International Council for the
Exploration of the Sea

REPORT OF THE HERRING ASSESSMENT WORKING GROUP FOR THE AREA SOUTH OF 62°N

Charlottenlund, 9-18 March 1977

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Note: See also Doc. C.M.1977/H:3 - APPENDIX.

1. Introduction and Participation

1.1. The Herring Assessment Working Group for the Area South of 62°N met at Charlottenlund in the period 9th – 18th March 1977 to report to the Liaison Committee meeting in April – May 1977 on the following subjects:

(a) reassessment of the state of, and appropriate levels of TAC for North Sea and Skagerak herring in 1977 and 1978.

(b) the appropriate TAC for Celtic Sea herring in the periods 1st April – 31st March in 1977 and 1978.

(c) the TAC level for Division VIa herring in 1977 and 1978.

(d) the appropriate TAC in the Northern Irish Sea (Division VIIa) for herring in 1977 and 1978.

(e) reassessment of the state of the North Sea sprat population and the appropriate TAC for 1978.

(f) reassessment of the sprat stock in Division IIIa and the Norwegian West Coast fiords with appropriate advice on management action.

(g) to report on the distribution of the stocks of, and fisheries on, certain pelagic species in relation to extended economic fishery zones.

1.2 Member countries were represented by the following scientists:

Dr H Ackefors	Sweden
Dr R S Bailey	UK (Scotland)
Mr E Bakken	Norway
Mr A B Bowers	UK (I.O.M)
Mr A Corten	Netherlands
Dr P O Johnson	UK (England)
Mr J Jakobsson	Iceland
Dr A Lindquist	Sweden
Mr M Liwoch	Poland
Mr A Maucorps	France
Mr J Molloy	Ireland
Mrs E Nielsen	Denmark
Mr K Popp Madsen	Denmark
Mr A Saville (Chairman)	UK (Scotland)
Mr B Sjöstrand	Sweden
Mr G Speiser	Federal Republic of Germany
Mr Ø Ulltang	Norway
Mr R J Wood	UK (England)
Mr O J Østvedt	Norway

1.3 The absence of representatives from USSR, and of any biological data for the relevant fisheries by that country, was noted with regret.

2. North Sea

2.1.1 The fishery in 1976

Catch data for the years 1967 – 76 (preliminary for 1976) are given in Table 2.1. The total North Sea catch, excluding Skagerak, amounted to 169 233 tons as compared to 312 798 tons in 1975.

2.1.2   Prior to 1975 the preliminary estimates increased by about 10% when the final catch data became available. The 1975 preliminary catch data however, increased, much less by only about 3% and as regards the 1976 catch, little change is expected on the figure given in Table 2.1. The Skagerak catch (Table 2.2) decreased sharply from 51 911 tons in 1975 to 14 010 tons in 1976. The total 1976 catch for the North Sea and Skagerak was thus 183 243 tons. NEAFC Recommendation (8) allowed a TAC of 160 000 tons in 1976 for this area.

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 IVa E the catches in 1976 decreased to 2 451 tons from 9 652 in 1975. In area IVa W the catches increased to 108 183 tons from 95 761 tons in 1975. In Division IVb the total catch decreased to 46 262 tons from 181 858 tons in 1975. The catch of the socalled adult fishery (for human consumption) in that Division decreased to 38 540 tons from 91 110 in 1975, and the young herring catch decreased from 90 748 tons in 1975 to 7 722 tons in 1976. It should be noted that in 1976 there was a ban on directed herring fisheries for industrial purposes which would have had its main impact on the young herring fishery in IVb. In Division IVc and VIId and e, the catches decreased to 12 337 tons from 25 527 tons in 1975. Thus, a sharp decrease in catch has taken place in all areas except in IVa W.

2.1.4   The number 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 below. Annual catches in numbers per age group in each of the last 10 years are given in Table 2.10.

Millions of herring caught per age group (winter rings)

| Year | Age | | | | | | Total |
	0	1	2	3	4	5 and older	
1972	750	3 341	1 441	344	131	40	6 047
1973	289	2 368	1 344	659	150	96	4 906
1974	996	846	773	362	126	87	3 190
1975	264	2 461	542	260	141	87	3 755
1976	238	116	872	105	49	43	1 423

2.1.5   The catches of 0-group herring in 1976 were of the same level as in 1975. Since a ban on directed fishery for industrial purposes was in force, it is concluded that the major part of these 0-group fish were landed as by-catches (see section 2.7). As in 1975 the socalled adult fisheries were primarily dependent on the 1973 year class which in 1976 made up 74% by number of the total catch of North Sea herring of 1-ring and older.

The small catches of 0-group in 1975 and 1976 primarily reflect the weakness of the 1974 and 1975 year classes. The extremely low numbers of 1-ringers in 1976 is a function both of the weakness of the 1974 year class and of the prohibition on directed fisheries for industrial purposes.

2.2 Fishing Mortality in 1975

2.2.1 Fishing mortality on adults (year class 1973 and older)

No direct estimates of the F on adults in 1976 were available. It was agreed, that some reduction in effort had probably taken place in 1976 due to fishing restrictions but that the effort had remained high and the level was probably not less than about $\frac{2}{3}$ of the 1975 adult fishing mortality.

After some trial cohort analysis runs with varying input Fs for 1976, an F of 0.8 was chosen as a reasonable assumption for 1976, although results of the larval surveys might indicate an even higher level (see section 2.5).

2.2.2 Fishing mortality on 1-ringers (year class 1974)

No direct estimate of the fishing mortality rate on 1-ringers in 1976 was available. In previous years the F on this age group has been very high (about 0.9). Since a major part of this mortality was generated by the industrial fishery on young herring, the ban on industrial fishing would have greatly reduced the F on 1-ringers in 1976.

In 1975 about $\frac{1}{4}$ of the F on 1-ringers was generated by the socalled adult fishery or a value of about 0.2. The Working Group agreed that a lower F on 1-ringers in 1976 than 0.2 would not be realistic and accepted this value as the best available.

2.2.3 Fishing mortality of 0-group (year class 1975)

No direct estimate of the F on 0-group in 1976 was available. Preliminary data from the Young Herring Surveys in 1977 indicate a year class strength of about 0.9×10^9 as 1-ringers in the early months of 1977. A catch of 238×10^6 0-group in 1976 would then have corresponded to an F on 0-group of 0.22 in 1976. The Working Group accepted 0.2 as the best available estimate of the fishing mortality rate on this age group in 1976.

2.3 Results from Cohort Analysis

Calculated fishing mortalities and stock sizes for the period 1967 - 75 are given in Tables 2.11 and 2.12. It should be noted that the estimates of fishing mortality and stock size for 1975 are highly dependent on the input Fs for 1976 and too much reliance should not be placed on them.

The fishing mortalities on 1-ringers have varied between 0.7 and 1.04 during the period 1971 - 74. The fishing mortalities on adult fish have remained at a level of about 1.0 since 1968.

The stock biomass has declined continuously from a level of about 1.2 million tons in 1967 to 320 thousand tons in 1974.

The estimates of year class abundances prior to 1973 are very similar to those given in the previous report (Doc. C.M.1976/H:2).

2.4 Recruitment

2.4.1 Year class 1975

A first estimate of the 1975 year class was available from preliminary data from the YHS in 1977. Using the regression formula given in C.M.1976/H:2 (Y = 0.00238 X +1.34) this year class would be estimated as 1.5×10^9 as 1-ringers. The Working Group calculated a new regression,

using the most recent cohort analysis estimates for year classes 1968-73. As the intercept of this regression line on the Y-axis was not significantly different from zero it was decided to draw a new regression line through the origin (and through the arithmetic mean of all points). This was considered to be the best regression line for predicting Y and was of the form

$$Y = .00300 \ X$$

Using this regression, the preliminary estimate of abundance from the YHS in 1977 (299/hour) indicates a stock abundance of 1-group of 0.90×10^9. As the catch of 0-group in 1976 was 238×10^6, the strength of this year class as 0-group is estimated as 1.3×10^9.

2.4.2 Year class 1974

The first estimate of this year class from the Young Herring Surveys was 2.5×10^9 based on the former regression equation. In 1976 the Working Group estimated this year class ar 1.7×10^9 as 0-group. This estimate was based on the assumption of an F on 0-group in 1975 of 0.18. By adopting a fishing mortality rate on 1-group of 0.2 in 1976 the 0-group strength of this year class derived from cohort analysis is now 1.0×10^9.

2.4.3 Year class 1973

The best estimate for the 1973 year class now available is 5.9×10^9. A first estimate of this year class based on data from the 1975 YHS was 6.0×10^9, and in 1976 the Working Group accepted 5.8×10^9 as the best estimate. Thus, the evidence now available shows that the first estimate of this year class was accurate.

2.5 Estimates of spawning stock biomass from herring larval surveys

Provisional abundance estimates were calculated for the 1976 spawning season from 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 <10mm, 10-15mm and >15mm in length, between surveys made in 1976 and comparable surveys carried out during 1975. The results are given in Table 2.13.

2.5.1 Northern North Sea

Two surveys were carried out in the Orkney/Shetland area during the autumn of 1976. The full results of the first survey from 2-14 Sept were not available at the time of the Assessment Working Group meeting. The numbers of herring larvae per square metre were however available for approximately half of the stations which had been sampled and these stations were randomly scattered throughout the survey area. The total number of herring larvae per square metre of all size groups from these stations was 1 455, and for the same stations in 1975 was 1 403. From the proportions of larvae of the three size groups at these stations, compared with the numbers in the complete survey in 1975, raising factors were calculated from which preliminary estimates of total numbers of larvae for the whole survey area in 1976 could be made. In Table 2.13 the abundance estimates given for 2-14 September 1976 were derived in this way. The total abundance estimates both in 1975 and 1976 for the first half of September are very similar, but larvae <10mm were somewhat more abundant in 1976.

A second survey was carried out from 13-23 September 1976 in the Orkney/Shetland area, and the results of this survey were complete. The abundance estimate of larvae <10mm was very similar to the mean value from two surveys carried out at approximately the same dates in 1975.

The conclusions from these surveys must be that the size of the spawning stocks of herring in the northern North Sea were similar in 1975 and 1976.

2.5.2 Central North Sea

There was a very good coverage of this area in the autumn of 1976 with extensive surveys being made in four separate periods during the months of September and October. Larval densities were generally very low compared with recent years. Three surveys can be compared directly with surveys carried out in this area in 1975. Because of the gap in the coverage from 23 September to 8 October 1975 it is more reasonable to compare the total numbers of larvae of all size groups rather than only <10mm in length, and these give a reduction of 55% in 1976 compared with 1975.

2.5.3 Southern North Sea and eastern Channel

Only one complete survey of this area was made during the winter of 1976/77. A total abundance estimate of 9×10^9 larvae was obtained for the period 3-7 January 1977 and this may be compared with 7×10^9 for 7-29 January 1976. A restricted survey consisting of 19 stations in the eastern Channel from 22-23 January 1977 yielded no herring larvae at all. Larval production was obviously very low in both years, but at a comparable level.

2.5.4 Spawning stock size

The Report of the Working Group on North Sea herring larval surveys (ICES C.M.1976/H:17) contained regressions of estimated abundances of larvae <10mm in length on spawning stock biomass for the northern and central North Sea separately. From these it may be deduced that the stock of herring spawning in the northern North Sea in 1976 was approximately 40 000 tons (the same value as 1975). In the central North Sea the mean survey value of 61.7×10^9 for larvae <10mm in length from all four surveys in 1976 indicates a spawning stock biomass of only about 23 000 tons. If it is assumed that the southern North Sea/Channel spawning stock was also about 20 000 tons, the total North Sea spawning stock in 1976/77 would have been about 85 000 tons.

This total North Sea spawning stock in 1976 is considerably lower than that given in paragraph 2.6, of 155 000 tons from analysis of catch data. It should be noted however that in this latter estimate of the 1976 spawning stock biomass 114 000 tons is contributed by the 1973 year class. This year class is also a strong one in Div VIa, and it is known that a major part of the recruitment to the stock in that area spends its juvenile stage in the North Sea and that recruitment to it is not complete until age 4. An appreciable part of the catch of this year class taken in the North Sea in 1976 is likely, therefore, to have been of fish which would not spawn in the North Sea; but which, with the assessment method used, will have been incorporated in the estimate of the North Sea spawning stock size. The discrepancy between the estimates from catch data and from larval production could be accounted for if an appreciable part of the catch of the 1973 year class in the North Sea in 1976 were fish which would have recruited to VIa.

2.6 Distribution of catches in July 1973, 1975 and 1976

The Working Group plotted the distribution of catches, on a statistical square basis for the month of July in 1973, 1975 and 1976. July was chosen because this is the month in which the largest catches have been taken in recent years, and in using such data to get a measure of changes in the area of distribution of the stock it is necessary to compare the same period in each year. Data were available from Denmark (consumption fishery), France, Federal Republic of Germany, Iceland, Netherlands, Norway, Poland and United Kingdom. Thus the major fisheries (except those of the USSR and Sweden) for adult herring were covered. The results are shown in Figures 1 - 3.

The most striking differences between the distribution of catches in the two later years as compared with 1973 are that the fishing area in the eastern parts of IVa and IVb has almost completely disappeared so that in 1975, and especially in 1976, practically all the catches were taken at Shetland, and along the east coast of Britain. It should also be noted that the catches have decreased sharply from 1973 to the later years. Thus the July catch decreased from about 84 000 tons in 1973 to 17 000 tons in 1975 and in 1976. In 1973 catches of more than 1 000 tons were taken in 11 squares, as compared with 5 in 1975, and 6 in 1976. Thus the total area where appreciable fishing took place decreased sharply from 1973 to the two later years.

2.7   **By-catch of Herring in Fisheries for Other Species**

2.7.1   A by-catch of herring will be unavoidable in some of the fisheries carried out with small meshed gear. In the present situation, where the stock of North Sea herring is so low that the Working Group's advice is a total prohibition of directed fisheries for herring, estimates of the effect of by-catches are of obvious interest. Acting on a request of NEAFC the Working Group had already undertaken a survey of the incidence of by-catches at its meeting in October 1976 (C.M.1976/Li:4) but had to conclude that the material then available was not detailed enough to elucidate the problem adequately.

At the present meeting Danish and British data were available on a statistical rectangle basis for 1974 - 76.

2.7.2   The main fisheries using small meshed gear are now directed at Norway pout, sprat, and sandeels. A directed industrial fishery for herring also took place until October 1975 when a NEAFC recommendation came into force prohibiting such fisheries.

In case of the Norway pout and sprat fisheries in 1974-75, it is therefore not possible to make a clear distinction between herring landed as by-catch and herring landed from a directed fishery on herring. On the same voyage fishing operations may often have had both herring and Norway pout or sprats as direct objectives. Only in case of sandeel is the fishery clearly defined by the special gear in use.

2.7.3   **By-catches in fisheries for Norway pout**

Figures 4 - 9 show the catch of herring in each statistical square from which Norway pout was landed in the years 1974 - 76. For each year the herring catch is shown both as percentage of the Norway pout landings per square, and as actual weight. The general picture shows small herring percentages in the main area of the Norway pout fisheries with values above 15% only occurring in the border zone. In 1974 - 75 high values are found at the entrance of Skagerak but with percentages as high as 63% of herring in these instances it is rather a case of a fishery directed to herring with Norway pout as a by-catch.

The overall percentages are shown below:

	Norway pout (tons)	Herring (tons)	Herring (as % of Norway pout)
1974	473 876	15 179	3.2
1975	248 510	18 749	7.5
1976	244 220	4 199	1.7

If the squares at the entrance to Skagerak are omitted, the percentages of herring in 1974 and 1975 are 0.9 and 5.6 respectively.

2.7.4 By-catch in fisheries for sprat

In 1974 and 1975 only the sprat fishery, in winter, close to the east coast of the UK can be defined as a directed fishery. In the eastern and central North Sea it is not possible to distinguish between landings from fisheries directed at either sprat or herring. In 1976, however, all herring landed from squares in which sprat were caught must be considered as by-catch. The herring percentage by statistical squares, for Danish and Scottish sprat fisheries, are shown in Figure 10.

The overall percentage of herring in the sprat landings was 2.53%. It should be noted that this figure, as well as those from the Norway pout fishery, are overestimates because in both fisheries by-catches of other species occur and have not been incorporated in the calculations. The overall percentage in the Danish sprat fishery in 1976 was as follows:

	Sprat (tons)	Herring (tons)	Herring (as % of sprat)
1976	303 400	7 660	2.53

2.7.5 By-catch of herring in sandeel fisheries

Samples from sandeel landings contained no herring in all years and areas except in the vicinity of Monkey Bank off Thyborøn. Here the highest percentage found was 3.1%. In the overall sandeel catch herring amounted to only about 0.1%.

2.7.6 The 90% decline in the industrial catches of North Sea herring in 1976 is partly due to the ban on the directed herring fishery for industrial purposes and partly to the weakness of the 1974 year class. The latter will have had less influence in the northern North Sea, where the herring by-catch consists of comparatively older fish. Even so, the low percentage by-catch figure in 1976 would probably increase with an increase in the herring stock size. In the Norway pout fishery the percentage by-catch in 1974 was, on the other hand, of the same order of size as in 1976 considering that the total catch in 1974 was about twice as high. In the central North Sea the small year class 1974 has evidently had an effect on the amount of by-catch and an appreciably higher percentage could be expected from a herring year class of average strength.

2.8 TACs for 1977 and 1978

2.8.1 In the previous report of the Working Group (C.M.1976/H:2) a relationship was shown between the size of the spawning stock and the recruitment produced by that stock, at spawning stock sizes below about 800 000 tons. At the present meeting, one further point could be added to this curve, for the 1975 year class, and small modifications were made to the points for other recent year classes in the light of the new data available. These changes, however, have only strengthened the evidence that, on average, recruitement has been sharply reduced as the spawning stock size has declined. The total spawning stock biomasses in recent years have been: 1973-220 000 tons, 1974-158 000 tons, 1975-96 000 tons, and 1976-155 000 tons. The spawning stock quoted for 1976 is appreciably lower than that estimated in the previous report because that value was based on the assumption that no fishery would be permitted after 30 June 1976. In practice – as discussed in para. 2.5. – the estimates of larval production in 1976 would suggest that the effective spawning stock size in the North Sea in 1976 may have been appreciably lower. even than the value for that year quoted above. In the light of these values, and the ensuing very small year classes born in 1974 and 1975, it would seem clear that only the most stringent conservation action can ensure the recovery of this stock to a level where it can support an adequate fishery.

2.8.2   In the previous report a prognosis was given of the time necessary to rebuild the spawning stock to a level of 800 000 tons if there was a complete prohibition on a directed adult herring fishery and with two assumed levels of fishing mortality rate on the juvenile fish. This prognosis has been largely outdated by two new elements of the situation: (a) that this prognosis was based on the assumption that no catch of adult fish would be taken after 30 June 1976, whereas appreciable catches have been taken subsequently; (b) that some data are now available which allow a more realistic estimate of the fishing mortality rate on the juvenile fish in the situation, since October 1975, when a prohibition was introduced on a directed fishery on them for industrial purposes.

Incorporating these changes, a prognosis has been made of the rate of rebuilding of the spawning stock, up to 1979, in the absence of any directed fishery on any component of the population. These prognoses are based on two assumptions: (a) that the fishing mortality on the 0- and 1-groups will be 0.2 in the absence of any directed fishery on them (paragraphs 2.2.2 - 2.2.3), (b) at spawning stock sizes below 200 000 tons the recruitment will be 1.2×10^{7} 0-group fish which is the mean of the values for the 1974 and 1975 year classes which were produced by spawning stocks of this order of size. This is given in the text table below. Some fishing was carried on in the early months of 1977 and it is estimated that the catch taken then amounted to about 25 000 tons. It has been assumed in this option that no catch will be taken subsequently, up to the end of 1979. Even under these stringent conditions and with the low juvenile fishing mortalities which are estimated from the by-catch of the Recommendation 2 fisheries, the spawning stock will be only half of the minimum desirable level by 1979.

2.8.3   In the text table below prognoses are also given of the effects of less stringent conservation regimes. These are included because they were requested by one delegate to ICES, as a basis for advising his government on appropriate action. These prognoses were calculated on the basis of TAC levels of total catch (including unavoidable by-catch) of 75 000 tons and 150 000 tons. The first of these options shows that under these conditions there will be only a very slow theoretical increase in spawning stock; the second will result in a rapid decline of the spawning stock and the elimination of the stock within a few years. It must also be stressed that these estimates are open to some margin of error and the data from the larval surveys would suggest that the errors are more likely to be in the direction of over-estimates of stock sizes.

It must be stressed that at the current low levels of spawning stock biomass forecasting stock sizes more than 3 years ahead is extremely difficult, because of natural variations in recruitment, which are independent of the size of the parent stock . With the small spawning potential which these low stocks entail, unfavourable conditions for survival could result in the recruitment being virtually nil, and this would result in a major reduction in the annual projected stock sizes and therefore in subsequent recruitement.

Catch and spawning stock size (in '000 ton units) under various options of TAC

	1976	1977	1978	1979
F adult	0.8	0.13	0	0
Catch (juveniles)	12	12	11	14
Catch (adults)	158	25	0	0
Spawning sotck	155	185	289	400

	1976	1977	1978	1979
F adult	0.8	0.36	0.30	0.28
Catch (juveniles)	12	12	11	11
Catch (adults)	158	63	65	65
Spawning stock	155	160	200	210
F adult	0.8	1.1	1.8	
Catch (juveniles)	12	12	11	
Catch (adults)	158	139	139	
Spawning stock	155	100	50	

2.8.4   On the basis of the above results, it must be quite apparent that the Working Group can only reiterate advice given on previous occasions that, if the North Sea herring stock is to return to a viable condition, it is imperative that all directed fisheries are prohibited immediately. The results given in paragraphs 2.2.2, 2.2.3 and 2.2.7 show that the ban on fisheries for industrial purposes (Recommendation 8C) has reduced very markedly the expected fishing mortality rates on juvenile fish. However, the lack of effective action on the adult fisheries has resulted in a further deterioration in the adult stock. This means that, although recovery will theoretically be rapid once all directed fishing is prohibited, the time at which the desirable stock level of 800 000 tons will be attained has been further postponed.

The Working Group were also asked by one delegate to advise: "Whether all herring stocks within the North Sea are in an equally serious state and whether they require equally stringent conservation measures. In particular, whether some herring fishing could be allowed in the northern part of the North Sea".

The results of herring larval surveys and the results from the fisheries suggest that the spawning stocks in the northern and central areas of the North Sea have declined to about one tenth, or less, of their former values during the last five years. These results are largely supported by independent cohort analysis of the catches taken within these areas. Under these circumstances, there is no doubt that in all areas there is an equal requirement for the most stringent conservation action and that any relaxation in one area cannot be justified.

3   Celtic Sea

3.1   Catch data

The catch data for the Celtic Sea fishery for the years and seasons since 1965/66 are given in Tables 3.1 and 3.2. The 1976 figures are provisional and slight alterations have been made in the 1975 figures quoted in the previous Working Group report. The serious decline in total catch which has been a feature of this fishery since 1972/73 continued during 1976 and the total for the 1976/77 season of 7 000 tons is the lowest since about 1956. This decline has been a feature of the catches of all countries consistently fishing in the area. The TAC for this fishery in the 1976/77 season was originally fixed by NEAFC at 16 800 tons. This figure was later reduced, to 10 815 tons at the meeting in April 1976 but even this reduced figure was not achieved.

3.2   Racial composition of the Celtic Sea herring stock

In the previous report it was pointed out that there was some evidence of the presence of an autumn spawning stock of herring in the Celtic Sea and that, if the proportion of this stock increased in the catches, it might affect future management policy. These autumn spawning herring which in 1975/76 constituted over 35% of the Irish catch, amounted to 38% of it in 1976/77. There is, however, no new evidence to suggest that they comprise a separate component but an examination of the available data would suggest that there has been a very definite change in the spawning time which now lasts from September to January.

3.3   Catch in numbers per age group

The age composition of the total catch in 1976/77 was calculated from Irish, French and Dutch data, using the same procedure as in previous reports. Because of the revised catch data for 1975/76 some slight changes have been made in the previously calculated age composition of the catches in that season. The revised age compositions of the catches from 1965/66 to 1976/77 are given in Table 3.3.

3.4   Mean weight at age

New data were available on mean weight at age for Celtic Sea herring in 1976/77 from Dutch, Polish, French and Irish sources. The Irish data covered the spawning period (September to January) while the Dutch, Polish and French data came mainly from the early part of the season. Both sets of data were weighted, in proportion to the catches in the two periods, to obtain mean weights at age covering the whole season. These values are slightly lower than those used in the previous assessment which were based entirely on Irish data. They are, however, similar to the mean weights used in the 1975 assessment, obtained from the von Bertalanffy equation.

The mean weights at age for the two periods of 1976/77 are given in Table 3.4. In estimating the TAC the weighted means for the whole season were used. In estimating the stock biomass at 1 April the data for the period April-August were used as they were considered the more appropriate to that time.

3.5   Estimates of fishing mortality in the 1976/77 season

As in previous years, the only direct mortality estimates for Celtic Sea herring are those derived from Irish catch per unit effort data. In assessments prior to the 1976 one, there was considerable agreement between values of F obtained from cohort analysis and values of Z estimated from

Irish catch per unit effort data. The value of Z obtained from the Irish data was therefore used to estimate the input for cohort analysis. However, in 1976 the value of Z obtained from the Irish catch per effort data seemed unrealistically high and there had been considerable variation in these values from 1974 to 1976. Because of this the mean value over the last three seasons, 0.82, was used as an input F in 1976. In 1977 the value obtained from Irish data was 0.68 which was lower than that obtained in the 1976/1977 season. All the values of F from cohort analysis were compared to the corresponding values of F from Irish catch per unit effort data, using a two-year running mean (Table 3.5). The resulting regression (Fig 11) is significant and the value of F for 1976/77 calculated from the regression using the Irish catch per unit effort figure is 0.81. This was then used as an input F for the 1976/77 season. If the same procedure had been adopted in 1976, the input value would have been 0.74.

3.6 Estimates of fishing mortalities in previous seasons

Fishing mortalities and stock sizes in previous seasons have been calculated by cohort analysis using the catch composition in Table 3.3.7, assuming an F on fully recruited age groups of 0.81 in the 1976/77 season. The results of this analysis are given in Tables 3.6 and 3.7.

Fishing mortalities on 1-ring fish have, in previous assessments, been considered to represent only a small portion of the adult F (approximately 15%). However, there are indications that F for 1-ringers has increased since 1972 and over the last four seasons it has represented 31% of the adult F. This may have resulted from an increase in growth of Celtic Sea herring which has caused an earlier recruitment to the spawning stock. In a situation where the recruitment level has declined so dramatically in recent years an increase of this level in the F on 1-ring fish will have serious effects on stock sizes. Accordingly the stock size at 1 April 1977 has been calculated using both 0.12 and 0.25 as input values of F on 1-ringers.

3.7 Recruitment and stock size

Previous assessments of Celtic Sea herring have pointed out the serious lack of data for estimating future recruitment to this stock. In this situation the only method of estimating the recruitment level is by an examination of the past data from cohort analysis. Up to 1975, the recruitment value used in making prognoses of stock size was the mean value since 1957. In 1975 the modal value (100×10^6) was used instead of the mean (166×10^6) as it was considered to be a more realistic estimate. It is now clear that exceptionally strong year classes entered the fishery in the period 1966 to 1971, and that since then there has been a very substantial decrease in the recruitment level. Indeed the modal value given above has been exceeded only once since 1970.

The adult stock size has also shown a dramatic decline since 1969 and at 1 April 1976 was less than 10 000 tons; the adult stock size and the recruitment levels are shown in Fig 12. Although it has not been possible to demonstrate a relationship between stock level and resulting recruitment, it is obvious that a continuation of the existing trend in recruitment will result in a situation where the adult stock will be reduced to a very low level which in turn will generate a complete failure in recruitment.

Because of this it would not be justified to continue using the modal recruitment to estimate future stock sizes. A better estimate would be obtained from the recent period when the stock size has been at a low level. According the mean level of recruitment during the period 1972-1975 was used. This gave an estimate of 61×10^6 1-ringers.

The 1972/73 and 1973/74 year classes were estimated as 31.8 and 30.9 million 1-ring fish, but no information is available about the strength of either the 1974/75 or 1975/76 year classes. The weakness of the 72/73 and 73/74 year classes might suggest that even the estimate of 61×10^6 1-ring fish used in the prognosis might be too high.

3.8 ## TAC for 1977/78 and 1978/79

In 1976 the Working Group recommended that there should be no fishing in the Celtic Sea in 1977/78 as the first step in a policy of rebuilding the stock to an acceptable level of approximately 40 000 tons. In April 1976 the Liaison Committee suggested to NEAFC that the best way of rebuilding the stock to this level would be to reduce the TAC already agreed for 1976/77 from 16 800 to 6 500 tons. At a subsequent meeting of NEAFC the TAC for 1976/77 was reduced from 16 800 to 10 850 tons but no figure was agreed for the 1977/78 season.

It is difficult to estimate, under these conditions, what the fishing intensity on Celtic Sea herring will be in 1977/78. It is possible that:
  a) All fishing will be prohibited for the complete season (minimal F)
  b) The catch will be set at the level suggested by the Liaison Committee of 6 500 tons.

With an adult F of 0.81 and an F on 1-ringers of 0.25 during the 1976/77 season the corresponding adult stock size at 1 April 1977 is approx 8 350 tons. With a minimal catch of 500 tons, or a catch of 6 500 tons the stock sizes at 1 April 1978 will be 16 800 tons or 11 000 tons respectively. A catch of 6 500 tons would require an F on the fully recruited age groups of 0.75 which is close to the average level of recent years. These estimates assume that the 1974/75 year class is 61×10^6 l.w. ring fish and it has already been pointed out that this may be an overestimate.

It is obvious, therefore, that at the present stock level, all fishing should be prohibited during 1977/1978 on this stock. Even if this advice is followed, the stock size at the beginning of the 1978/79 season will still be below the level which the Liaison Committee considered to be too low to guarantee survival. No fishing can therefore be allowed in these circumstances.

The advice of the 1976 Working Group can only be re-emphasised; that all fishing on this stock must be prohibited for two years when the situation should be reviewed to estimate the degree of recovery.

3.9 ## Herring catches in Division VIIf (Bristol Channel)

In recent years herring have also been taken from area VIIf and the annual catches from this area shown below have risen from zero in 1966 to over 3 000 tons in 1975. These are taken mainly by Dutch, French, and USSR fleets. From limited Dutch data it would appear that this area is inhabited by a very small stock of spring spawners. However, there is a possibility that some of these herring may have originated in the Celtic Sea.

Herring catches in Area VIIf

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Tons	+	+	523	3	1 053	520	1 031	196	590	3 378	

Because any indigenous stock in Area VIIf is very small and because of the possibility of the presence of herring from the Celtic Sea, it would seem advisable to restrict the catches in VIIf to about 1 000 tons, until more information becomes available about this fishery.

4   Herring in Division VIa

4.1.1   Total catches and the fisheries in VIa

The total catches reported by each country in Div VIa for the period 1967-74 are given in Table 4.1, together with the revised catches for 1975 and the preliminary estimates of catches taken in 1976. Also included are estimates of the weight of herring taken in each year in the Moray Firth young herring and sprat fisheries. The final figure for 1975 shows an increase of about 13 000 tons over the preliminary figure for that year given in the previous report. The decrease of the preliminary total catch in 1976 compared with the final 1975 catch is about 34 700 tons (25%). Of the TAC of 136 000 tons for 1976 set by NEAFC only 78% was taken.

4.1.2   The revised catch figures for 1975 by Norway, Faroes and Iceland show that the sharp decline in catches by these countires mentioned in the previous report was about 83%, from 41 155 tons to 7 040 tons. In 1976 the main cause of the fall in the total estimated catch was the reduction in the Scottish contribution. Some other countries increased their catches whilst those of others decreased.

4.2   Catch in number in Division VIa

4.2.1   Estimates of numbers of autumn spawning herring per age group caught in Div VIa in each of the years 1967-1976 are given in Table 4.2. and in the Moray Firth in Table 4.3. Also a Table 4.4 was added that gives the sum of Table 4.2 and 4.3. The estimates for the period 1967 to 1972 are taken from Saville and Morrison (1973), and from unpublished Scottish data on catch in numbers in the Moray Firth fishery.

4.2.2   The figures from 1975 were amended to correct for the revised catches for 1975. For 1976 the catch in numbers are compiled from national data. These numbers were raised for countries for which no age composition data were available, taking into account the seasonality of the fisheries.

4.3   Stock and mortality estimates

4.3.1   The catches in numbers over the period 1957-1976 were used as the basis for a cohort analysis. Some changes in the input data were made compared with the previous year. Whereas in 1976 the oldest age group incorporated in the analysis was the 10-ringers, in 1977 the catches of 9-ringers and older were incorporated as a plus-group. This change is likely to have had a negligible effect on the output data used as the basis for the assessment. Some changes were also made in the input F's for the oldest age-groups, as can be seen by comparison of Table 4.5 with the corresponding ones in previous reports. An input value of fishing mortality of 0.7 was estimated for the last year from catch per arrival data in November-December 1975 and 1976 in the Scottish pair-trawl fishery in the Minch. Although similar data for 1974 and 1975 were not used in the previous year's analysis owing to the introduction of local quota regulations in 1975, this objection did not apply to the same extent in this year's analysis. By November 1976 there was no likelihood of the UK quota being reached and effort restriction caused by local catch quotas was held in abeyance. In November-December 1975 it is possible that some local quota regulations were enforced which had a small affect. If so, the value of F calculated from 1975 - 1976 is likely to be an underestimate. It is quite clear however that the F in 1976 was higher than the value of 0.5 used as an input in the previous report for 1975.

4.3.2   Estimated fishing mortalities and stock in numbers per age group in the period 1965-1976 are given in Table 4.5 and 4.6. They indicate that the value of F in 1975 was 0.8, ie higher than the input value used in the previous year's cohort analysis.

For this reason the stock in 1975 and predicted stock in 1976 were seriously overestimated. The biomass of the stock of 2 years and older in 1975 is now estimated to have been 250 000 tons, not 368 000 tons as previously estimated. From Table 4.5 it would appear that the F's on the fully recruited age groups have been above the value giving the MSY per recruit since 1971 and have increased to an even higher level in the last three years. The biomass of the stock of 2-ring and older fish (Table 4.6) reached a peak level of over 670 000 tons in 1972 with recruitment of the very strong 1969 year class. It has subsequently declined to less than half this level in 1975 and 1976.

4.3.3   To obtain estimates of the strength of the most recent year classes a new regression was calculated between the number of 1-ringers estimated by cohort analysis and the number of 1-ringers caught per arrival by pair trawlers in the North Minch in November-December (Fig 13). Using the results of this regression and the cohort analysis the following recruitment levels (number x 10^{-6}) were estimated.

Year class	Previous estimate based on		New estimate based on	
	Cohort Analysis	Scottish cpue	Cohort Analysis	Scottish cpue
1970	1186	-	1150	-
1971	537	-	493	-
1972	-	1546	935	-
1973	-	1600	1263	1890
1974	-	-	-	1367

Thus, the 1971 and 1972 year classes are weaker than originally estimated and both rather below the mean of 1 468 x 10^6 over the period 1965-1974.

The 1973 year class on all estimates is slightly better than average, while this estimate of the 1974 year class indicates that it is of about average strength. However whilst the regression is significant the confidence limits of a single estimate from it are exceedingly wide. The 95% confidence limits on this estimate of the 1974 year-class are - 177.5 to 2 910.7. In the light of this the estimate was considered unuseable and the recruitment of this year class in calculating TAC's was set at the modal value.

4.4   Catch prognosis for 1977 and 1978

4.4.1   A prediction has been made of the catch which can be taken in 1977 and 1978. The basic age composition of the stock at 1st January 1976 was calculated from the catch in numbers per age group in that year using a fishing mortality rate of 0.7 on fully recruited age groups as discussed in paragraph 4.3.1. In previous assessments the F on 2-ringers was taken as 50% of that on older fish. As will be seen from Table 4.5 in recent years the ratio of 2-ringers to adult F has been increasing. It would appear that 70% of the adult F is now a more appropriate value and accordingly a value of 0.5 was used as the fishing mortality rate on 2-ringers in calculating the stock of fish of that age group.

4.4.2   As in the previous report the recruiting year-classes for which no information is available from which to estimate their abundance were taken as being equal to the most frequent recruitment value in the period 1957-73 (650 x 10^6).

4.4.3   The number of 2-ringed herring recruiting to the fishery in VIa is affected by catch of 1-ringers in the Moray Firth sprat fishery. To account for these catches an F of 0.13 was applied, of which 10% of the adult F in VIa was assumed to be generated in VIa, the remainder in the Moray Firth.

4.4.4   The basic parameters used in calculating the TAC for 1977 are given below. The mean weights at age used were the same as in the previous report.

Age (rings)	Number per age group at 1 Jan 1977 ($\times 10^{-6}$)	Mean Weight per age group (gms)
1	650.0	90
2	516.4	121
3	530.5	158
4	114.7	175
5	41.1	186
6	34.6	206
7	81.8	218
8	13.4	224
$\geqslant 9$	18.0	224

On this basis the biomass of the stock of 2-ringers and older at 1st January 1977 is estimated to be 206 000 tons.

4.4.5   Predicted catches in 1977 and TAC's for 1978 have been calculated using two alternative assumptions:

a) The TAC of 83 000 tons recommended in the previous report for 1977 will be taken. This with the reduced stock at 1st January 1977 given above will require a fishing mortality of 0.6 on fully recruited age groups rather than the value of 0.3 advocated in the previous report. If this catch is taken then the stock at 1st January 1978 will be only 188 000 tons. On this assumption the TAC for 1978, using an F of 0.3 as advocated in the previous report for this population, would be 44 000 tons and leave a predicted stock biomass at 1st January 1979 of 213 000 tons.

b) The TAC of 1977 was recalculated using an F of 0.3 on the new estimate of stock. On this basis the TAC for 1977 would be reduced to 48 000 tons and give a stock biomass at 1st January 1978 of 226 000 tons. If this catch is taken in 1977 the TAC for 1978 at the same F would be 53 000 tons and leave a stock biomass at 1st January 1979 of 241 000 tons.

4.4.6   Predicted catch figures with the corresponding values of F and the biomass of the adult component of the stock are given below in 1 000 ton units.

1976 Biomass	1977 Biomass	1977 F	Catch	1978 Biomass	1978 F	Catch	1979 Biomass
		0.60	85	188	0.30	44	213
238	206	0.30	48	226	0.30	53	241

In the previous report it was stated that an F of 0.3 should be used as an intermediate step in getting from the present high F's to the $F_{0.1}$ value of 0.18. This should still be the aim but in view of the sacrifices in immediate catch that this would demand it would seem more appropriate to delay its attainment until there is evidence of recruitment of a strong year-class which would permit it to be done with the minimum short term disruption of the fisheries.

Of the two alternatives discussed in paragraph 4.4.5 the Working Group would recommend that the TAC in 1977 should be reduced to the figure of 48 000 tons appropriate to an F of 0.3. This would give an adult stock biomass both in 1977 and 1978 at a somewhat higher level than the other option. It should be appreciated that these biomasses are at a lower level than in any year since 1965. The TAC in 1977 at this level would also result in more equalisation of the catch levels between 1977 and 1978. On this basis the TAC for 1978 would then be 53 000 tons.

4.4.7 Herring catches in Division VIIb-c

Herring catches in Division VIIb-c were very small up to the late sixties. In 1970, however, an Irish fishery developed on overwintering herring in Galway Bay, and in 1975 and 1976 substantial catches were also recorded by Dutch boats fishing in the northern part of the area. As a result the reported catch from this area in 1976 amounted to over 19 000 tons. Additionally, as pointed out in previous reports, a considerable amount of the Irish catch reported as having been taken in VIa, have, in fact, been caught in division VIIb-c. The total catches reported from this area are given in Table 4.7.

Biological data on herring caught in this area are available from Ireland in 1969 and from Netherlands in 1975 and 1976. These would indicate that the same population is being exploited by these countries. Grainger (1976) has suggested, from an examination of Irish data that for management purposes the herring in VIIb-c and those fished by Irish vessels in VIa are indistinguishable. Because of national catch quotas in the adjacent Celtic Sea and VIa areas there is a possibility of diversion of effort to, and of mistaken attribution of catches to, VIIb-c. It would therefore be advisable to restrict catches in this area by imposing a precautionary TAC of 10 000 tons until more information is obtained.

5 Irish Sea Herring (Division VIIa)

5.1 Introduction

It is convenient to consider separately the Manx stock and the Mourne stock; both of these are small autumn spawning stocks. The Manx stock appears to be maintaining a reasonable stock size and recruitment level; the Mourne stock is in danger of extinction.

5.2 Catch and effort

5.2.1 Tables 5.2.1 and 5.2.2 give the annual catches in the North Irish Sea, 1967 to 1976, by country and by stock. The reduction of UK catch of Manx stock by 16% from 1975 to 1976 was influenced by a nationally determined TAC for UK vessels which was set at 12 000 tons; the catch taken by UK exceeded this figure. The total catch of the Mourne stock was, however, only 261 tons lower than in the previous year. Effort on the Manx stock was reduced in 1976 by 12% from that of the previous year. There are no reliable data for effort on the Mourne stock. Table 5.2.3 gives the fishing effort on the Manx stock from 1964 to 1976 together with the fishing mortality calculated by cohort analysis for these years.

5.3 Age composition of the catch

Total catches, by weight, of Manx herring were converted to numbers at each age by the use of data from samples of catch landed in Isle of Man, England, Northern Ireland and France. Catches of Mourne herring were similarly treated with data from landings in Northern Ireland, Ireland and England. It may be seen from Tables 5.3.1 (a) and (b) that 2-ring and 3-ring fish were the most common age groups in catches of the Manx stock and that herrings older than 3-rings made up about 24% of the catch in 1976. 0, 1 and 2-group herrings were the most numerous age groups in Mourne catches; older fish were very scarce.

5.4 The industrial fishery in the Irish Sea

The industrial fishery carried out in the northern part of the Irish Sea continued in 1976. Catches from this fishery, however, decreased because of a closure of the reduction plant from April to September. Estimates of the weight of young herring taken in these industrial catches, (based on samples obtained since 1969) are shown below.

Year	1969	1970	1971	1972	1973	1974	1975	1976
Tons	2 210	3 796	2 715	2 251	1 913	2 190	1 573	779

The herring taken in this fishery are mainly 0, 1 and II group and they have been shown to be mainly recruits to the Mourne fishery. The total catch, expressed as numbers of fish per age group, is shown in Table 5.3.2 for the period 1969 to 1976.

The NEAFC recommendation (8c) which came into force in October 1975, prohibits the landing of herring for industrial purposes (subject to a 10% tolerance level). The previous report of the Working Group also recommended that a minimum size limit of 20 cm for herring should be introduced in Division VIIa. Both these recommendations must be rigorously enforced if the catches of young herring from this area are to be reduced.

5.5 Stock estimates and mortality

5.5.1 Manx stock

Table 5.4.1(a) gives the Manx stock size by age at 1 January each year, estimated by cohort analysis with input values of $M = 0.1$ for all years, $F = 0.5$ for all fully recruited age groups in 1976, and $F = 0.7$ for the terminal age group in 1975. Input values of F for the last age group in 1974 and earlier years were taken from mean F for each year estimated by a cohort analysis carried out in 1976 (C.M. 1976/H:2).

The estimates of F from Table 5.4.1(a), together with the effort data given in Table 5.2.3 were used to calculate the regression equation

$$F = 0.0001616 \text{ (effort)} + 0.185$$

$$n = 12 \qquad r = 0.896$$

Applying this equation to the 1976 effort (total catch ÷ Isle of Man catch per landing) gives $F = 0.58$ for 1976. This value of F together with the 1976 catch data given in Table 5.3.1(a) indicates a total stock size (ages 2-8) of 206 million fish at 1 January 1976, with recruitment of 112 million 2-ring fish, assuming that F operated uniformly on age groups 2-8-rings, and that $M = 0.1$ for these ages.

Millions of fish at 1 January 1976

Age (rings)	2	3	4	5	6	7	8	8+	Total 2-8
Stock in number ($\times 10^{-6}$)	111.7	40.9	32.1	9.1	5.7	5.5	0.8	1.75	205.8

The Manx stock increased between 1966 and 1971. A good recruitment of the 1971 year class gave a high stock level in 1974, but high fishing mortality in 1974 with an only average recruitment in 1975 resulted in a 30% reduction in stock size from 1974 to 1975. Recruitment in 1976 appears to have been above average which has, to some extent, offset the impact on stock size of a level of fishing mortality in 1976 which was considerably higher than that recommended in the previous report.

5.5.2 Mourne stock

A reduction in the industrial fishery (paragraph 5.4) in the North Irish Sea in 1976 contributed to only half as many O-group herring being caught as in the previous year, although another factor involved was the weakness of the 1975 year class. It was assumed that the fishing mortality rate had not changed appreciably in recent years. On this basis an input F of 0.9 was used for 1976 for 1 - 8 ring fish. The results are given in Table 5.4.1(b) including the mean F at each age during the years 1971-1974. These are substantially higher on 1-3 ring fish than on fish of 4 rings and above, while O-group fish have an intermediate value.

Since the industrial fishing on O-group herring operated in 1976 for only 3 months instead of the usual 4 months of the year, it was assumed that fishing mortality on O-group herring was reduced by 25%.

The mean O-group F = 0.8 for years 1971-74 was therefore reduced to F = 0.6. From the cohort analysis the numbers of 1-ring fish and older in 1975 was 74 million and in 1976 it was 75 million. A weighted mean fishing mortality was calculated for 1-3 ring fish in 1975 of F = 0.95 and for 4-8 ring fish of F = 0.80. The values used in calculating the stock size of Mourne herring at 1 January 1976 and 1 January 1977 from the catch in number taken during 1976 were therefore as follows:
O-ring F = 0.6; 1-3 rings F = 1.0 and 4-8 rings F = 0.80.

Millions of fish at 1 January 1976

Age (rings)	0	1	2	3	4	5	6	7	8	9	Total
	27.0	42.9	14.7	5.7	2.9	1.3	0.7	0.3	0.3	0.1	95.9

5.6 Prognosis for 1977 and 1978

5.6.1 Mourne Stock

The mean number of O-group recruit herring during the years 1969-1974 from VPA was 160 million. This was reduced by 25%, as in the previous report, to allow for the possibility that some of the O-group herring taken in the industrial fishery recruit to stocks other than the Mourne one. This gave a value of 120 million fish. From the catch of O-group herring in 1976, the initial strength of the 1975 year class was, however, calculated to be only 27 million fish. This is by far the lowest size of any year class of Mourne herring since assessment became possible. It strongly suggests in conjunction with the steady decline in recruitment shown in Table 5.4.1(b) that a stock and recruitment situation exists in the Mourne stock at the present time. With the current very low size of spawning stock all future year classes are likely to be weak. The mean recruitment-level of 120 million fish is likely to be far too high as an estimate of future recruitment in the present situation. It was considered more realistic to reduce this to 60 million fish, for the initial strength of the 1976 and 1977 year classes. These values have therefore been used in calculating both catch and stock size given in Table 5.4.2(b). On this basis the total stock at 1 January 1977 was only 6 456 tons. This is some 2 200 tons lower than at 1 January 1976 and 16 100 tons lower than at 1 January 1971. If fishing mortality continues at the same level in 1977 as in the previous two years the stock at 1 January 1978 will be some 600 tons lower at 5 866 tons. This largely depends however on recruitment by the 1976 and 1977 year classes being at the level indicated. Fish which have already recruited to the Mourne stock, and the numbers of which can be predicted with some confidence, will only contribute about 2 500 tons to this total weight.

In the present situation the only sensible course of action would be to impose a complete ban on fishing for herring of the Mourne stock until a recovery has taken place. If this advice is acted upon and fishing stopped at the end of June 1977 it is likely that some 1 000 tons of herring would still be taken in 1977 up to this date. On the assumptions of recruitment discussed above the stock size at 1st January 1978 would then be some 10 500 tons. A reduced catch in 1977 of about 2 000 tons would, on the same assumptions, give a stock size of about 8 300 tons at 1st January 1978.

In the light of these projections it is recommended that fishing for herring within 12 miles of the east coast of Northern Ireland and the Republic of Ireland, between $53^\circ 20'N$ and $54^\circ 40'$, be prohibited from 30 June 1977.

5.6.2 Manx stock

Table 5.4.2(a) gives the calculated effect on stock size at 1 January 1978 of various levels of catch in 1977. A catch of 10 000 tons as recommended in the previous report (C.M.1976/H:2) would allow the stock to increase given average recruitment. A catch of 14 000 tons would maintain the present stock size, any greater catch would reduce it, making the stock and catch even more dependent on recruitment than at present.

TAC for 1977 and 1978

Given the necessity for closure of the Mourne fishery it is clear that the Manx stock will be subjected to increased pressure if effort is not controlled in 1977. $F_{0.1}$ on this stock is = 0.22. It is unrealistic to expect to reduce fishing to this level in 1977. It was agreed that an F of 0.4 would not seriously damage the stock, provided recruitment continues at a level similar to that in the years since 1969. A TAC in 1977 of 12 000 tons, together with a close season over the spawning area for 6 weeks from 1 October, as has been applied in the last three years, is calculated to produce an F of 0.4. The stock level of 1 January 1978, given normal recruitment, would then sustain a catch of 10 000 tons at an F of 0.3 or 13 000 tons at an F of 0.4.

It is therefore recommended (a) that fishing for herring be prohibited within 12 miles of the coast of the Isle of Man from 1 October 1977 to 13 November 1977 and that the TAC for 1977 is 12 000 tons; (b) that fishing for herring be prohibited within 12 miles of the coast of the Isle of Man from 1 October 1978 to 12 November 1978 and that the TAC for 1978 is 12 500 tons.

5.6.3 TACs for 1977 and 1978 in North Irish Sea (Division VIIa)

Although for assessment purposes it is realistic to treat the Mourne stock and the Manx stock independently there is some mixing of them in catches taken to the west of the Isle of Man in summer. Accordingly, although management action can be taken for the two stocks independently when they are segregated immediately before and during spawning, annual TACs can only be set, and enforced, for the total herring population in the North Irish Sea.

It must be emphasised, therefore, that in the light of the recommendation in paragraph 5.6.1 that fishing on the Mourne stock should be reduced to the minimum practicable level in 1977 and 1978, that the TACs for the North Irish Sea (Division VIIa) as a whole should be no more than those given for these years for the Manx stock, namely: 1977-12 000 tons, 1978-12 500 tons.

6.   Sprat Assessment for the North Sea and Skagerrak

6.1   Introduction

In 1976 the Working Group decided for the purpose of assessment and management that the Skagerrak and Norwegian west coast fjord sprats (in ICES Division IVa east) should be treated as a distinct stock unit and assessed separately from those of the North Sea. This procedure has also been adopted in the following report.

6.2   North Sea sprat

6.2.1   The North Sea fishery in 1976

In Table 6.1 the North Sea sprat catches for the years 1967-76 are presented by fishing areas and countries. The total provisional catch in 1976 was 617 000 tons, a small reduction on the previous year's record catch of 641 000 tons. This deficit was mainly due to slightly reduced catches in both Division IVb east and west, whereas the catch in Division IVa west increased from 37 000 tons in 1975 to 45 000 tons in 1976, owing mainly to the development of a purse-seine fishery on the Fladen Ground by Norwegian vessels in the last quarter of the year. Very little catch was taken from Division IVc in the southern North Sea.

Denmark with 303 000 tons again accounted for the major part of the total catch (49%), but its catch showed a reduction of 23 000 tons on the previous year. Norway, with 106 000 tons (17% of the total) was the second largest, but caught 41 000 tons less than in 1975. This was mainly due to a scarcity of suitable shoals for purse-seining off the northeast coast of England during the last quarter of 1976, which resulted in a diversion of this effort to the Fladen Ground. Conversely, the 1976-77 winter fishery along the northeast coast of England within the 12-mile limit, has proved to be one of the best so far recorded.

Other major catches in 1976 were taken by USSR (54 000 tons), England (50 000 tons), Faroe Island (46 000 tons) and Scotland (31 000 tons), and the catches by all these countries showed increases over the catches made in 1975.

Figure 14 shows the distribution of catch by areas in 1976 for Denmark, Norway, Sweden, Scotland and England, which between them accounted for about 494 000 tons or 80% of the total catch. Information on catch distribution was not available for the remaining countries. The areas chosen were basically determined by those used for reporting the Danish catches.

In 1976 the area immediately off the northeast coast of England was the most important, yielding about 29% of the total catch accounted for in this Figure. Other high yield areas were the block to the east of Flamborough Head and those in the German Bight towards the Danish coast. The Fladen Ground area also produced a fairly large catch.

The catches from Division IVb in 1976 accounted for 92% of the total North Sea catch, with more of this being taken in Division IVb west (364 000 tons) than in Division IVb east (206 000 tons). The catch from Division IVb east was almost entirely taken by Danish vessels in the period July-November. The fishery in Division IVb west is exploited by the vessels of several countries, mainly within the period December to March. This seasonal shift in effort from Division IVb east to Division IVb west is best illustrated by the monthly catches for Denmark in each of these Divisions, as shown in the text table on p.21. The shift in fishing effort to the west after November is due to reduced availability of fish on the Division IVb east grounds in the winter months.

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Monthly landings of sprats in Divisions IVb west and IVb east in 1976 by Denmark (in thousands tons)

Div.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
IVb W	22.2	28.5	20.4	3.5	1.3	0.2	0.4	4.8	0.5	0.7	3.8	16.3
IVb E	0.2	0.4	0.7	1.0	1.0	4.5	26.1	43.8	39.8	31.8	49.2	1.4

The catch in number per age group in 1976 was calculated from the national data for age compositions in each Division and these are presented in Table 6.2. The 1973 yearclass continued to contribute strongly to the catch in Division IVb west in 1976 but was of less importance in the other areas. The 1974 yearclass was also well represented in Division IVb west. The 1975 yearclass predominated in the catches from Division IVb east and Division IVa west, whilst also making an appreciable contribution to those in Division IVb west. The 1976 yearclass (O-group) appears well represented in all the main areas and may thus be above average strength.

6.2.2. Weight at age in the North Sea sprat

The values of average weight at age in the catches in 1976 are summarised in Table 6.3 by quarterly periods and ICES areas. The estimates for the first and last quarters are generally similar in the different areas, but show wider divergences in the second and third quarters. This variation in the summer period could be due to a combination of generally lower sampling levels and the fact that the fish would be intrinsically more variable in weight at this time, due to spawning and feeding. The overall mean weights for quarters and for the whole year were calculated by weighting the values for the sub-divisions by catch in numbers in each sub-division and quarter. The values given in the first line of Table 6.3 are the ones used in calculating yields and TAC.

6.2.3. Fishing mortality, stock size and recruitment

The high sprat landings of 1975 were almost maintained in 1976, although in the previous report it had been expected that there would be a considerable decrease if fishing effort remained constant (C.M.1976/H:2). It was, therefore, essential to examine the most recent data available for changes in mortality rate and recruitment. Unfortunately, no effort data were available for the offshore fisheries, which exploit the fully recruited age groups. Hence, no up-to-date estimates of total mortality rate (Z) could be made to compare with the value of around 1.25 estimated in the previous report for the period 1974-75. The only available approach was to adopt a modified VPA as discussed below.

Since the catch data back to 1967 were available on a fishing season rather than calendar year basis, the VPA was carried out using annual catches in numbers from 1 July to 30 June. The quarterly catches in numbers for 1976 are given in Table 6.4, and the catch for the 1975-76 season in Table 6.5. The data used for the compilation of catch in numbers were provided by Denmark, Norway and the United Kingdom. The remainder of the catch, predominantly taken by the Faroes and USSR, was raised to catch in numbers using the most appropriate data available from other countries.

The VPA was carried out using the same natural mortality coefficient (0.8) as in the previous year. Owing to the absence of an estimate of total mortality for the 1975-76 season, the Working Group first carried out the VPA, using identical input

values of fishing mortalities to those used in the previous year, i.e., 0.05 on the 0/1-group, 0.27 on the 1/2, 2/3 and 3/4 groups, and 0.20 on the 4/5 group. The results indicated a mean value of F in 1974-75 of only 0.19 which was very much lower than the value of 0.45 estimated from catch per unit effort (cpue) data from the period October-December 1974 and 1975. A series of trial computer runs were, therefore, carried out until the level of fishing mortality in the previous year approximated to that estimated by cpue. Since the cpue estimate covered half the previous season (1974-75) and half the current season (1975-76), however, the mean of the two VPA values had to be 0.45. Since the fishing mortalities from VPA were not the same on each age group, the input values of F were distributed in the same proportions as the mean values of F for the period 1971-73, after the offshore fishery started. A lower value for the oldest age groups was used because effort is likely to be directed at the most abundant age groups in a fish such as sprat with a short lifespan.

The output from the final run of the VPA is given in Table 6.6. It indicates that fishing mortality has been highest in fish of two years of age since 1972. Although the mortality rate dropped in 1974-75, it increased markedly in 1975-76. Thus the high level of catch in 1976 was almost certainly due to an increase in fishing effort.

Estimates of stock size and recruitment from the VPA are given in Table 6.7. As in the previous report, they indicate that both stock and recruitment increased from a low level in the early 1970s. The VPA indicates that the 1974 yearclass was above average but not as good as that of 1973. The first estimate of the 1975 yearclass indicates that it also is above average.

As a result of a series of good yearclasses, the sprat stock also appears at present to be slightly above the long-term level of 940 000 tons. The mean annual recruitment from 1967 to 1975 was 170×10^9. Thus, the present indications are that the high level of catches since 1973 have not depleted the stock to any marked extent.

There are no reliable estimates of the strength of the 1976 yearclass. The numbers of 0-group sprats caught in the latter half of 1976, shown in Table 6.5., however, were considerably higher than in either of the previous two years. This may indicate that the abundance of the 1976 yearclass is at least average and perhaps even greater.

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

Using weight at age data collected in 1976 by a number of countries (Table 6.5), new yield per recruit curves were prepared. Since fishing mortality varies with age, the calculations were made on the basis of the mean exploitation pattern found by VPA from 1971-74. The ratios of F at each age compared with F of one year olds = 1 are given below:

$$F_0 = 0.14; \quad F_1 = 1.00; \quad F_2 = 1.85; \quad F_3 = 1.41; \quad F_4 = 0.37.$$

Despite small differences in the biological parameters used, the yield and stock per recruit curves shown in Figure 15 differ very little in form from those given in Doc. C.M.1976/H:2. They indicate that the maximum sustainable yield per recruit is slightly lower (2.5g compared with 2.8g calculated previously) and that the spawning stock would be depleted to about 1/3 of the unexploited level at an F of about 0.53, i.e., very close to the level estimated in the previous report. Some change in these results would be expected using a different exploitation pattern, but there seems little need at present to consider further changes until the effects of the recent change in minimum mesh size regulation has been fully monitored.

6.2.5.   Catch prediction in 1977 and calculation of TAC for 1978

The VPA output in 1977 is subject to the same reservations as mentioned in Doc. C.M.1976/H:2. Indeed, the absence of catch per unit effort data for 1976 reduces its reliability even further. Nevertheless, in the absence of a more reliable method, the Working Group used the results of the above assessment to predict the likely catch in 1977 and to calculate a TAC for 1978.

The basis for the prediction was as follows:

(a) Recruitment of the 1976 and 1977 yearclasses was assumed to be average, i.e., 170×10^9 fish.

(b) The required fishing mortality was taken to be 0.53, i.e., the maximum value if the spawning stock is not to be reduced less than 1/3 of the unexploited level.

Using the results of the VPA and the catch in numbers in the last half of 1976, the stock in the sea at 1 January 1977 was estimated to be around 1.04×10^6 tons consisting of:

Age group	1	2	3	4
	111.8×10^9	43.0×10^9	16.1×10^9	7.3×10^9

Assuming that the catch of 0-group in 1977 will be the same as in 1976 (i.e., $2\ 860 \times 10^6$), the catch in 1977 at an F in the older age groups of 0.53 is estimated to be 487 000 tons. To take the same catch as in 1976, the value of F would have to increase from 0.56 to 0.73.

Since it is impossible to predict 1977 catches with any certainty, two alternative TACs have been calculated for 1978 on the basis

a)   that the F in 1977 will be 0.53, and

b)   that in 1977 the catch will be the same as in 1976.

To produce an F no higher than 0.53 in 1978, the TAC for 1978 should be set at

a)   410 000 tons, or

b)   374 000 tons,

depending on the level of catch in 1977.

The long-term sustainable yield at an F of 0.53 is estimated to be 368 000 tons at the recent average level of recruitment. Since recruitment accounts for a large proportion of the variation in stock size, however, the recommended catch in each year is not likely to remain constant.

6.3.   Sprat in Division IIIa and the Norwegian fjords

6.3.1.   Stock separation

As outlined in the previous report of the Working Group, the sprat occurring in Division IIIa (Skagerrak and Kattegat) and in Division IVa east (Norwegian west coast fjords) can be considered as a unit stock. Most of the sprat in these areas

originate from the spawning ground between the northern part of Jutland and
the Swedish west coast. Sprats are also found in Norwegian fjords north of 62°N,
i.e., in Division IIa. Their origin is not clearly understood, but they may be
derived from local spawning to a great extent than the sprats in the fjords further
south. For management purposes, however, these sprats can be considered to belong
to the same unit stock as sprat in fjords south of 62°N.

6.3.2. The fishery

The catches of sprat in Divisions IIIa, IVa east and IIa for the period 1967-76!
are given in Table 6.8. The Norwegian catch is entirely taken within the fjords
by purse-seine. The Swedish catch is partly taken in coastal areas on the west
coast of Sweden by purse-seine and partly in the open part of the Kattegat by
trawl. The Danish catch is mainly taken in the Kattegat by trawl.

In 1976, the total catch in the Skagerrak was 16 200 tons, about the same as the
previous year. The catch in the Kattegat, however, declined from 81 600 tons
in 1975 to 40 500 tons in 1976. The Norwegian fjord catches dropped from 7 400
tons in 1975 to 6 100 tons in 1976, a decrease occurring both north and south of
62°N.

Unfortunately, no effort data are available from which any estimate can be made
as to whether this decline resulted from a reduction in stock or a reduction in
fishing effort.

6.3.3. Biological data

Biological observations on sprat from the Swedish fishery exist for a considerable
time. Additional information is available from the Norwegian fjord fishery, and
there are data from the Danish trawl fishery for the most recent years.

The percentage age compositions, excluding the 0/1 group, and the mean age in purse-
seine catches from the coastal area in Sweden and in trawl catches from the open
sea, are given in Table 6.9. The percentage of 0/1-group sprat in Swedish catches
in winter is shown in Table 6.10. From these data, no changes in exploitation
pattern during the last year can be detected. The recruitment of the 1975 year-
class, as indicated by the proportion of 0/1-group in 1975/76 seems to be at the
same level as in previous years. There is at present no reliable evidence on the
strength of the 1976 yearclass, but Danish age compositions in the Skagerrak and
Kattegat in the last half of 1976 show a considerably higher percentage of 0-group
than at the same period in 1975 (Table 6.11). This indicates that the 1976 year-
class is probably not below average strength.

6.3.4. Stock assessment

The implications of sprat biology on the management of sprat stocks have been
discussed in previous reports by the Working Group (Anon., 1975 and 1976). Restric-
tions on the fishing of young sprat would not result in any significant gain in
yield per recruit. Heavy exploitation of 0-group sprat would, however, reduce the
spawning stock size. Because of the dependence of the traditional fisheries on the
recruiting yearclasses, and the relatively few year classes generally present, it
would be prudent to maintain the adult stock at a high level. Moreover, with
regulations on sprat and herring fisheries in the North Sea, there could be a
diversion of fishing effort to the Skagerrak and Kattegat. For these reasons,
it seems necessary to set a TAC for 1978 for this area.

The Working Group considered the data available for carrying out a cohort analysis.
The data on catch in number did not cover a major part of the catch for a long
enough period to provide reliable results. Acoustic surveys have been carried out,
but only for a restricted period and can therefore not provide data on stock changes
or measures of recruitment.

In view of this, the TAC could only be determined from the level of catch
in recent years. In the previous report, it was advised that the TAC
for 1977 should be set at the level of catch in 1975 of 100 000 tons.
In the light of the decline in catch in 1976 this level of TAC would seem
likely to be too high. It is therefore recommended that the TAC for both
1977 and 1978 for Division IIIa and the Norwegian fjords in Division IVa
be set at the same level as the mean catch over the period 1973-76, i.e.,
80 000 tons.

7 Future research requirements

7.1 The Working Group realised that stock assessments based on assumptions
about the fishing mortality in the most recent year (cohort analysis)
will become impossible in the North Sea as soon as a complete ban on
fishing or even severe catch restrictions, are introduced. An important
index of adult stock size under those circumstances will be derived from
larval surveys. It is imperative, therefore, that during 1977, and
subsequent years, a complete coverage by larval surveys is obtained for
all spawning areas, and for the whole spawning season. Obviously the
results of these surveys should be available at the time of the next
meeting of the Working Group. It is also strongly recommended that further
studies are undertaken into the application of larval data for stock
assessment.

It will, of course, also be imperative that the International Young Herring
Surveys are maintained at their current level of sampling intensity in
order to monitor changes in recruitment levels, and how these respond to
changes in spawning stock size.

Apart from larval surveys and young herring surveys other sources of
information, such as catch/effort and acoustic surveys should be utilised
as much as possible in order to obtain checks on changes in stock sizes.

7.2 Similarly in Division VIa, and in the Celtic Sea there is a growing need for
other estimates of stock size, as a check on those obtained from catch
statistics and catch sampling data. In the Celtic Sea there are currently
no routine survey programmes for measuring recruitment, larval production,
or acoustic estimates of population size. In VIa larval surveys have been
carried out but at a somewhat inadequate sampling intensity. The Pelagic
Fish (Northern) Committee should at its next meeting pursue vigorously
methods of improving the data available for assessment in these areas.

8. Summary

8.1 The catch of herring from the North Sea in 1976 was only slightly more than half the very low level of 1975. Despite the recruitment to the adult stock of the moderately strong 1973 year class the spawning stock size estimated from catch data in 1976 was not more than 155 000 tons. The results of larval surveys suggested that larval production was very low in 1976 and gave an estimate of spawning stock size of only 85 000 tons.

8.2 All the indications are that the 1974 and 1975 year classes, which will recruit to the spawning stock in the North Sea in 1977 and 1978, are very weak ones. The catches of these year classes in the Recommendation 2 fisheries in 1976 were at a very low level of about 8 000 tons. This partly reflects their low abundance, but also the effects of Recommendation 8C which prohibited directed fisheries on herring for reduction purposes. The 1976 results accordingly give the first tentative estimates of the fishing mortality rates which will be generated on juvenile herring by the Recommendation 2 fisheries for other species. The estimates of total fishing mortality on both 0-group and 1-group in 1976 are 0.2. The 0-group F is almost entirely generated by the by-catch in the Recommendation 2 fisheries. Of the catch of 1-group fish in 1976, however, only 43% was taken as by-catch. Accordingly the F on 1-group, generated by the Recommendation 2 by-catch would be about 0.1.

8.3 The evidence therefore is very clearly that the stock is now in an even poorer condition than was predicted in the last report, and will deteriorate further in the immediate future unless drastic action is taken. The low values of juvenile F in the absence of a directed fishery on juveniles quoted above will, if correct, mean, that given an adequate spawning stock, the recovery will be more rapid than had been hitherto expected. This obstacle to getting effective action on restricting the adult human consumption fisheries has therefore been largely removed.

In the light of this the Working Group must reiterate their advice that the only action which will reduce the imminent risk of a permanent collapse of the North Sea herring fisheries is the complete prohibition of all directed fisheries immediately. If this is done and the prohibition maintained throughout the remainder of 1977, 1978 and 1979 it is estimated that, given the expected level of recruitment, the spawning stock will have returned to about half the minimum desirable level by 1979. Recovery thereafter should be rapid, given adequate management. The situation will be monitored again early in 1978, and in 1979. But in the light of the very low levels which the stock has been allowed to reach it must be pointed out that the prohibition of fishing will have to be maintained at least throughout the remainder of 1977 and the whole of 1978.

Prognoses were also made of the effects of TACs of 75 000 and 150 000 tons in 1977 and 1978, merely to indicate that even catches at these low levels would have very serious repercussions. The former would result in no appreciable increase in the present very low level of stock size up to 1979, even at the low juvenile fishing mortality rates assumed. The latter would result in a complete collapse of the stock by 1978.

8.4 In the Celtic Sea the catch taken during the 1976/77 season was the lowest recorded from that area since 1956. Only about 65% of the reduced TAC agreed for that season was attained. This low total catch did not result from a reduction in the effective fishing effort. The fishing mortality rate on this stock has been at a more or less constant level since the 1972/73 season.

8.5 The adult stock is estimated to have been less than 10 000 tons at 1 April 1976, compared with a fairly constant level of 80-90 thousand tons in the late 1960s. This low level of stock size is the result of a

continuous decline since 1972 which can be ascribed to: (a) high fishing mortality rates since the 1971/72 season and (b) reduced levels of recruitment which were first evident in 1970 and which have been particularly low in the last two years. There are also indications that the fishing mortality rate on the 1 ringed fish, which were formerly only lightly exploited, has increased, since 1972, as a proportion of the fishing mortality rate on fully recruited age-groups. This may be due to an increase in the growth rate, and a corresponding reduction in the mean age at first sexual maturity, but could have serious repercussions on the stock if the overall exploitation rate is not drastically reduced.

8.6   The stock size at 1 April 1977 is estimated to be approximately 8 300 tons. With a stock size of this level the TAC of 6 500 tons provisionally suggested by the Liaison Committee for the 1977/78 season is much too high. It would demand a fishing mortality rate, on the fully recruited age groups, close to the average level of recent years, and would result in a stock size of only 11 000 tons at 1 April 1978 even on a fairly optimistic assumption of the recruitment level. It would seem imperative therefore that all fishing should be prohibited on this stock during the 1977/78 season. Even under these conditions the stock size at 1 April 1978 will be below the level considered necessary to guarantee the continuance of the stock and, although the position will be reviewed early in 1978, a prohibition of fishing during the 1978/79 season must also be envisaged.

8.7   In recent years there has been a marked increase in herring catches reported from Division VIIf (Bristol Channel) where in 1975 the reported catches amounted to 3 400 tons. Little data is available on the biological characteristics of the herring population of this area but there is a possibility that some of it may be of Celtic Sea origin. In conjunction with a prohibition on herring fishing in that area it would seem desirable therefore to restrict the expansion of the fisheries in Division VIIf by a precautionary TAC of 1 000 tons until more information is available on the population structure and state of exploitation in that area.

8.8   The total international catch in Division VIa in 1975 at 141 000 tons is now seen to be 13 000 tons greater than the preliminary figure for that year given in the previous report. The preliminary figure for 1976 of 107 000 tons is much lower than the TAC agreed by NEAFC or the catches achieved in any of the years since 1969. The total catch in the offshore fisheries was maintained at a similar level to that of 1975; the major decline took place in the UK inshore fishery.

8.9   It is now clear that the stock at 1 January 1976 was considerably over-estimated in the previous report due to a too low estimate of the fishing mortality rate in 1975. The new estimates suggest that the fishing mortality rate on this stock has been above the MSY per recruit rate since 1971, and has increased even further in the last three years. The biomass of the adult stock reached a peak level of over 670 000 tons in 1972 and is estimated to have declined to less than half this level by 1 January 1975. In 1976 there may have been a minor increase due to the recruitment of the moderate 1973 year class but most of the potential gain from this was counteracted by the heavy exploitation to which the adult stock was subjected in 1975.

8.10   The preliminary estimate of the 1974 year class, which will recruit to the adult stock in 1977, suggests that it is slightly above average but the confidence limits on this estimate are high. The stock biomass at 1 January 1977 is estimated at 206 000 tons. With a stock of this size the TAC of 83 000 tons, estimated in the previous report at a fishing mortality rate of 0.3, would demand an F of 0.6. At an F of 0.3 the TAC

is now estimated to be 48 000 tons in 1977.

8.11   The TAC for 1978 will depend on the TAC agreed for, and the catch taken
       in, 1977. If the TAC originally suggested (83 000 tons) is adhered to
       the TAC for 1978 will be 44 000 tons. If the figure of 48 000 tons,
       appropriate to the new estimate of stock size, is accepted the TAC in
       1978 will be 53 000 tons. Both of these figures for 1978 are, to a
       considerable extent, dependent on the estimate of the strength of the 1974
       year class for which the reliability is low. The Working Group would
       advocate TACs of: 1977 - 48 000 tons, 1978 - 53 000 tons as these results
       in higher spawning stock biomasses in both years and give slightly
       greater safety margins against overestimation of recruitment.

8.12   Herring catches in Divisions VIIb-c have recently increased sharply due
       to the development of an Irish fishery on overwintering herring in Galway Bay
       and by Dutch vessels fishing in that area in summer and autumn. The
       recorded catch in 1976 was over 19 000 tons. The data available, although
       incomplete, would suggest that the populations fished in VIIb-c and in
       the southern part of VIa are indistinguishable and should be treated as
       a single management unit. The catches taken in VIIb-c should accordingly
       be restricted to a level of 10 000 tons immediately and a fuller asses-
       ment made at the first opportunity.

8.13   In the North Irish Sea (Division VIIa) preliminary catch figures indicate
       that the catches taken from the Manx stock and Mourne stocks decreased
       by about 3 000 tons and 260 tons respectively from the 1975 figures.
       In the Mourne stock the recruitment level has declined steadily in
       recent years in conjunction with a decline in the size of the spawning
       stock. The current high exploitation levels combined with low recruitment
       have resulted in a reduction in stock from 22 700 tons at 1 January 1971
       to 6 500 tons at 1 January 1977. If fishing mortality were to continue
       at the same level in 1977 as in recent years the predicted stock would be
       reduced to less than 6 000 tons, of which only 2 500 tons would be
       contributed by age groups whose abundance is known with any great confidence.

       On this basis it is recommended that fishing on this stock should be
       prohibited from 30 June 1977. This could be achieved by a closure for
       herring fishing in waters within 12 miles of the east coasts of Northern
       Ireland and of the Republic of Ireland between 53°20'N and 54°40'N.
       On the assumptions of the recruitment discussed in paragraph 5.6.1 this
       would lead to a build up of the stock to 10 500 tons at 1 January 1978.
       The position will be reviewed early in 1978, to see if this recovery has
       been achieved, and in the lights of the results future management
       requirements will be recommended.

8.14   Effort on the Manx stock decreased by about 12% between 1975 and 1976.
       The catch in 1976 was still well above the level to which it was hoped
       in the previous report, that it would be restricted. Recruitment to this
       stock in 1976 however was above average and largely compensated for the
       high F. On the basis of this higher recruitment the TAC of 10 000 tons
       for 1977 advocated in the previous report could be increased to 12 000
       tons provided that, as in recent years, it is combined with a close
       season within 12 miles of the coast of the Isle of Man from 1 October -
       20 November 1977. If this is agreed the appropriate TAC for 1978 would
       be 12 500 tons, again with a prohibition of fishing within 12 miles over
       the same period.

       Because there is some mixing of the Manx and Mourne stocks to the west
       of the Isle of Man, as discussed in the previous report, the herring
       population in the North Irish Sea, as regards TACs, must be treated as
       one management unit. In the light of the necessity of keeping the catch
       from the Mourne stock to a minimum, as discussed in paragraph 8.13., it
       should be stressed that the estimated TACs for the Manx stock should also
       be the TACs for the whole of the North Irish Sea. Accordingly it is

recommended that the TACs for the North Irish Sea (Division VIIa) should be: 1977 - 12 000 tons, 1978 - 12 500 tons.

8.15   An industrial fishery for juvenile herring, which mainly recruit to the Mourne stock, continued in 1976 despite a recommendation in the previous report of a minimum size of 20 cm, and despite NEAFC Recommendation 8C which prohibited industrial landings of herring from October 1975. It is imperative, if the Mourne stock in particular is to be properly managed, that these recommendations be rigorously enforced.

8.16   The total international catch of North Sea sprat in 1976 at 617 000 tons was slightly less than in 1975; and also slightly less than the TAC agreed by NEAFC. This catch was taken by an exploitation rate close to that recommended in the previous report of the Working Group. Although the 1974 and 1975 year classes appear not to be as strong as the 1973 year class, which has made a major contribution to the fishery since the 1973-74 season, they are above average strength and this high level of recruitment has permitted the high catch levels of recent years to be taken without depleting the stock.

8.17   On the basis of the new data available the TAC estimated for 1977 is 487 000 tons; somewhat higher than the 400 000 tons estimated in the previous report for that year. The TAC in 1978 will be dependent on the catch taken in 1977. It has been calculated on two assumptions: (a) if the TAC in 1977 is set at 487 000 tons the TAC for 1978 will be 410 000 tons.
(b) if the TAC in 1977 is set at the 1976 catch level of 620 000 tons the TAC in 1978 will be 374 000 tons.

8.18   The total sprat catch from Division IIIa and the Norwegian fjords in 1976 at 61 800 tons was the lowest recorded from this stock since 1972. Practically all of this decrease in catch between 1975 and 1976 resulted from a sharp decline in that taken in the Kattegat where the catches declined from 81 600 tons in 1975 to 40 500 tons in 1976. There are no data available for this area to estimate whether this marked reduction was due to a decline in abundance or in fishing effort.

8.19   The biological data available for the sprat population in this area do not yet permit the assessment of a TAC by any of the conventional methods. However the decrease in catches from 1975 to 1976 must give cause for concern, and would suggest that the precautionary value for 1977 of 100 000 tons, suggested in the previous report, was too high. The Working Group would therefore recommend that in 1977 and 1978 a TAC for the sprat population in Division IIIa and the Norwegian west coast fjords should be set at 80 000 tons.

8.20   The Working Group are concerned that, if recommendations for prohibition of fishing, or sharp reductions in catch, on severely depleted stocks are implemented, the conventional methods of monitoring the recovery of stocks will become unusable or of very doubtful accuracy. Under these circumstances the Working Group consider it essential to emphasise how dependent their assessments will then be on the results of herring larval surveys, to monitor changes in the adult stock and on the Young Hering Surveys to monitor changes in recruitment. Accordingly in paragraph 7 some recommendations are made on future research requirements.

8. Résumé

8.1. Les captures de hareng en Mer du Nord pour 1976 furent légèrement supérieures à la moitié seulement de ce qu'elles ont été en 1975. Malgré le recrutement au stock d'adultes de la classe d'âge modérément abondante de 1973, le stock de géniteurs estimé d'après les données de captures en 1976 ne fut pas supérieur à 155 000 tonnes. D'après les résultats des campagnes d'inventaires de larves il semblerait que la production larvaire fut très faible en 1976 et l'on en déduirait un stock de géniteurs de seulement 85 000 tonnes.

8.2. Toutes les indications montrent que les classes d'âge de 1974 et 1975 qui seront recrutées au stock de géniteurs de Mer du Nord en 1977 et 1978 sont très faibles. Les captures de ces classes d'âge, en 1976, dans les pêcheries s'effectuent dans le cadre de la Recommandation n° 2, se sont situées à un niveau très bas d'environ 8 000 tonnes. Ceci reflète non seulement leur faible abondance mais également les effets de la Recommandation 8c qui a interdit les pêches dirigées sur le hareng à des fins de transformation en huile et farine. Il est donc possible d'obtenir, à partir des résultats de 1976 une première estimation des taux de mortalité due à la pêche (F) qui seront engendrés sur le hareng juvénile par les pêcheries sous Recommandation conduites pour d'autres espèces: ces estimations sont de 0.2 pour les harengs des deux groupes d'âge 0 et 1.

8.3. Il est clairement établi que le stock est maintenant dans une situation encore plus mauvaise que celle prédite dans le dernier rapport et se détériorera encore dans un futur immédiat à moins d'une action énergique ne soit entreprise. Les faibles valeurs de F sur les juvéniles, consécutives à l'absence d'une exploitation dirigée sur les immatures, comme citées ci-dessus, signifient, si elles sont exactes, que le rétablissement (du stock) sera plus rapide qu'il n'avait été espéré auparavant, dans la mesure où elles sont associées à un stock de géniteurs suffisant.

Pour ces raisons, le Groupe de Travail doit réitérer son conseil stipulant que la seule action qui réduira, dans des conditions acceptables, les risques d'un effondrement des pêcheries de hareng en Mer du Nord, consiste en une interdiction complète et immédiate de toutes pêches dirigées. Si cela est réalisé et si l'interdiction est maintenue pour le restant de 1977 ainsi qu'en 1978 et 1979, on estime que, étant donné le niveau attendu du recrutement, le stock de géniteurs n'aura atteint la moitié du minimum souhaité qu'en 1979.

Par la suite, avec une gestion adaptée, le rétablissement serait rapide. La situation sera encore contrôlée au début des années 1978 et 1979. Mais, en raison du niveau très bas auquel on a laissé tomber le stock, il doit être souligné que l'interdiction de pêche doit être maintenue, au moins pour le reliquat de 1977 et toute l'année 1978.

Les effets de prises maximales autorisées (P.M.A.) de 75 000 et 150 000 tonnes en 1977 et 1978 furent également prognostiqués uniquement pour démontrer que, même des captures aussi faibles, pourraient avoir de très sérieuses répercussions. Dans le premier cas, il n'en résulterait aucune augmentation appréciable de la taille du stock d'ici 1979 malgré les faibles taux de mortalité due à la pêche estimés pour les juvéniles. Dans le second cas, on assisterait à un effondrement total du stock pour 1978.

8.4. En Mer Celtique, la capture correspondant à la saison 1976/77 fut la plus basse enregistrée en ce secteur depuis 1956. Environ 65% seulement de la faible P.M.A. autorisée pour cette saison ont été atteints. Cette prise globale réduite n'a cependant pas résulté d'une réduction de l'effort de

pêche effectif. Le taux de mortalité due à la pêche est resté pour ce stock à un niveau plus ou moins constant depuis la saison 1972/73.

8.5. L'estimation du stock d'adultes est inférieure à 10 000 tonnes au 1er avril 1976, valeur que l'on peut comparer au niveau sensiblement constant des 80 - 90 milles tonnes qu'il atteignait à la fin des années 1960. Ceci est le résultat d'un déclin continu depuis 1972 qui peut être imputé à :
(a) Les taux élevés de mortalité due à la pêche depuis la saison 1971/72 et (b) de faibles recrutements au cours des deux dernières années. Il apparaît également que le taux de mortalité due à la pêche sur les poissons du groupe 1 qui n'étaient auparavant que légèrement exploités, s'est accru depuis 1976, comme étant une fraction du taux de mortalité due à la pêche des groupes d'âge pleinement recrutés. Ceci peut être dû à une augmentation du taux de croissance ainsi qu'à une diminution correspondante de l'âge moyen à la première maturité sexuelle mais pourrait avoir de sérieuses répercussions sur le stock si le taux d'exploitation global n'était pas sévèrement réduit.

8.6. La dimension du stock au 1er avril 1977 est estimée approximativement à 8 300 tonnes. Dans ces conditions, la P.M.A. de 6 500 tonnes suggérée provisoirement par le Comité de Liaison pour la saison 1977/78 est beaucoup trop élevée. Cela demanderait, en effet, un taux de mortalité due à la pêche sur les groupes d'âges pleinement recrutés, proche du niveau moyen des années récentes et il en résulterait un stock de 11 000 tonnes seulement au 1er avril 78, même dans une hypothèse assez optimiste quant au recrutement. En conséquence, il semblerait indispensable d'interdire toute pêche sur ce stock pendant la saison de 1977/78. Même dans ces conditions, le stock au 1er avril 1978 sera inférieur à ce qui est considéré comme nécessaire pour garantir la perpétuation du stock et, bien que la proposition soit revue au début de 1978, l'interdiction de pêche durant la saison de 1978/79 doit être également envisagée.

8.7. Au cours des dernières années on a assisté à une augmentation prononcée des captures de hareng en provenance de la Division VIIf (Canal de Bristol) où en 1975 les prises enregistrées s'élevaient à 3 400 tonnes. Peu d'informations sont disponibles quant aux caractéristiques biologiques de la population de hareng de ce secteur mais il est vraisemblable qu'une fraction soit originaire de la Mer Celtique. Conjointement à l'interdiction de la pêche du hareng dans cette région, il semblerait en conséquence opportun de restreindre le développement de ces pêcheries dans la Division VIIf par une P.M.A. de 1 000 tonnes jusqu'à ce que davantage informations soient disponibles sur la structure de la population et l'état de l'exploitation dans ce secteur.

8.8. La capture totale internationale dans la Division VIa en 1975 s'élève à 141 000 tonnes et est supérieure de 13 000 tonnes à la valeur provisoire donnée pour cette année dans le rapport précédent. L'estimation préliminaire de 107 000 tonnes pour 1976 est très inférieure à la P.M.A. agréée par la NEAFC ainsi qu'aux captures réalisées lors de n'importe quelle année depuis 1969. La prise totale dans les pêcheries du large s'étant maintenue à un niveau semblable à celui de 1975, la diminution principale provient en fait des pêcheries côtières du Royaume Uni.

8.9. Il est maintenant évident que le stock au 1er janvier 1976 a été considérablement surestimé dans le rapport précédent consécutivement à une trop faible évaluation du taux de mortalité due à la pêche en 1975. Les nouvelles estimations suggèrent que ceux-ci ont été, depuis 1971, supérieurs au taux correspondant à la production maximale soutenue (M.S.Y.) par recrue et ont même encore augmenté au cours des 3 dernières années. La biomasse du stock d'adultes a atteint un niveau maximum de plus de 670 000 tonnes en 1972 et on estime qu'il est tombé à moins de la moitié de celui-ci au 1er janvier 1975.

En 1976, un léger accroissement s'est sans doute produit grâce au recrutement de la classe d'âge moyenne de 1973 mais la plus grande partie du gain potentiel qui en aurait découlé a été contrecarré par la forte exploitation dont le stock d'adultes fut l'objet en 1975.

8.10. L'estimation préliminaire de la classe d'âges de 1974 qui sera recrutée au stock d'adultes en 1977, suggère que celle-ci serait légèrement supérieure à la moyenne mais les limites de confiance de ce calcul sont espacées. La biomasse du stock au 1er janvier en 1977 est évaluée à 206 000 tonnes. Avec un stock de cette importance, la P.M.A. de 83 000 tonnes, supposée correspondre, dans le rapport précédent, à une mortalité due à la pêche de 0.3 demanderait en fait un "F" de 0.6. La P.M.A. de 1977 calculée avec un F de 0.3 est maintenant de 48 000 tonnes.

8.11. La P.M.A. pour 1978 dépendra de celle agréée pour 1977 et de la capture effectuée cette même année. Si la P.M.A. originalement suggérée (83 000 tonnes) est maintenue, celle pour 1978 sera de 44 000 tonnes. Si la valeur de 48 000 tonnes, appropriée à la nouvelle évaluation du stock, est acceptée, la P.M.A. en 1978 sera de 53 000 tonnes. Ces deux calculs pour 1978 sont, pour une très grande part, fonction de l'estimation de l'intensité de la classe d'âge de 1974, mais dont l'exactitude est sujette à caution. Le Groupe de Travail préconiserait des P.M.A. de 48 000 tonnes en 1977 et ·. 53 000 tonnes en 1978 dont le résultat sera une biomasse du stock de géniteurs plus importante pour chaque année et une marge accrue contre toute surestimation du recrutement.

8.12. Les captures de harengs dans les divisions VIIb - c ont rapidement augmenté à la suite du développement d'une pêcherie irlandaise sur le hareng hivernant dans la baie de Galway et de l'exploitation conduite par des chalutiers néerlandais dans ce secteur en été et en automne. La capture enregistrée en 1976 dépasserait 19 000 tonnes. Les informations disponibles bien qu'incomplètes donneraient à penser que les populations exploitées en VIIb - c et en VIa ne peuvent pas être distinguées les unes des autres et qu'il conviendrait de les traiter comme une seule unité de gestion. Les captures effectuées en VIIb - c seraient en conséquence limitées dans l'immédiat à 10 000 tonnes et une évaluation plus complète sera exécutée à la première occasion.

8.13. En Mer d'Irlande (Division VIIa), les valeurs provisoires de captures réalisées sur les stocks de l'Ile de Man et des Mourne indiquent que celles ci ont diminué respectivement de 3 000 et de 260 tonnes par rapport à 1975. L'effort de pêche développé sur le stock de l'Ile de Man a décrue d'environ 12% entre 1975 et 1976. La capture de 1976 était encore nettement supérieure à ce qui était souhaité dans le rapport précédent puisqu'elle aurait dû être limitée. Cependant, le recrutement en 1976 pour ce stock était au-dessus de la moyenne et a compensé dans une large mesure le F important. Sur la base de ce plus fort recrutement, la P.M.A. de 10 000 tonnes pour 1977 conseillé dans le précédent rapport pourrait être portée à 12 000 tonnes sous réserve que, à l'instar des dernières années, elle soit combiné avec un arrêt momentané de la pêche à l'intérieur des 12 milles de la côte de l'Ile de Man du 1er octobre au 20 novembre 1977. Si cela est agréé, la P.M.A. serait de 12 500 tonnes en 1978 avec le maintien de l'interdiction de pêche à l'intérieur des 12 milles pendant la même période.

8.14. Le recrutement du stock des Mourne a baissé régulièrement au cours des dernières années conjointement à une diminution de la taille du stock de géniteurs. Le haut niveau de l'exploitation actuelle associé à un faible recrutement ont entraîné une réduction du stock de 22 700 tonnes au 1er janvier 71 à 6 500 tonnes au 1er janvier 1977. Si la mortalité due à la pêche devait

se maintenir au même niveau en 1977 que lors des années récentes, on pourrait prévoir une diminution du stock au moins de 6 000 tonnes dont 2 500 tonnes seulement seraient composées de groupes d'âges dont on connaît l'abondance avec quelque certitude.

Sur ces bases, il est recommandé de cesser toute pêche sur ce stock à partir du 30 juin 1977. Ceci pourrait être obtenu par une interdiction d'accès, pour la pêche du hareng, des eaux situées à l'intérieur des 12 milles des côtes orientales de l'Irlande du Nord et de la République d'Irlande entre 53°20'N et 54°40'N. En fonction des hypothèses concernant le recrutement, telles qu'elles ont été discutées dans le paragraphe 5.6.1. cela aboutirait à la reconstruction d'un stock de 10 500 tonnes au 1er janvier 1978. La position sera révisée au début de 1978 afin de voir si ce rétablissement est obtenu et à la lumière des résultats, les exigences pour une gestion future seront recommandées.

8.15. Une pêcherie à fins industrielles de harengs juvéniles qui recrutent principalement dans le stock des Mourne, s'est poursuivie en 1976 malgré une recommandation du précédent rapport fixant une taille minimale de 20 cm et en dépit de la Recommandation 8c de la NEAFC interdisant les débarquements de hareng pour les industries d'huile et de farine à partir du 1er octobre 1975. Il est impératif, si l'on souhaite gérer convenablement le stock des Mourne, tout spécialement, que ces Recommandations soient appliquées avec rigueur.

8.16. La capture globale internationale de sprat en Mer du Nord pour 1976 était avec 617 000 tonnes légèrement inférieure à celle de 1975 et de même sensiblement moindre que la P.M.A. agréée par la NEAFC. Le taux d'exploitation consécutif à cette capture a été proche de celui recommandé dans le rapport précédent du Groupe de Travail. Bien que les classes d'âge de 1974 et 1975 apparaissent comme n'étant pas aussi abondantes que celle de 1973 qui a contribué pour la plus grande part à l'exploitation depuis la saison 1973/74, elles sont d'une intensité supérieure à la moyenne et cet important recrutement a permis aux captures des dernières années d'atteindre ces niveaux sans entraîner l'épuisement du stock.

8.17. En fonction des nouvelles données disponibles, on a évalué <u>la P.M.A. pour 1977</u> <u>à 487 000 tonnes</u> qui est quelque peu supérieure aux 400 000 tonnes calculées dans le précédent rapport pour cette année. La P.M.A. de 1978 dépendra des captures réalisées en 1977 ; elle a été calculée en fonction de 2 hypothèses : (a) <u>Si la P.M.A. de 1977 est fixée à 487 000 tonnes, celle de 1978 sera de</u> <u>410 000 tonnes</u>; (b) <u>Si la P.M.A. de 1977 est fixée au niveau de la capture de</u> <u>1976 (620 000 tonnes) celle de 1978 sera de 374 000 tonnes</u>.

8.18. La capture totale de sprat dans la division IIIa et les fjords norvégiens en 1976 avec 61 800 tonnes fut la plus faible enregistrée pour ce stock depuis 1972. Cette chute entre 1975 et 1976 est presque exclusivement consécutive à la diminution brusque des captures dans le Kattegat qui passèrent de 81 600 tonnes en 1975 à 40 500 tonnes en 1976. Il n'existe aucune information permettant d'estimer si, dans ce secteur, cette réduction importante fut consécutive à un déclin de l'abondance ou de l'effort de pêche.

8.19. Les données biologiques disponibles sur la population du sprat dans cette région n'autorisent pas encore une évaluation de la P.M.A. par aucune des méthodes conventionnelles. Cependant, la chute des captures entre 1975 et 1976 est une source de préoccupation et donnerait à penser que la valeur de précaution de 100 000 tonnes pour 1977 suggérée dans le précédent rapport, serait trop élevée. Le Groupe de Travail recommanderait en conséquence qu'en 1977 et 1978 une P.M.A. pour la population de sprat dans la division IIIa et les fjords de la côte occidentale de Norvège soit fixée à 80 000 tonnes.

8.20. Le Groupe de Travail est conscient que, si les Recommandations d'interdiction
de pêche ou des réductions importantes de captures sont mises en oeuvre sur
les stocks sévèrement diminués, les méthodes conventionnelles de contrôle
du rétablissement de ces stocks deviendront inutilisables ou d'une exactitude
très douteuse. En ces circonstances, le Groupe de Travail considère qu'il
est essentiel de faire ressortir combien leurs évaluations deviendront
dépendantes des résultats de campagnes d'inventaires de larves de harengs pour
contrôler les changements dans le stock d'adultes et d'inventaires de jeunes
harengs (YHS) pour suivre ceux dans le recrutement. En conséquence, dans
le paragraphe 7 quelques Recommandations ont été faites concernant les
exigences de la recherche future.

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Table 2.1. Herring. Catch in tons 1967-1976.
North Sea (Sub-Area IV and Divisions VIId and e) by country.
Skagerrak (Division IIIa) total catch.

Country\Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*)
Belgium	410	134	468	1 200	681	1 337	2 160 a)	603	2 451	1 376
Denmark	135 000	163 100	180 260	133 331	185 393	213 738	174 254 a)	61 728	115 616	30 172
Faroe Islands	35 993	49 995	40 640	58 365	45 524	48 444	54 935 b)	26 161 b)	25 854	17 515
Finland	-	-	-	-	-	-	-	-	-	1 034
France	11 478	12 852	15 307	11 482	11 408	12 901	22 235	12 548	20 391	11 832
German Dem.Rep.	-	-	-	290	475	127	1 728	3 268	2 689	2 624
Germany, Fed.Rep.	32 312	21 216	12 798	7 150	3 570	3 065	10 634 c)	12 470	6 953	1 682
Iceland	5 684	44 489	19 997	22 951	37 171	31 998	23 742 d)	29 017	16 286	9 324
Netherlands	37 270	22 306	29 769	46 218	32 479	24 829	34 070	35 106	38 416	19 647
Norway	240 032	211 904	114 938	193 102	125 842	117 501	99 739	40 975	34 183	27 386
Poland	37 816	11 954	9 221	5 057	2 031	2 235	5 738	9 850	7 069	7 072
Sweden	121 591	88 061	33 109	34 670	36 880	7 366	4 222 e)	3 561	6 858	5 372
UK (England) f)	8 215	5 128	6 666	9 702	4 113	394	2 268	5 699	6 475	9 662
UK (Scotland)	18 138	16 477	22 053	21 885	25 073	17 227	16 012	15 034	8 904	15 015
USSR	11 660	70 029	61 549	18 078	9 500	16 386	30 735	18 096	20 653	9 520
Total North Sea	695 599	717 645	546 775	563 481	520 140	497 548	484 012	275 116	312 798	169 233
Skagerrak	279 744	280 036	113 279	71 071	61 570	67 021	84 566	55 512	51 911	14 010
Grand Total	975 343	997 681	660 054	634 552	581 710	564 569	568 578	330 628	364 709	183 243

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 Skagerrak border and allocated to that area on the basis of age analysis.

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

f) Catches from Moray Firth not included.

*) Preliminary.

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

Year	Denmark	Faroe Islands	Germany, Fed.Rep.	Iceland	Netherlands	Norway	Poland	Sweden	USSR	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	29 997	8 053	108	1 209	-	196	-	12 348	-	51 911
1976[*]	7 363	2 376	6	123	-	-	-	4 142	-	14 010

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	UK Scotland	Sweden	USSR	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	-	8 036	-	-	-	-	1 539	24	53	-	-	-	-	9 652
1976[*]	-	1 288	-	11	113	-	-	-	-	5	-	1 034	-	2 451

[*] Preliminary

[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	UK England	UK 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	14 031	16 124	-	1 266	1 151	1 566	7 868	2 222	26 355	6 310	-	6 674	-	12 194	95 761
1976*	19 134	15 355	1 034	3 985	1 614	1 275	9 091	7 421	23 768	6 199	-	11 823	4 138	3 346	108 183

a) See Table 2.1. 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	UK England	UK 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	4 374	9 730	4 963	1 538	2 480	6 879	28 963	7 743	759	6 403	2 230	6 858	8 190	91 110
1976*)	2 068	807	1 962	896	367	233	9 362	3 618	606	9 361	3 192	200	5 868	38 540

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

*) Preliminary.

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	88 191	2 557	-	90 748	181 858
1976*	7 682	40	-	7 722	46 262

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	Faroe Islands	France	Germany, Fed.Rep.	Netherlands	Norway	Poland	UK 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	2 451	984	-	14 162	350	7 207	32	-	72	269	25 527
1976*	1 376	-	1 353	5 874	-	2 864	-	262	301	306	12 337 a)

a) Included 1 ton caught by German, Dem.Rep.

*) Preliminary.

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

Year	Area	Age in winter rings 0	1	2	3	4	5	6	7	8	>8	Total
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	–	267.0	120.0	69.0	49.0	40.2	9.8	6.3	2.9	1.1	565.3
	IVaE of 2°E	–	82.5	8.2	7.0	2.4	0.4	0.1	0.1	–	–	100.7
	IVb (adult)	–	268.8	147.1	124.2	81.2	14.8	5.8	2.7	0.5	0.3	645.4
	IVbYH	262.8	1 818.1	139.2	19.8	2.6	–	0.4				2 242.9
	IVc+VIId	1.0	24.1	127.2	39.6	5.3	1.8					199.0
	Total NS	263.8	2 460.5	541.7	259.6	140.5	57.2	16.1	9.1	3.4	1.4	3 753.3
1976	IVaW of 2°E	–	19.8	583.6	58.1	18.5	13.8	3.7	2.7	0.5	0.3	701.0
	IVaE of 2°E	–		11.4	1.2	0.5	0.5	0.4	0.1		–	14.1
	IVb (adult)	0.8	32.0	194.4	16.3	25.6	18.2	1.8	0.3		–	289.4
	IVbYH	237.4	49.6	17.7	0.5	1.8	–	–	–	–	–	307.0
	IVc+VIId	–	15.0	65.0	28.5	2.4	–	0.6	–	–	–	111.5
	Total NS	238.2	116.4	872.1	104.6	48.8	32.5	6.5	3.1	0.5	0.3	1 423.0

Table 2.9. Skagerrak 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
1976	53.7	44.1	57.5	4.6	1.1	0.5	0.1	0.1	–	–	161.8

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
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
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
1974	996.1	846.1	772.6	362.0	126.0	56.1	22.3	5.0	2.0	1.1	3 189.3
1975	263.8	2 460.5	541.7	259.6	140.5	57.2	16.1	9.1	3.4	1.4	3 753.3
1976	238.2	116.4	872.1	104.6	48.8	32.5	6.5	3.1	0.5	0.3	1 423.0

Table 2.11 Total North Sea. Calculated fishing mortality.

Winter rings \ Year	1967	1968	1969	1970	1971	1972	1973	1974	1975[1]	1976[x]
0	0.09	0.12	0.03	0.11	0.11	0.17	0.15	0.19	0.31	0.2
1	0.50	0.52	0.56	0.47	0.97	0.92	1.04	0.70	0.88	0.2
2	0.48	1.47	0.88	1.09	1.00	0.91	1.11	1.07	1.28	0.8
3	0.84	1.92	0.94	1.30	1.26	0.83	1.37	0.94	1.26	0.8
4	0.91	1.07	0.87	1.31	1.04	0.80	0.99	0.97	1.11	0.8
5	0.81	1.16	1.05	0.86	0.98	0.53	0.96	1.20	1.69	0.8
6	0.98	1.10	1.47	1.08	2.37	0.48	1.23	1.10	1.32	0.8
7	1.30	1.43	1.07	0.88	2.63	0.07	0.69	0.58	2.30	0.8
8	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.8
$\overline{F}_W \geq 2$	0.71	1.51	0.91	1.15	1.12	0.88	1.17	1.03	1.27	0.8

[1] inaccurate estimates.

[x] Assumed values.

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

Winter rings / Years	1967	1968	1969	1970	1971	1972	1973	1974	1975[*]
0	7.58	7.62	3.82	9.06	7.11	5.01	2.24	5.90	1.04
1	4.43	6.25	6.10	3.35	7.35	5.79	3.82	1.75	4.39
2	3.23	2.42	3.36	3.15	1.90	2.52	2.08	1.22	0.78
3	2.51	1.81	0.51	1.26	0.96	0.63	0.92	0.62	0.38
4	0.65	0.99	0.24	0.18	0.31	0.25	0.25	0.21	0.22
5	0.56	0.24	0.31	0.09	0.04	0.08	0.10	0.08	0.07
6	0.66	0.23	0.07	0.10	0.04	0.01	0.05	0.04	0.02
7	0.10	0.22	0.07	0.01	0.03	+	+	0.01	0.01
8	0.14	0.02	0.05	0.02	0.01	+	+	+	+
$\Sigma 0 + 1$	12.01	13.87	9.92	12.41	14.46	10.80	6.06	7.65	5.43
$\Sigma 2 - 8$	7.85	5.93	4.61	4.81	3.29	3.49	3.40	2.18	1.48
Biomass in t x 10^{-3}	1 191.00	1 045.40	670.00	634.80	591.10	519.30	503.00	320.80	306.30

[*] Inefficient estimates.

Table 2.13   Provisional Estimates of the Abundance of Herring
              Larvae in the North Sea in 1976/77 and Comparable
              Estimates for 1975/76

Area	1975/76 (x 10^{-9})	1976/77 (x 10^{-9})

Northern North Sea	Sept 3-19
	  $<$ 10 mm - 446
	Sept 10-24)
	  $<$ 10 mm - 100)
	                 )
	Sept 20-25)
	  $<$ 10 mm - 68)
		Sept 2-14
		  $<$ 10 mm - 618
		Sept 13-23
		  $<$ 10 mm - 90

Central North Sea		Sept 3-14
		  $<$ 10 mm - 96
		  10-15 mm - 20
		  $>$ 15 mm - 0
		  Total - 116

	Sept 15-23
	  $<$ 10 mm - 91
	  10-15 mm - 84
	  $>$ 15 mm - 10
	  Total - 175
		Sept 16-24
		  $<$ 10 mm - 134
		  10-15 mm - 263
		  $>$ 15 mm - 8
		  Total - 405

	Oct 8-14
	  $<$ 10 mm - 79
	  10-15 mm - 708
	  $>$ 15 mm - 35
	  Total - 822
		Sept 28-Oct 10
		  $<$ 10 mm - 4
		  10-15 mm - 105
		  $>$ 15 mm - 17
		  Total - 126

	Oct 21-29
	  $<$ 10 mm - 8
	  10-15 mm - 206
	  $>$ 15 mm - 62
	  Total - 276
		Oct 18-23
		  $<$ 10 mm - 13
		  10-15 mm - 10
		  $>$ 15 mm - 16
		  Total - 39

Southern North Sea
& Eastern Channel
	Jan 7-29
	  $<$ 11 mm - 3
	  11-16 mm - 3
	  $>$ 16 mm - 1
	  Total - 7
		Jan 3-7
		  $<$ 11 mm - 3
		  11-16 mm - 5
		  $>$ 16 mm - 1
		  Total - 9

Table 3.1. Annual Celtic Sea herring catches 1965-1976.

Year	France	German Dem.Rep.	Germany, Fed.Rep.	Ireland	Netherlands	Poland	UK	USSR	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	400	-	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	5 553	7	294	13 105	5 834	1 125	-	334	26 375[a]
1974	2 261	-	433	13 991	2 105	954	-	-	19 744
1975	1 924	-	361	8 430	2 825	512	24	1 054	15 130
1976[*]	2 157	147	28	3 705	1 627	324	-	826	8 814

Table 3.2. Celtic Sea herring catches by season (1 April to 31 March).

Season	France	German Dem.Rep.	Germany, Fed.Rep.	Ireland	Netherlands	Poland	UK	USSR	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	4 143	7	294	11 317	5 834	1 139	-	334	23 191[a]
1974/5	2 150	-	435	11 683	2 462	954	-	-	17 684
1975/6	2 451	-	399	6 524	2 441	579	24	1 054	13 472
1976/7[*]	1 578	147	36	2 970	1 264	257	-	826	7 078

[*] Provisional
[a] Including 123 tons for Bulgaria.

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

Season	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	8 742	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	11 452	13 077	15 709	6 898	6 042	3 252	1 268	964	1 022	59 685
1976-77	7 262	9 090	5 202	5 196	2 092	2 669	1 384	1 005	777	34 701

Table 3.4. Mean weights Celtic Sea herring 1976/77.

Age in rings	April-August[1]	September-January[2]	Weighted mean[3]
0	-	37	37
1	118	139	132
2	162	195	183
3	193	229	216
4	210	259	242
5	220	270	253
6	228	288	267
7	232	295	273
8	235	299	277
8+	238	317	289

1) Based on French, Polish and Dutch data.
2) Based on Irish data.
3) Figures for April-August weighted by 35%, and for September-January by 65%, according to catches taken in both periods.

Table 3.5. Comparison of values of F from VPA and from Irish cpue data (Two-year means).

Season	VPA	Cpue
1964-1966	0.37	0.43
1965-1967	0.36	0.41
1966-1968	0.45	0.32
1967-1969	0.45	0.37
1968-1970	0.50	0.41
1969-1971	0.58	0.42
1970-1972	0.69	0.58
1971-1973	0.74	0.72
1972-1974	0.71	0.74
1973-1975	0.78	0.63
1974-1976	0.81	0.82
1975-1977	?	0.88

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

W. Rings \ Season	1965/6	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6[*]	1976/7[*]
1	0.00	0.03	0.03	0.05	0.06	0.01	0.04	0.10	0.26	0.16	0.49	0.12
2	0.30	0.23	0.24	0.34	0.52	0.35	0.44	0.87	0.75	0.85	0.82	0.81
3	0.21	0.38	0.34	0.39	0.61	0.50	0.68	0.62	0.82	0.82	0.92	0.81
4	0.35	0.31	0.53	0.29	0.58	0.59	0.91	0.57	0.44	0.95	0.98	0.81
5	0.22	0.49	0.45	0.45	0.51	0.67	0.99	0.81	0.71	0.45	0.76	0.81
6	0.21	0.57	0.68	0.38	0.67	0.57	0.82	0.58	0.63	0.62	0.78	0.81
7	0.51	0.23	0.88	0.61	0.74	0.43	0.60	0.48	1.03	0.82	0.45	0.81
8	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.81
Weighted F (adults)	0.30	0.36	0.39	0.37	0.57	0.51	0.72	0.79	0.75	0.82	0.84	0.81

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

W. Rings \ Season	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975[*]	1976[*]
1	109.8	202.0	220.5	276.4	133.3	73.4	257.4	82.3	100.6	31.8	30.9	67.4
2	290.0	99.3	176.7	192.9	239.0	113.2	65.8	223.1	67.5	70.0	24.5	17.1
3	52.9	195.1	71.7	125.6	124.3	129.2	72.5	38.2	84.5	28.9	27.2	9.8
4	56.0	38.9	121.0	46.4	77.2	60.9	70.7	33.1	18.6	33.8	11.5	9.8
5	18.5	35.6	25.9	64.2	31.4	39.3	30.6	25.8	16.9	10.9	11.9	3.9
6	25.3	13.5	19.7	15.0	37.0	17.1	18.3	10.3	10.4	7.5	6.3	5.0
7	32.2	18.6	6.9	9.0	9.2	17.1	8.8	7.3	5.2	5.0	3.6	2.6
8	2.9	17.6	13.4	2.6	4.4	4.0	10.1	4.4	4.1	1.7	2.0	2.1
Adult stock in numbers	477.8	418.6	435.3	455.7	522.5	363.7	276.8	342.2	207.2	157.8	87.0	50.3
Adult stock in weight	79 571	81 271	82 813	85 478	97 432	73 515	54 819	61 218	27 570	29 683	16 993	9 814

*) Inefficient estimates.

Table 3.8. Catch prognoses and estimated stock sizes. Celtic Sea.

Age (rings)	Mean weights		Catch 1976/77	Stock 1 Apr.1977	Catches		Stock at 1 Apr. 1978	
	Apr.-Jun.	All season			A	B	A	B
1	118	132	7 262	61 000	549	4 453	61 000	61 000
2	162	183	9 090	54 102	2 489	21 589	51 935	50 764
3	193	216	5 202	6 881	317	2 746	46 047	28 497
4	210	242	5 196	3 938	181	1 571	5 865	3 625
5	220	253	2 092	3 933	181	1 969	3 349	2 074
6	228	267	2 669	1 584	73	632	3 349	2 071
7	232	273	1 384	2 020	93	806	1 351	834
8	235	277	1 005	1 048	48	418	1 721	1 064
>8	238	289	777	1 349	62	538	2 035	1 262
Weight 2→>8				13 182			21 665	16 157
Catch 1→>8			7 126		842	6 569		
F. adult			0.81		0.05	0.54		
F. juvenile			0.12		0.001	0.08		
1	118	132	7 262	61 000	549	12 871	61 000	61 000
2	162	183	9 090	24 255	1 116	12 249	51 935	42 989
3	193	216	5 202	6 881	316	3 475	20 646	10 363
4	210	242	5 196	3 938	181	1 989	5 846	2 940
5	220	253	2 092	3 933	181	1 986	3 349	1 683
6	228	267	2 669	1 584	73	800	3 349	1 680
7	232	273	1 384	2 020	93	1 020	1 351	677
8	235	277	1 005	1 048	48	529	1 721	863
>8	238	289	777	1 349	62	681	2 035	1 024
Weight 2→>8				8 347			16 328	10 939
Catch 1→>8			7 126		510	6 510		
F. adult			0.81		0.05	0.75		
F. juvenile			0.25		0.001	0.25		

Table 4.1. Total catches of herring (metric tons) in Division VIa, 1967-1976.

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976[*]
Belgium	-	-	-	-	-	-	-	-	-	11
Denmark	-	-	-	-	554	150	932	-	374	249
Faroe Islands[a]	-	-	-	15 100	8 100	8 094	10 003	5 371	3 895	1 316
France	379	1 124	966	1 293	2 055	680	2 441	547	1 293	1 643
German Dem.Rep.	177	3	416	207	330	935	2 507	2 037	1 994	929
Germany, Fed.Rep. of	17 318	14 874	15 805	16 548	7 700	4 108	17 443	14 354	9 099	4 860
Iceland	-	-	-	5 595	5 416	2 066	2 532	9 566	2 633	3 273
Ireland[b]	12 290	13 390	11 895	11 716	12 161	17 308	14 668	12 557	10 417	8 558
Netherlands	4 576	2 957	1 514	1 102	9 252	23 370	32 715	19 635	19 360	21 039
Norway	-	-	-	20 199	76 720	17 400	36 302	26 218	512	5 307
Poland	727	2 791	3 188	3 709	-	-	5 685	6 368	2 934	3 085
UK (England)	-	7	3	1	-	-	-	45	125	20
UK (Scotland)	67 404	65 180	90 222	103 530	99 537	107 638	120 800	107 475	85 395	53 351
USSR	-	-	-	3	-	?	2 052	5 388	3 232	2 987
Total	102 871	100 326	124 009	179 003	221 271	174 873	247 148	209 561	141 263	106 504
Scottish juvenile herring and sprat fisheries in Moray Firth	6 507	4 985	3 100	1 385	5 666	10 242	7 219	13 003	2 454	313

[*] Preliminary figures.

[a] Figures supplied by Fiskirannsóknarstovan.

[b] Catches mainly taken in Division VIIb and landed in VIa.

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
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	22	106 038	256 555	107 971	84 977	228 583	38 929	15 573	20 304	29 689[1]	–	–
1976	795	59 191	362 986	122 970	44 035	36 958	87 742	14 457	5 817	13 327		

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
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	–
1976	7 651	12 712	467	–	–

Table 4.4. Herring autumn spawners. Catch in number x 10^{-3}, Division VIa, Moray Firth included.

Year / Age (rings)	0	1	2	3	4	5	6	7	8	9	10	>10
1967	186 598	207 947	28 648	273 723	49 755	48 320	36 143	15 226	10 397	15 068	10 962	7 937
1968	71 425	220 870	105 348	26 031	243 304	19 679	28 436	17 699	7 275	4 493	5 326	4 570
1969	192 368	39 160	107 189	84 565	27 604	264 558	25 795	45 908	27 932	11 003	5 197	13 058
1970	16 299	238 431	108 872	272 693	124 498	42 623	185 380	24 821	29 920	14 276	5 156	6 903
1971	209 598	169 780	286 148	346 206	261 891	94 206	25 876	166 165	16 425	16 286	8 038	5 578
1972	249 941	321 539	753 355	210 243	72 885	83 361	37 428	13 445	94 577	8 154	5 855	5 377
1973	267 872	50 737	273 783	990 183	155 828	66 476	68 522	26 512	8 037	53 767[1)	–	–
1974	536 119	312 029	153 833	205 806	553 627	90 584	45 144	43 069	18 504	45 393[1)	–	–
1975	82 698	185 723	257 116	108 284	84 977	228 583	38 929	15 573	20 304	29 689[1)	–	–
1976	8 446	71 903	363 453	122 970	44 035	36 958	87 742	14 457	5 817	13 327[1)	–	–

1) Age 9 and older.

Table 4.5. 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[*)	1976[*)
0	0.07	0.18	0.11	0.07	0.13	0.00	0.16	0.39	0.24	0.34	0.12	0.01
1	0.11	0.45	0.25	0.17	0.04	0.21	0.05	0.35	0.11	0.43	0.17	0.13
2	0.01	0.25	0.09	0.17	0.10	0.15	0.37	0.28	0.49	0.52	0.67	0.50
3	0.18	0.20	0.18	0.10	0.18	0.37	0.83	0.44	0.63	0.75	0.75	0.70
4	0.29	0.25	0.19	0.22	0.44	0.38	0.65	0.36	0.61	0.78	0.72	0.70
5	0.21	0.23	0.24	0.16	0.35	0.28	0.49	0.39	0.58	0.77	0.78	0.70
6	0.13	0.27	0.32	0.19	0.29	0.40	0.25	0.33	0.56	0.89	0.80	0.70
7	0.33	0.33	0.26	0.23	0.48	0.44	0.66	0.18	0.37	0.73	0.80	0.70
8	0.40	0.38	0.44	0.17	0.59	0.58	0.51	0.89	0.14	0.42	0.81	0.70
≥9	0.40	0.40	0.40	0.40	0.40	0.40	0.50	0.50	0.60	0.70	0.70	0.70
Mean F_w >3	0.28	0.27	0.29	0.21	0.34	0.39	0.58	0.44	0.53	0.76	0.76	0.70

*) Inefficient estimates.

Table 4.6. Herring in Division VIa (Moray Firth included). Stock in number x 10^{-6} and biomass of adult stock at the beginning of the year.

Age (in rings)	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975[*]	1976[*]
0	702	1 329	1 833	1 122	1 675	4 164	1 491	806	1 315	1 958	771	892
1	2 998	590	1 002	1 482	947	1 333	3 752	1 150	493	935	1 263	619
2	312	2 428	340	709	1 131	820	980	3 234	736	398	551	967
3	448	279	1 706	280	541	921	638	615	2 211	407	214	255
4	285	337	207	1 283	229	410	575	251	358	1 064	174	91
5	136	193	238	140	931	181	252	273	158	176	440	77
6	60	100	139	170	108	591	123	139	168	80	74	182
7	106	47	69	91	126	73	359	87	91	87	30	30
8	68	69	31	48	66	71	43	168	66	57	38	12
≥9	29	41	42	18	37	33	36	23	63	52	34	28
Total ≥2	1 444	3 494	2 772	2 739	3 169	3 100	3 006	4 790	3 851	2 321	1 555	1 642
Biomass ≥2 in 1 000+	241	488	451	450	508	511	488	674	614	391	250	241

Table 4.7. Herring catches in Area VIIb-c.

Country	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
France	-	-	-	-	-	+	-	713	-	733	42	312	-	10	20	1
German Dem.Rep.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	240
Germany, Fed.Rep.	-	-	-	-	-	-	-	-	71	180	52	23	5	+	914	-
Ireland	701	784	66	110	158	120	108	30	145	1 518	1 646	3 154	5 036	4 412	5 576	5 095
Netherlands	-	-	-	-	-	187	-	525	355	179	61	71	200	51	9 815	13 626
Poland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	83
UK (Scotland)	-	8	5	-	-	-	-	-	-	-	-	-	-	25	-	-
USSR	-	-	-	-	-	-	-	-	-	2	-	347	-	1 266	646	118
Total	701	792	71	110	158	307	108	1 268	571	2 612	1 801	3 907	5 241	5 764	16 971	19 163

[*] Inefficient estimates.

Table 5.2.1. Herring. Total catches in North Irish Sea (Division VIIa), 1967-76.

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976[*]
France	-	-	-	558	1 815	1 224	254	3 194	813	507
Ireland	118	68	2 328	3 933	3 131	2 529	3 614	5 894	4 790	3 205
Netherlands	-	-	-	-	-	260	143	1 116	630	989
UK	7 145	8 389	9 821	17 912	21 861	23 337	18 587	27 489	18 244	16 401
USSR	-	-	-	-	-	-	-	945	26	-
Total	7 263	8 457	12 149	22 403	26 807	27 350	22 598	38 638	24 503	21 102

Table 5.2.2. Herring. Total catches by stock in North Irish Sea, 1967-76.

Country	1967		1968		1969		1970		1971		1972	
	1	2	1	2	1	2	1	2	1	2	1	2
France	-	-	-	-	-	-	558	-	1 815	-	1 224	-
Ireland	-	118	-	68	-	2 328	-	3 933	-	3 131	-	2 529
Netherlands	-	-	-	-	-	-	-	-	-	-	260	-
UK	5 885	1 260	7 645	744	9 139	682	15 629	2 283	18 758	3 103	19 308	4 029
USSR	-	-	-	-	-	-	-	-	-	-	-	-
Total Manx	5 885		7 645		9 139		16 187		20 573		20 792	
Total Mourne	1 378		812		3 010		6 216		6 234		6 558	

/Cont'd.

Country	1973		1974		1975		1976[*]	
	1	2	1	2	1	2	1	2
France	254	-	3 194	-	813	-	507	-
Ireland	-	3 614	1 783	4 111	2 406	2 384	1 816	1 389
Netherlands	-	143	1 116	-	630	-	989	-
UK	13 071	5 516	23 639	3 850	15 408	2 836	12 831	3 570
USSR	-	-	945	-	26	-	-	-
Total Manx	13 325		30 677		19 283		16 143	
Total Mourne	9 273		7 961		5 220		4 959	

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

Table 5.2.3. Catch per unit effort and fishing mortality on Manx stock.

Year	Effort (trawler landings)	Cpue tons	F from cohort analysis
1964	164	3.58	0.19
1965	727	5.97	0.50
1966	681	3.92	0.26
1967	851	6.92	0.37
1968	1 395	5.48	0.33
1969	1 151	7.94	0.26
1970	1 455	11.13	0.45
1971	2 699	7.71	0.55
1972	1 958	10.62	0.56
1973	1 362	10.00	0.41
1974	4 083	7.51	0.80
1975	2 770	6.96	0.65
1976	2 449	6.59	

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

Year \ Rings	1	2	3	4	5	6	7	8	8+
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	3.64	41.76	26.05	11.28	13.15	6.46	1.96	1.27	0.00
1973	1.75	18.74	22.74	10.69	5.52	4.07	2.09	1.03	0.37
1974	12.95	95.95	32.55	19.41	9.65	4.09	4.55	1.03	0.00
1975	5.63	38.94	36.61	9.44	6.17	4.11	1.89	0.96	0.38
1976	9.26	47.04	17.23	13.50	3.85	2.39	2.30	0.32	0.74

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
1976	11.4	25.4	8.7	3.4	1.6	0.7	0.4	0.1	0.1	0.1

Table 5.3.2. North Irish Sea industrial fishery.
Numbers of herring caught per yearclass in each year (10^{-6}).

Yearclass	1969	1970	1971	1972	1973	1974	1975	1976
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	0.1
1974	-	-	-	-	-	-	20.3	11.7
1975	-	-	-	-	-	-	-	10.4
Total (10^{-6})	75.0	190.2	143.5	109.3	81.0	80.0	44.0	21.1
Tons	2 210	3 796	2 715	2 251	1 913	2 190	1 573	779
N/Kg	33.9	50.1	52.9	48.6	42.3	36.5	27.9	28.3

Table 5.4.1(a). Manx herring, Division VIIa.
Stock in millions (from cohort analysis) at beginning of year.

Age (rings)	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	32	73	101	131	95	146	131	96	209	114	144	?
2	59	29	66	90	118	86	131	113	83	187	92	132
3	14	34	22	42	58	85	53	67	63	58	78	48
4	2	7	23	15	28	39	51	27	36	35	21	38
5	2	1	4	14	11	19	23	28	14	22	14	11
6	3	1	1	2	8	8	8	12	13	8	11	7
7	1	2	1	0	1	6	5	4	4	8	3	1
8	0	1	1	0	0	1	3	2	2	2	3	2
Stock in millions (ages 2-8)	81	75	118	163	224	244	274	253	215	320	222	239
Stock biomass in tons (ages 2-8)	14 507	14 408	22 043	30 435	42 117	48 017	52 880	49 208	42 275	59 979	43 085	44 875

Fishing mortalities by year and age

Age (rings)	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	0.01	0	0.01	0	0	0.01	0.04	0.04	0.01	0.13	0.04
2	0.46	0.15	0.33	0.33	0.23	0.37	0.57	0.49	0.27	0.77	0.59
3	0.69	0.28	0.26	0.33	0.30	0.42	0.56	0.52	0.48	0.90	0.68
4	0.71	0.36	0.42	0.20	0.27	0.43	0.49	0.56	0.37	0.86	0.60
5	0.29	0.46	0.62	0.40	0.26	0.72	0.58	0.68	0.53	0.60	0.65
6	0.30	0.25	1.34	0.46	0.29	0.47	0.55	0.86	0.41	0.85	0.49
7	0.39	0.11	–	0.68	0.48	0.69	0.52	0.66	0.68	0.97	1.14
8	1.12	0.05	0.16	–	–	–	–	0.80	–	0.75	0.49
Weighted mean (ages 2-8)	0.50	0.26	0.37	0.33	0.26	0.45	0.55	0.56	0.41	0.80	0.65

Table 5.4.1(b). Mourne herring, Division VIIa.
Stock in millions (from cohort analysis) at beginning of year.

Age (rings) \ Year	1969	1970	1971	1972	1973	1974	1975[*]	1976[*]
0	.126	277	181	155	108	112	71	?
1	?	68	97	68	65	50	46	48
2	?	?	39	43	27	21	16	16
3	?	?	19	4	25	11	6	6
4	?	?	4	5	2	8	3	3
5	?	?	2	3	3	1	3	1
6	?	?	4	1	2	1	0	1
7	?	?	1	3	1	1	0	0
8	?	?	1	0	2	0	0	0
Total stock in numbers (0-8)	?	?	348	282	235	205	145	?
Total stock biomass (1-8)	?	?	22 555	17 647	18 189	13 340	9 978	(9 886)

Fishing mortalities by year and age

Age (rings) \ Year	1969	1970	1971	1972	1973	1974	1975	Mean 1971-74
0	0.52	0.95	0.87	0.76	0.67	0.78	0.36	0.77
1	?	0.46	0.72	0.84	1.04	1.01	0.99	0.90
2	?	?	2.28	0.45	0.81	1.15	0.91	1.17
3	?	?	1.20	0.30	1.00	1.23	0.67	0.93
4	?	?	0.29	0.46	0.43	1.06	0.77	0.56
5	?	?	0.23	0.25	0.67	1.33	1.23	0.62
6	?	?	0.17	0.26	0.68	1.05	0.28	0.54
7	?	?	0.26	0.30	0.78	1.05	0.48	0.60
8	?	?	0.39	0.11	0.79	0.96	0.80	0.56
Weighted mean (0-8 rings)	?	?	1.09	0.73	0.85	0.93	0.76	
Weighted mean (1-8 rings)	?	?	1.31	0.70	0.97	1.08	0.95	

[*] Inefficient estimates.

Table 5.4.2 (a)   Projected stocks, and catches, of the Manx
stock in 1977 and 1978 at various levels
of fishing mortality

F in 1977	Catch in 1977 (tons)	Biomass at 1st January 1978 (tons)	Catch in 1978 (tons)	
			F = 0.3	F = 0.4
0.32	10000	42550	10500	13400
0.40	12000	40480	10000	12800
0.49	14000	37780	9330	11900
0.58	16000	36380	9000	11500

Table 5.4.2(b). Mourne stock projection, Division VIIa.

Age (W. rings)	Assuming no reduction in F in 1977 and 1978									Assuming F reduced by half in 1977			Assuming closure of both industrial and adult fisheries from 1 July 1977		
	Catch 1976 $Nox10^{-6}$	F_{1976}	Stock 1.1.76 $Nox10^{-6}$	Stock 1.1.77 $Nox10^{-6}$	F_{1977}	Catch 1977 $Nox10^{-6}$	Stock 1.1.78 $Nox10^{-6}$	F_{1978}	Catch 1978 $Nox10^{-6}$	F_{1977}	Catch 1977 $Nox10^{-6}$	Stock 1.1.78 $Nox10^{-6}$	F_{1977}	Catch 1977 $Nox10^{-6}$	Stock 1.1.78 $Nox10^{-6}$
0	11.37	0.58	27.02	60.00	0.77	30.86	60.00	0.77	30.86	0.38	18.12	60.00	0	0	60.00
1	25.39	0.96	42.90	13.69	0.96	8.10	25.14	0.96	14.88	0.48	4.98	37.14	0.50	5.15	54.29
2	8.70	0.96	14.70	14.86	0.96	8.80	4.74	0.96	2.81	0.48	5.41	7.67	0.20	2.57	7.52
3	3.37	0.96	5.69	5.09	0.96	3.01	5.15	0.96	3.05	0.48	1.85	8.32	0.20	0.88	11.01
4	1.55	0.80	2.94	1.97	0.80	1.04	1.76	0.80	0.93	0.40	0.62	2.85	0.15	0.26	3.77
5	0.66		1.25	1.19		0.63	0.80		0.42		0.37	1.20		0.16	1.53
6	0.38		0.72	0.51		0.27	0.49		0.26		0.16	0.72		0.07	0.93
7	0.13		0.25	0.29		0.15	0.21		0.11		0.09	0.31		0.04	0.40
8	0.14		0.27	0.10		0.05	0.12		0.06		0.03	0.18		0.01	0.23
9	0.07		0.13	0.11		0.06	0.04		0.02		0.03	0.06		0.01	0.08
10				0.05		0.03	0.04		0.02		0.02	0.07		0.01	0.09
11							0.02		0.01			0.03			0.04
Metric tons	4 959		8 677	6 456		3 666	5 866		3 322		2 222	8 302		1 099	10 608

Table 6.1. Sprat catches in the North Sea ('000 metric tons) 1967-76.

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976[a]
IVa West										
Denmark	-	-	-	-	-	-	-	5.3	0.5	0.7
Faroe Islands	-	-	-	-	-	-	-	0.2	12.9	0.5
France	+	-	-	-	-	-	-	-	-	-
Germany, Fed.Rep.of	+	-	-	-	-	-	+	-	-	+
Netherlands	-	+	+	+	+	+	+	+	+	+
Norway	-	-	-	-	0.9	2.2	-	-	1.5	29.9
Poland	+	-	-	-	-	+	+	-	0.3	-
Sweden	-	-	-	-	-	-	1.0	2.2	11.0	+
UK (England)	-	-	-	-	+	-	0.2	-	-	-
UK (Scotland)	19.1	13.0	12.4	3.8	15.0	29.8	49.4	41.2	9.4	12.6
USSR	-	-	-	-	-	-	-	1.0	1.3	1.6
Total	19.1	13.0	12.4	3.8	15.9	32.0	50.6	49.9	36.9	45.3
IVa East (North Sea stock)										
Denmark	-	-	-	-	-	-	-	-	-	0.2
Norway	-	-	-	-	-	-	-	-	-	1.9
UK (Scotland)	-	-	-	-	-	-	-	-	-	+
Total	-	-	-	-	-	-	-	-	-	2.1
IVb West										
Belgium	-	-	-	-	-	-	-	-	-	+
Denmark	...	...	...	8.6	9.9	14.4	47.0	55.4	106.6	103.3
Faroe Islands	-	-	-	-	-	-	-	4.0	30.0	45.3
France	-	1.0	-	-	-	-	-	-	-	-
German Dem.Rep.	+	-	-	-	-	-	-	1.7	4.5	7.1
Netherlands	+	+	2.0	+	+	+	-	-	-	-
Norway	-	-	-	-	-	4.1	3.4	9.5	145.7	69.4
Poland	+	+	-	-	-	+	-	-	9.1	10.5
Sweden	-	-	-	-	-	-	-	-	-	7.9
UK (England)	11.9	2.6	3.3	11.2	25.5	21.8	34.6	25.5	32.5	49.7
UK (Scotland)	7.4	13.4	22.0	9.5	7.2	3.6	2.9	8.6	4.9	18.1
USSR	-	-	-	-	1.2	0.8	17.9	32.9	47.8	52.6
Total	19.3	17.0	27.3	29.3	43.8	44.7	105.8	137.7	381.1	363.9

a) Preliminary.

/Cont'd. .....

Table 6.1 (Continued). Sprat catches in the North Sea ('000 metric tons) 1967-1976.

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976[a]
					IVb East					
Denmark	17.4	18.1	18.5	16.2	19.9	28.8	93.9	104.0	215.2	199.1
German Dem.Rep.	-	-	-	-	-	-	-	-	0.4	-
Germany, Fed.Rep. of	11.5	16.7	6.3	7.6	5.1	1.7	11.0	17.5	0.5	1.5
Norway	-	-	-	-	-	-	-	-	-	4.9
Total	28.9	34.8	24.8	23.8	25.0	30.5	104.9	121.5	216.1	205.5
					IVc					
Belgium	0.4	0.4	0.4	0.6	0.1	0.1	0.2	+	+	-
Denmark	-	-	-	-	-	-	-	0.9	3.9	0.1
France,	-	+	0.1	+	+	-	+	0.3	0.1	-
Germany, Fed.Rep. of	-	-	-	+	-	+	-	-	-	-
Netherlands	0.2	1.0	1.6	1.5	1.0	0.4	+	+	0.2	-
UK (England)	3.2	6.2	4.2	3.9	0.2	+	0.8	3.4	2.9	+
USSR	-	-	-	-	-	-	-	+	+	0.2
Total	3.8	7.6	6.3	6.0	1.3	0.5	1.0	4.6	7.1	0.3
					Total North Sea					
Belgium	0.4	0.4	0.4	0.6	0.1	0.1	0.2	+	+	+
Denmark	17.4	18.1	18.5	24.8	29.8	43.2	140.9	165.6	326.2	303.4
Faroe Islands	-	-	-	-	-	-	-	4.2	42.9	45.8
France	+	1.0	0.1	+	+	-	+	0.3	0.1	-
German Dem.Rep.	+	-	-	-	-	-	-	1.7	4.9	7.1
Germany, Fed.Rep. of	11.5	16.7	6.3	7.6	5.1	1.7	11.0	17.5	0.5	1.5
Netherlands	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	106.1
Poland	+	+	-	-	-	+	+	-	9.4	10.5
Sweden	-	-	-	-	-	-	1.0	2.2	11.0	7.9
UK (England)	15.1	8.8	7.5	15.1	25.7	21.8	35.6	28.9	35.4	49.7
UK (Scotland)	26.5	26.4	34.4	13.3	22.2	33.4	52.3	49.8	14.3	30.7
USSR	-	-	-	-	1.2	0.8	17.9	33.9	49.1	54.4
Total	71.1	72.4	70.8	62.9	86.0	107.7	262.3	313.6	641.2	617.1

a) Preliminary figures as reported.   + = Less than 0.1.   ... = No data available.
   - = Magnitude known to be nil.

Table 6.2. Total North Sea sprat catch 1974-76. Numbers caught per age group x 10^{-6} in each sub-division.

Area	Year	Age group						
		0	1	2	3	4	5	6
IVaW	1974	961.6	2 963.1	693.0	112.0	12.2	–	–
	1975	267.2	2 011.1	1 025.4	363.6	11.1	2.2	–
	1976	938.5	2 777.2	715.0	365.3	26.5	0.3	–
IVaE	1976	6.1	46.1	38.0	24.8	1.3	–	–
IVbW	1974	609.4	6 848.1	6 033.4	1 095.6	220.8	49.5	20.7
	1975	665.4	5 110.0	17 287.0	4 396.0	282.7	17.0	–
	1976	1 004.2	14 903.6	12 280.6	7 586.0	423.0	6.7	1.4
IVbE	1974	3.3	8 486.7	4 727.9	116.5	1.7	3.9	–
	1975	9.8	13 169.0	9 282.0	149.5	6.3	–	–
	1976	911.2	18 631.4	1 193.1	94.9	0.2	–	0.01
IVc	1974	21.7	766.2	620.8	28.6	1.8	3.3	–
	1975	–	1 182.4	499.1	45.8	1.8	–	–
	1976			Negligible				

Table 6.3. Mean weights at age of sprats in North Sea landings, 1976.

Months	Age group					
	0	1	2	3	4	5
IVa West of 2°E						
Jan-Mar	-	2.11	8.45	16.85	19.18	23.20
Jul-Sep	1.95	10.88	16.12	20.52	-	-
Oct-Dec	2.51	7.89	17.31	22.53	-	-
IVb West of 3°E						
Jan-Mar	-	2.33	9.87	16.56	21.06	26.43
Apr-Jun	-	6.80	11.81	16.43	23.00	24.70
Jul-Sep	-	9.26	11.80	16.00	-	-
Oct-Dec	2.32	9.02	16.07	19.62	23.08	-
IVb East of 3°E						
Jan-Mar	-	2.17	9.63	-	-	-
Apr-Jun	-	2.54	7.94	11.75	-	-
Jul-Sep	2.61	6.54	17.06	19.33	-	-
Oct-Dec	2.58	8.17	19.77	24.28	-	-
Weighted mean for all Sub-Areas						
Jan-Mar	-	2.27	9.85	16.56	20.99	26.22
Apr-Jun	-	2.60	11.24	16.36	23.00	24.70
Jul-Sep	2.46	6.55	15.78	19.60	-	-
Oct-Dec	2.48	8.37	17.90	20.95	23.08	-
Overall weighted mean						
	2.48	6.26	11.58	16.71	21.27	26.10

Table 6.4. Total North Sea sprat catch in 1974, 1975 and 1976.
Numbers caught per age group x 10^{-6} in each three-month period.

Year	Months	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	–
	Apr–Jun	–	361.8	2 083.5	148.6	26.1	4.7	–
	Jul–Sep	46.7	4 909.8	1 784.7	36.2	0.9	4.6	–
	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	–
	Apr–Jun	–	446.2	1 163.2	68.9	6.5	–	–
	Jul–Sep	15.0	10 588.1	5 760.0	75.1	3.1	–	–
	Oct–Dec	675.2	6 351.6	6 122.5	660.2	57.3	4.4	–
1976	Jan–Mar	–	9 360.9	9 997.0	6 678.0	373.0	6.2	1.4
	Apr–Jun	–	2 017.2	964.6	740.1	40.9	0.8	–
	Jul–Sep	79.6	16 536.4	599.5	40.1	–	–	–
	Oct–Dec	2 780.4	8 443.7	2 659.4	612.7	37.1	–	–

Table 6.5. North Sea sprat catch 1967–1976.
Numbers caught per age group x 10^{-6} in the period 1 July to 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
1975–76	12 069	27 901	19 301	1 149	67

Table 6.6. Estimates of F in North Sea sprat from 1967-1975 from annual VPA.

Age	Fishing season									Weighted mean 1967/8-1973/4
	1967-8	1968-9	1969-70	1970-1	1971-2	1972-3	1973-4	1974-5[1]	1975-6	
0/1	0.02	0.00	0.03	0.11	0.07	0.07	0.04	0.04	0.08[*]	0.04
1/2	0.05	0.02	0.09	0.06	0.35	0.42	0.44	0.29	0.49[*]	0.16
2/3	0.12	0.09	0.04	0.11	0.10	0.86	0.73	0.74	0.71[*]	0.16
3/4	0.14	0.10	0.08	0.08	0.14	0.12	1.28	0.35	0.56[*]	0.13
4/5	0.10[*]	0.10[*]	0.10[*]	0.10[*]	0.10[*]	0.10[*]	0.10[*]	0.20[*]	0.20[*]	
Weighted mean 1/2 and over	0.07	0.05	0.07	0.07	0.21	0.42	0.47	0.33	0.56	

Mean   0.45

*) Input values.   1) Reliability of estimate questionable.

Table 6.7. Stock biomass and annual recruitment of North Sea sprat, as estimated from VPA.

Year	Total stock in '000 tonnes at 1 July	Spawning stock in '000 tonnes at 1 July (2 years old + older)	Number of 0-group recruits at 1 July x 10^{-9}
1967	917	416	192
1968	1 156	626	113
1969	1 079	762	129
1970	982	632	68
1971	727	556	63
1972	496	331	145
1973	579	200	363
1974	1 213	236	234
1975	1 319	684	227
1976*)	1 127	538	
Mean 1967-75	941	494	170

*) Predicted from input values.

Table 6.8. Sprat catches in the Skagerrak, Kattegat and the Norwegian fjords. ('000 metric tons), 1966-76.

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976[a]
IIIa											
Denmark	3.4	5.3	3.1	1.6	4.2	2.2	2.1	54.4	48.9	73.6	40.7
Norway	1.1	3.3	2.1	1.7	2.4	2.9	2.4	3.2	1.4	2.1	0.8
Sweden[b]	4.3	3.9	4.6	3.5	8.4	12.0	21.2	18.7	20.5	23.0	15.2
Total	8.8	12.5	9.8	6.8	15.0	17.1	25.7	76.3	70.8	98.7	56.7
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	1.8
IIa (North of 62°N, Norwegian fjords)											
Norway	1.9	0.6	1.3	4.9	5.5	2.6	4.2	4.2	5.5	5.0	4.3

a) Preliminary figures as reported.

b) 1966-69 not complete.

Table 6.9. Percentage distribution of yearclasses and mean age from 1-group onwards in Swedish sprat samples taken from September to March.

Season / Age groups	Purse seines and land seines within the archipelago							Trawl fishery in Skagerrak and Kattegat						
	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
1975/76	78.0	15.7	4.5	1.4	0.3	–	2.10	80.3	14.2	4.1	1.2	0.2	–	2.27

Table 6.10. Percentage of 0/1-group sprat in samples from
the Swedish sprat fishery during Spetember to
March.

Season	Purse seines and land seines within the archipelago	Trawls in Skagerrak 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
1975/76	7.3	15.3

Table 6.11. Percentage age compositions of Danish and
Swedish trawl catches from the Skagerrak
and Kattegat in each quarter of 1975 and 1976.

| Year	Month	Age group						
		0	1	2	3	4	5	6
Denmark								
1975	Jan-Mar	–	62.9	28.6	8.1	0.3	–	–
	Apr-Jun	–	29.9	51.0	19.0	–	–	–
	Jul-Sep	0.4	90.5	8.2	0.8	0.003	–	–
	Oct-Dec	7.6	56.1	3.1	33.1	–	–	–
1976	Jan-Mar	–	50.7	47.9	1.4	0.2	0.1	–
	Apr-Jun	–	86.4	8.9	4.3	0.1	–	–
	Jul-Sep	16.8	77.0	5.7	0.6	–	–	–
	Oct-Dec	54.7	43.9	1.4	–	–	–	–
Sweden								
1975	Jan-Mar	–	36.9	38.3	22.1	2.2	0.5	–
	Apr-Jun	No information						
	Jul-Sep							
	Oct-Dec	3.1	81.2	12.9	0.2	–	–	–
1976	Jan-Mar	–	20.4	62.6	11.7	4.0	1.3	0.2
	Apr-Jun	–	34.6	38.4	18.7	5.6	2.5	0.1
	Jul-Sep	8.3	45.2	33.7	11.2	1.2	0.4	–
	Oct-Dec	5.9	42.7	40.5	9.4	1.5	0.5	–
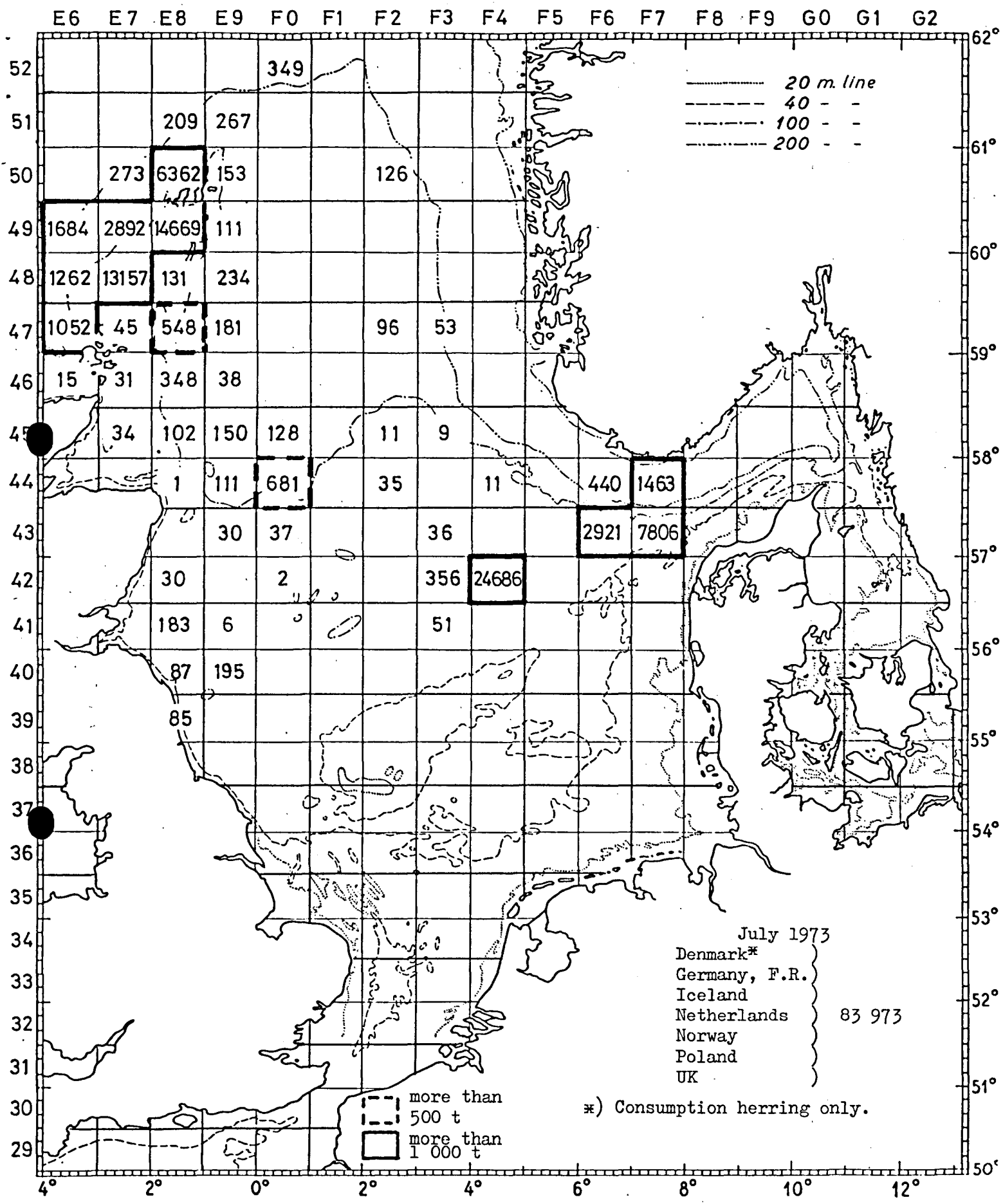
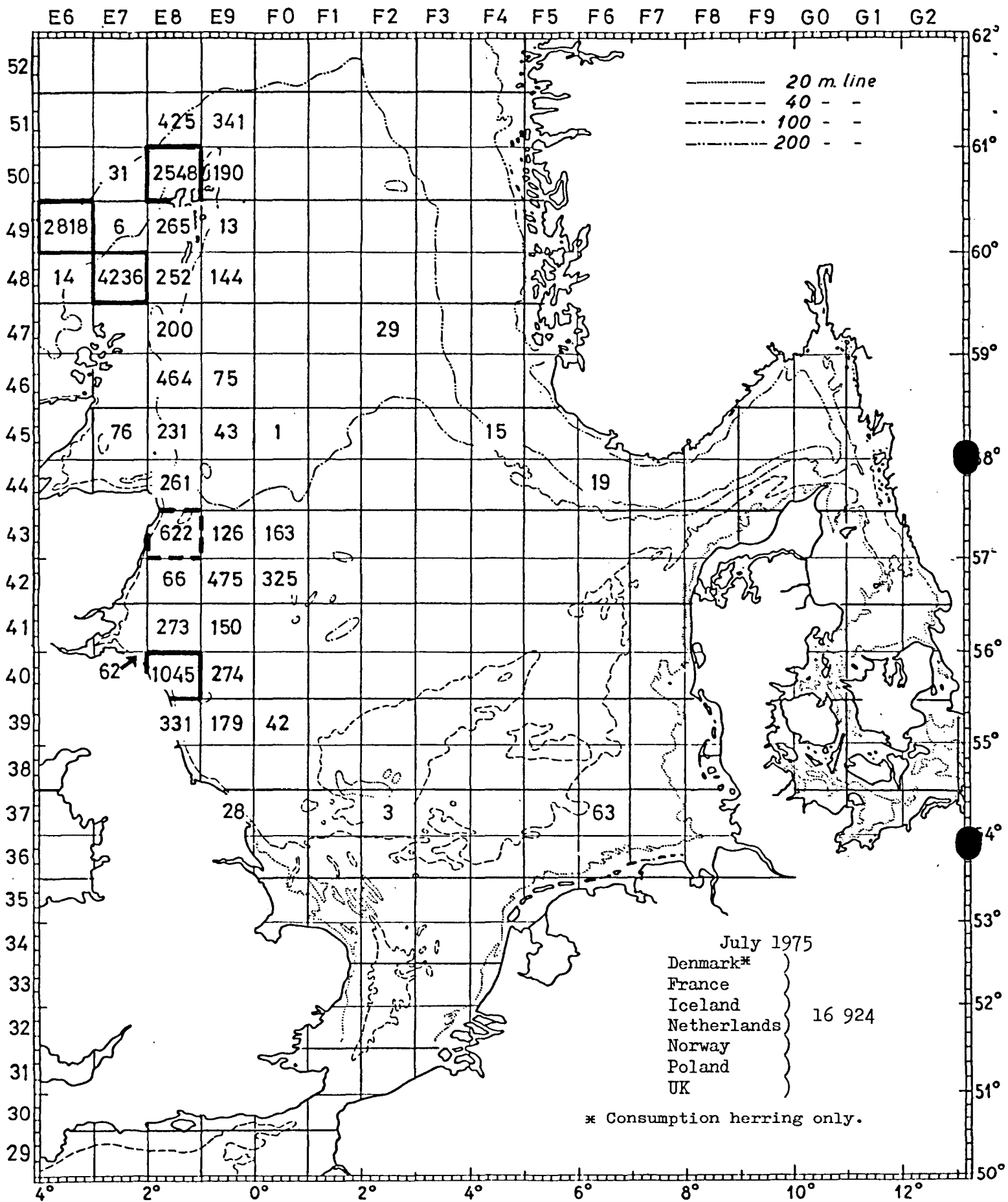Figure 1. Catch of herring per statistical square in July 1973.

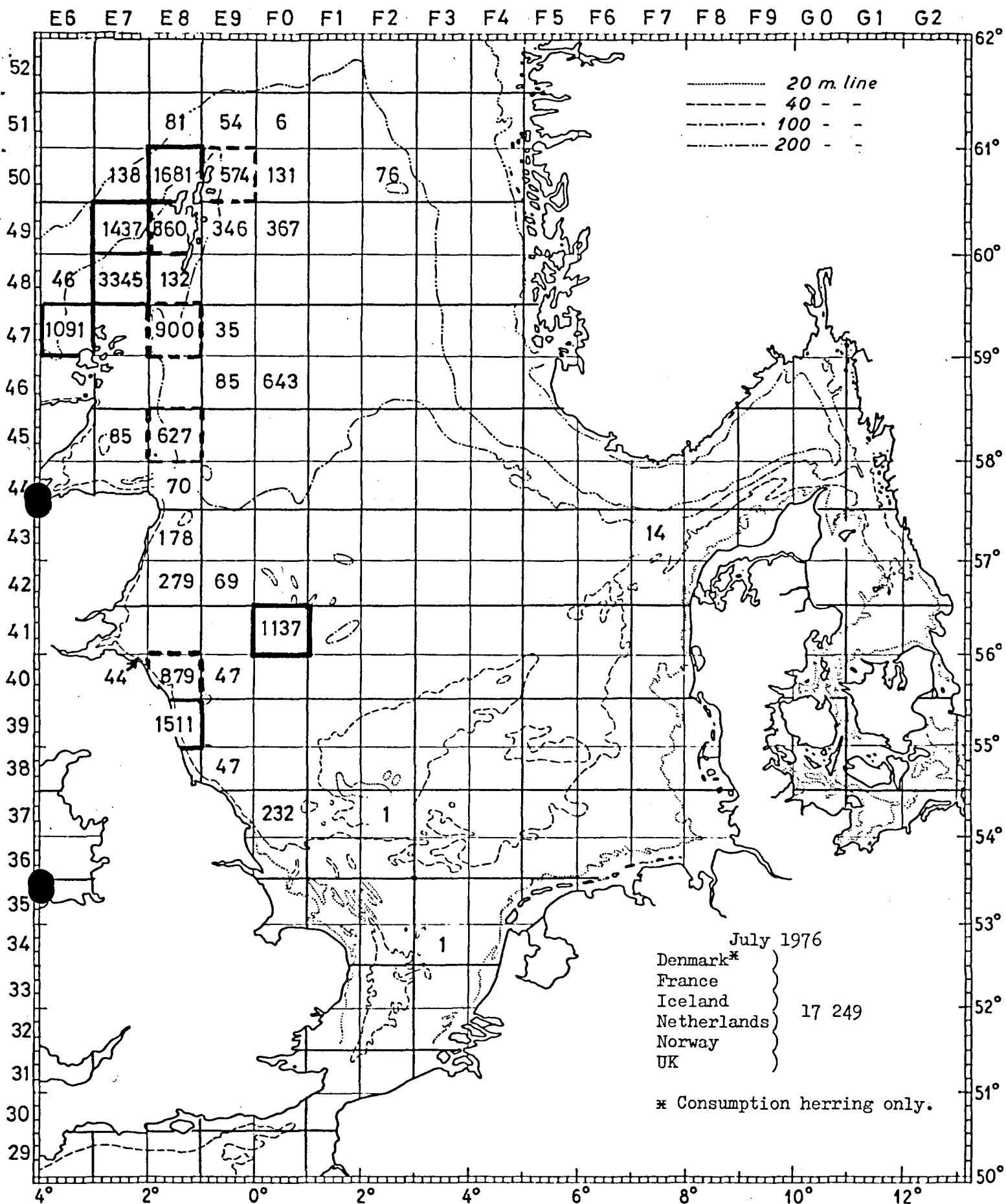Figure 2. Catch of herring per statistical square in July 1975.

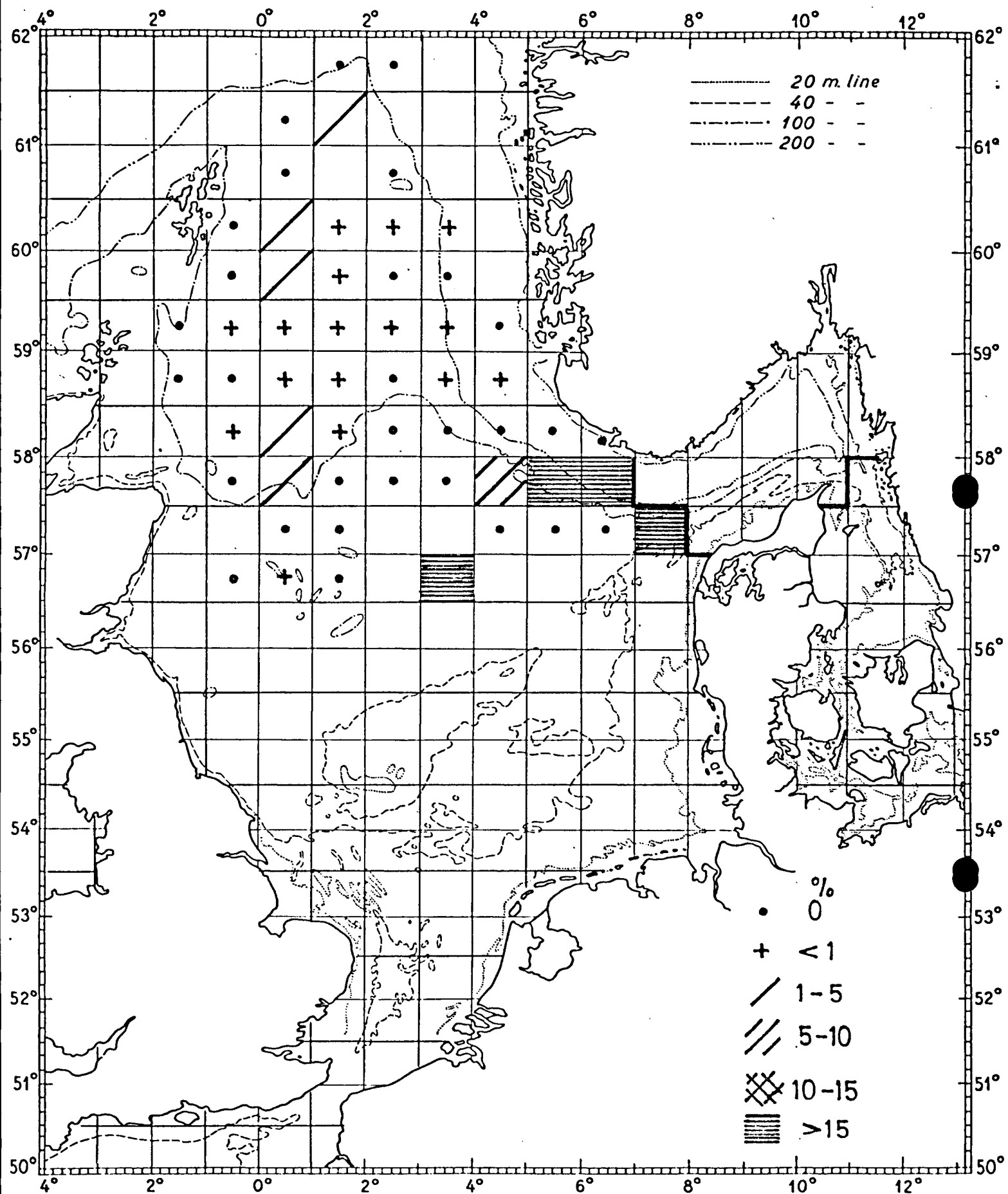Figure 3. Catch of herring per statistical square in July 1976.

July 1976

Denmark*
France
Iceland
Netherlands   17 249
Norway
UK

* Consumption herring only.

20 m. line
40 - -
100 - -
200 - -

Figure 4. Bycatch of herring in Norway Pout catches in 1974 expressed as a percentage of Norway Pout landing.
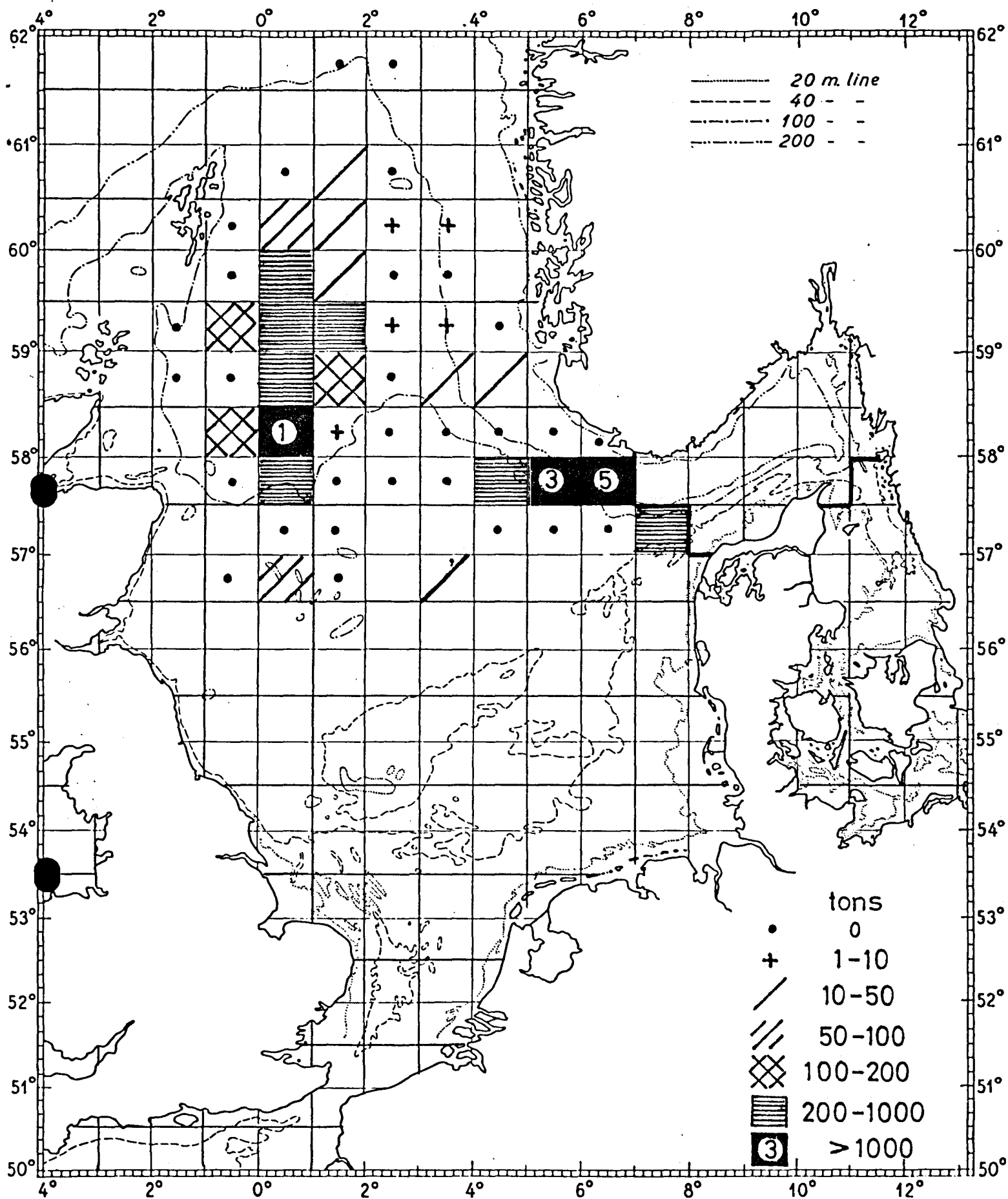
Figure 5. Bycatch of herring in Norway Pout fishery in 1974 expressed as weight of herring landed.
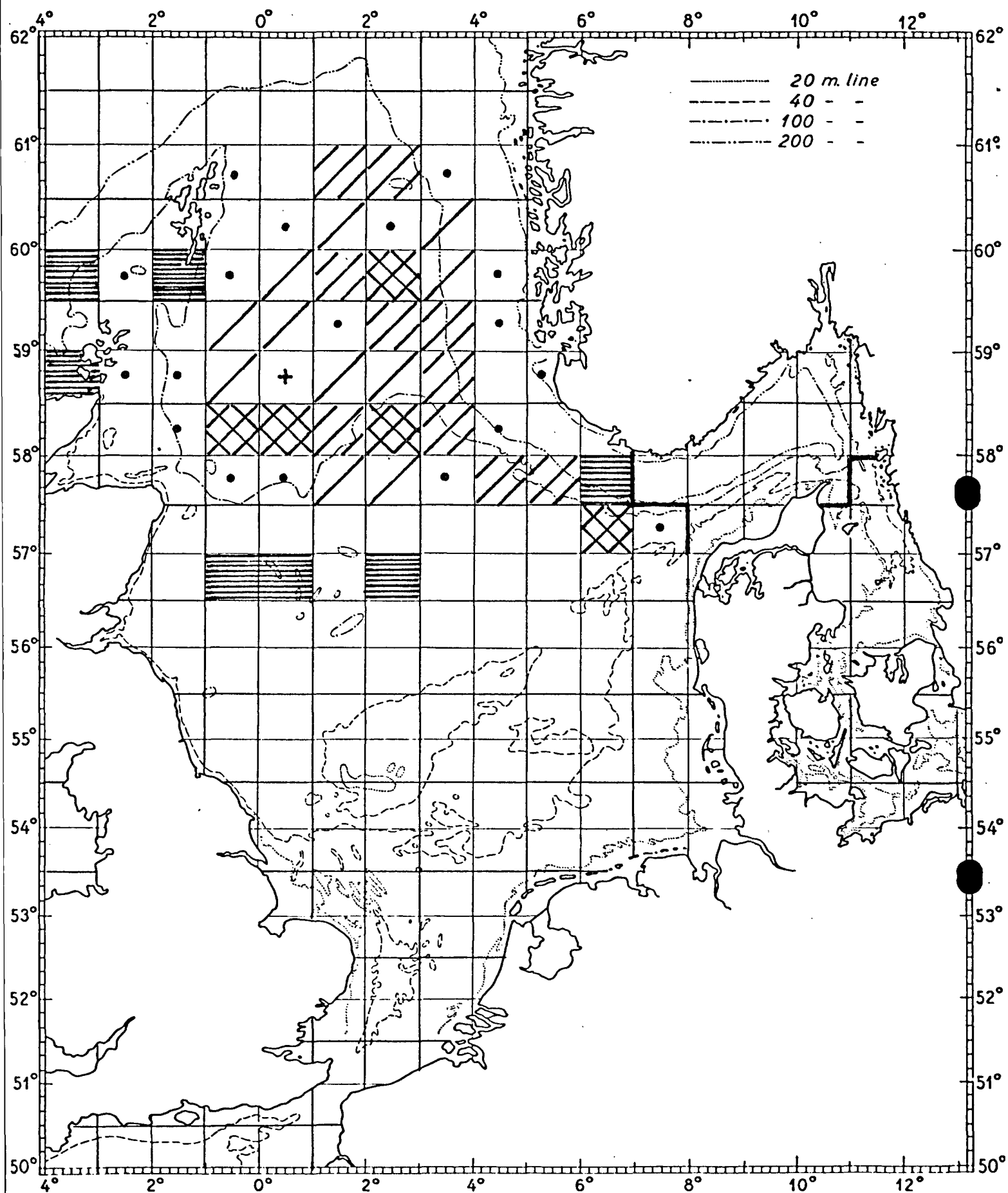
Figure 6. Bycatch of herring in Norway Pout catches in 1975 expressed as percentage of Norway Pout landed (symbols as in Figure 4).
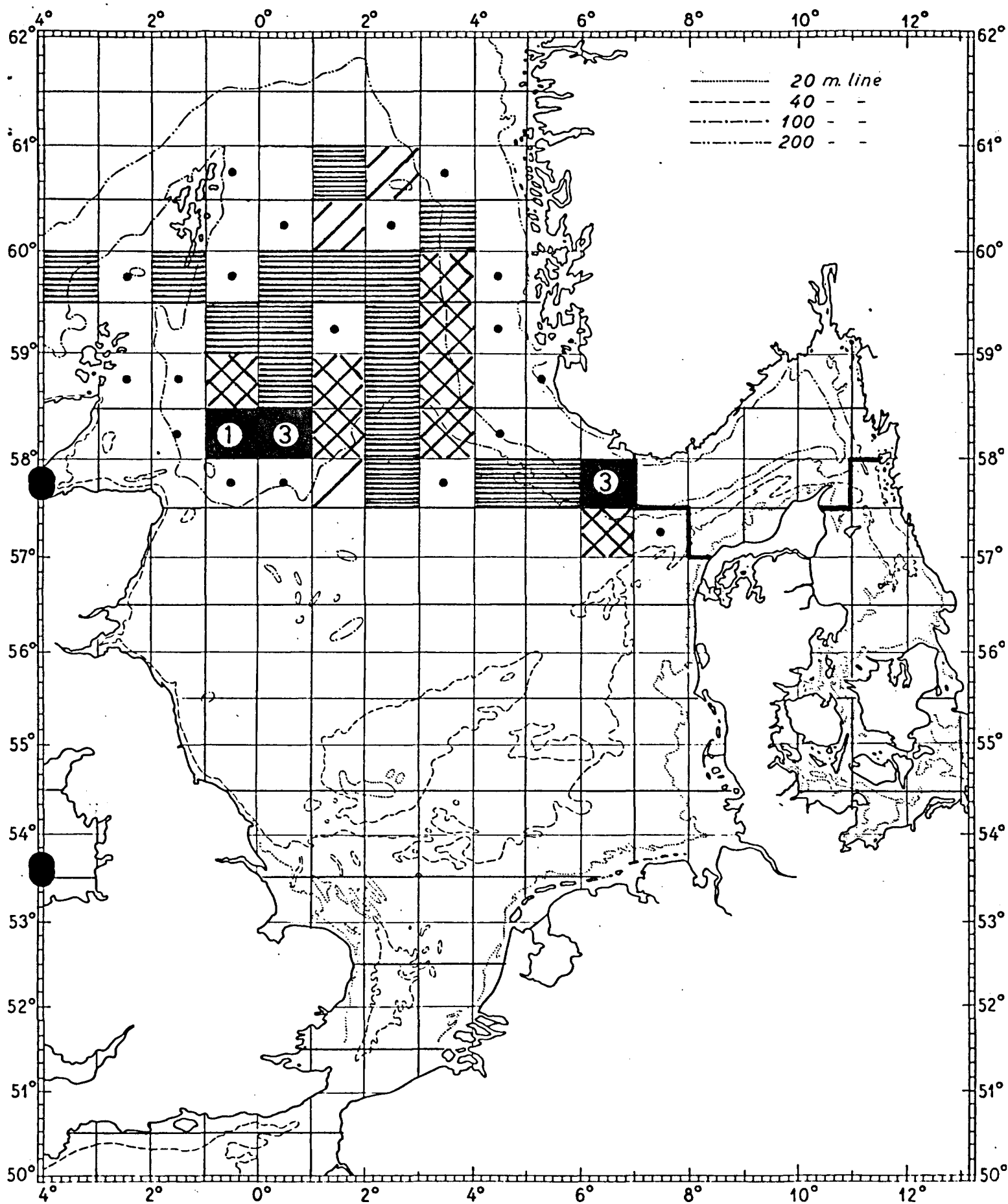
Figure 7. Bycatch of herring in Norway Pout fishery in 1975 expressed
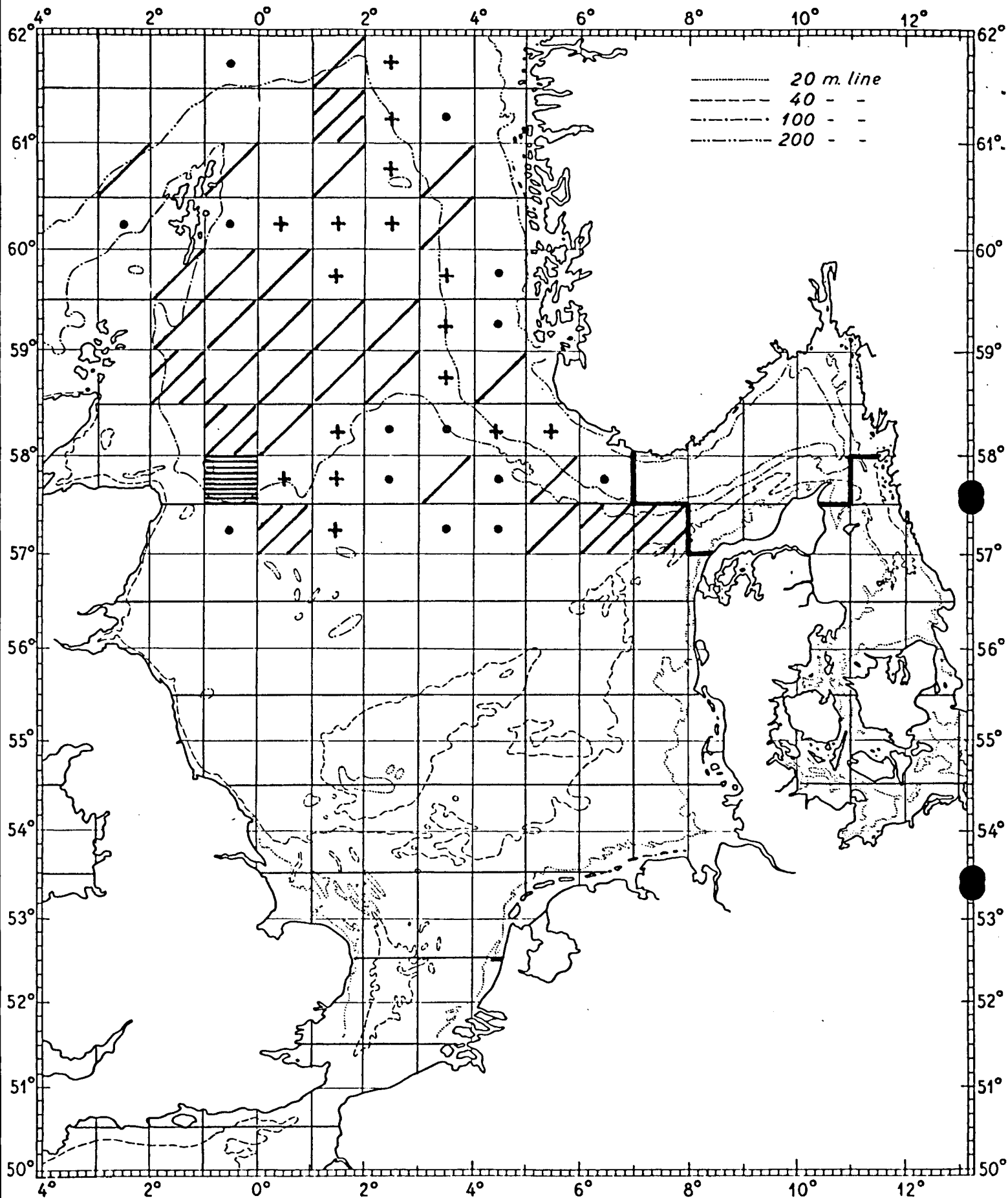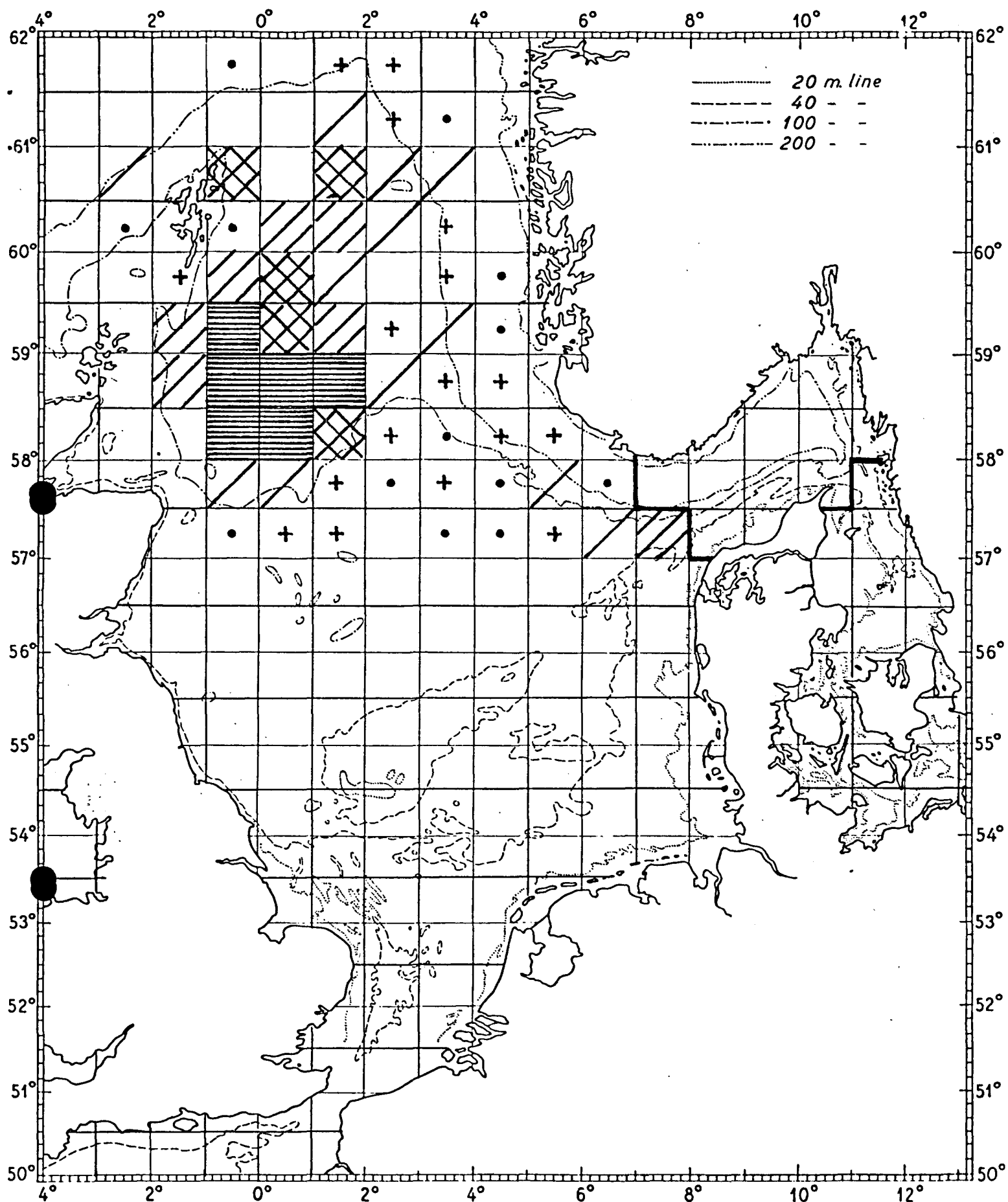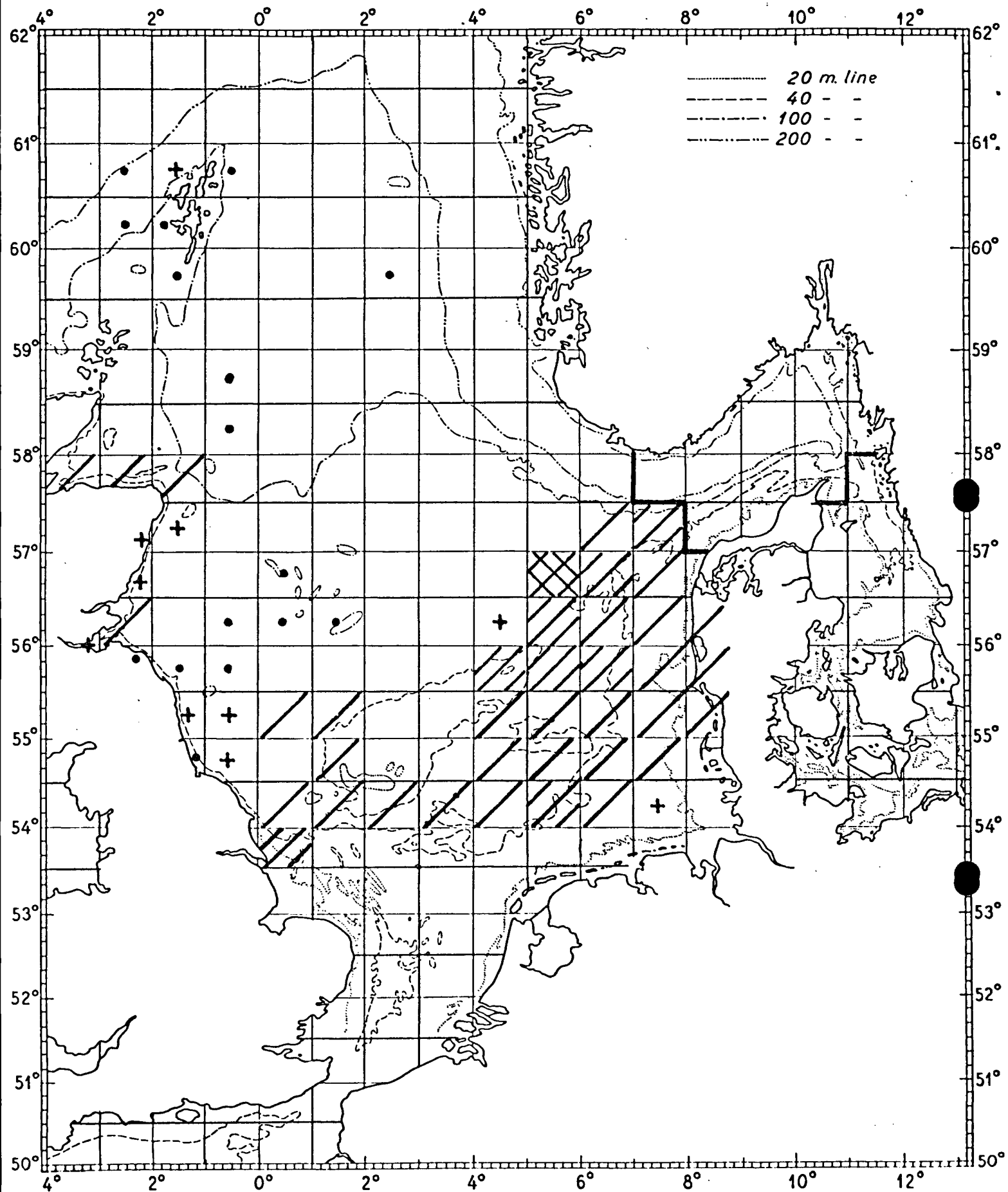as weight of herring landed (symbols as in Figure 5).

Figure 8. Bycatch of herring in Norway Pout catches in 1976
expressed as percentage of Norway Pout landed
(symbols as in Figure 4).

Figure 9. Bycatch of herring in Norway Pout fishery in 1976 expressed as weight of herring landed (symbols as in Figure 5).

Figure 10. Bycatch of herring in sprat catches in 1976 expressed
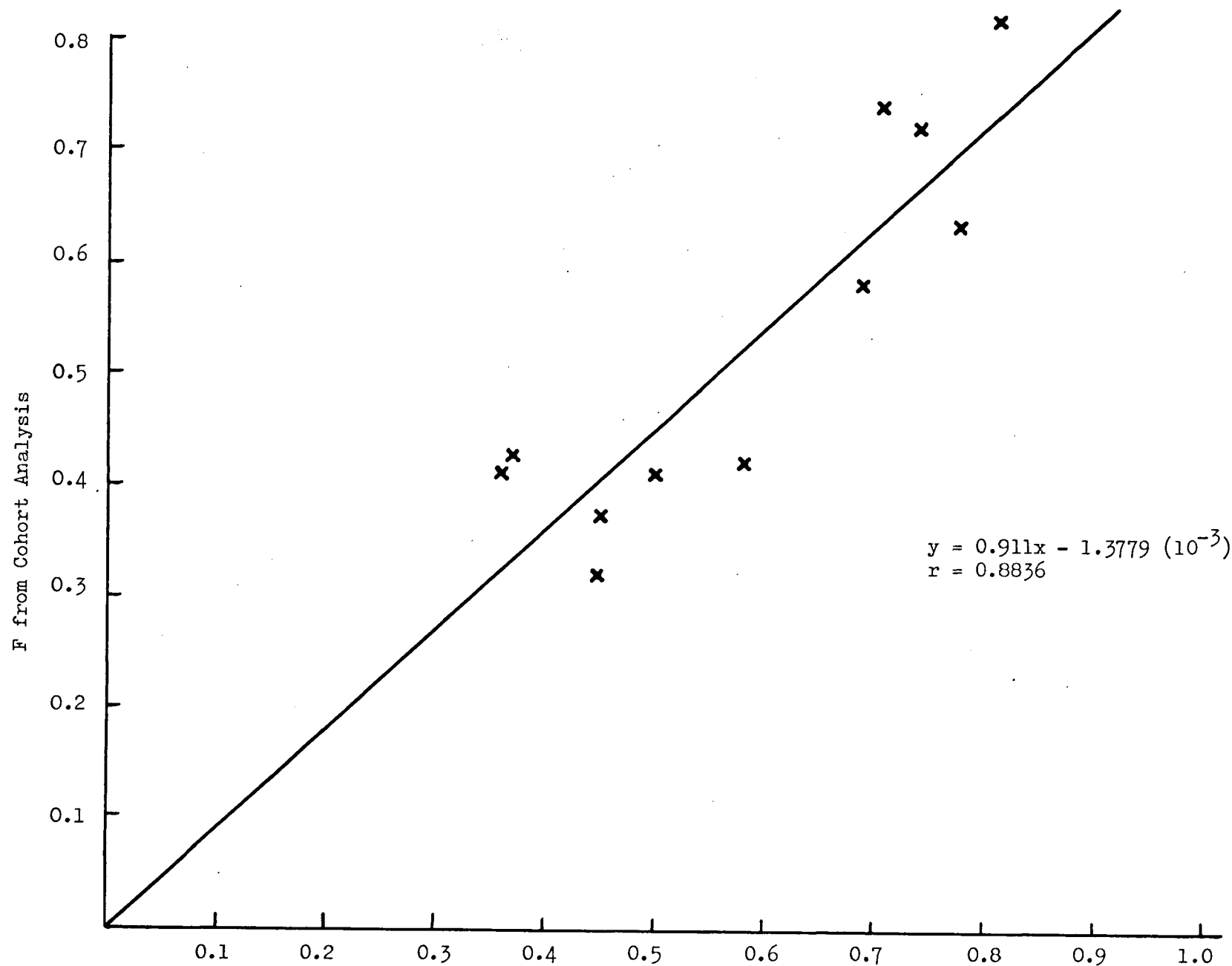as a percentage of sprat landed (symbols as in Figure 4).

Figure 11. Regression of F from Cohort Analysis of Celtic Sea herring on F estimated from Irish catch per unit effort data.
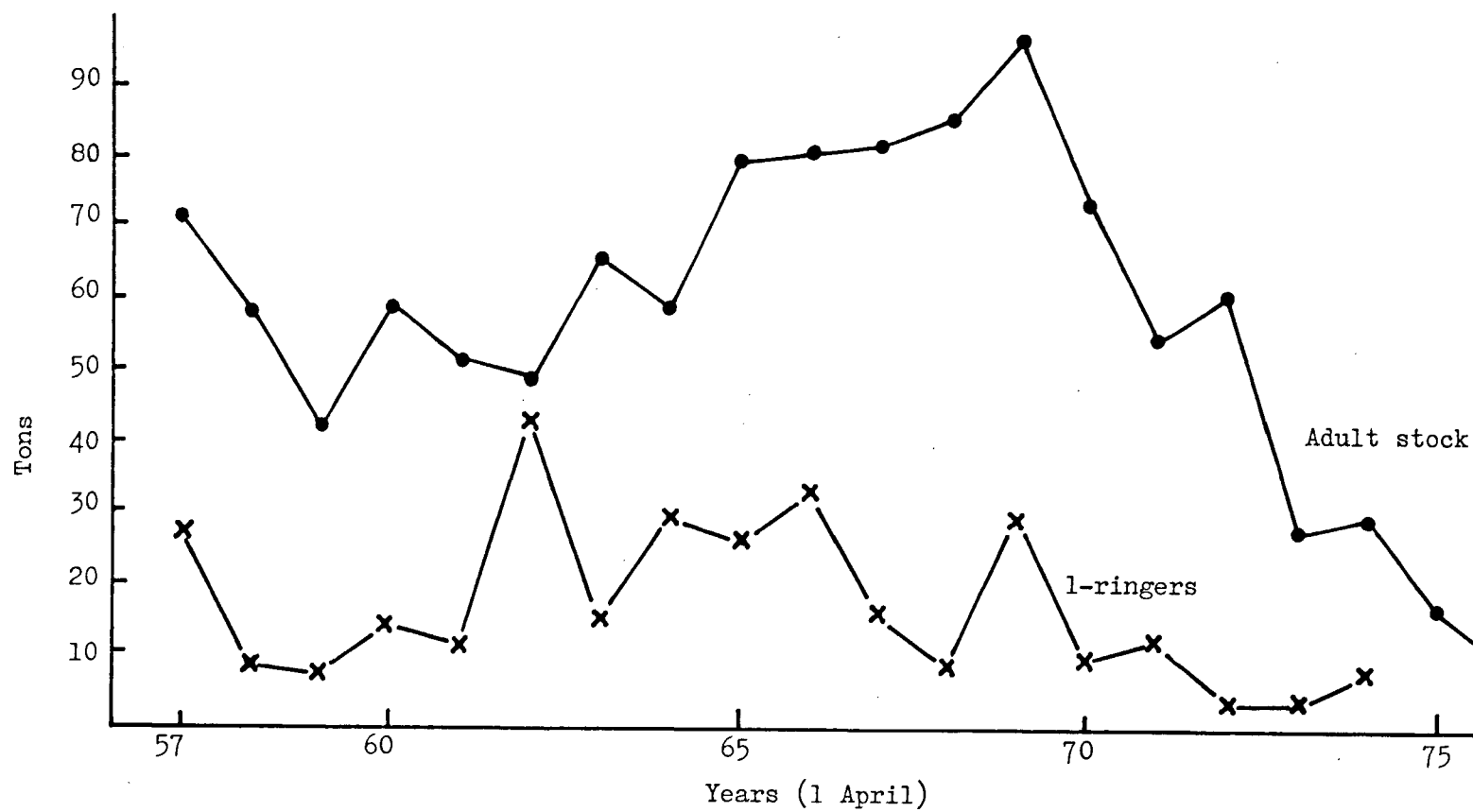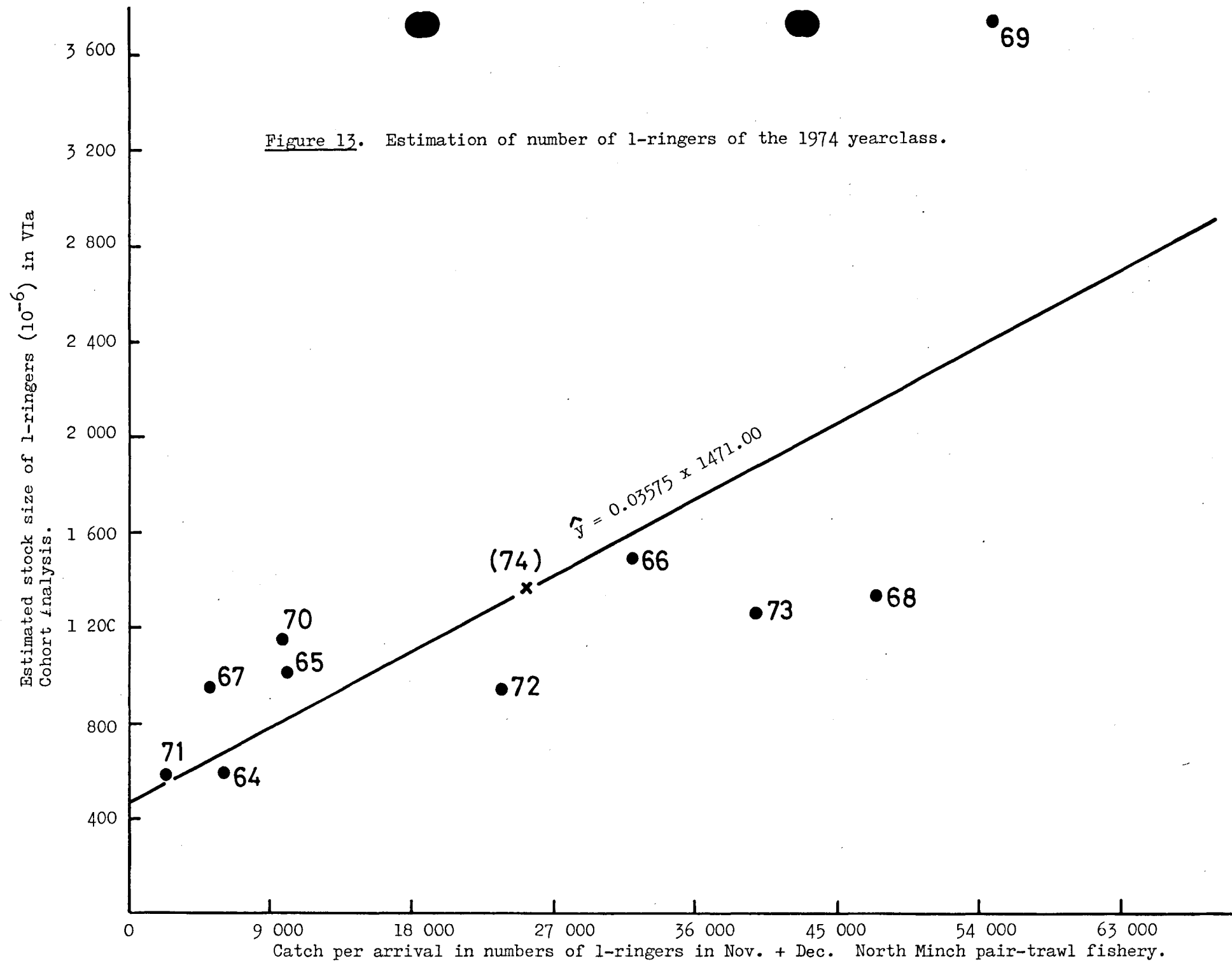
The plotted regression line is given by:

$$y = 0.911x - 1.3779 \ (10^{-3})$$
$$r = 0.8836$$

Figure 12. Celtic Sea. Adult stock biomass and biomass of 1-ring fish two years later.

Figure 13. Estimation of number of l-ringers of the 1974 yearclass.

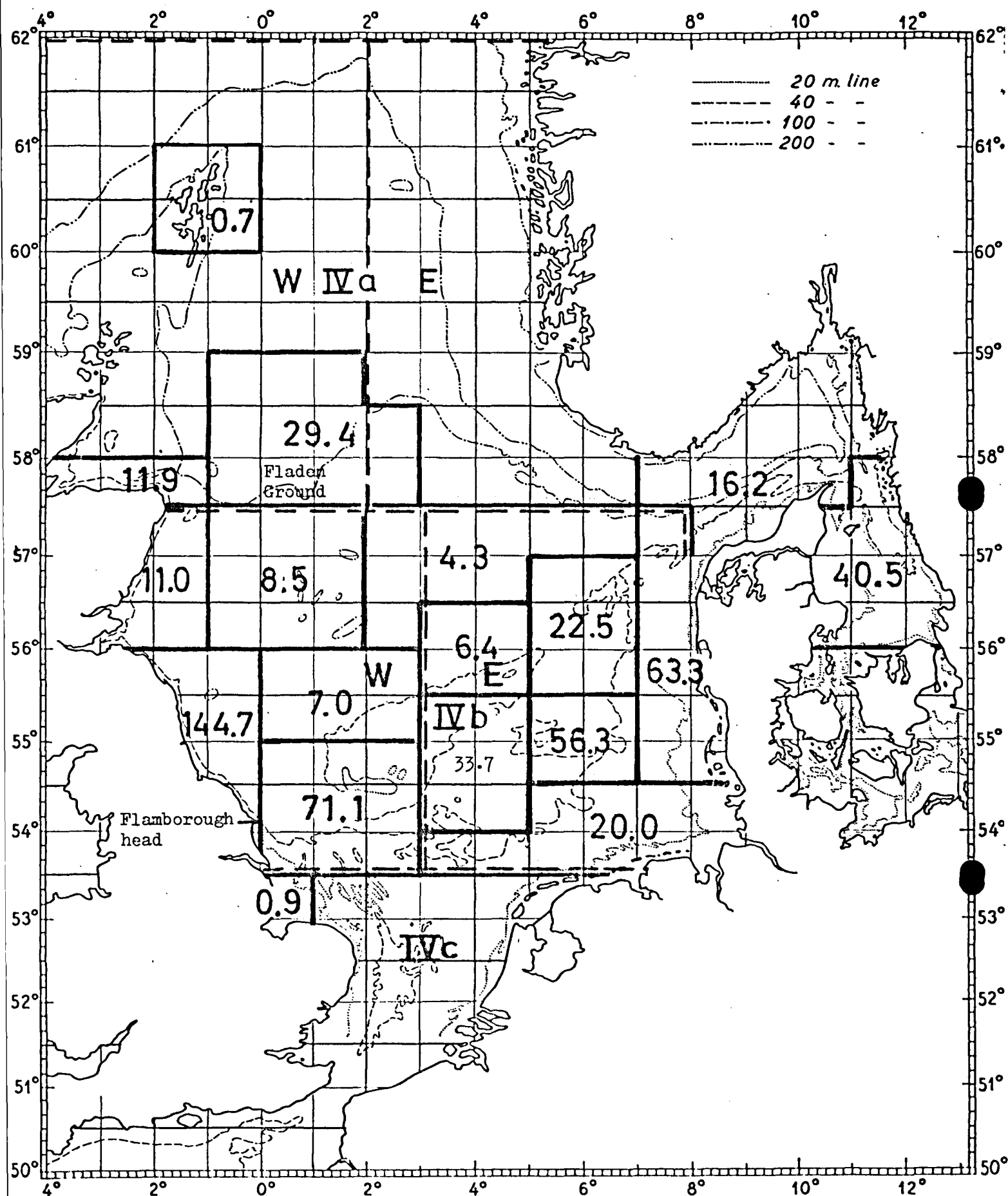$\hat{y} = 0.03575 \times 1471.00$

Figure 14. Landings of sprats ('000 metric tons) from each area of the
North Sea and Skagerrak in 1976 by Denmark, Norway, Sweden,
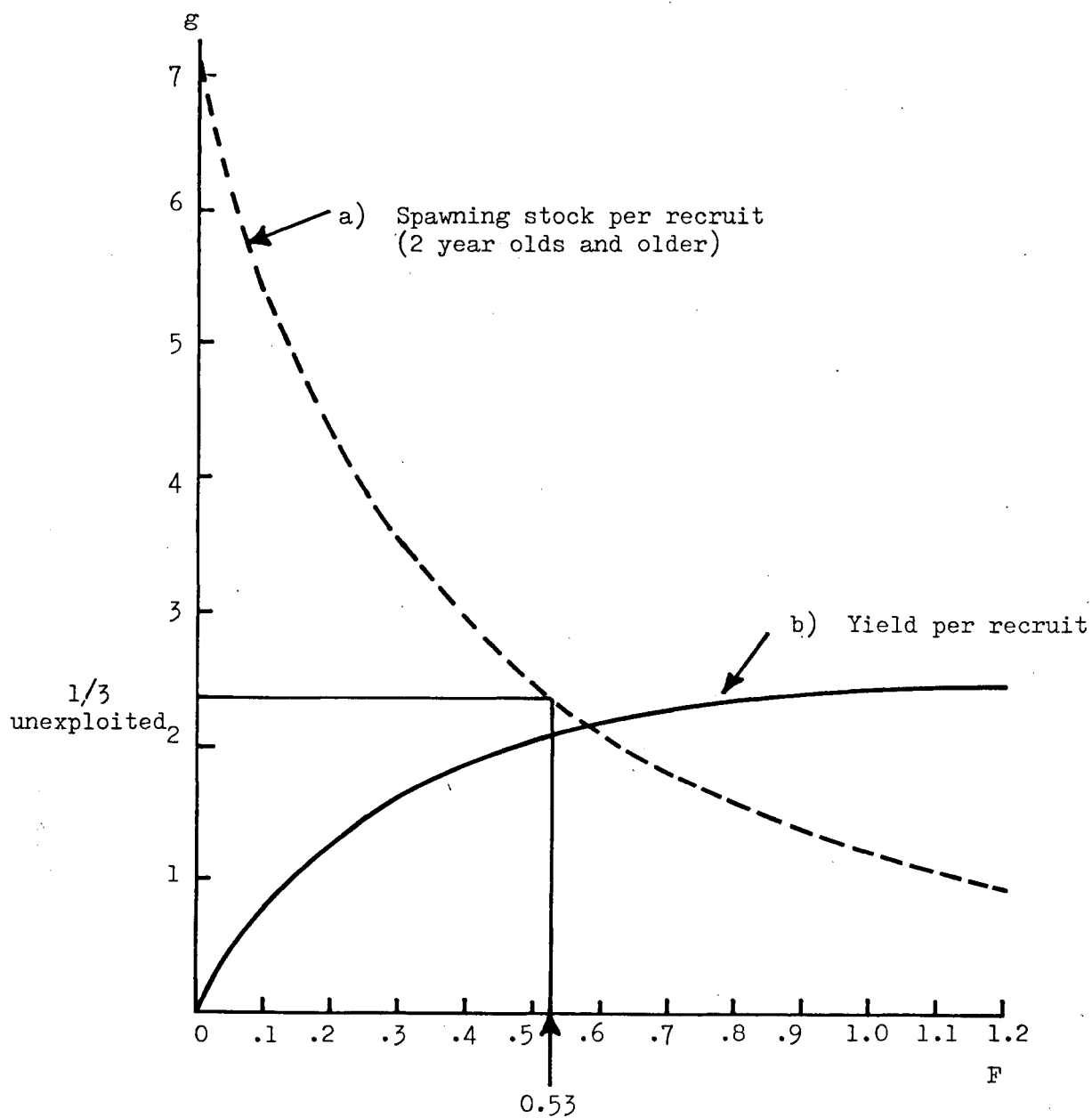England and Scotland.

Figure 15. Equilibrium spawning stock and yield per recruit
at different levels of fishing mortality.