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International Council for the
Exploration of the Sea

C.M.1978/H:3
Pelagic Fish Committee

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

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International Council for the
Exploration of the Sea

Council Meeting 1978

C.M.1978/H:3
Pelagic Fish Committee

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ERRATA SHEET

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

Please note the following change:

Section 2.6, third paragraph on page 10, 9th line from the top:

Delete "particularly", insert "partially"

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

1. PARTICIPANTS AND TERMS OF REFERENCE

1.1 Participants

| | |
|------------------------|-----------------------------|
| R S Bailey | United Kingdom (Scotland) |
| E Bakken | Norway |
| A B Bowers | United Kingdom (England) |
| A C Burd | United Kingdom (England) |
| A Corten | Netherlands |
| O Hagström | Sweden |
| J Jakobsson (Chairman) | Iceland |
| H Jákupsstovu | Denmark (Faroe Islands) |
| A Lindquist | Sweden |
| K Popp Madsen | Denmark |
| A Maucorps | France |
| J Molloy | Ireland |
| J A Morrison | United Kingdom (Scotland) |
| E Nielsen | Denmark |
| A Schumacher | Federal Republic of Germany |
| B Sjöstrand | Sweden |
| G Speiser | Federal Republic of Germany |
| Ø Ulltang | Norway |
| R J Wood | United Kingdom (England) |
| O J Østvedt | Norway |

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; and
- 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.

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 a preliminary estimation for the year 1977.

Previous ICES 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 of 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 tons to be taken in Division IVb and 600 tons in Division VIIId.

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 41 273 tons, compared with 174 834 tons, which is the revised catch figure for 1976.

The preliminary Skagerrak catch figure indicates an increase from the former one of 15 550 tons to 37 587 tons (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 9 958 tons of by-catch, about 9 500 tons were taken in the industrial fisheries. In the directed fisheries the main herring catch was taken in Division IVa (west) where it amounted to 25 795 tons and reflected the exploitation before the enforcement of the ban; in addition, about 650 tons were taken after February as by-catch. The corresponding revised figure for that area for 1976 gives 101 552 tons (and 4 025 tons as by-catch). In Division IVa (east), the catch decreased from 2 257 tons in 1976 to 737 tons in 1977, while the by-catch increased from 11 to 272 tons, respectively. In Division IVb, the total catch in adult fisheries was in 1976 41 475 tons, while the 1977 catch amounted to 3 690 tons, of which about 2 500 tons were taken under quota allowance (8 974 tons were taken as by-catch). The corresponding by-catch in 1976 was 7 719 tons. In Divisions IVc + VIIId-e, the catch was 1 091 tons, of which about 600 tons were taken under quota allowance, as compared with 18 009 tons 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 | 147 | 37 | 170 | 9 | 10 | 630 |

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 represent 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 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 Doc. C.M.1977/H:11.

The Working Group noted that the 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 (Doc. C.M.1977/H:11) 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 (Doc. C.M.1977/H:11). The new equation is:

$$y = 0.0031x - 0.21$$

where: y is the VPA stock estimate of 1-ringers, 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 found for year class 1976. Taking into account a catch of 257×10^6 0-ringers in 1977, the fishing mortality on year class 1976 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 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 year class 1975 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 fishery 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 on year class 1975.

2.2.3 Estimates of year class strength

Mean catches per hour of 1-ringers during the YHS from 1970 onwards, the derived estimates of year class strength 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 | Corresponding estimate of year class strength in billions of fish | Best estimate of year class as 1-group from VPA (in billions) |
|------------|--|---|---|
| 1968 | 822 | 2.34 | 3.35 |
| 1969 | 2 647 | 8.00 | 7.35 |
| 1970 | 1 629 | 4.84 | 5.79 |
| 1971 | 827 | 2.35 | 3.82 |
| 1972 | 1 195 | 3.49 | 1.75 |
| 1973 | 1 592 | 4.73 | 4.39 |
| 1974 | 452 | 1.19 | 0.73 |
| 1975 | 342 | 0.85 | |
| 1976 | 498 | 1.33 | |

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 northerly and easterly 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 eastern Channel of 19-23 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 7-29 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 Coop.Res.Rep., No.68, 1977) 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:

$$\text{Northern North Sea} \quad y = 0.04171x + 49.393$$

$$\text{Central North Sea} \quad y = 0.07365x + 30.044$$

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

| | <u>1976</u> (tons) | <u>1977</u> (tons) |
|--------------------|--------------------|--------------------|
| Northern North Sea | 66 014 | 89 768 |
| Central North Sea | <u>34 445</u> | <u>46 965</u> |
| Combined | <u>100 459</u> | <u>136 733</u> |
| | | + <u>36 274</u> |

If a further 10 - 20 000 tons 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 tons 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 tons 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 tons 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 tons 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 tons 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., sand eels, 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 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 sand eel 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 tons or 15-20% of the total by-catch.

It is not possible, however, to assess 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:

| <u>Fishery for</u> | <u>Total landings (tons)</u> | <u>By-catch (%)</u> | <u>Calculated catch of herring (tons)</u> |
|--------------------|------------------------------|---------------------|---|
| Sandeel | 780 000 | 0.17 | 1 330 |
| Norway pout | 387 000 | 0.19 | 740 |
| Sprat | 304 000 | 2.26 | <u>7 030</u> |
| | | Total herring | <u>9 100</u> |

If this is taken to be about 90% of the total catch, then the best estimate amounts to 10 000 tons of herring caught as by-catch which is very close to 11 200 tons, 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 reduced 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 (Doc. C.M.1977/H:3) the spawning stock of the North Sea herring was estimated at about 155 000 tons 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 $\frac{2}{3}$ 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 tons. 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 tons 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 tons, 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 below.

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 | 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.

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

Even under these most stringent management regimes the spawning stock in 1978 will only have recovered to about 1/3 of the desired level of 800 000 tons. In 1979 it is expected that the stock will be about 1/2 that level.

In the 1976 report of the Working Group (Doc. C.M.1976/H:2) 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 tons or less than 1/3 of the desired level of 800 000 tons.

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 tons. During the most recent years the stock has been brought down to a very low level due to overexploitation and mal-management. 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 Kattegat (Doc. C.M.1977/H:41).

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 (Doc. C.M.1977/H:41) 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 $1\frac{1}{2}$ - $1\frac{3}{4}$ 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. Further, after a sharp increase in catches of juvenile herring in Skagerrak-Kattegat in 1973, a decrease in estimated number of 2 year old herring in the North Sea is observed for 1974. This indicates that the recruitment to the adult stock in the North Sea is particularly dependent on juvenile herring spending their first years of life in 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 tons 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 cohort analyses. 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 analyses 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 tons. Because the stock biomass in 1976 and 1977 is estimated at only 8 000 - 10 000 tons the most realistic estimate of recruitment to now use in prognoses 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 F₁-ringers in 1976/77. The stock size of 8 347 tons, based on F₁-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 tons.

The stock size has been further projected to 1 April 1979, assuming no fishing on adults in 1978/79, and an $F_{1-ringers}$ 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 tons.

The stock sizes in 1978 and 1979 are still considerably below the level of 40 000 tons, 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 tons 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 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 tons, i.e., about 65% of its quota of 39 000 tons. 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. This 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 tons 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 650×10^6 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 tons 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 250×10^6 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 tons at 1 January 1978. The results of this prediction are shown in the text table below (in '000 tons):

| Age (rings) | Number per age group at 1 Jan. 1978 ($\times 10^{-6}$) | Mean weight per age group (gms) |
|-------------|--|---------------------------------|
| 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 (Doc. C.M.1977/H:3).

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 tons. Since then, they increased substantially and since 1972 averaged above 35 000 tons. However, in 1977 there was a drop to 19 000 tons.

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 tons 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 EEC and applied to all vessels. The TACs referred to the N. Irish Sea and was not divided by stocks. The TACs recommended, the TAC set and the catch taken each year 1975-77 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 United Kingdom. Catch and fishing mortality were still higher in 1977 than the values recommended by the Working Group (Doc. C.M.1977/H:3). 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 tons, of which 12 431 tons was from the Manx stock.

6.1.3 Mourne stock

The total catch of herring in the Mourne stock in 1977 was 2 983 tons, made up of 1 809 tons consumption and 1 174 tons caught for industrial purposes. The comparable data for 1976 were 4 180 tons consumption, 779 tons industrial, giving a total of 4 959 tons. There was thus a reduction of about 40% in the catch of adults in 1977, largely as a result of the implementation by 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 |
|------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| Tons | 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 (Doc. C.M.1977/H:3), 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 (Doc. C.M.1977/H:3). 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) | | | | | | | | | | | Total |
|-------------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 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 tons would generate an F of 0.51, 11 000 tons $F = 0.45$, 10 000 tons $F = 0.40$ and 9 000 tons $F = 0.35$.

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 tons and for 1979 11 000 tons 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 $53^{\circ}20'N$ and $55^{\circ}N$ 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 45.38×10^6 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 spawning stock biomass was calculated to be 6 693 tons at 1 January 1977 and 6 891 tons 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 tons, 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 tons)

| 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 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 tons. 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 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 tons of the total could be accounted for by the 1-group. The remaining 630 000 tons were then allocated among the remaining age groups. The resulting stock in number was:

| <u>Age</u> | <u>Number x 10⁻⁹</u> |
|------------|---------------------------------|
| 2-group | 33.1 |
| 3-group | 21.4 |
| 4-group | 2.2 |
| 5-group | 0.01 |

For the 0-group, the 170 000 tons 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 128×10^{-9} .

7.6 Catch Prediction and Advice on TAC

At the 1977 meeting, the Working Group advised a TAC of 410 000 tons 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 tons 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 tons. 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 tons 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 Table 8.1. 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 tons, and thus lower than the catch of the preceding year, 16 200 tons. In the Kattegat, however, the catch in 1977 was 56 906 tons, which is a considerable increase compared to the catch of 1976, which amounted to 40 500 tons. The Norwegian fjord catches (see Table 8.2) increased from 6 100 tons in 1976 to 12 000 tons 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 tons) | 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 tons (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.

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Table 2.1 HERRING. Catch in tons 1968-77.
 North Sea (Sub-area IV and Divisions VIIId 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 | 1 236 |
| German Dem.Rep. | - | - | 290 | 475 | 127 | 1 728 | 3 268 | 2 689 | 2 624 | - |
| Germany, Fed.Rep. | 21 216 | 12 798 | 7 150 | 3 570 | 3 065 | 10 634 ^{c)} | 12 470 | 6 953 | 1 654 | 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) | 5 128 | 6 666 | 9 702 | 4 113 | 394 | 2 268 | 5 699 | 6 475 | 9 662 | 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 | 174 834 | 41 273 |
| 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 | 190 384 | 78 860 |

- a) Total includes 2 107 tons for human consumption unspecified to area.
 b) Supplied by Fiskirannsóknarstovan.
 c) From Federal Republic of Germany national statistics compiled by Federal Research Board of Fisheries, Hamburg.
 d) Excludes 15 938 tons caught on Skagerrak border and allocated to that area on the basis of age analysis.
 e) Swedish catches in Danish ports reported by area (North Sea, Skagerrak) used for area allocation of Swedish landings reported as Skagerrak and North Sea in Swedish statistics.
 f) Catches from Moray Firth not included.
 *) Preliminary.

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

| Year | Denmark | Faroe Islands | Germany Fed.Rep. | Iceland | Netherlands | Norway | Poland | Sweden | USSR | Total |
|-------|---------|---------------------|------------------|----------------------|-------------|--------|--------|----------------------|--------|---------|
| 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 tons.
North Sea, northeast (Division IVa east of 2°E).

| Year | Belgium | Denmark | Faroe Isl. | France | German Dem.Rep. | Germany Fed.Rep. | Iceland | Netherlands | 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 tons.
North Sea, northwest (Division IVa west of 2°E).

| Year | Denmark | Faroe Isl. | Finland | France | German Dem.Rep. | Germany Fed.Rep. | Iceland | Netherlands | 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 | - | 25 795 |

* Preliminary.

a) See Table 2.1 footnote under relevant country.

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

| Year | Denmark | Faroe Isl. | France | German Dem.Rep. | Germany Fed.Rep. | Iceland | Netherlands | 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 tons.
North Sea Central (Division IVb).

| Year | Young herring fisheries | | | | | | Total young and adult fisheries (Tables 2.5 and 2.6) |
|------|-------------------------|-------------------|--------|--------------|---------------|---------|--|
| | Denmark | Germany, Fed.Rep. | Sweden | 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 tons.
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 ton caught by German Democratic Republic.

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

| Country | IVa west | | IVa east | | IVb | | IVc+VIId | |
|-------------------|----------|------------------|----------|------|-------|-------|----------|------|
| | 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 | 7 915 | 8 974 | 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 | 1 458.7 |
| | IVaE of 2°E | - | 75.1 | 91.0 | 17.8 | 5.8 | 0.7 | 0.1 | - | - | - | 190.5 |
| | IVb | - | 25.2 | 46.4 | 98.8 | 20.5 | 6.7 | 0.6 | 0.2 | 0.6 | - | 199.0 |
| | IVbYH | 750.4 | 2 896.6 | 337.9 | 21.1 | 6.4 | 1.2 | 0.2 | - | - | - | 4 013.8 |
| | IVc+VIIId,e | - | 4.8 | 135.1 | 29.3 | 9.3 | 5.0 | - | - | - | - | 183.5 |
| | Total NS | 750.4 | 3 340.6 | 1 440.5 | 343.8 | 130.6 | 32.9 | 5.0 | 0.2 | 1.1 | 0.4 | 6 045.5 |
| 1973 | IVaW of 2°E | - | 52.5 | 742.1 | 452.6 | 58.0 | 39.5 | 20.3 | 2.6 | 0.5 | 0.6 | 1 368.7 |
| | IVaE of 2°E | - | 0.3 | 16.2 | 23.1 | 6.3 | 7.2 | 1.0 | 0.3 | 0.8 | - | 55.2 |
| | IVb | - | 242.5 | 180.1 | 39.0 | 28.3 | 4.7 | 7.2 | - | - | - | 501.8 |
| | IVbYH | 289.4 | 2 070.5 | 362.5 | 29.4 | 2.6 | 0.5 | 0.2 | 0.3 | - | - | 2 755.4 |
| | IVc+VIIId,e | - | 2.2 | 43.3 | 115.1 | 55.0 | 7.4 | 1.9 | 0.5 | 0.1 | 0.0 | 225.5 |
| | Total NS | 289.4 | 2 368.0 | 1 344.2 | 659.2 | 150.2 | 59.3 | 30.6 | 3.7 | 1.4 | 0.6 | 4 906.6 |
| 1974 | IVaW of 2°E | 65.3 | 162.9 | 98.5 | 112.9 | 97.1 | 36.0 | 18.6 | 4.5 | 1.5 | 1.0 | 598.3 |
| | IVaE of 2°E | 5.7 | 131.8 | 24.2 | 10.8 | 1.0 | - | - | - | 0.1 | - | 173.6 |
| | IVb (adult) | - | 54.0 | 493.7 | 212.3 | 19.5 | 18.9 | 3.6 | 0.3 | 0.4 | 0.1 | 802.8 |
| | IVbYH | 925.1 | 493.5 | 132.1 | 5.7 | - | - | - | - | - | - | 1 556.4 |
| | IVc+VIIId | - | 3.9 | 24.1 | 20.3 | 8.4 | 1.2 | 0.1 | 0.2 | - | - | 58.2 |
| | Total NS | 996.1 | 846.1 | 772.6 | 362.0 | 126.0 | 56.1 | 22.3 | 5.0 | 2.0 | 1.1 | 3 189.3 |
| 1975 | IVaW of 2°E | - | 267.0 | 120.0 | 69.0 | 49.0 | 40.2 | 9.8 | 6.3 | 2.9 | 1.1 | 565.3 |
| | IVaE of 2°E | - | 82.5 | 8.2 | 7.0 | 2.4 | 0.4 | 0.1 | 0.1 | - | - | 100.7 |
| | IVb (adult) | - | 268.8 | 147.1 | 124.2 | 81.2 | 14.8 | 5.8 | 2.7 | 0.5 | 0.3 | 645.4 |
| | IVbYH | 262.8 | 1 818.1 | 139.2 | 19.8 | 2.6 | - | 0.4 | - | - | - | 2 242.9 |
| | IVc+VIIId | 1.0 | 24.1 | 127.2 | 39.6 | 5.3 | 1.8 | - | - | - | - | 199.0 |
| | Total NS | 263.8 | 2 460.5 | 541.7 | 259.6 | 140.5 | 57.2 | 16.1 | 9.1 | 3.4 | 1.4 | 3 753.3 |
| 1976 | IVaW of 2°E | - | 19.4 | 572.9 | 56.3 | 17.9 | 13.2 | 3.6 | 2.6 | 0.5 | 0.3 | 686.7 |
| | IVaE of 2°E | - | - | 10.6 | 1.1 | 0.5 | 0.5 | 0.4 | - | - | - | 13.1 |
| | IVb (adult) | 0.9 | 35.5 | 205.9 | 17.6 | 28.4 | 20.3 | 1.8 | 1.8 | 0.5 | 0.1 | 312.8 |
| | IVbYH | 237.3 | 49.5 | 17.7 | 0.5 | 1.7 | - | - | - | - | - | 306.7 |
| | IVc+VIIId | - | 22.2 | 94.4 | 41.8 | 3.5 | 0.5 | 0.3 | - | - | - | 162.7 |
| | Total NS | 238.2 | 126.6 | 901.5 | 117.3 | 52.0 | 34.5 | 6.1 | 4.4 | 1.0 | 0.4 | 1 482.0 |
| 1977 | IVaW of 2°E | 2.3 | 2.4 | 8.4 | 159.9 | 7.9 | 3.5 | 2.0 | 0.8 | 0.2 | - | 187.4 |
| | IVaE of 2°E | 0.4 | 3.3 | + | 2.0 | 0.5 | 0.4 | 0.4 | 0.2 | 0.2 | - | 7.4 |
| | IVb (adult) | - | 0.9 | 20.2 | 5.3 | 0.2 | 1.5 | 0.7 | - | + | - | 28.8 |
| | IVbYH | 253.8 | 136.3 | 3.1 | - | - | - | - | - | - | - | 393.2 |
| | IVc+VIIId | - | 0.7 | 5.2 | 2.4 | 0.6 | 0.2 | + | + | - | - | 9.1 |
| | Total NS | 256.5 | 143.6 | 36.9 | 169.6 | 9.2 | 5.6 | 3.1 | 1.0 | 0.4 | - | 625.9 |

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 10 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 |

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

| Years Winter rings | 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 $\times 10^{-9}$ and stock biomass.

| Years Winter rings | 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 | + | + | + | + |
| $\Sigma 0 + 1$ | 12.01 | 13.87 | 9.92 | 12.41 | 14.46 | 10.80 | 6.06 | 7.65 | 5.43 |
| $\Sigma 2-8$ | 7.85 | 5.93 | 4.61 | 4.81 | 3.29 | 3.49 | 3.40 | 2.18 | 1.48 |
| Biomass in $t \times 10^{-3}$ | 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 ($\times 10^{-9}$) | 1977/78 ($\times 10^{-9}$) |
|--|--|--|
| Northern North Sea | <u>4-11 Sep.</u> < 10 mm - 733 <u>13-23 Sep.</u> < 10 mm - 64 | <u>31 Aug. - 16 Sep.</u> < 10 mm - 1582 <u>19-29 Sep.</u> < 10 mm - 354 |
| Central North Sea | <u>3-14 Sep.</u> < 10 mm - 86 <u>16-24 Sep.</u> < 10 mm - 137 <u>28 Sep. - 10 Oct.</u> < 10 mm - 4 <u>18-23 Oct.</u> < 10 mm - 12 | <u>11-16 Sep.</u> < 10 mm - 502 <u>20-22 Sep.</u> < 10 mm - 310 <u>2-10 Oct.</u> < 10 mm - 104 <u>14-19 Oct.</u> < 10 mm - 3 |
| Southern North Sea and Eastern Channel | <u>3-7 Jan.</u> < 11 mm - 2 11-16 mm 5 Total 7 | <u>13-16 Dec.</u> < 11 mm - 1 Total 1 <u>19-22 Dec.</u> < 11 mm - 1 11-16 mm - 1 Total 2 <u>2-6 Jan.</u> < 11 mm - 0 11-16 mm 8 Total 8 <u>19-23 Jan.</u> < 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 tons 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 tons for Bulgaria.

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

| Season | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | >8 | Total |
|---------|--------|---------|--------|--------|--------|--------|--------|-------|-------|---------|
| 1965/6 | 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 tons.

| 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 (metric tons) 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.

| Age(rings) Year | 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.

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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 |

* Inefficient estimates.

Table 4.4 Herring in Division VIa (Moray Firth included). Stock in number $\times 10^{-6}$ 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 tons) | 488 | 451 | 450 | 510 | 513 | 489 | 667 | 603 | 377 | 225 | 172 | 82 |

*Inefficient 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 |
| Netherl-lands | - | - | - | - | - | - | - | - | - | - | 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 |
| Nether-lands | - | 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.

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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. (tons) | 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 (tons) recommended by ICES Working Group | TAC set | | | Total catch (tons) | \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.

| Rings \ Year | 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.

| Rings \ Year | 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 tons | 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)

| | | | |
|--|-----|-----|-----|
| | .31 | .74 | .60 |
|--|-----|-----|-----|

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

| 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 | 22.9 | 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 | 4.2 |
| 8 | .5 | .1 | .5 | .4 | .0 | .4 | 1.4 | 1.5 |
| \sum_{2}^{8} | <u>76.9</u> | <u>67.5</u> | <u>112.0</u> | <u>158.4</u> | <u>217.2</u> | <u>236.7</u> | <u>263.7</u> | <u>243.8</u> |

| AGE | 1973 | 1974 | 1975 | 1976 | 1977 |
|-----|--------------|--------------|--------------|--------------|--------------|
| 1 | 131.9 | 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 | 1.3 |
| 8 | 1.7 | 1.1 | 1.5 | 1.2 | 1.2 |
| | <u>202.3</u> | <u>293.1</u> | <u>184.6</u> | <u>175.4</u> | <u>152.1</u> |

Table 6.10 HERRING Mourne stock.
Fishing mortalities by year and by age

| Year Age(rings) | 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.

| Year Age (rings) | 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 (tons)(1-8 rings) | ? | ? | 18 433 | 14 764 | 15 766 | 11 245 | 8 123 | 7 235 | 6 894 |

* Inefficient 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 (tons) | Stock ages 2-8 | | F | Catch (tons) | Stock ages 2-8 | | F | Catch (tons) |
| No.x10 ⁻⁶ | Tons | | | No.x10 ⁻⁶ | Tons | | | No.x10 ⁻⁶ | Tons | | |
| 151.5 | 30 231 | 0.6 | 14 507 | 146 | 29 239 | .35 | 9 210 | 175 | 35 614 | .35 | 11 009 |
| | | | | | | .45 | 11 350 | 164 | 33 199 | .35 | 10 329 |
| | | | | | | .55 | 13 307 | 154 | 30 986 | .35 | 9 705 |

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 |

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| 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. x 10 ⁻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 metric tons) 1967-77.
(Data provided by Working Group members)

| Country | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 ^{a)} |
|-----------------------------------|------|------|------|------|------|------|-------|-------|-------|-------|--------------------|
| <u>IVa West</u> | | | | | | | | | | | |
| 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 |
| <u>IVa East (North Sea stock)</u> | | | | | | | | | | | |
| Denmark | - | - | - | - | - | - | - | - | - | 0.2 | 0.1 |
| Norway | - | - | - | - | - | - | - | - | - | 1.9 | 0.7 |
| UK (Scotland) | - | - | - | - | - | - | - | - | - | + | 0 |
| Total | - | - | - | - | - | - | - | - | - | 2.1 | 0.8 |
| <u>IVb West</u> | | | | | | | | | | | |
| 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 metric tons), 1967-77.
(Data provided by Working Group members)

| Country | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 ^{a)} |
|------------------------|------|------|------|------|------|-------|-------|-------|-------|-------|--------------------|
| <u>IVb East</u> | | | | | | | | | | | |
| 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 |
| <u>IVc</u> | | | | | | | | | | | |
| 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 |
| <u>Total North Sea</u> | | | | | | | | | | | |
| 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 tons 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 | tons | 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 | tons | 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 | tons | 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 | tons | 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 |
| <u>IVa west of 2°E</u> | | | | | | | |
| 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 | - |
| <u>IVb west of 3°E</u> | | | | | | | |
| 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 | - | - |
| <u>IVb east of 3°E</u> | | | | | | | |
| 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 |
| | | <u>Weighted mean for all Areas</u> | | | | | |
| 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 | - |
| | | <u>Overall weighted mean</u> | | | | | |
| 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 |
| | | <u>Weighted mean for all Areas</u> | | | | | |
| | | | 2.34 | 8.54 | 15.93 | 20.59 | 26.22 |
| | | | 2.32 | 9.70 | 15.13 | 22.75 | 24.70 |
| | | 2.46 | 7.64 | 12.48 | 21.55 | 22.75 | |
| | | 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 inefficient 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 |
| At 1 July | | | | | | |
| Age | 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 inefficient 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 |

* Inefficient estimates.

Table 8.1 SPRAT. Landings in '000 tons, 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.

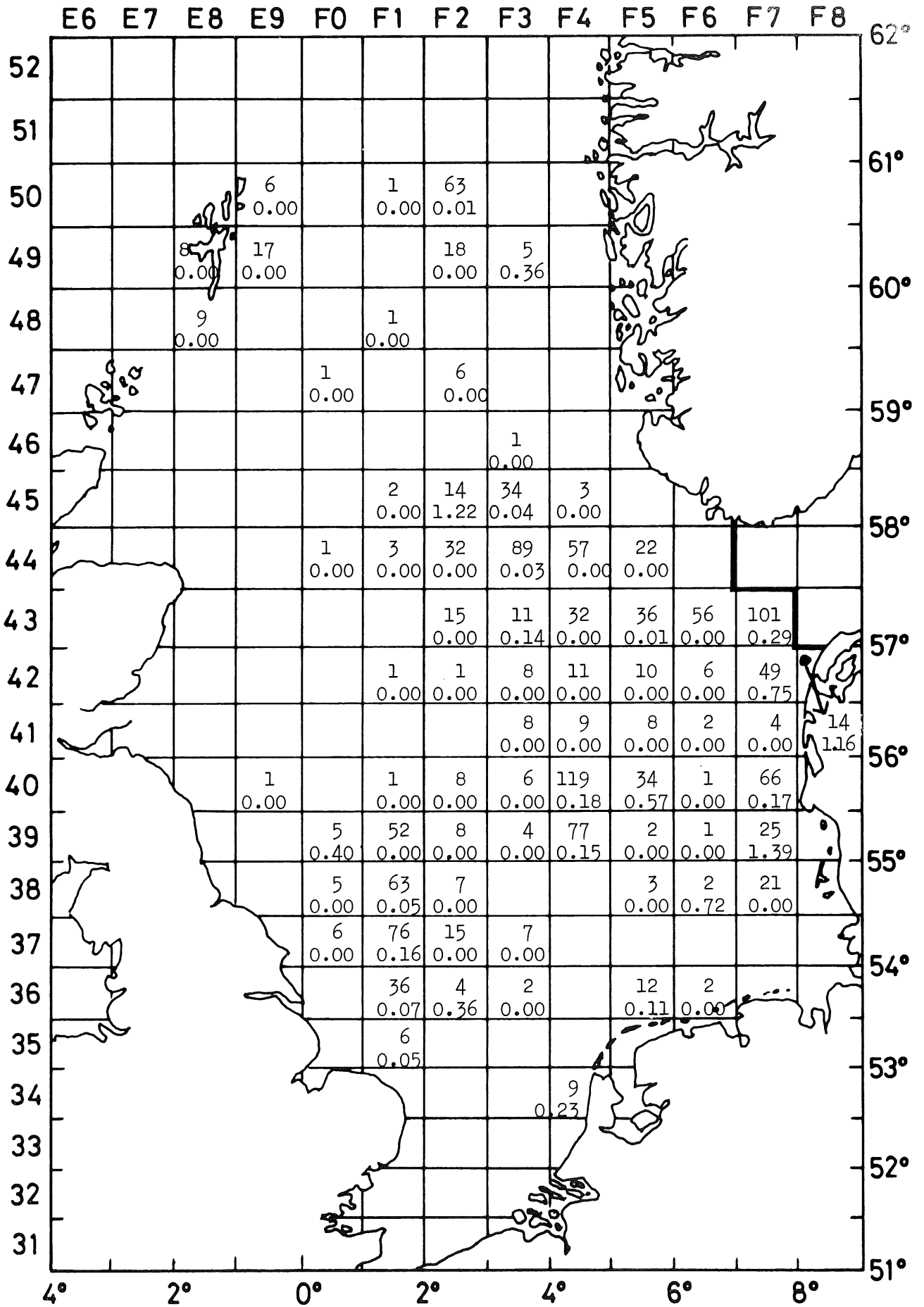


Figure 1. By-catch of herring in the 1977 sandeels fisheries (upper figure - number of samples, lower figure - mean percentage). (Data from Danish and Scottish national laboratories.)

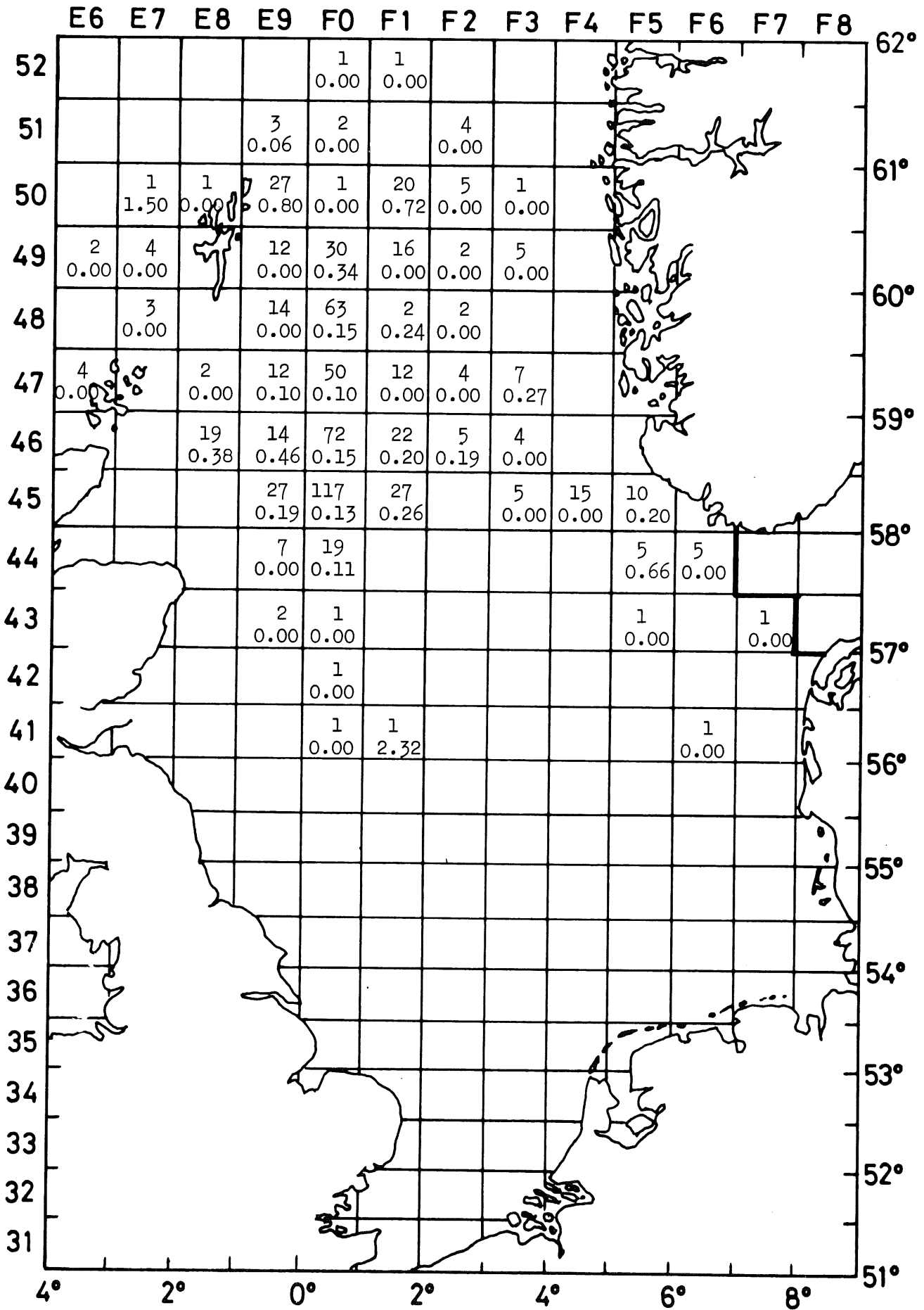


Figure 2. By-catch of herring in the 1977 Norway pout fisheries (upper figure - number of samples, lower figure - mean percentage). (Data from Danish and Scottish national laboratories.)

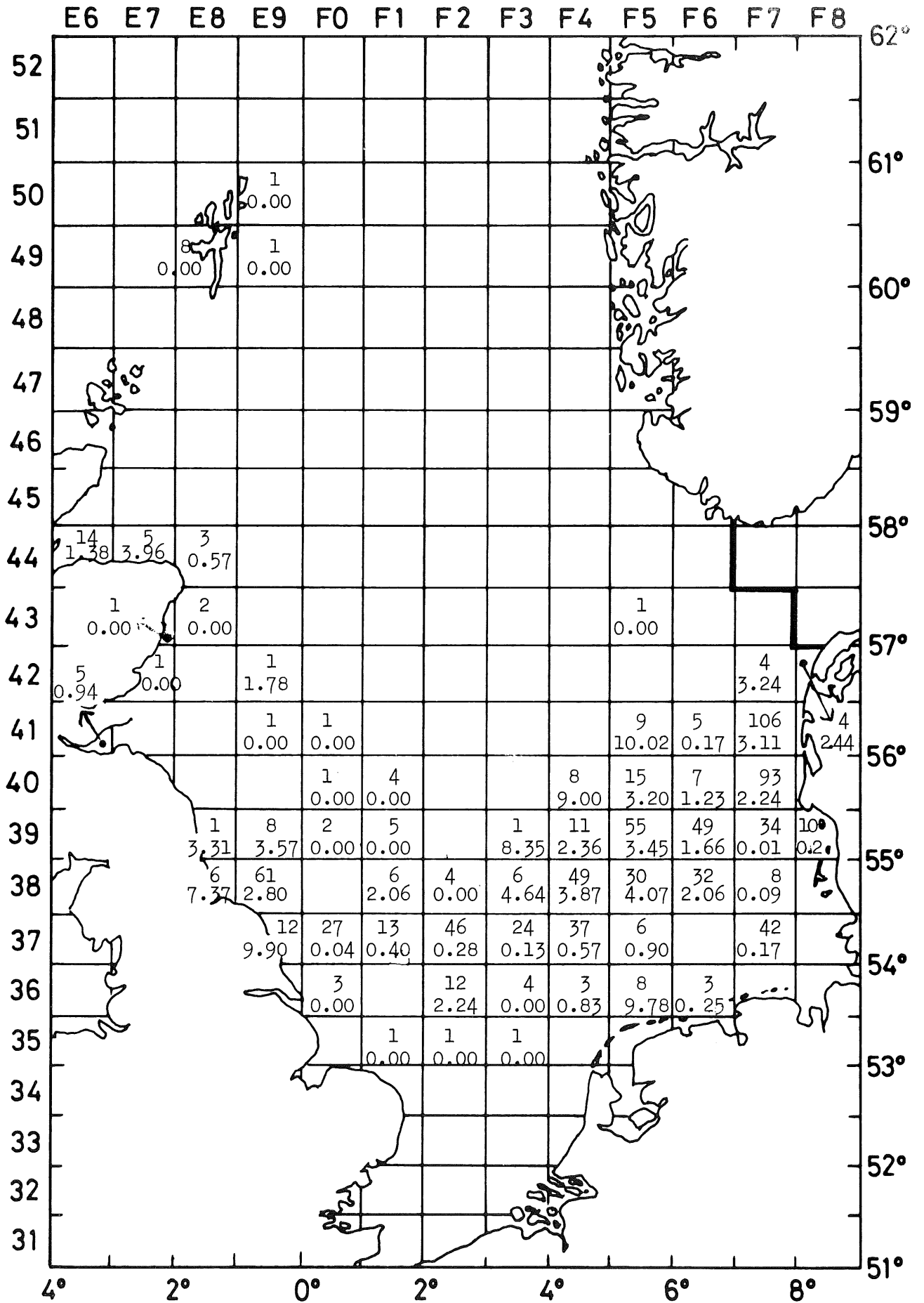
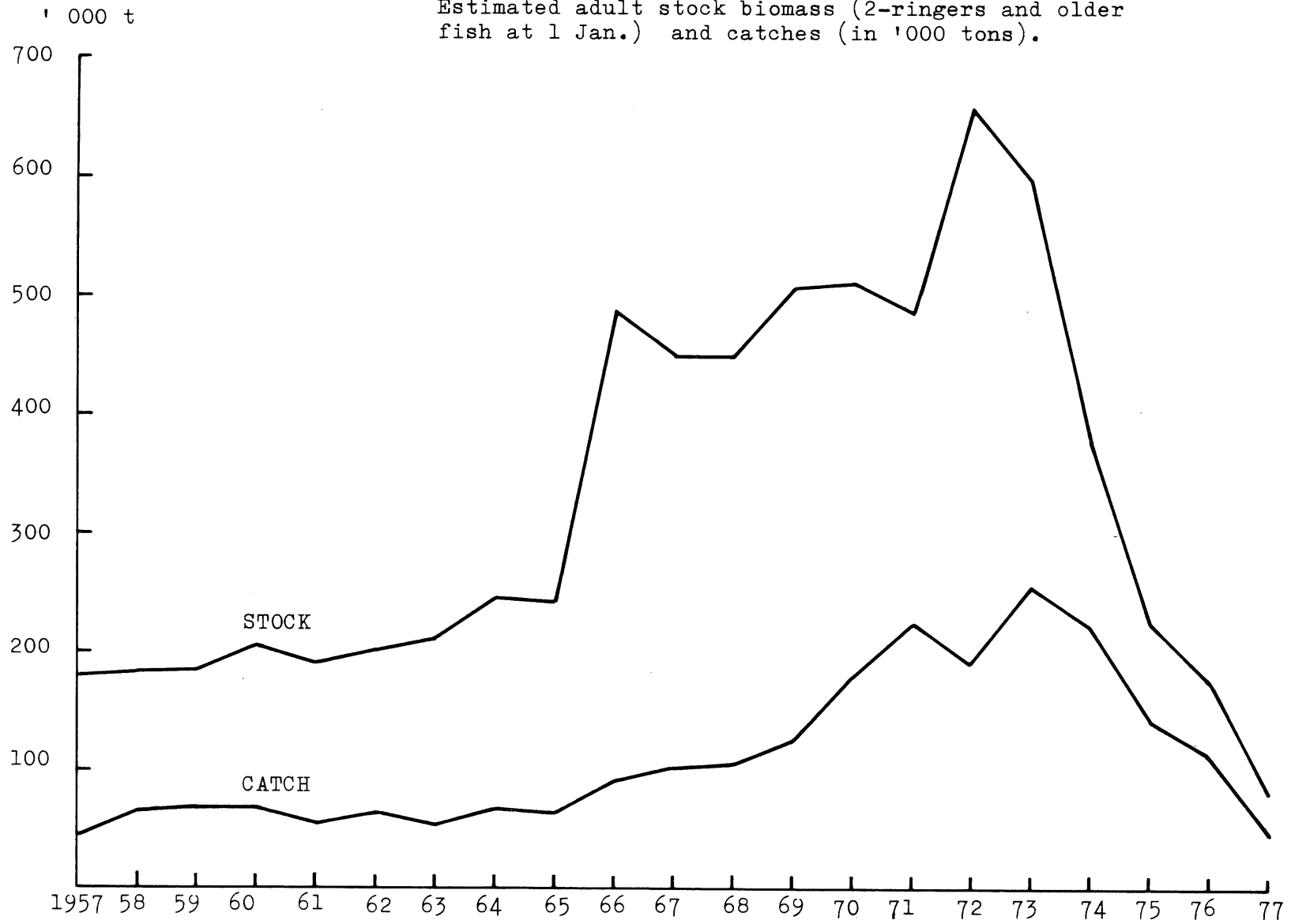


Figure 3. By-catch of herring in the 1977 sprat fisheries (upper figure - number of samples, lower figure - mean percentage). (Data from Danish, English and Scottish national laboratories.)

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



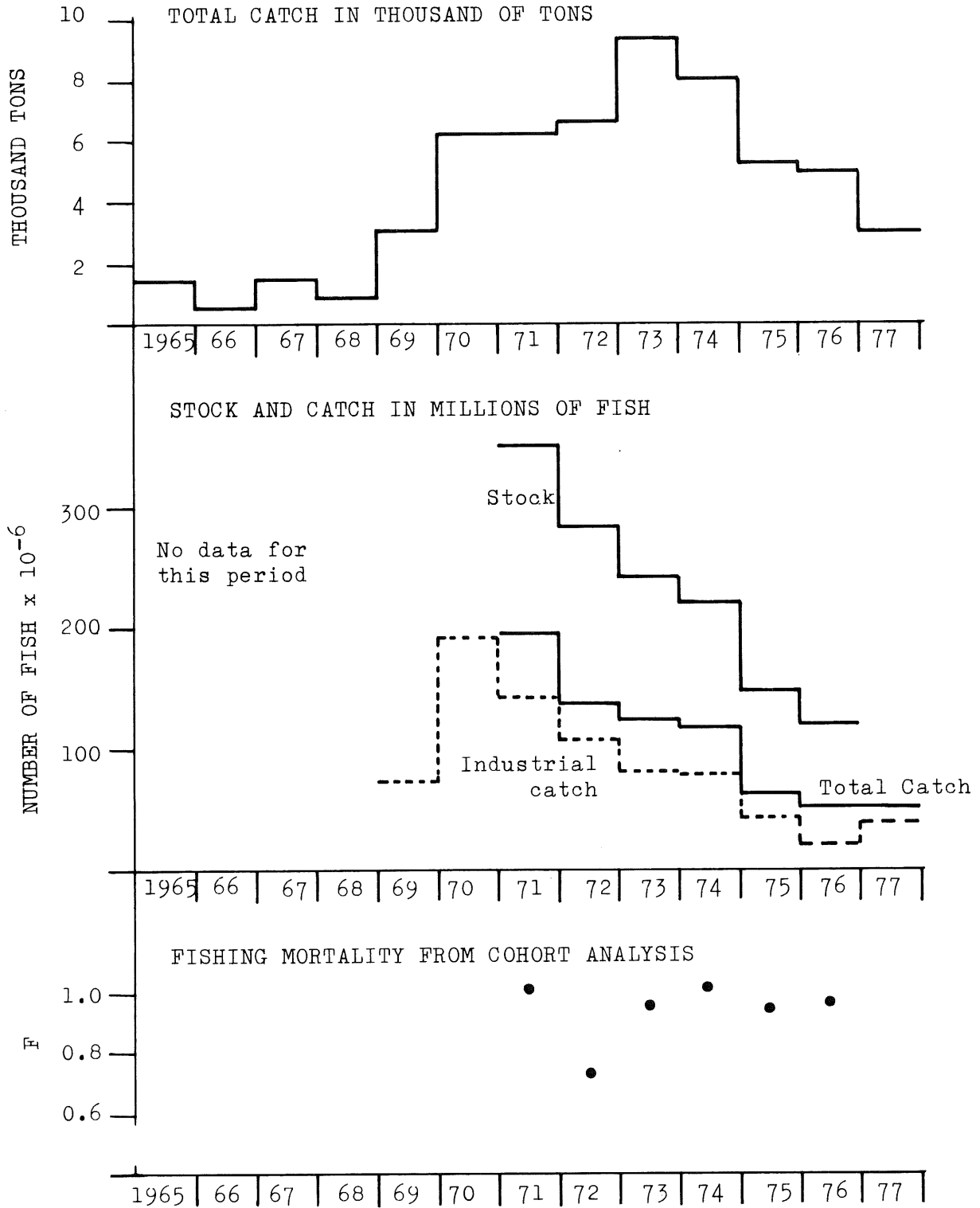


Figure 5. Division VIIa Irish Sea herring, Mourne stock. Catch by weight and number, stock size and fishing mortality 1965-77.

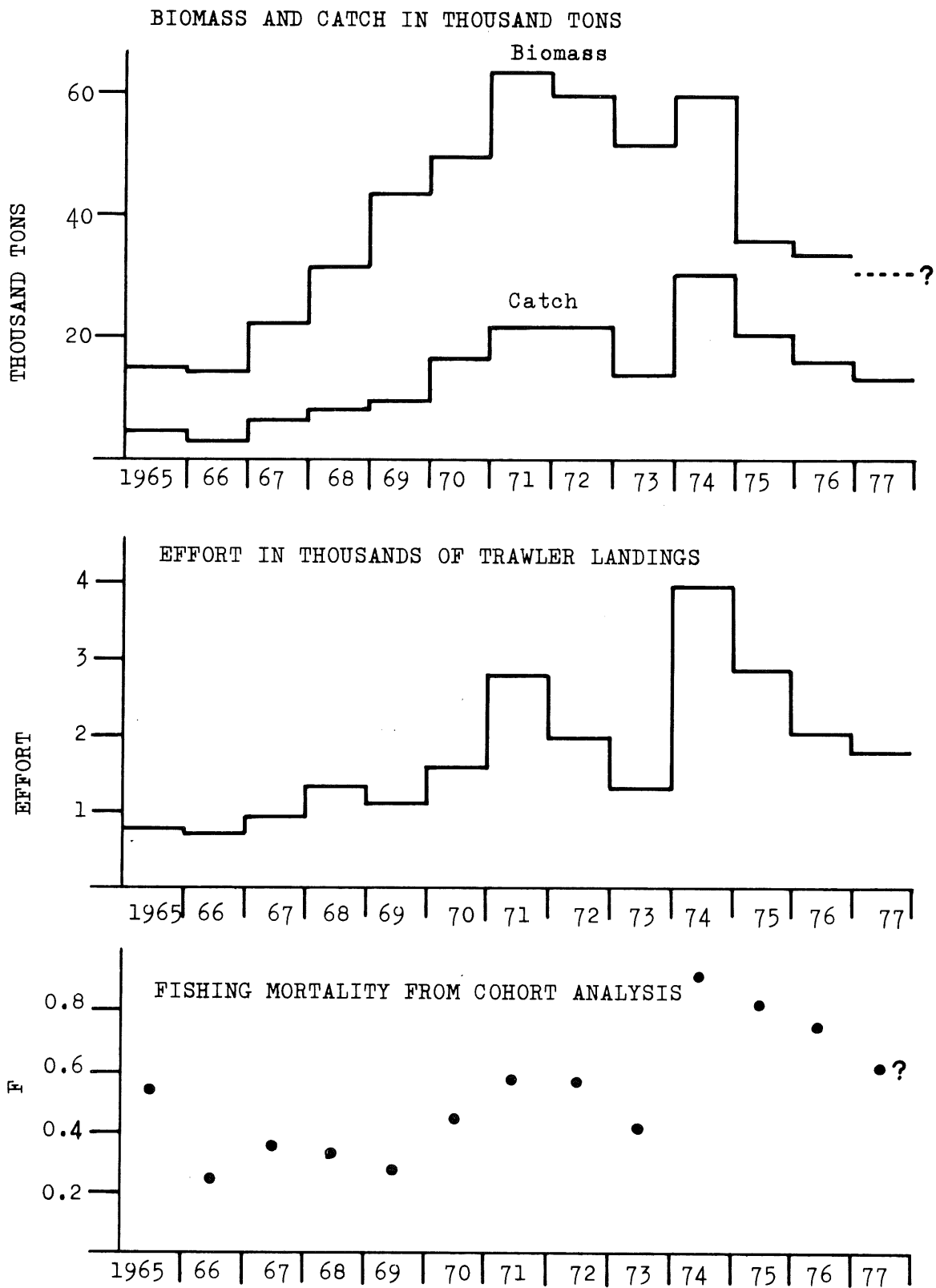


Figure 6. Division VIIa Irish Sea Herring, exploited Manx stock. Biomass, catch, effort and fishing mortality, 1965-77.