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1. PARTICIPANTS AND TERMS OF REFERENCE

1.1 Participants

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V Nikolaev, ICES Statistician, also participated in the meeting.

1.2 Terms of Reference

The Herring Assessment Working Group for the Area South of 62°N met at Charlottenlund from 9-18 March 1978, in accordance with C.Res.1977/2:28, to re-assess the state and appropriate levels of TACs in 1978 and 1979 for:

a) North Sea and Skagerrak herring;

b) Celtic Sea herring;

c) Divisions VIa and VIIb,c herring;

d) Northern Irish Sea herring (Division VIIa);

e) North Sea sprat;

f) the sprat stock in Division IIIa and the Norwegian west coast fjords.

In addition, the Working Group reviewed the previous year's report (Doc. C.M.1977/H:3, Appendix 1-8)* on the distribution of, and fisheries on, certain pelagic stocks in relation to zones of extended fisheries jurisdiction.

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* Later incorporated in Cooperative Research Report, No.86.

2. NORTH SEA AND SKAGERRAK HERRING

2.1 The Fishery in 1977

2.1.1 Catch data

Catch data for the years 1968 to 1976 are given in Table 2.1, with preliminary estimates for the year 1977.

Previous Working Group reports have advised a ban on directed fishing for herring in the North Sea and reduction of by-catches in other fisheries. The major event in 1977 has been the partial ban on the fishery in the North Sea and eastern English Channel. The ban was imposed from 1 March 1977. In addition to catches made before this date, two allocations were made by EEC to be taken in the closed period. These allocations were 2 500 tonnes to be taken in Division IVb and 600 tonnes in Division VIId.

The 1977 catch figures thus comprise herring catches made before the enforcement of the ban, the two small allocations and the by-catch of herring in fisheries directed to some other species both in trawl and purse-seine fisheries.

The total North Sea catch, excluding Skagerrak, amounted to 41 283 tonnes, compared with 174 961 tonnes, which is the revised catch figure for 1976.

The preliminary Skagerrak catch figure indicates an increase from the former one of 15 550 tonnes to 37 587 tonnes (Table 2.2).

Tables 2.3 - 2.7 give the North Sea catch data by Sub-divisions as in the previous reports. In addition, the total recorded by-catch is given in Table 2.8 for all fisheries. Of the total of 9 968 tonnes of by-catch, about 9 500 tonnes were taken in the industrial fisheries. In the directed fisheries the main herring catch was taken in Division IVa (west) where it amounted to 25 797 tonnes and reflected the exploitation before the enforcement of the ban; in addition, about 650 tonnes were taken after February as by-catch. The corresponding revised figure for that area for 1976 was 101 552 tonnes (and 4 205 tonnes as by-catch). In Division IVa (east), the catch decreased from 2 257 tonnes in 1976 to 737 tonnes in 1977, while the by-catch increased from 11 to 272 tonnes, respectively. In Division IVb, the total catch in adult fisheries was 41 475 tonnes in 1976, while the 1977 catch amounted to 3 690 tonnes, of which about 2 500 tonnes were taken under quota allowance (8 984 tonnes were taken as by-catch). The corresponding by-catch in 1976 was 7 935 tonnes. In Divisions IVc + VIId-e, the catch was 1 091 tonnes, of which about 600 tonnes were taken under quota allowance, as compared with 17 501 tonnes in 1976.

2.1.2 Catch in numbers by age

Numbers of herring at each age in catches by fishing areas are given in Tables 2.9 and 2.10, and those for the total North Sea are summarised in the text table below (with revised figures for 1976). Annual catches in number per age group in 1967-76 are given in Table 2.11

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	127	901	117	52	46	1 481
1977	257	144	37	170	9	10	627

It should be noted that due to the seasonality of the 1977 catches the mean weight at age data as given in the text table on p.9 are not applicable to the 1977 catch in number data.

Despite the prohibition of directed fisheries on herring for industrial purposes, the catch of 0-group herring has increased as compared with the previous year and represents about 40% by number of the total catch of North Sea herring. The total catch of juvenile herring (0 + 1 groups) was about 65% of the total catch in numbers. These were practically all taken as by-catch in the industrial fisheries.

The 1973 year class predominated in the adult age groups and contributed 27% of the total 1977 catch in numbers.

Compared with previous years, the monthly pattern of catches in 1977 is completely different. The catch of adults was derived from fishing during a relatively short period in the first months of the year, and from small catches in summer and the last months of the year. In the light of this, no estimates of input F could be made. Last year's cohort analysis is found in Tables 2.11-2.13.

2.2 Recruitment

2.2.1 Year class 1976

Preliminary data from the Young Herring Survey in February 1978 indicate a mean catch of 1-group herring of 498/hour for the herring standard area as defined in Cooperative Research Report (ICES, 1978b).

The Working Group noted that rather high catches of 1-ringed herring were reported from hauls made in the Kattegat. Because of uncertainty about the racial composition of 1-group herring in the Kattegat, the statistical rectangles in this area have not been included in the standard area.

The introduction of the new GOV standard gear (see ICES, 1978b) may have caused an increase in catching capacity of some countries. Out of eight countries participating in the survey, three countries used the new standard gear. Not enough data from comparative fishing experiments were available to make a quantitative assessment of the change in fishing power. The results obtained during the 1978 survey

were compared directly with those from earlier years. At the last meeting of the Working Group on North Sea Young Herring Surveys, a new regression of YHS mean abundance on VPA stock estimates was calculated (ICES, 1978b). The new equation is:

$$y = 0.0031x - 0.21$$

where: y is the VPA stock estimate of 1-ringers ($\times 10^{-9}$), and

x is the mean catch of 1-group herring per hour for the new standard area as defined in the above report.

Using this formula, a preliminary estimate of 1.33×10^9 1-ringers was obtained for the 1976 year class. Taking into account a catch of 257×10^6 0-ringers in 1977, the fishing mortality on the 1976 year class during 1977 is calculated at 0.17, and the initial size of the year class as 0-group at 1.73×10^9.

2.2.2 Year class 1975

The final figure for the mean catch of this year class during the 1977 YHS (which became available only after the last meeting) is 342/hour. Using the new regression equation given above, the best estimate for this year class as 1-ringers is 0.85×10^9. During the previous assessment, an estimate of 0.90×10^9 1-ringers was obtained on the basis of preliminary results from the 1977 YHS.

It was not possible to obtain a second, independent estimate of the 1975 year class strength from information on the fishery. The low by-catches of the 1975 year class as 1-group in the industrial fisheries in 1977 were probably due partly to the scarcity of this age group, and partly to the ban on directed fishing for juvenile herring that has been in force since 1976. As it is not possible to estimate the fishing mortality on 1-ringers in 1977 with any degree of accuracy, a reliable estimate of year class strength cannot be obtained on the basis of catch data. The Working Group, therefore, had to use the revised estimate from the 1977 YHS as its only source of information on the 1975 year class.

2.2.3 Estimates of year class strength

Mean catches per hour of 1-ringers during the YHS from 1970 onwards and the corresponding VPA values of year class strength are given in the text table below.

Year class	Mean catch/hour 1-group in standard area	Best estimate of year class as 1-group from VPA (in number x 10^{-9})
1968	822	3.35
1969	2 647	7.35
1970	1 629	5.79
1971	827	3.82
1972	1 195	1.75
1973	1 592	4.39
1974	452	0.73
1975	342	
1976	498	

2.3 Estimates of Spawning Stock Biomass from Herring Larval Surveys

The complete results from all the international surveys of herring larvae which were carried out during 1977/78 in the North Sea and adjacent waters, were available to the Working Group. Precise estimates of the abundance of herring larvae <10 mm in length were calculated using the standard technique for these surveys. The mean number of larvae <10 mm beneath 1 square metre at each station worked was multiplied by the appropriate surface area in square metres and the results summed to give a total abundance estimate. A comparison was made of the abundance estimates for herring larvae <10 mm in length between surveys made in 1977 and comparable surveys carried out during 1976. The results are given in Table 2.14.

2.3.1 Northern North Sea

There was a good coverage of the Northern North Sea during both the first and second halves of September 1977, with three research vessels operating in the Orkney/Shetland area in both periods.

In addition, the Buchan area was also surveyed adequately. The larval abundance estimates for the Northern North Sea show a substantial improvement on those for 1976. The highest station densities were found somewhat more north and east than usual. Some high numbers of larvae occurred at the northernmost stations worked to the west of the Shetland Islands, while others were also found immediately to the south of Shetland and to the east of Orkney.

2.3.2 Central North Sea

There was again an excellent coverage of this area in the autumn of 1977 with extensive surveys being made in four separate periods during the months of September and October. Larval densities were overall substantially higher than in 1976, with the highest individual station densities off the Longstone and Flamborough Head.

2.3.3 Southern North Sea and eastern Channel

This area received more attention during the winter of 1977/78 than for some years. Four surveys were carried out, but as only one was made in 1976/77, it is only possible, unfortunately, to compare the survey of 2-6 January 1978, from which an estimate of 8×10^9 for larvae 11-16 mm in length was obtained with the survey of 3-7 January 1977, from which the estimates were 2×10^9 for larvae <11 mm in length and 5×10^9 for larvae 11-16 mm in length. The survey in the eastern Channel from 19 to 23 January 1978 is of interest as a total abundance estimate of 28×10^9 was obtained for larvae of all sizes from this survey indicating that peak production occurred about mid-January. The most recent comparable survey took place from 7 to 29 January 1976, when a total abundance estimate of 15×10^9 was obtained. It is obvious that larval production was again very low during 1977/78, and at present there is no evidence of any recovery of the stock spawning in this area.

2.3.4 Spawning stock size

The report of the Working Group on North Sea Herring Larval Surveys (ICES, 1977a) contained linear regressions of estimated abundances of larvae <10 mm in length on spawning stock biomass for the Northern and Central North Sea separately. The Herring Assessment Working Group, however, considered that a functional regression was more appropriate to these data and so separate functional regressions

(Ricker, 1973) were calculated incorporating the new data both on catch and larval abundance, which had become available since the report of the Larval Working Group was written. The new regressions are:

Northern North Sea $y = 0.04171x + 49.393$

Central North Sea $y = 0.07365x + 30.044$

where: y = the estimated spawning stock from the regressions ($\times 10^{-3}$ tonnes), and

x = the mean survey abundance of herring larvae ($\times 10^{-9}$).

The size of the spawning stock in both the Northern and Central North Sea in 1976 and 1977 given below was calculated from the regressions.

	1976 (tonnes)	1977 (tonnes)
Northern North Sea	66 014	89 768
Central North Sea	34 445	46 965
Combined	100 459	136 733
	Increase:	36 274

If a further 10 - 20 000 tonnes for the spawning stock in the Southern North Sea/eastern Channel area are added to the above figures for 1976, then the total is in reasonable agreement with the 155 000 tonnes for that year which was estimated from analysis of catch data at the previous meeting of the Working Group. The increase in size of the spawning stock in 1977 of 36 274 for the Northern and Central North Sea combined, which is indicated by the larval survey data, is in close agreement with the increase of 25 000 tonnes calculated by the Working Group from the catch data for 1977 (see text table in Section 2.5).

It also confirms that the Working Group estimate of the weakness of the 1974 year class at only 1.0×10^9 0-group was approximately correct.

The spawning stock size of herring in the Northern and Central North Sea combined in 1977 is estimated at 136 733 tonnes from the larval survey data. Some allowance must be made for herring spawning in the Southern North Sea/eastern Channel, but the total North Sea spawning stock estimate, based on larval survey data, cannot be larger than about 160 000 tonnes at the present time.

Although the analysis of the 1977 herring larval survey's data produced results which compare very well with the prognosis of stock size assessed from the catch data and the exploitation rates,the Working Group felt that attempts should be made to improve methods of correlating larval data, e.g. by correlating the total larval production in the North Sea with the VPA estimates of the total North Sea stock size. Therefore, the Group was aware that fecundity data are required.

2.4 By-Catch of Herring in Industrial Fisheries

The Working Group was also asked to consider the by-catch of herring in the North Sea industrial fisheries on a detailed area and time basis in order to assess whether a further decrease in the by-catch could be achieved from closures.

Samples from industrial landings in 1977 were available in the case of Denmark, England and Scotland by months and statistical rectangles. The data were treated separately for each of the three main fisheries, i.e., sandeels, Norway pout and sprat. In the case of the Danish industrial landings these species contributed 91.1% of the grand total.

A yearly mean percentage was calculated for each statistical rectangle, using the number of samples per month as the weighting factor. The results are shown in Figures 1-3. From these charts it is obvious that neither in the case of the Norway pout nor the sandeel fisheries was by-catch of herring a particular problem in any part of the North Sea in 1977. The highest by-catch percentages were found in the fishery for sprat. Even in this case, the percentage by-catch in most rectangles seldom exceeds 5%, and the overall by-catch in the total sprat fishery is only 2.26%. Percentages close to 10 are only seen in inshore catches off Scarborough Head, east of Borkum Riff and around the tail-end of Dogger Bank. The actual catch of herring from these areas amounts to about 2 000 tonnes or 15-20% of the total by-catch.

It is not possible, however, to asses on a long-term basis whether closures of these areas will result in a corresponding reduction in the by-catch, mainly because distribution of herring and sprat can change locally within short periods of time.

The Working Group considered that better results could be achieved by strict enforcement of the 10% restriction on by-catch both in weight and in numbers. The latter would provide an additional protection of 0-group herring which at times may constitute a relatively higher percentage in number than in weight.

Further protection of the weak herring year classes at present could be obtained by reducing the maximum permissible by-catch below 10%.

An estimate of the total by-catch of herring in all industrial fisheries in 1977 is given below:

Fishery for:	Total landings (tonnes)	By-catch (%)	Calculated catch of herring (tonnes)
Sandeel	780 000	0.17	1 330
Norway pout	387 000	0.19	740
Sprat	304 000	2.26	7 030
		Total herring	9 100

If this is taken to be about 90% of the total catch, then the best estimate amounts to 10 000 tonnes of herring caught as by-catch which is very close to 11 200 tonnes, which the Working Group estimated would be taken as by-catch in industrial fisheries in 1977 and which it used in the prognosis in last year's report.

With reference to the latter it is noted that, while the by-catch percentage in the sprat fishery in 1976 was calculated at 2.53% or close to that in 1977, the percentage in the Norway pout fishery has decreased from 1.7% to 0.17%, i.e., a reduction to one-tenth.

2.5 State of the Stock and Advice on TAC

In the previous report (ICES, 1979) the spawning stock of the North Sea herring was estimated at about 155 000 tonnes in 1976. This estimate was based on catch data and the input fishing mortalities for

1976. At its present meeting the Working Group considered that this was still the best estimate of the spawning stock in 1976. The estimate of the stock at 1 January 1977 was therefore calculated from the catch in number data (revised) for 1976 (as given in Table 2.9) and the F values for 1976 given in Table 2.12 for 1-ringers and older fish.

The spawning stock in 1977 was derived from this estimate by applying 2/3 of the natural mortality and the fishing mortality which was generated by the catches before the spawning season (F = 0.18). On this basis, the spawning stock in 1977 was calculated to be in the order of 180 000 tonnes. This is almost the same figure as last year's prognosis, as would be expected since the same basic criteria were used in both cases. The catches actually taken in 1977 were somewhat higher than assumed, thus accounting for the small difference between the two estimates of the 1977 spawning stock size. The increase from 1976 to 1977 of only 25 000 tonnes reflects the present poor recruitment to the stock.

Independent estimates of the spawning stock sizes in the Central and Northern North Sea for 1976 and 1977 were available from the herring larval surveys. As discussed in Section 2.3, these estimates are in close agreement with that calculated from the catch data.

Since the advice of the Working Group continues to be that the spawning stock should be allowed to increase as soon as possible to the level of 800 000 tonnes, a stock prediction for 1979 can only be made on the assumption that there will be no fishing for herring in 1978, whether for adults or for juveniles as a by-catch in the industrial fisheries. It is, therefore, assumed that fishing mortality on 1-group herring in 1978 will be restricted to that already generated in the industrial fisheries (assumed $F_{1978} = 0.05$). Catches of 0-group herring in 1978 will not affect the spawning stock biomass in 1979.

The results of these calculations as well as the basic parameters used are given in the text table on p.9.

In the absence of any fishing at all the spawning stock estimate for 1979 would be about 450 000 tonnes.

Even under the most stringent management regimes the spawning stock in 1978 will only have recovered to about 1/3 of the desired level of 800 000 tonnes. In 1979 it is expected that the stock will be about ½ that level.

In the 1976 report of the Working Group (ICES, 1978a) a relationship was shown between the size of the spawning stock and recruitment. The estimates of the abundance of 1-ringers based on the YHS in 1977 and 1978 have added two more year classes to the previous series of poor recruitment. Thus, out of the four most recent year classes (1973-76), the 1973 year class was about 85% of an average year class as 0-group, while the three most recent year classes have only been about 20% of the average 0-group abundance. During this period the spawning stock was in the range between 95 000 - 220 000 tonnes or less than 1/3 of the desired level of 800 000 tonnes.

North Sea herring prediction

Age group	Mean weight in catch[1]	Stock in number (millions) at 1 January of the year		
		1977	1978	1979
0	15	1 730		
1	50	850[2]	1 330[2]	
2	126	543	630	1 145
3	176	695	411	570
4	211	90	525	372
5	243	40	68	475
6	251	27	30	62
7	267	5	20	27
8	271	3	4	18
9	271	1	3	3
F juvenile 0-group		0.17		
1-group		0.20	0.05	
$\bar{F}$ adult		0.18	0	
Catch juv. (t)		9 500	3 080 *)	
Catch adults (t)		31 775	0	
Spawning stock biomass (t)		180.10[3]	275.10[3]	435.10[3]

1) Mean weight of spawners taken as mean weight in catch for 2-ringers and older fish.

2) Estimates from YHS.

*) Catches of 0-group herring in 1978 are not included in this figure. Such catches will not affect the spawning stock size in 1979.

The North Sea herring can be one of the most valuable living resources in the North-East Atlantic with an OSY* annual yield of about 800 000 tonnes. During the most recent years the stock has been brought down to a very low level due to overexploitation and mismanagement. In 1977 the first important steps were taken to rebuild the stock by enforcement of the partial ban on directed herring fisheries.

In the light of this and in the absence of improvement in the recruitment level, it must be quite clear that the Working Group can only recommend that there should be no directed fishing for the North Sea herring in 1978 and 1979. In addition, the most stringent measures must be taken to minimise the by-catch of the North Sea herring.

One of the members, Mr Corten, objected to the above advice of the Working Group because in his opinion this advice was biased in favour of the industrial fisheries.

2.6 Juvenile Herring Fishery in the Kattegat

The catches of 0- and 1-group herring in the North Sea and Kattegat are given in Table 2.15 for 1973-76, and for the Skagerrak for 1974-77 (see Table 2.10). The Kattegat data are from the report of the Danish-Swedish Study Group on the Herring in the Kattegat (ICES, 1977b).

*OSY = Optimal Sustainable Yield

In 1973-75, the catches of 0-group herring in the Kattegat were extremely high (1.8 - 2.8 x 109 herring), and in fact the catches in the Kattegat were mainly made up of 0- and 1-group herring (85 - 95% by numbers).

The 0- and 1-group catches in the Skagerrak were also high or 60 - 85% of the total number of herring caught in that area.

It has been stated (ICES, 1977b) that "Larvae from the North Sea, and perhaps even from the areas northwest of Scotland, drift into the Skagerrak in February-April. After the metamorphosis in inshore waters in May-June, they spend about one year in the Kattegat-Skagerrak and seem to leave the area in the following spring at approximately 1½ - 1 3/4 years of age".

Since the proportion of autumn spawners is not known in the juvenile catches in the Skagerrak and the Kattegat, it is not possible to assess the effect of this fishery on the North Sea herring stock.

It should, however, be noted that there was a sharp increase in the industrial (juvenile) fishery in the Kattegat in 1957-58 and again in 1961-63, and coinciding with the possible recruitment of the strong North Sea 1956 and 1960 year classes to that area. Furthermore, after a sharp increase in catches of juvenile herring in the Skagerrak-Kattegat in 1973, a decrease in the estimated number of 2 year old herring in the North Sea was observed for 1974. This indicates that the recruitment to the adult stock in the North Sea is partially dependent on juvenile herring spending their first years of life in the Skagerrak-Kattegat.

The Working Group agreed that regardless of identification of the herring in the Skagerrak and Kattegat juvenile fishery, it was imperative for rational exploitation of the stocks concerned that this fishery be either stopped or limited to a very low level. As a further measure, the Group recommended that a minimum landing size of 18 cm should be imposed for the Kattegat.

3. CELTIC SEA HERRING

3.1 The Fishery in the 1977/78 Season

3.1.1 Catch data

As recommended in the report of the 1977 Working Group, all herring fishing was prohibited in the Celtic Sea during the 1977/78 season. In spite of this, however, nearly 3 000 tonnes were taken by Irish, Dutch, French and the Federal Republic of Germany fleets. The Dutch and the Federal Republic of Germany catches were a reported by-catch in their mackerel and sprat fisheries, while the Irish and French catches were the result of illegally directed herring fisheries. The catch data for the Celtic Sea fishery for the years and seasons since 1966/67 are given in Tables 3.1 and 3.2. The 1977 figures are provisional and some slight alterations have been made in the 1976 figures quoted in the previous report.

3.1.2 Catch in numbers by age

The age composition of the total catch in 1977/78 was calculated from Irish, French and Dutch data, using the same procedure as in previous reports. The revision of the catches during the 1976/77 season was so slight that it was not necessary to change the catch in numbers for that season. The age compositions of the catches since 1966/67 are given in Table 3.3.

3.2 Estimates of Fishing Mortality

In previous years, the only direct mortality estimates for Celtic Sea herring were those derived from Irish catches per unit effort data. However, because of the closure of the fishery during 1977/78, no estimate of F was available from this or any other source to calculate a value of input F for a cohort analysis. It was not possible, therefore, to recalculate fishing mortalities and stock sizes as in previous seasons.

3.3 State of the Stock and Advice on TAC

3.3.1 Herring survey in 1977/78

An Irish survey was carried out from September 1977 to January 1978 by a commercial vessel to obtain samples for biological analysis. and also to obtain an impression of the amount of herring appearing on the spawning grounds. The area covered was confined to the major spawning ground off Dunmore East, where traditionally herring have appeared each season.

No shoals were detected during the period mid-September to mid-January. Towards the end of January, one small shoal (which spawned in early February) was found and some samples were obtained from this. On occasions throughout this period, some illegal fishing took place. However, the skippers involved in this fishing also indicated that the "markings" obtained were very poor. Some drift netting also took place from small inshore boats, but again there was a scarcity of herring. This was particularly noticeable in the eastern section of the Celtic Sea.

Throughout the period September to February, considerable sprat fishing, both experimental and commercial, took place over the recognised herring grounds. The skippers involved reported a complete absence of any herring markings in the area.

Overall, the evidence obtained from the organised herring survey, the illegal fishing activities, both trawl and drift netting, and the experience of the sprat fishermen, would indicate that there was almost a complete absence of shoals on the spawning grounds.

3.3.2 Recruitment

Since 1970, it has been shown that there has been a very substantial decrease in the level of recruitment and the value used by the previous Assessment Group in their prognosis was reduced to 61×10^6 fish. This was the mean value during the 1972-75 period when the adult stock biomass averaged about 34 000 tonnes. Because the stock biomass in 1976 and 1977 is estimated at only 8 000 - 10 000 tonnes the most realistic estimate of recruitment to use in prognoses now would be that estimate of the last year classes to enter this fishery. These were the 1972/73 and 1973/74 year classes, which were estimated at 31.8 and 30.9 million 1-ring fish. Accordingly, the level of recruitment used in stock prognosis was 30 million fish.

3.3.3 Estimated adult stock size and advice on TAC

Because of the restrictions on the fishery in 1977/78, data on the catch in 1977/78 could not be used to estimate the stock size at 1 April 1978. The prognosis of stock size had therefore to be based on the stock size at 1 April 1977, calculated during the previous assessment. Two alternative values for the stock size at 1 April 1977 were calculated in the previous assessment, using values of 0.12 and 0.25 for $F_{1\text{-ringers}}$ in 1976/77. The stock size of 8 347 tons, based on $F_{1\text{-ringers}}$ of 0.25 in 1966/77, was considered

to be the most realistic estimate for 1 April 1977. The assumption of a recruitment of 61 million fish in 1977 was considered to be too optimistic, and this figure was changed to 30 million fish. The mean weights at age used in estimating the stock biomass were the same as those used in the previous assessment (Table 3.4).

Starting from the stock size at 1 April 1977, the catch taken in 1977/78 was used to calculate $F_{1977/78}$ and the stock size at 1 April 1978. The weighted mean F in 1977/78 was 0.30 and the stock size at 1 April 1978 was calculated at 10 200 tonnes.

The stock size has been further projected to 1 April 1979, assuming no fishing on adults in 1978/79, and an $F_{1\text{-ringers}}$ of 0.14 to account for the by-catch of juvenile herring in the sprat fishery. Recruitment of the new year classes has been set at 30 million fish each year. On these assumptions, the adult stock at 1 April 1979 is expected to increase to 14 000 tonnes.

The stock sizes in 1978 and 1979 are still considerably below the level of 40 000 tonnes considered necessary to guarantee the continuance of the stock. Under these circumstances, no fishing should be allowed on the Celtic Sea herring stock in 1979/80.

Because the adult stock is so low, even small catches can create a high mortality rate. For this reason, it is imperative that the prohibition on herring fishing in the Celtic Sea be rigorously enforced. The amount of herring taken as a by-catch in the mackerel fisheries can also result in substantial catches being taken. It is therefore recommended that all by-catches of herring be further restricted and landings of such herring prohibited.

4. HERRING IN DIVISION VIa

4.1 The Fishery in 1977

4.1.1 Catch data

The total catches reported by each country in Division VIa for the period 1968-75, together with the revised catches for 1976 and the preliminary estimates of catches taken in 1977, are given in Table 4.1. Also included are estimates of the weight of herring taken in each year in the Moray Firth young herring and sprat fisheries. The final catch figure for 1976 shows an increase of 5% over the preliminary total catch reported in 1977. The preliminary catch figure of 47 600 tonnes for 1977 represents 43% of the total for the previous year and is almost exactly the revised figure for the TAC in 1977, recommended by the Working Group at its 1977 meeting.

The revised catch figures for 1976 show a sharp decline in total catches from the 1975 level. Catches by Scotland and the Federal Republic of Germany decreased by 38% and 45% respectively, and provided the major reduction in catch. In 1977, major catch decreases were recorded by Scotland (53%), Netherlands (60%), Norway (79%) and the Federal Republic of Germany (97%). Furthermore, a number of countries which previously participated in the fishery did not fish in Division VIa in 1977; in 1976 their catches represented 10% of the total.

4.1.2 Catch in numbers by age

Estimates of the number of autumn spawning herring per age group caught in Division VIa (including the Moray Firth) in each of the years 1968-77 are given in Table 4.2. The estimates for the period 1968 to 1972 are taken from Saville and Morrison (1973) and from unpublished Scottish data on catch in numbers in the Moray Firth fishery.

The figures for 1976 were amended to correct for the revised catches for 1976. For 1977, national age composition data were available for practically the entire catch.

4.2 Fishing Mortality and Stock Estimates

Catch in numbers over the period 1957-77 from the whole of Division VIa was used as the basis for a cohort analysis. Because of changes in the fishing pattern in the Minch in 1977 (a greater concentration on small herring), mortality rates calculated from catch per arrival data in the Scottish pair-trawl fishery in the Minch were not used as in previous years to obtain an estimate of input F values. Instead, the Working Group assessed the available information on changes in effort between 1976 and 1977.

In 1977, there was evidence of a scarcity of herring in Division VIa; the Scottish fishery in the Minch took only 25 000 tonnes, i.e., about 65% of its quota of 39 000 tonnes. In addition, the Dutch fleet found herring to be much scarcer than usual by September and reported a reduced catch per unit effort in the area. For the other countries that continued to fish in Division VIa, there was little information available either on effort or whether herring were easily located.

To estimate the likely change in effort from 1976 to 1977, account was taken of that proportion of effort in 1976 which was due to countries which either discontinued their fishing in 1977 or which took very small catches. Of the remaining countries, only Scotland reported a drop in nominal effort proportional to its drop in catch. The Working Group considered that the drop in fishing intensity was not proportional to the nominal effort, and only decreased to 75% of the 1976 level. In the absence of any effort data, it was assumed that there had been no change in the effort of France and Ireland. On this basis the Working Group agreed that there had been a reduction in total fishing intensity of 30% between 1976 and 1977.

On this basis, cohort analyses were run with a range of input values of F on the fully recruited age groups to determine which most closely agreed with the apparent drop in fishing intensity between 1976 and 1977. The input F of 0.8 gave the closest agreement and indicated a weighted mean F in 1976 of 1.11. The input was therefore accepted by the Working Group.

Estimated fishing mortalities and stock in numbers per age group derived from the cohort analysis are given in Tables 4.3 and 4.4. They indicate that the values of F in both 1975 and 1976 at 0.89 and 1.11 respectively, were considerably above the corresponding input values of 0.5 and 0.7 used in the last two Working Group reports, as shown in greater detail in the text table below:

Estimated Fishing Mortalities (weighted mean)

WG reports	Fishing year					
	1972	1973	1974	1975	1976	1977
1975	0.43	0.59	0.70*			
1976	0.31	0.55	0.63	0.50*		
1977	0.44	0.53	0.76	0.76	0.70*	
1978	0.45	0.63	0.82	0.89	1.11	0.80*

* Input Fs.

In last year's report it was already shown that the value of F in 1975 was about 0.8 and considerably higher than the input value of 0.5 used in the 1976 Working Group report. For this reason, the stock in 1975 and the predicted stock in 1976 were seriously overestimated.

In the text table below the estimated stock biomass at 1 January each year derived from the cohort analysis as given in the last three years' Working Group reports, together with this year's estimates are indicated:

Estimated adult stock biomass (2-ringers and older fish) in '000 tonnes at the beginning of the year

WG reports	Fishing year						
	1972	1973	1974	1975	1976	1977	1978
1975			402*	303*	159*		
1976	704	650	433	368*	416*	357*	
1977	674	614	391	250	238*	206*	
1978	667	603	377	225	172	82*	68*

* Based on input F values.

From Table 4.3 it is clear that fishing mortality on the fully recruited age groups has been about 4 times above the $F_{0.1}$ (0.18) value in the last four years.

4.3 State of the Stock and Advice on TAC

Because of the change in fishing pattern in the Minches, the regression of catch per unit effort (c.p.u.e.) of 1-ringers from the pair-trawl fishery in the N.Minch against cohort analysis values could not be used to supply an independent estimate of the strength of the 1975 year class. The text table below compares recruitment estimates derived from the new cohort analysis, with estimates from both cohort analysis and c.p.u.e. from the 1977 Working Group report:

Year class	Estimated no. of 1-ringers x 10^{-6}		
	Previous cohort analysis	New cohort analysis	c.p.u.e.
1970	1 150	1 139	-
1971	493	469	-
1972	935	851	-
1973	1 263	921	1 890
1974	-	246	1 367

Both the 1972 and 1973 year classes are weaker than previously estimated, and the value for the 1974 year class is less than half the modal recruitment value of 650 x 10^6 that was used in the previous report in making a prognosis for 1977 and 1978.

It cannot be stressed sufficiently that, in making an assessment of the state of the herring stock in Division VIa, the Working Group had to depend entirely on a subjective assessment of the change in fishing effort between 1976 and 1977. Furthermore, the values of mortality rate, stock size and recruitment obtained are critically dependent on the value of input F chosen. To carry out a more reliable assessment it is imperative that the Working Group be provided with independent estimates of stock size or a reliable index of change in stock. In addition, in order to carry out stock predictions, reliable estimates of year class strength are needed.

The TAC of 53 000 tonnes that was recommended for 1978 in the 1977 Working Group report would imply a level of F equal to 1.5. This is clearly an unacceptable level of fishing mortality. In view of the very serious state of this stock (Figure 4) and the reduced level of recruitment, the Working Group recommends that no catches from this stock should be taken in either 1978 or 1979.

However, at the time of the 1978 meeting of the Working Group, some catches had already been taken. It was realised that before the implementation of the above recommendation could be achieved, a considerable catch could have been taken. As a result of this conclusion, it was decided to carry out a catch and stock biomass prediction to demonstrate the consequences of various levels of catch to the level of adult biomass of this stock. The basic parameters used in the prediction are given in the text table below. The mean weights at age are the same as used in the previous report. Because in the past recruitment had been so seriously overestimated, a value of 250 x 10^6 1-ringers was used in this prediction as this was the lowest of any recent estimates of this parameter. The starting value for this prediction was an adult stock size of 68 000 tonnes at 1 January 1978. The results of this prediction are shown in the text table below (in '000 tonnes):

Age (rings)	Number per age group at 1 Jan. 1978 (x 10^{-6})	Mean weight per age group (g)
1	250.0	90
2	226.4	121
3	76.2	158
4	92.1	175
5	19.6	186
6	9.6	206
7	10.1	218
8	15.9	224
≥9	3.6	224

1976	1977			1978			1979
Biomass	Biomass	F	Catch	Biomass	F	Catch	Biomass
172	82	0.80	48	68	0.18	10	88
					0.64	30	66
					1.50	53*	41
					2.00	60	32

* TAC recommended by Working Group in 1977 (ICES, 1979).

The serious decline in the herring stock in Division VIa has not been adequately predicted in previous Working Groups, although clear warnings of the downward trend were spelled out in the reports from the 1975 and 1977 meetings of the Working Group. Thus, in most years the Working Group used levels of input Fs for the cohort analysis which were too low in all the most recent years except at the 1975 meeting, and overestimated recruitment.

This sequence of events in Division VIa is closely analogous to what has happened in practically all the main herring stocks in the North-East Atlantic. This similarity strongly suggests that, in all cases when there is any evidence of a decrease in stock biomass, and

reduced recruitment, extreme caution should be taken in making stock predictions and in advising TACs. In addition, it points to the absolute necessity for independent estimates of stock size.

5. RELATIONSHIP BETWEEN HERRING STOCKS IN DIVISION VIIb,c, AND DIVISION VIa

5.1 General Review

The relationship between herring taken in Division VIa and Division VIIb,c has been discussed by previous Working Groups. It has been suggested that two separate components exist in Division VIa, and that those herring taken in the southern part of Division VIa and in Division VIIb,c constitute one management unit. The stock structure in these Divisions has assumed considerable importance because of the rise in the catches in Division VIIb,c in recent years and also because of the dramatic decline in the catches in the northern part of Division VIa. Despite the request by the 1975 Working Group for more biological information about the catches taken by fleets in the southernmost parts of Division VIa and the suggestion that a tagging programme be inaugurated in that area, little additional conclusive evidence was available to this meeting. Because the fishery takes place across the boundary between the two Divisions and the fact that Irish catch statistics have until recently been reported inaccurately, it was decided to make a separate assessment for Division VIIb,c combined with that part of Division VIa which lies south of 57°N and west of 7°W, this boundary being chosen as being the division line between the two major fisheries in Division VIa. It is important to note that this assessment makes use of data also used in the assessment of Division VIa in Section 4.2 above.

Catches from this area for the purpose of the assessment were obtained by combining the catches reported to Bulletin Statistique for Division VIIb,c (Table 5.1) together with those reported for certain fishing areas in Division VIa south of 57°N (Table 5.2).

The total catches from the combined areas were constant during the period 1967-71, averaging about 24 000 tonnes. Since then, they increased substantially and since 1972 averaged above 35 000 tonnes. However, in 1977 there was a drop to 19 000 tonnes.

Catches in number per age group were estimated from this new area from 1967 using a combination of Irish, Dutch, the Federal Republic of Germany and Polish data.

5.2 Advice on TAC

Using an input F value of 0.60 obtained from Irish and Dutch catch per effort data and the catch in number data since 1967, the cohort analysis was made.

Values of F obtained from this cohort analysis showed little fluctuation up to 1972, averaging about 0.20. Subsequent to this, they increased and since 1972 have averaged 0.51. It would, therefore, appear that this stock reacted very quickly to the increased exploitation rate in recent years in spite of the recruitment of the very strong 1969 year class. Because of the lack of information about recruitment and the dangers of overexploitation in Division VIIb,c, it would be advisable to stabilise the catches in the Division at the level of the 1967-71 period.

The Working Group therefore recommends that the TAC for herring in Division VIIb,c should be set at 7 000 tonnes for 1978 and for 1979.

6. IRISH SEA HERRING (DIVISION VIIa)

6.1 The Fishery in 1977

6.1.1 Introduction

It is convenient to consider separately the Manx stock and the Mourne stock; both of these are small spawning stocks.

Tables 6.1 and 6.2 give the annual reported catches in the North Irish Sea 1967 to 1977, by country and by stock. Table 6.3 gives the fishing effort on the Manx stock from 1967 to 1977 together with the catch per unit effort and the fishing mortality calculated by cohort analysis for these years. There are no reliable data for effort on the Mourne stock.

Catches subsequent to 1974 were influenced by annual TACs; those for 1975 and 1976 were determined nationally by the United Kingdom and applied only to the United Kingdom vessels; that for 1977 was determined by the EEC and applied to all vessels. The TACs referred to the N. Irish Sea and were not divided by stocks. The TACs recommended, the TAC set and the catch taken each year from 1975 to 1977 are given in Table 6.4, together with the fishing mortality derived from cohort analyses. F was estimated separately for the two stocks.

6.1.2 Manx stock

The TACs progressively reduced catches and fishing mortality on the Manx stock from the very high values obtaining in 1974; the biggest reduction of catch was in that of the United Kingdom. Catch and fishing mortality were still higher in 1977 than the values recommended by the Working Group (ICES, 1979). The reported catches for 1977 shown in Tables 6.1 and 6.2 are almost certainly underestimated. Weight of herring landed in this fishery is determined by counting boxes of an assumed nominal weight, usually 50 kg; extensive sampling in 1977 indicated that the nominal weight was very frequently exceeded. The catch shown in Table 6.4 has been adjusted to allow for this and therefore differs from the reported catch for 1977 shown in Table 6.1. The reported catch for 1977 was 15 414 tonnes, of which 12 431 tonnes was from the Manx stock.

6.1.3 Mourne stock

The total catch of herring from the Mourne stock in 1977 was 2 983 tonnes, made up of 1 809 tonnes for human consumption and 1 174 tonnes caught for industrial purposes. The comparable data for 1976 were 4 180 tonnes consumption and 779 tonnes industrial, giving a total of 4 959 tonnes. There was thus a reduction of about 40% in the catch of adults in 1977, largely as a result of the implementation by the EEC from August-December of the recommendation that fishing should be prohibited within 12 miles of the east coast of Northern Ireland and the Republic of Ireland, between 53°20'N and 54°40'N, made in the last report of this Working Group.

6.1.4 Catch in numbers by age

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, Ireland, Northern Ireland, and the Netherlands. Catches of Mourne herring were similarly treated

with data from landings in Northern Ireland, Ireland and England. The age composition of the Manx catch is given in Table 6.5 and that of the Mourne catch in Table 6.6. The Manx catch is heavily dependent on 1-, 2- and 3-ring fish; herring older than 3-rings made up 13% of the catch in 1977 as opposed to 24% in 1976. 1-ring herring made up a higher proportion (17%) of the catch in 1977 than usual. It may be seen from Table 6.6 that 0- and 1-ring herring were the most numerous age groups in the catch of Mourne herring.

6.1.5 The industrial fishery

The industrial fishery carried out in the northwestern part of the Irish Sea continued in 1977. Although landings taken from the fishery decreased in 1977, the amounts of herring taken as a by-catch in the sprat fishery increased considerably. Estimates of the total weights of young herring taken, based on samples obtained since 1969, are shown below.

Year	1969	1970	1971	1972	1973	1974	1975	1976	1977
Tonnes	2 210	3 796	2 715	2 251	1 913	2 190	1 573	779	1 174

The herring taken in the fishery are mainly 0- and 1-group. The 0-group fish are first taken during the summer and they are exploited until they begin to migrate offshore in the summer of the following year. Over 90% of the catches are taken in the period November to February. These herring are believed to be mainly pre-recruits to the Mourne stock, but recruits to the Celtic Sea fishery are also exploited in the fishery. The total catch expressed as numbers of herring per age group is shown in Table 6.7 for the fishery for the period 1969-77.

At the 1976 meeting, the Working Group drew attention to the quantities of young herring taken in this fishery in spite of the NEAFC Recommendation (8 c),which prohibits the landings of herring for industrial purposes (subject to a 10% tolerance limit), and in spite of the introduction of a minimum size limit of 20 cm for herring. It is extremely disappointing, therefore, to note the increased herring catches recorded in 1977. There is a prohibition on all fishing on adult herring in both the Mourne and Celtic Sea stocks designed to increase stock sizes as rapidly as possible.

In view of the critical state of both of these stocks, the Working Group strongly recommends that catching of juvenile herring in this area should be prohibited.

6.2 Fishing Mortality and Stock Estimates

6.2.1 Manx stock

Stock estimates were initiated by cohort analysis with an input F of 0.56 for all fully recruited age groups in 1977 with M = 0.1 for all ages and all years. The input F = 0.56 was obtained from a regression of F from previous cohort analyses (Working Group, 1977) on effort data 1969-76. Input F for the oldest age groups in 1976 (9 and 9+) was taken from the mean F, weighted by catch, ages 2-ring to 8-ring, determined as the analysis progressed. Annual mean Fs from this cohort analysis correlated with the effort data given in Table 6.3 for the years 1970-76 gave a correlation coefficient r = 0.92, and a new regression of cohort F on effort was obtained

which gave an estimated value of $F_{1977} = 0.60$. This value was used as an input F_{1977} for a cohort analysis by computer. Input F for the oldest age groups in earlier years than 1977 was taken from the annual weighted mean F estimated by the cohort analysis described above. A regression of output annual mean F from the cohort analysis on the effort gave

$$F = 0.000182 \text{ (effort)} + 0.203$$

From this equation estimated $F_{1977} = 0.605$ so the cohort analysis was accepted without iteration. The results of the cohort analysis are given in Tables 6.8 and 6.9. It can be seen from Table 6.9 that the stock size reached a peak value in 1974 at a level of 293 million mature fish age 2-rings and more than 2. Fishing mortality was high in 1974 and subsequent years, and the stock has declined steadily since 1974.

6.2.2 Mourne stock

For a first cohort run a mean weighted value of F was calculated for 2-7 ring fish from the estimated stock in numbers of herring at each age on 1 January 1977, which was given in the previous report of the Working Group (ICES, 1979), and the catch in number for these age groups taken in 1977. This gave F = 0.60 and the cohort was run with this input value for all age groups in 1977. Input values of F for the last age group in 1976 and earlier years were taken from the mean weighted value of F for age groups 1-8 years estimated by a cohort analysis carried out in 1977 (ICES, 1979). The stock projection of numbers of herring per age group at 1 January 1977 in that report was calculated with the following values of F_{1976}: 0-ring F = 0.58; 1-3 rings F = 0.96 and 4-8 rings F = 0.80. These were based on the values which had been estimated for 1975 from the 1977 Working Group cohort. The reason for this was that both the stock of 1-8 ring fish and the catch which was taken were almost identical in both of these two years (1975 and 1976). The new 1978 cohort (Tables 6.10 and 6.11, see also Figure 5) gave the following values for 1975: 1-3 rings F = 0.95, and 4-8 rings F = 0.83. It was concluded that both the projected stock size for age groups 2-7 rings on 1 January 1977 and the weighted value of $F_{1977} = 0.60$ for these ages would have been correct. The new cohort gave values for 0-group herring of $F_{1975} = 0.38$ and $F_{1976} = 0.23$. In view of the reduced industrial catches of 0-group herring in both years, these values were considered to be realistic. A new stock number for 1-ring herring at 1 January 1977 was then calculated from the 0-ring catch in number in 1976 and F = 0.23. This gave 38.15 million fish; thus the catch of 16.31 million 1-ringers in 1977 would have generated a value of F = 0.59. The number of 0-ring herring at 1 January 1977 was also adjusted and was based on a mean value of 60.50 million fish for the two years 1975 and 1976 from the new cohort, reduced by 25% as before, to allow for the possibility that some of the 0-group herring taken in the industrial fishery recruit to other stocks. The number of 0-ring Mourne herring at 1 January 1977 was therefore assumed to be 45.38 million fish. The industrial fishery in 1977 would have generated a mortality of F = 0.61; thus, the value of fishing mortality in 1977 was approximately the same for all age groups of herring of the Mourne stock. The stock in number at 1 January 1978 was then calculated from the catch in number per age group in 1977 and a value of F = 0.60 on all age groups in that year.

Millions of fish at 1 January 1978

Age (rings)											
0	1	2	3	4	5	6	7	8	9	10	Total
45.4	22.5	18.8	6.9	2.7	1.1	0.7	0.3	0.2	0.1	0.1	98.8

6.3 State of the Stocks and Advice on TACs

6.3.1 Manx stock

The ICES stock prediction programme was run with the following assumptions:

a) that the stock in number in 1977 was that shown by the cohort analysis (Table 6.9), except that the population age 1 was reduced because young fish surveys indicate that this year class was below modal value;

b) that relative F would be the same for all age groups 2-rings and older;

c) that weight for age would remain at 1977 values;

d) that the number of 1-group fish in 1978 and 1979 would be about 100 million fish;

e) that F_{1979} would be 0.35.

Runs were made with F_{1978} = 0.35, 0.45 and 0.55. The results are given in Table 6.12.

A TAC in 1978 of 12 000 tonnes would generate an F of 0.51, 11 000 tonnes F = 0.45, 10 000 tonnes F = 0.40 and 9 000 tonnes F = 0.35.

Figure 6 shows that there has been a sharp decline in spawning stock biomass since 1974, coinciding with high fishing mortality in 1974, 1975 and 1976. During this period there has been an increase in weight for age, so that there are fewer fish per ton.

The stock size is now heavily dependent on recruitment, and evidence from young fish surveys, though not rigorous, indicates that recruitment in 1977 and 1978 is below average, and well below the levels that built up the stock size and maintained it at a good level in the early 1970s. The Working Group considered that fishing mortalities at present levels are dangerous in view of the state of the stock and that F for 1978 and 1979 should be held to about F = 0.35 as a step towards gradually reducing F to 0.2, the necessity of which had been stressed by the Working Group before. In order to achieve this, it is recommended that the TAC for 1978 be 9 000 tonnes and for 1979 11 000 tonnes for the N.Irish Sea, including inshore bays and loughs in the area; and that prohibition on fishing for herring in the North Irish Sea for 6 weeks from the end of September, which has operated each year from 1973, be continued in 1978 and 1979. Because the inshore area is the area where the young fish occur, it is further recommended that directed herring fishing be prohibited in a zone extending 12 miles from the English coast between 53°20'N and 55°N in order to protect the juvenile component of the Manx stock.

6.3.2 Mourne stock

In the absence of any other recruitment estimate for herring of the Mourne stock it was assumed that 0-group recruitment in 1978 and 1979 would be at the level of 45.38 x 10^6 fish, discussed above. It

was also assumed that the catches of young herring would continue to be made in the industrial fishery at the same levels as in previous years. Therefore, the mean 0-ring F = 0.69 for the years 1971-75 from the cohort analysis would be appropriate for both 1978 and 1979. As part of the fishing mortality on 1-ring herring of the Mourne stock is generated in the industrial fishery and part in the consumption fishery, it was assumed that at high levels of adult fishing mortality, F = 0.50 and over, there would be no difference between F on 1-ring and older fish. This was the case in 1977, when the distribution of the catches of Mourne herring changed following the closure of the area within 12 miles of the coast of Ireland in which the spawning grounds are situated. This change has invalidated the use of the cohort mean F with age except on the 0-ring fish. At the lower level of F = 0.40 on the adults, a small increase was made to F = 0.45 on the 1-ring fish, this being the value of F generated by the industrial catch alone on 1-ring fish in 1977.

Stock predictions were made for a range of values of F in 1978 and F = 0.4 on 2-ring and older herring in 1979. One prediction was also made with F = 0.60 on all age groups in both years, and in this case the value of F was not changed at all from that calculated to have been generated by the catch taken from this stock in 1977. The results are shown in Table 6.13. The stock biomass (1-8 rings) was calculated to be 6 693 tonnes at 1 January 1977 and 6 891 tonnes at 1 January 1978.Even at the lowest values of F in 1978 and 1979 little increase in the size of the spawning stock can be expected, and at the higher values the stock size would continue to decline. These estimates of stock size are very dependent on the levels of recruitment assumed, and at the present low levels of spawning stock these may well be overoptimistic.

It is recommended that the present prohibition on fishing for herring within 12 miles of the coast of Ireland should be continued, and in view of the substantial catches of 1-ring herring of both Manx and Mourne origin which have been caught in Belfast Lough during the winter of 1977/78 it is also recommended that the closed area should be extended to the northern boundary of Division VIIa at latitude 55°00'N. The Working Group once again draws attention to the fact that there can be very little prospect of a recovery by this stock while the industrial fishery continues in the N.Irish Sea. It is imperative that this fishery is terminated at once, otherwise it is very likely that this stock will not continue to survive.

7. NORTH SEA SPRAT

7.1 Introduction

Following the procedure adopted at previous Working Group meetings, the sprat populations in the North Sea and in the Skagerrak, Kattegat and Norwegian fjords have been treated as separate stocks. Sub-divisions of the North Sea for the purpose of reporting catches followed that used in the previous reports: Division IVa was divided into western and eastern Sub-divisions at 2°E, and Division IVb at 3°E.

7.2 The Fishery in 1977

7.2.1 Catch data

The sprat catches in the North Sea for the years 1968-77 are shown in Table 7.1. The provisional total for 1977 was 304 000 tonnes, that is about half the catch taken in each of the previous two years. The main reduction in catch occurred in Division IVb, particularly in Division IVb west, while catches in Division IVa

remained at the previous level. The geographical and seasonal distribution of the sprat fishery in 1977 is shown in the text table below:

1977 catches of sprat from the North Sea

(in thousand tonnes)

Division	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
IVa west	12	-	+	31
IVa east	-	+	-	1
IVb west	78	5	10	31
IVb east	25	7	57	45
IVc	2	+		

The seasonal distribution of the fishery is demonstrated by Table 7.2, showing monthly catches taken by Danish trawlers.

In 1977, Denmark again accounted for the major part, 59%, of the total catch, although catches were reduced by about 40% compared to 1976. United Kingdom catches account for 30% of the total, and increased slightly above the level of 1976. The Norwegian and Faroese catches were reduced by 80% and 95%, respectively, compared to 1976. Catches by other European countries decreased owing to the reduced fishing activities in the North Sea in 1977.

The decrease in observed catch could chiefly arise from a real decrease in abundance with fishing effort remaining at the levels of 1975 and 1976. On the other hand, the reduction in catch could mainly arise from a real reduction in effort. In the case of USSR, Sweden, the German Democratic Republic and Poland there was a direct withdrawal of effort in 1977. Norwegian and Faroese purse-seiners found difficulty in locating suitable shoals in the first quarter of 1977 and as a consequence exploited more attractive stocks. Some of the decrease in the Danish sprat catches in 1977 could be accounted for by a transfer of effort to the sandeel fishery,which was particularly successful in 1977. In contrast, United Kingdom catches remained at about the same level, but overall it would seem that the reduction of catch reflects some reduction in effort directed at the sprat.

7.2.2 Catch in numbers by age

Catches in numbers by age in 1977 for each Sub-division of the North Sea are given in Table 7.3 and by quarter in Table 7.5. The strong 1975 year class (two year olds in 1977) was again a prominent feature especially in Division IVb, where it was the predominant age group (62% of the total). Thus, the high catches of the 0-group in 1976 mentioned in the previous report (p.21) did not lead to high catches of 1-group in 1977.

7.3 Weight at Age

Weight at age data were available from Danish and Scottish sampling in 1977. To examine whether annual differences existed, weighted mean values for each Sub-division and quarter were calculated for 1976 and 1977 (Table 7.4). The overall mean weights at age in the

catches for all Sub-divisions and quarters combined showed little difference between the two years except in the case of two year old fish. The mean weight of the 1974 year class as 2 year olds was greater than that of the 1975 year class at the same age and this was found in all quarters of the year and in all Sub-divisions.

7.4 Fishing Mortality and Recruitment Estimates

Following previous practice, a cohort analysis was carried out using annual catches in numbers from 1 July to 30 June. The catches for each season since 1967 used in the analysis are shown in Table 7.6. In the absence of data on effort for the 1976 offshore fisheries, no estimates of total mortality could be obtained from changes in catch per unit effort.

A cohort analyses was, therefore, made with an assumed natural mortality of 0.8, as used previously, and the same fishing mortality in 1977 as used for 1976 in the previous report. The results appear in Table 7.7, and are summarised to show revised estimates of recruitment in Table 7.8.

7.5 Stock Size Estimate

Owing to the small number of age groups in the population, cohort analysis gives stock size estimates of questionable reliability unless the input values of F are accurate. Since no further effort or catch per unit effort data from the offshore fisheries were available, no accurate estimate of input F could be made. No estimate of stock size in 1977 was, therefore, made from an assumption of F in 1977.

In January 1978 an acoustic survey for sprat was carried out along the east coast of England and Scotland. Although little sampling of traces was possible, the presence of commercial sprat fisheries in much of the area surveyed indicated the strong likelihood that a greater part of the acoustic targets were sprat. Using a target strength of -34 dB kg^{-1}, the biomass estimate for the total area surveyed was 795 000 tonnes. In view of the distribution of fishing at this time, it is likely that this quantity represents a high proportion of the total stock in the western half of the North Sea. In the absence of other information, the results of the survey were used as a minimum estimate of the total stock in the North Sea. Full details of the results of these surveys will be presented to the 1978 Statutory Meeting.

The acoustic estimate of stock size in January 1978 was converted to stock in number according to the age distribution in the catches and mean weights at age in the last quarter of 1977. It was, however, known from sampling carried out during the acoustic survey that the 1-group fish were mainly distributed in the northern part of the area surveyed. Very roughly, therefore, it was estimated that perhaps 170 000 tonnes of the total could be accounted for by the 1-group. The remaining 630 000 tonnes were then allocated among the remaining age groups. The resulting stock in number was:

Age	Number x 10^{-9}
2-group	33.1
3-group	21.4
4-group	2.2
5-group	0.01

For the 1-group, the 170 000 tonnes were converted to number assuming a mean weight of 1.3 g, i.e., half the mean weight of this age group

in the catch, because only the larger members of this age group are recruited to the fishery at this season. On this basis, the number of 1-group was estimated to be 128 x 10^{-9}.

7.6 Catch Prediction and Advice on TAC

At the 1977 meeting, the Working Group advised a TAC of 410 000 tonnes for 1978. From the level of landings in early 1978, it is unlikely that this TAC will be taken. However, if it is, then the seasonal pattern of fishing in 1978 will inevitably be very different from that in previous seasons. In 1977, for example, the seasonal division of catch as percentage of the annual total in each quarter was:

Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
38%	4%	21%	37%

Should a catch of 400 000 tonnes be taken in 1978, it would probably mean a big change in the seasonal pattern of exploitation; consequently, it is not possible to predict the stock at 1 January 1979.

By multiplying the catches in numbers by age for each year in Table 7.3 by the mean weights at age in Table 7.4, the contribution of each age group to the fishery can be calculated in terms of weight; over the period 1974-77 the mean percentage contribution from each age group was:

Age groups					
0	1	2	3	4	5
1.0%	32.7%	51.2%	13.6%	1.4%	0.2%

To carry out a prognosis to set a TAC for the current year (1978), one knows nothing about the abundance of 0-group sprats and one has only a preliminary estimate of the 1-group. Thus, on average 33.7% of the projected TAC is liable to some error.

To carry out a prognosis into next year (1979), however, one has no information about the 0- and 1-groups (33.7%) and only a very provisional estimate of the abundance of the 2-group (a further 51.2%). Since recruitment as shown in Table 7.8 can vary by a factor of over 5, any prognosis based on average values of recruitment could be in serious error.

On the basis of the acoustic survey estimate, a catch prediction was carried out for 1978. Using an M of 0.8, an F on 2-group and older of 0.53 (as advocated in the previous report) and a proportionately lower F on the 1-group of 25% that on the older fish, i.e., 0.13, the catch in 1978 would be 290 000 tonnes. This is appreciably lower than the TAC advised by the Working Group at its previous meeting. However, because the acoustic survey estimate of stock size is an estimate of only part of the stock, there is no reason to advise a revision of the TAC for 1978.

The Working Group recommends that a precautionary TAC of 400 000 tonnes be set for 1979 until a more reliable estimate of stock size can be obtained.

8. SPRAT IN DIVISION IIIa AND THE NORWEGIAN FJORDS

8.1 The Fishery in 1977

The catches of sprat in Divisions IIIa, IVa east and IIa for the period 1968-77 are given in Tables 8.1 and 8.2. The Norwegian catch is entirely taken within the fjords by purse-seine. The Swedish catch is partly taken in coastal areas 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 1977, the total catch in the Skagerrak was 9 337 tonnes, and thus lower than the catch of the preceding year, 16 200 tonnes. In the Kattegat, however, the catch in 1977 was 56 906 tonnes, which is a considerable increase compared to the catch of 1976, which amounted to 40 500 tonnes. The Norwegian fjord catches (see Table 8.2) increased from 6 100 tonnes in 1976 to 12 000 tonnes in 1977, an increase occurring both north and south of 62°N.

8.2 Stock Assessment and Advice on TAC

As shown in Table 8.3, the catches are dominated by 1-group sprat. Therefore, any TAC or catch projection will be very dependent on the strength of the 1-group.

To get a first estimate of the recruitment, Swedish data from the Young Herring Surveys were used. Mean catch per hour of 1-group sprat from a standard area composed of four statistical squares in the Kattegat are given together with total landings for Division IIIa for the period 1974-77. (No data are available yet from the Survey in 1978.)

Year	1974	1975	1976	1977
Catch/hour	1 553	5 431	1 809	3 594
Landings in Div. IIIa ('000 tonnes)	70.8	98.7	61.3	67.5

Although the time series is short and based on a limited number of hauls, it suggests a co-variation.

The year class that will constitute the basis for the sprat fishery in 1979 will not emerge before the autumn in 1978. There are no possibilities to assess the strength of this year class until the beginning of 1979.

The only possibility to set a TAC based on some factual evidence would be to change the period for which a TAC is valid from the calendar year to a July-June period. This would enable an assessment to be made only 3-4 months prior to the new regulation period.

Without any biological basis for forecasting stock size in 1979, the Working Group can only suggest a TAC at the level of the average catch of 1976-77, i.e., 65 000 tonnes (excluding any Norwegian fjord).

9. SHORTCOMINGS AND GAPS IN DATA REQUIRED FOR STOCK ASSESSMENT PURPOSES - FUTURE RESEARCH REQUIREMENTS

As larval surveys have now become the main source of information on the size of the adult stock both in the North Sea and in Division VIa, the utmost effort should be spent in obtaining a complete coverage of spawning areas and periods, and also in interpreting the results of the surveys. The Working Group was of the opinion that a better balance of sampling effort should be obtained between the North Sea and Division VIa.

In 1977, some duplication of effort occurred in the Shetland/Orkney area east of 4°W, whereas no data on larval production west of 4°W were available to the Working Group. The coverage of the various spawning areas could probably also be improved by a regular radio-contact between the ships participating in the surveys during the same period.

It is recommended that the Working Group on North Sea Herring Larval Surveys is transformed into a Working Group for all herring larval surveys south of 62°N. This new Working Group should be convened at the earliest possible occasion, in order to make plans for a complete coverage of the spawning areas and periods in both the North Sea and Division VIa, starting from the 1978 season.

In order to facilitate further improvement of correlating larval abundance and spawning stock size it is recommended that fecundity studies be undertaken for the main spawning populations of herring in the North Sea.

Because of the prohibition of fishing in the Celtic Sea and the subsequent lack of any catch per effort data, it is essential to obtain direct estimates of stock size based on alternative methods. The Working Group recommends that larval surveys be initiated in the Celtic Sea during and after the spawning period.

It is recommended that attempts should be made to investigate whether the behaviour and distribution of the North Sea herring at some time of the year does not make it possible to carry out an abundance echo survey. It is suggested that regarding the spawning population north of Scotland an echo survey could be successfully carried out either prior to spawning, in July or on wintering concentrations if these could be located.

In view of the possibility that recruitment of the North Sea herring may to some extent be dependent on exploitation of juvenile herring in the Skagerrak and Kattegat, it is recommended that biological investigations be initiated to determine the mixing of stocks in these areas.

It is recommended once again that steps be taken to clarify stock identification and mixing of stocks in Division VIa and Division VIIb,c.

In view of the necessity to monitor changes in the abundance of North Sea sprat it is recommended that acoustic surveys, e.g., in January, should be coordinated so that the entire area of sprat distribution in the North Sea (as shown in the stock review report) be surveyed simultaneously. Similarly, it is recommended that acoustic surveys for sprat be carried out in the Skagerrak and Kattegat.

10. SUMMARY

10.1 The catch of herring from the North Sea in 1977 was 41 283 tonnes[1] of which about 10 000 tonnes were taken as by-catch, mainly in the industrial fisheries. The major event affecting the fishery was the partial fishing ban imposed from 1 March 1977. The catch taken in Skagerrak in 1977 was (preliminary) 37 587 tonnes and had increased sharply from the 1976 figure of 15 550 tonnes.

10.2 Using catch data and F values for 1976 and taking account of the 1977 catches the spawning stock in 1977 was calculated to be of the order of 180 000 tonnes. This is 25 000 tonnes (about 16%) above the estimated spawning stock size in 1976. The results of the larval surveys indicated an increase in spawning stock of 36 000 tonnes in the northern and central North Sea in 1977 with a total spawning stock of 137 000 tonnes for these two areas combined.

10.3 The results from the International Young Herring Surveys show that the 1975 year class is very weak and that the 1976 year class, although slightly better, continues the series of weak year classes recruiting to the North Sea herring in recent years. The 1977 catches of the 1975 and 1976 year classes in the NEAFC Recommendation 2 fisheries were at a similar level to those of the corresponding age groups in 1976. They are similar to the estimated values given in the previous report made on the assumption that the fishing mortality rates generated by the Recommendation 2 fisheries for other species would continue at the same levels unless further restrictions were introduced in 1977.

The estimates of total fishing mortality on 0-group in 1977 was F = 0.17 and on 1-group F = 0.13. These mortality rates were almost entirely generated by the by-catch in the NEAFC Recommen- 2 fisheries.

10.4 The available evidence regarding the state of the North Sea herring confirms that although the present management regime has prevented any further depletion of the stock, it is still at a very low level of abundance as predicted in the last year's report and there is, so far, no evidence of improved recruitment.

In the light of this the Working Group must reiterate their advice that the spawning stock should be rebuilt as quickly as possible to the desired level of 800 000 tonnes. Prohibition of all fishing for the remainder of 1978 and in 1979 would allow the spawning stock to recover to about half the minimum desirable level. However, the further rate of recovery would depend upon improvement in the strength of the incoming year classes and adequate management.

In the light of this, and in the absence of improvement in the recruitment level, it must be quite clear that the Working Group can only recommend that there should be no directed fishing for the North Sea herring in 1978 and 1979. In addition, the most stringent measures must be taken to minimise the by-catch of the North Sea herring.

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1) Preliminary figure; the final figure was 46 010 tonnes.

10.5 In recent years very high catches of 0- and 1-group herring have been taken in the Skagerrak-Kattegat area. There is a strong probability that some of these fish would have recruited to the North Sea herring. It is imperative for rational exploitation of the stocks concerned (North Sea and Skagerrak-Kattegat) that this fishery on juvenile herring be either stopped or limited to a very low level. As a further measure, the Group recommended that a minimum landing size of 18 cm should be imposed for the Kattegat.

10.6 In the Celtic Sea all herring fishing was prohibited during the 1977/78 season. In spite of this almost 3 000 tonnes were taken either due to illegal fishing or recorded as by-catch. The results of extensive herring surveys which were carried out from September 1977 to January 1978 support the Working Group's previous assessment that the Celtic herring stock is now in a depleted state and consequently it is recommended that all fishing of Celtic Sea herring should be prohibited in 1978/79.

It is imperative that the prohibition on herring fishing in the Celtic Sea be rigorously enforced because even small catches could create a high mortality rate while the stock is in such a depleted state as at present. In order to prevent illegal catches being recorded as by-catch it is further recommended that the landing of by-catches of herring from this area be prohibited.

10.7 The total international catch in Division VIa in 1976 is now seen to be 5 000 tonnes (5%) greater than the preliminary figure for that given in the previous report. The preliminary figure for 1977 of 47 600 tonnes[1] is only about 43% of the total for the previous year and happens to be almost exactly the revised figure for the TAC in 1977 recommended by the Working Group at its 1977 meeting. Since 1974 the United Kingdom inshore fishery has declined from about 107 000 tonnes to about 58 000 tonnes in 1976 and to only 25 000 tonnes in 1977. The total catch in the offshore fishery also declined sharply in 1977.

10.8 In 1977 a number of management decisions resulted in the total withdrawal of effort by some countries and a considerable reduction in catches of others. It is quite clear that there was thus some decrease in fishing effort in Division VIa. In order to estimate this change in effort, account was taken of that proportion of the total fishing effort in 1976 which was due to countries which either discontinued their fishing in 1977 or took very small catches. Of the countries fully participating in the fishery in 1977 only Scotland reported a drop in nominal effort proportional to the drop in catch and the Working Group considered that this corresponded to a 25% drop in fishing intensity. For the total fishery in Division VIa it was estimated that there had been a reduction in total fishing intensity of 30% between 1976 and 1977.

In order to obtain this reduction in fishing mortality between 1976 and 1977, the input F for 1977 in the cohort analyses could not be lower than about 0.8 which would imply a weighted mean F in 1976 of 1.11. On this basis it is clear that the fishing mortality rates have been underestimated in recent years and that this has resulted in overestimation of the stock size and recruitment.

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1) The final figure was 48 568 tonnes.

This sequence of events in Division VIa is closely analogous to what has happened in practically all the main and now depleted herring stocks in the northeast Atlantic.

10.9 A prognosis based on the new estimates results in an adult stock biomass at 1 January 1978 of 68 000 tonnes. This is only about 13% of the average stock abundance in 1966-73. In view of this and the apparent drastic reduction in recruitment, the Working Group recommends that in Division VIa no catches of herring should be taken either in the remainder of 1978 or in 1979.

At the time of the Working Group meeting it was estimated that already about 10 000 tonnes had been taken in 1978 which would have generated a fishing mortality of F = 0.18, on an annual basis. In the event of no other catches being taken there would be a slight recovery of the adult biomass to 87 000 tonnes at the beginning of 1979 assuming recruitment at a level of 250 million 1-ringers at 1 January 1978. Catches in 1978 of 30 000 tonnes or greater would on the other hand result in further decline of the stock.

10.10 During the period 1972-76 recorded catches in Divisions VIIb-c increased considerably from approximately 4 000 tonnes to 18 000 tonnes. In 1977, however, there was a drop to 12 000 tonnes.

The relationship between the herring taken in Divisions VIIb-c and the southern part of Division VIa has been discussed in previous reports. The data available, although incomplete, would suggest that these populations are indistinguishable and should be treated as one management unit. In the absence of any new evidence on this matter, an assessment was carried out for Divisions VIIb-c combined with that part of Division VIa which lies south of latitude 57°N and west of longitude 7°W; this boundary was chosen as being the boundary line between two of the major fisheries in Division VIa. During the period 1972-76 recorded catches in this area were at the relatively high level of about 35 000 tonnes. In 1977 there was, however, a sharp drop to about 19 000 tonnes. From this assessment it would appear that prior to 1972 the fishing mortality was at the level of F = 0.2 but rose to F = 0.5 as soon as fishing activities were increased in 1972 and later years. It would therefore appear that the herring population(s) in this area reacted very quickly to the increased exploitation rate in recent years.

The Working Group considered that more research on stock structure, migration and recruitment should be conducted before the setting up of a new management unit could be justified. Nevertheless, due to the probable diversion of effort from Division VIa the Working Group recommends that a precautionary TAC in Divisions VIIb-c be set at 7 000 tonnes for 1978 and 1979.

10.11 In the North Irish Sea (Division VIIa) preliminary catch figures indicate that the catches taken from the Manx and Mourne stocks decreased by about 3 800 tonnes and 2 000 tonnes respectively. The total reported catch for the Division in 1977 was 15 414 tonnes as compared with the TAC recommended by the Working Group of 12 000 tonnes. It was noted that in 1977 the catches of the Manx herring included a higher proportion of 1-ringed fish than in previous years and that herring older than 3 rings only made up 13% of the catches in 1977. It is quite clear from the present evidence that the Manx stock has been on a downward trend during the last few years and the need for a reduction in the exploitation rate is becoming acute if the stock is not to be brought to the same state of depletion as other herring stocks in the Northeast Atlantic.

10.12 The abundance of the Mourne stock is still at a very low level and the Working Group once again draws attention to the fact that there can be very little prospect of recovery by this stock while the industrial fishery (contra all regulations) continues in the N.Irish Sea. It is imperative that this fishery is terminated at once, in order to safeguard the continued existence of the Mourne stock.

10.13 The Working Group recommended that the TAC for 1978 be 9 000 tonnes and for 1979 11 000 tonnes for the N.Irish Sea, including inshore bays and loughs in the area; and that the prohibition on fishing for herring in the N.Irish Sea for 6 weeks from the end of September, which has operated each year from 1973, be continued in 1978 and 1979. Because the inshore area is the area where the young fish occur, it is further recommended that directed herring fishing be prohibited in a zone extending 12 miles from the English coast between 53°20'N and 55°N in order to protect the juvenile component of the Manx stock.

It is also recommended that the present prohibition on fishing for herring within 12 miles of the coast of Ireland should be continued, and in view of the substantial catches of 1-ring herring of both Manx and Mourne origin which have been caught in Belfast Lough during the winter of 1977/78, it is also recommended that the closed area should be extended to the northern boundary of Division VIIa at latitude 55°00'N.

10.14 The total international catch of North Sea sprat in 1977 of 304 000 tonnes was only about half the catch taken in each of the previous two years and only about 62% of the TAC recommended by the Working Group (1977 meeting). This drop in catch could be at least partly accounted for by direct withdrawal of fishing activity by several nations as well as diversion of effort to other stocks (i.e., sandeel and capelin). Since no further effort or catch per unit effort data from the offshore fisheries were available, no estimate of exploitation rate could be made for 1977 and no valid estimate of the 1977 stock size could be calculated on that basis.

In January 1978 an acoustic survey for sprat was carried out along the east coast of England and Scotland. Although little sampling of traces was possible, the presence of commercial sprat fisheries in much of the area surveyed, indicated the strong likelihood that a greater part of the acoustic targets were sprat. Using a target strength of -34 dB kg^{-1}, the biomass estimate for the total area surveyed was about 800 000 tonnes. In view of the distribution of fishing at this time, it is likely that this quantity represents a high proportion of the total stock in the western half of the North Sea. In the absence of other information, the results of the surveys were used as a minimum estimate of the total stock in the North Sea.

On the basis of the acoustic survey estimate a catch prediction was made for 1978 using the same criteria as in the previous report (M = 0.8, F on 2 group and older = 0.53). From this calculation the catch in 1978 would be 290 000 tonnes. This is appreciably lower than the TAC advised by the Working Group at its previous meeting. However, because the acoustic survey estimate of stock size is an estimate of only part of the stock, there is no good reason to advise a revision of the TAC for 1978. Because recruitment in 1978 cannot be reliably predicted, no calculated TAC can be advised for 1979, but the Working Group recommends that a precautionary TAC of 400 000 tonnes be set until a more reliable estimate of stock size can be obtained.

10.15 The total sprat catch from Division IIIa and the Norwegian fjords in 1977 at 79 500 tonnes was somewhat higher than that taken (67 400 tonnes) in 1976. The catches in Kattegat and the Norwegian fjords increased while those in the Skagerrak decreased from 17 400 tonnes in 1976 to 10 500 tonnes in 1977.

As in previous years the Working Group did not have biological data to forecast stock strength in 1979. Without any biological basis for forecasting stock size in 1979, the Working Group can only suggest a TAC at the level of the average catch of 1976-77, i.e., 65 000 tonnes (excluding any Norwegian fjords).

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10. RÉSUMÉ - en français

10.1 La capture de hareng de la Mer du Nord en 1977 a été de 41 283 tonnes[1] dont environ 10 000 tonnes furent prises en tant que captures accessoires, principalement dans les pêcheries dites "industrielles". L'évènement marquant de l'exploitation fut l'interdiction partielle de pêche, imposée à partir du 1er mars 1977. La capture en provenance du Skagerrak en 1977 s'est élevée à 37 587 tonnes (donnée provisoire) en nette augmentation par rapport à celle de 1976 qui était de 15 550 tonnes.

10.2 D'après les données de captures et les valeurs de mortalité par pêche en 1976 et compte tenu des prises de 1977, le stock de géniteurs en 1977 serait d'environ 180 000 tonnes. Ceci le situe à 25 000 tonnes (environ 16%) au-dessus de la valeur estimée en 1976. Les résultats des campagnes d'inventaires de larves traduisent une augmentation du stock de géniteurs de 36 000 tonnes dans le nord et le centre de la Mer du Nord en 1977, pour un stock global de géniteurs de 137 000 tonnes pour ces 2 régions combinées.

10.3 Les résultats de la campagne internationale d'inventaire de jeunes harengs indiquent que la classe d'âge de 1975 est très faible et que celle de 1976, bien que légèrement meilleure, se situe dans la série des classes d'âge faibles recrutant en tant que hareng de la Mer du Nord au cours des dernières années. Les captures de ces classes d'âge en 1977, dans les pêcheries s'inscrivant dans le cadre de la Recommandation 2 de la NEAFC se sont situées à un niveau identique à celui des prises des groupes d'âge correspondants en 1976. Elles correspondent aux valeurs données dans le rapport précédent établi dans l'hypothèse que les pêcheries, sous Recommandation 2 pour les autres espèces, se poursuivraient sans que de nouvelles restrictions aient été introduites en 1977.

Les estimations de la mortalité totale par pêche pour le groupe 0 en 1977 ont été de F = 0.17 et pour le groupe 1 de F = 0.13. Ces taux de mortalité ont été presque entièrement engendrés par les captures accessoires de pêcheries sous Recommandation 2 de la NEAFC.

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1) Donnée provisoire; la valeur définitive est de 46 010 tonnes.

10.4 Compte tenu des preuves disponibles concernant l'état du hareng de la Mer du Nord, il se confirme que, si le régime de gestion actuel a bien empêché une dégradation complémentaire du stock, son abondance se situe à un niveau très bas comme il avait été prédit dans les rapports des dernières années et il n'y a pas, jusqu'à présent, de signes d'amélioration du recrutement.

A la lumière de ceci, le Groupe de Travail doit réitérer son avis portant sur la nécessité de relever aussi rapidement que possible le stock de géniteurs au niveau souhaité de 800 000 tonnes. L'interdiction de toute pêche pour le restant de 1978 et en 1979 permettrait au stock de géniteurs de se reconstituer à environ la moitié de ce minimum désirable. Cependant, la vitesse future du rétablissement dépendrait de l'amélioration de la force des classes d'âge à venir et d'une gestion adaptée.

En conséquence et en l'absence d'amélioration du recrutement, il devient évident que le Groupe de Travail ne peut que recommander l'interdiction de la pêche dirigée sur le hareng de la Mer du Nord pour 1978 et 1979. En complément, les mesures les plus strictes doivent être prises afin de minimiser les captures accessoires de hareng de la Mer du Nord.

10.5 Au cours des dernières années, des captures importantes de hareng des groupes 0 et 1 ont été effectuées dans la région du Skagerrak et du Kattegat. Il est hautement probable qu'une fraction de ces poissons aurait été recrutée comme hareng de la Mer du Nord. Il est impératif, pour une exploitation rationnelle des stocks concernés (Mer du Nord et Skagerrak-Kattegat) que cette exploitation de harengs juvéniles soit arrêtée ou limitée à un très faible niveau. Comme mesure supplémentaire, le Groupe de Travail recommande qu'une taille minimale au débarquement de 18 cm soit imposée pour le Kattegat.

10.6 En Mer Celtique, toute pêche du hareng était interdite durant la saison 1977/78. Malgré ceci, presque 3 000 tonnes furent capturées consécutivement à une exploitation illégale ou dans le cadre de prises accessoires. Les résultats d'extensives campagnes d'inventaires de hareng qui furent effectuées de septembre 1977 à janvier 1978 confirment l'évaluation précédente du Groupe de Travail qui met en évidence que le stock de hareng de la Mer Celtique est à présent dans un réel état d'épuisement; en conséquence, il est recommandé que toute pêche de hareng de la Mer Celtique soit interdite en 1978/79.

Il est impératif que cette interdiction de la pêche du hareng de la Mer Celtique soit rigoureusement appliquée, car même des pêches de faible importance pourraient engendrer un taux de mortalité élevé, en raison de l'état d'appauvrissement dans lequel se trouve le stock à l'heure actuelle. Afin d'éviter que toute capture illégale ne soit enregistrée comme prise accessoire, il est de plus recommandé que le débarquement de captures accessoires, en provenance de cette région, soit interdit.

10.7 La capture totale internationale dans la Division VIa en 1976 est maintenant supérieure de 5 000 tonnes (5%) à la valeur provisoire donnée dans le rapport précédent pour cette région. La donnée provisoire de 47 600 tonnes[1]) pour 1977 ne représente que 43% de

1) La valeur définitive est de 48 568 tonnes.

la capture globale de l'année dernière et correspond presque exactement à la valeur réajustée comme Prise Maximale Autorisée (PMA) par le Groupe de Travail lors de sa réunion de 1977. Depuis 1974, la pêcherie côtière du Royaume-Uni a chuté d'environ 107 000 tonnes à 58 000 tonnes en 1976 et seulement 25 000 tonnes en 1977. La capture totale de la pêcherie hauturière a, elle aussi, diminuée nettement en 1977.

10.8 En 1977, plusieurs décision de gestion entraînèrent la disparition totale de l'effort de pêche de quelques pays et une réduction considérable des captures de certains autres. Il est assez évident qu'il y eut ainsi une diminution de l'effort de pêche dans la Division VIa. Afin de quantifier cette modification de l'effort, il fut tenu compte de la proportion de l'effort de pêche total exercé en 1976, par ces pays qui arrêtèrent leur exploitation en 1977 ou ne réalisèrent que de très faibles captures. Des nations qui participèrent pleinement à l'exploitation en 1977, seule l'Ecosse a rapporté une diminution de l'effort nominal proportionnelle à celle des captures et le Groupe de Travail a considéré que cela correspondait à une chute de 25% de l'intensité de pêche. En conséquence, on estime que pour la pêcherie globale dans la Division VIa, il y eut entre 1976 et 1977 une réduction globale de l'intensité de pêche totale de 30%.

Afin de convertir cette diminution en terme de mortalité par pêche entre 1976 et 1977, le F d'entrée de 1977 pour l'analyse de cohorte ne pourrait être inférieur à environ 0.8, ce qui impliquerait un F moyen pondéré en 1976 de 1.11. Sur cette base, il est clair que les taux de mortalité par pêche ont été sous-estimés ces dernières années et qu'il en est résulté une surestimation de la taille du stock et du recrutement.

Cette série d'évènements dans la Division VIa présente une analogie étroite avec ce qui s'est passé pour pratiquement tous les principaux stocks de harengs au nord-est de l'Atlantique et qui sont maintenant appauvris.

10.9 Il résulte d'une prévision basée sur les nouvelles estimations que la biomasse du stock d'adultes au ler janvier 1978 est de 68 000 tonnes. Ceci représente environ 13% seulement de l'abondance moyenne du stock pour la période 1966-73. En raison de ce fait et de la réduction évidente et très importante du recrutement, le Groupe de Travail recommande que dans la Division VIa, aucune capture de hareng ne soit effectuée pour le restant de 1978 ou en 1979.

Lors de la réunion du Groupe de Travail, il a été estimé qu'environ 10 000 tonnes avaient déjà été capturées en 1978, ce qui aurait engendré une mortalité par pêche de F = 0.18 sur une base annuelle. Dans l'éventualité où aucune autre prise ne serait effectuée, il s'en suivrait une légère reconstitution de la biomasse adulte qui atteindrait 87 000 tonnes au début de 1979 sur l'hypothèse d'un recrutement de 250 millions de poissons d'un anneau au ler janvier 1978. Par contre, des captures de 30 000 tonnes ou plus auraient pour conséquence une diminution complémentaire du stock.

10.10 Durant la période 1972-76, les captures enregistrées en provenance des Divisions VIIb-c ont augmenté considérablement passant d'environ 4 000 tonnes à 18 000 tonnes. En 1977, cependant, elles tombèrent à 12 000 tonnes.

La connexion entre le hareng pris dans les Divisions VIIb-c et la zone méridionale de Division VIa, a été traitée dans de précédents rapports. Les données disponibles, bien qu'incomplètes, suggéraient que ces populations sont indissociables et pourraient être traitées comme une seule unité de gestion. En l'absence d'aucune nouvelle preuve en la matière, une évaluation fut effectuée pour les Divisions VIIb-c combinée avec cette fraction de la Division VIa qui se situe au sud de la latitude 57°N et à l'ouest de la longitude 7°W; cette limite fut choisie comme étant la ligne de séparation entre les deux principales pêcheries dans la Division VIa. Pendant la période 1972-76, les captures enregistrées dans cette zone se situaient à un niveau relativement élevé de 35 000 tonnes. En 1977, cependant, elles chutèrent à 19 000 tonnes environ. De cette évaluation, il ressortirait que la mortalité par pêche qui était d'environ F = 0.2 avant 1972, s'est élevé à F = 0.5 dès que l'exploitation s'accrût à partir de cette date. Il semblerait, en conséquence, que la population (ou les populations) de hareng, dans cette région réagit (ou réagissent) très rapidement au taux d'exploitation élevé de ces dernières années.

Le Groupe de Travail a considéré que davantage de recherches sur la structure du stock, la migration et le recrutement devraient être effectuées avant que ne soit justifiée l'instauration d'une nouvelle unité de gestion. Néanmoins, en raison d'un éventuel transfert de l'effort depuis la Division VIa, le Groupe de Travail recommande qu'une PMA (PMA: Prise Maximale Autorisée = TAC) de précaution dans les Divisions VIIb-c soit fixée à 7 000 tonnes pour 1978 et 1979.

10.11 Dans le nord de la Mer d'Irlande (Division VIIa), les valeurs provisoires des captures indiquent que celles originaires des stocks de Mourne et de l'Ile de Man ont décru respectivement d'environ 2 000 et 3 800 tonnes. La prise globale rapportée pour cette Division en 1977 a été de 15 414 tonnes comparée à la PMA de 12 000 tonnes recommandée par le Groupe de Travail. Il a été noté qu'en 1977, les captures de hareng de l'Ile de Man englobaient une plus forte proportion de poissons du groupe 1 que les années précédentes et que les harengs de plus de 3 anneaux constituaient seulement 13% de la capture (en 1977). Il est maintenant évident que le stock de l'Ile de Man tend à diminuer depuis ces dernières années et le besoin d'une réduction du taux d'exploitation est devenu aigu, si l'on veut pas voir le stock se retrouver dans la même situation d'appauvrissement que d'autres stocks de hareng du Nord-est de l'Atlantique.

10.12 L'abondance du stock de Mourne est encore très faible et une nouvelle fois le Groupe de Travail attire l'attention sur l'absence de perspective pour ce stock tant que continue (contre toutes règlementations) son exploitation à des fins industrielles dans le nord de la Mer d'Irlande. Il est impératif que cette exploitation soit enfin arrêtée afin de sauvegarder l'existence du stock de Mourne.

10.13 Le Groupe de Travail recommande des PMA de 9 000 tonnes pour 1978 et 11 000 tonnes pour 1979, pour la pêche dans le nord de la Mer d'Irlande, valeurs incluant les captures effectuées dans les baies côtières et les "loughs" de cette région et l'interdiction de la pêche du hareng dans le nord de la Mer d'Irlande pour 6 semaines à partir de la fin septembre; cette interdiction en vigueur chaque année depuis 1973 sera reconduite en 1978 et 1979. Comme la zone côtière correspond à un secteur où les juvéniles sont abondants,

il est de plus recommandé que la pêche dirigée sur le hareng soit interdite dans la zone des 12 milles au large des côtes anglaises entre 53°20'N et 55°N afin de protéger la composante juvénile du stock de l'Ile de Man.

Il est également recommandé de maintenir l'actuelle interdiction de pêche du hareng à l'intérieur des 12 milles côtiers de l'Irlande et, en raison des captures importantes de hareng d'1 anneau, originaires aussi bien de l'Ile de Man que de Mourne, captures effectuées dans la Baie de Belfast au cours de l'hiver 1977/78, il est encore recommandé que le cantonnement soit étendu jusqu'à la limite nord de la Division VIIa, à la latitude de 55°N.

10.14 La prise globale internationale de sprat en Mer du Nord en 1977 qui a été de 304 000 tonnes n'a représenté que la moitié des captures effectuées au cours de chacune des deux dernières années et seulement 62% environ de la PMA recommandée par le Groupe de Travail (réunion de 1977). Cette chute de la capture pourrait être, pour partie, la conséquence d'une cessation directe de l'activité halieutique de plusieurs nations ainsi qu'également d'un transfert de l'effort vers d'autres stocks (lançons, capelan, par exemple). Puisque aucune donnée complémentaire d'effort ou de capture par unité d'effort des pêcheries hauturières n'était disponible, le taux d'exploitation pour 1977 n'a pu être estimé et la taille du stock en 1977 n'a pu être calculée avec quelque certitude sur cette base.

En janvier 1978, une campagne d'inventaire acoustique a été effectuée sur le sprat le long de la côte orientale de l'Angleterre et de l'Ecosse. Bien que l'échantillonage des traces effectué fut faible, la présence de pêcheries commerciales de sprat sur la majorité de la région couverte indiquait, avec une forte probabilité, que la plus grande part des échos rencontrés était constituée de sprat. En utilisant un indice de réflexion de -34 dB kg^{-1}, on a estimé que la biomasse de la région inventoriée était de 800 000 tonnes environ. En fonction de la distribution de la pêche à cette époque, il est probable que cette quantité représente une forte proportion du stock global dans la moitié occidentale de la Mer du Nord. En l'absence de toute autre information, les résultats des campagnes d'inventaires furent utilisés comme estimation minimale du stock total de la Mer du Nord.

Sur la base de l'estimation de la campagne d'inventaire acoustique, une prévision de capture pour 1978 fut effectuée en utilisant les mêmes critères que dans le précédent rapport (M = 0.8, F = 0.53 pour les poissons du groupe 2 et plus). D'après ce calcul, la capture en 1978 serait de 290 000 tonnes. Ceci est nettement inférieur à la PMA conseillée par le Groupe de Travail à sa réunion précédente. Cependant, puisque l'estimation de la taille du stock dérivée de la campagne d'inventaire acoustique ne concerne qu'une partie de celui-ci, il ne semble pas nécessaire de conseiller une révision de la PMA pour 1978. En raison de l'impossibilité de prédire avec certitude le recrutement en 1978, aucune PMA calculée ne peut être conseillée pour 1979, cependant le Groupe de Travail recommande qu'une PMA de précaution de 400 000 tonnes soit fixée jusqu'à ce qu'une estimation de l'importance du stock plus digne de confiance puisse être obtenue.

10.15 En 1977, la capture totale de sprat de 79 500 tonnes, en provenance de la Division IIIa et des fjords norvégiens a été sensiblement supérieure à celle de 1976 (67 400 tonnes). Les prises dans le

Kattegat et les fjords norvégiens ont augmenté alors que celles dans le Skagerrak ont baissé de 17 400 tonnes en 1976 à 10 500 tonnes en 1977.

Comme pour les années précédentes, le Groupe de Travail ne possédait pas les données biologiques permettant de prévoir l'importance du stock en 1979. Ne disposant d'aucune base scientifique pour prévoir la taille du stock en 1979, le Groupe de Travail peut seulement suggérer la fixation d'une PMA à partir de la capture moyenne de 1976-77, soit environ 65 000 tonnes (fjords norvégiens exclus).

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Table 2.1 HERRING. Catch in tonnes 1968-77.
North Sea (Sub-area IV and Divisions VIId and e) by country.
Skagerrak (Division IIIa excl. Kattegat) total catch.

(Data provided by Working Group members)

Country/Year	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	134	468	1 200	681	1 337	2 160	603	2 451	1 430	-
Denmark	163 100	180 260	133 331	185 393	213 738	174 254[a]	61 728	115 616	34 841	12 769
Faroe Islands	49 995	40 640	58 365	45 524	48 444	54 935[b]	26 161[b]	25 854	14 378	6 942
Finland	-	-	-	-	-	-	-	-	1 034	-
France	12 852	15 307	11 482	11 408	12 901	22 235	12 548	20 391	14 468	1 246
German Dem.Rep.	-	-	290	475	127	1 728	3 268	2 689	2 623	-
Germany,Fed.Rep.	21 216	12 798	7 150	3 570	3 065	10 634[c]	12 470	6 953	1 617	216
Iceland	44 489	19 997	22 951	37 171	31 998	23 742[d]	29 017	16 286	9 412	-
Netherlands	22 306	29 769	46 218	32 479	24 829	34 070	35 106	38 416	20 146	4 134
Norway	211 904	114 938	193 102	125 842	117 501	99 739	40 975	34 183	27 386	2 849
Poland	11 954	9 221	5 057	2 031	2 235	5 738	9 850	7 069	7 072	-
Sweden	88 061	33 109	34 670	36 880	7 366	4 222[e]	3 561	6 858	4 777	1 751
UK(England)[f]	5 128	6 666	9 702	4 113	394	2 268	5 699	6 475	9 827	3 224
UK(Scotland)[f]	16 477	22 053	21 885	25 073	17 227	16 012	15 034	8 904	15 015	8 152
USSR	70 029	61 549	18 078	9 500	16 386	30 735	18 096	20 653	10 935	-
Total North Sea	717 645	546 775	563 481	520 140	497 548	484 012	275 116	312 798	174 961	41 283
Skagerrak	280 036	113 279	71 071	61 570	67 021	84 566	55 512	51 911	15 550	37 587
Grand Total	997 681	660 054	634 552	581 710	564 569	568 578	330 628	364 709	190 511	78 860

a) Total includes 2 107 tonnes 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 tonnes 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 tonnes.
Skagerrak (Division IIIa excl. Kattegat).

Year	Denmark	Faroe Islands	Germany Fed.Rep.	Iceland	Nether-lands	Norway	Poland	Sweden	USSR	Total
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	1 553	6	123	-	-	-	6 505	-	15 550
1977*	19 382	10 064	32	-	-	-	-	8 109	-	37 587

* Preliminary.
a) See Table 2.1 footnote under relevant country.

Table 2.3. HERRING. Total catch in tonnes.
North Sea, northeast (Division IVa east of 2°E).

Year	Belgium	Denmark	Faroe Isl.	France	German Dem.Rep.	Germany Fed.Rep.	Iceland	Nether-lands	Norway	Poland	UK Scotland	Sweden	USSR	Total
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	-	1 220	-	-	113	-	-	-	-	5	-	919	-	2 257
1977*	-	-	-	-	-	-	-	-	437	-	-	300	-	737

* Preliminary.

a) See Table 2.1 footnote under relevant country.

Table 2.4. HERRING. Total catch in tonnes.
North Sea, northwest (Division IVa west of 2°E).

Year	Denmark	Faroe Isl.	Finland	France	German Dem.Rep.	Germany Fed.Rep.	Iceland	Nether-lands	Norway	Poland	UK England	UK Scotland	Sweden	USSR	Total
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	14 011	12 446	1 034	4 183	1 614	1 275	9 179	7 421	23 768	6 199	-	11 823	3 858	4 741	101 552
1977*	5 515	6 942	-	100	-	-	-	1 240	2 412	-	-	8 137	1 451	-	25 797

* Preliminary.
a) See Table 2.1 footnote under relevant country.

Table 2.5 HERRING. Total catch in tonnes.
North Sea, Central (Division IVb). Adult herring fisheries.

Year	Denmark	Faroe Isl.	France	German Dem.Rep.	Germany Fed.Rep.	Iceland	Nether-lands	Norway	Poland	UK England	UK Scotland	Sweden	USSR	Total
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	5 472	499	2 026	896	342	233	9 362	3 618	606	9 361	3 192	-	5 868	41 475
1977*	608	-	-	-	213	-	2 455	-	-	414	-	-	-	3 690

* Preliminary

Table 2.6. HERRING. Total catch in tonnes.
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	UK (England)	UK (Scotland)	Total	
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

Table 2.7. HERRING. Total catch in tonnes.
North Sea Southern and English Channel, East and West
(Divisions IVc and VIId and e).

Year	Belgium	Denmark	Faroe Isl.	France	Germany Fed.Rep.	Nether-lands	Norway	Poland	U.K. England	USSR	Total
1971	673	25	-	6 160	126	16 385	-	-	82	-	23 451
1972	1 337	57	-	9 999	112	11 450	-	-	49	-	23 004
1973	2 160	132	-	13 767	2 257	11 754	-	-	93	-	30 163
1974	603	36	-	4 573	432	1 692	-	1	41	5	7 383
1975	2 451	984	-	14 162	350	7 207	32	-	72	269	25 527
1976	1 430	2 351	1 433	8 035	-	3 363	-	262	301	326	17 501[a)]
1977*	-	-	-	694	-	397	-	-	-	-	1 091

* Preliminary.

a) Included 1 tonne caught by the German Democratic Republic.

Table 2.8 HERRING by-catch (in weight) by areas and countries.

	IVa west		IVa east		IVb		IVc+VIId	
Country	1976	1977	1976	1977	1976	1977	1976	1977
Denmark	4 105	502	-	186	7 682	5 958	-	-
Faroe Isl.								
France	100	148[x]	11	44	88	198	25	62
Germany, Fed.Rep.						3		
Netherlands				42				
Norway								
Sweden								
UK(England)					165	2 810		
UK(Scotland)						15		
Total	4 205	650	11	272	7 935	8 984	25	62

x) Assumed.

Table 2.9. HERRING North Sea catch in millions of fish by age.

Year	Area	Age in winter rings										Total
		0	1	2	3	4	5	6	7	8	>8	
1972	IVaW of 2°E	-	338.9	830.1	176.8	88.6	19.3	4.1	-	0.5	0.4	1 458.
	IVaE of 2°E	-	75.1	91.0	17.8	5.8	0.7	0.1	-	-	-	190.
	IVb	-	25.2	46.4	98.8	20.5	6.7	0.6	0.2	0.6	-	199.
	IVbYH	750.4	2 896.6	337.9	21.1	6.4	1.2	0.2	-	-	-	4 013.
	IVc+VIId,e	-	4.8	135.1	29.3	9.3	5.0	-	-	-	-	183.
	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.
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.
	IVaE of 2°E	-	0.3	16.2	23.1	6.3	7.2	1.0	0.3	0.8	-	55.
	IVb	-	242.5	180.1	39.0	28.3	4.7	7.2	-	-	-	501.
	IVbYH	289.4	2 070.5	362.5	29.4	2.6	0.5	0.2	0.3	-	-	2 755.
	IVc+VIId,e	-	2.2	43.3	115.1	55.0	7.4	1.9	0.5	0.1	0.0	225.
	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.
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.
	IVaE of 2°E	5.7	131.8	24.2	10.8	1.0	-	-	-	0.1	-	173.
	IVb (adult)	-	54.0	493.7	212.3	19.5	18.9	3.6	0.3	0.4	0.1	802.
	IVbYH	925.1	493.5	132.1	5.7	-	-	-	-	-	-	1 556.
	IVc+VIId		3.9	24.1	20.3	8.4	1.2	0.1	0.2	-	-	58.
	Total NS	996.1	846.1	772.6	362.0	126.0	56.1	22.3	5.0	2.0	1.1	3 189.
1975	IVaW of 2°E	-	267.0	120.0	69.0	49.0	40.2	9.8	6.3	2.9	1.1	565.
	IVaE of 2°E	-	82.5	8.2	7.0	2.4	0.4	0.1	0.1	-	-	100.
	IVb (adult)		268.8	147.1	124.2	81.2	14.8	5.8	2.7	0.5	0.3	645.
	IVbYH	262.8	1 818.1	139.2	19.8	2.6	-	0.4				2 242.
	IVc+VIId	1.0	24.1	127.2	39.6	5.3	1.8					199.
	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.
1976	IVaW of 2°E	-	19.4	572.9	56.3	17.9	13.2	3.6	2.6	0.5	0.3	686.
	IVaE of 2°E	-	-	10.6	1.1	0.5	0.5	0.4	-	-	-	13.
	IVb (adult)	0.9	35.5	205.9	17.6	28.4	20.3	1.8	1.8	0.5	0.1	312.
	IVbYH	237.3	49.5	17.7	0.5	1.7	-	-	-	-	-	306.
	IVc+VIId	-	22.2	94.4	41.8	3.5	0.5	0.3	-	-	-	162.
	Total NS	238.2	126.6	901.5	117.3	52.0	34.5	6.1	4.4	1.0	0.4	1 482.
1977	IVaW of 2°E	2.3	2.4	8.4	159.9	7.9	3.5	2.0	0.8	0.2	-	187.
	IVaE of 2°E	0.4	3.3	+	2.0	0.5	0.4	0.4	0.2	0.2	-	7.
	IVb (adult)	-	0.9	20.2	5.3	0.2	1.5	0.7	-	+	-	28.
	IVbYH	253.8	136.3	3.1	-	-	-	-	-	-	-	393.
	IVc+VIId	-	0.7	5.2	2.4	0.6	0.2	+	+	-	-	9.
	Total NS	256.5	143.6	36.9	169.6	9.2	5.6	3.1	1.0	0.4	-	625.

Table 2.10. HERRING 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	64.6	49.7	63.1	5.1	1.2	0.5	0.2	0.1	-	-	184.4
1977	54.4	118.8	87.6	37.5	8.9	4.5	2.8	0.8	+	-	315.3

Table 2.11 Millions of HERRING caught annually per age group (winter rings) in the North Sea over the last 11 years.

Year \ Winter rings	0	1	2	3	4	5	6	7	8	>8	Total
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	126.6	901.5	117.3	52.0	34.5	6.1	4.4	1.0	0.4	1 482.0
1977	256.8	144.3	44.7	186.4	10.8	7.0	4.1	1.5	0.7	+	656.3

Table 2.12. HERRING. Total North Sea. Calculated fishing mortality.

Winter rings \ Years	1967	1968	1969	1970	1971	1972	1973	1974	1975[1)]	1976*
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
$\bar{F}_w \geq 2$	0.71	1.51	0.91	1.15	1.12	0.88	1.17	1.03	1.27	0.8

1) Inaccurate estimates.

* Assumed values.

Table 2.13. HERRING. 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[1)]
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	+	+	+	+
Σ0 + 1	12.01	13.87	9.92	12.41	14.46	10.80	6.06	7.65	5.43
Σ2-8	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

1) Inaccurate estimates.

Table 2.14. Estimates of the abundance of herring larvae in the North Sea in 1977/78 and comparable estimates for 1976/77.

Area	1976/77 (x 10^{-9})	1977/78 (x 10^{-9})
Northern North Sea	4-11 Sep. < 10 mm - 733 13-23 Sep. < 10 mm - 64	31 Aug. - 16 Sep. < 10 mm - 1582 19-29 Sep. < 10 mm - 354
Central North Sea	3-14 Sep. < 10 mm - 86 16-24 Sep. < 10 mm - 137 28 Sep. - 10 Oct. < 10 mm - 4 18-23 Oct. < 10 mm - 12	11-16 Sep. < 10 mm - 502 20-22 Sep. < 10 mm - 310 2-10 Oct. < 10 mm - 104 14-19 Oct. < 10 mm - 3
Southern North Sea and Eastern Channel	3-7 Jan. < 11 mm - 2 11-16 mm 5 Total 7	13-16 Dec. < 11 mm - 1 Total 1 19-22 Dec. < 11 mm - 1 11-16 mm - 1 Total 2 2-6 Jan. < 11 mm - 0 11-16 mm 8 Total 8 19-23 Jan. < 11 mm - 3 11-16 mm 25 Total 28

Table 2.15 Catches in millions of 0- and 1-group HERRING and percentage of total catch in numbers.

Year	Fishing area	0-group		1-group		0+1 group	
		N	%	N	%	N	%
1973	North Sea	289	5.9	2 368	48.3	2 657	54.2
	Kattegat	2 823	68.8	726	17.7	3 549.2	86.5
1974	North Sea	996	31.2	846	26.5	1 842	57.8
	Skagerrak	632	58.3	292	26.9	924	85.2
	Kattegat	1 867	63.9	617	21.1	2 484	85.1
1975	North Sea	264	7.0	2 460	65.5	2 724	72.6
	Skagerrak	76	12.6	381	63.5	457	76.1
	Kattegat	1 929	61.0	1 090	34.5	3 020	95.5
1976	North Sea	238	16.1	127	8.5	365	24.6
	Skagerrak	65	35.0	50	26.9	115	62.0
	Kattegat	369	17.7	1 424	68.3	1 793	86.0

Table 3.1 Annual Celtic Sea HERRING catches 1965-77.

(Data provided by Working Group members)

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	1 919	147	28	3 705	1 627	324	-	826	8 258
1977*	88	-	96	1 394	1 399	-	78	-	3 055

* Provisional. a) Including 123 tonnes for Bulgaria.

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

(Data provided by Working Group members)

Year	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	1 371	147	36	2 970	1 324	257	-	826	7 019
1977/8*	38	-	96	1 322	1 322	-	-	-	2 828

* Provisional. a) Including 123 tonnes 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
1965/6	58	70 937	9 456	15 911	3 433	4 584	12 241	1 391	7 566	125 576
1966/7	6 337	19 146	58 633	9 827	13 193	5 585	3 581	8 742	3 839	128 614
1967/8	6 921	36 168	19 486	47 837	8 954	9 334	3 894	6 462	6 684	145 741
1968/9	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
1970/1	640	31 540	48 706	25 937	18 270	7 095	5 751	1 925	3 194	143 058
1971/2	10 262	22 451	34 382	40 536	18 449	9 807	3 779	4 846	2 143	146 655
1972/3	7 279	124 357	16 922	13 817	13 674	4 331	2 654	2 103	749	185 886
1973/4	22 171	34 122	45 162	6 269	8 251	4 655	3 209	1 966	714	126 519
1974/5	4 516	38 285	15 427	19 865	3 782	3 311	2 668	806	742	89 402
1975/6	11 452	13 077	15 709	6 898	6 042	3 252	1 268	964	1 022	59 685
1976/7	7 262	9 090	5 202	5 196	2 092	2 669	1 384	1 005	777	34 701
1977/8	3 833	3 986	3 407	1 498	767	532	284	36	55	14 398

Table 3.4 Catch prognoses and estimated stock size, Celtic Sea.
Numbers of fish in thousands, stock weight in tonnes.

Age (rings)	Mean weights		Stock 1 Apr.77	Catch 1977/78	F 1977/78	Stock 1 Apr.78	F 1978/79	Stock 1 Apr.79
	Apr-Jun	All season						
1	118	132	30 000	3 833	0.14	30 000	0.14	30 000
2	162	183	24 255	3 986	0.19	23 610	0.00	23 610
3	193	216	6 881	3 407	0.73	18 143		21 367
4	210	242	3 938	1 498	0.51	3 000		16 419
5	220	253	3 933	767	0.23	2 138		2 715
6	228	267	1 584	532	0.43	2 828		1 935
7	232	273	2 020	284	0.16	933		2 559
8	235	277	1 048	36	0.04	1 557		844
>8	238	289	1 349	55	0.04	2 083		3 294
Weight (Stock 2-8)			8 347			10 150		14 011

Table 4.1 Total catches of HERRING (tonnes) in Division VIa, 1968-77.
(Data provided by Working Group members)

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	-	-	-	-	-	-	-	-	12	-
Denmark	-	-	-	554	150	932	-	374	249	-
Faroe Islands[a]	-	-	15 100	8 100	8 094	10 003	5 371	3 895	4 017	3 564
France	1 124	966	1 293	2 055	680	2 441	547	1 293	1 528	1 548
German Dem.Rep.	3	416	207	330	935	2 507	2 037	1 994	929	-
Germany, Fed.Rep.of	14 874	15 805	16 548	7 700	4 108	17 443	14 354	9 099	4 980	140
Iceland	-	-	5 595	5 416	2 066	2 532	9 566	2 633	3 273	-
Ireland[b]	13 390	11 895	11 716	12 161	17 308	14 668	12 557	10 417	8 558	7 189
Netherlands	2 957	1 514	1 102	9 252	23 370	32 715	19 635	19 360	20 812	8 285
Norway	-	-	20 199	76 720	17 400	36 302	26 218	512	5 307	1 098
Poland	2 791	3 188	3 709	-	-	5 685	6 368	2 934	3 085	6
Sweden	-	-	-	-	-	-	-	-	2 206	261
UK (England)	7	3	1	-	-	-	45	125	20	301
UK (N.Ireland)	4	3	1	-	-	-	3	6	1	1
UK (Scotland)	65 180	90 222	103 530	99 537	107 638	120 800	107 475	85 395	53 351	25 222
USSR	-	-	3	-	?	2 052	5 388	3 232	3 092	-
Total	100 330	124 012	179 004	221 825	181 749	248 080	209 564	141 269	111 420	47 615
Scottish juvenile herring and sprat fisheries in Moray Firth	4 985	3 100	1 385	5 666	10 242	7 219	13 003	2 454	313	249

* Preliminary figures.

a) Figures supplied by Fiskirannsóknarstovan.

b) Catches prior to 1976 mainly taken in Division VIIb and landed in Division VIa.

Table 4.2 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
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	78 894	386 932	123 947	44 430	36 714	87 477	14 208	5 766	13 078[1]	-	-
1977*	11 871	38 583	60 446	119 446	25 492	12 455	13 062	20 601	2 939	3 255[1]	-	-

* Preliminary.
1) Age 9 and older.

Table 4.3 HERRING in Division VIa, Moray Firth included. Fishing mortalities by year and by age.

Age(rings)	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*	1977*
0	0.18	0.11	0.07	0.13	0.00	0.16	0.41	0.26	0.44	0.28	0.03	0.05
1	0.45	0.25	0.17	0.04	0.21	0.05	0.35	0.12	0.49	0.24	0.41	0.15
2	0.25	0.09	0.17	0.10	0.15	0.37	0.29	0.51	0.56	0.85	0.97	0.56
3	0.20	0.18	0.10	0.18	0.37	0.84	0.45	0.66	0.79	0.88	1.24	0.80
4	0.25	0.29	0.22	0.14	0.38	0.64	0.37	0.64	0.86	0.80	1.03	0.80
5	0.23	0.24	0.16	0.35	0.28	0.49	0.38	0.59	0.85	0.96	0.88	0.80
6	0.27	0.32	0.19	0.29	0.40	0.25	0.33	0.54	0.92	1.01	1.14	0.80
7	0.33	0.26	0.23	0.48	0.44	0.66	0.18	0.37	0.68	0.86	1.23	0.80
8	0.38	0.44	0.17	0.59	0.58	0.51	0.89	0.14	0.42	0.70	0.80	0.80
≥ 9	0.40	0.40	0.40	0.40	0.40	0.50	0.50	0.60	0.70	0.70	0.70	0.80
Mean F_w ≥ 3	0.25	0.22	0.20	0.30	0.38	0.66	0.45	0.63	0.82	0.89	1.11	0.80

* Inaccurate estimates.

Table 4.4 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)	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*	1977*
0	1 329	1 849	1 125	1 663	4 098	1 480	782	1 222	1 582	359	330	256
1	590	1 002	1 495	950	1 322	3 692	1 139	469	851	921	246	291
2	2 428	340	709	1 143	822	970	3 179	725	376	473	657	147
3	279	1 706	280	541	932	641	605	2 160	396	194	184	226
4	337	207	1 284	229	410	584	250	348	1 013	162	73	48
5	193	238	140	931	181	253	279	157	166	390	66	24
6	100	139	170	108	591	123	139	174	79	64	135	25
7	47	69	91	126	73	359	87	91	92	28	22	39
8	69	31	48	66	71	43	168	66	57	42	11	6
≥9	41	42	18	37	33	36	23	63	52	34	16	3
Total ≥ 2	3 494	2 772	2 740	3 181	3 113	3 009	4 730	3 784	2 231	1 387	1 164	518
Biomass ≥ 2 (in '000 tonnes)	488	451	450	510	513	489	667	603	377	225	172	82

* Inaccurate estimates.

Table 5.1 Total HERRING catches, Division VIIb and c.
(Data for 1967-75 from Bulletin Statistique)

Year	France	German Dem.Rep.	Germany Fed.Rep.	Ireland	Nether-lands	Poland	UK	USSR	Total
1967				108					108
1968	713			30	525				1 268
1969			71	145	355				571
1970	733		180	1 518	179			2	2 612
1971	42		52	1 646	61				1 801
1972	312		23	3 154	71			347	3 907
1973			5	5 036	200				5 241
1974	10		-	4 412	51		25	1 266	5 764
1975	20		914	5 576	9 815			646	16 971
1976		240	28	5 537	12 306	83		118	18 312
1977*	-			8 727	3 132			-	11 859

* Provisional.

Table 5.2 Total HERRING catches. Division VIa south of 57°N and west of 7°W.
(Data provided by Working Group members)

Year	France	German Dem.Rep.	Germany Fed.Rep.	Ireland	Nether-lands	Poland	UK	USSR	Total
1967	1 970		8 424	12 182	3 660				26 236
1968	825		7 600	13 360	2 717				24 502
1969	2 478		6 200	11 895	1 515	2 000			24 088
1970	911		4 900	11 716	1 094	3 100			21 721
1971	2 966		1 300	12 161	850	1 326			18 603
1972	-		1 100	17 308	4 648	3 218			26 274
1973	-		7 900	14 668	13 073	5 685			41 326
1974	-		6 300	12 557	4 599	2 773		2 000	28 229
1975	-	1 994	5 600	10 417	9 117	334		1 500	28 962
1976	48	500	900	8 558	4 983	3 000		-	17 989
1977*	-		-	7 189				-	7 189

*Provisional

Table 6.1 HERRING. Total catches in North Irish Sea (Division VIIa), 1967-77 (includes industrial catch).
(Data provided by Working Group members)

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
France	-	-	-	558	1 815	1 224	254	3 194	813	651	85
Ireland	118	68	2 328	3 933	3 131	2 529	3 614	5 894	4 790	3 205	3 331
Netherlands	-	-	-	-	-	260	143	1 116	630	989	500
UK	7 145	8 389	9 821	17 912	21 861	23 337	18 587	27 489	18 244	16 401	11 498
USSR	-	-	-	-	-	-	-	945	26	-	-
Total	7 263	8 457	12 149	22 403	26 807	27 350	22 598	38 638	24 503	21 246	15 414

* Preliminary

Table 6.2 HERRING. Total catch by stock in North Irish Sea, 1967-77.

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	

(ctd.)

Country	1973		1974		1975		1976		1977*	
	1	2	1	2	1	2	1	2	1	2
France	254	-	3 194	-	813	-	651	-	85	-
Ireland	-	3 614	1 783	4 111	2 406	2 384	1 816	1 389	2 009	1 322
Netherlands	-	143	1 116	-	630	-	989	-	500	-
UK	13 071	5 516	23 639	3 850	15 408	2 836	12 831	3 570	9 837	1 661
USSR	-	-	945	-	26	-	-	-	-	-
Total Manx	13 325		30 677		19 283		16 287		12 431	
Total Mourne	9 273		7 961		5 220		4 959		2 983	

Note

1 = Manx stock
2 = Mourne stock

* Preliminary.

Table 6.3 Effort, catch per unit effort and fishing mortality on Manx stock. North Irish Sea (Division VIIa).

Year	Effort (trawler landings)	C.p.u.e. (tonnes)	F from cohort analysis
1967	851	6.92	0.37
1968	1 395	5.48	0.34
1969	1 151	7.94	0.27
1970	1 455	11.13	0.45
1971	2 699	7.71	0.58
1972	1 958	10.62	0.58
1973	1 362	10.00	0.41
1974	4 083	7.51	0.91
1975	2 770	6.96	0.81
1976	2 471	6.59	0.74
1977	2 208	5.63	0.60*

* Provisional estimate

Table 6.4 TACs and catch of HERRING for North Irish Sea, 1975-77.

Year	TAC (tonnes) recommended by ICES Working Group	TAC set			Total catch (tonnes)	$\hat{F}$ at TAC recommended by ICES Working Group	$\hat{F}$ generated by catch taken	
		for UK	for other countries	Total			Manx	Mourne
1975	12 000	18 000	None set		24 503	0.4	0.81	0.94
1976	11 000	12 000	None set		21 102	0.4	0.74	0.96
1977[1)]	12 000	11 900	1 300	13 200	17 872	0.4	0.61	0.60

1) Catch in 1977 estimated from sampling programme (see text).

Table 6.5 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	0.001	0.29
1969	0.19	22.84	14.25	6.24	2.47	1.97	0.42	0.02	0.001
1970	0.75	25.24	27.89	13.24	9.42	2.88	2.66	0.31	0.001
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	0.001
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	0.001
1975	5.63	38.94	36.61	9.44	6.17	4.11	1.89	0.96	0.38
1976	9.34	47.46	17.38	13.62	3.88	2.41	2.32	0.32	0.75
1977	13.98	33.04	20.29	5.85	3.92	1.16	0.81	0.55	0.47

Table 6.6 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	10.4	25.4	8.7	3.4	1.6	0.7	0.4	0.1	0.1	0.1
1977	26.4	16.3	6.0	2.4	0.9	0.6	0.3	0.1	0.1	0.0

Table 6.7 North Irish Sea. Catch of HERRING in number (10^{-6}) by year and by age in the industrial fishery.

Age (rings) \ Year	1969	1970	1971	1972	1973	1974	1975	1976	1977
0	48.1	161.5	100.3	78.4	50.2	57.9	20.3	10.4	26.4
1	18.2	23.7	30.3	28.8	29.7	19.0	21.6	11.7	13.3
2	7.7	3.6	3.5	1.8	0.6	2.3	1.5	0.1	0.3
3	1.0	1.4	0.4	0.3	0.5	0.8	0.6	-	-
Total	75.0	190.2	134.5	109.3	81.0	80.0	44.0	22.2	40.0
Total in tonnes	2 210	3 796	2 715	2 251	1 913	2 190	1 573	779	1 174
N/kg	33.9	50.1	49.5	48.6	42.3	36.5	28.0	28.5	34.0

Table 6.8 HERRING - Manx stock.
Fishing mortalities by year and by age (M = 0.10)

Age	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	.01	.00	.01	.00	.00	.01	.04	.04	.01	.15
2	.48	.17	.34	.34	.23	.37	.59	.50	.29	.87
3	.72	.30	.28	.33	.30	.43	.56	.56	.50	1.01
4	.74	.39	.47	.22	.28	.46	.52	.55	.42	.95
5	.37	.49	.70	.47	.29	.75	.62	.74	.51	.73
6	.58	.34	1.58	.57	.36	.58	.60	1.02	.47	.77
7	1.61	.29	.41	1.11	.72	1.04	.75	.73	1.00	1.35
8+	.55	.27	.37	.34	.26	.46	.57	.59	.43	.90
Mean F for ages > = 2 and < = 8 (weighted by stock in numbers)										
	.54	.26	.37	.34	.27	.45	.58	.58	.41	.91

Age	1975	1976	1977
1	.05	.11	.15
2	.75	.67	.60
3	.89	.79	.60
4	.82	.88	.60
5	.82	.86	.60
6	.71	.79	.60
7	.90	1.04	.60
8+	.81	.73	.60
Mean F for ages > = 2 and < = 8 (weighted by stock in numbers)			
	.81	.74	.60

Table 6.9 HERRING Manx stock.
Stock in numbers at beginning of year (in number x 10^{-6}).

Age	1965	1966	1967	1968	1969	1970	1971	1972
1	29.9	71.9	98.8	128.2	95.0	140.9	127.1	90.7
2	56.3	26.8	64.3	88.4	115.5	85.8	126.8	110.3
3	13.8	31.8	20.5	41.8	56.8	82.9	53.7	63.3
4	2.1	6.1	21.3	14.0	27.1	37.9	48.6	27.9
5	1.6	.9	3.7	12.0	10.1	18.6	21.8	26.3
6	1.5	1.0	.5	1.7	6.8	6.8	7.9	10.5
7	.5	.8	.6	.1	.9	4.3	3.5	4.0
8	.5	.1	.5	.4	.0	.4	1.4	1.5
$\sum_{2}^{8}$	76.9	67.5	112.0	158.4	217.2	236.7	263.7	243.8

Age	1973	1974	1975	1976	1977
1	191.9	99.0	118.2	94.4	105.3
2	78.6	171.9	77.3	101.6	76.6
3	60.2	53.4	65.0	33.1	47.0
4	32.6	33.0	17.6	24.2	13.6
5	14.5	19.4	11.5	7.0	9.1
6	11.3	7.9	8.4	4.6	2.7
7	3.4	6.4	3.3	3.7	1.9
8	1.7	1.1	1.5	1.2	1.2
$\sum_{2}^{8}$	202.3	293.1	184.6	175.4	152.1

Fishing mortalities by year and by age

Age (rings) \ Year	1969	1970	1971	1972	1973	1974	1975	1976	Mean 1971-75
0	0.51	0.94	0.87	0.76	0.67	0.79	0.38	0.23	0.69
1	?	0.45	0.71	0.84	1.03	1.02	1.00	1.01	0.92
2	?	?	2.21	0.44	0.80	1.10	0.92	0.92	1.09
3	?	?	1.21	0.28	1.02	1.19	0.61	0.92	0.86
4	?	?	0.29	0.46	0.38	1.05	0.71	0.73	0.58
5	?	?	0.23	0.25	0.68	1.00	1.18	0.73	0.67
6	?	?	0.18	0.26	0.69	1.10	0.17	0.79	0.48
7	?	?	0.27	0.31	0.79	1.07	0.52	0.40	0.59
8	?	?	0.33	0.12	0.87	0.99	0.83	1.07	0.63
Weighted mean (0-8 rings)	?	?	0.97	0.71	0.82	0.91	0.67	0.64	
Weighted mean (1-8 rings)	?	?	1.09	0.64	0.95	1.06	0.94	0.96	

Table 6.11 HERRING. Mourne stock.
Stock in millions (from cohort analysis) at beginning of year.

Age (rings) \ Year	1969	1970	1971	1972	1973	1974	1975	1976*	1977*
0	126	278	181	155	108	112	68	53	?
1	?	68	98	68	66	50	46	42	40
2	?	?	39	44	27	21	16	15	15
3	?	?	19	4	25	11	6	6	6
4	?	?	4	5	3	8	3	3	2
5	?	?	2	3	3	2	3	1	1
6	?	?	3	1	2	1	1	1	1
7	?	?	1	3	1	1	0	0	0
8	?	?	1	0	2	0	0	0	0
Total stock in numbers (0-8 rings)	?	?	348	283	237	206	143	121	?
Total stock in numbers (1-8 rings)	?	?	167	128	129	94	75	68	65
Total stock biomass (tonnes) (1-8 rings)	?	?	18 433	14 764	15 766	11 245	8 123	7 235	6 894

* Inaccurate estimates.

Table 6.12 Manx HERRING stock prediction.

Age (rings)	Number (x 10^{-6}) at 1 Jan.1978	Mean weight (g)	Proportional fishing mortality
1	101.37	104	0.29
2	69.98	177	1.0
3	38.04	206	1.0
4	23.34	226	1.0
5	6.75	255	1.0
6	4.52	262	1.0
7	1.34	287	1.0
8(a plus group)	1.54	287	1.0

1977				1978				1979			
Stock ages 2-8		F	Catch (tonnes)	Stock ages 2-8		F	Catch (tonnes)	Stock ages 2-8		F	Catc (tonne
No.x10^{-6}	Tonnes			No.x10^{-6}	Tonnes			No.x10^{-6}	Tonnes		
151.5	30 231	0.6	14 507	146	29 239	.35	9 210	175	35 614	.35	11 00
						.45	11 350	164	33 199	.35	10 32
						.55	13 307	154	30 986	.35	9 70

Table 6.13 Mourne HERRING stock prediction.

Age (rings)	Number x 10^{-6} at 1 Jan.1977	Mean weight (g)	Proportional fishing mortality
0	45.38	26	1
1	37.84	60	1
2	13.94	160	1
3	5.52	192	1
4	2.13	221	1
5	1.37	244	1
6	0.58	256	1
7	0.30	261	1
8	0.26	264	1
9	0.07	265	1
10	0.05	267	1

1977				1978						1979					
Stock No. x 10^{-6} 1-8 rings	Stock weight 1-8 rings (t)	F	Catch (t)	Stock No.x 10^{-6} 1-8 rings	Stock weight 1-8 rings (t)	F 0-gr.	F 1-gr.	F 2-8	Catch (t)	Stock No.x10^{-6} 1-8 rings	Stock weight 1-8 rings (t)	F 0-gr.	F 1-gr.	F 2-8	Catch (t)
62.1	6 693	.60	3 397	53.2	6 891	.60	.60	.60	3 482	48.9	6 331	.60	.60	.60	3 241
						.69	.58	.58	3 461	47.5	6 320	.69	.448	.40	2 591
						.69	.50	.50	3 155	45.9	6 736	.69	.448	.40	2 721
						.69	.448	.40	2 773	52.1	7 214	.69	.448	.40	2 872

Table 7.1 SPRAT catches in the North Sea ('000 tonnes) 1967-77.
(Data provided by Working Group members)

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977[a]
IVa West											
Denmark	-	-	-	-	-	-	-	5.3	0.5	0.6	0.1
Faroe Islands	-	-	-	-	-	-	-	0.2	12.9	2.5	0.4
France	+	-	-	-	-	-	-	-	-	-	+
German Dem.Rep.	-	-	-	-	-	-	-	-	-	-	+
Germany,Fed.Rep.of	+	-	-	-	-	-	+	-	-	+	0.6
Netherlands	-	+	+	+	+	+	+	+	+	+	+
Norway	-	-	-	-	0.9	2.2	-	-	1.5	29.9	16.0
Poland	+	-	-	-	-	+	+	-	0.3	-	-
Sweden	-	-	-	-	-	-	1.0	2.2	11.0	+	0
UK (England)	-	-	-	-	+	-	0.2	-	-	-	0
UK (Scotland)	19.1	13.0	12.4	3.8	15.0	29.8	49.4	41.2	9.4	12.7	26.9
USSR	-	-	-	-	-	-	-	1.0	1.3	1.2	+
Total	19.1	13.0	12.4	3.8	15.9	32.0	50.6	49.9	36.9	46.9	44.0
IVa East (North Sea stock)											
Denmark	-	-	-	-	-	-	-	-	-	0.2	0.1
Norway	-	-	-	-	-	-	-	-	-	1.9	0.7
UK (Scotland)	-	-	-	-	-	-	-	-	-	+	0
Total	-	-	-	-	-	-	-	-	-	2.1	0.8
IVb West											
Belgium	-	-	-	-	-	-	-	-	-	+	0
Denmark	...	...	...	8.6	9.9	14.4	47.0	55.4	106.6	104.4	57.5
Faroe Islands	-	-	-	-	-	-	-	4.0	30.0	42.9	1.8
France	-	1.0	-	-	-	-	-	-	-	-	+
German Dem.Rep.	+	-	-	-	-	-	-	1.7	4.5	6.4	0.7
Netherlands	+	+	2.0	+	+	+	-	-	-	-	0
Norway	-	-	-	-	-	4.1	3.4	9.5	145.7	73.0	5.5
Poland	+	+	-	-	-	+	-	-	9.1	10.5	0
Sweden	-	-	-	-	-	-	-	-	-	7.9	0
UK (England)	11.9	2.6	3.3	11.2	25.5	21.8	34.6	25.5	32.5	49.7	51.9
UK (Scotland)	7.4	13.4	22.0	9.5	7.2	3.6	2.9	8.6	4.9	18.1	10.9
USSR	-	-	-	-	1.2	0.8	17.9	32.9	47.8	50.4	1.6
Total	19.3	17.0	27.3	29.3	43.8	44.7	105.8	137.7	381.1	362.3	123.9

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

ctd...

Table 7.1(ctd) SPRAT catches in the North Sea ('000 tonnes), 1967-77.
(Data provided by Working Group members)

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977[a)]
IVb East											
Denmark	17.4	18.1	18.5	16.2	19.9	28.8	93.9	104.0	215.2	201.1	126.8
German Dem.Rep.	-	-	-	-	-	-	-	-	0.4	-	0.7
Germany, Fed.Rep.of	11.5	16.7	6.3	7.6	5.1	1.7	11.0	17.5	0.5	1.7	4.3
Norway	-	-	-	-	-	-	-	-	-	5.1	0
Sweden	-	-	-	-	-	-	-	-	-	-	1.5
Total	28.9	34.8	24.8	23.8	25.0	30.5	104.9	121.5	216.1	207.9	133.3
IVc											
Belgium	0.4	0.4	0.4	0.6	0.1	0.1	0.2	+	+	-	0
Denmark	-	-	-	-	-	-	-	0.9	3.9	0.3	1.4
France	-	+	0.1	+	+	-	+	0.3	0.1	-	+
German Dem.Rep.	-	-	-	-	-	-	-	-	-	0.1	+
Germany, Fed.Rep.of	-	-	-	+	-	+	-	-	-	-	0.4
Netherlands	0.2	1.0	1.6	1.5	1.0	0.4	+	+	0.2	-	0
UK (England)	3.2	6.2	4.2	3.9	0.2	+	0.8	3.4	2.9	0.7	0.2
USSR	-	-	-	-	-	-	-	+	+	0.2	-
Total	3.8	7.6	6.3	6.0	1.3	0.5	1.0	4.6	7.1	1.3	2.0
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	306.6	179.9
Faroe Islands	-	-	-	-	-	-	-	4.2	42.9	45.4	2.2
France	+	1.0	0.1	+	+	-	+	0.3	0.1	-	+
German Dem.Rep.	+	-	-	-	-	-	-	1.7	4.9	6.5	1.4
Germany,Fed.Rep.of	11.5	16.7	6.3	7.6	5.1	1.7	11.0	17.5	0.5	1.7	5.3
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	109.9	22.2
Poland	+	+	-	-	-	+	+	-	9.4	10.5	+
Sweden	-	-	-	-	-	-	1.0	2.2	11.0	7.9	1.5
UK (England)	15.1	8.8	7.5	15.1	25.7	21.8	35.6	28.9	35.4	50.4	52.1
UK (Scotland)	26.5	26.4	34.4	13.3	22.2	33.4	52.3	49.8	14.3	30.8	37.8
USSR	-	-	-	-	1.2	0.8	17.9	33.9	49.1	51.8	1.6
Total	71.1	72.4	70.8	62.9	86.0	107.7	262.3	313.6	641.2	621.5	304.0

a) Preliminary figures as reported. + = less than 0.1. - = magnitude known to be nil.

Table 7.2 Monthly landings of SPRAT in Sub-divisions IVb west and IVb east in 1976 and 1977 by Denmark.
('000 tonnes and percentage of total within Division and year).

Div. & Year			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Σ
IVb west	1976	tonnes	22.2	28.5	20.4	3.5	1.3	0.2	0.4	4.8	0.5	0.7	3.8	16.3	102.6
		%	22	28	20	3	1	-	-	5	-	1	4	16	
	1977	tonnes	18.3	15.1	2.0	2.3	0.6	+	+	0.2	0.4	+	0	12.6	51.5
		%	36	29	4	4	1	-	-	-	1	-	-	24	
IVb east	1976	tonnes	0.2	0.4	0.7	1.0	1.0	4.5	26.1	43.8	39.8	31.8	49.2	1.4	199.9
		%	-	-	-	1	1	2	13	22	20	16	25	1	
	1977	tonnes	7.1	11.7	4.9	0.2	0.2	6.2	11.6	31.8	12.4	28.3	5.4	7.1	126.9
		%	6	9	4	-	-	5	9	25	10	22	4	6	

Table 7.3 Total North Sea SPRAT catch 1974-77. Numbers caught per age group x 10^{-6} in each 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	-
	1977	472.5	3 354.4	1 255.8	212.3	5.9	-	-
IVaE	1976	6.1	46.1	38.0	24.8	1.3	-	-
	1977	1.3	26.1	15.3	7.8	-	-	-
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
	1977	480.8	3 878.1	8 538.4	1 144.2	112.1	12.0	-
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
	1977	163.5	4 941.4	8 779.7	108.4	-	-	-
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					
	1977	-	45.6	342.2	20.0	0.8	-	-
Total	1974	1 596.0	19 064.1	12 075.1	1 352.7	236.5	56.7	20.7
	1975	942.4	21 472.5	28 093.5	4 954.9	301.9	19.2	-
	1976	2 860.0	36 358.3	14 226.7	8 071.0	451.0	7.0	1.4
	1977	1 118.1	12 245.6	18 931.4	1 492.7	118.8	12.0	-

Table 7.4 Mean weights at age of SPRAT in North Sea landings, 1976 and 1977.

Year	Months	Age group 0	1	2	3	4	5
		IVa west of 2°E					
1976	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	-	-
1977	Jan-Mar	-	2.54	7.19	17.42	17.32	-
	Apr-Jun	-	0.88	8.13	-	-	-
	Jul-Sep	-	7.00	12.00	-	-	-
	Oct-Dec	2.43	8.73	15.36	21.46	30.20	-
		IVb west of 3°E					
1976	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	-
1977	Jan-Mar	-	2.25	7.82	15.55	20.34	-
	Apr-Jun	-	2.60	9.74	12.69	22.50	-
	Oct-Dec	2.43	8.10	16.64	22.94	-	-
		IVb east of 3°E					
1976	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	-	-
1977	Jan-Mar	-	2.73	6.14	10.78	-	-
	Apr-Jun	-	2.00	6.49	22.00	-	-
	Jul-Sep	6.86	8.73	9.18	23.50	-	-
	Oct-Dec	5.16	11.60	16.69	24.59	-	-

ctd...

Table 7.4(ctd) Mean weights at age of SPRAT in North Sea landings, 1976 and 1977.

		Age group					
		0	1	2	3	4	5
		Weighted mean for all Areas					
1976	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	-
1977	Jan-Mar	-	2.41	7.22	15.30	20.19	-
	Apr-Jun	-	2.03	8.15	13.90	22.50	-
	Jul-Sep	6.86	8.73	9.18	23.50	-	-
	Oct-Dec	2.71	9.32	16.46	22.19	30.20	-
		Overall weighted mean					
1976	$\bar{X}$	2.48	6.26	11.58	16.71	21.27	26.10
		.65	6.38	10.33	17.16	20.77	26.10
1977		2.92	6.49	9.08	17.60	20.36	-
		0	1	2	3	4	5
	Jan-Mar		2.34	8.54	15.93	20.59	26.22
	Apr-Jun		2.32	9.70	15.13	22.75	24.70
	Jul-Sep	2.46	7.64	12.48	21.55	22.75	
	Oct-Dec	2.60	8.85	17.18	21.57	26.64	

Table 7.5 North Sea SPRAT catch in 1974-77. 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	-	-
1977	Jan-Mar	-	4 197.2	11 962.6	962.9	104.7	12.0	-
	Apr-Jun	-	540.3	670.9	52.7	1.5	-	-
	Jul-Sep	57.3	2 803.1	3 248.4	165.9	11.1	-	-
	Oct-Dec	1 060.8	4 705.0	3 049.5	311.2	1.5	-	-

Table 7.6 North Sea SPRAT catch in 1967-77. 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
1976-77	2 860	29 718	15 892	1 668	143

Table 7.7.a North Sea SPRAT.
Estimates of fishing mortality from 1967-77.

Age	Fishing season									
	1967-8	1968-9	1969-70	1970-1	1971-2	1972-3	1973-4	1974-5	1975-6 1)	1976-7
0/1	.02	.00	.03	.11	.07	.07	.05	.03	.07	.08*
1/2	.05	.02	.09	.06	.35	.42	.42	.37	.34	.49*
2/3	.12	.09	.04	.11	.10	.86	.73	.70	1.15	.71*
3/4	.14	.10	.08	.08	.14	.12	1.28	.35	.50	.56*
4/5	.10*	.10*	.10*	.10*	.10*	.10*	.10*	.20*	.20*	.20*
Weighted mean 1/2 and over	.07	.05	.07	.07	.22	.44	.48	.42	.52	.55

* Input values.

1) Reliability of estimates questionable.

Note: below broken line inaccurate estimates.

Table 7.7.b North Sea SPRAT.
Stock in numbers x 10^{-6} at 1 July.

Age	At 1 July					
	1967	1968	1969	1970	1971	1972
0	192 009	113 220	128 630	67 933	62 885	149 356
1	79 990	84 763	50 661	55 920	27 282	26 433
2	27 988	34 094	37 158	20 812	23 781	8 630
3	5 303	11 166	14 049	15 980	8 338	9 690
4	166	2 077	4 549	5 838	6 642	3 245

Age	At 1 July			
	1973	1974	1975	1976
0	290 620	311 977	257 708	53 757
1	62 626	123 618	136 180	107 953
2	7 769	18 433	38 206	43 382
3	1 644	1 677	4 133	5 449
4	3 867	205	530	1 131

Note: below broken line inaccurate estimates.

Table 7.8 Annual recruitment of North Sea SPRAT as estimated from cohort analysis.

Year	Number of 0-group recruits at 1 July x 10^{-9}
1967	192
1968	113
1969	129
1970	68
1971	63
1972	149
1973	291
1974	312*
1975	258*
1976	54*
Mean 1967-76	175

* Inaccurate estimates.

Table 8.1 SPRAT. Landings in '000 tonnes, 1966-77, Division IIIa.

Year	Skagerrak			Kattegat		Division IIIa Total
	Denmark	Sweden	Norway	Denmark	Sweden	
1966	2.1	2.0	1.0	2.5	2.3	9.9
1967	2.1	2.0	3.3	3.6	1.9	12.9
1968	0.5	3.1	2.1	2.6	1.5	9.8
1969	0.8	1.9	1.7	0.8	1.6	6.8
1970	1.1	2.4	2.4	3.1	6.0	15.0
1971	0.7	2.4	2.9	1.5	9.6	17.1
1972	0.8	3.3	2.4	1.4	17.9	25.8
1973	19.4	2.5	3.2	19.3	16.2	60.6
1974	17.3	2.0	1.4	31.6	18.6	70.9
1975	12.9	2.1	2.1	69.7	20.9	107.7
1976	12.8	2.6	2.0	30.4	13.5	61.3
1977	7.1	2.2	1.2	47.1	9.8	67.4

Table 8.2 Norwegian landings of SPRAT from west coast fjords, 1966-77.

Year	IVa east	IIa N 62°N
1966	10.7	1.9
1967	10.2	0.6
1968	6.4	1.3
1969	11.8	4.9
1970	6.4	5.5
1971	4.4	2.6
1972	6.9	4.2
1973	8.8	4.2
1974	3.3	5.5
1975	2.4	5.0
1976	1.8	4.3
1977	5.8	6.3

Table 8.3 Danish landings of SPRAT in number per age group. Division IIIa (millions).

Year	Months	0	1	2	3	4	5
1975	Jan-Mar	-	406.42	185.04	52.37	2.23	
	Apr-Jun	-	195.7	333.74	124.28		
	Jul-Sep	28.58	5 246.54	472.8	47.97	.30	
	Oct-Dec	123.28	907.08	50.84	.59		
	Total	151.86	6 755.74	1 042.42	225.21	2.53	
1976	Jan-Mar	-	336.0	164.95	9.11	1.23	.65
	Apr-Jun	-	556.41	57.07	27.38	.91	
	Jul-Sep	509.96	2 334.72	171.39	16.8	2.21	
	Oct-Dec	918.64	1 084.09	23.24	.55		
	Total	1 428.6	4 311.22	416.65	44.73	4.35	
1977	Jan-Mar	-	2 515.11	408.99	11.29		
	Apr-Jun	-	2 177.51	482.99	20.7	3.37	
	Jul-Sep	725.13	2 185.47	208.70	30.26	7.42	
	Oct-Dec x)						

x) Data for the Kattegat not available.

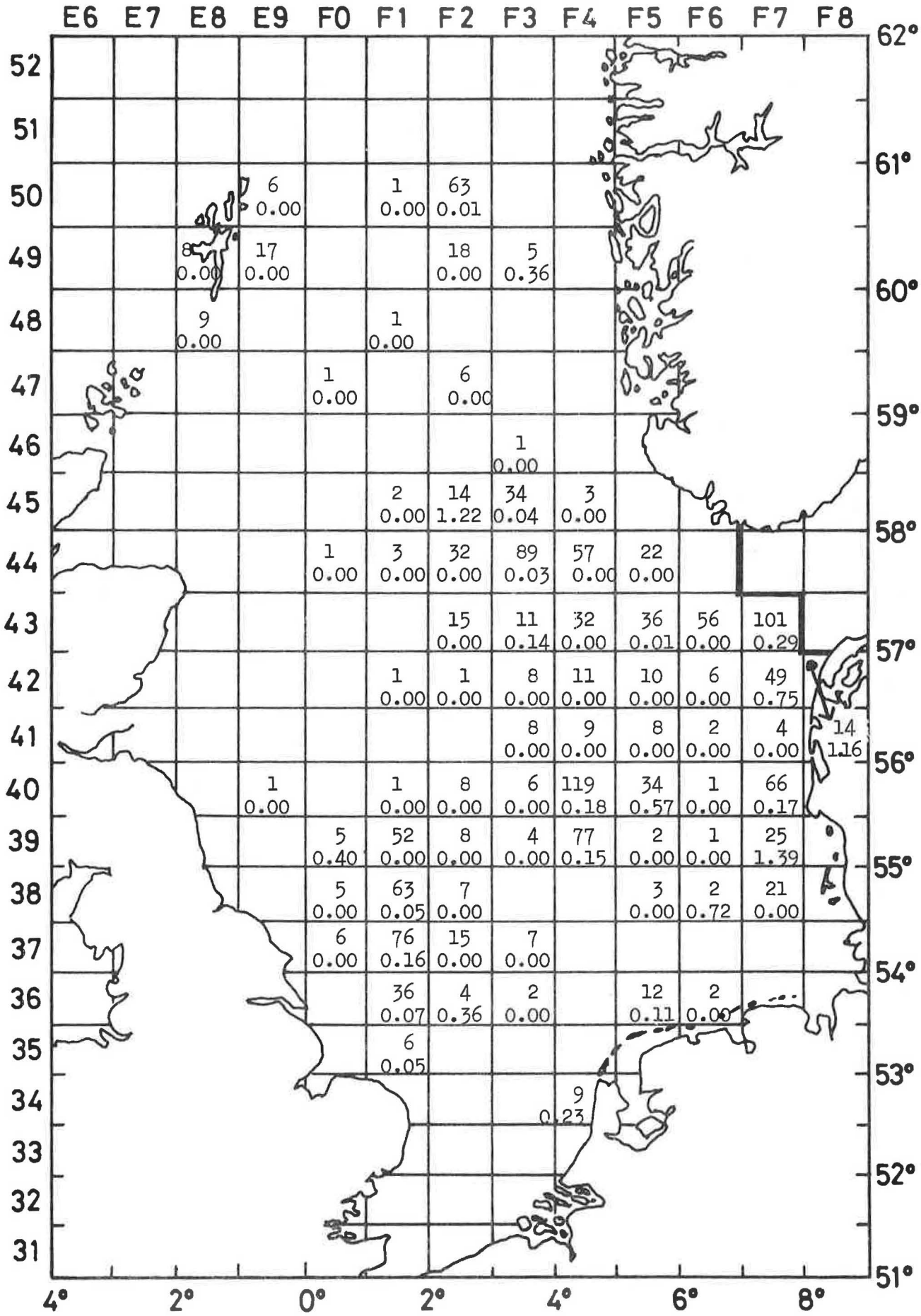


Figure 1. By-catch of herring in the 1977 sandeel fisheries (upper figure - number of samples, lower figure - mean percentage). (Data from Danish and Scottish national laboratories).

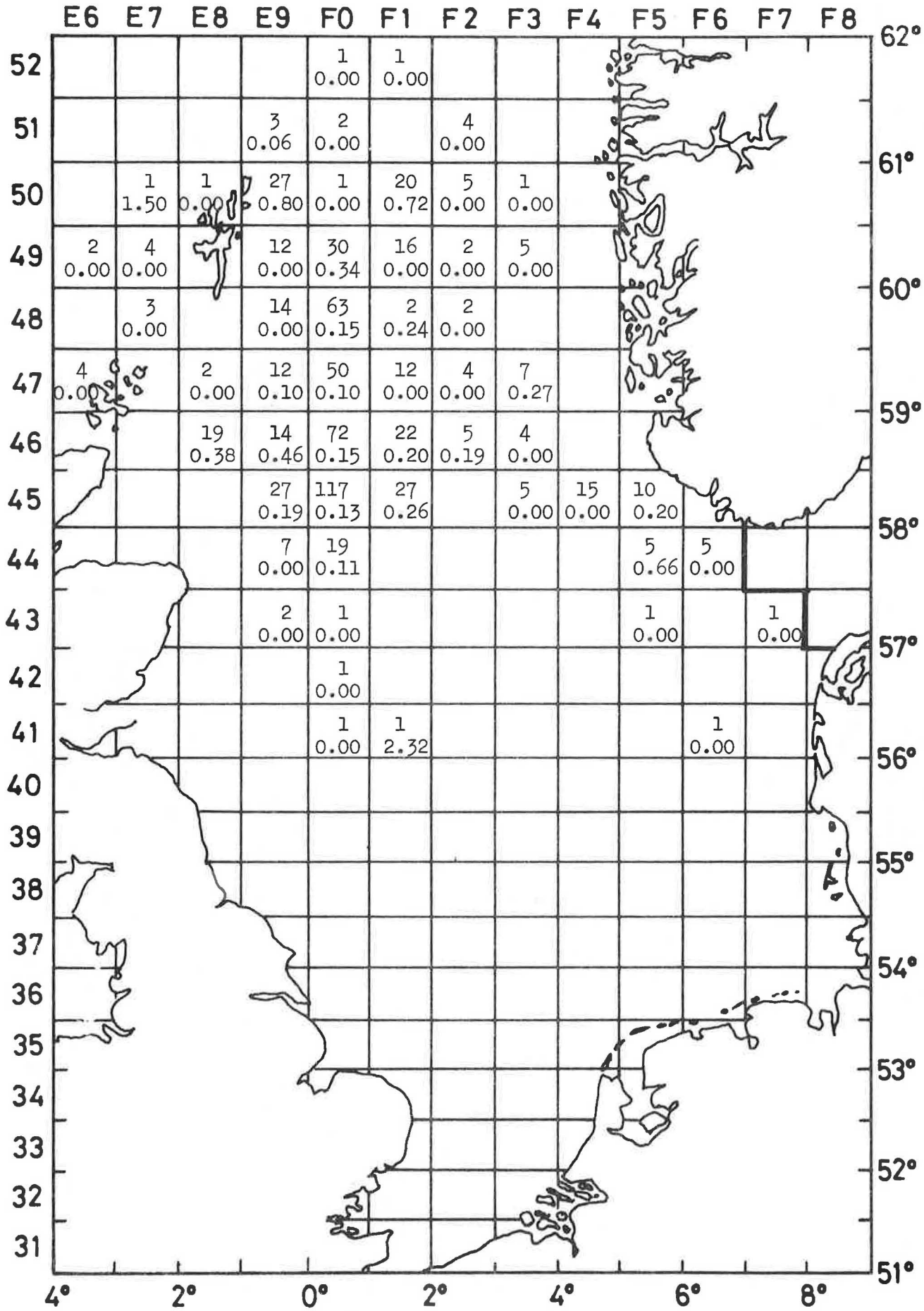


Figure 2. By-catch of herring in the 1977 Norway pout fisheries (upper figure - number of samples, lower figure - mean percentage). (Data from Danish and Scottish national laboratories.)

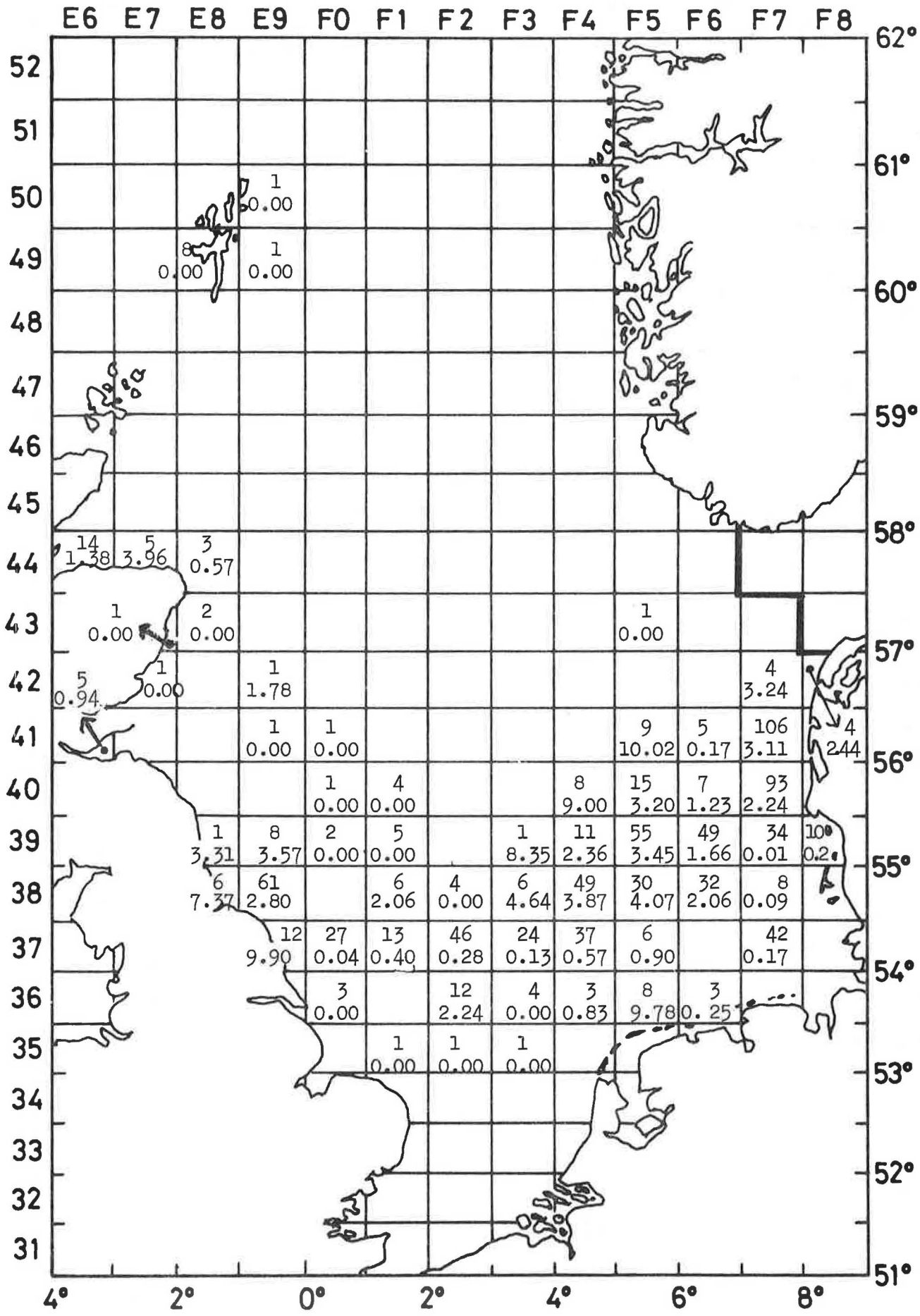
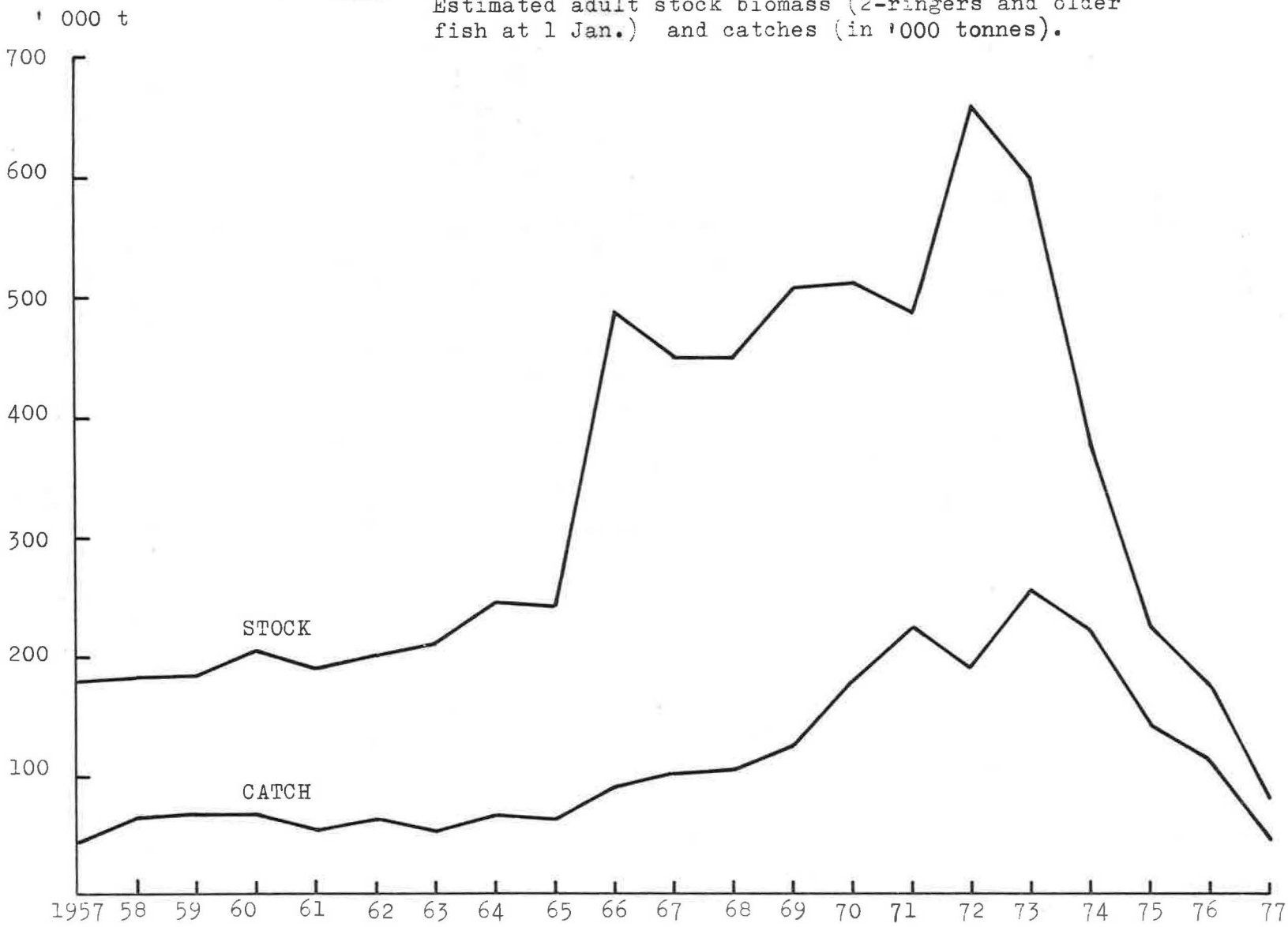


Figure 3. By-catch of herring in the 1977 sprat fisheries (upper figure - number of samples, lower figure - mean percentage). (Data from Danish, English and Scottish national laboratories.)

Figure 4. Division VIa Herring.
Estimated adult stock biomass (2-ringers and older fish at 1 Jan.) and catches (in '000 tonnes).



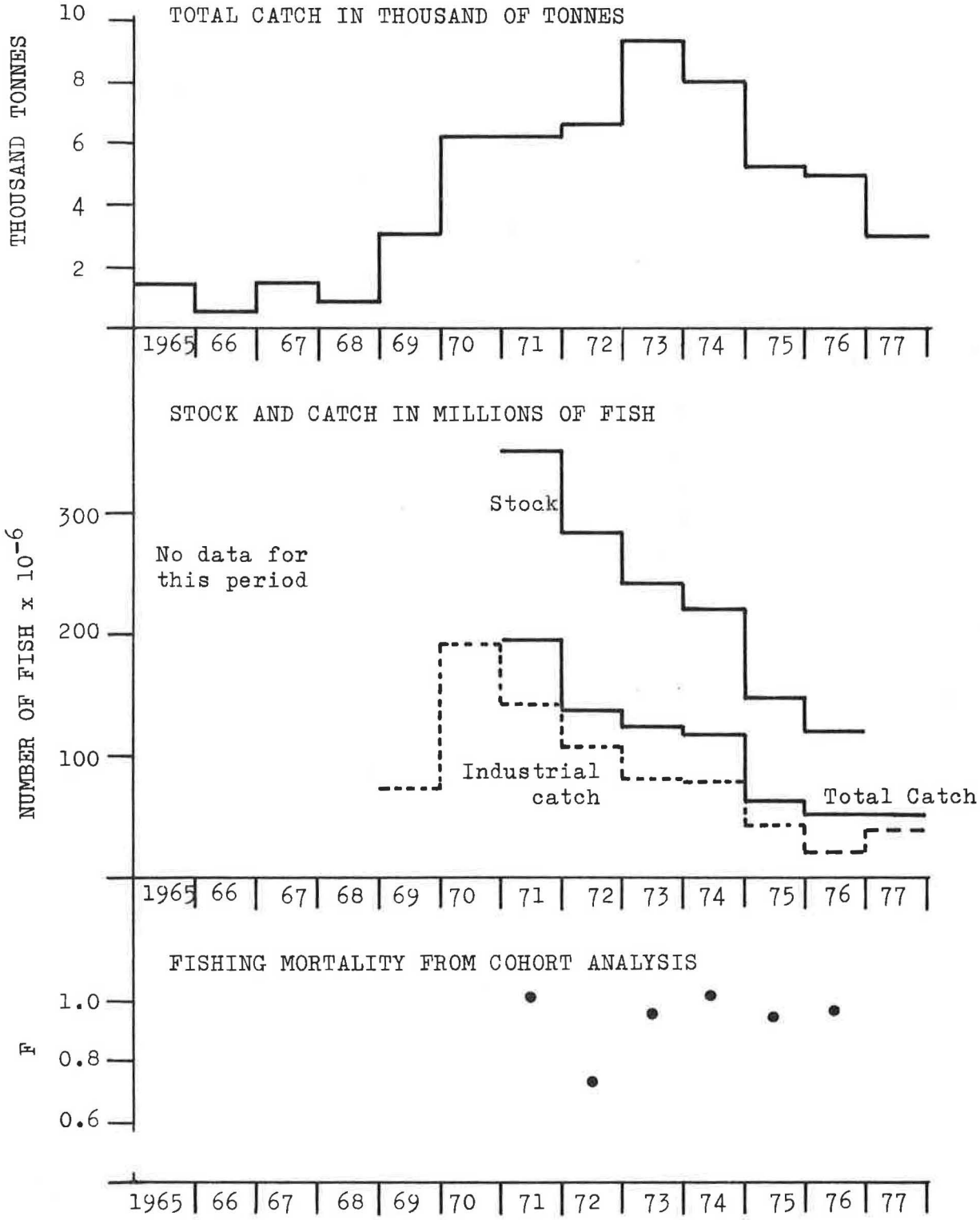


Figure 5. Division VIIa Irish Sea herring, Mourne stock. Catch by weight and number, stock size and fishing mortality 1965-77.

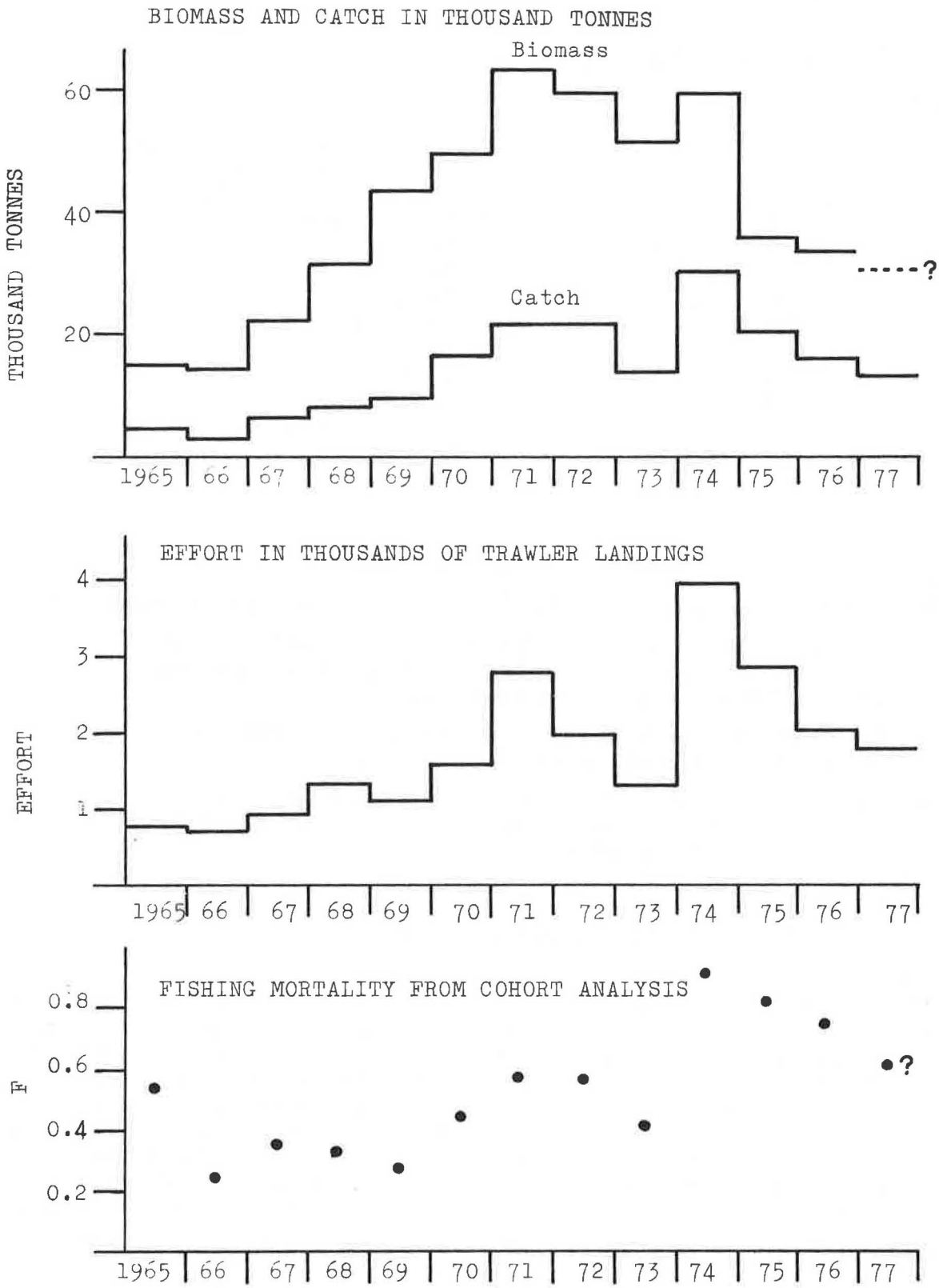


Figure 6. Division VIIa Irish Sea Herring, exploited Manx stock. Biomass, catch, effort and fishing mortality, 1965-77.

B. REPORT ON MEETING, 28-30 SEPTEMBER 1978

1. PARTICIPANTS AND TERMS OF REFERENCE

1.1 Participants

R S Bailey	United Kingdom (Scotland)
A B Bowers	United Kingdom (England)
A C Burd	United Kingdom (England)
A Corten	Netherlands
H í Jakupsstovu	Denmark (Faroes)
J Jakobsson (Chairman)	Iceland
A Maucorps	France
J Molloy	Ireland
E Nielsen	Denmark
K Popp Madsen	Denmark
H Rosenberg	Sweden
A Schumacher	Federal Republic of Germany
Ø Ulltang	Norway
G Wagner	Federal Republic of Germany
O J Østvedt	Norway

1.2 Terms of Reference (see also Annexes 1 and 2)

The Herring Assessment Working Group met for 3 days in order to:

1. evaluate the position of the herring in the Firth of Clyde in relation to neighbouring herring stocks and assess the state of Clyde herring;
2. consider necessary measures to be taken to monitor depleted or recovering herring stocks;
3. During the first day of the meeting, the Group was requested, unexpectedly, to make a new assessment of the Mourne herring stock.

2. THE HERRING POPULATIONS OF THE FIRTH OF CLYDE

2.1 Introduction

Traditionally, herring fishing in the Firth of Clyde was carried out using anchored gill-nets (trammel nets) on Ballantrae Bank during the spring spawning season and ring-nets over a large part of the Firth. Ring-netting took place in the outer reaches of the Firth before and during the spawning season and in the inner parts of the Firth for the rest of the year. Since 1968 pair trawling has played an increasing part in the fishery and is now the only method in regular use. Occasional landings are also made by purse-seine and herring are also landed when they are caught incidentally to demersal fishing.

A chart of the Firth of Clyde showing the spawning area and the relationship with other herring fisheries is shown in Figure 7.

2.2 Landings

Annual landings of herring caught in the Firth of Clyde from 1955-78 are given in Table 1. The seasonality of the fisheries is shown by the monthly landings given in Table 2. Landings by all methods combined fluctuated reaching peaks of 15 680 tonnes in 1960 and 15 096 tonnes in 1965. After 1969 there was a fairly steady decline to a level of 3 000 - 5 000 tonnes from 1971-77.

2.3 Racial Composition of the Landings

Until recent years the Clyde herring fishery was based almost entirely on spring-spawning herring which spawn locally in the Firth of Clyde. These fish are characterised by a high mean vertebral count (57.0 - 57.2) and a low number of keeled scales (14.1 - 14.3). Spawning occurs from February to mid-April at Ballantrae Bank and until recently to the south of Arran. The larvae tend to drift into the upper reaches of the Firth (Saville, 1964). Recruitment to the spawning population from these areas occurs at an age of 2-3 years, the proportion of two year old spawning herring increased in recent years as a concomitant of increased growth rate from 1964-70 (Saville and Jackson, 1974).

Since 1969 the racial composition of herring in the landings has changed. This is shown by a change in maturity composition and in mean vertebral counts. Whereas the mean VS of herring caught by trammel net on the spawning ground in spring has been stable over a long period (1930-76), in recent years the mean VS of herring caught in the months April-December has decreased (Table 3).

The change in composition of maturation stages is shown in Table 4. In 1968 fish in maturation stages 5 and 6 (ripe herring) were found in significant quantities in the Clyde only in the spring and spents (stages 7-8) only in the late spring and early summer. From 1969 onwards a larger proportion of the fish sampled in the months August-November have been ripe, and recovering spents (stage 8) have been found from about October-December.

On a division of the catches based on maturation stages it has been estimated that approximately 80% of the herring caught in the Clyde in 1968 were spring spawners, and about 40% in 1974.

2.4 The Origin of Autumn-Spawning Herring in the Clyde

Although ripening herring (maturity stages 4 and 5) are found in the Clyde in autumn, there is no evidence of spawning at that time of year within the Firth. To investigate the relationship between these herring and the autumn-spawning stocks in adjacent areas, the Working Group examined mean numbers of vertebrae, length and weight at age, age composition and tag returns.

2.4.1 Vertebral counts

As shown in Table 3, the mean vertebral counts of Clyde herring of both races combined are now 56.5 - 56.8. These means, however, include spring- spawning fish and the true mean for the autumn-spawning component is likely to be lower depending on the proportion of spring spawners.

Vertebral counts of Clyde herring in comparison with adjacent stocks are shown in the table below:

	1972	1973	1974	1975	1976
Clyde [1]	56.50	56.55	56.43	-	-
Isle of Man[2]	56.19	56.20	56.25	56.24	56.20
South Minch[1]	56.49	56.42	-	-	-
Mourne[3]	-	56.76	56.62	56.66	56.76

1) 2-ringers and older June-August

2) 2-ringers and older July-September

3) Spawning fish of all ages September-November

Thus the VS of Clyde autumn-spawners is not inconsistent with that of adjacent stocks. Owing to the uncertainty of the exact proportion of spring and autumn spawners in the Clyde samples, however, this criterion cannot be used as a guide to the racial origin of the autumn spawners.

2.4.2 Length and weight at age

Based on data collected in July and August the mean length at age of Clyde herring is very much higher than that of any adjacent population.

The length frequency distribution of Clyde herring, however, is in some cases bimodal and in almost all other cases very extended (Figure 8). This indicates that the Clyde population contains a component of very large, fast-growing fish that are not caught in any other fishery. The high mean length at age is clearly reflected in the high mean weight at age (Figure 9). This component, furthermore, makes up a considerable proportion of the Clyde population.

2.4.3 Year class strength of Clyde herring in relation to neighbouring stocks

Age compositions of Clyde autumn spawners were compared with those of neighbouring populations in order to investigate possible relationships. No strong resemblance existed with the herring of the Isle of Man, the NW coast of Ireland, and the South Minch. In the Clyde herring, few year classes have been outstanding over a prolonged period. Only year class 1966 was a relatively strong one during most of its life span. This year class was only of moderate strength in the South Minch and NW of Ireland. Year class 1963 and 1969, which were very strong in the southern parts of VIa, were not exceptional in the Clyde, with the exception of year class 1963 as 2-ringers. Nor was year class 1971, the outstanding year class in the Isle of Man fishery, anything exceptional in the Clyde.

So, although there is a remote resemblance in age composition between Clyde autumn spawners and the herring of southern VIa, the age composition data do not indicate a strong connection between Clyde herring and any of the neighbouring stocks in particular.

Nevertheless, the increase in abundance of autumn-spawning herring in the Clyde which took place in the period from 1969 onwards coincides with that period during which the stock of herring in VIa increased as a result of improved recruitment.

2.4.4 Tagging

Recent tagging experiments were carried out in October 1976 (2 600 released) and July 1977 (1 300 released). The fish tagged were representative of landings in those months, containing a wide range of lengths and maturation stages. They too can be assumed to have consisted of a mixture of spring and autumn spawners. The tag returns by month and area are given in Table 5. Neither experiment shows a clear seasonal pattern of recaptures and there is no evidence to support an exodus of herring from the Clyde in autumn 1977. The results of these recent experiments support earlier tagging experiments in which some mixing between the Clyde and adjacent populations was demonstrated (Saville, 1962; Baxter, 1963).

Most of the returns from the recent experiments have been from within the Clyde. The few returns from other areas (area VIIa Irish Sea 6; area VIa NW Ireland 2; area VIa Minch 2) indicate a degree of mixing with adjacent stocks, but provide no firm evidence for the racial origin of Clyde autumn spawning herring.

2.4.5 The data referred to in Sections 2.4.1 to 2.4.4 provide no firm basis on which to determine the racial origin of Clyde autumn spawners, and indeed suggest that their origin may be complex.

2.5 The State of the Clyde Herring

2.5.1 The spring-spawning stock

From the catch per unit effort in the spring trammel net fishery (Figure 10), it is clear that the spring spawning component in the Clyde has declined markedly since 1965. This conclusion is supported by the results of herring larval surveys carried out since 1968 (Saville et al., 1974; McKay, unpubl. data). Larval production estimates for each season taken from these sources are reproduced in Table 6.

On the basis of this evidence, there is little doubt that the spring-spawning stock is now at a very low level.

2.5.2 The autumn spawners

Because allocation to race is unreliable it is not possible at present to make any firm assessment of population trends in the autumn-spawning component. They undoubtedly increased in relative abundance during the period 1969-76, when the spring-spawning stock was declining. There is less certainty about trends in absolute abundance.

2.6 Management of the Clyde Herring

2.6.1 Previous management

As a result of the clear evidence of a decrease in the abundance of spring-spawning herring in the Clyde, a national measure was introduced in 1972 barring fishing for herring in the period January-March inclusive each year. Until 1976 this seasonal closure allowed

an exemption for the traditional trammel net fishery, but following a re-assessment of the state of the spring-spawning stock in 1976, the ban in January-March was extended to all methods of fishing in 1977 and 1978.

The seasonal closure was aimed at protecting the spring-spawning stock. In addition, from 1976-78 a total allowable catch was agreed nationally, and the fishery managed on a quota basis. In 1978 the TAC is set at 4 000 tonnes. The purpose of this measure was to reduce the level of exploitation on both the spring and autumn-spawning components.

2.6.2 Working Group advice

Since the Clyde herring population contains a component of fish which spawn within the Clyde in spring, and since it also contains a component of autumn-spawning herring which cannot at present be allocated to any adjacent stock, the Working Group recommends that the Clyde fishery be treated as a separate management unit, at least until further information on the life history of the autumn spawners is available. For this purpose, the Firth of Clyde is defined as that area within a line drawn from Mull of Kintyre to Corsewall Point (see Figure 7).

The main facts to be taken into account in drawing up advice on management of Clyde herring are:

(i) that there is a need to protect the spring-spawning component which is currently at a low level, and

(ii) that at least a proportion of the autumn-spawning component probably belongs to an adjacent stock of herring, all of which are at present subject to severe catch restrictions.

Taking this into account, the Working Group advocates a reduction in the catch of Clyde herring to roughly half its present level. It therefore recommends that a TAC for 1979 be set at not more than 2 000 tonnes.

Since there is also a clear need to give the spring spawning stock a high degree of protection, the seasonal closure should be continued.

In order to protect the juvenile component of the Clyde herring, it is recommended that the minimum landing size regulations for neighbouring areas (20 cm) should be enforced in the Clyde.

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Saville, A and Jackson, S H. 1974. Recent changes in the growth of Clyde spring spawning herring. ICES, Doc. C.M.1974/H:29, pp.5 (mimeo.).

Table 1. Landings of herring from the Firth of Clyde by gear, in tonnes, 1955-78.

Year	Pair trawl	Ring-net	Purse-seine	Trammel net	Other Methods	Total
1955		3 799		251		4 050
1956		4 772		71		4 843
1957		5 779		136		5 915
1958		4 812		114		4 926
1959		10 455		75		10 530
1960		15 555		125		15 680
1961		10 743		105		10 848
1962		3 705		284		3 989
1963		6 918		155		7 073
1964		14 148		361		14 509
1965		14 578		518		15 096
1966		9 228		579		9 807
1967		7 628		301		7 929
1968	608	8 490		335		9 433
1969	2 772	7 484	33	305		10 594
1970	2 926	4 569	59	209		7 763
1971	1 482	2 450		156		4 088
1972	1 934	2 110	48	134		4 226
1973	3 051	1 491	67	106		4 715
1974	3 360	290	160	223	29	4 061
1975	3 460	21	2	140	42	3 664
1976	3 993	19	1	76	49	4 139
1977	4 672	139	6	-	29	4 847
1978[1)]	1 657	-	-	-	67	1 724

1) January - August inclusive.

Table 2. Monthly landings (tonnes) of herring from the Firth of Clyde January 1966 - August 1978.

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Ring-Net													
JAN	685	296	422	157	162	44	*	*	*	*	*	*	*
FEB	2148	833	2573	924	247	171	*	*	*	13*	*	*	*
MAR	855	568	876	154	147	454	*	*	*	*	*	*	*
APR	31	671	422	495	526	402	299	79	57	7			
MAY	146	291	636	741	325	305	315	129	115				
JUN	530	188	77	701	790	111	204	58	40				
JUL	1198	430	231	1266	1249	177	127	259	22			13	
AUG	1177	1157	789	960	581	163	307	347	42			61	
SEP	833	778	497	783	240	366	148	461	6			44	
OCT	752	1312	1196	674	111	83	319	26	3		12	19	
NOV	510	817	567	495	13	64	296	107	<1		7	3	
DEC	363	287	204	134	177	110	95	25	4	<1			
Pair-Trawl													
JAN				348	284	228	*	*	*	*	*	*	*
FEB			136	638	1170	190	*	*	*	*	*	*	*18
MAR			1	32	59	14	*	*	*36	*	*	*	*3
APR				15		4	101	237	341	362	521	530	204
MAY				19			254	256	165	283	436	544	234
JUN					3		453	410	567	203	281	640	238
JUL						83	289	429	668	354	332	481	374
AUG					99	222	394	246	501	240	473	540	586
SEP				111	164	153	115	207	304	515	541	515	
OCT			8	655	713	378	91	686	448	811	586	537	
NOV			265	709	270	129	167	357	244	571	588	557	
DEC			198	246	165	80	71	223	87	120	235	328	
Trammel Net													
JAN	74	7	65	< 1								*	*
FEB	468	294	258	258	152	130	52	71	91	55	7	*	*
MAR	37		13	46	57	27	82	36	132	85	69	*	*
All Methods Combined													
JAN	759	303	487	506	446	272	*	*	*	*	*	*	*
FEB	2616	1127	2967	1820	1569	491	52*	71*	91*	68*	7*	*	18*
MAR	892	568	890	232	263	495	82*	36*	168*	85	69*	*	3*
APR	31	671	422	510	526	406	400	316	398	369	521	530	204
MAY	146	291	636	760	325	305	569	385	280	283	436	544	234
JUN	530	188	77	700	793	111	657	468	607	203	281	640	238
JUL	1198	430	230	1266	1249	260	416	688	690	354	332	494	374
AUG	1177	1157	789	960	680	385	700	593	543	240	473	601	586
SEP	833	778	497	894	404	519	263	668	310	515	541	559	
OCT	756	1312	1104	1329	824	461	410	711	451	811	598	556	
NOV	510	817	832	1204	283	193	463	464	245	571	595	560	
DEC	363	287	402	380	342	190	166	248	91	120	236	328	
unknown				33	59		48	67	189	44	50	35	
TOTAL	9807	7929	9433	10594	7763	4088	4226	4715	4063	3663	4139	4847	

* Subject to closure of directed herring fishery.

Table 3. Mean vertebral counts of herring (2 rings and older) from the Firth of Clyde, 1968-1976. (No. of fish sampled in parantheses.)

	Ring-net and pair trawl fisheries (Apr-Dec)		Trammel net fishery	
1968	56.86	(1457)	57.10	(95)
1969	56.90	(1649)	56.97	(150)
1970	56.76	(1602)	57.12	(141)
1971	56.74	(1483)	57.08	(184)
1972	56.71	(1349)	57.05	(501)
1973	56.63	(1134)	56.66	(93)
1974	56.77	(1015)	57.27	(99)
1975	56.53	(462)	56.93	(60)
1976	56.78	(539)	57.03	(169)

Table 4. CLYDE HERRING: Percentage of ripe (stage 5-6) and spent (stage 7-8) fish in samples each month.

Year	1965	1966	1967	1968		1969		1970		1971		1972		1973		1974		1975	1976
Maturity State				Ripe	Spent	Ripe	Spent	Ripe	Spent	Ripe	Spent	Ripe	Spent	Ripe	Spent	Ripe	Spent		
JAN				24	6	7	3	54	4	67	10	No samples		No samples		No samples			
FEB				80	1	99	0	95	4	97	2	94	2	99	0	No samples			
MAR				78	4	71	24	2	71	85	11	95	3	92	2	90	5		
APR				2	65	<1	83	0	89	0	84	0	60	0	82	No samples			
MAY				33	35	0	58	0	73	0	83	0	57	<1	83	<1	58		
JUN				0	40	0	37	0	46	0	32	0	44	0	36	0	32		
JUL				0	22	<1	27	0	13	5	10	0	11	0	20	4	7		
AUG				1	11	14	7	2	2	16	2	21	2	2	27	22	8		
SEP				1	3	6	0	10	6	13	4	28	3	4	0	10	5		
OCT				<1	3	0	5	3	8	5	5	16	11	0	9	20	14		
NOV				1	3	0	12	14	9	9	19	10	7	3	25	26	26		
DEC				2	3	27	4	31	24	36	5	6	44	5	57	5	17		

Table 5. Numbers of recaptures by month and area of herring released in the Firth of Clyde.

		Released October 1976 No. recaptured						Released July 1977 No. recaptured					
		Clyde	Irish Sea	NW Ireland	Minch	Unknown	No. per 100 arrivals in Clyde	Clyde	Irish Sea	NW Ireland	Minch	Unknown	No. per 100 arrivals in Clyde
1976	Oct	10					4.0						
	Nov	108				1	42.5						
	Dec	10					16.1						
	Total	128				1							
1977	Jan	10											
	Feb	2				1							
	Mar	6	1										
	Apr	25					10.6						
	May	30					13.9						
	Jun	17		1			5.9						
	Jul	25					12.1	22				1	10.6
	Aug	14				1	6.1	57	2				24.9
	Sep	13					4.6	56	1			1	19.7
	Oct	27				1	11.9	65	1			3	28.6
	Nov	24				1	9.4	42	1		2	1	16.4
	Dec	13		1			7.5	16					9.2
	Total	206	1	2		4		258	5		2	6	
1978	Jan	0						2					
	Feb	0						1					
	Mar	1						1					
	Apr	1					0.8	5				2	4.1
	May	2					1.2	7				1	4.0
	Jun	2					0.9	4					1.8
	Jul	1					0.4						0.0
	Aug	1					0.5	1					0.5
	Total	8						21				3	
Grand total		342	1	2	0	5		279	5	0	2	9	

Table 6. Larval production of spring spawning herring at Ballantrae Bak

	Larval production x 10^{-11}
1958	3.38
59	0.32
1960	5.26
61	8.28
62	1.19
63	2.11
64	4.71
65	7.67
66	-
67	5.20
68	-
69	-
1970	5.08
71	-
72	0.84
73	0.15
74	3.64
75	0.38

1958-72 taken from Saville et al. (1974).
1973-75 kindly supplied by McKay (unpubl. data).

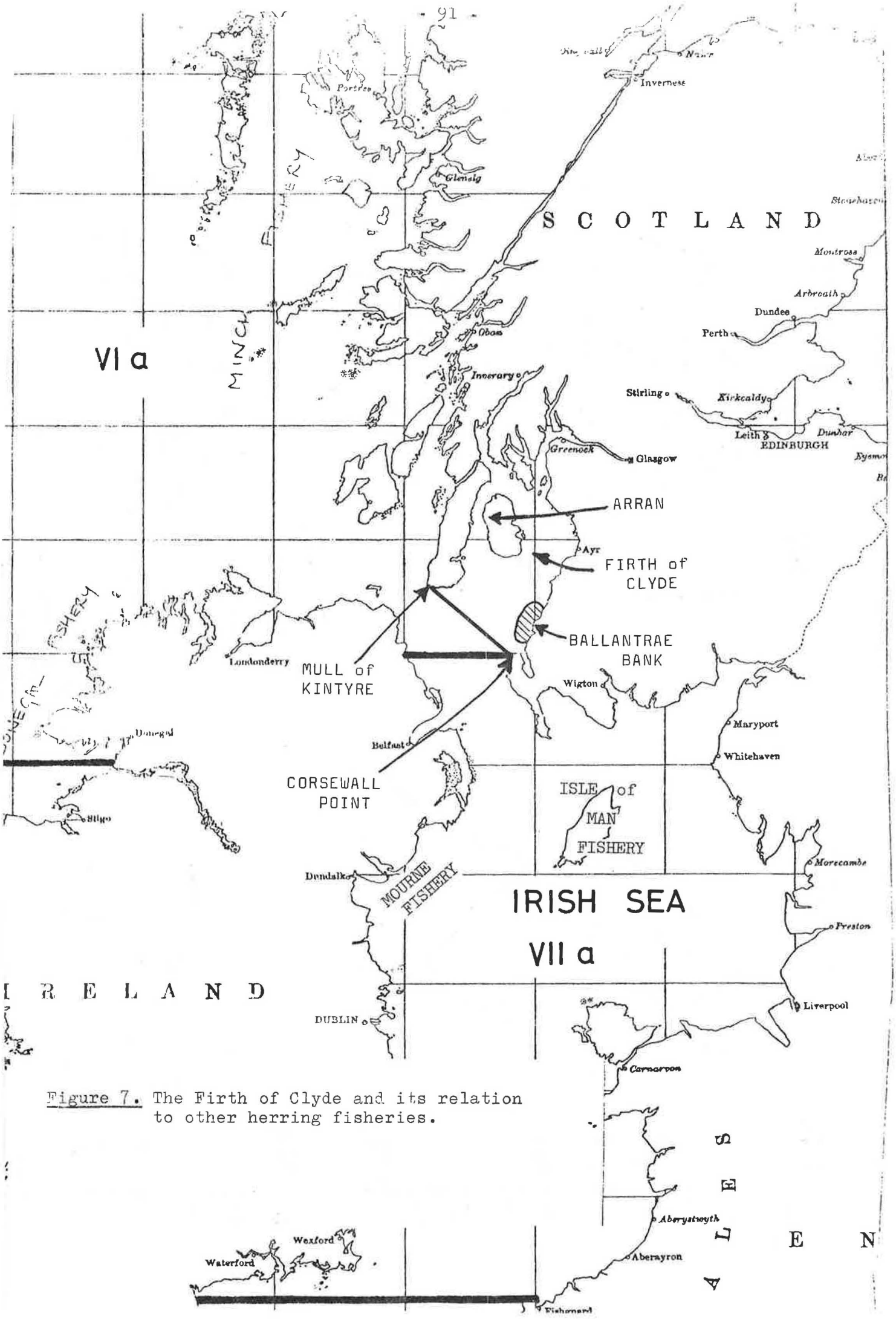
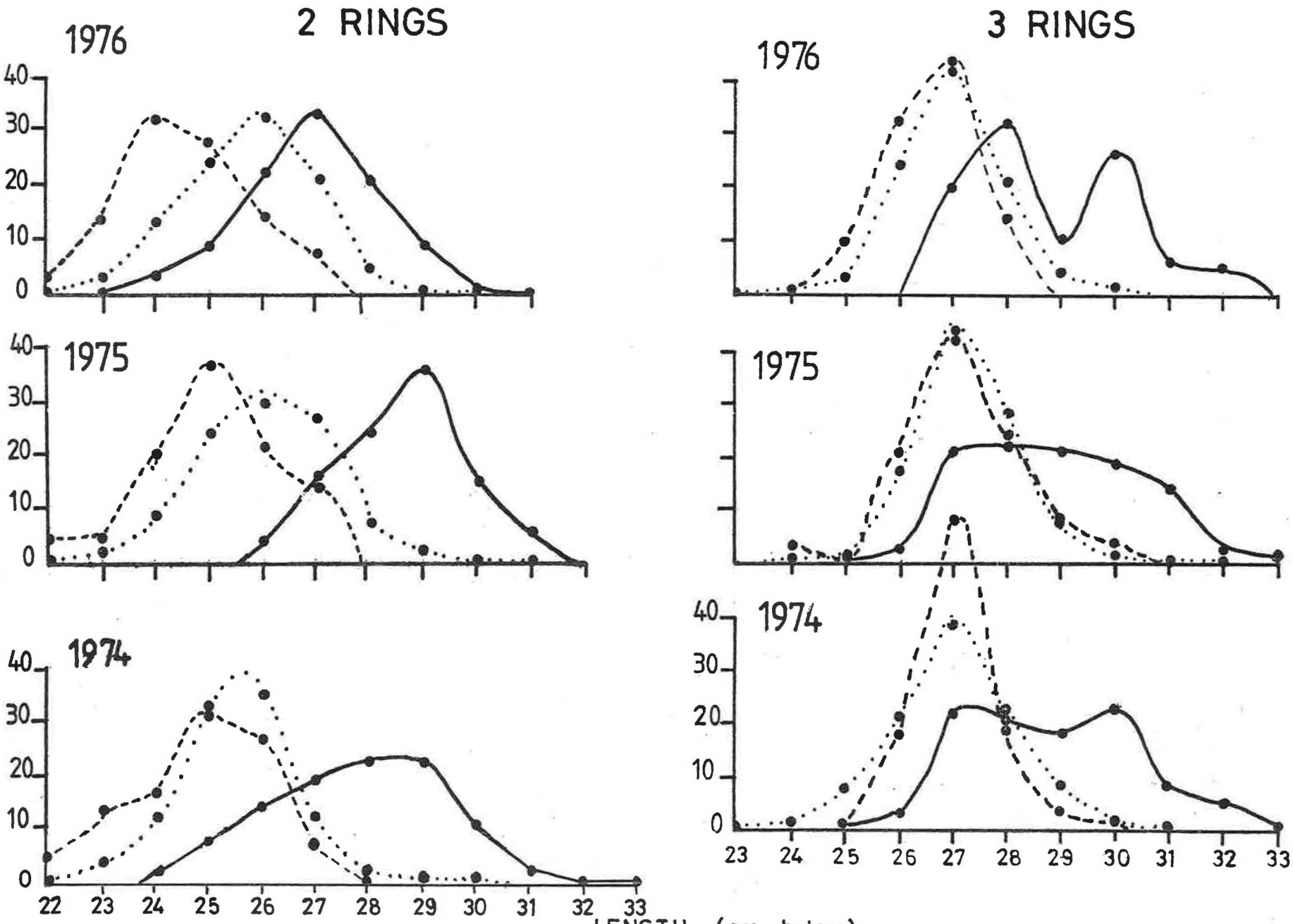


Figure 7. The Firth of Clyde and its relation to other herring fisheries.

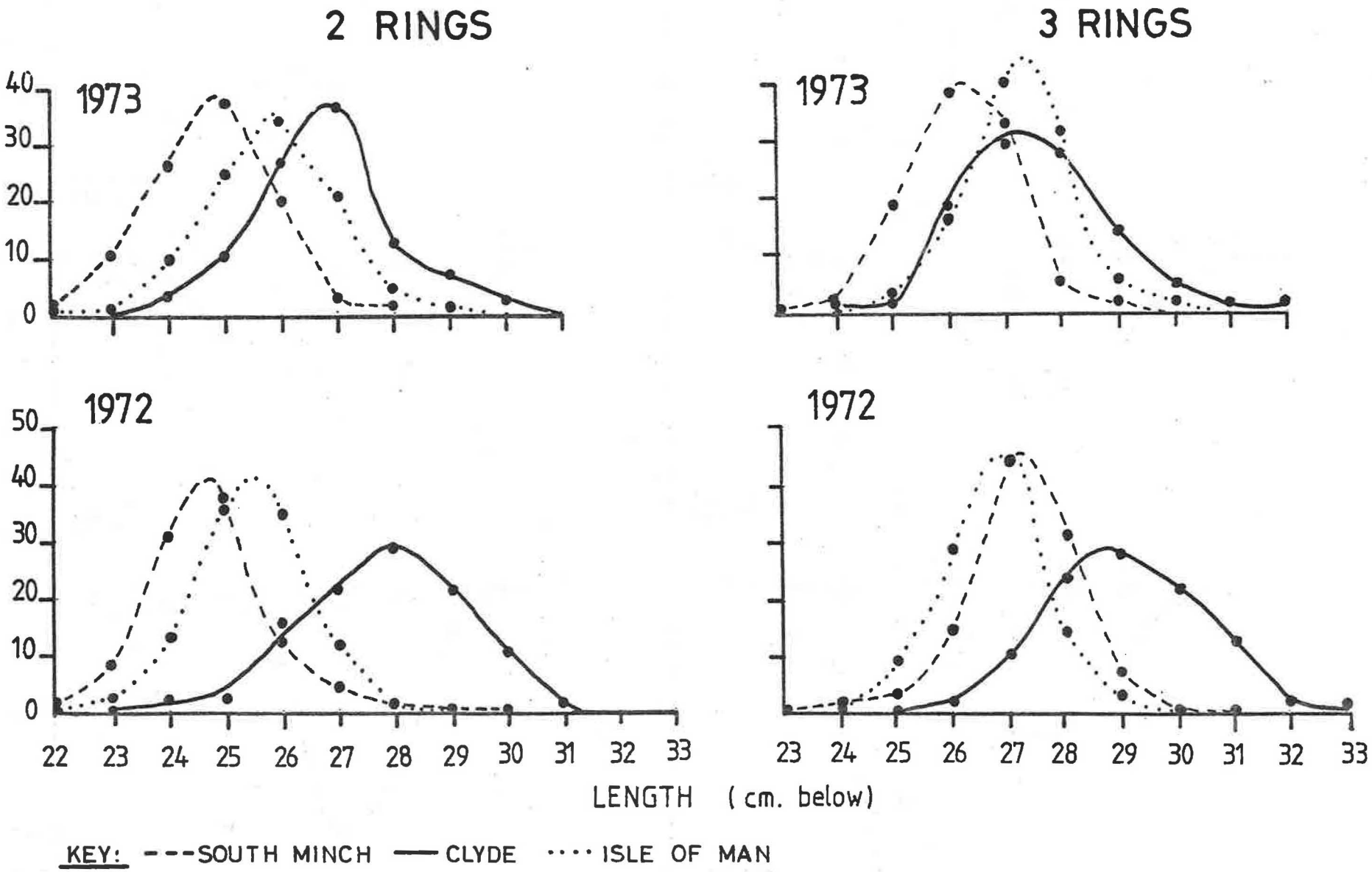
Figure 8. Percentage length compositions of Clyde, Manx and South Minch autumn spawned herring. (2 and 3 ringers.)



KEY: --- SOUTH MINCH —— CLYDE ···· ISLE OF MAN

continued

Figure 8 continued. (2 and 3 ringers)



continued

Figure 8 continued. (4 and 5 ringers)

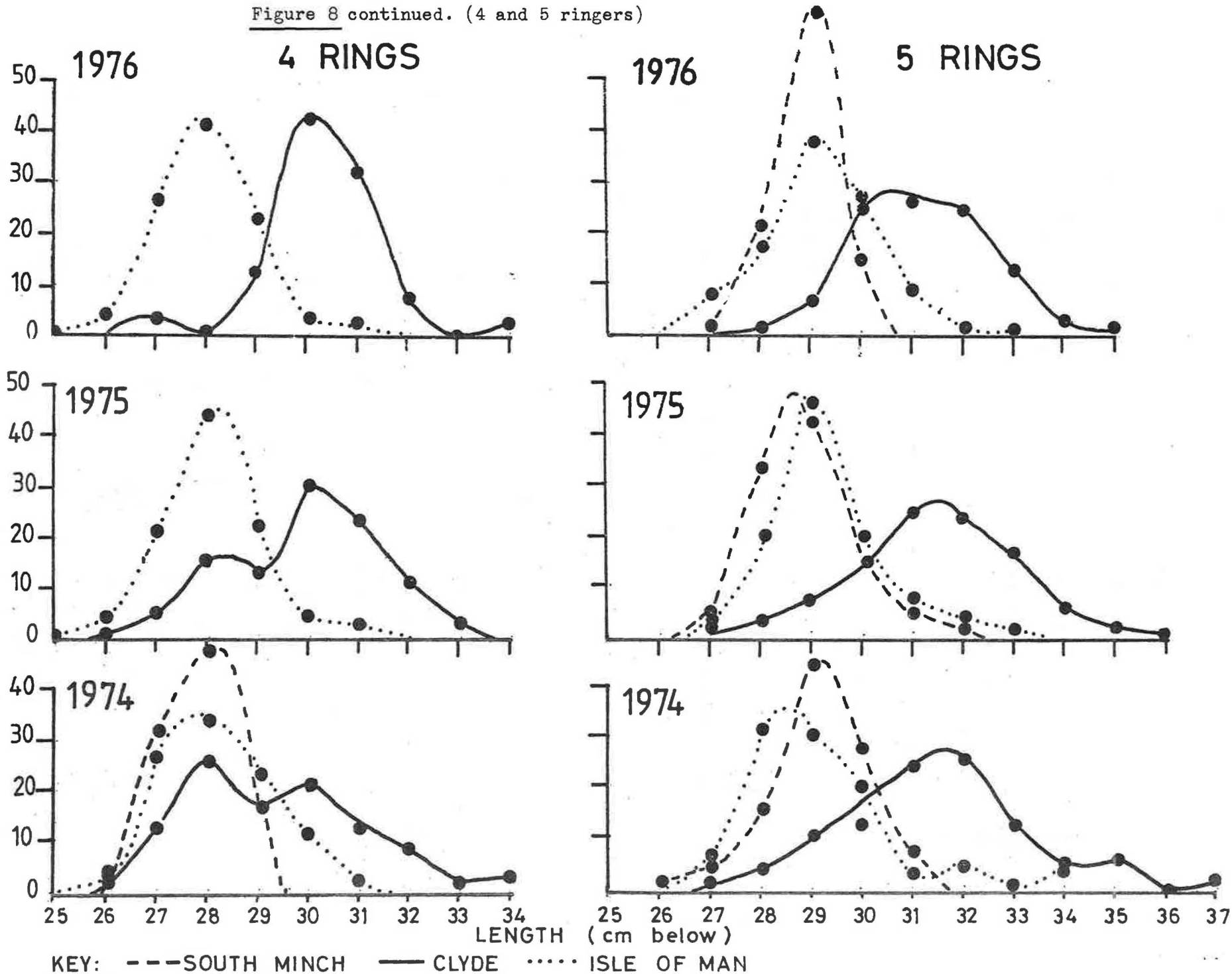


Figure 8 continued. (4 and 5 ringers)

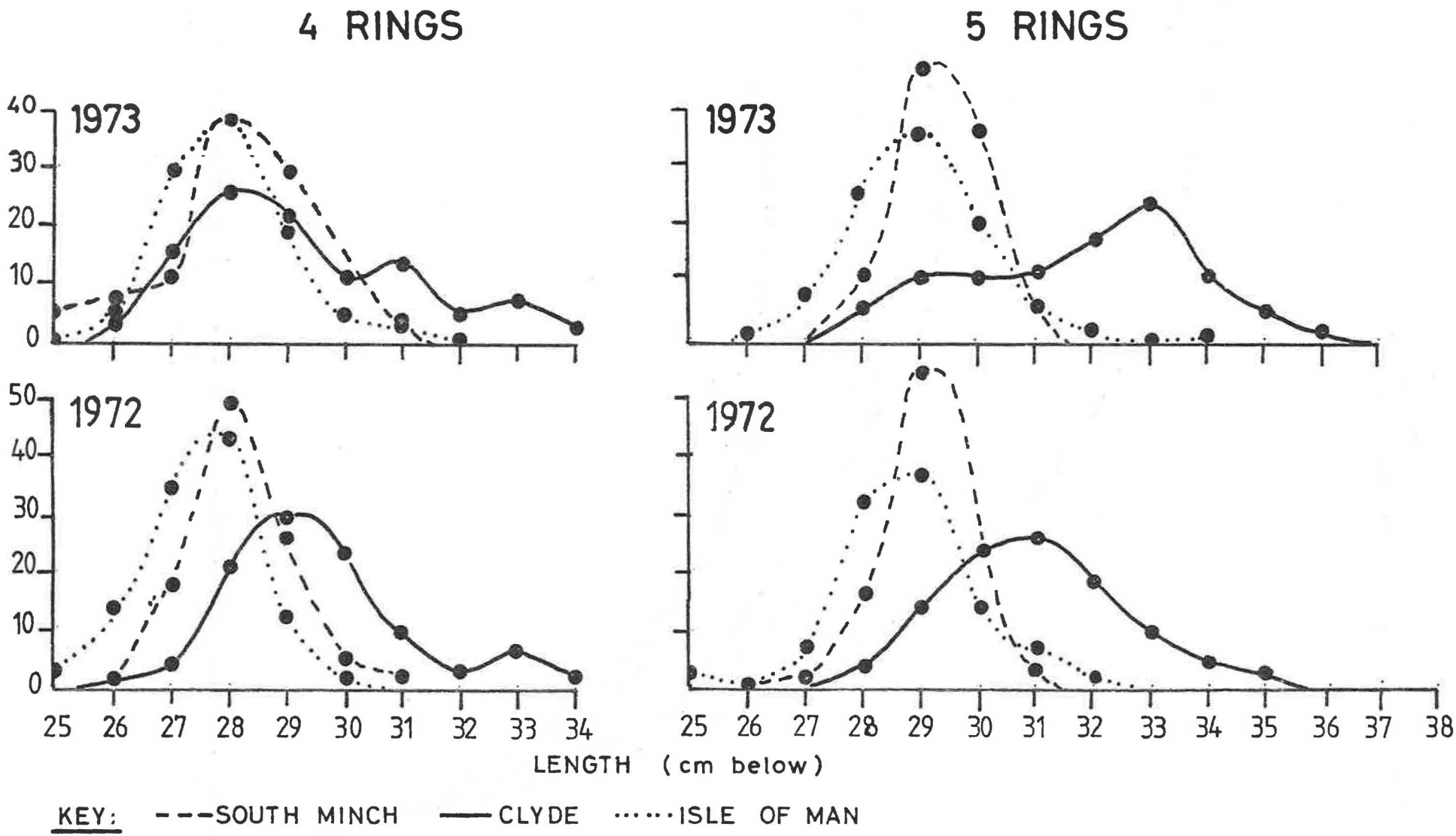


Figure 9. Growth curves of Clyde herring in comparison with adjacent stocks.

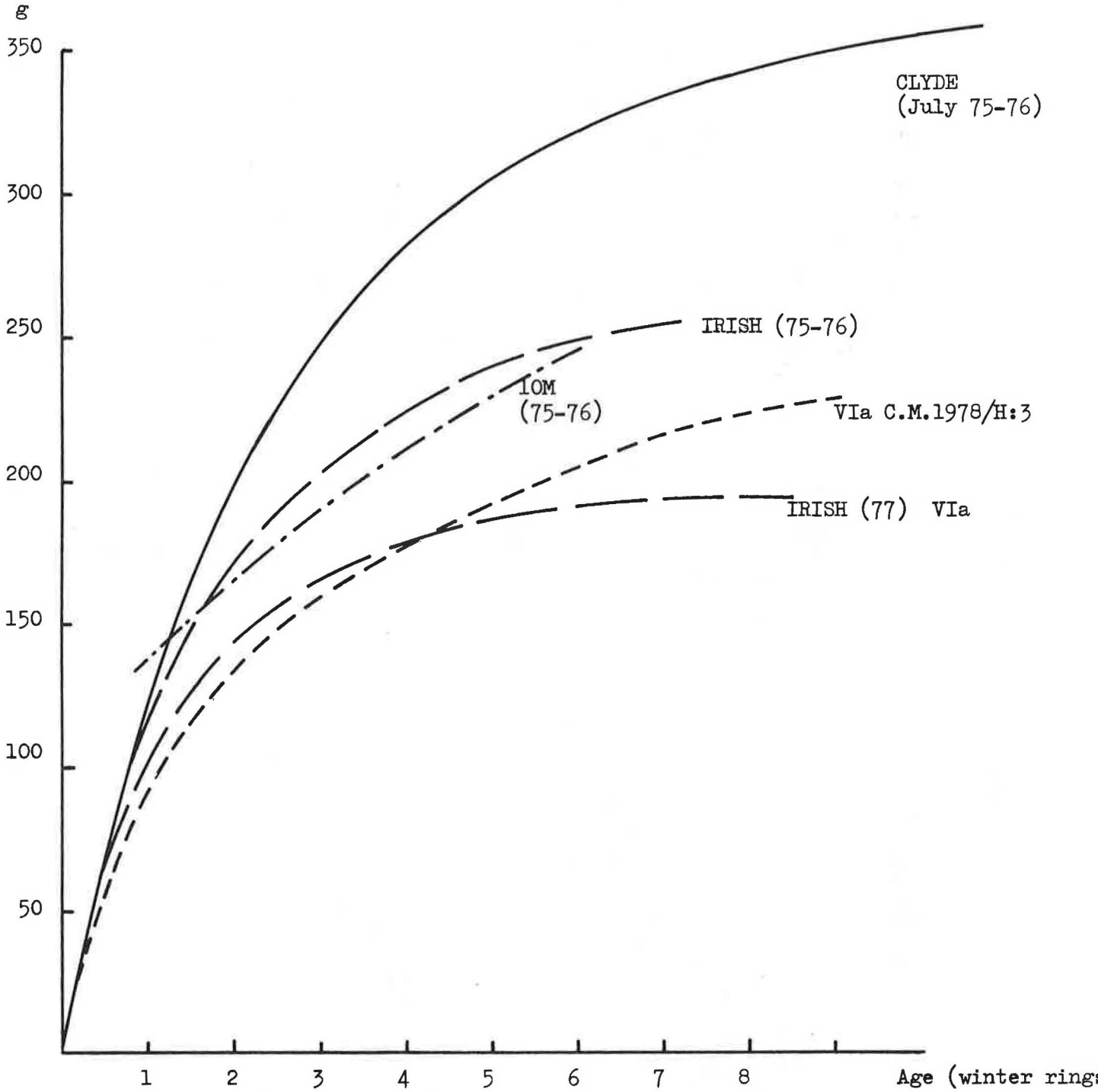
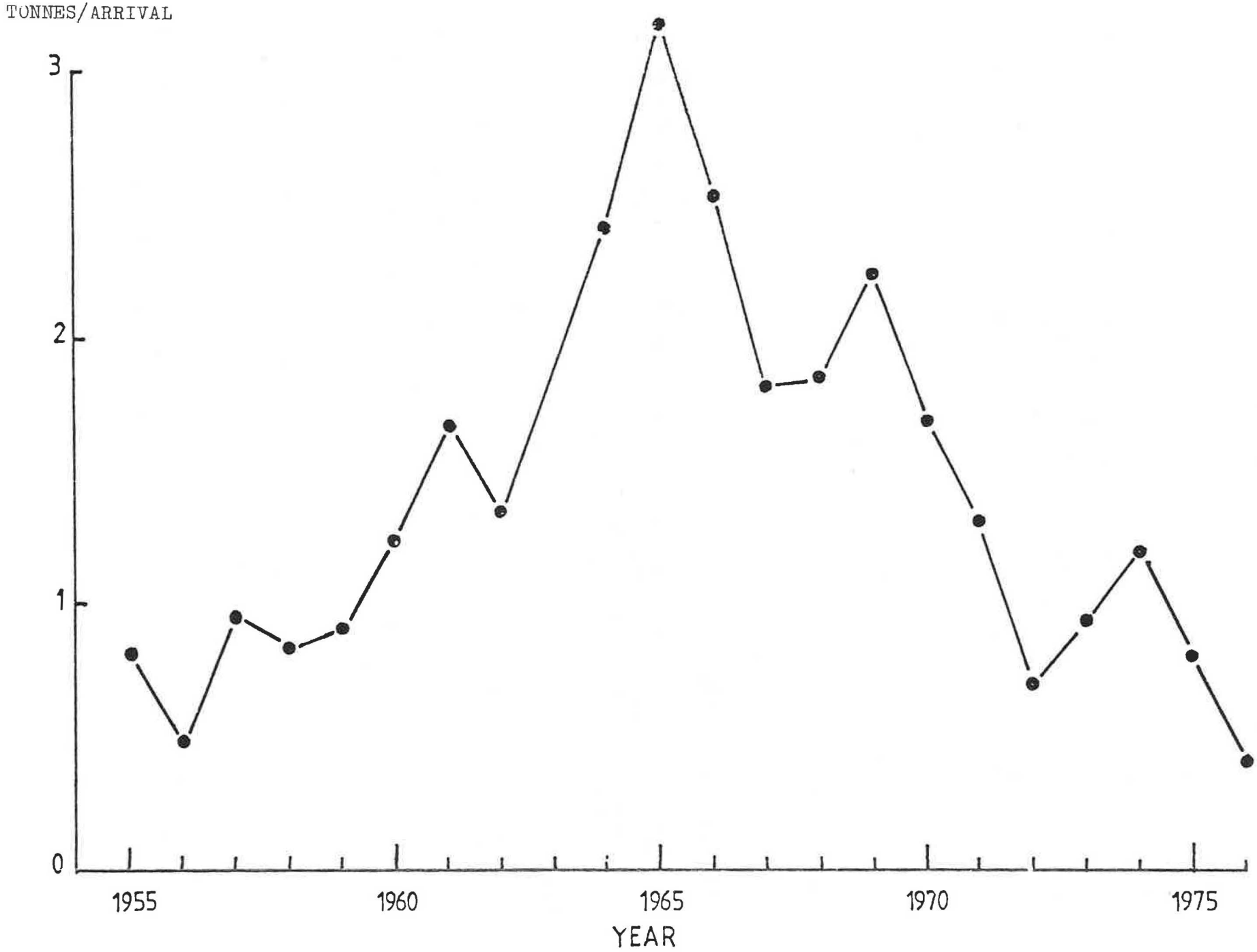


Figure 10. Catch per arrival in the Clyde trammel net fishery, 1955-75.



3. ASSESSMENT AND MONITORING OF DEPLETED OR RECOVERING STOCKS

3.1 With the present prohibition of fishing for herring in VIa and the North Sea, there is an acute need for independent measures of abundance for the stocks in these areas. The following lines of research were discussed and recommended.

3.2 Acoustic Surveys

The Working Group considered the problems encountered in carrying out acoustic surveys in the North Sea and adjacent areas. After an extensive discussion it was agreed to recommend that an ICES coordinated acoustic survey be carried out in 1979. To avoid dissipating the available effort over too great an area, it seemd advisable to confine the survey to those areas where the greater part of the North Sea and VIa herring adult stocks are likely to be found.

3.2.1 Objectives

The primary objective of the survey would be to estimate the biomass of adult herring north of 57°N both in Sub-division IVaW and Division VIa. A secondary, but nonetheless important objective would be to determine the composition of the spawning stock in each area by fishing.

3.2.2 Timing

The survey should take place in July 1979 and depending on the results, should be repeated in subsequent years.

3.2.3 Vessel Requirements

It is recommended that the survey should be carried out by three research vessels equipped with echo-integrators and three ships for scouting and sampling. For that item, the possibility of using chartered vessels should be considered nationally. It is also recognised that in practice the same ships might be involved in scouting, sampling and echointegrating.

3.2.4 Methods

At the beginning of the survey, the scouting vessels would carry out an extensive search in areas thought likely to contain herring. Having located concentrations, they would investigate them for a period of up to several days to determine their behaviour pattern and hence the time of day or night at which integration is most likely to succeed. The echointegrator surveys would then be carried out as an intensive grid over a limited and well-defined area. Throughout the period, intensive sampling would be carried out to determine the age composition of the population in each area.

3.2.5 Coordination

The survey should be coordinated by a planning group consisting of members from each country participating. This group would be responsible for the detailed planning of the surveys.

3.2.6 Reporting of results

The planning group will be responsible for allocating the results of the surveys and for preparing a report which would be presented at the Statutory Meeting in 1979.

3.3 Herring Tagging Experiment 1979

It is proposed that a major tagging experiment be undertaken in 1979 in the area between Donegal and the northern North Sea.

3.3.1 The objectives

1) To estimate the strength of the stocks in VIa and IV.

2) To estimate recruitment to the stocks and to examine the interrelation between these stocks.

3) To estimate natural mortality.

3.3.2 The experiment

a) Area. - Tagging should be spread over the area between Donegal, through the Minches, west of the Hebrides and the areas around Orkney and Shetland.

b) Timing. - To avoid tagging full herring, it is considered that the tagging should take place in the period May to July. The experiment should be repeated annually as long as necessary.

c) Tagging method. - Internal tags would be used and in order to get sufficient recoveries it is considered that a minimum of 100 000 tags should be liberated. In view of the area involved and the timing, it is considered that two purse-seine vessels should be employed. On each vessel it is proposed that there should be two tagging teams of two men. These should not be changed throughout the period of tagging.

3.3.3 Tag recaptures

In order to ensure that the liberated tagged fish are distributed over the whole area of distribution of the stocks, it is not proposed to establish a regular recovery system before January 1980.

Because of the ban on commercial herring catching, it would be necessary to hire a number of experimental fishing vessels. The catches of these vessels would have to be screened for tagged fish using a tag detector system. The catches would be sold to defray the costs of the experiment.

3.3.4 Biological sampling

Throughout the tagging experiments regular biological samples of the fish caught would be examined.

Similarly, all experimental catches would be sampled.

3.3.5 Tagging mortality

During the experimental tagging period, tagging mortality experiments should be conducted. It is essential for the successful analysis of the data that some priority should be placed on these experiments.

3.3.6 Planning Group

A Planning Group should be set up to make more detailed proposals and assess costs for the entire scheme. A very rough estimate of the cost of the tagging in 1979 would be of the order of

D.Kr. 2.5 million. This is equivalent to a catch at present prices of 250-500 tonnes of herring.

3.4 Young Herring Surveys

The feasibility of the extension of the ICES North Sea Young Herring Survey was discussed. The Working Group came to the conclusion that although there could be great advantages in young herring surveys in areas outside the North Sea, these would be best taken care of by national rather than international effort. It was, therefore, recommended that the Young Herring Surveys outside the North Sea should be either continued (Irish Sea and VIa) or initiated (Celtic Sea) on national basis.

3.5 Larval Surveys

The Working Group discussed the coordination and extension of larval surveys for monitoring changes in spawning stock size. The Group recommends that the sampling intensity in Division VIa should be brought up to the same level as in the North Sea, i.e., one survey every 15 days during the hatching season. The Group also reiterates its former recommendation that the Working Group on North Sea Herring Larval Survey is transformed into a Working Group for all herring larval surveys south of 62°N. This new Working Group should be convened at the earliest possible occasion, in order to make plans for a complete coverage of the spawning areas and periods in both the North Sea and Division VIa, starting from the 1978 season.

The current programme for monitoring direct assessment of herring stocks in the area considered by the Working Group is set out in the text table below. In addition, proposals made in this report are included.

Current and proposed monitoring programme of herring stocks in the area south of 62°N

Stock	Larval surveys	Recruit surveys	Acoustic surveys	Tagging experiments
North Sea and Skagerrak (including eastern Channel)	ICES	ICES	Proposed ICES	Proposed ICES
Celtic Sea	Ireland	-	Ireland (spawning survey qualitative)	-
VIa (excluding Clyde)	Scotland	Scotland	Proposed ICES	Proposed ICES
Clyde	Scotland	-	-	Scotland
West coast Ireland	-	-	-	-
Irish Sea	Survey of Mourne spawning ground	-	-	-

4. MOURNE HERRING

4.1 The Herring Assessment Working Group estimated the status of the Mourne herring stock as of 1 January 1978 to be as follows (see page 20).

Millions of fish at 1 January 1978

Age (rings)

0	1	2	3	4	5	6	7	8	9	10	Total
45.4	22.5	18.8	6.9	2.7	1.1	0.7	0.3	0.2	0.1	0.1	98.8

The spawning stock biomass was estimated to be 6 900 tonnes at 1 January 1978.

0-group recruitment in 1978 was assessed at 45 million fish; it was stressed that this figure might well be overoptimistic because the spawning stock size was very low.

The recommendation made by the Working Group in March 1978 is reproduced below.

It is recommended that the present prohibition on fishing for herring within 12 miles of the coast of Ireland should be continued, and in view of the substantial catches of 1-ring herring of both Manx and Mourne origin which have been caught in Belfast Lough during the winter of 1977/78, it is also recommended that the closed area should be extended to the northern boundary of Division VIIa at latitude 55°00'N. The Working Group once again draws attention to the fact that there can be very little prospect of a recovery by this stock while the industrial fishery continues in the N.Irish Sea. It is imperative that this fishery is terminated at once, otherwise it is very likely that this stock will not continue to survive.

The ACFM endorsed this recommendation.

4.2 It is now known that the Mourne stock has been subjected to fishing in 1978 by drift-netters and trawlers, and by an industrial fishery in the Irish Sea.

By 26 September drift-netters were reported to have taken 400 tonnes of mature fish in the area within half a mile from the Northern Ireland baselines between a line running due east from Roaring rock (approx. 54°10'N) and a line running due southeast from Haulbowline rock (54°0'N). It is understood that this fishery was stopped on 26 September 1978.

The estimated total catch of Mourne herring in 1978 to date (29 Sept.)is about 2 350 tonnes. This estimate will probably be increased as more accurate data become available. The total includes about 360 tonnes of herring taken by the industrial fishery; the remainder includes catches by trawlers and drifters.

The total catch of Mourne herring in 1977 was 2 983 tonnes.

4.3 Information is not yet available on the age distribution of the 1978 catch. It is therefore not possible to make a firm stock assessment as at September 1978 but the following facts are clear.

(i) The Mourne stock was in a seriously depleted state at the beginning of 1978, and in particular the spawning stock was at such a low level that recruitment was in jeopardy and the extinction of the stock was a real possibility.

(ii) Despite the recommendations of the Working Group and ACFM, the substantial fishing in 1978 will further reduce the spawning stock and the status of this stock will be even more serious than was stated in the Working Group's report.

(iii) It must be concluded that the Mourne stock is in such a critical state that the Working Group can only repeat its previous recommendations that no catch should be allowed from this stock. The Working Group also draws attention to the continuation of the industrial fishery in the Irish Sea which kills a large number of juvenile herring of the Mourne stock.

4.4 The Working Group recommends:

(i) that directed herring fishing be prohibited within 12 miles of the coast of Ireland between 53°00'N and 55°00'N for the remainder of 1978 and the whole of 1979.

(ii) that industrial fishing in the Irish Sea be prohibited for the remainder of 1978 and the whole of 1979.

5. SUMMARY

5.1 Annual landings of herring caught in the Firth of Clyde fluctuated during the period 1955-68 reaching peaks of about 15 000 tonnes in 1960 and 1965. After 1969 there was a fairly steady decline to a level of 3 000 - 5 000 tonnes from 1970-77.

Until recent years the Clyde herring fishery was based almost entirely on spring spawning herring which spawned locally in the Firth of Clyde. Since 1969 the racial composition of the herring in the landings has changed so that a major component now consists of autumn spawning herring. There is, however, no evidence of spawning at that time of year within the Firth. In order to investigate the relationship between these herring and the autumn spawning stocks in adjacent areas the Working Group examined data on mean numbers of vertebrae, length and weight at age, age composition and tag returns. These data provided no firm basis to determine the racial origin of Clyde autumn spawners, and indeed suggest that their origin may be complex. The main facts to be taken into account in drawing up advice on management of Clyde herring are:

(i) that there is a need to protect the spring spawning component which is currently at a low level, and

(ii) that at least a proportion of the autumn spawning component probably belongs to an adjacent stock of herring, all of which are at present subject to severe catch restrictions.

Taking this into account, the Working Group advocates a reduction in the catch of Clyde herring to roughly half its present level. It therefore recommends that a TAC for 1979 be set at not more than 2 000 tonnes.

Since there is also a clear need to give the spring spawning stock a high degree of protection, the seasonal closure should be continued.

In order to protect the juvenile component of the Clyde herring, it is recommended that the minimum landing size regulations for neighbouring areas (20 cm) should be enforced in the Clyde.

5.2 With the present prohibition of fishing for herring in Division VIa and the North Sea, there is an acute need for independant measures of abundance for the herring stocks in these areas. The Working Group therefore proposed that ICES launch two major projects for this purpose, i.e. acoustic abundance surveys and extensive herring tagging experiments. In addition, the Working Group recommended that the International Young Herring Surveys and the Larval Surveys should be continued and extended.

5.3 The total catch of Mourne herring 1 Jan. - 29 Sep. 1978 was about 2 350 tonnes. Information was not available on the age distribution of these catches and it was, therefore, not possible to make a firm stock assessment as at September 1978. The Working Group reiterated its former recommendation that the Mourne stock was in such a critical state that no catch should be allowed from this stock.

5. RÉSUMÉ - en français

5.1 Les débarquements annuels de hareng en provenance du Golfe de la Clyde ont fluctué durant la période 1955-68 en atteignant des maxima d'environ 15 000 tonnes en 1960 et 1965. La production a décliné régulièrement à partir de 1969 pour atteindre un niveau de 3 000 à 5 000 tonnes de 1970 à 1977.

Jusqu'à une période récente, la pêcherie de hareng da la Clyde était presque entièrement basée sur du hareng géniteur de printemps qui pondait localement dans le Golfe de la Clyde. Depuis 1969, la composition raciale du hareng dans les débarquements a changé de telle manière que les harengs géniteurs d'automne en constituent maintenant la majeure partie. Il n'existe cependant aucune preuve mettant en évidence une reproduction à cette époque de l'année à l'intérieur du Golfe. Afin d'examiner la relation existante entre ces harengs et les stocks de géniteurs d'automne dans les zones voisine, le Groupe de Travail a examiné les données des moyennes vertébrales, taille et poids par âge, composition en âge et de marquage. Ces données n'ont permis aucune conclusion ferme quant à l'origine raciale des géniteurs d'automne de la Clyde et suggèrent en fait que cette origine peut être complexe. Les faits principaux à prendre en compte dans l'établissement de l'avis pour la gestion du hareng de la Clyde sont:

(i) qu'il est nécessaire de protéger la composante de géniteurs de printemps qui est actuellement réduite à un niveau faible; et

(ii) qu'au moins une fraction de la composante de géniteurs d'automne appartient à un des stocks voisins de harengs qui sont tous l'objet de sévères restrictions de capture.

Considérant cette situation, le Groupe de Travail conseille de réduire environ de moitié la capture actuelle du hareng de la Clyde. Il recommande en conséquence la fixation d'une PMA ne dépassant pas 2 000 tonnes.

Comme il est absolument nécessaire de protéger efficacement le stock de géniteurs de printemps, l'interdiction saisonnière devrait être maintenue.

Afin de protéger la composante juvénile de hareng de la Clyde, il est recommandé que les règlementations concernant la taille minimale au débarquement pour les régions voisines (20 cm) soient mises en oeuvre dans la Clyde.

5.2 En raison de l'interdiction actuelle de pêche du hareng dans la Division VIa et en Mer du Nord, des mesures indépendantes de l'abondance des stocks de hareng dans ces régions s'avèrent indispensables. En conséquence, le Groupe de Travail a proposé que le CIEM lance 2 projets de première importance répondant à cette préoccupation, c'est-à-dire des campagnes d'inventaire acoustique d'abondance et des expériences extensives de marquage de hareng. De plus, le Groupe de Travail a recommandé que les campagnes d'inventaires de hareng juvénile et celle de larve puissent être continuées et étendues.

5.3 La capture totale de hareng de Mourne a été d'environ 2 350 tonnes du 1er janvier au 29 septembre 1978; ne disposant d'aucune information sur la composition en âge de ces captures, il a été impossible d'effectuer une évaluation précise de ce stock en septembre 1978. Le Groupe de Travail a donc réitéré sa recommandation précédente stipulant que aucune pêche sur le stock de Mourne ne saurait être autorisée en raison de l'état critique dans lequel il se trouve.

ANNEX 1

Extrait d'une Lettre de la Commission des Communautés Européennes concernant le Hareng de la Clyde

Dans le rapport de l'ACFM 1978, il est recommandé qu'aucune capture de hareng n'ait lieu dans la Division VIa aussi bien pour le reste de l'année 1978 que pour l'année 1979. Cette recommandation ne comportant aucune exception, cela implique qu'en particulier la pêche du hareng dans la zone de la "Clyde", zone comprise dans la Division VIa, est également concernée. Toutefois le Cooperative Research Report No.37 (p.26) fait mention de l'existence d'un stock de hareng frayant au printemps dans l'estuaire de la Clyde. Dans ces conditions, certaines questions se posent au sujet desquelles la Commission souhaiterait obtenir des informations scientifiques.

Le stock de hareng auquel il est fait référence dans ce rapport a-t-il atteint un niveau de surexploitation tel que sa pêche doit également être interdite? Dans la négative comment un TAC peut-il être calculé? Y-a-t-il des migrations vers la Clyde des stocks frayant en automne à l'ouest de l'Ecosse? Connait-on leur importance? Peut-on calculer également les taux de mélange entre ces éventuels différents stocks à l'intérieur de cette zone ainsi que les variations saisonnières de ce taux?

Il parait également intéressant de connaître l'évolution de l'exploitation de cette pêche dans la Clyde ainsi que celles d'autres stocks de hareng frayant également au printemps dans la Division VIa.

Vous comprendrez certainement l'intérêt que la Communauté porte à ces questions et je vous serais très reconnaissant si le CIEM pouvait aussi éclairer la Commission sur la façon dont la recommandation visant à interdire la pêche du hareng dans la Division VIa doit être interprétée.

English Translation of the EEC Letter about Clyde Herring

In the 1978 ACFM report, a recommendation was made that no catch of herring should take place in Division VIa both during the rest of 1978 as well as during the whole of 1979. There was no exception to this rule in the recommendation; it therefore implies that it also applies to herring fishing in the Clyde area which is part of Division VIa. However, Cooperative Research Report No.37 (p.26) refers to the existence of a spring spawning stock of herring which spawns in the Firth of Clyde. Consequently, there are some questions on which the Commission would like to obtain scientific advice.

Is the herring stock referred to in this report so heavily exploited that fishing on it should be prohibited? If not, how could a TAC be assessed? Are there migrations into the Clyde of autumn spawning

stocks which spawn to the west of Scotland? Is their magnitude known? Is it also possible to calculate the mixing rate between these possibly different stocks in this area as well as its seasonal variations?

It would also be interesting to know the evolution of the exploitation of this Clyde fishery as well as of other spring spawning herring stocks which spawn in Division VIa.

You will certainly understand the interest which the Community takes in these matters, and I would be grateful to the ICES if it could advise the Commission on how the recommendation prohibiting fishing in Division VIa should be interpreted.

ANNEX 2

The EEC Commission Request to ICES for Scientific Advice on the Mourne Herring Stock

Could ICES please answer during forthcoming meeting following questions:

1. What is the estimated status of the Mourne herring stock as of 19 September 1978 in the light of fishing since January 1978?

2. What would be the effect of taking out 400 tonnes of this stock between 20 September and 27 October 1978 in an area within half a mile from the northern Irish baselines between a line running due east from the Roaring Rock (approx. 54 degrees 10 minutes north) and a line running due southeast from the Haulbowline Rocks (approx. 54 degrees zero minutes north) with boats under 35 feet registered length (drift-netters)?

Indication of spine colours

Reports of the Advisory Committee on Fishery Management	Red
Reports of the Advisory Committee on Marine Pollution	Yellow
Fish Assessment Reports	Grey
Pollution Studies	Green
Others	Black

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