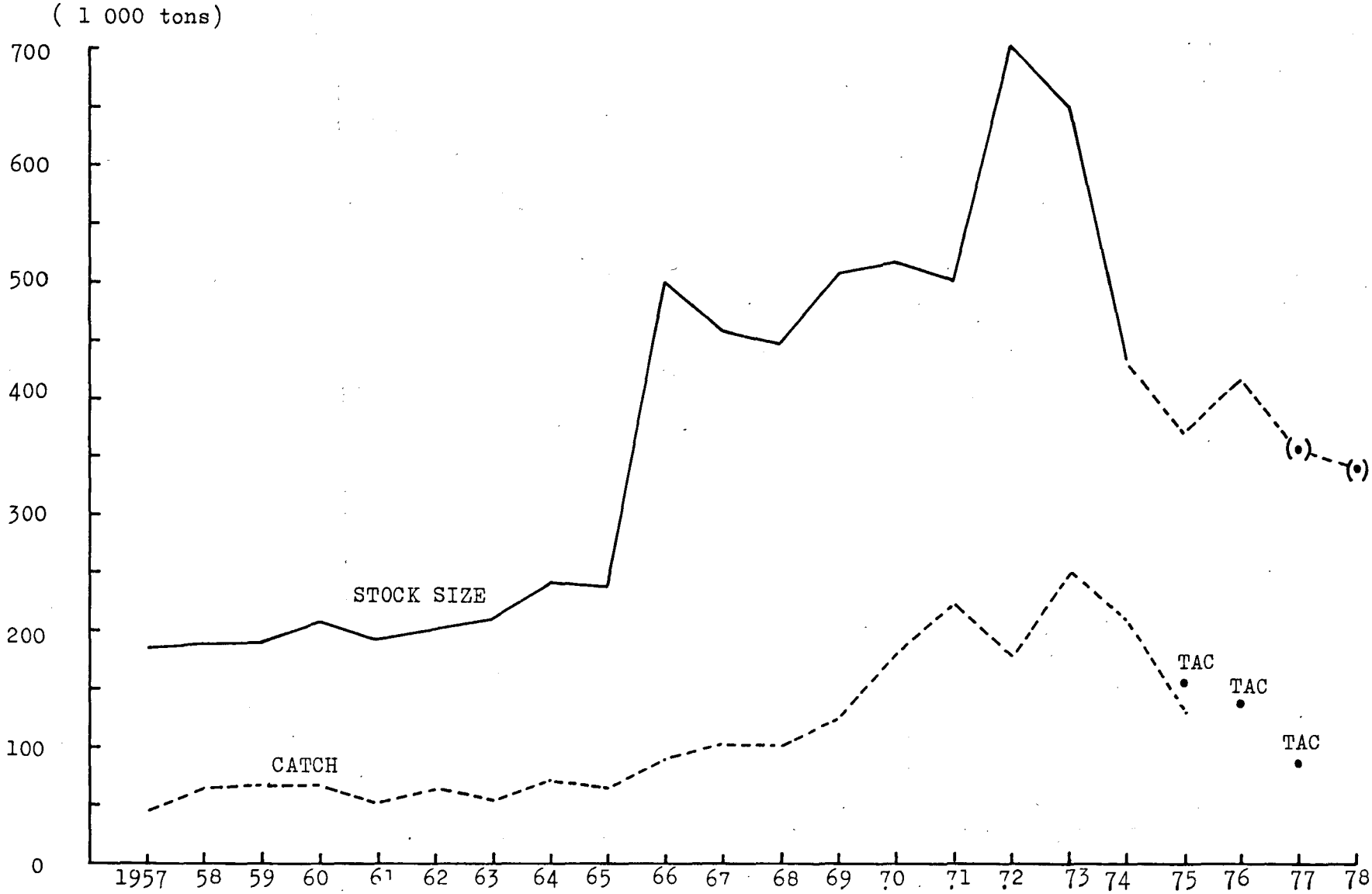


Figure 3. VIa herring.
Estimated stock size (2-ringers and older) and catches
(in 1 000 tons)

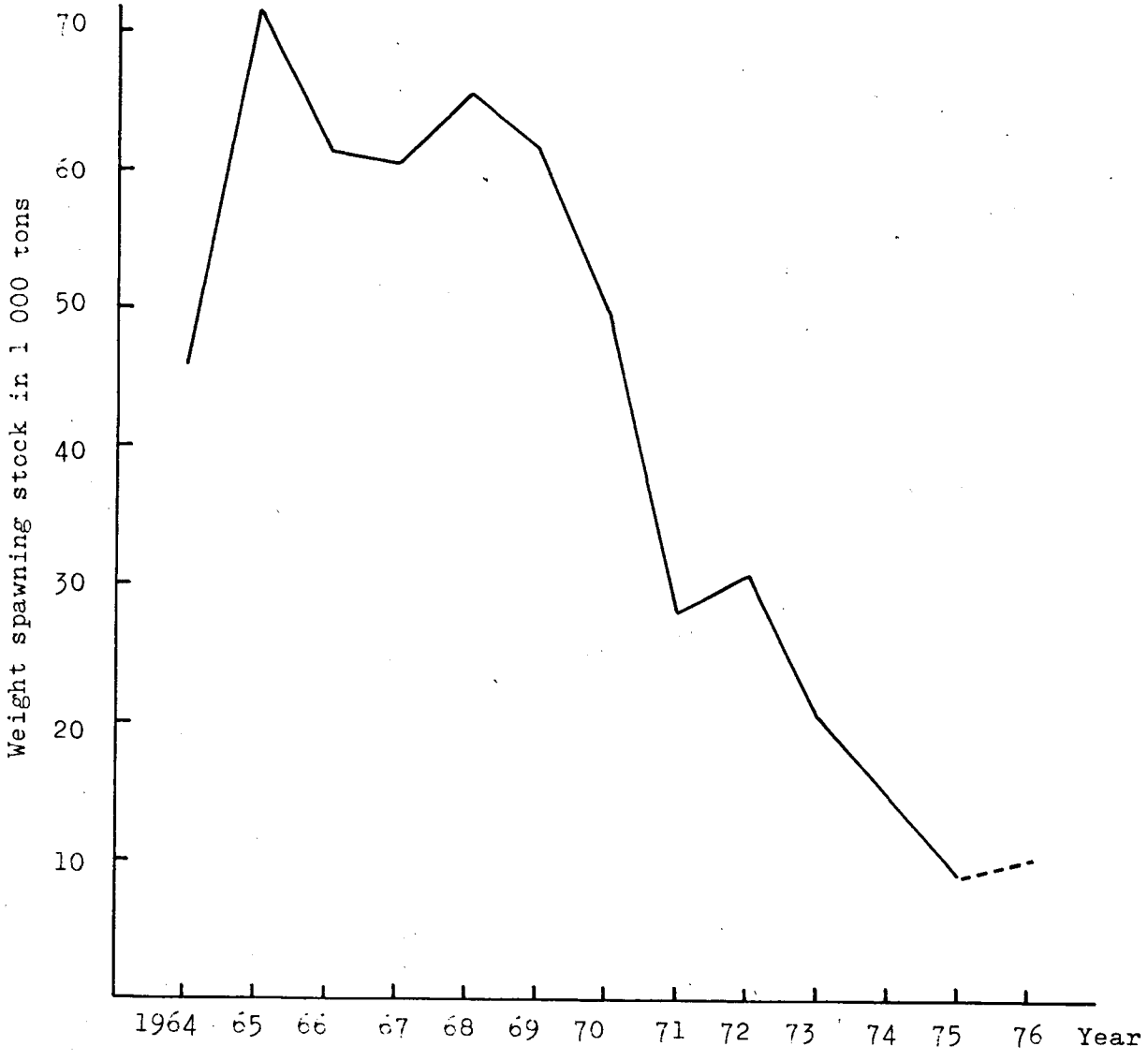


Figure 2. Celtic Sea spawning stock.

Figure 1. Year class strength of North Sea herring and the biomass of the spawning stock which produced that year class.

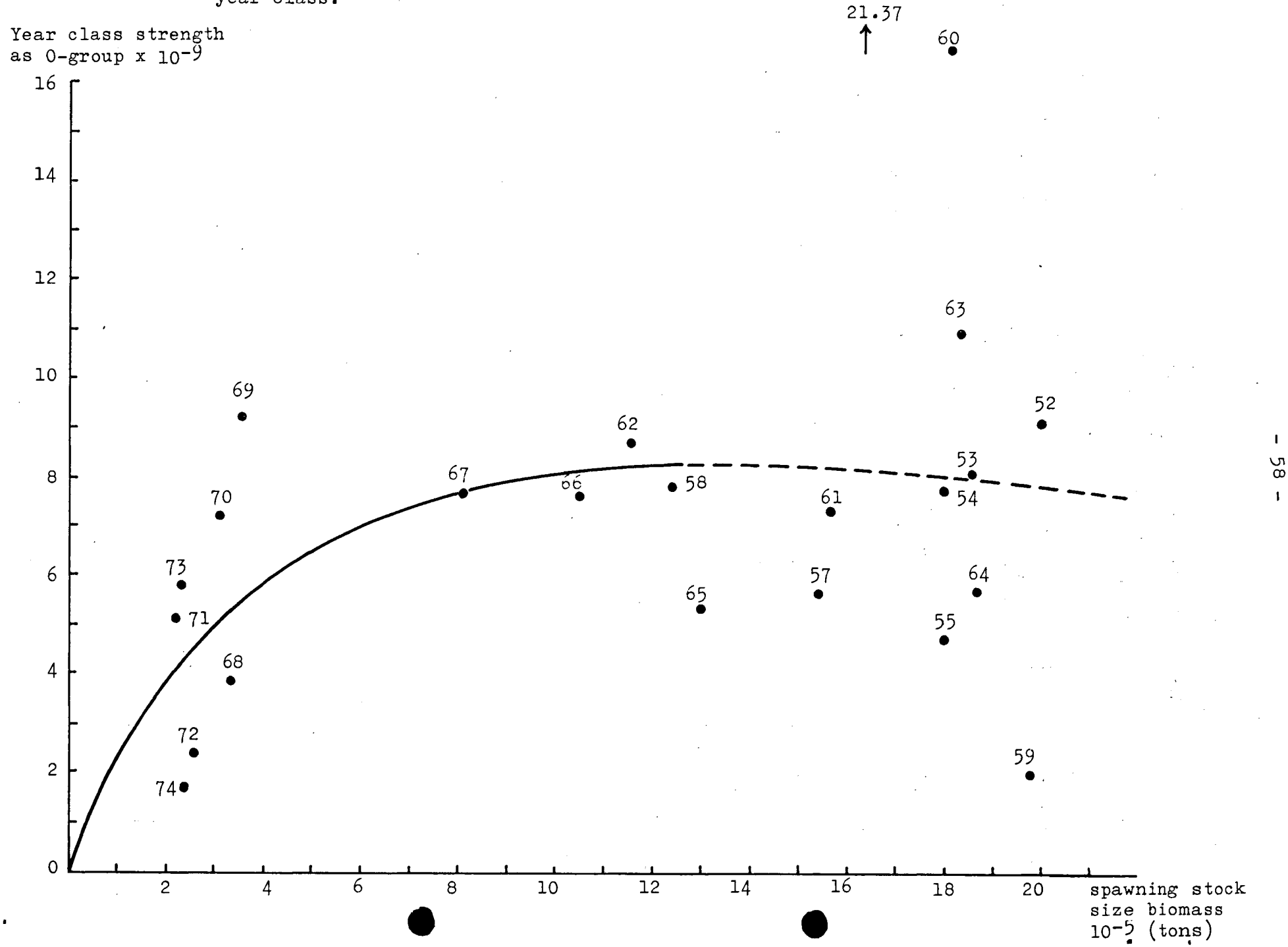


Table 6.12. Percentage of 0/1-group sprat in samples from the Swedish sprat fishery during September to March.

Season	Purse seines and land seines within the archi-pelago	Trawls in Skagerak and Kattegat
1966/67		16.2
1967/68	6.7	9.0
1968/69	9.0	35.8
1969/70	1.5	8.4
1970/71	4.9	9.9
1971/72	1.6	30.4
1972/73	2.3	29.7
1973/74	8.3	19.8
1974/75	3.8	19.5

Table 6.11. Percentage distribution of year classes and mean age from I-group onwards in Swedish sprat samples taken from September to March.

Season	Purse seines and land seines within the archipelago							Trawl fishery in Skagerak and Kattegat						
	Age Groups													
	1/2	2/3	3/4	4/5	5/6	6/7	Mean age	1/2	2/3	3/4	4/5	5/6	6/7	Mean age
1960/61	58.3	41.7					2.42	49.1	49.1	1.9				2.53
1961/62	90.7	6.2	3.1				2.12	59.9	30.8	9.1	0.3			2.50
1962/63	31.6	68.4					2.68	64.6	33.3	2.0				2.37
1963/64	61.3	17.9	20.5	0.3			2.60	87.0	9.3	3.7				2.17
1964/65	83.6	11.3	2.8	2.4			2.24	65.1	32.1	2.8	0.3			2.39
1965/66	60.7	29.6	7.9	1.3	0.6		2.51	55.3	33.0	9.8	1.4	0.5		2.59
1966/67	59.3	30.6	6.9	2.8	0.5		2.55	73.5	24.5	1.9	0.1			2.29
1967/68	69.1	25.2	4.4	1.3			2.38	61.6	28.8	8.3	1.3	0.2		2.50
1968/69	56.7	31.2	9.1	2.2	0.8		2.59	72.6	16.0	7.3	4.2			1.93
1969/70								48.3	33.4	12.9	4.1	1.3		2.77
1970/71	48.0	38.8	11.2	1.6	0.5		2.69	71.7	22.7	5.1	0.3	0.2		2.37
1971/72	85.9	12.2	1.6				2.15	71.5	25.5	2.3	0.1			2.29
1972/73	77.9	19.1	2.8	0.2	0.1		2,26	72.8	23.0	4.0	0.2			2.32
1973/74	59.3	27.7	11.7	1.1	0.1	0.1	2.53	76.4	17.9	4.9	0.7	0.1	0.1	2.32
1974/75	33.7	35.4	18.8	7.1	1.0		2.98	75.3	22.4	3.3	0.8	0.2		2.29

Table 6.10. Sprat catches in the Skagerak and Kattegat ('000 metric tons) 1966-75.

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975[a]
					IIIa					
Denmark	3.4	5.3	3.1	1.6	4.2	2.2	2.1	54.4	48.9	75.7
Norway[b]	1.1	3.3	2.1	1.7	2.4	2.9	2.4	3.2	1.4	1.8
Sweden[b]	4.3	3.9	4.6	3.5	8.4	12.0	21.2	18.7	20.5	23.0
Total	8.8	12.5	9.8	6.8	15.0	17.1	25.7	76.3	70.8	100.5
					IVa East (Norwegian west coast fjords)					
Norway	10.7	10.2	6.3	11.8	6.4	4.4	6.9	8.8	3.3	2.4

a) Preliminary figures as reported.

b) 1966-69 not complete.

Table 6.8. Stock biomass and annual recruitment of North Sea sprat, as estimated from Virtual Population Analyses.

	Total stock in 000' tons at 1 July	Numbers of 0-group recruits at 1 July x 10^{-9}
1967	874	192
1968	1 154	113
1969	1 170	129
1970	1 040	68
1971	820	75
1972	445	257
1973	(801)*	(381)*
1974	1 624	236
Mean 1967-74	991	181

* The values in parentheses are extremely uncertain.

Table 6.9. Total mortality rate (Z) of North Sea sprat calculated from catch/effort data.

Area IVb(E) Danish data) Nos. x 10^{-6}/1000 hrs trawling	Oct	Nov	Dec
1 + older 1974	210.8	183.1	75.8
2 + older 1975	46.5	45.7	26.4
Z (1975)	1.51	1.39	1.05
Mean			1.32

Area IVb (W) (Soviet data) Nos. x 10^{-6}/1000 hrs trawling	Oct	Nov	Dec
1 + older 1974	123.6	391.5	278.4
2 + older 1975	55.7	74.2	87.8
Z	0.79	1.66	1.15
Mean			1.20

Table 6.6. Estimates of F in North Sea sprat from 1967-1974 from annual VPA.

Age	Fishing season 1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74[1)]	1974-75	Weighted mean 1967/8-1972/3
0/1	0.02	0.00	0.03	0.11	0.06	0.04	0.04	0.05*)	0.04
1/2	0.05	0.02	0.09	0.06	0.35	0.34	0.22	0.27*)	0.10
2/3	0.12	0.09	0.04	0.11	0.10	0.86	0.51	0.27*)	0.13
3/4	0.14	0.10	0.08	0.08	0.14	0.12	1.28	0.20*)	0.10
4/5	0.10*)	0.10*)	0.10*)	0.10*)	0.10*)	0.10*)	0.10*	0.20*)	
Weighted mean 1/2-3/4	0.07	0.04	0.07	0.07	0.22	0.39	0.26		

Table 6.7. Estimates of quarterly F in North Sea sprat 1974-75 from quarterly VPA.

Age	1974 Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	1975 Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Total F from Jul 1974 - Jun 1975
0	-	-	0.00	0.01	-	-	0.00	-	0/1 0.04
1	0.02	0.00	0.02	0.03	0.03	0.00	0.12	0.10*)	1/2 0.17
2	0.15	0.06	0.07	0.04	0.11	0.01	0.07	0.10*)	2/3 0.39
3	0.27	0.06	0.02	0.04	0.27	0.01	0.01	0.10*)	3/4 0.26
4	0.54	0.12	0.01	0.08	0.19	0.01	0.00	0.10*)	

*) Input values. 1) Inefficient estimate.

Table 6.4. North Sea sprat catch 1967-75. Numbers caught per age group x 10^{-6} in the period 1 July - 30 June.

Year	Age Group 0/1	1/2	2/3	3/4	4/5
1967-68	2 319	2 841	2 176	472	11
1968-69	324	1 424	1 956	721	137
1969-70	2 881	3 007	1 100	730	300
1970-71	5 003	2 068	1 564	828	385
1971-72	2 805	5 688	1 534	775	438
1972-73	6 901	6 470	3 615	752	214
1973-74	10 709	15 285	2 912	885	255
1974-75	6 139	27 219	6 648	351	26

Table 6.5. Total North Sea sprat catch 1974 and 1975. Numbers caught per age group x 10^{-6}.

	Age Group 0	1	2	3	4	5	6
1974 Jan-Mar	-	7 620.0	7 341.8	1 043.2	198.7	40.3	-
1974 Apr-Jun	-	361.8	2 083.5	148.6	26.1	4.7	-
1974 Jul-Sep	46.7	4 909.8	1 784.7	36.2	0.9	4.6	-
1974 Oct-Dec	1 549.3	6 172.9	865.1	74.5	10.6	7.2	-
1975 Jan-Mar	-	4 096.6	14 973.2	3 929.0	233.7	14.1	-
1975 Apr-June	-	446.2	1 163.2	68.9	6.5	-	-
1975 Jul-Sep	15.0	10 588.1	5 760.o	75.1	3.1	-	-
1975 Oct-Dec	675.2	6 351.6	6 122.5	660.2	57.3	4.4	-

Table 6.3 Total North Sea sprat catch 1974 and 1975.
Numbers caught per age group x 10^{-6}.

Area	Year	Age group 0	1	2	3	4	5	6
IVa(W)	1974	961.56	2 963.11	693.01	111.98	12.23		
	1975	267.15	2 011.08	1 025.43	363.59	11.07	2.24	
IVb(E)	1974	3.34	8 486.67	4 727.88	116.51	1.73	3.91	
	1975	9.80	13 169.04	9 281.97	149.50	6.26		
IVb(W)	1974	609.38	6 848.08	6 033.40	1 095.59	220.80	49.52	20.68
	1975	665.42	5 110.00	17 287.01	4 395.97	282.70	16.99	
IVc	1974	21.73	766.15	620.77	28.59	1.83	3.34	
	1975		1 182.43	499.09	45.84	1.76		

Table 6.2 Percentage age compositions of landings 1967 - 1975.

Division IVb - west of 3°E (English data from North Shields fishery)

Fishing Season	Age Group					
	0/1	1/2	2/3	3/4	4/5	5/6
1967-68	17.1	53.8	16.9	11.1	1.2	
1968-69	3.0	37.5	43.1	11.7	4.3	0.3
1969-70	89.5	4.9	2.2	2.9	0.5	0.1
1970-71	40.9	25.3	22.8	8.3	2.8	
1971-72	8.8	77.9	8.6	4.2	0.4	
1972-73	33.7	44.2	17.9	2.9	1.1	0.2
1973-74	58.5	39.3	1.7	0.6		
1974-75	15.7	59.9	22.0	2.2	0.2	

Division IVb - east of 3°E (Danish data)

Fishing Season	Age Group				
	0	1	2	3	>3
1967		10	76	14	
1968		9	57	27	5
1969		1	41	39	20
1970	0.3	33	33	22	12
1971		23	40	20	17
1972	4	1	76	16	2
1973	15	69	11	4	1
1974		65	35	0.2	
1975		59	40	0.8	+

Table 6.1 (ctd). Sprat catches in the North Sea ('000 metric tons) 1966-75.

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975[a]
IVb East										
Denmark	24.5	17.4	18.1	18.5	16.2 min	19.9	28.8	93.9	104.0	215.2
Germany, Federal Republic of	8.5	11.5	16.7	6.3	7.6	5.1	1.7	11.0	17.5	0.4
Total	33.0	28.9	34.8	24.8	23.8 min	25.0	30.5	104.9	121.5	215.6
IVc										
Belgium	1.4	0.4	0.4	0.4	0.6	0.1	0.1	0.2	+	+
Denmark	-	-	-	-	-	-	-	-	0.9	3.9
France	+	-	+	0.1	+	+	-	+	0.3	0.1
Germany, Federal Republic of	-	-	-	-	+	-	+	-	-	-
Netherlands	1.5	0.2	1.0	1.6	1.5	1.0	0.4	+	+	0.2
U.K. (England)	5.7	3.2	6.2	4.2	3.9	0.2	+	0.8	3.4	2.9
Total	8.6	3.8	7.6	6.3	6.0	1.3	0.5 min	1.0	4.6	7.1
Total North Sea										
Belgium	1.4	0.4	0.4	0.4	0.6	0.1	0.1	0.2	+	+
Denmark	24.5	17.4 min	18.1	18.5	24.8	29.8	43.2	140.9	165.6	326.2
Faroe Islands	-	-	-	-	-	-	-	-	4.2	42.9
France	+	+	1.0	0.1	+	+	-	+	0.3	0.1
German Democratic Republic	+	+	-	-	-	-	-	-	1.7	1.7[b]
Germany, Federal Republic of	8.5	11.5	16.7	6.3	7.6	5.1	1.7 min	11.0	17.5	0.4 min
Netherlands	1.5	0.2	1.0	3.6	1.5	1.0	0.4	+	+	0.2
Norway	-	-	-	-	-	0.9	6.3	3.4	9.5	147.2
Poland	+	+	+	-	-	-	+	+	-	9.4
Sweden	-	-	-	-	-	-	-	1.0	2.2	10.0
U.K. (England)	6.6	15.1	8.8	7.5 min	15.1	25.7	21.8	35.6	28.9	35.4
U.K. (Scotland)	71.1	26.5	26.4	34.4	13.3 min	22.2	33.4	52.3	49.8	14.3
U.S.S.R.	-	-	-	-	-	1.2	0.8	17.9	32.9	47.5
Total	113.6	71.1	72.4	70.8	62.9	86.0	107.7	262.3	312.5	635.3

a) Preliminary figures as reported. min

b) Estimated by the Working Group.

+ = Less than 0.1

... = No data available

- = Magnitude known to be nil

Table 6.1 Sprat catches in the North Sea ('000 metric tons) 1966-75.

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975[a]
IVa West										
Denmark	-	-	-	-	-	-	-	-	5.3	0.5
Faroe Islands	-	-	-	-	-	-	-	-	0.2	12.9
France	-	+	-	-	-	-	-	-	-	-
Germany, Federal Republic of	-	+	-	-	-	-	-	+	-	-
Netherlands	-	-	+	+	+	+	+	+	+	-
Norway	-	-	-	-	-	0.9	2.2	-	-	1.5
Poland	-	+	-	-	-	-	-	+	-	3.3
Sweden	-	-	-	-	-	-	-	1.0	2.2	10.0
U.K. (England)	+	-	-	-	-	+	-	0.2	-	-
U.K. (Scotland)	65.1	19.1	13.0	12.4	3.8	15.0	29.8	49.4	41.2	9.4
Total	65.1	19.1	13.0	12.4	3.8	15.9	32.0	50.6	48.7	37.5
IVb West										
Denmark	...	...	...	...	8.6	9.9	14.4	47.0	55.4	106.6
Faroe Islands	-	-	-	-	-	-	-	-	4.0	30.0
France	-	-	1.0	-	-	-	-	-	-	-
German Democratic Republic	+	+	-	-	-	-	-	-	1.7	1.7[b]
Netherlands	+	+	+	2.0	+	+	+	-	-	-
Norway	-	-	-	-	-	-	4.1	3.4	9.5	145.7
Poland	+	+	+	-	-	-	+	-	-	6.1
U.K. (England)	0.9	11.9	2.6	3.3	11.2	25.5	21.8	34.6	25.5	32.5
U.K. (Scotland)	6.0	7.4	13.4	22.0	9.5	7.2	3.6	2.9	8.6	4.9
U.S.S.R.	-	-	-	-	-	1.2	0.8	17.9	32.9	47.5
Total	6.9	19.3	17.0	27.3	29.3	43.8	44.7	105.8	137.7	375.1

(cont'd)

Table 5.3.3. North Irish Sea industrial fishery.
Numbers of herring caught per year class in each year (10^{-6}).

Year class	1969	1970	1971	1972	1973	1974	1975
1965	1.0						
1966	7.7	1.4					
1967	18.2	3.6	0.4				
1968	48.1	23.7	30.5	0.3			
1969		161.5	30.3	1.8	0.5		
1970			100.3	28.8	0.6	0.8	
1971				78.4	29.7	2.3	0.6
1972					50.2	19.0	1.5
1973						57.9	21.6
1974							20.3
Total (10^{-6})	75.0	190.2	143.5	109.3	81.0	80.0	44.0
Tons	2 210	3 796	2 715	2 251	1 913	2 190	1 573
N/Kg	33.9	50.1	52.9	48.6	42.3	36.5	27.9

Table 5.3.2(b). Mourne herring Division VIIa.
Stock in millions (from VPA) at beginning of year.

Age (rings) \ Year	1969	1970	1971	1972	1973	1974*)	1975*)
0	125	280	181	154	112	124	?
1	?	68	100	68	65	53	57
2	?	?	39	45	27	21	19
3	?	?	19	3	27	11	6
4	?	?	4	5	2	9	3
5	?	?	2	3	3	1	4
6	?	?	4	1	2	1	0
7	?	?	1	3	1	1	0
8	?	?	1	1	2	0	0
Total stock in numbers (0-8)	?	?	351	283	241	221	?
Total stock biomass (1-8)	?	?	28 535	20 313	20 927	15 457	(12 980)

Fishing mortalities by year and age.

Age (rings)						
0	0.52	0.93	0.87	0.76	0.64	0.67
1	?	0.46	0.69	0.84	1.05	0.91
2	?	?	2.34	0.43	0.80	1.17
3	?	?	1.22	0.33	0.95	1.19
4	?	?	0.28	0.48	0.49	0.85
5	?	?	0.22	0.24	0.71	1.90
6	?	?	0.16	0.25	0.67	1.25
7	?	?	0.23	0.28	0.75	1.00
8	?	?	0.34	0.09	0.71	0.87
Mean	?	?	0.70	0.41	0.75	1.09

*) Inefficient estimates.

Table 5.3.2(a). Manx herring Division VIIa.
Stock in millions (from VPA) at beginning of year.

Age (rings)	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974*)	1975*)
1	32	73	100	128	96	140	127	91	201	102	32
2	58	29	66	90	116	86	126	110	79	180	80
3	14	33	22	42	58	83	54	62	60	54	75
4	2	6	22	16	28	39	49	28	32	34	19
5	1	1	4	13	12	19	23	26	15	19	13
6	1	1	1	2	8	8	8	12	12	8	8
7	1	1	0	0	1	5	5	4	4	7	4
8	1	0	0	0	0	1	2	3	2	2	2
Stock in number (2-8)	78	71	115	163	223	241	267	245	204	304	201
Stock biomass (2-8)	14 734	13 937	22 092	31 518	43 526	48 820	63 254	49 266	41 393	58 998	42 750

Fishing mortalities by year and age.

Age (rings)										
1	0.01	0.00	0.01	0.00	0.00	0.01	0.04	0.04	0.01	0.14
2	0.47	0.15	0.34	0.34	0.23	0.37	0.60	0.50	0.28	0.77
3	0.69	0.29	0.25	0.33	0.30	0.43	0.55	0.56	0.49	0.93
4	0.73	0.36	0.44	0.20	0.27	0.44	0.51	0.53	0.42	0.87
5	0.59	0.47	0.61	0.42	0.25	0.72	0.58	0.72	0.47	0.71
6	0.65	0.75	1.46	0.46	0.31	0.46	0.56	0.86	0.44	0.67
7	0.73	0.34	2.30	0.86	0.48	0.77	0.49	0.63	0.66	0.13
8	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Mean	0.71	0.71	0.39	0.32	0.29	0.48	0.54	0.62	0.47	0.87

*) Inefficient estimates.

Table 5.3.1(a). Catch in number x 10^{-6} Manx stock.

Year \ Rings	1	2	3	4	5	6	7	8	8+
1964	0.01	2.58	0.37	0.13	0.22	0.24	0.25	0.03	0.07
1965	0.31	20.78	6.78	1.03	0.46	0.63	0.41	0.31	0.08
1966	0.18	3.89	7.91	1.88	0.33	0.27	0.18	0.04	0.03
1967	1.02	17.82	4.79	7.61	1.80	0.38	0.20	0.20	0.20
1968	0.44	24.46	11.29	2.68	4.33	0.70	0.06	0.00	0.29
1969	0.19	22.84	14.25	6.24	2.47	1.97	0.42	0.02	0.00
1970	0.75	25.24	27.89	13.24	9.42	2.88	2.66	0.31	0.00
1971	4.98	54.36	21.91	18.68	9.67	3.41	1.74	1.04	0.12
1972	3.59	41.24	25.72	11.14	12.99	6.38	1.94	1.25	0.00
1973	1.71	18.32	22.23	10.45	5.40	3.98	2.04	1.01	0.36
1974	12.55	92.99	31.55	18.81	9.35	3.96	4.41	1.00	0.00
1975	5.59	38.64	36.33	9.37	6.12	4.08	1.88	0.95	0.38

Table 5.3.1(b). Catch in number x 10^{-6} Mourne stock.

Year \ Rings	0	1	2	3	4	5	6	7	8	8+
1969	48.1	18.2	7.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0
1970	161.5	23.7	3.6	1.4	0.0	0.0	0.0	0.0	0.0	0.0
1971	100.3	47.4	33.1	12.9	1.1	0.4	0.5	0.2	0.2	0.03
1972	78.4	37.0	14.9	0.9	1.9	0.6	0.3	0.7	0.1	0.3
1973	50.2	40.4	14.0	15.5	0.8	1.4	1.0	0.5	1.0	0.2
1974	57.9	30.3	13.6	7.2	5.1	1.0	0.9	0.6	0.2	0.4
1975	20.3	27.7	9.3	2.8	1.4	1.7	0.1	0.2	0.2	0.1

Table 5.2.3. Effort and mortality on Manx stock.

Year	Effort (trawler landings)	F from VPA
1964	164	0.19
1965	727	0.71
1966	681	0.31
1967	851	0.39
1968	1 395	0.32
1969	1 151	0.29
1970	1 455	0.48
1971	2 669	0.54
1972	1 934	0.62
1973	1 332	0.47
1974	3 957	(0.87)
1975	2 749	(0.65)

Table 5.2.1. Herring. Total catches in Division VIIa (North Irish Sea), 1964 - 75.

Country	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975*)
France	-	-	-	-	-	-	558	1 815	1 224	254	3 194	789
Ireland	85	52	18	118	68	2 328	3 933	3 131	2 529	3 614	5 894	4 790
Netherlands	-	-	-	-	-	-	-	-	-	143	1 116	532
U.K.	1 849	5 617	3 178	7 145	8 389	9 821	17 912	21 861	23 337	18 587	27 489	18 244
Total	1 934	5 669	3 196	7 263	8 457	12 149	22 403	26 807	27 090	22 598	37 693	24 355

Table 5.2.2. Herring. Total catches by stock in Division VIIa 1964 - 75.

Country	1964		1965		1966		1967		1968		1969	
	1	2	1	2	1	2	1	2	1	2	1	2
France	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	85	-	52	-	18	-	118	-	68	-	2 328
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-
U.K.	587	1 262	4 338	1 279	2 667	511	5 885	1 260	7 645	744	9 139	682
Total Manx	587		4 338		2 667		5 885		7 645		9 139	
Total Mourne	1 347		1 331		529		1 378		812		3 010	

(Continued)

Table 5.2.2. (Continued)

Country	1970		1971		1972		1973		1974		1975*)	
	1	2	1	2	1	2	1	2	1	2	1	2
France	558	-	1 815	-	1 224	-	254	-	3 194	-	789	-
Ireland	-	3 933	-	3 131	-	2 529	-	3 614	1 783	4 111	2 406	2 384
Netherlands	-	-	-	-	-	-	-	143	1 116	-	532	-
U.K.	15 629	2 283	18 758	3 103	19 308	4 029	13 071	5 516	23 639	3 850	15 408	2 836
Total Manx	16 187		20 573		20 532		13 325		29 732		19 135	
Total Mourne	6 216		6 234		6 558		9 273		7 961		5 220	

1. Manx stock. 2. Mourne stock. *) Preliminary.

Table 4.4. Herring in Division VIa (Moray Firth included). Fishing mortalities by year and age.

Age (rings)	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974*)	1975*)
0	0.08	0.19	0.11	0.07	0.13	0.00	0.15	0.04	0.15	0.29	
1	0.11	0.57	0.26	0.17	0.04	0.20	0.05	0.33	0.10	0.24	0.13
2	0.08	0.24	0.12	0.18	0.10	0.15	0.35	0.26	0.47	0.46	0.25
3	0.19	0.19	0.17	0.14	0.20	0.36	0.81	0.42	0.58	0.68	0.50
4	0.29	0.26	0.29	0.20	0.19	0.44	0.62	0.34	0.55	0.67	0.50
5	0.25	0.23	0.25	0.16	0.32	0.45	0.62	0.36	0.53	0.64	0.50
6	0.14	0.34	0.32	0.20	0.29	0.34	0.48	0.47	0.50	0.75	0.50
7	0.42	0.34	0.36	0.23	0.51	0.45	0.51	0.44	0.63	0.59	0.50
8	0.39	0.53	0.47	0.26	0.58	0.66	0.53	0.54	0.46	1.14	0.50
9	0.38	0.54	0.83	0.33	0.68	0.59	0.82	0.48	0.45	0.51	0.50
Mean F_w ≥2	0.22	0.25	0.20	0.19	0.23	0.32	0.55	0.31	0.55	0.93	-

Table 4.5. Herring in Division VIa (Moray Firth included). Stock in number x 10^{-6} and biomass of the adult stock at beginning of year.

Age (rings)	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974*)	1975*)
0	615	1 267	1 865	1 144	1 719	4 400	1 533	620	1 991	2 264	
1	3 143	510	945	1 509	969	1 371	3 942	1 186	537	1 546	1 539
2	328	2 554	262	658	1 156	837	1 013	3 397	768	437	1 106
3	438	275	1 827	210	495	943	651	645	2 353	435	250
4	286	328	205	1 389	165	367	593	263	384	1 191	200
5	117	194	230	139	1 026	123	214	290	169	201	558
6	58	82	139	162	107	677	71	105	183	89	96
7	88	46	53	92	120	72	436	39	59	101	39
8	70	53	29	33	66	65	42	237	23	28	51
9	25	43	28	17	23	33	30	22	125	13	8
10	24	15	23	11	11	11	17	12	12	73	7
Total ≥2	1 434	3 590	2 796	2 711	3 169	3 128	3 067	5 010	4 076	2 568	2 315
Biomass ≥2 in 1 000 tons	238	498	457	449	508	517	499	704	650	433	368

*) Inefficient estimates

Table 4.2. Herring autumn spawners. Catch in number x 10^{-3}, Division VIa.

Year \ Age (rings)	0	1	2	3	4	5	6	7	8	9	10	>10
1966	-	6 299	251 086	33 526	70 449	38 471	22 691	12 656	20 790	17 005	7 418	8 752
1967	-	30 944	22 374	263 880	49 150	48 320	36 143	15 226	10 397	15 068	10 962	7 937
1968	-	58 215	90 027	26 031	243 304	19 679	28 436	17 699	7 275	4 493	5 326	4 570
1969	-	14 077	106 022	84 565	27 604	264 558	25 795	45 908	27 932	11 003	5 197	13 058
1970	-	158 085	107 037	272 693	124 498	42 623	185 380	24 821	29 920	14 276	5 156	6 903
1971	-	53 113	283 962	346 206	261 891	94 206	25 876	166 165	16 425	16 286	8 038	5 578
1972	147	35 047	647 919	208 367	72 885	83 361	37 428	13 445	94 577	8 154	5 855	5 377
1973	-	17 654	271 166	990 183	155 828	66 476	68 522	26 512	8 037	53 767[1]	-	-
1974	-	61 641	143 585	205 806	553 627	90 584	45 144	43 069	18 504	45 393[1]	-	-
1975	20	99 018	232 698	93 827	75 178	209 646	36 051	14 500	18 988	27 851[1]	-	-

[1] Age 9 and older.

Table 4.3. Catch in numbers x 10^{-3}, Moray Firth.

Year	Age in rings				
	0	1	2	3	4
1966	211 639	205 376	266 530	11 791	344
1967	186 598	177 003	6 274	9 843	605
1968	71 425	162 655	15 321	-	
1969	192 368	25 083	1 167	-	
1970	16 299	80 346	1 835	-	
1971	209 598	116 667	2 186	-	
1972	24 794	286 492	105 436	1 876	
1973	267 872	33 083	2 617	-	
1974	536 119	250 388	10 248	-	
1975	82 676	79 685	561	313	

Table 4.1. Total catches of herring (metric tons) in Division VIa, 1966-1975.

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975*)
Belgium	23	-	-	-	-	-	-	-	-	-
U.K. England	1	-	7	3	1	-	-	-	45	-
Faroe Islands[a]	-	-	-	-	15 100	8 100	8 094	10 003	5 371	10
France	1	379	1 124	966	1 293	2 055	680	2 441	547	2 720
German Dem.Rep.	412	177	3	416	207	330	935	2 507	2 037	1 994[c]
Germany, Fed.Rep.	14 634	17 318	14 874	15 805	16 548	7 700	4 108	17 443	14 354	4 283
Iceland	-	-	-	-	5 595	5 416	2 066	2 532	9 566	2 633
Ireland[b]	7 759	12 290	13 390	11 895	11 716	12 161	17 308	14 668	12 557	10 417
Netherlands	251	4 576	2 957	1 514	1 102	9 252	23 370	32 715	19 635	19 305
Norway	-	-	-	-	20 199	76 720	17 400	36 302	26 218	509
Poland	-	727	2 791	3 188	3 709	-	-	5 685	6 368	2 934
U.K. Scotland	69 363	67 404	65 180	90 222	103 530	99 537	107 638	120 800	107 475	80 468
USSR	-	-	-	-	3	-	?	2 052	5 388	2 967
Total	92 444	102 871	100 326	124 009	179 003	221 271	174 873	247 148	209 561	128 240
Scottish juvenile herring and sprat fisheries in Moray Firth	20 734	6 507	4 985	3 100	1 385	5 666	10 242	7 219	13 003	2 454

*) Preliminary figures.

a) Figures supplied by Fiskirannsóknarsotvan.

b) Catches mainly taken in Division VIIb and landed in VIa.

c) Reported to NEAFC.

Table 3.8. Catch prognosis. Celtic Sea

Age in rings	Mean weight (g)	Catch 1975-76 x 10^{-3}	Stock size (x 10^{-3}) 1 April 1976	Catch 1976-77	Stock size 1 April 1977
1	137.6	11 737	100 000	11 600	100 000
2	198.9	13 402	87 441	48 705	79 500
3	238.8	16 100	9 958	5 547	33 140
4	264.5	7 070	11 962	6 663	3 774
5	268.6	6 192	5 253	2 926	4 534
6	290.6	3 333	4 601	2 563	1 991
7	294.3	1 300	2 476	1 379	1 744
8	301.8	988	966	538	938
8+	317.6	1 047	734	409	366
Weight in tons		Calculated 13 640 Actual 13 807	8 688 Adults ≥2 rings Weights previous season	16 599	10 120 Adults ≥2 rings Weights previous season
Source of data and assumptions made	Irish data 1975-76 season	Data reported to WG meeting	Assumptions: F_{ad} 1975/76 = 0.82 F_{juv} 1975/76 = 0.12 Year class 1974 = 100 million 1-ringers	Assumptions: NEAFC quota of 16 800 t will be approx. taken (F_{ad} = 0.87 F_{juv} = 0.13)	Assumptions: year class 1975 = 100 mill. 1-ringers

Table 3.6. Fishing mortalities from VPA and weighted mean values of F.

Season	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75 +	1975/76 +
W. rings											
1	0.00	0.03	0.03	0.05	0.06	0.01	0.04	0.09	0.25	0.16	0.10
2	0.30	0.23	0.24	0.34	0.52	0.35	0.44	0.87	0.72	0.79	0.82
3	0.21	0.38	0.34	0.39	0.61	0.50	0.71	0.62	0.82	0.74	0.82
4	0.35	0.31	0.53	0.29	0.58	0.59	0.92	0.61	0.44	0.96	0.82
5	0.22	0.49	0.45	0.45	0.51	0.67	0.99	0.82	0.82	0.46	0.82
6	0.21	0.57	0.68	0.38	0.67	0.57	0.82	0.58	0.65	0.83	0.82
7	0.51	0.23	0.88	0.61	0.74	0.43	0.60	0.48	1.03	0.86	0.82
8	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.82
Weighted F (adults)	0.31	0.40	0.50	0.40	0.60	0.55	0.82	0.65	0.76	0.80	0.82

+ inefficient estimates

Table 3.7. Calculated stock size in numbers (x 10^{-6}) by age and year (M=0.1) at 1 April

Season	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974+	1975 +
W. rings											
1	109.8	202.0	220.5	276.1	131.0	73.3	256.9	84.5	104.1	32.4	129.5
2	290.0	99.3	176.8	192.9	238.7	111.2	65.7	222.7	69.6	73.2	25.0
3	52.9	195.1	71.7	125.6	124.3	128.9	70.7	38.2	84.1	30.7	30.0
4	56.0	38.9	121.0	46.4	77.2	60.9	70.5	31.5	18.5	33.5	13.2
5	18.5	35.6	25.9	64.2	31.4	39.3	30.6	25.3	15.4	10.8	11.6
6	25.3	13.5	19.7	15.0	37.0	17.1	18.3	10.3	10.2	6.1	6.2
7	32.2	18.6	6.9	9.0	9.2	17.1	8.8	7.3	5.2	4.8	2.4
8	2.9	17.6	13.4	2.6	4.4	4.0	10.1	4.4	4.1	1.7	1.8
Adult stock in numbers	477.8	418.6	435.4	455.7	522.2	378.5	274.7	339.7	207.1	160.8	90.2
Adult stock in weight (tons)	71 732	61 269	60 450	65 373	61 333	49 045	28 020	30 679	20 503	15 095	8 935

+ inefficient estimates

Table 3.3. Celtic Sea. Catch in number per age group x 10^{-3} (1 Apr - 31 March)

	Age in rings									
	1	2	3	4	5	6	7	8	8+	Total
1965-66	58	70 937	9 456	15 911	3 433	4 584	12 241	1 391	7 566	125 576
1966-67	6 337	19 146	58 633	9 827	13 193	5 585	3 581	8 472	3 839	128 614
1967-68	6 921	36 168	19 486	47 837	8 954	9 334	3 894	6 462	6 684	145 741
1968-69	11 699	53 028	38 421	11 207	22 286	4 538	3 965	1 251	4 608	151 003
1969-70	7 787	91 994	54 473	32 318	11 881	17 265	4 612	2 130	3 418	225 878
1970-71	640	31 540	48 706	25 937	18 270	7 095	5 751	1 925	3 194	143 058
1971-72	10 262	22 451	34 382	40 536	18 449	9 807	3 779	4 846	2 143	146 655
1972-73	7 279	124 357	16 922	13 817	13 674	4 331	2 654	2 103	749	185 886
1973-74	22 171	34 122	45 162	6 269	8 251	4 655	3 209	1 966	714	126 519
1974-75	4 516	38 285	15 427	19 865	3 782	3 311	2 668	806	742	89 402
1975-76	11 737	13 402	16 100	7 070	6 192	3 333	1 300	988	1 047	61 169

Table 3.4. Mean weight at age Celtic Sea herring

Age in rings	Mean weights used in CM 1975/H:2	Mean weights Irish catch 1975/76
1	128.4	137.6
2	170.4	198.9
3	210.6	238.8
4	238.9	264.5
5	257.4	268.6
6	267.0	290.6
7	269.7	294.3
8	277.8	301.8
8+	277.8	317.6

Table 3.5. Mortality Estimates for Celtic Sea herring

Season	Z from Irish catch/effort	F adult from VPA assuming F 1975/76=0.82
1967-68	0.52	0.50
1968-69	0.42	0.40
1969-70	0.60	0.60
1970-71	0.44	0.55
1971-72	0.92	0.82
1972-73	0.75	0.65
1973-74	0.92	0.76
1974-75	0.54	0.80
1975-76	1.29	

Table 3.1. Annual Celtic Sea Herring Catches 1965-1975

Year	Bulgaria	France	Germany D.R.	Germany F.R.	Ireland	Netherlands	Poland	U.K.	U.S.S.R	Total
1965	-	1 742	-	353	3 980	7 198	-	1 054	-	14 327
1966	-	5 506	-	1 143	6 891	16 605	112	197	-	31 454
1967	-	3 825	-	910	11 133	13 184	300	398	-	29 750
1968	-	2 637	-	1 662	9 480	15 679	130	598	-	30 186
1969	-	7 038	-	5 906	18 712	16 256	252	-	-	48 164
1970	-	3 629	-	1 481	24 702	7 015	1 191	220	-	38 236
1971	-	3 393	-	974	12 602	9 672	881	65	-	27 587
1972	-	7 327	-	393	20 109	6 758	751	-	618	35 956
1973	123	5 553	7	294	13 105	5 834	1 125	-	334	26 375
1974	-	2 261	-	433	13 991	2 105	954	-	-	19 744
1975+	-	1 920	-	399	8 430	2 646	512	-	2 139	16 046

Table 3.2. Celtic Sea Herring Catches by seasons (1 April - 31 March)

Season	Bulgaria	France	Germany,D.R.	Germany, F.R.	Ireland	Netherlands	Poland	U.K.	U.S.S.R.	Total
1965/6	-	1 742	-	353	3 482	13 071	-	1 054	-	19 702
1966/7	-	5 506	-	1 143	8 061	11 459	112	197	-	26 478
1967/8	-	3 825	-	910	10 736	10 204	425	398	-	26 498
1968/9	-	2 637	-	1 662	11 996	12 191	130	598	-	29 214
1969/70	-	7 038	-	5 906	16 712	13 111	261	400	-	43 428
1970/1	-	3 627	-	1 481	19 106	4 667	778	220	-	29 879
1971/2	-	3 383	-	974	13 757	10 600	880	65	-	29 659
1972/3	-	7 327	-	393	18 846	6 852	751	-	618	34 878
1973/4	123	4 143	7	294	11 317	5 834	1 139	-	334	23 191
1974/5	-	2 150	-	435	11 683	2 462	954	-	-	17 684
1975/6+	-	1 882	-	399	6 474	2 401	512	-	2 139	13 807

+ Provisional

The catches reported for France, Ireland and U.S.S.R. include some catches of Celtic Sea herring made in Divisions VIIa-f.