Fol. 41 Assess



International Council for the
Exploration of the Sea

C.M.1986/Assess:15



# *REPORT OF THE INDUSTRIAL FISHERIES WORKING GROUP*

Copenhagen, 7 - 13 March 1986

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# 1 INTRODUCTION

## 1.1 Participants

| | |
|---|---|
| R. S. Bailey | UK (Scotland) |
| E. Bakken | Norway |
| J. Casey | UK (England and Wales) |
| H. Gislason (part-time) | Denmark |
| O. Hagström | Sweden |
| J. Lahn-Johannessen | Norway |
| N. A. Nielsen (Chairman) | Denmark |
| H. Sparholt (part-time) | Denmark |

Dr. E. D. Anderson, ICES Statistician, attended the meeting occasionally.

## 1.2 Terms of Reference

At the recent Statutory meeting in London it was decided (C.Res.1985/2:3:4) that the Industrial Fisheries Working Group (Chairman: Mr. N. A. Nielsen) will meet at ICES headquarters from 7-13 March 1986 to:

a) estimate monthly quantities and quarterly geographical distribution and size composition of by-catches of herring, cod, haddock, whiting, mackerel and saithe taken in the fisheries for Norway pout, sandeel and sprat in the North Sea and adjacent waters and report them to the relevant Stock Assessment Working Groups;

b) assess the status of the stocks of the target species for industrial fisheries, i.e., sprat in Sub-area IV, Divisions IIIa and VIId,e and Norway pout and sandeel in Sub-area IV. Data should be made available to allow assessments of Norway pout and sandeel in Sub-area VI and Division IIIa;

c) provide quarterly catch-at-age and mean-weight-at-age data for 1985 for North Sea stocks as input for the Multispecies VPA.

In addition to the terms of reference, the Chairman of ACFM asked the Working Group to discuss three more items:

1) The geografical distribution of sprat, Norway pout and sandeel by quarter should be described and reported to the Multispecies Working Group.

The Working Group found it possible to use data from the recruitment surveys, in particular the IYFS and EGFS. Maps showing the geographical distribution of sprat would be very useful for the Sprat Biology Workshop to be held in Bergen in November, and it was decided that the conveners of this Workshop should coordinate the aggregation and decide upon the format and lay-out of the map.

For Norway pout, it was decided that the chairman of the Industrial Fisheries Working Group would coordinate the collection and

preparation of the data. Geographical distribution of sandeel is more difficult to obtain, and the Working Group could not point to other possibilities than information on catch by area and month given in annual reports of this Working Group.

2) The definition and interpretation of "safe biological limits" should be discussed for each target species.

3) Provide an estimate of the long-term potential of each stock.

As regards items 2) and 3), the Working Group did not respond to these requests. The questions are very difficult to answer, in particular for sprat, Norway pout and sandeel, because the population dynamics of these species are not yet fully described, and the Working Group did not find time to go into these problems at its meeting.

### 1.3 Data Deficiences

In 1985, sampling of major parts of the Danish industrial landings and by-catches in Swedish consumption fisheries was seriously hampered due to the unwillingness of the industry to allow samples for biological data (age, length, weight, nos. etc.). While the species composition of the Danish landings are provided by the Fishery Inspectorate, the composition of Swedish catches for reduction depends on the biological sampling.

These difficulties will probably be solved early in 1986. In some cases, an artificial data set has been constructed in order to keep time-series intact. Such cases are discussed in the sections in question.

## 2 TRENDS IN THE INDUSTRIAL FISHERIES FOR SANDEEL, SPRAT AND NORWAY POUT IN THE NORTH SEA AND DIVISION IIIa

### 2.1 Trends in the North Sea Fisheries

Table 2.1 basically contains the same information as in the previous Working Group report, but the present lay-out emphasises the fact that there are three rather distinct fisheries. The fishery for clupeoids has by tradition been regarded as a sprat fishery with herring as the prime by-catch. Due to recent changes in the relative abundance of the sprat and herring stocks, the latter species has become the predominant catch component. Whereas sprat caught both by small-meshed trawl and purse seine are included, the herring landings referred to in this table are derived only from small-meshed trawl catches predominantly consisting of juveniles. Contrary to figures presented in the last report, landings from the directed purse seine fishery for adult herring for reduction have been omitted. The industrial fishery for demersal species is mainly based upon resources of Norway pout and partially upon blue whiting. In this context, only catches taken by small-meshed trawl are being taken into consideration. By-catches of Annex V species (protected species)

occur in all major fisheries, though predominantly in the fishery for demersal species.

The overall decrease in annual industrial landings observed since 1974 resulted in a minimum of 1,033,000 tonnes in 1985 (Table 2.1). This represents about 2/3 of the average figure of 1,560,000 tonnes for the previous decade. The decrease from 1984 to 1985 was mainly due to the exceptionally low Norway pout landings of 197,000 tonnes. The landings of the various species in 1985 have been broken down by quarters in order to present seasonal distribution patterns.

Considering recent trends, there has apparently been a rather continuous decline in the landings of sprat and Annex V species (predominantly haddock, whiting and saithe), whereas those of herring and blue whiting indicate a recent increasing trend which culminated in 1982 and 1983. Annual landings of sandeel and Norway pout suggest irregular fluctuations without any obvious trend.

## 2.2 Trends in the Division IIIa Fisheries

Table 2.2 is compiled from data given in the Report of the ad hoc Study Group on Management Measures for the Small-Meshed Fishery in Division IIIa (Anon., 1986a). The lay-out of the table is similar to Table 2.1 and the data covering the period 1974-84 have been revised during the present meeting. No data were available for 1985. Besides a recent increasing trend in herring landings and a corresponding decreasing trend in sprat landings, there is apparently no particular trend in landings of sandeel and demersal species.

# 3 BY-CATCHES IN THE INDUSTRIAL FISHERIES FOR SANDEEL, NORWAY POUT AND BLUE WHITING IN THE NORTH SEA

## 3.1 By-catch of Annex V Species in the North Sea

Table 3.1.1 presents annual landings of the major species haddock, whiting and saithe in the industrial fisheries. By-catches of each species have fluctuated differently over the years since 1975, but indicate an overall decreasing trend. In recent years, this clearly applies to haddock and whiting, whereas the by-catch of saithe has slightly increased.

Maps showing the monthly by-catch in the Norway pout - blue whiting fishery by ICES rectangle for the period October 1984 to May 1985 were available to the Working Group.

Figures 3.1.1-3.1.3 show the distribution of Annex V species by ICES rectangles as percent of total catch in the Norway pout and blue whiting fisheries in the last quarter of 1984 and the first and second quarters of 1985, respectively. In general the percentage of Annex V species has been at a comparatively low level, except for some rectangles in the first quarter of 1985 located in the Norwegian Deeps.

The exceptionally high by-catch observed in some of the rectangles in the Norwegian Deeps was chiefly a result of young saithe migrating into the area. The catches represent a comparatively small proportion of the total quarterly landings.

Tables 3.1.2-3.1.3 give the estimated species compositions in the Norwegian fisheries for Norway pout and sandeel. The relative species composition in the Norway pout fishery presents a rather consistent pattern up to 1985 when a sharp decline in the Norway pout landings took place.

## 4 NORWAY POUT

### 4.1 Landings

#### North Sea

Landings by country for the years 1957-85 are shown in Table 4.1.1. In 1985 the total landings amounted to nearly 200,000 tonnes which is the lowest figure since 1969 and only 55% of the catch in the previous year. Table 4.1.2 showing the monthly landings in 1980-85 also indicates that the main reduction in 1985, when compared with 1984 took place in the third and fourth quarters. On a national level, Norwegian landings show the heaviest decline (73%) while the Faroes and Denmark declined with 48% and 35%, respectively.

#### Division VIa

Landings by country are given in Table 4.1.3 for the years 1971-84. For 1985, only Scottish landing figures were available to the Working Group at its meeting.

#### Division IIIa

Table 4.1.4 shows landing figures for the period 1971-85. According to these, 1985 gave the lowest figure on record being only 14% of the 1984 landings. The Working Group could not offer an explanation for this development.

### 4.2 Fishing Effort

#### Danish effort data

Danish effort and cpue data for each size category of vessel participating in the Norway pout fishery for the years 1982-85 are given in Table 4.2.1. The data presented to the Working Group for 1985 were in a different form to those for the years 1982- 84. Previously, cpue was presented in tonnes/days fishing and tonnes/length of trip for each vessel category. For 1985, however, only data relating to tonnes/length of trip were available. The mean ratios of the cpue in tonnes/days fishing to tonnes/length of trip for 1982-84 were, therefore, used to convert the 1985 data into tonnes/days fishing for each vessel category.

Adjustment of these data to a common unit of effort was made by fitting the power regression $y = ax^b$ where y is tonnage/days fishing and x = mean tonnage of each vessel category minus 50

tonnes to force the curve through the point 50,0 (Figure 4.2.1 in Anon., 1985a).

There has been a general increase in the level of sampling since 1982 with 82% of the landings by weight sampled in 1985.

Norwegian effort data

The cpue in hectolitres/days fishing/mean GRT in the Norwegian fishery for Norway pout and blue whiting for the period 1976-85 are presented in Table 4.2.3. Corresponding data for the directed fishery for Norway pout (defined as those catches containing greater than or equal to 70% Norway pout by weight) are given in Table 4.2.4 and Figure 4.2.1. The weighted annual mean data for these cpue series are shown in Figure 4.2.2.

Large fluctuations are apparent in the quarterly catch rates (Figure 4.2.1). The weighted annual mean cpue in the directed Norway pout fishery indicates a reduction in biomass in 1985 compared to that for 1984 (Figure 4.2.2).

Faroese effort data

No Faroese effort data were available to the Working Group for 1985.

Total Danish and Norwegian effort

Danish and Norwegian effort data for 1985 were combined and standardized using the method outlined in the 1985 report (Anon., 1985a) and added to the existing time-series from 1982-84 (Table 4.2.5). As in previous years, the distribution of Norwegian effort for each quarter differs from that of Denmark. Compared to 1984, Danish effort has increased in the fourth quarter of 1985, remained about the same in the first, and was reduced in the second and third quarters with a particularly marked reduction in the second (74%) of 1984 effort. A similar comparison of the Norwegian data reveals that effort increased in the first and fourth quarters and was reduced in the second and third quarters.

The standardized total effort in 1985 shows an overall decrease of about 25% on the 1984 value. This was due to a marked reduction in the second and third quarters which dominated the slight increase in the first and fourth quarters.

## 4.3 Predation Mortality

Independent estimates of Z for Norway pout were available for three areas: Faroes, Clyde and Scotland west coast for a period when there was no exploitation and for the northern North Sea for the period 1935-55 prior to the development of the fishery (Bailey and Kunzlik, 1984). In these circumstances, Z is equivalent to M and, therefore, may be assumed to be a guide to the value of M to be input to VPA. These independent estimates are given in the text table below:

| Area | Observed Z $yr^{-1}$ from survey data |
|---|---|
| Faroes | 1.48 |
| Scottish west coast | 1.5 |
| Clyde | 2.43 |
| North Sea (1935-55) | 1.60 |

With the exception of the Clyde, the other areas for periods prior to the development of the fishery show reasonably consistent estimates of Z in the region of 1.5 - 1.6 $yr^{-1}$, which does not differ from the values of M input to VPA in previous years. The Working Group considered that the high value for the Clyde area may be unusual (Bailey and Kunzlik, 1984), and was, therefore, ignored.

In an attempt to estimate values of M at age for input to VPA, the $\log_n$ transformed percentage age distributions from Bailey and Kunzlik (1984) were plotted against age for the Faroes and Scottish west coast (Figures 4.3.1-4.3.2). Appropriate curves were fitted by eye to these data, which revealed an increase in Z on older age groups. This observation was consistent for all areas. The appropriate Z on age arrays derived from these data are given below:

| Age | Faroes | Scottish west coast |
|---|---|---|
| 0 | ? | ? |
| 1 | 0.7 | 0.7 |
| 2 | 0.7 | 0.7 |
| 3 | 2.3 | 2.3 |
| 4+ | 2.3 | 2.3 |

This increase in Z on older ages in the unexploited stocks may be due to a number of factors (for discussion see Bailey and Kunzlik,1984).

However,the Working Group recommends that the possibility of an increase in M with age should be taken into consideration by the Multispecies Working Group.

The values of Z in the text table above in comparison with the estimates of M from the latest MSVPA indicate that $M_1$ may be somewhat lower than 1.0 for the 0- to 2-group.

## 4.4 Catch at Age and VPA Results

The catch in numbers at age by quarter for the years 1974-85 are given in Table 4.4.1. Data for 1985 were available for Danish, Norwegian and Scottish landings and these data were raised to the national catches to give the age distribution of the total catch.

As in previous years, M was estimated to be 1.6 per $year^{-1}$ on all ages.

The combined Danish and Norwegian effort series, the IYFS 1986 1-group and the 1985 EGFS 0-group index were used to tune the VPA. The relationship between effort and the mean F on 1- to 3-groups weighed by the population numbers from a trial VPA was used to predict the mean F per quarter from the third quarter in 1984 to the fourth quarter in 1985 (Figure 4.4.1). As terminal F's were used, an F-array which gave 1) an exploitation pattern in the third and fourth quarters of 1985 close to the mean exploitation pattern in those quarters in 1980 to 1983 (Figure 4.4.2), and 2) mean F's for the third quarter in 1984 to the fourth quarter in 1985 close to those predicted by the effort series. This procedure was done iteratively and the resulting F-array was used in the final VPA run tuned to the effort data. Finally, an input F on 0-groups was chosen to match the VPA number of the 1985 year class as predicted by the IYFS (1 Jan. 1986) 1986 1-group index (Figure 4.4.3) and the English groundfish survey 0-group index in 1985 (Figure 4.4.4) (1 Oct. 1985). As seen from the figures, the two surveys gave approximately the same estimate of the strength of the 1985 year class.

VPA Results

Output from the final run is given in Tables 4.4.2 and 4.4.3 and the total stock biomass and spawning stock biomass are shown in Figure 4.4.5.

The spawning stock biomass decreased from 1983 to 1984 and further decreased from 1984 to 1985. The SSB is in 1985 at the same low level as in 1981 and 1978. The SSB as estimated from VPA (Figure 4.4.5) and the time series of Norwegian cpue values (Figure 4.4.2) are generally in good agreement and both identify the years with low SSB: 1978, 1981 and 1985. The very sharp decline in cpue from 1984 to 1985 is not shown in the SSB, even though the SSB declines 18% from 1983 to 1984 and 20% from 1984 to 1985.

An increase of the input F's would match the cpue series better; this would contradict the method used for tuning of the VPA to effort data. The Working Group decided to retain the input F as discussed above but noted the discrepancy in 1984-85 between the cpue series and SSB as estimated from the VPA.

The VPA shows that the low catch in 1985 of 200,000 tonnes can, partly, be explained by a reduction in effort and consequently in fishing mortality, and, partly, by rather low recruitment (1-group) and low 2-group in 1985.

## 4.5 Research Vessel Surveys

Research vessel indices for Norway pout abundance are given in Table 4.5.1. The English Norway pout November surveys were discontinued in 1985 but two new indices have been included in the table in addition to the IYFS and EGFS indices. These are from the Scottish groundfish survey and the Norwegian acoustic survey carried out in August and June, respectively. Preliminary data on catch of Norway pout below 15 cm are shown in Figure 4.5.1.

The most striking observation to be made from these data is that the IYFS 1-group index, the EGFS 0-group index and the Norwegian acoustic survey 0-group index all indicate a poor 1985 year

class. The IYFS and EGFS indicate an approximate reduction to 60% of the average year-class strength from 1974-84, whereas the Norwegian acoustic survey suggests a 60% decline on the 1984 year-class strength. The EGFS is only 10% of the mean 1977-81. The Norwegian acoustic survey data should be treated with some caution since this survey was not conducted over exactly the same area in 1985 as in 1984. However, the general agreement between the surveys, together with the reduced catch of 0-group Norway pout in the fourth quarter of 1985 (Table 4.4.1), despite an increase in effort in the fishery for that quarter (Table 4.2.5), points to a weak 1985 year class.

## 4.6 Weight at Age

Mean weight at age by quarters in 1985 is given in Table 4.6.1. It is important to note that these figures may be somewhat erroneous since a paucity of samples in 1985 necessitated using the mean weight at age for 1984 (calculated from a combination of Danish and Norwegian catches) together with catch in number at age from Danish landings in 1985 in order to produce mean weight at age for 1985. Since the majority of catches were taken by Denmark (83%), the figures in Table 4.5.1 will generally be biased towards the 1984 mean weight at age.

Table 4.6.2 shows the quarterly and annual landings in weight by age as a percentage of annual landings. The importance of the age groups fluctuates with year-class strength but the 1- and 2-group individuals generally comprise 90-95% of the overall landings, and catches in 1985 did not diverge from these values.

## 4.7 Catch Prediction

Like last year a SHOT estimate (see Appendix A, Anon., 1984a) was calculated by using an updated version of last year's formula (based on data from 1974 to 1985):

$$Y(t) = 0.30\ Y(t-1) + 0.0716R1$$

where Y is yield and R1 is the 1-group IYFS index. The prediction last year of the 1985 catch was 322,000 tonnes. Compared to the actual catch of 196,600 tonnes, this was a gross overestimate. A part of the discrepancy can, however, be explained by a decrease in effort. With the same fishing effort in 1986 as in recent years, the predicted catch in 1986 is 200,000 tonnes (see Figure 4.7.1).

The SHOT method was also used on the English groundfish survey index of 0-group and the obtained formula was:

$$Y(t) = 0.30\ Y(t-1) + 0.1855R0$$

where R0 is the 0-group index. The predicted catch in 1986 is 77,000 tonnes (Figure 4.7.2) which is very low due to the extremely low index value in 1985 for the 0-group in the English groundfish survey.

The ICES standard prediction program was also applied to predict the catch in 1986. The fishing pattern in 1985 was assumed to be

retained in 1986. The recruitment of 1-groups in 1986 is taken from the VPA which was fitted to both the IYFS and the English groundfish survey. Unchanged fishing level in 1986 compared with 1985 will give a catch of 215,300 tonnes in 1986.

## 5 SANDEEL

### 5.1 Landings in 1985

#### North Sea

Landings decreased from 668,000 tonnes in 1984 to 621,000 tonnes in 1985, mainly owing to a decrease in landings by the Faroes, Norway and UK (Scotland) (Table 5.1.1).

Monthly landings are given in Table 5.1.2, 79% of the total being taken in the second quarter of the year.

Monthly landings for each of the areas in Figure 5.1.1 are given in Table 5.1.3 for all countries' landings except the Faroes. Annual totals for the same areas are compared with those in previous years in Table 5.1.4. The most significant proportional changes in 1985 were the increased landings in Areas 1B (east of Scotland), 5 (the Dutch coast) and 6 (the German Bight) and the decreases in Areas 2B and 3 (south of Norway) and at Shetland. As in 1984, the bulk of the catches came from Area 1A (the area north of the Dogger Bank).

#### Division VIa

Scottish landings from Division VIa again increased from 14,200 tonnes in 1984 to 18,600 tonnes in 1985 (Table 5.1.5)

#### Division IIIa

Danish landings from Division IIIa, at 6,300 tonnes were the lowest since 1977 and only 23% of those in 1984 (Table 5.1.6).

### 5.2 Fishing Effort

Norwegian effort and catch-per-unit-effort data for the years 1976-85 as given in Table 5.2.1. These data apply to only a small proportion of the total international landings.

Danish effort data were treated as in the previous report by multiplying the number of days fishing by scaling factors for each vessel size category. The effort indices for the years 1982-85 are given in Table 5.2.2. In 1985, effort data were available for 81% of the catches in the southern area and 65% in the northern area. These indicate that total international effort increased in the southern area by 23% and decreased in the northern area by 25%.

In the Shetland fishery, the number of days fishing in 1985 decreased by 51% to the lowest level since 1979 (Table 5.2.3).

## 5.3 Predation Mortality

At the 1985 meeting of the Industrial Fisheries Working Group, a comparison was made between the number of sandeels dying estimated from the VPA's and the number of sandeels eaten by each main predator estimated from the ICES stomach sampling project. Since major discrepancies were identified, the Working Group, at its present meeting, carried out a further comparison of values of M used in previous assessments and estimates obtained from MSVPA. This evaluation was carried out:

a) because realistic values of M were required by the Working Group for its assessments and yield-per-recruit calculations and

b) so that they could provide comments and advice for the ad hoc Multispecies Assessment Working Group about the level of residual mortality ($M_1$) used in their assessment.

At the 1985 meeting of the Working Group, the following values of M were used in the VPA's:

| | | |
|---|---|---|
| 0-group | 2.0 $year^{-1}$ | (applied to the second half of the year only, i.e., 1.0 half $year^{-1}$) |
| 1-group | 0.75 $year^{-1}$ | (equally divided between the two halves of the year) |
| ≥2-group | 0.5 $year^{-1}$ | |

At the present meeting, it was possible to compare these values with the outputs from the MSVPA carried out in November 1985. These were made assuming a residual natural mortality rate (mortality due to factors other than predation by the five main predators) ($M_1$) of 0.1 $year^{-1}$. Values of M ($M_1 + M_2$) coming out of the key run of the MSVPA for each half year from 1974-84 are given in Table 5.3.1, together with the means for the 11-year series.

The main discrepancies between MSVPA output and VPA input values lie in the partitioning of M between the two halves of the year and in the value for the 0-group. The seasonal pattern of the fisheries (the tendency to close the fisheries in July/August, or the transfer of exploitation to the 0-group at Shetland) indicates that all age groups except the 0-group become less accessible to the fishermen in the second half of the year. This may also indicate that they become less available to predators, in which case the decrease in M from the first to the second half of the year may not be unrealistic.

A check on the absolute level of M can be obtained by comparison with that obtained from catch curves and from a consideration of the numbers that die due to causes other than predation by the five main predators ($M_1$). The numbers and biomass of sandeels dying naturally as a result of other causes in each quarter of 1981 are given in Table 5.3.2.

There is little information about predation by other predators. From energetic considerations (Furness, 1984), however, the ap-

proximately 4 million seabirds that breed or are present at colonies around the North Sea require about 930 x $10^9$ kJ during the breeding season (i.e., the second and third quarters). A high percentage of this (perhaps more than 90%) is taken as sandeels (Furness, 1984) which have been estimated to provide 6.5 kJ $g^{-1}$ (Harris and Hislop, 1978). Thus the consumption of sandeels by seabirds during these quarters alone is likely to be of the order of 140,000 tonnes, which can be compared with a value of 81,000 tonnes for the same two quarters in Table 5.3.2. Since the former figure takes no account of predation by mammalian or other fish predators, it is likely that an $M_1$ of 0.025 per quarter is too low at least in these two quarters. A value of 0.2 $year^{-1}$ would be more realistic.

Estimates of Z from catch curves during the early development of a fishery also give some information on likely values of M.

This was investigated in some detail by the Working Group on Norway pout and sandeels in the North Sea in 1979 (Anon., 1979), when it was concluded that a value of M = 0.5 was appropriate for the southern North Sea, and a value within the range M = 0.5-1.0 for the northern North Sea. At its present meeting, age-composition data were presented for the first years of the Shetland and Division VIa sandeel fisheries.

Estimates of Z obtained by plotting ln of numbers at each age $\geq$ 2 against age gave mean annual values of 1.0 and 0.8 in the two areas, respectively. These are very much higher than the mean value of 0.44 coming from the MSVPA for the same age groups (Anon., 1986b). There could be several possible reasons for this, but one is that there may be a decrease in catchability with age caused by differential timing of re-entry into the sand after midsummer. To reduce the possible effect of this, catch curves were plotted using age compositions from the second quarter only, when all age groups might be expected to be equally available to the fishery (Figure 5.3.1). These data are not well fitted by a straight line and values of Z have, therefore, been obtained only from those parts of the curves that are reasonably linear, i.e., ages 4-7 at Shetland, and 4-6 in Division VIa. The following estimates of Z were obtained:

| Year | Shetland | Year | Division VIa |
|---|---|---|---|
| 1975 | 0.48 | 1982 | 1.54 |
| 1976 | 0.49 | 1983 | 1.42 |
| 1977 | 0.82 | 1984 | 1.28 |
| 1978 | 1.14 | 1985 | 0.96 |

Catch curves are notoriously sensitive to trends in recruitment. Taking the Shetland data, however, the first two values are close to the 11-year annual weighted mean of 0.44 coming out of the MSVPA (Table 5.3.1). Thus, while the catch-curve values may not provide more accurate estimates of M, they are not inconsistent with the value of around 0.5 used in the previous year's VPA for ages $\geq$2. According to the MSVPA, however, this should be divided approximately in the ratio 2:1 in the first and second halves of the year, respectively.

The value of M for the 1-group would appear from MSVPA to be somewhat higher than the 0.75 used in last year's VPA. A value of 1.1 would be more consistent with MSVPA divided into 1.0 and 0.1 in the first and second halves of the year, respectively.

For the 0-group, a value of M is required only for the second half of the year. MSVPA gives an estimate of 0.45 which is much lower than the 1.0 used in the 1985 VPA. Although predation by other predators (both seabirds and unidentified) may be higher than that implied in the $M_1$ used in MSVPA, the Working Group was not in a position to quantify it.

On the basis of these considerations, the Working Group used the following values of M in VPA's for all assessment areas:

| Age | First half | Second half |
|---|---|---|
| 0-group | - | 0.5 |
| 1-group | 1.0 | 0.1 |
| ≥2-group | 0.33 | 0.17 |

Predation mortality by species and area

The MSVPA outputs give estimates of the number of sandeels consumed in the entire North Sea by each of the five main predators in each quarter. In terms of biomass, this amounted to 660,000 tonnes in 1981. The percentages of each age group taken by each predator are given in Table 5.3.3. The predominant predator was thus the whiting.

To investigate the predation by whiting further, data were available on the relative abundance of whiting and the relative sandeel consumption by whiting in each roundfish area. To allocate the amount of sandeels consumed by whiting to each of these areas, the products of the numbers of sandeels per 1,000 stomachs and the abundance index of whiting for each area in each quarter were used. The results are given in Table 5.3.4. This indicates the overriding importance of Area 3 to the east of Scotland, an area in which there has been almost no sandeel fishery.

As pointed out above, predation mortality may be different in different areas of the North Sea. Age composition data analysed in 1979 (Anon., 1979) and at the present meeting also support the suggestion that M may vary geographically. The Working Group would thus bring to the attention of the Multispecies Working Group the need to take regional differences into account.

## 5.4 Catch at Age and VPA

### 5.4.1 Catch at age

North Sea

Data on catch in numbers at age were supplied by Denmark, Norway and the UK. Norwegian catches in the southern area were allocated using Danish data for May and June and Faroese catches (3,500 tonnes) were assumed to have been taken in the southern area in the second quarter and were allocated using appropriate Danish data.

The catches in numbers at age in 1985 are given by months or quarters in Tables 5.4.1-5.4.3. In both the southern and northern areas, the 2-group outnumbered 1-group in the catches. The 0-group was present in significant quantities in the southern area (24%) and at Shetland (50%), but was poorly represented in the northern area (4%).

Division VIa

Catch in numbers at age for the years 1980-85 are given by quarter in Table 5.4.4. The catches were predominantly of 0- and 1-group.

### 5.4.2 Input fishing mortality

The effort data available for each of the these areas were used to calibrate the VPA's.

Southern area

Effort data were available for each half-year period since 1982 (see Table 5.2.2). Assuming constant fishing mortality on each age group, different values of input fishing mortalities for the second half of 1985 were chosen. For each input F, the estimated fishing mortalities for each half-year period since 1982 are plotted against the half annual effort. Three examples are shown in Figure 5.4.1 for input values 0.3, 0.1 and 0.05, respectively.

The plot itself and the derived correlation coefficient for each input value show the input value which gives the most consistent linear relationship between fishing mortality and effort for the entire period 1982-85. The text table below gives the correlation coefficient between effort and F for input F's in the range shown in Figure 5.4.1.

| Input F (2nd half 1985) | 0.3 | 0.2 | 0.1 | 0.09 | 0.07 | 0.05 |
|---|---|---|---|---|---|---|
| Correlation F and effort | 0.85 | 0.92 | 0.97 | 0.97 | 0.94 | 0.88 |

This result points to an input value of 0.1 and Figure 5.4.1 shows a good fit to a straight line.

One could argue that ideally the relation between F and effort should be established using only "converged" values in the VPA; however, this method is not yet feasible because of the small number of points.

If, however, points for 1985 are excluded, the estimated regression predicts a fishing mortality of 0.1 in the second half of 1985.

It was, therefore, concluded that an input value of 0.1 for the second half of 1985 should be accepted.

In the present analysis, the half annual F and effort have been plotted in the same diagram assuming the relation between F and effort is the same for the fishery in the first half year and the second half year. The plot does not contradict this assumption even if more points are needed before firm conclusions can be made.

Northern area

The method for determining input values for the VPA is identical with the method used for the southern area.

Input values (F second half of 1985) in the range 0.01 to 0.2 were tried and for each value the correlation coefficient between F and effort was calculated.

| Input F (1st half of 1985) | 0.2 | 0.1 | 0.05 | 0.03 | 0.01 |
|---|---|---|---|---|---|
| Correlation F and effort | 0.77 | 0.87 | 0.90 | 0.87 | 0.72 |

For the input values 0.2, 0.05 and 0.01, respectively, the corresponding plots are shown in Figure 5.4.2.

Generally the correlation between F and effort is lower for this area, probably because a smaller fraction of the total catch is sampled in this area. The input value of F = 0.05 gives a reasonable fit and it was accepted to use this as the input value.

Shetland area

In this area, fishing effort expressed as number of days fishing was used to choose the appropriate input F value in the last half of 1985. Using converged values of F from trial VPA runs 1974-81), the weighted mean $F_{1-4}$ in the first half of the year was significantly correlated with the effort in the same period (Figure 5.4.3). Using this to predict the F in the first half of 1985, gave a value of 0.153. To obtain this, an input F of 0.08 was required in the second half of the year. Similarly, the $F_o$ in the second half of the year was significantly correlated with the effort in the same period for the years 1976-81 in which $F_o$ had

converged (Figure 5.4.3) (1974 and 1975, the first two years of the fishery, were omitted because $F_o$ in these years was anomalously low). From this, $F_o$ in the second half of 1985 was predicted to be 0.19.

5.4.3 VPA results

VPA's were carried out separately for each assessment area (Figure 5.1.1) using the values of M given in Section 5.3. For the purpose of calculating stock and spawning stock biomasses, long-term mean values of weights at age were used as in the previous report. For ease of reference, these are given in the relevant stock-in-number tables.

Southern area

Catch-at-age data used in the VPA are given in Table 5.4.5 and fishing mortality rates and stock size in Tables 5.4.6 and 5.4.7. The results indicate that the spawning stock size rose to its highest recorded level of 1.6 million tonnes in 1985 with the recruitment of the above-average 1981-83 year classes. The 1984 year class was the poorest since 1973, so the spawning stock in 1986 is expected to be at a lower level, but still well above the average of the 14-year series.

Recruitment of the 1985 year class is more problematic because F on the 0-group as a proportion of that on older age groups has been very variable. Set at half of that on older sandeels in 1985 indicates an average year class.

Northern area

Catch-at-age data used in the VPA are given in Table 5.4.8 and fishing mortality rates and stock size in Tables 5.4.9 and 5.4.10, respectively. The results indicate that recruitment by the 1984 year class was very much lower than any other year class in the previous 12 years. Spawning stock size decreased to a minimum in 1983 and has subsequently recovered with the entry of the strong 1982 and 1983 year classes. Its projected level in 1986 is about average. Recruitment of the 1985 year class is dependent on the input F on the 0-group in 1985. F on this age group as a proportion of F on older age groups has been extremely variable (Table 5.4.9). It is, therefore, not possible to draw any firm conclusion about the strength of this year class.

Shetland area

Catch-at-age data used in the VPA are given in Table 5.4.11. Estimated values of fishing mortality rate are given in Table 5.4.12 and stock size in numbers and biomass in Table 5.4.13. The results indicate that F dropped considerably in 1985 from a peak in 1982. Recruitment of the 1985 year class at 1 July 1985 was the lowest in the 12-year series and followed two year classes which themselves were no better than average. While the spawning stock biomass in 1985 was still high because of the good 1981 and 1982 year classes, the total stock biomass dropped in 1985. If this analysis is correct, the total stock biomass will be lower in 1986, although the spawning stock biomass will not decrease.

Comparison with previous year's assessments

Comparisons between the absolute stock sizes as estimated in this year's assessment with those estimated in last year's assessment are difficult because of the changes made in the assumptions on natural mortality. However, trends observed in biomass are identical, i.e., a high stock level in the southern area is observed in 1984 and 1982 also in this year's assessment; and similarly for the northern area, the 1982 and 1983 stock sizes are low both in this year's and in last year's assessments.

## 5.5 Research Vessel Surveys

No data of use in sandeel assessments are currently provided by research vessel surveys.

## 5.6 Weight at Age

Weights at age in the catch for 1985 were available for the northern assessment area (Norwegian data) and the Shetland area (UK data) (Table 5.6.1), but there were no data for the southern area for 1985.

Table 5.6.2 gives the percentage weight of landings by age in each area calculated using the catches in number at age in Tables 5.4.1-5.4.3 and the long-term mean weights at age given in the 1984 Working Group report. In the southern area, 2-group predominated and 1-group was particularly poorly represented. In the northern area, 2- and 3-group were most abundant and at Shetland, 1- and 2-group. In no area was the 0-group predominant in 1985.

## 5.7 Catch Predictions

Because of the uncertain reliability of the strength of the 1985 year class in each area, no catch predictions were made for 1986. An attempt to use short-cut methods also failed to provide a useful predictor of catches, mainly because the proportion of the catch provided by the recruiting age group varied considerably from year to year and because there were no indices of recruitment other than catches of the relevant age groups in the previous year.

## 5.8 Yield per Recruit

In the 1985 Industrial Fisheries Working Group report, Y/R calculations were used to explore the effect of closing sandeel fisheries in different combinations of months. These calculations were carried out using alternative values of M of 0.5 and 1.0 $year^{-1}$ and variable natural mortalities used in the VPA. The new values of M used in this year's assessment lie roughly within the range covered in the previous year's calculations. The different division of M between the two halves of the year, however, will be expected to have some effect on the results, but the Working Group was not in a position to repeat the calculations in the time available. For this reason, last year's calculations are given again in Table 5.8.1.

## 6 SPRAT IN DIVISION IIIa

### 6.1 Landings

Landings by areas and country from 1974 to 1985 based upon data provided by Working Group members are shown in Table 6.1.1. The major part of the sprat catches has in previous years been taken in the industrial fishery. The balance between herring and sprat in the industrial landings has changed since 1982 and the herring have become the most important component in the catch. A detailed description of the small-meshed fisheries in Division IIIa is given in the Report of the ad hoc Study Group on Management Measures for the Small-Meshed Fisheries in Division IIIa (Anon., 1986a).

The sampling of the industrial landings and by-catches has been far from satisfactory in the past and the situation has further deteriorated in recent years (see Section 1.4). Bearing in mind the uncertainties of the sprat landing statistics, the trend in the landings do indicate a drastic decrease in the sprat stock.

### 6.2 Fishing Effort

No data were available to the Working Group.

### 6.3 Catch at Age and VPA

No catch-at-age data were available.

### 6.4 Research Vessel Surveys

#### Acoustic surveys

Acoustic surveys have been carried out in Division IIIa by Denmark, Norway and Sweden in 1976 and from 1979-85. The surveys do not cover the shallow part and the archipelago which is an important part of the distribution area for especially the younger components of the sprat stocks. The estimated sprat biomasses from these surveys are given in Table 6.4.1. The results from the two surveys carried out in August-September and November do not show any sign of recovery of the sprat stock from the low level estimated in 1984.

#### Trawl surveys

Indices of 1- and ≥2-group and all age group sprat from the IYFS carried out by Sweden in 1974-86 are shown in Table 6.4.2. The indices of 1-group do not indicate any improvement of the recruitment to the stock and the 1985 year class is the weakest ever recorded.

The indices of all age groups (Table 6.4.2) indicate small changes in the total stock. The proportion of 2-group and older sprat appears to cancel out the variations in the 1-group sprat in the total index. The indices for 2-group and older have in-

creased since 1983 and the index for 1986 is the highest in the time series. The trend in the index for 2-group and older sprat is not corroborated by the trend in the total landings nor by the trends in the acoustic estimate. However, the total landings have been dominated by 0- and 1-group and do not reflect the "adult" stock. The trend in the "old" sprat index could explain why the purse seine fishery for consumption purposes has not experienced any scarcity of adult sprat. However, it was not possible during the meeting to test if the IYFS is a useful estimator of the adult stock.

## 6.5 Catch Prediction for Division IIIa Sprat

### Regression of 1-group indices on yield

In the 1985 report of this Working Group, a regression of 1-group sprat on yields in Division IIIa was presented. The intercept of the regression was so large that the 1-group index was useless as a predictor. Even though the Working Group reduced the predicted catch in 1985 from 62,000 tonnes to 40-50,000 tonnes, it is still twice the preliminary landing figure for that year. Since the regression was calculated, both the landing figures and the index have been revised. Using the present values from Tables 6.1.1 and 6.4.2, a new regression was calculated. The new regression of 1-group sprat on yield is shown in Figure 6.5.1. The parameter values of the regression are:

$$\text{Yield } (10^{-3})\ t = 0.01\ R_1 + 29.8$$
$$(df = 9;\ r = 0.65;\ t = {}^{1}2.51)$$

According to the regression, the 1986 index indicates a catch of about 37,000 tonnes in 1986, of which, however, the intercept accounts for 30,000 tonnes, and it was decided not to use this regression for catch prediction.

### SHOT estimate

The percentage contribution of each age group by weight in the catches over the period 1975-83 based on Danish age distribution is given below:

| Year | 0-group | 1-group | ≥2-group |
|---|---|---|---|
| 1975 | 0.7 | 73.3 | 25.9 |
| 1976 | 10.1 | 75.3 | 14.6 |
| 1977 | 13.4 | 61.7 | 24.9 |
| 1978 | 1.6 | 92.1 | 6.4 |
| 1979 | 4.0 | 82.2 | 13.8 |
| 1980 | 2.7 | 82.3 | 15.0 |
| 1981 | 2.1 | 64.7 | 33.2 |
| 1982 | 3.8 | 49.5 | 46.7 |
| 1983 | 31.3 | 43.9 | 24.8 |
| Mean | 7.7 | 69.4 | 22.8 |

The distribution is calculated from quarterly numbers at age from the 1984 Industrial Fisheries Working Group report and quarterly mean weights at age from the 1983 Industrial Fisheries Working Group report. From this, a "hangover" coefficient of 0.228 was used, this being the average proportion of the catch in each year attributed to the 2-group and older.

The data required to make a SHOT estimate are given below:

| Year (t) | Recruitment ($R_1$) index from IYFS (1-group) | Yield in year t Y(t) | Y (t) - 0.228Y (t - 1) |
|---|---|---|---|
| 1975 | 5,339 | 103,500 | 86,628 |
| 1976 | 2,069 | 59,400 | 35,802 |
| 1977 | 5,713 | 72,900 | 59,357 |
| 1978 | 5,119 | 83,100 | 66,479 |
| 1979 | 3,338 | 100,600 | 81,653 |
| 1980 | 4,960 | 86,600 | 63,663 |
| 1981 | 2,809 | 79,400 | 59,655 |
| 1982 | 1,577 | 51,200 | 33,097 |
| 1983 | 1,173 | 29,000 | 17,326 |
| 1984 | 4,141 | 39,900 | 33,288 |
| 1985 | 2,077 | 28,600 | 19,503 |
| 1986 | 684 | - | - |

The regression of Y(t) - 0.228 Y(t-1) on $R_1$ shown in Figure 6.5.2 has the following parameter values:

$$Y(t) = 0.228\ Y(t-1) + 10.490\ R_1 + 14{,}053$$
$$(df = 9;\ \ r = 0.72;\ \ t = 3.120)$$

The regression through the origin is

$$Y(t) = 0.228\ Y(t-1) + 14.520\ R_1$$

The predicted catch in 1986 using the $R_1$ value of 684 for the 1-group and corrected for unpredicted catches of 0-group is:

28,000 tonnes (fitted regression)
18,000 tonnes (regression through origin)

The predicted catch in 1986 is based on the assumption that the fishing level and exploitation pattern in 1986 will be similar to those in the years used in the SHOT estimate.

There are, however, indications from the landing figures that the exploitation pattern has changed in the most recent years. A change in the fishing pattern is also indicated in the SHOT estimate, where the predictions for 1984 and 1985 have overestimated the catches. The reduction of total landings is mainly due to lower catches in the Danish industrial fishery for sprat, whereas the landings for consumption purposes (Sweden and Norway) with purse seine have been stable or even increased in the latest years. The increased proportion of Swedish and Norwegian landings indicate that the "hangover" coefficient of 0.228 could be too

low in the most recent years as this fishery exploits the adult part of the stock.

Changes in the fishing pattern and a subsequent higher "hangover" coefficient in 1986 imply that the present catch predictions could be biased. The present prediction formula has overestimated the catch in 1984 and 1985 and the lower catch prediction is believed to be the most likely. Assuming that the level of fishing and the relative proportions of sprat and young herring will remain the same, a sprat catch around 20,000 tonnes could be expected in 1986.

## 7 NORTH SEA SPRAT

### 7.1 Landings

Table 7.1.1 gives landings of sprat by nation and reporting areas as shown in Figure 7.1.1. The landings in 1985 (peeliminary) were about 50,000 tonnes, a reduction of 27,000 tonnes compared to 1984. Sprat landings have shown a declining trend since 1978-79, and the present low level has not been recorded since the early 1960's.

A major part of the 1985 landings came from Sub-division IVb East. Danish catches accounted for 80% of the total, and about 70% was taken in the fourth quarter of the year (Table 7.1.3).

Landings of sprat reported in Division VIa by the United Kingdom (Scotland) for 1985 were 3,000 tonnes, a slight increase compared to previous years (Table 7.1.2).

Recorded catches in Sub-division IVa West in 1985 were higher than in 1984.

Most of the catch was taken in the fourth quarter as compared to the third quarter in earlier years. Table 7.1.3 shows that the highest catches were taken in October.

### 7.2 Fishing Effort

No effort data were available.

### 7.3 Catch-at-Age Data

Due to serious sampling problems (see Section 1.4), catch-at-age data by quarters were only available for a small part (17%) of the total sprat landings in 1985. For this reason, the Working Group considered the idea of discontinuing the data series of catch at age for the North Sea stock. This would, however, put the Multispecies Working Group in a difficult position. Therefore, it was decided to construct catch-at-age data for 1985 by applying the average age composition in Danish catches in 1981-83 by quarters and by sprat areas to catches taken in 1985 by Denmark, Federal Republic of Germany and Belgium. Observed age compositions were used for catches by Norway and UK (England).

The resulting catch in number by age, by area and by quarter is given in Table 7.3.1. Because of the way in which the data were derived, no information on relative year-class strength can be obtained.

## 7.4 Research Vessel Surveys

### 7.4.1 Acoustic surveys

In January 1986, Scotland conducted an acoustic survey for sprat off the east coast of Scotland and northeast England, also covering the Moray Firth and Firth of Forth. Sprats were generally scarce, but dense concentrations were recorded in some restricted inshore areas in the two firths, where echo- integration was not possible. A preliminary analysis of the survey data indicated a total biomass in those areas where integration was possible of around 20,000 tonnes, of which over 90% were 1-group (1985 year class). In the inshore areas, most sprats were older than 1-group. This survey thus indicates no major change in population since December 1984 (18,000 tonnes) in the area surveyed, although the quantity of sprats in the inner firths is not known.

In late July - early August, Denmark did an acoustic survey of the areas along the Danish coast between Sylt and Hirtshals and up to 60 n. miles off the shore line. This area contains the so-called sprat box in which a major part of the sprat catches in the 1970's were taken, when herring were scarce. The largest concentration of sprat was found in the southwestern corner of the survey area, i.e., between the Sylt Outer Ground and Monkey Bank, where about 47,000 tonnes of sprat biomass was estimated. In the sprat box itself, about 2,000 tonnes were measured.

During 25 October-29 November 1985, a survey which included acoustics was conducted by Norway. The survey covered Division IVa, Sub-division IVb East and Division IIIa. Within the North Sea, sprats were only recorded in the German Bight, i.e., east of $3^0$ East between latitudes $54^0$ and $55^0$ N. The biomass of sprat in the areas was estimated at 2,400 tonnes, corresponding to 267 x $10^6$ fish. Samples obtained by pelagic trawl indicated that less than 15% by number was 0-group (1985 year class).

### 7.4.2 International Young Fish Surveys (IYFS)

Preliminary data from the IYFS in February 1986 were available to the Group. The data related to 375 hauls and were presented as no. of sprat per 1 hr hauls, averaged for each statistical rectangle for "sprat total" and "sprat <10 cm".

The observed overall distribution of "sprat <10 cm" in 1986 (Figure 7.4.1) is very similar to the 1985 distribution (Anon., 1985). Most of the sprat occurred in the German Bight area and off the east coasts of England and Scotland. "Sprat <10 cm" were found in much the same area as older sprat.

The 1986 index of 1-group sprat was estimated from no. of "sprat <10 cm" as in previous years.

On this basis, the 1986 1-group index for Division IVb was found to be 68 (Table 7.4.1). The 1986 index is substantially lower than that for 1985 (512) and for 1984 (349). The 1986 index relating to Sub-division IVb East only is also at a very low level.

On the basis of available age-length keys and length distributions from Division IVb, where most of the 1-group occurred, it was calculated that the index should be reduced by 17% (see Section 9).

### 7.4.3 Other surveys

England conducted a groundfish survey (GFS) covering most parts of the North Sea in August-September 1984 and 1985. A chart showing the distribution of sprat is shown in Figures 7.4.2 and 7.4.3, but reliable estimates of relative stock size cannot be made, mainly because the fishing efficiency of the Grandon trawl in relation to sprat is unknown.

Again, the survey shows that sprat were only found in the German Bight area as did the Norwegian acoustic survey in November and the IYFS in February 1986.

The contoured distribution charts from the GFS in 1984 and 1985 indicate that the sprat had a more dispersed distribution in 1985.

## 7.5 Weight at Age

Weight at age in the catch in 1985 was only available from England, together with mean weights in Norwegian catches. These data accounted for a minor part of the total catch only.

## 7.6 Predation Mortality

VPA's in previous years were based on $M = 0.8\ year^{-1}$ for all age groups. The *ad hoc* Multispecies Assessment Working Group has provided estimates of predation mortality (Anon., 1986b). Adding mortality due to other causes than predation (M1 = 0.1) to the "key run" predation mortality, the following M's are obtained:

| Age | M |
|---|---|
| 0 | 0.35 |
| 1 | 0.77 |
| 2 | 1.44 |
| 3 | 0.46 |
| 4+ | 0.56 |

The Industrial Fisheries Working Group noted the marked difference in values of M for the 1- and 2-group and no biological explanation for such a difference could be given. However, the

general trend in the values supported the view of the Group that M probably declined by age, and that the overall level was in conformity with earlier analyses of M, found to be 0.8 on fully-recruited age groups.

Information on predation M by quarters was also available from the Multispecies Assessment Working Group. This indicated that on average a high proportion, about 80%, of the M on the 0-group was exerted in the first and second quarters of the year, while for the older age groups about 40% was exerted in both the first and last quarters.

The Industrial Fisheries Working Group found it difficult to explain the apparent low M in the second and third quarters. It might seem possible that predators shift to other prey in summer and thereby reducing M on the sprat, but the Group could not analyse this further at the meeting.

## 7.7 State of the Stock and Catch Prediction

An assessment of the present state of the stock cannot be based on a VPA since catch-at-age data for 1985 were unavailable for a major part of the catch. The latest VPA, based on catches in 1984 (Tables 7.3.2, 7.3.3 and 7.3.4 in Anon., 1985a), indicate that the total stock biomass was about 100,000 tonnes by the beginning of 1985.

All indicators of stock size and stock development show that the sprat stock in the North Sea is at a very low level (Figure 7.7.1). The total landings in 1985 were reduced by 35% in relation to landings in 1984, and the low level of 50,000 tonnes has not been recorded since the early 1960s. The three acoustic surveys in 1985 indicate that total sprat biomass in the North Sea was below 100,000 tonnes. The stock index from the International Young Fish Survey (IYFS, all ages, Table 7.4.1) and the index of recruitment from the same survey (IYFS, Division IVb, 1-group, Table 7.4.1) are both lower than in any preceding years since 1972.

Assuming that the fishing mortality in 1986 will remain the same, a SHOT estimate (Anon., 1984a) can be used for a prediction. Based on the preliminary index of 68, a catch of 34,000 tonnes is predicted. Using the corrected index, the 1986 catch is predicted to be 32,000 tonnes. However, it is noted that the SHOT estimate has overestimated the catch in the most recent years.

It seems that sprats in the North Sea are now only found in restricted, inshore areas on the east coast of the UK and in the German Bight. It is possible that the total stock biomass remained at about the same level from the beginning of 1985 to the beginning of 1986. The 1983 year class was possibly somewhat stronger than the preceding one and as catches in 1985 were reduced, it is possible that fishing mortality was reduced. This might be linked to a diversion in fishing effort from sprat to the much more abundant young herring. None of these assumptions could, however, be substantiated or tested by the Working Group.

It remains clear that the stock is at a very low level and that recruitment is also very poor compared to the mid-1970s. It is

still not possible to determine whether the recent low level of recruitment is a consequence of the small size of the spawning stock, or adverse environmental conditions or a combination of the two.

If the fishing mortality in 1986 remains the same, the catch estimate by the SHOT method (Figure 7.7.2) will be 32,000 tonnes.

## 8 CHANNEL SPRAT (ICES Divisions VIId,e)

### 8.1 Landings

Table 8.1.1 shows the nominal catches of sprat for Divisions VIId,e in 1975-85. United Kingdom catches increased to 2,922 tonnes in 1985 from 2,398 tonnes in 1984. No catches in 1985 were reported from countries other than the UK, who took about 60% of the 1983-84 total. As in previous years, the fishery operated in the Lyme Bay area. Fishing began in August and continued until the beginning of February 1986 (Table 8.1.2). The monthly distribution of catches was similar to that in 1984, with the majority being taken in October and November (74%). This coincided with the appearance of large shoals several miles in extent, concentrated mainly within three miles of the coast and centered on Lyme Regis. Due to local by-laws, larger vessels were unable to fish within the 3-mile limit and catches were taken mainly by smaller vessels, which transferred their catches to the larger boats. A period of bad weather dispersed the shoals during November and the fleet was unable to locate further concentrations over the remainder of the season, which had virtually finished by the end of December.

### 8.2 Fishing Effort

There is no time series of consistent fishing effort data and, in the absence of any acoustic estimate for the last two years, a guideline to trends in the resource is highly dependent upon the age composition of the Lyme Bay catches. However, for the last two years, the monthly distribution of the catches has been similar, with the exception that in 1985 the main fishery ended rather earlier than in 1984 as a result of bad weather. This observation, together with the fact that overall landings were less in 1985 than in 1984, would seem to indicate that fishing effort over the season has not increased.

### 8.3 Predation Mortality

No predation mortality estimates were available for this stock.

### 8.4 Research Vessel Surveys

No research vessel surveys were conducted during 1984-85.

## 8.5 Catch at Age

Table 8.5.1 shows the age composition of the catches for the seasons 1966-67 to 1985-86. Age group 2/3 individuals accounted for 69.4% of the overall catch in numbers, thus emphasizing the overiding importance of the 1983-84 year class in the 1985-86 landings. This situation is similar to that when the strong 1978-79 and 1979-80 year classes were passing through the population and is in contrast to that in 1984-85 when the catch showed a similar composition to the season prior to 1978-79.

## 8.6 Weight at Age - Lyme Bay Fishery

Average weight at age by quarters and by seasons for the period 1973-86 are presented in Table 8.6.1. The overall average weight in the fourth quarter of 1985 is lower than that in 1984 which was also lower than that in 1983. This is a reflection of the lower average weight of the 1/2 to 4/5-year-olds and the high proportion (83% in number) of age 2/3 and 3/4 fish in the catches.

## 8.7 Percentage Weight in the Catch - Lyme Bay Fishery

Table 8.7.1 shows the seasonal percentage weight in the catch by age from the 1976-77 to 1985-86 season. A total of 69.4% of the catch by weight was composed of 2/3-year-old individuals, thus emphasizing the importance of the 1983-84 year class in the fishery in 1985.

## 8.8 VPA and Catch Prediction

Since 1983, it has been the practice of the Working Group to provide a separable VPA analysis for the Lyme Bay area based on UK landings data only. However, since the relationship between the Lyme Bay area sprat population and those further offshore in the Western Channel is not known, previous population estimates using VPA have not been considered representative of the area as a whole and have not been used by ACFM as a basis for management advice. The Working Group, therefore, decided not to include a VPA assessment for this stock in this year's report.

As an alternative to VPA, the Working Group attempted to provide a short-term catch forecast. However, as is clearly evident from Tables 8.5.1 and 8.7.1, this fishery is largely dependent on three age groups. An attempt to correlate the catch with the catch in numbers at age of the recruiting year classes in the preceding years proved unsuccessful. No short-term forecast was, therefore, possible. However, since the fishery in 1985/86 was largely dependent on the 1983/84 year class and there is no indication of strong 1984/85 or 1985/86 year classes, it is likely that for the 1986/87 season, catches will remain at much the same level as in 1985/86.

## 9 THE USE OF IYFS DATA

Preliminary results from the 1986 IYFS were available to the Working Group and preliminary indices were calculated. Together with the charts showing the distribution by area, this information enables the Working Group to make predictions.

Length distributions were available on the preliminary exchange tapes from England, Denmark and Scotland. This information was used, together with preliminary age-length keys from Scotland, Norway and Denmark, to correct the preliminary index.

Norway Pout

A preliminary age-length key for Norway pout is shown in the text table below.

| Roundfish area | Proportion of 1-group at length (cm) | | | | | |
|---|---|---|---|---|---|---|
| | 11 | 12 | 13 | 14 | 15 | 16 |
| 1 | 100 | 100 | 83 | - | - | - |
| 2 | 100 | 100 | 98 | 10 | 9 | - |
| 3 | 100 | 100 | 80 | 28 | - | - |
| 4 | 100 | 100 | 100 | 100 | 50 | - |
| 7 | 100 | 100 | 100 | 100 | - | - |

The number of 1-group Norway pout in the available length distributions was calculated using the above age-length key. This number was then compared with the number of Norway pout below 15 cm in the available length distributions, and the result indicated that the "less than 15-cm rule" would overestimate the number of 1-group Norway pout only with 3%.

Sprat

Only very few age-length keys were available, and these are summarised in the text table below.

| Area | Proportion of 1-group at length (cm) | | | | | |
|---|---|---|---|---|---|---|
| | 8.0 | 8.5 | 9.0 | 9.5 | 10.0 | 10.5 |
| Division IVb east of 2°E | 100 | 92 | 55 | 78 | 40 | - |
| Division IVb west of 2°E | 100 | 100 | - | - | - | - |

Similar calculations as for the Norway pout showed that the "less than 10-cm rule" would overestimate the index with 17%.

Correction of sprat indices using the appropriate age-length could reduce the index significantly.

Future Use of the IYFS

The Working Group looks forward to the meeting next year, when the IYFS data base hopefully will be available to the Working Group during the meeting. Questions such as distribution of the old sprat in the IYFS and maturity ogives for Norway pout are types of questions which could be answered during the meeting and give a firm basis for discussions.

It would be very useful if more countries could provide preliminary exchange tapes. These could give rather complete information on distribution and be useful, especially when final tapes from the most recent years become available.

## 10 OTHER BUSINESS

ICES Sprat Biology Workshop

The Working Group discussed the terms of reference of the Sprat Biology Workshop scheduled to take place in November 1986. In view of the importance of the Workshop to the future work of the Working Group, the Group stressed the need to concentrate on subjects of direct relevance to assessment problems. The following topics were listed as being of particular importance:

1) Stock identity and stock separation:

   a) otolith types, $L_1$,

   b) morphometrics,

   c) genetics.

2) Stock development in different areas of the North Sea;

3) Distribution patterns:

   a) changes during 1970-85 in relation to environmental factors,

   b) seasonal migration,

   c) larval drift.

4) Population parameters:

   a) growth,

   b) age determination.

5) Data-base requirements.

## 11 REFERENCES

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Table 2.1. Industrial landings from the fisheries for SANDEEL, SPRAT and NORWAY POUT in the North Sea ('000 tonnes) 1974-85.

| Year | Major fisheries | | | | | By-catch Annex V species[2] | Total |
|---|---|---|---|---|---|---|---|
| | | Clupeoids | | Gadoid species | | | |
| | Sandeel | Sprat | Herring | Norway Pout | Blue Whiting[1] | | |
| 1974 | 525 | 314 | - | 736 | 62 | 220 | 1,857 |
| 1975 | 428 | 641 | - | 560 | 42 | 128 | 1,799 |
| 1976 | 488 | 622 | 12 | 435 | 36 | 198 | 1,791 |
| 1977 | 786 | 304 | 10 | 390 | 38 | 147 | 1,675 |
| 1978 | 787 | 378 | 8 | 270 | 100 | 68 | 1,611 |
| 1979 | 578 | 380 | 15 | 320 | 64 | 77 | 1,434 |
| 1980 | 729 | 323 | 7 | 471 | 76 | 69 | 1,675 |
| 1981 | 569 | 209 | 84 | 236 | 62 | 85 | 1,245 |
| 1982 | 620 | 153 | 153 | 360 | 118 | 57 | 1,461 |
| 1983 | 537 | 91 | 155 | 423 | 118 | 38 | 1,362 |
| 1984 | 669 | 80 | 35 | 355 | 79 | 34 | 1,252 |
| 1985[3] | 621 | 50 | 63 | 197 | 73 | 29 | 1,033 |
| 1 Quarter[4] | 4.3 | 8.0 | 14.3 | 43.4 | 9.9 | 9.7 | 89.6 |
| 2 Quarter[4] | 488.5 | 0.8 | 1.2 | 13.5 | 31.8 | 4.6 | 540.4 |
| 3 Quarter[4] | 119.2 | 4.8 | 35.4 | 54.4 | 19.2 | 6.5 | 239.5 |
| 4 Quarter[4] | 5.7 | 36.6 | 11.8 | 75.3 | 11.7 | 8.3 | 149.4 |
| Average 1974-84 | 611 | 318 | 44 | 414 | 72 | 102 | 1,560 |

[1] Anon. (1985b).
[2] Anon. (1984b; 1984c).
[3] Preliminary.
[4] For 1985; does not include Faroese data.

Table 2.2. Industrial landings from the fisheries for SANDEEL, SPRAT and NORWAY POUT in Division IIIa ('000 tonnes) 1974-84[1].

| | Major fisheries | | | | | |
|---|---|---|---|---|---|---|
| | | Clupeoids | | Gadoid species | | |
| Year | Sandeel | Sprat[2] | Herring | Norway Pout | Blue Whiting | Total |
| 1974 | 8 | 74 | 76 | 13 | - | 171 |
| 1975 | 17 | 101 | 57 | 19 | - | 197 |
| 1976 | 22 | 59 | 38 | 42 | - | 161 |
| 1977 | 7 | 73 | 32 | 21 | - | 132 |
| 1978 | 23 | 83 | 16 | 25 | - | 147 |
| 1979 | 34 | 101 | 13 | 25 | 6 | 179 |
| 1980 | 39 | 87 | 25 | 26 | 14 | 191 |
| 1981 | 59 | 79 | 63 | 30 | + | 231 |
| 1982 | 18 | 51 | 54 | 44 | 5 | 172 |
| 1983[3] | 28 | 29 | 89 | 30 | 16 | 192 |
| 1984[3] | 19 | 40 | 112 | 46 | 15 | 224 |
| Mean | 25 | 71 | 52 | 29 | - | 177[4] |

[1] Anon. (1986a).
[2] Landings for human consumption included.
[3] Preliminary.
[4] Blue whiting excluded.

Table 3.1.1. North Sea. Total reported by-catch (tonnes)[1] of HADDOCK, WHITING and SAITHE for reduction purposes.

| Species | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984[2] | 1985[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Haddock | 41,380 | 48,204 | 34,993 | 9,659 | 16,380 | 22,461 | 16,985 | 19,378 | 13,075 | 9,216 | 6,046 |
| Whiting | 86,376 | 149,759 | 106,104 | 55,274 | 59,021 | 45,747 | 66,595 | 32,990 | 23,637 | 18,219 | 15,184 |
| Saithe | 37,678 | 66,766 | 6,197 | 2,566 | 1,635 | 363 | 1,280 | 5,003 | 1,445 | 5,616 | 7,895 |

[1] Anon. (1984b; 1984c).

[2] Preliminary.

Table 3.1.2. North Sea. Species composition in Norwegian NORWAY POUT landings (tonnes) for reduction purposes.

| Year | Quarter | Landings | Norway pout | Blue whiting | Cod | Haddock | Whiting | Saithe | Herring | Mackerel | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 1 | 14,469 | 10,569 | 913 | 195 | 306 | 759 | 107 | - | - | 1 620 |
| | 2 | 36,896 | 18,473 | 14,093 | 207 | 359 | 312 | 130 | - | - | 3 322 |
| | 3 | 42,900 | 32,532 | 6,499 | 136 | 346 | 42 | 87 | - | - | 3 258 |
| | 4 | 13,794 | 8,614 | 1,247 | 12 | 214 | 86 | 18 | - | - | 3 603 |
| | 1-4 | 108,059 | 70,188 | 22,752 | 550 | 1,225 | 1,199 | 342 | - | - | 11,803 |
| 1981 | 1 | 8,565 | 6,996 | 363 | 58 | 106 | 359 | 75 | - | 1 | 607 |
| | 2 | 28,700 | 17,276 | 7,826 | 111 | 392 | 221 | 72 | - | 25 | 2,777 |
| | 3 | 30,127 | 20,001 | 6,214 | 64 | 365 | 69 | 1,024 | - | 12 | 2,378 |
| | 4 | 9,217 | 7,342 | 777 | 26 | 239 | 150 | 50 | - | 4 | 629 |
| | 1-4 | 76,609 | 51,615 | 15,180 | 259 | 1,102 | 799 | 1,221 | - | 42 | 6,391 |
| 1982 | 1 | 8,555 | 7,468 | 175 | 58 | 129 | 306 | 41 | - | - | 378 |
| | 2 | 48,017 | 33,659 | 9,949 | 135 | 467 | 59 | 176 | - | - | 3,572 |
| | 3 | 68,498 | 29,383 | 27,937 | 78 | 321 | 120 | 4,368 | - | 17 | 6,274 |
| | 3 | 30,191 | 17,459 | 10,065 | 11 | 97 | 180 | 418 | - | - | 1,961 |
| | 1-4 | 155,261 | 87,969 | 48,126 | 282 | 1,014 | 665 | 5,003 | - | 17 | 12,185 |
| 1983 | 1 | 8,631 | 6,018 | 1,652 | 71 | 133 | 175 | 303 | - | - | 286 |
| | 2 | 82,562 | 32,367 | 38,569 | 386 | 431 | 141 | 406 | - | 57 | 10,205 |
| | 3 | 74,000 | 45,493 | 20,157 | 254 | 240 | 133 | 603 | 3 | 19 | 7,098 |
| | 4 | 17,627 | 13,429 | 2,693 | 29 | 129 | 170 | 133 | - | - | 1,044 |
| | 1-4 | 182,820 | 97,307 | 63,071 | 740 | 933 | 619 | 1,445 | 3 | 76 | 18,623 |
| 1984 | 1 | 15,282 | 8,932 | 4,302 | 141 | 102 | 225 | 357 | - | - | 1,223 |
| | 2 | 81,039 | 36,876 | 31,134 | 595 | 900 | 690 | 3,839 | 6 | - | 6,999 |
| | 3 | 50,448 | 31,786 | 14,445 | 90 | 289 | 35 | 590 | 6 | 2 | 3,205 |
| | 4 | 11,028 | 6,169 | 2,779 | 36 | 83 | 231 | 830 | - | 1 | 899 |
| | 1-4 | 157,797 | 83,763 | 52,660 | 862 | 1,374 | 1,181 | 5,616 | 12 | 3 | 12,326 |
| 1985 | 1 | 12,639 | 6,031 | 691 | 139 | 452 | 674 | 3,981 | 130 | 1 | 540 |
| | 2 | 44,831 | 8,710 | 28,332 | 182 | 107 | 101 | 2,891 | - | - | 4,508 |
| | 3 | 24,842 | 3,501 | 16,295 | 77 | 10 | 2 | 485 | - | 1 | 4,471 |
| | 3 | 17,410 | 4,587 | 9,203 | 71 | 127 | 78 | 538 | - | 2 | 2,804 |
| | 1-4 | 99,722 | 22,829 | 54,521 | 469 | 696 | 855 | 7,895 | 130 | 4 | 12,323 |

Table 3.1.3. North Sea. Species composition in Norwegian SANDEEL landings (tonnes) 1979-85.

| Year | Landings | Sandeel | Cod | Haddock | Whiting | Saithe | Herring | Mackerel | Others |
|---|---|---|---|---|---|---|---|---|---|
| 1979 | 103,273 | 101,420 | 231 | 520 | 208 | 250 | - | - | 644 |
| 1980 | 147,748 | 144,752 | 54 | 1,118 | 382 | - | - | - | 1,442 |
| 1981 | 53,370 | 52,641 | 29 | 504 | 68 | 6 | 4 | 6 | 112 |
| 1982 | 47,647 | 46,514 | 86 | 703 | 107 | - | 8 | - | 229 |
| 1983 | 12,376 | 12,179 | 34 | 100 | 8 | - | 3 | 2 | 50 |
| 1984 | 23,479 | 23,383 | - | 10 | 16 | - | - | - | 70 |
| 1985 | 13,382 | 13,064 | 75 | 35 | 3 | - | - | - | 205 |

Table 4.1.1 NORWAY POUT annual landings ('000 tonnes) in Sub-area IV by countries, North Sea, 1957-85.

| 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 | - | - | - | 14.7 |
| 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 | 75.4 | - | 3.0 | - | 320.2 |
| 1980 | 366.2 | 34.1 | 70.2 | - | 0.6 | - | 471.1 |
| 1981 | 167.5 | 16.6 | 51.6 | - | + | - | 235.7 |
| 1982 | 256.3 | 15.4 | 88.0 | - | - | - | 359.7 |
| 1983 | 301.1 | 24.5 | 97.3 | - | + | - | 422.9 |
| 1984 | 251.9 | 19.1[1] | 83.8 | - | 0.1 | - | 354.9 |
| 1985 | 163.7 | 9.9 | 22.8 | - | 0.1 | - | 196.5 |

[1] Including by-catch.

Table 4.1.2 NORWAY POUT, North Sea. National landings (tonnes) by months 1983-85.

| Month | Denmark | Norway | Faroes | Scotland | Total[1] |
|---|---|---|---|---|---|
| 1983 | | | | | |
| Jan | 10,343 | 856 | | - | 11,887 |
| Feb | 19,621 | 2,939 | | - | 23,941 |
| Mar | 19,720 | 2,223 | | - | 23,290 |
| Apr | 7,628 | 4,795 | | - | 13,181 |
| May | 1,851 | 15,205 | | - | 18,084 |
| Jun | 5,563 | 12,367 | | - | 19,016 |
| Jul | 20,217 | 12,655 | | - | 34,889 |
| Aug | 39,145 | 20,446 | | - | 63,250 |
| Sep | 70,668 | 12,392 | | - | 88,172 |
| Oct | 47,949 | 4,948 | | - | 56,157 |
| Nov | 30,630 | 6,369 | | - | 39,279 |
| Dec | 27,801 | 2,112 | | - | 31,757 |
| Total | 301,136 | 97,306 | 24,463 | - | 422,903 |
| 1984 | | | | | |
| Jan | 14,263 | 2,639 | | - | 17,770 |
| Feb | 18,691 | 2,455 | | - | 22,347 |
| Mar | 5,696 | 3,838 | | - | 10,076 |
| Apr | 6,000 | 6,949 | | - | 13,685 |
| May | 7,097 | 19,861 | | - | 28,489 |
| Jun | 1,057 | 10,066 | | - | 11,755 |
| Jul | 16,598 | 6,948 | | - | 24,884 |
| Aug | 40,362 | 13,909 | | 89 | 57,443 |
| Sep | 49,925 | 10,929 | | - | 64,311 |
| Oct | 37,469 | 5,100 | | - | 44,987 |
| Nov | 36,525 | 366 | | - | 38,987 |
| Dec | 18,290 | 703 | | - | 20,072 |
| Total | 251,886 | 83,763 | 19,067 | 89 | 354,806 |
| 1985 | | | | | |
| Jan | 14,263 | 3,400 | | - | 18,603 |
| Feb | 15,616 | 1,608 | | - | 18,141 |
| Mar | 7,439 | 1,023 | | 51 | 8,963 |
| Apr | 3,465 | 1,615 | | - | 5,350 |
| May | 1,342 | 4,316 | | - | 5,959 |
| Jun | - | 2,779 | | - | 2,927 |
| Jul | 3,151 | 1,437 | | - | 4,832 |
| Aug | 17,857 | 1,255 | | - | 20,129 |
| Sep | 29,884 | 809 | | - | 32,327 |
| Oct | 30,606 | 2,289 | | - | 34,646 |
| Nov | 21,072 | 1,559 | | - | 23,836 |
| Dec | 19,057 | 739 | | - | 20,850 |
| Total | 163,752 | 22,829 | 9,931 | 51 | 196,563 |

[1] Monthly totals estimated assuming Faroes catch is distributed monthly as the Danish and Norwegian catch.

Table 4.1.3 NORWAY POUT. Annual landings (tonnes) in Division VIa (for 1971-84, data officially reported to ICES).

| Country | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|---|---|
| Belgium | 1 | - | - | - | - | - | - |
| Denmark | 363 | 186 | 42 | - | 193 | - | - |
| Faroes | - | - | 1,743 | 1,581 | 1,524 | 6,203 | 2,177 |
| Germany,Fed. Rep. | - | - | - | 179 | - | 8 | - |
| Netherlands | - | - | - | - | 322 | 147 | 230 |
| Norway | - | - | - | 144[4] | - | 82[4] | - |
| Poland | - | - | - | 75 | - | - | - |
| UK (Scotland)[2] | 1,622 | 3,760 | 9,282 | 4,702 | 6,614 | 6,346 | 2,799 |
| USSR | - | - | - | 40 | 2 | 7,147 | - |
| Total | 1,986 | 3,946 | 11,067 | 6,721 | 8,655 | 19,933 | 5,206 |

| Country | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985[1] |
|---|---|---|---|---|---|---|---|---|
| Belgium | - | - | - | - | - | - | - | - |
| Denmark | 4,443 | 15,609 | 13,070 | 2,877 | 751 | 530 | 4,301 | - |
| Faroes | 18,484 | 4,772 | 3,530 | 3,540 | 3,026 | 6,261 | 3,400 | - |
| Germany,Fed.Rep. | - | - | - | - | - | - | 70[3] | - |
| Netherlands | 21 | 98 | 68 | 182 | 548 | 1,040 | - | - |
| Norway | - | - | - | - | - | - | ... | - |
| Poland | - | - | - | - | - | - | - | - |
| UK(Scotland)[2] | 302 | 23 | 1,202 | 1,158 | 586 | -[4] | 23 | 13 |
| USSR | - | - | - | - | - | - | - | - |
| Total | 23,250 | 20,502 | 17,870 | 7,757 | 4,911 | 7,831 | 7,794 | 13 |

[1] Preliminary.
[2] Amended using national data.
[3] Data not available.
[4] Including by-catch.

Table 4.1.4 NORWAY POUT. Annual landings (tonnes) in Division IIIa (for 1971-84, data officially reported to ICES).

| Country | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|---|---|
| Denmark | 25,800 | 17,259 | 23,152 | 10,669 | 15,666 | 40,144 | 20,694 |
| Faroes | - | - | 643 | - | - | - | - |
| Norway | 296 | - | - | 62[2] | 925[2] | 50[2] | 104 |
| Sweden | - | -[4] | -[4] | -[4] | 3,272 | 2,255 | 318 |
| Total | 26,096 | 17,259 | 23,795 | 10,731 | 19,863 | 42,449 | 21,116 |

| Country | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985[1] |
|---|---|---|---|---|---|---|---|---|
| Denmark | 23,922 | 23,951 | 26,235 | 29,273 | 51,317 | 36,124 | 66,895 | 9,349 |
| Faroes | - | - | - | - | - | - | - | |
| Norway | 362 | 1,182 | 141 | 752 | 1,265 | 990 | 947 | - |
| Sweden | 591[3] | 32 | 39 | 60 | 103 | 52 | - | - |
| Total | 24,875 | 25,165 | 26,415 | 30,085 | 52,685 | 37,166 | 67,842 | 9,349 |

[1] Preliminary (provided by W.G. members).

[2] Including by-catch.

[3] Includes North Sea.

[4] Included in the North Sea.

Table 4.2.1 NORWAY POUT. Danish cpue data (tonnes/days fishing) by vessel category for 1982-85.

| Vessel GRT | 1982 | 1983 | 1984 | 1985 | Scaling factor[1] |
|---|---|---|---|---|---|
| 51-100 | 12.81 | 8.90 | 8.44 | 10.46 | 1.00 |
| 101-150 | 22.84 | 22.44 | 19.52 | 17.76 | 1.69 |
| 151-200 | 27.39 | 28.43 | 23.36 | 20.61 | 2.15 |
| 201-250 | 29.31 | 32.28 | 26.01 | 25.73 | 2.53 |
| 251-300 | 29.22 | 30.96 | 26.20 | 22.99 | 2.85 |
| 301- | 26.46 | 33.37 | 31.07 | 23.77 | 3.00 |

[1] According to the model in Figure 4.2.1.

Table 4.2.2 NORWAY POUT. Percentage of the Danish catches (by weight) sampled for fishing effort in the Danish fishery.

| Year | Quarter | | | | Total |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| 1982 | 79% | 48% | 33% | 50% | 46% |
| 1983 | 60% | 52% | 68% | 81% | 70% |
| 1984 | 84% | 62% | 57% | 70% | 66% |
| 1985 | 69% | 53% | 77% | 94% | 82% |

Table 4.2.3 NORWAY POUT. Catch per unit effort, hectolitres per days fishing per mean GRT, by quarters in the Norwegian fishery.

| Year | Quarter | | | | Weighted mean all year |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| 1976 | 1.458 | 1.401 | 1.010 | 1.214 | 1.221 |
| 1977 | 1.299 | 1.346 | 1.304 | 1.413 | 1.346 |
| 1978 | 0.916 | 1.251 | 1.631 | 1.427 | 1.353 |
| 1979 | 1.192 | 1.276 | 1.512 | 1.656 | 1.364 |
| 1980 | 1.000 | 2.198 | 1.648 | 1.518 | 1.658 |
| 1981 | 1.050 | 1.383 | 1.120 | 1.032 | 1.186 |
| 1982 | 0.841 | 1.693 | 1.674 | 1.571 | 1.559 |
| 1983 | 1.454 | 1.677 | 1.441 | 1.569 | 1.566 |
| 1984 | 1.229 | 2.023 | 1.406 | 1.217 | 1.589 |
| 1985 | 0.944 | 1.164 | 0.801 | 0.868 | 0.976 |

Table 4.2.4 NORWAY POUT. Cpue as in Table 4.2.3, except that those catches with less than or equal to 70 % Norway pout in weight are excluded.

| Year | Quarter | | | | Weighted mean all year |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| 1976 | 1.435 | 1.451 | 0.992 | 1.200 | 1.223 |
| 1977 | 1.302 | 1.397 | 1.304 | 1.450 | 1.362 |
| 1978 | 0.926 | 1.254 | 1.527 | 1.447 | 1.306 |
| 1979 | 1.272 | 1.217 | 1.559 | 1.676 | 1.425 |
| 1980 | 0.989 | 2.351 | 1.734 | 1.592 | 1.634 |
| 1981 | 1.068 | 1.429 | 1.194 | 1.055 | 1.218 |
| 1982 | 0.841 | 1.676 | 1.681 | 1.603 | 1.548 |
| 1983 | 1.381 | 1.703 | 1.466 | 1.555 | 1.556 |
| 1984 | 1.243 | 2.151 | 1.461 | 1.163 | 1.668 |
| 1985 | 0.996 | 1.236 | 0.751 | 0.829 | 0.967 |

Table 4.2.5 NORWAY POUT. Danish and Norwegian fishing effort (no. of fishing days). The mean Norwegian vessel size in each quarter is shown. The Danish effort data have been scaled to this vessel size in each quarter. The Norwegian landings with less than or equal to 70% Norway pout have been excluded.

| | Quarter | | | |
|---|---|---|---|---|
| Parameter | 1 | 2 | 3 | 4 |
| 1982 | | | | |
| Norwegian av. GRT | 161.2 | 122.5 | 160.5 | 170.9 |
| Norwegian effort | 733 | 2,240 | 1,934 | 740 |
| Danish effort | 2,283 | 764 | 4,565 | 2,468 |
| Total | 3,016 | 3,004 | 6,499 | 3,208 |
| Standardized total[1] | 3,122 | 2,726 | 6,714 | 3,415 |
| 1983 | | | | |
| Norwegian av. GRT | 150.3 | 155.4 | 147.8 | 154.8 |
| Norwegian effort | 302 | 1,671 | 2,302 | 811 |
| Danish effort | 3,077 | 934 | 4,546 | 4,237 |
| Total | 3,379 | 2,605 | 6,848 | 5,048 |
| Standardized total[1] | 3,379 | 2,650 | 6,800 | 5,125 |
| 1984 | | | | |
| Norwegian av. GRT | 146.2 | 121.0 | 139.9 | 175.5 |
| Norwegian effort | 473 | 1,633 | 1,622 | 282 |
| Danish effort | 2,587 | 1,077 | 4,752 | 3,759 |
| Total | 3,060 | 2,710 | 6,374 | 4,041 |
| Standardized total[1] | 3,023 | 2,444 | 6,164 | 4,357 |

[1] Total effort scaled to fishing days of a 150-GRT vessel.

.....Cont.

Table 4.2.5 cont...

| | | | | |
|---|---|---|---|---|
| 1985 | | | | |
| Norwegian av. GRT | 142.7 | 144.2 | 175.2 | 196.8 |
| Norwegian effort | 600 | 805 | 595 | 443 |
| Danish effort | 2,584 | 281 | 2,131 | 4,056 |
| Total | 3,184 | 1,086 | 2,726 | 4,499 |
| Standardized total[1] | 3,109 | 1,066 | 2,940 | 5,125 |

Table 4.4.1 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[1] | - | 13,450 | 414 | 26 | 1 |
| | 2[1] | - | 7,873 | 193 | 26 | 1 |
| | 3[1] | 846 | 9,966 | 489 | 145 | - |
| | 4[1] | 5,720 | 7,809 | 140 | 4 | - |
| 1975 | 1[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 | 4,244 | 763 | 49 | - |
| | 4 | 864 | 2,154 | 167 | 11 | - |
| 1980 | 1 | - | 5,044 | 1,075 | 59 | 2 |
| | 2 | - | 2,586 | 689 | 29 | 5 |
| | 3 | 24 | 7,711 | 1,960 | 18 | - |
| | 4 | 641 | 3,920 | 512 | 6 | - |
| 1981 | 1 | - | 2,223 | 1,688 | 76 | 6 |
| | 2 | - | 1,072 | 621 | 77 | - |
| | 3 | 77 | 1,316 | 944 | 17 | 1 |
| | 4 | 36,560 | 1,038 | 301 | 3 | 1 |

[1] Not used in VPA.

cont'd....

Table 4.4.1 (cont'd)

| Year | Quarter | Age Groups | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| 1982 | 1 | - | 5,267 | 415 | 216 | - |
| | 2 | - | 3,251 | 275 | 23 | - |
| | 3 | 151 | 6,576 | 431 | 62 | - |
| | 4 | 1,058 | 3,017 | 46 | - | - |
| 1983 | 1 | - | 3,969 | 1,224 | 14 | - |
| | 2 | - | 1,723 | 1,165 | 9 | - |
| | 3 | 421 | 5,495 | 1,485 | 16 | 1 |
| | 4 | 2,520 | 4,053 | 358 | 7 | 1 |
| 1984 | 1 | - | 2,732 | 1,361 | 142 | - |
| | 2 | - | 2,230 | 1,153 | 266 | - |
| | 3 | 1 | 5,238 | 1,666 | - | - |
| | 4 | 2,209 | 3,457 | 727 | - | - |
| 1985 | 1 | - | 2,220 | 1,337 | 188 | 1 |
| | 2 | - | 840 | 142 | 13 | - |
| | 3 | 6 | 1,373 | 777 | 19 | - |
| | 4 | 665 | 2,932 | 171 | - | - |

Table 4.4.2 NORWAY POUT. Quarterly VPA fishing mortality (Quarter$^{-1}$).

| Year | Quarter | Age groups 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1976 | 3 | 0.001 | 0.24 | 0.45 | 0.04 | - |
| | 4 | 0.06 | 0.27 | 0.60 | 0.58 | - |
| 1977 | 1 | - | 0.14 | 0.15 | 0.14 | 0.20 |
| | 2 | - | 0.09 | 0.10 | 0.06 | - |
| | 3 | 0.001 | 0.16 | 0.43 | 0.63 | - |
| | 4 | 0.03 | 0.29 | 0.25 | 0.15 | - |
| 1978 | 1 | - | 0.08 | 0.21 | 0.18 | 0.20 |
| | 2 | - | 0.05 | 0.19 | 0.95 | - |
| | 3 | 0.002 | 0.16 | 0.45 | 0.46 | - |
| | 4 | 0.01 | 0.17 | 0.43 | 0.19 | - |
| 1979 | 1 | - | 0.07 | 0.20 | 0.55 | 0.20 |
| | 2 | - | 0.08 | 0.09 | 0.19 | - |
| | 3 | 0.005 | 0.17 | 0.58 | 0.82 | - |
| | 4 | 0.007 | 0.15 | 0.30 | 0.54 | - |
| 1980 | 1 | - | 0.06 | 0.12 | 0.20 | 0.20 |
| | 2 | - | 0.05 | 0.13 | 0.18 | - |
| | 3 | - | 0.26 | 0.87 | 0.20 | - |
| | 4 | 0.02 | 0.25 | 0.79 | 0.11 | - |
| 1981 | 1 | - | 0.10 | 0.20 | 0.31 | 0.20 |
| | 2 | - | 0.08 | 0.13 | 0.80 | - |
| | 3 | - | 0.16 | 0.39 | 0.52 | - |
| | 4 | 0.23 | 0.23 | 0.26 | 0.20 | - |
| 1982 | 1 | - | 0.06 | 0.17 | 0.37 | - |
| | 2 | - | 0.06 | 0.20 | 0.07 | - |
| | 3 | - | 0.19 | 0.71 | 0.37 | - |
| | 4 | 0.01 | 0.16 | 0.18 | - | - |
| 1983 | 1 | - | 0.04 | 0.11 | 0.10 | - |
| | 2 | - | 0.03 | 0.18 | 0.10 | - |
| | 3 | - | 0.15 | 0.46 | 0.33 | - |
| | 4 | 0.03 | 0.20 | 0.24 | 0.30 | |
| 1984 | 1 | - | 0.05 | 0.12 | 0.17 | - |
| | 2 | - | 0.06 | 0.17 | 0.72 | - |
| | 3 | - | 0.24 | 0.50 | 0.05 | - |
| | 4 | 0.02 | 0.31 | 0.55 | - | - |
| 1985 | 1 | - | 0.03 | 0.23 | 0.34 | 0.01 |
| | 2 | - | 0.02 | 0.04 | 0.04 | - |
| | 3 | - | 0.05 | 0.44 | 0.10 | - |
| | 4 | 0.01 | 0.18 | 0.20 | - | - |

Data prior to 1980 provided by 1984 VPA analysis.

Table 4.4.3 NORWAY POUT. 6 Quarterly VPA. Stock in number x $10^{-6}$

| Year | Quarter | Age groups 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1976 | 3 | 197,354 | 30,693 | 1,963 | 67 | - |
| | 4 | 132,130 | 16,258 | 843 | 43 | - |
| 1977 | 1 | - | 83,710 | 8,353 | 310 | 17 |
| | 2 | - | 48,689 | 4,831 | 181 | - |
| | 3 | 110,491 | 29,737 | 2,941 | 115 | - |
| | 4 | 74,015 | 17,037 | 1,281 | 41 | - |
| 1978 | 1 | - | 48,269 | 8,568 | 668 | 24 |
| | 2 | - | 29,978 | 4,636 | 372 | - |
| | 3 | 196,582 | 19,136 | 2,582 | 97 | - |
| | 4 | 131,519 | 10,966 | 1,116 | 37 | - |
| 1979 | 1 | - | 87,164 | 6,218 | 490 | 20 |
| | 2 | - | 54,307 | 3,409 | 192 | - |
| | 3 | 222,405 | 33,750 | 2,083 | 107 | - |
| | 4 | 148,295 | 19,191 | 787 | 33 | - |
| 1980 | 1 | - | 101,612 | 11,371 | 393 | 13 |
| | 2 | - | 64 018 | 6,752 | 216 | - |
| | 3 | 64,138 | 40,813 | 3,968 | 121 | - |
| | 4 | 42,974 | 21,140 | 1,110 | 67 | - |
| 1981 | 1 | - | 28,285 | 11,009 | 338 | 40 |
| | 2 | - | 17,158 | 6,016 | 166 | - |
| | 3 | 317,212 | 10,632 | 3,530 | 50 | - |
| | 4 | 212,571 | 6,062 | 1,608 | 20 | - |
| 1982 | 1 | - | 112,984 | 3,226 | 835 | - |
| | 2 | - | 71,460 | 1,827 | 386 | - |
| | 3 | 253,107 | 45,262 | 1,002 | 240 | - |
| | 4 | 169,540 | 25,026 | 329 | - | - |
| 1983 | 1 | - | 112,786 | 14,334 | 184 | - |
| | 2 | - | 72,379 | 8,617 | 112 | - |
| | 3 | 16,829 | 47,117 | 4,834 | 68 | - |
| | 4 | 112,465 | 27,137 | 2,051 | 32 | - |
| 1984 | 1 | - | 73,340 | 14,916 | 1,086 | - |
| | 2 | - | 46,943 | 8,896 | 613 | - |
| | 3 | 180,222 | 29,657 | 5,031 | 200 | - |
| | 4 | 120,806 | 15,653 | 2,039 | 127 | - |
| 1985 | 1 | - | 79,183 | 7,709 | 786 | 85 |
| | 2 | - | 51,275 | 4,089 | 376 | - |
| | 3 | 120,937 | 33,688 | 2,625 | 241 | - |
| | 4 | 81,061 | 21,467 | 1,137 | - | - |

Data prior to 1980 provided by 1984 VPA analysis.

Table 4.5.1. Research vessel indices for NORWAY POUT.

| Year class | IYFS[1] February | | EGFS[2] August | ENPS[3] November | | | | SGFS[4] August | | | | NAS[5] June |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1-group | 2-group | 0-group | 0-group | 1-group | 2-group | 3-group | 1-group | 2-group | 3-group | ⩾4-group | 0-group |
| 1968 | - | 6 | - | - | - | - | - | - | - | - | - | - |
| 1969 | 35 | 22 | - | - | - | - | - | - | - | - | - | - |
| 1970 | 1,556 | 653 | - | - | - | - | - | - | - | - | - | - |
| 1971 | 3,425 | 438 | - | - | - | - | - | - | - | - | - | - |
| 1972 | 4,207 | 399 | - | - | - | - | - | - | - | - | - | - |
| 1973 | 25,626 | 2,412 | - | - | - | - | - | - | - | - | - | - |
| 1974 | 4,242 | 385 | - | - | - | - | - | - | - | - | - | - |
| 1975 | 4,599 | 334 | - | - | - | - | - | - | - | - | - | - |
| 1976 | 4,813 | 1,215 | - | - | - | - | 5 | - | - | - | 4 | - |
| 1977 | 1,913 | 240 | 1,387 | - | - | 222 | 82 | - | - | 12 | 4 | - |
| 1978 | 2,690 | 611 | 1,210 | - | 5,501 | 431 | - | - | 346 | 9 | 1 | 3,550 |
| 1979 | 4,081 | 557 | 1,607 | 6,449 | 4,519 | 123 | 36 | 1,928 | 127 | 16 | - | - |
| 1980 | 1,379 | 403 | 151 | 2,106 | 2,146 | 42 | - | 185 | 37 | 1 | 1 | - |
| 1981 | 4,315[7] | NA | 1,770 | 23,946 | 7,166 | 1,935[6] | 74[6] | 1,031 | 90 | 7 | - | - |
| 1982 | 2,612[7] | NA | 1,817 | 19,567 | 7,603 | 132[6] | - | 505 | 78 | 6 | - | - |
| 1983 | 3,587[7] | NA | 1,501 | 21,852 | 6,524[6] | - | - | 597 | 186 | - | - | - |
| 1984 | 2,764[7] | NA | 176 | 5,416[6] | - | - | - | 649 | - | - | - | 2,150 |
| 1985 | 1,949[7] | NA | 97 | - | - | - | - | - | - | - | - | 812 |

[1] International Young Fish Survey, arithmetic mean catch in no/h.

[2] English groundfish survey, arithmetic mean catch in no./h. Roundfish areas 1,2 and 3.

[3] English Norway Pout surveys, arithmetic mean catch in no./h. northern North Sea.

[4] Scottish groundfish surveys, arithmetic mean catch in no./h.

[5] Norwegian acoustic survey, estimated number x $10^{-9}$.

[6] 1984 figures for English Survey (semi-pelagic trawl) October/November 1984. Average no./h. for Roundfish areas 1,2 and 3 (40 hours fishing).

[7] Preliminary.

Table 4.6.1 NORWAY POUT. North Sea 1985. Mean weight at age by quarters, Danish, Norwegian and Scottish catches combined (grammes).[1]

| Quarters | Age groups | | | | |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 |
| 1 | - | 7.86 | 22.70 | 45.26 | 41.8 |
| 2 | - | 12.56 | 28.81 | 43.38 | - |
| 3 | 8.37 | 23.10 | 36.52 | 58.99 | 62.0 |
| 4 | 6.23 | 26.97 | 40.90 | - | - |

[1] These figures should be treated with caution (see text).

Table 4.6.2 NORWAY POUT. North Sea. Quarterly and annual landings in weight by age as a percentage of the overall landings.

| Year | Quarter | Age groups | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| 1979 | 1 | - | 11 | 6 | 2 | - |
| | 2 | - | 10 | 2 | 0.3 | - |
| | 3 | 1 | 32 | 10 | - | - |
| | 4 | 2 | 19 | 3 | - | - |
| | Total | 3 | 72 | 21 | 3 | - |
| 1980 | 1 | - | 8 | 4 | - | - |
| | 2 | - | 5 | 3 | - | - |
| | 3 | - | 38 | 17 | - | - |
| | 4 | 1 | 19 | 4 | - | - |
| | Total | 1 | 70 | 28 | 1 | - |
| 1981 | 1 | - | 7 | 16 | 1 | - |
| | 2 | - | 6 | 6 | 1 | - |
| | 3 | - | 16 | 16 | - | - |
| | 4 | 10 | 14 | 6 | - | - |
| | Total | 10 | 43 | 44 | 3 | - |
| 1982 | 1 | - | 10 | 3 | 2 | - |
| | 2 | - | 7 | 1 | 1 | - |
| | 3 | 1 | 42 | 5 | 1 | - |
| | 4 | 2 | 24 | 1 | - | - |
| | Total | 3 | 83 | 10 | 4 | - |
| 1983 | 1 | - | 7 | 6 | - | - |
| | 2 | - | 4 | 7 | - | - |
| | 3 | 1 | 29 | 13 | - | - |
| | 4 | 4 | 25 | 3 | - | - |
| | Total | 5 | 65 | 29 | 1 | - |
| 1984 | 1 | - | 5 | 9 | 2 | - |
| | 2 | - | 6 | 1 | 3 | - |
| | 3 | - | 26 | 16 | - | - |
| | 4 | 4 | 20 | 7 | - | - |
| | Total | 4 | 57 | 33 | 5 | - |
| 1985 | 1 | - | 8 | 14 | 4 | - |
| | 2 | - | 5 | 2 | - | - |
| | 3 | - | 14 | 13 | 1 | - |
| | 4 | 2 | 35 | 3 | - | - |
| | Total | 2 | 62 | 31 | 5 | - |

Table 5.1.1 Landings of SANDEEL from the North Sea, 1952-85 in '000 tonnes.

| Year | Denmark | Germany, Fed.Rep. | Faroes | Nether-lands | Norway | Sweden | UK | Total |
|---|---|---|---|---|---|---|---|---|
| 1952 | 1.6 | - | - | - | - | - | - | 1.6 |
| 1953 | 4.5 | + | - | - | - | - | - | 4.5 |
| 1954 | 10.8 | + | - | - | - | - | - | 10.8 |
| 1955 | 37.6 | + | - | - | - | - | - | 37.6 |
| 1956 | 81.9 | 5.3 | - | + | 1.5 | - | - | 88.7 |
| 1957 | 73.3 | 25.5 | - | 3.7 | 3.2 | - | - | 105.7 |
| 1958 | 74.4 | 20.2 | - | 1.5 | 4.8 | - | - | 100.9 |
| 1959 | 77.1 | 17.4 | - | 5.1 | 8.0 | - | - | 107.6 |
| 1960 | 100.8 | 7.7 | - | + | 12.1 | - | - | 120.6 |
| 1961 | 73.6 | 4.5 | - | + | 5.1 | - | - | 83.2 |
| 1962 | 97.4 | 1.4 | - | - | 10.5 | - | - | 109.3 |
| 1963 | 134.4 | 16.4 | - | - | 11.5 | - | - | 162.3 |
| 1964 | 104.7 | 12.9 | - | - | 10.4 | - | - | 128.0 |
| 1965 | 123.6 | 2.1 | - | - | 4.9 | - | - | 130.6 |
| 1966 | 138.5 | 4.4 | - | - | 0.2 | - | - | 143.1 |
| 1967 | 187.4 | 0.3 | - | - | 1.0 | - | - | 188.7 |
| 1968 | 193.6 | + | - | - | 0.1 | - | - | 193.7 |
| 1969 | 112.8 | + | - | - | - | - | 0.5 | 113.3 |
| 1970 | 187.8 | + | - | - | + | - | 3.6 | 191.4 |
| 1971 | 371.6 | 0.1 | - | - | 2.1 | - | 8.3 | 382.1 |
| 1972 | 329.0 | + | - | - | 18.6 | 8.8 | 2.1 | 358.5 |
| 1973 | 273.0 | - | 1.4 | - | 17.2 | 1.1 | 4.2 | 296.9 |
| 1974 | 424.1 | - | 6.4 | - | 78.6 | 0.2 | 15.5 | 524.8 |
| 1975 | 355.6 | - | 4.9 | - | 54.0 | 0.1 | 13.6 | 428.2 |
| 1976 | 424.7 | - | - | - | 44.2 | - | 18.7 | 487.6 |
| 1977 | 664.3 | - | 11.4 | - | 78.7 | 5.7 | 25.5 | 785.6 |
| 1978 | 647.5 | - | 12.1 | - | 93.5 | 1.2 | 32.5 | 786.8 |
| 1979 | 449.8 | - | 13.2 | - | 101.4 | - | 13.4 | 577.8 |
| 1980 | 542.2 | - | 7.2 | - | 144.8 | - | 34.3 | 728.5 |
| 1981 | 464.4 | - | 4.9 | - | 52.6 | - | 46.7 | 568.6 |
| 1982 | 506.9 | - | 4.9 | - | 46.5 | 0.4 | 52.2 | 610.9 |
| 1983 | 485.1 | - | 2.0 | - | 12.2 | 0.2 | 37.0 | 536.5 |
| 1984 | 596.3 | - | 11.3 | - | 28.3 | - | 32.6 | 668.5 |
| 1985 | 587.6 | - | 3.5 | - | 13.1 | - | 17.2 | 621.4 |

+ = less than half unit.
- = no information or no catch.

Table 5.1.2 SANDEEL North Sea. Monthly landings ('000) by country 1984 + 1985.

| Year / Month | | Denmark | Faroes | Norway | Scotland | Total |
|---|---|---|---|---|---|---|
| 1984 | Jan | - | | - | - | - |
| | Feb | - | | - | - | - |
| | Mar | 1,334 | | 20 | - | 1,354 |
| | Apr | 62,510 | | 20 | 5,499 | 68,029 |
| | May | 210,598 | | 2,167 | 8,134 | 220,899 |
| | Jun | 232,497 | n/a | 26,123 | 6,413 | 265,033 |
| | Jul | 67,590 | | - | 6,349 | 73,939 |
| | Aug | 18,373 | | - | 5,005 | 23,378 |
| | Sep | 3,364 | | - | 1,134 | 4,498 |
| | Oct | 5 | | - | 44 | 49 |
| | Nov | - | | - | - | - |
| | Dec | - | | - | - | - |
| Total | | 596,271 | 11,254 | 28,330 | 32,578 | 657,179[1] |
| 1985 | Jan | - | | - | - | - |
| | Feb | - | | - | - | - |
| | Mar | 4,338 | | - | - | 4,338 |
| | Apr | 51,116 | | 295 | 1,446 | 52,857 |
| | May | 204,639 | | 3,364 | 3,938 | 211,941 |
| | Jun | 210,831 | | 9,295 | 3,624 | 223,750 |
| | Jul | 81,333 | n/a | 110 | 4,326 | 85,769 |
| | Aug | 19,905 | | - | 2,268 | 22,173 |
| | Sep | 10,130 | | - | 1,188 | 11,318 |
| | Oct | 5,316 | | - | 378 | 5,694 |
| | Nov | - | | - | - | - |
| | Dec | - | | - | - | - |
| Total | | 587,608 | 3,547 | 13,064 | 17,168 | 617,840[1] |

[1] Excl. Faroese.

Table 5.1.3 North Sea SANDEEL.
Catch (tonnes) by month and area (Denmark, Norway, UK (Scotland)) 1985 for areas in Figure 5.1.1.

| Month | 1A | 1B | 1C | 2A | 2B | 2C | 3 | 4 | 5 | 6 | Shetland | Unallocated |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mar | 1,181 | 9 | 321 | 1,657 | 359 | 51 | 1 | 128 | 51 | 580 | - | - |
| Apr | 17,585 | 19,120 | 244 | 9,960 | 530 | - | 1,152 | 218 | 488 | 1,644 | 1,446 | 470 |
| May | 110,771 | 20,641 | 327 | 28,493 | 2,535 | - | 8,187 | 5,833 | 4,981 | 26,230 | 3,938 | - |
| Jun | 128,065 | 6,774 | 1,896 | 9,287 | 3,450 | - | 4,296 | 23,859 | 6,973 | 35,526 | 3,624 | - |
| Jul | 21,235 | 191 | 43 | 15,201 | 17 | - | 6,515 | 15,187 | 5,938 | 17,116 | 4,326 | - |
| Aug | 2,441 | 120 | 19 | 12,007 | 44 | - | 738 | 1,313 | 246 | 2,977 | 2,268 | - |
| Sep | 95 | 17 | - | 4,274 | 138 | - | 5,364 | - | - | 204 | 1,226 | - |
| Oct | 32 | 2 | - | 1,464 | - | - | 3,607 | 19 | 14 | 175 | 381 | - |
| Total | 281,405 | 46,874 | 2,850 | 82,343 | 7,073 | 51 | 29,860 | 46,557 | 18,691 | 84,452 | 17,209 | 470 |

Table 5.1.4. Annual landings ('000 tonnes) of SANDEELS by sub-area of the North Sea [Denmark, Norway, United Kingdom (Scotland)].

| Year | Sub-areas | | | | | | | | | | | Assessment areas[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1A | 1B | 1C | 2A | 2B | 2C | 3 | 4 | 5 | 6 | Shetland | Northern | Southern |
| 1972 | 98.8 | 28.1 | 3.9 | 24.5 | 85.1 | 0.0 | 13.5 | 58.3 | 6.7 | 28.0 | 0.0 | 130.6 | 216.3 |
| 1973 | 59.3 | 37.1 | 1.2 | 16.4 | 60.6 | 0.0 | 8.7 | 37.4 | 9.6 | 59.7 | 0.0 | 107.6 | 182.4 |
| 1974 | 50.4 | 178.0 | 1.7 | 2.2 | 177.9 | 0.0 | 29.0 | 27.4 | 11.7 | 25.4 | 7.4 | 386.6 | 117.1 |
| 1975 | 70.0 | 38.2 | 17.8 | 12.2 | 154.7 | 4.8 | 38.2 | 42.8 | 12.3 | 19.2 | 12.9 | 253.7 | 156.5 |
| 1976 | 154.0 | 3.5 | 39.7 | 71.8 | 38.5 | 3.1 | 50.2 | 59.2 | 8.9 | 36.7 | 20.2 | 135.0 | 330.6 |
| 1977 | 171.9 | 34.0 | 62.0 | 154.1 | 179.7 | 1.3 | 71.4 | 28.0 | 13.0 | 25.3 | 21.5 | 348.4 | 392.3 |
| 1978 | 159.7 | 50.2 | | 346.5 | 70.3 | | 42.5 | 37.4 | 6.4 | 27.2 | 28.1 | 163.0 | 577.2 |
| 1979 | 194.5 | 0.9 | 61.0 | 32.3 | 27.0 | 72.3 | 34.1 | 79.4 | 5.4 | 44.3 | 13.4 | 195.3 | 355.9 |
| 1980 | 215.1 | 3.3 | 119.3 | 89.5 | 52.4 | 27.0 | 90.0 | 30.8 | 8.7 | 57.1 | 25.4 | 292.0 | 401.2 |
| 1981 | 105.2 | 0.1 | 42.8 | 151.9 | 11.7 | 23.9 | 59.6 | 63.4 | 13.3 | 45.1 | 46.7 | 138.1 | 378.9 |
| 1982 | 189.8 | 5.4 | 4.4 | 132.1 | 24.9 | 2.3 | 37.4 | 75.7 | 6.9 | 74.7 | 52.0 | 74.4 | 479.2 |
| 1983 | 197.4 | - | 2.8 | 59.4 | 17.7 | - | 57.7 | 87.6 | 8.0 | 66.0 | 37.0 | 78.2 | 419.0 |
| 1984 | 337.8 | 4.1 | 5.9 | 74.9 | 30.4 | 0.1 | 51.3 | 56.0 | 3.9 | 60.2 | 32.6 | 91.8 | 532.8 |
| 1985 | 281.4 | 46.9 | 2.8 | 82.3 | 7.1 | 0.1 | 29.9 | 46.6 | 18.7 | 84.5 | 17.2 | 79.7 | 513.5 |

[1] Assessment areas: Northern - Sub-areas 1B, 1C, 2B, 2C, 3.
Southern - Sub-areas 1A, 2A, 4, 5, 6.

Table 5.1.5 SANDEEL, Division VIa.
Landings in tonnes 1976-85 as officially reported to ICES.

| Country | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| Denmark | - | - | - | - | 109 | - | - | - | - | - |
| Norway | 17 | 54 | - | - | - | - | - | - | - | - |
| UK (Scotland) | + | 13 | + | - | 211 | 5,972 | 10,873 | 13,051 | 14,166 | 18,586 |

Table 5.1.6 SANDEEL, Division IIIa.
Landings in tonnes as officially reported to ICES except where indicated.

| Country | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| Denmark | 21,418 | 6,082 | 21,731 | 33,305 | 39,357 | 59,408 | 21,540 | 34,286[1] | 27,679[1] | 6,271[1] |
| Faroes | - | - | 2 | - | - | - | - | - | - | - |
| Sweden | 67 | 432 | 1,121[2] | 3 | 9 | 44 | 5 | 31 | - | - |

[1] Estimate provided by Working Group members.

[2] Includes North Sea.

Table 5.2.1. Fishing effort in the SANDEEL fisheries - Norwegian data.

| Year | Fishing days Norwegian vessels FD | Mean gross registered tonnage GRT | Fishing effort FD x GRT x $10^{-3}$ | Sandeel landings (t x $10^{-3}$) Norwegian | Total international | fishing effort raised to total catch |
|---|---|---|---|---|---|---|
| | | | Northern assessment area | | | |
| | | | 1st half of year | | | |
| 1976 | 595 | 198.8 | 118.3 | 11.1 | 110.3 | 1,175.5 |
| 1977 | 2,212 | 172.3 | 381.1 | 50.4 | 276.0 | 2,087.0 |
| 1978 | 1,747 | 203.4 | 355.3 | 44.9 | 109.7 | 868.0 |
| 1979 | 1,407 | 213.8 | 300.8 | 29.6 | 47.7 | 484.4 |
| 1980 | 2,699 | 204.7 | 552.5 | 112.8 | 220.9 | 1,081.7 |
| 1981 | 1,780 | 212.6 | 378.4 | 42.8 | 93.3 | 824.2 |
| 1982 | 1,222 | 210.1 | 256.7 | 27.0 | 62.3 | 591.7 |
| 1983 | 324 | 267.8 | 86.8 | 8.5 | 54.5 | 556.4 |
| 1984 | 145 | 185.8 | 26.9 | 3.5 | 74.1 | 569.5 |
| 1985 | 366 | 212.8 | 77.9 | 8.7 | 69.9 | 625.8 |
| | | | 2nd half of year | | | |
| 1977 | 457 | 184.9 | 84.5 | 11.8 | 110.0 | 787.7 |
| 1978 | 806 | 203.7 | 164.2 | 22.5 | 53.3 | 388.2 |
| 1979 | 1,720 | 188.9 | 324.9 | 53.2 | 147.7 | 902.2 |
| 1980 | 1,130 | 206.1 | 232.9 | 33.2 | 71.1 | 499.6 |
| 1981 | 414 | 189.0 | 78.2 | 7.9 | 44.9 | 446.0 |
| 1982 | - | - | - | - | 12.0 | - |
| 1983 | 66 | 208.0 | 13.7 | 2.4 | 23.7 | 133.1 |
| 1984 | - | - | - | - | 17.7 | - |
| 1985 | - | - | - | - | 16.8 | - |
| | | | Southern assessment area - all year | | | |
| 1977 | 537 | 185.2 | 99.5 | 14.0 | 392.3 | 2,780 |
| 1978 | 1,044 | 222.2 | 232.0 | 24.3 | 577.2 | 5,508 |
| 1979 | 765 | 240.1 | 183.7 | 18.2 | 355.9 | 3,595 |
| 1980 | 3 | 208.0 | 0.6 | 0.1 | 401.2 | 2,407 |
| 1981 | 72 | 199.5 | 14.4 | 1.4 | 378.9 | 2,826 |
| 1982 | 607 | 236.1 | 143.3 | 20.3 | 479.2 | 3,386 |
| 1983 | 40 | 280.5 | 11.2 | 1.2 | 419.2 | 3,786 |
| 1984 | 504 | 246.6 | 124.3 | 22.2 | 532.8 | 2,983 |
| 1985 | 201 | 250.0 | 50.2 | 4.5 | 513.4 | 5,728 |

Table 5.2.2 Danish fishing effort indices
(days fishing multiplied by scaling factors for each vessel category), 1982-85.

| Year | Southern area | | | | Northern area | | | |
|---|---|---|---|---|---|---|---|---|
| | Fishing effort index | Catch sampled for fishing effort t | Total International catch t | Derived total international effort index | Fishing effort index | Catch sampled for fishing effort t | Total international catch t | Derived total international effort index |
| 1982 | | | | | | | | |
| 1st half | 22,408 | 141,565 | 426,515 | 67,512 | 2,925 | 10,792 | 62,305 | 16,887 |
| 2nd half | 2,272 | 9,209 | 52,626 | 12,984 | 529 | 2,043 | 11,984 | 3,103 |
| Total | | | | 80,596 | | | | 19,990 |
| 1983 | | | | | | | | |
| 1st half | 39,894 | 220,983 | 359,753 | 64,946 | 5,580 | 16,391 | 54,515 | 18,559 |
| 2nd half | 7,627 | 29,538 | 59,268 | 15,304 | 2,490 | 12,224 | 23,741 | 4,836 |
| Total | | | | 80,250 | | | | 23,395 |
| 1984 | | | | | | | | |
| 1st half | 51,629 | 353,669 | 461,132 | 67,317 | 11,710 | 45,372 | 74,137 | 19,134 |
| 2nd half | 14,675 | 59,577 | 71,655 | 17,650 | 3,145 | 10,992 | 17,677 | 5,058 |
| Total | | | | 84,967 | | | | 24,192 |
| 1985[1] | | | | | | | | |
| 1st half | 68,000 | 356,828 | 417,057 | 79,478 | 10,203 | 43,893 | 70,363 | 16,356 |
| 2nd half | 15,629 | 69,507 | 110,585 | 24,866 | 1,804 | 6,000 | 6,209 | 1,866 |
| Total | | | | 104,344 | | | | 18,222 |

[1] Preliminary data.

Table 5.2.3 Fishing effort (days absent) by month and year in the Shetland sandeel fishery 1974-85. UK (Scotland) data.

| Month | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan | - | 6 | - | - | - | - | - | - | - | - | - | - |
| Feb | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Mar | - | 22 | 6 | 77 | 12 | - | - | - | - | - | - | - |
| Apr | - | 85 | 132 | 191 | 116 | 38 | 95 | 234 | 242 | 83 | 227 | 57 |
| May | 5 | 104 | 127 | 217 | 316 | 134 | 156 | 289 | 355 | 295 | 385 | 146 |
| Jun | 142 | 112 | 222 | 305 | 250 | 161 | 229 | 299 | 359 | 385 | 303 | 158 |
| Total | 147 | 330 | 487 | 790 | 694 | 333 | 480 | 822 | 956 | 763 | 915 | 361 |
| Jul | 165 | 205 | 312 | 277 | 187 | 106 | 242 | 440 | 361 | 339 | 337 | 191 |
| Aug | 116 | 219 | 241 | 160 | 234 | 108 | 212 | 346 | 297 | 297 | 263 | 133 |
| Sep | 117 | 80 | 79 | 89 | 204 | 44 | 72 | 198 | 254 | 127 | 102 | 80 |
| Oct | 88 | 13 | 65 | 35 | 78 | 1 | - | - | - | 11 | 7 | 27 |
| Nov | 16 | - | 4 | - | - | - | - | - | - | - | - | - |
| Dec | - | - | - | - | - | - | - | - | - | - | - | - |
| Total | 502 | 517 | 701 | 561 | 703 | 259 | 526 | 1,024 | 977 | 774 | 709 | 431 |
| Annual total | 649 | 847 | 1,188 | 1,351 | 1,397 | 592 | 1,006 | 1,846 | 1,933 | 1,537 | 1,624 | 792 |

Table 5.3.1 Estimates of M ($M_1$ + $M_2$) for SANDEELS from the key run of the MSVPA (1985 analysis).

| Age | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 11-year mean | Value used in 1985 VPA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | First half of year | | | | | | | |
| 0 | 0.56 | 0.53 | 0.48 | 0.40 | 0.38 | 0.41 | 0.43 | 0.34 | 0.20 | 0.23 | 0.26 | 0.38 | - |
| 1 | 1.58 | 1.22 | 1.25 | 1.01 | 0.97 | 0.99 | 1.06 | 1.19 | 0.61 | 0.66 | 0.55 | 1.01 | 0.375 |
| 2 | 0.71 | 0.42 | 0.41 | 0.33 | 0.28 | 0.27 | 0.29 | 0.36 | 0.24 | 0.22 | 0.18 | 0.34 | 0.25 |
| 3 | 0.17 | 0.13 | 0.14 | 0.13 | 0.12 | 0.12 | 0.13 | 0.16 | 0.12 | 0.10 | 0.08 | 0.13 | 0.25 |
| 4 | 0.39 | 0.29 | 0.31 | 0.30 | 0.26 | 0.18 | 0.30 | 0.40 | 0.28 | 0.22 | 0.17 | 0.28 | 0.25 |
| 5 | 0.73 | 0.40 | 0.41 | 0.35 | 0.31 | 0.32 | 0.31 | 0.42 | 0.28 | 0.24 | 0.19 | 0.36 | 0.25 |
| 6 | 0.29 | 0.18 | 0.20 | 0.20 | 0.17 | 0.20 | 0.18 | 0.24 | 0.21 | 0.15 | 0.13 | 0.20 | 0.25 |
| | | | | | | Second half of year | | | | | | | |
| 0 | 0.67 | 0.68 | 0.53 | 0.40 | 0.39 | 0.36 | 0.49 | 0.33 | 0.37 | 0.26 | 0.43 | 0.45 | 1.00 |
| 1 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.08 | 0.09 | 0.09 | 0.08 | 0.07 | 0.08 | 0.08 | 0.375 |
| 2 | 0.14 | 0.14 | 0.16 | 0.16 | 0.16 | 0.15 | 0.20 | 0.19 | 0.16 | 0.12 | 0.13 | 0.16 | 0.25 |
| 3 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.11 | 0.10 | 0.09 | 0.07 | 0.08 | 0.09 | 0.25 |
| 4 | 0.20 | 0.22 | 0.24 | 0.26 | 0.25 | 0.24 | 0.32 | 0.30 | 0.26 | 0.17 | 0.20 | 0.24 | 0.25 |
| 5 | 0.08 | 0.09 | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.07 | 0.08 | 0.08 | 0.25 |
| 6 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 | 0.06 | 0.07 | 0.25 |

Table 5.3.2 Number and biomass of SANDEELS dying through natural causes other than predation by the five main predators in each quarter of 1981 (from key run of 1985 MSVPA). Mean weights (g) are those for southern area, taken from Table 5.5.2 in 1984 report).

| Age | Quarter | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I | | II | | III | | IV | | |
| | No. x $10^{-6}$ | $\bar{w}$ | No. x $10^{-6}$ | $\bar{w}$ | No. x $10^{-6}$ | $\bar{w}$ | No. x $10^{-6}$ | $\bar{w}$ | |
| 0 | 17,712 | (1.0)[1] | 15,174 | 1.4 | 11,079 | 3.2 | 8,698 | 4.4 | |
| 1 | 2,399 | 2.6 | 1,160 | 5.3 | 493 | 10.4 | 455 | 10.1 | |
| 2 | 845 | 5.8 | 482 | 9.4 | 222 | 17.9 | 178 | 21.7 | |
| 3 | 230 | 8.2 | 161 | 13.1 | 106 | 17.3 | 99 | 18.7 | |
| 4 | 45 | 8.9 | 24 | 16.8 | 10 | 21.8 | 8 | 21.3 | |
| 5 | 16 | 11.3 | 8 | 17.3 | 3 | 23.4 | 2 | 27.0 | |
| 6 | 11 | 9.0 | 7 | 20.7 | 5 | 17.7 | 5 | (27.0)[1] | |
| Biomass (t) | 31,417 | | 34,718 | | 46,764 | | 48,940 | | Σ 161,839 |

[1] Assumed value.

Table 5.3.3 MSVPA estimates of the percentage of each age group of SANDEELS taken by each predator in 1981.

| Sandeel age | Predator | | | | |
|---|---|---|---|---|---|
| | Cod | Whiting | Saithe | Mackerel | Haddock |
| 0 | 11.4 | 62.1 | 1.2 | 12.6 | 12.7 |
| 1 | 18.8 | 68.3 | 0.5 | 9.8 | 2.5 |
| 2 | 19.5 | 58.2 | 0.6 | 19.2 | 2.4 |
| ⩾3 | 30.8 | 57.0 | 1.0 | 9.2 | 2.0 |
| Biomass | 17.3 | 41.4 | 0.9 | 21.1 | 19.2 |

Table 5.3.4 Estimated biomass of SANDEELS ($t \times 10^{-3}$) consumed by whiting in each roundfish area and quarter in 1981.

| Roundfish area | Quarter | | | | Σ | % |
|---|---|---|---|---|---|---|
| | I | II | III | IV | | |
| 1 | 0.8 | 18.1 | 2.2 | - | 21.1 | 7.7 |
| 2 | 0.1 | 1.1 | 7.4 | 11.0 | 19.7 | 7.2 |
| 3 | 16.7 | 96.2 | 36.2 | 28.1 | 177.3 | 64.6 |
| 4 | 0.6 | 17.6 | 7.8 | 0.2 | 26.2 | 9.6 |
| 5 | - | 9.2 | 0.4 | 0.5 | 10.0 | 3.6 |
| 6 | 2.7 | 13.3 | 0.4 | 2.1 | 18.5 | 6.7 |
| 7 | 0.1 | - | 1.4 | 1.3 | 1.8 | 0.6 |

Table 5.4.1 SANDEELS. No. caught x $10^{-6}$. Southern area of N orth Sea 1985.

| Quarter | Age group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | ≥9 | Total |
| Jan-Mar | - | 105.5 | 628.3 | 8.8 | 0.5 | - | - | - | - | - | 743.1 |
| Apr-Jun | 6,517.0 | 7,619.0 | 38,341.4 | 2,459.5 | 230.9 | 18.3 | 6.6 | 6.6 | - | - | 55,199.3 |
| Jul-Sep | 9,865.4 | 1,890.4 | 3,227.2 | 2,233.8 | 162.9 | 77.1 | 29.8 | 14.0 | 14.0 | 5.3 | 17,519.9 |
| Oct-Dec | 2,074.8 | 6.2 | 2.1 | - | - | - | - | - | - | - | 2,083.2 |
| Total | 18,457.2 | 9,621.1 | 42,199.0 | 4,702.1 | 394.3 | 95.4 | 36.4 | 20.6 | 14.0 | 5.3 | 75,545.[F] |

Excluding Faroese - allocated to 2nd quarter.

Table 5.4.2 SANDEEL. No. caught x $10^{-6}$.
Northern area of North Sea 1985.

| Quarter | Age group | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | ≥5 | Total |
| Jan-Mar | - | 114.2 | 34.9 | 7.5 | 0.6 | - | 157.3 |
| Apr-Jun | 1.4 | 2,574.3 | 3,257.6 | 994.8 | 376.7 | 107.2 | 7,311.9 |
| Jul-Sep | 301.1 | 100.0 | 223.7 | 78.4 | 6.6 | 5.0 | 714.8 |
| Oct-Dec | 48.1 | 9.2 | 15.7 | 10.9 | 0.8 | 0.7 | 85.5 |
| Total | 350.6 | 2,797.7 | 3,531.9 | 1,091.6 | 384.7 | 112.9 | 8,269.5 |

Table 5.4.3 SANDEELS. Shetland. No.caught x $10^{-6}$ 1985.

| Month | Age group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ≥8 | Total |
| Apr | - | 407.4 | 34.0 | 13.1 | 6.5 | 2.4 | 0.9 | - | 0.1 | 464.3 |
| May | 0.6 | 450.5 | 165.4 | 95.7 | 31.8 | 7.4 | 3.6 | 0.7 | 0.7 | 756.4 |
| Jun | 152.2 | 218.3 | 113.4 | 57.3 | 17.0 | 7.0 | 1.7 | 0.4 | 0.4 | 567.6 |
| Jul | 996.4 | 154.7 | 127.3 | 69.0 | 18.6 | 10.4 | 2.3 | 0.6 | 0.5 | 1,379.6 |
| Aug | 685.9 | 81.1 | 23.1 | 12.6 | 1.0 | 1.0 | 0.5 | 0.2 | - | 805.4 |
| Sep | 279.4 | 13.0 | 5.4 | 1.4 | 0.4 | - | - | - | - | 299.6 |
| Oct | 86.9 | 4.0 | 1.7 | 0.5 | 0.1 | - | - | - | - | 93.2 |
| Total | 2,201.4 | 1,329.0 | 470.2 | 249.6 | 75.3 | 28.1 | 9.0 | 1.9 | 1.6 | 4,366.2 |

Table 5.4.4 Weight landed (t) and number of SANDEELS at age $10^6$ landed by Scottish vessels from Division VIa by quarter, 1980-85.

| Year | Quarter | Weight landed (t) | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | ≥7 |
| 1980 | Jan-Mar | - | - | - | - | - | - | - | - | - |
| | Apr-Jun | - | - | - | - | - | - | - | - | - |
| | Jul-Sep | 180 | 3.4 | 2.8 | 0.8 | 2.4 | 1.3 | 1.4 | 0.2 | 0.2 |
| | Oct-Dec | - | - | - | - | - | - | - | - | - |
| | Total | 180 | 3.4 | 2.8 | 0.8 | 2.4 | 1.3 | 1.4 | 0.2 | 0.2 |
| 1981 | Jan-Mar | - | - | - | - | - | - | - | - | |
| | Apr-Jun | 63 | - | 0.1 | 4.2 | 2.1 | 0.9 | 0.1 | 0.1 | 0.01 |
| | Jul-Sep | 5,881 | 486.4 | 306.3 | 212.2 | 27.9 | 5.3 | - | 1.2 | - |
| | Oct-Dec | 28 | 2.3 | 1.5 | 1.0 | 0.1 | 0.03 | - | 0.01 | - |
| | Total | 5,972 | 488.7 | 307.9 | 217.4 | 30.1 | 6.2 | 0.1 | 1.3 | 0.01 |
| 1982 | Jan-Mar | - | - | - | - | - | - | - | - | - |
| | Apr-Jun | 5,858 | 360.1 | 253.3 | 189.5 | 201.0 | 66.9 | 27.6 | 3.2 | 0.8 |
| | Jul-Sep | 4,905 | 546.9 | 47.1 | 65.9 | 100.6 | 35.8 | 26.0 | 9.5 | 2.2 |
| | Oct-Dec | 24 | 1.2 | 0.2 | 0.7 | 0.6 | 0.2 | 0.03 | 0.01 | - |
| | Total | 10,737 | 908.2 | 300.6 | 256.1 | 302.2 | 102.9 | 53.6 | 12.7 | 3.0 |
| 1983 | Jan-Mar | - | - | - | - | - | - | - | - | - |
| | Apr-Jun | 7,031 | 390.5 | 520.1 | 134.5 | 82.1 | 100.5 | 25.4 | 10.4 | 1.2 |
| | Jul-Sep | 6,020 | 2,256.0 | 105.9 | 28.7 | 19.7 | 20.0 | 3.9 | 2.5 | 0.8 |
| | Oct-Dec | - | - | - | - | - | - | - | - | - |
| | Total | 13,051 | 2,646.5 | 626.0 | 163.2 | 101.8 | 120.5 | 29.3 | 12.9 | 2.0 |
| 1984 | Jan-Mar | - | - | - | - | - | - | - | - | - |
| | Apr-Jun | 8,105 | 185.8 | 858.1 | 219.6 | 134.7 | 65.9 | 27.4 | 7.8 | 1.4 |
| | Jul-Sep | 6,061 | 1,751.0 | 99.0 | 66.6 | 114.8 | 38.3 | 26.4 | 8.0 | 3.2 |
| | Oct-Dec | - | - | - | - | - | - | - | - | - |
| | Total | 14,166 | 1,936.8 | 957.1 | 286.2 | 249.5 | 104.2 | 53.8 | 15.8 | 4.6 |
| 1985 | Jan-Mar | - | - | - | - | - | - | - | - | - |
| | Apr-Jun | 8,855 | 53.3 | 138.6 | 436.7 | 181.1 | 139.2 | 55.1 | 27.0 | 7.3 |
| | Jul-Sep | 9,440 | 2,991.7 | 13.4 | 162.8 | 117.2 | 73.0 | 28.2 | 12.2 | 0.9 |
| | Oct-Dec | 291 | 215.0 | + | + | + | + | - | - | - |
| | Total | 18,586 | 3,260.0 | 152.1 | 599.5 | 298.4 | 212.2 | 83.4 | 39.3 | 8.2 |

Table 5.4.5 SANDEELS in the southern North Sea. VPA catch in numbers, half year (x $10^{-6}$).

| Age group | 1972 | | 1973 | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | - | 13 | - | 670 | 76 | - | - | 4 | - | - | 13,263 | 922 | 41,224 |
| 1 | 2,839 | 86 | 14,497 | 206 | 5,989 | 226 | 11,458 | 480 | 16,308 | 249 | 19,500 | 269 | 58,839 | 2,774 |
| 2 | 15,695 | 1,148 | 2,515 | 53 | 3,930 | 10 | 1,694 | 1,046 | 14,505 | 2,358 | 5,596 | 27 | 16,948 | 385 |
| 3 | 418 | 35 | 3,832 | 151 | 497 | - | 2,838 | 170 | 1,522 | 392 | 6,300 | 8 | 1,793 | 125 |
| 4 | 128 | 24 | 183 | 5 | 1,968 | 3 | 529 | 253 | 1,234 | 102 | 965 | 8 | 1,006 | 97 |
| 5 | 94 | 16 | 89 | 3 | 205 | - | 666 | - | 171 | 20 | 445 | 3 | 114 | 26 |
| 6 | 20 | - | 31 | 2 | 22 | - | 91 | - | 72 | 58 | 239 | 3 | 21 | 26 |
| 7 | 3 | - | 7 | 1 | 11 | - | 2 | - | 1 | 16 | 124 | - | 14 | 7 |
| 8 | 29 | - | 53 | - | 73 | - | 3 | - | - | - | 36 | - | 26 | - |
| Total | 19,225 | 1,308 | 21,221 | 423 | 13,363 | 315 | 17,280 | 1,949 | 33,817 | 3,195 | 33,204 | 13,581 | 79,684 | 44,665 |

| Age group | 1979 | | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | 181 | 1,947 | 62 | 72 | 415 | 43,420 | 242 | 5,039 | 955 | 9,298 | 20 | - | 6,573 | 11,940 |
| 1 | 16,018 | 5,210 | 33,269 | 4,738 | 13,394 | 407 | 56,545 | 4,718 | 2,232 | 240 | 62,517 | 9,422 | 7,790 | 1,896 |
| 2 | 22,737 | 2,085 | 12,472 | 840 | 11,719 | 1,892 | 6,224 | 490 | 35,029 | 2,806 | 2,257 | 92 | 39,301 | 3,229 |
| 3 | 4,487 | 138 | 3,794 | 575 | 2,466 | 115 | 3,277 | 344 | 934 | 513 | 13,272 | 577 | 2,490 | 2,234 |
| 4 | 1,265 | 110 | 375 | 9 | 774 | 36 | 1,813 | 36 | 234 | 2 | 267 | 44 | 233 | 163 |
| 5 | 441 | 30 | 63 | - | 353 | 3 | 94 | 4 | 122 | - | 109 | - | 18 | 77 |
| 6 | 244 | - | 50 | - | 84 | - | 24 | - | 25 | - | 66 | - | 7 | 30 |
| 7 | 3 | - | - | - | 16 | - | 8 | - | - | - | - | - | 7 | 14 |
| 8 | 32 | - | - | - | 5 | - | - | - | 6 | - | - | - | - | 14 |
| Total | 45,409 | 9,520 | 50,086 | 6,234 | 29,226 | 45,873 | 68,227 | 10,631 | 39,537 | 12,859 | 78,508 | 10,135 | 56,419 | 19,597 |

Note: 1 = Jan-Jun, 2 = Jul-Dec.

Table 5.4.6 SANDEELS in the southern North Sea. VPA fishing mortality per half year.

M = 0-group 0.5 half year$^{-1}$ applied to 2nd half only
1-group 1st half 1.0
2nd half 0.1
≥2-group 1st half 0.33
2nd half 0.17

| Age Group | 1972 | | 1973 | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | - | - | - | - | - | - | - | - | - | - | 0.04 | - | 0.21 |
| 1 | 0.12 | 0.01 | 0.35 | 0.01 | 0.20 | 0.02 | 0.14 | 0.01 | 0.41 | 0.02 | 0.27 | 0.008 | 0.52 | 0.06 |
| 2 | 0.57 | 0.08 | 0.28 | 0.01 | 0.30 | 0.001 | 0.16 | 0.15 | 0.56 | 0.17 | 0.51 | 0.004 | 0.92 | 0.05 |
| 3 | 0.15 | 0.02 | 0.41 | 0.03 | 0.11 | - | 0.54 | 0.06 | 0.34 | 0.15 | 0.99 | 0.003 | 0.44 | 0.05 |
| 4 | 0.39 | 0.12 | 0.13 | 0.004 | 0.57 | 0.002 | 0.23 | 0.18 | 0.78 | 0.14 | 0.68 | 0.01 | 0.60 | 0.11 |
| 5 | 0.50 | 0.16 | 0.96 | 0.06 | 0.29 | - | 0.57 | - | 0.18 | 0.03 | 1.55 | 0.03 | 0.22 | 0.08 |
| 6 | 0.04 | - | 0.54 | 0.05 | 1.17 | - | 0.28 | - | 0.15 | 0.18 | 0.65 | 0.01 | 0.38 | 1.23 |
| 7 | 0.01 | - | 0.02 | 0.002 | 0.56 | - | (0.50) | - | 0.004 | 0.13 | 0.76 | - | 0.09 | 0.06 |
| 8 | (0.50) | - | (0.50) | - | (0.50) | - | (0.50) | - | - | - | (0.50) | - | 0.50) | - |
| $\bar{F}_{1-4}$ | 0.34 | 0.05 | 0.34 | 0.01 | 0.24 | 0.01 | 0.16 | 0.04 | 0.46 | 0.10 | 0.35 | 0.007 | 0.56 | 0.06 |

| Age Group | 1979 | | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 0.01 | - | 0.001 | - | 0.09 | - | 0.02 | - | 0.02 | - | - | - | (0.05) |
| 1 | 0.21 | 0.15 | 0.42 | 0.15 | 0.32 | 0.02 | 0.30 | 0.06 | 0.02 | 0.003 | 0.27 | 0.09 | 0.19 | (0.10) |
| 2 | 0.99 | 0.23 | 0.64 | 0.08 | 0.65 | 0.21 | 0.53 | 0.07 | 0.72 | 0.12 | 0.04 | 0.002 | 0.63 | (0.10) |
| 3 | 1.15 | 0.09 | 0.89 | 0.33 | 0.38 | 0.03 | 0.73 | 0.16 | 0.21 | 0.18 | 1.31 | 0.17 | 0.08 | (0.10) |
| 4 | 1.10 | 0.26 | 0.41 | 0.02 | 1.10 | 0.13 | 0.86 | 0.04 | 0.16 | 0.002 | 0.14 | 0.03 | 0.10 | (0.10) |
| 5 | 1.10 | 0.18 | 0.24 | - | 1.46 | 0.04 | 0.62 | 0.05 | 0.17 | - | 0.15 | - | 0.02 | (0.10) |
| 6 | 2.05 | - | 0.56 | - | 0.92 | - | (0.50) | - | (0.50) | - | 0.18 | - | 0.02 | (0.10) |
| 7 | (0.50) | - | 0.005 | - | (0.50) | - | 0.28 | - | - | - | - | - | 0.04 | (0.10) |
| 8 | (0.50) | - | - | - | (0.50) | - | - | - | (0.50) | - | - | - | - | - |
| $\bar{F}_{1-4}$ | 0.44 | 0.17 | 0.47 | 0.14 | 0.42 | 0.08 | 0.32 | 0.06 | 0.21 | 0.04 | 0.28 | 0.07 | 0.38 | (0.10) |

Note: 1 = Jan-Jun, 2 = Jul-Dec.

Table 5.4.7 SANDEELS in the southern North Sea. VPA. Stock size in numbers x $10^{-6}$ (biomass in '000 tonnes).

| Age group | 1972 | | 1973 | | 1974 | | 1975 | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 124,697 | - | 83,762 | - | 226,280 | - | 122,255 |
| 1 | 40,727 | 13,346 | 75,633 | 19,622 | 50,804 | 15,262 | 137,187 | 43,876 |
| 2 | 41,754 | 16,975 | 11,994 | 6,516 | 17,559 | 9,334 | 13,594 | 8,349 |
| 3 | 3,497 | 2,163 | 13,269 | 6,341 | 5,449 | 3,500 | 7,865 | 3,294 |
| 4 | 456 | 221 | 1,793 | 1,135 | 5,211 | 2,111 | 2,953 | 1,679 |
| 5 | 274 | 119 | 165 | 45 | 953 | 514 | 1,778 | 725 |
| 6 | 624 | 432 | 86 | 36 | 36 | 8 | 433 | 236 |
| 7 | 263 | 186 | 364 | 256 | 29 | 12 | 7 | - |
| 8 | 85 | - | 157 | - | 215 | - | 10 | - |
| SSB | 494 | | 345 | | 357 | | 331 | |
| Total biomass | 719 | | 762 | | 637 | | 1,087 | |

| Age group | 1976 | | 1977 | | 1978 | | 1979 | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 211,091 | - | 381,858 | - | 268,489 | - | 249,076 |
| 1 | 74,151 | 18,098 | 128,033 | 35,998 | 221,406 | 48,604 | 131,355 | 39,159 |
| 2 | 39,244 | 16,155 | 16,139 | 6,945 | 32,316 | 9,276 | 41,342 | 11,033 |
| 3 | 6,057 | 3,103 | 11,471 | 3,068 | 5,835 | 2,699 | 7,473 | 1,699 |
| 4 | 2,623 | 866 | 2,260 | 825 | 2,581 | 1,020 | 2,163 | 518 |
| 5 | 1,185 | 708 | 637 | 97 | 688 | 399 | 772 | 193 |
| 6 | 612 | 379 | 579 | 218 | 80 | 39 | 312 | 29 |
| 7 | 199 | 142 | 267 | 90 | 182 | 119 | 10 | - |
| 8 | - | - | 105 | - | 76 | - | 94 | - |
| SSB | 553 | | 384 | | 463 | | 571 | |
| Total biomass | 962 | | 1,090 | | 1,683 | | 1,295 | |

(cont'd)

Table 5.4.7 (cont'd)

| Age group | 1980 | | 1981 | | 1982 | | 1983 | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 123,310 | - | 610,406 | - | 340,514 | - | 694,203 |
| 1 | 149,572 | 36,303 | 74,736 | 19,901 | 336,894 | 91,821 | 202,652 | 73,254 |
| 2 | 30,485 | 11,570 | 28,349 | 10,662 | 17,620 | 7,489 | 78,599 | 27,510 |
| 3 | 7,402 | 2,194 | 8,991 | 4,404 | 7,265 | 2,511 | 5,869 | 3,435 |
| 4 | 1,307 | 626 | 1,326 | 319 | 3,610 | 1,100 | 1,804 | 1,100 |
| 5 | 336 | 189 | 520 | 87 | 236 | 92 | 895 | 541 |
| 6 | 136 | 56 | 160 | 46 | 71 | - | 74 | - |
| 7 | 24 | 17 | 47 | - | 38 | 21 | - | - |
| 8 | - | - | 15 | - | - | - | 18 | - |
| SSB | 436 | | 441 | | 340 | | 910 | |
| Total biom. | 1,260 | | 853 | | 2,197 | | 2,027 | |

| Age group | 1984 | | 1985 | | 1986 | Mean weight (g) | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 1 | 2 |
| 0 | - | 113,753 | | 310,460 | - | - | 2.42 |
| 1 | 413,894 | 116,660 | 68,995 | 20,919 | 179,120 | 5.51 | 7.50 |
| 2 | 66,055 | 45,586 | 96,605 | 36,845 | 17,127 | 9.96 | 10.75 |
| 3 | 20,639 | 4,016 | 38,375 | 25,491 | 28,127 | 13.74 | 14.12 |
| 4 | 2,429 | 1,521 | 2,860 | 1,860 | 19,460 | 16.3 | 17.71 |
| 5 | 926 | 574 | 1,243 | 879 | 1,420 | 17.6 | 19.8 |
| 6 | 457 | 273 | 484 | 342 | 671 | 18.5 | - |
| 7 | - | - | 230 | 160 | 261 | 18.9 | - |
| 8 | - | - | - | - | 122 | 19.1 | - |
| SSB | 1,006 | | 1,571 | | 919 | | |
| Total biom. | 3,286 | | 1,951 | | 1,906 | | |

Note: 1 = Jan-Jun, 2 = Jul-Dec.

Table 5.4.8 SANDEELS in the northern North Sea (Shetland excluded). VPA, catch in numbers, half year (x $10^{-6}$)

| Age group | 1972 | | 1973 | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 4,930 | - | 337 | 472 | 9,979 | 99 | 9,282 | 237 | 6,126 | 3,686 | 3,067 | - | 7,820 |
| 1 | 3,398 | 846 | 4,057 | 143 | 19,850 | 384 | 7,186 | 74 | 5,697 | 648 | 24,307 | 2,856 | 6,127 | 1,001 |
| 2 | 2,045 | - | 1,657 | 68 | 1,347 | 53 | 5,249 | 105 | 1,130 | 84 | 2,351 | 913 | 2,338 | 307 |
| 3 | 115 | - | 836 | 20 | 1,424 | 11 | 1,508 | 1 | 445 | 368 | 516 | 142 | 573 | 39 |
| 4 | 79 | - | 89 | - | 276 | 7 | 248 | - | 101 | 19 | 124 | 99 | 78 | 1 |
| 5 | 62 | - | 58 | 1 | 73 | 5 | 87 | - | 39 | 10 | 17 | 28 | 45 | 1 |
| 6 | 60 | - | 1 | - | 2 | - | - | - | 15 | 8 | 3 | 15 | 21 | - |
| Total | 5,759 | 5,776 | 6,698 | 570 | 23,444 | 10,439 | 14,377 | 9,463 | 7,664 | 7,262 | 31,007 | 7,119 | 9,181 | 9,169 |

| Age group | 1979 | | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 44,203 | 17 | 8,349 | 17 | 9,128 | 2 | 6,530 | - | 7,911 | - | - | 1 | 349 |
| 1 | 2,335 | 1,310 | 13,394 | 1,173 | 5,505 | 346 | 3,518 | 65 | 5,684 | 303 | 11,692 | 1,207 | 2,688 | 109 |
| 2 | 1,328 | 433 | 8,865 | 214 | 4,109 | 94 | 2,132 | - | 1,215 | 316 | 1,647 | 121 | 3,292 | 239 |
| 3 | 242 | 66 | 1,050 | 19 | 904 | 14 | 556 | - | 89 | 19 | 153 | 43 | 1,002 | 89 |
| 4 | 5 | 10 | 645 | 4 | 128 | 6 | 76 | - | 8 | - | 4 | - | 377 | 7 |
| 5 | 2 | - | 144 | 3 | 19 | - | 9 | - | - | - | - | - | 78 | 3 |
| 6 | 5 | - | 38 | 1 | 27 | - | - | - | 4 | - | - | - | 25 | 1 |
| Total | 3,917 | 46,022 | 24,155 | 9,762 | 10,709 | 9,588 | 6,293 | 6,595 | 7,000 | 8,549 | 13,496 | 1,370 | 7,462 | 797 |

Note: 1 = Jan-Jun, 2 = Jul-Dec.

Table 5.4.9 SANDEELS in the northern North Sea (Shetland excluded). VPA fishing mortality rates per half year.

| Age group | 1972 | | 1973 | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 0.15 | - | 0.004 | - | 0.29 | - | 0.21 | - | 0.07 | - | 0.08 | - | 0.12 |
| 1 | 0.24 | 0.13 | 0.31 | 0.02 | 0.72 | 0.04 | 0.65 | 0.02 | 0.34 | 0.09 | 0.86 | 0.37 | 0.44 | 0.18 |
| 2 | 0.54 | - | 0.40 | 0.03 | 0.33 | 0.02 | 1.08 | 0.05 | 0.42 | 0.05 | 0.52 | 0.42 | 0.60 | 0.15 |
| 3 | 0.26 | - | 0.66 | 0.03 | 1.21 | 0.02 | 1.26 | 0.003 | 0.35 | 0.58 | 0.52 | 0.28 | 0.55 | 0.07 |
| 4 | 0.56 | - | 0.48 | - | 0.73 | 0.04 | 1.18 | - | 0.34 | 0.10 | 0.42 | 0.76 | 0.26 | 0.003 |
| 5 | 3.36 | - | 2.06 | 0.19 | 1.67 | (0.50) | 0.86 | - | 0.87 | 0.66 | 0.13 | 0.35 | 1.05 | 0.07 |
| 6 | (0.50) | - | (0.50) | - | (0.50) | - | - | - | (0.50) | - | (0.50) | - | (0.50) | - |
| $\bar{F}_{1-4}$ | 0.29 | 0.09 | 0.35 | 0.02 | 0.70 | 0.04 | 0.81 | 0.03 | 0.34 | 0.12 | 0.82 | 0.38 | 0.47 | 0.16 |

| Age group | 1979 | | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 0.58 | - | 0.28 | - | 0.33 | - | 0.13 | - | 0.10 | - | - | - | (0.05) |
| 1 | 0.08 | 0.09 | 0.64 | 0.16 | 0.55 | 0.09 | 0.36 | 0.02 | 0.28 | 0.03 | 0.39 | 0.10 | 0.50 | (0.05) |
| 2 | 0.39 | 0.23 | 1.56 | 0.13 | 1.30 | 0.08 | 1.20 | - | 0.43 | 0.20 | 0.25 | 0.03 | 0.42 | (0.05) |
| 3 | 0.18 | 0.07 | 1.45 | 0.08 | 1.29 | 0.06 | 1.04 | - | 0.18 | 0.06 | 0.15 | 0.06 | 0.35 | (0.05) |
| 4 | 0.01 | 0.03 | 2.12 | 0.06 | 1.25 | 0.17 | (0.50) | - | 0.05 | - | 0.02 | - | 1.09 | (0.05) |
| 5 | 0.01 | - | 0.80 | 0.04 | (0.50) | - | 0.43 | - | - | - | - | - | 0.68 | (0.05) |
| 6 | (0.50) | - | (0.50) | - | (0.50) | - | - | - | (0.50) | - | - | - | (0.50) | - |
| $\bar{F}_{1-4}$ | 0.12 | 0.11 | 0.88 | 0.15 | 0.76 | 0.09 | 0.52 | 0.01 | 0.30 | 0.06 | 0.37 | 0.08 | 0.46 | (0.05) |

Note: 1 = Jan-Jun, 2 = Jul-Dec.

Table 5.4.10 SANDEELS in Northern North Sea (Shetland excluded) stock size (million) and biomass ('000 tonnes).

| Age group | 1972 | | 1973 | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 44,907 | - | 95,992 | - | 49,779 | - | 62,323 | - | 110,155 | - | 47,559 | - | 84,756 |
| 1 | 25,211 | 7,334 | 23,461 | 6,328 | 57,962 | 10,414 | 22,593 | 4,342 | 30,708 | 8,071 | 62,105 | 9,638 | 26,491 | 630 |
| 2 | 5,675 | 2,380 | 5,833 | 2,810 | 5,590 | 2,892 | 9,058 | 2,207 | 3,858 | 1,831 | 6,687 | 2,851 | 6,014 | 238 |
| 3 | 579 | 320 | 2,008 | 750 | 2,309 | 496 | 2,392 | 489 | 1,766 | 897 | 1,468 | 626 | 1,573 | 655 |
| 4 | 213 | 88 | 270 | 120 | 614 | 213 | 408 | 90 | 411 | 211 | 422 | 200 | 398 | 221 |
| 5 | 70 | 2 | 74 | 7 | 101 | 14 | 173 | 53 | 76 | 23 | 161 | 102 | 79 | 20 |
| 6 | 178 | - | 1 | - | 5 | - | - | - | 44 | - | 10 | - | 61 | - |
| SSB | 111 | | 146 | | 167 | | 208 | | 122 | | 153 | | 145 | |
| Total biomass | 253 | | 277 | | 491 | | 335 | | 294 | | 501 | | 293 | |

(cont'd)

Table 5.4.10 (cont'd)

| Age group | 1979 | | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | | 1986 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| 0 | - | 125,369 | - | 43,080 | - | 40,695 | - | 66,616 | - | 100,845 | - | 17,258 | - | 9,075 | - |
| 1 | 45,410 | 15,356 | 42,765 | 8,325 | 19,768 | 4,207 | 17,743 | 4,539 | 35,399 | 9,791 | 55,094 | 13,677 | 10,467 | 2,348 | 5,236 |
| 2 | 4,753 | 2,308 | 12,650 | 1,910 | 6,420 | 1,264 | 3,478 | 757 | 4,045 | 1,595 | 8,571 | 4,782 | 11,228 | 5,325 | 2,021 |
| 3 | 1,728 | 1,039 | 1,551 | 262 | 1,416 | 280 | 980 | 248 | 639 | 384 | 1,309 | 813 | 3,923 | 1,983 | 4,273 |
| 4 | 517 | 368 | 816 | 70 | 204 | 42 | 224 | - | 209 | 144 | 307 | 217 | 647 | 156 | 1,591 |
| 5 | 186 | 132 | 301 | 98 | 56 | - | 30 | 14 | - | - | 121 | 87 | 183 | 67 | 125 |
| 6 | 16 | - | 111 | - | 79 | - | - | - | 12 | - | - | - | 74 | - | 54 |
| SSB | 140 | | 261 | | 138 | | 83 | | 79 | | 166 | | 293 | | 219 |
| Total biomass | 395 | | 501 | | 248 | | 182 | | 278 | | 474 | | 352 | | 248 |

| Age group | Mean weight (g) | |
|---|---|---|
| | 1 | 2 |
| 0 | - | 3.03 |
| 1 | 5.64 | 13.23 |
| 2 | 13.05 | 27.84 |
| 3 | 27.3 | 36.20 |
| 4 | 42.2 | 44.00 |
| 5 | 47.5 | 65.75 |
| 6 | 53.0 | - |

Note: 1 = Jan - Jun.
2 = Jul - Dec.

Table 5.4.11 SANDEELS in the Shetland area. VPA. Catch in numbers, half year x $10^{-6}$.

| Age Group | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | | 1979 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 953 | - | 36 | 86 | 4,486 | 464 | 5,644 | 99 | 5,430 | - | 1,310 |
| 1 | 6 | 834 | 117 | 4,256 | 1,690 | 527 | 2,830 | 525 | 4,406 | 651 | 1,488 | 480 |
| 2 | 53 | 34 | 552 | 63 | 294 | 152 | 664 | 153 | 1,020 | 168 | 388 | 137 |
| 3 | 11 | 14 | 79 | 39 | 115 | 40 | 40 | 12 | 71 | 46 | 68 | 22 |
| 4 | 7 | 20 | 12 | 13 | 13 | 15 | 44 | 26 | 21 | 7 | 12 | 14 |
| 5 | 5 | - | 7 | - | 11 | 3 | 6 | 2 | 20 | 3 | 8 | 7 |
| 6 | + | 1 | 4 | 3 | 4 | 2 | 7 | 1 | 3 | - | 2 | - |
| 7 | 6 | - | 2 | - | 2 | - | 3 | + | + | - | 1 | - |
| 8 | - | - | 2 | - | + | - | + | - | 1 | - | - | - |

| Age Group | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | 77 | 7,134 | 105 | 13,605 | 717 | 16,283 | 592 | 4,073 | 1,940 | 4,833 | 153 | 2,049 |
| 1 | 569 | 242 | 1,917 | 568 | 5,216 | 416 | 2,914 | 1,035 | 1,843 | 481 | 1,076 | 253 |
| 2 | 368 | 104 | 1,424 | 92 | 1,184 | 77 | 661 | 121 | 1,064 | 154 | 313 | 158 |
| 3 | 273 | 29 | 399 | 28 | 494 | 35 | 199 | 28 | 401 | 36 | 166 | 83 |
| 4 | 96 | 13 | 113 | 6 | 190 | 9 | 85 | 17 | 134 | 10 | 55 | 20 |
| 5 | 80 | 6 | 53 | 3 | 86 | 6 | 23 | 6 | 38 | 9 | 17 | 11 |
| 6 | 37 | + | 26 | + | 29 | 1 | 14 | + | 14 | 1 | 6 | 3 |
| 7 | 14 | - | 3 | + | 9 | + | 4 | + | 7 | 1 | 1 | 1 |
| 8 | - | - | 3 | - | 10 | - | 1 | - | 2 | - | 1 | - |

Note: 1 = Jan - Jun.
2 = Jul - Dec.

Table 5.4.12 SANDEELS in the Shetland area. VPA. Fishing mortality rates.

| Age group | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | | 1979 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 0.04 | - | 0.003 | - | 0.22 | - | 0.24 | - | 0.31 | - | 0.07 |
| 1 | 0.001 | 0.34 | 0.01 | 1.44 | 0.28 | 0.21 | 0.38 | 0.18 | 0.55 | 0.23 | 0.22 | 0.16 |
| 2 | 0.11 | 0.11 | 0.40 | 0.08 | 0.32 | 0.29 | 0.44 | 0.18 | 0.61 | 0.20 | 0.21 | 0.11 |
| 3 | 0.07 | 0.12 | 0.40 | 0.37 | 0.20 | 0.11 | 0.12 | 0.05 | 0.13 | 0.12 | 0.12 | 0.06 |
| 4 | 0.08 | 0.39 | 0.14 | 0.26 | 0.21 | 0.44 | 0.17 | 0.16 | 0.13 | 0.06 | 0.04 | 0.07 |
| 5 | 0.18 | - | 0.25 | - | 0.38 | 0.20 | 0.34 | 0.19 | 0.18 | 0.04 | 0.09 | 0.12 |
| 6 | 0.04 | 0.14 | 0.30 | 0.46 | 0.34 | 0.22 | 0.84 | 0.43 | 0.42 | - | 0.04 | - |
| 7 | (0.5) | - | (0.5) | - | (0.5) | - | 0.72 | (0.5) | (0.5) | - | (0.5) | - |
| $\bar{F}_{1-4}$ | 0.01 | 0.31 | 0.06 | 1.22 | 0.28 | 0.22 | 0.38 | 0.17 | 0.54 | 0.21 | 0.21 | 0.14 |

| Age group | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 0.31 | - | 0.45 | - | 0.46 | - | 0.19 | - | 0.29 | - | (0.19) |
| 1 | 0.07 | 0.06 | 0.22 | 0.14 | 0.57 | 0.12 | 0.24 | 0.20 | 0.22 | 0.12 | 0.16 | (0.08) |
| 2 | 0.18 | 0.08 | 0.55 | 0.06 | 0.50 | 0.06 | 0.29 | 0.08 | 0.32 | 0.07 | 0.11 | (0.08) |
| 3 | 0.36 | 0.06 | 0.48 | 0.06 | 0.59 | 0.08 | 0.22 | 0.04 | 0.45 | 0.07 | 0.11 | (0.08) |
| 4 | 0.38 | 0.08 | 0.37 | 0.03 | 0.70 | 0.07 | 0.28 | 0.09 | 0.33 | 0.04 | 0.15 | (0.08) |
| 5 | 0.72 | 0.10 | 0.61 | 0.06 | 0.87 | 0.13 | 0.25 | 0.10 | 0.31 | 0.12 | 0.09 | (0.08) |
| 6 | 1.69 | 0.15 | 0.97 | 0.03 | 1.26 | 0.15 | 0.56 | 0.06 | 0.38 | 0.05 | 0.11 | (0.08) |
| 7 | (0.5) | - | 1.17 | (0.5) | 2.23 | (0.5) | 1.67 | (0.5) | 1.00 | (0.5) | 0.06 | (0.08) |
| $\bar{F}_{1-4}$ | 0.11 | 0.06 | 0.30 | 0.11 | 0.56 | 0.10 | 0.25 | 0.16 | 0.26 | 0.10 | 0.15 | (0.08) |

Note: 1 = Jan - Jun.
2 = Jul - Dec.

Table 5.4.13 SANDEELS in the Shetland area. VPA. Stock size in numbers x $10^{-6}$, biomass in tonnes.

| Age group | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | | 1979 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 0 | - | 27,497 | - | 17,495 | - | 28,031 | - | 33,038 | - | 25,765 | - | 23,588 |
| 1 | 8,214 | 3,018 | 15,944 | 5,798 | 10,584 | 2,932 | 13,576 | 3,398 | 15,732 | 3,335 | 11,495 | 3,379 |
| 2 | 574 | 369 | 1,940 | 934 | 1,246 | 649 | 2,153 | 995 | 2,576 | 1,006 | 2,400 | 1,399 |
| 3 | 200 | 134 | 279 | 135 | 730 | 429 | 409 | 260 | 699 | 443 | 694 | 442 |
| 4 | 101 | 67 | 101 | 63 | 78 | 46 | 325 | 196 | 208 | 131 | 332 | 228 |
| 5 | 35 | 21 | 38 | 22 | 41 | 20 | 25 | 13 | 142 | 85 | 105 | 69 |
| 6 | 13 | 9 | 18 | 9 | 18 | 9 | 14 | 4 | 9 | 4 | 69 | 48 |
| 7 | 19 | - | 7 | - | 5 | - | 6 | 2 | 2 | - | 4 | - |
| SSB | 6,781 | | 14,515 | | 14,478 | | 18,944 | | 23,745 | | 24,587 | |
| Total biom. | 29,533 | | 58,680 | | 43,795 | | 56,550 | | 67,323 | | 56,428 | |

(cont'd)

Table 5.4.13 (cont'd)

| Age group | 1980 | | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | | 1986 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| 0 | - | 33,687 | - | 47,047 | - | 54,805 | - | 29,310 | - | 24,326 | - | 14,929 | - |
| 1 | 13,301 | 4,564 | 15,003 | 4,424 | 18,240 | 3,810 | 20,927 | 6,036 | 14,664 | 4,341 | 11,073 | 3,456 | 7,488 |
| 2 | 2,602 | 1,561 | 3,899 | 1,620 | 3,463 | 1,504 | 3,053 | 1,641 | 4,479 | 2,330 | 3,471 | 2,232 | 2,886 |
| 3 | 1,055 | 531 | 1,221 | 545 | 1,282 | 512 | 1,198 | 695 | 1,274 | 582 | 1,825 | 1,173 | 1,738 |
| 4 | 353 | 173 | 421 | 208 | 435 | 156 | 399 | 216 | 560 | 291 | 457 | 283 | 913 |
| 5 | 180 | 63 | 134 | 52 | 170 | 51 | 123 | 69 | 167 | 88 | 236 | 155 | 220 |
| 6 | 51 | 7 | 48 | 13 | 41 | 8 | 38 | 16 | 53 | 26 | 66 | 42 | 121 |
| 7 | 40 | - | 5 | 1 | 11 | 1 | 6 | 1 | 12 | 3 | 21 | 14 | 33 |
| SSB | 30,256 | | 37,972 | | 36,833 | | 32,831 | | 43,606 | | 43,147 | | 45,160 |
| Total biom. | 67,100 | | 79,530 | | 87,357 | | 90,799 | | 84,226 | | 73,819 | | 65,902 |

| Age group | Mean weight (g) | |
|---|---|---|
| | 1 | 2 |
| 0 | - | 1.69 |
| 1 | 2.77 | 4.87 |
| 2 | 5.23 | 7.25 |
| 3 | 8.51 | 9.64 |
| 4 | 10.97 | 12.17 |
| 5 | 13.2 | 14.7 |
| 6 | 15.0 | 16.5 |
| 7 | 16.4 | 17.7 |

Note: 1 = Jan - Jun.
2 = Jul - Dec.

Table 5.6.1 SANDEEL North Sea. Mean weight (g) at age by month 1985.

| Age | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
|---|---|---|---|---|---|---|---|---|
| | | | | Northern area (Norwegian data) | | | | |
| 0 | - | - | - | 2.0 | 2.0 | - | - | - |
| 1 | - | 3.5 | 6.5 | 8.7 | 10.3 | - | - | - |
| 2 | - | 11.9 | 13.6 | 14.4 | 16.2 | - | - | - |
| 3 | - | 19.8 | 19.5 | 23.9 | 26.6 | - | - | - |
| 4 | - | 23.1 | 24.3 | 29.0 | 30.1 | - | - | - |
| 5 | - | 28.8 | 30.4 | 35.3 | 36.2 | - | - | - |
| | | | | Shetland area (Scottish data) | | | | |
| 0 | - | - | 0.2 | 0.5 | 1.0 | 1.6 | 3.2 | 3.0 |
| 1 | - | 2.1 | 3.0 | 5.5 | 6.0 | 6.1 | 7.3 | 6.7 |
| 2 | - | 5.2 | 6.0 | 7.5 | 8.3 | 8.5 | 9.6 | 8.8 |
| 3 | - | 7.5 | 7.8 | 9.7 | 11.2 | 10.7 | 10.7 | 9.9 |
| 4 | - | 9.1 | 10.2 | 13.5 | 15.1 | 15.2 | 15.1 | 13.9 |
| 5 | - | 11.4 | 14.8 | 15.4 | 16.2 | 14.8 | - | - |
| 6 | - | 13.7 | 13.0 | 22.5 | 22.6 | 16.7 | - | - |
| 7 | - | - | 16.8 | 28.0 | 29.0 | 22.5 | - | - |
| 8 | - | 16.2 | 18.2 | 26.4 | 23.9 | - | - | - |
| 9 | - | - | 16.6 | 26.1 | 28.8 | - | - | - |

Table 5.6.2 SANDEEL North Sea percentage annual landings by weight by age.

| Stock | Year | Age | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Southern North Sea | 1979 | 1 | 28 | 47 | 16 | 6 | 2 | 1 | - | - |
| | 1980 | - | 61 | 25 | 12 | 2 | - | - | - | - |
| | 1981 | 42 | 17 | 29 | 8 | 3 | 1 | - | - | - |
| | 1982 | 2 | 67 | 14 | 10 | 7 | - | - | - | - |
| | 1983 | 5 | 5 | 84 | 5 | 1 | - | - | - | - |
| | 1984 | - | 70 | 4 | 25 | 1 | + | + | - | - |
| | 1985 | 7 | 10 | 71 | 11 | 1 | + | + | + | + |
| Northern North Sea | 1979 | 61 | 16 | 17 | 6 | - | - | - | - | - |
| | 1980 | 12 | 35 | 21 | 15 | 13 | 3 | 1 | - | - |
| | 1981 | 27 | 23 | 24 | 18 | 5 | 1 | 1 | - | - |
| | 1982 | 21 | 25 | 32 | 18 | 4 | 1 | - | - | - |
| | 1983 | 21 | 44 | 30 | 4 | 1 | - | - | - | - |
| | 1984 | - | 77 | 18 | 4 | + | - | - | - | - |
| | 1985 | 1 | 14 | 42 | 26 | 14 | 4 | - | - | - |
| 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 | - | - |
| | 1982 | 48 | 25 | 13 | 8 | 4 | 2 | 1 | + | + |
| | 1983 | 25 | 48 | 16 | 5 | 3 | 1 | 1 | + | + |
| | 1984 | 30 | 29 | 23 | 10 | 4 | 2 | 1 | + | + |
| | 1985 | 21 | 32 | 22 | 15 | 6 | 3 | 1 | + | + |

Table 5.8.1 Yield per recruit and spawning stock biomass per recruit (2-7 group at 1 January) at recent levels of F assuming closures for different periods of the year.

| Stock | M = 0.5 | | | M = 1.0 | | | M variable[1] with age | | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard run | No.fishing aft. June | Fishing only May-June | Standard run | No.fishing aft. June | Fishing only May-June | Standard run | No.fishing aft. June | Fishing only May-June |
| | | | | Yield per recruit (g) | | | | | |
| Southern North Sea | 2.57 | 2.65 | 2.76 | 0.54 | 0.47 | 0.42 | 1.39 | 1.28 | 1.32 |
| Northern North Sea | 2.96 | 3.34 | 4.30 | 1.28 | 1.14 | 1.06 | 1.97 | 1.74 | 2.30 |
| Shetland | 1.36 | 1.35 | 1.40 | 0.35 | 0.21 | 0.17 | 0.99 | 0.68 | 0.68 |
| | | | | Spawning stock biomass per recruit (g) | | | | | |
| Southern North Sea | 2.54 | 3.59 | 4.09 | 1.71 | 1.85 | 1.96 | 1.54 | 1.91 | 2.19 |
| Northern North Sea | 1.62 | 3.09 | 6.11 | 1.51 | 1.93 | 2.59 | 0.69 | 1.14 | 2.19 |
| Shetland | 1.07 | 2.50 | 3.37 | 0.90 | 1.11 | 1.23 | 0.54 | 1.19 | 1.59 |

[1] M 0-group 0.167 $months^{-1}$ from 1 July.
M 1-group 0.0625 $months^{-1}$.
M 2-group 0.0417 $months^{-1}$.

Table 6.1.1 Landings of SPRAT in Division IIIa and in Norwegian fjords in Division IVa ('000 tonnes). (Data provided by Working Group members).

| Year | Skagerrak | | | | Kattegat | | | Div. IIIa Total | Fjords of Western Norway (Div.IVaE) | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Denmark | Sweden | Norway | Total | Denmark | Sweden | Total | | | |
| 1974 | 17.9 | 2.0 | 1.2 | 21.1 | 31.6 | 18.6 | 50.2 | 71.3 | 3.3 | 74.6 |
| 1975 | 15.0 | 2.1 | 1.9 | 19.0 | 60.7 | 20.9 | 81.6 | 100.6 | 2.9 | 103.5 |
| 1976 | 12.8 | 2.6 | 2.0 | 17.4 | 27.9 | 13.5 | 41.4 | 58.8 | 0.6 | 59.4 |
| 1977 | 7.1 | 2.2 | 1.2 | 10.5 | 47.1 | 9.8 | 56.9 | 67.4 | 5.4 | 72.8 |
| 1978 | 26.6 | 2.2 | 2.7 | 31.5 | 37.0 | 9.4 | 46.4 | 77.9 | 5.2 | 83.1 |
| 1979 | 33.5 | 8.1 | 1.8 | 43.4 | 45.8 | 6.4 | 52.2 | 95.6 | 5.0 | 100.6 |
| 1980 | 31.7 | 4.0 | 3.4 | 39.1 | 35.8 | 9.0 | 44.8 | 83.9 | 2.9 | 86.8 |
| 1981 | 26.4 | 6.3 | 4.6 | 37.3 | 23.0 | 16.0 | 39.0 | 76.3 | 3.1 | 79.4 |
| 1982 | 10.5 | 6.7 | 1.8 | 19.0 | 21.4 | 4.8 | 26.2 | 45.2 | 6.0 | 51.2 |
| 1983 | 3.4 | 6.4 | 1.9 | 11.7 | 9.1 | 5.7 | 14.8 | 26.5 | 3.0 | 29.5 |
| 1984 | 13.2 | 5.4 | 1.8 | 20.4 | 10.9 | 5.2 | 16.1 | 36.5 | 3.6 | 40.1 |
| 1985[1] | 1.3 | 8.1[2] | 2.1 | 11.5 | 4.6 | 5.4 | 10.0 | 21.5 | 7.1 | 28.6 |

[1] Preliminary figures.

[2] Sweden: No samples of 14,000 tonnes reported as clupeoid by-catch in Skagerrak and 4,000 tonnes are estimated to be sprat.

Table 6.4.1 A summary of acoustic estimates of the sprat stock in Division IIIa.

| Year | Month | Vessel | Biomass (tonnes) |
|---|---|---|---|
| 1976 | 6 | "Argos" | 50,000 |
| | 9 | "Argos" | 135,000 |
| 1979 | 9 | "Argos" | 130,500 |
| 1980 | 3 | "M' Gonahan" | 150,000 |
| | 9 | "Argos" | 74,000 |
| | 11 | "J. Hjort" | 65,000 |
| 1981 | 9 | "Dana" | 20,000 |
| 1982 | 9 | "Dana" | 24,000 |
| 1983 | 9 | "Dana" | 13,000 |
| | 12 | "Eldjarn" | 8,000 |
| 1984 | 9 | "Argos"/"Dana" | 900 |
| 1985 | 9 | "Argos"/"Dana" | 500 |
| | 11 | "Eldjarn" | 300 |

Table 6.4.2 Indices of SPRAT, 1-group, ≥2-group and all ages in Division IIIa from IYFS 1974-86.

| Year | Index 1-group | Index ≥2-group | Index Total |
|---|---|---|---|
| 1974 | 1,325 | - | - |
| 1975 | 5,339 | - | - |
| 1976 | 2,069 | - | - |
| 1977 | 5,713 | 984 | 6,697 |
| 1978 | 5,119 | 2,117 | 7,236 |
| 1979 | 3,338 | 1,482 | 4,820 |
| 1980 | 4,960 | 3,592 | 8,558 |
| 1981 | 2,809 | 3,068 | 5,877 |
| 1982 | 1,577 | 4,695 | 6,272 |
| 1983 | 1,173 | 1,685 | 2,858 |
| 1984 | 4,141 | 2,216 | 6,357 |
| 1985 | 2,077 | 2,667 | 4,744 |
| 1986 | 684 | 4,834 | 5,518 |

Table 7.1.1 SPRAT catches in the North Sea ('000 tonnes) 1976-85 (data provided by Working Group members).

| Country | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | IVa West | | | | | |
| Denmark | 0.6 | 0.1 | - | - | - | 2.8 | - | - | - | 0.9 |
| Faroe Islands | 2.5 | 0.4 | - | - | - | - | - | - | - | - |
| France | - | + | - | - | - | - | - | - | - | - |
| German Dem.Rep. | - | + | - | - | - | - | - | - | - | - |
| Germany, Fed.Rep. | + | 0.6 | - | - | 0.1 | - | - | - | - | - |
| Netherlands | + | + | - | - | - | - | - | - | - | 6.7 |
| Norway | 29.9 | 16.0 | 1.3 | - | - | - | - | - | - | - |
| Poland | - | - | - | - | - | - | - | - | - | - |
| Sweden | + | - | - | - | - | - | - | - | - | - |
| UK (England) | - | - | - | - | - | - | - | - | - | - |
| UK (Scotland) | 12.7 | 26.9 | 16.9 | 6.8 | 3.8 | 1.0 | + | - | + | - |
| USSR | 1.2 | + | - | - | | - | - | - | - | - |
| Total | 46.9 | 44.0 | 18.2 | 6.8 | 3.9 | 3.8 | + | - | + | 7.6 |
| | | | | | IVa East (North Sea) Stock | | | | | |
| Denmark | 0.2 | 0.11 | - | - | - | - | + | - | - | + |
| Norway | 1.9 | 0.7 | 0.1 | + | 0.4 | - | - | 3.0 | - | - |
| UK (Scotland) | + | - | - | - | - | - | - | - | - | - |
| Total | 2.1 | 0.8 | 0.1 | + | 0.4 | 0 | + | 3.0 | - | + |
| | | | | | IVb West | | | | | |
| Belgium | + | - | - | - | - | - | - | - | - | - |
| Denmark | 104.4 | 57.5 | 44.1 | 75.3 | 76.7 | 53.6 | 23.1 | 32.6 | 5.6 | 1.8 |
| Faroe Islands | 42.9 | 1.8 | - | 2.8[2] | 2.8[2] | - | - | - | - | - |
| France | - | + | - | - | - | - | - | - | - | - |
| German Dem. Rep. | 6.4 | 0.7 | - | - | - | - | - | - | - | - |
| Netherlands | - | - | - | - | - | - | - | - | - | - |
| Norway | 73.0 | 5.5 | 56.2 | 47.8 | 18.3 | 0.2 | 8.6 | - | - | - |
| Poland | 10.5 | - | - | - | - | - | - | - | - | - |
| Sweden | 7.9 | - | - | - | - | - | - | - | - | - |
| UK (England) | 49.7 | 51.9 | 53.9 | 12.9 | 2.4 | - | - | - | + | - |
| UK (Scotland) | 18.1 | 10.9 | 14.8 | 5.0 | 2.5 | 0.7 | 0.2 | + | + | - |
| USSR | 50.4 | 1.6 | - | - | - | - | - | - | - | - |
| Total | 362.3 | 123.9 | 169.0 | 143.8 | 102.7 | 54.5 | 31.9 | 32.6 | 5.6 | 1.8 |

[1] Preliminary figures as reported.

[2] Includes IVb East.

+ = less than 0.1.

- = magnitude known to be nil.

(cont'd)

Table 7.1.1 (cont'd).

| Country | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | IVb East | | | | | |
| Denmark | 201.1 | 126.8 | 161.0 | 191.5 | 149.0 | 127.5 | 91.2 | 39.2 | 62.1 | 36.6 |
| German Dem.Rep. | - | 0.7 | - | - | - | - | - | - | - | - |
| Germany, Fed.Rep. | 1.7 | 4.3 | - | 1.8 | 6.1 | 4.8 | 1.5 | - | 0.6 | 0.6 |
| Norway | 5.1 | - | 29.8 | 27.4 | 33.7 | 0.2 | 7.2 | 12.0 | 3.9 | - |
| Sweden | - | 1.5 | - | - | 0.6 | - | - | - | - | - |
| Total | 207.9 | 133.3 | 190.8 | 222.7 | 189.4 | 132.5 | 99.9 | 51.2 | 66.6 | 37.2 |
| | | | | | IVc | | | | | |
| Belgium | - | - | - | - | - | - | - | - | - | + |
| Denmark | 0.3 | 1.4 | - | 1.5 | 6.5 | 4.3 | 2.4 | 1.0 | 0.5 | + |
| France | - | + | - | - | - | - | - | - | - | - |
| German Dem.Rep. | 0.1 | + | - | - | - | - | - | - | - | - |
| Germany, Fed.Rep. | - | 0.4 | - | - | - | - | - | - | - | - |
| Netherlands | - | - | - | - | - | - | - | - | 0.1 | - |
| Norway | - | - | 0.2 | 3.1 | 16.2 | - | 3.7 | - | 3.5 | - |
| UK (England) | 0.7 | 0.2 | - | 1.4 | 4.3 | 14.0 | 14.9 | 3.6 | 0.9 | 3.4 |
| USSR | 0.2 | - | - | - | - | - | - | - | - | - |
| Total | 1.3 | 2.0 | 0.2 | 6.0 | 27.0 | 18.3 | 21.0 | 4.6 | 5.0 | 3.4 |
| | | | | | Total North Sea | | | | | |
| Belgium | + | + | + | + | - | - | - | - | - | + |
| Denmark | 306.6 | 179.9 | 205.1 | 268.3 | 232.2 | 188.2 | 116.6 | 72.6 | 68.1 | 39.5 |
| Faroe Islands | 45.4 | 2.2 | - | 2.8 | 2.8 | - | - | - | - | - |
| France | - | + | - | - | - | - | - | - | - | - |
| German Dem.Rep. | 6.5 | 1.4 | - | - | - | - | - | - | - | - |
| Germany, Fed.Rep. | 1.7 | 5.3 | - | 3.8 | 6.2 | 4.8 | 1.5 | - | 0.6 | - |
| Netherlands | + | + | - | - | - | - | - | - | 0.1 | 0.6 |
| Norway | 109.9 | 22.2 | 87.6 | 78.6 | 68.6 | 0.4 | 19.5 | 12.0 | 7.4 | 6.7 |
| Poland | 10.5 | + | - | - | - | - | - | - | - | - |
| Sweden | 7.9 | 1.5 | - | - | 0.6 | - | - | - | - | - |
| UK (England) | 50.4 | 52.1 | 53.9 | 14.3 | 6.7 | 14.0 | 14.9 | 3.6 | 0.9 | 3.4 |
| UK (Scotland) | 30.8 | 37.8 | 31.7 | 11.8 | 6.3 | 1.7 | 0.2 | + | + | - |
| USSR | 51.8 | 1.6 | - | - | - | - | - | - | - | - |
| Total | 621.5 | 304.0 | 378.3 | 379.6 | 323.4 | 209.1 | 152.7 | 88.2 | 77.2 | 50.2 |

[1] Preliminary figures as reported.

+ = less than 0.1.

- = magnitude known to be nil.

Table 7.1.2 SPRAT in Division VIa. Landings in tonnes.

| Country | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| Denmark | - | - | 259 | - | - | 242 | - | - | - | - |
| Faroes | 181 | - | - | - | - | - | - | - | - | - |
| Germany, Fed.Rep. | 37 | + | - | 97 | - | 2 | - | - | - | - |
| Ireland | 673 | 282 | 533 | 12 | 1,787 | 790 | 287 | - | - | - |
| Netherlands | 661 | 49 | 46 | 125 | 428 | 892 | 2,156 | 1,447 | - | - |
| Norway | 35 | 267 | - | - | - | - | 24 | - | - | - |
| UK (Scotland)[2] | 6,455 | 4 246 | 11,563 | 1,087 | 2,987 | 1,488 | 1,057 | 1,971 | 2,438 | 2,933 |
| Total | 8,042 | 4,844 | 12,401 | 1,321 | 5,202 | 3,414 | 3,524 | 3,418 | 2,438 | 2,933 |

Source: ICES Statistician.

[1] Preliminary figures.

[2] Amended from national data.

Table 7.1.3 SPRAT catches in '000 tonnes (Denmark, Norway and United Kingdom) in sub-divisions of the North Sea, 1985. (Catches in fjords of Western Norway excluded.)

| Month | Area | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 1 | - | 72 | 651 | 467 |
| 2 | - | - | 18 | 5,101 | 693 |
| 3 | - | - | 7 | 781 | 210 |
| 4 | - | - | 2 | 652 | - |
| 5 | - | - | 63 | 7 | - |
| 6 | - | - | 84 | - | - |
| 7 | 1 | - | 13 | 151 | 1 |
| 8 | 11 | - | 17 | 1,791 | - |
| 9 | 32 | 15 | 146 | 2,593 | 4 |
| 10 | 3,871 | 9 | 151 | 13,751 | 67 |
| 11 | 3,671 | - | 604 | 3,000 | 43 |
| 12 | 8 | - | 652 | 8,162 | 1,437 |

Table 7.3.1 North Sea SPRAT. Estimated numbers by age caught in 1985.

| Sub-divisions | Months | Age groups | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 |
| IVa W | Jan-Mar | - | 0.05 | 0.36 | 0.04 | + | - |
| | Jul-Sep | - | 0.90 | 2.27 | - | - | - |
| | Oct-Dec | - | 395.71 | 43.96 | 2.22 | 2.22 | - |
| | Total | - | 296.66 | 46.59 | 2.26 | 2.22 | - |
| IVa E (Excl.Norw. fjords) | Jul-Sep | - | 0.31 | 0.77 | - | - | - |
| | Oct-Dec | - | 0.18 | 0.46 | - | - | - |
| | Total | - | 0.49 | 1.23 | - | - | - |
| IVb W | Jan-Mar | - | 1.28 | 8.84 | 0.98 | 0.02 | - |
| | Apr-Jun | - | 7.69 | 6.96 | 0.78 | 0.03 | - |
| | Jul-Sep | 0.12 | 15.28 | 2.13 | 0.11 | - | - |
| | Oct-Dec | 9.57 | 59.73 | 34.23 | 2.38 | 0.04 | 0.04 |
| | Total | 9.69 | 83.98 | 52.16 | 4.25 | 0.09 | 0.04 |
| IVb E | Jan-Mar | - | 86.17 | 594.83 | 66.18 | 1.35 | 0.15 |
| | Apr-Jun | - | 34.01 | 30.80 | 3.45 | 0.12 | 0.12 |
| | Jul-Sep | 3.18 | 393.25 | 54.98 | 2.91 | 0.09 | - |
| | Oct-Dec | 173.86 | 1,084.80 | 621.92 | 43.32 | 0.77 | 0.77 |
| | Total | 177.04 | 1,598.23 | 1,302.53 | 115.86 | 2.33 | 1.04 |
| IVc | Jan-Mar | - | 142.50 | 107.80 | 5.10 | 0.10 | 0.10 |
| | Apr-Jun | - | - | - | - | - | - |
| | Jul-Sep | 0.03 | 0.33 | 0.06 | 0.01 | - | - |
| | Oct-Dec | 46.96 | 138.97 | 28.38 | 7.81 | 0.40 | - |
| | Total | 46.99 | 281.80 | 136.24 | 12.92 | 0.50 | 0.10 |
| Total North Sea | Jan-Mar | - | 230.00 | 711.83 | 72.30 | 1.47 | 0.25 |
| | Apr-Jun | - | 41.70 | 37.76 | 4.23 | 0.15 | 0.12 |
| | Jul-Sep | 3.33 | 410.07 | 60.21 | 3.03 | 0.09 | - |
| | Oct-Dec | 230.39 | 1,679.39 | 728.95 | 55.73 | 3.43 | 0.81 |
| | Total | 233.72 | 2,361.16 | 1,538.75 | 135.29 | 5.14 | 1.18 |

Table 7.4.1 North Sea SPRAT. Research vessel surveys.

| Year of observ. | Surveys | | | | Commercial fisheries | |
|---|---|---|---|---|---|---|
| | IYFS GOV N.Sea No/hr all ages | IYFS GOV Div. IVb 1-group | IYFS GOV Div. IVb E 1-group | IYFS IKMT Div. IVb E 1-group | North East England winter fishery x $10^{-6}$ 1-group | N.Sea catches 1 qtr. x $10^{-6}$ 1-group |
| 1970 | - | - | - | - | 1,172 | - |
| 1971 | - | - | - | - | 730 | - |
| 1972 | 873 | 90 | - | - | 218 | - |
| 1973 | 713 | 123 | - | - | 1,022 | - |
| 1974 | 2,631 | 481 | - | - | 1,517 | 7,620 |
| 1975 | - | - | - | - | 339 | 4,097 |
| 1976 | 2,127 | 1,186 | - | - | 557 | 9,361 |
| 1977 | 3,031 | 136 | - | - | 361 | 4,197 |
| 1978 | 2,208 | 1,474 | - | - | 732 | 2,462 |
| 1979 | 569[1] | 248[1] | - | - | 330 | 2,770 |
| 1980 | 3,770 | 1,402 | 1,916 | 328 | 59 | 1,448 |
| 1981 | 2,107 | 886 | 1,146 | 107 | - | 2,249 |
| 1982 | 602 | 183 | 512 | 47 | - | 1,021 |
| 1983 | 852 | 399 | 730 | 12 | - | 357 |
| 1984 | -[2] | 349 | -[2] | -[2] | - | 134 |
| 1985 | 638 | 512 | -[2] | -[2] | - | -[2] |
| 1986 | 170 | 68 | -[2] | 96 | - | - |

[1] Low figures due to abnormal conditions on the survey.

[2] Not yet available.

Table 8.1.1 Nominal catch (tonnes) of SPRAT in Divisions VIId,e, 1976-85 (data for 1975-85 as officially reported to ICES).

| Country | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | - | - | - | - | - | - | - | 3 | - | - |
| Denmark | 447 | 74 | 1,796 | 9,981 | 7,483 | b) | 286 | 638[2] | 1,417 | - |
| Faroe Islands | 6 | - | - | - | - | - | - | - | - | - |
| France | 115 | 120 | 225 | 2,373 | 1,867 | 146 | 44 | 60 | 47 | - |
| Germany, Fed.Rep. | - | - | 34 | 6 | 52 | 1 | - | - | - | - |
| Netherlands | 49 | 115 | 826 | 441 | 1,401 | 1,015 | 1,533 | 2,350 | 589 | - |
| Norway | - | - | - | - | 65 | - | - | - | - | - |
| UK (England + Wales) | 3,107 | 2,928 | 2,118 | 2,032 | 6,864 | 10,183 | 4,749 | 4,756 | 2,398 | 2,922 |
| Total | 3,724 | 3,237 | 4,999 | 14,833 | 17,732 | 13,890 | 6,612 | 7,807 | 4,451 | 2,922 |

[1] Preliminary.

[2] Landings in foreign ports Jul-Dec not included.

Table 8.1.2 Lyme Bay area fishery - Monthly catches (tonnes) (United Kingdom vessels only).

| Season | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1961-62 | - | - | - | 1 | 27 | 4 | 427 | 428 | 35 | 922 |
| 1962-63 | - | - | - | 309 | 238 | 131 | 148 | 187 | 58 | 1,071 |
| 1963-64 | - | - | - | 263 | 53 | 82 | 385 | 276 | 24 | 1,083 |
| 1964-65 | - | - | - | 25 | 56 | 20 | 242 | 465 | 8 | 816 |
| 1965-66 | - | - | - | 47 | 81 | 165 | 610 | 302 | 17 | 1,222 |
| 1966-67 | - | - | - | 3 | 152 | 368 | 703 | 355 | 1 | 1,583 |
| 1967-68 | - | - | 18 | 76 | 238 | 422 | 560 | 43 | 3 | 1,360 |
| 1968-69 | 11 | - | 4 | 122 | 142 | 298 | 373 | 123 | 1 | 1,074 |
| 1969-70 | - | - | - | 140 | 131 | 276 | 915 | 283 | 76 | 1,821 |
| 1970-71 | - | 7 | 38 | 90 | 184 | 549 | 553 | 106 | 20 | 1,547 |
| 1971-72 | - | - | 369 | 101 | 232 | 228 | 410 | 70 | - | 1,410 |
| 1972-73 | - | - | 107 | 209 | 132 | 87 | 404 | 165 | 49 | 1,153 |
| 1973-74 | - | - | 313 | 186 | 194 | 350 | 311 | 96 | 40 | 1,490 |
| 1974-75 | 184 | 451 | 209 | 533 | 838 | 405 | 157 | 30 | - | 2,807 |
| 1975-76 | - | - | 66 | 649 | 289 | 111 | 204 | 6 | - | 1,325 |
| 1976-77 | 289 | 440 | 1,039 | 123 | 594 | 347 | 234 | 103 | 5 | 3,174 |
| 1977-78 | 31 | 680 | 768 | 725 | 115 | 84 | 201 | 54 | - | 2,658 |
| 1978-79 | - | 252 | 368 | 545 | 450 | 209 | 58 | 37 | 28 | 1,947 |
| 1979-80 | - | - | 90 | 674 | 706 | 337 | 150 | 38 | 2 | 1,997 |
| 1980-81 | - | - | 458 | 815 | 1,423 | 1,872 | 2,069 | 138 | 54 | 6,829 |
| 1981-82 | - | - | 11 | 475 | 1,854 | 4,311 | 855 | 265 | 100 | 7,871 |
| 1982-83 | - | - | 54 | 844 | 1,017 | 641 | 522 | 90 | 31 | 3,199 |
| 1983-84 | - | - | 82 | 477 | 706 | 1,772 | 157 | 101 | 55 | 4,350 |
| 1984-85 | - | - | 331 | 834 | 643 | 252 | 225 | 94 | 19 | 2,398 |
| 1985-86 | - | 104 | 463 | 1,401 | 769 | 132 | 52 | 1 | - | 2,922 |

Period mean values (indicated by first year of seasonal pair)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1961-65 | - | - | - | 129 | 91 | 81 | 362 | 332 | 29 | 1,024 |
| 1966-70 | 2 | 1 | 12 | 86 | 170 | 383 | 621 | 182 | 20 | 1,477 |
| 1971-75 | 37 | 90 | 213 | 336 | 337 | 236 | 297 | 73 | 18 | 1,637 |
| 1976-80 | 64 | 274 | 545 | 577 | 658 | 570 | 542 | 74 | 18 | 3,322 |
| 1981-85[1] | - | 21 | 188 | 806 | 998 | 1,422 | 362 | 110 | 41 | 3,948 |

[1] Provisional

Table 8.5.1 Lyme Bay SPRAT fishery, 1966-86.
Numbers caught per age group x $10^{-6}$.

| Season | Age group | | | | | |
|---|---|---|---|---|---|---|
| | 0/1 | 1/2 | 2/3 | 3/4 | 4/5 | 5/6 |
| 1966-67 | 0.55 | 11.67 | 44.00 | 18.56 | 11.67 | 3.60 |
| 1967-68 | 2.28 | 46.79 | 33.10 | 5.08 | 0.66 | 0.39 |
| 1968-69 | 0.08 | 29.99 | 29.24 | 4.03 | 0.44 | 0.10 |
| 1969-70 | 0.13 | 17.53 | 62.78 | 18.60 | 2.73 | 0.35 |
| 1970-71 | 0.01 | 4.12 | 46.03 | 26.94 | 1.57 | 0.54 |
| 1971-72 | 0.80 | 20.22 | 28.01 | 22.96 | 4.12 | 0.34 |
| 1972-73 | 1.51 | 32.20 | 22.20 | 10.20 | 3.96 | 0.38 |
| 1973-74 | 0.50 | 22.91 | 46.12 | 9.08 | 5.06 | 2.42 |
| 1974-75 | 0.30 | 40.77 | 82.73 | 12.67 | 8.84 | 3.55 |
| 1975-76 | 0.16 | 13.33 | 25.25 | 23.28 | 6.39 | 1.47 |
| 1976-77 | 0.73 | 40.34 | 108.52 | 34.87 | 6.56 | 0.37 |
| 1977-78 | 0.12 | 19.48 | 69.33 | 43.89 | 7.50 | 0.48 |
| 1978-79 | 9.20 | 41.71 | 44.64 | 18.97 | 5.72 | 0.01 |
| 1979-80 | 1.17 | 26.97 | 55.45 | 7.58 | 4.07 | 0.33 |
| 1980-81 | 0.76 | 51.33 | 220.79 | 55.35 | 6.15 | 0.26 |
| 1981-82 | 1.08 | 52.00 | 161.91 | 131.28 | 20.94 | 0.55 |
| 1982-83 | 1.16 | 4.81 | 49.74 | 58.89 | 25.41 | 0.25 |
| 1983-84 | 7.19 | 13.18 | 47.05 | 74.09 | 40.61 | 9.16 |
| 1984-85 | 1.21 | 40.15 | 44.27 | 28.25 | 9.60 | 1.23 |
| 1985-86[1] | 1.50 | 14.87 | 105.14 | 21.10 | 7.78 | 1.15 |

[1] Provisional.

Table 8.6.1 Lyme Bay area SPRAT, 1973-86. Mean weight at age.

| Season | Quarter | Age groups | | | | | | Overall mean |
|---|---|---|---|---|---|---|---|---|
| | | 0/1 | 1/2 | 2/3 | 3/4 | 4/5 | 5/6 | |
| 1973-74 | 3 | 6.4 | 15.6 | 18.2 | 23.5 | 24.7 | 25.1 | 19.5 |
| | 4 | 4.6 | 8.0 | 18.2 | 24.9 | 25.8 | 25.7 | 16.4 |
| | 1 | 6.2 | 10.0 | 15.5 | 23.3 | 24.4 | 24.4 | 15.0 |
| | Season | 4.8 | 9.2 | 17.3 | 24.2 | 25.2 | 25.2 | 16.5 |
| 1974-75 | 3 | 4.4 | 11.0 | 17.6 | 24.4 | 29.0 | 30.7 | 15.9 |
| | 4 | 3.6 | 9.2 | 18.9 | 25.6 | 29.6 | 30.7 | 19.0 |
| | 1 | 4.7 | 8.6 | 14.8 | 20.6 | 23.3 | 24.8 | 12.3 |
| | Season | 3.9 | 9.8 | 18.1 | 25.2 | 29.4 | 30.6 | 17.4 |
| 1975-76 | 3 | - | 15.4 | 17.1 | 22.1 | 28.6 | 27.0 | 19.1 |
| | 4 | 3.7 | 9.5 | 16.4 | 24.1 | 29.1 | 28.0 | 19.2 |
| | 1 | 2.5 | 9.6 | 15.7 | 23.0 | 28.9 | 26.7 | 17.7 |
| | Season | 3.1 | 9.7 | 16.3 | 23.8 | 29.0 | 27.8 | 18.9 |
| 1976-77 | 3 | - | 12.8 | 16.8 | 20.4 | 27.2 | 26.2 | 17.3 |
| | 4 | 3.3 | 7.7 | 17.7 | 23.7 | 28.1 | 32.7 | 17.2 |
| | 1 | 2.6 | 8.2 | 15.1 | 21.0 | 27.2 | - | 12.3 |
| | Season | 2.9 | 9.3 | 16.8 | 22.0 | 27.7 | 28.1 | 16.5 |
| 1977-78 | 3 | - | 8.2 | 16.3 | 22.4 | 26.4 | 32.4 | 18.6 |
| | 4 | - | 6.8 | 18.1 | 22.6 | 24.9 | 30.5 | 19.3 |
| | 1 | 6.4 | 5.2 | 14.5 | 218.1 | 22.4 | 28.7 | 9.8 |
| | Season | 6.4 | 6.2 | 16.7 | 22.3 | 25.5 | 31.3 | 17.5 |
| 1978-79 | 3 | 3.5 | 15.4 | 19.2 | 25.4 | 29.6 | - | 20.9 |
| | 4 | 6.3 | 11.8 | 16.5 | 23.9 | 29.6 | - | 15.2 |
| | 1 | 4.9 | 10.1 | 13.1 | 19.9 | 28.3 | - | 10.6 |
| | Season | 5.7 | 12.1 | 16.8 | 24.5 | 29.6 | - | 16.2 |
| 1979-80 | 3 | 3.0 | 18.2 | 23.6 | 25.8 | 32.9 | 30.7 | 23.1 |
| | 4 | 3.5 | 16.5 | 23.2 | 27.0 | 31.6 | - | 22.4 |
| | 1 | 4.0 | 9.7 | 19.2 | 22.1 | 20.7 | - | 12.5 |
| | Season | 3.9 | 14.3 | 22.9 | 26.8 | 30.7 | 31.0 | 21.0 |
| 1980-81 | 3 | - | 17.4 | 24.3 | 25.6 | 29.9 | 34.5 | 24.4 |
| | 4 | 5.2 | 16.1 | 21.4 | 24.8 | 29.9 | 32.0 | 21.7 |
| | 1 | 3.1 | 11.8 | 17.1 | 21.0 | 28.6 | 34.5 | 16.3 |
| | Season | 3.1 | 13.5 | 19.9 | 23.6 | 29.7 | 32.9 | 19.7 |
| 1981-82 | 3 | - | 17.3 | 19.5 | 21.4 | 33.0 | - | 19.6 |
| | 4 | 6.1 | 14.7 | 21.5 | 25.5 | 28.5 | 31.0 | 23.4 |
| | 1 | 6.4 | 12.1 | 16.5 | 20.2 | - | - | 14.7 |
| | Season | 6.4 | 12.9 | 20.3 | 25.2 | 28.5 | 31.0 | 21.4 |
| 1982-83 | 3 | - | 16.0 | 18.9 | 24.9 | 27.5 | 32.9 | 23.9 |
| | 4 | 6.1 | 15.8 | 19.6 | 24.7 | 27.9 | 32.4 | 23.7 |
| | 1 | - | 13.0 | 18.8 | 22.5 | 26.1 | - | 20.0 |
| | Season | 6.1 | 14.1 | 19.3 | 24.4 | 27.8 | 32.4 | 22.9 |
| 1983-84 | 4 | 4.1 | 15.2 | 20.6 | 23.6 | 27.1 | 27.6 | 23.2 |
| | 1 | - | 16.2 | 19.9 | 23.3 | 26.9 | 28.7 | 23.3 |
| | Season | 4.1 | 15.3 | 20.5 | 23.5 | 27.0 | 27.5 | 23.2 |
| 1984-85 | 3 | - | 12.5 | 17.3 | 22.9 | 25.7 | - | 18.7 |
| | 4 | 5.9 | 16.0 | 19.4 | 23.5 | 26.5 | 27.9 | 20.3 |
| | 1 | 5.9 | 11.5 | 17.2 | 22.8 | 26.7 | 30.7 | 13.9 |
| | Season | 5.9 | 14.0 | 18.7 | 23.4 | 26.4 | 28.1 | 18.8 |
| 1985-86 | 3 | - | 16.1 | 19.2 | 22.6 | 22.0 | - | 19.3 |
| | 4 | 6.4 | 15.6 | 17.9 | 21.9 | 23.6 | 32.0 | 18.6 |
| | 1 | 5.6 | 14.9 | 19.4 | 22.2 | 28.3 | - | 17.8 |
| | Season | 6.3 | 15.6 | 18.2 | 22.0 | 23.4 | 32.0 | 18.7 |

Table 8.7.1 Percentage weight in the catch.
Lyme Bay sprat fishery.

| Season | Age | | | | | | Mean age |
|---|---|---|---|---|---|---|---|
| | 0/1 | 1/2 | 2/3 | 3/4 | 4/5 | 5/6 | |
| 1976-77 | 0.4 | 21.1 | 56.7 | 18.2 | 3.4 | 0.2 | 2.03 |
| 1977-78 | 0.09 | 13.8 | 49.2 | 31.2 | 5.3 | 0.3 | 2.29 |
| 1978-79 | 7.7 | 34.7 | 37.1 | 15.8 | 4.8 | 0.01 | 1.75 |
| 1979-80 | 1.2 | 18.2 | 58.0 | 7.9 | 4.3 | 0.3 | 1.87 |
| 1980-81 | 0.23 | 15.3 | 66.0 | 16.5 | 1.8 | 0.1 | 2.05 |
| 1981-82 | 0.3 | 14.1 | 44.0 | 35.7 | 5.7 | 0.1 | 2.33 |
| 1982-83 | 0.8 | 3.4 | 35.5 | 42.0 | 18.1 | 0.2 | 2.74 |
| 1983-84 | 3.8 | 6.9 | 24.6 | 38.7 | 21.2 | 4.8 | 2.81 |
| 1984-85 | 1.0 | 32.2 | 35.5 | 22.7 | 7.7 | 1.0 | 2.07 |
| 1985-86 | 1.0 | 9.8 | 69.4 | 13.9 | 5.1 | 0.8 | 2.15 |

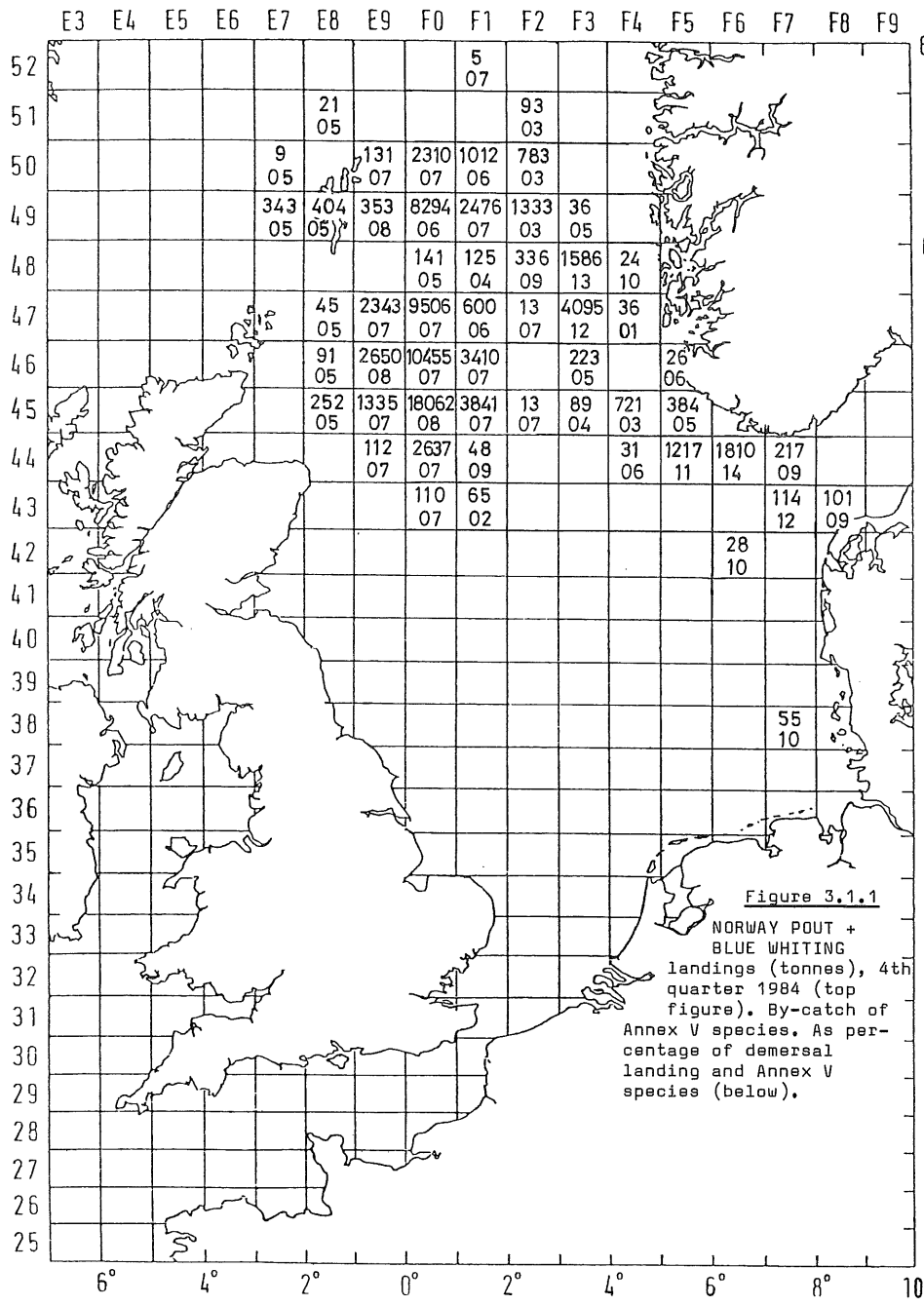



Figure 3.1.1

NORWAY POUT + BLUE WHITING landings (tonnes), 4th quarter 1984 (top figure). By-catch of Annex V species. As percentage of demersal landing and Annex V species (below).

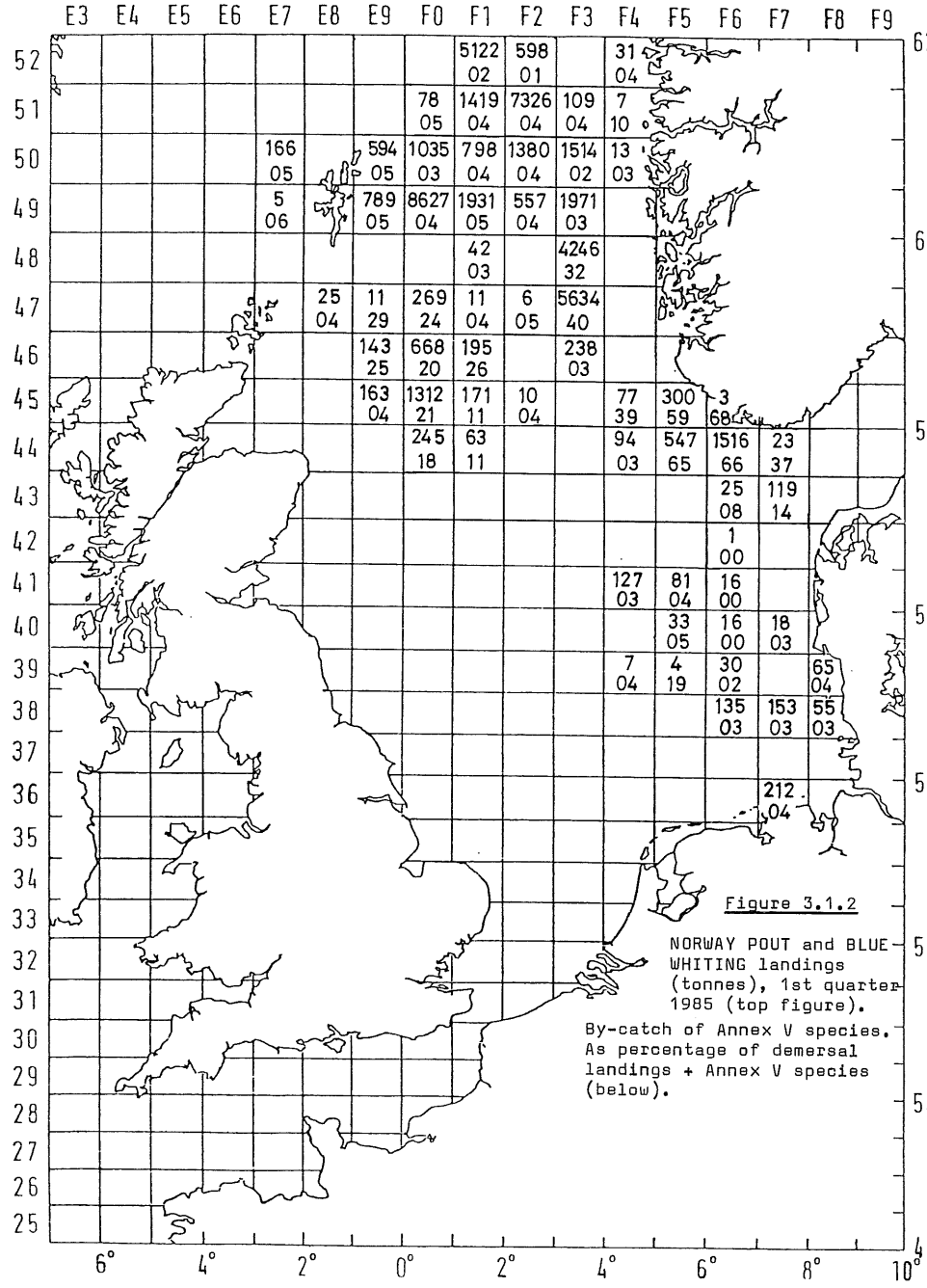



Figure 3.1.2

NORWAY POUT and BLUE WHITING landings (tonnes), 1st quarter 1985 (top figure).

By-catch of Annex V species. As percentage of demersal landings + Annex V species (below).

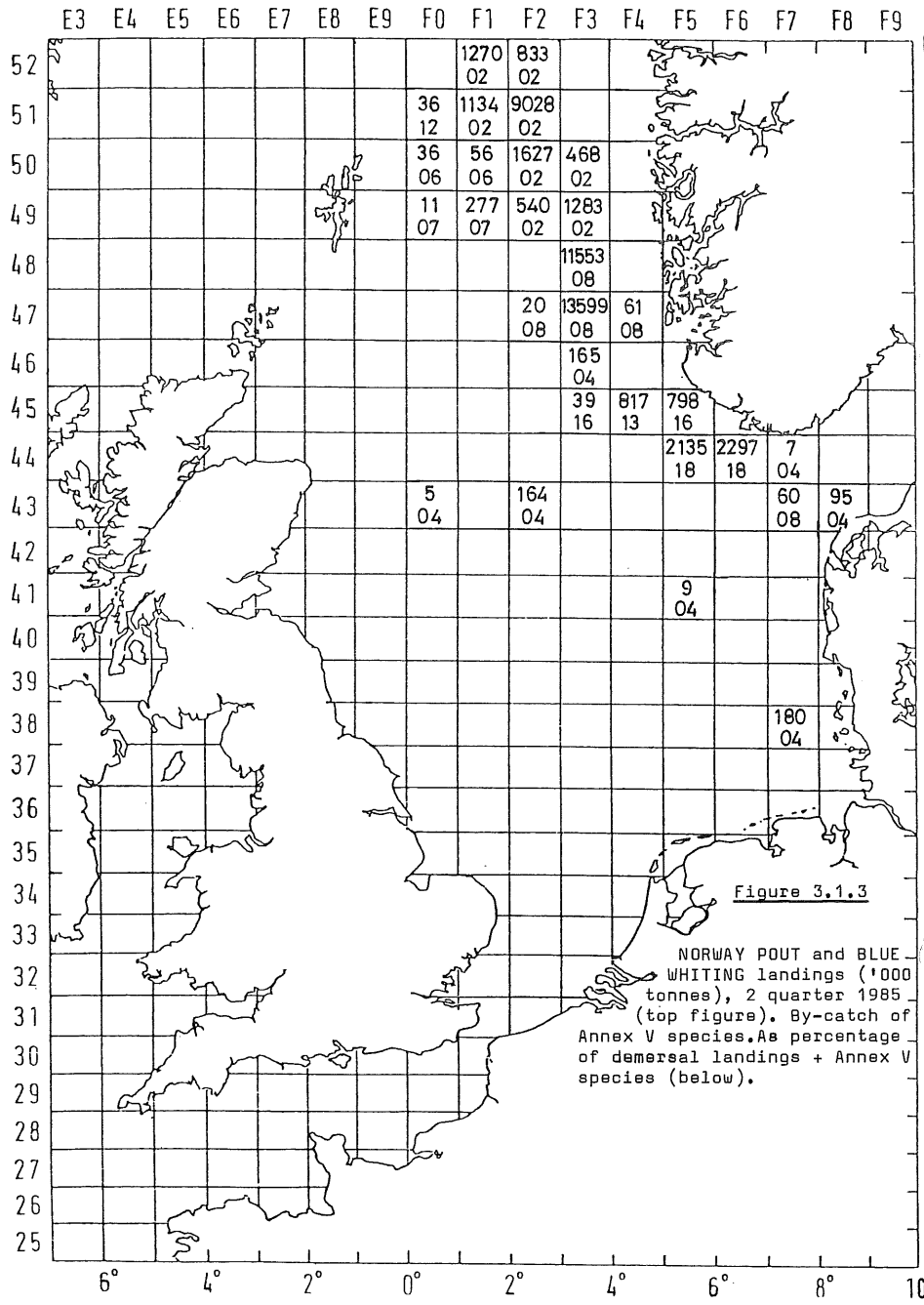



Figure 3.1.3

NORWAY POUT and BLUE WHITING landings ('000 tonnes), 2 quarter 1985 (top figure). By-catch of Annex V species.As percentage of demersal landings + Annex V species (below).

Figure 4.2.1 Norwegian cpue values for the NORWAY POUT fishery by quarters (landings with <70% Norway pout are excluded).

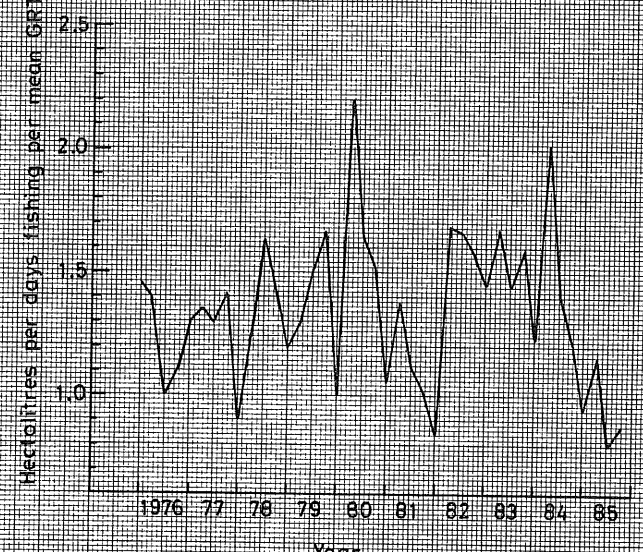


Figure 4.2.2 NORWAY POUT. Norwegian cpue values, Weighted annual means.

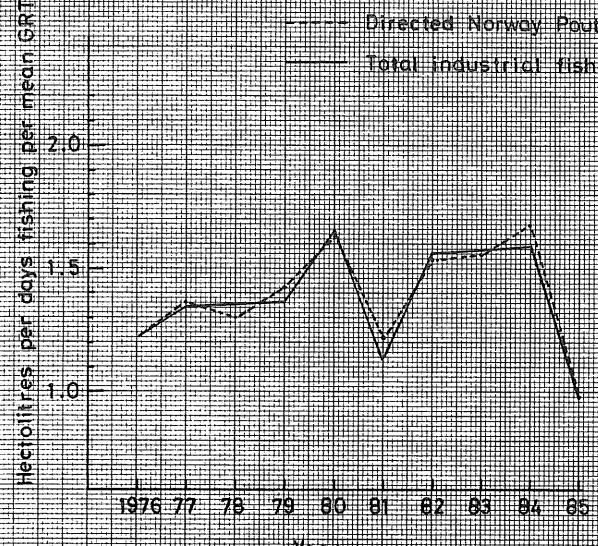


Figure 4.3.1 NORWAY POUT catch curve analysis Faroes areas

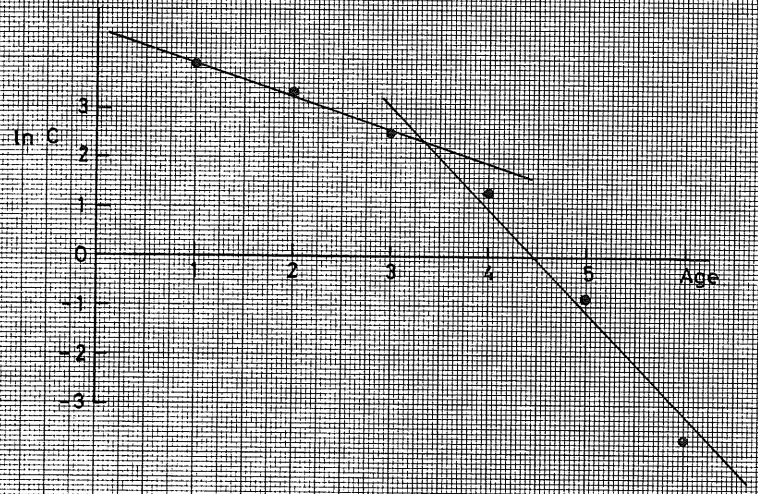



Figure 4.3.2 NORWAY POUT catch curve analysis Scottish W.Coast

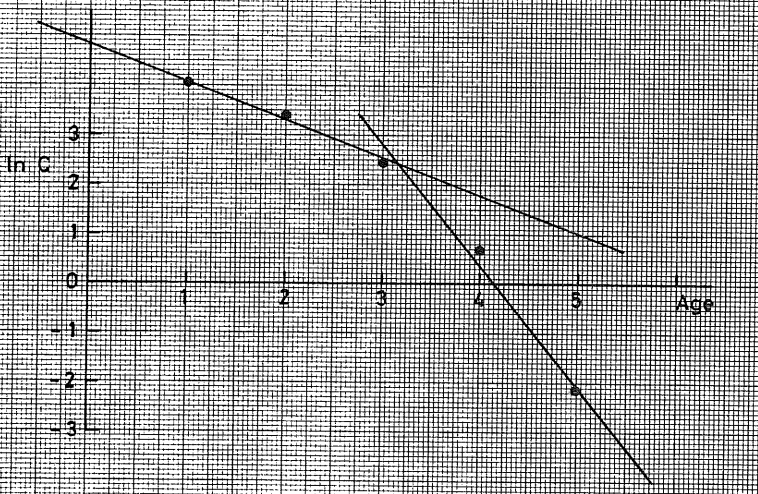
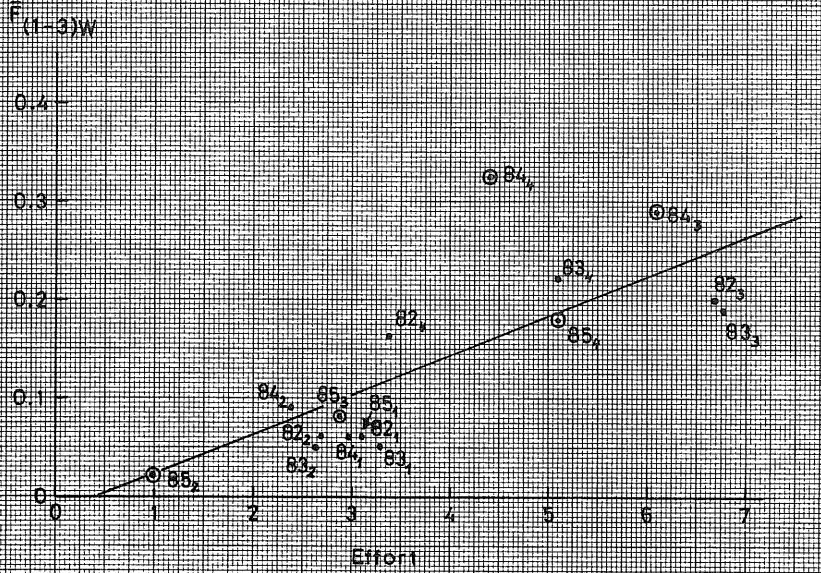


Figure 4.4.1 NORWAY POUT. Mean F against the combined Danish and Norwegian efforts. Years and quarters indicated at each point.




Regression on all quarters Q1, 1982 - Q2 1984:

$r^2$ = 0.71 ($r$ =0.84) p <5% n = 10

intercept = 0.02

slope 0.04

Predictions:

| | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|
| 1984 | - | - | 0.19 | 0.13 |
| 1985 | 0.09 | 0.01 | 0.08 | 0.16 |

Figure 4.4.2 NORWAY POUT. Exploitation pattern in Q3 and Q4 1985 compared to the mean exploitation pattern in 1980-83.

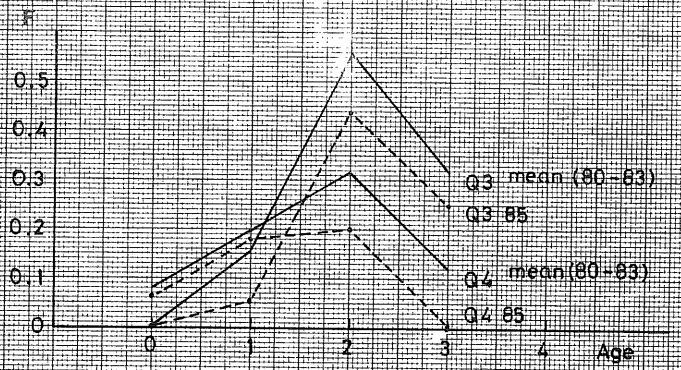
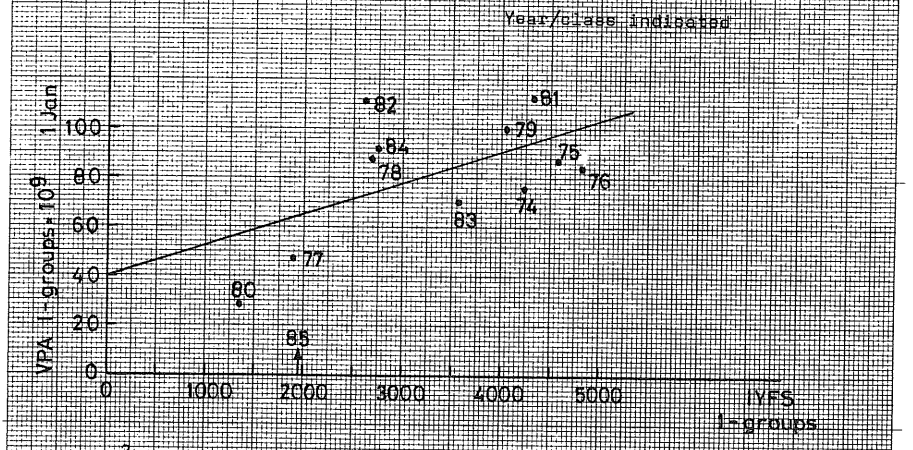
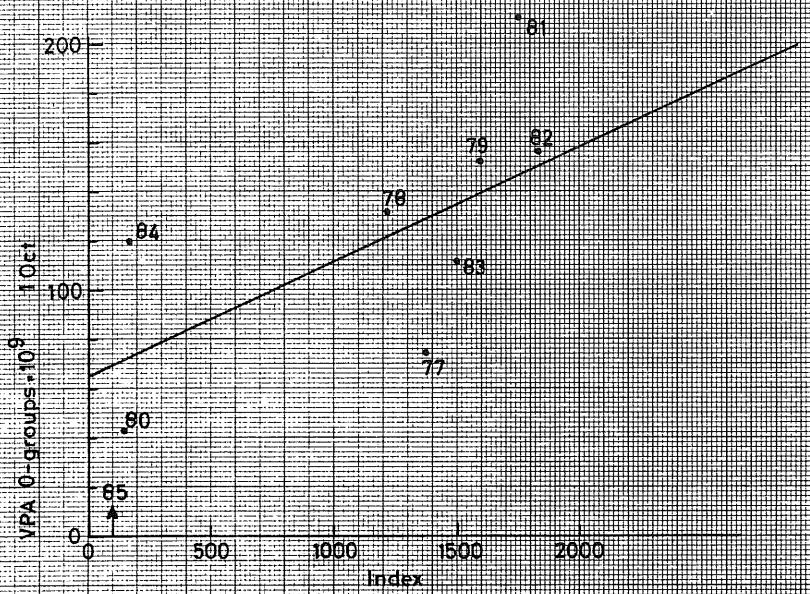



Figure 4.4.3 NORWAY POUT. IYFS index against VPA 1-groups at 1 January.




$R^2$ = 0.56
intercept: 39.97
slope: 0.01
X = 19492 Y= 64.37 x $10^9$

Figure 4.4.4 NORWAY POUT. The English Groundfish Survey 0-group index against VPA 0-groups at 1 October.




$R^2$ = 0.45
intercept = 65.1
slope = 0.051
$\bar{X}$ = 972 $\bar{y}$ = 70.0 x $10^{-9}$

Figure 4.4.5 NORWAY POUT quarterly stock biomass and annual spawning biomass.

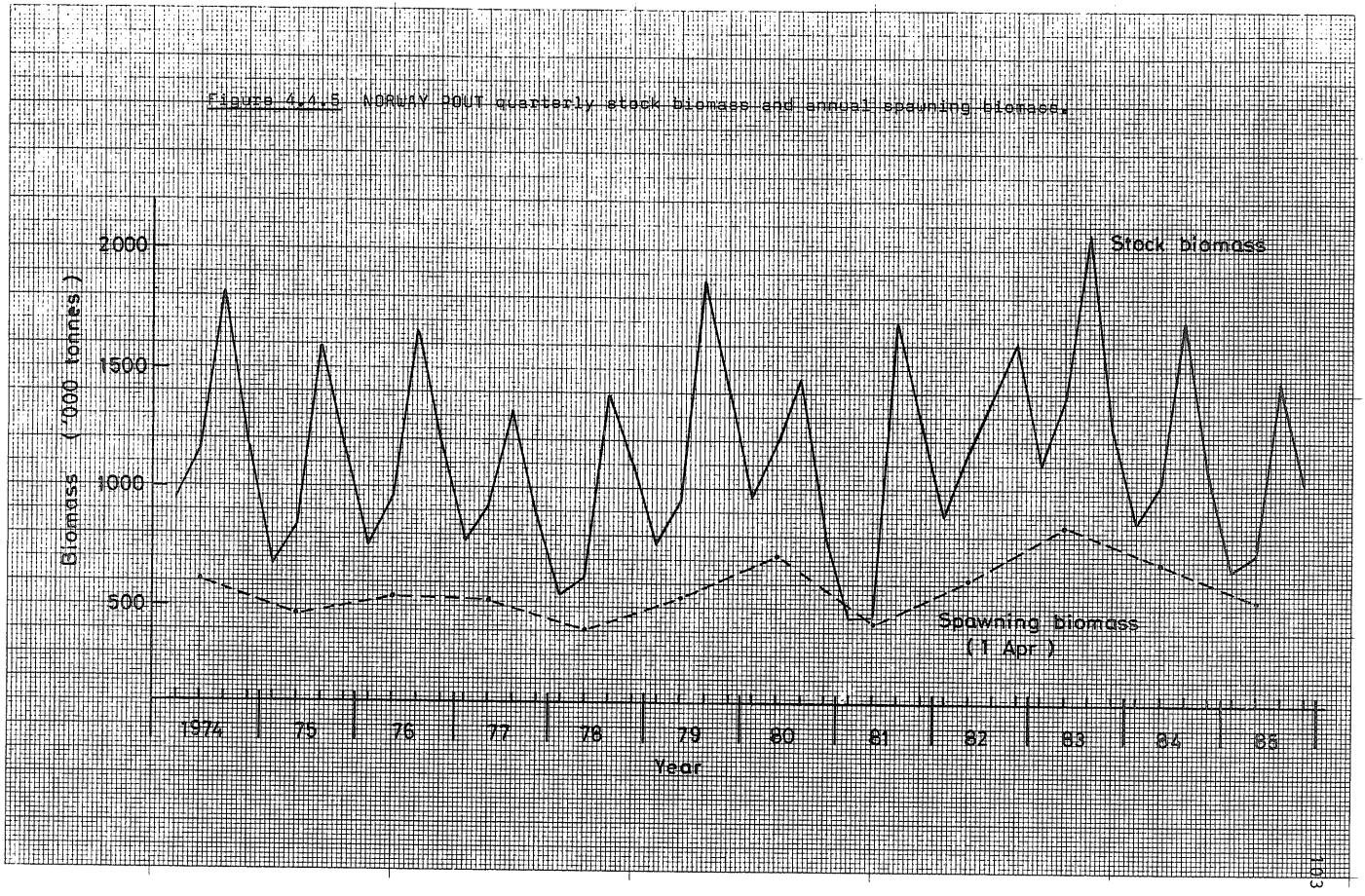


Figure 4.5.1 NORWAY POUT, North Sea. Average number of Norway pout below 15 cm. IYFS February 1986. Preliminary data.

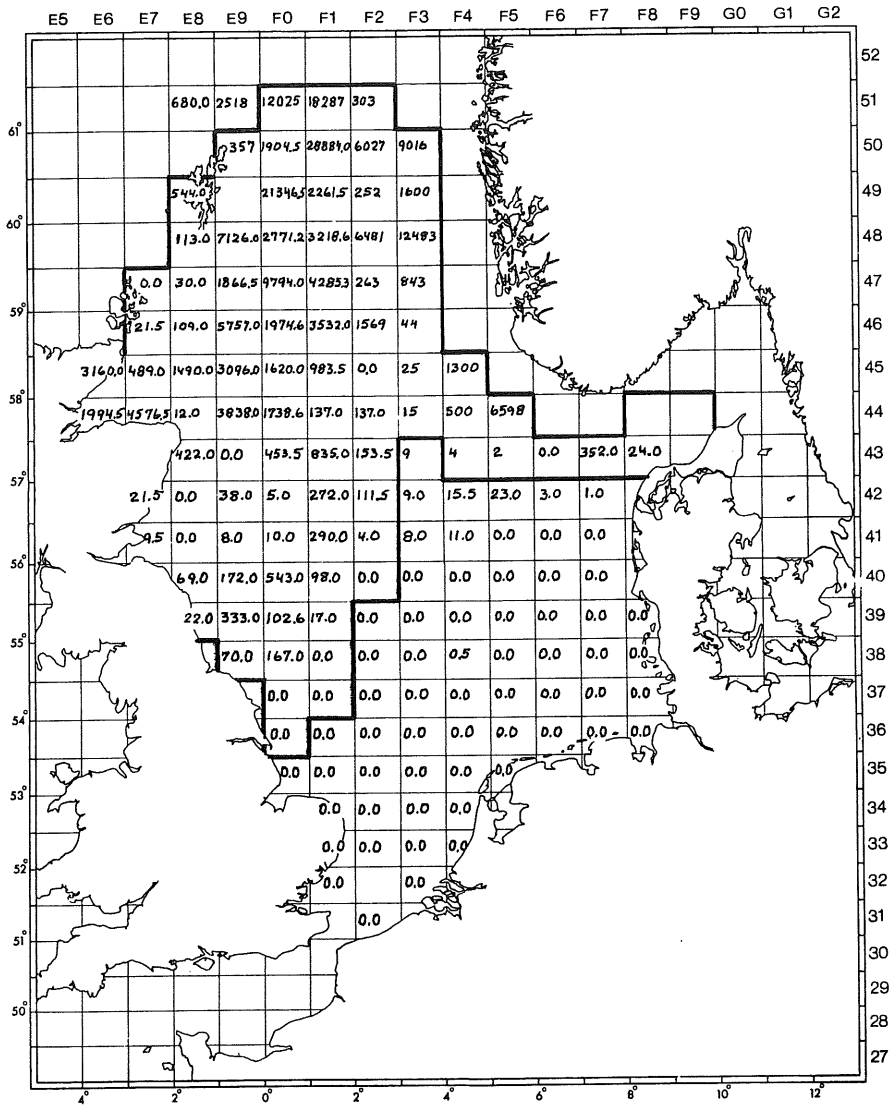
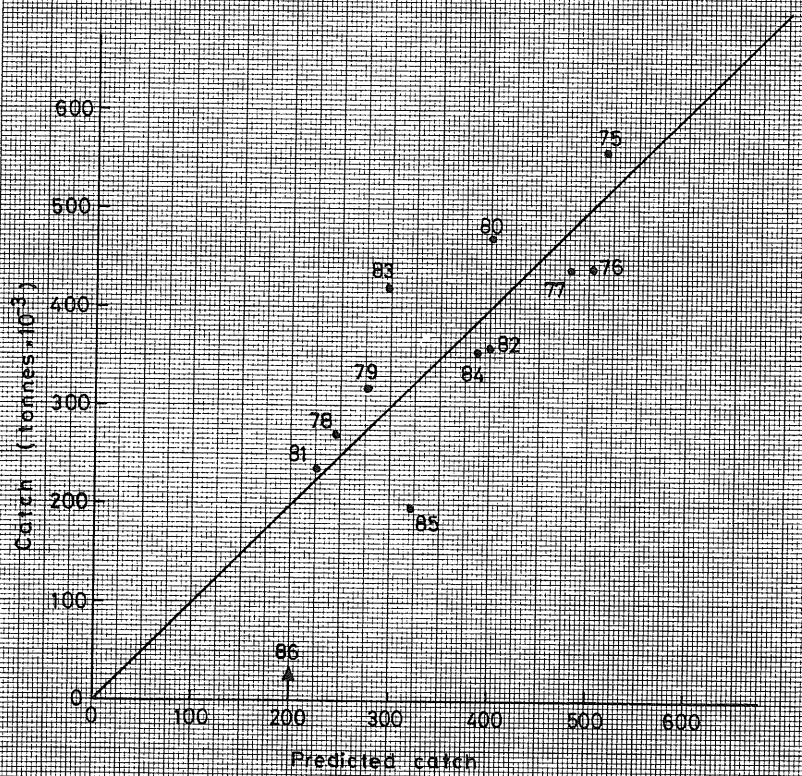


Figure 4.7.1 NORWAY POUT. Shot prediction of catch using IYFS 1-group index.




Shot prediction

$$Y(t) = 0.25 \times Y(t-1) + 0.6788 \times R_1$$

Figure 4.7.2 NORWAY POUT. Prediction of the catch using EGFS 0-group index.

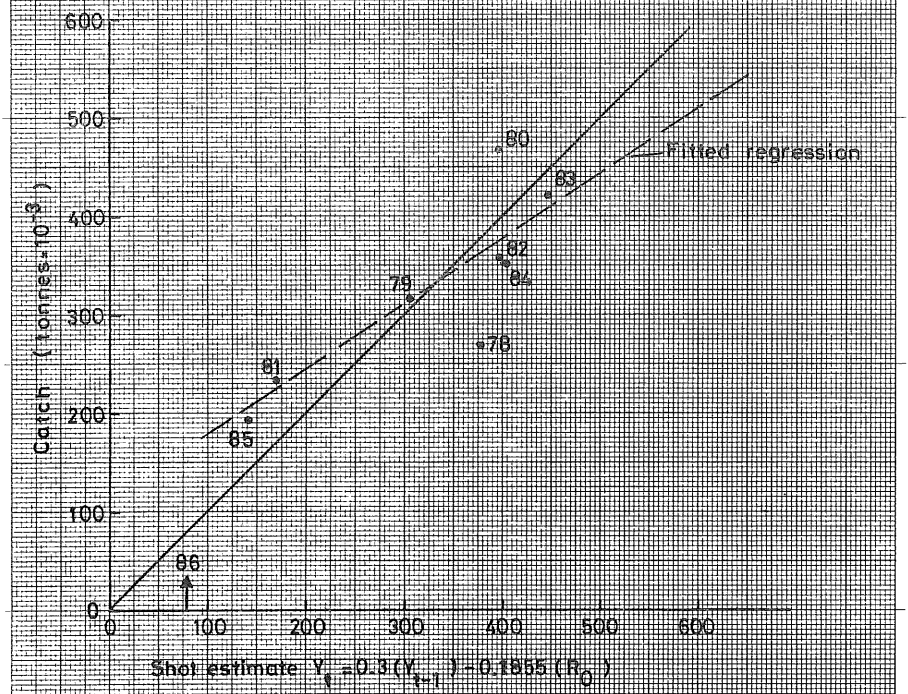


Figure 5.1.1 Danish SANDEEL areas and assessment areas used by the Working Group.

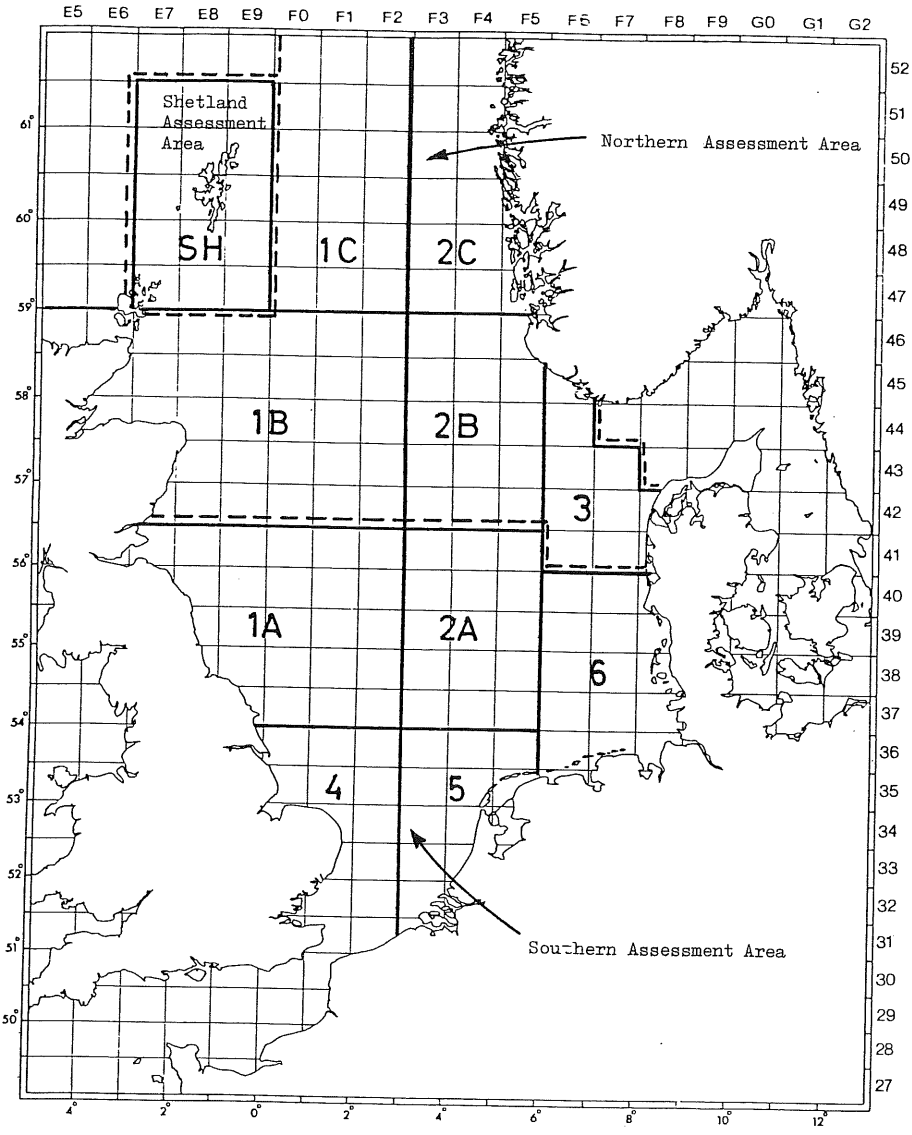


Figure 5.5.1 Catch areas for SANDEELS (all on same log scale).

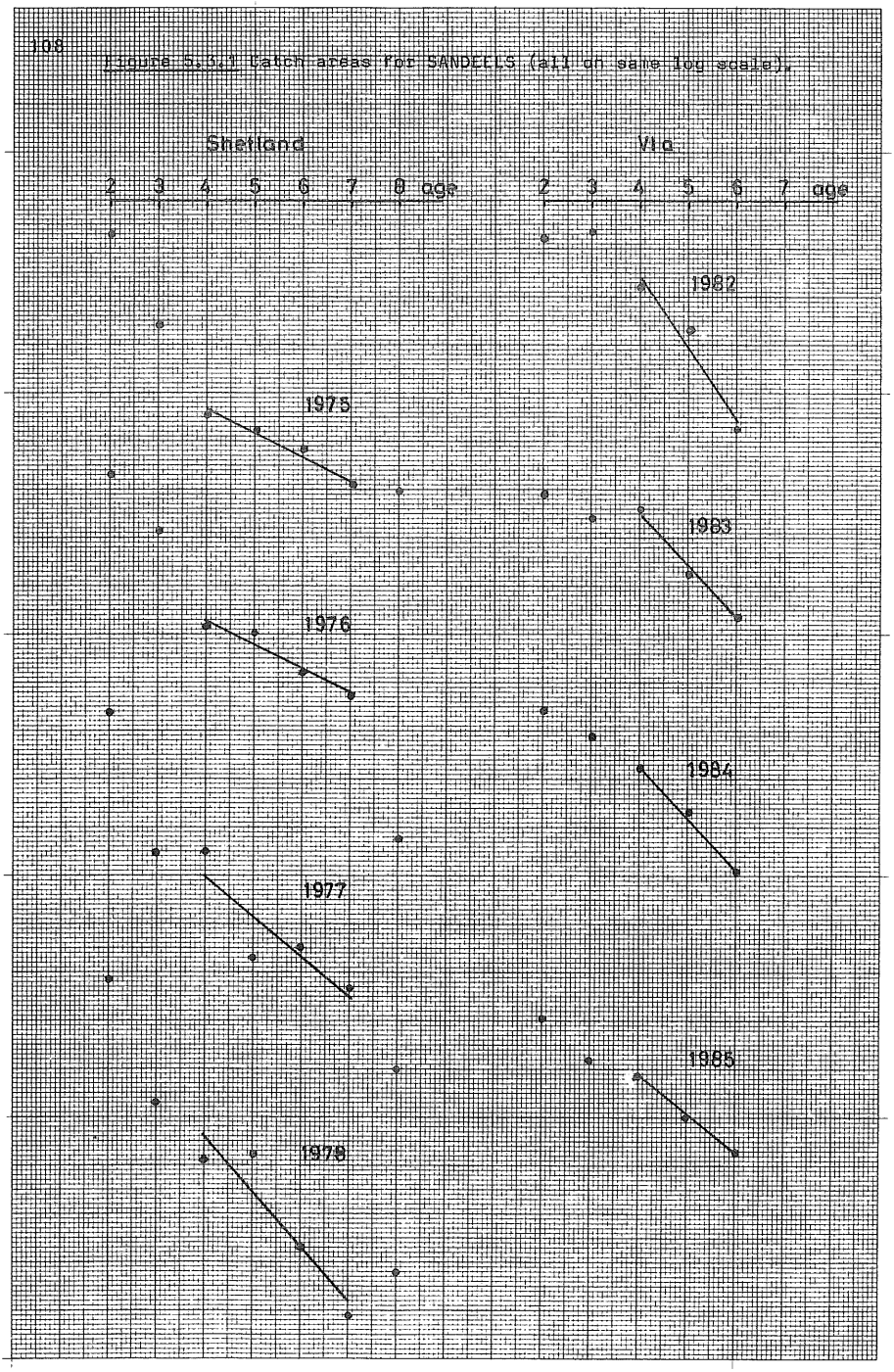
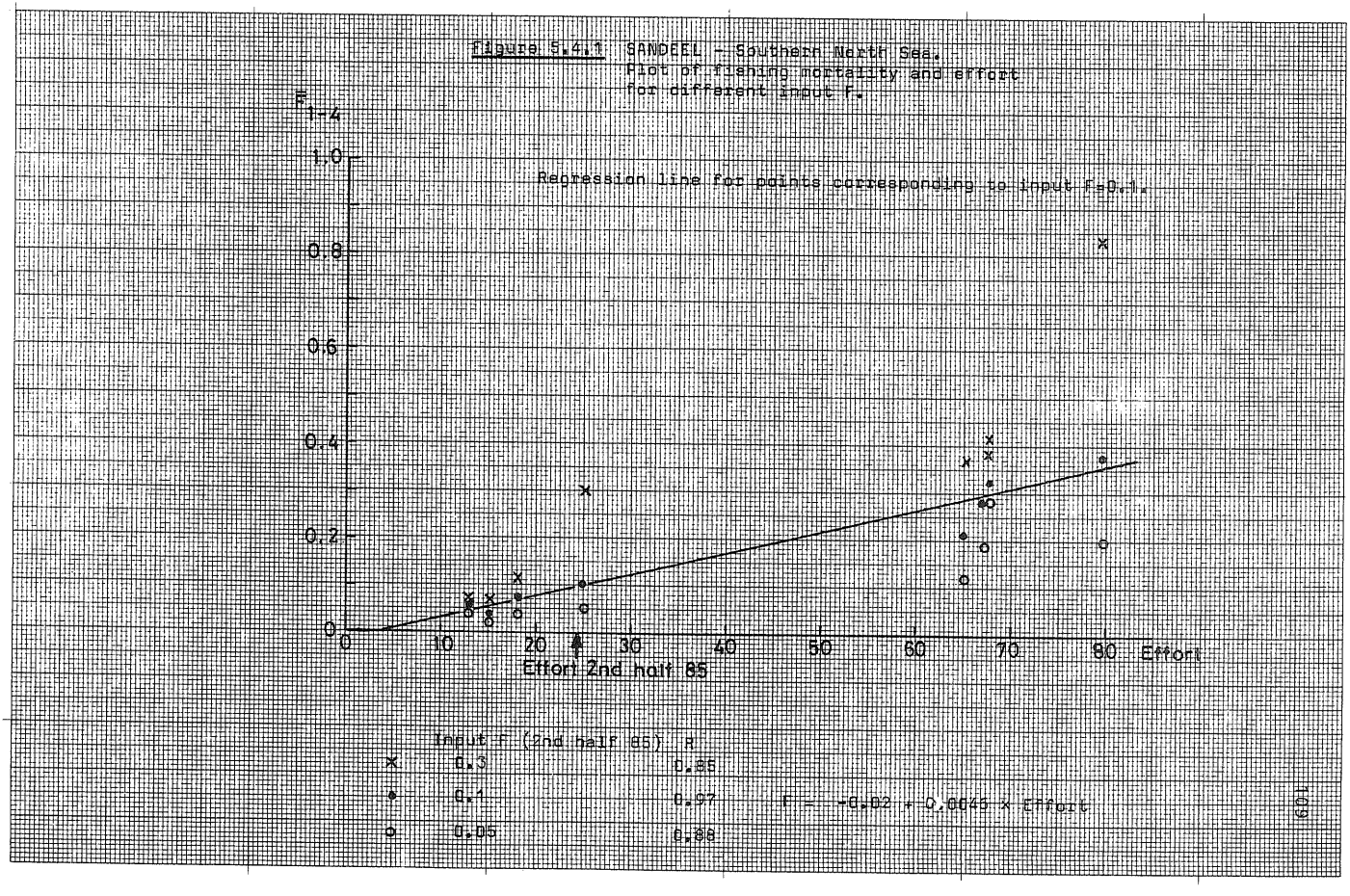


Figure 5.4.1 SANDEEL - Southern North Sea.
Plot of fishing mortality and effort for different input F.




ICES

Figure 5.4.2 SANDEEL Northern North Sea. Plot of fishing mortality and effort for different input F.

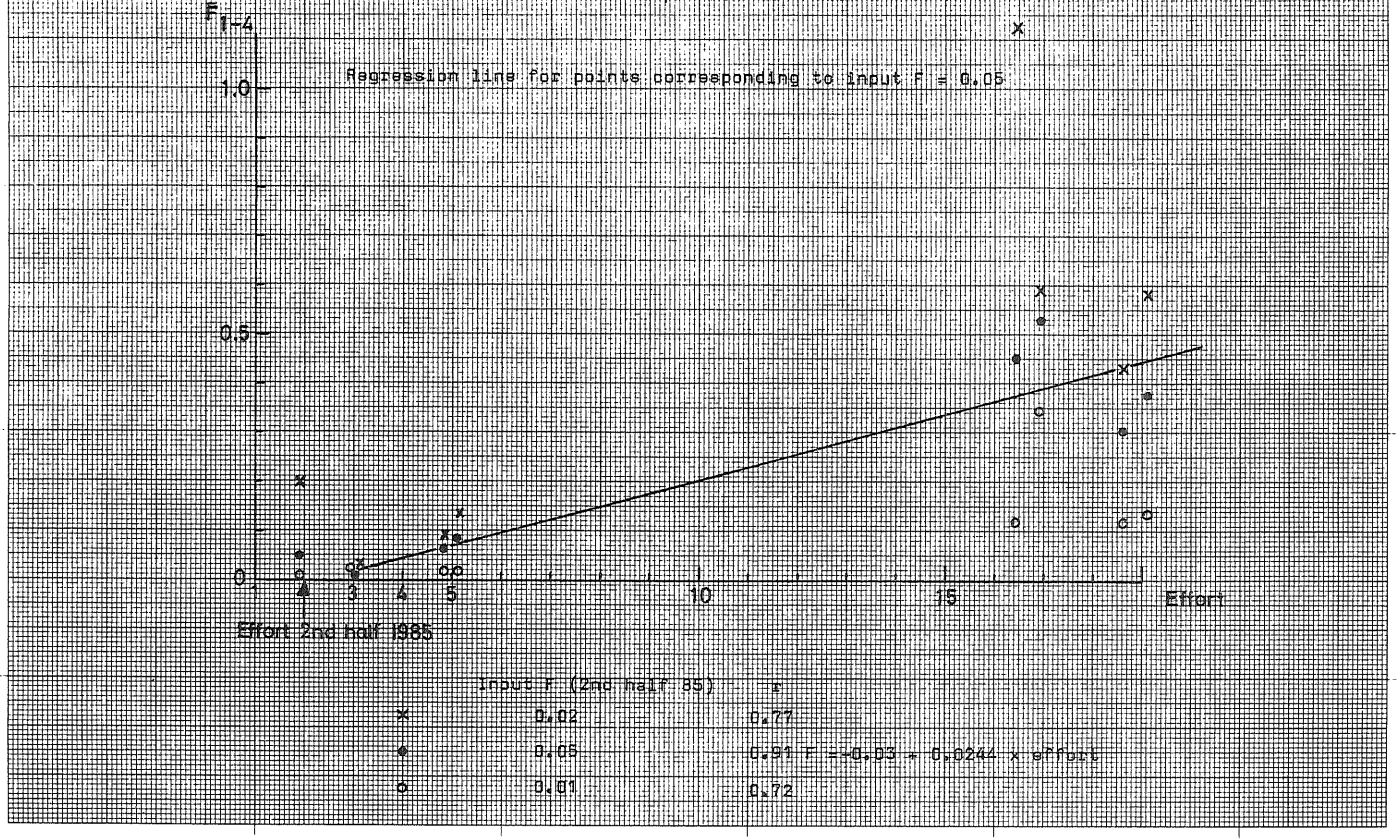


Figure 5.4.3 SANDEEL Shetland area.
Plot of F and effort.

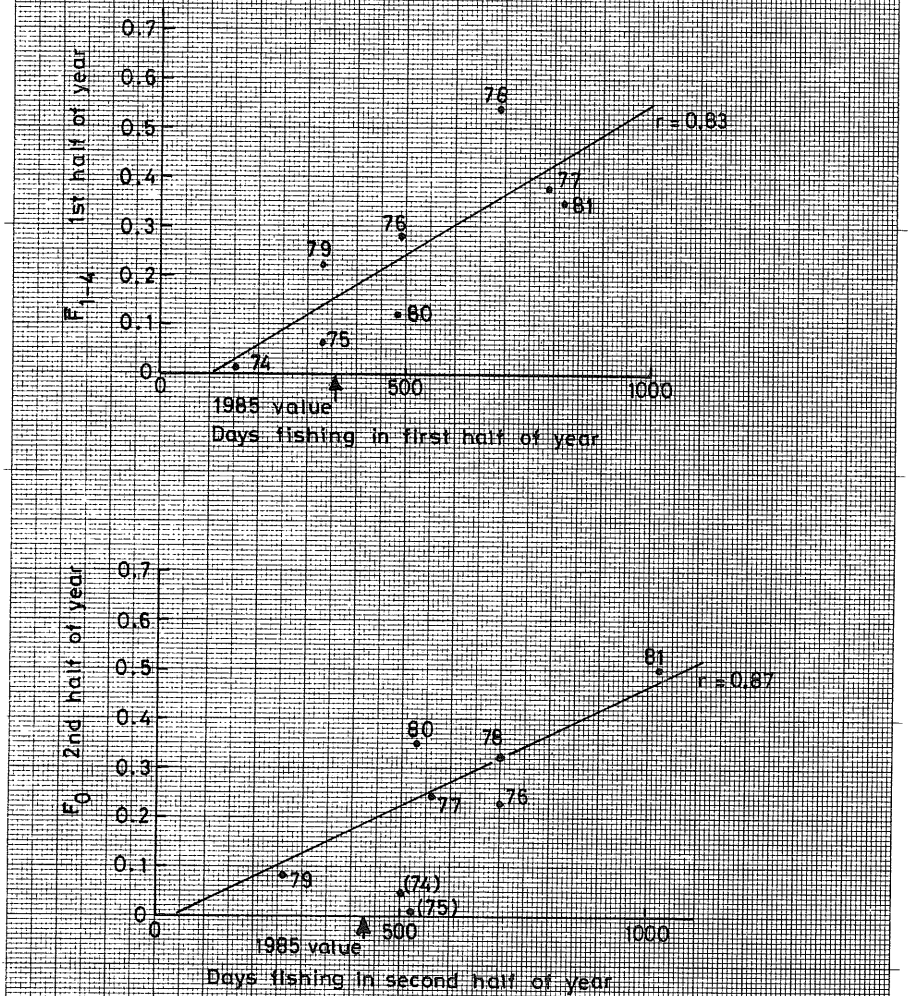


Figure 6.5.1 Regression of 1-group SPRAT index from IYFS in Division IIIa on yield in $10^{-9}$ tonnes the same year as IYFS. Years indicated.

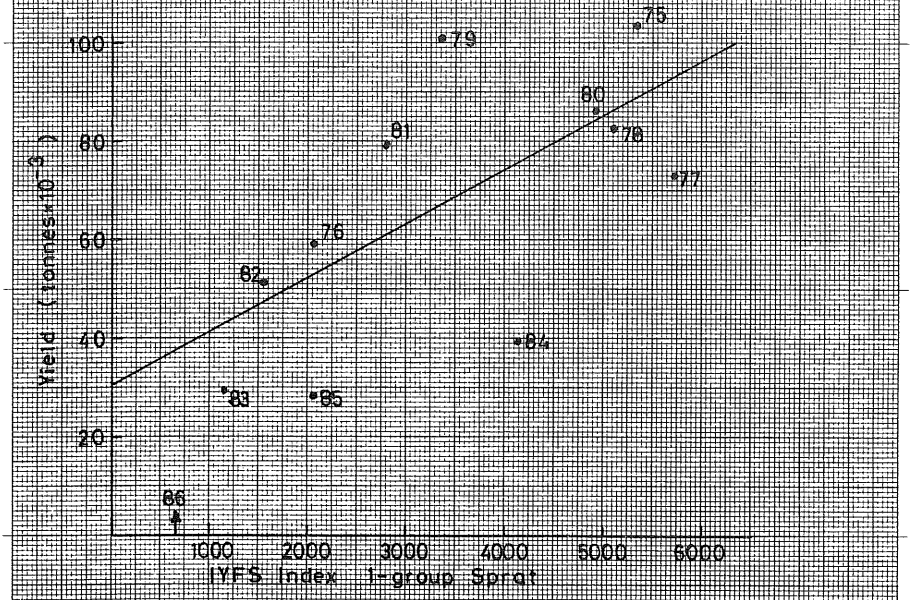


Figure 6.5.2 Shot estimate. Regression of 1-group index $R_1$ of SPRAT from IYFS on $Y_{(t)}=0.228\ Y_{(t-1)}$, on years indicated.

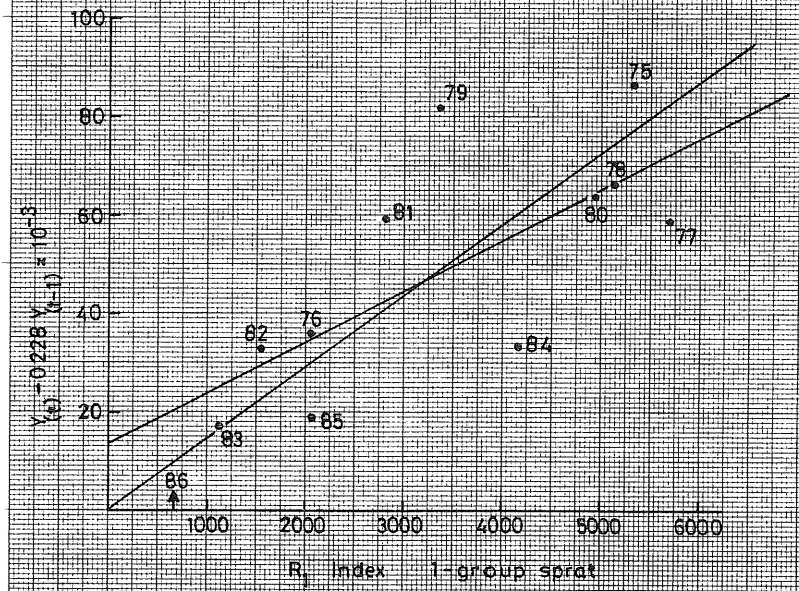


Figure 7.1.1 International SPRAT reporting areas.

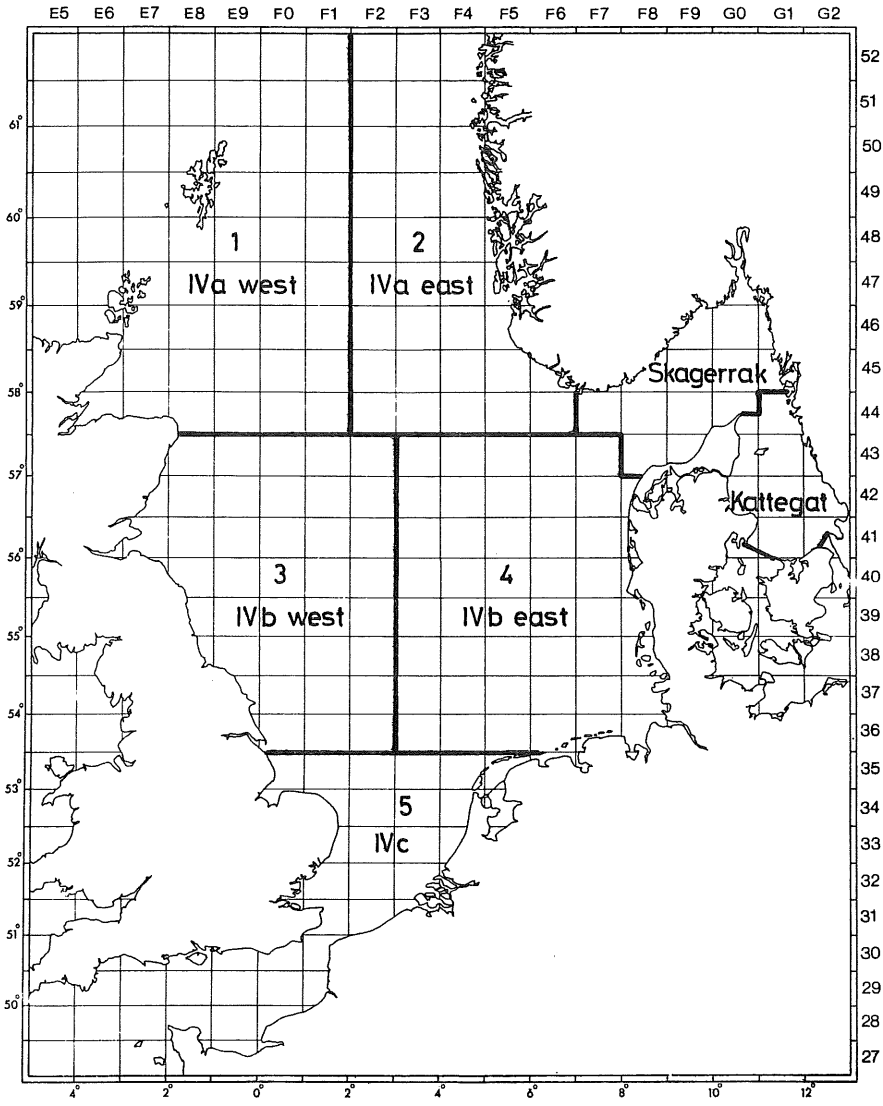


Figure 7.4.1 SPRAT, North Sea. Average number/haul of Sprat < 10 cm.
IYFS, February 1986. Preliminary data based on 375 hauls.

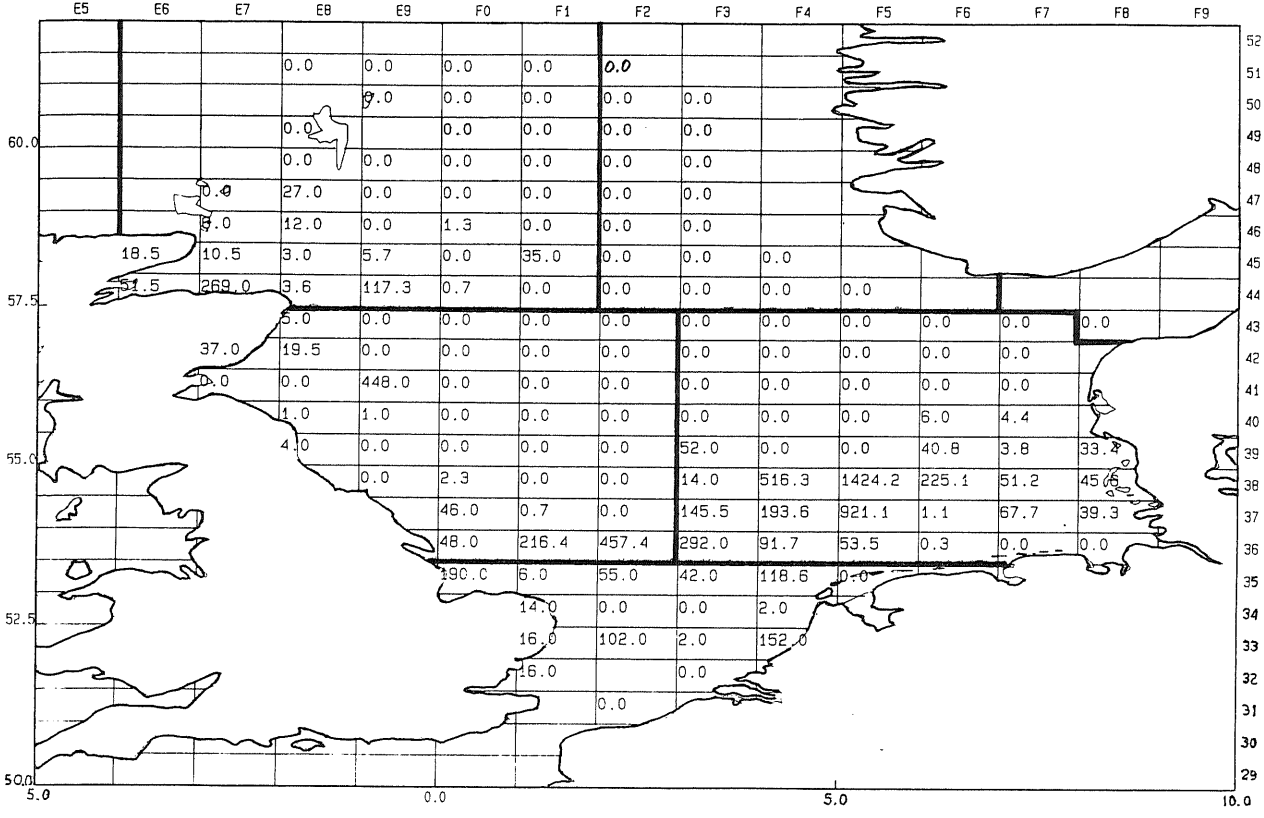


Figure 7.4.3 English Groundfish survey August 1985.
Distribution of SPRAT (kg/h).

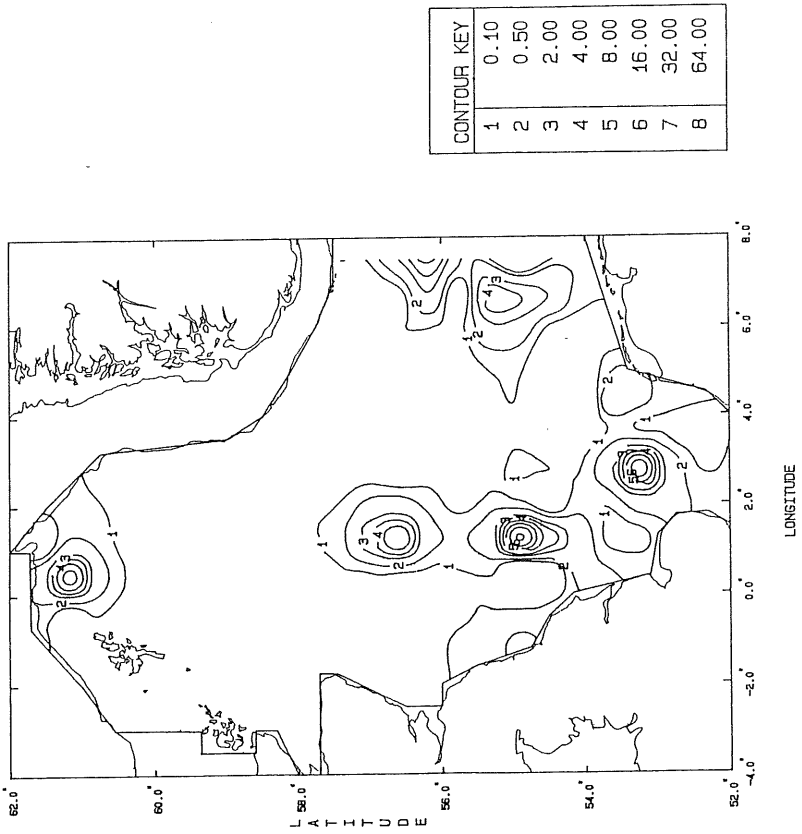


Figure 7.7.1 SPRAT, North Sea. Indicators of stock development: Annual catch, total stock size from VPA and an index of abundance, all ages, from International Young Fish Surveys (IYFS).

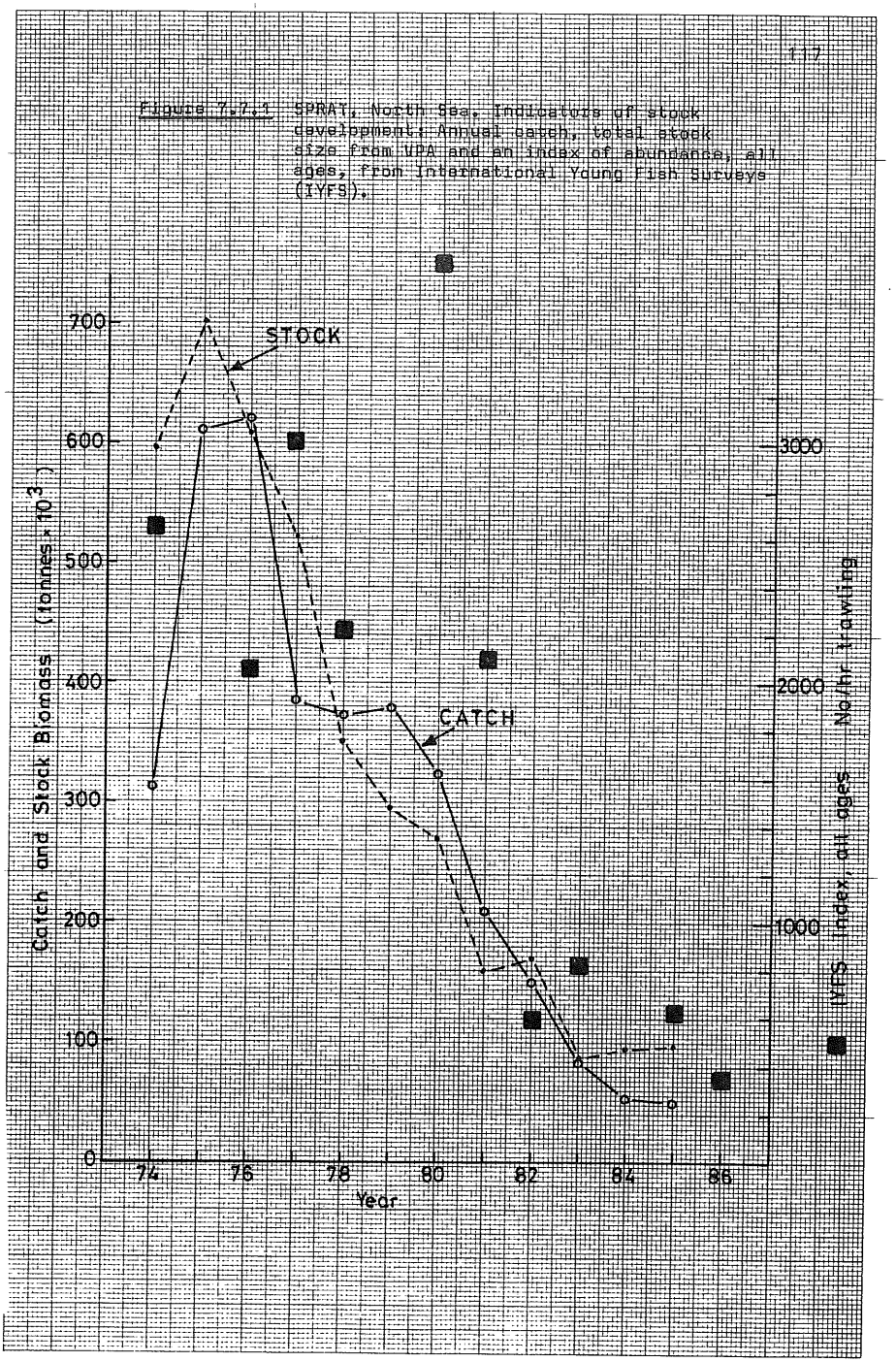
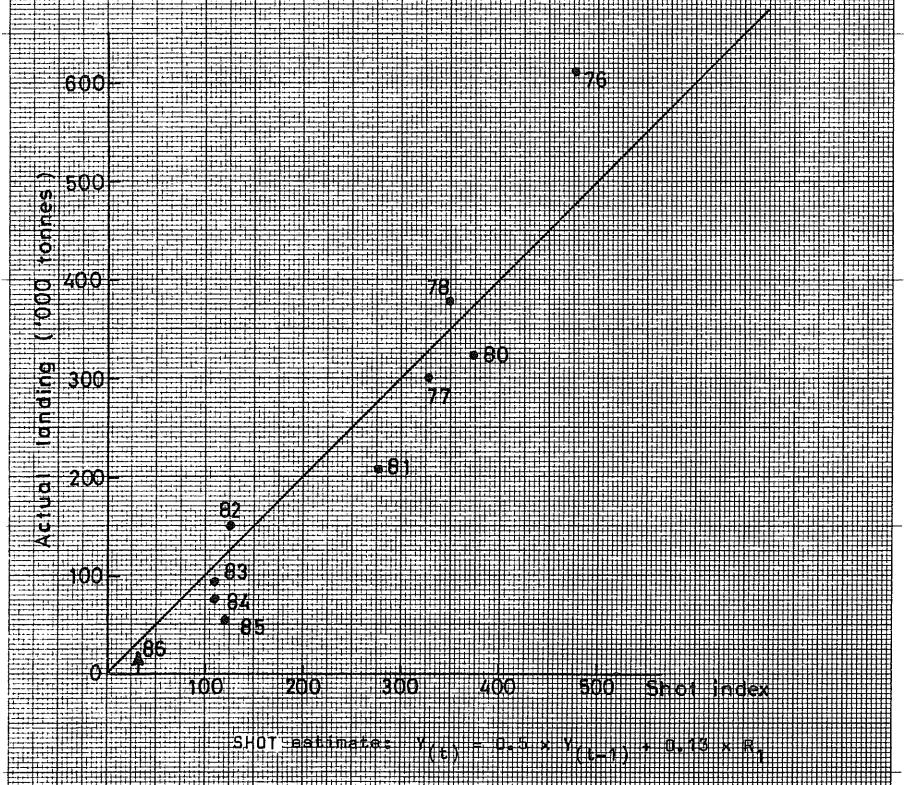


Figure 7.7.2 SPRAT, North Sea.
Actual landings vs. catch predictions
by SHOT-method.




SHOT-estimate: $Y_{(t)} = 0.9 \times Y_{(t-1)} + 0.13 \times R_t$