This Report not to be quoted without prior reference to the Council[x)]

International Council for the
Exploration of the Sea

C.M.1984/Assess:9

INDUSTRIAL FISHERIES WORKING GROUP

ICES headquarters, 7-13 March 1984

This document is a report of a Working Group of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council. Therefore, it should not be quoted without prior consultation with the General Secretary.

---

x) General Secretary,
ICES,
Palægade 2-4,
DK-1261 Copenhagen K,
Denmark.

TABLE OF CONTENTS

ctd.

Table of Contents (ctd)

-o-o-o-

REPORT OF THE INDUSTRIAL FISHERIES WORKING GROUP

1. INTRODUCTION

1.1 Participants

R S Bailey	United Kingdom (Scotland)
A Corten	Netherlands
D Garrod	United Kingdom (England)
J Lahn-Johannessen	Norway
B Mesnil	France
N A Nielsen	Denmark
J G Pope (Chairman)	United Kingdom (England)
K Popp Madsen	Denmark
H Sparholt	Denmark
P Sparre	Denmark

K Hoydal attended the meeting as ICES Statistician.

1.2 Terms of Reference

It was decided at the 71st Statutory Meeting of ICES (C.Res.1983/2:8:1) that the Industrial Fisheries Working Group (Chairman: Mr J G Pope) should meet at ICES headquarters 7-13 March 1984 to:

(i) report the results for by-catch species, e.g., herring, cod, haddock, whiting, mackerel and saithe in the North Sea and adjacent waters to the relevant ICES Stock Assessment Working Groups,

(ii) assess the state of the stocks of the target species for industrial fisheries, i.e., sprat in the North Sea, Divisions IIIa and VIId-e, Norway pout and sandeels,

(iii) take into account the levels of predation mortality implied by the results of the stomach sampling project,

(iv) analyse the effect of changes in the data sets of weight at age and age at first maturity on the time series of stock and spawning stock biomass.

1.3 Timing of Meeting and Participation

The Working Group found the timing of this year's meeting more satisfactory than last year's since it allowed preliminary young fish survey data and full national statistics for 1983 to be available. They stress the need for future meetings to be held at the same time or later. As last year, the ability of the Working Group to comment fully on the Division IIIa sprat fishery and herring by-catches was hampered by the lack of Swedish participation.

1.4 Management Considerations and Methodology

The comments of the Working Group upon management considerations remain valid (Anon., 1982) as do the comments on methodology (Anon., 1983a). The Working Group has, therefore, attempted to extend its use of less traditional methods in this report. In particular, it has made use of a method of catch prediction developed by Shepherd (1983), the Shepherd TAC (SHOT). The general approach of this method, as well as the Working Group's method for estimating the coefficients, are dexcribed in Appendix A.

2. RECENT TRENDS IN THE INDUSTRIAL FISHERIES

In the previous report (Doc. C.M.1983/Assess:7) of the Industrial Fisheries Working Group, a definition of the industrial fisheries, the structure, the interrelation of fishing intensity on the target species and a description of the fisheries were dealt with in some detail (see Section 2 in last year's Report, Anon., 1983a). Revisions of these descriptions will be made in the future as necessary. Recent trends in the fisheries are shown in Table 2.1.1.

Since 1973, the total industrial landings have fluctuated between 1.1 million and 1.9 million tonnes annually (Table 2.1.1). The figures for the period 1981-83 were somewhat lower than the average of 1.6 million tonnes.

Total annual landings of the target industrial species (Norway pout, sandeel and sprat) have ranged between 0.9 million to 1.6 million tonnes. The landings for 1981-83 were slightly below the average of 1.3 million tonnes. The substantial drop in sprat landings observed during this period has resulted in a decrease from 323 000 tonnes in 1980 to 91 000 tonnes in 1983, the lowest recorded level since 1971, whereas landings of Norway pout have increased from a minimum of 235 000 tonnes in 1981 to a near average figure of 421 000 tonnes in 1983. Sandeel landings varied irregularly around the average of 577 000 tonnes, the 1981 figure being close to this average, while those of the subsequent years were above and below, respectively.

Total annual landings of by-catch for reduction purposes have fluctuated between 150 000 and 300 000 tonnes. Landings of blue whiting in recent years have been at a comparatively high level, 106 000 tonnes in 1982 and 89 000 tonnes in 1983, whereas those of protected species (haddock, whiting and saithe) have shown a decreasing trend with a minimum of 39 000 tonnes in 1983. By-catch of herring has increased sharply in the past 3 years, from 7 000 tonnes in 1980 to more than 150 000 tonnes in 1982 and 1983.

3. BY-CATCHES IN THE INDUSTRIAL FISHERIES IN THE NORTH SEA AND DIVISION IIIa

3.1 Herring By-Catches in the North Sea in 1982 (revised figures)

The main revision has occurred in the central North Sea, where the preliminary figure of 90 000 tonnes given in last year's report has now been changed into 150 000 tonnes (Table 3.1.1). This is mainly due to the inclusion of catches in the fourth quarter of the year. These catches consisted both of 0-group and 1-group herring, indicating that the fishery was conducted further offshore than in the third quarter. The total annual catch in numbers of 0-group herring has now increased from 8 269 million to 9 575 million, and the total catch of 1-group from 392 million to 910 million (Table 3.1.2).

3.2 Herring By-Catches in the North Sea in 1983

The annual catch figure by area (Table 3.1.1) shows a continuation of the situation in the previous year, with a relatively high catch (153 000 tonnes) taken in the central North Sea. This catch again consisted mainly of 0-group herring (Table 3.2.1), and it was presumably taken mainly in the third quarter of the year in inshore waters of the eastern central North Sea.

Considering the sprat catches taken in this area at this time of the year (Table 7.1.3), it is clear that herring was not a by-catch but the prime target species for the fishery.

3.3 Herring By-Catches in Division IIIa

One country reported a by-catch of 393 tonnes. mainly consisting of 1-ringers from the Skagerrak. This is probably only a minor fraction of the total herring by-catch in Division IIIa. Unfortunately, no by-catch data were available from other countries fishing in this Division.

3.4 By-Catch of Other Species

The most predominant species occurring as by-catch in the fisheries are recorded in Table 3.4.1. Blue whiting form the most important by-catch in the Norway pout landings from the Norwegian Deeps and the annual landings have been at a comparatively high level in recent years, exceeding 100 000 tonnes in 1982 and being close to 90 000 tonnes in 1983. Recent trends for haddock and whiting are decreasing, the estimated 1983 landings being 15 000 tonnes and 23 000 tonnes, respectively. Reported by-catch of saithe has been at low levels since 1977, being approximately 1 500 tonnes in 1983.

The quarterly distribution of haddock and whiting by-catch by sub-areas of the North Sea is presented in Table 3.4.2 for 1982 and 1983 (for areas see also Figure 3.4.1). In 1982, the largest by-catch of haddock was landed in the first and third quarters, whereas in 1983 the landings were more evenly distributed throughout the year. Whiting by-catch was particularly high during the first quarter and comparatively high in the fourth quarter of 1982, while in 1983 the major landings occurred during the first and third quarters of the year.

Species compositions in the Norwegian Norway pout and sandeel fisheries are given in Tables 3.4.3 and 3.4.4, respectively. The contribution of blue whiting in the Norway pout landings has been quite significant in 1982 and 1983, following a major influx of immature fish to the Norwegian Deeps. By-catch in the sandeel fisheries was rather small. Faroese by-catch landings for human consumption are presented in Table 3.4.5.

3.5 Problems with By-Catch Regulations

3.5.1 Background

The question was raised of problems caused to some industrial fishermen by current by-catch restrictions of 10% of protected species, by weight, in industrial catches. The Working Group, therefore, considered this problem in broad terms.

They recalled that by-catch regulations were introduced in the past because it is not always possible to harvest resources of Norway pout, sprat and other industrial species without taking an unavoidable catch of protected consumption species. A by-catch derogation can be seen as having three main purposes, which are:

1) to allow the industrial fishery to be conducted with small-meshed gear;

2) to prevent damage to the consumption fishery thus providing a measure of equity between the industrial fishermen and the consumption fishermen, who are subject to other constraints;

3) to direct the industrial fishermen's efforts towards the target industrial fish.

Since the balance between the two types of fishery is clearly a matter of overall management policy, the Working Group only concerned itself with problems with the first objective. The Working Group could not, however, examine the problem in any detail apart from pointing to its possible existence and that there may be possibilities of forecasting by-catch levels, if a more flexible regulation system should prove desirable.

3.5.2 Industrial fisheries with by-catch problems

The North Sea sprat fisheries and the Norway pout fisheries both generate significant by-catches of protected species. The North Sea sprat fishery has had a very considerable by-catch of herring and other species in recent years. For the last two years, the annual percentage by-catch for herring alone has been more than 50%. With the current low abundance of sprat, clearly a problem of this size cannot be resolved by even a doubling of the by-catch derogation, if this approach was seen to be desirable in relation to the herring stock.

The Norway pout fishery takes by-catches of haddock, whiting and saithe. Unfortunately, by-catch of these species are only documented relative to the total industrial fishery catch (less sandeels). Even on this basis, Table 3.4.2 indicates that by-catches of haddock and whiting exceeded 10% in a number of areas and times in 1982 and 1983. It thus appears that the by-catch problem has a seasonal aspect, being most acute at the beginning and at the end of the Norway pout season.

Considering these figures, it should be kept in mind that they indicate overall percentages, while the 10% by-catch regulations refer to single landings, i.e., an overall percentage just below 10 would suggest that an appreciable number of landings must have exceeded the legal level. It should also be kept in mind that the by-catch considered in the present report only refers to that part of the landings, which are delivered to the fish-meal plants. A certain amount of marketable fish is sorted from the catches and landed for human consumption but has not been quantified. The by-catch will consequently tend to be underestimates of the actual ones and would thus indicate that the 10% rule has not been generally enforced or strictly adhered to, even in the most recent years.

If henceforth the existing regulations were vigorously enforced, then it seems likely that the Norway pout fishery would in most years be forced to change from the previous pattern of fishing. The extent to which this would affect the overall health of the industrial fisheries is difficult to determine, since it would depend upon the extent to which the fishermen could redistribute their effort onto purer concentrations of Norway pout.

Unfortunately, at present the Working Group does not have by-catch figures in sufficient detail. These should be made available in an as disaggregated form as possible if this problem is to be pursued further.

3.5.3 Factors which affect by-catch rates

It is extremely likely that the level of unavoidable by-catch will depend upon the ratio between the abundance of the industrial stocks and the abundance of the protected species within the area of the industrial fishery and on the patchiness of the species' distribution.

Figure 3.6.1 shows a plot of the by-catch of whiting against the calculated whiting spawning stock biomass in the same year for the total North Sea. Two separate relationships can be detected in this figure: a higher level relationship corresponding to the period 1972-77 before EEC regulations (e.g., the 'Norway pout box') came into force, while the lower level in 1978-82 represents the relationship following these regulations. It can thus be expected that by-catch levels will increase in cases where the protected species become more abundant and/or the industrial species become less abundant. When this happens, the restraints put upon the industrial fisheries by fixed by-catch percentages will increase. If the risk of taking excessive by-catch rates becomes sufficiently high, fishermen will no longer be able to work on parts of their usual grounds and the yield of the industrial fisheries might decline. If it were to decline, then from the point of the industrial fisheries there thus might be a case for a temporary adjustment of by-catch restrictions in exceptional circumstances. Equally, from the viewpoint of consumption fisheries, there might be an argument for a temporary reduction in by-catch restriction levels when consumption stocks were in an unusually low abundance.

3.5.4 The predicted by-catch rates

To make adjustments, it would be necessary to predict by-catch rates for the next year. In the case of the by-catch of haddock and whiting, predictions of by-catch amounts are already made by the Roundfish Working Group (Anon., 1983b), using a VPA prediction method. As an alternative method, the Working Group has developed a by-catch predictor based upon Shepherd's 1983 method, which is shown in Figure 3.6.2. The predicted by-catch for 1984, using this formulation, is 48 000 tonnes, which is comparatively low, mostly due to poor whiting recruitment. Since the Norway pout catch is predicted in Section 4.9 to be about 400 000 tonnes, the annual average by-catch rate should be be similar to that in 1983. The by-catch in 1985 should, however, be larger at more than 60 000 tonnes due to the larger 1983 year class of whiting. Whether or not this will lead to high by-catch rates will, however, depend upon the size of the 1984 Norway pout year class. At present, the Working Group is unable to predict the catch of Norway pout beyond the current year. It is, however, possible that predictors might be developed, based on surveys in the second half of the year which would enable ACFM to predict the next year's catch of Norway pout and hence the by-catch rate. Clearly, a reliable predictor of by-catch rate would be a requirement if by-catch restrictions were to be adjusted.

4. NORWAY POUT

4.1 Landings 1957-83

Landings of Norway pout from the North Sea by country for the years 1957-83 are shown in Table 4.1.1. The total landings have in the last 15 years varied between 300 000 and 500 000 tonnes, except for some few years. The total landings in 1983 were 421 000 tonnes.

The monthly landings by country in the years 1980-83 are given in Table 4.1.2. The table shows that the largest catches are taken in the period August - November.

Division VIa

Landings of Norway pout from Division VIa by country are given in Table 4.1.3.

Division IIIa

Landings of Norway pout from Division IIIa by country are given in Table 4.1.4.

4.2 Effort Data

Norwegian effort data

A new set of data representing the whole industrial fleet fishing for Norway pout and blue whiting is available from 1976 onwards. The cpue values (hectolitres per days fishing per mean GRT) by quarters are presented in Table 4.2.1 and Figure 4.2.1. The weighted annual means, including and excluding by-catch respectively, are shown in Figure 4.2.2.

Figure 4.2.1 shows considerable quarterly changes in catch rates. Figure 4.2.2 indicates a series of rather stable weighted annual mean catch rates. The similar series for Norway pout (by-catch excluded) fits comparatively well with the total annual means, thus demonstrating the importance of Norway pout in this mixed fishery.

Faroese effort data

The updated cpue series (kg per hour trawling) shows the same annual and seasonal pattern as the Norwegian data (Table 4.2.2 and Figure 4.2.3).

4.3 Catch at Age and VPA Results

Table 4.3.1 shows the catch in numbers by quarter for the years 1974-83. Catch at age data were available in 1983 for the Danish and Norwegian landings. These samples account for 90% of the total catches, and they were raised to give an age distribution of the total catch.

The catch at age in Table 4.3.1 was used as an input to a quarterly VPA. In last year's report it was attempted to estimate the total mortality, Z, on Norway pout. The results indicated a total mortality in the range 1.5 - 2.5 year^{-1}. The natural mortality, M, was chosen at a level which gave a total mortality in the range above.

This year, preliminary data from the International ICES Stomach Sampling Project were available. These data give an estimate of the number of Norway pout taken by other fish in 1981. The natural mortality was then chosen to match the level of predation in 1981.

In the text table below the estimated number of Norway pout taken by cod, whiting, saithe and mackerel (Daan, 1983) are shown.

Age	0	1	2	3
Nos. x 10^{-9}	120	23	6	0.2

The natural mortalities which would produce these predation estimates were 0.4 per quarter on all ages.

Compared to the values used in the VPA in last year's report, these are higher on the young age groups and lower on the older age groups, but the total level of natural mortality is unchanged. A natural mortality of 0.4 per quarter was thus adopted.

The fishing mortalities for the last year were chosen to fullfill the requirements:

1. Constant level of fishing mortality in the latest year.
2. Recruitment in accordance with the IYFS 1-group index.

These two objectives turned out to be in agreement thus placing some confidence on the VPA results.

A plot of the IYFS index of Norway pout as 1-group versus the estimated recruitment as 1-group is shown in Figure 4.3.1. The assumption of average fishing mortalities in the latest years produces recruitments which correlate fairly well with the IYFS index for the years 1977-82. The fishing mortality on 0- and 1-group fish has been modified to give recruitment near the established line.

The estimated fishing mortalities are shown in Table 4.3.2 and the stock in numbers by quarter is shown in Table 4.3.3.

Figure 4.3.2 shows the stock biomass and the spawning biomass as estimated in the VPA. The maturity ogive used was 0.1 on 1-group and 1.0 on older age groups. The weight at age used are shown in the text table below.

Age	0		1				2				3				4
Quarter	2	3	1	2	3	4	1	2	3	4	1	2	3	4	1
Av. weight	4	6	7	15	25	23	22	34	43	42	40	50	60	58	56

The spawning stock biomass (Figure 4.3.2) shows similar trends as the cpue plots (Figures 4.2.1, 4.2.2 and 4.2.3). To illustrate this further, a plot of the spawning stock biomass (estimated as at 1 April) versus the Norwegian cpue is shown in Figure 4.3.3. The data series show a good correlation ($r^2 = 0.80$).

Summarising the available data seem to be in accordance with the VPA. The stock size, with the exception of that in 1981, has been relatively stable around 1 000 000 tonnes in the last 8 years,although the stock size fluctuates within a year because of the rapid growth. The spawning stock has in the same period varied between 300 000 - 700 000 tonnes without any trend.

The average fishing mortalities in the years 1979-83 were estimated and are shown in the text table below.

Average fishing mortalities by age 1979-83

Age group	0	1	2	3
Av. fish	0.08	0.61	1.42	1.52
M	1.6	1.6	1.6	1.6

4.4 Research Vessel Surveys

The series of research vessel recruitment indices are given in Tables 4.4.1 and 4.4.2. The areas to which each index applies are shown in Figure 4.4.1

In the previous report it was shown that only the IYFS 1-group index correlates with the VPA estimate. On this basis it would appear that the 1982 year class was below average, while the 1983 year class is about average.

4.5 Weight at Age in the Catch

Mean weight at age by quarters are shown in Table 4.5.1.

4.6 Percentage Landings in Weight by Age

Table 4.6.1 shows the quarterly and annual landings in weight by age as a percentage of the annual landings.

The importance of the age group varies with year class strengths, but in general the 1-group makes up 70% of the catches and the 2-group comprises 25% of the annual landings.

4.7 Predation Mortality

Predation mortality estimates are discussed in Section 4.3.

4.8 Equilibrium Yield

No calculations of equilibrium yield of Norway pout were undertaken at this meeting.

4.9 Catch Prediction

At the Working Group meeting in 1983, a prediction was given based on results from the IYFS. The catch of Norway pout in a given year was correlated with the sum of IYFS 1-group + IYFS 2-group indices. However, the IYFS 2-group indices for 1983 and 1984 were not available to the Working Group this year, and a new method for prediction was investigated.

The SHOT estimates (see Appendix A) were calculated in three different ways, all based on data from the years 1975-83.

a) $Y(t) = a + b\ Y(t-1) + C\ R_1$

This model was fitted using multivariate regression giving the following results:

$$Y(t) = 109.4 + 0.24\ Y(t-1) + 0.05\ R_1$$

r^2 for this model was 0.64.

b) The proportion of the 2-group and older (by weight) of the catch is on average 25% (see Section 4.6). On this basis, the 'hangover' coefficient was chosen as 0.25. This is in agreement with the analysis under a) above.

A simple linear regression of $Y(t)-0.25\ Y(t-1)$ on R_1 gave the model:

$$Y(t) = 104.8 + 0.25\ Y(t-1) + 0.05\ R_1$$

r^2 for this model was 0.54.

c) A regression of $Y(t)-0.25\ Y(t-1)$ on R_1 through the origin gave a recruitment multiplier of 0.079 and hence a SHOT estimate of

$$Y(t) = 0.25\ Y(t-1) + 0.079\ R_1$$

Figure 4.9.1 shows the predicted catch catch from Model c) and the observed catch.

The opinion of the Working Group was that Method c) gave as reasonable results as the other methods, and this method is equivalent with SHOT methods for other stocks. Therefore, Method c) could be used as an alternative to the method given in last year's report, which was based solely on the IYFS index.

The predicted catch using Method c) in 1984 is 390 000 tonnes, assuming fishing levels to be similar to those prevailaing in recent years.

5. SANDEEL

5.1 Landings in 1983

North Sea

Landings decreased from 611 000 tonnes in 1982 to 536 000 tonnes in 1983, the lowest level since 1976 (Table 5.1.1). Landings by all countries fishing for sandeels decreased, the largest proportionate decrease being recorded by Norway (46 000 tonnes to 12 000 tonnes).

Monthly landings are given by country in Table 5.1.2. Landings by Denmark and Norway were concentrated in the second quarter of the year (83% and 78%, respectively), while landings by Scottish vessels were more evenly distributed between the second and third quarters (54% in the period April-June).

Monthly landings in each of the areas shown in Figure 5.1 are given in Table 5.1.3 for Denmark, Norway and the United Kingdom. In most fishing areas, landings had finished by the end of July, exceptions being sandeel areas 3 and 6 adjacent to the Danish coast and the Shetland area. In this respect, the seasonal distribution of the landings was very similar to that in 1982.

Annual totals for each Sub-area given in Table 5.1.4 show how the geographical distribution of the sandeel fisheries are changing. Significant increases in landings occurred in areas 3 (approaches to the Skagerrak) and 4 (southwestern North Sea), while landings from the northern assessment area as a whole remained roughly at the same level as in 1982. Landings from the Shetland area decreased significantly in 1983.

Division VIa

Scottish landings from Division VIa increased from 10 900 tonnes in 1982 to 13 000 tonnes in 1983 (Table 5.1.5)

Division IIIa

According to the data reported to ICES, landings increased from 22 000 tonnes in 1982 to 34 000 tonnes in 1983 (Table 5.1.6). Almost all was taken by the Danish vessels.

5.2 Fishing Effort

Norwegian effort and catch per unit effort data were available for the northern and southern assessment areas for the years 1976-83 (Table 5.2.1), and United Kingdom data for the Shetland area for the years 1975-83 (Table 5.2.2).

Estimates of total fishing effort were obtained by raising the Norwegian effort by the ratio of total international effort to Norwegian catch. In the northern assessment area, where Norwegian landings accounted for 10-50% of the total, effort in the first half of the year decreased rather sharply in 1982 and remained at this level in 1983. In the southern area, Norwegian effort accounts for only a small fraction of the total and is unlikely to be representative.

In the Shetland fishery, the effort decreased by 24% in 1983.

5.3 Catch at Age and VPA

5.3.1 Catch at age

Catch in numbers at age was compiled for the three assessment areas shown in Figure 5.1.1. Relevant monthly data were provided by Denmark, Norway and the United Kingdom, and the small landings by the Faroes and Sweden were allocated to age using Danish data for the northern assessment area.

The catches in number at age for 1983 are given by months in Tables 5.3.1 - 5.3.3. In the southern area, the catches were predominantly of 0-group in July and 2-group in April-June. The percentage of 1-group was lower than in the previous year. In the northern area, 1-group predominated in April and May, the 2-group in June-July, and the 0-group from August to October. Few sandeels older than 3-group were caught. At Shetland, 1-group sandeels formed a higher percentage of the catch than in 1982, and the 0-group was correspondingly less well represented.

5.3.2 VPA results

VPAs were made separately as in previous years for the southern and northern areas of the North Sea and for Shetland (Figure 5.1.1). For all areas, the analyses were carried out using half-yearly data. The value of M was taken to be 0.5 year^{-1} for all ages in all years. Subsequent comparisons with the ICES Stomach Sampling Project data for 1981 indicate that this value is a substantial underestimate at least for the two youngest age groups. The following VPA results should, therefore, be treated with caution.

The input catch in numbers data are given in Tables 5.3.4, 5.3.7 and 5.3.10. For the southern area, values of input F for the last half of 1983 were chosen, which resulted in an annual mean F in 1983 at roughly the same level as in the previous four years. For the northern area, Norwegian effort data given in Table 5.2.1 indicated some decrease in effort in 1982, and a value of input F was chosen which gave estimates of annual F which roughly matched this decrease. In the case of the Shetlands, F values from a trial analysis were plotted against effort data to provide a method of tuning the input value. The resulting values of fishing mortality rate are given in Tables 5.3.5, 5.3.8 and 5.3.11, and the estimated stock size in numbers at 1 January in Tables 5.3.6, 5.3.9 and 5.3.12.

Southern area of the North Sea

In the absence of effort data, no independent evidence was available to substantiate the input values of F for southern North Sea sandeel and hence the stock size and recruitment in 1983. On the assumption that there had been no trend in fishing effort over the period 1980-83, the results of the VPA indicate that F on the 1-group and older decreased in 1981 and 1982 and increased in 1983. The increase in 1983 can partly be explained by the size of the 1982 year class, which appears to have been the weakest so far recorded. The 1981 year class, however, appears to be a strong one and contributed heavily to the catches in the first half of 1983.

Another interpretation of these results could be that the poor 1982 year class forced effort to increase on the 2-group in 1983 and that this year class was not particularly strong. The fishing mortality rate in 1983, however, would have had to be very high to reduce the estimate of the 1981 year class to an average level, and the high catches of this year class in the latter half of 1981 and in 1982 and 1983 would tend to indicate that it was indeed a large one.

From the small size of the 1982 year class it is likely that the spawning stock will decrease in 1983 back to the average level of the previous ten years.

Because of the large fluctuations in F on the 0-group in the southern area, it is not possible to judge the reliability of the estimate of the strength of the 1983 year class from the VPA. Using the results of the VPA, however, there is some indication of a correlation between year class strength as 0-group and the catches of 0-group over the period when there has been a fishery on this age group (Figure 5.3.1). Since the catch of 0-group in 1983 was relatively small, this tends to indicate that the 1983 year class is lower than average.

Northern area of the North Sea (Shetland)

Catches in the northern area during the second half of the year are composed almost entirely of 0-group sandeels (Table 5.3.7). Preliminary VPAs, based on assumed values of terminal F in the second half year, were tuned to Norwegian fishing effort data (raised to international effort) in both halves of the years 1976-83 (Table 5.2.1). Final selection of terminal F was such that the value for F per age group in the second half year which, with the F estimated from it for the first half year, gave the best correlation for both sets of half-yearly effort data. Estimates of F and stock size are given in Tables 5.3.8 and 5.3.9.

Fishing mortality in the first half of 1983 has remained close to the 1982 level, following a reduction from the 1981 level. Catches in the second half of 1983 increased slightly over the very low levels of 1982 and with it the assumed level of terminal fishing mortality. There has been no distinctive trend in stock size since the second half of 1980, and present levels appear to be close to those recorded throughout the 1970s.

VPA-catch at age data for the Shetland fishery is given in Table 5.3.10, and the resulting fishing mortalities and stock numbers are given in Tables 5.3.11 and 5.3.12. Since fishing mortality switches rather sharply from the 1-group and older in the first half of the year to the 0-group in the second half of the year, two separate plots of F against fishing effort are shown in Figure 5.3.2. These show some correlation between F on ages 1-4 and effort in the first half of the year over the period 1977-82. On this basis, the mortality rate on 1-group and older in 1983 appears to have decreased since 1982.

There is also some correlation between F on the 0-group and fishing effort in the second half of the year over the same period of years, and this indicates that the fishing mortality rate on this age group in 1983 remained at its recent level of around 0.7-0.8.

On the basis of this analysis, it appears that the 1981 and 1982 year classes were above average, while the 1983 year class may be a weak one.

5.4 Research Vessel Surveys

No relevant data were available for comparison with VPA results.

5.5 Weight at Age

Data for 1983 were provided by Denmark divided into the northern and southern areas (Table 5.5.1).

To calculate the effects of seasonal closures of the sandeel fisheries (Section 5.8), mean weights at age for different seasons of the year are required. In Table 5.5.2 are given the means of all the monthly mean values reported by the Working Group in previous reports, together with those for 1983. Since the few outlying values (presumably based on very few fish) might bias the means obtained, they were omitted.

To provide representative mean weights at age for the first and second halves of the year, the monthly means given in Table 5.5.2 were weighted by the numbers caught at age in the respective months in 1981 and 1982 (Table 5.5.3). Since these were to be used for Y/R calculations, growth curves were fitted by eye and smoothed values for the higher ages are also given in Table 5.5.3.

5.6 Percentage Landings in Weight by Age

Table 5.6.1 gives percentage weight of landings by age updated for 1983.

In the southern area, the contribution of the 2-group was exceptionally high (84%). In the northern area, the composition was similar to that of previous years except that the 3-group fish and older made a smaller contribution than in the previous three years.

At Shetland, 1-group sandeels made the largest contribution to the landings, and the 0-group was correspondingly reduced in importance to 25%.

5.7 Predation Mortality

The summed results of the VPAs for each assessment area were considered in general terms in the light of the preliminary results of the ICES Stomach Sampling Project. The numbers of sandeels estimated to have died naturally in 1981 by VPA are compared with the estimated numbers eaten by cod, whiting, saithe and mackerel in the text table below:

Age group	No. x 10^{-9} VPA	Stomach sampling**)	
0	74*	166	+379 eaten by whiting which have not been allocated to age
1	21	152	
2	7	2	
3	3	1	
4	+	-	
5	+	-	

*) Only in the period July-December.
**) Compiled from Daan (1983) and Gislason (1983).

The number of sandeels eaten by whiting is calculated from the number of whiting caught and the number eaten by other predators and not from stock numbers obtained from VPA.

These results are difficult to compare in detail, because over half the estimate of sandeels eaten have not been allocated to age. In addition, the numbers of sandeels estimated to have been eaten by whiting are probably conservative estimates, and it is known that sandeels are an important constituent in the diet of other predators. Despite these reservations, it is clear that the value of M of 0.5 year^{-1} used in the analyses is an underestimate at least for age groups 0 and 1. To examine this further, it will be necessary to allocate the sandeels eaten by whiting to age and, in particular, to divide the 0-group into those eaten in the first and second halves of the year since the VPA is carried backwards only to 1 July. Because of the provisional nature of the estimates, the Working Group made no adjustments to their estimates of fishing mortality and stock size; it was recognised, however, that the estimates of stock size and fishing mortality rate are almost certain to be under- and overestimates, respectively.

5.8 Yield per Recruit

In its 1983 report, the Working Group estimated the gains in yield per recruit to be expected, if exploitation of the 0-group was ended. ACFM subsequently advised that this could best be achieved by restricting the fishery to the first half of the year. Moreover, since a considerable proportion of the yield in the first half of the year comes from the 1-group, ACFM also advised that additional gains could be expected by delaying the start of the fishery until May to allow growth, thereby reducing the season to a two-month period.

Even if gains in Y/R can theoretically result from seasonal closures, the Working Group doubted if these gains could in fact be achieved because the landings in any month are limited by available outlets at least during the main part of the sandeel season. Indeed, concentration of the yield into a two- or three-month period could almost certainly result in a net loss in yield to the sandeel fisheries. It would further create fluctuations in the supply of fish, which could have the effect of transferring effort to other target species with larger by-catches.

To estimate the potential changes in yield if the fisheries in the second half of the year were closed, the Working Group calculated yield/recruit curves using the exploitation pattern in the years 1978-82. These are given in the text table below.

Mean values of F during the period 1978-82 from VPA

Age	Southern area		Northern area		Shetland	
	1st half	2nd half	1st half	2nd half	1st half	2nd half
0	0.01	0.23	0.00	0.46	0.01	0.60
1	0.45	0.09	0.49	0.11	0.51	0.17
2	0.77	0.15	1.07	0.12	0.52	0.12
3	0.90 Mean 0.84	0.25 Mean 0.14	1.26	0.06	0.40 Mean 0.47	0.09 Mean 0.11
4	0.93	0.12	0.83	0.05	0.38	0.07
5	0.72	0.07	0.56	0.02	0.55	0.11
6	0.90	0.24			0.85	0.06

Yield per recruit was calculated with and without the F values in the second half of the year, using weights at age given in Table 5.5.3. Separate calculations were made assuming a natural mortality rate of 0.5 and 1.0 year^{-1} on the 0-group, with 0.5 year^{-1} on all older ages. The results of these calculations are shown for different relative values of F in Figures 5.8.1 - 5.8.3. For present calculated levels of F, the effects of closing the fisheries in the second half if the year are given in the text table below.

Percentage change in Y/R at current levels of F
if exploitation in the second half of year is ended

	M on 0-group	
	0.5 $year^{-1}$	1.0 $year^{-1}$
Southern area	+7.7%	+5.7%
Northern area	+18.3%	+14.2%
Shetland	+4.3%	-1.6%

These estimates indicate that there might be marginal gains in the yield per recruit in the Southern and Shetland areas, with rather higher gains in the Northern area (because of the higher W_∞ in this area). The changes are also influenced by the level of M assumed for age 0 and 1 (see Section 5.7) and by the VPA results. In view of the uncertainty about the expected increases and in view also of the doubts about the likelihood of being able to benefit from them, the Working Group was of the opinion that there is no overriding reason for influencing the seasonality of the sandeel fisheries at current levels of stock size and recruitment.

The estimates of change in Y/R given above are lower than those given in the previous report. This is because the previous calculations took no account of the fact that there is some exploitation of the 0-group in the first half of the year, and of the older age groups in the second.

5.9 Catch Predictions

Since a variable proportion of the landings are formed by 0-group sandeels, it is not possible to make firm predictions of likely catches over the year as a whole in any of the sandeel fisheries. Accepting the results of the VPAs and also assuming that fishing mortalities and seasonal patterns of exploitation remain approximately constant, however, some rough guide to expected landings in 1984 can be given. These should, however, be treated with considerable caution. The Working Group has attempted this for the first time in order that such a procedure might be judged against events. They should not be used for management of these stocks.

Southern North Sea

Using mean values of F at age over the period 1980-83, catches in 1984 of 1-group and older are estimated to be 405 000 tonnes. To this might be added a further 5% of 0-group, giving a total of 425 000 tonnes.

Northern North Sea

Since the fishing mortality rate has dropped in this area in the past two years, the input level in 1983 was assumed to be carried over into 1984. In this case, the catch of 1-group and older in 1984 might be in the order of 130 000 tonnes. In the last four years, the 0-group has contributed 20% of the total, in which case the total landings in 1984 might be in the order of 160 000 tonnes.

Shetland

Prediction of catches in this area is rather uncertain because of the rather high contribution of 0-group to the weight landed in most years. Catches of 1-group and older are predicted to be 17 000 tonnes in 1984, and since the 0-group on average contributes 33% of the total, the total annual catch could be in the order of 25 000 tonnes, that is, rather lower than in the previous three years.

Total Estimate

If these predictions for each age have any validity, then the total North Sea catch of sandeels in 1984 might be in the order of 600 000 tonnes. Unless there is a change in effort, there is thus no reason to expect a major change in landings from recent years.

6. SPRAT IN DIVISION IIIa

6.1 Landings

Landings by area and country from 1969 to 1983 are shown in Table 6.1.1, which includes revised landing figures for 1982 and preliminary data for 1983. Reporting areas are shown in Figure 6.1.1. The decline in landings since 1980 continued in 1983 in the Skagerrak, where landings were about 8 000 tonnes lower than in 1982 while the Kattegat landings showed a slight increase of perhaps 2 000 tonnes. It should be noted that sampling of the industrial landings in the Kattegat has been insufficient in the past, and that 1983 is the first year in which some reliance can be placed upon the species composition. The major bias in the Kattegat figures in previous years would probably be a tendency to overestimate landings of sprat and underestimate the landings of young herring at least since 1976-77.

The landings by quarters are shown in Table 6.1.2, which shows a decline in the proportion taken in the third quarter as compared with earlier years; this may be an effect of a closure of the sprat fishery in July-September 1983.

6.2 Effort

There are still no data available on the industrial effort in Division IIIa.

6.3 Catch at Age and VPA

Numbers caught at age have been estimated since 1975, using Danish data raised to total catch excluding the fjords of western Norway (Division IVa East). Table 6.3.1 shows the array of data including an updating of 1982 and preliminary figures for 1983.

A VPA was not run due to the doubts about the accuracy of the sprat catches mentioned in Section 6.1.

For other input figures to a VPA, reference is made to last year's report (Anon., 1983a).

6.4 Research Vessel Surveys

Acoustic surveys

Acoustic surveys have been carried out in Division IIIa by Denmark, Norway and Sweden in 1976 and in 1979-83. The surveys were directed at herring and do not cover the shallow western part of the Kattegat, which is an important part of the distribution area, especially for the younger components of the sprat stock.

The sprat biomasses estimated from these surveys are shown in Table 6.4.1. The September survey form the longest time series with comparable data and indicates a continuous decline from 1979 to 1983, which is roughly in accordance with the development in landings. An evaluation of the possible use of these data could, however, not be undertaken during the Working Group meeting due to the lack of information on the age compositions of the estimated biomasses.

Trawl surveys

Recruitment indices of 1-group sprat obtained by Sweden in connection with IYFS since 1971 were re-calculated in accordance with the method applied to 1-group herring (Anon., 1979). While the old indices were calculated as the arithmetic mean of the geometric means of hauls within each of the 7 rectangles of the standard area, the new indices are calculated as the arithmetic mean of the arithmetic means of all rectangles sampled. Table 6.4.2 shows the two sets of indices together with the number of squares sampled.

It appears from both sets that the 1983 year class is rather strong as compared with the two previous year classes. The same indication is found in the landings of 0-group sprat in 1983 (Table 6.3.1), which compares with the very strong 1977 year class.

6.5-6.8 No new results were available, which made calculations of weight at age, weight percentage by age in the catches, other estimates of mortality or equilibrium yield, meaningful.

6.9 Prediction

A regression of yield in tonnes on 1-group indices for 1978-83 (in which period the GOV trawl has been standard gear) gives a coefficient of r = 0.77 and indicates a possible catch of 70 000 - 75 000 tonnes in 1984. The regression is shown in Figure 6.9.1.

7. NORTH SEA SPRAT

7.1 Landings

Landings of North Sea sprat by nations and by areas for the years 1974-83 are given in Table 7.1.1, and reporting areas are shown in Figure 6.1.1. The declining trend observed since 1979 is continued. Catches in 1983 were only 91 000 tonnes compared to 153 000 tonnes in 1982 and 209 000 tonnes in 1981. This trend is apparent in all areas (and was particularly evident in Division IVc). In Division IVb west, the catches in 1983 remained at a similar level to 1982, with catches in United Kingdom coastal waters remaining very low.

Sprat catches by months and by international reporting area (see Figure 6.1.1) for 1980-83 are given in Table 7.1.3. The usual fishing pattern is unchanged. Catches are made predominantly in Area 4 (Division IVb east) in July-October, with a lesser peak in January.

Division VIa

Landing data for 1983 were reported only by Scotland (Table 7.1.2). They show an increase in catches by Scottish vessels, largely as a result of the continued growth of a fishery in the Firth of Clyde, which accounted for 1 150 tonnes in 1983.

7.2 Effort Data

No effort data were available.

7.3 Catch at Age Data and VPA

7.3.1 Catch at age data

Sampling data were available for landings by Denmark, England, Norway and Scotland. Landings by other nations accounted for a minor part of the total.

Catch compositions by areas and quarters are given for 1982 and 1983 in Table 7.3.1. They indicate that in 1983 age group 1 contributed a major part of the catches in number in the third and fourth quarters, in Division IVb east, and in the fourth quarter in Division IVb west. Age group 2 accounts for a significant part of the fisheries during the first quarter.

7.3.2 VPA

Input catch at age data for quarterly VPA are given in Table 7.3.2. Due to the absence of a reliable abundance index series and effort data, trial VPAs on the range of years 1977-83 were carried out using a 'self-tuning' method as was done during previous meetings; terminal Fs in the fourth quarter of 1983 were adjusted according to the average for each age in the last quarter over the years 1979-81. No other attempt was made to modify the inputs to these preliminary VPAs.

The resulting fishing mortalities are given in Table 7.3.3, and the numbers at age and biomass in Table 7.3.4. (Results for 1974-76 are reproduced from last year's report and were not generated by the new VPA.)

Trends in fishing mortality, total stock and spawning stock biomass are shown in Figure 7.3.1.

7.4 Acoustic Survey

Acoustic surveys were carried out in the eastern part of Division IVb in December 1983 by Norway and in the western part of Divisions IVa and IVb in January 1984 by Scotland. Coverage was not adequate to make an estimate of the total North Sea biomass, but estimates for the main areas are compared with earlier estimates in Table 7.4.1. Estimates of sprat biomass for each half statistical rectangle surveyed are given in Figure 7.4.1. They were standardised to the target strength/length relationship recommended in the 1983 report of the Planning Group on an ICES-Coordinated Herring and Sprat Acoustic Survey (Anon., 1983c), i.e., $TS = -8.7 \log L - 19.6$ dB/kg, where L is in cm. The results of earlier surveys standardised to this target strength/length relationship were taken from Tables 5 and 6 in Johnson *et al.* (1983).

Owing to the provisional nature of the estimates of target strength used to analyse the results of these surveys, little reliance can be placed on the absolute value of the biomass estimates obtained. The surveys in the winter 1983-84, however, show no evidence of any change in the abundance of sprats in the western North Sea, and it can only be concluded that the sprat population in this area is still at a very low level. In Division IVb (east), the abundance of sprats older than the recruiting year class appeared to be higher than in 1981 and 1982, but no comparison is possible with 1983 since no survey was carried out in this area in early 1983.

Other research vessel surveys

Preliminary results were available from the International Young Fish Survey in February 1984. Table 7.4.2 shows an index of 525 for the new year class 1983. This index, however, is based on numbers of sprat < 10 cm which presumably contain a considerable number of 2 year olds. The index for the 1983 year class will thus be reduced when age/length keys for the 1984 IYFS become available. It is suggested that in future years the length class <9 cm will be used as a first approximation for the number of 1 year old sprat in the IYFS. No progress has yet been made in exchanging sprat data from IKMT (Isaac-Kidd mid-water trawl) catches during the IYFS prior to the Working Group meeting.

Table 7.4.2 and Figure 7.4.2 also show results from the Scottish midwater trawl survey in November 1983. Although the catches of 0- and 1-group sprat showed a slight increase over the previous year, it should be remembered that this survey covers only a limited part of the sprat distribution area, and that a relationship between the indices from this survey and sprat recruitment has not yet been demonstrated. Table 7.4.2 also presents catches of 1-group sprat from the commercial fisheries in order to continue this series.

7.5 Weights at Age

For the years prior to 1982 the values given in previous meeting reports were used. For 1982 and 1983, mean weights in the Danish catches were available by months and areas (Table 7.5.1). Quarterly weights in each area for each year were calculated using arithmetic means. Using quarterly catches in number in each area, weighted averages were computed to provide quarterly estimates on mean weights in the Danish catches for the whole North Sea. These values were adopted for weights in international catches and in the stock, except for an approximate value of 1 g given for age 0 in the first part of the year.

7.6 Age Composition by Weight

The contribution of each age group to the catches in weight is given in the text table below.

Percentage contribution of each age group to the landing weight

Year	Age groups						
	0	1	2	3	4	5	
1974-77	1.0	32.7	51.2	13.6	1.4	0.2	%
1978-81	0.5	56.0	29.9	12.4	1.3	+	%
1982	0.2	52.7	46.7	0.2	+	+	%
1983	0.6	54.5	33.3	10.0	1.5	+	%

The average for the years 1974-77 is taken from last year's report. For 1978-81, average quarterly weights at age in Danish catches in 1980 and 1981 are as given in the 1982 Working Group report and these were used together with quarterly catches in number (see Table 7.3.2) to produce average quarterly and annual catches in weight at age.

For 1982 and 1983, weights at age in Danish catches in each year were used in the same way.

The trends seen in previous reports is still apparent; age groups 1 and 2 contribute the largest part of the landings, up to 99% in 1982, and age groups 3 and older have decreased in the catch.

7.7 Predation Mortality

The results of the ICES Stomach Sampling Project 1981 allow for some considerations of the natural mortality of sprat in the North Sea. The text table below shows the VPA number per age group on 1 January 1981, the number dying naturally during 1981 according to VPA and the number eaten by cod, whiting, saithe and mackerel calculated on the basis of Daan (1983) and Gislason (1983). The number eaten by mackerel is assumed to be 0.2 x 10^9 0-groups, and none of the other age groups.

Age groups	Number in stock (N x 10^9) at 1 Jan. 1981 (VPA)	Number x 10^9 dying naturally during 1981 (VPA)	Number x 10^9 eaten in 1981
1	41	19.4	14.1
2	12	3.2	4.7
3	1.7	.4	.2

The number eaten fits quite well with the number dying naturally according to VPA. The M = .8 year^{-1} used in the VPA thus seems reasonable.

7.8 Equilibrium Yield

A logistic equilibrium yield has been calculated with the same method as that used in last year's report. Using Walter's first approximation, a regression line was fitted of biomasses at the 1st of January of any year t, as estimated in the preliminary VPA (see Table 7.3.4) on an index of fishing pressure being the ratio of landings during the previous season (July t-2, to March t-1) to biomass in mid-season (1 January t-1). This plot is given in Figure 7.8.1.

Equilibrium yields were then estimated for each season by multiplying each ordinate on the equilibrium line by the landing/biomass ratio for the same season. This gives the parabola plotted in Figure 7.8.2 (corrected for error in last year's report), together with the actual landings. On the basis of indications given by this figure, the high yield/biomass ratios observed in 1979-81 may have contributed to the decline in landings in recent years.

The conclusions given in the previous report remain valid. The expected maximum equilibrium yield is expected at a fishing pressure value close to natural mortality.

7.9 Catch Prognosis

An application of Shepherd's SHOT method was attempted to predict catches of North Sea sprat in 1984 (see Appendix A).

Using the figures of relative catch in weight at age given in Section 7.6, the 'hangover' factor for landings in any year t-1 was chosen to be approximately 0.5 in order to take due account of the catch composition of earlier years (for the most recent years, the coefficient would be closer to 0.4, but the final result is not changed).

For the coefficient correcting for recruitment levels, an approximate value of 0.13 was determined for use with the IYFS indices of age group 1 fish in Division IVb (R1) as given in Table 7.4.2. A preliminary predictor based on data from the years 1973-83 was not used, because this predictor tended to overestimate systematically the catch in the most recent years. Because of this, and because of a general inadequacy of the survey coverage in the earliest years, it was decided to base the predictor on data from 1976-83. No data were available for 1975.

Results for 1979 were excluded due to the inadequacy of the IYFS index for this year.

SHOT estimates of Y(t) were then obtained using the equation:

$$Y(t) = 0.5\ Y(t-1) + 0.13\ R1.$$

These are plotted against actual landings in Figure 7.9.1, where the diagonal (index = exact prediction of landings) is drawn for reference. It can be seen that the SHOT indices give some prediction of landings in past years.

Using the equation given above with landings and IYFS index in 1984, landings of 115 000 tonnes are predicted for 1984. Due to the biassed provisional IYFS estimate (see Section 7.4) this is an overestimate, and when the correct recruitment index becomes available, it should be re-calculated by ACFM. It should be carefully noted that this prediction for 1984 assumes the same level of fishing in 1984 as in 1983. Reductions in the level of fishing in 1984 would lead to approximately proportional reductions in this estimate.

7.10 State of the North Sea Sprat Stock

Figure 7.10.1 summarises trends in the catch and age composition of North Sea sprat in Divisions IVb (west) and IVb (east) since 1974. These two areas accounted for over 80% of the catches in the period and reflect the changes that have taken place. The fishery was based primarily on sprat in Division IVb (west) from the beginning of the period until 1977, but since then a greater proportion of the catch has been taken in Division IVb (east) with a predominance of 1-group fish. This change in emphasis reached a peak in 1979, and landings have declined steadily since then.

The basic fishery and population characteristics are summarised in Table 7.10.1. It is believed that the sprat population increased in the mid-1960s, but the stock biomass and recruitment estimates up to 1974 (given separately in Table 7.10.1.A) are less reliable than those since 1974 in Table 7.10.1.B. Since 1978-79, the catch has been greater than the estimated total biomass at the beginning of the year. The balance was drawn from the growth of fish in the stock and new recruits. Table 7.10.1.B also records a sharp decline in recruitment over the same years. In this situation, some decline in stock is not unexpected. The present relatively low level of both the total and the spawning stock biomass, therefore, appears to have arisen from the combined effects of previously high catches coupled with poor recruitment.

It is not possible to decide whether the recently low level of spawning stock of North Sea sprat has influenced recruitment itself. The stock may have declined primarily as a consequence of poor recruitment following adverse environmental conditions. Whatever is the cause, all the available evidence indicates the spawning of North Sea sprat is now relatively small. Recovery is heavily dependent on the occurrence of a new strong year class, and inspection of Table 7.10.1 suggests these may occur only once, and sometimes twice, in five years, but no one can forecast when. It is less obvious whether active management of the stock by a reduction in fishing to maintain or make a contribution towards an increase in stock size would be of material benefit. At these levels the stock may rapidly be changed by a factor of two, and if a given environmental circumstance permits a favourable level of survival, it is reasonable to expect that the resulting year class should also be raised by a factor of two. This could be of importance so there is an argument for a careful control of the fishery to prevent the stock from falling below its present level, and to ensure that any strong new year class can be used to rebuild the stock. It is especially plausible that the recent decline in sprat recruitment has been associated with increased predation by the recovering herring stocks - at least in the southeastern North Sea.

Whatever the merits of these possibilities, the fact is that the sprat stock is now at a relatively low level, and without wishing to draw too close a comparison with other pelagic stocks, the analogy with North Sea mackerel is obvious. The Mackerel Working Group (Anon., 1978) summarised the position as follows:

> "With the decline in the stock size resulting from previous recruit failure, the spawning stock (of North Sea mackerel) may be below the level required to produce a year class of reasonable strength".

This applies now to the North Sea sprat. It may be capable of generating a strong year class under especially favourable conditions, but the stock is small and it may take time. Until this happens, the North Sea sprat stock must remain a cause for serious concern.

Having regard for the biological arguments, the Working Group is not convinced that any benefit would follow a prohibition on sprat fishing; in its view it would be wiser to regulate the fishery at a lower level than that predicted by the SHOT method, which assumes fishing mortalities in 1984 to continue at the level of recent years, i.e., the situation calls for some restraint short of closure of the fishery.

8. CHANNEL SPRAT (ICES Divisions VIId,e)

8.1 The Fishery 1983/84

Table 8.1.1 shows the nominal catches for Divisions VIId,e in 1974-83. Egg surveys of earlier years have shown adult stocks to be widely distributed throughout Divisions VIId and VIIe at spawning time, with at least partial separation east and west of longitude 2°W. The only directed sprat fishery takes place in Lyme Bay (see Table 8.1.2), in the winter season, and in some years during the summer as well. In 1983-84, the winter fishery accounted for almost all of the estimated catch of 3 857 tonnes, compared to 6 612 tonnes in 1982, and over 10 000 tonnes in the two previous seasons. The relatively high catches 1979/80 - 1981/82 were associated with the strong 1978 year class and fishing activity connected with the Cornish mackerel fishery. The decline in catch in 1983/84 has arisen through reduced recruitment and the effect on fishing activity of the implementation of the closed area for mackerel and also as a result of anomalous distribution of sprat in this season. Fish were distributed very close inshore early in the season (November) and then dispersed (Table 8.1.2). Figure 8.1.1 shows the seasonal catches at Lyme Bay.

The relationship between the Lyme Bay sprat concentration and the Western Channel sprat as a whole is not known. It is assumed that the fishery depends on a proportion of the total stock which returns to Lyme Bay in successive seasons.

8.2 Fishing Effort Data

There is no time series of consistent fishing effort data, so the guideline to trends in the resource depends upon the age composition of the catches and the results of an acoustic survey.

8.3 Age Structure of the Exploited Population and VPA

The age composition of the catches in 1982/83 and 1983/84 (Table 8.3.1) shows changes from earlier years as the stronger year classes 1978/80 pass through the fishery. The relative age distribution of the sprat may also have been influenced by the apparently atypical seasonal distribution of the fishery - though this may itself be the result of weaker recruitment.

The results of VPA are dominated by the assumption M = 0.85 and the broad framework of parameter estimates is stable for a range of assumptions on the selection pattern and terminal F. The analysis has, therefore, been conducted with the assumption used by the Working Group in 1983, giving the estimates of fishing mortality in Table 8.3.2 and biomass, recruitment and numbers in the stock are summarised in Tables 8.3.3 and 8.3.4.

The variations in fishing mortality ($\bar{F}_c$ (Shepherd, 1983)) over the time series reflect the increase resulting from the activity of larger pelagic trawlers early in the season in the mid-1970s, and a second increase associated with the mackerel fishery around 1980. This was almost certainly attracted by the improved abundance of Lyme Bay sprat following the appearance of a series of stronger year classes, especially that of 1978. Evidently, this part of the West Channel sprat stock has now returned closer to the level of the mid-1970s.

8.4 Research Vessel Surveys

8.4.1 Acoustic survey

The English vessel R/V "Clione" conducted an acoustic survey of the Lyme Bay area in December 1983. This was hampered by adverse weather conditions and the pattern of the commercial fishing activity suggests that at that time the sprat were dispersing from the area where the fishery had taken place in November and early December. The survey did, however, cover the same area as in 1981. The estimate of acoustic biomass at 8 500 tonnes in 1983 is rather less than half the quantity estimated in 1981 (see Figure 8.4.1).

8.5 Weight at Age - Lyme Bay Fishery

The average weight at age 1983-84 has been added to the series in Table 8.5.1. The overall average weight in 1983/84 was somewhat less than in the same quarter of 1981/82 and 1982/83, but this arises from the lower average weight of 5 to 6 year olds. The average weight of age groups providing the majority of the catch was close to that recorded in the previous year.

8.6 Percentage Weight in the Catch

No percentages were calculated for this stock.

8.7 Other Mortality Estimates

No predation mortality estimates were available for this stock.

8.8 Equilibrium Yield

The data for Lyme Bay sprat, and especially the passage through the fishery of the strong year classes 1978-80, are sufficiently coherent to justify estimation of potential yield for this part of the stock. The present pattern of selection to the fishery gives an asymptotic potential yield curve with the estimated level of fishing mortality below $F_{0.1}$.

8.9 Prediction

The yield per recruit curve for Lyme Bay sprat indicates that the present level of exploitation has been below $F_{0.1}$, and bearing in mind that this constitutes only a part of the Western Channel sprat stock, and that the remainder is not exploited, the stock as a whole is evidently underexploited. The maximum recorded biomass in 1979-80 of about 70 000 tonnes (Table 8.3.4) corresponds to the lower end of the range 65 000 - 100 000 tonnes deduced from egg surveys for Division VIIe sprat as a whole in 1981, and it may be that in these years the Lyme Bay population represented the greater part of the stock. The long-term potential for the Division VIIe sprat at that level was estimated to be in the range of 20 000 - 42 000 tonnes.

Having regard for the apparent reduction in biomass of the Lyme Bay sprat population, as confirmed by the acoustic survey and the recently weaker year classes, it might be considered prudent to reduce the allowable catch below the long-term potential of 20 000 tonnes estimated previously and recommended by ACFM in 1983. The 1983/84 catch at 3 500 tonnes and the Y/R analysis indicate, however, that a modest increase in catch from the present level should not be expected to have a detrimental effect on the stock.

9. EVALUATION OF SAMPLING AND REPORTING PROCEDURES

9.1 Statistical Requirements

The Working Group considers that the statistical requirements set out in Section 7.1 of the 1982 report (Anon., 1982) remain in force.

At present, annual landings, weight, and catches at age are available to the Working Group, both for the target species and the major by-catch species. In most cases, data are also available by month or quarter and by sampling sub-areas.

9.2 Recommendations

The Working Group felt that because of the very restricted time available during the actual meeting, emphasis should be placed on items to be treated between meetings and presented as working papers at the following meeting.

Apart from the general items recommended in last year's report (see Section 9.3), the following specific tasks should be undertaken by different laboratories and the results presented at the 1985 meeting of the Working Group.

These tasks are:

1) Growth curves (weight and length) for different, well defined fishing grounds for sandeel. It is known that growth rate may vary considerably between grounds or banks in close proximity to each other. (Aberdeen Lab.: Shetland grounds; Charlottenlund: southern North Sea; Norway: northeastern North Sea. Mr Popp Madsen will coordinate this research).

2) Evaluation of the influence of the final results of the stomach contents investigation in 1981 upon assessment of industrial target species. (Charlottenlund and Lowestoft laboratories to confer on this, following the Multi-Species Working Group.)

3) By-catch problems. - Disaggregated catch details are required for the Norway pout fishery to further illuminate the by-catch problems (Charlottenlund, Bergen and Torshavn laboratories).

4) Environmental factors. - A study of factors which may affect sprat abundance, and factors which affect sandeel distribution. (All members of the Working Group to consider this problem.)

REFERENCES

Anon. 1978. Report of the Mackerel Working Group. ICES, Doc. C.M.1978/H:4.

Anon. 1979. Report of the Herring Assessment Working Group. ICES, Doc. C.M.1979/H:6.

Anon. 1982. Report of the Industrial Fisheries Working Group. ICES, Doc. C.M.1982/Assess:6.

Anon. 1983a. Report of the Industrial Fisheries Working Group. ICES, Doc. C.M.1983/Assess:7.

Anon. 1983b. Report of the North Sea Roundfish Working Group. ICES, Doc. C.M.1983/Assess:18.

Anon. 1983c. Report of the 1983 Planning Group on ICES-coordinated herring and sprat acoustic surveys. ICES, Doc. C.M.1983/H:12.

Anon. 1984. Reports of the ICES Advisory Committee on Fishery Management 1983. ICES, Coop.Res.Rep., No.128.

Armstrong et al. 1983. A preliminary report on the analysis of the whiting stomachs collected during 1981. ICES, Doc. C.M.1983/G:59.

Daan, N. 1983. Analysis of the cod samples collected during the 1981 Stomach Sampling Project. ICES, Doc. C.M.1983/G:61.

Gislason, H. 1983. A preliminary estimate of the yearly intake of fish by saithe in the North Sea. ICES, Doc. C.M.1983/G:52.

Johnson et al. 1983. Report on echo-integrator surveys for sprat undertaken in the North Sea during the 1982-83 winter season. ICES, Doc. C.M.1983/H:28.

Shepherd, J. 1983. Two measures of overall fishing mortality. J.Cons.int. Explor.Mer, 41(1).

Shepherd, J. 1984. Short-cut TACs. (working document).

APPENDIX A

THE SHEPHERD HANGOVER TAC (SHOT)

A new approach to catch forecasting developed by Shepherd (1983) was used to make predictions of the 1984 North Sea catches of Norway pout and sprat. This predicts catches in year t, Y(t) as

$$Y(t) = \alpha\, Y(t-1) + \beta\, R(t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where R(t) is an index of recruitment and α and β are coefficients. Both coefficients are strictly functions of fishing mortality but as a first approximation may be considered as constants on the assumption of constant fishing levels when fishing mortality predictors (e.g., fishing effort data) are unavailable. The rationale of Equation 1 is obviously that where fishing mortality remains the same, the current year's catch is a proportion α (<1.0) of the previous year's catch plus an increment due to recruitment. The coefficient α called the hangover factor could be calculated in a number of ways. The Working Group chose to make plausible guesses as to its value by setting it equal to the average proportion of annual catches supplied by fish aged 2 or older. The coefficient β can then either be estimated by regression or be estimated as

$$\beta = \left\{ \sum_{t=t_1}^{t_2} Y(t) - \alpha \sum_{t=t_1}^{t_2} Y(t-1) \right\} \Big/ \sum_{t=t_1}^{t_2} R(t) \quad \ldots\ldots \quad (2)$$

where t_1 and t_2 are the first and last years with data.

This formulation for β gives SHOT estimates for years y_1 to y_2, which have the same average value as the yield in these years. Estimated in this way, fortunately the predictions seem rather insensitive to the precise hangover factor adopted.

Table 2.1.1 Total industrial landings (tonnes x 10^{-3}) from the North Sea, 1974-1983.

YEAR	Target industrial species				By-catch for reduction[6]				TOTAL[4]
	Norway pout	Sandeel	Sprat	Sum	Blue whiting[1]	Protected species[2]	Herring[3]	Sum	
1974	735.8	524.8	313.6	1 574.2	62.2	220.4		282.6	1 856.8
1975	559.7	428.2	641.2	1 629.1	42.0	127.8		169.8	1 798.9
1976	435.4	487.6	621.5	1 544.5	36.0	198.0	12.0	246.0	1 790.5
1977	389.9	785.6	304.0	1 479.5	38.4	147.3	9.5	195.2	1 674.7
1978	270.1	786.8	378.3	1 435.2	99.9	67.6	7.8	175.3	1 610.5
1979	319.8	577.8	379.6	1 272.2	63.3	78.0	15.3	156.6	1 433.8
1980	470.4	728.5	323.4	1 522.3	75.1	71.3	7.3	153.7	1 676.0
1981	235.4	568.6	209.1	1 013.1	61.8	85.4	84.2	235.8	1 266.9
1982	359.0	610.9	152.7	1 122.6	106.6	59.0	152.9	318.5	1 441.1
1983[5]	421.3	536.5	91.2	1 049.0	88.9	39.3	154.5	282.7	1 331.7

1) C.M.1984/Assess:2
2) C.M.1983/Assess:16 and 18 (Haddock, whiting, saithe)
3) C.M.1983/Assess:9
4) Does not include other species which on an average range between 20 000 and 40 000 tonnes
5) Preliminary
6) By-catches do not include fish landed for human consumption

Table 3.1.1. Herring by-catch North Sea in tonnes by year and Division

Division	1977	1978	1979	1980	1981	1982	1983
IVa West	502	27	443	705	7 933	331	546
IVa East	186	-	2	48	-	491	574
IVb	8 790	7 545	14 882	6 008	75 533	150 357	153 361
IVc	-	223	1	494	702	1 699	11
Total	9 478	7 795	15 328	7 255	84 168	152 878	154 492

Table 3.1.2. Revised herring by-catch North Sea in numbers at age (million) for 1982

Winterrings	0	1	2	3	4	5	6	7	8+
Division IVa West	-	-	-	-	-	1	1	-	1
Division IVa East	-	2	5	-	-	-	-	-	-
Division IVb	9 575	898	62	3	-	-	-	-	-
Division IVc	-	10	8	8	-	-	-	-	-
Total	9 575	910	75	11	-	1	1	-	1

Table 3.2.1. Herring by-catch North Sea in numbers at age (million) for 1983

Winterrings	0	1	2	3	4	5	6	7	8+
Division IVa West	-	-	-	1	1	-	-	-	1
Division IVa East	-	1	5	-	-	-	-	-	-
Division IVb	10 029	915	81	3	-	-	-	-	-
Division IVc	1	-	-	-	-	-	-	-	-
Total	10 030	916	86	4	1				1

Table 3.4.1 Total reported by-catch (tonnes) of HADDOCK, WHITING SAITHE and BLUE WHITING for reduction purposes, 1975-1983[1]

Species	1975	1976	1977	1978	1979	1980	1981	1982	1983[2]
Haddock	41 380	48 204	34 993	9 659	17 414	25 154	17 615	20 980	15 056
Whiting	86 376	149 759	106 104	55 274	59 021	45 747	66 595	32 990	22 752
Saithe	37 678	66 766	6 197	2 566	1 635	363	1 280	5 003	1 445
Blue Whiting	41 955	36 024	38 389	99 874	63 333	75 129	61 754	106 560	88 888

1) C.M.1984/Assess:2, C.M.1983/Assess:16 and 18

2) Preliminary

Table 3.4.2 North Sea. Total industrial landings in tonnes (sandeel excluded) and estimated by-catches of HADDOCK and WHITING for 1982 and 1983. Sprat is also excluded from Norwegian and United Kingdom totals.

Area	Quarter I			Quarter II			Quarter III			Quarter IV		
1982	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting	Total ind.	Haddock	Whiting
S.-a. I-III	9 451	1 546	2 895	310	1		97 864	3 121	695	47 346	1 575	5 041
IV	37 060	3 674	4 632	7 675	946	677	21 812	772	105	39 852	904	1 067
Div. Va	18 706	1 078	1 692	45 525	1 738	280	78 986	3 640	1 046	37 293	398	510
Vb	15	1	4	532	31	99	45 291	56	595	17 458	21	105
S.-a VI	50 955	355	10 514	5 418	112	1 524	85 462		420	53 791		574
1983												
S.-a. I-III	27 910	2 239	2 438	9 206	264	81	64 425	1 558	553	75 413	1 689	2 507
IV	26 271	1 133	1 256	6 665	276	427	15 079	310	116	26 987	784	819
Div. Va	21 949	492	503	92 342	2 344	211	129 557	2 077	1 382	30 566	986	1 173
Vb	31	15	3	2 344	63		63 760	413	2 627	10 707	256	501
S.-a. VI	8 127		2 586	7 217		463	102 674	36	3 003	66 871	121	2 103

S.-a. = Sub-area

Table 3.4.3 North Sea. Species composition in Norwegian Norway POUT landings (tonnes) for reduction purposes, 1975-1983.

Year	Quarter	Landings	Norway Pout	Blue whiting	Cod	Haddock	Whiting	Saithe	Herring	Mackerel	Others
1975	1 - 4	297 222	218 900	40 210	1 188	9 840	13 243	4 330			9 511
1976	1 - 4	200 777	108 937	34 600	783	3 133	6 744	12 850			33 730
1977	1 - 4	143 001	98 291	20 737	661	920	2 707	4 390			15 300
1978	1 - 4	136 455	80 755	39 989	659	766	1 462	2 494			10 351
1979	1	24 504	17 087	4 971	153	298	1 032	179	2	3	995
	2	40 310	18 963	17 504	202	406	315	289		2	2 808
	3	33 602	23 856	6 584	98	625	132	309	1		2 178
	4	19 387	15 158	1 871	26	1 254	189	99		4	1 221
	1 - 4	117 803	75 046	30 930	479	2 583	1 659	876	3	9	7 202
1980	1	14 469	10 355	810	195	947	759	107			1 296
	2	36 896	18 281	13 623	207	1 414	312	130			2 929
	3	42 900	32 449	6 400	136	655	42	87			3 131
	4	13 794	8 375	1 129	12	902	86	18			3 272
	1 - 4	108 059	69 460	21 962	550	3 918	1 199	342			10 628
1981	1	8 565	6 996	363	58	102	359	75		1	611
	2	28 700	17 276	7 826	111	336	221	72		25	2 833
	3	30 127	19 790	6 135	64	841	69	1 024		12	2 192
	4	9 217	7 249	745	26	453	150	50		4	541
	1 - 4	76 609	51 311	15 069	259	1 731	799	1 221		42	6 177
1982	1	8 555	7 443	158	58	186	306	41			363
	2	48 017	33 502	9 731	135	948	59	176			3 466
	3	68 498	28 991	27 702	78	1 202	120	4 368			6 020
	4	30 191	17 408	10 019	11	288	180	418		17	1 867
	1 - 4	155 261	87 344	47 610	282	2 624	665	5 003		17	11 716
1983	1	8 631	5 773	1 592	71	138	168	303			586
	2	82 562	31 545	38 272	386	2 276	141	406		57	9 479
	3	74 000	44 949	19 963	254	949	133	603	3	19	7 127
	4	17 627	13 400	2 663	29	527	170	133			705
	1 - 4	182 820	95 667	62 490	740	3 890	612	1 455	3	76	17 897

Table 3.4.4 North Sea, species composition in Norwegian SANDEEL landings 1979-1983 (tonnes).

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

Table 3.4.5 By-catch landed for human consumption by Faroese Industrial Trawlers from ICES Division IVa. Target species Norway POUT-SANDEEL 1975-1983 (tonnes). Information from Vädihagtalsstovan.

	1975	1976	1977	1978	1979	1980	1981	1982	1983*
Total landings Ind. Trawlers	67 832	68 960	57 630	20 548	26 025	43 212	26 944	22 462	33 619
Landed for human consumption									
Cod	652	448	257	50	111	150	94	60	210
Haddock	82	85	45	12	7	27	29	15	111
Whiting	-	-	-	-	7	21	21	56	91
Ling	7	208	306	88	68	44	71	18	-
Monkfish	28	96	87	24	-	12	49	2	-
Saithe	287	425	318	213	407	1 020	417	672	896
Others	269	132	159	8	201	247	56	182	5
TOTAL	1 325	1 394	1 172	395	801	1 521	737	1 005	1 313

* Preliminary

Table 4.1.1 NORWAY POUT. Annual landings (in thousand tonnes) in Sub-area IV by countries North Sea 1957-83

Year	Denmark	Faroes	Norway	Sweden	UK (Scotland)	Others	Total
1957			0.2				0.2
1958							
1959	61.5		7.8				69.3
1960	17.2		13.5				30.7
1961	20.5		8.1				28.6
1962	121.8		27.9				149.7
1963	67.4		70.4				137.8
1964	10.4		51.0				61.4
1965	8.2		35.0				43.2
1966	35.2		17.8			+	53.0
1967	169.6		12.9			+	182.6
1968	410.8		40.9			+	451.8
1969	52.5	19.6	41.4			+	113.5
1970	142.1	32.0	63.5		0.2	0.2	238.0
1971	178.5	47.2	79.3		0.1	0.2	305.3
1972	259.6	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	51.2	63.0	2.9	13.0	0.6	345.9
1974	464.5	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	63.6	218.9	2.3	22.7	1.0	559.7
1976	244.9	64.6	108.9	+	17.3	1.7	435.4
1977	232.2	50.9	98.3	2.9	4.6	1.0	389.9
1978	163.4	19.7	80.8	0.7	5.5	-	270.1
1979	219.9	21.9	75.0		3.0		319.8
1980	366.2	34.1	69.5		0.6		470.4
1981	167.5	16.6	51.3		+		235.4
1982	256.3	15.4	87.3		0		359.0
1983*	301.1	24.5	95.7		+		421.3

*Preliminary

Table 4.1.2 NORWAY POUT. North Sea. National landings (tonnes) by months 1980-1983 (Denmark, Norway, United Kingdom (Scotland).

Month	Denmark	Norway	Faroes	UK (Scotland)	Total
1980					
Jan	14 792	4 962	2 299	193	22 246
Feb	18 620	3 459	3 534	315	25 928
Mar	11 653	1 934	2 010	-	15 597
Apr	7 233	2 103	158	8	9 502
May	7 853	8 004	2 249	-	18 106
Jun	3 114	8 174	2 104	-	13 392
Jul	55 385	8 673	3 001	-	67 059
Aug	66 255	10 492	2 325	-	79 072
Sep	71 144	13 284	7 846	87	92 361
Oct	60 474	1 340	3 976	-	65 790
Nov	28 749	6 248	3 279	-	38 276
Dec	20 938	787	1 282	-	23 077
Total	366 210	69 460	34 063	603	470 336
1981					
Jan	11 782	2 822	784		15 388
Feb	20 632	2 892	1 601		25 125
Mar	10 923	1 282	1 577	-	13 782
Apr	6 103	3 119	2 147	-	11 369
May	1 414	6 733	2 291	-	10 438
Jun	4 541	7 424	1 726	-	13 691
Jul	7 471	5 510	2 817	-	15 798
Aug	25 715	10 226	724	-	36 665
Sep	16 465	4 054	-	-	20 518
Oct	23 721	2 502	958	-	27 181
Nov	17 174	1 413	1 136	-	19 723
Dec	21 540	3 334	810	-	25 684
Total	167 481	51 311	16 573	0	235 365
1982					
Jan	13 072	3 968	223	-	17 263
Feb	12 998	1 769	641	-	15 408
Mar	12 117	1 706	1 379	-	15 202
Apr	10 162	6 028	1 098	-	17 288
May	542	7 705	1 068	-	9 315
Jun	0	19 769	1 160	-	20 929
Jul	32 488	10 984	2 225	-	45 697
Aug	38 939	8 708	1 891	-	49 538
Sep	66 734	9 299	1 608	-	77 641
Oct	25 223	8 104	2 072	-	35 399
Nov	23 888	4 943	1 330	-	30 161
Dec	20 060	4 361	675	-	25 096
Total	256 223	87 344	15 370	0	358 937
1983					1)
Jan	10 343	821		-	11 852
Feb	19 621	2 819		-	23 821
Mar	19 720	2 133		-	23 200
Apr	7 628	4 673		-	13 059
May	1 851	14 819		-	17 698
Jun	5 563	12 053		-	18 702
Jul	20 217	12 504		-	34 738
Aug	39 145	20 201		-	63 005
Sep	70 668	12 244		-	88 024
Oct	47 949	4 937		-	56 146
Nov	30 630	6 355		-	39 265
Dec	27 801	2 108		-	31 753
Total	301 136	95 667	24 463	0	421 266

1) Estimated, assuming Faroes catch is monthly distributed as the Danish and Norwegian catch.

Table 4.1.3 NORWAY POUT. Annual landings (tonnes) in Division VIa (For 1971-1982 data officially reported to ICES)

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983*)
Belgium	1	-	-	-	-	-	-	-	-	-	-	-	-
Denmark	363	186	42	-	193	-	-	4 443	15 609	13 070	2 877	751	530
Faroes	-	-	1 743	1 581	1 524	6 203	2 177	18 484	4 772	3 530	3 540	3 026	6 261
Germany, Fed.Rep.	-	-	-	179	-	8	-	-	-	-	-	-	-
Netherlands	-	-	-	-	322	147	230	21	98	68	182	548	3)
Norway	-	-	-	144 2)	-	82 2)	-	-	-	-	-	-	-
Poland	-	-	-	75	-	-	-	-	-	-	-	-	-
UK (Scotland) 1)	1 622	3 760	9 282	4 702	6 614	6 346	2 799	302	23	1 202	1 158	586	+
USSR	-	-	-	40	2	7 147	-	-	-	-	-	-	-
Total	1 986	3 946	11 067	6 721	8 655	19 933	5 206	23 250	20 502	17 870	7 757	1 885	

*) Preliminary 1) Amended using national data. 2) Including by-catch. 3) Data not available

Table 4.1.4 NORWAY POUT. Annual landings (tonnes) in Division IIIa (For 1971-1982 data officially reported to ICES)

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 3)
Denmark	25 800	17 259	23 152	10 669	15 666	40 144	20 694	23 922	23 951	26 235	29 273	51 023 4)	19 391
Faroes			643										
Norway	296			62*)	925*)	50*)	104	362	1 182	141	752	1 259	233
Sweden		1)	1)	1)	3 272	2 255	318	591 2)	32	39	60	103	51 5)
Total	26 096	17 259	23 795	10 731	19 863	42 449	21 116	24 875	25 165	26 415	30 085	52 385	19 675

1) Included in the North Sea. 2) Includes North Sea. 3) Preliminary. 4) Landings in foreign ports Jul-Dec not included.

5) Data from Data Form 5

*) Including by-catch

Table 4.2.1 Norway Pout. Catch per unit of effort, hectolitres per days fishing per mean GRT, by quarters in the Norwegian fishery.

QUARTER YEAR	1	2	3	4	Weighted mean all year	By-catch ex-cluded
1976	1.458	1.401	1.010	1.214	1.221	0.662
1977	1.299	1.346	1.304	1.413	1.346	0.925
1978	0.916	1.251	1.631	1.427	1.353	0.801
1979	1.192	1.276	1.512	1.656	1.364	0.869
1980	1.000	2.198	1.648	1.518	1.658	1.066
1981	1.050	1.383	1.120	1.032	1.186	0.794
1982	0.841	1.693	1.674	1.571	1.559	0.877
1983	1.454	1.677	1.441	1.569	1.566	0.900

Table 4.2.2 Faroese cpue data, industrial trawlers NORWAY POUT in ICES Division IVa and IVb (kg/hours).

Month	1978	1979	1980	1981	1982	1983*
January	1 389	1 830	1 543	2 005	1 109	2 625
February	932	1 207	1 755	1 104	1 384	1 575
March	896	1 207	1 478	1 210	1 839	1 384
April	670	1 061	1 523	1 204	1 777	1 493
May	1 110	885	1 978	1 308	1 553	2 356
June	1 052	1 542	2 508	1 015	1 755	1 990
July	784	1 178	1 576	1 294	2 301	1 363
August	1 242	1 331	2 387	1 051	2 571	2 298
September	3 007	2 495	2 807	-	2 297	2 227
October	2 215	2 139	2 648	1 663	2 297	2 176
November	1 915	2 003	1 993	1 387	2 346	2 105
December	2 168	2 455	2 222	1 496	2 003	1 250
Weight average/nom.	1 266	1 557	2 084	1 250	2 026	1 807
Total effort reported in Log books	11 300	6 660	9 918	11 256	7 287	3 192
Total catch reported Log books	14 307	10 375	20 673	14 072	14 777	5 511
Total landings	17 699	21 497	34 064	16 573	15 349*)	30 306

*)Preliminary

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

Year	Quarter	Age Groups 0	1	2	3	4
1974	1	-	13 450	414	26	1
	2	-	7 873	193	26	1
	3	846	9 966	489	145	-
	4	5 720	7 809	140	4	-
1975	1	-	3 742	1 726	13	-
	2	-	7 206	383	2	-
	3	889	7 117	349	-	-
	4	9 968	2 027	461	1	-
1976	1	-	4 950	589	91	-
	2	-	7 580	645	58	-
	3	197	5 349	590	2	-
	4	5 986	3 157	320	15	-
1977	1	-	9 171	950	33	3
	2	-	3 577	367	8	-
	3	61	3 580	861	45	-
	4	1 655	3 540	236	5	-
1978	1	-	2 931	1 371	93	4
	2	-	1 181	650	194	-
	3	304	2 385	786	30	-
	4	1 225	1 400	322	6	-
1979	1	-	5 079	940	170	3
	2	-	3 270	249	27	1
	3	968	4 243	763	49	-
	4	861	2 147	166	11	-
1980	1	-	5 025	1 072	59	2
	2	-	2 576	686	29	5
	3	24	7 709	1 959	18	-
	4	640	3 913	511	6	-
1981	1	-	2 223	1 688	76	6
	2	-	1 072	621	77	0
	3	76	1 309	944	17	1
	4	36 557	1 036	301	3	1
1982	1	-	5 264	415	216	0
	2	-	3 243	274	23	0
	3	151	6 563	429	62	0
	4	1 058	3 015	46	0	0
1983	1	-	3 945	1 221	14	0
	2	-	1 714	1 139	9	0
	3	420	5 485	1 477	16	1
	4	2 519	4 052	358	7	1

Not used in VPA

Table 4.3.2 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	0.2
	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	-	0.27	0.91	0.20	-
	4	0.02	0.26	0.86	0.12	-
1981	1		0.10	0.21	0.37	0.20
	2		0.08	0.14	1.09	
	3	-	0.16	0.42	1.09	
	4	0.25	0.24	0.29	0.85	
1982	1		0.06	0.17	0.45	0.20
	2		0.06	0.21	0.09	
	3	0.001	0.22	0.74	0.50	
	4	0.01	0.18	0.20	-	
1983	1		0.06	0.13	0.11	-
	2		0.04	0.21	0.11	
	3	0.003	0.24	0.59	0.37	
	4	0.024	0.35	0.35	0.35	

Table 4.3.3. NORWAY POUT. Quarterly VPA. Stock in number x 10^{-6}

		Age Groups				
Year	Quarter	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	131 525	10 898	1 101	41	
1979	1		87 168	6 173	480	23
	2		54 310	3 378	186	
	3	222 258	33 752	2 062	103	
	4	148 197	19 193	774	30	
1980	1		98 639	11 128	385	12
	2		62 042	6 591	211	
	3	63 253	39 496	3 862	118	
	4	42 381	20 261	1 042	65	
1981	1		27 889	10 426	295	39
	2		16 893	5 626	136	
	3	294 112	10 454	3 268	31	
	4	197 087	5 948	1 434	7	
1982	1		102 627	3 151	718	2
	2		64 521	1 777	308	
	3	173 921	40 618	970	188	
	4	116 460	21 927	309	-	
1983	1		77 205	12 261	170	-
	2		48 551	7 230	103	
	3	192 623	31 152	3 926	62	
	4	128 777	16 456	1 454	28	

Table 4.4.1 Recruitment indices of Norway POUT 1959-83 as shown by number per hour's fishing on research vessel surveys.

Year class	Abundance on pelagic 0-group surveys	Abundance in northwestern North Sea in Scottish autumn surveys		Abundance on international young fish surveys[1)]	
	Arithmetic mean	Geometric mean as		Arithmetic mean as	
	0-group	0-group	1-group	1-group	2-group
1959		-	106.8 (22)		
1960		10.9 (22)	28.1 (14)		
1961		59.6 (14)	181.7 (15)		
1962		25.0 (15)	141.8 (15)		
1963		8.5 (15)	6.6 (14)		
1964		14.0 (14)	18.6 (11)		
1965		1.2 (11)	6.1 (13)		
1966		16.4 (13)	-		
1967		-	243.2 (17)		
1968		4.5 (7)	-		6
1969		-	33.1 (4)	35	22
1970		101.7 (4)	111.7 (12)	1 556	653
1971	3 347 (26)	16.7 (12)	328.8 (22)	3 425	438
1972	545 (28)	36.3 (22)	16.6 (10)	4 207	399
1973	2 558 (28)	224.4 (10)	121.6 (22)	25 626	2 412
1974	3 237 (28)	84.4 (22)	9.5 (11)	4 242	385
1975	3 623 (28)	41.2 (11)	-	4 599	334
1976	10 884 (28)	-	131.5 (16)	4 813	1 215
1977	1 521 (28)	77.7 (16)	83.9 (34)	1 913	240
1978	2 974 (27)	144.3 (34)	-	2 690	611
1979	1 868 (27)	-	-	4 081	557
1980	500 (27)	-	18.7 (22)	1 375	403
1981	2 843 (27)	191.5 (22)	97.8 (29)	4 315	n/a
1982	970	36.1 (29)	47.7 (19)	2 612	n/a
1983	750 (27)	25.9 (19)		3 587	

NB. Number of statistical rectangles sampled shown in brackets

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

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

Year class	Groundfish survey August North Sea 0-group (entire North Sea)	Norway Pout survey - November			
		0-group (main Norway Pout distribution area)	1-group	2-group	3-group
1976	-				5
1977	1 387			222	82
1978	1 210		5 501	431	-
1979	1 607	6 449	4 519	123	36
1980	151	2 106	2 146	42	-
1981	1 770	23 946	7 166	1 935	
1982	1 817	19 567	7 603		
1983	1 501	21 852			

Table 4.5.1 NORWAY POUT. North Sea 1983.
Mean weight at age by quarters, Danish and Norwegian catch combined (grammes).

Quarters 1983	Age group				
	0	1	2	3	4
I	-	7.72	22.54	45.41	-
II	-	10.78	26.84	50.56	-
III	8.37	22.87	36.20	61.19	62.00
IV	6.18	26.73	40.14	66.62	67.00

Table 4.6.1 Norway POUT. North Sea. Quarterly and annual landings in weight by age as a percentage of the overall landings.

Year and Quarter	Age 0	1	2	3	4
1979					
I	0	11%	6%	2%	-
II	0	10%	2%	0.3%	0
III	1%	32%	10%	-	0
IV	2%	19%	3%	-	0
1979 Total	3%	72%	21%	3%	-
1980					
I	0	8%	4%	-	-
II	0	5%	3%	-	-
III	-	38%	17%	-	-
IV	1%	19%	4%	-	-
1980 Total	1%	70%	28%	1%	-
1981					
I	0	7%	16%	1%	-
II	0	6%	6%	1%	0
III	-	16%	16%	-	-
IV	10%	14%	6%	-	0
1981 Total	10%	43%	44%	3%	-
1982					
I	-	10%	3%	2%	
II		7%	1%	1%	
III	1%	42%	5%	1%	
IV	2%	24%	1%		
1982 Total	3	83%	10%	4%	-
1983 I	-	7%	6%	-	
II	-	4%	7%	-	
III	1%	29%	13%	-	
IV	4%	25%	3%		
1983 Total	5%	65%	29%	1%	-

Table 5.1.1 Landings of SANDEEL from the North Sea 1952- 83 in thousand tonnes.

Year	Denmark	Germany,Fed.Rep.	Faroes	Netherlands	Norway	Sweden	U.K.	Total
1952	1.6	0	0	0	-	0	0	1.6
1953	4.5	+	0	0	-	0	0	4.5
1954	10.8	+	0	0	-	0	0	10.8
1955	37.6	+	0	0	-	0	0	37.6
1956	81.9	5.3	0	+	1.5	0	0	88.7
1957	73.3	25.5	0	3.7	3.2	0	0	105.7
1958	74.4	20.2	0	1.5	4.8	0	0	100.9
1959	77.1	17.4	0	5.1	8.0	0	0	107.6
1960	100.8	7.7	0	+	12.1	0	0	120.6
1961	73.6	4.5	0	+	5.1	0	0	83.2
1962	97.4	1.4	0	0	10.5	0	0	109.3
1963	134.4	16.4	0	0	11.5	0	0	162.3
1964	104.7	12.9	0	0	10.4	0	0	128.0
1965	123.6	2.1	0	0	4.9	0	0	130.6
1966	138.5	4.4	0	0	0.2	0	0	143.1
1967	187.4	0.3	0	0	1.0	0	0	188.7
1968	193.6	+	0	0	0.1	0	0	193.7
1969	112.8	+	0	0	0	0	0.5	113.3
1970	187.8	+	0	0	+	0	3.6	191.4
1971	371.6	0.1	0	0	2.1	0	8.3	382.1
1972	329.0	+	0	0	18.6	8.8	2.1	358.5
1973	273.0	0	1.4	0	17.2	1.1	4.2	296.9
1974	424.1	0	6.4	0	78.6	0.2	15.5	524.8
1975	355.6	0	4.9	0	54.0	0.1	13.6	428.2
1976	424.7	0	-	0	44.2	-	18.7	487.6
1977	664.3	0	11.4	0	78.7	5.7	25.5	785.6
1978	647.5	0	12.1	0	93.5	1.2	32.5	786.8
1979	449.8	0	13.2	0	101.4	0	13.4	577.8
1980	542.2	0	7.2	0	144.8	0	34.3	728.5
1981	464.4	0	4.9	0	52.6	0	46.7	568.6
1982	506.9	0	4.9	0	46.5	0.4	52.2	610.9
1983	485.1	0	2.0	0	12.2	0.2	37.0	536.5

- = no information

+ = less than half unit

Table 5.1.2 SANDEEL. North Sea. Monthly landings (tonnes) by country 1980-83.

Year and Month		Denmark	Faroes	Norway	U.K. (Scotland)	Total
1980	Feb		68			68
	Mar	12 558	111	6 048		18 717
	Apr	31 228	735	7 103	2 060	41 126
	May	192 155	1 679	37 092	4 450	235 376
	Jun	214 867	3 566	61 603	10 877	290 913
	Jul	68 403	1 048	10 228	7 555	87 234
	Aug	10 290		2 849	5 311	18 450
	Sep	7 827		3 119	1 346	12 293
	Oct	4 863		16 055		20 918
	Nov			716		716
	Total	542 191	7 207	144 813	31 599	725 810
1981	Jan	4	-	-	-	4
	Feb	-	-	172	-	172
	Mar	8 758	268	4 731	-	13 757
	Apr	42 875	415	5 356	5 018	53 664
	May	120 410	439	27 179	7 430	155 458
	Jun	109 175	96	6 100	10 032	125 403
	Jul	118 130	1 300	5 575	10 403	135 408
	Aug	30 724	1 162	1 455	7 107	40 448
	Sep	16 836	1 181	-	5 968	23 985
	Oct	17 502	74	2 031	710	20 317
	Nov	-	-	-	-	-
	Total	464 414	4 935	52 599	46 668	568 616
1982	Jan	-	n/a	-	-	-
	Feb	-		-	-	-
	Mar	844		3 306	-	4 150
	Apr	83 948		8 895	5 953	98 796
	May	168 551		16 797	9 349	194 697
	Jun	188 963		17 516	10 011	216 490
	Jul	55 240		-	10 889	66 129
	Aug	7 310		-	8 017	15 327
	Sep	2 060		-	6 458	8 518
	Oct	-		-	1 329	1 329
	Nov	-		-	-	-
	Total	506 916	4 903	46 514	52 006	605 436 excl. Faroe
1983	Jan	-	n/a	-	-	-
	Feb	-		-	-	-
	Mar	-		210	-	210
	Apr	59 388		1 055	2 431	62 874
	May	162 952		6 363	7 477	176 792
	Jun	182 159		2 141	10 074	194 374
	Jul	59 709		2 410	8 397	70 516
	Aug	14 253		-	6 769	21 022
	Sep	5 089		-	1 729	6 818
	Oct	1 548		-	124	1 672
	Nov	3		-	-	3
	Dec	-		-	-	-
	Total	485 101	2 000	12 179	37 001	534 281

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

Year	Month	AREA 1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland
1979	Mar			351			682					
	Apr	11 476	49	3 602	2 067	1 130	1 536	534	4 090			906
	May	47 648	+	4 099	23 149	2 044	642	5 992	38 584	867	8 848	2 985
	Jun	119 632	281	12 556	4 316	5 886	333	7 978	24 277	1 645	21 598	3 907
	Jul	15 700	454	2 149	1 253	17 593	1 997	6 408	12 493	2 859	12 266	2 413
	Aug		143	14 883		86	63 574	7 043			11	2 518
	Sep			8 868	1 490	112	1 306	542			764	649
	Oct		+	14 455		173	2 262	5 630			764	26
	Nov							5				
	Total	194 456	927	60 963	32 275	27 024	72 332	34 132	79 444	5 371	44 251	13 404
1980	Mar	581		6 048	1 938	605	9 433				1	
	Apr	6 797	1 031	6 374	5 043	4 208	13 179		1 956			1 803
	May	108 561	821	30 256	27 870	21 595	808	20 477	10 676	991	8 422	3 219
	Jun	81 909	1 404	44 828	48 682	23 865	247	35 706	11 399	6 146	26 316	6 845
	Jul	17 249	74	9 140	5 978	2 079	102	18 076	6 812	1 516	18 240	6 920
	Aug			2 833		16		10 290				5 311
	Sep			3 100		19		5 213			2 617	1 346
	Oct			15 995			3 218	242			1 463	
	Nov			716								
	Total	215 097	3 330	119 290	89 511	52 387	26 987	90 004	30 843	8 653	57 059	25 444
1981	Feb	-	-	172	-	-	-	-	-	-	-	
	Mar	-	-	4 703	-	-	7 364	-	-	-	1 422	-
	Apr	18 116	-	5 257	4 535	-	9 132	4 863	2 238	678	3 412	5 019
	May	63 193	19	25 712	16 685	2 840	5 445	4 953	19 111	852	8 779	7 430
	Jun	22 388	1	4 631	8 477	990	1 699	15 475	27 018	11 184	23 429	10 016
	Jul	-	90	906	87 721	5 111	227	6 001	15 074	584	7 991	10 403
	Aug	-	-	1 455	8 304	-	-	22 420	-	-	-	7 107
	Sep	-	-	-	12 081	453	-	4 302	-	-	-	5 968
	Oct	1 466	-	-	14 063	2 310	-	1 596	-	-	98	710
	Nov	-	-	-	-	-	-	-	-	-	-	-
	Total	105 163	110	42 836	151 866	11 704	23 867	59 610	63 441	13 298	45 131	46 652
1982	Mar	-	-	502	844	2 130	674	-	-	-	-	-
	Apr	42 046	4 981	3 153	23 007	6 071	1 150	2 891	1 905	-	7 639	5 953
	May	67 920	34	139	67 822	14 837	370	20 265	2 066	-	11 895	9 349
	Jun	73 654	349	586	31 521	756	139	3 278	41 203	5 916	49 077	10 011
	Jul	6 167	-	-	8 901	1 058	-	2 124	30 512	956	5 522	10 889
	Aug	-	-	-	-	-	-	6 742	-	-	568	8 017
	Sep	-	-	-	-	-	-	2 060	-	-	-	6 456
	Oct	-	-	-	-	-	-	-	-	-	-	1 329
	Nov	-	-	-	-	-	-	-	-	-	-	-
	Total	189 787	5 364	4 380	132 095	24 852	2 333	37 360	75 686	6 872	74 701	52 006
1983	Mar	-	-	186	-	24	-	-	-	-	-	-
	Apr	32 375	-	465	6 059	2 325	-	17 427	1 439	-	353	2 431
	May	111 701	-	627	16 287	8 588	-	11 015	7 378	-	13 719	7 477
	Jun	50 096	-	1 571	16 667	4 395	-	7 892	57 004	-	46 675	10 074
	Jul	3 265	-	-	20 359	2 410	-	3 520	21 756	8 000	2 809	8 397
	Aug	-	-	-	-	-	-	11 245	-	-	3 008	6 769
	Sep	-	-	-	-	-	-	5 018	-	-	71	1 729
	Oct	-	-	-	-	-	-	1 548	-	-	-	124
	Nov	-	-	-	3	-	-	-	-	-	-	-
	Total	197 437	-	2 849	59 375	17 742	-	57 665	87 577	8 000	66 635	37 001

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*	
	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	0	2.8	59.4	17.7	0	57.7	87.6	8.0	66.6	37.0	78.2	419.0

* 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 1974-1983 as officially reported to ICES

Country \ Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Denmark							109			
Norway			17	54						
UK(Scotland)	+	+	+	13	+		211	5 972	10 873	13 051

Table 5.1.6 SANDEEL, Division IIIa
Landings in tonnes as officially reported to ICES

Country	YEAR												
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983**
Denmark	21 567	7 919	9 878	7 912	16 421	21 418	16 082	21 731	33 305	39 357	59 408	21 540	34 286*
Faroes								2					
Sweden		1)	1)	1)	79	67	432	1 121 2)	3	9	44	5	0

1) Included in the North Sea
2) Includes North Sea
* Final data for Denmark not yet available
** Preliminary

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

YEAR	Fishing Days by 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
2nd half of year						
1976	119	165.5	19.7	2.0	44.9	442.3
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	0	-	-	-	12.0	-
1983	66	208.0	13.7	2.4	23.7	133.1
Southern assessment area - all year						
1976	1 488	237.8	353.8	30.7	330.6	3 808
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

Table 5.2.2 Fishing effort (hours fishing) by month and year in the Shetland SANDEEL fishery, 1975-1983. UK (Scotland) data.

Month \ Year	1975	1976	1977	1978	1979	1980	1981	1982	1983
January	35								
February	20								
March	298	36	436	234					
April	725	1 175	1 209	654	308	626	1 457	1 153	485
May	868	1 203	1 408	2 030	990	886	2 069	2 523	1 477
June	989	2 043	1 893	1 859	1 027	1 832	2 387	2 497	2 187
July	1 724	2 632	1 673	1 350	693	1 647	2 277	2 240	1 960
August	2 333	2 023	947	1 683	760	1 192	1 652	1 928	2 228
September	730	670	528	1 473	340	395	1 062	1 695	1 013
October	186	484	212	934	9		135	357	82
November		245							
December									
Total	7 908	10 511	8 306	10 217	4 127	6 578	11 039	12 393	9 432

Table 5.3.1 SANDEELS. No. caught x 10^{-6}.
Southern area of the North Sea 1983.

Month	AGE GROUP									
	0	1	2	3	4	5	6	7	8	
Jan.	-	-	-	-	-	-	-	-	-	
Feb.	-	-	-	-	-	-	-	-	-	
Mar.	-	-	-	-	-	-	-	-	-	
Apr.	-	109.8	5119.4	71.7	-	-	-	-	-	
May	-	516.1	15375.9	387.1	73.7	43.9	13.5	-	-	
Jun.	955.4	1605.7	14533.4	475.2	160.4	77.7	11.1	-	5.6	
Jul.	9271.3	239.8	2806.3	281.3	1.7	-	-	-	-	
Aug.	-	-	-	231.4	-	-	-	-	-	
Sep.	26.2	-	-	-	-	-	-	-	-	
Oct.	-	-	-	-	-	-	-	-	-	
Nov.	-	-	-	-	-	-	-	-	-	
Dec.	-	-	-	-	-	-	-	-	-	
Σ	10252.9	2471.4	37835.0	1446.7	235.8	121.6	24.6	-	3.7	52393.6

Table 5.3.2 SANDEELS. No. caught x 10^{-6}.
Northern area of the North Sea 1983.

Month	AGE GROUP							
	0	1	2	3	4	5	6	
Jan.	-	-	-	-	-	-	-	
Feb.	-	-	-	-	-	-	-	
Mar.	-	7.9	7.4	0.5	0.1	-	-	
Apr.	-	3652.5	59.6	6.3	0.8	-	-	
May	-	1680.3	298.7	43.2	4.3	-	3.7	
Jun.	-	343.4	849.6	39.0	3.0	-	-	
Jul.	-	303.3	315.7	18.6	-	-	-	
Aug.	5471.6	-	-	-	-	-	-	
Sep.	1864.5	-	-	-	-	-	-	
Oct.	575.2	-	-	-	-	-	-	
Nov.	-	-	-	-	-	-	-	
Dec.	-	-	-	-	-	-	-	
Σ	7911.3	5987.4	1531.0	107.6	8.2	-	3.7	15549.2

Table 5.3.3 SANDEELS - Shetland. No. caught x 10^{-6} 1983.

Month	AGE GROUP								
	0	1	2	3	4	5	6	7	8
Apr.	0.1	423.8	97.1	35.0	11.6	4.6	3.0	0.6	0.2
May	0.4	1303.3	298.5	107.7	35.7	14.0	9.1	1.7	0.8
Jun.	591.9	1186.4	265.1	56.0	37.5	4.8	1.9	2.1	-
Jul.	2582.1	619.0	54.3	14.4	9.3	2.3	0.8	0.3	0.5
Aug.	892.0	373.7	62.5	13.3	7.7	3.4	+	-	+
Sep.	558.7	39.9	3.7	0.3	0.1	-	-	-	-
Oct.	39.9	2.8	0.3	+	+	-	-	-	-
Σ	4665.1	3949.5	781.4	226.8	101.9	29.2	14.7	5.0	1.5

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

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

Year / Age Group	1978		1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2	1	2
0	922	41 224	181	1 947	62	72	415	43 420	242	5 039	955	9 298
1	58 839	2 774	16 018	5 210	33 269	4 738	13 394	407	56 545	4 718	2 232	240
2	16 948	385	22 737	2 085	12 472	840	11 719	1 892	6 224	490	35 029	2 806
3	1 793	125	4 487	138	3 794	575	2 466	115	3 277	344	934	513
4	1 006	97	1 265	110	375	9	774	36	1 813	36	234	2
5	114	26	441	30	63	0	353	3	94	4	122	0
6	21	26	244	0	50	0	84	0	24	0	25	0
7	14	7	3	0	0	0	16	0	8	0	0	0
8	26	-	32	-	0	-	5	-	0	-	6	-
Total	79 684	44 665	45 409	9 520	50 086	6 234	29 226	45 873	68 227	10 631	39 537	12 859

Table 5.3 5 SANDEELS in the southern North Sea. VPA. Fishing mortalities per half-year, $M = 0.5\ year^{-1}$

Year / Age Group	1972		1973		1974		1975		1976		1977	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0	0	0	0	0.006	0.001	0	0	0	0	0	0.08
1	0.15	0.007	0.45	0.01	0.27	0.02	0.19	0.01	0.53	0.01	0.35	0.008
2	0.57	0.08	0.28	0.009	0.30	0.001	0.16	0.14	0.56	0.17	0.52	0.004
3	0.15	0.02	0.41	0.03	0.11	0.000	0.54	0.06	0.34	0.15	0.99	0.003
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
5	0.50	0.16	0.96	0.06	0.29	0.000	0.57	0.00	0.18	0.03	1.56	0.03
6	0.04	0.00	0.54	0.05	1.17	0.000	0.28	0.00	0.15	0.18	0.65	0.01
7	0.01	0.00	0.02	0.002	0.56	0.000	(0.50)	-	0.004	0.13	0.76	0.00
8	(0.50)	-	(0.50)	-	(0.50)	-	(0.50)	-	-	-	(0.50)	-
Weighted Mean 1-4	0.41	0.04	0.41	0.01	0.29	0.008	0.21	0.04	0.54	0.09	0.45	0.007

Year / Age Group	1978		1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0.006	0.41	0.001	0.02	0.001	0.001	0.001	0.17	0.02	0.54	0.008	(0.10)
1	0.66	0.06	0.30	0.16	0.60	0.16	0.34	0.02	0.37	0.05	0.52	(0.10)
2	0.92	0.05	0.99	0.23	0.72	0.10	0.92	0.31	0.38	0.05	0.65	(0.10)
3	0.44	0.05	1.15	0.09	0.89	0.33	0.48	0.04	1.56	0.72	0.13	(0.10)
4	0.60	0.11	1.12	0.27	0.40	0.02	1.10	0.13	1.43	0.09	2.23	(0.10)
5	0.21	0.07	1.06	0.18	0.25	0.00	1.46	0.04	0.62	0.05	(0.50)	-
6	0.38	1.22	2.06	0.00	0.56	0.00	0.99	0.00	(0.50)	-	(0.50)	-
7	0.09	0.06	(0.50)	-	0.005	0.00	(0.50)	-	0.31	0.00	-	-
8	(0.50)	-	(0.50)	-	-	-	(0.50)	-	-	-	(0.60)	-
Weighted Mean 1-4	0.70	0.06	0.60	0.17	0.64	0.16	0.50	0.08	0.40	0.05	0.60	(0.10)

Table 5.3.6 SANDEELS in the southern North Sea. VPA. Stock size in numbers x 10^{-6}

Year / Age Group	1972		1973		1974		1975		1976		1977	
	1	2	1	2	1	2	1	2	1	2	1	2
0	-	57 140	-	36 845	-	97 826	-	56 788	-	94 851	-	189 030
1	22 390	14 946	44 501	22 016	28 695	17 106	76 120	49 236	44 227	20 246	73 870	40 491
2	40 318	17 747	11 565	6 806	16 965	9 774	13 123	8 734	37 923	16 913	15 549	7 236
3	3 372	2 260	12 812	6 634	5 254	3 655	7 604	3 452	5 884	3 252	11 104	3 213
4	441	232	1 729	1 186	5 033	2 208	2 847	1 754	2 538	908	2 189	867
5	264	124	160	48	920	537	1 717	758	1 144	741	618	101
6	603	452	83	38	35	8	418	246	591	396	560	228
7	254	195	352	268	28	12	7	0	192	149	258	94
8	82	-	152	-	208	-	10	-	0	-	101	-

Year / Age group	1978		1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2	1	2
0	-	136 218	-	107 920	-	67 345	-	312 213	-	13 526	-	110 199
1	135 562	54 485	70 110	40 589	82 336	35 198	52 385	29 090	205 068	110 316	6 148	2 844
2	31 297	9 733	39 996	11 534	27 039	10 242	23 256	7 969	22 297	11 929	81 766	33 256
3	5 612	2 806	7 241	1 781	7 156	2 294	7 238	3 488	4 551	748	8 860	6 080
4	2 495	1 068	2 076	528	1 266	658	1 283	333	2 615	486	284	24
5	668	420	747	202	315	190	504	91	228	96	347	0
6	76	41	304	30	131	58	148	43	68	0	71	0
7	175	125	9	0	24	18	45	0	33	19	0	0
8	73	-	91	-	0	-	14	-	0	-	15	-

Table 5.3.7 SANDEELS in the northern North Sea (Shetland excluded). VPA, catch in numbers, half-year (x 10^{-6})

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

Year / Age Group	1978 Jan-Jun	1978 Jul-Dec	1979 Jan-Jun	1979 Jul-Dec	1980 Jan-Jun	1980 Jul-Dec	1981 Jan-Jun	1981 Jul-Dec	1982 Jan-Jun	1982 Jul-Dec	1983 Jan-Jun	1983 Jul-Dec
0	0	7 820	0	44 203	17	8 349	17	9 128	2	6 530	0	7 911
1	6 127	1 001	2 335	1 310	13 394	1 173	5 505	346	3 518	65	5 684	303
2	2 338	307	1 328	433	8 865	214	4 109	94	2 132	0	1 215	316
3	573	39	242	66	1 050	19	904	14	556	0	89	19
4	78	1	5	10	645	4	128	6	76	0	8	0
5	45	1	2	0	144	3	19	0	9	0	0	0
6	21	0	5	0	38	1	27	0	0	0	4	0
Total	9 181	9 169	3 917	46 022	24 155	9 762	10 709	9 588	6 293	6 595	7 000	8 549

Table 5.3.8 SANDEELS in the northern North Sea (Shetland excluded). VPA. Fishing mortalities per half-year. M = 0.5 $year^{-1}$. Weighted mean F ages 1-4.

Year / Age Group	1972		1973		1974		1975		1976		1977	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0	0.27	0	0.008	0.01	0.48	0.003	0.37	0.004	0.12	0.13	0.16
1	0.31	0.12	0.40	0.02	0.90	0.04	0.82	0.02	0.44	0.08	1.08	0.36
2	0.54	0.00	0.40	0.03	0.33	0.02	1.09	0.05	0.42	0.05	0.52	0.42
3	0.26	0.00	0.66	0.03	1.21	0.02	1.26	0.003	0.35	0.58	0.52	0.28
4	0.56	0.00	0.48	0.00	0.73	0.04	1.18	0.00	0.34	0.10	0.42	0.75
5	3.37	0.00	2.07	0.19	1.68	(0.50)	0.86	0.00	0.88	0.65	0.13	0.34
6	(0.50)	-	(0.50)	-	(0.50)	-	-	-	(0.50)	-	(0.50)	-
Mean 1-4	0.37	0.09	0.42	0.02	0.84	0.04	0.96	0.03	0.43	0.11	0.94	0.37

Year / Age Group	1978		1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0	0.24	0	0.90	0.001	0.47	0	0.35	0.23	0.34	0	(0.18)
1	0.57	0.18	0.11	0.09	0.85	0.17	0.71	0.09	1.25	0.006	0.61	(0.06)
2	0.60	0.15	0.40	0.22	1.56	0.13	1.57	0.12	2.83		0.16	(0.06)
3	0.55	0.07	0.18	0.07	1.45	0.08	1.29	0.05	0.50		0.19	(0.06)
4	0.26	0.003	0.01	0.03	2.13	0.06	1.25	0.17	0.43		0.50	
5	1.06	0.07	0.01	0.00	0.80	0.03	(0.50)					
6	(0.50)	-	(0.50)		(0.50)		(0.50)					
Mean 1-4	0.56	0.16	0.15	0.10	1.11	0.16	1.01	0.09	0.44	0.01	0.42	(0.06)

Table 5.3.9 SANDEELS in the northern North Sea (Shetland excluded)

VPA. Stock size in numbers x 10^{-6}

Year / Age Group	1972		1973		1974		1975		1976		1977	
	1	2	1	2	1	2	1	2	1	2	1	2
0	-	23 093	-	47 908	-	29 438	-	33 457	-	59 018	-	23 833
1	14 349	8 203	13 670	7 104	37 014	11 674	14 229	4 862	17 949	9 009	40 585	10 680
2	5 485	2 492	5 646	2 951	5 407	3 034	8 754	2 298	3 722	1 912	6 447	2 974
3	560	336	1 941	785	2 238	520	2 316	510	1 697	933	1 416	653
4	207	92	262	126	594	223	395	94	396	220	406	208
5	68	2	72	7	98	14	167	55	74	24	155	106
6	172	-	1	-	5	-	0	-	43	-	10	-

Year / Age Group	1978		1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2	1	2
0	-	40 618		82 358		24 835		34 942		25 157		(54 074)
1	15 871	7 029	24 785	17 252	25 944	8 619	12 065	4 621	19 275	11 929	13 885	(5 873)
2	5 822	2 502	4 597	2 421	12 285	2 003	5 684	921	3 296	736	9 233	(6 125)
3	1 519	685	1 679	1 095	1 506	275	1 372	293	634	29	573	(368)
4	384	231	499	385	795	74	197	44	216		23	
5	76	21	179	138	291	102	54		29			
6	59											

Table 5.3.10 SANDEELS in the Shetland area.
VPA. Catch in numbers, half year x 10^{-6}.

Age group	1974		1975		1976		1977		1978	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
0	0	953	0	36	86	4 486	464	5 644	99	5 430
1	6	834	117	4 256	1 690	527	2 830	525	4 406	651
2	53	34	552	63	294	152	664	153	1 020	168
3	11	14	79	39	115	40	40	12	71	46
4	7	20	12	13	13	15	44	26	21	7
5	5	0	7	0	11	3	6	2	20	3
6	+	1	4	3	4	2	7	1	3	0
7	6	0	2	0	2	0	3	+	+	0
8	0	-	2	-	+	-	+	-	1	-

Age group	1979		1980		1981		1982		1983	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
0	0	1 310	77	7 134	105	13 605	717	16 283	592	4 073
1	1 488	480	569	242	1 917	568	5 216	416	2 914	1 035
2	388	137	368	104	1 424	92	1 184	77	661	121
3	68	22	273	29	399	28	494	35	199	28
4	12	14	96	13	113	6	190	9	85	17
5	8	7	80	6	53	3	86	6	23	6
6	2	0	37	+	26	+	26	1	14	+
7	1	0	14	0	3	+	9	+	4	+
8	0	-	0	-	3	-	10	-	1	-

Table 5.3.11 SANDEELS in the Shetland area.
VPA. Fishing mortalities per half-year. $M = 0.5$ year $^{-1}$.

Age group	1974		1975		1976		1977		1978	
	1	2	1	2	1	2	1	2	1	2
0	0	0.10	0	0.005	0.005	0.40	0.02	0.42	0.006	0.57
1	0.002	0.33	0.02	1.39	0.37	0.20	0.50	0.17	0.73	0.23
2	0.11	0.11	0.40	0.08	0.32	0.29	0.44	0.18	0.61	0.20
3	0.07	0.12	0.40	0.37	0.20	0.11	0.12	0.05	0.12	0.12
4	0.08	0.38	0.14	0.26	0.21	0.44	0.17	0.15	0.13	0.06
5	0.18	0.00	0.25	0.00	0.38	0.20	0.34	0.19	0.18	0.04
6	0.04	0.14	0.31	0.46	0.34	0.22	0.85	0.43	0.42	0.00
7	(0.50)	-	(0.50)	-	(0.50)	-	0.73	(0.5)	(0.50)	-
Weighted mean 1-4	0.02		0.10		0.35		0.46		0.66	

Age group	1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2
0	0	0.16	0.004	0.67	0.003	0.82	0.02	0.80	0.06	(0.75)
1	0.32	0.17	0.10	0.06	0.40	0.21	0.99	0.19	0.33	(0.20)
2	0.22	0.12	0.20	0.08	0.65	0.08	0.94	0.14	0.57	(0.20)
3	0.12	0.06	0.39	0.07	0.55	0.07	0.82	0.13	0.69	(0.20)
4	0.04	0.07	0.37	0.08	0.43	0.04	0.95	0.11	0.53	(0.20)
5	0.09	0.12	0.72	0.10	0.59	0.06	1.15	0.21	0.46	(0.20)
6	0.04	0.00	1.70	0.15	0.97	0.03	1.14	0.12	1.23	(0.20)
7	(0.50)	-	(0.50)	-	1.18	(0.50)	2.25	(0.50)	1.11	(0.20)
Weighted mean 1-4	0.27		0.16		0.49		0.97		0.37	

Table 5.3.12 SANDEELS in the Shetland area.
VPA. Stock size in numbers x 10^{-6}.

Age group	1974		1975		1976		1977		1978	
	1	2	1	2	1	2	1	2	1	2
0	14 768	11 502	10 081	7 851	19 832	15 369	24 266	18 490	18 040	13 963
1	4 293	3 337	8 120	6 221	6 083	3 261	8 053	3 806	9 475	3 559
2	552	384	1 870	975	1 202	679	2 078	1 040	2 504	1 064
3	193	140	269	140	704	447	395	272	676	464
4	97	70	97	65	75	48	313	205	201	138
5	34	22	37	22	39	21	24	13	137	89
6	13	10	17	10	17	10	13	4	9	4
7	18	0	7	0	5	0	6	2	2	0

Age group	1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2
0	12 603	9 816	21 060	16 334	34 671	26 910	43 058	32 903	11 699	8 591
1	6 151	3 489	6 495	4 559	6 527	3 409	9 182	2 652	11 525	6 429
2	2 202	1 375	2 296	1 465	3 338	1 363	2 157	658	1 701	750
3	681	471	951	502	1 049	470	981	337	445	174
4	321	239	347	186	365	186	342	102	231	106
5	102	72	174	66	134	58	139	34	72	35
6	67	50	50	7	47	14	42	11	22	5
7	3	0	39	0	5	1	10	1	7	2

Table 5.5.1 SANDEEL - North Sea. Mean weight (g) at age by months in Danish catches, 1983.

Age	April	May	June	July	August	September
Northern Area						
0					2.06(127)	2.69(107)
1	5.32(142)	7.55(386)	9.55(109)	5.00		
2		16.68(42)	14.25(278)	22.08		
3		33.50(7)	37.50(2)	11.47		
4		33.00(1)	40.00			
5						
6		60.00(1)				
Southern Area						
0			1.95(155)	2.05(480)	2.06	2.69
1	3.60(31)	8.08(131)	8.11(441)	7.66(105)		
2	7.14(1483)	9.57(3039)	9.73(2286)	11.40(699)		
3	14.28(21)	16.60(101)	18.26(146)	12.58(154)	13.00(1)	
4		19.32(20)	18.99(56)	12.93(1)		
5		16.54(13)	19.65(28)			
6		19.15(4)	30.33(4)			
7						
8			18.50(1)			
9						
10			17.50(1)			

Table 5.5.2. SANDEEL.
Mean weight at age by months. (Arithmetic mean of mean values reported to Working Group from 1974-83, excluding outlying values.)

	Month	Age 0	1	2	3	4	5	6	7	8
Northern Area	Mar	-	4.06	10.69	20.02	28.78	30.20	18.50	-	-
	Apr	-	4.15	10.94	19.98	35.49	35.16	26.50	-	-
	May	1.31	7.02	14.98	28.46	38.34	43.46	45.40	-	-
	Jun	1.35	9.64	19.23	36.94	49.47	56.80	59.30	-	62.00
	Jul	2.46	11.67	27.55	36.20	57.20	48.75	51.82	-	-
	Aug	3.13	17.06	36.39	56.20	63.48	75.50	81.00	-	-
	Sep	3.38	21.24	37.45	58.04	64.15	73.00	-	-	-
	Oct	3.97	20.58	34.98	48.40	67.00	-	-	-	-
	Nov	7.07	28.00	-	-	-	-	-	-	-
Southern Area	Mar	-	2.58	5.82	8.18	8.87	11.33	9.00	13.83	13.83
	Apr	-	3.20	6.52	10.43	14.74	15.64	21.14	15.22	14.64
	May	1.32	5.88	9.60	12.58	15.75	16.28	17.43	17.18	17.63
	Jun	1.56	6.88	12.17	16.39	19.77	19.99	23.66	26.75	17.66
	Jul	2.01	7.44	10.74	14.08	17.71	19.80	17.67	16.75	16.36
	Aug	4.23	11.99	23.55	19.16	26.49	27.00	-	-	-
	Sep	3.45	11.63	19.50	18.73	21.33	-	-	-	-
	Oct	4.38	10.14	21.66	-	-	-	-	-	-
Shetland	Mar	-	1.56	3.78	4.86	-	-	-	-	-
	Apr	0.10	2.21	4.03	6.45	8.70	10.08	11.27	13.59	16.51
	May	0.40	3.07	4.72	7.47	9.06	11.66	13.20	14.13	15.57
	Jun	0.86	4.40	6.94	10.31	14.09	16.60	20.62	21.04	23.41
	Jul	1.40	4.78	6.86	9.21	11.91	15.66	16.31	20.08	23.30
	Aug	1.89	4.97	7.88	10.59	11.58	14.12	20.13	18.30	17.02
	Sep	2.03	5.19	7.57	10.92	15.23	15.04	17.80	13.00	-
	Oct	2.32	5.04	7.71	10.62	16.45	16.50	-	-	-

Table 5.5.3. SANDEEL - North Sea.
Mean weight at age in catches in the first and second halves of the year. (Obtained by weighting monthly means given in Table 5.5.2 by the numbers caught in those months.)

Age	Northern Area		Southern Area		Shetland	
	1st half	2nd half	1st half	2nd half	1st half	2nd half
0	1.35	3.03	1.56	2.42	0.86	1.69
1	5.64	13.23	5.51	7.50	2.77	4.87
2	13.05	27.84	9.96	10.75	5.23	7.25
3	27.30	36.20	13.74	14.12	8.51	9.64
4	42.23	57.20 (44)	17.95 (16.3)	17.71	10.97	12.17
5	47.51	-	16.61 (17.6)	19.80	13.60 (13.2)	15.00 (14.7)
6	56.43 (53)	-	19.11 (18.5)	-	14.55 (15.0)	18.74 (16.5)
7	-	-	20.36 (18.9)	-	16.66 (16.4)	15.27 (17.7)
8	-	-	17.08 (19.1)	-	17.62	-

Values in parentheses are smoothed values obtained by fitting a growth curve through the data by eye.

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

Stock	Year	AGE 0	1	2	3	4	5	6	7	8
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	-	-	-	-
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	-	-	-	-
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	+	+

Table 6.1.1 Landings of SPRAT in Division IIIa and in Norwegian fjords in Division IVa (10^{-3} tonnes). (Data provided by Working Group members).

Year	SKAGERRAK				KATTEGAT			IIIa TOTAL	Fjords of Western Norway (IVa E)	GRAND TOTAL
	Denmark	Sweden	Norway	Total	Denmark	Sweden	Total			
1969	0.8	1.9	1.7	4.4	0.8	1.6	2.4	6.8	11.8	18.6
1970	1.1	2.4	2.4	5.9	3.1	6.0	9.1	15.0	6.4	21.4
1971	0.7	2.4	2.9	6.0	1.5	9.6	11.1	17.1	4.4	21.5
1972	0.8	3.3	2.4	6.5	1.4	17.9	19.3	25.8	6.9	32.7
1973	19.4	2.5	3.2	25.1	19.3	16.2	35.5	60.6	8.8	69.4
1974	17.3	2.0	1.2	20.5	31.6	18.6	50.2	70.7	3.3	74.0
1975	14.9	2.1	1.9	18.9	69.7	20.9	90.6	109.5	2.9	112.4
1976	12.8	2.6	2.0	17.4	30.4	13.5	43.9	61.3	0.6	61.9
1977	7.2	2.2	1.2	10.6	53.3	9.8	63.1	73.7	5.4	79.1
1978	23.1	2.2	2.7	28.0	36.1	9.4	45.5	73.5	5.2	78.7
1979	17.3	8.1	1.8	27.2	45.8	6.4	52.2	79.4	5.0	84.4
1980*	43.1	-	3.4	46.5	35.8	-	35.8	102.4	2.9	105.3
1981	26.4	13.4	4.6	44.4	23.8	15.8	39.6	84.0	3.1	87.1
1982	11.0	6.7	1.8	19.5	15.4	4.8	20.2	39.7	6.0	45.7
1983	3.4	6.7	1.5	11.6	9.1	13.2	22.3	33.9	3.0	36.9

* Sweden: 20 124 tonnes in Div. IIIa. Included in total but allocation to Skagerrak and Kattegat not possible.

Table 6.1.2 Landings of SPRAT in Div. IIIa by quarters (tonnes) (Norwegian fjords in Div IIIa exluded).

Year	Months	Kattegat	Skagerrak	Total
1981	Jan - Mar	10 334	9 993	20 337
	Apr - May	3 029	3 682	6 711
	Jun - Aug	13 635	25 034	38 669
	Sep - Dec	12 610	5 674	18 284
	Total	39 618	44 383	84 001
1982	Jan - Mar	6 247	1 058	7 305
	Apr - May	2 903	6 410	9 313
	Jun - Aug	7 939	8 156	16 395
	Sep - Dec	3 073	3 880	6 953
	Total	20 162	19 504	39 666
1983*	Jan - Mar	5 459	2 489	7 948
	Apr - May	3 213	806	4 019
	Jun - Aug	3 923	3 288	7 211
	Sep - Dec	9 729	3 530	13 259
	Total	22 324	10 113	32 437

*) Norwegian landings from the Skagerrak not included (1 500 tonnes for 1983)

Table 6.3.1 SPRAT in Div. IIIa. Numbers caught x 10^{-6}

Year	Quarter	Age group					
		0	1	2	3	4	5
1975	Jan - Mar		435.86	200.44	56.28	2.46	
	Apr - Jun		230.75	398.91	146.51	0.16	
	Jul - Sep	32.81	5 979.74	527.61	50.92	0.34	
	Oct - Dec	139.22	985.73	54.32	0.68		
	Total	172.03	7 632.08	1 181.28	254.39	2.96	
1976	Jan - Mar		336.00	164.95	9.11	1.23	0.65
	Apr - Jun		556.41	57.07	27.38	0.91	
	Jul - Sep	509.96	2 334.72	171.39	16.80	2.21	
	Oct - Dec	918.64	1 084.09	23.24	0.55		0.11
	Total	1 428.60	4 311.22	416.65	53.84	4.35	0.76
1977	Jan - Mar		2 515.11	408.99	11.29		
	Apr - Jun		2 177.51	483.23	20.70	3.37	
	Jul - Sep	725.13	2 185.47	208.70	30.26	7.42	1.21
	Oct - Dec	1 948.34	813.86	142.90	0.79		
	Total	2 673.47	7 691.95	1 243.82	63.04	10.79	1.21
1978	Jan - Mar		4 376.51	203.89	12.52		
	Apr - Jun		5 004.51	33.18	3.57		
	Jul - Sep	23.99	3 987.97	61.57	14.70	0.70	
	Oct - Dec	261.12	262.21	16.70	0.84		
	Total	285.11	13 631.20	315.34	31.63	0.70	
1979	Jan - Mar		1 098.75	426.69	60.68	1.92	1.94
	Apr - Jun		763.41	239.49	2.39	-	-
	Jul - Sep	690.32	3 674.64	7.37	1.59	-	1.99
	Oct - Dec	260.04	1 360.87	22.45	2.51	-	3.13
	Total	950.36	6 897.67	696.00	67.37	1.92	7.06
1980	Jan - Mar		1 161.54	748.60	25.02	0.73	
	Apr - Jun		5 155.16	421.79	3.66		
	Jul - Sep	407.17	6 306.95	68.40	14.86		
	Oct - Dec	413.46	671.10	5.65			
	Total	820.63	13 294.75	1 244.44	43.54	0.73	
1981	Jan - Mar		1 369.29	1 498.93	20.67		
	Apr - Jun	218.29	374.10	478.02	20.58		
	Jul - Sep	416.08	3 757.70	98.14	17.39		
	Oct - Dec	33.69	1 112.97	110.94	5.28		
	Total	668.06	6 614.06	2 186.03	63.92		
1982	Jan - Mar		520.09	423.70	48.88	0.47	
	Apr - Jun		190.36	374.98	103.77	3.18	
	Jul - Sep	2.70	1 270.12	173.94	27.67		
	Oct - Dec	317.62	336.18	28.07			
	Total	320.32	2 316.75	1 000.69	180.32		
1983	Jan - Mar		1 817.18	202.91	10.94	1.36	
	Apr - Jun	4.17	565.15	183.80	31.65		
	Jul - Sep	264.99	423.76	29.14	61.38		
	Oct - Dec	2 386.29	253.02	51.90	2.40		
	Total	2 655.45	3 059.11	467.75	106.37	1.36	

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

Year	Month	Biomass tonnes
1976	6	50 000
	9	135 000
1979	9	130 500
1980	3	150 000
	9	74 000
	11	65 000
1981	9	20 000
1982	9	24 000
1983	9	13 000
	12	8 000

Table 6.4.2 Indices of 1-group SPRAT abundance in Division IIIa from IYFS 1973-83.

Year class	New index (Arithmetic mean)	Old index (geometric mean)	Rectangles sampled
1973	2 704	1 324	8
1974	12 124	5 074	7
1975	4 222	464	8
1976	10 862	1 403	12
1977	6 263	4 223	11
1978	4 774	886	10
1979	5 307	4 253	13
1980	2 809	2 423	14
1981	1 841	495	12
1982	1 173	528	14
1983	4 141	2 113	14

Table 7.1.1. SPRAT catches in the North Sea ('000 tonnes), 1974-83 (data provided by Working Group members).

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983[a)]
					IVa West					
Denmark	5.3	0.5	0.6	0.1	-	-	-	2.8	-	-
Faroe Islands	0.2	12.9	2.5	0.4	-	-	-	-	-	-
France	-	-	-	+	-	-	-	-	-	-
German Dem.Rep.	-	-	-	+	-	-	-	-	-	-
Germany, Fed.Rep.	-	-	+	0.6	-	-	0.1	-	-	-
Netherlands	+	+	+	+	-	-	-	-	-	-
Norway	-	1.5	29.9	16.0	1.3	0	-	-	-	-
Poland	-	0.3	-	-	-	-	-	-	-	-
Sweden	2.2	11.0	+	0	-	-	-	-	-	-
U.K. (England)	-	-	-	0	-	-	-	-	-	-
U.K. (Scotland)	41.2	9.4	12.7	26.9	16.9	6.8	3.8	1.0	+	-
USSR	1.0	1.3	1.2	+	-	-	-	-	-	-
Total	49.9	36.9	46.9	44.0	18.2	6.8	3.9	3.8	+	0
					IVa East (North Sea stock)					
Denmark	-	-	0.2	0.1	-	-	-	-	+	-
Norway	-	-	1.9	0.7	0.1	+	0.4	-	-	3.0
U.K. (Scotland)	-	-	+	0	-	-	-	-	-	-
Total	-	-	2.1	0.8	0.1	...	0.4	0	+	3.0
					IVb West					
Belgium	-	-	+	0	-	-	-	-	-	-
Denmark	55.4	106.6	104.4	57.5	44.1	75.3	76.7	53.6	23.1	32.6
Faroe Islands	4.0	30.0	42.9	1.8	-	2.8[b)]	2.8[b)]	-	-	-
France	-	-	-	+	-	-	-	-	-	-
German Dem.Rep.	1.7	4.5	6.4	0.7	-	-	-	-	-	-
Netherlands	-	-	-	0	-	-	-	-	-	-
Norway	9.5	145.7	73.0	5.5	56.2	47.8	18.3	0.2	8.6	-
Poland	-	9.1	10.5	0	-	-	-	-	-	-
Sweden	-	-	7.9	0	-	-	-	-	-	-
U.K. (England)	25.5	32.5	49.7	51.9	53.9	12.9	2.4	-	-	-
U.K. (Scotland)	8.6	4.9	18.1	10.9	14.8	5.0	2.5	0.7	0.2	+
USSR	32.9	47.8	50.4	1.6	-	-	-	-	-	-
Total	137.7	381.1	362.3	123.9	169.0	143.8	102.7	54.5	31.9	32.6

a) Preliminary figures as reported
b) Division IVb East and West.
+ = less than 0.1.
- = magnitude known to be nil.

/Continued

Table 7.1.1. (Continued)

SPRAT catches in the North Sea ('000 tonnes), 1974-83 (data provided by Working Group members).

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983[a)]
					IVb East					
Denmark	104.0	215.2	201.1	126.8	161.0	191.5	149.0	127.5	91.2	39.2
German Dem.Rep.	-	0.4	-	0.7	-	-	-	-	-	-
Germany, Fed.Rep.	17.5	0.5	1.7	4.3	-	1.6	6.1	4.8	1.5	-
Norway	-	-	5.1	0	29.8	27.4	33.7	0.2	7.2	12.0
Sweden	-	-	-	1.5	-	-	0.6	-	-	-
Total	121.5	216.1	207.9	133.3	190.8	222.7	189.4	132.5	99.9	51.2
					IVc					
Belgium	+	+	-	0	-	-	-	-	-	-
Denmark	0.9	3.9	0.3	1.4	-	1.5	6.5	4.3	2.4	1.0
France	0.3	0.1	-	+	-	-	-	-	-	-
German Dem.Rep.	-	-	0.1	+	-	-	-	-	-	-
Germany, Fed.Rep.	-	-	-	0.4	-	-	-	-	-	-
Netherlands	+	0.2	-	0	-	-	-	-	-	-
Norway	-	-	-	-	0.2	3.1	16.2	-	3.7	-
UK(England)	3.4	2.9	0.7	0.2	0.0	1.4	4.3	14.0	14.9	3.6
USSR	+	+	0.2	-	-	-	-	-	-	-
Total	4.6	7.1	1.3	2.0	0.2	6.0	27.0	18.3	21.0	4.6
					Total North Sea					
Belgium	+	+	+	+	+	+	+	-	-	-
Denmark	165.6	326.2	306.6	179.9	205.1	268.3	232.2	188.2	116.6	72.6
Faroe Islands	4.2	42.9	45.4	2.2	-	2.8	2.8	-	-	-
France	0.3	0.1	-	+	-	-	-	-	-	-
German Dem.Rep.	1.7	4.9	6.5	1.4	-	-	-	-	-	-
Germany, Fed.Rep.	17.5	0.5	1.7	5.3	-	3.8	6.2	4.8	1.5	-
Netherlands	+	0.2	+	+	-	-	-	-	-	-
Norway	9.5	147.2	109.9	22.2	87.6	78.6	68.6	0.4	19.5	15.0
Poland	-	9.4	10.5	+	-	-	-	-	-	-
Sweden	2.2	11.0	7.9	1.5	-	-	0.6	-	-	-
UK(England)	28.9	35.4	50.4	52.1	53.9	14.3	6.7	14.0	14.9	3.6
UK(Scotland)	49.8	14.3	30.8	37.8	31.7	11.8	6.3	1.7	0.2	+
USSR	33.9	49.1	51.8	1.6	-	-	-	-	-	-
Total	313.6	641.2	621.5	304.0	378.3	379.6	323.4	209.1	152.7	91.2

a) Preliminary figures as reported.

Table 7.1.2. SPRAT in Division VIa.
Landings in tonnes.

Countries	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983*)
Denmark					259			242		
Faroes	109	56	181							
France										
Germany, Fed.Rep.	22	123	37	+		97		2		
Ireland	713	517	673	282	533	12	1 787	790	287	
Netherlands	223	140	661	49	46	125	428	892	2 156	
Norway			35	267					24	
Poland									-	
UK/Scotl.[1)]	5 959	8 127	6 455	4 246	11 563	1 087	2 987	1 488	1 057	1 859
Total	7 026	9 053	8 042	4 844	12 401	1 321	5 202	3 414	3 524	1 859

Source: ICES Statistician
1) Amended from national data.
*) Preliminary figures.

Table 7.1.3. SPRAT catches in thousand tonnes (Denmark, Norway and United Kingdom) in Sub-divisions of the North Sea (1980-1983) (see Figure 6.1.1).

1980

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

1981

Month	AREAS 1	2	3	4	5
1	0.6	-	12.7	3.0	10.3
2	-	-	14.4	9.1	6.9
3	-	-	+	3.1	+
4	-	-	+	0.2	+
5	-	-	1.5	0.4	0.2
6	-	-	0.4	0.6	0.2
7	-	-	-	20.5	-
8	-	-	1.4	26.3	-
9	2.8	-	2.9	35.9	-
10	+	-	-	20.1	-
11	0.1	-	13.3	8.3	-
12	0.3	-	8.0	-	0.7

1982

Month	AREAS 1	2	3	4	5
1	+	-	23.7	17.9	13.3
2	-	-	1.8	1.0	7.1
3	-	-	0.8	0.1	+
4	-	+	+	-	-
5	-	-	+	0.1	-
6	-	-	0.1	0.1	-
7	-	-	-	4.7	+
8	-	-	-	15.1	-
9	-	-	-	21.2	-
10	-	-	0.7	27.3	-
11	-	-	1.2	4.3	-
12	-	-	3.5	6.5	-

1983

Month	AREAS 1	2	3	4	5
1	-	-	1.0	13.0	2.9
2	-	-	0.3	0.5	0.7
3	-	-	-	+	0.1
4	-	-	+	0.1	+
5	-	-	+	0.2	-
6	-	-	0.3	0.6	+
7	-	-	-	4.5	+
8	-	-	+	15.8	-
9	-	-	-	5.6	-
10	-	-	-	3.2	-
11	-	-	21.1	5.7	-
12	-	-	9.7	1.8	0.9

Table 7.3.1 North Sea SPRAT in 1982 and 1983. Numbers caught per age group x 10^{-6} in 1982.

Divisions	Months	Age groups 0	1	2	3	4	5
IVa W	Jan-Mar	-	-	3.1	0.5	0.1	-
	Apr-Jun	-	-	-	-	-	-
	Jul-Sep	-	-	-	-	-	-
	Oct-Dec	-	-	-	-	-	-
	Total						
IVa E (excl. Norwegian fjord catch)	Jan-Mar	-	-	-	-	-	-
	Apr-Jun	-	+	0.1	0.1	-	-
	Jul-Sep	-	-	-	-	-	-
	Oct-Dec	-	-	-	-	-	-
	Total	-	+	0.1	0.1	-	-
IVb W	Jan-Mar	-	35.4	2 609.6	254.8	13.1	4.5
	Apr-Jun	-	-	11.7	-	-	-
	Jul-Sep	-	-	-	-	-	-
	Oct-Dec		17.8	86.7	5.4	0.6	1.2
	Total						
IVb E	Jan-Mar	-	63.1	1 729.3	100.1	3.3	-
	Apr-Jun	-	3.4	7.3	5.4	0.7	-
	Jul-Sep	20.8	4 813.2	60.8	2.1	-	-
	Oct-Dec	34.8	2 682.3	537.2	5.1		
	Total						
IVc	Jan-Mar	-	922.2	1 535.8	239.7	99.9	0.5
	Apr-Jun	-	-	12.1	-	-	-
	Jul-Sep	-	-	-	-	-	-
	Oct-Dec		0.6				
	Total						
TOTAL NORTH SEA (excl.last quarter)	Jan-Mar	-	1 020.7	5 877.8	595.1	116.4	5.0
	Apr-Jun	-	3.4	31.2	5.5	0.7	-
	Jul-Sep	20.8	4 813.2	60.8	2.1	-	-
	Oct-Dec	34.8	2 700.7	623.9	10.5	0.6	1.2
	Total	55.6	8 538.0	6 593.7	613.2	117.7	6.2

........Continued

Table 7.3.1 (continued) North Sea SPRAT in 1982-83.
Numbers caught per age group x 10^{-6}
in 1983.

Divisions	Months	Age groups 0	1	2	3	4	5
IVa W	Jan-Mar	-	-	-	-	-	-
	Apr-Jun	-	-	-	-	-	-
	Jul-Sep	-	-	-	-	-	-
	Oct-Dec	-	-	-	-	-	-
	Total	-	-	-	-	-	-
IVa E (excl. Norweg. fjord catch)	Jan-Mar	-	-	-	-	-	-
	Apr-Jun	-	-	-	-	-	-
	Jul-Sep	-	-	-	-	-	-
	Oct-Dec	-	-	-	-	-	-
	Total	-	-	-	-	-	-
IVb W	Jan-Mar	-	118.2	59.8	39.1	0.8	-
	Apr-Jun	-	4.4	15.2	4.0	-	-
	Jul-Sep	-	7.1	-	-	-	-
	Oct-Dec	49.6	1 605.5	443.2	20.6	-	-
	Total	49.6	1 735.2	518.2	63.7	0.8	-
IVb E	Jan-Mar	-	231.6	716.9	304.7	20.7	3.0
	Apr-Jun	1.1	18.5	40.6	1.3	-	-
	Jul-Sep	10.1	2 648.6	341.0	27.0	-	-
	Oct-Dec	75.0	351.6	306.8	24.6	0.1	-
	Total	86.2	3 250.3	1 405.3	357.6	20.8	3.0
IVc	Jan-Mar	-	7.5	156.2	139.2	16.6	-
	Apr-Jun	0.6	2.5	0.3	-	-	-
	Jul-Sep	0.2	0.7	0.1	-	-	-
	Oct-Dec	6.1	59.5	11.4	1.5	-	-
	Total	6.9	70.2	168.0	140.7	16.6	-
TOTAL NORTH SEA	Jan-Mar	-	357.3	932.9	483.0	38.1	3.0
	Apr-Jun	1.7	25.4	56.1	5.3	-	-
	Jul-Sep	10.3	2 656.4	341.1	27.0	-	-
	Oct-Dec	130.7	2 016.6	761.4	46.7	0.1	-
	TOTAL	142.7	5 055.7	2 091.5	562.0	38.2	3.0

Table 7.3.2 North Sea SPRAT catch in 1975-83. Numbers caught per age group x 10^{-6} in each three-month period.

Year	Months	Age group						
		0	1	2	3	4	5	6
1975	Jan-Mar	-	4 096.6	14 973.2	3 929.0	233.7	14.1	-
	Apr-Jun	-	446.2	1 163.2	68.9	6.5	-	-
	Jul-Sep	15.0	10 588.1	5 760.0	75.1	3.1	-	-
	Oct-Dec	675.2	6 351.6	6 122.5	660.2	57.3	4.4	-
1976	Jan-Mar	-	9 360.9	9 997.0	6 678.0	373.0	6.2	1.4
	Apr-Jun	-	2 017.2	964.6	740.1	40.9	0.8	-
	Jul-Sep	79.6	16 536.4	599.5	40.1	-	-	-
	Oct-Dec	2 780.4	8 443.7	2 659.4	612.7	37.1	-	-
1977	Jan-Mar	-	4 197.2	11 962.6	962.9	104.7	12.0	-
	Apr-Jun	-	540.3	670.9	52.7	1.5	-	-
	Jul-Sep	57.3	2 803.1	3 248.4	165.9	11.1	-	-
	Oct-Dec	1 060.8	4 705.0	3 049.5	311.2	1.5	-	-
1978	Jan-Mar	-	2 461.9	2 839.3	3 770.1	344.5	-	-
	Apr-Jun	-	1 077.5	123.8	3.2	0	-	-
	Jul-Sep	6.3	17 785.5	216.5	14.7	0.7	-	-
	Oct-Dec	636.8	6 932.7	3 955.8	1 159.0	214.9		
1979	Jan-Mar	-	2 770.0	6 422.2	2 670.6	131.2	0.7	-
	Apr-Jun	-	203.6	452.0	14.0	1.1	-	-
	Jul-Sep	-	25 379.1	388.3	2.1	0	-	-
	Oct-Dec	433.0	8 394.8	1 494.6	122.4	34.9	-	-
1980	Jan-Mar	-	1 448.0	12 764.4	1 323.2	103.7	0.7	-
	Apr-Jun	-	134.0	84.5	2.4	0.3	-	-
	Jul-Sep	15.1	10 143.3	811.6	4.7	-	-	-
	Oct-Dec	515.7	4 518.5	2 767.4	111.8	19.5	-	-
1981	Jan-Mar	-	2 249.3	5 218.6	1 055.5	22.1	1.5	-
	Apr-Jun	23.0	87.0	189.2	29.1	-	1.7	-
	Jul-Sep	192.2	7 626.5	1 140.8	46.1	3.0	-	-
	Oct-Dec	158.0	2 326.8	1 448.9	69.9	0.7	0.4	-
1982	Jan-Mar	-	1 020.7	5 877.8	595.1	116.4	5.0	-
	Apr-Jun	-	3.4	31.2	5.5	0.7	-	-
	Jul-Sep	20.8	4 813.2	60.8	2.1	-	-	-
	Oct-Dec	34.8	2 700.7	623.9	10.5	0.6	1.2	-
1983	Jan-Mar	-	357.3	932.9	483.0	38.1	3.0	-
	Apr-Jun	1.7	25.4	56.1	5.3	-	-	-
	Jul-Sep	10.3	2 656.4	341.1	27.0	-	-	-
	Oct-Dec	130.7	2 016.6	761.4	46.7	0.1	-	-

Table 7.3.3 North Sea SPRAT. Fishing mortality by quarters (VPA) $M = 0.8\ year^{-1}$. Input fishing mortalities are in brackets. 1974-1978 from previous report.

Year	Quarter	Age groups 0	1	2	3	4
1974	1	–	.052	.30	.59	1.41
	2	–	.003	.13	.13	.69
	3	.0003	.053	.15	.05	.44
	4	.0141	.087	.10	.14	(1.00)
1975	1	–	.046	.31	.92	.84
	2	–	.005	.035	.034	.046
	3	.000	.156	.245	.047	.028
	4	.004	.132	.446	.706	(1.000)
1976	1	–	.072	.315	1.339	1.213
	2	–	.020	.045	.488	.386
	3	.001	.224	.035	.043	.000
	4	.039	.170	.217	1.597	(1.000)
1977	1	–	.077	.386	.114	1.720
	2	–	.013	.033	.008	.086
	3	.001	.084	.220	.032	1.568
	4	.012	.198	.332	1.287	(1.000)
1978	1	–	.034	.176	.889	.445
	2	–	.019	.010	.002	.000
	3	.000	.478	.022	.008	.002
	4	.005	.346	.695	1.615	(1.000)
1979	1	–	.027	.627	1.685	.829
	2	–	.002	.079	.029	.013
	3	–	.458	.090	.005	.000
	4	.027	.268	.575	.489	(1.000)
1980	1	–	.029	.834	1.748	1.041
	2	–	.003	.011	.011	.007
	3	–	.374	.135	.026	.000
	4	.011	.284	.904	1.435	(1.000)
1981	1	–	.063	.617	1.147	1.478
	2	.001	.003	.039	.076	.000
	3	.006	.397	.344	.167	1.167
	4	.006	.201	.992	.407	(1.000)
1982	1	–	.047	1.127	1.837	3.742
	2	–	.000	.014	.063	.405
	3	.001	.413	.034	.031	.000
	4	.001	.431	.557	.212	(1.000)
1983	1	–	.016	.258	1.199	4.785
	2	–	.001	.022	.032	.000
	3	.001	.200	.180	.226	.000
	4	(.008)	(.230)	(.760	(.760)	(.900)

Table 7.3.4 North Sea SPRAT. Number in stock, N x 10^{-9}, at the beginning of each quarter and biomass, tonnes x 10^{-3}, at the beginning of the year. (VPA) M = 0.8 $year^{-1}$. 1974-78 from previous report.

Year	Quarter	Age groups					Biomass	
		0	1	2	3	4	Total	Adult
1974	1	-	166	31	2.5	.3	598	432
	2	-	129	19	1.2	+		
	3	148	105	14	.8	+		
	4	121	82	9.6	.6	+		
1975	1	-	98	61	7.1	.4	702	576
	2	-	99	37	2.3	.2		
	3	222	81	29	1.8	.1		
	4	182	57	19	1.4	.1		
1976	1	-	148	41	9.8	.6	613	465
	2	-	113	24	2.1	.1		
	3	97	91	19	1.1	.1		
	4	79	59	15	.8	.1		
1977	1	-	62	41	9.9	.1	522	460
	2	-	47	23	7.2	+		
	3	122	38	18	5.8	+		
	4	100	29	12	4.6	+		
1978	1	-	81	19	7.0	1.1	354	273
	2	-	64	13	2.3	.6		
	3	176	51	11	1.9	.5		
	4	144	26	8.6	1.6	.4		
1979	1	-	116	15	3.5	.3	288	172
	2	-	93	6.6	.5	.1		
	3	83	76	5.0	.4	.1		
	4	68	39	3.7	.3	.1		
1980	1	-	55	25	1.7	.2	268	213
	2	-	44	8.7	.2	.1		
	3	61	36	7.1	.2	+		
	4	50	20	5.1	.2	+		
1981	1	-	41	12	1.7	+	159	119
	2	-	31	5.5	.4	+		
	3	37	20	4.3	.3	+		
	4	30	14	2.5	.2	+		
1982	1	-	24	9.4	.8	.1	173	90
	2	-	19	2.5	.1	+		
	3	37	16	2.0	.1	+		
	4	30	8.5	1.6	.1	+		
1983	1	-	24	4.5	.7	+	132	51
	2	-	20	2.8	.2	+		
	3	22	16	2.3	.1	+		
	4	18	11	1.6	.1	+		

Adult = 2 + 3 + 4

Table 7.4.1 Acoustic estimates of North Sea SPRAT biomass ($t \times 10^{-3}$) standardised to the target strength - length relationship given in Section 7.4.

AREA		1980		1981		1982		1983		1984	
		1-group	Older	1-group	Older	1-group	Older	1-group	Older	1-group	Older
Norway	IVa E	2.5	-	No survey		No survey		No survey		No survey	
	IVb E	125.9	59.6	10.0	5.7	9.0	4.0	No survey		12.0	25.1
	IVb W	8.5	2.0	-	0.8	0.9	0.3	No survey		No survey	
	IVc	8.3	15.4	0.4	4.3	No survey		No survey		No survey	
Scotland	IVa W	2.0	0.4	2.9	0.8	3.2	0.1	1.3	0.2	1.8	0.3
	IVb W (56°-57°30'N)	2.0	0.4	12.5	0.1	2.8	0.5	2.5	<0.1	0.8	0.3
	(54°-56°N)	0.2	<0.1	6.0	5.0	5.3	0.3	1.9	0.1	0.3	2.3
TOTAL by Norway, England and Scotland	IVa W	2.0	0.4	2.9	0.8	3.2	0.1	1.3	0.2	1.8	0.3
	IVb W	11.7	7.5	21.5	66.1	15.8	20.9	4.6	7.3	1.1	2.6
	IVb E	125.9	59.6	10.0	5.7	9.8	4.2	-	-	12.0	25.1
	IVc	8.3*)	15.4*)	7.1	46.8	3.1	81.0	1.8	52.5	-	-

*) Excluding Wash and Thames estuary.

Table 7.4.2 North Sea SPRAT
Research vessel surveys.

Year of observation	SURVEYS						Commercial fisheries	
	IYFS N.Sea No/hr all ages	IYFS Div. IVb 1-gr.	IYFS IVb E IKMT 1-gr.	IYFS IVb E Bottom trawl 1-gr.	Mid-water surveys November 0-gr.	Mid-water surveys November 1-gr.	NE Engl. fishery winter x 10^{-6} 1-gr.	North Sea x 10^{-6} Catches first quarter 1-gr.
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 a)	248 a)					330	2 770
1980	3 770	1 402	328	1 916	2 831	81	59	1 448
1981	2 107	886	107	1 146	1 075	60	-	2 249
1982	602	183	47	512	1 044	38	-	1 021
1983	852	399	12	730	1 536	84		357
1984		525 b)						

a) Low figures due to abnormal conditions on the survey.
b) Preliminary figure, probably overestimate.

<u>Table 7.5.1</u> North Sea SPRAT. Mean weights at age by quarters, 1982 and 1983 (in grams)

YEAR	QUARTER \ AGE	0	1	2	3	4	5
1	JAN-MAR	-	3.4	8.1	16.0	16.9	20.7
9	APR-JUN	(1)	6.2	7.4	14.2	27.0	-
8	JUL-SEP	3.7	7.2	18.7	25.5	-	-
2	OCT-DEC	4.9	10.8	16.9	25.9	26.0	30.7
	YEAR	4.4	8.4	9.5	16.3	18.0	22.6
1	JAN-MAR	-	3.3	8.7	13.5	32.0	-
9	APR-JUN	(1)	6.8	13.8	21.0	-	-
8	JUL-SEP	2.6	7.0	13.2	14.5	-	-
3	OCT-DEC	3.9	12.4	18.5	25.4	19.0	-
	YEAR	3.8	8.9	16.0	17.6	31.1	-

Table 7.10.1 Yield and stock characteristics of North Sea SPRAT.

A. 1967-73 (Anon., 1977, based on annual VPA)

Year	Catch ('000 t)	Total biomass ('000 t)	Spawning biomass ('000 t)	$R_1 x 10^{-9}$ (year class)
1967	81		416	129
1968	79		626	76
1969	83		762	86
1970	69		632	46
1971	90		556	42
1972	115		331	100
1973	271		200	194
B. 1974-83 (Based on quarterly VPA)				
1974	314	598	432	98
1975	641	702	576	148
1976	621	613	465	62
1977	384	522	460	81
1978	378	354	273	117
1979	380	289	172	55
1980	323	273	213	41
1981	209	162	119	24
1982	153	100	90	24
1983	91			

Spawning stock and R_1 1967-73 from Doc. C.M.1977/H:3, where $R_1 = R_o e^{-0.5M}$, R_o being estimated at 1st July.

Table 8.1.1 Nominal catch (tonnes) of SPRAT in Divisions VIId,e, 1974-83 (data for 1974-1982 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983*
Belgium	-	-	-	-	-	-	-	-	-	3
Denmark	-	-	447	74	1 796	9 981	7 483	b)	286	638 a)
Faroe Islands	-	-	6	-	-	-	-	-	-	-
France	520	147	115	120	225	2 373	1 867	146	44	+
German Dem.Rep.	-	-	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	-	-	-	-	34	6	52	1	-	
Netherlands	16	109	49	115	826	441	1 401	1 015	1 533	NA
Norway	-	-	-	-	-	-	65	-	-	-
Poland	1	-	-	-	-	-	-	-	-	-
U.K. (Eng. & Wales)	3 256	1 315	3 107	2 928	2 118	2 032	6 864	10 183	4 749	3 216
Total	3 793	1 571	3 724	3 237	4 999	14 833	17 732	13 890	6 612	(3 857)

* Preliminary

a) Landings in foreign ports Jul-Dec not included

b) As per 22 February 1983, no final data available

NA) Not available

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	Season Total	% CATCH TO END DECEMBER
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		2 656	
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	479	1 686	261		← 626 →		(3 135)[1)]	
Period Mean Values											
1961-65				129	91	81	362	332	29	1 024	29.4%
1966-70	2	1	12	86	170	383	621	182	20	1 477	44.3%
1971-75	37	90	213	336	337	236	297	73	18	1 637	76.3%
1976-80	64	274	545	577	658	570	542	74	18	3 322	80.9%
1981-82			33	660	1 436	2 476	689	144	52	5 490	83.9%

1) Catches Jan - March estimated as 20% of 83/84 seasonal total catch

Table 8.3.1 Lyme Bay area SPRAT fishery, 1966-83.
Numbers caught per age group x 10^{-6} in each season.

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	0.16	4.81	49.74	58.89	25.41	0.25
1983-84	9.00	11.5	40.0	52.3	22.8	6.3*

* Based on catches Oct-Dec 1983

Table 8.3.2 Lyme Bay SPRAT. Annual fishing mortalities (traditional analysis, using terminal populations generated by separable VPA).

Annual $M = 0.85^{-1}$; $S = 0.3$; $F = 0.5$; %Z applied in estimation of biomass = 0.0

Season	Age Groups					$\bar{F}_c$	$\bar{F}_p$
	1/2	2/3	3/4	4/5	5/6		
1967-68	0.07	0.19	0.17	0.09	0.05	0.13	0.11
1968-69	0.03	0.11	0.06	0.03	0.03	0.08	0.05
1969-70	0.02	0.15	0.20	0.10	0.08	0.14	0.07
1970-71	0.01	0.11	0.18	0.05	0.05	0.12	0.05
1971-72	0.03	0.10	0.14	0.07	0.02	0.09	0.06
1972-73	0.06	0.09	0.10	0.06	0.02	0.08	0.07
1973-74	0.04	0.25	0.10	0.13	0.10	0.17	0.10
1974-75	0.09	0.40	0.20	0.26	0.25	0.27	0.18
1975-76	0.02	0.15	0.40	0.30	0 13	0.24	0.09
1976-77	0.08	0.43	0.69	0.39	0.05	0.38	0.20
1977-78	0.05	0.40	0.69	0.69	0.09	0.41	0.18
1978-79	0.04	0.32	0.38	0.37	0.03	0.28	0.14
1979-80	0.01	0.14	0.16	0.27	0.06	0.15	0.07
1980-81	0.04	0.24	0.43	0.40	0.05	0.26	0.12
1981-82	0.07	0.31	0.45	0.64	0.12	0.29	0.17
1982-83	0.02	0.18	0.37	0.30	0.02	0.22	0.10

$\bar{F}_c$ and $\bar{F}_p$ - see Shepherd 1982

Table 8.3.3 Lyme Bay SPRAT. Number in stock (millions) at beginning of first year of each season (traditional analysis using terminal populations generated by separable VPA). Annual M = 0.85 year^{-1}; S = 0.3; F = 0.5; %Z applied in estimation of biomass = 0.0

Season	Age Group					2 - 6
	1/2	2/3	3/4	4/5	5/6	Biomass (tonnes)
1967-68	992	283	49	12	12	16 415
1968-69	1 593	395	100	18	5	25 375
1969-70	1 583	662	150	40	7	31 859
1970-71	988	665	243	53	16	28 921
1971-72	904	420	255	87	21	25 175
1972-73	763	373	162	95	35	22 390
1973-74	872	306	146	63	38	19 375
1974-75	689	358	102	57	24	18 193
1975-76	1 068	269	102	36	19	18 724
1976-77	770	448	99	29	11	17 997
1977-78	581	304	125	21	8	12 259
1978-79	1 495	236	87	27	5	25 117
1979-80	3 634	613	73	25	8	68 981
1980-81	2 130	1 536	227	26	8	65 791
1981-82	1 101	878	519	63	8	47 132
1982-83	302	438	275	141	14	23 791
[1983-84	205	126	156	81	44	12 744]

Table 8.3.4 Lyme Bay SPRAT. Biomass, recruitment (R_1) and fishing mortality (traditional analysis using terminal populations generated by separable VPA).

$M = 0.85$; $S = 0.3$; $F = 0.5$. Biomass and age at the beginning of the 1st year of each seasonal pair.

YEAR	Biomass (Ktonnes)	$R_1 \times 10^{-6}$	$\bar{F}_c$ *)
1967	16.4	992	.13
1968	25.4	1 593	.08
1969	31.9	1 583	.14
1970	28.9	988	.12
1971	25.2	904	.09
1972	22.4	763	.08
1973	19.4	872	.17
1974	18.2	689	.27
1975	18.7	1 068	.24
1976	18.0	770	.38
1977	12.3	581	.41
1978	25.1	1 495	.28
1979	69.0	3 634	.15
1980	65.8	2 130	.26
1981	47.1	1 101	.29
1982	23.8	302	.22
(1983	12.7	205	.47)

*) $\bar{\bar{F}}_c$ - see Shepherd (1982)

Table 8.5.1 Lyme Bay area SPRAT.
Mean weight/age.

Season	Quarter	Age Group 0/1	1/2	2/3	3/4	4/5	5/6	Overall Mean
1972-73	3	5.1	12.7	22.1	24.7	25.9	26.5	19.9
	4	5.3	11.3	21.9	24.9	26.5	27.2	20.3
	1	4.9	10.2	17.9	21.2	22.8	23.4	13.6
	Season	4.9	10.5	19.7	23.3	25.0	25.6	16.0
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	-	6.6	18.1	22.6	24.9	30.5	19.3
	1	6.4	5.2	14.5	18.1	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	-	10.8
	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	31.0	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	14.3	21.0	24.0	27.1	27.6	21.7

Figure 3.4.1. Danish NORWAY POUT areas.

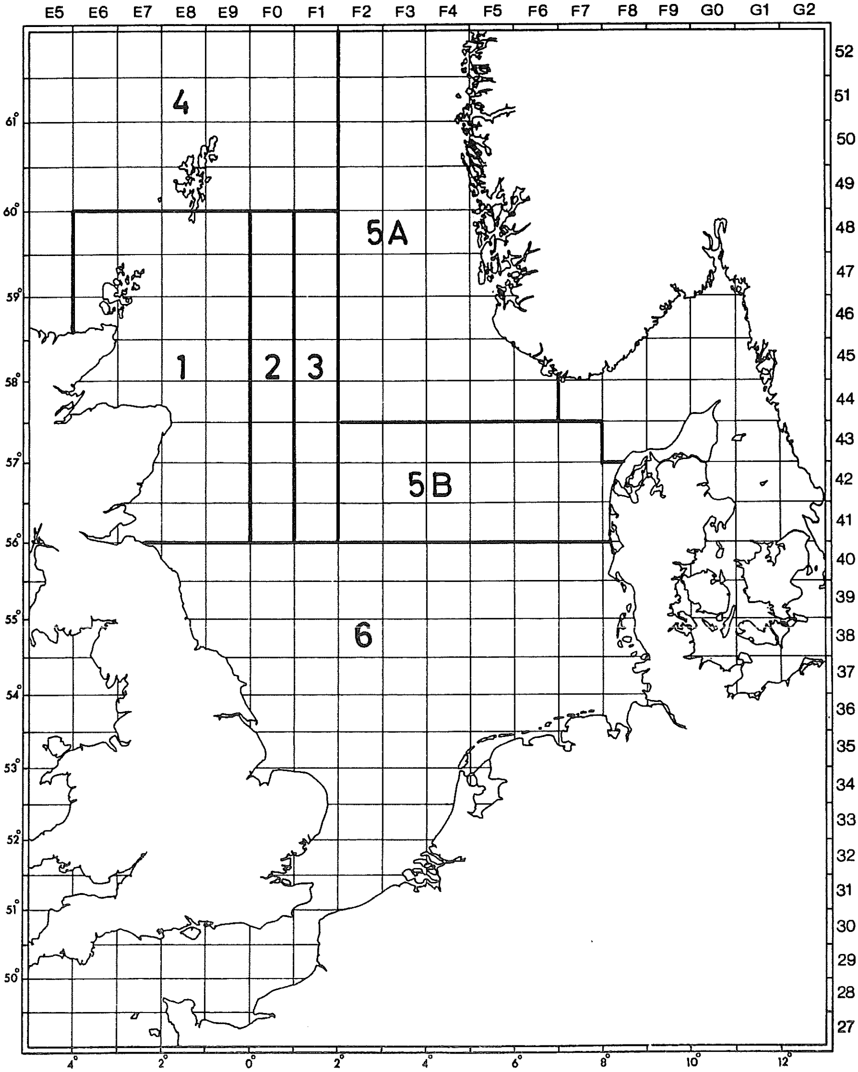
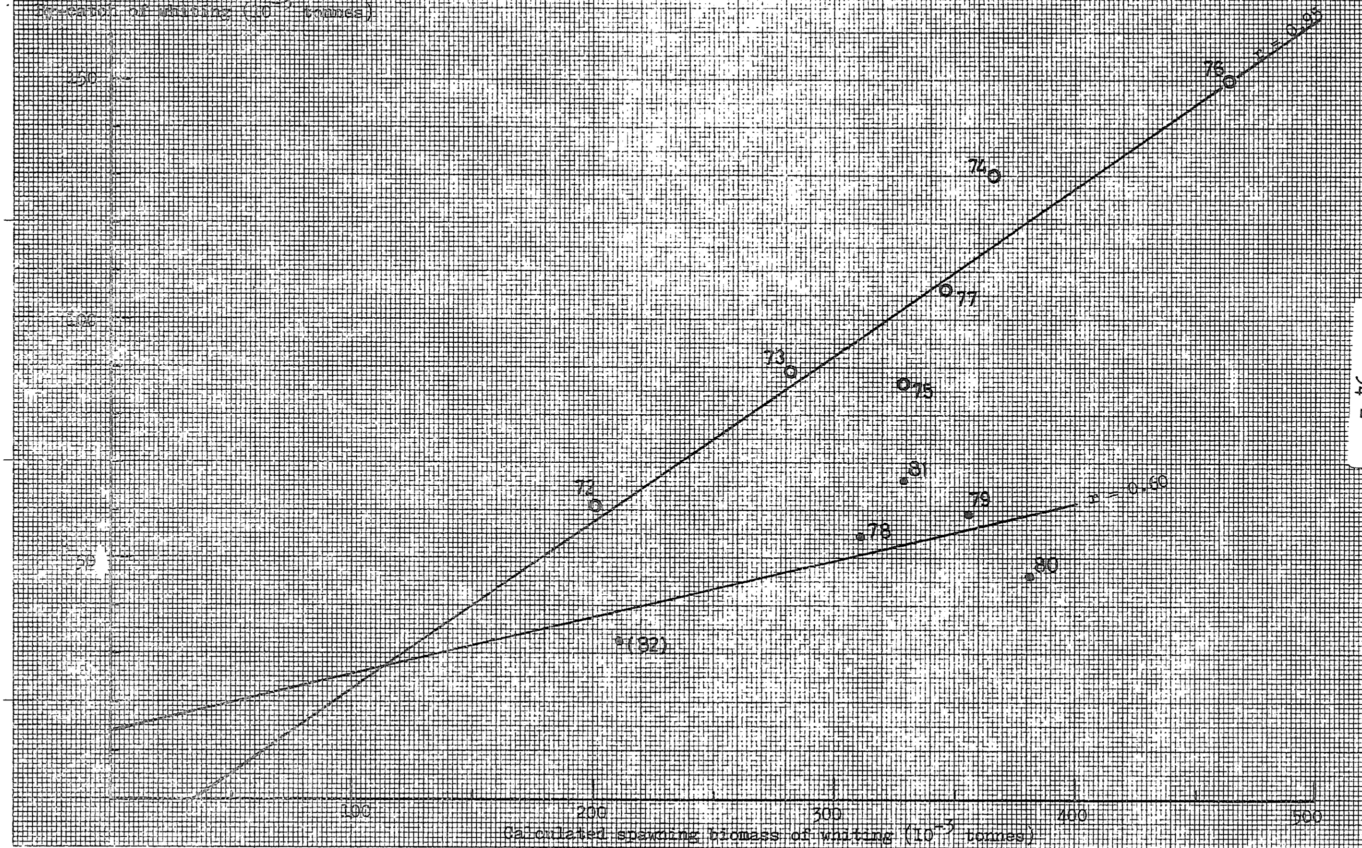


Figure 7.6.1. Prediction of by-catch of WHITING as a function of whiting spawning stock biomass.



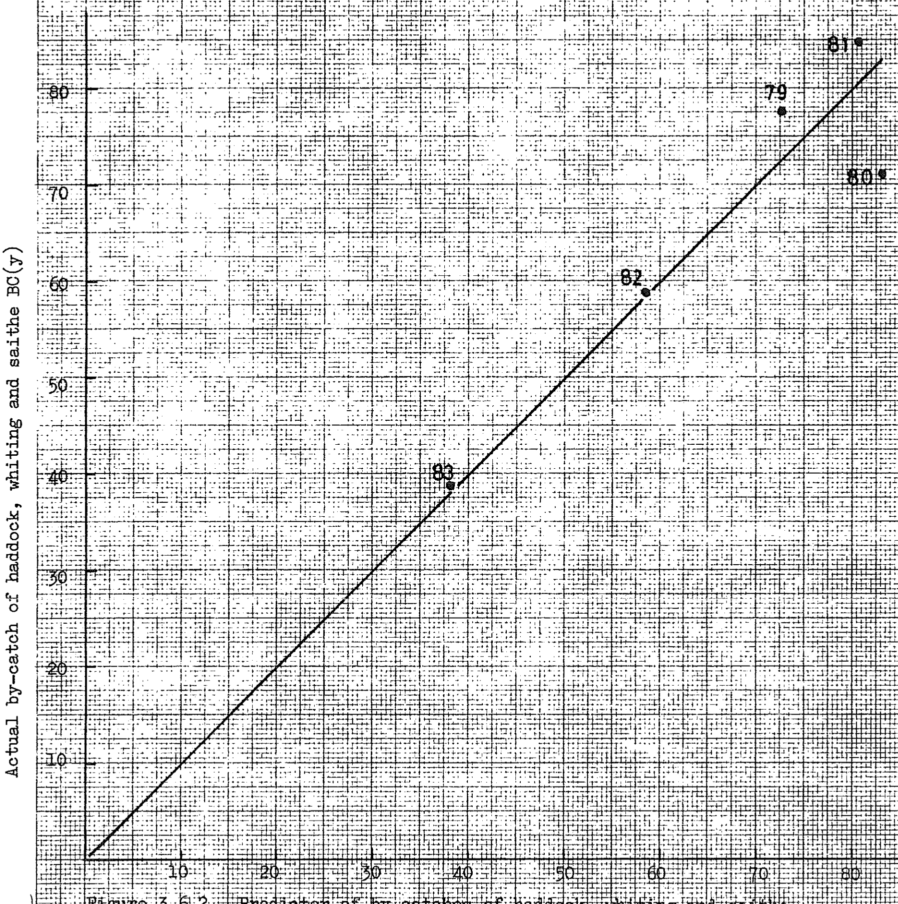


Figure 3.6.2. Predictor of by-catches of haddock, whiting and saithe. Individual relationships were successfully fitted to the separate by-catches of haddock and whiting from 1979–83 based upon the previous year's by-catch of the species and an index of recruitment. In the case of haddock, the IYFS 1-year-old index for the year was used while in the case of whiting, the IYFS 1-year-old index for the previous year was used. These relationships together with an average catch of saithe were consolidated into the overall by-catch predictor. "SHOT" estimates of by-catch of haddock, whiting and saithe.

$$BC(y) = 0.3\,BC(y-1) + 0.028R\,(1,y,HAD) + 0.073R\,(1,y-1,\ WHI) + 1.36.$$

Figure 4.2.1. Norwegian cpue values for the NORWAY POUT fishery (including by-catch) by quarters.

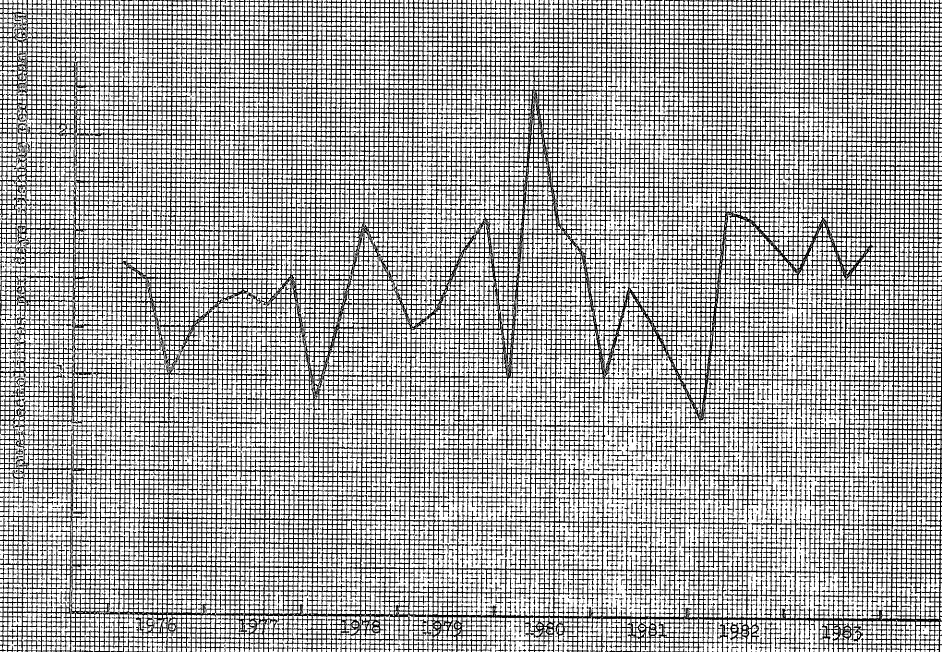


Figure 4.2.2. NORWAY POUT.
Norwegian cpue values. Weighted annual means.

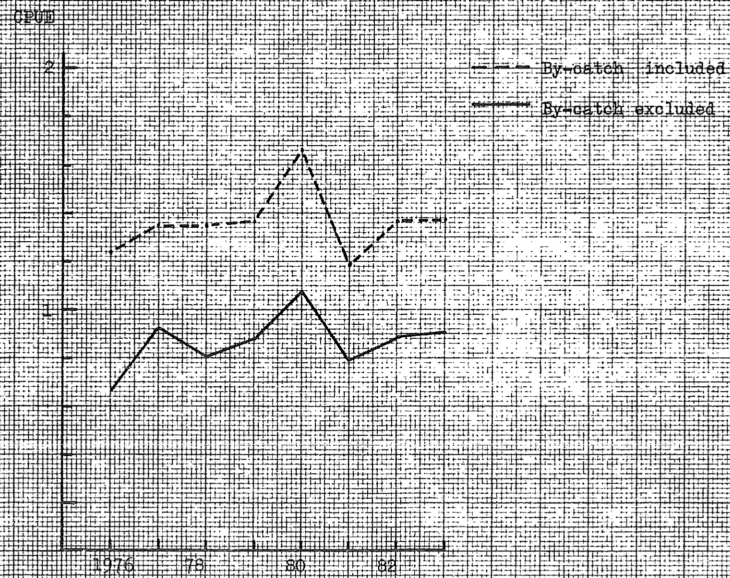


Figure 4.2.3. Faroese cpue values for the NORWAY POUT fishery (tonnes per hour trawling) by quarters.

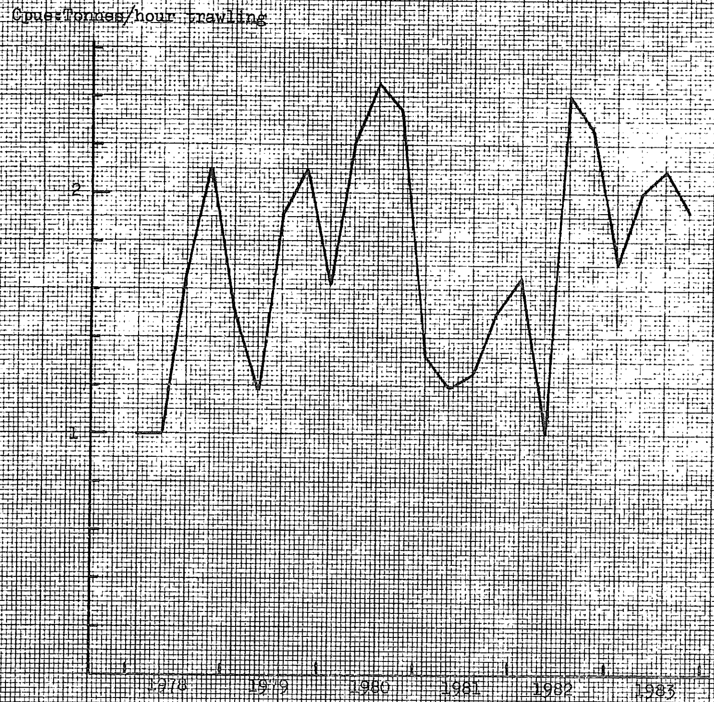


Figure 4.3.1. NORWAY POUT. North Sea.
VPA-estimated 1-group vs IYFS index of 1-group.

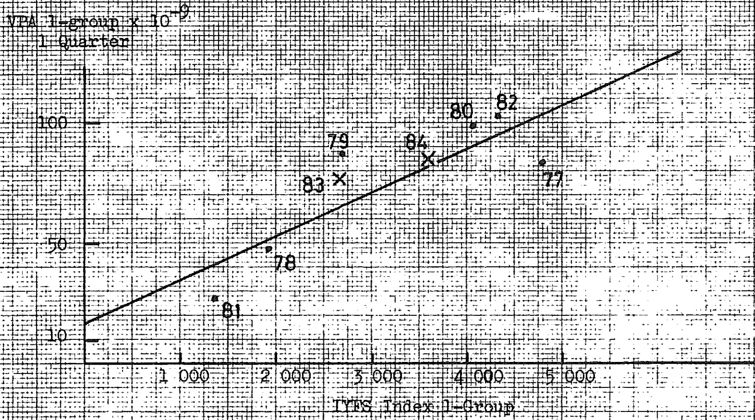


Figure 4.3.2. NORWAY POUT.
Stock biomass and spawning biomass.

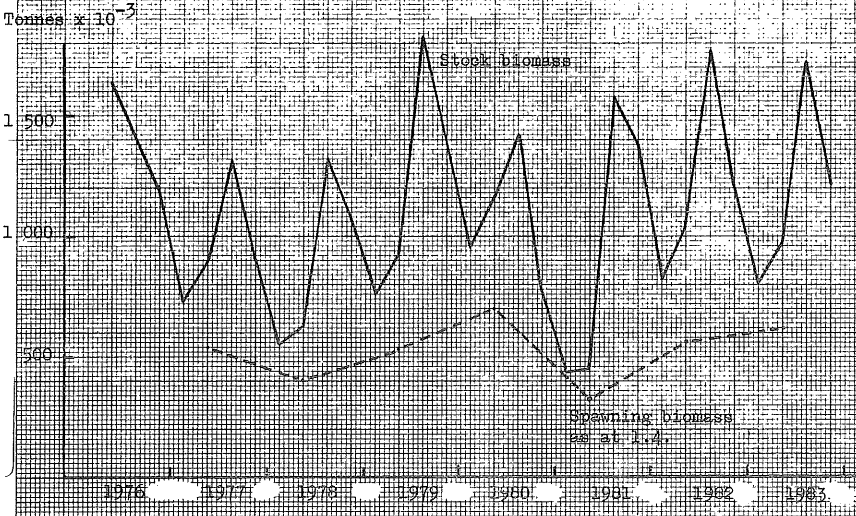


Figure 4.3.3 Cpue in the Norwegian fisheries versus spawning stock biomass at 1 April (from VPA).

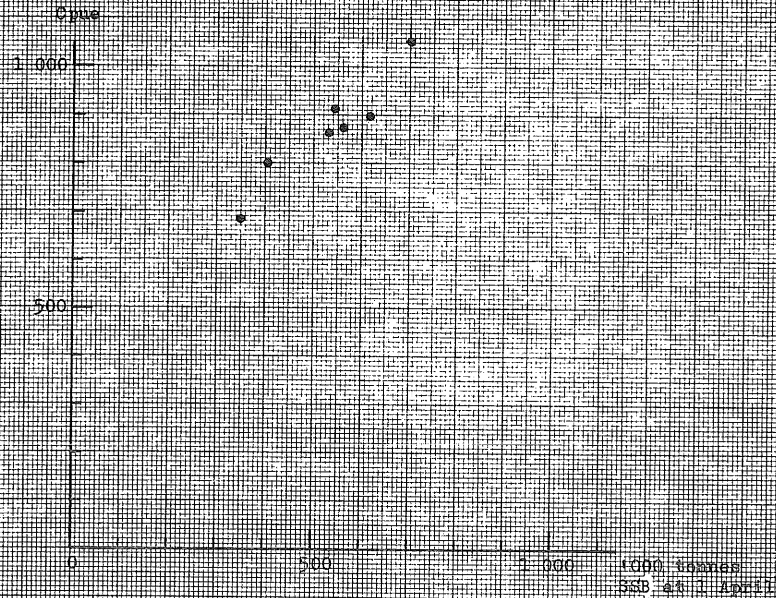


Figure 4.4.1. Sampling areas used for recruitment indices of NORWAY POUT shown in Table 4.4.1.

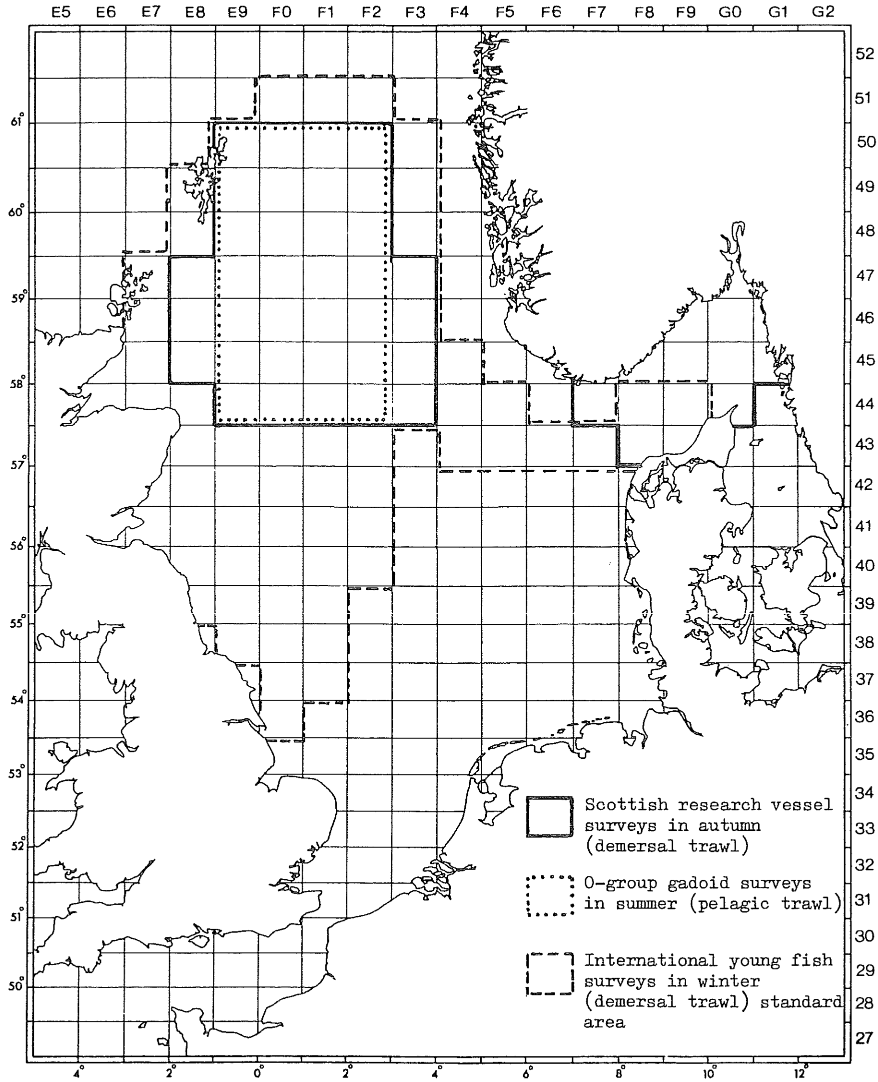


Figure 4.9.1. NORWAY POUT.
Prediction of catch.

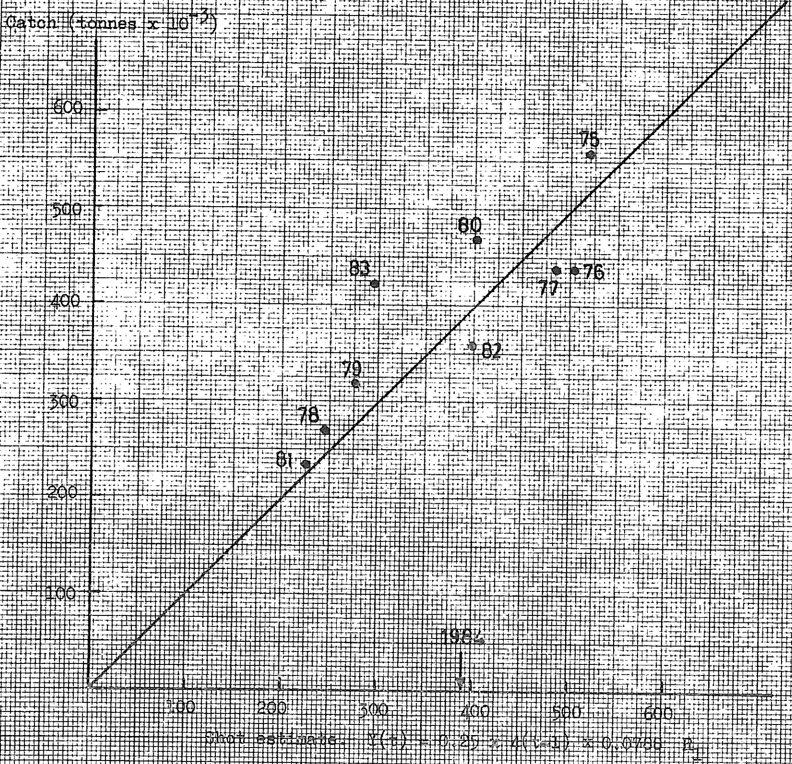


Figure 5.1.1. Danish SANDEEL areas and assessment areas used by the Working Group.

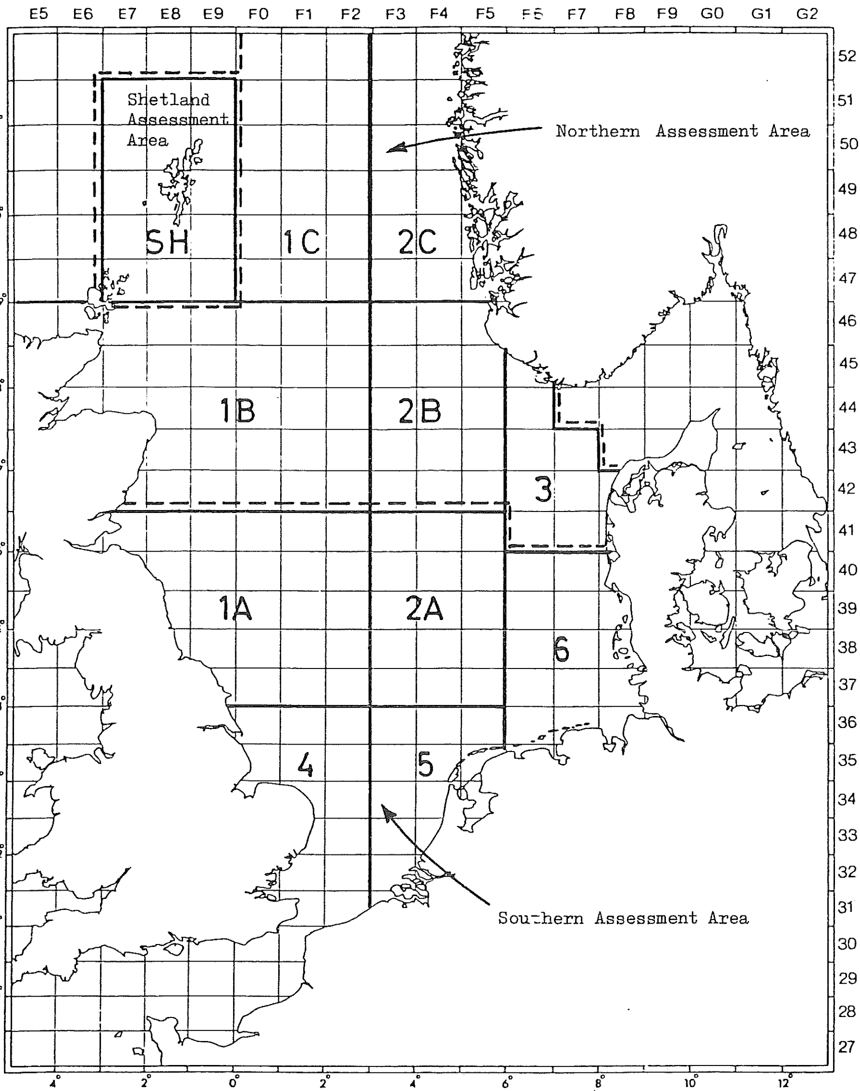


Figure 5.3.2. Year-class strength of SANDEEL plotted against catch of 0-group.

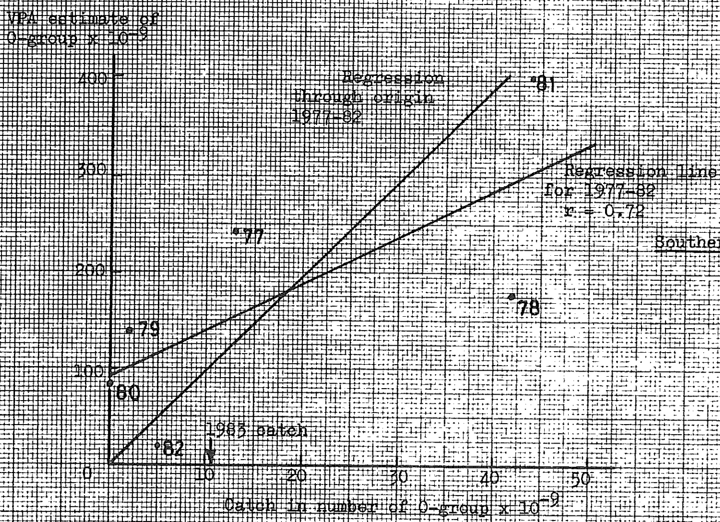


Figure 5.3.2. Correlation between F and fishing effort in the Shetland SANDEEL fishery.

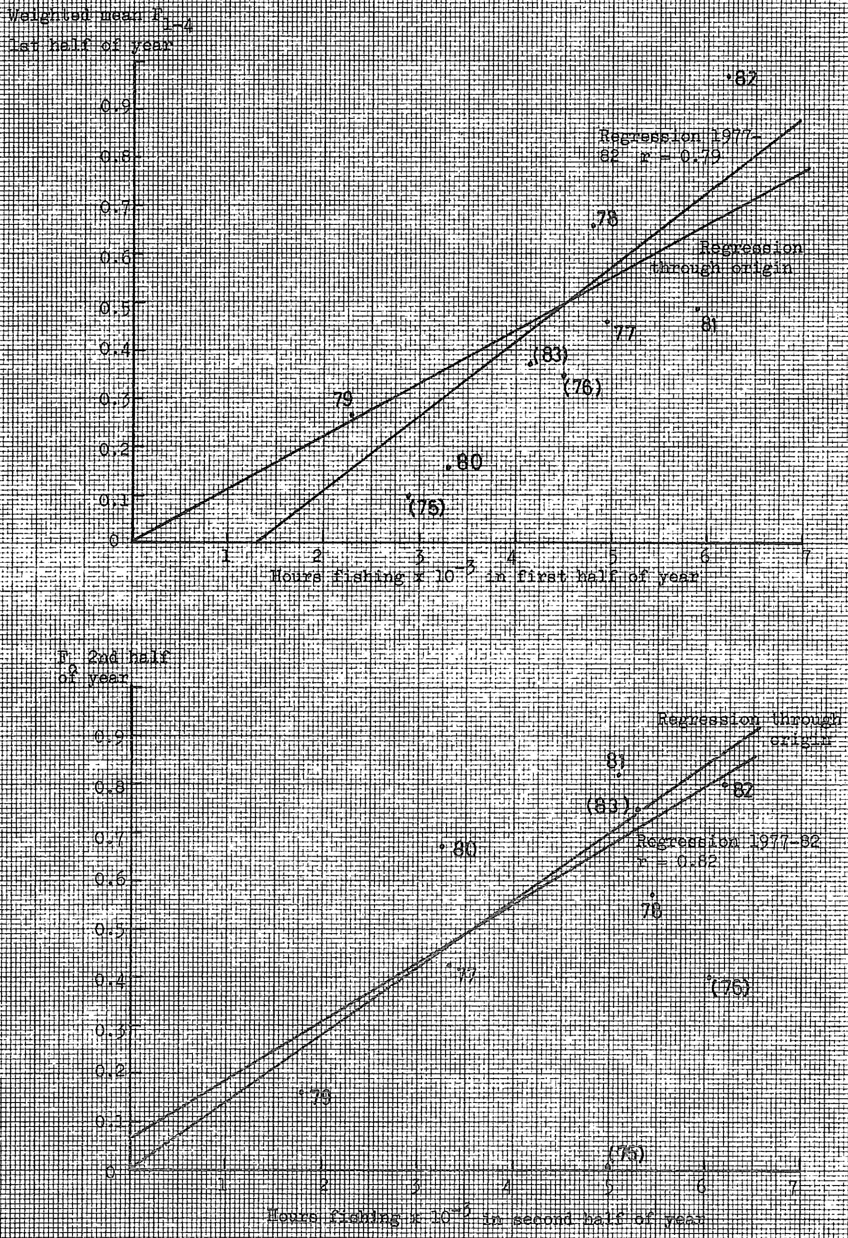


Figure 5.8.1. Southern North Sea SANDEEL.
Yield per recruit (g) for sandeels in the southern North Sea.

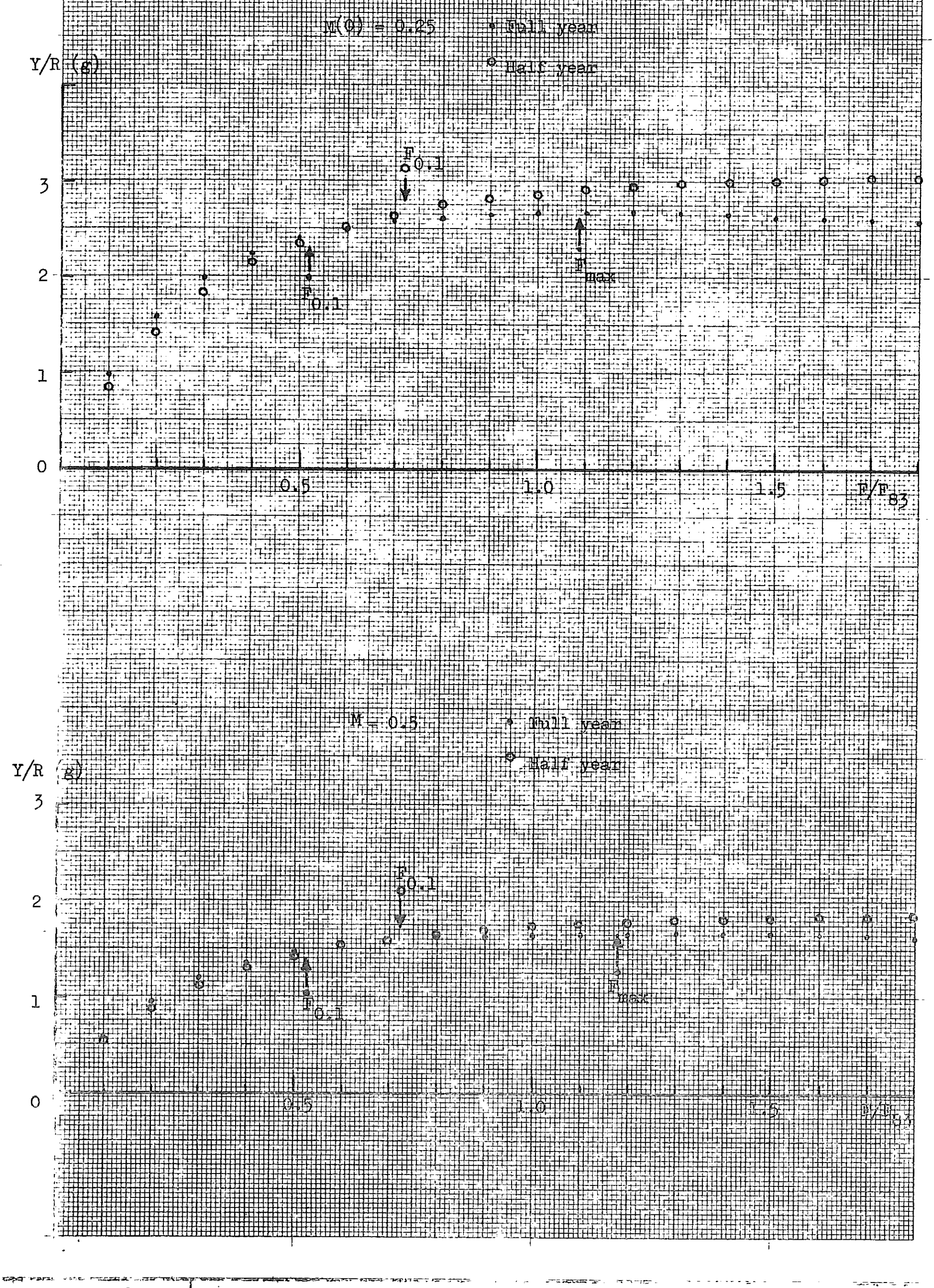


Figure 5.6.2. Northern North Sea SANDEEL.
Yield per recruit (g) for sandeel in the northern North Sea.

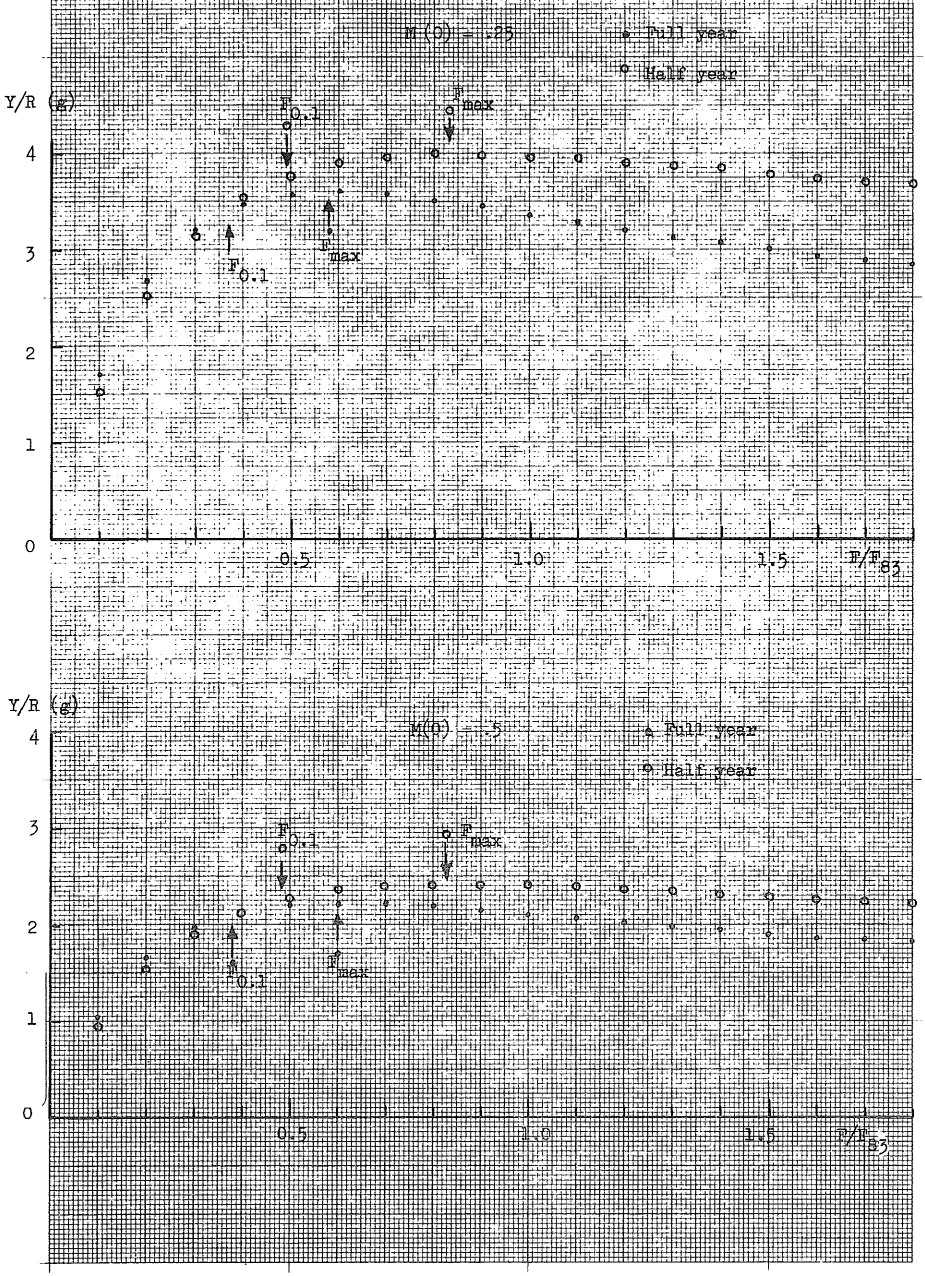
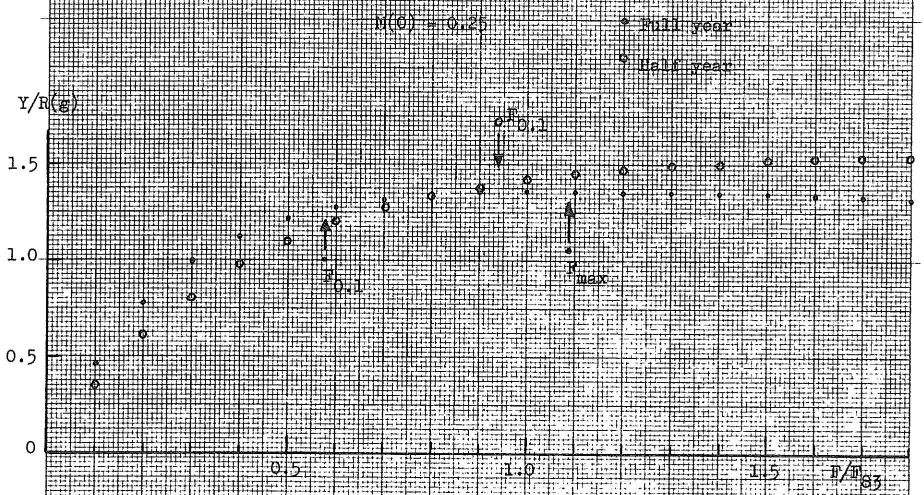


Figure 5.8.3. Shetland SANDEEL.
Yield per recruit (g) for sandeel in the Shetlands.



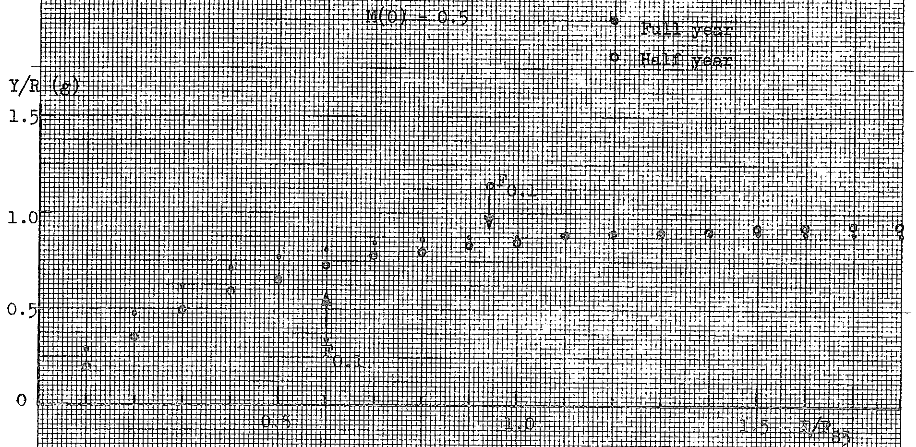


Figure 6.1.1. International SPRAT reporting areas.

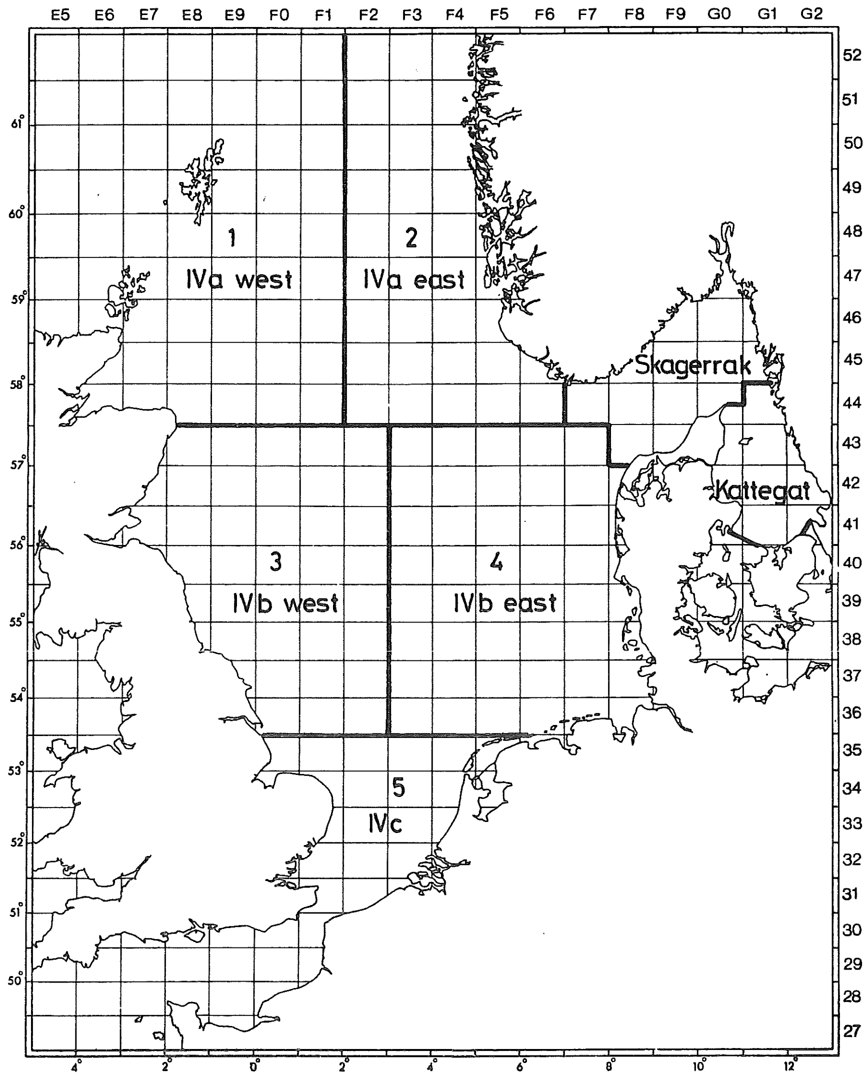


Figure 6.9.1. Regression of total yield of SPRAT in Division IIIa on revised 1-group indices in the same year.

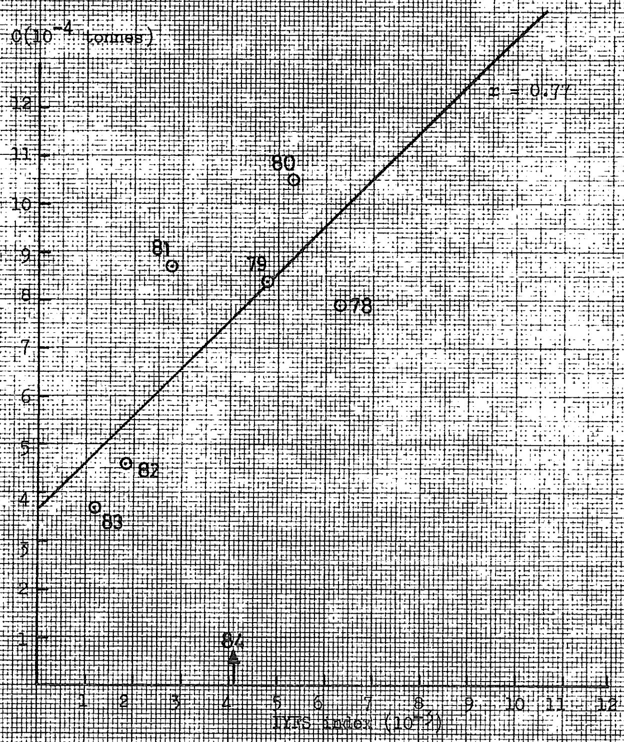


Figure 7.3.1. North Sea SPRAT.
Biomass (tonnes x 10^3) at the beginning of the year, total stock and adult stock (age groups 2, 3 and 4) in relation to average annual fishing mortality on 1- and 2-groups.

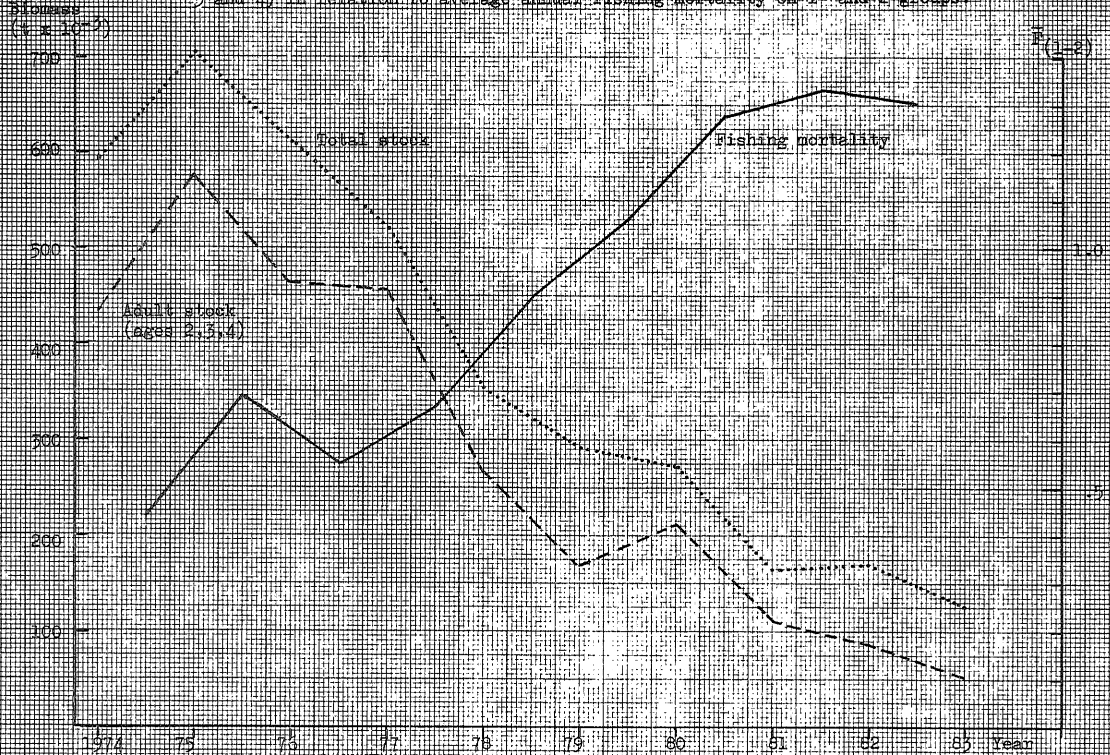


Figure 7.4.1. Acoustic estimates of SPRAT biomass (t x 10^{-3}) in each half statistical rectangle, December 1983 in Division VIb(E) (Norway) and January 1984 in Division IVa and IVb (W) (Scotland).

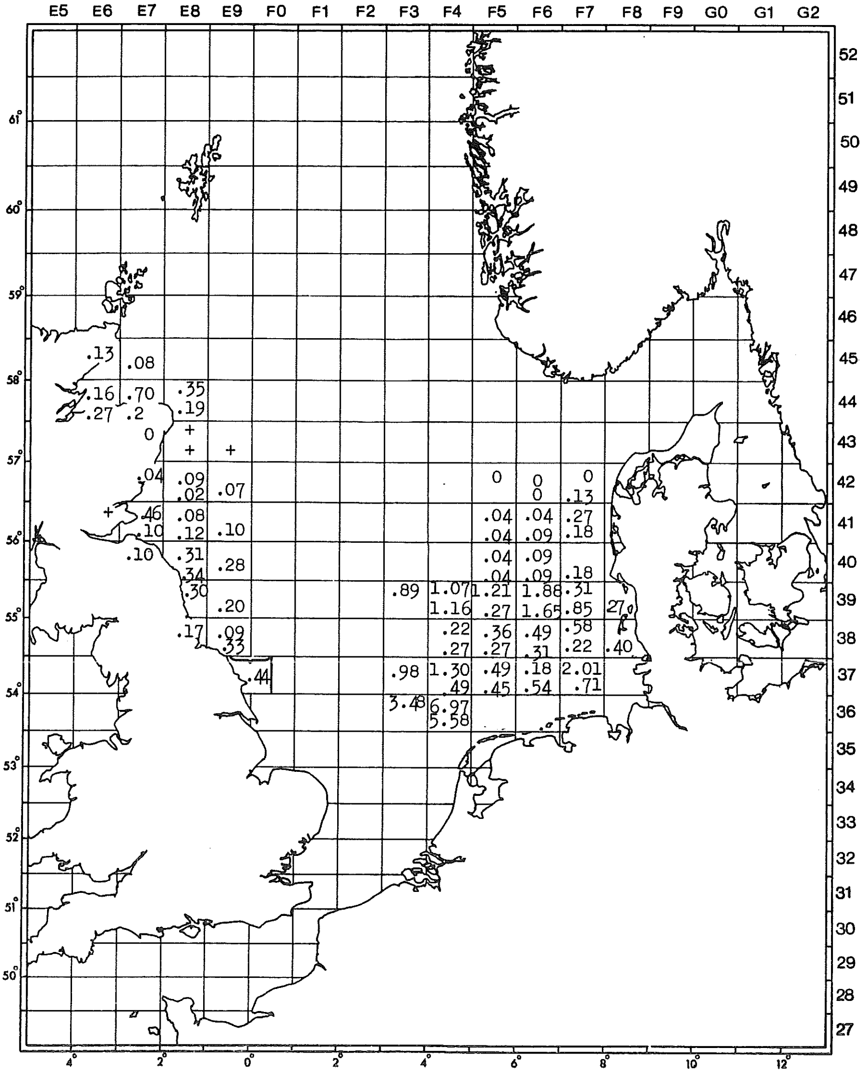


Figure 7.4.2. 0-group SPRAT.
No/hour, 1983.

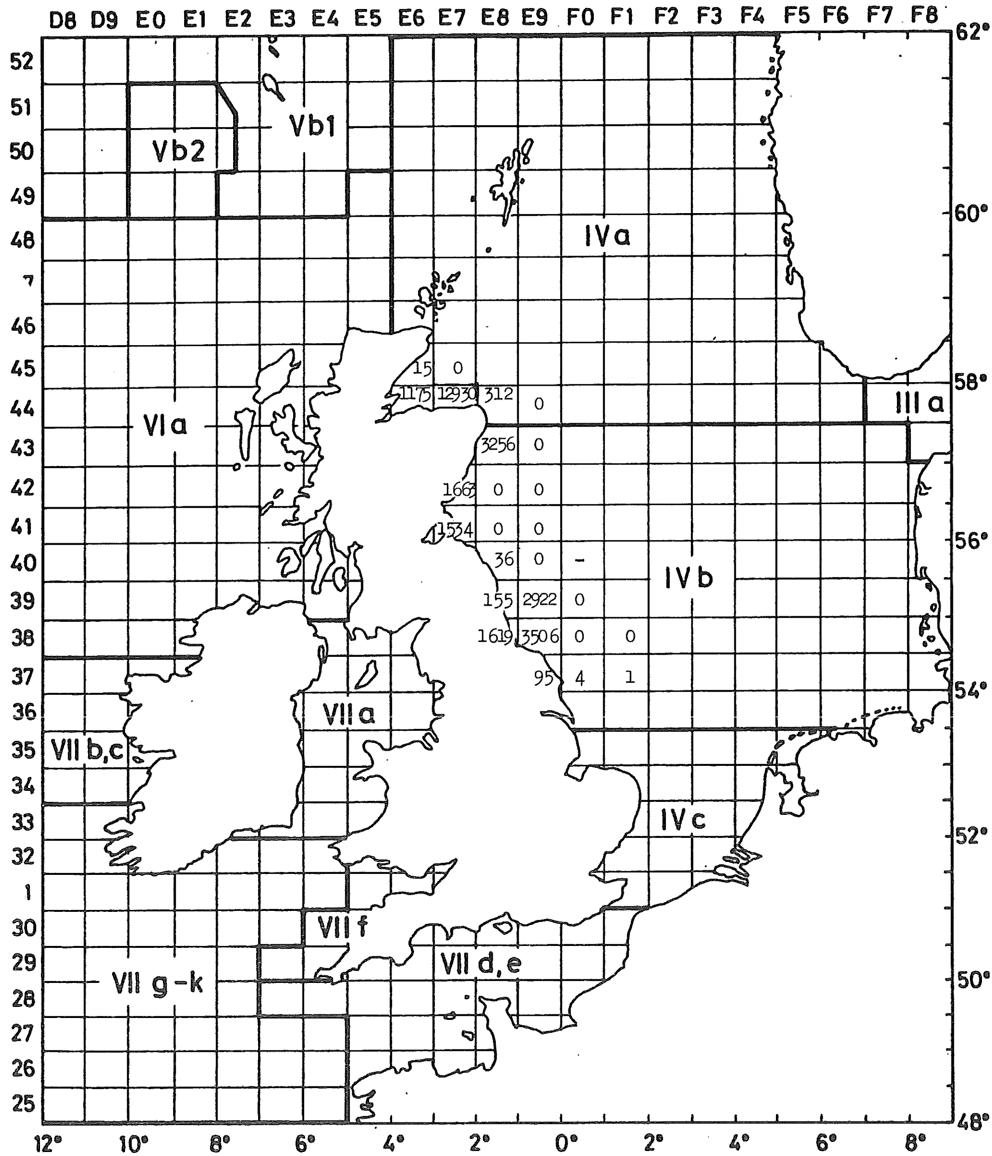


Figure 7.8.1. North Sea SPRAT.
Logistic equilibrium line (WALTER'S first approximation).
Dates refer to biomasses at 1 January.

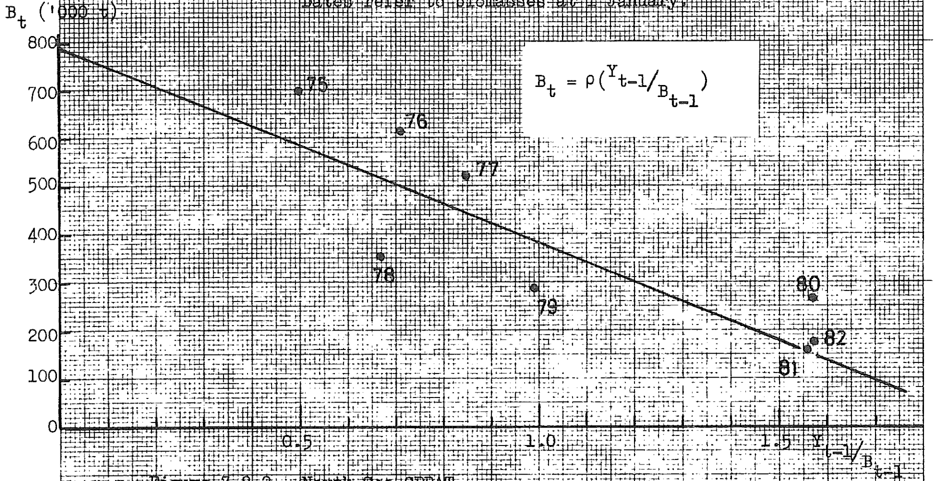


Figure 7.8.2. North Sea SPRAT.
Logistic equilibrium catch (parabola) plotted versus
actual landings during fishing season (July$_{t-1}$ - March$_t$).

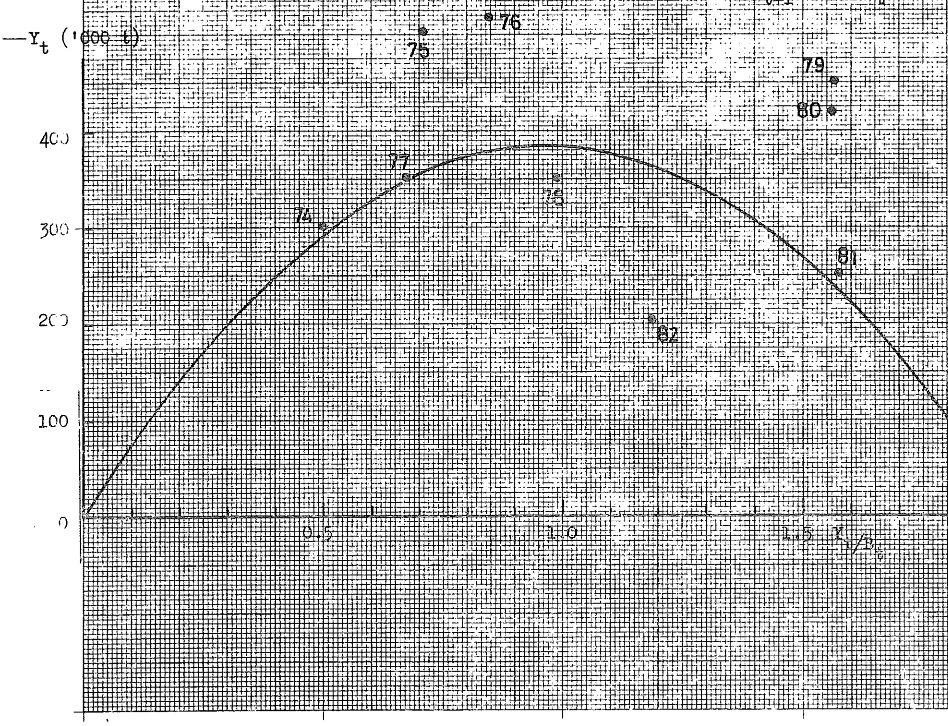


Figure 7.9.1. North Sea SPRAT.
Plot of SHEPHERD'S index vs actual landings.

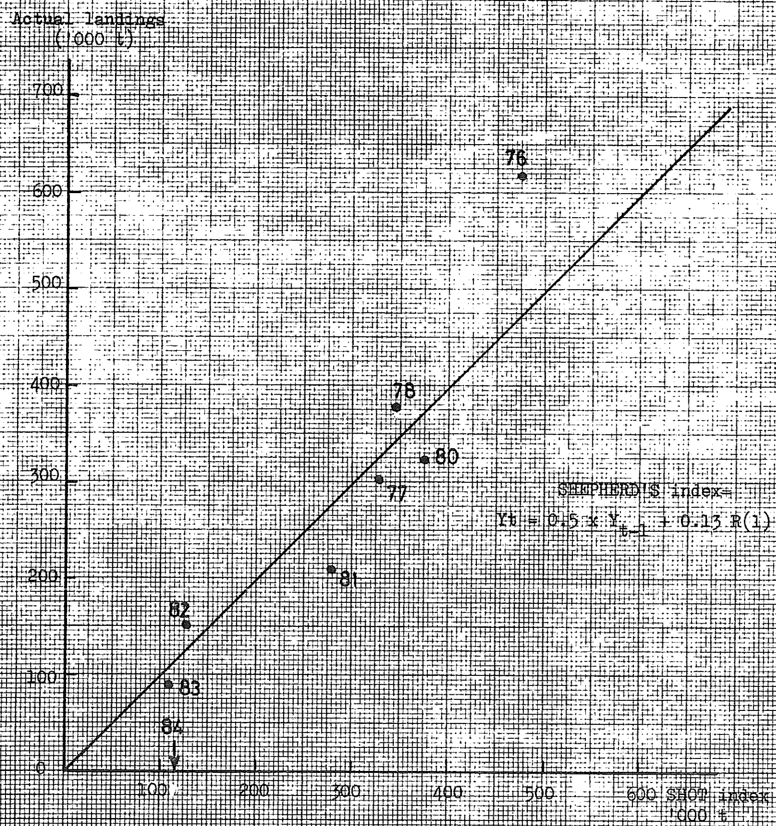


Figure 7.10.1. Trends in catch and age composition of North Sea SPRAT landings 1974-83.

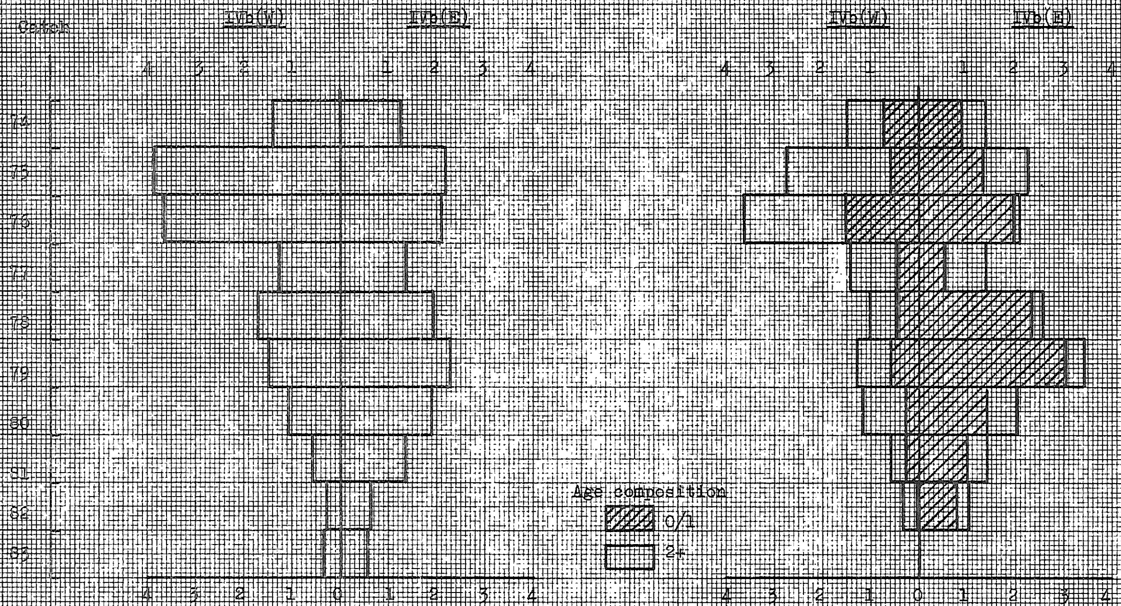


Figure 8.1.1. Lyme Bay area SPRAT - Seasonal catches by United Kingdom vessels.

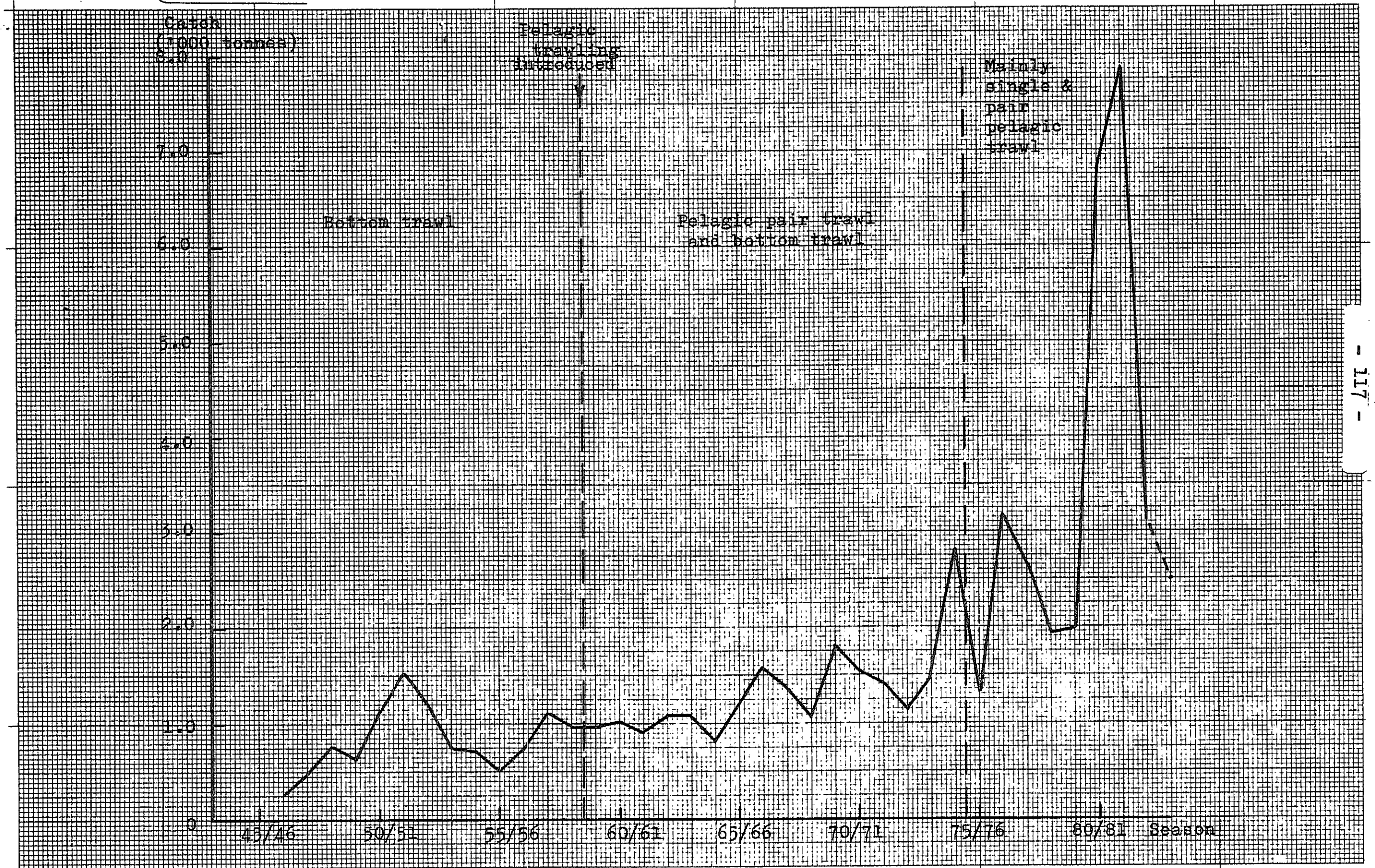


Figure 8.4.1. SPRAT acoustic biomass estimates ('000 tonnes). December 1981 and December 1983.