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International Council for the
Exploration of the Sea

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WORKING GROUP FOR NORWAY POUT, SANDEEL AND SPRAT

FISHERIES IN THE NORTH SEA AND ADJACENT WATERS

ICES headquarters, 16-22 March 1982

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1.1 Participants

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Kjartan Hoydal attended the meeting as the ICES Statistician.

1.2 Terms of Reference

At the last Statutory Meeting, the Council adopted C.Res.1981/2:27:1 as follows:

> "It was decided that a new Working Group for Norway Pout, Sandeel and Sprat Fisheries in the North Sea and Adjacent Waters (ICES Sub-area IV, Divisions IIIa and VIa) should meet at ICES headquarters 16 to 22 March 1982 under the chairmanship of Mr J G Pope (Lowestoft) to:
>
> (i) collect and review all available data from industrial fisheries on catch and effort, species composition of catch, and size (age) composition of the different species as far back as possible,
>
> (ii) report the results for the by-catch species, e.g., herring, cod, haddock, whiting, mackerel and saithe to the relevant ICES Assessment Working Groups,
>
> (iii) evaluate the sampling and reporting procedures,
>
> (iv) assess the state of the stocks of the target species for industrial fishing, i.e., sprat, Norway pout and sandeels.

1.3 Importance of Industrial Fisheries

Figure 1.3.1 shows the catch by year of all reported landings and underlines the importance of the industrial fisheries, which form more than 50% of the landings since the mid-1960s. This indicates the need for continued biological monitoring of the biological state of these fisheries, and provision of information, which can be the basis for managemental discussions.

The Working Group therefore suggests that it meet annually in March each year.

1.4 Managemental Considerations

In previous years the industrial fisheries have been regulated by by-catch regulations and/or by closed area systems. For sprat a TAC has been recommended, but has not been taken the last 5 years.

The basic assumption, underlying the advice given by ACFM on fisheries management on behalf of ICES, might in very general terms be formulated as that there is a possibility to indicate fishing mortality levels for each stock, which will reduce the variations in the output from the stock. For most of the stocks considered by ICES, reduced total fishing pressure or improved exploitation patterns would stabilize the stocks and hence the yields.

Looking at the industrial fisheries this basic assumption might not be true, and generally the stocks exploited may not necessarily react in the same way to the fishery as others, due to a variety of reasons.

To be able to say anything useful about the management or non-management of these fisheries, the following questions have to be answered:

- Can the variability in the yields from these fisheries be reduced by regulating the fishing pressure or changing the exploitation pattern?
- Is it possible with any accuracy to project yields in these fisheries or at least indicate levels, which could guide the industry and the managing bodies?
- To what degree are the industrial fisheries dependant on the by-catches of undersized fish of species which play a major role in the human consumption fisheries, and how will a certain effort in the industrial fisheries affect the yield in the human consumption fisheries?
- What biological description of these stocks and fisheries is necessary to be meaningful in an assessment of the economical consequences for the fishing fleets, the fishing industry, etc.?
- Will major fluctuations in these important prey species introduce fluctuations in the predator species' abundance exploited in the human consumption fisheries?

The answer to these questions - or the difficulty to answer them - will be found in the different species sections in this report.

Discussing the base for management of these stocks it turns up that more detailed knowledge of the practical constraints and economic considerations plays an important part. Although it is not possible to rule out that management on purely biological considerations might be pertinent, it is obviously a greater understanding of the operations of the fleets and economic constraints that determines the need for management of these fisheries. The Working Group therefore feels the need for a Dialogue with fisheries economists, in order to be able to proceed and plan the sampling of useful data and, as a first step in this direction, the Group would therefore wish to have its terms of reference widened, to include the study of areas, which might be important in economic considerations. This calls for assessments of the fisheries as a whole, and not only the individual biological stocks.

This would also solve the problem: which Working Group is expected to assess the effects of by-catches of species, which play a major role in the human consumption fisheries, and place this assessment naturally within this Group.

Projection of stock levels in short life-span species can only be made shortly before exploitation begins or even after it has started, because of the dependence of catches on recruiting year classes. Any advice has therefore to be implemented on a short notice. Last but not least, it must be pointed out that even if the answer is that no direct management of these fisheries is feasible, the importance of the species and their role in the North Sea ecosystem are obvious, and monitoring of this large part of the productivity in the North Sea is of great importance.

An important aspect of managing the industrial fisheries is the regulation of by-catches of juvenile consumption fish. By-catch levels have to be chosen in accordance with the interests of both the consumption fisheries and the industrial fisheries. Although in some cases there may be a net overall economic benefit from further restrictive measures aimed at saving juvenile consumption fish, this may not necessarily be true in all instances. When large year classes of certain consumption species are entering the industrial fisheries, it could even be necsssary to temporarily increase the allowable by-catches. Otherwise, the industrial fisheries might be limited to part of their usual area only, and the losses in this sector of the industry might not be compensated for by the gains in the consumption fisheries, particularly if the market cannot completely absorb the surplus yield of consumption fish.

In order to enable fishery managers to balance the interests of the industrial fisheries against those of the consumption fisheries, they should be provided with data indicating the reduction in industrial catches to be expected from various restrictions of by-catches. To provide such information, the Working Group would need far better data on the geographical and seasonal distribution of by-catches, and on the possibilities for fishermen to fish selectively for industrial species.

1.5 Answer to a Question from the EEC Parliament

A specific question from the EEC parliament was discussed by the Group. The question was: Do high catch levels of sprat in the center of Division IVb during summer have a negative effect on the winter sprat fishery in the western half of this Division?

Having examined detailed catch distributions for sprat in Division IVb, the Working Group would like to draw the attention of EEC to the fact that in recent years there have been no significant sprat catches during summer in the center of Division IVb.

2. DESCRIPTION OF THE FISHERIES - North Sea

2.1 Introduction

Under its terms of reference the Working Group was called upon to report on the distribution in time and space of the industrial fisheries as a whole. As most countries endeavour to provide estimates of the catches of the principal species by area and time, adjustments are made to remove by-catches from these data and the figures derived from the reported species catch given in Bulletin Statistique or Working Group reports. The accumulation of the split data bases is itself a major data analysis for individual countries. To additionally accumulate the data at an international level was a task that the Working Group could not attempt.

The Working Group report on Norway Pout and Sandeel in the North Sea (Doc. C.M.1978/G:12) gave monthly charts of the international catch of Norway pout and sandeels for 1977. As a guide to the annual changes in area of fishing to these data have been added the sprat data for 1977. The three species have been summed per rectangle per month, and the charts are shown in the figure section. These can be taken as a general description of the way the industrial fishery changes within years.

2.2 The Fishery in 1977

January - March, Figures 2.1 - 2.3

During this period the fisheries are concentrated in two areas in the North Sea. The southern area is exploited mainly for sprat by Danish and United Kingdom trawlers and Norwegian purse seiners. The United Kingdom vessels work almost entirely in coastal waters, while the Danish trawlers and the Norwegian purse seiners work further offshore and move eastward as the season progresses.

The northern North Sea fisheries is based upon Norway pout though sprat catches are taken in Scottish coastal areas by local vessels. The charts indicate that the fishery progresses along the western edge of the Norwegian Deep and towards the end of March includes some sandeel fishing. In this same area blue whiting becomes an important component of the industrial catch. This species is taken generally in deeper water than the Norway pout, and the proportion in the catch depends on fishing practice in relation to depth.

April - June, Figures 2.4 - 2.6

The main distributions of catch reflect the general distribution of abundance of sandeels. The commencement of the fishery in any area appears to be dependent on sea temperature. The early fisheries usually take place in the southwestern area and along the southern edge of the Norwegian Deep in the vicinity of the Viking Bank and Klondyke.

The sandeel fisheries in the northern North Sea and at Shetland are relatively new phenomena. It is unknown whether the sandeel stock in the northeastern part is an extension from the southern population or an increase of a small native population.

Sprat catches fall off during this period, which corresponds with the commencement of the spawning period.

July, Figure 2.7

This is typically a month of transition as sprat and Norway pout fisheries begin to increase and sandeels begin to decline. For the chart, the western catches are derived from a United Kingdom sprat fishery which occurred only in that year, while the Danish coastal fishery is also directed at sprat. In both cases, this is associated with the entry of a new year class moving into deeper water.

August - December, Figures 2.8 - 2.12

The two main features are the insentification of the Norway pout fishery in the north and the movement of the sprat fisheries from the coast towards the centre of the North Sea. The development of the United Kingdom coastal winter sprat fisheries is also apparent.

2.3 The Fleets

The types of vessels exploiting these three major species differ widely both between and within countries. Purse seiners direct their effort in the North Sea at sprat. They tend to work only when sprat shoals are heavily aggregated and in deep water. As a consequence, the age composition of the sprat taken in this gear tends to be of older fish than that taken by trawl. Because of the limitations on operation and sprat availability, the possibilities for exploiting sprat by this method varies between years.

The trawl fleets of the different nations taking part in these fisheries vary from small boats of 8-10 GRT to about 500 GRT. As a consequence, their area of operation differs markedly. In general, the smaller vessels (<100 GRT) operate within a limited range of their harbours and concentrate on sandeel and sprat, while the larger vessels are more flexible and direct their effort on sandeel and Norway pout. On the Norwegian shelf edge, the small-meshed trawler fleet of Norwegian vessels has decreased from about 300 vessels in 1975 to almost 100 in 1981.

The minimum legal mesh sizes for trawls fishing for sprat and Norway pout is 16 mm. However, in many cases mesh sizes in excess of this may be used. Thus, in the sprat fisheries cod-end mesh sizes of up to 20 mm are not uncommon. In the case of Norway pout, similar size meshes are also used.

For sandeels, there is no mesh regulation from 1 March to 31 October, while the rest of the year 16 mm applies.

2.4 Annual Variations in the Distribution of the Catches

For 1979 and 1980, it has been possible to accumulate the annual international catches of Norway pout, sandeel and sprat by Danish statistical areas. These are shown in Tables 2.4.1 to 2.4.3, in which are also given the monthly catch statistics.

Comparing the 1979 distribution of sandeel catches with that for 1980, it can be seen that the fishery in the western North Sea was much more successful than in 1979. The newly expanding fishery off Shetland is also seen. The Norway pout catches show that in January and February the exploitation tends to concentrate in Areas 4 and 5A, while in the autumn Area 2 is dominant. The sprat areas and catches, Figure 2.15 and Table 2.4.3, show the concentration of the fishery in both years in Division IVb.

The data are summarized by months in Table 2.4.4. The total catches per month are remarkably stable except for those months dependent on sandeel. The impression is gained that monthly losses on one species tend to be recouped by increased catches on another.

2.5 Total Number of Trawling Hours

The total fishing time by month and international statistical square was calculated using Danish, Norwegian and United Kingdom data on the trawler fleet. The Danish is obtained from catch per hour and total catch from a sample of the vessels. The fishing time of the Norwegian and United Kingdom fleets was estimated using the number of journeys and an estimated fishing time per day.

It is apparent that the result of the calculations should be interpreted as the <u>total time</u> fishing in each square by month and not as a measure directly related to fishing mortality. This is because the fleet consists of several types of vessels, each of different fishing power. However, the relation between fishing times and fishing mortality might well be different in the three fisheries.

However, Figures 2.16-2.27 show the activity of the fleet throughout the year and thus render a description of the activities of the fishery.

2.6 Fisheries in Division VIa

Industrial fisheries in Division VIa are very new and, in marked contrast to the North Sea, account for only a minor percentage of the total landings of fish from this area.

Although not strictly an industrial fishery, a small mesh pair trawl fishery for sprat takes place in inshore waters off the west coast of Scotland in winter. In general, by-catches of herring in this fishery are low. Most of the catch is of large, good quality sprat landed for canning although in most winters a proportion is landed for reduction.

In addition, a small local industrial trawl fishery primarily for Norway pout began in the early 1970s out of Stornoway. Only rarely did the vessels venture further than the North Minch. From 1978, larger Danish and Faroese industrial trawlers have caught Norway pout (together with immature blue whiting) in the areas to the south and west of the outer Hebrides, mainly in the autumn.

Sandeels have never been prominent in the catches from Division VIa, but in 1981 a small local fishery for this fish began in the North Minch by the same vessels that fish for Norway pout in some seasons.

2.7 The Skagerrak and the Kattegat (Division IIIa)

The industrial fleet in Division IIIa can also be divided into components with different characteristics.

In the more sheltered waters of this area a significantly larger part of the total landings is taken by small vessels, the so-called "home boats" than is the case in the North Sea. Typically, they leave harbour in the morning and return the same evening.

The bigger vessels are undertaking voyages of several days and explore all areas within Division IIIa with seasonal trips to more distant areas, e.g. the North Sea and the Baltic. Parts of the industrial landings are by-catches from the fisheries on Pandalus (mainly the Skagerrak) and on Nephrops (mainly in the Kattegat). A special fishery on whiting was allowed according to Article 6 in the NEAFC recommendations for vessels with engine power less than 150 HP.

Unfortunately, no complete data set was available to the Working Group, which could give a reasonable picture of the distribution of the fisheries in time and space. This lack of data is especially acute in the case of the Kattegat area.

3. BY-CATCHES IN INDUSTRIAL FISHERIES (NORTH SEA)

3.1 Total By-Catches by Year and Division, 1976-80 (Herring)

By-catches of herring by Division have been reported by the Herring Assessment Working Group (C.M.1981/H:8), and the relevant data are given in their report in Tables 2.1.3-2.1.6. These tables include by-catches of herring both in the industrial fisheries and in the human consumption fisheries. The best estimates for the by-catches of herring in the industrial fisheries are probably obtained by combining the national figures for Denmark, Norway and the United Kingdom:

Division	1976	1977	1978	1979	1980
IVa west	4 105	502	27	443	705
IVa east	-	186	-	2	48
IVb	7 847	8 790	7 545	14 882	6 008
IVc and VIId	-	-	223	1	494
Total	11 952	9 478	7 795	15 328	7 255

It is seen that the by-catches of herring in the industrial fisheries (mainly sprat) are predominantly from Division IVb.

3.2 Herring By-Catches in Numbers per Age Group 1976-80

By-catches in numbers per age group are reported by the Herring Assessment Working Group on an annual basis for the industrial fisheries in Division IVb. Data for the five most recent years have been extracted from the 1981 report of this Working Group (Table 3.2.1).

Age groups caught are mainly 0- and 1-ringers, and there is a significant increase in numbers of 0-ringers for the two most recent years. However, in the 1980 report of the Working Group, it is expressed that the reporting of by-catches in earlier years was less efficient, which makes a direct comparison between the years difficult.

3.3 Herring By-Catches in 1981 and 1982

Provisional data on herring by-catches in 1981 are given in Table 3.3.1 (tonnage by country and division) and 3.3.2 (numbers at age). No data were yet available on the by-catches from Denmark in the second half of 1981.

Both Norway and England had very limited sprat catches in the North Sea in 1981, and they reported their herring by-catches to be negligible.

In the period 11 January - 2 February 1982, Norwegian purse seiners took some 15 000 tonnes of sprat in the central and southern North Sea. Their rather crude estimate for the herring by-catch was 337 tonnes for Division IVb and 64 tonnes for Division IVc.

3.4 Seasonal and Geographical Distribution of Herring By-Catches

Information on seasonal and geographical distribution of herring by-catches was available from various sources:

a) The 1980 report of the Herring Assessment Working Group, Addendum II, page 5, contains a chart with by-catches in 1979 split by statistical rectangles. This chart has been reproduced in this report as Figure 3.4.1. In the same Addendum (p.4), it is described that in 1979 the by-catch in the eastern part of Division IVb was mainly taken in July-September, whereas in the western part of IVb the main by-catches were taken in October-December, and to a lesser extent in January-March.

b) The 1981 report of the Herring Assessment Working Group (p.98) gives a chart with percentage of herring in samples of sprat catches in 1979-80. This chart has been reproduced here as Figure 3.4.2 with the additional Scottish data. It is seen that by-catches of herring were mainly concentrated in certain squares along the Danish and United Kingdom coasts.

c) Data were provided by Scotland on percentage herring in samples from the sprat fishery in 1981 (Figure 3.4.3). The highest by-catch percentages in the North Sea occurred in January in the inner Moray Firth and in the inner Firth of Forth, both of which are well known nursery areas for herring.

d) Norwegian data on their purse seiner fishery for sprat in January 1982 in the central and southern North Sea (mainly Silver Pit area) show that their catches contained an average of 2.6% herring (weight).

Reviewing the above data it is seen that during the years 1979-81 by-catches of herring were mainly concentrated in a few restricted areas and seasons. The largest by-catches of herring, both in weight and in numbers, were taken in the Danish coastal zone north of Esbjerg. The by-catches consist of very small 0-group herring, which are taken mainly in the 3rd quarter of the year. Because of the small size of the herring at this time of the year, even a relatively low by-catch in weight will represent a high number of individuals. No information was available on the by-catches of this area in the autumn of 1981.

The second area with high by-catches of herring was the region off the English northeast coast. By-catches in 1979 and 1980 were taken here mainly in the winter period, when the size of the herring must at least have been slightly bigger than in the autumn fishery along the Danish coast. It should be noted that no sprat fishery in this region occurred in 1981, and that by-catches of herring in this year must therefore have been negligible.

Other coastal areas in the North Sea with major herring by-catches are the inner reaches of the Firth of Firth and the Moray Firth. By-catches in these waters occur only during the winter months, and they consist of relatively small herring.

In addition to the coastal areas mentioned above, by-catches of herring are also taken in the Silver Pit area (south of the Dogger Bank), and in the Bløden area (eastern central North Sea). The mean length of the herring in these offshore areas is generally higher than in the coastal waters, and the number per kg is therefore lower.

3.5 International By-Catches (excluding Herring)

Apart from herring, by-catches of haddock, whiting, saithe and blue whiting have been reported to the respective Working Groups (C.M.1981/G:8, G:9 and H:12). Furthermore, by-catches of haddock and whiting were reported by sub-areas to the *ad hoc* Working Group on the Norway pout box problems in 1979 (C.M.1979/G:2). Other important species like cod, mackerel, plaice and sole tend to occur in such negligible quantities in the industrial fisheries that they have not been accounted for by the respective Working Groups. Reproduced from recent Working Group reports, Table 3.5.1 gives the total international by-catch figures of haddock, whiting, saithe and blue whiting from 1975 to 1980. The figures for the first three species reflect a declining trend in recent years, most significantly for saithe, whereas landings of blue whiting have increased.

In extension of the former Working Group report on the Norway pout box problems, the by-catch of haddock and whiting are presented by Sub-areas (see Figure 2.13) from 1975 up to and including the first half of 1981 (Table 3.5.2).

The overall figures for both species decreased radically from 1976 to 1977. Since then, the annual by-catch of haddock has varied from approximately 10 000 to 20 000 tonnes, and that of whiting between 40 000 and 50 000 tonnes. The introduction of the Norway pout box produced a shift of the Norway pout fishery towards adjacent fishing grounds which partially may have caused the significant drop in the by-catch rates, especially because of the increased inspection at sea.

Quota regulations and recent limitations on allowable by-catch may also have made their significant impact on the reduced by-catch landings as well.

3.6 Norwegian By-Catches

As requested by the Council (C.Res.1981/2:27:1 (i)) the species composition of the Norwegian Norway pout and sandeel fisheries are presented in Tables 3.6.1 and 3.6.2, respectively. The figures represent landings for reduction purposes, excluding fish sorted out for human consumption. Blue whiting form the major by-catch in the Norway pout fishery, whereas the proportions of herring and mackerel are negligible (Table 3.6.1). The protected species: cod, haddock, whiting and saithe occur in variable, though on an average comparatively small, quantities. The group "others" mainly consists of deep water species caught together with blue whiting, like argentines, redfish and silvery pout.

Recent sampling of sandeel landings clearly demonstrate that the rate of by-catch is very low, between 1% and 2% only (Table 3.6.2).

3.7 Faroese By-Catches

In Table 3.7.1 the by-catches for Faroese industrial trawlers are given for the years 1975-81. These are only that part of the by-catch, which is sorted out and landed for human consumption.

3.8 By-Catch Numbers at Age

By-catch for herring, cod, haddock, whiting, mackerel and saithe numbers at age data were not available from Denmark for the second half of 1981. It was thought most appropriate that the relevant Working Groups should estimate these numbers as seemed most appropriate to them and, therefore, the Working Group made no attempt to supply these results.

4. NORWAY POUT

4.1 Landings 1979-81

North Sea

Landings of Norway pout from the North Sea for the years 1957-81 are given in Table 4.1.1, those for 1981 being incomplete.

In 1979 and 1980, total landings increased from the low level of 1978 but not up to the high levels of 1974 and 1975. The increases were due to increases in the catch of Denmark and the Faroes, whereas landings by Norway and the United Kingdom decreased. In 1981, Faroese, Norwegian and United Kingdom landings decreased. Danish landings were available for only the first half of the year.

The monthly landings by country are given in Table 4.1.2. In 1979 and 1980, peak landings were made in September with a lesser peak in February. Landings in the first half of 1981 were lower than in the same period of the two previous years, those of the predominant country - Denmark - decreasing from 65 788 tonnes in 1979 and 63 265 tonnes in 1980 to 51 305 tonnes in 1981.

Following previous reports, landings of Norway pout by sub-divisions of the North Sea (see Figure 2.13) are given in Table 4.1.3, by quarters for 1979 and 1980. In both years, the catches were made entirely in the northern North Sea with peaks in the first quarter in the Norwegian zone (Division IVa) and mainly in the third quarter in other sub-areas.

Division VIa

A small fishery for Norway pout has existed in Division VIa for some years (Table 4.1.4). Scottish vessels fish for this species almost entirely in the North Minch, while vessels from other countries fish south and west of the Outer Hebrides. In 1978, a major increase in the more offshore fishery took place, 23 000 tonnes being taken in Division VIa in that year. This fishery was maintained until 1980, but landings returned to their previous level in 1981.

Division IIIa

Landings of Norway pout in Division IIIa, which have been made predominantly by Denmark, are given in Table 4.1.5. With the exception of 1974, when the catch was 11 000 tonnes, and 1976, when it rose to 42 000 tonnes, the catches have remained relatively constant, averaging 24 000 tonnes in the eleven years 1971-81.

4.2 Effort Data

4.2.1 Norwegian effort data

From the Norwegian fishery for Norway pout, cpue data (tonnes per number of fishing days per GRT) are available by quarters from 1972-80 (Figure 4.2.1). Considerable seasonal fluctuations occur annually, but the curve also indicates long-term variations over the years. As the fishery has been partly directed towards blue whiting, the average annual cpue values were reduced accordingly to make them comparable with the IYFS abundance indices for 1- and 2-group Norway pout (Figure 4.2.2). The fairly good relationship between the two sets of data indicate that the IYFS indices may provide useful estimates for the development of the Norway pout fishery during the same year.

4.2.2 Faroese effort data

Table 4.2.1 shows catches per unit effort (kg/hour) for Faroese industrial trawlers by month for the years 1978-81. The cpue's are plotted against the time on Figure 4.2.3. The figure shows a moderately increasing cpue for the years 1978-80. This is in good agreement with the Norwegian cpue, shown in Figure 4.2.1. The Faroese data show a markedly lower cpue in 1981 compared to previous years, thus indicating a relatively low abundance in 1981.

4.3 Catch at Age and VPA Results

North Sea (Sub-area IV)

Data on catch in numbers by age by quarters for the years 1974-78 were given in Table 2.4.1 of the 1979 report of the Working Group on Norway Pout and Sandeels in the North Sea (C.M.1979/G:26). The data series was extended to include the years 1979, 1980 and the two first quarters of 1981.

For 1979 and 1980, data on numbers caught were provided by Denmark, Norway and Scotland. Faroese landings, accounting for about 7% of the total of each year, were not covered by sampling, but were included by a proportional raising of the quarterly summed numbers caught by other nations.

For 1981, data were available from Norway. Scotland had no catch, while Denmark could only present data from the first half of the year. The Faroes had no catch in number data, and their landings were treated as outlined above.

The catch in numbers at age data for 1974 to 1st half of 1981 are given in Table 4.3.1.

Estimates of fishing mortalities for Norway pout were obtained from a quarterly VPA. Input data (catch at age per quarter) are shown in Table 4.3.1. Natural mortality is assumed constant for all age groups. Two assumptions on natural mortality were tested: $M = 1.00$ year^{-1} and $M = 2.00$ year^{-1}. Fishing mortalities for the two runs are shown in Tables 4.3.2 and 4.3.4, respectively, and stock sizes in numbers are given in Tables 4.3.3 and 4.3.5, respectively.

Fishing mortalities for the last quarter (second quarter of 1981) were estimated by averaging fishing mortalities for the second quarter of the years 1976-78.

Due to the lack of quantitative knowledge on natural mortality, the present VPA estimates of exploitation patterns should be treated with reservations. Age group 5 and older Norway pout do not occur in the catch statistics, and it is thus tempting to believe that old age and spawning stress mortality deplete the older part of the stock. As Norway pout is known to be one of the major prey species for cod, whiting and saithe, the natural mortality on the younger age groups must be a function of the abundance of these predators. Thus, there are good reasons to believe that the natural mortality of Norway pout is high and varies from year to year, as far as the younger age groups are concerned. This could seriously affect the results obtained by VPA. Nevertheless, the reasonable correlations with recruitment indices must be somewhat encouraging.

The above-mentioned complications especially apply to small short-lived species as the three industrial target species. A more general problem also encountered here (and in most other assessments made by ICES Working Groups) is the problem of getting estimates of fishing mortalities for the last year. Such estimates of terminal fishing mortalities may be obtained from effort data. As effort data from the major industrial fleets are not available to the Working Group, no estimates for the terminal Fs can be given.

West of Scotland (Division VIa)

Numbers caught at age by quarters for Scottish landings 1971-81 were available, but there were no data from other nations fishing in the area, mainly Denmark and the Faroes.

Skagerrak and Kattegat (Division IIIa)

Landings from this are are almost entirely by Denmark. There are no data on catch at age.

4.4 Research Vessel Surveys

Recruitment indices

Series of research vessel data given in the previous report are extended in Table 4.4.1. Areas to which each series applies are shown in Figure 4.4.1.

The International 0-Group Gadoid Survey in June each year demonstrates a very low abundance of 0-group Norway pout in 1980, in fact the lowest since the surveys started in 1971. In 1981, the abundance was very close to the mean from 1971-80.

Bottom trawling surveys by Scottish research vessels in the late autumn were not carried out in 1979 or 1980. In 1981, the relative index of 0-group Norway pout abundance was the second highest in the seventeen year series, whereas the 1-group index value (the 1980 year class) was only 20% of the long-term mean.

The abundance index from the International Young Fish Survey given in the last report of the Norway Pout and Sandeel Working Group (C.M.1979/G:26) could not be updated in the same form. Since the International Gadoid Survey Working Group has adopted a different standard area for Norway pout, the series given in Table 4.4.1 is based on the area used by that Group, and the index values are as given in the report of their 1981 meeting (C.M.1981/H:10),updated to include the results of the 1981 survey and preliminary results of the 1982 survey. Among recent year classes the 1979 year class was close to the long-term average, the 1980 year class weak and the 1981 year class about average.

Results from two new series of research vessel cruises (English research vessels) are summarized in Table 4.4.2. On the groundfish survey,which takes place around August each year, covering the entire North Sea, the 1979 year class as 0-group was average, the 1980 year class 17% of the 5-year average, and the 1981 year class over twice the average. The three surveys of the main Norway pout distribution area in November also indicated a low abundance of the 1980 year class both as 0- and 1-group. The abundance of 0-group in 1981 was higher than in the two previous years.

The research vessel survey indications of recruitment of Norway pout show some consistency. Of the most recent year classes, the 1979 year class appears to have been about average, while that of 1980 was rather poor. The 1981 year class was clearly stronger than that of 1980, but the surveys differ in indicating whether it was strong or average.

Regression analysis of recruitment indices on VPA estimates of stock numbers was carried out. IYFS indices of 1-group and 2-group Norway pout on VPA estimates of numbers in the first quarter are shown in Table 4.4.3. The index from the pelagic 0-Group Survey (carried out in June) on the third quarter of first year is shown in Table 4.4.4. The regressions were made for two sets of VPA results, namely, estimates of stock size under the assumption of M = 1.00 $year^{-1}$ and M = 2.00 $year^{-1}$ (cf. Section 4.3). Only one of the six regressions demonstratesa clear relationship between VPA and recruitment indices. There was a correlation coefficient of 0.80 for the regression of the VPA results with M = 1.0 $year^{-1}$ and IYFS 1-group estimates. This is shown in Figure 4.4.2. Figure 4.4.3 and Figure 4.4.4 give the equivalent relationships for the 1-group and VPA figures with M = 2.0 year^{-1} and 2-group and VPA figures with M = 1.0 year^{-1}, respectively. Figure 4.4.5 shows the relationship between 0-group indices and VPA figures with M = 1.0 year^{-1}.

4.5 Weight at Age

Mean weights at age by quarter as observed in Norwegian catches are given in Table 4.5.1 for the years 1979-81. The figures for age groups 0 and 1, and for age group 2 in the first half of these years are rather similar, while some discrepancies appear in the observed weights of 3 year olds as these fish become less available to the fishery with time. The results deviate very little from the results in previous years.

4.6 Percentage Landings in Weight by Age

Table 4.6.1 shows the percentage landings by weight in 1979 and 1980 by quarter. In both years landings are dominated by the 1- and 2-year olds, which together supplied 93% of the landings in 1979, and 98% in 1980. More than 2/3 of these landings were made in the second half of the year at the same time as 0-group fish are caught.

4.7 Other Measures of Mortality

No additional measures of fishing mortality on Norway pout were available to the Working Group.

4.8 Yield per Recruit

Yield per recruit curves for Norway pout are given in C.M.1977/F:7 for various values of M and t_c. In that report, it is tentatively concluded that no increase in yield could be obtained by either an increase or a decrease in F.

The yield per recruit for the present level of fishing mortality ($F \sim 1.0$) is considerably higher when the age at first capture is set at 1 year than at ½ year, assuming at least that M is not higher than 1.0. Theoretically, an increase in yield could, therefore, be expected from measures aimed at avoiding catches of 0-group Norway pout. However, neither restrictions of the fishing area nor an increase in mesh size are likely to result in a decreased catch of 0-group. The distribution area of 0-group fish coincides with that of older fish, which makes it impossible to close specific nursery areas. An increase in mesh size is not likely to affect the selectivity of the gear to a large extent because of meshing problems and blocking of the meshes due to the large quantities of fish being caught simultaneously.

A change in the timing of the fishery is not likely to increase the yield per recruit. Monthly catch statistics (Table 4.1.2) show that catches occur throughout the year, with a maximum in August-September and October, and a minimum in the period March-June. The mean weight for age groups 1-3 shows the biggest increase in the period May-August (C.M.1978/G:12, p.20). It can thus be concluded that the main fishery takes place when the fish have nearly reached their maximum weight for the season.

4.9 Catch Prediction and Biomass

Given the lack of fishing effort data for this species for the major fleet and the lack of catch at age data for the second half of 1981, it is not practical to make predictions of catch, biomass or spawning stock biomass for 1982 for Norway pout by the usual VPA-prediction route. It is possible to obtain some idea of what the coefficient of variation of such a catch prediction might be using the method given in Appendix A. This suggests that a prediction of the 1979 landings made in early 1979 would have had a coefficient variation of approximately 20% and a similar result would also have occurred, had a prediction of the 1980 landings been made in early 1980.

The prediction of catches (or indeed of biomass) by the VPA prediction for Norway pout could not, therefore, be made very accurately, even where suitable data were available.

The total catch was related to the IYFS indices of the 1- and 2-year olds by multiple regression. Only the years 1975-80 were considered, which involves the 1973-79 year classes.

The catch and the 1-group index had a correlation of 0.74, catch and 2-group were correlated by 0.51, and the 1- and 2-groups (within a year) had an insignificant correlation (-0.05), suggesting orthogonal X variables.

The multiple regression was

$$Y = 91\ (\pm 84) + 6.92\ (\pm 2.05) \times 10^{-2}\ \text{1-group index}$$
$$+ 6.90\ (\pm 2.85) \times 10^{-2}\ \text{2-group index}$$

This regression accounted for 74% (corrected of df) of the variation. The intercept was not significantly different from 0, but both of the regression coefficients were significantly larger than 0 ($p = 0.95$, $df = 3$). Since the regression coefficients were so close, a new pooled index was arrived at by summing the 1- and 2-group indices.

In Figure 4.9.1 the total catch has been plotted versus this pooled index for all the years 1970-80. Using all the years in a linear regression gives a slope that is significantly different from zero ($6.91(\pm 1.48) \times 10^{-2}$). However, due to the fact that the IYFS started in 1970, and that the North Sea was not properly covered in the first years, the Working Group considered it more appropriate only to include the years 1975-80 in the regression. This gives a significant slope and an intercept which is not significantly different from zero (Figure 4.9.1).

The coefficients of variation for individual years in the predictions vary from 25% to 15% for a 1- and 2-index that varies from 3 000 to 1 000.

The preliminary 1-group index of Norway pout in the beginning of 1982 is 3 959. The 2-group (1980 year class) index is not available, but probably very low judged from its 1-group index for 1981. This would result in a total index of about 4 000, which leads to a total catch of 400 000 tonnes. The actual catch, however, depends on whether the fishing effort increases or decreases.

5. SANDEEL

5.1 Landings 1979-81

North Sea

Total landings of sandeels (almost entirely the lesser sandeel *Ammodytes marinus*) from the North Sea in the period 1952-81 are given in Table 5.1.1. After the peak landings of 790 000 tonnes in both 1977 and 1978, landings dropped in 1979 to 580 000 tonnes and rose in 1980 to 730 000 tonnes. The total landings in 1981 are not known owing to the non-availability of Danish landings in the second half of the year.

Landings by individual countries followed, to a large extent, the overall trend in showing a decrease in 1979 and an increase in 1980 (with the exception of the Faroes which were subject to quotas during this period). In 1981, the Norwegian catch decreased sharply, whereas the United Kingdom catch increased.

Monthly landings given in Table 5.1.2 show the usual seasonality, starting in March, reaching a peak in May or June, and ending in October or early November. In all three years, landings by Norway increased to a small peak in October. Landings in the first half of the year by the major sandeel fishing country, Denmark, decreased in 1979 and increased in 1980. In 1981, they decreased sharply from 451 000 tonnes (1980) to 281 000 tonnes (1981).

Regional landings in the North Sea are shown by months in Table 5.1.3, and annual landings by sub-areas given in Figure 2.14 are given in Table 5.1.4. The largest increase in the period 1978-80 took place in the central part of the northern North Sea (Sub-area 1c). Other increases took place in Sub-area 3 (approaches to the Skagerrak), Sub-area 1a (the west central North Sea), and Sub-area 6 (the Danish coast), while a significant decrease occurred in the east central North Sea (Sub-area 2a).

The seasonal pattern of landings given in Table 5.1.3 shows differences between areas. The landings from the more southern areas of the North Sea tended to finish in July, whereas those further north continued until the autumn.

Division VIa

Significant landings of sandeels in Division VIa (6 000 tonnes) were made for the first time in 1981, by local Scottish vessels in the North Minch (Table 5.1.5).

Division IIIa

Landings of sandeels in Division IIIa have fluctuated considerably since 1971 (Table 5.1.6), but have shown a progressive increase since 1977 to a maximum of 40 000 tonnes in 1981. Landings are made almost entirely by Denmark.

5.2 Fishing Effort and Catch at Age

Fishing effort

The Working Group was not able to update the series of effort data given in the last report of the Norway Pout and Sandeel Working Group, which was based on Danish catch per unit effort data. The only new data were effort in numbers of hours fishing in the Shetland sandeel fishery since 1975. These are given in Table 5.2.1. In most years, the effort rises rather sharply in April and May, maintains a relatively constant level until July or August, and then decreases in September, ending during October. The total annual effort has varied by a factor of 2.7, the highest being in 1981.

Catch at age

North Sea

The numbers of sandeels caught at age were compiled for three areas of the North Sea:

a) "Shetland" - an area limited by latitudes 57°00'N and 61°30'N, longitudes 3°00'W and 0°00'. (Figure 2.14, area SH)

b) "Northern area" - northern North Sea limited to the south by latitude 56°30'N west of 6°00'E and by latitude 56°00' east of 6°00'E, further limited to the east by the line separating ICES Sub-area IV and Div.IIIa. (Fig. 2.14, Areas 1B+1C+2B+2C and 3).

c) "Southern area" - southern North Sea south of limitations given above. (Figure 2.14, areas 1A+2A+4+5 and 6).

1978 catch in number at age by month for "Shetland" and "Northern area" combined are given in the report of the Working Group on Norway Pout and Sandeels in the North Sea (C.M.1979/G:26). In the same report, annual catch at age is given for previous years for each of the three areas, back to 1974 for Shetland, to 1972 for Northern area and to 1971 for Southern area. Catch at age by month for these earlier years are found in the 1978 report of the same Working Group (C.M.1978/G:12).

At the present meeting, the series of catch at age by month was extended to include 1979, 1980 and the first six months of 1981. Data were provided by Denmark, Norway and Scotland. Danish and Norwegian age distributions were applied to the insignificant landings by the Faroes, for which there were no sampling data.

These results are shown in Tables 5.3.1 to 5.3.3.

As outlined in previous sections, the later half of 1981 could not be included, since data from Denmark were not available.

West of Scotland

Catch at age by month for 1981 were provided by Scotland.

Skagerrak and Kattegat

No data were available.

5.3 VPA Results

In the absence of a firm estimate of natural mortality and of fishing effort data to correct terminal fishing mortality and changes in the exploitation pattern, VPA results must necessarily be very tentative. They should, however, give an indication of patterns of annual recruitment and some idea of trends in fishing mortality.

The VPA for the southern and northern North Sea stocks were made using half-year data, while that for the Shetland was made using yearly data. A half-yearly analysis was chosen for the former two stocks to fully utilize available age data (data for the second half of 1981 not being available from Denmark). Tables 5.3.4, 5.3.7 and 5.3.10 give the input data for the VPA for the three areas, respectively. A natural mortality of 0.5 $year^{-1}$ was adopted in all cases. Table 5.3.5 shows the fishing mortality at age for southern North Sea sandeel. Table 5.3.8 shows the half-yearly fishing mortality at age for northern North Sea sandeel, and Table 5.3.11 the annual fishing mortality for Shetland sandeel.

Figure 5.3.1 shows plots of the fishing mortality on 0, 1, 2, 3 and 4 year olds in the southern North Sea sandeels, and Figure 5.3.2 shows the plots of half-yearly fishing mortality for northern North Sea sandeel. These indicate the seasonal nature of these fisheries, most mortality being generated in the first half year (i.e. second quarter) of the year. The southern North Sea results indicate some upward trend in mortality, while that for the northern North Sea has varied widely, being highest during the mid-1970s.

Tables 5.3.6 and 5.3.9 show the numbers at age by half-yearly intervals for the southern North Sea sandeel and the northern North Sea sandeel, respectively. Table 5.3.12 shows the numbers at age of the Shetland sandeel. Table 5.3.13 shows the VPA estimates of recruitment for the three sandeel stocks. Biomasses and spawning stock sizes are not shown due to uncertainties in the estimates of M and terminal fishing mortality. The recruitment series for the various stocks do not appear to be correlated.

A comparison of values of fishing mortality rate of Shetland sandeels derived from VPA with fishing effort is given in Table 5.3.14. Since this fishery started only in 1974, it is likely that the first two or three years involved an element of learning, in particular to locate the main concentrations of sandeel. Correlation has, therefore, been tested only for the years 1977 and onwards. The main exploitation on the Shetland sandeel stock is on the age groups 0-3. The value of F used in the correlation was, therefore, the arithmetic mean F for these four age groups.

The results of fitting linear regression equations to the data show high values of the correlation coefficient with all values of input F in the VPA. The intercept on the Y-axis, giving an estimate of F at zero, is 0.07 to 0.10, gives some credibility to the value of $M = 0.5$ year^{-1} used in the VPA.

5.4 Research Vessel Surveys

5.4.1 Recruitment

Sandeels are not adequately sampled by any of the routine bottom trawling surveys. They are, furthermore, not available to bottom trawls for most of the period November-February.

0-group sandeels remain pelagic until about July in the southern North Sea and at Shetland and until slightly later in the offshore areas of the northern North Sea (see appearance of 0-group in the landings given in Tables 5.3.1-5.3.3). In June they are caught in substantial numbers in the International 0-Group Gadoid Surveys and are reported each year in the reports of these surveys. The surveys, however, cover only the more northern parts of the North Sea and they are, therefore, unlikely to provide any index of recruitment for the North Sea as a whole. An analysis was carried out on the sandeel data from these surveys, but there was no evidence of any correlation with the results from VPA. It can therefore be concluded that there is no existing series of survey data than can be used to estimate sandeel recruitment.

5.5 Weight at Age

Mean weight at age of sandeels by months and area are given in Tables 5.5.1 to 5.5.3. The first two display figures for the northern and southern North Sea, respectively, as derived from Danish sampling in 1979 and 1980. It can be seen that mean weights in spring are much less than those of corresponding younger age in September-October, and this is true also for individuals of each year class between 1979 and 1980. The apparent loss of weight is considerable in some cases, and this may be due to delayed availability of larger fish or to age-reading difficulties in the early months, or area differences.

Table 5.5.3 gives figures for sandeel in the Shetland area as observed in Scottish catches in the years 1979-81. The problem mentioned above is still observed in the data for 1979 and 1980, and mean weights at age are still observed to be highly variable from year to year.

The values of weight at age in the southern and northern areas, but not at Shetland, are consistently lower than those given in the 1978 report of the Norway Pout and Sandeel Working Group for earlier years.

5.6 Percentage Landings by Weight by Age

Table 5.6.1 shows the percentage landings by age for each of the three sandeel stocks, for 1979-80 for the main stocks and 1979-81 for the Shetland stock. In these years, 1- and 2-year olds have dominated the southern North Sea stock, but in both the northern and Shetland stocks 0-groups have made a large, but variable, contribution to the landings.

5.7 Other Measures of Mortality

Using catch in number per hour's fishing in the Shetland sandeel fishery, values of Z were calculated (Table 5.7.1). As the fishery switches to the 0-group when they appear in June-July, values of Z were estimated using cpue of age groups 1-7 in April-May, and age groups 2-8 in April-May of the following year. The estimates are very variable from year to year, but the mean for the years 1975-81 is 1.14. This compares with values ranging from 1.00 - 1.04 from VPA, assuming a value of M = 0.5.

5.8 Yield per Recruit

In an earlier report (C.M.1977/F:7, p.37), yield curves were presented for sandeel, using various values of M and different growth parameters. From these curves it can be seen that the yield/recruit remains fairly constant over the range F = 0.7-2.0, assuming M = 0.5 (as has been done for the VPA in the present report). Theoretically, a gain in yield/recruit could probably be achieved by increasing the age at first capture, but in practice such a measure does not appear to be feasible. Increasing the mesh size would result in enormous meshing problems and virtually no increase in the selectivity of the net. A minimum landing size or closed nursery area are not feasible because of the unpredictable distribution pattern of 0-group sandeel.

As a last method to increase the yield/recruit, one could consider a shift of the fishing season in order to allow the fish more time to grow during the feeding season.

Table 5.1.2 shows that the biggest catches of sandeel generally are taken in May and June. The monthly weight at age data for the years 1974-77, presented in C.M.1978/G:12, indicated a sharp increase in weight at age for all age groups from July-August. This increase, however, is much less apparent in weight at age data for 1979-80, presented in this report.

If the large increase in weight in late summer would be a yearly recurring pattern, an increase in yield/recruit could probably be obtained by shifting the fishing season by 2 months. In practice, however, the fish are no longer available to the fishermen in large quantities after May/June, probably because they bury themselves in the bottom again. The fishery has, therefore, no choice but to catch the sandeels during the months in which they are available.

5.9 Catch Prediction

The percentage landings by age for the separate stocks of sandeels (Table 5.6.1) suggest that northern North Sea landings may in some years be dominated by 0-group fish. For example, in 1979 the 0-group constituted 61% of the landing.

Since a prediction could only assume an average recruitment for 0-groups, considerable inaccuracy could clearly be the result in the forecasts of 0-groups.

These sources of variation would be less apparent in the southern North Sea, where 0-groups are not appreciably caught and perhaps at Shetland, where the recruitment series, at least so far, appear less variable than in the other two areas. The variability of the estimates of the other ages will largely depend upon whether or not the considerable variation in fishing mortality shown in Tables 5.3.5 and 5.3.8 can be explained by a measure of fishing effort.

A further important source of variation in predicted catches will certainly be the variation in weight at age data between different fishing grounds. Given these problems, the prediction of future catch for this species by the VPA-prediction method would seem unprofitable, particularly in the present situation where neither effort data for 1981 nor catch at age data for the second half of 1981 are available for the main areas. Hence, no catch projection has been made for 1982.

6. SPRAT

6.1 Landings 1979-81

North Sea

As described in the 1981 Herring Assessment Working Group report (C.M.1981/H:8), total landings of sprat in the North Sea decreased to 320 000 tonnes in 1980, mainly as a result of decreases in the central North Sea. A significant increase occurred in the southern North Sea.

Sprat landings for the years 1971-81 are given in Table 6.1.1 for the areas shown in Figure 2.15. Total landings for 1981 are not known since landings by Denmark were not available. Landings by other countries, however, decreased from 91 000 tonnes in 1980 to 22 000 tonnes in 1981. This decrease mainly resulted from a decrease in Norwegian landings (only 400 tonnes in 1981 compared with 69 000 tonnes in 1980), and the only vessels showing an increase in landings were English vessels in coastal waters of the southern North Sea. The concentration of sprat fisheries in the southern part of the North Sea thus appeared to be maintained in 1981. Indeed, from the figures available, only 1 000 tonnes of sprat were landed in 1981 from the northern North Sea (Division IVa).

Division VIa

A Scottish fishery in inshore areas to the west of Scotland has taken place for many years (annual reports in "Annales Biologiques"). After increasing to a peak of 11 600 tonnes in 1978, the landings have returned to a rather low level (Table 6.1.2). Landings by other countries from this Division have been relatively small.

Division IIIa

Landings of sprat from this Division, previously given in the report of the Division IIIa Working Group, are given in Tables 6.1.3 and 6.1.4. Those of Denmark are divided into the Skagerrak and the Kattegat, but Swedish landings in 1980 and 1981 were not allocated in this way. Total landings increased progressively from 79 000 tonnes in 1978 to 123 000 tonnes in 1981, this increase being most marked in the Skagerrak (Table 6.1.4).

6.2 Effort Data

No effort data were available for the sprat fishery.

6.3 Catch at Age and VPA Results

6.3.1 Catch at age

North Sea (Sub-area IV)

Numbers caught per age group in each three-month period for the years 1974-80 are given by the Herring Assessment Working Group for the Area South of 62°N in its 1981 report (C.M.1981/H:8, Table 8.2).

Danish landings account for a major part of the total, and as data from this country were only available for the first six months of 1981, the previous data series could only be extended by two additional three-month periods.

Data on numbers caught in 1981 were otherwise given by England, Scotland and Norway. Data for landings of other nations were not available, but these amounted to a small proportion only of the total. Landings of the Federal Republic of Germany were assumed to come from Divisions IVb,e in the first quarters, and the age distribution of Danish catches was applied (Tables 6.3.1 and 6.3.2).

Following previous practice, landings from fjords of western Norway (Divisions IVa,e) were excluded from the North Sea and included in Division IIIa.

Skagerrak and Kattegat (Division IIIa)

In the report of the Working Group on Division IIIa Stocks (C.M.1981/G:12), the numbers at age are given for Danish landings by quarters 1975-80.

The sprat fishery in this area is carried out by Denmark, Sweden and Norway. No data on numbers caught at age in 1981 were available from either of these countries.

West of Scotland (Division VIa)

Numbers caught at age have not previously been reported. At the present meeting, data were presented by Scotland for the years 1974-81, on the basis of sampling covering about 80% - 90% of the landings, except for 1980, when landings by Ireland accounted for a significant part of the total.

The data are available, but were not considered by the Working Group.

6.3.2 VPA Results

The catch by number by age on a quarterly basis were available from 1974 up to the second quarter of 1981 (incl.). In the absence of better knowledge, the North Sea catches are taken as coming from a single stock.

No effort data to calibrate the input Fs were available. Instead, the VPA was run on the assumption that the fishing mortalities in the second quarter of 1981 were equal to the average in the second quarter in the period 1976-78 on the 1-4 year olds. The input fishing mortality on the 0-group in 1982 was chosen so that this (recruiting) year class becomes equal to the average 1974-80 (130×10^9 at 1 July). The resulting Fs for $M = 0.80$ year^{-1} on an annual basis are given in Table 6.3.3. The average fishing mortalities in 1974-80 as a function of age are shown in Figure 6.3.1. This figure also shows the seasonal character of the fishery. The stock numbers at age estimated from this VPA are given in Table 6.3.4.

In Figure 6.3.2 the annual F on the 1, 2 and 3 year olds are plotted from 1974 to 1980. There are some uncertainties of the Fs in 1980 due to the input Fs in 1981. However, due to the high values of F and the resulting convergence, the values for 1979 and, in particular, for the earlier years are not subject to large uncertainties.

In Figure 6.9.1 the total stock (1+) biomass in the beginning of the year is plotted for the period 1974-80. Uncertainties about M and mean weights may change the absolute level of the stock size. There is, however, little doubt of the general reduction of the stock from the 1974-75 level up to 1979-80.

6.4 Research Vessel Surveys

6.4.1 Trawling surveys

Sprat data collected in the International Young Fish Surveys have previously been reviewed by Johnson (C.M.1974/H:18, and C.M.1978/H:31). Charts of the distribution by rectangle of all age groups of sprat for the years 1977-82 are given in Figures 6.4.1 to 6.4.6.

Apart from the anomalous year 1979, the charts show a progressive decrease in the numbers of rectangles in which largenumbers of sprat were caught and, in particular, a rather sharp decrease was observed in the 1982 surveys, as shown in the text table below:

	No. of rectangles units	
Year of Survey	≥ 10 000 sprats/hr	≥1 000 sprats/hr
1977	9	37
1978	7	30
1979*	0	18
1980	7	32
1981	5	31
1982**	2	17

* Survey carried out in bad weather, affecting catch rates of several species. (See report Herring Assessment Working Group, C.M.1981/H:8).

** Provisional. Data based on results from England, Scotland, Norway, Netherlands and Sweden only.

At the meeting, it was not possible to partition the catches into their component age groups. Johnson (1974, 1978), however, demonstrated a clear difference in the age composition of bottom trawl and pelagic trawl samples of sprat. 1-group sprat in February have a mean length of approximately 3-5 cm and are probably not fully available to bottom trawls.

Figures 6.4.1 to 6.4.6 also demonstrate a change in the distribution of sprat in the North Sea. Catches in Division IVa W decreased to a very low level in 1982, this trend following the recent trend in landings from this Sub-division. In most years the largest survey catches have been made in the east central part of the North Sea (Divisions IVb and e). In 1981 and 1982 there was evidence of a progressive southwesterly shift of the centre of gravity of the population. This is again in agreement with the change in the distribution of commercial catches.

While the International Young Fish Survey may not provide a reliable index of the recruiting year class, it has nevertheless demonstrated a shift in the distribution and overall abundance.

In November 1980 and 1981, Scottish research vessel surveys were carried out in the western half of the North Sea using an international young gadoid pelagic trawl fished in the way advocated for the 0-group gadoid surveys, i.e., in a stepped haul from near bottom to near surface. The results of these surveys (Figure 6.4.7) show that 0-group sprat in this area are concentrated close to the coast. Furthermore, in all rectangles covered in both years, there was a marked decrease in the numbers of 0-group sprat caught.

6.4.2 Acoustic survey

The ICES coordinated acoustic survey for North Sea sprat continued in January-February 1982. Vessels from Norway and the United Kingdom participated, and the results of the different surveys were compiled into a report at the meeting of the Acoustic Survey Planning Group, held in Aberdeen in early March. The full results of the survey will be presented at the 1982 Statutory Meeting in a joint report by the Convenor of the survey, Dr P O Johnson.

The results of the survey are given in Figure 6.4.8. Standardized to a sprat target strength of -29 dB/kg as used in the 1981 survey, there were an estimated 230 000 tonnes of sprat in the survey area. This compares with 195 000 tonnes in the 1981 survey. In 1982, however, the main sprat concentrations were close inshore in the Wash and Thames estuary. As shown in the text table below, there was a southward shift in the centre of gravity of the population in 1982.

Estimated biomass of sprat ('000 tonnes) in each Sub-division

	1981	1982
IVa W	3.6	4.8
IVb W	99.3	52.2
IVb E	26.8	23.2
IVc	65.4	149.8

At the time of the Working Group meeting, the biomass estimates had not been partitioned into the recruiting and older age groups of sprat.

The acoustic surveys in 1981 and 1982 provide no evidence for any significant change in stock size between the two years. The 1980 acoustic survey indicated a much higher stock size when converted to refer to the same target strength value. It was pointed out by the Herring Assessment Working Group (C.M.1981/H:8) that this reduction in stock size was consistent with a much higher value of F for 1980 than that estimated for 1978 and 1979. Based on a comparison of catches in number in 1980 with acoustic estimates in 1980 and 1981, however, Johnson (C.M.1981/H:14) deduced, either that natural mortality is considerably underestimated, or that the 1980 stock was overestimated by the acoustic survey.

6.5 Weight at Age

North Sea

Mean weights at age in landings 1976-77 and by quarters of the year were given in the report of the Herring Assessment Working Group for the Area South of 62°N in 1978 (C.M.1978/H:3).

Mean weight by age and month for Danish catches in 1980 were reported by the Working Group in 1981 (C.M.1981/H:8). At the present meeting, similar Danish data for catches in 1981 were available, and they are given in Table 6.5.1, together with the 1980 data.

The monthly weights demonstrated marked seasonal changes. The 1-group increases from about 2 grams in February-March to 11 grams in October-November, followed by a decline to about 6 grams in March-April as 2-group, and a new rapid increase to about 18 grams in October-November.

The mean weights of the 0- and 1-group in the catches were not representative of weights in the stock. The weight of 1-group sprat in January was chosen to be 1 gram as also assumed by previous Working Groups.

A new set of weights were established for calculation of stock biomass by the VPA. The weights were calculated as unweighted means of the 1980 and 1981 data for each quarter, except for the 1-group in the first quarter. The data in Table 6.5.1 were incomplete for the 4- and 5-group, and, for this reason, previously published data (C.M.1978/H:3) were used. On this basis, the following quarterly mean weights by age group were calculated and applied:

Quarter	Age groups 1	2	3	4	5
1	1.00	7.46	15.38	20.59	26.22
2	5.70	11.97	19.88	22.75	
3	8.38	13.68	19.32	22.75	
4	10.59	17.02	22.27	26.64	

The weights given above for the first quarter of the year were used for the computation of stock biomass at the beginning of each year. The weights differ from those of the previous assessment and the stock biomasses of each age group as reported here are not directly comparable to those reported last year (C.M.1981/H:8). This mainly concerns the 2- and 3-groups, for which the previous weights were 8.86 and 13.56 grams, respectively.

Skagerrak and Kattegat

No new data were available for these areas.

6.6 Age Composition by Weight

Estimates of the mean contribution to the fishery from each age group of sprat have been made by the Herring Assessment Working Group (C.M.1978/H:3). By multiplying the catches in numbers by age for each of the years 1974-77 by the mean weights at age, the following percentages were derived:

Age groups

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

This illustrates the dependence of the fishery on two age groups and also the problem of making any catch prognosis into next year on the basis of data from the fishery. The data series ends by July 1981 and provides no information on the abundance of the 1981 year class.

6.7 Other Measures of Mortality

No additional measures of mortality were available to the Working Group.

6.8 Yield per Recruit

In ICES Doc. C.M.1977/H:3 (pages 22 and 85), a yield/recruit curve is presented for sprat, calculated on the basis of the exploitation pattern in the period 1971-74.

For the most recent years (1977-80) the average exploitation pattern for the total North Sea has been calculated from data on fishing mortality given in Table 6.3.3.The two sets of data are compared in the text table below.

Ratios of F at each age compared with F of 1 year olds

Ringers	0	1	2	3	4
1971-74	0.14	1.00	1.85	1.41	0.37
1977-80	0.03	1.00	2.00	3.50	3.68

There has been an appreciable change in exploitation pattern, with an an increased fishing mortality on the older age groups. The reason for this could not be resolved at this meeting of the Working Group.

In Appendix B a calculation is presented of the effects of shifting the sprat fishery either more to the western part or to the eastern part of the central North Sea. Because most parameters used in this calculation were based on assumptions rather than on established data, no practical conclusions should be drawn from the results. However, the exercise indicates a possible approach to the management of the central North Sea sprat fisheries as one unit, and it indicates what data would be required for this purpose.

The effet of limited seasonal and area closures, suggested in the ACFM report from 1981, was not investigated. Such measures should be studied, since they might be beneficial to both the herring and sprat fisheries.

6.9 Prognosis

Due to the lack of calibrated input Fs, the lack of catch data from the last half of 1981, and the lack of independent recruitment data, the VPA can only form a basis for evaluating the historical development of the stock up to about 1980 (Figure 6.9.1).

The arbitrary input Fs used for 1981 imply that the stock decreased by 48% from the beginning of 1980 to the beginning of 1981. If the increasing trend of the Fs over the years 1974-80 continued on to 1981, the stock may have been reduced still further.

The acoustic estimates (described in Section 6.4.2) indicated that the stocks at the beginning of 1981 and 1982 were lower than in 1980. Taking these estimates at their face value, the reduction was about 58%.

Section 6.4.2 described the changes in abundance of sprat recorded in the IYFS (Figures 6.4.1 to 6.4.6). Since the winter of 1979, there has been a withdrawal of sprat from the northeast British coastal areas. Increasing abundances have been observed in the Wash and Thames estuary and in this latter area a profitable fishery developed during the winters of 1980-81 and 1981-82 after a period of absence of over 25 years.

Both from IYFS and the sprat acoustic surveys, a considerable reduction in biomass between January 1980 and January 1982 is indicated. Figure 6.9.2 shows the abundances in numbers per hours fishing of the recruiting sprat in the IYFS for 1980 and 1981. It is clearly seen that the 1981 mean abundance in the main nursery area east of 3° is reduced to between a 1/3 and 1/4 of the 1980 value.

While completed data are not yet available for the 1982 IYFS, some data on the length and age compositions of the catches in Division IVb east covering the main areas of abundance indicate that the juvenile fish (< 8 cm) numbered about 18% of the total catches. From the preliminary data available, this would suggest that recruitment may be reduced by up to 1/3 from that in 1981. In view of the evident further reduction in abundance in the IYFS of 1982, the Group felt that there are reasons for advocating caution in continuing to base advice for 1982 and 1983 on historic catch levels.

In no year in the recent period, i.e. 1977-80, has the catch reached the 400 000 tonnes referred to as a precautionary TAC. Assuming that Denmark took the same proportion of its catch in the last six months of 1981 as it did in 1974-80 (mean 71%, range 61-84%), then their expected catch in 1981 would be about 170 000 tonnes, placing the 1981 catch at about 200 000 tonnes. The trend in catch mirrors the trend in declining spawning stock biomass indicated by VPA and shown in Figure 6.9.1.

The Working Group considers that the trends indicated in the data series reflect a major reduction in the North Sea sprat stock, particularly as this has taken place without restriction of effort in the latest years. While it is possible that some of the decrease in catch may result from a reduced mortality brought about by the evident re-distribution of the stock into English coastal waters, nevertheless the Group considers it realistic to expect the catch for 1982 to be no higher than that in 1981.

7. EVALUATION OF SAMPLING AND REPORTING PROCEDURES

7.1 Statistical Requirements and Management Strategies

If an assessment of the historic status of a stock only is required, annual catches at age, an average weight at age table and some estimate of natural mortality may be sufficient, through the use of VPA and yield per recruit calculations. If one tries to go beyond a historic assessment and provide up-to-date management advice, such as annual TACs, or make prognoses, the same information is required. In addition, other information becomes necessary:

a) Firstly, a mean of calibrating the VPA is needed. The required information on changes in stock biomass and recruitment may be provided by trawling surveys or, in the case of sprat, echo-surveys.

b) Secondly, an important source of information on abundance is catch per unit effort in the commercial fisheries, which requires data on fishing effort. This becomes particularly important, if some form of direct control of fishing effort is envisaged. In this case, information is also needed to relate fishing power to vessel and gear characteristics.

c) For prognosis, early estimates of recruitment are essential in the case of recruit fisheries.

d) Because of annual variation, annual weight at age tables may be necessary.

Even simple assessments of the state of each stock require disaggregated data for the correct interpretation of the changes that are found. Appropriate breakdown may be by quarter of the year and defined sub-areas, but in the absence of a real understanding of the problem involved, it may be more appropriate to provide data by months and statistical rectangles. Data in this form would also facilitate comparison with the results of research vessel surveys. In fast-growing species, monthly weight at age data may also be necssary.

If more sophisticated management strategies are to be used, for example temporary or permanent closures of certain areas, disaggregated data are even more necessary. Large catches of young fish of protected species in a particular time-area stratum may suggest the desirability of a closure in that area. Only if more comprehensive data in a disaggregated form are available, however, can the true costs and benefits of such strategies be estimated. To provide the sort of detailed advice that may be needed in the management of industrial and other competing fisheries, data are required sub-divided by fleet. This will involve the provision of data, not only on by-catches in the industrial fisheries but also on discards in the human consumption fisheries.

7.2 The Present Situation

At present, annual landings, weight and catches at age are available to the Working Group, both for the target species and the major by-catch species, although the non-availability of Danish data for the second half of 1981 ruled out any assessment of up-to-date stock levels. In most cases, data are also available by month or quarter and by sampling sub-areas.

The availability of effort data is much less satisfactory, and for this reason, estimation of abundance based on cpue (both to estimate mortality rates and recruitment) is not possible. No data are available on a fleet basis for a major part of the fishery.

7.3 Recommendations

If the Working Group is to fulfill its terms of reference, data of the type described above are required in a disaggregated form. To summarize, these are:

1) Catch and effort data by statistical rectangle and month, sub-divided by different fleet components.

2) Catch in number at age by Sub-area and month.

3) Original survey data, not only published mean values etc.

4) Weight at age data by month and Sub-area.

5) A computer data base of IYFS data should be created at ICES headquarters.

Since many of the data required already exist, priority should be given to making them available, perhaps by the provision of a computerized data base. Only when what already exists is available, will it be possible to assess the need for new types of data.

Furthermore, our poor knowledge of the value of natural mortality on these fish stocks makes it difficult to interpret data from the three target species. Investigations into what the natural mortality is, how it comes about, and whether it varies with time would be very beneficial.

Detailed investigation of the catch per effort data for these fisheries may also be very valuable.

Investigation of the changed areal distribution of sprat in the last two years would seem very worthwhile.

Investigations of stock structure in sprat would be very useful.

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APPENDIX A

FORMULA FOR COEFFICIENT OF VARIATION OF CATCH PREDICTIONS

by

J G Pope

Estimate of coefficient of variation of predicted catches of industrial fish (Pope - in press) gives a formulae for the coefficient of variation of a predicted catch (designed to maintain a constant fishing mortality) for stocks like North Sea cod where predictions are made two years ahead using typical VPA/prediction methods (e.g. setting a TAC for 1983 on 1981 data). For the industrial fisheries, such a prediction would clearly be absurd since as Tables 4.6.1, 5.6.1 and 6.6.1 indicate, most of the landings come from ages where year class strength would have to be guessed since no information would be available. The possibility of predicting the next year's catches, however, seem superficially more possible. For example, this Working Group providing predictions for 1982 based on 1981 and past years catch at age and effort data (were these available) interpreted by VPA and recruitment indices for the 1981 and 1980 year classes from the IYFS (for Norway pout and perhaps sprat, but not for sandeel). Pope's (ibid) formulae may be adapted and simplified for this circumstance as follows where Y(.) indicates the 1982 landing and Y(j) the landing of the jth age class.

$$
\begin{aligned}
CV\,(Y\,(.))^2 = \; & (\theta\,(c) + \bar{\Phi}\,(c))\; CV\,(c)^2 \\
+ \; & (\theta\,(f) + \bar{\Phi}\,(f))\; CV\,(f)^2 \\
+ \; & (\theta\,(R) + \bar{\Phi}\,(R))\; CV\,(R)^2 \\
+ \; & (\theta\,(w) + \bar{\Phi}\,(w))\; CV\,(w)^2
\end{aligned}
$$

where CV ( ) indicates coefficient of variation about the true annual value.

C = catch at age data (assumed for simplicity to have the same CV for all j)

f = fishing effort data

R = recruitment indices (assumed for simplicity to have the same CV for all ages for which they are used)

N = weight at age (assumed for simplicity to have the same CV for all j)

θ (c) and $\bar{\Phi}$ (c) etc. represent components due respectively to the most recent years' data and past years' data used to calibrate effort and recruitment values. Approximate formulaes for these in the one-year situation are:

$$\theta\ (c) = \sum_{j=2}^{g} (j)^2 \ /\ Y(\cdot)^2$$

$$\theta\ (f) = \left[\ Y\ (o)^2 + Y\ (1)^2 - 0.8 \sum_{j=2}^{g} Y\ (j)\right]^2 \ /\ Y\ (\cdot)^2$$

$$\theta\ (R) = \left[Y\ (o)^2 + Y\ (1)^2\right] \ /\ Y(\cdot)^2$$

$$\theta\ (w) = \sum_{j=0}^{g} Y(j)^2 \ /\ Y\ (\cdot)^2$$

$$\phi\ (c) \simeq \sum_{j=0}^{g} Y\ (j)^2 \ /\ \left[Y\ (\cdot)^2 \times (y - 1)\right]$$

$$\phi\ (f) = \left[Y\ (o)^2 + Y\ (1)^2 + 2.5 \times \sum_{j=2}^{g} Y(j)^2\right] \ /\ \left[Y\ (\cdot)^2 \times (y-1)\right]$$

$$\phi\ (R) = \left[Y\ (o)^2 + Y\ (1)^2\right] \ /\ \left[(Y\ (\cdot)^2 \times (y-1)\right]$$

$$\phi\ \ (R) = \left[Y\ (o)^2 + Y\ (1)^2\right] \ /\ \left[Y\ (\cdot)^2 \times (y-1)\right]$$

$$\phi\ (w) = 0$$

where g is the oldest age and y the number of years for which reliable catch at age data are available.

Using this on Norway pout would give the following results:

$$CV\ (L(79))^2 = .15\ CV(c) + .44\ CV(f) + .62\ CV(R) + .57\ CV(w)$$

while in 1980

$$CV\ (L(80)) = .19\ CV(c) + .37\ CV(f) + .59\ CV(R) + .57\ CV(w)$$

since the coefficient of catch at age data is possibly no better than 10%, say 15%.

CV(f) is difficult to estimate due to having no effort data, but were these available might be expected typically to reduce the variability of fishing mortality estimates to about half their usual variation. A value of 25% therefore seems a sensible ranging shot. CV(R) would be the raw variation of recruitment for 0-group fish, while preliminary regression of VPA recruitment on the IYFS index of 1-year old Norway pout explains 25% of the raw variation in recruitment. Raw recruitment seems to have a CV of about 50% for this stock, so a composite figure of about 40% seems indicated.

The coefficient of variation of weight at age data is difficult to estimate, but clearly the value for 1-year old fish would dominate. Variations in weight between years and quarters suggest a figure of about 20%. These values of coefficient of variation in the input data streams indicate that

$$CV\ (L(79)) \simeq 39\%$$

$$CV\ (L(80) \simeq 38\%$$

-o-o-o-

APPENDIX B

If the sprat resources in the North Sea are to be managed as a single stock, at least two competing fisheries should be identified: the Division IVb east summer and autumn fishery, mainly directed towards age I, as shown by catch at age data, and the western fishery. In order to understand the interactions of these two fisheries, it would be important to know how yield per recruit would react to changes of the respective fishing efforts. Starting from VPA results, leading to a fishing mortality vector, F_i at age i, this can be based upon a splitting of F_i into two components, $F_{e,i}$ and $F_{w,i}$. $F_{e,i}$ being the component related to the eastern fishery, $F_{w,i}$ the western component. The relative importance of a component is just given by its contribution to catch at age i:

(1) $$F_{e,i} = \frac{C_{e,i}}{C_i}$$ and (2) $$F_{w,i} = \frac{C_{w,i}}{C_i}$$

if C_i is the total catch at age i, $C_{e,i}$ and $C_{w,i}$ being associated to the eastern and western catches.

If a reference situation is considered, associated to a particular fishing mortality vectors $F_{e,i}^{*}$ and $F_{w,i}^{*}$, any exploitation pattern can be defined by two multipliers, m_{fe} and m_{fw}, associated to the eastern and western fisheries. So, if the fishing rate is to be multipled by m_{fe} and m_{fw}, respectively, the new fishing mortality vector will be defined by

$$F_i = m_{fe} \; F_{e,i}^{*} + m_{fw} \; F_{w,i}^{*}$$

If the number of recruits surviving at the beginning of age i is N_i, the catch in months will be:

$$C_{e,i} = C_i \frac{m_{fe} \; F_{e,i}^{*}}{F_i}$$

and

$$C_{w,i} = C_i \frac{m_{fe} \; F_{w,i}^{*}}{F_i}$$

C_1 being given the usual catch equation. Catches in weight, for either total or each fishery can be easily derived from these catch in numbers. Mean weight at age are given in App.B/ Table 1, p.33). These are means of values given in previous reports, smoothed, and thus differ from those quoted in Section 6.5.

In the case of sprat, two problems appear at once: how should a reference situation be defined; how can the fishing mortality vector be split? This second problem should not have been a real one, if catch at age per Sub-area could have been available. Unfortunately, if the VPA could have been conducted on a quarterly basis, catch at age by sub-areas were only available on a yearly basis. The splitting has so been performed only according to respective yearly catches at age. It appeared, however, reasonable to consider that fishing mortality in the eastern area should be limited to the third and fourth quarters, and not significantly going beyond age 1. An average value on year classes 1975 to 1978 has consequently been used, year class 1976 not being taken into account, because of abnormally low fishing mortality values (perhaps related to a poor sprat year class, and a more attractive than usual sandeel fishery). This defines a reference fishing mortality pattern for the eastern fishery, starting on the third quarter on 0-group, and defined on a quarterly basis (App.B,Table 1, p. 33).

Defining a reference mortality vector for the western fishery is slightly more complicated. With the eastern component being eliminated, an average value from the results of the VPA can be used. This has been carried out on year classes 1975 to 1978 for ages 0 and 1. Because of convergence problems, only year classes 1975, 1976 and 1977 have been used for age 2, 1975 and 1976 for age 3, and 1975 for age 4. Some roundings have been performed, in order to simplify the calculations. Such roundings are not likely to have affected significantly the results. More important is the partial averaging procedure and that could be discussed, and the non-availability of the geographically disaggregated catches at age per quarter. These reasons make it necessary to consider the calculations as a first exercise, and these should be refined later on. Other natural mortality values than .8 (on an annual basis) should at least be tried.

The results for overall yield per recruit (in grammes) appear on Appendix B, Figure 1 (p. 34), the multiplier for the eastern fishery appearing on the x-axis, the western multiplier defining the y-axis. Both multipliers go from .0 to 1.5. Apart from the overall yield per recruit, the partial yields per recruit going to the eastern and western fisheries have also been calculated. They appear in Appendix B, Figure 1.

Finally, it appeared useful to complete this yield per recruit study with a spawning biomass per recruit assessment. It has been considered that spawning takes place in spring, first maturity appearing at age 2. At this level, spawning biomass is assumed to be proportional to the average individual weight. Although such numbers are always difficult to interpret, it must be pointed out that within what has been defined as the reference situation, the spawning biomass per recruit is reduced to 15% of what it would be without any fishing.

APPENDIX B, Table 1 Input data for analysis of North Sea SPRAT
Eastern and Western fisheries

Age Group (Year)	Quarter	Reference Fishing Mortality F_{east}	F_{west}	Mean Weight at Age
0	3	0	0.01	1.00
	4	0.005	0.05	1.81
1	1	0	0.05	2.34
	2	0	0.01	2.32
	3	.36	0.08	7.64
	4	.24	0.06	8.85
2	1	0	0.40	8.54
	2	0	0.04	9.70
	3	0	0.11	12.48
	4	0	0.53	17.18
3	1	0	0.53	15.93
	2	0	0.02	15.13
	3	0	0.01	21.55
	4	0	1.00	21.57
4	1	0	0.80	20.59
	2	0	0	22.75
	3	0	0	22.75
	4	0	1.00	26.64

Annual natural mortality M = 0.80
First spawning starting at age 2

APPENDIX B, Figure 1. North Sea SPRAT.
Yield per recruit considerations. For explanation, see text in Appendix B.

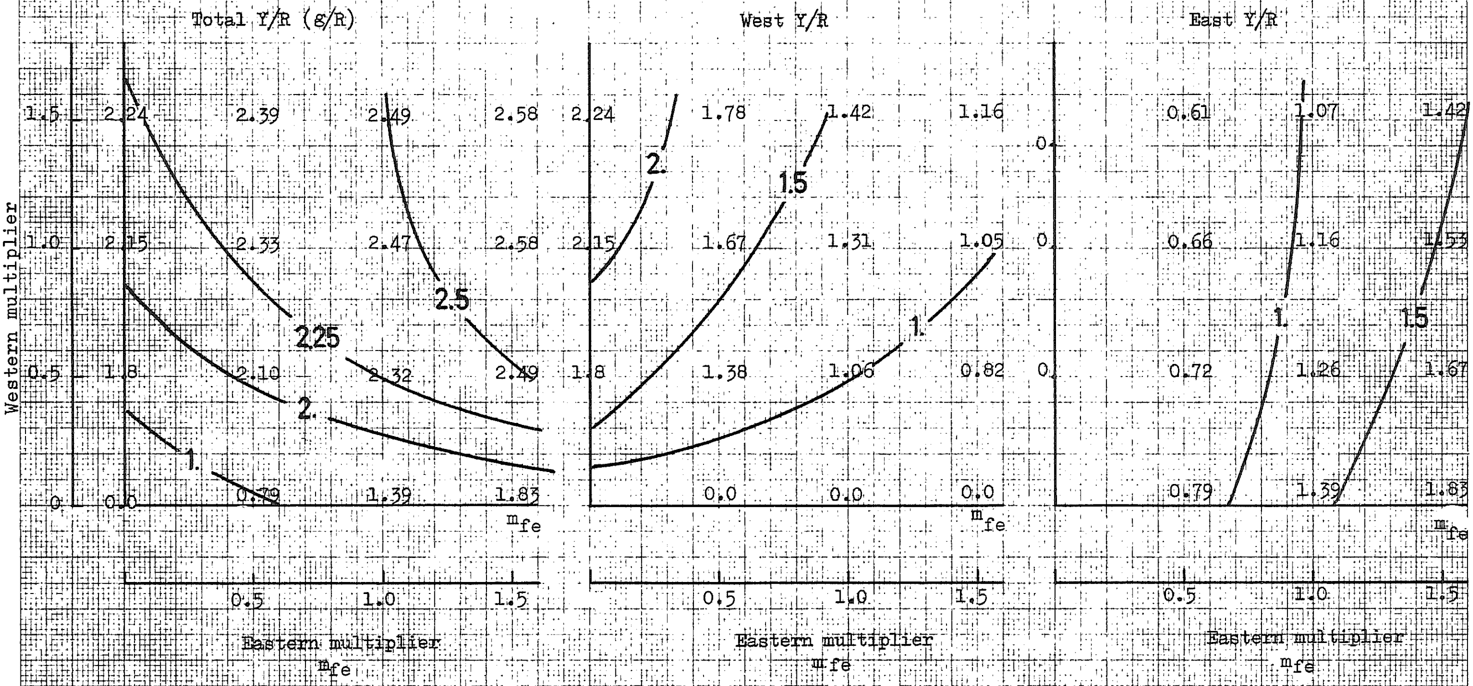


Table 2.4.1 1979-1980 Norway POUT catches in thousand tonnes (Denmark, Norway and Scotland) by Danish statistical areas (For areas given in Figure 2.13).

1 9 7 9

Month	AREAS						
	1	2	3	4	5A	5B	6
1		0.4	0.1	58.1	13.9	+	
2				19.3	11.2	+	
3	0.2	+	0.1	8.9	9.2	0.1	
4		1.7	2.6	4.5	7.4	-	
5	0.1	0.2	0.2	4.8	5.5		
6		0.1	+	-	9.7		
7	0.4	7.5	0.8	5.7	10.1		
8	0.4	10.4	5.1	17.8	10.2	0.9	
9	1.2	47.8	6.4	0.3	4.0		
10		10.9	12.2	10.2	7.1		
11		0.6	12.1	5.4			
12	0.2	-	-	5.0	1.9		
Area total	2.5	79.6	39.6	140.0	90.2	1.0	

1 9 8 0

Month	AREAS						
	1	2	3	4	5A	5B	6
1		0.2		7.6	12.2		
2		0.4	0.1	9.5	12.4		
3	0.1	0.3		5.2	7.9		
4				2.5	6.8		
5				4.3	10.7	1.5	
6			0.4	2.7	8.1	+	
7	0.6	3.3	0.8	17.5	31.6	10.2	
8		23.5	33.4	0.4	17.2	2.3	
9	0.8	43.6	26.1	2.2	10.9	1.0	
10	12.4	20.9	18.2	6.9	3.3		
11	4.9	14.5	4.0	2.8	8.7		
12	2.2	5.7	0.4	7.0	6.1		
Area total	21.0	112.4	83.4	68.6	135.9	15.0	

Table 2.4.2 1979-1980 SANDEEL catches in thousand tonnes (Denmark, Norway, United Kingdom) by Danish statistical areas. (For areas given in Figure 2.14.)

1 9 7 9

Month	AREAS										
	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetl.
1											
2											
3						1.0					
4	11.5	+	3.6	2.1	1.1	1.5	0.5	4.1			0.9
5	47.6		4.1	23.1	2.0	0.6	6.0	38.6	0.9	8.8	3.0
6	105.9	7.1		3.9	5.9		6.8	24.3	1.2	21.6	3.9
7	15.7	+	2.1	1.3	17.6	2.0	6.4	12.5	2.9	12.3	2.4
8		7.2	14.9		+	61.5	7.0				2.5
9		0.5	8.9	1.5	+	1.3	0.5			0.8	0.6
10		5.6	14.4		+	2.3	5.6			0.8	+
11		+					+				
12											
Area total	180.7	20.4	48.0	31.9	26.6	70.2	32.8	79.5	5.0	44.3	13.3

1 9 8 0

Month	AREAS										
	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetl.
1											
2											
3	0.6		6.0	1.9	0.6	9.4					
4	6.8	1.0	6.4	5.0	4.2	13.2		2.0			5.0
5	108.6	16.1	28.5	27.9	21.0	0.8	20.5	10.7	1.0	8.4	7.4
6	81.3	1.4	44.8	48.7	21.6	0.2	35.7	11.4	6.1	26.3	10.0
7	17.2	0.1	9.1	6.0	1.9	0.1	18.1	6.8	1.5	18.2	10.4
8							10.3				7.1
9							5.2			2.6	6.0
10						3.2	0.2			1.5	0.7
11											
12											
Area total	214.5	18.6	94.8	89.5	49.3	26.9	90.0	30.9	8.6	57.0	46.6

Table 2.4.3 SPRAT catches in thousand tonnes (Denmark, Norway and United Kingdom) in Sub-divisions.

1 9 7 9

Month	AREAS 1	2	3	4	5
1	0.6		37.7	19.8	2.9
2	1.1		10.3	2.3	1.1
3	+		10.9	8.4	
4		+		2.7	
5			0.1	+	
6				1.1	
7			+	19.4	+
8				105.4	
9			5.0	19.6	
10	0.9		6.7	26.6	
11	4.0		27.2	15.2	
12	0.2		13.1	25.6	2.0

1 9 8 0

Month	AREAS 1	2	3	4	5
1	3.0		28.1	52.4	17.5
2	0.7		27.7	1.9	3.5
3			2.8	4.6	1.1
4	1.2		0.6	+	
5			0.2	+	+
6			0.7	1.3	
7			0.3	29.7	
8			0.5	34.9	
9			0.1	15.1	
10			10.6	36.6	0.1
11			15.1	24.7	
12			12.1	2.8	4.3

Table 2.4.4 Total industrial species. Catches by months for 1979 and 1980 (Danish, Norwegian and United Kingdom) thousand tonnes.

1979					1980				
Month	Pout	Sand eel	Sprat	Total	Month	Pout	Sand eel	Sprat	Total
1	72.5		61.0	133.5	1	20.0		81.0	101.0
2	30.5		14.7	45.2	2	22.4		33.8	56.2
3	18.5	1.0	19.3	38.8	3	13.5	18.5	8.5	40.5
4	16.2	25.3	2.7	44.2	4	9.3	43.6	0.8	53.7
5	10.8	134.7	0.1	145.6	5	16.5	250.9	0.2	267.6
6	9.8	180.6	1.1	191.5	6	11.2	287.5	2.0	300.7
7	24.5	75.2	19.4	119.1	7	64.0	89.4	30.0	183.4
8	44.8	93.1	105.4	243.3	8	76.8	17.4	35.4	129.6
9	59.7	14.1	24.6	98.4	9	84.6	13.8	15.2	113.6
10	40.4	28.7	34.2	103.3	10	61.7	5.6	47.3	114.6
11	18.1		46.4	64.5	11	34.9		39.8	74.7
12	7.1		40.9	48.0	12	21.4		19.2	40.6
Total	352.9	552.7	369.8	1275.4	Total	436.3	726.7	313.2	1476.7

Table 3.2.1 HERRING by-catch in numbers per age (millions) in Division IVb.

Year	Age in winterrings									
	0	1	2	3	4	5	6	7	8	>8
1976	237	50	18	1	2	-	-	-	-	-
1977	254	136	3	-	-	-	-	-	-	-
1978	138	168	1	-	-	-	-	-	-	-
1979	542	156	8	-	-	-	-	-	-	-
1980	625	137	6	1	1	-	-	-	-	-

Table 3.3.1 HERRING by-catch in 1981 (in tonnes).

Country	IVa W	IVa E	IVb	IVc+VIId	Total
Denmark*	431	-	3 090	78	3 599
Norway	-	-	-	-	-
UK (Scotland)	533	-	33	-	566
UK(England)	-	-	-	-	-

* first half of 1981 only.

Table 3.3.2 HERRING by-catch in 1981 in numbers ($x\ 10^6$) at age

Division	Country	Age in winterrings				
		0	1	2	3	>3
IVa W	Denmark*	-	-	-	-	1.5
	UK(Scotland)	1.3	20.4	5.0	0.2	-
IVb	Denmark*	5.4	98.8	11.9	0.6	-
	UK(Scotland)	0.9	2.2	-	-	-
IVc	Denmark*	-	2.0	0.5	-	-

* first half of 1981 only.

Table 3.5.1 Total reported by-catch of HADDOCK, WHITING SAITHE AND BLUE WHITING, 1975-80.

Species	1975	1976	1977	1978	1979	1980
Haddock	41 380	48 204	34 993	9 659	17 414	25 154
Whiting	86 376	149 759	106 104	55 274	59 021	45 747
Saithe	37 678	66 766	6 197	2 566	1 635	363
Blue Whiting	39 408	28 251	37 945	97 145	62 623	81 815

Table 3.5.2. North Sea. Total industrial landings in tonnes (sandeel excluded) and estimated by-catches of haddock and whiting by quarters for 1975 to the first half of 1981. Sprat is also excluded from Norwegian and United Kingdom totals.

Year	Area	Quarter I			Quarter II			Quarter III			Quarter IV		
		Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting
1975	1	34 006	3 638	6 375	9 344	1 550	1 639	31 140	1 856	444	45 711	980	8 721
	2	27 665	3 894	5 773	16 305	2 186	2 738	101 738	2 452	3 001	91 438	1 902	13 164
	3	8 092	760	1 444	3 978	620	962	17 688	2 368	107	10 383	189	2 197
	4	16 304	1 143	2 003	13 188	1 202	1 945	17 914	170	438	26 212	571	3 699
	5A	44 243	4 083	7 389	122 173	2 954	2 367	78 465	2 951	341	44 708	1 496	465
	5B	4 676	18	28	5 819	160	1 346	57 086	402	1 471	10 663	1 092	1 093
	6	143 043	182	1 984	23 458	183	2 878	139 555	887	6 417	69 797	525	3 199
1976	1	43 515	8 372	25 227	8 024	455	1 847	42 609	964	2 477	52 154	1 952	5 361
	2	32 441	5 660	16 993	8 457	408	1 035	67 985	1 679	3 122	70 754	2 550	8 403
	3	9 403	1 667	4 762	2 159	72	382	13 863	310	407	12 457	568	1 923
	4	25 755	3 105	8 151	38 160	1 534	4 290	21 202	548	878	15 986	518	962
	5A	34 330	1 030	3 800	65 004	585	1 036	78 652	1 669	1 266	20 266	181	1 029
	5B	5 159	1 117	2 179	6 417	187	852	63 578	5 563	2 023	23 756	449	2 224
	6	98 456	2 409	16 603	39 381	828	14 534	107 760	1 655	9 796	91 214	217	3 281

/Continued ....

Table 3.5.2 (Continued)

Year	Area	Quarter I			Quarter II			Quarter III			Quarter IV		
		Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting
1977	1	26 196	2 617	3 603	10 870	948	833	36 721	1 505	2 627	1 640	1	120
	2	22 205	1 642	2 378	671	1	0	39 931	714	827	71 537	1 001	3 942
	3	14 500	1 392	1 779	148	3	11	4 597	64	95	2 224	67	128
	4	25 616	1 972	2 557	5 181	135	398	12 542	318	183	35 584	722	2 768
	5A	36 655	1 049	3 016	35 307	161	573	44 983	222	1 004	27 166	205	246
	5B	4 507	277	519	4 064	96	811	16 244	170	2 326	12 458	25	2 288
	6	63 370	196	3 255	20 179	131	4 084	58 961	140	6 508	54 978	88	3 732
1978	1	0	0	0	188	1	2	0	0	0	213	9	19
	2	16 616	1 103	930	9 112	471	265	36 414	1 105	286	2 366	56	1
	3	4 045	152	249	631	26	0	7 561	486	30	72	0	2
	4	30 437	653	1 552	6 814	165	313	25 473	1 593	262	38 683	1 539	1 861
	5A	36 115	719	1 880	41 417	330	676	67 768	457	92	46 625	597	379
	5B	339	13	20	4 012	63	1 268	17 937	73	3 662	7 695	46	626
	6	43 358	101	6 351	37 437	441	8 099	87 530	6	11 213	74 625	196	8 900

/Continued ....

Table 3.5.2. (Continued)

Year	Area	Quarter I			Quarter II			Quarter III			Quarter IV		
		Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting
1979	1	236	3	11	261	5	3	1 270	38	14	218	14	3
	2	51	1	2	2 661	258	213	69 942	2 695	869	12 528	453	375
	3	222	16	20	3 687	416	308	14 066	790	733	14 615	918	1 079
	4	36 735	680	968	13 874	781	834	27 051	438	408	31 478	3 054	549
	5A	59 394	972	2 071	47 158	762	911	35 722	1 417	795	14 580	357	187
	5B	140	12	10	877	18	266	47 071	288	1 480	14 531	37	3 835
	6	71 187	119	30 259	16 037	391	4 634	115 492	94	987	71 780	0	1 649
1980	1	228	4	67	0	0	0	1 414	53	10	21 715	500	1 489
	2	539	9	160	0	0	0	71 591	2 456	769	48 332	1 693	4 490
	3	0	0	0	416	18	0	63 226	1 724	997	25 567	848	1 421
	4	33 192	2 134	4 086	16 592	1 768	5 839	25 492	905	47	20 458	868	569
	5A	46 461	2 057	1 290	56 600	2 133	3 263	72 179	1 208	87	25 527	1 398	1 085
	5B	0	0	0	9 205	548	938	45 521	691	2 709	12 527	16	378
	6	72 277	55	4 925	4 133	320	758	75 355	729	5 550	77 814	0	496

/Continued ....

Table 3.5.2. (Continued).

	Area	Quarter I			Quarter II			Quarter III			Quarter IV		
		Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting
1981	1	4 071	412	414	619	86	192						
	2	1 205	185	289	56	0	0						
	3	0	0	0	0	0	0						
	4	32 706	1 489	3 128	15 429	494	549						
	5A	24 315	604	864	38 611	492	518						
	5B	0	0	0	1 979	0	469						
	6	74 566	590	25 872	19 644	289	7 494						

1												
2												
3												
4												
5A												
5B												
6												

Table 3.6.1 North Sea. Species composition in Norwegian Norway POUT landings (tonnes)*
for reduction purposes, 1975-1981.

Year	Quarter	Landings	Norway pout	Blue whiting	Cod	Haddock	Whiting	Saithe	Herring	Mackerel	Others
1975	1-4	297 222	218 900	40 210	1 188	9 840	13 243	4 330			9 511
1976	1-4	200 777	108 937	34 600	783	3 133	6 744	12 850			33 730
1977	1-4	143 001	98 291	20 737	661	920	2 707	4 390			15 300
1978	1-4	136 455	80 755	39 989	659	766	1 462	2 494			10 351
	1	24 504	17 087	4 971	153	298	1 032	179	2	3	995
	2	40 310	18 963	17 504	202	406	315	289		2	2 808
1979	3	33 602	23 856	6 584	98	625	132	309	1		2 178
	4	19 387	15 158	1 871	26	1 254	189	99		4	1 221
	1-4	117 803	75 046	30 930	479	2 583	1 659	876	3	9	7 202
	1	14 469	10 355	810	195	947	759	107			1 296
	2	36 896	18 281	13 623	207	1 414	312	130			2 929
1980	3	42 900	32 449	6 400	136	655	42	87			3 131
	4	13 794	8 375	1 129	12	902	86	18			3 272
	1-4	108 059	69 460	21 962	550	3 918	1 199	342			10 628
	1	8 572	6 995	363	58	102	359	75		1	619
	2	36 909	19 091	10 743	132	403	235	116		32	6 157
1981	3	30 380	19 712	6 188	65	846	69	1 033		12	1 806
	4	9 274	7 182	751	26	457	150	50		4	654
	1-4	85 135	52 980	18 045	281	1 808	813	1 274		49	9 236

* Prior to 1975 the sampling is not regarded as adequate for a reliable break down of the landings into separate species.

Table 3.6.2 North Sea, species composition in Norwegian SANDEEL landings 1979-81 (tonnes).

Year	Landings	Sandeel	Cod	Haddock	Whiting	Saithe	Herring	Mackerel	Others
1979	103 273	101 420	231	520	208	250	-	-	442
1980	147 748	144 752	54	1 118	382	-	-	-	1 442
1981	53 370	52 641	29	504	68	6	4	6	112

Table 3.7.1 By-catch landed for human consumption by Faroese Industrial Trawlers from ICES Div.IVa Target species Norway POUT SANDEEL 1975-1981, tonnes.

	1975	1976	1977	1978	1979	1980	1981*
Total landings Ind. Trawlers	67 832	68 960	57 630	20 548	26 025	43 212	26 985
Landed for human consumption							
Cod	652	448	257	50	111	150	94
Haddock	82	85	45	12	7	27	29
Whiting	-	-	-	-	7	21	21
Ling	7	208	306	88	68	44	71
Monkfish	28	96	87	24	-	12	49
Saithe	287	425	318	213	407	1 020	417
Others	269	132	159	8	201	247	56
Σ	1 325	1 394	1 172	395	801	1 521	737

* Preliminary

Table 4.1.1. NORWAY POUT. Annual landings (in thousand tonnes) by countries. North Sea 1957-81.

Year	Denmark	Faroes	Norway	Sweden	UK (Scotland)	Others	Total
1957			0.2				0.2
1958							
1959	61.5		7.8				69.3
1960	17.2		13.5				30.7
1961	20.5		8.1				28.6
1962	121.8		27.9				149.7
1963	67.4		70.4				137.8
1964	10.4		51.0				61.4
1965	8.2		35.0				43.2
1966	35.2		17.8			+	53.0
1967	169.6		12.9			+	182.6
1968	410.8		40.9			+	451.8
1969	52.5	19.6	41.4			+	113.5
1970	142.1	32.0	63.5		0.2	0.2	238.0
1971	178.5	47.2	79.3		0.1	0.2	305.3
1972	259.6	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	51.2	63.0	2.9	13.0	0.6	345.9
1974	464.5	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	63.6	218.9	2.3	22.7	1.0	559.7
1976	244.9	64.6	108.9	+	17.3	1.7	435.4
1977	232.2	50.9	98.3	2.9	4.6	1.0	389.9
1978	163.4	19.7	80.8	0.7	5.5	-	270.1
1979	219.9	21.9	75.0		3.0		319.8
1980	366.2	34.1	69.5		0.6		470.4
1981 1)	51.3 2)	19.1	53.0		+		127.3 3)

1) Preliminary.
2) Jan-June only.
3) Incomplete.

Table 4.1.2. NORWAY POUT. North Sea. National landings (tonnes) by months 1979-81 (Denmark, Norway, United Kingdom (Scotland)).

Month	Denmark	Norway	Faroes	UK (Scotland)	Total
1979					
Jan	13 790	7 645	4 040	1 141	26 616
Feb	19 363	5 957	2 310	981	28 611
Mar	14 924	3 485	1 550	-	19 959
Apr	12 527	3 584	1 257	-	17 368
May	4 927	5 913	973	-	11 813
Jun	257	9 466	1 235	-	10 958
Jul	14 039	10 425	1 523	-	25 987
Aug	35 152	9 485	1 983	166	46 786
Sep	55 438	3 946	3 927	332	63 643
Oct	32 646	7 703	1 834	188	42 371
Nov	12 351	5 658	1 243	134	19 386
Dec	4 470	1 797	53	74	6 394
Total	219 884	75 064	21 928	3 016	319 892
1980					
Jan	14 792	4 962	2 299	193	22 246
Feb	18 620	3 459	3 534	315	25 928
Mar	11 653	1 934	2 010	-	15 597
Apr	7 233	2 103	158	8	9 502
May	7 853	8 004	2 249	-	18 106
Jun	3 114	8 174	2 104	-	13 392
Jul	55 385	8 673	3 001	-	67 059
Aug	66 255	10 492	2 325	-	79 072
Sep	71 144	13 284	7 846	87	92 361
Oct	60 474	1 340	3 976	-	65 790
Nov	28 749	6 248	3 279	-	38 276
Dec	20 938	787	1 282	-	23 077
Total	366 210	6 946	34 063	603	470 336
1981					
Jan	11 782	2 821	1 066	-	15 669
Feb	20 632	2 891	2 177	-	25 700
Mar	10 923	1 283	2 144	-	14 350
Apr	6 103	3 838	2 920	-	12 861
May	1 414	8 145	3 115	-	12 674
Jun	451	7 108	2 347	-	9 906
Jul		5 503	3 831	-	
Aug		10 180	985	-	
Sep	n/a	4 029	-	-	n/a
Oct		2 501	1 303	-	
Nov		1 346	1 545	-	
Dec		3 335	1 102	-	
Total	51 305*	52 980	19 057	0	-

* Jan-Jun only

Table 4.1.3. NORWAY POUT. North Sea. Landings (tonnes) by quarters and areas in 1979-81[1]).

Year	Quarter	Sub-division							Total
		1	2	3	4	5A	5B	6	
1979	I	209	45	166	31 701	35 064	101	0	67 286
	II	2 051		2 812	9 292	22 515	4	0	36 674
	III	1 208	65 707	12 251	24 603	24 317	897	0	128 983
	IV	193	11 535	12 243	26 648	14 402	0	0	65 021
	Total	80 948		27 472	92 244	96 298	1 002	0	297 964
1980	I	137	324	0	23 039	32 428	0	0	55 928
	II	0	0	385	8 923	25 648	1 533	0	36 489
	III	68 661		59 945	23 532	59 658	13 524	0	225 320
	IV	19 549	40 405	22 481	18 045	18 056	0	0	118 536
	Total	129 076		82 811	73 539	135 790	15 057	0	436 273
1981	I								
	II								

1) Faroe data excluded

Table 4.1.4. NORWAY POUT. Annual landings (tonnes) in Division VIa (source: ICES Statistician).

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Belgium	1	-	-	-	-	-	-	-	-	-	-
Denmark	363	186	42	-	193	-	-	4 443	15 609	13 070	2 862
Faroes	-	-	1 743	1 581	1 524	6 203	2 177	18 484	4 772	3 530	1)
Germany, Fed.Rep.	-	-	-	179	-	8	-	-	-	-	526
Netherlands	-	-	-	-	322	147	230	21	98	68	
Norway	-	-	-	144[3)]	-	82[3)]	-	-	-	-	-
Poland	-	-	-	75	-	-	-	-	-	-	-
UK (Scotland)[2)]	1 622	3 760	9 282	4 702	6 614	6 346	2 799	302	23	1 202	1 157
USSR	-	-	-	40	2	7 147	-	-	-	-	-
Total	1 986	3 946	11 067	6 721	8 655	19 933	5 206	23 250	20 502	17 870	4 545

1) Included in the North Sea. 2) Amended using national data. 3) Including by-catch.

Table 4.1.5. NORWAY POUT. Annual landings (tonnes) in Division IIIa (source: ICES Statistician).

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Denmark	25 800	17 259	23 152	10 669	15 666	40 144	20 694	23 922	23 951	26 235	28 632
Faroes			643								
Norway	296			62[*)]	925[*)]	50[*)]	104	362	1 182	141	45[*)]
Sweden		1)	1)	1)	3 272	2 255	318	591[2)]	32	39	58
Total	26 096	17 259	23 795	10 731	19 863	42 449	21 116	24 875	25 165	26 415	28 735

*) Including by-catch. 1) Included in the North Sea. 2) Includes North Sea.

Table 4.2.1 Faroese cpue data, industrial trawlers
Norway POUT in ICES Division IVa (kg/hour)

Month	1978	1979	1980	1981
January	1 389	1 830	1 543	2 005
February	932	1 207	1 755	1 104
March	896	1 207	1 478	1 210
April	670	1 061	1 523	1 204
May	1 110	885	1 978	1 308
June	1 052	1 542	2 508	1 015
July	784	1 178	1 576	1 294
August	1 242	1 331	2 387	1 051
September	3 007	2 495	2 807	-
October	2 215	2 139	2 648	1 663
November	1 915	2 003	1 993	1 387
December	2 168	2 455	2 222	1 496
Weight average	1 266	1 557	2 084	1 250
Total effort reported in Log books	11 300	6 660	9 918	11 256
Total catch reported	14 307	10 375	20 673	14 072
Total landings	17 699	21 497	34 064	19 057 *

* Preliminary

Table 4.3.1 Norway POUT. Input data for quarterly VPA. Catch at age (no x 10^{-6}).

Year	Quarter	Age Groups 0	1	2	3	4
1974	1	-	13 450	414	26	1
	2	-	7 873	193	26	1
	3	846	9 966	489	145	-
	4	5 720	7 809	140	4	-
1975	1	-	3 742	1 726	13	-
	2	-	7 206	383	2	-
	3	889	7 117	349	-	-
	4	9 968	2 027	461	1	-
1976	1	-	4 950	589	91	-
	2	-	7 580	645	58	-
	3	197	5 349	590	2	-
	4	5 986	3 157	320	15	-
1977	1	-	9 171	950	33	3
	2	-	3 577	367	8	-
	3	61	3 580	861	45	-
	4	1 655	3 540	236	5	-
1978	1	-	2 931	1 371	93	4
	2	-	1 181	650	194	-
	3	304	2 385	786	30	-
	4	1 225	1 400	322	6	-
1979	1	-	5 079	940	170	3
	2	-	3 270	249	27	1
	3	968	4 243	763	49	-
	4	861	2 147	166	11	-
1980	1	-	5 025	1 072	59	2
	2	-	2 576	686	29	5
	3	24	7 709	1 959	18	-
	4	640	3 913	511	6	-
1981	1	-	2 183	1 658	75	6
	2	-	995	569	74	-

Table 4.3.2 Norway POUT. M = 1.00 Year^{-1} Fishing mortality from quarterly VPA.

		Age Groups				
Year	Quarter	0	1	2	3	4
1974	1	-	0.22	0.26	0.09	0.20
	2	-	0.20	0.20	0.13	-
	3	0.01	0.46	1.19	2.71	-
	4	0.11	0.86	1.79	0.82	-
1975	1	-	0.10	0.50	0.90	0.20
	2	-	0.31	0.20	0.30	-
	3	0.01	0.61	0.31	0.09	-
	4	0.17	0.37	0.91	0.60	-
1976	1	-	0.12	0.18	0.48	0.20
	2	-	0.30	0.33	0.69	-
	3	0.0	0.38	0.61	0.05	-
	4	0.11	0.43	0.86	0.61	-
1977	1	-	0.25	0.23	0.20	0.20
	2	-	0.16	0.14	0.07	-
	3	0.0	0.25	0.60	0.77	-
	4	0.06	0.43	0.34	0.17	-
1978	1	-	0.13	0.31	0.23	0.20
	2	-	0.09	0.26	1.15	-
	3	0.0	0.28	0.60	0.56	-
	4	0.02	0.27	0.56	0.21	-
1979	1	-	0.14	0.32	0.71	0.20
	2	-	0.13	0.14	0.24	-
	3	0.01	0.26	0.83	0.96	-
	4	0.02	0.22	0.43	0.60	-
1980	1	-	0.12	0.17	0.30	0.20
	2	-	0.09	0.16	0.25	-
	3	0.0	0.45	1.01	0.26	-
	4	0.05	0.47	0.89	0.14	-
1981	1	-	0.25	0.39	0.32	0.20
	2	-	0.18	0.24	0.64	-

Table 4.3.3 Norway POUT. M = 1.00 year^{-1}. Stock size in numbers (x10^{-6}) from quarterly VPA.

		Age Groups				
Year	Quarter	0	1	2	3	4
1974	1	-	76 693	2 024	342	3
	2	103 622	47 943	1 214	243	-
	3	80 701	30 438	776	167	-
	4	62 106	15 015	185	9	-
1975	1	-	43 345	4 941	25	3
	2	121 007	30 470	2 344	8	-
	3	94 240	17 428	1 489	4	-
	4	72 612	7 387	855	3	-
1976	1	-	47 807	3 982	268	1
	2	108 815	32 887	2 584	129	-
	3	84 746	18 981	1 449	50	-
	4	65 826	10 112	616	37	-
1977	1	-	46 008	5 121	203	16
	2	52 581	27 801	3 126	129	-
	3	40 950	18 513	2 136	93	-
	4	31 838	11 283	915	34	-
1978	1	-	23 341	5 699	506	22
	2	97 284	15 606	3 239	313	-
	3	75 765	11 117	1 954	77	-
	4	58 738	6 570	838	34	-
1979	1	-	44 667	3 891	372	21
	2	105 529	30 329	2 208	143	-
	3	82 186	20 750	1 501	87	-
	4	63 155	12 446	509	26	-
1980	1	-	48 427	7 811	252	11
	2	24 909	33 304	5 143	145	-
	3	19 399	23 674	3 403	88	-
	4	15 087	11 715	962	53	-
1981	1	-	11 188	5 712	307	36
	2	-	6 801	3 001	174	-

Table 4.3.4 Norway POUT. M = 2.00 $year^{-1}$. Fishing mortality from quarterly VPA.

		Age Groups				
Year	Quarter	0	1	2	3	4
1974	1	-	0.10	0.16	0.06	0.20
	2	-	0.10	0.14	0.10	-
	3	0.0	0.25	0.93	2.34	-
	4	0.04	0.46	1.27	0.68	-
1975	1	-	0.04	0.24	0.53	0.20
	2	-	0.14	0.11	0.18	
	3	0.0	0.27	0.18	0.06	-
	4	0.05	0.16	0.57	0.49	-
1976	1	-	0.04	0.09	0.29	0.20
	2	-	0.12	0.18	0.43	-
	3	0.0	0.16	0.34	0.04	-
	4	0.03	0.18	0.45	0.51	-
1977	1	-	0.09	0.10	0.11	0.20
	2	-	0.06	0.07	0.05	-
	3	0.0	0.11	0.33	0.54	-
	4	0.01	0.21	0.20	0.14	-
1978	1	-	.04	0.16	0.15	0.20
	2	-	.03	0.14	0.82	-
	3	0.0	.10	0.36	0.39	-
	4	0.01	.11	0.35	0.17	-
1979	1	-	.04	.14	0.45	0.20
	2	-	.05	.07	0.17	-
	3	0.0	.11	.43	0.73	-
	4	0.0	.10	.22	0.50	-
1980	1	-	.04	.09	.15	0.20
	2	-	.04	.10	0.14	-
	3	0.0	0.22	0.68	.17	-
	4	.01	.23	.55	0.11	-
1981	1	-	0.09	0.19	0.20	0.20
	2	-	0.07	0.13	0.43	-

Table 4.3.5 Norway POUT. $M = 2.00$ year^{-1} . Stock size in numbers ($x10^{-6}$) from quarterly VPA.

		Age Groups				
Year	Quarter	0	1	2	3	4
1974	1	-	185 763	3 602	594	4
	2	568 158	102 345	1 868	340	-
	3	344 605	56 033	985	187	-
	4	208 362	26 385	235	11	-
1975	1	-	121 975	10 097	40	3
	2	704 815	71 103	4 807	14	-
	3	427 492	37 603	2 622	7	-
	4	258 602	17 384	1 323	4	-
1976	1	-	149 183	8 991	456	2
	2	644 504	86 676	5 001	207	-
	3	390 911	46 757	2 540	82	-
	4	236 948	24 264	1 093	48	-
1977	1	-	139 108	12 301	421	17
	2	407 616	77 330	6 732	230	-
	3	247 232	44 153	3 801	133	-
	4	149 907	24 033	1 651	47	-
1978	1	-	89 648	11 871	821	25
	2	718 163	52 119	6 156	427	-
	3	435 588	30 703	3 233	114	-
	4	263 963	16 792	1 364	47	-
1979	1	-	159 157	9 110	582	24
	2	666 505	92 626	4 805	225	-
	3	404 256	53 665	2 723	116	-
	4	244 448	29 294	1 074	34	-
1980	1	-	14 706	16 119	525	12
	2	152 439	85 659	8 954	273	-
	3	92 459	49 972	4 904	144	-
	4	56 061	24 421	1 506	74	-
1981	1	-	33 510	11 824	528	40
	2	-	18 648	5 904	263	-

Table 4.4.1 Recruitment indices of Norway POUT 1959-81, as shown by number per hour's fishing on research vessel surveys.

Year class	Abundance on pelagic 0-group surveys	Abundance in northwestern North Sea in Scottish autumn surveys				Abundance on international young fish surveys[2]	
	Arithmetic mean	Geometric mean as				Arithmetic mean as	
	0-group	0-group		1-group		1-group	2-group
1959		-		106.8	(22)		
1960		10.9	(22)	28.1	(14)		
1961		59.6	(14)	181.7	(15)		
1962		25.0	(15)	141.8	(15)		
1963		8.5	(15)	6.6	(14)		
1964		14.0	(14)	18.6	(11)		
1965		1.2	(11)	6.1	(13)		
1966		16.4	(13)	-			
1967		-		243.2	(17)		
1968		4.5	(7)	-			6
1969		-		33.1	(4)	35	22
1970		101.7	(4)	111.7	(12)	1 556	653
1971	3 347 (26)	16.7	(12)	328.8	(22)	3 425	438
1972	545 (28)	36.3	(22)	16.6	(10)	4 207	399
1973	2 558 (28)	224.4	(10)	121.6	(22)	25 626	2 412
1974	3 237 (28)	84.4	(22)	9.5	(11)	4 242	385
1975	3 623 (28)	41.2	(11)	-		4 599	334
1976	10 884 (28)	-		131.5	(16)	4 813	1 215
1977	1 521 (28)	77.7	(16)	83.9	(34)	1 913	240
1978	2 974 (27)	144.3	(34)	-		2 690	611
1979	1 868 (27)	-		-		4 081	557
1980	500 (27)	-		18.7	(22)	1 375	
1981	2 843 (27)	191.5	(22)			3 959[1]	

NB. Number of statistical rectangles sampled shown in brackets.

1) Preliminary: based on allocation to age by length composition.

2) From report of International Gadoid Survey Working Group: standard area C.M. 1981/H:10, Standard area of 93 statistical rectangles.

Table 4.4.2 Recruitment indices of Norway POUT as shown by the number per hour's fishing on English research vessel surveys.

Year/class	Groundfish survey August-North Sea 0-group	Norway pout survey November 0-group	1-group	2-group	3-group
1976	-				0.5
1977	61 295			22.2	8.2
1978	57 342		550.1	43.1	-
1979	69 087	644.9	451.9	12.3	
1980	11 576	210.6	214.6		
1981	145 015	2394.6			

Table 4.4.3 Regression of Norway POUT VPA stock numbers on IYFS abundance indices, under two assumptions of natural mortality

Year Class	X I-group IYFS	Y I-group from quarterly VPA 1st Quarter. No. x 10^{-6} M = 1.00 $year^{-1}$	 M = 2.00 $year^{-1}$
1973	25 626	76 693	185 763
1974	4 242	43 345	121 975
1975	4 599	47 807	149 183
1976	4 813	46 008	139 108
1977	1 913	23 341	89 648
1978	2 690	44 667	159 157
1979	4 081	48 829	147 601
1980	1 375	11 188	33 510
1981	3 959		
y = a + bx:	r	.80	0.59
1973-80	a	30 711	106 664
	b	1.94	3.50

Year Class	X 2-group IYFS	Y 2-group from quarterly VPA 1st Quarter. No. x 10^{-6} M = 1.00 $year^{-1}$	 M = 2.00 $year^{-1}$
1973	399	2 024	3 602
1974	2 412	4 941	10 097
1975	385	3 982	8 991
1976	334	5 121	12 301
1977	1 215	5 699	11 871
1978	240	3 891	9 110
1979	611	7 811	16 119
1980	557		
y = a + bx:	r	.22	.12
	a	4 380	98 822
1972-78	b	0.50	0.60

Table 4.4.4 Regression of Norway POUT VPA Stock numbers on abundance indices of pelagic O-group surveys (June)

Year Class	x O-group pelagic O-group Surveys		y O-group from quarterly VPA (3rd quarter) No. x 10^{-9} M = 1.00 $year^{-1}$	 M = 2.00 $year^{-1}$
1974	3 237		81	345
1975	3 623		94	427
1976	10 884		85	391
1977	1 521		41	247
1978	2 974		76	436
1979	1 868		82	404
1980	500		19	92
1981	2 843			
	y=a+bx	r:	.53	.45
		a	53.4	276.7
		b	.0042	.016

Table 4.5.1 Norway POUT. North Sea

Mean Weight at Age by Quarters in Norwegian Catches (in grams)

Quarters \ Age Group	0	1	2	3	4
1979					
I	-	8.12	24.22	44.05	72.88
II	-	11.73	27.38	49.54	
III	4.96	27.47	48.60		
IV	9.48	32.01	55.44		
1980					
I	-	8.27	20.97	51.52	
II	-	11.19	25.36	45.10	
III	5.84	26.58	46.94		
IV	8.27	26.91	44.30		
1981					
I	-	7.82	23.21	50.83	
II	-	15.15	29.21	47.71	
III	2.58	28.36	55.25		
IV	7.18	27.10	43.68		

Table 4.6.1 Norway POUT. North Sea

Quarterly and Annual Landings by Age as a Percentage of the Overall Landing

Year and Quarter	Age 0	1	2	3	4
1979					
I	0	11%	6%	2%	0.1%
II	0	10%	2%	0.3%	0
III	1%	32%	10%	-	0
IV	2%	19%	3%	-	0
1979 Total	3%	72%	21%	3%	0.1%
1980					
I	0	8%	4%	-	-
II	0	5%	3%	-	-
III	-	38%	17%	-	-
IV	1%	19%	4%	-	-
1980 Total	1%	70%	28%	1%	-

- = less than 0.5%

Table 5.1.1 Landings of SANDEEL from the North Sea 1952-81, in thousand tonnes.

Year	Denmark	Germany,Fed.Rep.	Faroes	Netherlands	Norway	Sweden	U.K.	Total
1952	1.6	0	0	0	-	0	0	1.6
1953	4.5	+	0	0	-	0	0	4.5
1954	10.8	+	0	0	-	0	0	10.8
1955	37.6	+	0	0	-	0	0	37.6
1956	81.9	5.3	0	+	1.5	0	0	88.7
1957	73.3	25.5	0	3.7	3.2	0	0	105.7
1958	74.4	20.2	0	1.5	4.8	0	0	100.9
1959	77.1	17.4	0	5.1	8.0	0	0	107.6
1960	100.8	7.7	0	+	12.1	0	0	120.6
1961	73.6	4.5	0	+	5.1	0	0	83.2
1962	97.4	1.4	0	0	10.5	0	0	109.3
1963	134.4	16.4	0	0	11.5	0	0	162.3
1964	104.7	12.9	0	0	10.4	0	0	128.0
1965	123.6	2.1	0	0	4.9	0	0	130.6
1966	138.5	4.4	0	0	0.2	0	0	143.1
1967	187.4	0.3	0	0	1.0	0	0	188.7
1968	193.6	+	0	0	0.1	0	0	193.7
1969	112.8	+	0	0	0	0	0.5	113.3
1970	187.8	+	0	0	+	0	3.6	191.4
1971	371.6	0.1	0	0	2.1	0	8.3	382.1
1972	329.0	+	0	0	18.6	8.8	2.1	358.5
1973	273.0	0	1.4	0	17.2	1.1	4.2	296.9
1974	424.1	0	6.4	0	78.6	0.2	15.5	524.8
1975	355.6	0	4.9	0	54.0	0.1	13.6	428.2
1976	424.7	0	-	0	44.2	-	18.7	487.6
1977	664.3	0	11.4	0	78.7	5.7	25.5	785.6
1978	647.5	0	12.1	0	93.5	1.2	32.5	786.8
1979	449.8	0	13.2	0	101.4	0	13.4	577.8
1980	542.2	0	7.2	0	144.8	0	34.3	728.5
1981	281.2[1)]	0	4.9	0	52.7	0	46.7	(380.6)

+ = less than half unit.
– = no information
1) Jan-Jun only.

Table 5.1.2 SANDEEL. North Sea. Monthly landings (tonnes) by country, 1979-81.

Year and Month		Denmark	Faroes	Norway	U.K. (Scotland)	Total
1979	Mar	682	57	351		1 090
	Apr	19 528	695	4 956	906	26 085
	May	124 062	3 687	7 811	2 985	138 545
	Jun	166 055	6 395	32 447	3 907	208 804
	Jul	60 710	2 352	12 462	2 413	77 937
	Aug	68 630		17 110	2 518	88 258
	Sep	2 908		10 174	649	13 731
	Oct	7 175		16 109	26	23 310
	Nov	5				5
Total		449 755	13 186	101 420	13 404	577 765
1980	Feb		68			68
	Mar	12 558	111	6 048		18 717
	Apr	31 228	735	7 103	2 060	41 126
	May	192 155	1 679	37 092	4 450	235 376
	Jun	214 867	3 566	61 603	10 877	290 913
	Jul	68 403	1 048	10 228	7 555	87 234
	Aug	10 290		2 849	5 311	18 450
	Sep	7 827		3 119	1 346	12 293
	Oct	4 863		16 055		20 918
	Nov			716		716
Total		542 191	7 207	144 813	31 599	725 810
1981	Jan	4				4
	Feb					-
	Mar	8 758	268	3 950		12 976
	Apr	42 875	415	5 978	5 018	54 286
	May	120 410	439	24 095	7 430	152 374
	Jun	109 175	96	9 076	10 032	128 379
	Jul		1 300	5 411	10 403	
	Aug		1 162	2 155	7 107	
	Sep	n/a	1 181		5 968	n/a
	Oct		74	1 625	710	
	Nov			406		
Total			4 935	52 696	46 668	

Table 5.1.3 SANDEEL. North Sea. Catch (tonnes) by month and area (Denmark, Norway, UK (Scotland)).

Year	Month	AREA 1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland
1979	Mar			351			682					
	Apr	11 476	49	3 602	2 067	1 130	1 536	534	4 090			906
	May	47 648	+	4 099	23 149	2 044	642	5 992	38 584	867	8 848	2 985
	Jun	119 632	281	12 556	4 316	5 886	333	7 978	24 277	1 645	21 598	3 907
	Jul	15 700	454	2 149	1 253	17 593	1 997	6 408	12 493	2 859	12 266	2 413
	Aug		143	14 883		86	63 574	7 043			11	2 518
	Sep			8 868	1 490	112	1 306	542			764	649
	Oct		+	14 455		173	2 262	5 630			764	26
	Nov							5				
	Total	194 456	927	60 963	32 275	27 024	72 332	34 132	79 444	5 371	44 251	13 404
1980	Mar	581		6 048	1 938	605	9 433				1	
	Apr	6 797	1 031	6 374	5 043	4 208	13 179		1 956			1 803
	May	108 561	821	30 256	27 870	21 595	808	20 477	10 676	991	8 422	3 219
	Jun	81 909	1 404	44 828	48 682	23 865	247	35 706	11 399	6 146	26 316	6 845
	Jul	17 249	74	9 140	5 978	2 079	102	18 076	6 812	1 516	18 240	6 920
	Aug			2 833		16		10 290				5 311
	Sep			3 100		19		5 213			2 617	1 346
	Oct			15 995			3 218	242			1 463	
	Nov			716								
	Total	215 097	3 330	119 290	89 511	52 387	26 987	90 004	30 843	8 653	57 059	25 444
1981	Mar			3 922			28					
	Apr			5 879			99					5 018
	May	351	19	23 232		493						7 430
	Jun	161	1	7 461		1 123	117	230				10 016
	Jul1)		90	328	884	3 758	227	124				10 403
	Aug1)			2 155								7 107
	Sep1)											5 968
	Oct1)					1 625						710
	Nov1)					406						
	Total											

1) Danish data not included.

<u>Table 5.1.4</u> Annual landings ('000 tonnes) of SANDEELS by Sub-areas of the North Sea shown in Figure 2.14.

<table>
<tr><th rowspan="2">Year</th><th colspan="11">Sub-areas</th></tr>
<tr><th>1a</th><th>1b</th><th>1c</th><th>2a</th><th>2b</th><th>2c</th><th>3</th><th>4</th><th>5</th><th>6</th><th>Shetland</th></tr>
<tr><td>1972</td><td>98.8</td><td>28.1</td><td>3.9</td><td>24.5</td><td>85.1</td><td>0.0</td><td>13.5</td><td>58.3</td><td>6.7</td><td>28.0</td><td>0.0</td></tr>
<tr><td>1973</td><td>59.3</td><td>37.1</td><td>1.2</td><td>16.4</td><td>60.6</td><td>0.0</td><td>8.7</td><td>37.4</td><td>9.6</td><td>59.7</td><td>0.0</td></tr>
<tr><td>1974</td><td>50.4</td><td>178.0</td><td>1.7</td><td>2.2</td><td>177.9</td><td>0.0</td><td>29.0</td><td>27.4</td><td>11.7</td><td>25.4</td><td>7.4</td></tr>
<tr><td>1975</td><td>70.0</td><td>38.2</td><td>17.8</td><td>12.2</td><td>154.7</td><td>4.8</td><td>38.2</td><td>42.8</td><td>12.3</td><td>19.2</td><td>12.9</td></tr>
<tr><td>1976</td><td>154.0</td><td>3.5</td><td>39.7</td><td>71.8</td><td>38.5</td><td>3.1</td><td>50.2</td><td>59.2</td><td>8.9</td><td>36.7</td><td>20.2</td></tr>
<tr><td>1977</td><td>171.9</td><td>34.0</td><td>62.0</td><td>154.1</td><td>179.7</td><td>1.3</td><td>71.4</td><td>28.0</td><td>13.0</td><td>25.3</td><td>21.5</td></tr>
<tr><td>1978</td><td>159.7</td><td colspan="2">50.2</td><td>346.5</td><td colspan="2">70.3</td><td>42.5</td><td>37.4</td><td>6.4</td><td>27.2</td><td>28.1</td></tr>
<tr><td>1979</td><td>194.5</td><td>0.9</td><td>61.0</td><td>32.3</td><td>27.0</td><td>72.3</td><td>34.1</td><td>79.4</td><td>5.4</td><td>44.3</td><td>13.4</td></tr>
<tr><td>1980</td><td>215.1</td><td>3.3</td><td>119.3</td><td>89.5</td><td>52.4</td><td>27.0</td><td>90.0</td><td>30.8</td><td>8.7</td><td>57.1</td><td>25.4</td></tr>
</table>

Table 5.1.5 SANDEEL, Division VIa.
Landings in tonnes.
(Source: ICES Statistician)

Country/Year	1974	1975	1976	1977	1978	1979	1980	1981
Denmark							109	
Norway			17	54				
UK(Scotland) 1)	+	+	+	13	+		211	5 972

1) Amended from national data

Table 5.1.6 SANDEEL, Division IIIa.
Landings in tonnes.
(Source: ICES Statistician)

Country	Year										
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Denmark	21 567	7 919	9 878	7 912	16 421	21 418	16 082	21 731	33 305	39 357	40 423
Faroes								2			
Sweden		1)	1)	1)	79	67	432	1 121 2)	3	9	32

1) Included in the North Sea.

2) Includes North Sea.

Table 5.2.1 Fishing effort (hours fishing) by month and year in the Shetland SANDEEL fishery, 1975-1981

Month \ Year	1975	1976	1977	1978	1979	1980	1981
January	35						
February	20						
March	298	36	436	234			
April	725	1 175	1 209	654	308	626	1 457
May	868	1 203	1 408	2 030	990	886	2 069
June	989	2 043	1 893	1 859	1 027	1 832	2 387
July	1 724	2 632	1 673	1 350	693	1 647	2 277
August	2 333	2 023	947	1 683	760	1 192	1 652
September	730	670	528	1 473	340	395	1 062
October	186	484	212	934	9		135
November		245					
December							
Total	7 908	10 511	8 306	10 217	4 127	6 578	11 039

Table 5.3.1 SANDEELS 1979. Number caught x 10^{-6}
Southern Area of the North Sea

Month	AGE GROUPS									
	0	1	2	3	4	5	6	7	8	
January		-	-	-	-	-	-	-		
February		-	-	-	-	-	-	-		
March		-	-	-	-	-	-	-		
April		1 646.9	2 284.3	450.7	81.3	7.5	4.3	-		
May		5 876.7	11 441.2	1 924.1	880.9	306.6	224.5	3.3		
June	180.7	8 494.5	9 011.8	2 112.5	302.9	126.7	15.3	-		
July	1 047.8	5 159.9	2 043.7	131.3	107.4	29.8	-	-		
August	-	0.6	-	-	-	-	-	-		
September	898.7	24.7	20.7	3.5	1.5	-	-	-		
October	-	24.7	20.7	3.5	1.5	-	-	-		
November	-	-	-	-	-	-	-	-		
December	-	-	-	-	-	-	-	-		
Σ	2 127.2	21 228.0	24 822.4	4 625.6	1 375.5	470.6	244.1	3.3		54 896.8

continued...

Table 5.3.1 SANDEELS 1980. Number caught x 10^{-6}

(continued) Southern Area of the North Sea

Month	AGE GROUPS									
	0	1	2	3	4	5	6	7	8	
January	-	-	-	-	-	-	-	-		
February	-	-	-	-	-	-	-	-		
March	-	1 984.1	-	0.1	-	-	-	-		
April	-	1 398.5	1 737.8	179.1	75.7	-	3.6	-		
May	-	9 701.4	6 994.0	3 220.1	232.6	49.1	19.7	-		
June	61.6	23 185.3	3 740.1	394.7	67.1	13.5	27.0	0.1		
July	71.7	4 265.5	823.0	575.3	9.2	-	-	-		
August	-	-	-	-	-	-	-	-		
September	-	302.7	11.1	-	-	-	-	-		
October	-	169.4	6.2	-	-	-	-	-		
November	-	-	-	-	-	-	-	-		
December	-	-	-	-	-	-	-	-		
Σ	133.3	41 006.9	13 312.2	4 369.3	384.6	62.2	50.3	0.1		59 319.3

continued....

Table 5.3.1 (continued) SANDEELS 1981. Number caught x 10^{-6}

Southern Area of the North Sea (Shetland excluded)

Month	AGE GROUPS									
	0	1	2	3	4	5	6	7	8	
January	-	1.0	-	-	-	-	-	-	-	
February	-	-	-	-	-	-	-	-	-	
March	-	3.6	234.0	36.1	19.0	7.2	-	0.9	0.9	
April	-	3 775.0	1 944.5	227.2	122.4	51.7	3.2	4.0	4.0	
May	-	4 836.0	5 535.9	1 391.2	541.4	259.0	77.3	7.9	-	
June	412.1	4 658.3	3 909.0	792.4	85.6	33.5	3.5	3.5	-	
July										
August										
September										
October										
November										
December										
Σ	412.1	13 273.9	11 623.4	2 446.9	768.4	351.4	84.0	16.3	4.9	28 981.3

Table 5.3.2 SANDEELS 1979. Numbers caught x 10^{-6}

Northern Area of the North Sea (Shetland excluded)

Month	AGE GROUPS									
	0	1	2	3	4	5	6	7	8	
January	-	-	-	-	-	-	-			
February	-	-	-	-	-	-	-			
March	-	25.9	121.5	-	-	-	-			
April	-	368.3	496.9	26.7	4.5	2.2	-			
May	-	1 403.9	76.4	62.7	-	-	-			
June	-	537.1	632.8	152.8	-	-	5.3			
July	912.4	916.9	390.0	62.4	9.5	-	-			
August	32 258.2	347.6	39.3	-	-	-	-			
September	3 684.6	-	-	-	-	-	-			
October	7 345.9	45.4	3.8	3.8	-	-	-			
November	1.7	+	-	-	-	-	-			
December	-	-	-	-	-	-	-			
Σ	44 202.8	3 645.1	1 760.7	308.4	14.0	2.2	5.3			49 938.5

continued....

Table 5.3.2 SANDEELS 1980. Numbers caught x 10^{-6}
(continued) Northern Area of the North Sea (Shetland excluded)

Month	AGE GROUPS									
	0	1	2	3	4	5	6	7	8	
January	-	-	-	-	-	-	-	-	-	
February	-	-	-	-	-	-	-	-	-	
March	-	1 102.0	1 777.9	21.6	-	-	-	-	-	
April	-	1 577.0	3 530.3	41.0	3.1	0.5	0.3	-	-	
May	0.1	6 807.5	2 219.7	60.1	15.4	7.5	0.9	0.4	-	
June	17.1	3 907.5	1 337.0	926.9	626.8	136.2	36.6	0.8	-	
July	834.9	827.4	169.8	19.4	3.7	3.1	0.5	0.2	0.4	
August	3 468.6	176.4	8.0	-	-	-	-	-	-	
September	2 204.7	3.7	-	-	-	-	-	-	-	
October	1 794.7	158.6	36.1	-	-	-	-	-	-	
November	45.9	6.8	1.0	-	-	-	-	-	-	
December	-	-	-	-	-	-	-	-	-	
Σ	8 366.0	14 566.9	9 078.8	1 069.0	649.0	147.3	38.3	1.4	0.4	33 917.0

continued...

Table 5.3.2 SANDEELS 1981. Numbers caught x 10^{-6}
(continued) Northern area of the North Sea (Shetland excluded).

Month	AGE GROUPS									
	0	1	2	3	4	5	6	7	8	
January	-	-	-	-	-	-	-	-		
February	-	-	-	-	-	-	-	-		
March	-	1 909.4	611.5	-	-	-	-	-		
April	-	2 275.3	1 406.5	42.6	-	-	-	-		
May	-	1 117.1	1 314.4	336.8	98.8	6.7	4.4	1.9		
June	17.0	913.0	467.1	133.2	83.9	6.9	16.9	3.4		
July										
August										
September										
October										
November										
December										
Σ	17.0	6 214.8	3 799.5	512.6	182.7	13.6	21.3	5.3		10 766.8

Table 5.3.3 SANDEELS (Shetland)

Numbers caught

Year/ Month	t	Age Groups 0	1	2	3	4	5	6	7	8
1979										
April	906	-	335.8	129.9	3.4	2.5				
May	2 985	-	498.8	111.8	27.9	4.2	3.4	0.9	0.5	
June	3 907	-	653.4	146.3	36.5	5.5	4.4	1.2	0.7	
July	2 413	42.1	263.7	89.0	14.7	13.1	7.2			
August	2 518	943.6	205.3	47.7	6.4	0.4				
September	649	311.5	10.3		1.1					
October	26	12.5	0.4							
Total	13 404	1 309.7	1 967.7	524.7	90.0	25.7	15.0	2.1	1.2	-
1980										
April	1 803	-	112.6	124.5	63.1	21.9	3.7	2.4		
May	3 219	0.6	401.9	126.5	52.6	14.7	7.6		0.6	
June	6 845	76.4	54.3	117.4	157.0	59.8	68.8	34.9	13.1	
July	6 920	5 132.6	81.7	10.0						
August	5 311	1 776.1	125.0	68.1	19.0	10.3	4.2	0.9		
September	1 346	225.4	35.5	26.4	10.2	2.3	1.4			
Total	25 444	7 211.1	811.1	472.9	301.9	109.0	85.7	38.2	13.7	-
1981										
April	5 018	-	1 076.9	445.3	66.3	12.1	5.4	5.6	0.6	0.2
May	7 430	0.5	369.1	556.7	171.6	32.9	11.4	10.9	1.3	1.1
June	10 016	104.3	470.9	421.6	161.3	68.1	36.5	9.7	1.1	1.7
July	10 403	5 618.5	427.8	57.9	16.8					
August	7 107	4 308.8	46.5	25.3	7.9	4.5	0.9			
September	5 968	3 287.0	84.0	7.8	2.7	1.7	1.9	0.4	0.4	
October	710	390.9	10.0	0.9	0.3	0.2	0.2			
Total	46 652	13 710.0	2 485.2	1 515.5	426.9	119.5	56.3	26.2	3.4	3.0

Table 5.3.4. SANDEEL in the southern North Sea.
VPA, catch in numbers, half year, x 10^{-6}.

Age		1972 1	1972 2	1973 1	1973 2	1974 1	1974 2	1975 1	1975 2	1976 1
0	1	0	0	13	0	670	0	0	0	4
	2	0	0	0	0	0	76	0	0	0
1	1	2839	0	14497	0	5989	0	11458	0	16308
	2	0	86	0	206	0	226	0	480	0
2	1	15695	0	2515	0	3930	0	1694	0	14505
	2	0	1148	0	53	0	10	0	1046	0
3	1	418	0	3832	0	497	0	2838	0	1522
	2	0	35	0	151	0	0	0	170	0
4	1	128	0	183	0	1968	0	529	0	1234
	2	0	24	0	5	0	3	0	253	0
5	1	94	0	89	0	205	0	666	0	171
	2	0	16	0	3	0	0	0	0	0
6	1	20	0	31	0	22	0	91	0	72
	2	0	0	0	2	0	0	0	0	0
7	1	3	0	7	0	11	0	2	0	1
	2	0	0	0	1	0	0	0	0	0
8	1	29	0	53	0	73	0	3	0	0
	2	0	0	0	3	0	0	0	0	0
Total		19225	1308	21221	423	13363	315	17280	1949	33817

Age		1976 2	1977 1	1977 2	1978 1	1978 2	1979 1	1979 2	1980 1	1980 2
0	1	0	0	0	922	0	181	0	62	0
	2	0	0	13263	0	41224	0	1947	0	72
1	1	0	19500	0	58839	0	16018	0	33269	0
	2	249	0	269	0	2774	0	5210	0	4738
2	1	0	5596	0	16948	0	22737	0	12472	0
	2	2358	0	27	0	385	0	2085	0	840
3	1	0	6300	0	1793	0	4487	0	3794	0
	2	392	0	8	0	125	0	138	0	575
4	1	0	965	0	1006	0	1265	0	375	0
	2	102	0	8	0	97	0	110	0	9
5	1	0	445	0	114	0	441	0	63	0
	2	20	0	3	0	26	0	30	0	0
6	1	0	239	0	21	0	244	0	50	0
	2	58	0	3	0	26	0	0	0	0
7	1	0	124	0	14	0	3	0	0	0
	2	16	0	0	0	7	0	0	0	0
8	1	0	36	0	26	0	32	0	0	0
	2	0	0	0	0	2	0	0	0	0
Total		3195	33204	13581	79684	44665	45409	9520	50086	6234

Age		1981 1
0	1	412
	2	0
1	1	13274
	2	0
2	1	11623
	2	0
3	1	2447
	2	0
4	1	768
	2	0
5	1	351
	2	0
6	1	84
	2	0
7	1	17
	2	0
8	1	1
	2	0
Total		28978

Table 5.3.5. SANDEEL in the southern North Sea.
VPA, fishing mortalities. M = 0.5 year^{-1}.

Year/Age	0	1	2	3	4	5	6	7	8
1972 1/2	0.00	0.15	0.57	0.15	0.39	0.50	0.04	0.01	0.50
2/2	0.00	0.01	0.08	0.02	0.12	0.16	0.00	0.00	-
1973 1/2	0.00	0.45	0.28	0.41	0.13	0.96	0.54	0.02	0.50
2/2	0.00	0.01	0.01	0.03	0.00	0.06	0.05	0.00	-
1974 1/2	0.01	0.27	0.30	0.11	0.57	0.29	1.17	0.56	0.50
2/2	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	-
1975 1/2	0.00	0.19	0.16	0.54	0.23	0.57	0.28	0.50	0.50
2/2	0.00	0.01	0.15	0.06	0.18	0.00	0.00	0.00	-
1976 1/2	0.00	0.52	0.56	0.36	0.78	0.18	0.15	0.00	0.00
2/2	0.00	0.01	0.17	0.15	0.14	0.03	0.18	0.13	-
1977 1/2	0.00	0.34	0.50	1.00	0.73	1.56	0.65	0.76	0.50
2/2	0.08	0.01	0.00	0.00	0.01	0.03	0.01	0.00	-
1978 1/2	0.01	0.65	0.86	0.43	0.61	0.24	0.38	0.09	0.50
2/2	0.44	0.06	0.04	0.05	0.11	0.08	1.22	0.06	-
1979 1/2	0.00	0.32	0.95	0.97	1.03	1.12	3.85	0.50	0.50
2/2	0.02	0.17	0.21	0.07	0.23	0.20	0.00	0.00	-
1980 1/2	0.00	0.56	0.86	0.77	0.28	0.21	0.66	0.03	0.00
2/2	0.00	0.15	0.13	0.26	0.01	0.00	0.00	0.00	-
1981 1/2	0.10	0.40	0.70	0.70	0.70	0.70	0.70	0.70	0.70

Table 5.3.6. SANDEEL in the southern North Sea.
VPA, numbers at age by half-years. Number x 10^6.

Year/Age	0	1	2	3	4	5	6	7	8
1972 1/2	-	22 390	40 318	3 372	441	264	603	254	82
2/2	57 140	14 946	17 747	2 260	232	124	452	195	
1973 1/2	-	44 501	11 565	12 812	1 729	160	83	352	152
2/2	36 213	22 016	6 806	6 634	1 186	48	38	268	
1974 1/2	-	28 203	16 965	5 254	5 033	920	35	28	208
2/2	97 579	16 723	9 774	3 655	2 208	537	8	12	
1975 1/2	-	75 927	12 825	7 604	2 847	1 717	418	7	10
2/2	57 403	49 086	8 502	3 452	1 754	758	246	0	
1976 1/2	-	44 706	37 806	5 703	2 538	1 144	591	192	0
2/2	97 562	20 616	16 823	3 112	908	741	396	149	
1977 1/2	-	75 981	15 837	11 033	2 080	618	560	258	101
2/2	191 538	42 131	7 460	3 159	783	101	228	94	
1978 1/2	-	137 516	32 575	5 786	2 453	603	76	175	73
2/2	129 729	55 994	10 712	2 942	1 036	369	41	125	
1979 1/2	-	65 076	41 170	8 004	2 181	722	264	9	91
2/2	113 179	36 676	12 432	2 361	608	183	4	0	
1980 1/2	-	86 431	23 994	7 855	1 717	377	116	3	0
2/2	58 030	38 366	7 900	2 830	1 009	239	47	3	
1981 1/2	-	45 130	25 723	5 415	1 700	778	186	37	2

Table 5.3.7. SANDEEL in the northern North Sea.
VPA, catch in numbers, half year, x 10^{-6}.

Age		1972		1973		1974		1975		1976
		1	2	1	2	1	2	1	2	1
0	1	0	0	0	0	472	0	99	0	237
	2	0	4 930	0	337	0	9 979	0	9 282	0
1	1	3 398	0	4 057	0	19 850	0	7 186	0	5 697
	2	0	846	0	143	0	384	0	74	0
2	1	2 045	0	1 657	0	1 347	0	5 249	0	1 130
	2	0	0	0	68	0	53	0	105	0
3	1	115	0	836	0	1 424	0	1 508	0	445
	2	0	0	0	20	0	11	0	1	0
4	1	79	0	89	0	276	0	248	0	101
	2	0	0	0	0	0	7	0	0	0
5	1	62	0	58	0	73	0	87	0	39
	2	0	0	0	1	0	5	0	0	0
6	1	60	0	1	0	2	0	0	0	15
	2	17	0	0	0	0	0	0	0	0
Total		5 775	5 776	6 698	570	23 444	10 439	14 377	9 463	7 664

Age		1976	1977		1978		1979		1980		1981
		2	1	2	1	2	1	2	1	2	1
0	1	0	3 686	0	0	0	0	0	17	0	17
	2	6 126	0	3 067	0	7 820	0	44 203	0	8 349	0
1	1	0	24 307	0	6 127	0	2 335	0	13 394	0	6 215
	2	648	0	2 856	0	1 001	0	1 310	0	1 173	0
2	1	0	2 351	0	2 338	0	1 328	0	8 865	0	3 799
	2	84	0	913	0	307	0	433	0	214	0
3	1	0	516	0	573	0	242	0	1 050	0	513
	2	368	0	142	0	39	0	66	0	19	0
4	1	0	124	0	78	0	5	0	645	0	183
	2	19	0	99	0	1	0	10	0	4	0
5	1	0	17	0	45	0	2	0	144	0	14
	2	10	0	28	0	1	0	0	0	3	0
6	1	0	3	0	21	0	5	0	38	0	21
	2	8	3	15	0	0	0	0	2	1	5
Total		7 262	31 007	7 119	9 181	9 169	3 917	46 022	24 155	9 762	10 767

Table 5.3.8. SANDEEL in the northern North Sea.
VPA, fishing mortalities. $M = 0.5\ year^{-1}$.

Year/Age	0	1	2	3	4	5	6
1972 1/2	0.00	0.31	0.54	0.26	0.56	3.37	0.50
2/2	0.27	0.12	0.00	0.00	0.00	0.00	-
1973 1/2	0.00	0.40	0.40	0.65	0.48	2.07	0.50
2/2	0.01	0.02	0.03	0.03	0.00	0.19	-
1974 1/2	0.01	0.90	0.33	1.21	0.73	1.68	0.50
2/2	0.48	0.04	0.02	0.02	0.04	0.50	-
1975 1/2	0.00	0.82	1.09	1.26	1.18	0.86	0.00
2/2	0.38	0.02	0.05	0.00	0.00	0.00	-
1976 1/2	0.00	0.45	0.42	0.35	0.34	0.88	0.50
2/2	0.12	0.09	0.05	0.58	0.10	0.65	-
1977 1/2	0.12	1.09	0.54	0.52	0.42	0.13	0.50
2/2	0.14	0.36	0.44	0.28	0.75	0.34	-
1978 1/2	0.00	0.50	0.61	0.58	0.26	1.06	0.50
2/2	0.24	0.15	0.15	0.07	0.00	0.07	-
1979 1/2	0.00	0.11	0.32	0.18	0.01	0.01	0.50
2/2	0.75	0.09	0.17	0.07	0.03	0.00	-
1980 1/2	0.00	0.57	1.52	0.84	2.41	0.93	0.50
2/2	0.35	0.09	0.12	0.03	0.08	0.04	-
1981 1/2	0.1	0.50	0.50	0.50	0.50	0.50	0.50

Table 5.3.9. SANDEEL in the northern North Sea.
VPA, numbers at age by half-years. Number x 10^6.

Year/Age	0	1	2	3	4	5	6
1972 1/2	-	14 349	5 485	560	207	68	172
2/2	23 093	8 203	2 492	336	92	2	
1973 1/2	-	13 670	5 646	1 941	262	72	1
2/2	47 908	7 104	2 951	785	126	7	
1974 1/2	-	37 014	5 407	2 238	594	98	5
2/2	29 438	11 674	3 034	520	223	14	
1975 1/2	-	14 229	8 754	2 316	395	167	0
2/2	33 193	4 862	2 298	510	94	55	
1976 1/2	-	17 744	3 722	1 697	396	74	43
2/2	58 849	8 850	1 912	933	220	24	
1977 1/2	-	40 453	6 323	1 416	406	155	10
2/2	25 754	10 578	2 878	653	208	106	
1978 1/2	-	17 366	5 743	1 445	384	76	59
2/2	40 931	8 187	2 440	628	231	21	
1979 1/2	-	25 028	5 498	1 631	455	179	15
2/2	93 456	17 441	3 121	1 058	350	138	
1980 1/2	-	34 468	12 432	2 050	766	264	107
2/2	32 055	15 192	2 112	689	53	81	
1981 1/2	-	17 668	10 801	1 457	519	38	61

Table 5.3.10. SANDEEL in the Shetland area.
VPA, catch in numbers x 10^{-6}.

	1974	1975	1976	1977	1978	1979	1980	1981
0	953	9	4600	6109	5528	1310	7211	13710
1	840	3336	2246	3355	5069	1968	811	2485
2	87	1397	450	816	1193	525	473	1516
3	25	282	157	53	117	90	502	427
4	27	51	28	70	28	26	109	120
5	5	28	15	8	23	15	86	56
6	2	19	6	8	3	2	38	26
7	6	9	2	4	1	1	14	3
8+	0	6	0	1	1	0	0	3
TOTAL	1945	5136	7503	10424	11963	3936	9044	18346

Table 5.3.11. SANDEEL in the Shetland area.
VPA, fishing mortalities. M = 0.5.

	1974	1975	1976	1977	1978	1979	1980	1981	1974-1979
0	0.11	0.00	0.34	0.39	0.51	0.13	0.64	0.40	0.25
1	0.21	1.07	0.55	0.67	1.03	0.49	0.75	0.70	0.67
2	0.14	0.98	0.57	0.58	0.81	0.38	0.30	0.70	0.58
3	0.14	1.37	0.37	0.16	0.21	0.17	0.57	0.70	0.40
4	0.27	0.69	0.67	0.41	0.17	0.09	0.47	0.70	0.38
5	0.13	0.74	0.63	0.63	0.32	0.18	0.69	0.70	0.44
6	0.07	1.63	0.52	1.59	0.61	0.06	1.47	0.70	0.75
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.70	1.00
8+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.70	1.00
F(1- 6),W	0.20	1.05	0.54	0.63	0.92	0.42	0.25	0.70	

Table 5.3.12. SANDEEL in the Shetland area.
VPA, stock size in numbers at 1 January.

	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	11407	10848	19780	23454	17226	13450	18980	51982	**********
1	5576	6187	6573	8505	9593	6276	7154	6097	21134
2	802	2740	1290	2294	2643	2071	2320	3718	1836
3	240	456	627	444	777	713	858	1047	1120
4	144	127	71	261	229	382	364	293	315
5	52	67	39	22	105	117	212	138	88
6	29	28	19	12	7	46	60	64	42
7	12	17	3	7	2	2	26	8	19
8+	0	11	0	1	3	0	0	7	5
TOTAL	18322	20480	28407	35001	30584	23057	29973	63355	
SPAWN. ST.	1339	3445	2048	3041	3765	3332	3840	5276	

	1974-1980
0	16450
1	7123
2	2031
3	588
4	225
5	88
6	29
7	10
8+	2

Table 5.3.13. Recruitment. Numbers at age 1 from VPA for SANDEEL for the three assessment areas.

Year class	Southern North Sea	Northern North Sea	Shetland
1971	22 390	14 349	
1972	44 501	13 670	
1973	28 203	37 014	5 576
1974	75 927	14 229	6 187
1975	44 706	17 744	6 573
1976	75 981	40 453	8 505
1977	137 516	17 366	9 593
1978	65 076	25 028	6 276
1979	86 431	34 468	7 154

Table 5.3.14 Comparison of F derived from VPA with fishing effort in Shetland SANDEEL fishery.

Year	Total hours fishing	Arithmetic mean F on age groups 0-3 input F on oldest age group		
		0.6	0.7	1.0
1974	-	0.15	0.15	0.15
1975	7 908	0.85	0.86	0.86
1976	10 511	0.45	0.46	0.47
1977	8 306	0.44	0.45	0.47
1978	10 217	0.62	0.64	0.69
1979	4 127	0.28	0.29	0.34
1980	6 578	0.38	0.42	0.42
1981	11 039	0.55*	0.63*	0.65*
1977-1981 Correlation coefficient		0.95	0.97	0.95
Corrected F in 1981		0.59	0.64	0.67
Value of 2 at zero effort		0.58	0.57	0.60

* Input value

Table 5.5.1 SANDEEL - Southern North Sea.
Mean weight at age by month in Danish catches (in grammes).

	Month / Age Group	1	2	3	4	5	6	7	8	9	10	11	12
1979	0						0.63	1.07		1.66			
	1				2.11	3.72	5.49	5.03	18.00	13.49			
	2				4.25	5.58	9.52	7.79		16.16			
	3				6.96	9.64	16.30	10.87		18.73			
	4				12.66	12.94	21.46	13.87		21.33			
	5				11.83	15.92	20.78	13.33					
	6				20.00	11.82	26.17						
	7					18.00	-						
	8+						16.49						
1980	0						1.00	2.00					
	1			1.27	1.96	5.40	6.34	7.88		7.85	7.85		
	2			-	4.62	7.00	8.88	9.72		21.33	21.33		
	3			9.00	9.76	9.65	18.02	13.72					
	4				13.72	18.08	18.12	26.00					
	5				-	17.62	19.71						
	6				28.00	22.00	19.71						
	7												
	8+												

Table 5.5.2 SANDEEL – Northern North Sea (excluding Shetlands)
Mean weight at age by month in Danish catches (in grammes)

Year	Age group \ Month	1	2	3	4	5	6	7	8	9	10	11	12
1979	0							1.29	2.40	1.83	3.24	6.45	
	1			2.17	2.65	5.48	7.25	10.79	12.93		16.30		
	2			7.77	7.97	14.31	15.56	35.08	23.00		25.50		
	3				19.15	25.52	33.54	44.66			35.00		
	4				33.66		–	56.76					
	5				38.92		–						
	6						55.50						
	7												
	8+												
1980	0						1.25	2.08	3.74	4.85	3.87		
	1			1.64	1.93	5.12	10.53	14.40	16.96	22.10	–		
	2			5.29	4.58	6.62	17.56	20.21	31.00		27.00		
	3			11.70	10.15	24.44	39.86	37.91					
	4					34.00	56.33	45.88					
	5					34.00	62.06	55.00					
	6						63.58	59.00					
	7						–						
	8+						80.00						

Table 5.5.3 SANDEEL - Shetland. Mean weight at age by month in Scottish catches (in grammes)

Year	Age group \ Month	1	2	3	4	5	6	7	8	9	10	11	12
1979	0							2.44	1.54	1.76			
	1				1.91	3.30		4.26	4.13	4.92			
	2				3.22	6.24		6.71	6.31	-			
	3				6.15	7.51		9.27	7.91	8.20			
	4				7.47	11.14		14.18	9.95				
	5					12.40		13.55					
	6					12.20							
	7					15.80							
	8+												
1980	0					0.80	0.87	1.54	1.72	2.83			
	1				4.14	4.70	6.20	6.14	4.78	7.25			
	2				4.84	5.78	9.31	6.10	6.84	7.92			
	3				6.53	8.20	11.17		8.71	9.76			
	4				7.10	8.56	16.56		12.21	16.07			
	5				10.02	12.49	18.74		18.90	15.72			
	6				10.02	-	19.33		20.60				
	7					19.10	20.39						
	8+												
1981	0					0.10	1.04	1.21	1.37	1.66			
	1				9.65	3.54	4.69	5.60	6.75	5.36			
	2				12.19	5.26	7.76	6.68	10.38	10.18			
	3				14.79	7.29	10.44	5.70	12.80	13.59			
	4				15.49	9.03	16.62		12.38	14.36			
	5				16.82	11.41	15.56		11.35	18.89			
	6				16.79	13.00	24.57			17.80			
	7				17.75	9.68	23.00			13.00			
	8+				19.25	13.34	28.10						

Table 5.6.1 SANDEEL North Sea percentage annual landings by weight by age.

Stock	Year	AGE 0	1	2	3	4	5	6	7	8
Northern North Sea	1979	61%	16%	17%	6%	-	-	-	-	-
	1980	12%	35%	21%	15%	13%	3%	1%	-	
Southern Nort Sea	1979	1%	28%	47%	16%	6%	2%	1%	-	-
	1980	-	61%	25%	12%	2%	-	-	-	-
Shetland	1979	11%	37%	45%	4%	2%	1%	-	-	-
	1980	45%	16%	12%	11%	6%	6%	3%	1%	
	1981	34%	31%	22%	7%	3%	2%	1%	-	-

Table 5.7.1 Values of Z calculated from catches in winter per unit effort in Shetland SANDEEL fishery.

Year	CPUE (thousand per hour's fishing) in April-May 1-7 group	2-8 group	Estimate of Z from year n to n + 1
1975	282.3	236.8	1.04
1976	640.8	99.5	1.17
1977	853.8	198.8	0.92
1978	1 727.0	340.3	2.06
1979	862.2	219.2	1.14
1980	616.5	276.2	0.50
1981	784.4	374.7	-
			mean Z 1.14

Table 6.1.1 SPRAT catches in the North Sea ('000 tonnes), 1971-81 (data provided by Working Group members).

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981[a)]
					IVa West						
Denmark	-	-	-	5.3	0.5	0.6	0.1	-	-	-	-[1)]
Faroe Islands	-	-	-	0.2	12.9	2.5	0.4	-	-	-	-
France	-	-	-	-	-	-	+	-	-	-	-
German Dem.Rep.	-	-	-	-	-	-	+	-	-	-	-
Germany, Fed.Rep.	-	-	+	-	-	+	0.6	-	-	0.1	-
Netherlands	+	+	+	+	+	+	+	-	-	-	-
Norway	0.9	2.2	-	-	1.5	29.9	16.0	1.3	0	-	-
Poland	-	+	+	-	0.3	-	-	-	-	-	-
Sweden	-	-	1.0	2.2	11.0	+	0	-	-	-	-
U.K. (England)	+	-	0.2	-	-	-	0	-	-	-	-
U.K. (Scotland)	15.0	29.8	49.4	41.2	9.4	12.7	26.9	16.9	6.8	3.8	1.0
USSR	-	-	-	1.0	1.3	1.2	+	-	-	-	-
Total	15.9	32.0	50.6	49.9	36.9	46.9	44.0	18.2	6.8	3.9	1.0
					IVa East (North Sea stock)						
Denmark	-	-	-	-	-	0.2	0.1	-	-	-	-[1)]
Norway	-	-	-	-	-	1.9	0.7	0.1	+	0.4	-
U.K. (Scotland)	-	-	-	-	-	+	0	-	-	-	-
Total	-	-	-	-	-	2.1	0.8	0.1	...	0.4	0
					IVb West						
Belgium	-	-	-	-	-	+	0	-	-	-	-
Denmark	9.9	14.4	47.0	55.4	106.6	104.4	57.5	44.1	75.3	76.7	28.1[1)]
Faroe Islands	-	-	-	4.0	30.0	42.9	1.8	-	2.8[b)]	2.8[b)]	-
France	-	-	-	-	-	-	+	-	-	-	-
German Dem.Rep.	-	-	-	1.7	4.5	6.4	0.7	-	-	-	-
Netherlands	+	+	-	-	-	-	0	-	-	-	-
Norway	-	4.1	3.4	9.5	145.7	73.0	5.5	56.2	47.8	18.3	0.4
Poland	-	+	-	-	9.1	10.5	0	-	-	-	-
Sweden	-	-	-	-	-	7.9	0	-	-	-	-
U.K. (England)	25.5	21.8	34.6	25.5	32.5	49.7	51.9	53.9	12.9	2.4	-
U.K. (Scotland)	7.2	3.6	2.9	8.6	4.9	18.1	10.9	14.8	5.0	2.5	0.7
USSR	1.2	0.8	17.9	32.9	47.8	50.4	1.6	-	-	-	-
Total	43.8	44.7	105.8	137.7	381.1	362.3	123.9	169.0	143.8	102.7	29.2

a) Preliminary figures as reported.
b) IVb East and West.
\+ = less than 0.1.
... = No data available.
\- = Magnitude known to be nil.

1) Jan-Jun only.
2) Assumed to be Division IVb E.

/Cont'd.

Table 6.1.1 (ctd)

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981[a)]
					IVb East						
Denmark	19.9	28.8	93.9	104.0	215.2	201.1	126.8	161.0	191.5	149.0	16.4[1)]
German Dem.Rep.	-	-	-	-	0.4	-	0.7	-	-	-	-
Germany, Fed.Rep.	5.1	1.7	11.0	17.5	0.5	1.7	4.3	-	1.8	6.1	4.8[2)]
Norway	-	-	-	-	-	5.1	0	29.8	27.4	33.7	+
Sweden	-	-	-	-	-	-	1.5	-	-	0.6	-
Total	25.0	30.5	104.9	121.5	216.1	207.9	133.3	190.8	222.7	189.4	21.2
					IVc						
Belgium	0.1	0.1	0.2	+	+	-	0	-	-	-	-
Denmark	-	-	-	0.9	3.9	0.3	1.4	-	1.5	6.5	4.3[1)]
France	+	-	+	0.3	0.1	-	+	-	-	-	-
German Dem.Rep.	-	-	-	-	-	0.1	+	-	-	-	-
Germany, Fed.Rep.	-	+	-	-	-	-	0.4	-	-	-	-
Netherlands	1.0	0.4	+	+	0.2	-	0	-	-	-	-
Norway	-	-	-	-	-	-	-	0.2	3.1	16.2	-
UK(England)	0.2	+	0.8	3.4	2.9	0.7	0.2	0.0	1.4	4.3	13.7
USSR	-	-	-	+	+	0.2	-	-	-	-	-
Total	1.3	0.5	1.0	4.6	7.1	1.3	2.0	0.2	6.0	27.0	18.0
					Total North Sea						
Belgium	0.1	0.1	0.2	+	+	+	+	+	+	+	-
Denmark	29.8	43.2	140.9	165.6	326.2	306.6	179.9	205.1	268.3	232.2	48.8[1)]
Faroe Islands	-	-	-	4.2	42.9	45.4	2.2	-	2.8	2.8	-
France	+	-	+	0.3	0.1	-	+	-	-	-	-
German Dem.Rep.	-	-	-	1.7	4.9	6.5	1.4	-	-	-	-
Germany, Fed.Rep.	5.1	1.7	11.0	17.5	0.5	1.7	5.3	-	3.8	6.2	4.8
Netherlands	1.0	0.4	+	+	0.2	+	+	-	-	-	-
Norway	0.9	6.3	3.4	9.5	147.2	109.9	22.2	87.6	78.6	68.6	0.4
Poland	-	+	+	-	9.4	10.5	+	-	-	-	-
Sweden	-	-	1.0	2.2	11.0	7.9	1.5	-	-	0.6	-
UK(England)	25.7	21.8	35.6	28.9	35.4	50.4	52.1	53.9	14.3	6.7	13.7
UK(Scotland)	22.2	33.4	52.3	49.8	14.3	30.8	37.8	31.7	11.8	6.3	1.7
USSR	1.2	0.8	17.9	33.9	49.1	51.8	1.6	-	-	-	-
Total	86.0	107.7	262.3	313.6	641.2	621.5	304.0	378.3	379.6	323.4	69.4

a) Preliminary figures as reported.

1) Jan-Jun only.

2) Assumed to be Division IVb E.

Table 6.1.2 SPRAT in Division VIa. Landings in tonnes

Countries	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Denmark								259			242
Faroes			1	109	56	181					
France	4										
Germany,Fed.Rep.				22	123	37	+		97		2
Ireland		908	1 650	713	517	673	282	533	12	1 787	
Netherlands		93	41	223	140	661	49	46	125	428	
Norway						35	267				
Poland		7	6								
UK/Scotland[1)]	1 179	5 225	7 502	5 959	8 127	6 455	4 246	11 563	1 087	2 987	1 410
Total	1 183	6 233	9 200	7 026	9 053	8 042	4 844	12 401	1 321	5 202	1 654

Source: ICES Statistician.

1) Amended from national data

Table 6.1.3 Landings of SPRAT in Division IIIa and in Norwegian fjords in Division IVa (10^{-3} tonnes).
(Data provided by Working Group members)

Year	SKAGERRAK				KATTEGAT			IIIa total	Norwegian fjords south of 62°N	Grand total
	Denmark	Sweden	Norway	Total	Denmark	Sweden	Total			
1969	0.8	1.9	1.7	4.4	0.8	1.6	2.4	6.8	11.8	18.6
1970	1.1	2.4	2.4	5.9	3.1	6.0	9.1	15.0	6.4	21.4
1971	0.7	2.4	2.9	6.0	1.5	9.6	11.1	17.1	4.4	21.5
1972	0.8	3.3	2.4	6.5	1.4	17.9	19.3	25.8	6.9	32.7
1973	19.4	2.5	3.2	25.1	19.3	16.2	35.5	60.6	8.8	69.4
1974	17.3	2.0	1.2	20.5	31.6	18.6	50.2	70.7	3.3	74.0
1975	14.9	2.1	1.9	18.9	69.7	20.9	90.6	109.5	2.9	112.4
1976	12.8	2.6	2.0	17.4	30.4	13.5	43.9	61.3	0.6	61.9
1977	7.2	2.2	1.2	10.6	53.3	9.8	63.1	73.7	5.4	79.1
1978	23.1	2.2	2.7	28.0	36.1	9.4	45.5	73.5	5.2	78.7
1979	17.3	8.1	1.8	27.2	45.8	6.4	52.2	79.4	5.0	84.4
1980	43.1	-	3.4	46.5	35.8	-	35.8	102.4	2.9	105.3
1981	52.8	13.4	4.1	70.3	41.8	15.8	57.6	127.9 1)	3.0	130.9

1) Sweden: 20 124 tonnes in 1980
in Division IIIa. Allocation to Skagerrak and
Kattegat not possible.

Table 6.1.4 Landings of SPRAT in Division IIIa by quarters (tonnes) (Norwegian fjords in Division IIIa not included).

Year	Months	Kattegat	Skagerrak	Total
1975	Jan-Mar	6 569	2 316	8 885
	Apr-Jun	11 610	450	12 060
	Jul-Sep	53 347	7 976	61 323
	Oct-Dec	19 541	8 248	27 789
	Total	91 067	18 990	110 057
1976	Jan-Mar	9 462	913	10 375
	Apr-Jun	4 867	997	5 864
	Jul-Sep	18 070	5 493	23 563
	Oct-Dec	10 253	10 001	20 254
	Total	42 652	17 404	60 056
1977	Jan-Mar	9 340	1 507	10 847
	Apr-Jun	10 499	189	10 688
	Jul-Sep	24 217	2 808	27 025
	Oct-Dec	18 938	6 067	25 005
	Total	62 994	10 571	73 565
1978	Jan-Mar	13 139	2 899	16 038
	Apr-Jun	7 949	6 313	14 262
	Jul-Sep	18 511	15 175	33 686
	Oct-Dec	6 757	4 398	11 155
	Total	46 356	28 785	75 141
1979	Jan-Mar	8 848	2 817	11 665
	Apr-Jun	5 549	1 042	6 591
	Jul-Sep	25 898	8 053	33 951
	Oct-Dec	11 922	15 218	27 140
	Total	52 217	27 130	79 347
1980 1)	Jan-Mar	10 312	2 345	16 992
	Apr-Jun	8 078	7 012	15 385
	Jul-Sep	15 010	31 421	54 072
	Oct-Dec	2 351	5 775	15 979
	Total	35 751	46 553	102 428
1981	Jan-Mar	16 402	6 453	22 855
	Apr-Jun	3 370	1 961	5 331
	Jul-Sep	20 979	55 574	76 553
	Oct-Dec	16 862	6 262	23 124
	Total	57 613	70 250	127 863

1) Swedish landings only included in total column.

Table 6.3.1 SPRAT, North Sea 1981

Number caught per age group x 10^{-6} by Divisions

Divisions	Months	Age Groups 0	1	2	3	4	5
IVa W	Jan - Mar	-	-	7.8	1.6	-	-
	Apr - Jun	-	-	-	-	-	-
IVa E	Jan - Mar	-	-	-	-	-	-
	Apr - Jun	-	-	-	-	-	-
IVb W	Jan - Mar	-	1 044.1	2 064.3	352.1	7.2	0.3
	Apr - Jun	3.4	6.7	106.9	23.5	-	1.5
IVb E	Jan - Mar	-	739.8	2 216.5	223.9	4.2	-
	Apr - Jun	19.6	78.2	63.7	1.6	-	-
IVc	Jan - Mar	-	465.4	930.0	477.9	10.7	1.2
	Apr - Jun	-	2.1	18.6	4.0	-	0.2
IV	Jan - Mar	-	2 249.3	5 218.6	1 055.5	22.1	1.5
	Apr - Jun	23.0	87.0	189.2	29.1	-	1.7

Table 6.3.2 North Sea SPRAT catch in 1974-81. 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	-	-
1978	Jan-Mar	-	2 461.9	2 839.3	3 770.1	344.5	-	-
	Apr-Jun	-	1 077.5	123.8	3.2	0	-	-
	Jul-Sep	6.3	17 785.5	216.5	14.7	0.7	-	-
	Oct-Dec	636.8	6 932.7	3 955.8	1 159.0	214.9		
1979	Jan-Mar	-	2 770.0	6 422.2	2 670.6	131.2	0.7	-
	Apr-Jun	-	203.6	452.0	14.0	1.1	-	-
	Jul-Sep	-	25 379.1	388.3	2.1	0	-	-
	Oct-Dec	433.0	8 394.8	1 494.6	122.4	34.9	-	-
1980	Jan-Mar	-	1 448.0	12 764.4	1 323.2	103.7	0.7	-
	Apr-Jun	-	134.0	84.5	2.4	0.3	-	-
	Jul-Sep	15.1	10 143.3	811.6	4.7	-	-	-
	Oct-Dec	515.7	4 518.5	2 767.4	111.8	19.5	-	-
1981	Jan-Mar	-	2 249.3	5 218.6	1 055.5	22.1	1.5	-
	Apr-Jun	23.0	87.0	189.2	29.1		1.7	-

Table 6.3.3 North Sea SPRAT. Fishing mortalities by quarters (VPA). Annual M = 0.80 $year^{-1}$. Input fishing mortalities are in brackets.

Year	Quarter	Age Groups 0	1	2	3	4
1974	1	-	.052	.30	0.59	1.41
	2	0	.003	.13	0.15	0.69
	3	.0003	.053	.15	.05	0.44
	4	.0141	.087	.10	.14	(1.00)
1975	1	-	.046	.31	.92	.84
	2	0	.006	.04	.03	.05
	3	.0001	.207	.25	.05	.03
	4	.0041	.184	.45	.71	(1.00)
1976	1	-	.072	.49	1.34	1.21
	2	0	.020	.08	.49	.39
	3	.0009	.224	.06	.04	0.0
	4	.0394	.170	.44	1.60	(1.00)
1977	1	-	.077	.39	.28	1.72
	2	0	.013	.03	.02	.09
	3	.0005	.084	.22	.09	1.57
	4	.0118	.198	.33	.24	(1.00)
1978	1	-	.034	.18	.89	.44
	2	0	.019	.01	.002	0
	3	+	.478	.02	.01	.002
	4	.0050	.346	.69	1.61	(1.00)
1979	1	-	.027	.63	1.68	.83
	2	0	.002	.08	.03	.01
	3	0	.465	.09	.01	0
	4	.0065	.275	.57	.49	(1.00)
1980	1	-	.027	.87	1.72	1.04
	2	0	.003	.01	.01	.01
	3	.0011	.338	.14	.03	0
	4	.0484	.247	1.02	1.33	(1.00)
1981	1	-	.305	.50	1.69	(1.13)
	2	(.0002)	(.017)	(.03)	(0.17)	0

Table 6.3.4 North Sea SPRAT. Number in stock at the beginning of each quarter (VPA)

Numbers x 10^{-9} M = 0.8 $year^{-1}$

Year	Quarter	Age Groups				
		0	1	2	3	4
1974	1	0	166	31	2.5	.3
	2	181	129	19	1.2	+
	3	148	105	14	.8	+
	4	121	82	9.6	.6	+
1975	1	0	98	61	7.1	.4
	2	271	77	37	2.3	.2
	3	222	62	29	1.8	.1
	4	182	41	19	1.4	.1
1976	1	0	148	28	9.8	.6
	2	118	113	14	2.1	.1
	3	97	91	11	1.1	.1
	4	79	59	8	.8	.1
1977	1	0	62	41	4.4	.1
	2	149	47	23	2.7	+
	3	122	38	18	2.2	+
	4	100	29	12	1.6	+
1978	1	0	81	19	7.0	1.1
	2	210	64	13	2.3	.6
	3	172	51	11	1.9	.5
	4	141	26	8.6	1.6	.4
1979	1	0	115	15	3.5	.3
	2	110	91	6.6	.5	.1
	3	90	75	5.0	.4	.1
	4	73	38	3.7	.3	.1
1980	1	0	60	24	1.7	.2
	2	18	48	8.2	.3	.4
	3	15	39	6.6	.2	+
	4	12	23	4.7	.2	+
1981	1	0	9.4	15	1.4	+
	2	25	5.7	7.2	.2	+

Table 6.5.1 North Sea SPRAT

Mean weight at age per month in Danish catches (in grams)

Year	Age Group \ Month	1	2	3	4	5	6	7	8	9	10	11	12
1980	0							-	2.00	2.25	2.15	3.00	4.65
	1	1.96	1.88	1.60			6.47	6.45	7.37	9.10	12.25	9.95	10.31
	2	8.86	6.23	5.80	9.50	14.27	14.27	11.35	13.95	14.32	19.44	19.43	14.34
	3	13.56	16.04	13.33					19.00		21.87	27.88	20.00
	4	21.60	19.27										
1981	0						2.25	4.05		5.00		3.75	3.71
	1	2.99	2.42	2.77	3.80	6.41	4.58	7.70	8.95	10.67	11.28	11.34	8.41
	2	10.00	7.20	6.69	6.28	13.43	14.08	13.96	12.91	15.58	16.78	16.91	15.17
	3	15.31	14.33	19.69		20.88	18.88	18.42	21.41	19.08	19.65	22.90	
	4	23.85	17.32			-			18.17		19.50		
	5					25.00					27.00		

Figure 1.3.1 Catch by year of all reported landings.

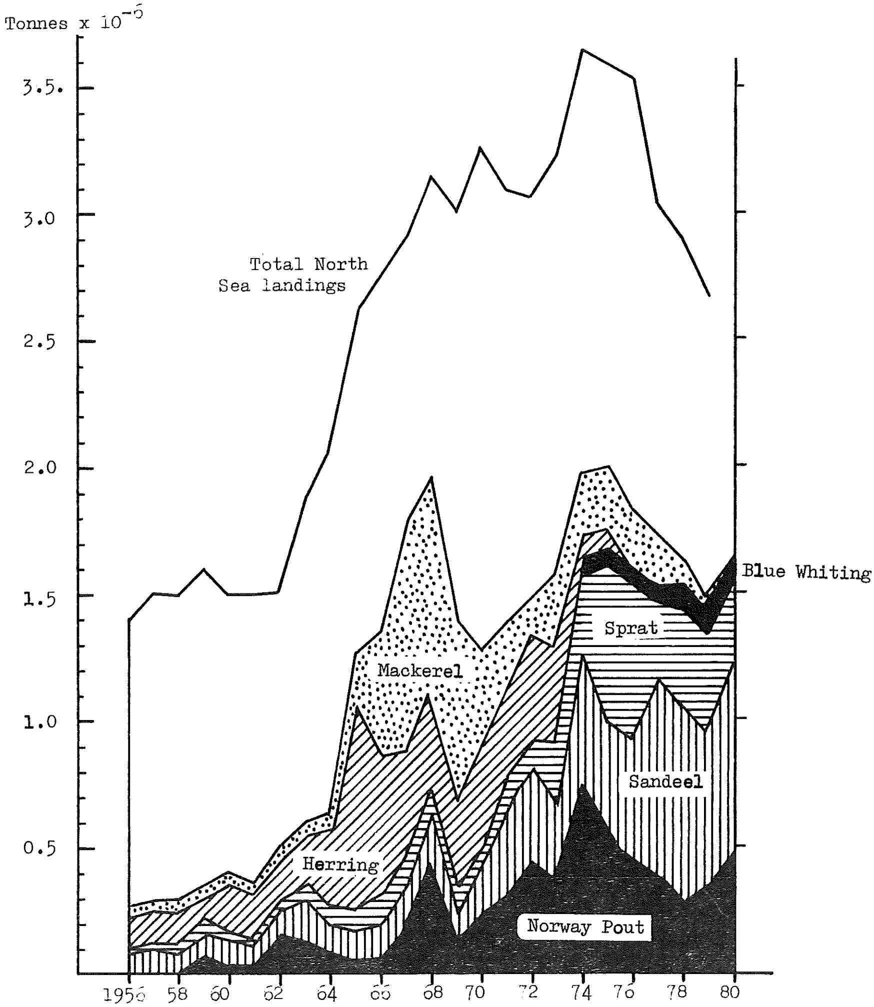


Figure 2.1. Total catch of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in January 1977 (75 800 tonnes).

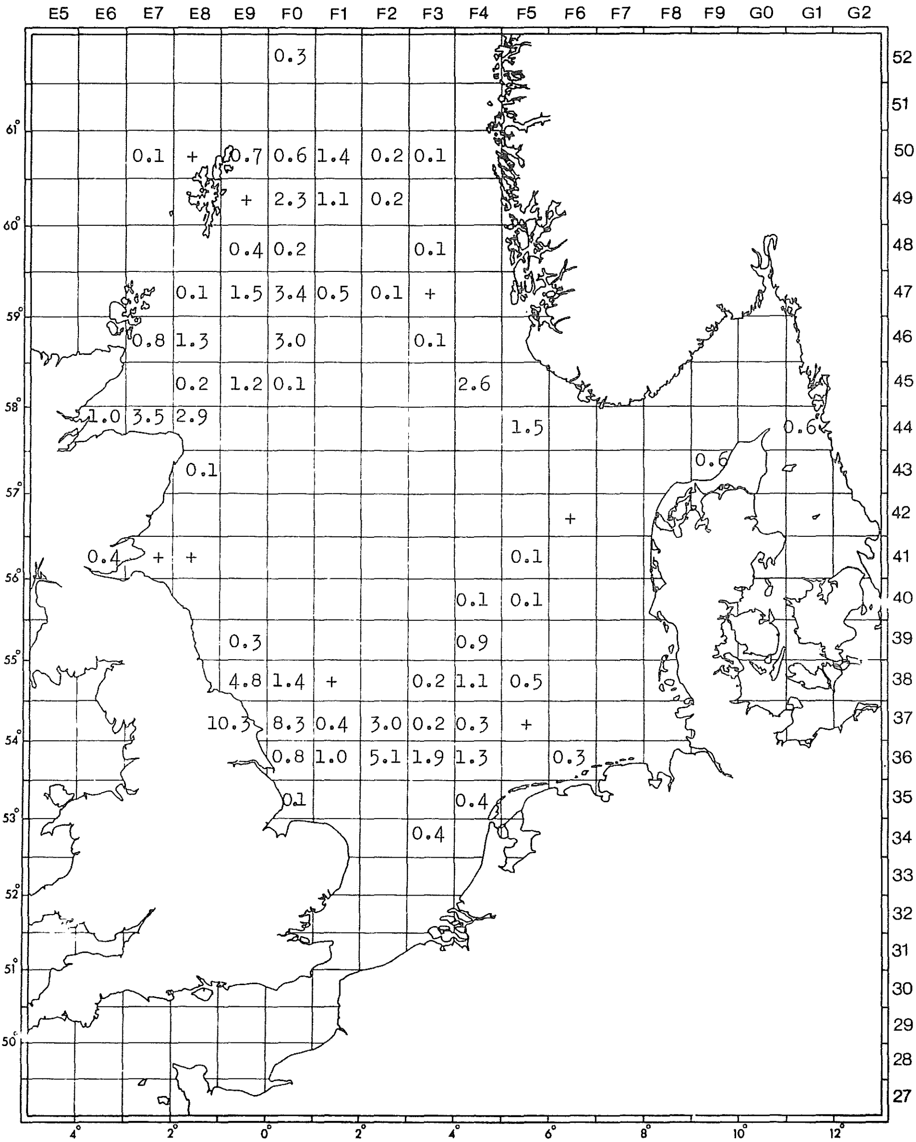


Figure 2.2. Total catch of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in February 1977 (77 700 tonnes).

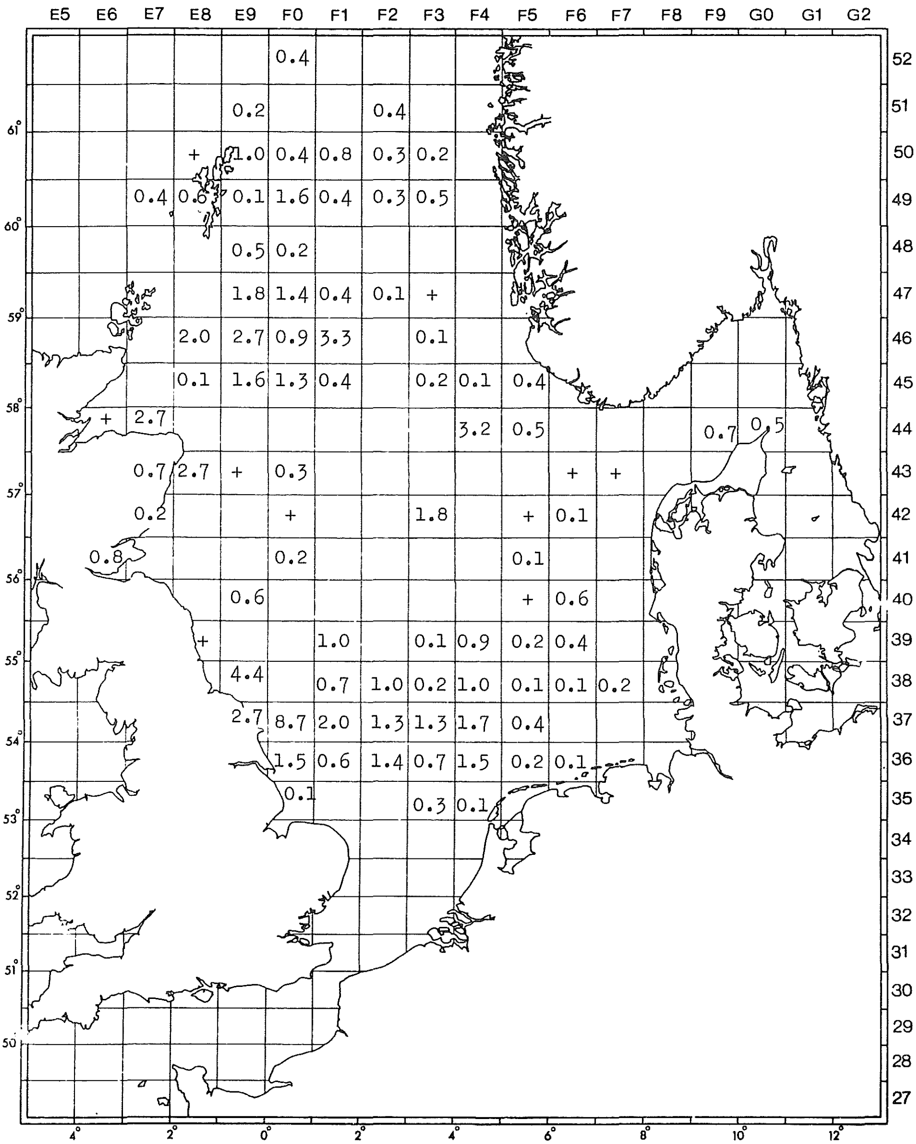


Figure 2.3. Total catch of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in March 1977 (71 000 tonnes).

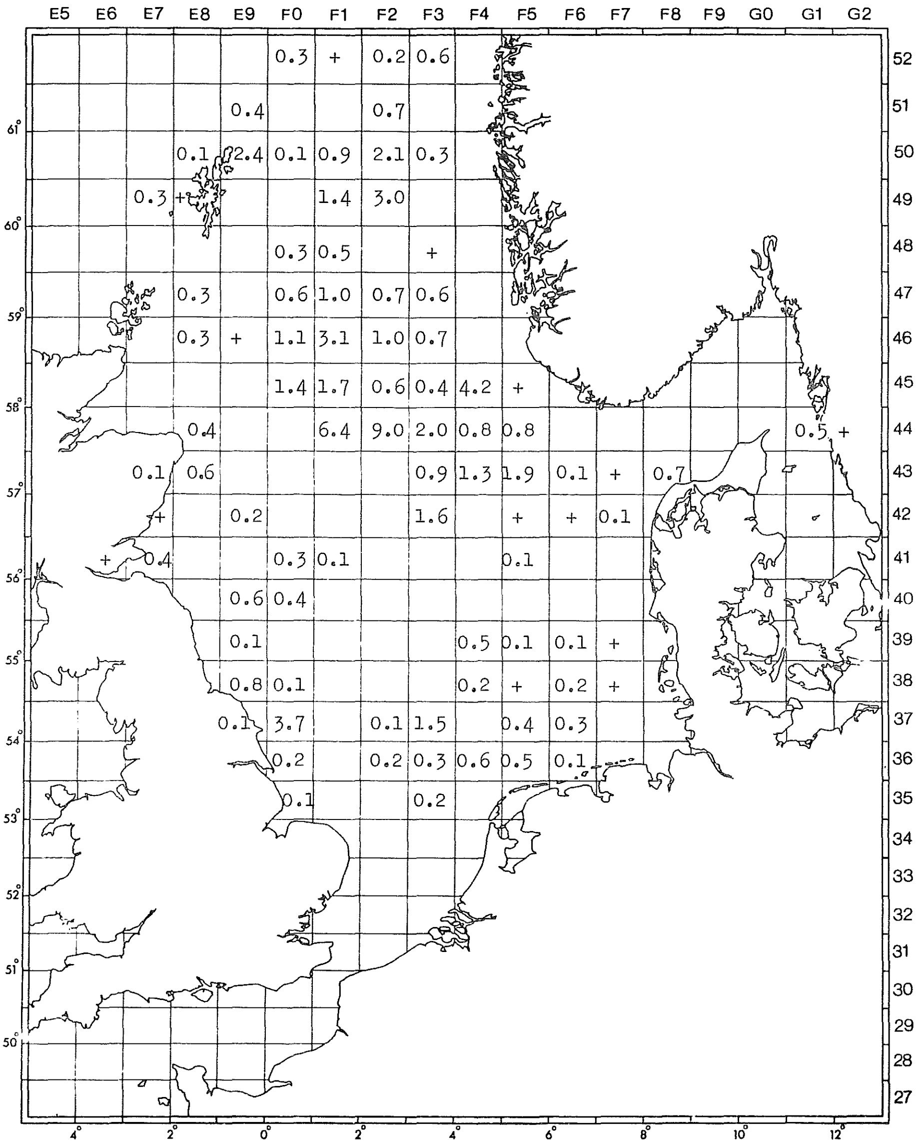


Figure 2.4. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in April 1977 (75 600 tonnes).

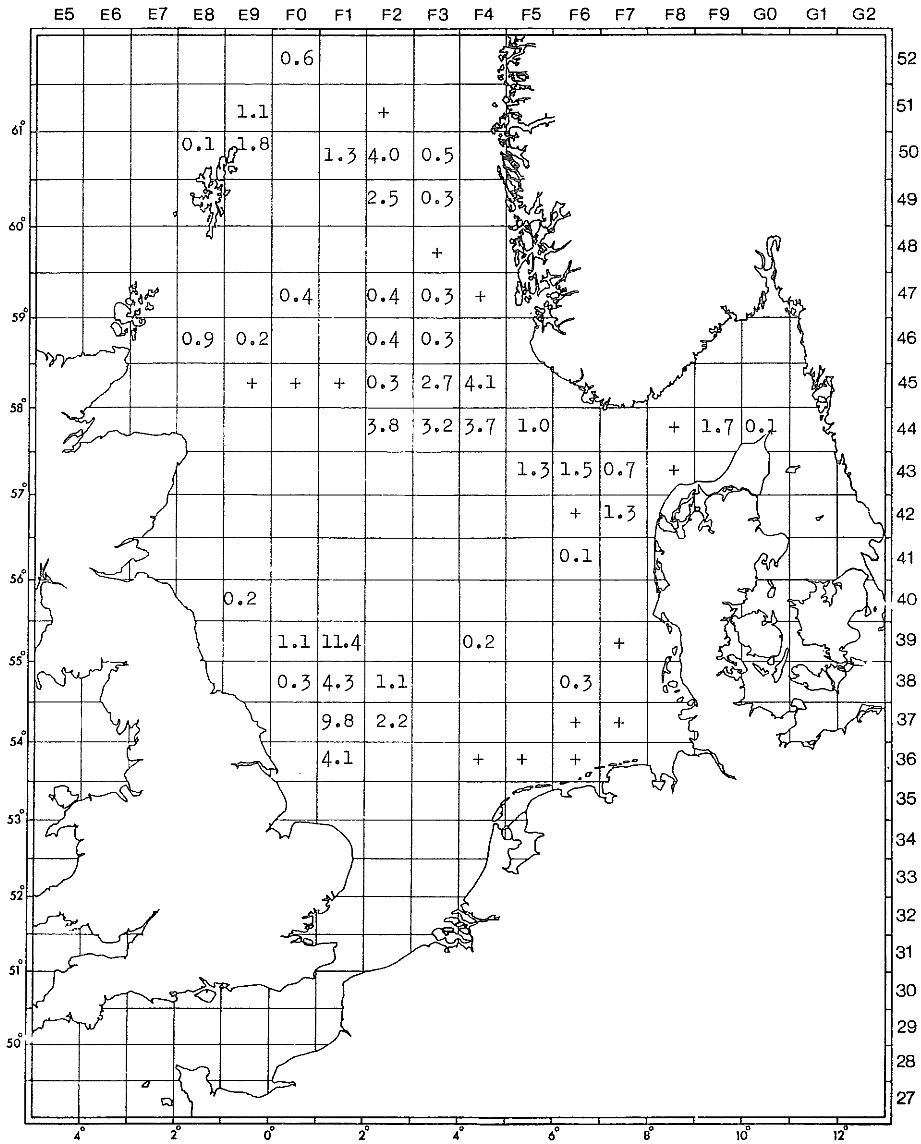


Figure 2.5. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in May 1977 (253 100 tonnes).

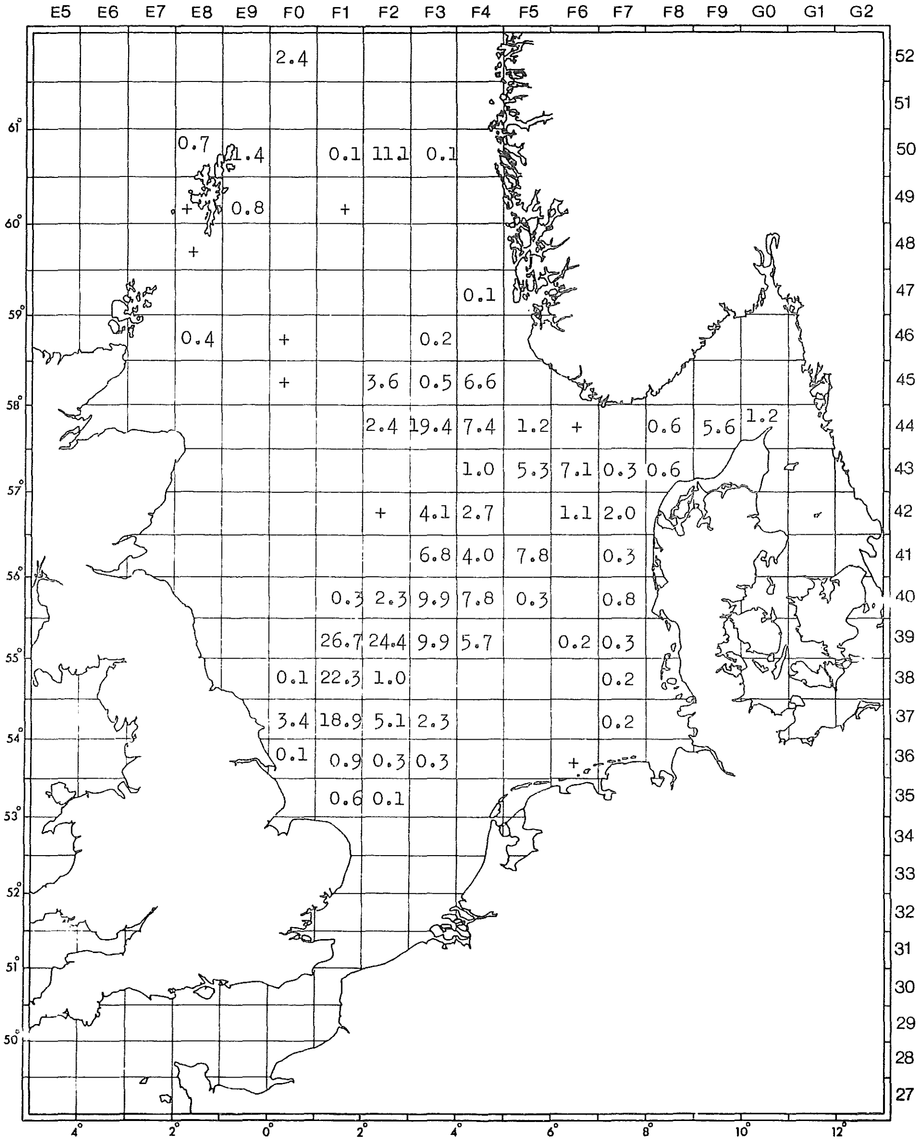


Figure 2.6. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in June 1977 (261 400 tonnes).

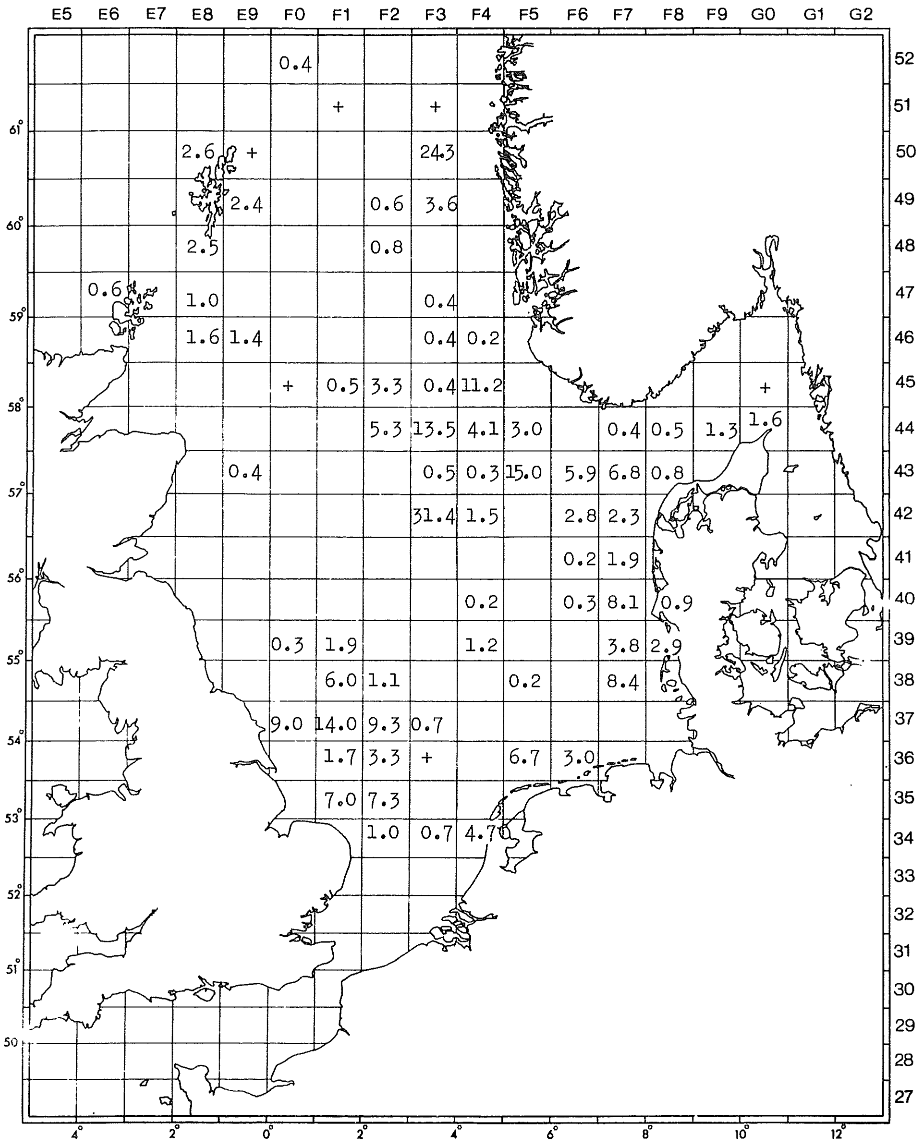


Figure 2.7. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in July 1977 (829 000 tonnes).

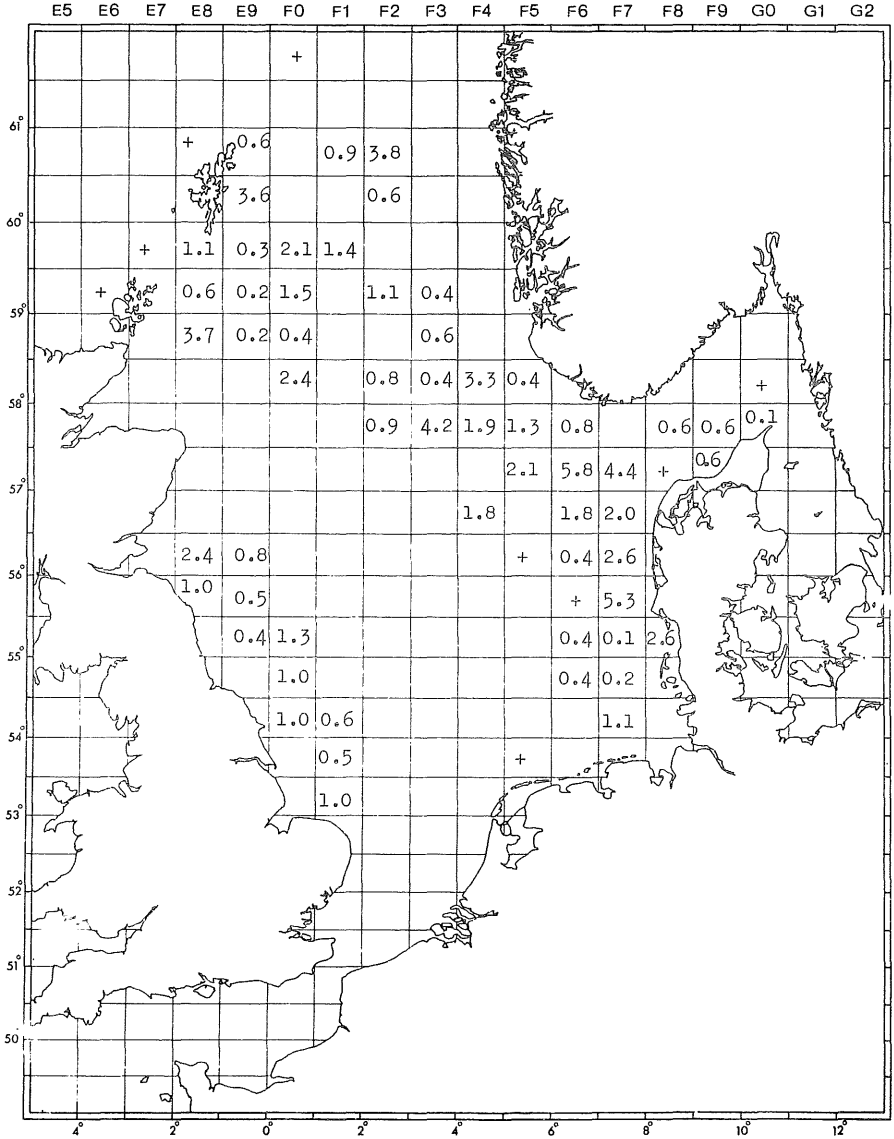


Figure 2.8. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in August 1977 (123 200 tonnes).

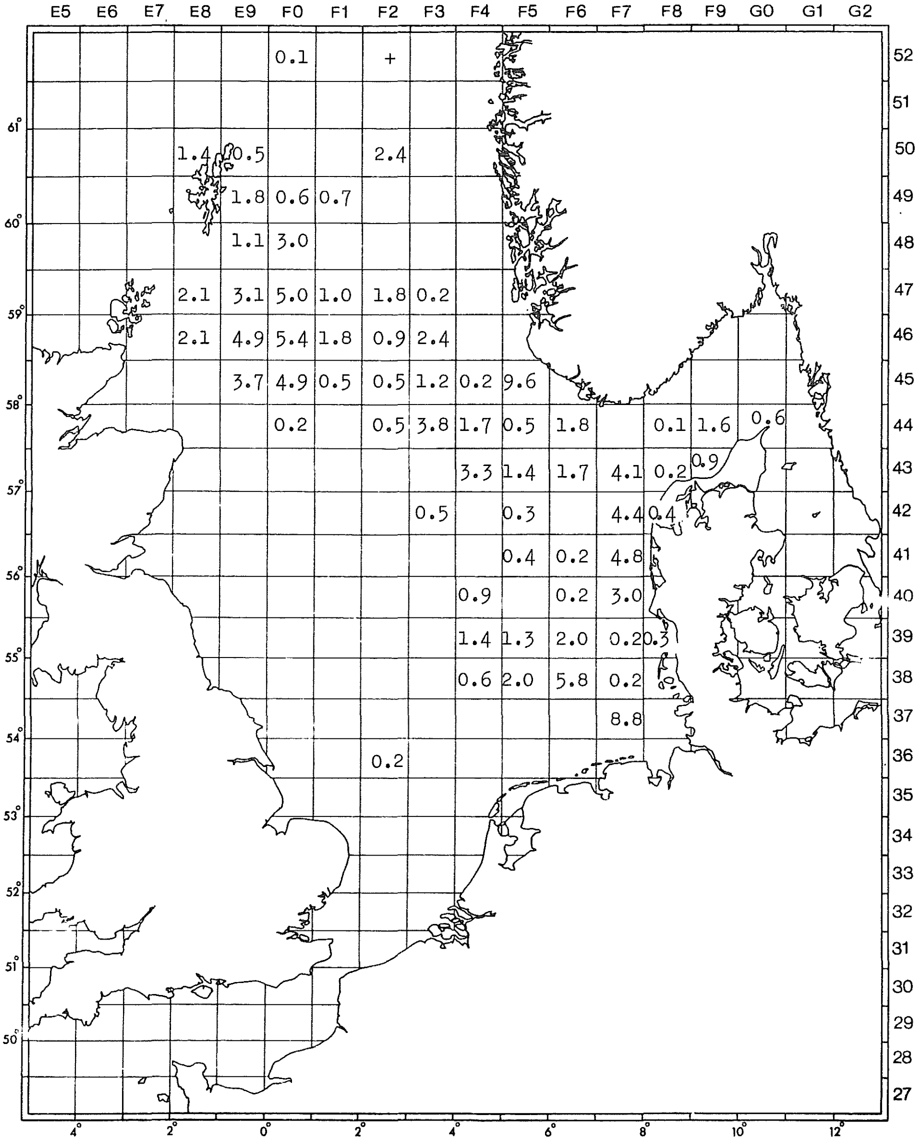


Figure 2.9. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in September 1977 (134 600 tonnes).

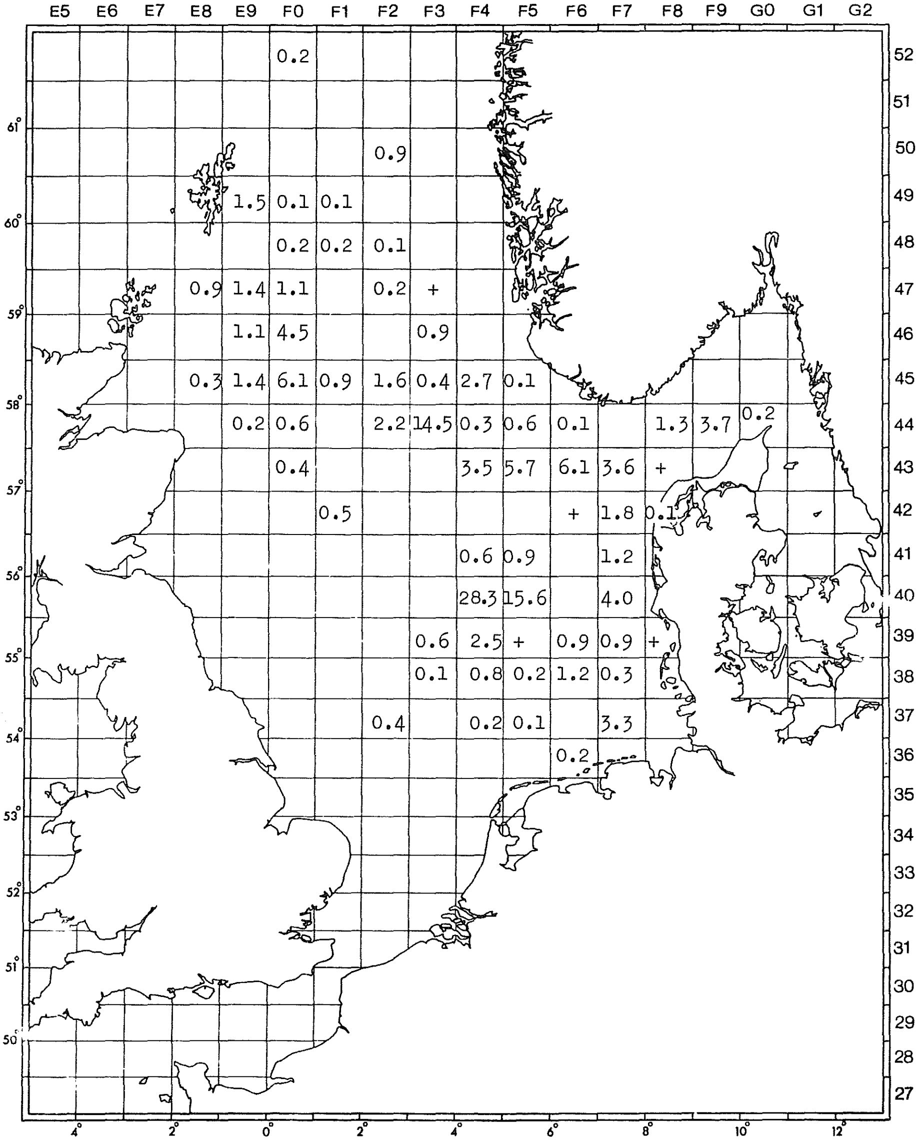


Figure 2.10. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in October 1977 (110 100 tonnes).

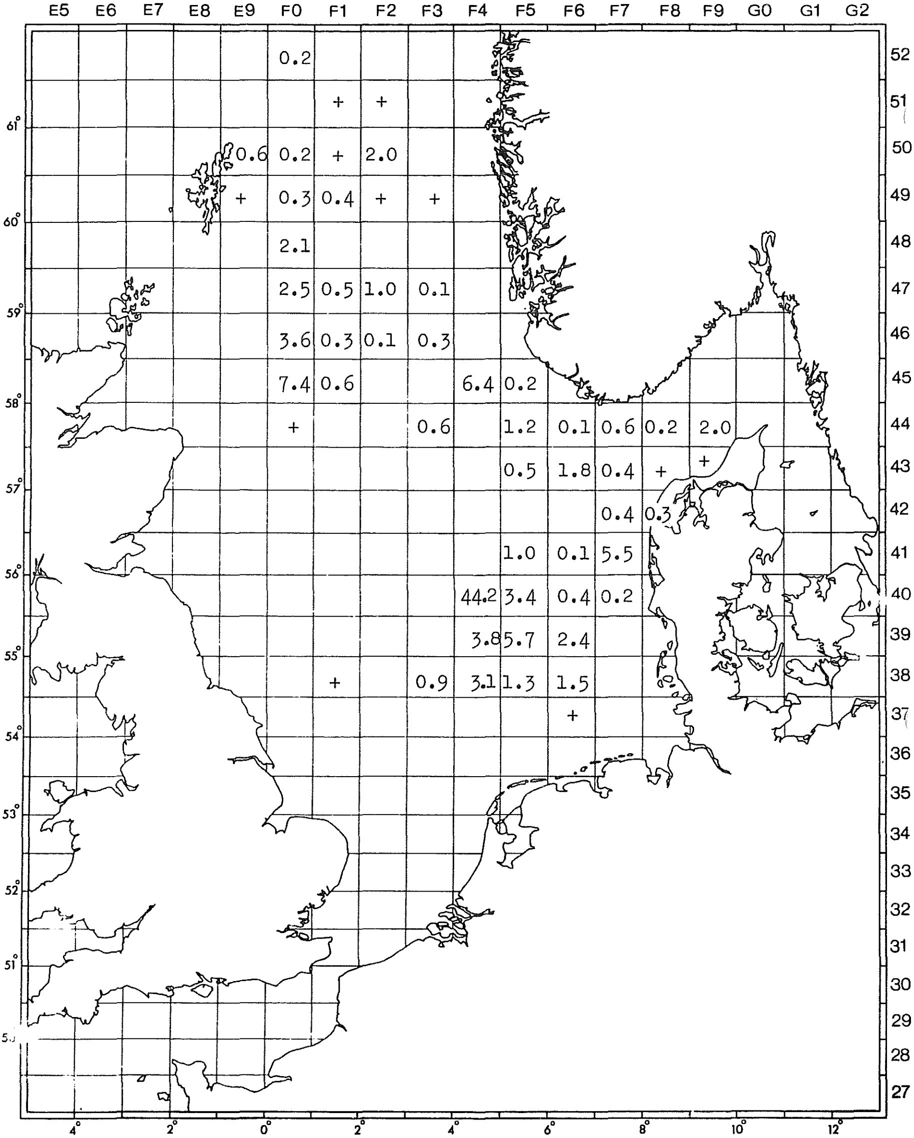


Figure 2.11. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in November 1977 (71 000 tonnes).

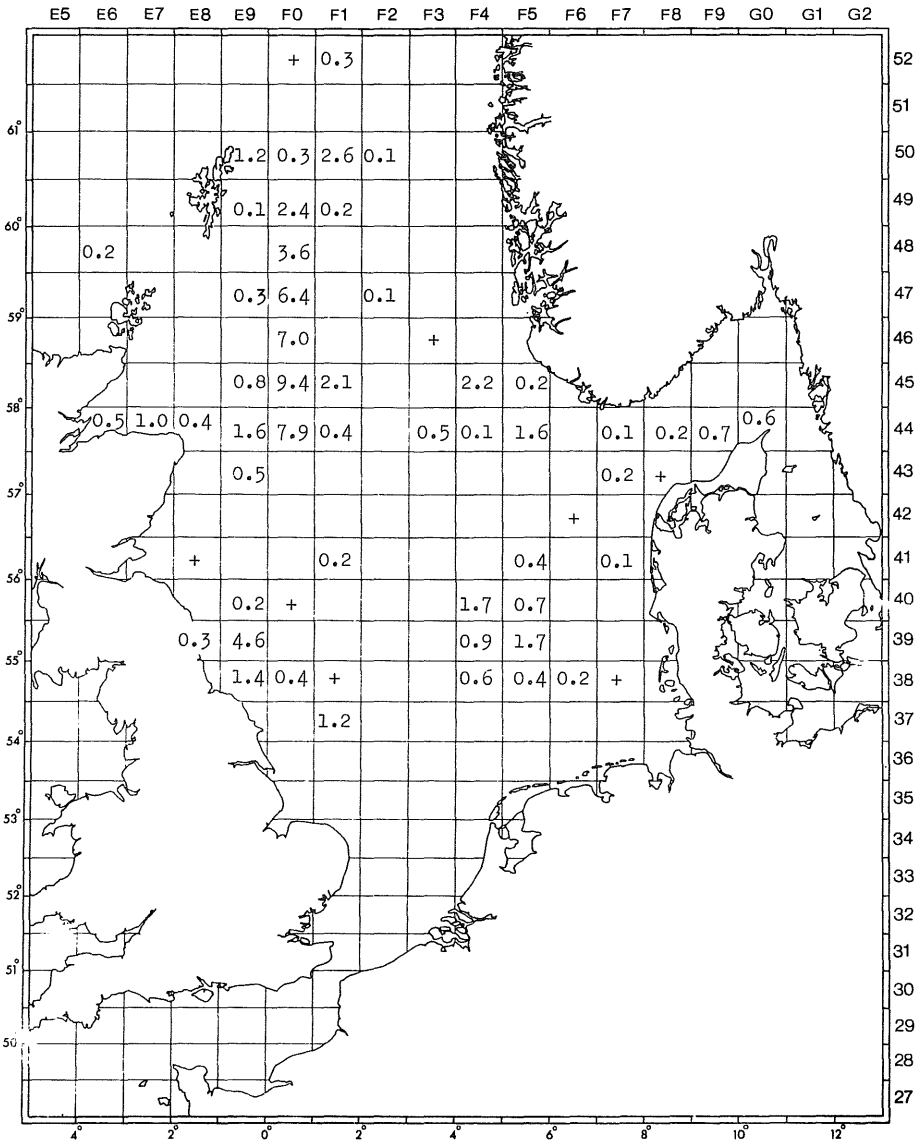


Figure 2.12. Catches of SPRAT, SANDEEL and NORWAY POUT ('000 tonnes) in December 1977 (80 900 tonnes).

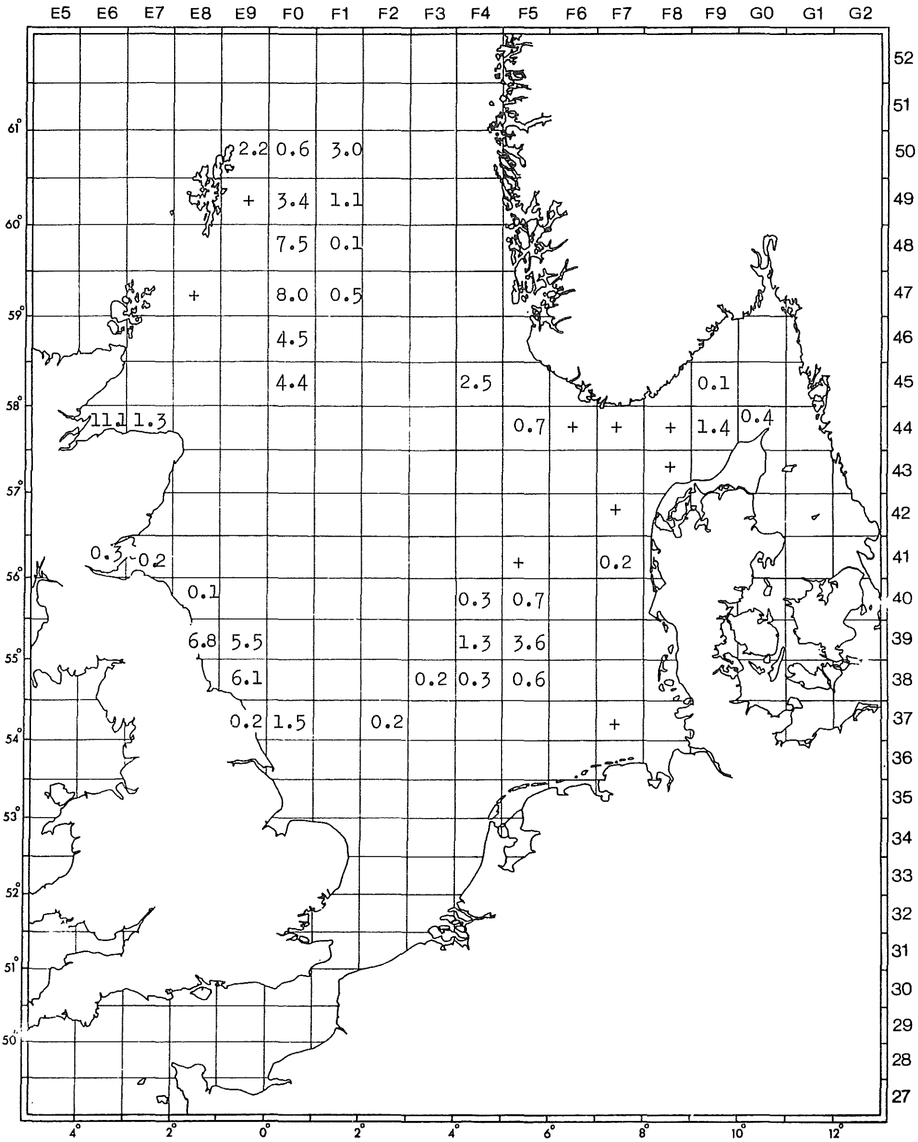


Figure 2.13. Danish NORWAY POUT areas.

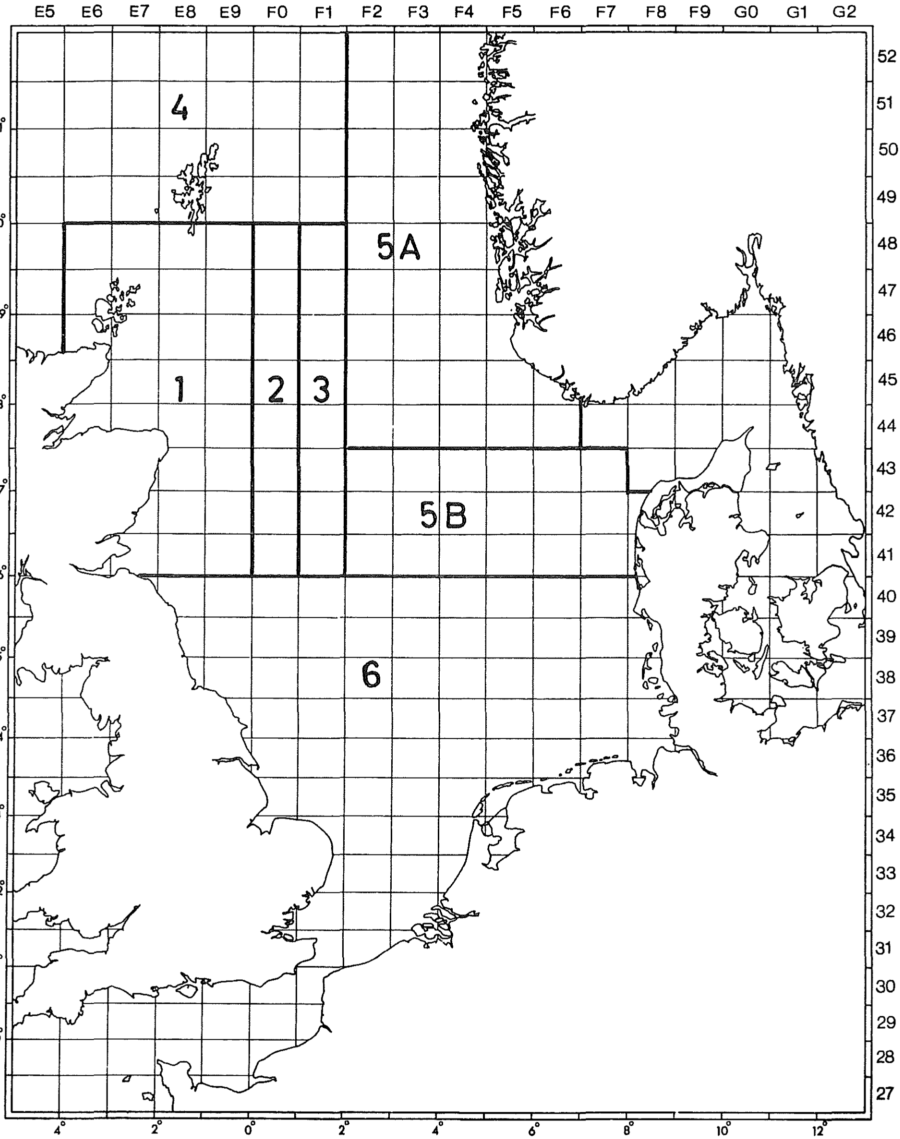


Figure 2.14. Danish SANDEEL areas.

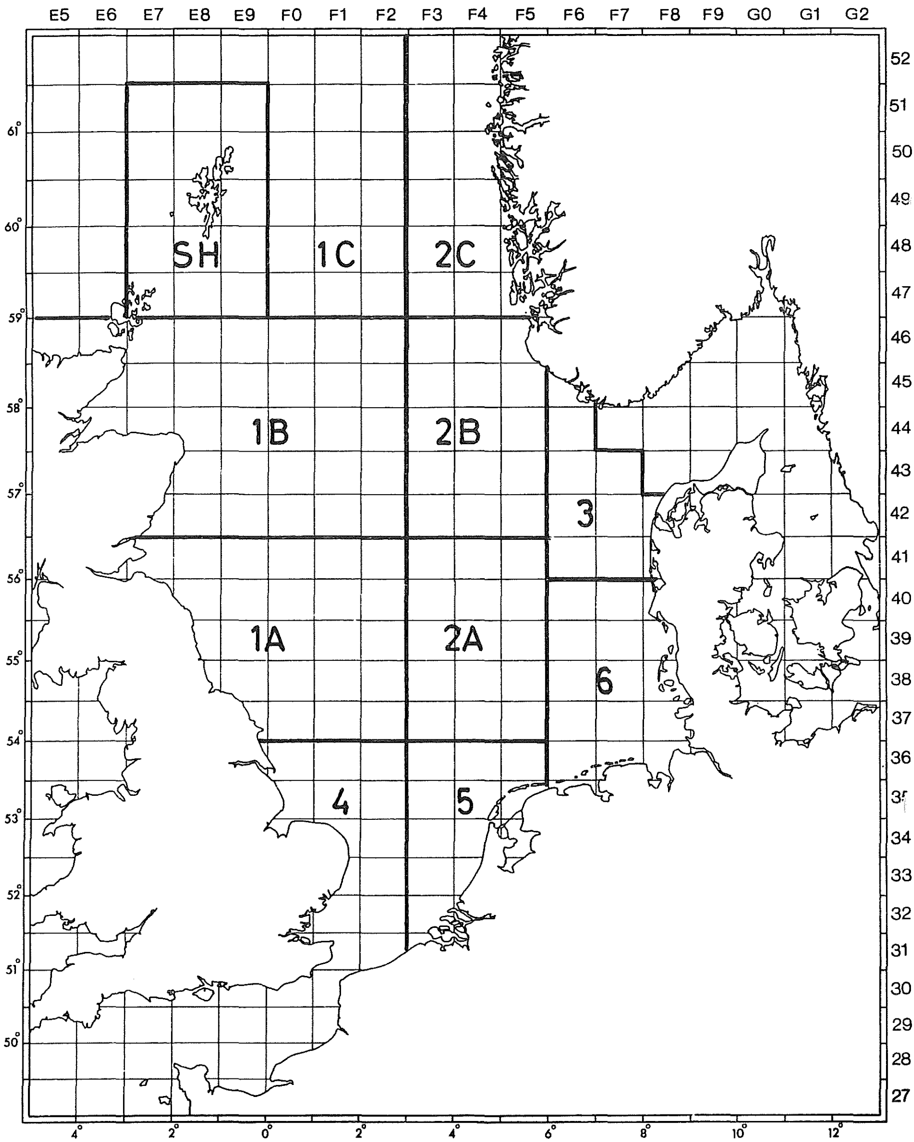
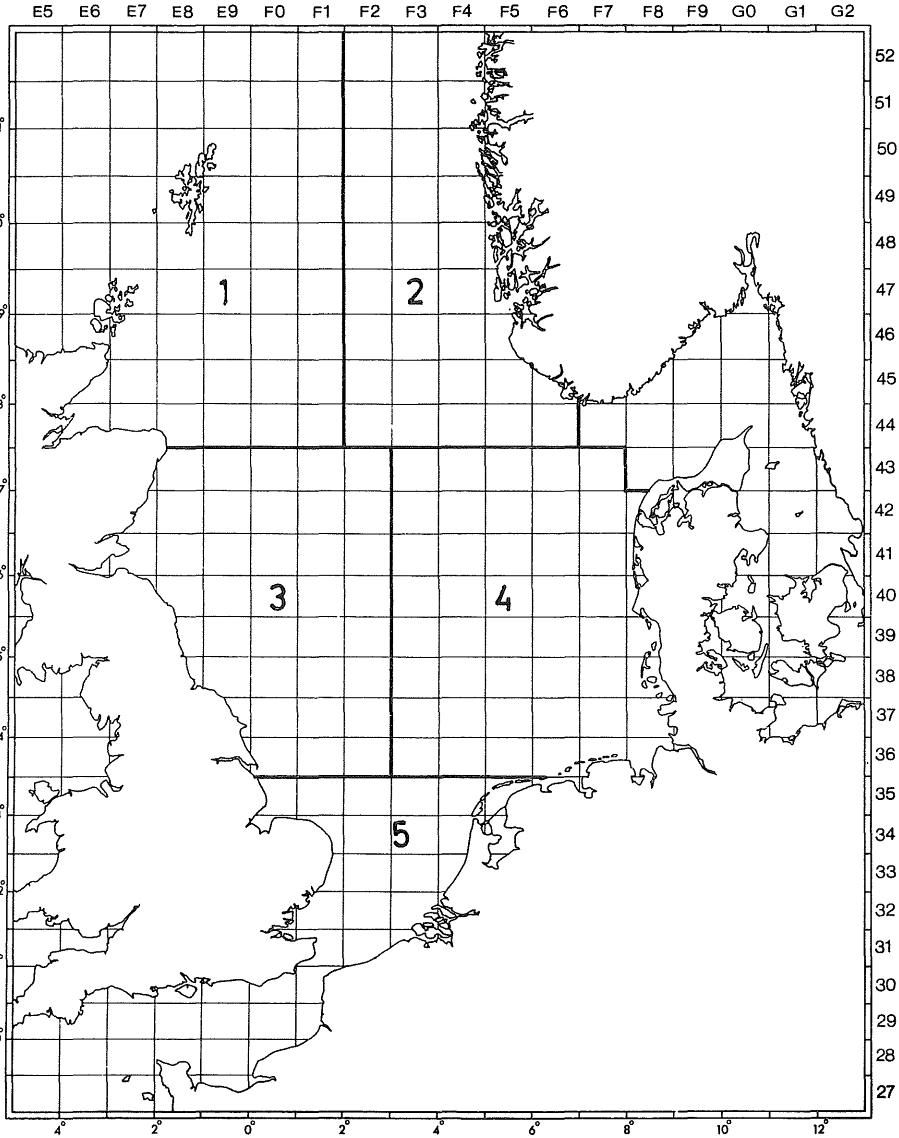


Figure 2.15. International SPRAT reporting areas.



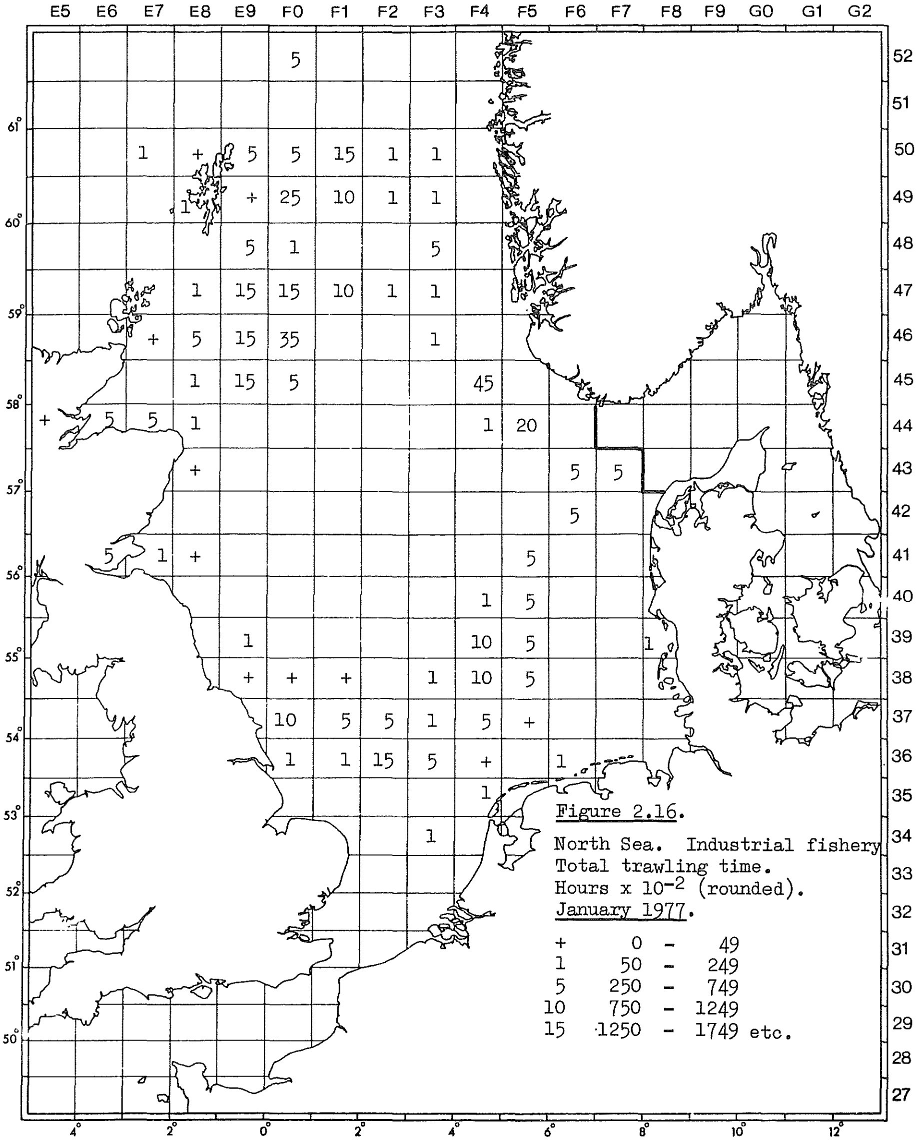


Figure 2.16.

North Sea. Industrial fishery
Total trawling time.
Hours x 10^{-2} (rounded).
January 1977.

+	0	-	49
1	50	-	249
5	250	-	749
10	750	-	1249
15	1250	-	1749 etc.

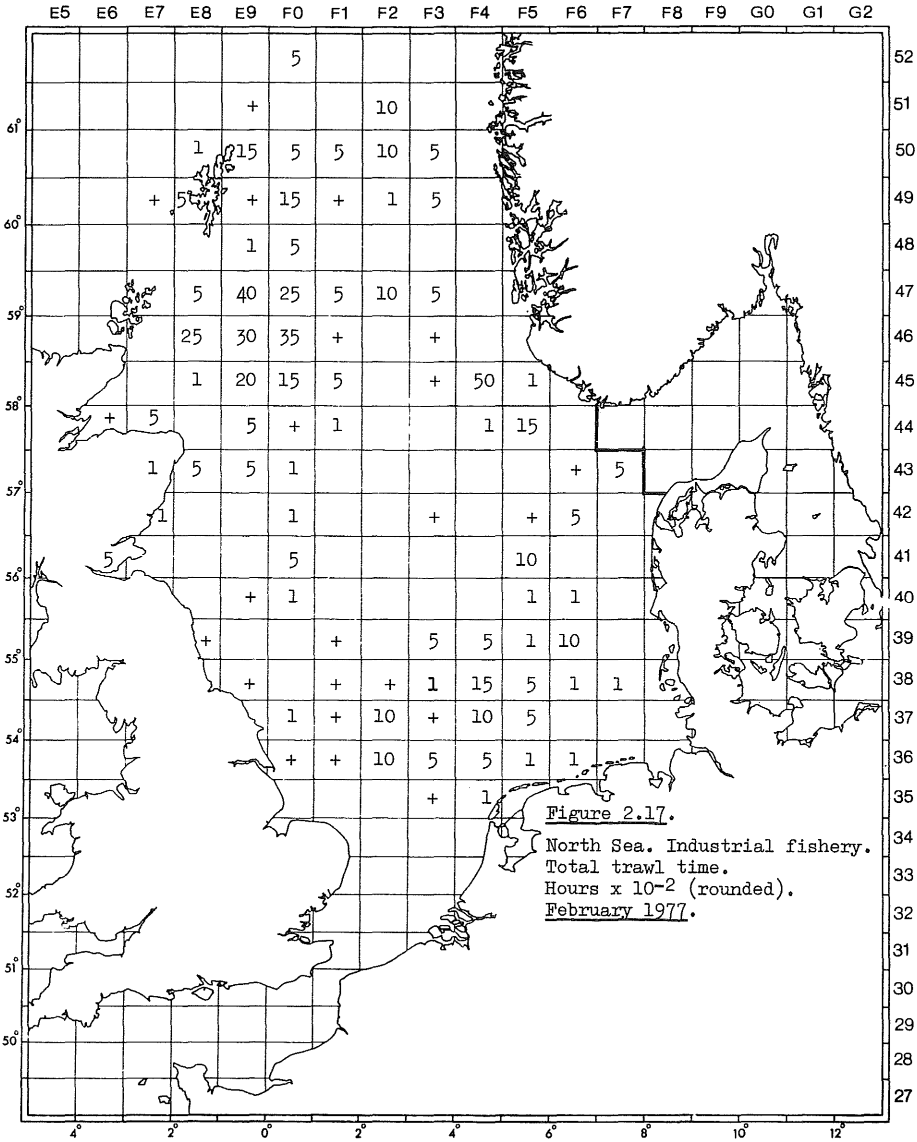


Figure 2.17.

North Sea. Industrial fishery.
Total trawl time.
Hours x 10^{-2} (rounded).
February 1977.

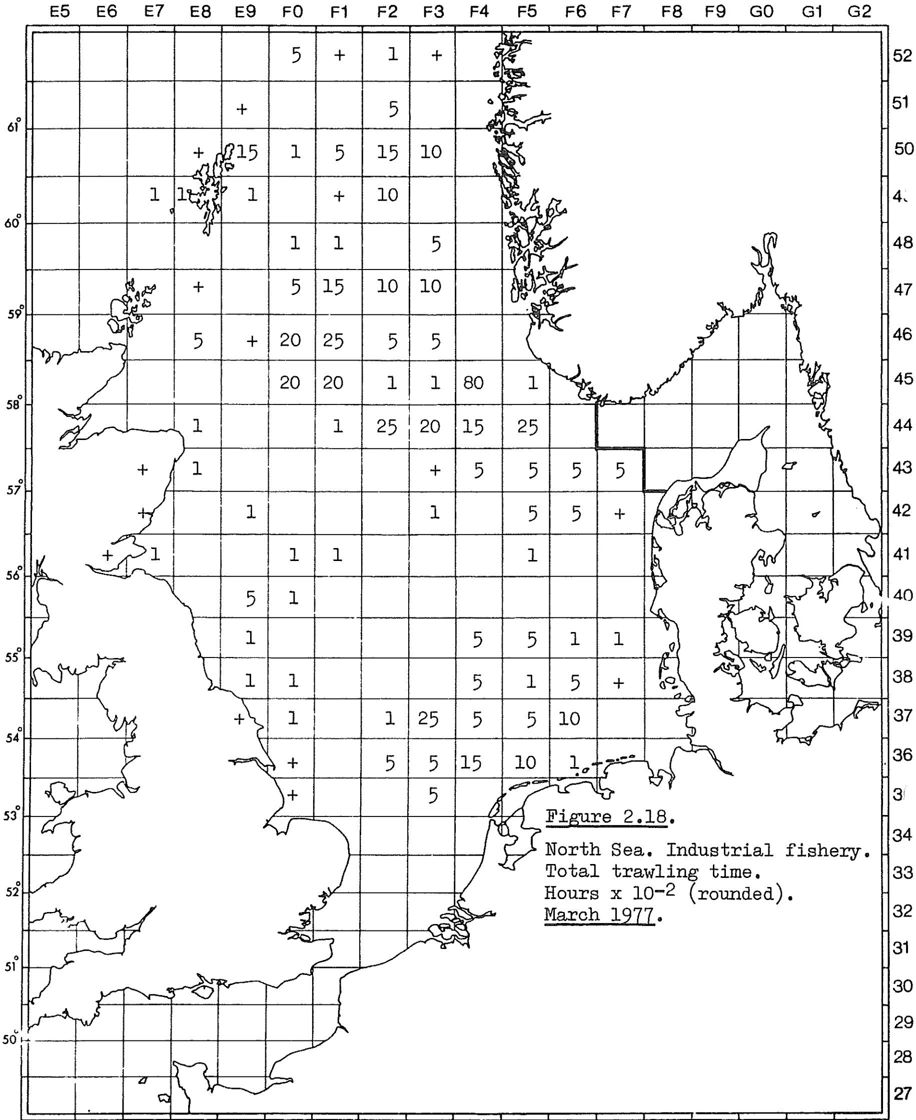


Figure 2.18.

North Sea. Industrial fishery.
Total trawling time.
Hours x 10^{-2} (rounded).
March 1977.

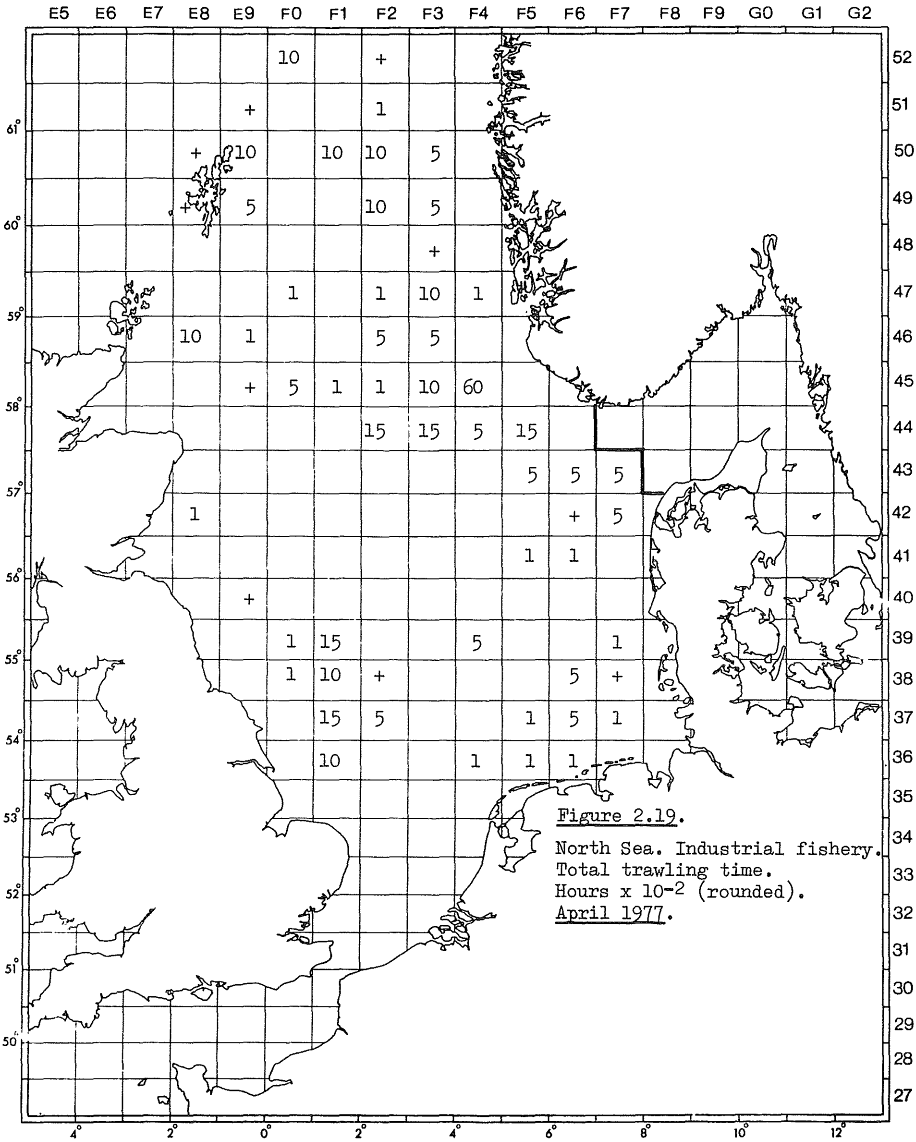


Figure 2.19.

North Sea. Industrial fishery. Total trawling time. Hours x 10^{-2} (rounded). April 1977.

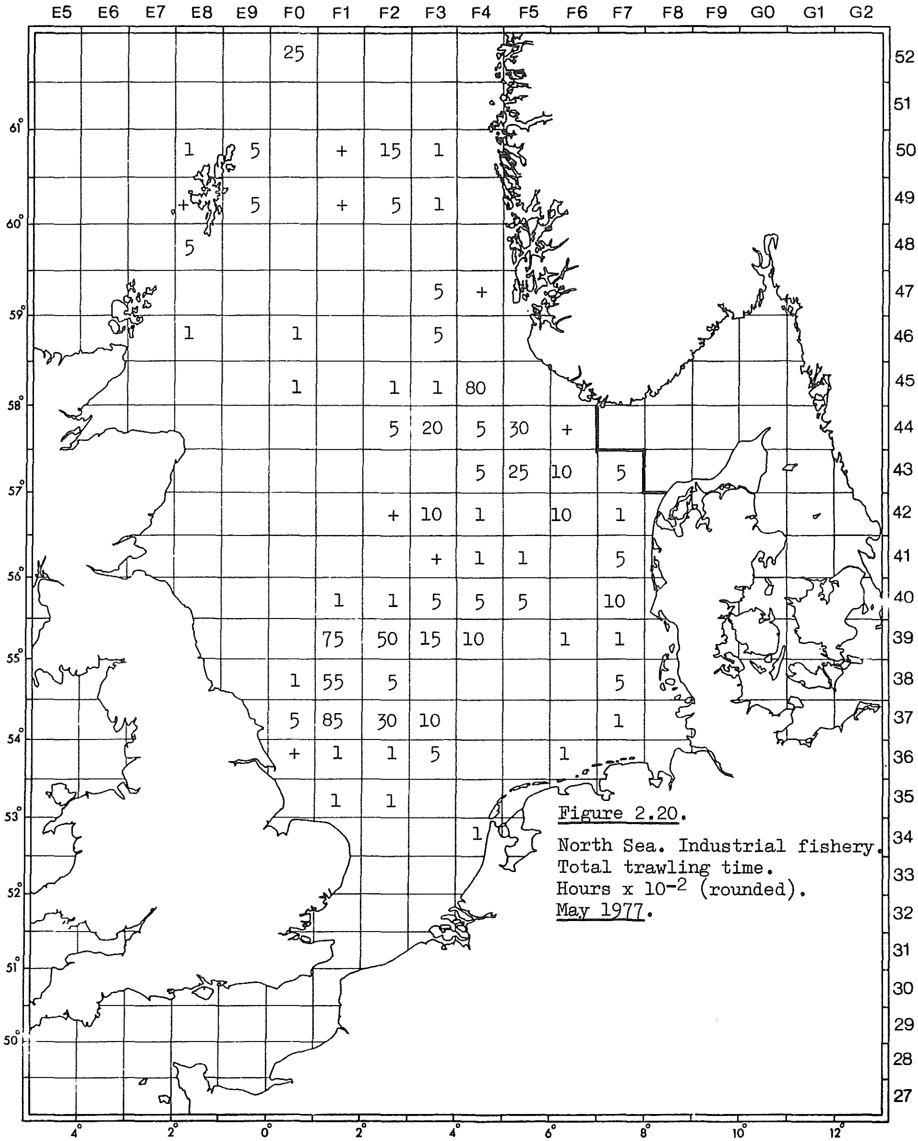


Figure 2.20.

North Sea. Industrial fishery.
Total trawling time.
Hours x 10^{-2} (rounded).
May 1977.

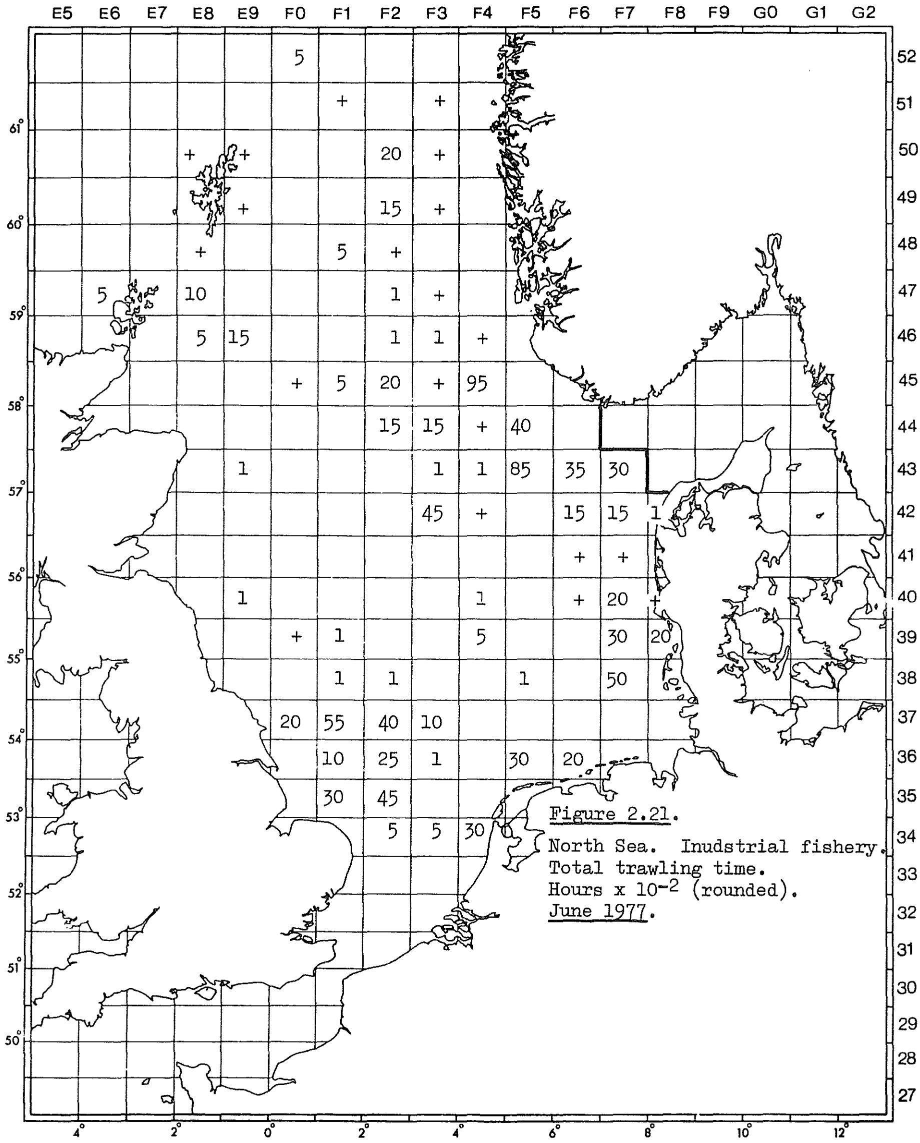


Figure 2.21.

North Sea. Inudstrial fishery.
Total trawling time.
Hours x 10^{-2} (rounded).
June 1977.

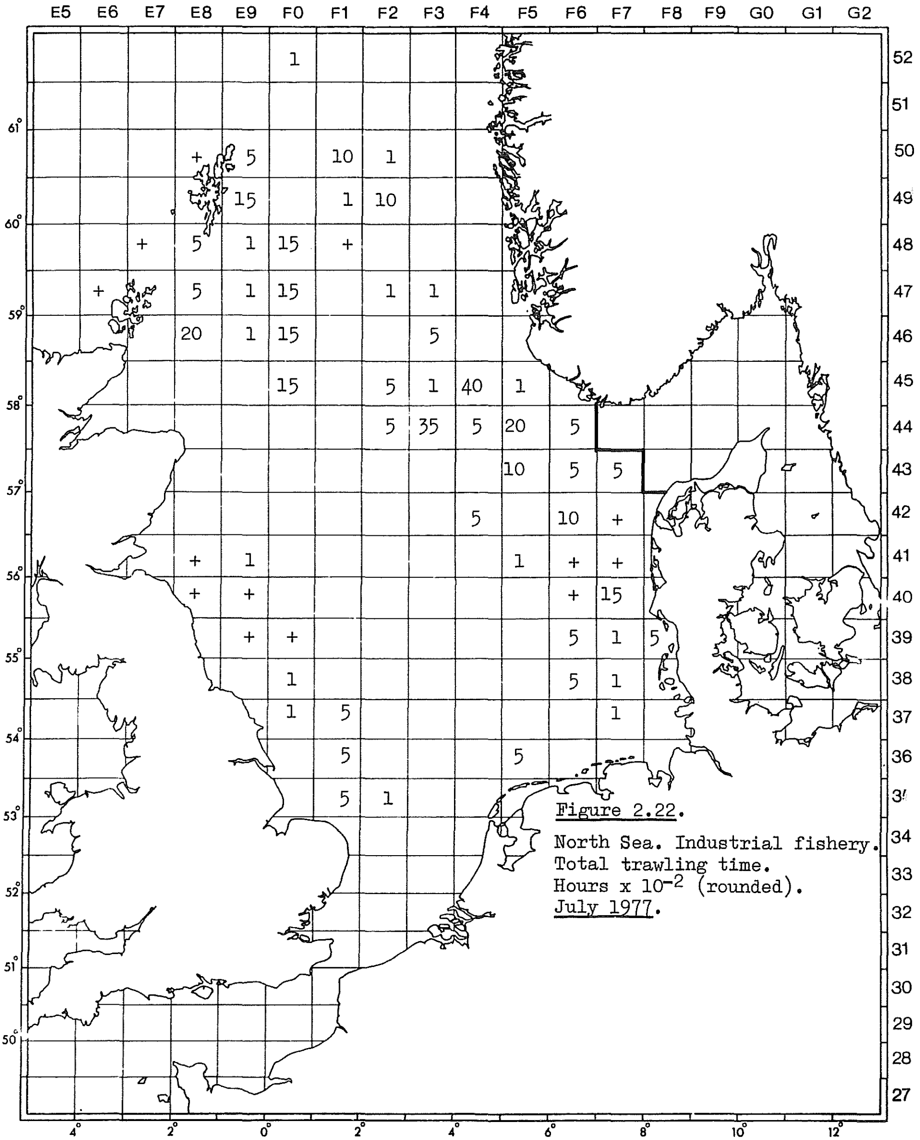


Figure 2.22.

North Sea. Industrial fishery. Total trawling time. Hours x 10^{-2} (rounded). July 1977.

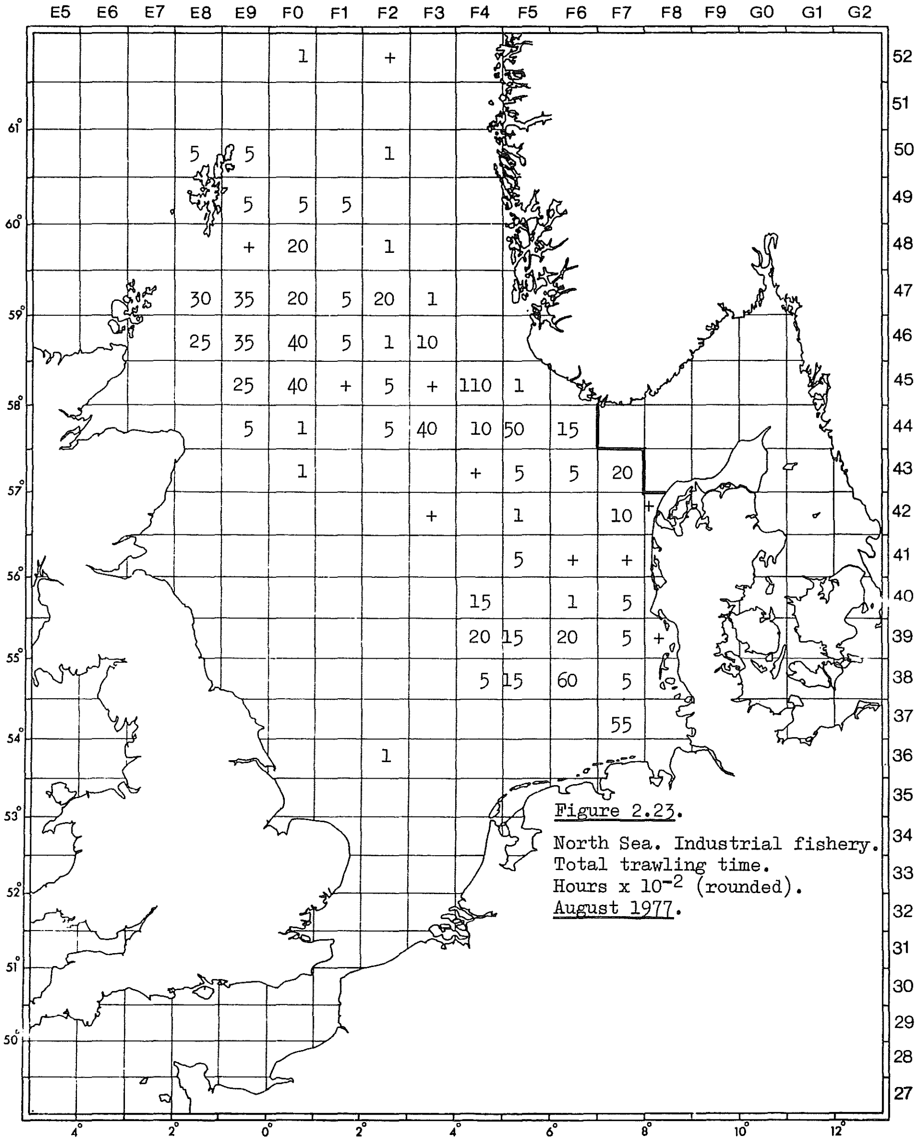


Figure 2.23.

North Sea. Industrial fishery.
Total trawling time.
Hours x 10^{-2} (rounded).
August 1977.

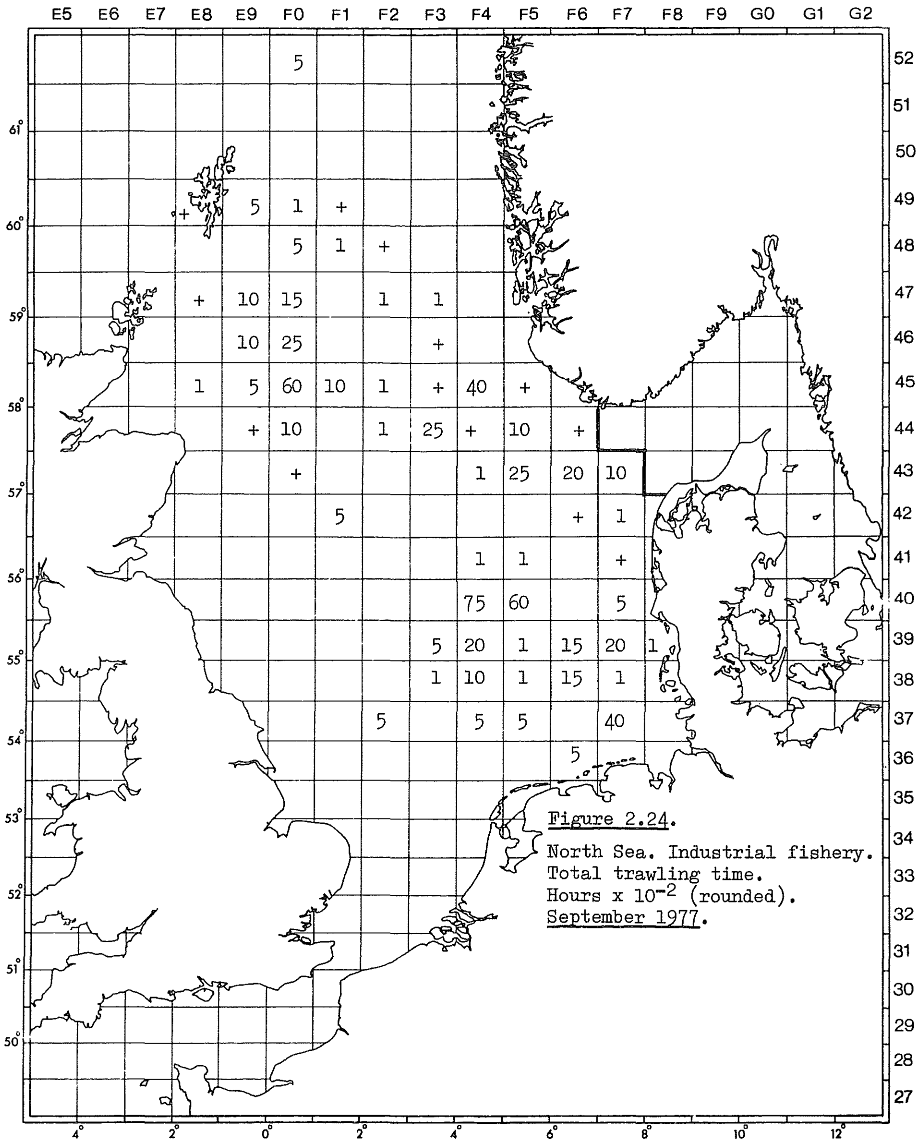


Figure 2.24.

North Sea. Industrial fishery.
Total trawling time.
Hours x 10^{-2} (rounded).
September 1977.

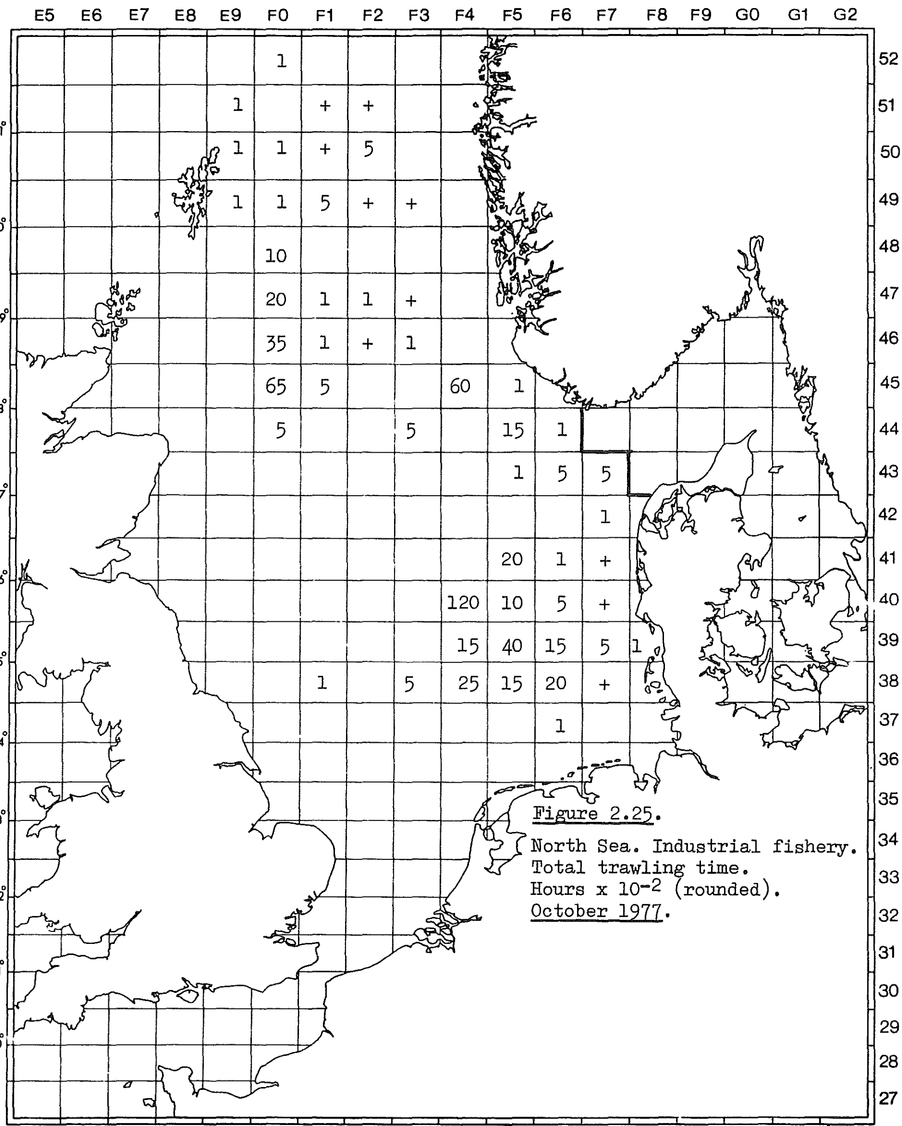


Figure 2.25.
North Sea. Industrial fishery.
Total trawling time.
Hours x 10^{-2} (rounded).
October 1977.

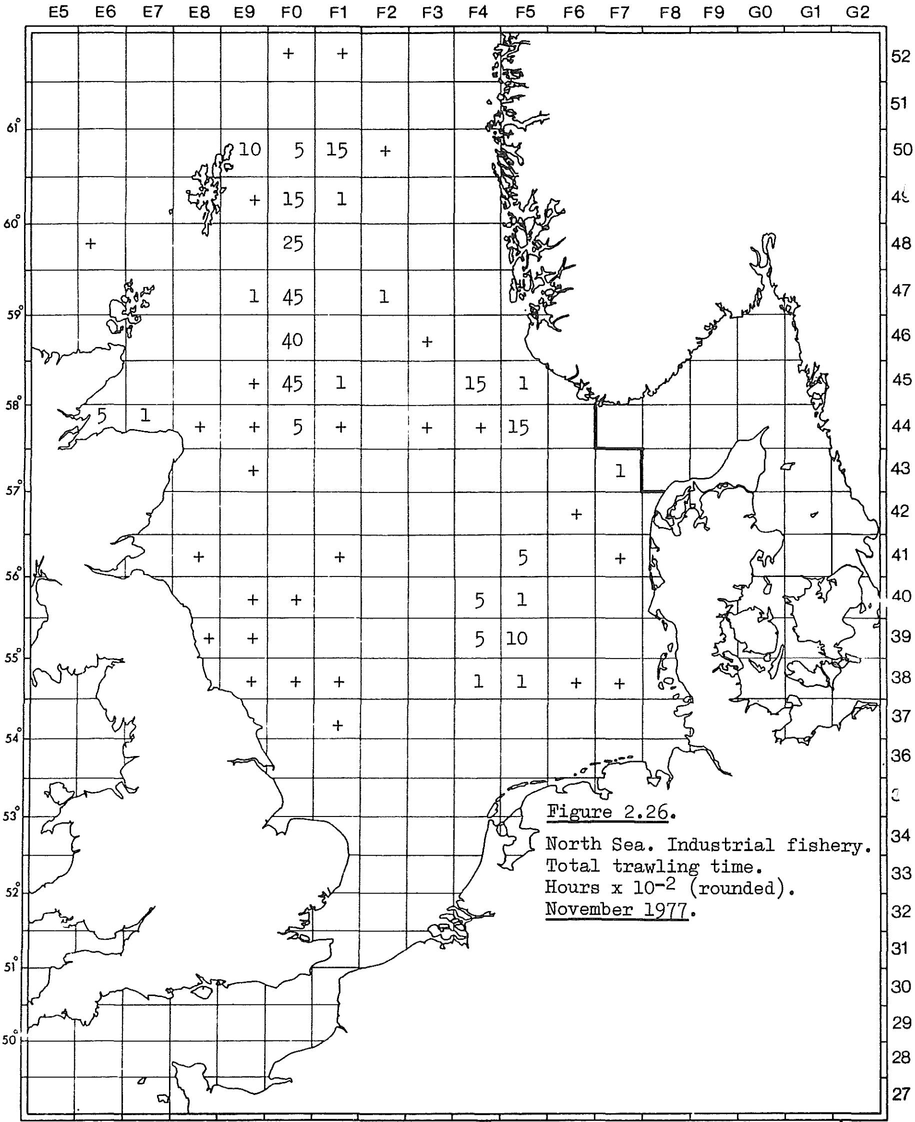


Figure 2.26.

North Sea. Industrial fishery.
Total trawling time.
Hours x 10^{-2} (rounded).
November 1977.

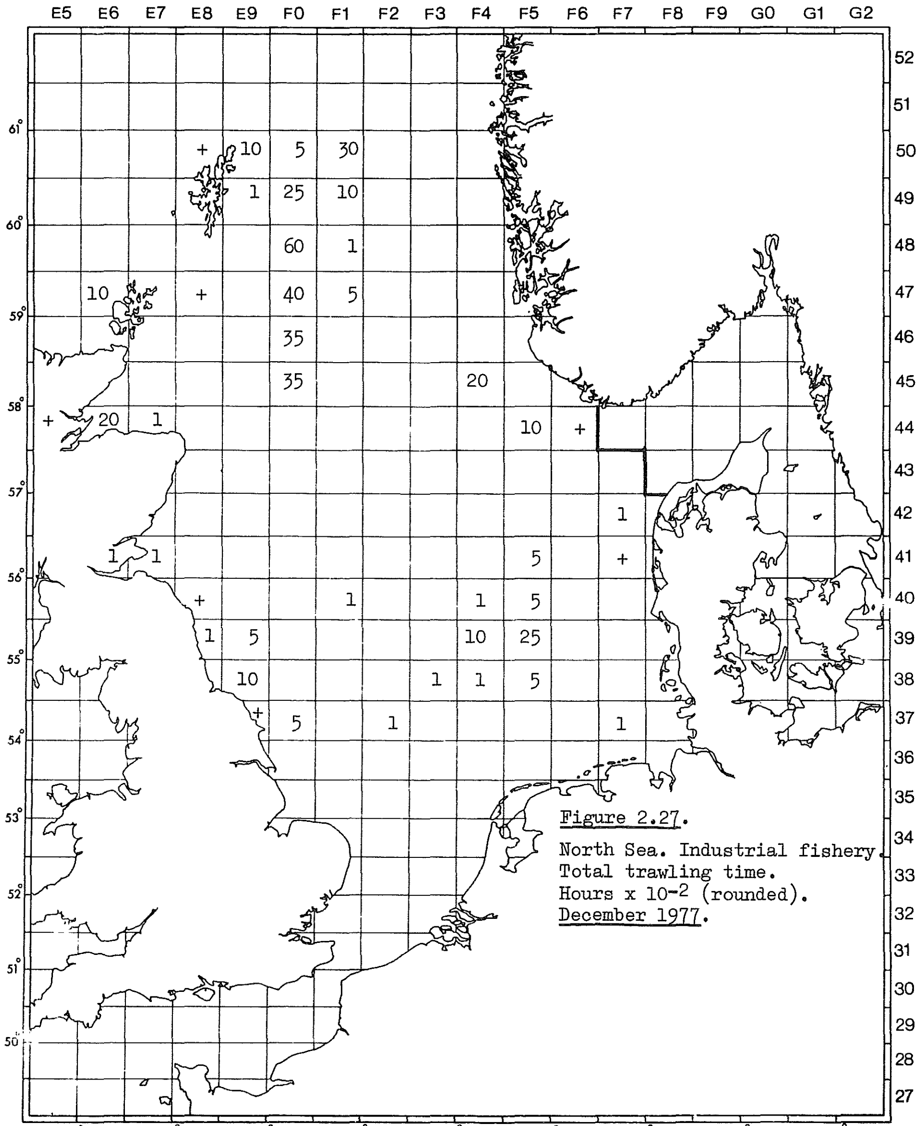


Figure 2.27.

North Sea. Industrial fishery. Total trawling time. Hours x 10^{-2} (rounded). December 1977.

Figure 3.4.1. Estimated HERRING by-catches in 1979.

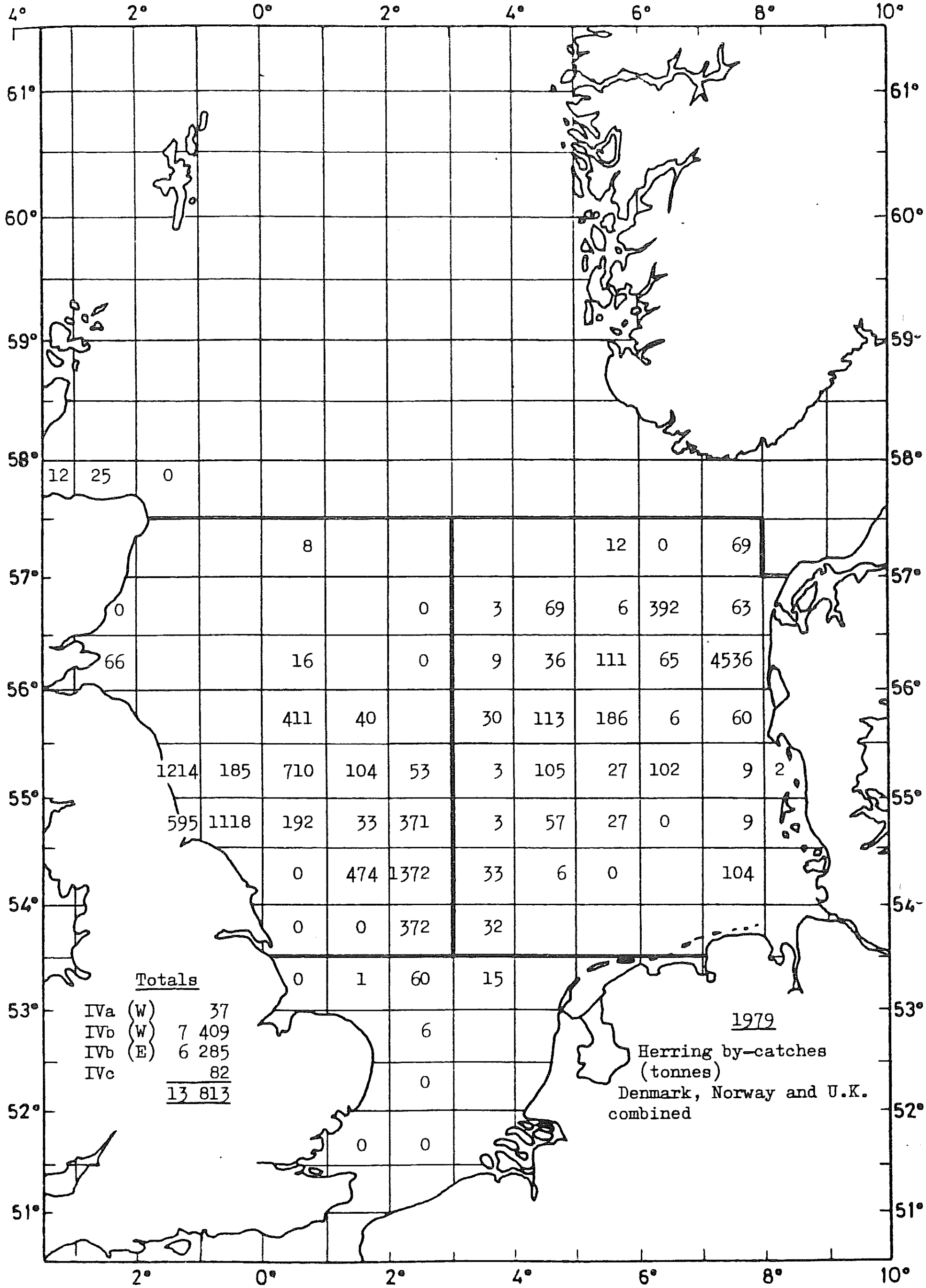


Figure 3.4.2. Percentage of HERRING in samples of Danish and Scottish SPRAT catches in 1979-80.

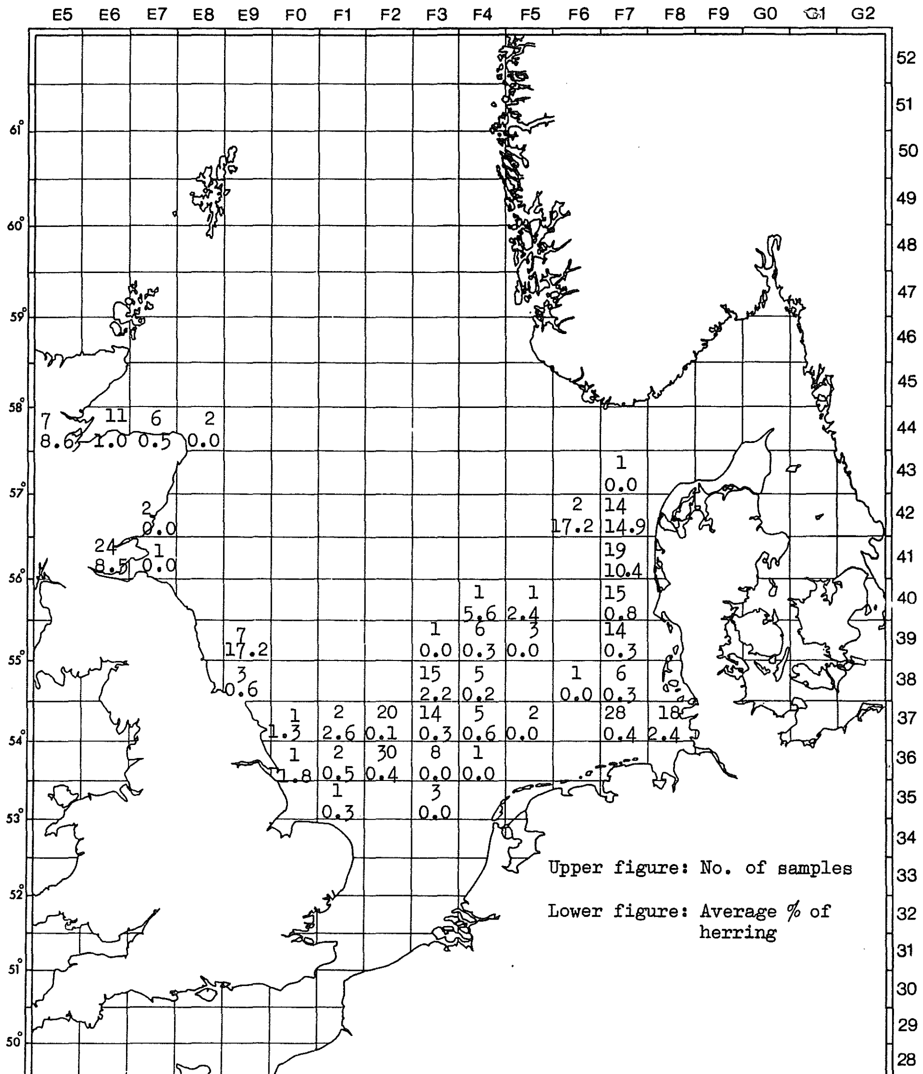


Figure 3.4.3. Percentage HERRING in individual samples of Scottish SPRAT catches, 1981.

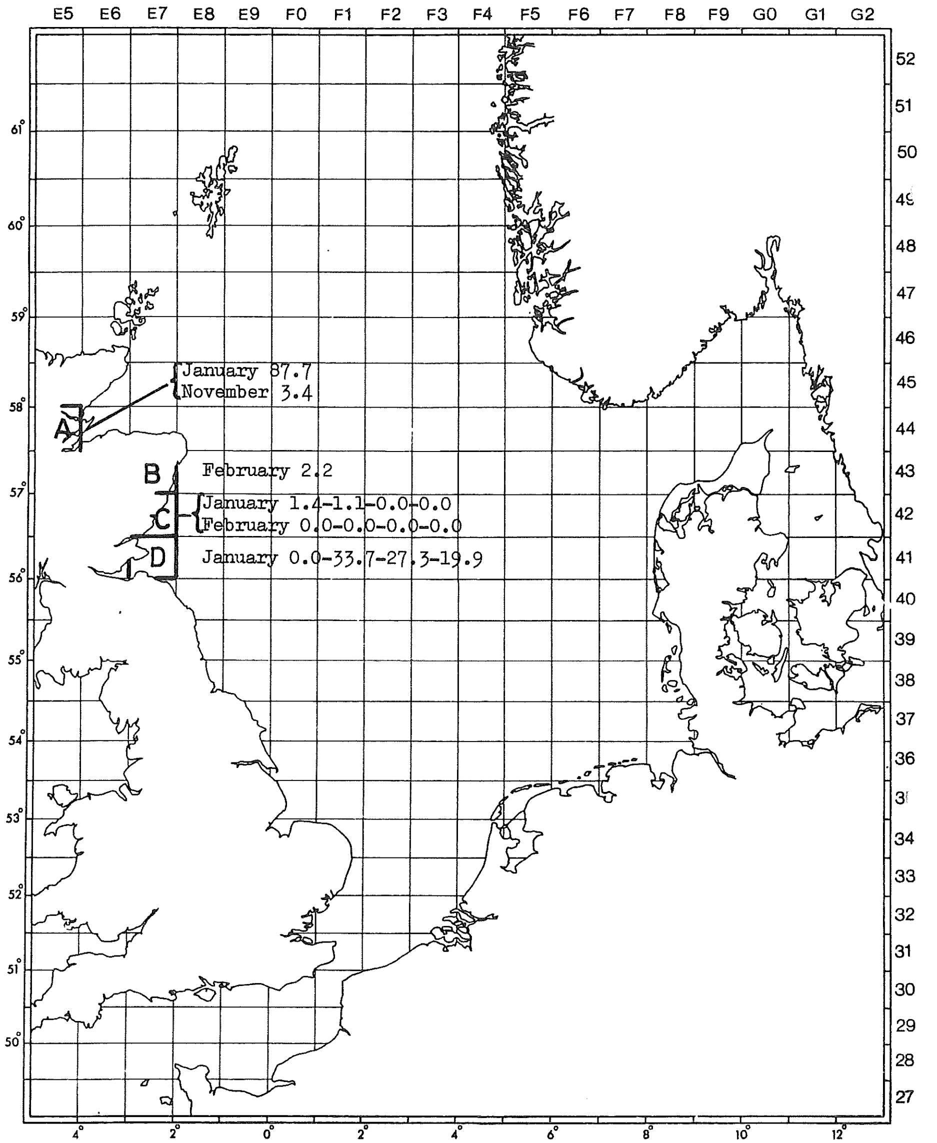


Figure 4.2.1. Norwegian CPUE figures for the NORWAY POUT fishery (including by-catches) by quarters, 1972-80.

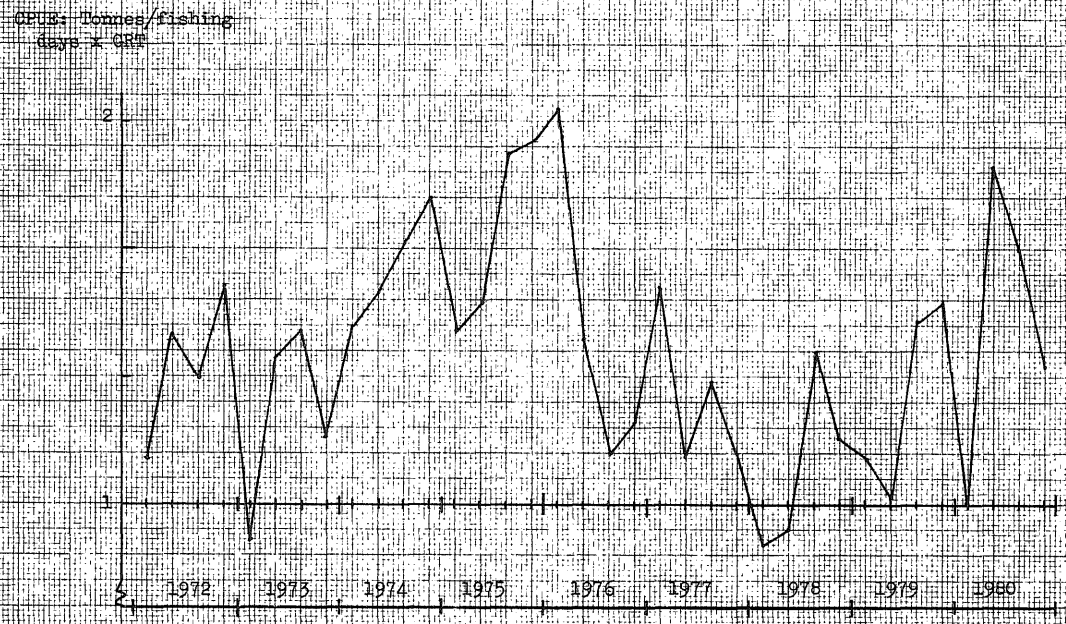
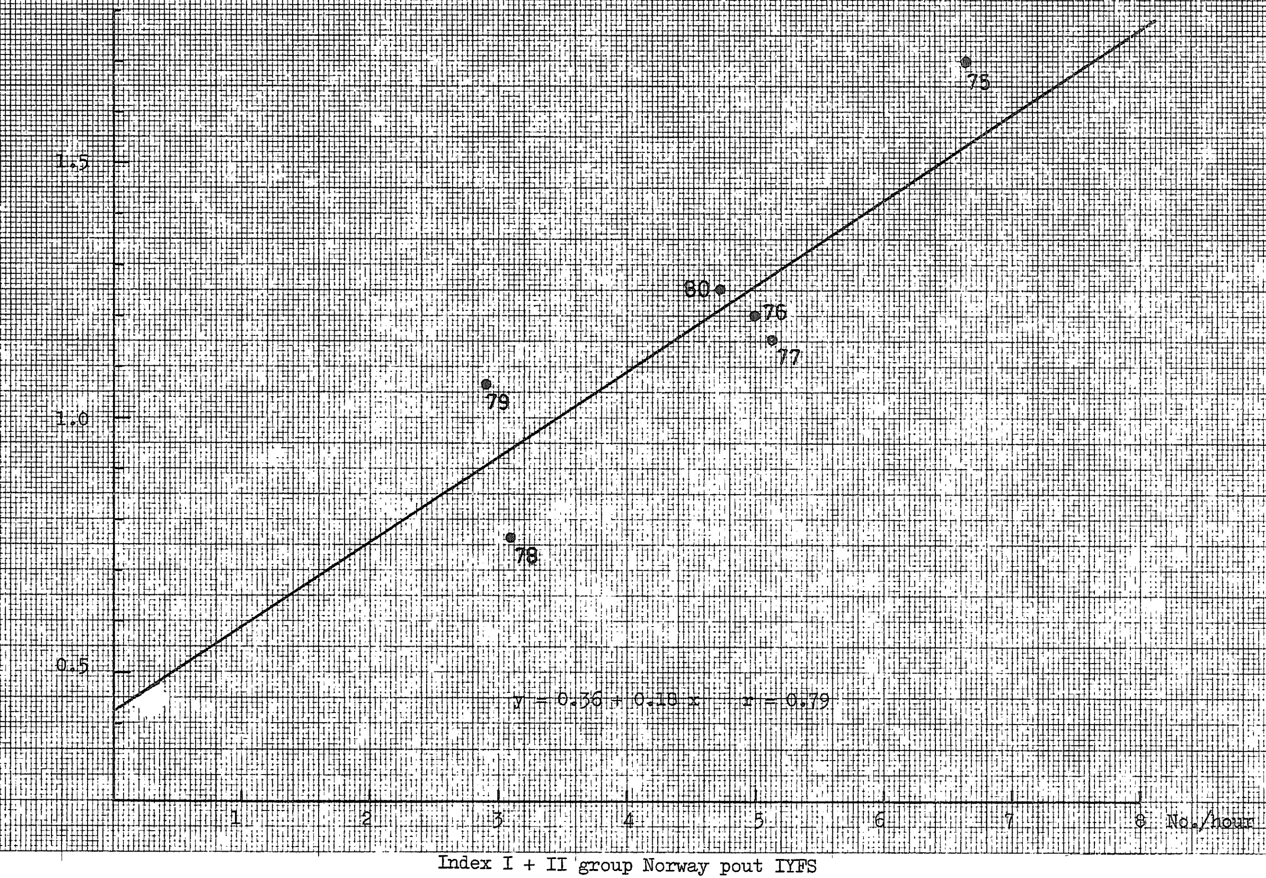


Figure 4.2.2. Relationship between abundance indices from IYFS and CPUE in the Norwegian fishery for NORWAY POUT. Blue whiting by-catches excluded.



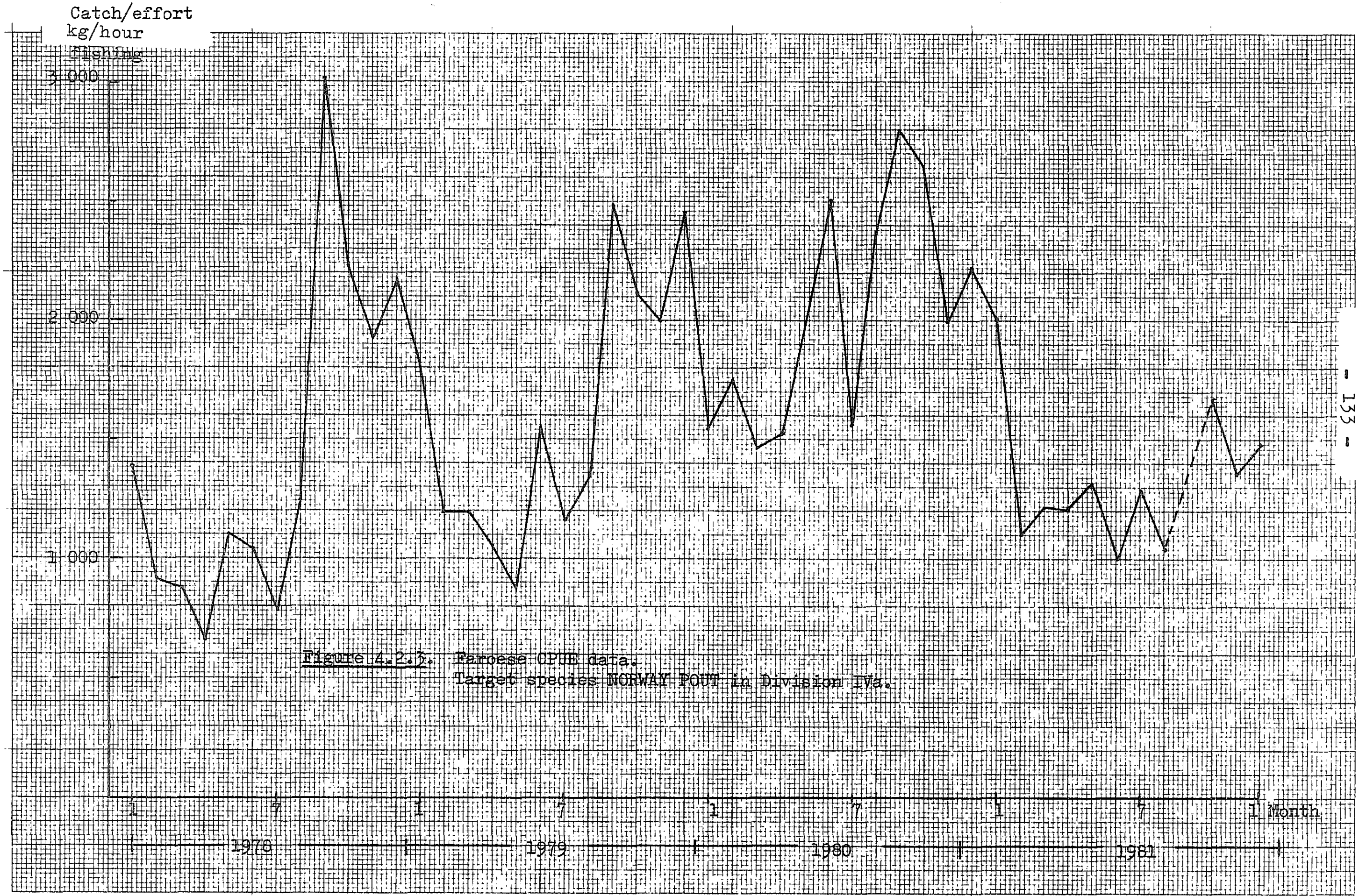


Figure 4.2.3. Faroese CPUE data.
Target species NORWAY POUT in Division IVa.

Figure 4.4.1. Sampling areas used for recruitment indices of NORWAY POUT shown in Table 4.5.1.

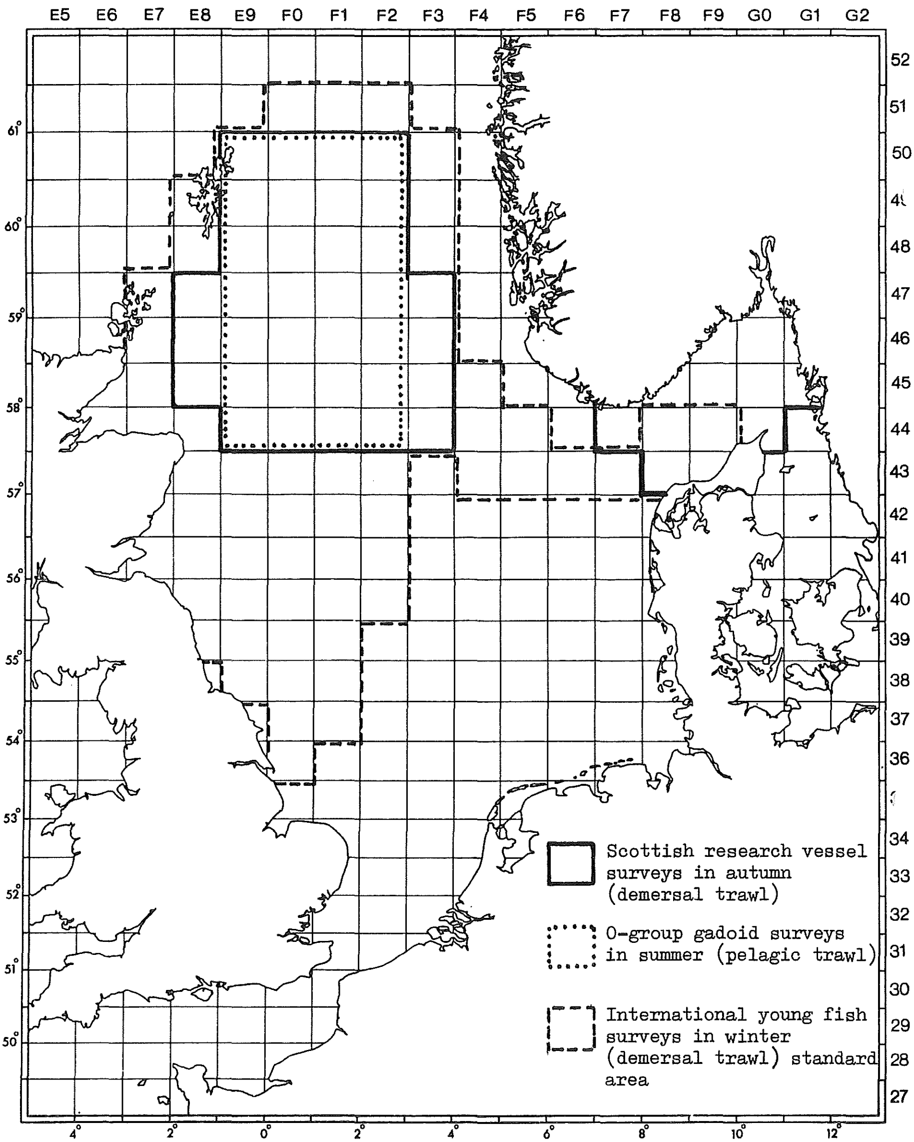


Figure 4.4.2. NORWAY POUT. Relationship between IYFS indices for 1-group and VPA estimates of 1-group in the first quarter of the year. M in VPA = 1 $year^{-1}$. Years refer to year class.

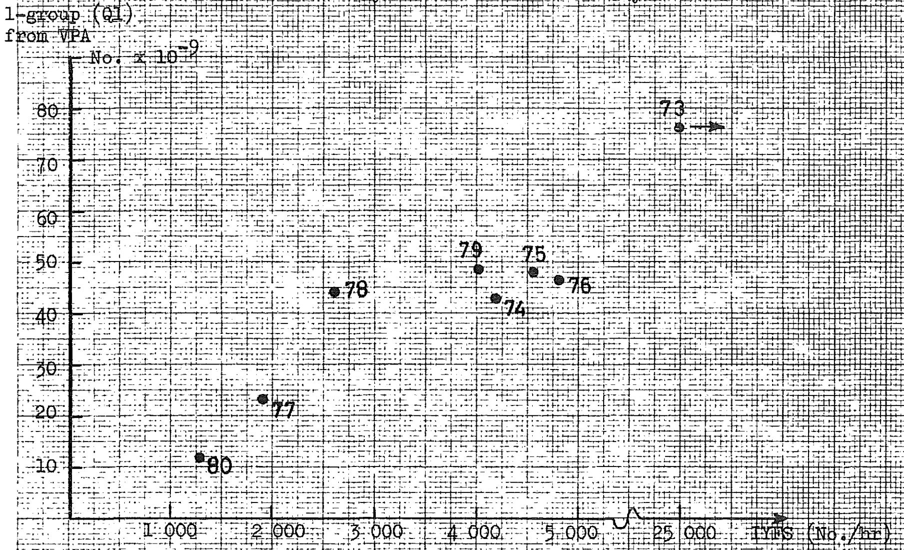


Figure 4.4.3. NORWAY POUT. Relationship between IYFS indices for 1-group and VPA estimates for 1-group in the first quarter of the year. M in VPA = 2.0 $year^{-1}$. Years refer to year class.

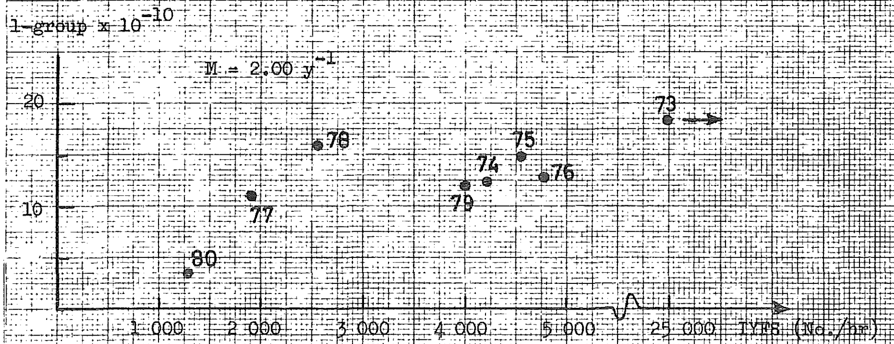


Figure 4.4.4. NORWAY POUT. Relationship between IYFS indices for 2-group and VPA estimates of 2-group in the first quarter of the year. M in VPA = 1.0 year^{-1}. Years refer to year class.

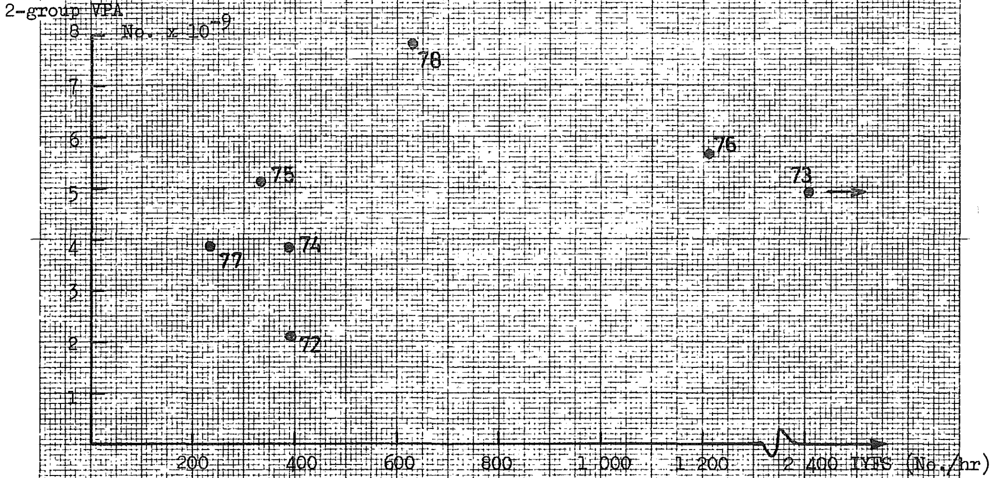


Figure 4.4.5. NORWAY POUT. Relationship between 0-group indices and VPA estimates for 0-group in the 3rd quarter of the year. M in VPA = 1.0 year^{-1}. Years refer to year class.

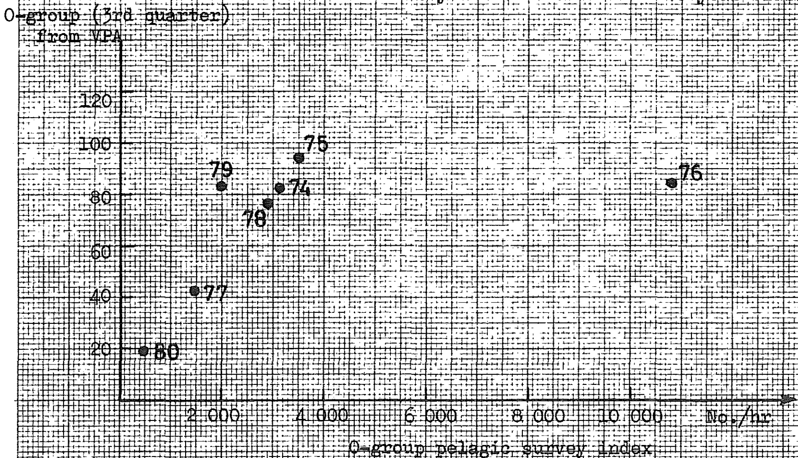


Figure 4.9.1. NORWAY POUT total catch versus IYFS index in the 1 and 2-group year classes 1970-80.

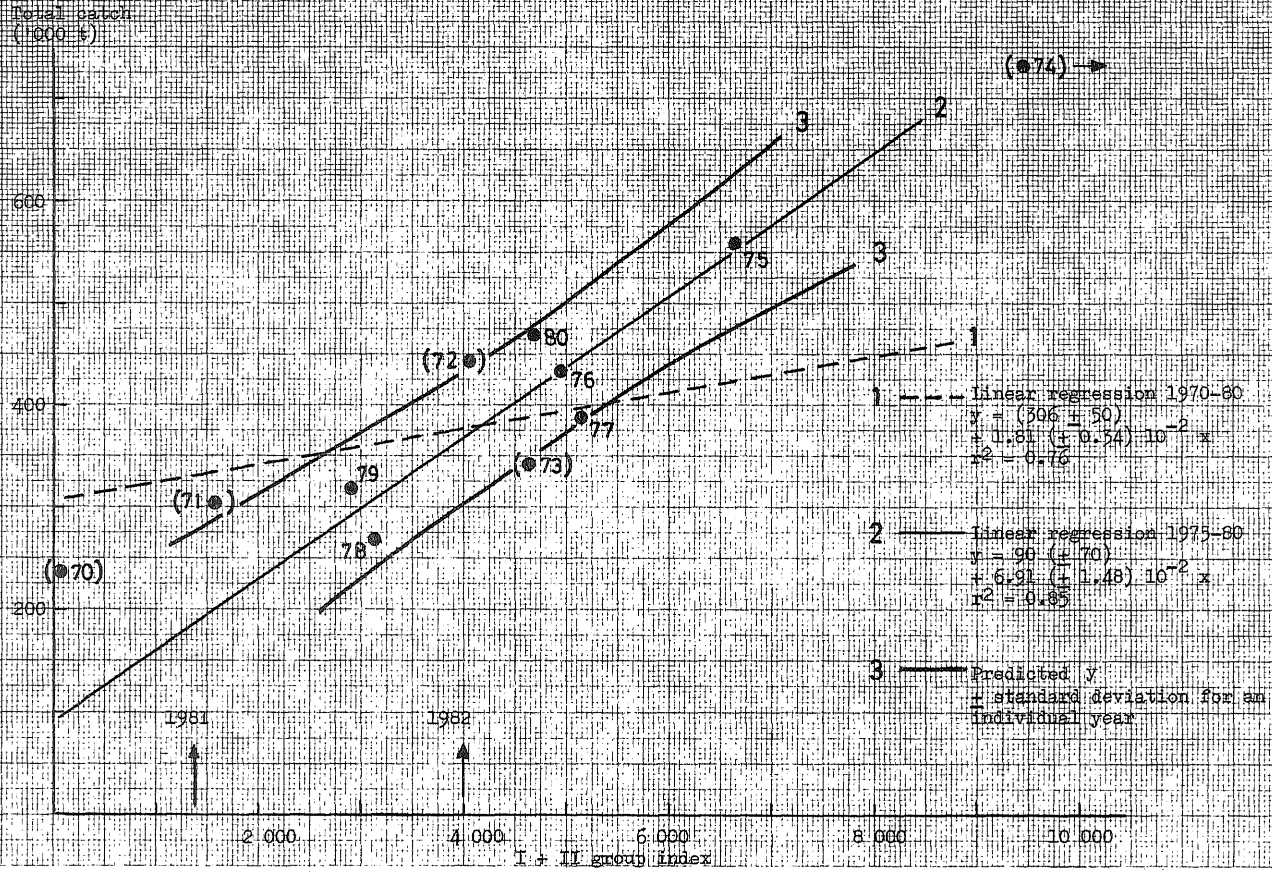


Figure 5.3.1. Southern North Sea SANDEEL.
Fishing mortalities for ages 0 to 4. M = 0.5 $year^{-1}$.

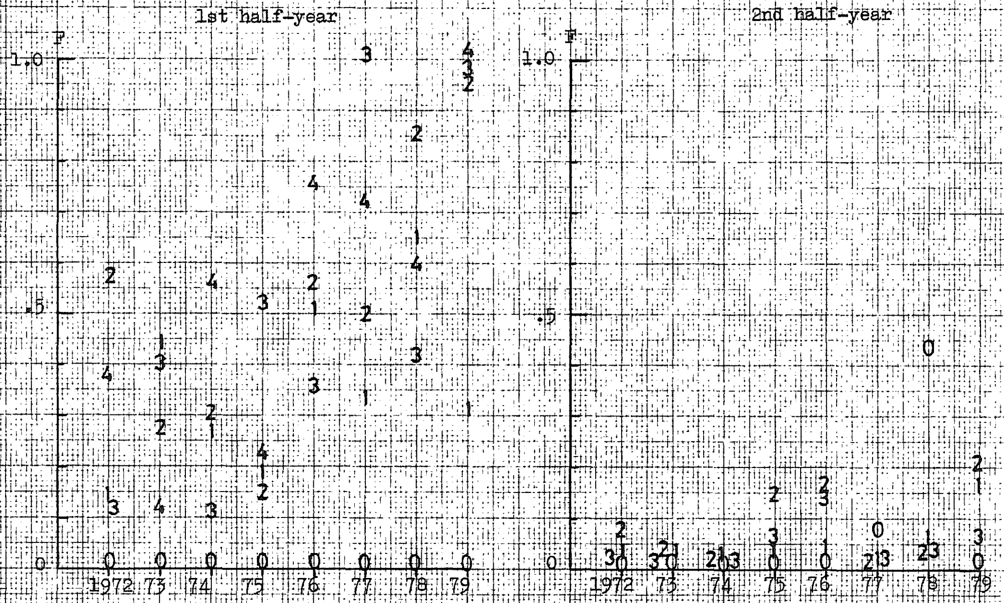


Figure 5.3.2. Northern North Sea SANDEEL.
Half-yearly fishing mortalities for ages 0-3. M = 0.5 year^{-1}.

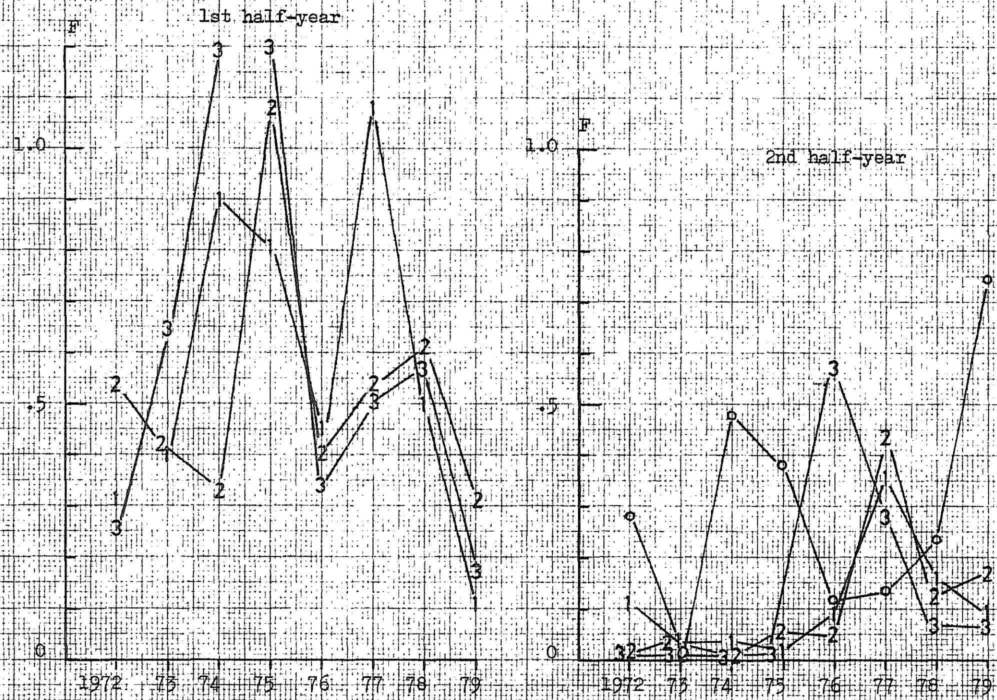


Figure 6.3.1. North Sea SPRAT.
Average fishing mortalities 1974-80 on a quarterly basis on the 0-4 year olds. (Annual M = 0.8 $year^{-1}$
$F_{4\ year,\ 4\ quarter}$ = 1.00 are input values).

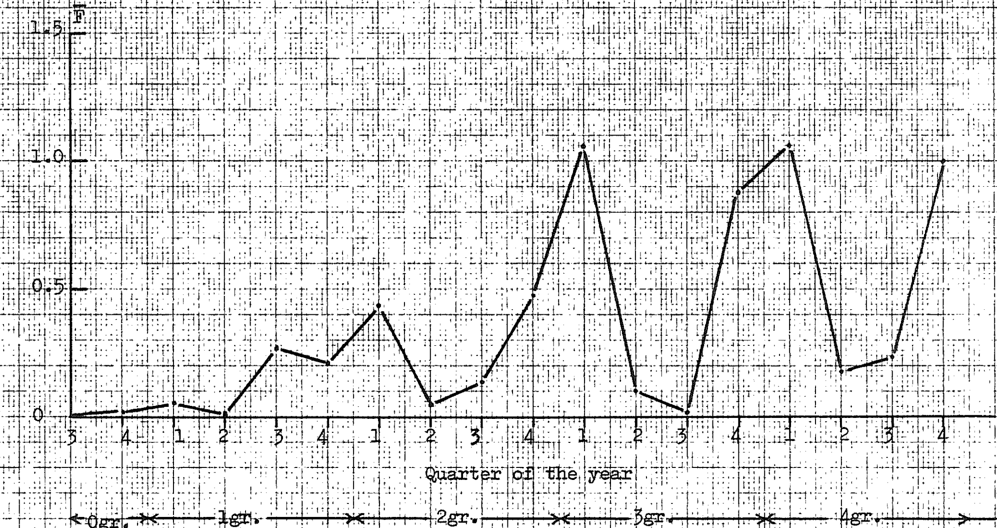
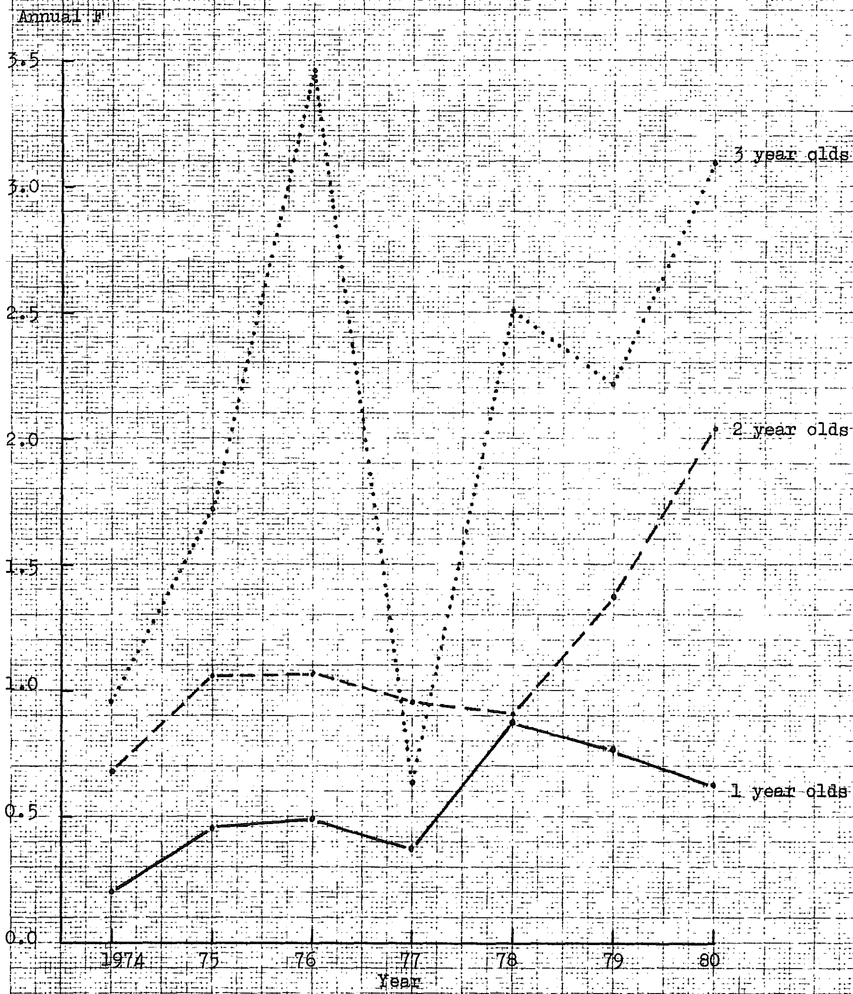


Figure 6.3.2. North Sea SPRAT.
Annual F on 1, 2 and 3 years old, 1974-80, from VPA.
$M = 0.8 \text{ year}^{-1}$. Year with terminal Fs 1981.



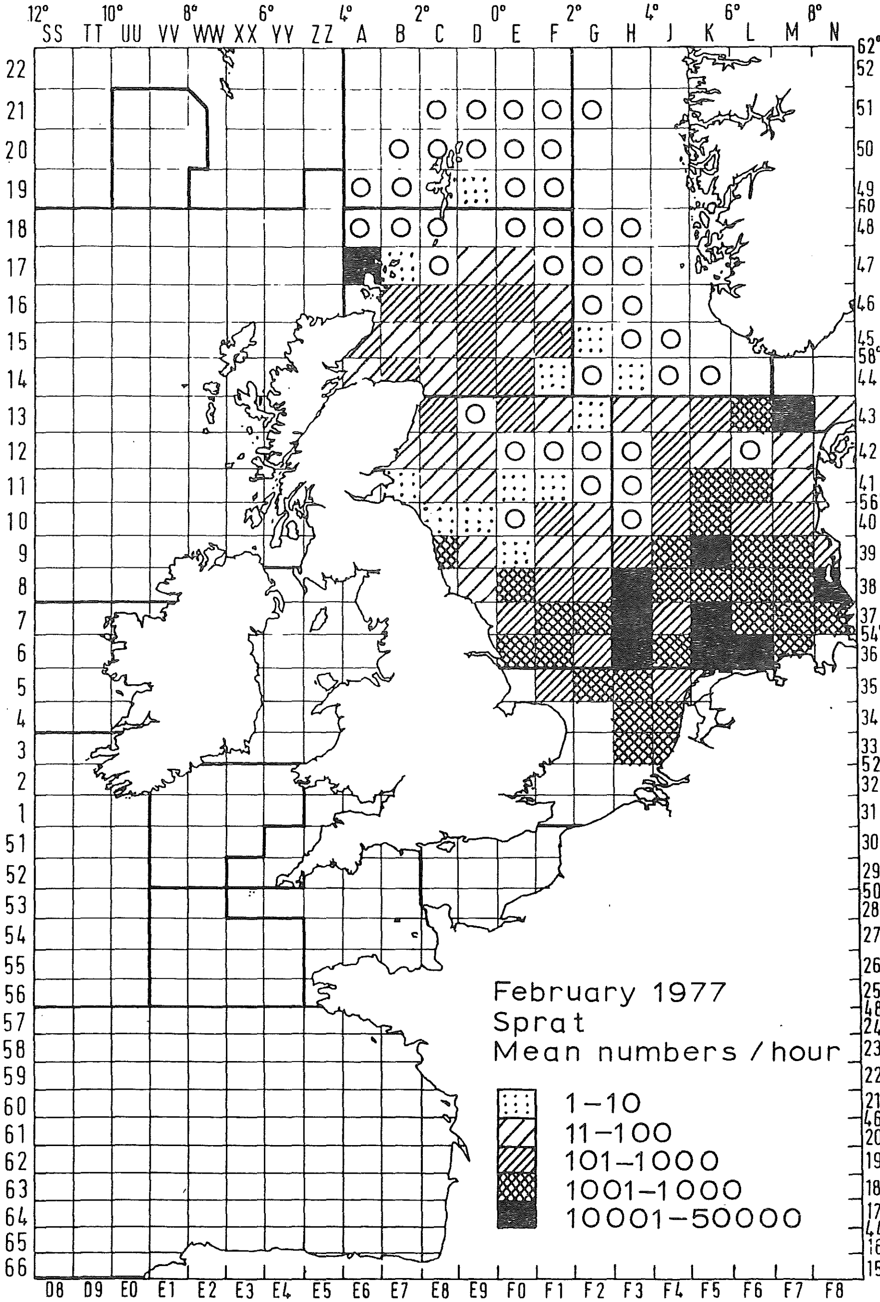


Figure 6.4.1. Density distributions of sprat in the North Sea as shown by bottom herring trawl samples in February 1977.

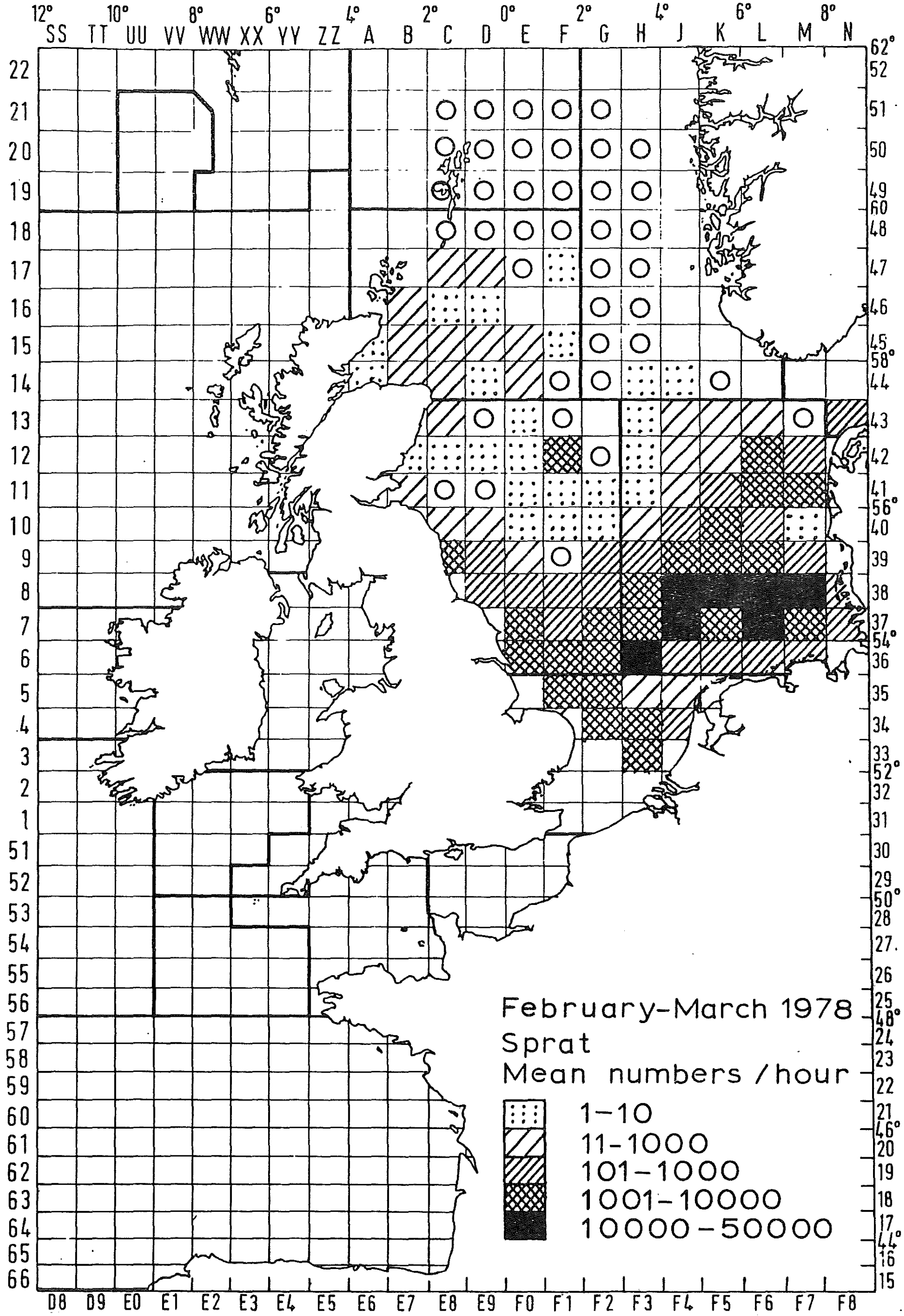


Figure 6.4.2. Density distributions of sprat in the North Sea as shown by bottom herring trawl samples in February-March 1978.

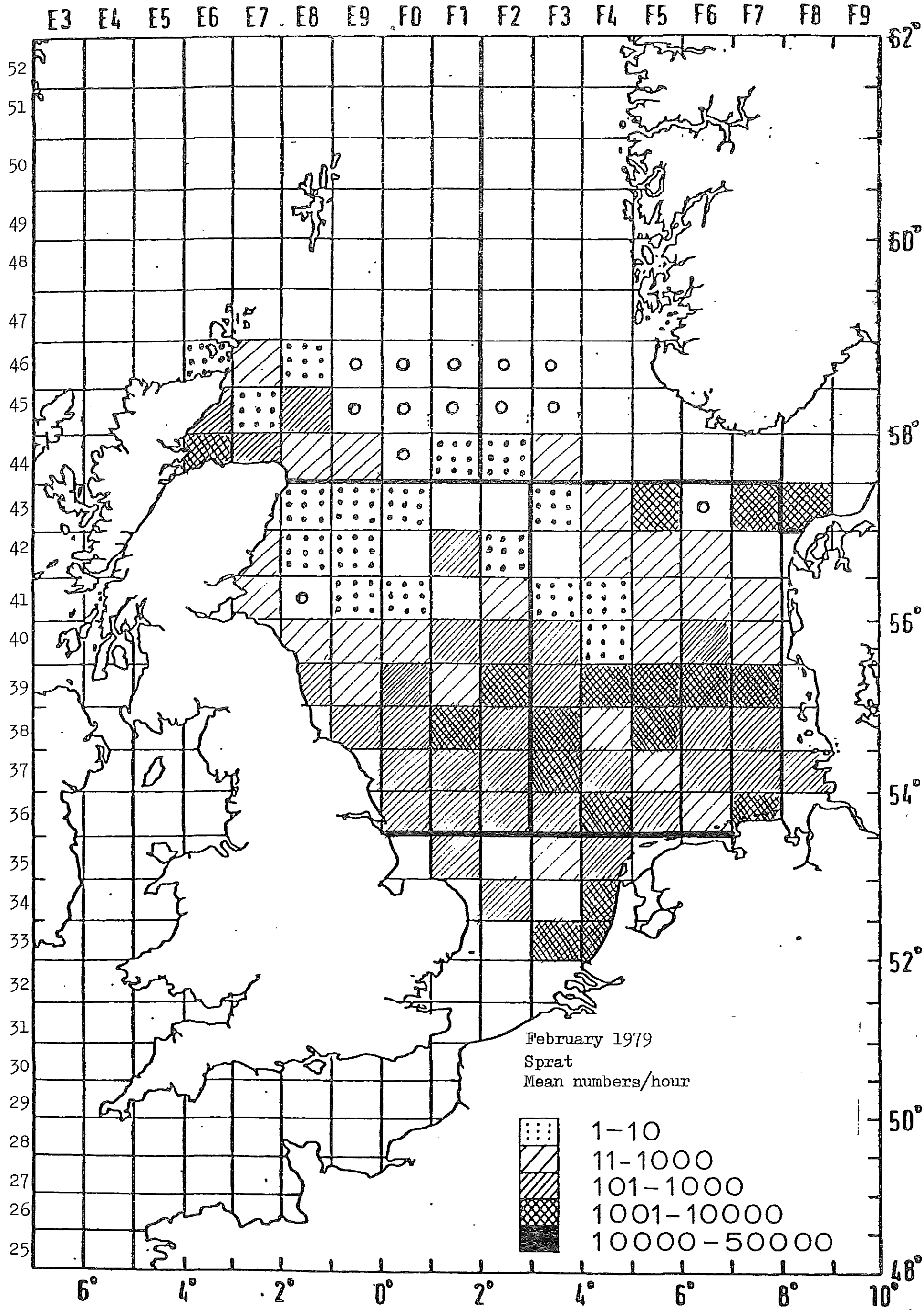


Figure 6.4.3. Density distributions of SPRAT in the North Sea as shown by bottom herring trawl samples in February 1979.

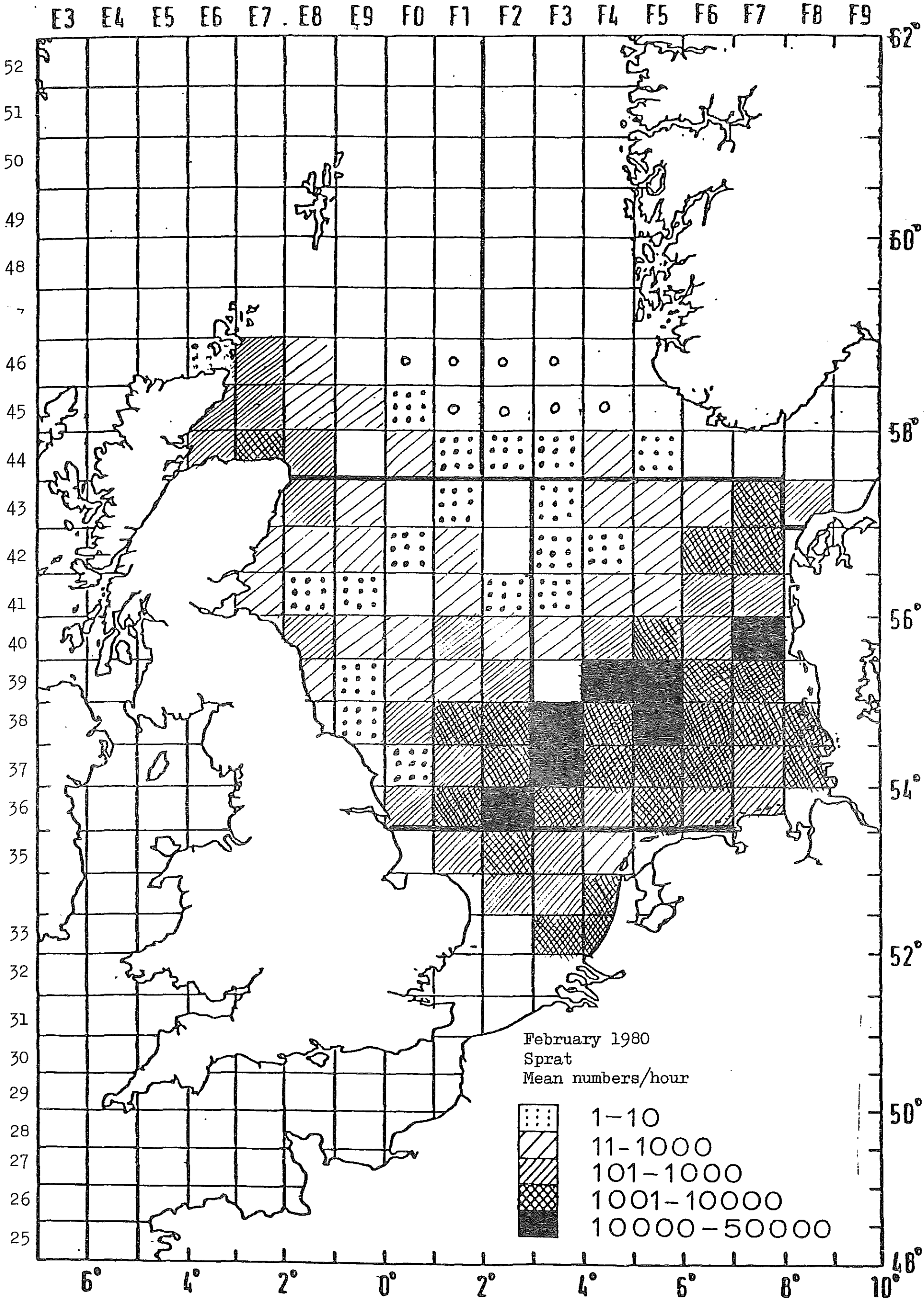


Figure 6.4.4. Density distributions of SPRAT in the North Sea as shown by bottom herring trawl samples in February 1980.

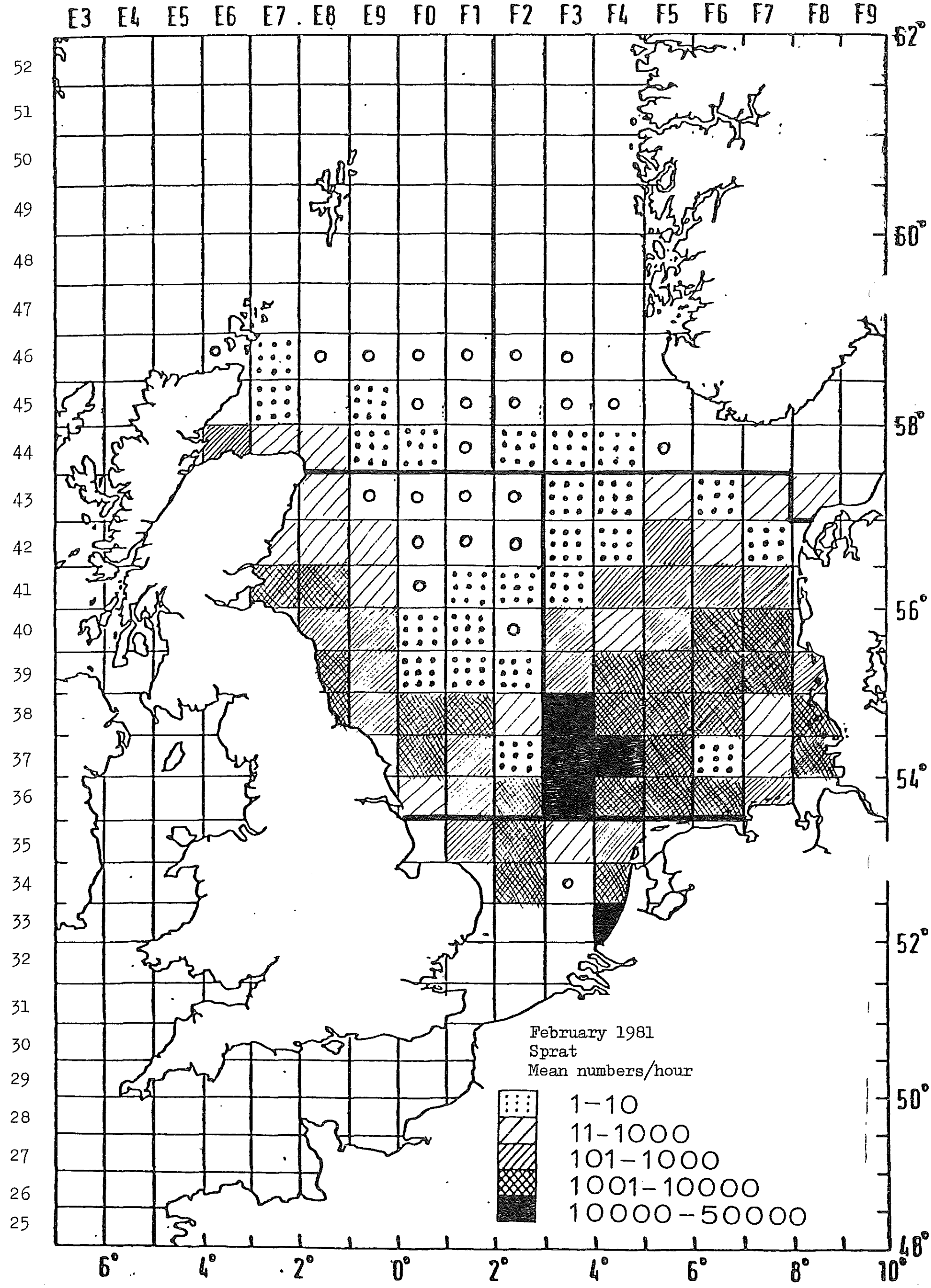


Figure 6.4.5. Density distributions of SPRAT in the North Sea as shown by bottom herring trawl samples in February 1981.

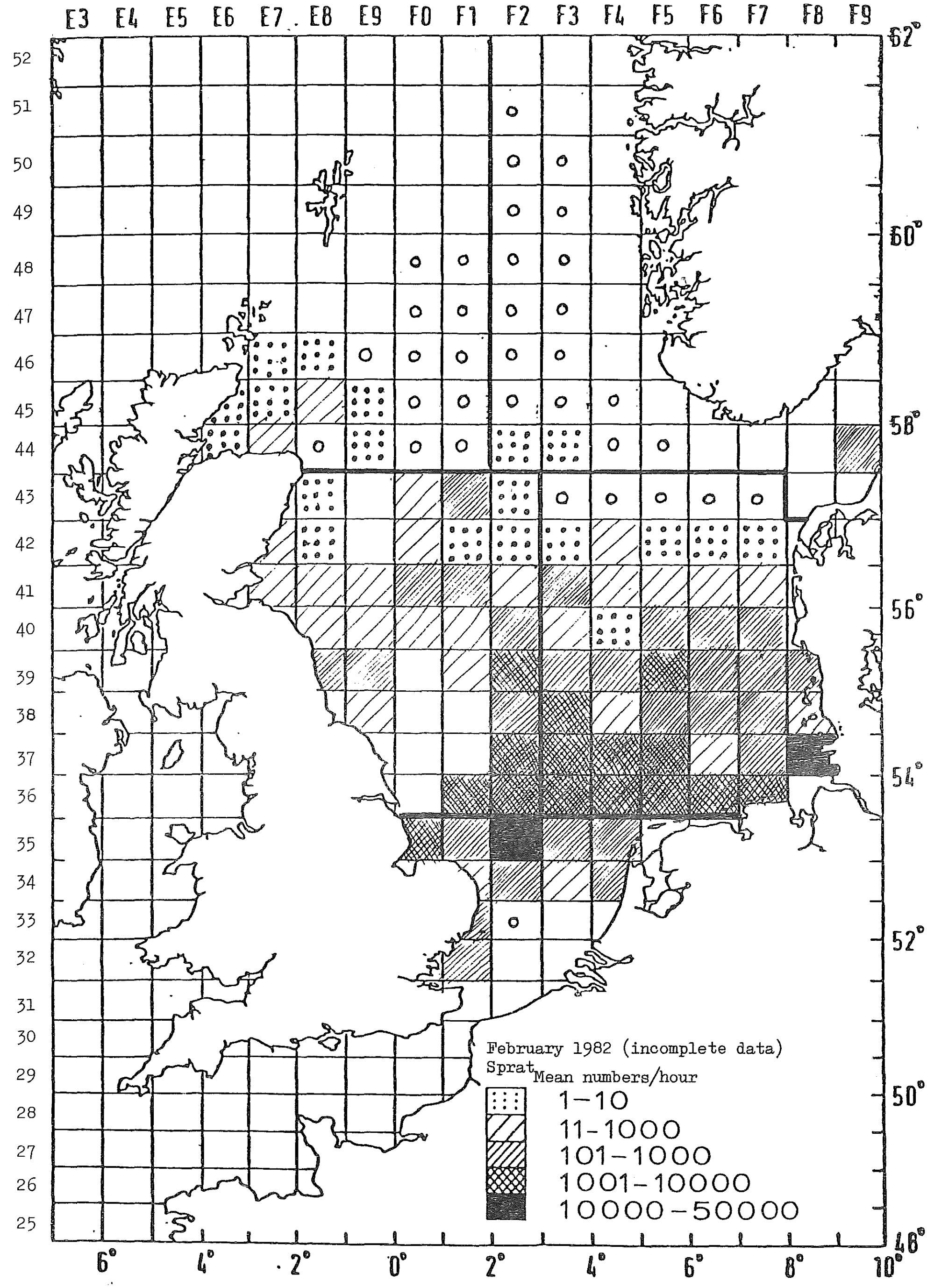


Figure 6.4.6. Density distributions of SPRAT in the North Sea as shown by bottom herring trawl samples in February 1982 (incomplete data).

Figure 6.4.7. Numbers of 0-group SPRAT per hour on Scottish 0-group sprat surveys in November. Upper figure: 1980, lower figure: 1981, dash: no sample.

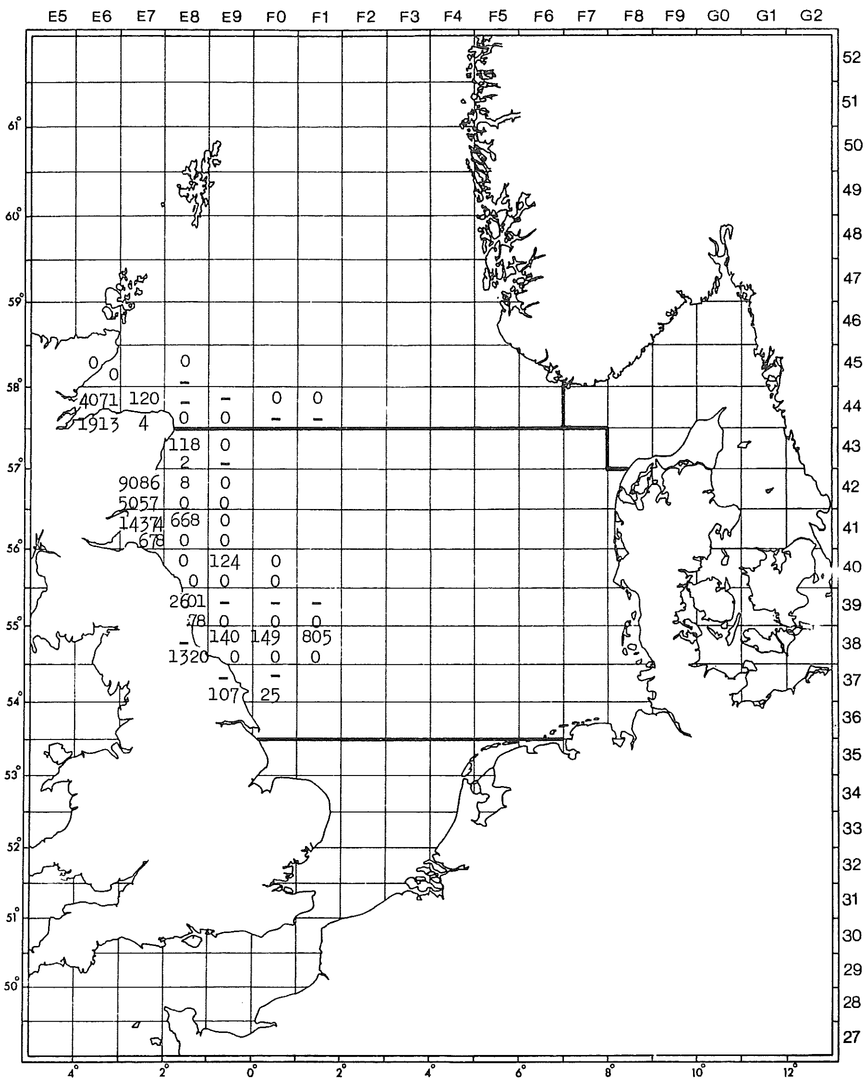


Figure 6.4.8. Estimated biomass ($t \times 10^{-3}$) of SPRAT in each half statistical rectangle January - February 1982. Standardized with reference to target strength of -29 dB/kg.

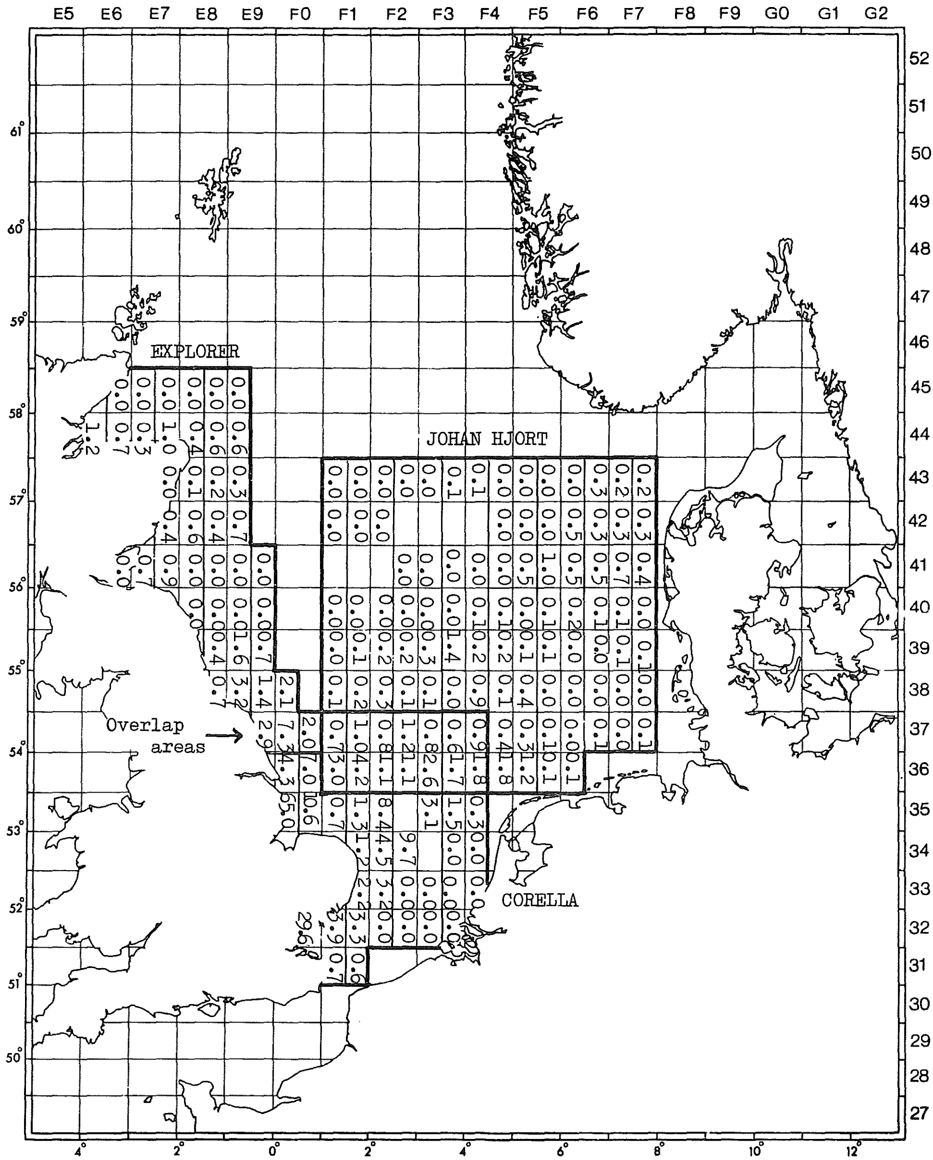


Figure 6.9.1. North Sea SPRAT.
Total stock, 1+ biomass and spawning stock biomass from VPA.
Mean F for 1-2 year olds. 1974-80. M = 0.8 year^{-1}.

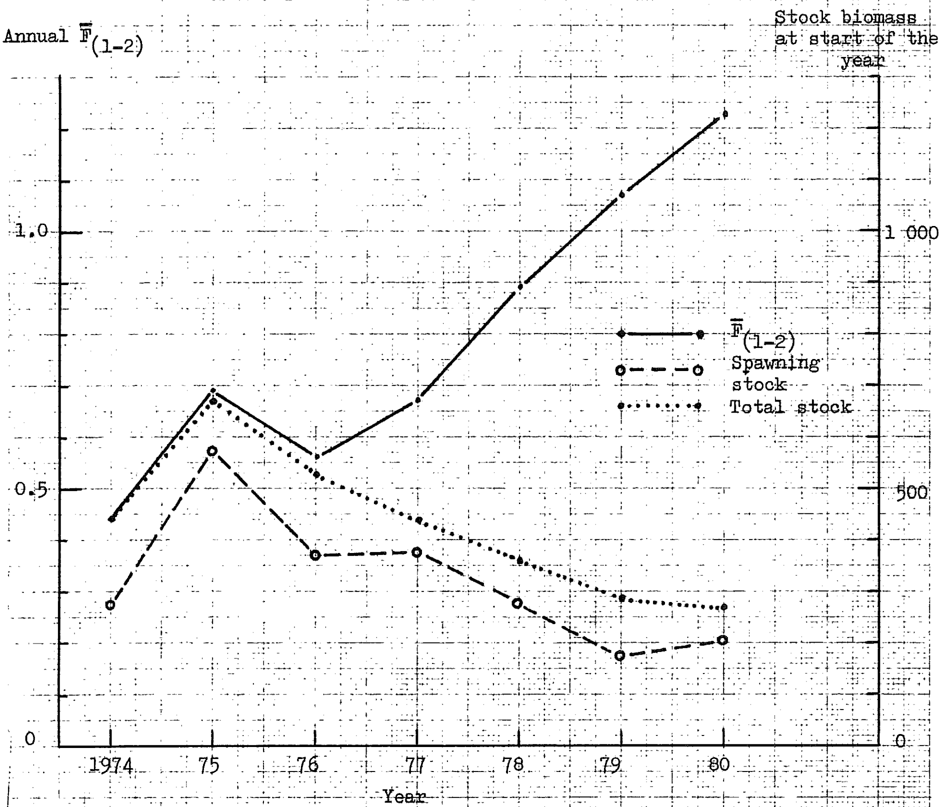
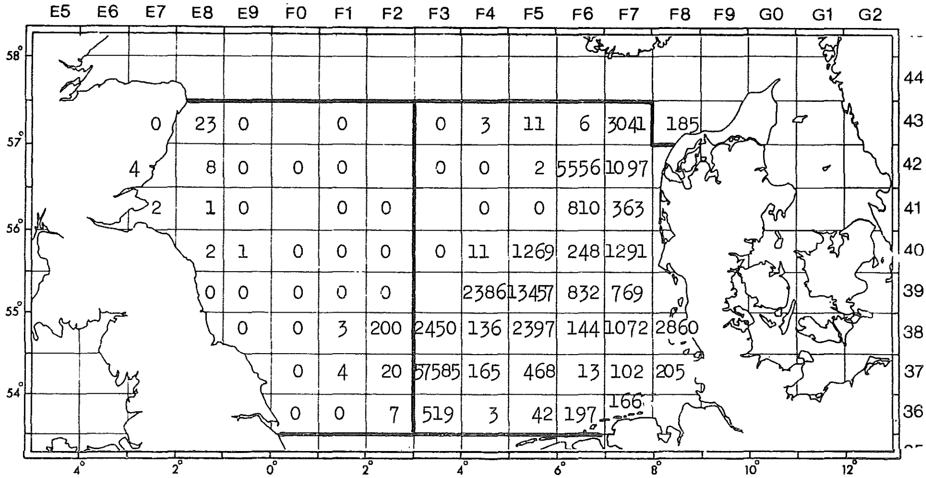
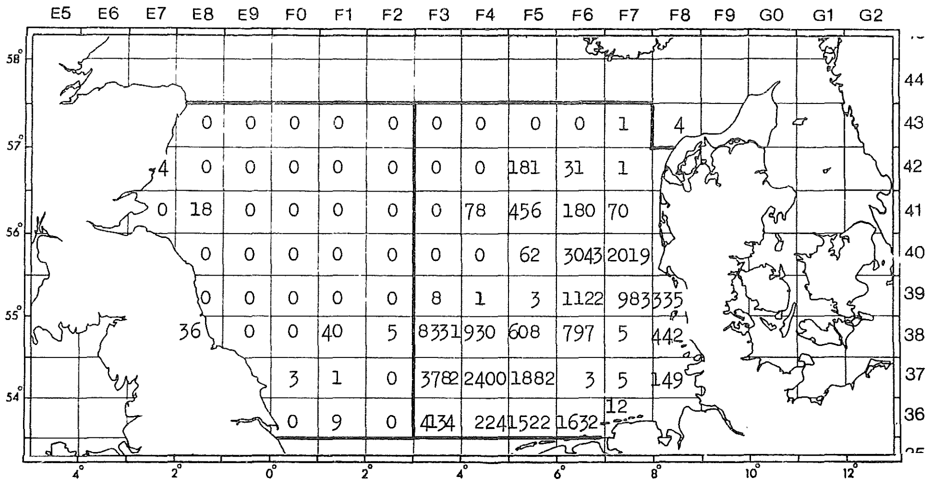


Figure 6.9.2. North Sea SPRAT.
Number per hours fishing of sprat less than 8 cm in the 1980 and 1981 IYFS.



IYFS Sprat 1980 <8 cm



IYFS Sprat 1981 <8 cm