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International Council for the
Exploration of the Sea

C.M.1989/Assess:13

REPORT OF THE INDUSTRIAL FISHERIES WORKING GROUP

Copenhagen, 29 March - 4 April 1989

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T A B L E   O F   C O N T E N T S

1 INTRODUCTION

1.1 Participation

H. Gislason (Chairman)	Denmark
O. Hagström (part-time)	Sweden
P.A. Kunzlik	UK (Scotland)
J. Lahn-Johannessen	Norway
A. Nicolajsen	Faroe Islands
N.A. Nielsen	Denmark
K. Popp Madsen	Denmark

1.2 Terms of Reference

At the Statutory Meeting in 1988, it was decided (C.Res.1988/ 2:4:8) that the Industrial Fisheries Working Group (Chairman: Mr H. Gislason) should meet at ICES Headquarters from 29 March – 4 April 1989 to:

a) consider the report of the Multispecies Assessment Working Group;

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

c) assess the status of the stocks of the target species in the industrial fisheries, i.e., sprat in Sub-area IV and Divisions IIIa, VIa, and VIId,e and Norway pout and sandeel in Sub-area IV and Divisions IIIa and VIa;

d) provide quarterly catch-at-age and catch and stock mean weight-at-age data and information on the relative distribution at different ages by quarter for North Sea stocks for 1988 as input for the multispecies VPA.

In addition, the Working Group received, through the ICES Secretariat, a request to:

e) assess the effects upon the North Sea sandeel stocks of catches of O-group sandeel and consider the necessity for and, if appropriate, the means of protecting this component of the stock.

The Working Group was presented with data on Norway pout in Division Vb. This stock is not included in the terms of reference of the Working Group and it was, therefore, decided only to append these data to the report (Annex 1).

In the "Guidance to Assessment Working Groups from ACFM and the Secretariat", it is requested that data on the length composition of the catch by fleet are supplied. The available data are presented in Annex 2.

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

2.1 Trends in the North Sea Fisheries

The annual landings from the industrial fisheries for the years 1974-1988 are given in Table 2.1. The total landings declined from a maximum of 1.9 million t in 1974 to a minimum of 1.0 million t in 1985. They remained at the low level of 1.1 million t in 1986 and 1987, but increased to 1.3 million t in 1988. The catch composition changed markedly from 1987 to 1988. As in the most recent years, sandeel by far comprised the bulk of the landings, exceeding 60% of the total in 1988, and the figure of 893,000 t is the highest on record. Landings of sprat increased from 32,000 t to 92,000 t and landings of herring from 47,000 t to 179,000 t. Norway pout landings continued to decline to a minimum of 102,000 t. By-catches of protected species increased from a minimum of 24,000 t in 1987 to 55,000 t in 1988.

2.2 Trends in the Division IIIa Fisheries

The annual landings from the industrial fisheries for the years 1974-1988 are given in Table 2.2. Total landings have oscillated around a long-term mean of 171,000 t without any particular trend, increasing from 121,000 t in 1987 to 146,000 t in 1988. Long-term trends decline in landings of sprat and Norway pout.

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

The annual landings of by-catches of the major protected species in the industrial fisheries are given in Table 3.1. The combined landings of haddock, whiting, and saithe declined to a minimum of 22,000 t in 1986, remained at the low level of 24,000 t in 1987, but increased to 55,000 t in 1988. The estimated figures by species were 50,000 t of whiting, 4,000 t of haddock, and 1,000 t of saithe. The by-catch of whiting was three times higher in 1988 than in the preceding year, that of haddock remained at the same level, and the by-catch of saithe dropped to one fourth of the 1987 figure.

Maps showing the distribution of protected species caught in the industrial fisheries were made available for 1988. They are not published in the present report, but are retained in the files of the Working Group.

The species compositions of the Norwegian fisheries for Norway pout and sandeel are shown in Tables 3.2 and 3.3. In 1988, the catch of blue whiting exceeded the landings of Norway pout. Whiting dominated the by-catch of protected species and, for the first time in many years, herring made a significant contribution as by-catch in the Norway pout fishery. In the sandeel fishery, the by-catch made up 3% of the total landings, mainly consisting of whiting, haddock, and dab (others).

4 NORWAY POUT

4.1 Landings

North Sea

Landings by country are shown in Table 4.1.1 for the period 1957–1988. Total landings were the lowest since 1966 and 31% lower than in 1987. Landings by month and country for the period 1986–1988 are given in Table 4.1.2 and show landings to be reduced in all quarters of 1988 except the last when compared with 1987.

Division VIa

Annual landings by country as officially reported to ICES are given in Table 4.1.3 for the period 1974–1988. The preliminary figures for 1988 show landings to be reduced to the level of 1981–1986 after the large increase in 1987.

Division IIIa

Table 4.1.4 shows annual landings by country as officially reported to ICES for the period 1975–1988.

4.2 Fishing Effort and Catch per Unit Effort

Danish CPUE

Danish catch per unit effort is given in Table 4.2.1 for the period 1982–1988 for each of the vessel size categories taking part in the Norway pout fishery. CPUE in the largest and smallest vessel categories increased in 1988 compared with 1987 and decreased for the four intermediate categories. CPUE data representing 99% of the Danish catch were sampled in 1988 (Table 4.2.2).

Norwegian CPUE

Norwegian CPUE is given in Table 4.2.3 by quarter for the Norway pout and blue whiting fishery during the period 1976–1988. Corresponding data for the directed Norwegian Norway pout fishery (defined as ≥ 70% Norway pout by weight) are given in Table 4.2.4.

In the directed fishery, the mean weighted CPUE increased from 1.194 hectolitres (hl) per day fishing per GRT to 1.276, whilst in the mixed fishery, it fell from 1.230 hl/d/GRT to 1.077. Norwegian effort in days fished and average GRT is shown in Table 4.2.5.

Total Danish and Norwegian effort

Danish and Norwegian effort data were standardized to a vessel category of 200 GRT using the methods outlined in the 1985 Working Group report (Anon., 1985).

The Danish CPUE and GRT data (Figure 4.2.1) were fitted to a GLM of the form:

$$CPUE = A_{year} \times (GRT - G_0)^b$$

where A_{year} is a year-dependent coefficient, b is a constant, and G_0 is a constant chosen to minimize the RMS of the model. $G_0 = 50$ was selected as a suitable value and the results of the analysis are shown in Table 4.2.6. The model was fitted to all data except for the 1988 smallest vessel category and the largest vessel category for which the data were considered to be outliers. Once fitted, the coefficient of determination was 0.91 and the results are shown in Table 4.2.7. As the results were close to those in the previous Working Group report (Anon., 1988a), the earlier results were actually used with a re-calculated value for A_{1988}. This was done to avoid a reworking of the standardized effort data shown in Table 4.2.7. The values for 1988 were simply estimated and included with previous estimates for the period 1982-1987.

Combined and standardized effort decreased in the first three quarters of 1988 compared with 1987 and increased slightly in the fourth quarter. Total effort was 33% down in 1988 compared to 1987 and the lowest level since 1982 at least.

4.3 Natural Mortality

As before, an annual value of 1.6 was used and, where appropriate, divided evenly between the four quarters of the year.

4.4 Catch at Age and VPA Results

Catch-at-age data for 1988 were available from Denmark and Norway. The data were combined and raised to total international landings. Tables 4.4.1 and 4.4.2 show the quarterly and annual catch in numbers at age, respectively.

Two VPA runs were performed. One used quarterly data and was "hand-tuned" to the IYFS 1-group index, as in previous Working Groups (e.g., Anon., 1988a). In addition, an annual VPA was run using the Laurec-Shepherd procedure. This used catch and effort data from four "fleets". They comprised Denmark/Norway combined; IYFS data (1- and 2-group indices); EGFS 0-, 1-, and 2-group indices; and SGFS 1- and 2-group indices (see Table 4.5). The VPA was tuned using data from 1982-1988 with no down-weighting of the older data. (Down-weighting was precluded as an option due to technical difficulties.)

Despite being tuned specifically to the IYFS 1-group index, the quarterly "hand-tuned" approach led to a worse fit between the IYFS 1-group index and VPA 1-group estimates ($R^2 = 0.57$) than did the Laurec-Shepherd approach ($R^2 = 0.66$). As a result, the Laurec-Shepherd annual procedure was determined to be the method of choice. Estimated fishing mortalities at age and stock in numbers at age calculated in this way are given in Tables 4.4.3 and 4.4.4, respectively.

The plot of VPA 1-group estimates on IYFS 1-group indices is shown in Figure 4.4.1. The plot of mean $\bar{F}_{(1-3)u}$ on effort is

given in Figure 4.4.2. (The plot, although not satisfactory, is
little worse than the equivalent quarterly "hand-tuned" relation-
ship.)

Catchabilities at age by fleet from the Laurec-Shepherd tuning
are given in Table 4.4.5. In all age groups, the fishery rather
than the survey data were most heavily weighted.

Due to the change in methods, a comparison is given in Figure
4.4.3 between total biomass estimates resulting from the new and
traditional procedures. In both cases, the weight at age in the
stock for the first quarter was used. From this it can be seen
that the new tuning method produces lower biomass estimates in
general and in recent years in particular. In 1987, the Laurec-
Shepherd estimate is only 48% of the "traditional" estimate, and
only 30% in 1988.

General trends in biomass estimates show that since 1985 the mean
total biomass has been 244,000 t, reduced from the 1976-1984 mean
of 728,000 t. The equivalent reduction in estimates of the spawn-
ing stock biomass is from 477,000 t to 167,000 t.

4.5 Research Vessel Surveys

Research vessel survey indices of abundance are given in Table
4.5 for the period 1968-1988. English Groundfish Survey data
(August) are now included for 0-group to 3-group inclusive. The
first indices for the 1988 year class are available from this
survey as 0-group, and in the February 1989 IYFS survey (preli-
minary) as 1-group. The preliminary IYFS index is estimated from
the numbers caught of fish $\leq$15 cm . This was not corrected by
examining age-length keys as previous adjustments have been mar-
ginal.

The 1989 IYFS 1-group index is 16 times the previous year's in-
dex, which was exceptionally low, and approximately two thirds of
the 1987 survey 1-group index. These relative changes are reflec-
ted by the EGFS 0-group index.

4.6 Weights at Age

The mean weights at age by quarter for age groups 0-4 are shown
in Table 4.6.1 for 1986-1988. The contribution by weight by age
group to the annual catch is shown in Table 4.6.2. It can be seen
that 50% of the catch in 1988 comprised 2-group fish, with 1-
group fish contributing only 27% of the catch. This contrasts
with the 1980-1987 mean 1-group contribution of 64% with no
single observation less than 43%. This is further evidence that
the 1987 year class was extremely poor.

4.7 Catch Predictions

A SHOT estimate was made using data for the years 1979-1988 with
a variable "hang-over" factor estimated from the yield/biomass
ratio and modified by inspection of recent effort indices. A
series of 1-group recruitment indices for inclusion in the SHOT
procedure was estimated using the RCRTINX2 program for which all
default options were chosen. The recruitment series combined VPA

1-group estimates with IYFS 1- and 2-group indices, EGFS 0-, 1-
and 2-group indices, and SGFS 1- and 2-group indices (see Table
4.5). The RCRTINX2 results are shown in Table 4.7.1.

The SHOT estimate was based on a spreadsheet procedure (Shepherd,
unpublished MS) and the input data and results are shown in Table
4.7.2. The SHOT estimates are also shown with actual landings in
Figure 4.7.

The SHOT prediction for 1989 assuming the same low level of
effort as in 1988 is 121,000 t, an increase of 14,000 t over the
1988 catch.

The fitted SHOT estimates compared to true landings (Figure 4.7)
correspond well for the years 1983 and 1985-1988. The fitted SHOT
value for 1984 is, however, 150% of the actual landings. This
anomaly is attributable to the recruit index for the 1983 year
class, which is high in all surveys, contrary to the VPA in which
it is estimated to be half of the value of the survey predic-
tions.

5 SANDEEL

5.1 Landings in 1988

North Sea

Landings increased in 1988 to 893,000 t, which is the highest
ever recorded. Annual landings by country are given in Table
5.1.1 and it shows that landings in the more recent years have
been at a record high level above 800,000 t. Prior to these
years, landings were in the range of 500,000-800,000 t. Table
5.1.2 shows the landings by months for Denmark, Norway, and UK
(Scotland). The majority of the landings (80%) are taken in the
period April-June. Much higher landings were taken in the early
period of the fishing season in 1988 compared with 1987. In 1988,
36% of the total landings were taken in May.

In 1988, the fishery was constrained by a TAC in the Norwegian
zone, and limitations on the landings on 0-group sandeel were
introduced in the second half of the year (see Section 5.6).
These regulations have had an effect on the monthly landings
which should be borne in mind when landings in 1988 are compared
with earlier years.

Landings by month and area for Denmark, Norway, and UK (Scotland)
are given in Table 5.1.3 for the years 1986-1988. The most im-
portant fishing areas are Areas IA and 2B (see Figure 5.1). In
1988, considerable catches were taken in Areas 3 and 6, which are
the coastal areas in the Eastern North Sea. The geographical
distribution of the landings in 1988 was similar to the distri-
bution in 1986.

Landings by area and assessment area are given in Table 5.1.4.

Landings from the Shetland area declined to the lowest on record
since 1974 when the fishery started. Landings in 1988 from the
Northern assessment area remained at the same high level, just
below 400,000 t as in 1986 and 1987. For the Southern assessment

area, the landings increased to 490,000 t which is close to the average for the last 10 years from that area.

Division VIa

The Scottish landings from Division VIa increased to 24,465 t in 1988 compared to 14,479 t in 1987 (Table 5.1.5). Landings in 1988 are at the same high level as in 1986, and above the average landings for this area.

Division IIIa

Officially estimated landings increased from 3,817 t in 1987 to 22,365 t in 1988 (Table 5.1.6). The increase in landings from Division IIIa in 1988 may be compared with the high landings from the adjacent Area 3 in the North Sea in 1988. In 1987 and also in 1985, low landings were observed both in Division IIIa and Area 3 of the North Sea (see Figure 5.1). Landings reported by Working Group members are given in Table 2.2.

5.2 Fishing Effort

Fishing effort data were available from all fleets fishing for sandeel. The effort data for Norwegian and Danish vessels are based on logbook data, with virtually 100% coverage in the most recent years (Table 5.2.1).

For the Norwegian fishery, effort data are available for the period 1976-1988. For each half year, the number of fishing days, the mean GRT of the fleet, CPUE, and catch are given in Table 5.2.2 for the Northern and Southern areas, respectively.

The Danish CPUE data are given by half year and vessel category (GRT size class) for the years 1982-1988 for each area (Tables 5.2.3 and 5.2.4).

For each area, a multiplicative model was fitted to the Danish CPUE data:

$$\text{CPUE (year, GRT)} = A_{\text{year}} \times \text{GRT}^B$$

The model assumes that the CPUE, in terms of the catch per day, is a power function of the GRT of the vessel. In addition, annual changes in CPUE are assumed to be a fixed proportion for all vessel groups.

The model-fitting results are shown in Table 5.2.5 for the Southern North Sea. The parameter B is estimated to be 0.5, which means that on average the catch per day for a 400 GRT vessel is twice as high as the catch per day for a 100 GRT vessel.

The model fit is rather good and explains 92% of the variance in the CPUE data. The fitted curve is shown in Figure 5.2 and points for 1988 have been indicated to show the multiplicative structure of the model.

The logarithms of the year parameter A_{year} are shown in Table 5.2.5. The first year is used as a reference year. The estimated

CPUE of a 200 GRT vessel for the period 1982-1988 is shown in Table 5.2.6. Standardized international effort is calculated using these values.

The results of the analysis for the Northern North Sea are shown in Table 5.2.7 and Figure 5.3. As shown in Figure 5.3, the model fit is not quite satisfactory since the GRT group of 275 GRT has lower CPUE than predicted. The $R^2 = 0.79$ is, however, still reasonably high.

The standardized CPUE for a Danish 200 GRT vessel is derived from the estimated parameters and shown in Table 5.2.8. The Norwegian data have been standardized to the same vessel size and the two series are combined. Combined CPUE and effort data for the Northern assessment area are shown in Table 5.2.8.

Compared to 1987, fishing effort increased in 1988 by about 10% in the Northern area and about 40% in the Southern area. The fishing effort in the Southern area is still below the level in the beginning of the 1980s.

For the Shetland area, fishing effort declined to the lowest level since the fishery began (Table 5.2.9). Table 5.2.10 gives effort data for Division VIa, and it can be seen that effort rose in 1988 compared with 1987.

5.3 Natural Mortality

No new information on mortality estimates was available to the Working Group and it adopted the same values as in 1987 and 1988. The values are given in Table 5.3.

5.4 Catch at Age and VPA

5.4.1 Catch at age

Southern and Northern areas

Data on catch at age were supplied by Denmark and Norway for the fishery in the Northern area. For the Southern area, the small Norwegian landings were allocated according to Danish age compositions.

The Faroese landings from the North Sea were all assumed to have been taken in the Northern area and were raised to age composition using combined Danish and Norwegian data.

The revised quarterly age compositions for 1987 and the quarterly age compositions for 1988 are given in Table 5.4.1. In 1987, the majority of the catches consisted of 2-group fish, and the strong 1985 year class also contributed significantly to the catch in 1988. The 3-year-olds in 1988 made up more than 50% of the catch in numbers.

The numbers caught in the Northern North Sea in 1987 and 1988 are shown in Table 5.4.2. The majority of the catches in 1988 consist of 2-group sandeel. The 1986 year class was also, in 1987 as 1-group, the most important age group in the catches.

Shetland

The UK (Scotland) catch in numbers for the Shetland area is given
in Table 5.4.3. The catch in numbers comprised mainly 0-group
sandeels (58%) with 1-group sandeels contributing only 3.5% of
the catch. The catch in numbers of 1-group sandeels was exceeded
by 2-group (16%), 3-group (12%), and 4-group (5%) fish in 1988.
Prior to this, the catch in numbers of 1-group had never been ex-
ceeded by any of the older age groups.

Division VIa

The catch in numbers at age from Division VIa is given in Table
5.4.4. The catch in numbers comprised mainly 2-group fish (49%)
with the 0-group and 1-group contributing 27% and 7%, respec-
tively.

5.4.2 Input fishing mortality

Southern North Sea

The Working Group decided to try both the semi-annual VPA tuned
to semi-annual effort data, and an annual VPA tuned to annual
effort data. The semi-annual VPA was prepared by the Working
Group because some effort in the second half of the year is
directed towards 0-group fish. An annual VPA will not take this
into account if tuned to annual data. The annual VPA may, how-
ever, be dealt with by the tuning module implemented on the ICES
computer and a more "objective" tuning might be expected.

Effort data were available for the Danish sandeel fleet in the
Southern North Sea. Constant catchability was assumed for this
fleet and no down-weighting of older years was applied. Fishing
mortality in the oldest age group was assumed equal to the
average F of the two younger age groups (ages 2 and 3).

Catch-at-age data, fishing mortality estimates, and stock sizes
are given in Tables 5.4.5 - 5.4.7.

Estimated catchability coefficients from the tuning module are
given in Table 5.4.8.

The estimated mean fishing mortalities $\bar{F}_{1-2}$ and $\bar{F}_{1-3}$ and fishing
effort data are plotted in Figure 5.4.

The plot in Figure 5.4 and the fairly constant catchability
coefficients shown in Table 5.4.6 suggest that the assessment is
reliable. However, the high variability on the 0-group log catch-
abilities implies that the estimate of the 0-group F in 1988 is
unreliable.

The catch-at-age data by half year are given in Table 5.4.9.
Fishing mortalities for the first half year in the period 1982-
1986 were averaged to give an average exploitation pattern for
the first half year. Input fishing mortalities in the second half
of 1988 were chosen to give this fishing pattern and mean $\bar{F}_{1-2}$ in
accordance with the linear plot of F and effort (Figure 5.5).

Estimated fishing mortalities and stock sizes are shown in Tables 5.4.10 and 5.4.11. Figure 5.6 shows the time series of fishing mortality and fishing effort for the period 1982-1988.

Northern area

For the Northern area, an annual VPA must be carried out on only four true age groups if the tuning module is used. The results of the tuning module with a terminal F for the oldest age group chosen as an average of the fishing mortality for ages 1 and 2 are shown in Tables 5.4.12 and Figure 5.7. The plot is far from convincing.

The Working Group then attempted a similar procedure with semi-annual data as for the Southern North Sea. Mean fishing mortalities for the period 1982-1986 were calculated to give the fishing pattern for the first half of the year. Input fishing mortalities for the second half of 1988 were chosen to produce this fishing pattern in the first half of 1988 and a mean F_{1-2} in accordance with the tuned plot of F and effort (see Figures 5.8 and 5.9).

Semi-annual catch at age, fishing mortality, and stock size estimates are given in Tables 5.4.13-5.4.15.

Shetland area

A semi-annual VPA was performed with input fishing mortality rates estimated as last year. An annual ad hoc tuned VPA was not run because it was considered inappropriate to use annual effort data when a marked seasonality occurs in the fishery. That is, catches of 1-group and older fish, effectively relating to only the first half of the year, would be tuned to effort data from both halves; similarly for catches of 0-group sandeel which effectively relate to effort in only the second half of the year.

Therefore, fishing effort was used to estimate values of F in the appropriate half of the year by correlating effort and converged values of F from a trial VPA. Input Fs were obtained using the relationship between F and effort over the period 1974-1984 and effort data for 1988.

F at age 0 in the second half of each year was correlated with effort in the same period (Figure 5.10), with the line forced through the origin. This resulted in an input F_0 of 0.035 for the second half of 1988. F_1 in the first half of 1988 was estimated to be 0.068 from the relationship shown in Figure 5.10 and this required an input F in the second half of the year of 0.014. Similarly, the unweighted mean $F_{(2-5)}$ in the first half of the year was estimated to be 0.096 (Figure 5.10) requiring input Fs of 0.004 for all age groups ≥ 2 in the second half of the year.

Division VIa

Input fishing mortality rates were estimated in the same way as for the Shetland area, but with a shorter time series of data. The argument against an annual ad hoc tuned VPA is not as convincing in this area as for Shetland. However, it was decided to retain the earlier approach of estimating input Fs prior to the implementation of a semi-annual tuning program currently in development by Working Group members.

F_0 was estimated for the second half of the year from the rela-
tionship shown in Figure 5.11 (this line was forced through the
origin). F_1 and $F_{(2-5)}$ were estimated from the relationships in
Figure 5.11 for the first half of the year and appropriate values
chosen for second half Fs in order to attain these figures. The
input Fs thus chosen were: 0-group = 0.06, 1-group = 0.036, and
2-group and older = 0.17.

5.4.3 **VPA results**

Southern North Sea

Catch-at-age data and estimates of fishing mortality and stock
size are given in Tables 5.4.5-5.4.7 for the annual VPA and in
Tables 5.4.9-5.4.11 for the semi-annual VPA.

The estimated stock sizes and fishing mortalities from the two
VPAs are very similar. Figure 5.12 provides a comparison of the
estimated SSB by the two VPAs. No major differences can be found.
The semi-annual VPA provides, however, information on the fishing
pattern which can be used for an evaluation of the effect of
seasonal restrictions on the 0-group fishery (dealt with in
Section 5.6).

The spawning stock biomass of sandeel in the Southern North Sea
declined somewhat in 1988 from a very high value in 1987. The
strong 1985 year class is still very abundant, while the 1986
year class is estimated to be of average abundance.

Northern North Sea

Catch at age, fishing mortality, and stock size are given in
Tables 5.4.13-5.4.15.

The fishing mortalities show an increasing trend over the last
six years (Figure 5.9). The spawning stock biomass is estimated
to have declined somewhat from 1987 to 1988, although it is still
on a high level compared to the period from 1976-1985. The high
level in recent years is due to the very strong 1985 and 1986
year classes.

Shetland area

Catch-at-age data used in the VPA are given in Table 5.4.16 for
the period 1977-1988. Estimated values of fishing mortality are
given in Table 5.4.17 and stock size in numbers and biomass
totals in Table 5.4.18. Mean weights at age used to calculate the
biomass totals are given in Table 5.4.19.

The results show that, in general, fishing mortality rates are
low compared with the early 1980s. The 1988 year class appears to
be below average for the period 1977-1988 and continues the
series of relatively poor year classes since 1984.

Estimated numbers of 1-group fish are very low, resulting from an
exceptionally poor year class in 1987. The previous Working Group
report (Anon., 1988a) did not estimate such a poor year class,
due to the relationship between historical F_0 and effort not
being forced through the origin when estimating F_0 for that year.
Had this been done, the estimated year-class strength would have

been about 3×10^9, close to the current estimate. Such an esti-
mate of the 1987 year class is supported by poor representation
of 1-group fish in the 1988 catch (see Section 5.4.1).

Recruitment and biomass levels are shown in Figure 5.13. Both
spawning stock biomass and total stock biomass continue to fall
in response to recent levels of recruitment. The 1988 spawning
stock and total spawning stock levels almost coincide in 1988 due
to the very low numbers of 1-group fish. As the very poor 1987
year class will enter the spawning stock in 1989 as 2-group fish,
it is probable that the spawning stock will decline further.

Division VIa

Catch-at-age data used in the VPA are shown in Table 5.4.20, the
estimated fishing mortality rates in Table 5.4.21, and stock size
in numbers and biomass totals in Table 5.4.22. Mean weights at
age, used to estimate biomass totals, are given in Table 5.4.19.

The current VPA supports the previous assessment of this stock
(Anon., 1988a). Total biomass has fallen due to the below-average
1987 year class entering the stock as 1-group. However, the
spawning stock biomass has risen in response to the good 1986
year class.

The 1988 year-class strength appears to be very low and, if so,
the total stock biomass will continue to fall in 1989. With both
the 1987 and 1988 year classes being below average, the spawning
stock will be expected to fall in 1989 and continue to fall in
1990 as those year classes enter the spawning stock as 2-group
fish.

As in the previous Working Group report (Anon., 1988a), caution
is urged in the interpretation of these results due to the short
series of data used to estimate input Fs and the rather poor re-
lationships thus derived (Figure 5.11).

5.5 Weights at Age

The quarterly mean weights at age for 1987 and 1988 are given in
Tables 5.5.1 and 5.5.2. In recent years, the mean weights at age
for the Northern assessment area have decreased, and the Working
Group decided to compare weights at age for the recent cohorts
with the long-term average values.

The mean weights at age in the catch for the 1982-1987 year
classes are plotted in Figure 5.14 for the Southern area. The
average of the mean weights for the period 1974-1983 are shown as
black dots in the figure. There seems to be no change in growth
for the Southern North Sea.

The figure shows that the mean weight increases significantly
from the second to the third quarter, but then declines during
the winter period. Previous analysis has shown this also to be
reflected by the length at age. This suggests that the fishery
exploits different parts of the population in the different
quarters.

The growth curves for the Northern North Sea can be found in
Figure 5.15. It appears that the growth has been significantly

reduced since the mid-1980s. The Working Group discussed a number of possible reasons for this change in growth, such as increased biomass of sandeel and herring in the area and differences in growth between fishing banks. The Working Group had no evidence for any of these possible reasons for reduced growth.

For both areas, the Working Group decided to smooth the growth curves by eye and use the fitted values in the assessment. The fitted curves are given in Figure 5.16 and the values by half year are given in Tables 5.5.5 and 5.5.6. These values were used to calculate the biomasses in the VPA.

5.6 Effects of Catches of O-Group upon the Sandeel Stocks in the North Sea

The Working Group was asked to assess the effects of catches of O-group sandeel upon the North Sea sandeel stocks and to consider the necessity for and, if appropriate, the means of protecting this component of the fishery.

The effects of catches of O-group sandeel have previously been dealt with by the Working Group. In its 1984 report, the Working Group estimated the gains in yield per recruit to be expected if the fisheries in the second half of the year were closed.

This year, the same type of calculations were made using the most recent values of the input parameters for the analyses. The developments in the multispecies model in the North Sea have improved the estimates of natural mortality compared to 1984 where two alternative values were considered.

The values of natural mortality used in the analysis are given in Table 5.3.

In addition, the VPAs are now tuned to effort data from all countries fishing for sandeel in the North Sea. The exploitation pattern estimated from the average fishing mortality at age in the years 1982-1986 is given in Table 5.6.1.

The change in mean weights at age discussed in Section 5.5 has also been included in this analysis.

For the stock in the Northern North Sea, the recent average weights at age for 1985-1988 given in Table 5.5.6 were used. For the stock in the Southern North Sea, the long-term average weights at age in the stock given in Table 5.5.5 were used.

Y/R curves are presented in Figure 5.17 with and without a complete closure of the fishery in the second half of the year.

The results show that only marginal changes in the Y/R can be expected from prohibiting the fishery in the second half of the year in the Northern North Sea irrespective of the level of fishing mortality. In the Southern North Sea, a substantial reduction in the Y/R may be expected. At the present level of fishing mortality, the result is a 10% decrease in the Y/R in the Southern North Sea and a marginal 0.4% increase in the Northern North Sea.

Another way of decreasing the fishing mortality on the O-group is to implement a minimum landing size which effectively will prevent O-groups from being caught. In August 1988, Norway introduced a minimum landing size of 10 cm accompanied by a by-catch rule stating that no more than 25% by number of the sandeels landed must be below the legal minimum size. Table 5.6.2, which shows the percentage of sandeel below 10 cm in the Danish fishery in the Northern North Sea, clearly indicates that the regulations may put a total stop to the fishery in the second half of the year and in some cases reduce the effort in the beginning of the first half.

In order to evaluate the effect of the by-catch regulation, samples from the Danish sandeel fishery in the Northern North Sea were analyzed. Samples from the period 1982-1986 were classified into two categories: those in which more than 25% of the individuals were below 10 cm and those with less than 25% below 10 cm. The relative number of samples falling in each of the two categories was used on a quarterly basis to estimate the proportion of the landings which would have been illegal if the rule had been in force. Afterwards, the age composition of these "illegal" landings was estimated from the age composition of the samples. An estimate of the number of sandeels at age which would not have been caught, given that the rule had been in force, was obtained by raising the age compositions to the total international landings.

In this way, it was estimated that 20% of the landings on average would have been classified as "illegal".

Table 5.6.3 shows how this reduction is distributed over the age groups. If the fishing mortality at age is reduced by the same proportion, then Y/R will increase by 2% at the present level of effort. This estimate does not, however, take into consideration that the probability of obtaining an "illegal" landing is likely to reduce the fishing effort.

6 SPRAT IN DIVISION IIIa

6.1 Landings

The landings by areas and countries from 1974-1988 are shown in Table 6.1. The figures are based on preliminary data provided by Working Group members, and the Norwegian catches in Division IVa east are excluded (these landings are included in Table 7.1.1).

The landings in 1988 decreased to about 8,800 t and are the lowest recorded since 1974.

The figures on landings are, however, of poor quality mainly due to insufficient sampling of the Swedish by-catches landed for industrial purposes, as in the previous three years.

6.2 Fishing Effort

No data were available to the Working Group.

6.3 Catch at Age and VPA

No catch-at-age data were available, and a VPA run was not carried out.

6.4 Research Vessel Surveys

6.4.1 Acoustic surveys

Two acoustic surveys were carried out, one in August by Sweden and one in December by Norway. Both surveys covered the open sea area, and inshore areas and fjords were not adequately sampled. In August, when the adult stock normally is distributed in the open sea, the acoustic survey gave an estimate of 17,000 t. The estimate in December, when the stock has a more inshore distribution, was much lower at about 1,000 t. Both estimates should be regarded as rather uncertain as the proportion of sprat in the total estimate from the surveys is very low. The estimates indicate, however, that the stock is still at a very low level.

6.4.2 International young fish survey

Final indices of 1-group and older sprat from the 1989 survey are given in Table 6.4. The main concentration was found in the southernmost parts of Kattegat as in previous years. The 1-group index of 442 is the lowest on record since 1974 and indicates still another weak year class. The index of older sprat (3,333) is one of the lowest in the series and corroborates the results of the acoustic survey.

6.5 State of the Stock and Catch Predictions

All stock indications show that the sprat stock in Division IIIa is still at a very low level. The 1988 year class is indicated to be the weakest since 1974 and the spawning stock could not be expected to recover in 1989.

Using the new recruitment value and preliminary catches in 1988, the SHOT method used in previous years

$$Y(t) = 0.228Y(t-1) + 14.52R_1$$

predicts a catch in 1989 of 10,000 t assuming no changes in fishing mortality and including an assumed catch level of 0-group sprat.

It is noted that the present SHOT method has overestimated the catch in recent years and the catch prediction for 1989 is likely too high.

7 NORTH SEA SPRAT

7.1 Landings

The landings of sprat from the North Sea increased again in 1988. The total catch was almost treble that of 1987 which again was double that of the preceding year. With a preliminary figure of 92,000 t, 1988 shows the highest catch in five years.

Table 7.1.1 shows the landings by area and country and represents data provided by the Working Group members as well as official figures from ICES files. Table 7.1.2 shows the landings by area and quarter. The discrepancy in the total between the two tables is caused by landings from the Norwegian fjords in Division IVa E which are only included in the former table. The two tables together indicate that the majority (80%) of the catch was taken by Denmark in Division IVb E in the third quarter of 1988. This is in contrast to the two preceding years when the main fisheries took place in the first and fourth quarters of 1986 and 1987, respectively.

Landings of sprat from Division VIa (Table 7.1.3) went from the low level of the two previous years to the highest catch but one in the recent 10-year period.

7.2 Fishing Effort

No effort data were available to the Working Group.

7.3 Catch in Number at Age

Quarterly catch-at-age data were available for Denmark, England, and Norway (Table 7.3.1). The catches were clearly dominated by 2-group sprat which is in good agreement with the age composition in the previous year when 80% of the catch consisted of the same year class (1986).

7.4 Research Vessel Surveys

7.4.1 Acoustic surveys

Acoustic surveys were carried out by Norway in June and July 1988 covering the central part of the Northern North Sea and the western part of the Central North Sea, and by Denmark in late July - early August in the eastern part of the North Sea, except for Helgoland Bay. Sweden did one acoustic survey in August in the Skagerrak and the northeastern North Sea, while Norway did a second survey in November-December covering the Eastern North Sea and Division IIIa.

It should be stressed that all of these surveys are designed to obtain estimates of herring abundance, and estimates of other pelagic species must be considered as by-products. They are mainly obtained from the species composition of trawl hauls carried out in connection with the acoustic measurements.

The Norwegian estimate of sprat biomass is based on the following parameters: TS = 20 log L − 69.8 dB (Ref. 1 fish). The Danish

estimates are based on a TS-length relation almost identical with the Norwegian one stated above.

The results of these surveys (reported by Working Group members) are summarized below:

July-August 1988

Division IVb West   15,400 t
Division IVb East   8,200 t (excl. S of $54^0 30'N$).

November-December 1988

Division IVb East   14,520 t.

It is obvious from a comparison between the estimates above and the catch figures stated in Section 7.1.1 that the discrepancy between the estimated biomass in the third quarter in Division IVb East and the corresponding landings is acute and amounts to almost one order of magnitude. For this reason, the Working Group decided to disregard the acoustic surveys in connection with any assessment of the North Sea sprat.

7.4.2 International Young Fish Survey

Preliminary data from the IYFS in February 1989 in the North Sea were available to the Working Group based on a compilation of 382 hauls covering 150 statistical rectangles. As age compositions were not yet available, the distribution of sprat as shown in Figure 7.4.1 comprises all ages. A preliminary index of 1-group abundance was obtained as mean no/hr in Division IVb of fish <10 cm. With a figure of 3,516, as compared to an index of 5,020 for all ages, it is clear that Figure 7.4.1 mainly describes the distribution of 1-group sprat.

In contrast to results of the IYFS in 1988, when the preliminary index for Division IVb was one of the lowest on record, the present 1989 estimate is the highest index on record (Table 7.4). This high index is heavily influenced by very high figures in two squares, especially in 37F8. The latter is, however, based on five hauls and cannot be excluded from the total estimate as a single outlier.

The 1988 sprat year class is quite strong, which is also apparent in the pattern of distribution. In contrast to the previous survey, high concentrations were also found in the western part of Division IVb. In 1989 (and 1988), the mean no/hr was higher in Division IVe than in Division IVb. This may suggest that a change in standard area from the one in present use to include the part of the North Sea which lies between 52^0 and $53^0 30'N$ may give a more representative abundance index for the sprat.

The Working Group also considered the feasibility of using the IYFS sub-areas for roundfish sampling in the case of sprat which hitherto have been sampled by the sub-areas used for herring. Length at age of sprat is markedly affected by depth and the Working Group found that Roundfish Sampling Area 6 (Southwestern North Sea) is at least too large and comprises so diverse depth conditions that the need for depth stratified sampling is evident.

Time did not allow an analysis of length at age versus depth for sprat and the Working Group recommends that this is studied further by the IYFS Working Group.

7.5 State of the Stock and Catch Prediction

Apart from the acoustic surveys, the other indicators point to a significant increase in the sprat stock in the North Sea. The landings in 1988 increased by 179% mainly due to the strength of the 1986 year class.

The indices from the IYFS 1989 indicate that the 1986 year class is strong and that the incoming 1988 year class is of considerable strength.

In last year's report, the Working Group refrained from doing any forecast of likely catch levels. The SHOT method applied in earlier years had seriously overestimated catches since 1983, probably because of a marked reduction in effort.

At the present meeting, the Working Group again attempted a catch prediction by the SHOT method under the assumption that an increase in effort has taken place in the last two years. The results are shown in Table 7.5 which indicates a catch level of 313,000 t in 1989 assuming $F_{89} = F_{88}$.

The Working Group also did a linear regression of catch on the North Sea index for all ages. This is shown in Figure 7.5 and indicates a catch level in 1989 of 490,000 t.

The Working Group realizes that these catch predictions are very high and influenced by the high IYFS figures obtained in a rather narrow band along the southeastern North Sea coast. The catch predictions should consequently be regarded with caution.

For this reason, the Working Group cannot point out a specific level of TAC, but it found no reason for recommending a TAC at or below the level of catches from 1985-1987.

8 CHANNEL SPRAT (DIVISIONS VIId,e)

8.1 Landings

The nominal landings are shown in Table 8.1.1. The total catch in 1988 of about 5,700 t was double that of 1987 mainly due to a 10-fold increase in the Danish landings.

The English fishery showed the following development.

There was little fishing activity for sprat during the year in the eastern Channel (Division VIId), primarily due to marketing problems, but the usual seasonal fishery in Lyme Bay ended in March and recommenced in September (Table 8.1.2). Dense and extensive shoals appeared very close to the shore around a large part of the Bay (within the 3-mile limit) early in September, and these supported a good fishery until a period of bad weather dispersed the fish early in November. Following this, the fishery remained patchy and tended to shift further to the west into the Start Point area. A fairly successful season has resulted, with

the catch to the end of December (1988/1989 season) at nearly 2,400 t already equivalent to the catch taken over the whole of the previous season.

8.2 Fishing Effort

Effort data were not available to the Working Group.

8.3 Research Vessel Surveys

No surveys were conducted during 1987-1988.

8.4 Catch at Age

Age compositions for the seasons 1966/1967 to 1988/1989 are shown in Table 8.4 for the Lyme Bay fishery. The 1986 year class con-tributed about 59% to the catch in the September-December period, and appears to have recruited fairly strongly to this fishery also. Full recruitment does not usually take place in this region until the fish are 3 years old (possibly moving here from the eastern Channel), and their representation a year earlier (when 2-year-olds) is not always a reliable indicator of the potential contribution to the catch in the following season.

The 1986 year class has, however, shown up as a predominant component of the population over a wide area during 1988, certainly well represented in parts of the west central and southern North Sea and also the western English Channel.

8.5 Weight at Age

The mean weight at age for Lyme Bay sprat is shown in Table 8.5. The dominating 1986 year class showed a mean weight in the fourth quarter of 1988 somewhat below the long-term average.

8.6 Percentage Weight in the Catch

The percentage weight in the catch in the Lyme Bay fishery is shown in Table 8.6. The two dominating year classes, 1985 and 1986, contributed 85% of the total weight in 1988.

8.7 VPA and Catch Prediction

Input data for a VPA are only available for the Lyme Bay fishery and cannot be considered representative for the area as a whole. This is especially so in 1988, when offshore catches amounted to almost 50% of the total. The Working Group, therefore, refrained from producing a VPA assessment for this stock. Without a re-liable estimate of recruitment and as the inshore and especially the offshore fisheries tend to be conducted on an opportunistic basis, it is not possible to estimate the level of the fishery with any degree of certainty.

9 REFERENCES

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Anon. 1988a. Report of the Industrial Fisheries Working Group. ICES, Doc. C.M.1988/Assess:15.

Anon. 1988b. Report of the North Sea Roundfish Working Group. ICES, Doc. C.M.1988/Assess:21.

Shepherd, J.G. Simple methods for short-term forecasting of catch and biomass (unpublished MS).

Table 2.1 Industrial landings from the fisheries for SANDEEL, SPRAT, and NORWAY POUT in the North Sea ('000 t), 1974-1988.

		Major fisheries					
		Clupeoids		Gadoid species		By-catch	
Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	protected species[1]	Total
1974	525	314	–	736	62	220	1,857
1975	428	641	–	560	42	128	1,799
1976	488	622	12	435	36	198	1,791
1977	786	304	10	390	38	147	1,675
1978	787	378	8	270	100	69	1,612
1979	578	380	15	320	64	77	1,434
1980	729	323	7	471	76	69	1,675
1981	569	209	84	236	62	85	1,245
1982	611	153	153	360	118	57	1,452
1983	537	88	155	423	118	38	1,359
1984	669	77	35	355	79	35	1,250
1985	622	50	63	197	73	29	1,033
1986	848	16	40	174	37	22	1,140
1987	825	33	47	147	30	24	1,106
1988[2]	893	92	179	102	28	55	1,349
Mean 1974-1987	643	256	45	362	67	86	1,459

[1] Haddock, whiting and saithe summarized from Table 3.1.
[2] Preliminary.

Table 2.2   Industrial landings[1] from the fisheries for SANDEEL, SPRAT, and NORWAY POUT in Division IIIa ('000 t), 1974-1988.

Year	Major fisheries					Total[3]
		Clupeoids		Gadoid species		
	Sandeel	Sprat[2]	Herring[5]	Norway pout	Blue whiting	
1974	8	71	76	13	-	168
1975	17	101	57	19	-	194
1976	22	59	38	42	-	161
1977	7	67	32	21	-	127
1978	23	78	16	25	-	142
1979	34	96	13	25	6	174
1980	39	84	25	26	14	188
1981	59	76	63	30	+	228
1982	18	45	54	44	5	166
1983	28	27	89	30	16	190
1984	19	37	112	46	15	229
1985	6	22	116	9	19	172
1986[4]	67	18	65	6	9	165
1987[4]	5	16	72	3	25	121
1988	23	3	97	8	15	146
Mean 1974-1988	25	57	62	24	-	171

[1] Data 1974-1984 from Anon. (1986), 1985-1987 provided by Working Group members.
[2] Landings for human consumption included.
[3] Blue whiting excluded.
[4] Preliminary.
[5] For years 1974-1985, human consumption landings used for reduction are included in these data.

Table 3.1   North Sea. Total reported by-catch ('000 t) of HADDOCK, WHITING, AND
            SAITHE for reduction purposes[1].

Species	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[2]
Haddock	35	11	16	22	17	19	13	10	6	3	4	4
Whiting	106	55	59	46	67	33	24	19	15	18	16	50
Saithe	6	3	2	–	1	5	1	6	8	1	4	1

[1] Anon.(1988b).
[2] Preliminary.

Table 3.2 North Sea. Species composition in Norwegian NORWAY POUT landings (t) for reduction purposes.

Year	Quarter	Landings	Norway pout	Blue whiting	Cod	Haddock	Whiting	Saithe	Herring	Mackerel	Others
1983	1	8,631	6,018	1,652	71	133	175	303	–	–	286
	2	82,562	32,367	38,569	386	431	141	406	–	57	10,205
	3	74,000	45,493	20,157	254	240	133	603	3	19	7,098
	4	17,627	13,429	2,693	29	129	170	133	–	–	1,044
	1-4	182,820	97,307	63,071	740	933	619	1,445	3	76	18,623
1984	1	15,282	8,932	4,302	141	102	225	357	–	–	1,223
	2	81,039	36,876	31,134	595	900	690	3,839	6	–	6,999
	3	50,448	31,786	14,445	90	289	35	590	6	2	3,205
	4	11,028	6,169	2,779	36	83	231	830	–	1	899
	1-4	157,797	83,763	52,660	862	1,374	1,181	5,616	12	3	12,326
1985	1	12,639	6,031	691	139	452	674	3,981	130	1	540
	2	44,831	8,710	28,332	182	107	101	2,891	–	–	4,508
	3	24,842	3,501	16,295	77	10	2	485	–	1	4,471
	3	17,410	4,587	9,203	71	127	78	538	–	2	2,804
	1-4	99,722	22,829	54,521	469	696	855	7,895	130	4	12,323
1986	1	9,463	6,996	669	62	655	121	220	–	–	740
	2	24,417	5,106	14,491	60	114	36	224	–	–	4,386
	3	18,485	7,396	9,300	63	44	–	442	–	–	1,240
	4	4,926	1,971	2,478	17	12	–	118	–	–	330
	1-4	57,291	21,469	26,938	202	825	157	1,004	–	–	6,696
1987	1	17,991	7,864	8,056	88	72	124	1,421	77	–	289
	2	28,606	14,685	10,062	99	67	112	1,782	62	–	1,737
	3	6,947	4,096	1,776	14	5	6	317	–	–	733
	4	16,522	7,491	5,018	–	–	25	99	–	–	3,889
	1-4	70,066	34,136	24,912	201	144	267	3,619	139	–	6,648
1988	1	6,889	5,822	323	–	21	172	69	14	41	427
	2	13,938	3,828	8,519	79	18	130	79	9	–	1,822
	3	19,654	1,333	15,914	24	–	–	206	19	–	2,138
	4	15,344	10,666	101	311	393	2,401	203	1,137	–	132
	1-4	55,825	21,103	24,857	414	452	2,703	557	1,199	41	4,519

Table 3.3   North Sea. Species composition in Norwegian SANDEEL landings (t), 1979-1988.

Year	Landings	Sandeel	Cod	Haddock	Whiting	Saithe	Herring	Mackerel	Others
1979	103,273	101,420	231	520	208	250	-	-	644
1980	147,748	144,752	54	1,118	382	-	-	-	1,442
1981	53,370	52,641	29	504	68	6	4	6	112
1982	47,647	46,514	86	703	107	-	8	-	229
1983	12,376	12,179	34	100	8	-	3	2	50
1984	23,479	23,383	-	10	16	-	-	-	70
1985	13,382	13,064	75	35	3	-	-	-	205
1986	82,791	82,079	105	74	19	123	15	-	376
1987	197,410	193,381	193	1,291	613	432	30	65	1,405
1988	190,600	185,054	263	1,293	1,967	143	80	36	1,764

Table 4.1.1 NORWAY POUT annual landings ('000 tonnes) in Sub-area IV by countries, North Sea, 1957-1988.

Year	Denmark	Faroes	Norway	Sweden	UK (Scotland)	Others	Total
1957	–	–	0.2	–	–	–	0.2
1958	–	–	–	–	–	–	–
1959	61.5	–	7.8	–	–	–	69.3
1960	17.2	–	13.5	–	–	–	30.7
1961	20.5	–	8.1	–	–	–	28.6
1962	121.8	–	27.9	–	–	–	14.7
1963	67.4	–	70.4	–	–	–	137.8
1964	10.4	–	51.0	–	–	–	61
1965	8.2	–	35.0	–	–	–	43._
1966	35.2	–	17.8	–	–	+	53.0
1967	169.6	–	12.9	–	–	+	182.6
1968	410.8	–	40.9	–	–	+	451.8
1969	52.5	19.6	41.4	–	–	+	113.5
1970	142.1	32.0	63.5	–	0.2	0.2	238.0
1971	178.5	47.2	79.3	–	0.1	0.2	305.3
1972	259.6	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	51.2	63.0	2.9	13.0	0.6	345.9
1974	464.5	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	63.6	218.9	2.3	22.7	1.0	559.7
1976	244.9	64.6	108.9	+	17.3	1.7	435.4
1977	232.2	50.9	98.3	2.9	4.6	1.0	389.9
1978	163.4	19.7	80.8	0.7	5.5	–	270.1
1979	219.9	21.9	75.4	–	3.0	–	320.2
1980	366.2	34.1	70.2	–	0.6	–	471.1
1981	167.5	16.6	51.6	–	+	–	235.7
1982	256.3	15.4	88.0	–	–	–	359.7
1983	301.1	24.5	97.3	–	+	–	422.9
1984	251.9	19.1[1]	83.8	–	0.1	–	354.9
1985	163.7	9.9	22.8	–	0.1	–	196.5
1986	146.3	6.6	21.5	–	–	–	174.4
1987	108.3	4.8	34.1	–	–	–	147.2
1988	79.0	1.5	21.1	–	–	–	101.6

[1] Including by-catch.

Table 4.1.2 NORWAY POUT, North Sea. National
             landings (tonnes) by months,
             1986-1988.

Month	Denmark	Norway	Faroes	Total[1]
1986				
Jan	11,598	2,579		14,736
Feb	13,468	3,674		17,818
Mar	4,276	743		5,217
Apr	-	825		858
May	-	1,998		2,077
Jun	-	2,283		2,373
Jul	475	2,145		2,723
Aug	4,716	3,260		8,290
Sep	30,884	1,991		34,172
Oct	43,831	1,115		46,719
Nov	22,004	574		23,469
Dec	15,001	282		15,886
Total	146,253	21,469	6,616	174,338
1987				
Jan	15,054	1,931		17,561
Feb	8,610	2,750		11,745
Mar	1,078	3,183		4,405
Apr	-	5,761		5,956
May	130	6,803		7,168
Jun	63	2,121		2,258
Jul	4,998	316		5,494
Aug	13,834	1,499		15,853
Sep	13,610	2,281		16,430
Oct	19,470	2,469		22,683
Nov	19,081	3,346		23,188
Dec	12,368	1,676		14,520
Total	108,296	34,136	4,830	147,262
1988				
Jan	7,605	2,457		10,212
Feb	8,013	1,698		9,856
Mar	403	1,667		2,101
Apr	-	512		520
May	-	1,888		1,916
Jun	71	882		967
Jul	2,148	495		2,682
Aug	7,383	528		8,029
Sep	4,007	310		4,381
Oct	15,983	1,886		18,135
Nov	23,868	7,497		31,833
Dec	9,481	1,283		10,925
Total	78,962	21,103	1,492	101,557

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

Table 4.1.3   NORWAY POUT. Annual landings (tonnes) in Division VIa.
              (Data officially reported to ICES.)

Country	1974	1975	1976	1977	1978	1979	1980	1981
Denmark	–	193	–	–	4,443	15,609	13,070	2,877
Faroes	1,581	1,524	6,203	2,177	18,484	4,772	3,530	3,540
Germany,Fed. Rep.	179	–	8	–	–	–	–	–
Netherlands	–	322	147[3]	230	21	98	68	182
Norway	144[3]	–	82[3]	–	–	–	–	–
Poland	75	–	–	–	–	–	–	–
UK (Scotland)[2]	4,702	6,614	6,346	2,799	302	23	1,202	1,158
USSR	40	2	7,147	–	–	–	–	–
Total	6,721	8,655	19,933	5,206	23,250	20,502	17,870	7,75(

Country	1982	1983	1984	1985	1986	1987	1988[1]
Denmark	751	530	4,301	8,547	5,832[4]	37,714[5]	5,849[5]
Faroes	3,026	6,261	3,400	998	–	–	–
Germany,Fed.Rep.	–	–	70	–	–	–	–
Netherlands	548	1,534	–	139	–	–	–
Norway	–	–	–	–	–	–	–
Poland	–	–	–	–	–	–	–
UK(Scotland)[2]	586	–	23	13	–	553	517
USSR	–	–	–	–	–	–	–
Total	4,911	8,325	7,794	9,697	5,832	38,267	6,366

[1] Preliminary.
[2] Amended using national data.
[3] Including by-catch.
[4] Includes Division VIb.
[5] Included in Division IVa.

Table 4.1.4   NORWAY POUT. Annual landings (tonnes) in Division
              IIIa. (Data officially reported to ICES.)

Country	1975	1976	1977	1978	1979	1980	1981
Denmark	15,666[2]	40,144[2]	20,694	23,922	23,951	26,235	29,273
Norway	952[2]	50[2]	104	362[3]	1,182	141	752
Sweden	3,272	2,255	318	591[3]	32	39	60
Total	19,863	42,449	21,116	24,875	25,165	26,415	30,085

Country	1982	1983	1984	1985	1986	1987	1988[1]
Denmark	51,317	36,124	67,007	85,082	32,056	47,527	44,909
Norway	1,265	990	947	831	400	1,682	700
Sweden	60	52	+	−	+	−	−
Total	52,685	37,166	67,954	85,913	32,456	49,209	45,609

[1] Preliminary.
[2] Including by-catch.
[3] Includes North Sea.

Table 4.2.1 NORWAY POUT. Danish CPUE data (tonnes/day fishing) by
            vessel category for 1982-1988.

Vessel GRT	1982	1983	1984	1985	1986	1987	1988
51-100	12.77	11.37	12.53	11.60	10.83	11.73	20.26
101-150	23.30	24.51	21.35	17.98	19.49	20.70	18.83
151-200	27.19	29.00	24.17	20.76	22.97	22.20	23.25
201-250	29.76	32.71	27.82	24.80	25.20	27.51	27.91
251-300	30.11	32.05	26.59	22.86	25.12	25.58	23.91
301-	28.41	31.81	37.47	26.86	26.63	31.10	38.44

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

Year	Quarter				Total
	1	2	3	4	
1982	74	40	35	45	44
1983	60	59	68	72	68
1984	80	50	57	53	64
1985	61	57	87	69	72
1986	80	-	90	62	73
1987	86	-	86	85	86
1988	99	-	99	99	99

Table 4.2.3 NORWAY POUT. Catch per unit effort (in units of hectolitres per day fishing per mean GRT) by quarters in the Norwegian fishery.

Year	Quarter				Weighted annual mean
	1	2	3	4	
1976	1.458	1.401	1.010	1.214	1.221
1977	1.299	1.346	1.304	1.413	1.346
1978	0.916	1.251	1.631	1.427	1.353
1979	1.192	1.276	1.512	1.656	1.364
1980	1.000	2.198	1.648	1.518	1.658
1981	1.050	1.383	1.120	1.032	1.186
1982	0.841	1.693	1.674	1.571	1.559
1983	1.454	1.677	1.441	1.569	1.566
1984	1.229	2.023	1.406	1.217	1.589
1985	0.944	1.164	0.801	0.868	0.976
1986	0.768	1.197	0.886	0.887	0.959
1987	1.001	1.651	1.155	1.052	1.230
1988	0.892	0.923	1.363	1.065	1.077

Table 4.2.4 NORWAY POUT. CPUE as in Table 4.2.3, based on those catches with at least 70% Norway pout in weight.

Year	Quarter				Weighted annual mean
	1	2	3	4	
1976	1.435	1.451	0.992	1.200	1.223
1977	1.302	1.397	1.304	1.450	1.362
1978	0.926	1.254	1.527	1.447	1.306
1979	1.272	1.217	1.559	1.676	1.425
1980	0.989	2.351	1.734	1.592	1.634
1981	1.068	1.429	1.194	1.055	1.218
1982	0.841	1.676	1.681	1.603	1.548
1983	1.381	1.703	1.466	1.555	1.556
1984	1.243	2.151	1.461	1.163	1.668
1985	0.996	1.236	0.751	0.829	0.967
1986	0.763	0.984	0.911	0.914	0.880
1987	0.958	1.552	1.225	1.144	1.194
1988	1.065	1.316	1.501	1.155	1.276

Table 4.2.5 NORWAY POUT. Norwegian fishing effort in
number of days and average vessel size
(GRT). Landings with less than 70% Norway
pout excluded.

Year	Quarter			
	1	2	3	4
1982				
Effort	733	2,240	1,934	740
Ave. GRT	161.2	122.5	160.5	170.9
1983				
Effort	302	1,671	2,302	811
Ave. GRT	150.3	155.4	147.8	154.8
1984				
Effort	473	1,633	1,622	282
Ave. GRT	146.2	121.0	139.9	175.5
1985				
Effort	600	805	595	443
Ave. GRT	142.7	144.2	175.2	196.8
1986				
Effort	503	294	693	261
Ave. GRT	166.5	121.8	170.7	212.4
1987				
Effort	715	599	290	431
Ave. GRT	181.5	144.5	130.4	177.3
1988				
Effort	237	224	695	576
Ave. GRT	183.3	170.7	119.7	159.8

Table 4.2.6 NORWAY POUT. North Sea. Analysis of variance model

$$CPUE = a_{years} \times (GRT - G_o)^b, \; G_0 = 50$$

Analysis of variance

Source	Sum of squares	df	F value	PR > F
Model	3.1124	7	48.40	0.0000
Error	0.2388	26	–	–
Total	3.3512	33	–	–

R^2(adj for df) = 0.91

a_{1982} = 3.94
a_{1983} = 4.06
a_{1984} = 3.63
a_{1985} = 3.16
a_{1986} = 3.32
a_{1987} = 3.46
a_{1988} = 3.39
b = 0.3894

Actual values used (see text)

a_{1982} = 3.98
a_{1983} = 4.16
a_{1984} = 3.89
a_{1985} = 3.29
a_{1986} = 3.41
a_{1987} = 3.63
a_{1988} = 3.53
b = 0.3801

Table 4.2.7 NORWAY POUT. Danish and Norwegian effort
(no. of fishing days) standardized to a
vessel size of 200 GRT.

Year	Quarter				Total
Country	1	2	3	4	
1982					
Norway	654	1,699	1,722	682	4,757
Denmark	1,922	502	3,929	2,234	8,587
Total	2,576	2,201	5,651	2,916	13,344
1983					
Norway	259	1,461	1,957	708	4,385
Denmark	2,317	510	3,739	3,602	10,168
Total	2,576	1,971	5,696	4,310	14,553
1984					
Norway	400	1,229	1,335	263	3,227
Denmark	1,887	454	3,783	4,433	10,557
Total	2,287	1,683	5,118	4,696	13,784
1985					
Norway	500	675	556	439	2,170
Denmark	2,179	208	2,009	3,290	7,686
Total	2,679	883	2,565	3,729	9,856
1986					
Norway	457	222	638	269	1,586
Denmark	1,645	0	1,397	3,332	6,374
Total	2,102	222	2,035	3,601	7,960
1987					
Norway	689	529	273	412	1,903
Denmark	1,271	7	1,335	1,790	4,403
Total	1,960	536	1,608	2,202	6,306
1988					
Norway	246	138	56	450	890
Denmark	676	3	571	2,080	3,330
Total	992	141	627	2,530	4,220

Table 4.4.1 NORWAY POUT. Input data for quarterly VPA.
            Catch at age (millions).

Year	Quarter	Age group				
		0	1	2	3	4
1982	1	–	5,267	415	216	–
	2	–	3,251	275	23	–
	3	151	6,576	431	62	–
	4	1,058	3,017	46	–	–
1983	1	–	3,969	1,224	14	–
	2	–	1,723	1,165	9	–
	3	421	5,495	1,485	16	1
	4	2,520	4,053	358	7	1
1984	1	–	2,732	1,361	142	–
	2	–	2,230	1,153	266	–
	3	1	5,238	1,666	–	–
	4	2,209	3,457	727	–	–
1985	1	–	2,220	1,337	188	1
	2	–	840	142	13	–
	3	6	1,373	777	19	–
	4	665	2,932	171	–	–
1986	1	–	395	1,066	72	3
	2	–	180	60	2	–
	3	–	1,186	245	6	–
	4	5,436	1,687	36	–	–
1987	1	–	2,665	398	12	1
	2	–	1,073	60	–	–
	3	8	1,585	165	–	–
	4	221	2,138	230	5	–
1988	1	–	246	699	20	–
	2	–	82	71	–	–
	3	24	183	250	–	–
	4	2,947	632	405	–	–

Table 4.4.2   VIRTUAL POPULATION ANALYSIS

NORWAY POUT

CATCH IN NUMBERS   UNIT: millions

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	6183	1716	1530	1832	665	36637	1209	2941	2210	671	5436	229
1	21035	19868	7897	14747	19261	5649	18111	15240	13657	7365	3448	7461
2	2143	2414	3129	2119	4236	3554	1167	4232	4907	2427	1407	853
3	167	91	323	257	112	173	301	46	416	220	80	17
4+	1	3	4	4	7	8	0	2	0	1	3	1
TOTAL	29529	24091	12882	18959	24281	46021	20788	22461	21190	10684	10374	8561

	1988
0	2971
1	1143
2	1425
3	20
4+	0
TOTAL	5559

Table 4.4.3 VIRTUAL POPULATI ANALYSIS

NORWAY POUT

FISHING MORTALITY COEFFICIENT   UNIT: Year-1   NATURAL MORTALITY COEFFICIENT = 1.60

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	.029	.017	.008	.008	.011	.136	.006	.024	.034	.017	.052	.014
1	.555	.566	.446	.443	.499	.550	.424	.426	.711	.748	.526	.426
2	1.068	.548	.853	1.160	1.272	.839	1.190	.865	1.415	1.702	2.288	1.446
3	.811	.557	.649	.801	.894	.795	.807	.646	1.063	1.225	1.407	.936
4+	.811	.557	.649	.801	.894	.795	.807	.646	1.063	1.225	1.407	.936
(1- 3)U	.812	.557	.649	.802	.888	.728	.807	.646	1.063	1.225	1.407	.936

	1988
0	.013
1	.411
2	.669
3	.541
4+	.541
(1- 3)U	.541

Table 4.4.4 VIRTUAL POPULATION ANALYSIS

NORWAY POUT

STOCK SIZE IN NUMBERS   UNIT: millions

BIOMASS TOTALS   UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	437686	209602	390300	460914	125204	566036	415587	249991	130974	79672	213229	32433
1	92366	85874	41625	78182	92316	25009	99707	83417	49286	25553	15815	40864
2	5753	10704	9844	5382	10138	11314	2914	13180	10995	4888	2441	1886
3	544	399	1249	847	341	574	987	179	1120	539	180	50
4+	2	11	15	13	21	27	0	8	0	2	7	3
TOTAL NO	536352	306590	443033	545337	228020	602960	519195	346774	192375	110654	231671	75237
SPS NO	52482	54051	31920	45332	56658	24419	53755	55075	36758	18205	10535	22371
TOT.BIOM	795007	853189	558744	700273	884067	448415	801533	881465	631697	308070	171974	329712
SPS BIOM	471726	552630	413056	426637	560960	360882	452558	589507	459197	218635	116624	186686

	1988	1989
0	446751	0
1	6456	88997
2	5388	864
3	90	557
4+	0	11
TOTAL NO	458685	
SPS NO	8705	
TOT.BIOM	167309	
SPS BIOM	144714	

Table 4.4.5 Norway pout. Output from Laurec-Shepherd tuning.

```
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,DENMARK/NORWAY      , has terminal q estimated as the mean
Fleet  2 ,IYFS                , has terminal q estimated as the mean
Fleet  3 ,EGFS                , has terminal q estimated as the mean
Fleet  4 ,SGFS                , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
     , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,
Oldest age F = 1.000*average of 2 younger ages. Fleets combined by variance of predictions
Fishing mortalities

   Age,    82,    83,    84,    85,    86,    87,    88,

    0,  .006,  .024,  .034,  .017,  .052,  .014,  .013,
    1,  .424,  .426,  .711,  .748,  .526,  .426,  .413,
    2, 1.190,  .865, 1.415, 1.702, 2.288, 1.446,  .670,
    3,  .807,  .646, 1.063, 1.225, 1.407,  .936,  .541,

Log catchability estimates

Age  0
Fleet,    82,    83,    84,    85,    86,    87,    88

 1 ,-14.64,-13.32,-12.91,-13.27,-11.94,-13.00,-12.65
 2 , No data for this fleet at this age
 3 , -4.73, -4.41, -6.00, -5.67, -6.86, -8.99, -8.50
 4 , No data for this fleet at this age
```

```
                            SUMMARY STATISTICS
             Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,   SE    ,INTRCPT,  SE
                   ,  q     ,      ,  F    , F    ,          , Slope   ,       ,Intrcpt

                1 ,-13.10 ,  .878, .0086 , .0086,  .000E+00,  .000E+00,-13.104,  .311
                2 , No data for this fleet at this age
                3 , -6.45 , 1.888, .0016 , .1041,  .000E+00,  .000E+00, -6.452,  .668
                4 , No data for this fleet at this age
                Fbar     SIGMA(int.)    SIGMA(ext.)     SIGMA(overall)  Variance ratio
                .013        .796           .954            .954            1.435
```

```
Age  1
Fleet,    82,    83,    84,    85,    86,    87,    88

 1 ,-10.36,-10.44, -9.87, -9.49, -9.62, -9.60, -9.23
 2 , -2.29, -2.73, -1.59, -1.54, -1.17, -1.76, -3.08
 3 , -4.10, -4.24, -2.95, -3.49, -3.40, -4.75, -4.67
 4 , -3.73, -4.26, -3.47, -2.72, -2.77, -3.95, -3.07
```

```
                            SUMMARY STATISTICS
             Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,   SE    ,INTRCPT,  SE
                   ,  q     ,      ,  F    , F    ,          , Slope   ,       ,Intrcpt

                1 , -9.80 ,  .481, .2336 , .2336,  .000E+00,  .000E+00, -9.802,  .170
                2 , -2.02 ,  .746, .1324 ,1.1914,  .000E+00,  .000E+00, -2.022,  .264
                3 , -3.94 ,  .727, .0194 , .8549,  .000E+00,  .000E+00, -3.940,  .257
                4 , -3.42 ,  .635, .0326 , .2912,  .000E+00,  .000E+00, -3.423,  .225
                Fbar     SIGMA(int.)    SIGMA(ext.)     SIGMA(overall)  Variance ratio
                .411        .309           .387            .387            1.575
```

```
Age  2
Fleet,    82,    83,    84,    85,    86,    87,    88

 1 , -9.32, -9.73, -9.18, -8.66, -8.15, -8.38, -8.75
 2 ,  -.89, -2.00, -1.46,  .00,  -.47,  -.23, -1.03
 3 , -4.32, -5.13, -3.62, -2.96, -2.57, -2.67, -4.14
 4 , -3.28, -4.00, -3.79, -2.04, -2.49, -3.20, -2.88
```

```
                            SUMMARY STATISTICS
             Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,   SE    ,INTRCPT,  SE
                   ,  q     ,      ,  F    , F    ,          , Slope   ,       ,Intrcpt

                1 , -8.88 ,  .594, .5850 , .5850,  .000E+00,  .000E+00, -8.884,  .210
                2 ,  -.87 ,  .753, .4194 , .7863,  .000E+00,  .000E+00,  -.869,  .266
                3 , -3.63 , 1.022, .0265 ,1.1126,  .000E+00,  .000E+00, -3.629,  .361
                4 , -3.10 ,  .740, .0452 , .5411,  .000E+00,  .000E+00, -3.097,  .262
                Fbar     SIGMA(int.)    SIGMA(ext.)     SIGMA(overall)  Variance ratio
                .669        .368           .139            .368            .142
```

Table 4.5 Research vessel indices for NORWAY POUT.

Year class	IYFS[1] February		EGFS[2] August				ENPS[3] November				SGFS[4] August		
	1-group	2-group	0-group	1-group	2-group	3-group	0-group	1-group	2-group	3-group	1-group	2-group	3-group
1968	-	6	-	-	-	-	-	-	-	-	-	-	-
1969	35	22	-	-	-	-	-	-	-	-	-	-	-
1970	1,556	653	-	-	-	-	-	-	-	-	-	-	-
1971	3,425	438	-	-	-	-	-	-	-	-	-	-	-
1972	4,207	399	-	-	-	-	-	-	-	-	-	-	-
1973	25,626	2,412	-	-	-	-	-	-	-	-	-	-	-
1974	4,242	385	-	-	-	25	-	-	-	-	-	-	-
1975	4,599	334	-	-	239	25	-	-	-	-	-	-	-
1976	4,813	1,215	-	770	119	-	-	-	-	5	-	-	-
1977	1,913	240	1,387	314	20	7	-	-	222	82	-	-	12
1978	2,690	611	1,599	600	60	15	-	5,501	431	-	-	346	9
1979	4,081	557	1,607	824	283	11	6,449	4,519	123	36	1,928	127	16
1980	1,375	403	151	385	13	1	2,106	2,146	42	-	185	37	1
1981	4,315	663	1,770	712	29	3	23,946	7,166	1,935	74[5]	1,031	90	7
1982	2,331	802	1,817	517	93	2	19,567	7,603	132[5]	-	505	78	6
1983	3,925	1,423	1,501	1,009	74	18	21,852	6,524	-	-	597	186	12
1984	2,109	384	160	300	47	-	5,416	-	-	-	649	51	1
1985	2,043	469	136	219	41	3	-	-	-	-	412	24	5
1986	3,023	760	109	152	34	-	-	-	-	-	338	119	-
1987	127[6]	na	2	26	-	-	-	-	-	-	128	-	-
1988	2,053[6]	-	45	-	-	-	-	-	-	-	-	-	-

[1] International Young Fish Survey, arithmetic mean catch in no/h.
[2] English groundfish survey, arithmetic mean catch in no./h, Roundfish Areas 1, 2, and 3.
[3] English Norway pout surveys, arithmetic mean catch in no./h, northern North Sea.
[4] Scottish groundfish surveys, arithmetic mean catch in no./h.
[5] 1984 figures for English survey (semi-pelagic trawl) October/November 1984. Average no./h. for Roundfish Areas 1, 2, and 3 (40 hours fishing).
[6] Preliminary.

Table 4.6.1 NORWAY POUT. North Sea 1986-1988. Mean weight at age
by quarters. Danish and Norwegian catches com-
bined (grammes).

Year	Quarter	Age group				
		0	1	2	3	4
1986	1	–	6.69	29.74	44.08	82.51
	2	–	14.49	42.92	55.39	–
	3	–	28.81	43.39	47.60	–
	4	7.20	26.90	44.00	–	–
1987	1	–	8.13	28.26	52.93	63.09
	2	–	12.59	31.51	–	–
	3	5.80	20.16	34.53	–	–
	4	7.40	23.36	37.32	46.60	–
1988	1	–	9.23	27.31	38.38	69.48
	2	–	11.61	33.26	–	–
	3	9.42	26.54	39.82	–	–
	4	7.91	30.60	43.31	–	–

Table 4.6.2 Norway pout, North Sea. Annual landings in weight
by age as a percentage of the overall landings.

Year	Age group				
	0	1	2	3	4
1980	1	70	28	1	–
1981	10	43	44	3	–
1982	3	83	10	4	–
1983	5	65	29	1	–
1984	4	57	33	5	–
1985	2	62	31	5	–
1986	22	49	26	3	–
1987	1	80	19	–	–
1988	23	27	49	1	–

Table 4.7.1

Analysis by RCRTINX2 of data from file POUT-RCRTINX
V SEA NORWAY POUT AS 1-GROUP: PGS1 1975: 0-2 GROUP DATA

Data for   7 surveys over   14 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER =   1 OVER   20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN   INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS   .20
MINIMUM OF   5 POINTS USED FOR REGRESSION

Yearclass =   1980

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	7.2269	.945	-5.348	.7900	5	5.4805	.20462	.35461	.24602
IYFS2	5.0014	.894	-1.180	.3790	5	4.1269	.52076	.52076	.08458
EGFS0	5.0239	.000	.000	.0000	0	.0000	.00000	.00000	.00000
EGFS1	5.9558	.000	.000	.0000	0	.0000	.00000	.00000	.00000
EGFS2	2.6591	.336	2.782	.8396	5	5.6648	.17345	.25478	.42445
SGFS1	5.2257	.000	.000	.0000	0	.0000	.00000	.00000	.00000
SGFS2	5.6576	.000	.000	.0000	0	.0000	.00000	.00000	.00000
MEAN						4.5512	.55543	.55543	.24489

Yearclass =   1981

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	3.3701	1.119	-4.703	.8955	6	4.5870	.21628	.24999	.43486
IYFS2	6.4985	2.097	-8.850	.2289	6	4.7762	1.16226	1.30699	.01591
EGFS0	7.4795	.000	.000	.0000	0	.0000	.00000	.00000	.00000
EGFS1	6.5695	1.548	-5.680	.7513	6	4.4923	.39127	.45369	.15293
EGFS2	5.4012	.462	2.169	.8620	6	5.7415	.25335	.28759	.32858
SGFS1	5.9595	.000	.000	.0000	0	.0000	.00000	.00000	.00000
SGFS2	4.5109	.000	.000	.0000	0	.0000	.00000	.00000	.00000
MEAN						4.1268	.55378	.55378	.08862

Yearclass =   1982

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	7.7545	1.118	-4.766	.9075	7	5.9061	.19217	.21274	.54754
IYFS2	6.6384	2.008	-9.322	.2758	7	5.1062	.93000	1.12715	.01950
EGFS0	7.5055	.631	-.228	.7614	5	4.5082	.39821	.45687	.11872
EGFS1	5.2500	1.616	-5.034	.7692	6	4.0137	.35233	.38649	.16590
EGFS2	4.5433	.914	1.693	.5224	7	4.4841	.57555	.62924	.06258
SGFS1	6.2265	.000	.000	.0000	0	.0000	.00000	.00000	.00000
SGFS2	4.5594	.000	.000	.0000	0	.0000	.00000	.00000	.00000
MEAN						4.2971	.53757	.53757	.08575

Yearclass =   1983

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	5.2754	1.209	-5.406	.7655	9	4.5957	.30512	.35708	.50425
IYFS2	7.2612	1.840	-7.364	.2985	8	5.9933	.84487	1.13591	.02679
EGFS0	5.5146	.621	-.171	.7783	6	4.3717	.33511	.36924	.25355
EGFS1	6.9177	1.744	-5.828	.6872	7	5.2591	.39197	.51535	.13117
EGFS2	4.3175	.612	1.696	.5329	8	4.3592	.51676	.55541	.11206
SGFS1	6.5936	.000	.000	.0000	0	.0000	.00000	.00000	.00000
SGFS2	5.2311	1.162	-1.108	.5794	5	4.9701	.85802	1.01502	.03355
MEAN						4.2411	.49930	.49930	.13865

Yearclass =   1984

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	7.6544	1.399	-7.029	.5751	9	5.6823	.44676	.49386	.19455
IYFS2	5.9532	3.177	-15.946	.0694	9	2.6680	1.90318	2.15142	.01066
EGFS0	5.0814	.672	-.604	.6806	7	2.8093	.34753	.56295	.15278
EGFS1	5.7071	2.322	-10.751	.2758	8	2.5179	.87095	1.14941	.03725
EGFS2	3.8712	.670	1.396	.4739	9	5.9911	.54768	.58809	.13999
SGFS1	5.4770	.783	-.906	.7195	5	4.1685	.41787	.46201	.22683
SGFS2	3.9512	1.559	-5.087	.2037	6	2.9953	1.17594	1.41171	.02429
MEAN						4.1959	.47602	.47602	.21567

cont'd.

Table 4.7.1   cont'd.

Yearclass =   1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	7.6227	1.665	-9.199	.5755	10	3.4929	.51296	.50763	.17864
IYFS2	6.1527	2.528	-12.053	.1495	10	3.4490	1.62413	1.52945	.02461
EGFS0	4.9200	.565	.187	.7897	8	2.9676	.52352	.41179	.55952
EGFS1	5.3950	1.769	-7.261	.4722	9	2.3866	.64516	.86555	.07685
EGFS2	5.7377	.952	.222	.3778	10	3.7067	.76625	.82325	.09495
SGFS1	6.0234	1.258	-4.142	.4426	6	3.4377	.80444	.90655	.07006
SGFS2	5.2139	1.377	-2.292	.3400	7	2.1385	.93050	1.26368	.05577
MEAN						4.0769	.55105	.55105	.18961

Yearclass =   1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	8.0143	2.153	-13.146	.5454	11	4.1051	.66347	.70425	.12102
IYFS2	6.6346	3.251	-16.737	.1524	11	4.8505	1.71296	1.94541	.01762
EGFS0	4.7005	.595	-.027	.8499	9	2.7703	.31381	.34088	.41575
EGFS1	5.0304	1.557	-5.771	.6591	10	2.0626	.52927	.71642	.11694
EGFS2	3.5553	1.332	-1.518	.3131	11	3.2186	1.07651	1.16351	.04434
SGFS1	5.8269	1.622	-6.568	.4291	7	2.8823	.95295	1.08604	.05089
SGFS2	4.7875	1.111	-1.022	.5640	8	4.2950	.69747	.76109	.10562
MEAN						3.9224	.67477	.67477	.15185

Yearclass =   1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	4.8520	2.209	-13.639	.5249	12	-2.9196	.64986	1.94051	.05077
IYFS2									
EGFS0	1.0986	.577	.212	.6940	10	.8454	.45816	.84175	.26975
EGFS1	5.2958	1.452	-4.950	.4602	11	-.1452	.74173	1.41550	.09542
EGFS2									
SGFS1	4.8598	1.610	-6.360	.5957	8	1.4616	.92253	1.29876	.11351
SGFS2									
MEAN						3.8959	.65717	.65717	.47076

Yearclass =   1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	7.6275	.957	-3.437	.7205	15	3.7127	.57606	.60491	.28585
IYFS2									
EGFS0	3.3286	.431	1.176	.8522	11	2.8258	.38869	.42342	.57361
EGFS1									
EGFS2									
SGFS1									
SGFS2									
MEAN						3.6852	.86544	.86544	.14057

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1980	3.82	45.76	.17	.19	3.26	26.01	1.15
1981	4.26	70.73	.16	.19	4.61	100.71	1.17
1982	4.08	59.19	.16	.12	4.44	84.42	.76
1983	4.60	99.03	.19	.16	3.92	50.29	.85
1984	3.74	42.15	.22	.21	3.28	26.55	.96
1985	3.31	27.23	.24	.20	2.82	16.91	.94
1986	3.22	25.05	.24	.29	3.73	41.86	1.17
1987	2.07	7.89	.44	.97	2.01	7.46	2.21
1988	3.20	24.55	.32	.31			.95

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Table 4.7.2

Norway pout   SHOT forecast spreadsheet version 3
                                                January 1989
Norway pout
running recruitment weights
        older   .00   G-M =   .00
        central   .80   exp(d) 1.00
        younger   .20   exp(d/2) 1.00

Year	Land -ings	Recrt Index	W'td Index	Y/B Ratio	Hang -over	Act'l Prodn	Est'd Prodn	Est'd SOC.	Act'l Expl Biom	Est'd Expl Biom	Est'd Land -ings
1979	320	5000		.70	.30	536			457		
1980	471	5000	4915	.70	.30	135			673		
1981	236	4576	5075	.70	.30	413			337		
1982	360	7073	6842	.70	.30				514		
1983	423	5919	6716	.70	.30	450	433	411	604	587	411
1984	355	9903	8765	.70	.30	326	571	527	507	752	527
1985	197	4215	3918	.50	.50	39	225	264	394	378	189
1986	174	2728	2683	.50	.50	151	141	169	348	338	169
1987	147	2505	2162	.45	.55	114	114	144	327	288	130
1988	102	789	1122	.40	.60	35	59	107	255	239	96
1989		2453	2855	.40	.60		149	121		302	121

<u>Table 5.1.1</u> Landings of SANDEEL from the North Sea, 1952-1987
('000 t).

Year	Denmark	Germany, Fed.Rep.	Faroes	Nether- lands	Norway	Sweden	UK	Total
1952	1.6	−	−	−	−	−	−	1.6
1953	4.5	+	−	−	−	−	−	4.5
1954	10.8	+	−	−	−	−	−	10.8
1955	37.6	+	−	−	−	−	−	37.6
1956	81.9	5.3	−	+	1.5	−	−	88.7
1957	73.3	25.5	−	3.7	3.2	−	−	105.7
1958	74.4	20.2	−	1.5	4.8	−	−	100.9
1959	77.1	17.4	−	5.1	8.0	−	−	107.6
1960	100.8	7.7	−	+	12.1	−	−	120.6
1961	73.6	4.5	−	+	5.1	−	−	83.2
1962	97.4	1.4	−	−	10.5	−	−	109.3
1963	134.4	16.4	−	−	11.5	−	−	162.3
1964	104.7	12.9	−	−	10.4	−	−	128.0
1965	123.6	2.1	−	−	4.9	−	−	130.6
1966	138.5	4.4	−	−	0.2	−	−	143.1
1967	187.4	0.3	−	−	1.0	−	−	188.7
1968	193.6	+	−	−	0.1	−	−	193.7
1969	112.8	+	−	−	−	−	0.5	113.3
1970	187.8	+	−	−	+	−	3.6	191.4
1971	371.6	0.1	−	−	2.1	−	8.3	382.1
1972	329.0	+	−	−	18.6	8.8	2.1	358.5
1973	273.0	−	1.4	−	17.2	1.1	4.2	296.9
1974	424.1	−	6.4	−	78.6	0.2	15.5	524.8
1975	355.6	−	4.9	−	54.0	0.1	13.6·	428.2
1976	424.7	−	−	−	44.2	−	18.7	487.6
1977	664.3	−	11.4	−	78.7	5.7	25.5	785.6
1978	647.5	−	12.1	−	93.5	1.2	32.5	786.8
1979	449.8	−	13.2	−	101.4	−	13.4	577.8
1980	542.2	−	7.2	−	144.8	−	34.3	728.5
1981	464.4	−	4.9	−	52.6	−	46.7	568.6
1982	506.9	−	4.9	−	46.5	0.4	52.2	610.9
1983	485.1	−	2.0	−	12.2	0.2	37.0	536.5
1984	596.3	−	11.3	−	28.3	−	32.6	668.5
1985	587.6	−	3.9	−	13.1	−	17.2	621.8
1986	752.5	−	1.2	−	82.1	−	12.0	847.8
1987	605.4	−	18.6	−	193.4	−	7.2	824.6
1988[1]	686.4	−	15.5	−	185.1	−	5.8	892.8

[1] Preliminary.
+ = less than half unit.
− = no information or no catch.

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Table 5.1.2   SANDEEL North Sea. Monthly landings (tonnes) by
               country, 1986-1988.

Year	Month	Denmark	Faroes	Norway	Scotland	Total[1]
1986	Jan	-		-	-	-
	Feb	-		-	-	-
	Mar	12,694		252	-	12,946
	Apr	79,355		8,352	2,069	89,776
	May	153,501		11,395	4,771	169,667
	Jun	297,498	n/a	41,252	2,487	341,237
	Jul	150,737		5,508	686	156,931
	Aug	57,598		2,314	870	60,782
	Sep	1,074		1,743	763	3,580
	Oct	-		11,263	315	11,578
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	752,457	4,150	82,079	11,961	846,497[1]
1987	Jan	-	-	-	-	-
	Feb	-	-	-	-	-
	Mar	15,159	-	4,681	7	19,847
	Apr	59,495	412	13,921	875	74,703
	May	143,719	1,141	27,308	2,385	174,553
	Jun	278,659	10,251	80,527	1,233	370,670
	Jul	94,532	6,815	15,230	925	117,502
	Aug	7,320	-	37,049	1,521	45,890
	Sep	6,471	-	8,451	280	15,202
	Oct	-	-	6,214	1	6,215
	Nov	12	-	-	-	12
	Dec	-	-	-	-	-
	Total	605,367	18,619	193,381	7,227	824,594
1988	Jan	-		-	-	-
	Feb	-		-	-	-
	Mar	48,766		21,582	4	70,352
	Apr	147,839		27,181	1,518	186,538
	May	246,852		65,160	2,481	314,493
	Jun	169,526		32,995	744	203,265
	Jul	33,120	n/a	104	633	33,857
	Aug	21,155		5,212	198	26,565
	Sep	9,224		9,111	181	18,516
	Oct	9,885		13,709	36	23,630
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	686,367	15,531	185,054	5,795	877,216[1]

[1] Excluding the Faroes.

Table 5.1.3 North Sea SANDEEL. Catch (tonnes) by month and area [Denmark, Norway, and
UK (Scotland)] in 1986, 1987, and 1988 for areas in Figure 5.1.

Month	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland
1986											
Mar	403	376	1,893	2,282	6,911	-	178	-	255	265	375
Apr	22,648	20,623	1,971	6,951	26,234	622	7,019	376	-	1,263	2,069
May	92,298	2,345	154	19,553	22,952	555	20,123	1,502	1,147	4,269	4,771
Jun	158,538	2,533	692	17,656	61,493	134	44,534	1,655	367	50,804	2,841
Jul	20,466	1,911	1,344	4,714	79,976	11	10,465	18,046	2,263	19,049	686
Aug	413	6,404	2,239	3,169	38,368	555	1,923	944	14	4,601	2,152
Sep	309	347	209	638	566	84	588	5	-	61	773
Oct	160	1,183	-	295	9,620	-	5	-	-	-	315
Total	295,235	35,722	8,502	55,258	244,120	1,961	84,835	22,528	4,046	80,312	13,982
1987											
Mar	319	7,175	753	1,729	9,646	-	218	-	-	-	7
Apr	8,066	26,465	21	2,573	35,361	-	445	471	-	14	875
May	80,175	1,973	80	25,627	58,415	262	2,081	347	979	1,088	2,385
Jun	138,904	20,609	239	10,601	161,637	-	480	1,396	357	24,963	1,233
Jul	46,253	1,181	-	8,079	15,086	-	1,113	17,429	6,322	14,299	925
Aug	1,100	4,873	-	8,013	31,827	-	545	1,765	-	2,152	1,521
Sep	242	704	49	2,866	7,698	94	741	-	-	2,622	280
Oct	-	668	-	-	5,564	-	-	-	-	-	1
Nov	-	-	-	-	-	-	12	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-
Total	275,059	63,648	1,142	53,488	325,234	356	5,635	21,408	7,658	45,138	7,227
1988											
Mar	-	25,627	-	234	43,482	-	1,005	-	-	-	4
Apr	58,156	26,432	525	6,288	83,185	-	8,237	1,689	495	538	993
May	178,614	3,192	625	21,750	62,602	-	13,224	8,295	206	24,053	1,932
Jun	48,998	1,968	126	11,767	31,143	205	14,385	18,341	7,459	68,129	744
Jul	9,548	21	38	2,346	66	-	7,913	6,967	1,853	9,472	633
Aug	1	593	721	2,468	4,619	133	15,860	-	1,971	1	196
Sep	231	500	-	1,336	12,254	-	4,013	-	-	1	181
Oct	536	103	-	825	19,135	2	2,993	-	-	-	36
Nov	-	-	-	-	-	-	-	-	-	-	-
Total	291,084	58,436	2,035	47,014	256,486	340	67,630	35,292	11,984	102,194	4,179

Table 5.1.4 Annual landings ('000 t) of SANDEELS by area (see Figure 5.1) of the North Sea
[Denmark, Norway, and UK (Scotland)].

Year	Area											Assessment areas[1]	
	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland	Northern	Southern
1972	98.8	28.1	3.9	24.5	85.1	0.0	13.5	58.3	6.7	28.0	0.0	130.6	216.3
1973	59.3	37.1	1.2	16.4	60.6	0.0	8.7	37.4	9.6	59.7	0.0	107.6	182.4
1974	50.4	178.0	1.7	2.2	177.9	0.0	29.0	27.4	11.7	25.4	7.4	386.6	117.1
1975	70.0	38.2	17.8	12.2	154.7	4.8	38.2	42.8	12.3	19.2	12.9	253.7	156.5
1976	154.0	3.5	39.7	71.8	38.5	3.1	50.2	59.2	8.9	36.7	20.2	135.0	330.6
1977	171.9	34.0	62.0	154.1	179.7	1.3	71.4	28.0	13.0	25.3	21.5	348.4	392.3
1978	159.7	50.2		346.5	70.3		42.5	37.4	6.4	27.2	28.1	163.0	577.2
1979	194.5	0.9	61.0	32.3	27.0	72.3	34.1	79.4	5.4	44.3	13.4	195.3	355.9
1980	215.1	3.3	119.3	89.5	52.4	27.0	90.0	30.8	8.7	57.1	25.4	292.0	401.2
1981	105.2	0.1	42.8	151.9	11.7	23.9	59.6	63.4	13.3	45.1	46.7	138.1	378.9
1982	189.8	5.4	4.4	132.1	24.9	2.3	37.4	75.7	6.9	74.7	52.0	74.4	479.2
1983	197.4	-	2.8	59.4	17.7	-	57.7	87.6	8.0	66.0	37.0	78.2	419.0
1984	337.8	4.1	5.9	74.9	30.4	0.1	51.3	56.0	3.9	60.2	32.6	91.8	532.8
1985	281.4	46.9	2.8	82.3	7.1	0.1	29.9	46.6	18.7	84.5	17.2	79.7	513.5
1986	295.2	35.7	8.5	55.3	244.1	2.0	84.8	22.5	4.0	80.3	14.0	375.1	457.4
1987	275.1	63.6	1.1	53.5	325.2	0.4	5.6	21.4	7.7	45.1	7.2	395.9	402.8
1988	291.1	58.4	2.0	47.0	256.5	0.3	37.6	35.3	12.0	102.2	4.7	384.8	487.6

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

Table 5.1.5 SANDEEL, Division VIa. Landings in tonnes,
            1983-1988, as officially reported to ICES.

Country	1983	1984	1985	1986	1987	1988
UK (Scotland)	13,051	14,166	18,586	24,469	14,479	24,465

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

Country	1982	1983	1984	1985	1986	1987	1988
Denmark	21,540	34,286[1]	27,679[1]	6,271[2]	67,304[2]	3,817[2]	22,365
Norway	–	178	–	–	–	–	–
Sweden	5	31	–	–	–	–	–

[1] Estimate provided by Working Group members.
[2] Preliminary.

Table 5.2.1 Percentage of the total international
            catch sampled for catch per unit effort.

Year	Southern	Northern
1976	–	9
1977	–	16
1978	–	41
1979	–	42
1980	–	50
1981	–	37
1982	25	57
1983	43	52
1984	48	74
1985	72	84
1986	73	88
1987	87	94
1988	99	99

Table 5.2.2 Fishing effort in the SANDEEL fisheries - Norwegian data.

Year	Fishing days Norwegian vessels FD	Mean gross registered tonnage GRT	Fishing effort FD x GRT ('000)	Sandeel landings ('000 t) Norwegian	Total international	Fishing effort raised to total catch
			Northern assessment area - first 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	1,081.5
1981	1,780	212.6	378.4	42.8	93.3	824.2
1982	1,222	210.1	256.7	27.0	62.3	591.7
1983	324	267.8	86.8	8.5	54.5	556.4
1984	145	185.8	26.9	3.5	74.1	569.5
1985	366	212.8	77.9	8.7	69.9	625.8
1986	1,562	192.4	300.5	59.2	221.3	1,123.3
1987	2,123	210.5	446.9	123.6	325.6	1,177.3
1988	3,748	198.2	742.9	156.8	331.3	1,569.7
			Northern assessment area - second half of year			
1977	457	184.9	84.5	11.8	110.0	787.7
1978	806	203.7	164.2	22.5	53.3	388.2
1979	1,720	188.9	324.9	53.2	147.7	902.2
1980	1,130	206.1	232.9	33.2	71.1	499.6
1981	414	189.0	78.2	7.9	44.9	446.0
1982	-	-	-	-	12.0	-
1983	66	208.0	13.7	2.4	23.7	133.1
1984	-	-	-	-	17.7	-
1985	-	-	-	-	16.8	-
1986	567	182.3	103.3	19.8	153.8	802.4
1987	1,584	193.0	305.7	68.2	89.3	400.3
1988	1,009	194.0	125.7	37.4	69.0	492.8
			Southern assessment area - all year			
1977	537	185.2	99.5	14.0	392.3	2,780
1978	1,044	222.2	232.0	24.3	577.2	5,508
1979	765	240.1	183.7	18.2	355.9	3,595
1980	3	208.0	0.6	0.1	401.2	2,407
1981	72	199.5	14.4	1.4	378.9	2,826
1982	607	236.1	143.3	20.3	479.2	3,386
1983	40	280.5	11.2	1.2	419.2	3,786
1984	504	246.6	124.3	22.2	532.8	2,983
1985	201	250.0	50.2	4.5	513.4	5,728
1986	77	218.2	16.8	3.1	457.4	2,479
1987	91	224.8	20.5	2.9	402.8	2,847.4
1988	13	208.0	2.7	0.8	487.6	1,645.7

Table 5.2.3   Sandeel Southern North Sea. Danish CPUE data.

Year	Vessel size (GRT)						
	5-50	50-100	100-150	150-200	200-250	250-300	>300
First half year							
1982	16.1	26.9	43.1	47.2	59.2	53.2	59.6
1983	17.0	20.6	36.3	44.4	49.1	51.2	50.9
1984	19.9	26.3	42.6	50.4	60.9	56.4	60.1
1985	13.8	21.2	35.5	43.4	49.8	49.1	56.3
1986	23.2	31.4	41.1	49.8	58.9	58.4	69.4
1987	23.2	34.8	53.1	68.6	81.0	76.2	98.0
1988	19.2	27.1	42.9	52.9	61.6	54.8	76.9
Second half year							
1982	-	20.3	37.5	40.5	-	27.9	-
1983	15.1	21.3	25.1	32.4	45.4	34.0	34.7
1984	12.7	16.4	26.9	34.2	36.5	40.2	40.9
1985	13.2	19.5	26.0	35.8	36.2	38.2	39.4
1986	18.4	25.2	32.5	44.5	45.8	51.8	55.5
1987	14.9	23.4	39.7	47.9	52.6	43.1	65.2
1988	18.8	29.3	29.9	33.0	34.5	30.1	44.0

Table 5.2.4 Sandeel Northern North Sea. Danish CPUE data.

Year	Vessel size (GRT)						
	5-50	50-100	100-150	150-200	200-250	250-300	>300
First half year							
1982	11.2	17.2	31.8	26.7	47.6	40.8	25.8
1983	11.1	17.1	23.6	23.9	31.6	36.4	41.3
1984	14.6	24.8	33.4	32.1	44.4	55.5	19.7
1985	12.1	17.2	35.7	51.2	57.9	67.2	55.8
1986	21.0	32.0	45.5	50.2	63.9	57.4	71.8
1987	23.7	40.7	66.5	67.5	86.7	83.0	102.5
1988	19.0	26.3	34.1	43.1	52.7	48.0	67.0
Second half year							
1982	-	17.7	33.6	46.7	19.9	-	-
1983	17.9	25.7	31.0	32.9	44.5	34.3	57.1
1984	113.2	22.0	21.5	35.2	-	28.3	24.0
1985	21.6	23.5	25.8	39.6	60.7	33.3	-
1986	17.1	27.5	51.0	50.0	77.9	74.0	80.7
1987	21.3	31.3	24.0	28.5	42.6	26.8	22.7
1988	16.8	22.7	29.7	32.0	42.2	33.1	42.3

Table 5.2.5 Sandeel southern North Sea. Results of the
estimated multiplicative model for Danish CPUE.

Model fitting results for: LOG(SSANCPU.CPUE)

```
Independent variable            coefficient  std. error   t-value   sig.level

CONSTANT                          1.188602    0.103908    11.4390    0.0000
LOG(SSANCPU.GRT)                  0.507155    0.018287    27.7337    0.0000
IND SSANCPU.YEAR1     82,  2     -0.298943    0.085542    -3.4947    0.0008
IND SSANCPU.YEAR1     83,  1     -0.118354    0.072946    -1.6225    0.1086
IND SSANCPU.YEAR1     83,  2     -0.352637    0.072946    -4.8342    0.0000
IND SSANCPU.YEAR1     84,  1      0.048335    0.072946     0.6626    0.5097
IND SSANCPU.YEAR1     84,  2     -0.38085     0.072946    -5.2210    0.000
IND SSANCPU.YEAR1     85,  1     -0.140038    0.072946    -1.9197    0.0585
IND SSANCPU.YEAR1     85,  2     -0.362737    0.072946    -4.9727    0.0000
IND SSANCPU.YEAR1     86,  1      0.109504    0.072946     1.5012    0.1372
IND SSANCPU.YEAR1     85,  2     -0.089645    0.072946    -1.2289    0.2227
IND SSANCPU.YEAR1     87,  1      0.33936     0.072946     4.6522    0.0000
IND SSANCPU.YEAR1     87,  2     -0.074748    0.072946    -1.0247    0.3086

IND SSANCPU.YEAR1     88,  1      0.088154    0.072946     1.2085    0.2304
IND SSANCPU.YEAR1     88,  2     -0.270859    0.072946    -3.7131    0.0004

R-SQ. (ADJ.) = 0.9115   SE=    0.136470   MAE=      0.097728  DurbWat=  1.347
Previously:    0.0000            0.000000            0.000000            0.000
95 observations fitted, forecast(s) computed for 3 missing val. of dep. var.
```


Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	18.2815	14	1.30582	70.1150	.0000
Error	1.48992	80	0.0186240		
Total (Corr.)	19.7714	94			

R-squared = 0.924643
R-squared (Adj. for d.f.) = 0.911455

Stnd. error of est. = 0.13647
Durbin-Watson statistic = 1.34705

Table 5.2.6 Sandeel Southern North Sea. Standardized CPUE.

Year	Half year	CPUE (t/day)	Total international catch ('000 t)	Total international fishing effort ('000 days)	
				Half year	Year
1982	1	48.15	426.5	8.9	
	2	35.74	52.6	1.5	10.4
1983	1	42.79	359.8	8.4	
	2	33.86	59.3	1.8	10.2
1984	1	50.51	461.1	9.1	
	2	32.93	71.1	2.2	11.3
1985	1	41.86	417.1	10.0	
	2	33.59	110.6	3.3	13.3
1986	1	53.72	386.4	7.2	
	2	44.05	75.5	1.7	8.9
1987	1	67.58	297.7	4.4	
	2	44.71	105.1	2.4	6.8
1988	1	52.58	455.0	8.7	
	2	36.75	32.6	0.9	9.6

Table 5.2.7   Sandeel northern North Sea. Results of estimated
              multiplicative model for Danish CPUE.

Model fitting results for: LOG(NSANCPU.CPUE)

```
-----------------------------------------------------------------------------
Independent variable            coefficient  std. error    t-value  sig.level
-----------------------------------------------------------------------------
CONSTANT                           0.834194    0.29695      2.8092     0.0069
LOG(NSANCPU.GRT)                   0.512542    0.055592     9.2198     0.0000
IND NSANCPU.YEAR1   82,  2        -0.056244    0.14077     -0.3995     0.6911
IND NSANCPU.YEAR1   83,  1        -0.187725    0.132524    -1.4165     0.1625
IND NSANCPU.YEAR1   83,  2         0.068806    0.132524     0.5192     0.6056
IND NSANCPU.YEAR1   84,  1         0.167465    0.132524     1.2637     0.2119
IND NSANCPU.YEAR1   84,  2        -0.144115    0.140646    -1.0247     0.3102
IND NSANCPU.YEAR1   85,  1         0.292327    0.132524     2.2058     0.0318
IND NSANCPU.YEAR1   85,  2         0.10743     0.132524     0.8106     0.4212
IND NSANCPU.YEAR1   86,  1         0.449255    0.132524     3.3900     0.0013
IND NSANCPU.YEAR1   86,  2         0.567859    0.132524     4.2849     0.0001
IND NSANCPU.YEAR1   87,  1         0.76726     0.132524     5.7896     0.0000
IND NSANCPU.YEAR1   87,  2        -0.029744    0.132524    -0.2244     0.8233
-----------------------------------------------------------------------------
IND NSANCPU.YEAR1   88,  1         0.24753     0.132524     1.8678     0.0673
IND NSANCPU.YEAR1   88,  2         0.012129    0.132524     0.0915     0.9274
-----------------------------------------------------------------------------
R-SQ. (ADJ.) = 0.7367  SE=    0.209539  MAE=      0.127998  DurbWat=  1.648
Previously:     0.0000        0.000000            0.000000            0.000
68 observations fitted, forecast(s) computed for 2 missing val. of dep. var.
```

Analysis of Variance for the Full Regression

```
-----------------------------------------------------------------------------
Source          Sum of Squares    DF    Mean Square     F-Ratio   P-value
-----------------------------------------------------------------------------
Model               8.84360       14      0.631686      14.3870     .0000
Error               2.32706       53      0.0439068
-----------------------------------------------------------------------------
Total (Corr.)      11.1707        67
```

R-squared = 0.791681
R-squared (Adj. for d.f.) = 0.736654

Stnd. error of est. = 0.209539
Durbin-Watson statistic = 1.6476

Table 5.2.8 Fishing effort indices for SANDEEL in the Northern North Sea (days fishing multiplied by scaling factors for each vessel category to represent days fishing for a vessel of 200 GRT).

	Norwegian			Danish					
Year	Fishing days	Catch sampled for fishing effort ('000 t)	CPUE (t/day)	Catch sampled for fishing effort ('000 t)	CPUE (t/day)	CPUE standardized to Norwegian data (t/day)	Total inter-national catch ('000 t)	Mean CPUE (t/day)	Derived inter-national effort ('000 days)
First half of year									
1976	593	11.1	18.7	-	-	-	110.3	18.7	5.9
1977	2,047	50.4	24.6	-	-	-	276.0	24.6	11.2
1978	1,762	44.9	25.5	-	-	-	109.7	25.5	4.3
1979	1,457	29.6	20.3	-	-	-	47.7	20.3	2.3
1980	2,732	112.8	41.3	-	-	-	220.9	41.3	5.3
1981	1,837	42.8	23.2	-	-	-	93.3	23.2	4.0
1982	1,254	27.0	21.5	13.5	34.9	24.5	62.3	21.8	2.9
1983	377	8.5	22.5	17.4	28.9	20.3	54.5	20.4	2.7
1984	140	3.5	25.0	54.1	41.2	29.0	74.1	26.1	2.8
1985	378	8.7	23.0	47.4	46.7	32.8	69.9	27.4	2.6
1986	1,531	59.2	38.6	154.1	54.7	38.5	221.3	35.5	6.2
1987	2,178	123.6	56.7	213.2	75.1	52.8	360.9	50.5	7.1
1988	3,730	156.8	42.0	158.1	44.7	31.4	331.3	43.4	7.6
Second half of year									
1976	108	2.0	18.5	-	-	-	44.9	18.5	2.4
1977	439	11.8	26.9	-	-	-	110.0	26.9	4.1
1978	814	22.5	27.6	-	-	-	53.3	27.6	1.9
1979	1,670	53.2	31.9	-	-	-	147.7	31.9	4.6
1980	1,148	33.2	28.9	-	-	-	71.1	28.9	2.5
1981	402	7.9	19.6	-	-	-	44.9	19.6	2.3
1982	-	-	-	1.8	33.0	28.3	12.0	30.5	0.4
1983	67	2.4	35.8	12.3	37.4	32.0	23.7	37.0	0.6
1984	-	-	-	10.7	30.2	25.9	17.7	22.8	0.8
1985	-	-	-	16.4	38.8	33.2	16.8	34.9	0.5
1986	540	19.8	36.7	96.1	61.5	52.7	153.8	52.6	2.9
1987	1,555	68.2	43.9	5.5	33.9	29.9	76.9	42.7	1.8
1988	994	27.4	27.6	41.5	35.3	30.2	69.0	32.2	2.1

Table 5.2.9 Fishing effort (days absent) by month and year in the Shetland sandeel fishery, 1976-1988. UK (Scotland) data.

Month	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986[1]	1987	1988
Jan	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	6	77	12	-	-	-	-	-	-	-	12	1	1
Apr	132	191	116	38	95	234	242	83	227	57	66	53	55
May	127	217	316	134	156	289	355	295	385	146	138	111	84
Jun	222	305	250	161	229	299	359	386	303	158	117	87	42
Total	487	790	694	333	480	822	956	764	915	361	333	252	18?
Jul	312	277	187	106	242	440	361	339	337	191	61	63	॥॥
Aug	241	160	234	108	212	346	297	297	263	133	143	90	23
Sep	79	89	204	44	72	198	254	127	102	80	56	27	18
Oct	65	35	78	1	-	-	65	11	7	27	30	2	5
Nov	4	-	-	-	-	-	4	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	701	561	703	259	526	1,024	981	774	709	431	290	182	99
Annual total	1,188	1,351	1,397	592	1,006	1,846	1,937	1,538	1,624	792	623	434	281

[1] 1986 data include an estimated 113 days of Danish fishing effort [calculated using UK (Scotland) CPUE data].

Table 5.2.10 Fishing effort (days absent) by month and year in the
Division VIa SANDEEL fishery, 1980-1988, UK (Scotland)
data.

Month	1980	1981	1982	1983	1984	1985	1986	1987	1988
Jan	–	–	–	–	–	–	–	–	–
Feb	–	–	–	–	–	–	–	–	–
Mar	–	–	–	–	–	–	–	–	–
Apr	–	4	54	21	11	7	7	3	26
May	–	4	121	112	119	131	104	22	87
Jun	–	–	168	112	128	124	117	79	139
Total	–	8	343	245	258	262	228	104	252
Jul	26	90	118	126	125	101	126	93	108
Aug	–	132	89	76	63	76	94	67	56
Sep	–	70	34	–	–	28	67	26	19
Oct	–	3	4	–	–	8	15	–	4
Nov	–	–	–	–	–	–	–	–	–
Dec	–	–	–	–	–	–	–	–	–
Total	26	295	245	202	188	213	302	186	186
Annual Total	26	303	588	447	446	475	530	290	439

Table 5.3 SANDEEL. Natural mortality coefficients.

Age group	Jan-Jun	Jul-Dec
0	–	0.80
1	1.00	0.20
2	0.40	0.20
3	0.40	0.20
4	0.40	0.20
5	0.40	0.20
≥6	0.40	0.20

Table 5.4.1   SANDEELS. Numbers caught (millions), in the southern area of the
              North Sea, 1987 and 1988.

1987	Age group										Total
	0	1	2	3	4	5	6	7	8	≥9	
Jan-Mar	–	81	160	12	2	–	–	–	–	–	240
Apr-Jun	–	4,270	22,611	1,146	139	24	–	–	–	–	28,190
Jul-Sep	298	3,095	6,664	196	45	6	–	–	–	–	10,304
Oct-Dec	–	–	–	–	–	–	–	–	–	–	–
Total	298	7,446	29,435	1,354	186	30	–	–	–	–	38 749

1988	Age group										Total
	0	1	2	3	4	5	6	7	8	≥9	
Jan-Mar	–	–	6	12	1	1	–	–	–	–	20
Apr-Jun	1,420	2,349	10,068	17,902	1,919	616	146	65	–	21	34,506
Jul-Sep	–	–	224	2,084	63	5	–	–	–	–	12,376
Oct-Dec	–	–	10	–	–	–	–	–	–	–	10
Total	1,420	2,349	10,308	19,998	1,983	622	146	65	–	21	36,912

Table 5.4.2 SANDEEL. Numbers caught (millions) in the northern
             area of the North Sea, 1987 and 1988.

1987	Age group							Total
	0	1	2	3	4	5	6	
Jan-Mar	–	652	1,575	131	1	–	–	2,359
Apr-Jun	–	25,584	9,280	219	106	32	16	35,237
Jul-Sep	443	5,211	198	–	–	–	–	5,852
Oct-Dec	12	557	–	–	–	–	–	569
Total	455	32,004	11,053	350	107	32	16	47,136

1988	Age group							Total
	0	1	2	3	4	5	6	
Jan-Mar	–	1,546	8,851	185	1	–	–	10,582
Apr-Jun	2,453	8,309	17,071	1,134	26	–	–	28,993
Jul-Sep	8,828	1,051	313	119	17	–	–	10,328
Oct-Dec	4,368	232	27	–	–	–	–	4,627
Total	15,649	11,138	26,262	1,438	43	–	–	54,530

Table 5.4.3   SANDEELS, Shetland. Numbers caught (millions), 1988, UK (Scotland) data.

Month	Age group								Total
	0	1	2	3	4	5	6	7+	
Mar	−	+	+	+	+	+	+	−	1
Apr	−	6	58	45	15	8	2	1	136
May	+	18	61	49	24	14	10	3	179
Jun	52	6	32	13	9	3	3	+	118
Jul	395	1	1	−	−	1	−	−	398
Aug	48	1	1	1	+	+	+	+	53
Sep	30	1	+	+	+	+	+	−	32
Oct	6	+	+	+	+	+	+	−	6
Total	531	33	154	109	48	28	15	4	923

Table 5.4.4   SANDEELS. Division VIa. Numbers caught (millions), 1988, UK (Scotland) data.

Month	Age group								Total
	0	1	2	3	4	5	6	7+	
Apr	−	56	174	31	2	2	1	+	265
May	6	83	344	83	25	26	16	−	582
Jun	789	48	698	121	14	25	5	2	1,703
Jul	133	64	423	72	9	19	9	1	730
Aug	39	8	106	44	16	20	13	4	250
Sep	511	+	18	14	3	5	2	2	44
Oct	+	+	2	1	+	†	+	+	5
Total	967	259	1,765	366	68	97	46	10	3,579

Table 5.4.5 VIRTUAL POPULATION ANALYSIS

SANDEEL IN THE SOUTHERN NORTH SEA

CATCH IN NUMBERS   UNIT: millions

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	4	13263	42147	2127	133	43835	5281	10253	20	18513	112	298
1	16557	19769	61613	21228	38007	13801	61263	2472	71940	9686	48979	7446
2	16863	5623	17333	24823	13312	13611	6714	37835	2349	42530	7626	29435
3	1914	6308	1918	4626	4369	2581	3621	1447	13849	4724	1845	1354
4	1336	973	1103	1376	385	810	1849	236	311	396	39	186
5+	338	849	236	750	113	461	130	153	175	167	9	30
TOTAL	37011	46785	124350	54929	56320	75099	78858	52396	88644	76016	58610	38749

	1988
0	1420
1	2349
2	10308
3	19998
4	1983
5+	854
TOTAL	36912

Table 5.4.6 VIRTUAL POPULATION ⌐ˈLYSIS

SANDEEL IN THE SOUTHERN NORTH S

FISHING MORTALITY COEFFICIENT UNIT: Year-1 VARIABLE NATURAL MORTALITY COEFFICIENT

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	.00	.02	.11	.01	.00	.05	.04	.01	.00	.02	.00	.01
1	.35	.25	.49	.28	.53	.41	.33	.09	.47	.17	.22	.13
2	.65	.46	.98	1.07	.72	1.03	1.00	.93	.26	2.11	.46	.46
3	.44	.95	.46	1.54	.95	.47	1.83	1.12	2.94	3.43	.92	.21
4	.54	.71	.72	1.30	.85	.78	1.42	1.03	1.60	2.77	.69	.34
5+	.54	.71	.72	1.30	.85	.78	1.42	1.03	1.60	2.77	.69	.34
(1- 2)U	.50	.36	.73	.67	.62	.72	.67	.51	.37	1.14	.34	.30
(1- 3)U	.48	.55	.64	.96	.73	.64	1.05	.72	1.23	1.90	.53	.27

	1988	1983-86
0	.00	.01
1	.19	.24
2	.67	.94
3	1.22	2.10
4	.94	1.52
5+	.94	1.52
(1- 2)U	.43	
(1- 3)U	.69	

Table 5.4.7   VIRTUAL POPULATION ANALYSIS

SANDEEL IN THE SOUTHERN NORTH SEA

STOCK SIZE IN NUMBERS   UNIT: millions

BIOMASS TOTALS   UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	744242	1313088	806424	752899	333878	1897842	251392	1567318	522533	2140579	510048	111506
1	92878	150258	259754	145991	151147	67355	365532	48629	312293	105489	424699	102932
2	45514	19696	35276	47839	33284	26837	13427	79395	13379	58511	26844	103108
3	6982	13056	6798	7292	9043	8887	5274	2700	17175	5651	3891	9292
4	4117	2465	2768	2363	861	1917	3037	465	481	499	100	847
5+	1041	2152	593	1289	253	1091	214	302	270	210	23	137

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TOT.BIOM	1143588	113/000	1647019	1363265	1181358	798962	1770645	1243206	1696697	1254112	2096923	1862591
SPS BIOM	772077	535967	608004	779302	576770	529543	308517	1048689	447525	832155	398127	1450865

	1988	1989
0	850485	0
1	22392	171135
2	27200	5552
3	35589	7647
4	4122	5762
5+	1775	1258

TOT.BIOM 1090889
SPS BIOM 1001321

Table 5.4.8   Sandeel southern North Sea. Output from Laurec-Shepherd tuning.

Module run at 16.09.58 02 APRIL 1989
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,DANISH   , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
     , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,
Oldest age F = 1.000*average of 2 younger ages. Fleets combined by variance of predictions
Fishing mortalities

```
  Age,    82,    83,    84,    85,    86,    87,    88,

    0,  .043,  .013,  .000,  .017,  .000,  .005,  .003,
    1,  .327,  .091,  .475,  .169,  .216,  .131,  .195,
    2, 1.004,  .931,  .262, 2.111,  .461,  .464,  .669,
    3, 1.828, 1.125, 2.939, 3.431,  .924,  .213, 1.221,
    4, 1.416, 1.028, 1.600, 2.771,  .692,  .338,  .945,
```

Log catchability estimates

Age 0
```
Fleet,    82,    83,    84,    85,    86,    87,    88

   1 , -5.49, -6.65,-11.91, -6.64, -9.93, -7.14, -7.96
```

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-7.96	2.379	.0034	.0034	.000E+00	.000E+00	-7.960	.841

```
Fbar      SIGMA(int.)   SIGMA(ext.)   SIGMA(overall)  Variance ratio
.003         2.38          0.000          2.38           0.000
```

Age 1
```
Fleet,    82,    83,    84,    85,    86,    87,    88

   1 , -3.46, -4.72, -3.17, -4.37, -3.72, -3.95, -3.90
```

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.90	.563	.1945	.1945	.000E+00	.000E+00	-3.899	.199

```
Fbar      SIGMA(int.)   SIGMA(ext.)   SIGMA(overall)  Variance ratio
.195         .563          0.000          .563           0.000
```

Age 2
```
Fleet,    82,    83,    84,    85,    86,    87,    88

   1 , -2.34, -2.39, -3.76, -1.84, -2.96, -2.69, -2.66
```

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-2.66	.641	.6690	.6690	.000E+00	.000E+00	-2.664	.227

```
Fbar      SIGMA(int.)   SIGMA(ext.)   SIGMA(overall)  Variance ratio
.669         .641          0.000          .641           0.000
```

Age 3
```
Fleet,    82,    83,    84,    85,    86,    87,    88

   1 , -1.74, -2.20, -1.35, -1.35, -2.27, -3.46, -2.06
```

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-2.06	.774	1.2207	1.2207	.000E+00	.000E+00	-2.062	.274

```
Fbar      SIGMA(int.)   SIGMA(ext.)   SIGMA(overall)  Variance ratio
1.221        .774          0.000          .774           0.000
```

Table 5.4.9 SANDEELS in the Southern North Sea. Catch in numbers, half-year (millions).

Age groups	1976 1	1976 2	1977 1	1977 2	1978 1	1978 2	1979 1	1979 2	1980 1	1980 2	1981 1	1981 2	1982 1	1982 2
0	4	-	-	13,263	922	41,224	181	1,947	62	72	415	43,420	242	5,039
1	16,308	249	19,500	269	58,839	2,774	16,018	5,210	33,269	4,738	13,394	407	56,545	4,718
2	14,505	2,358	5,596	27	16,948	385	22,737	2,085	12,472	840	11,719	1,892	6,224	490
3	1,522	392	6,300	8	1,793	124	4,487	138	3,794	575	2,466	115	3,277	344
4	1,234	102	965	8	1,006	97	1,265	110	375	9	774	36	1,813	36
5	171	20	445	3	114	26	441	30	63	-	353	3	94	4
6	72	58	239	3	21	26	244	-	50	-	84	-	24	-
7+	1	16	159	-	39	9	35	-	+	-	21	-	8	-

Age groups	1983 1	1983 2	1984 1	1984 2	1985 1	1985 2	1986 1	1986 2	1987 1	1987 2	1988 1	1988 2
0	955	9,298	20	-	6,573	11,940	-	112	-	298	1,420	-
1	2,232	240	62,517	9,423	7,790	1,896	43,629	5,350	4,351	3,095	2,349	-
2	5,029	2,806	2,257	92	39,301	3,229	7,333	293	22,771	6,664	10,074	234
3	934	513	13,272	577	2,490	2,234	1,604	241	1,158	196	17,914	2,084
4	234	2	267	44	233	163	30	9	141	45	1,920	63
5	122	-	109	-	18	77	-	9	24	6	617	5
6	25	-	66	-	7	30	-	-	-	-	146	-
7+	6	-	-	-	7	28	-	-	-	-	86	-

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

Table 5.4.10 SANDEELS in the Southern North Sea. VPA fishing mortality, half-year.

Age group	1976 1	1976 2	1977 1	1977 2	1978 1	1978 2	1979 1	1979 2	1980 1	1980 2	1981 1	1981 2	1982 1	1982 2
0	+	-	-	0.03	+	0.17	+	0.01	+	+	+	0.08	+	0.06
1	0.34	0.01	0.23	0.01	0.45	0.05	0.19	0.14	0.39	0.14	0.34	0.02	0.28	0.05
2	0.50	0.16	0.45	+	0.83	0.04	0.90	0.21	0.64	0.09	0.68	0.25	0.69	0.11
3	0.32	0.14	0.89	+	0.40	0.05	1.05	0.08	0.80	0.30	0.44	0.04	1.01	0.29
4	0.72	0.13	0.67	0.01	0.55	0.10	1.07	0.27	0.38	0.02	0.95	0.11	1.35	0.08
5	0.25	0.05	1.48	0.03	0.24	0.09	1.07	0.18	0.26	-	1.48	0.04	0.50	0.04
6	0.14	0.18	1.37	0.05	0.38	1.44	5.98	-	0.58	-	1.27	-	0.60	-
7+	0.40	+	0.80	-	0.40	+	0.80	-	0.40	-	0.60	-	0.60	-
$\bar{F}_{(1-2)}$	0.42	0.08	0.34	0.01	0.64	0.05	0.55	0.17	0.51	0.11	0.51	0.14	0.47	0.08

Age group	1983 1	1983 2	1984 1	1984 2	1985 1	1985 2	1986 1	1986 2	1987 1	1987 2	1988 1	1988 2
0	+	0.02	+	-	+	0.02	-	+	-	0.01	+	-
1	0.05	0.01	0.33	0.12	0.11	0.06	0.16	0.04	0.09	0.13	0.24	-
2	0.77	0.12	0.15	0.01	1.20	0.31	0.37	0.02	0.28	0.14	0.92	0.05
3	0.36	0.40	1.54	0.26	0.38	0.81	0.02	0.01	0.14	0.04	0.75	0.20
4	0.37	0.01	0.42	0.12	0.17	0.20	0.26	0.02	0.06	0.03	0.62	0.04
5	0.50	-	0.48	-	0.08	0.60	-	0.45	0.04	0.01	0.64	0.01
6	0.40	-	0.98	-	0.08	0.60	-	-	-	-	0.50	-
7+	+	-	-	-	0.40	+	-	-	-	-	0.50	-
$\bar{F}_{(1-2)}$	0.38	0.06	0.24	0.06	0.66	0.18	0.26	0.03	0.18	0.14	0.58	0.01

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

Table 5.4.11   SANDEELS in the southern North Sea. VPA stock size in numbers (millions)
(biomass in '000 t), half-year.

| Age | 1976 | | 1977 | | 1978 | | 1979 | | 1980 | | 1981 | | 1982 | |
group	1	2	1	2	1	2	1	2	1	2	1	2	1	2
0	-	330,696	-	570,255	-	381,100	-	355,234	-	158,585	-	842,532	-	166,072
1	87,269	22,871	148,591	43,524	247,594	58,065	144,626	44,026	158,347	39,491	71,210	18,615	372,833	104,959
2	44,185	18,013	18,501	7,917	35,392	10,309	45,037	12,232	31,350	11,082	28,062	9,491	14,873	5,020
3	6,762	3,308	12,623	3,483	6,458	2,890	8,093	1,897	8,138	2,449	8,315	3,597	6,069	1,488
4	2,844	926	2,355	811	2,844	1,103	2,254	517	1,429	656	1,488	387	2,841	492
5	917	477	666	101	657	348	816	200	324	166	529	81	284	115
6	666	388	372	63	80	37	261	-	137	52	136	26	63	-
7+	2	-	337	-	134	-	70	-	-	-	54	-	21	-
SSB	741	-	496	-	610	-	751	-	553	-	521	-	339	-
Total biom.	1,090	-	1,091	-	1,600	-	1,329	-	1,186	-	806	-	1,830	-

| Age | 1983 | | 1984 | | 1985 | | 1986 | | 1987 | | 1988 | |
group	1	2	1	2	1	2	1	2	1	2	1	2
0	-	775,680	-	252,330	-	1,027,146	-	181,952	-	38,442	-	-
1	71,341	24,951	342,473	90,567	113,379	37,218	453,741	141,866	81,683	27,535	17,079	-
2	86,675	26,914	20,212	11,721	65,656	13,255	28,761	13,386	111,321	56,273	19,754	5,289
3	3,668	1,708	19,506	2,794	9,514	4,377	7,950	4,037	10,695	6,232	40,067	12,643
4	909	421	938	415	1,768	977	1,592	1,043	3,088	1,955	4,925	1,772
5	371	151	343	143	300	186	669	449	846	348	1,560	554
6	91	-	123	31	117	73	-	-	-	-	443	-
7+	-	-	-	-	25	-	-	-	-	-	255	-
SSB	1,013	-	581	-	1,009	-	525	-	1,637	-	1,001	-
Total biom.	1,389	-	1,951	-	1,463	-	2,340	-	1,964	-	1,070	-

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

<u>Table 5.4.12</u>   Sandeel northern North Sea. Ouput from Laurec-Shepherd tuning.

Module run at 17.10.58 02 APRIL 1989
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,COMBINED DANISH AND , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
      , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,
Oldest age F = 1.000'average of 2 younger ages. Fleets combined by variance of predictions
Fishing mortalities

    Age,   82,   83,   84,   85,   86,   87,   88,

      0,   .172,   .171, .001,   .001, .035,   .012,   .014,
      1,   .468,   .370, .753,   .183, .231,   .340,   .736,
      2, 1.833, 1.055,   .424, 1.557, .809,   .274, 1.698,
      3, 1.151,   .713, .588,   .870, .520,   .307, 1.217,

Log catchability estimates

Age 0
Fleet,   82,   83,   84,   85,   86,   87,   88
————,————,————,————,————,————,————,————
  1 , -2.95, -2.96,-13.22, -7.80, -5.56, -6.59, -6.51

                              SUMMARY STATISTICS
                    Fleet , Pred. , SE(q),Partial,Raised,   SLOPE   ,   SE   ,INTRCPT, SE
                          ,   q   ,   ,   F   , F   ,   ,   Slope ,   ,Intrcpt
                    ————,————,————,————,————,————,————,————,————
                      1 , -6.51 , 3.725, .0144 , .0144, .000E+00, .000E+00, -6.514, 1.317
                     Fbar   SIGMA(int.)   SIGMA(ext.)   SIGMA(overall) Variance ratio
                     .014   3.72   0.000   3.72   0.000

Age 1
Fleet,   82,   83,   84,   85,   86,   87,   88
————,————,————,————,————,————,————,————
  1 , -1.95, -2.19, -1.56, -2.83, -3.67, -3.26, -2.58

                              SUMMARY STATISTICS
                    Fleet , Pred. , SE(q),Partial,Raised,   SLOPE   ,   SE   ,INTRCPT, SE
                          ,   q   ,   ,   F   , F   ,   ,   Slope ,   ,Intrcpt
                    ————,————,————,————,————,————,————,————,————
                      1 , -2.58 , .794, .7357 , .7357, .000E+00, .000E+00, -2.579,   .281
                     Fbar   SIGMA(int.)   SIGMA(ext.)   SIGMA(overall) Variance ratio
                     .736   .794   0.000   .794   0.000

Age 2
Fleet,   82,   83,   84,   85,   86,   87,   88
————,————,————,————,————,————,————,————
  1 , -.59, -1.14, -2.14, -.69, -2.42, -3.48, -1.74

                              SUMMARY STATISTICS
                    Fleet , Pred. , SE(q),Partial,Raised,   SLOPE   ,   SE   ,INTRCPT, SE
                          ,   q   ,   ,   F   , F   ,   ,   Slope ,   ,Intrcpt
                    ————,————,————,————,————,————,————,————,————
                      1 , -1.74 , 1.108,1.6979 ,1.6979, .000E+00, .000E+00, -1.743,   .392
                     Fbar   SIGMA(int.)   SIGMA(ext.)   SIGMA(overall) Variance ratio
                     1.698   1.11   0.000   1.11   0.000

Table 5.4.13 SANDEELS in the Northern North Sea. Catch in numbers, half-year (millions).

Age group	1976		1977		1978		1979		1980		1981	
	1	2	1	2	1	2	1	2	1	2	1	2
0	237	6,126	3,686	3,067	-	7,820	-	44,203	17	8,349	17	9,128
1	5,697	648	24,307	2,856	6,127	1,001	2,335	1,310	13,394	1,173	5,505	346
2	1,130	84	2,351	913	2,338	307	1,328	433	8,865	214	4,109	94
3	445	368	516	142	573	39	242	66	1,050	19	904	14
4	101	19	124	99	78	1	5	10	645	4	128	6
5+	54	18	20	43	66	1	7	-	183	4	46	-

Age group	1982		1983		1984		1985		1986		1987	
	1	2	1	2	1	2	1	2	1	2	1	2
0	2	6,530	-	7,911	-	-	1	349	7	7,105	-	455
1	3,518	65	5,684	303	11,692	1,207	2,688	109	23,934	7,077	26,236	5,768
2	2,132	-	1,215	316	1,647	121	3,292	239	2,600	473	10,855	198
3	556	-	89	19	153	43	1,002	89	200	-	350	-
4	76	-	8	-	5	-	377	7	-	-	107	-
5+	9	-	4	-	-	-	103	4	-	-	48	-

Age group	1988	
	1	2
0	2,453	13,196
1	9,855	1,283
2	25,922	340
3	1,319	119
4	26	17
5+	-	-

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

Table 5.4.14 SANDEELS in the Northern North Sea. VPA fishing mortality, half-year.

Age group	1976 1	1976 2	1977 1	1977 2	1978 1	1978 2	1979 1	1979 2	1980 1	1980 2	1981 1	1981 2
0	+	0.06	0.03	0.07	-	0.10	-	0.49	+	0.22	+	0.27
1	0.30	0.08	0.78	0.33	0.38	0.16	0.08	0.09	0.61	0.16	0.49	0.08
2	0.51	0.07	0.50	0.42	0.54	0.14	0.37	0.22	1.55	0.14	1.49	0.12
3	0.29	0.49	0.89	0.78	0.58	0.08	0.17	0.07	1.45	0.09	1.55	0.09
4	0.81	0.37	0.33	0.56	1.78	0.07	0.01	0.04	2.52	0.10	1.54	0.28
5+	(0.50)	-	(0.80)	-	(0.60)	-	(0.30)	-	(1.30)	-	(1.20)	-
F_{1-2}	0.41	0.08	0.59	0.38	0.48	0.15	0.23	0.16	1.08	0.15	0.99	0.10

Age group	1982 1	1982 2	1983 1	1983 2	1984 1	1984 2	1985 1	1985 2	1986 1	1986 2	1987 1	1987 2
0	+	0.15	-	0.12	-	-	+	+	+	0.03	-	0.01
1	0.34	0.01	0.41	0.05	0.60	0.19	0.22	0.02	0.39	0.32	0.26	0.14
2	1.12	-	0.46	0.23	0.51	0.07	1.28	0.31	0.93	0.49	1.33	0.07
3	2.55	-	0.18	0.06	0.19	0.08	1.45	0.52	0.51	-	0.97	-
4	1.00	-	0.40	-	0.02	-	2.58	(0.40)	-	-	(1.00)	-
5+	(1.00)	-	-	-	-	-	(0.90)	-	-	-	(0.90)	-
F_{1-2}	0.73	0.01	0.44	0.14	0.56	0.13	0.75	0.17	0.66	0.41	0.80	0.10

Age group	1988 1	1988 2
0	0.01	0.15
1	0.69	0.30
2	1.80	0.10
3	1.12	0.30
4	0.26	0.30
5+	-	-
F_{1-2}	1.24	0.20

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

Table 5.4.15 SANDEELS in the Northern North Sea. VPA stock size (millions) and
('000 t), half-year.

Age group	1976 1	1976 2	1977 1	1977 2	1978 1	1978 2	1979 1	1979 2	1980 1	1980 2
0	-	157,359	-	70,359	-	124,312	-	160,326	-	60,255
1	34,386	9,413	66,722	11,252	29,660	7,454	50,784	17,332	44,092	8,799
2	3,371	1,356	7,122	2,894	6,647	2,588	5,201	2,420	13,008	1,854
3	2,095	1,046	1,035	286	1,550	582	1,842	1,039	1,591	251
4	215	64	527	253	107	12	441	292	791	43
5+	159	-	48	-	169	-	31	-	290	-
SSB	144	-	194	-	187	-	176	-	346	-
Total biom.	368	-	627	-	380	-	506	-	632	-

Age group	1981 1	1981 2	1982 1	1982 2	1983 1	1983 2	1984 1	1984 2	1985 1	1985 2
0	-	54,743	-	67,188	-	97,968	-	47,287	-	255,746
1	21,703	4,904	18,744	4,904	25,969	6,353	38,897	7,827	21,247	6,280
2	6,148	932	3,703	809	3,956	1,679	4,928	1,986	5,321	996
3	1,325	188	679	35	663	372	1,090	607	1,517	239
4	188	27	141	-	29	-	288	189	459	23
5+	74	-	17	-	-	-	-	-	201	-
SSB	169	-	99	-	99	-	113	-	140	-
Total biom.	311	-	212	-	267	-	308	-	246	-

Age group	1986 1	1986 2	1987 1	1987 2	1988 1	1988 2
0	-	402,267	-	66,365	-	136,280
1	114,686	28,690	86,064	49,844	29,523	5,435
2	5,043	1,329	17,032	3,022	35,610	3,935
3	601	243	642	169	2,296	504
4	116	78	221	-	139	72
5+	-	-	665	-	-	-
SSB	98	-	234	-	629	-
Total biom.	672	-	871	-	777	-

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

Table 5.4.16

SANDEEL: SHETLAND: CATCH AT AGE IN NUMBERS   (-1 REPRESENTS < HALF A UNIT)
UNITS = MILLIONS

	1977		1978		1979		1980		1981		1982	
	1	2	1	2	1	2	1	2	1	2	1	2
0	737	5233	80	5373	0	1403	57	6375	157	13086	545	16306
1	3028	480	4203	691	2222	443	515	225	2284	678	5780	402
2	645	123	1114	102	232	133	379	108	1109	107	981	83
3	35	9	85	29	18	26	311	32	358	31	349	36
4	36	20	24	4	4	17	104	14	136	7	98	10
5	4	1	27	1	1	9	64	5	50	5	76	5
6	5	1	4	0	-1	0	33	1	24	1	25	1
7	2	1	1	0	-1	0	17	0	3	2	7	-1
8+	-1	0	2	0	0	0	2	0	4	1	6	0

	1983		1984		1985		1986		1987		1988	
	1	2	1	2	1	2	1	2	1	2	1	2
0	668	4936	1940	4833	153	2039	898	1328	19	400	52	492
1	2610	818	1843	481	1076	252	522	94	873	111	30	3
2	687	85	1064	154	313	157	352	25	53	16	151	4
3	221	22	401	36	166	83	327	24	35	10	107	2
4	96	15	134	10	55	20	141	11	38	8	48	1
5	28	5	38	9	17	11	58	3	16	7	26	2
6	17	1	14	1	6	3	14	1	4	1	15	1
7	5	-1	7	1	1	1	4	-1	1	-1	3	-1
8+	2	1	2	0	1	-1	2	-1	0	0	2	0

Table 5.4.17

| SANDEEL: | | | SHETLAND: | | | | | F AT AGE | | (-1 REPRESENTS < 0.0005 UNIT) | | | |

	1977		1978		1979		1980		1981		1982	
	1	2	1	2	1	2	1	2	1	2	1	2
0	.000	.169	.000	.235	.000	.069	.000	.240	.000	.281	.000	.336
1	.343	.135	.432	.191	.306	.149	.065	.058	.266	.192	.419	.074
2	.390	.134	.584	.106	.100	.085	.203	.091	.490	.087	.521	.083
3	.080	.028	.142	.073	.027	.054	.325	.056	.542	.091	.502	.097
4	.103	.085	.115	.029	.013	.084	.355	.084	.388	.033	.498	.091
5	.317	.189	.174	.010	.012	.125	.592	.097	.517	.095	.683	.094
6	.602	.225	1.716	.000	.004	.000	.988	.065	.919	.075	1.133	.117
7	.804	.500	.500	.000	.500	.000	.500	.000	.309	.500	1.699	.500
8+	.804	.000	.500	.000	.000	.000	.500	.000	.309	.500	1.699	.000
F 2- 5	.223	.109	.254	.055	.038	.087	.368	.082	.484	.076	.551	.091

	1983		1984		1985		1986		1987		1988	
	1	2	1	2	1	2	1	2	1	2	1	2
0	.000	.100	.000	.270	.000	.148	.000	.104	.000	.300	.000	.035
1	.170	.118	.100	.054	.183	.095	.104	.039	.189	.053	.068	.014
2	.192	.037	.245	.056	.049	.035	.205	.022	.030	.013	.103	.004
3	.366	.062	.265	.038	.088	.065	.105	.011	.043	.018	.121	.004
4	.448	.128	.721	.117	.083	.044	.164	.019	.024	.007	.118	.004
5	.463	.146	.615	.336	.320	.430	.188	.017	.038	.025	.031	.004
6	.590	.079	.963	.205	.441	.424	1.730	.646	.025	.014	.071	.004
7	1.896	.500	.969	.500	.339	.500	2.354	.500	2.021	.500	.034	.004
8+	1.896	.500	.969	.000	.339	.500	2.354	.500	.000	.000	.034	.000
F 2- 5	.367	.093	.461	.137	.135	.143	.166	.017	.034	.016	.093	.004

Table 5.4.18

SANDEEL: SHETLAND: STOCK AT AGE IN NUMBERS   (-1 REPRESENTS < HALF A UNIT)
PROPORTION OF F (INTERVAL 1) BEFORE SPAWNING = .00   PROPORTION OF M (INTERVAL 1) BEFORE SPAWNING = .00
0-GROUP NOT ACCOUNTED FOR IN TOTAL NUMBER OR BIOMASS
UNITS = MILLIONS

	1977		1978		1979		1980		1981		1982	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0	48257	0	36663	0	30605	0	42783	0	76083	0	81180
1	16038	4186	18305	4372	13020	3528	12840	4426	15127	4264	25800	6240
2	2391	1085	2995	1119	2957	1794	2490	1363	3421	1405	2881	1147
3	548	339	777	452	824	538	1349	653	1018	397	1054	428
4	442	267	270	161	344	227	417	196	506	230	297	121
5	18	9	201	113	128	85	171	63	148	59	182	62
6	13	5	6	1	92	61	61	15	47	13	44	9
7	5	1	3	0	1	0	50	0	12	6	10	1
8+	1	0	7	0	0	0	5	0	18	3	8	0
TBM	66954		78845		65389		68725		77151		102117	
SSB	22529		28140		29322		33159		35250		30651	

	1983		1984		1985		1986		1987		1988	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0	74926	0	29188	0	21343	0	19451	0	2196	0	20750
1	26064	8090	30465	10144	10015	3067	8272	2742	7879	2398	731	251
2	4746	2626	5886	3088	7871	5022	2284	1247	2159	1405	1863	1126
3	864	402	2073	1066	2389	1467	3970	2396	998	641	1135	674
4	318	136	309	101	840	518	1126	640	1940	1270	515	307
5	90	38	98	36	73	36	406	226	514	332	1033	671
6	46	17	27	7	21	9	19	2	182	119	265	165
7	7	1	13	3	5	2	5	-1	1	-1	96	62
8+	2	2	4	0	5	1	2	-1	0	0	63	0
TBM	109895		138177		99893		86755		72421		47301	
SSB	37698		53788		72151		63842		50596		45276	

Table 5.4.19 Mean weights at age (gram) used to calculate biomass totals for sandeels in Shetland and Division VIa.

Age group	Shetland		VIa	
	1	2	1	2
0	–	1.69	–	1.60
1	2.77	4.87	2.90	4.50
2	5.23	7.25	6.20	8.10
3	8.51	9.64	9.90	11.80
4	10.97	12.17	13.50	15.30
5	13.20	14.70	16.80	18.30
6	15.00	16.50	19.60	20.80
7+	16.40	17.70	21.80	22.80

Table 5.4.20

SANDEEL: VIa: CATCH AT AGE IN NUMBERS   (-1 REPRESENTS < HALF A UNIT)
UNITS = MILLIONS:

	1980		1981		1982		1983		1984		1985	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0	27	0	462	360	525	391	2253	186	1751	53	3207
1	0	20	-1	281	268	64	521	106	863	99	139	13
2	0	2	5	205	200	76	136	29	226	67	437	163
3	0	1	2	34	198	91	86	21	138	115	181	117
4	0	-1	1	14	62	34	111	18	67	38	139	73
5	0	1	-1	0	26	24	29	3	28	26	55	28
6	0	-1	-1	2	4	9	12	3	8	8	27	12
7+	0	-1	0	0	1	2	2	1	1	3	7	1

	1986		1987		1988	
	1	2	1	2	1	2
0	368	2702	0	595	795	173
1	859	996	521	676	187	72
2	140	68	97	232	1216	548
3	171	219	17	37	235	131
4	58	103	45	31	41	28
5	38	40	23	20	52	45
6	9	12	4	7	21	24
7+	6	6	1	4	3	8

Table 5.4.21

SANDEEL:		VIa:						F AT AGE		(-1 REPRESENTS < 0.0005 UNIT)	

	1980		1981		1982		1983		1984		1985	
	1	2	1	2	1	2	1	2	1	2	1	2
0	.000	.002	.000	.029	.000	.018	.000	.072	.000	.189	.000	.122
1	.000	.006	-1.000	.099	.043	.020	.044	.018	.072	.016	.041	.008
2	.000	.003	.002	.121	.105	.058	.059	.018	.052	.022	.102	.056
3	.000	.003	.004	.085	.181	.133	.096	.034	.121	.158	.083	.080
4	.000	.005	.004	.097	.244	.231	.262	.068	.160	.145	.324	.320
5	.000	.056	.002	.000	.297	.553	.353	.060	.159	.251	.354	.353
6	.000	.500	.012	.500	.114	.500	.694	.500	.252	.500	.492	.500
7+	.000	.500	.000	.000	.114	.500	.694	.500	.252	.500	.492	.500
F 2- 5	.000	.017	.003	.076	.207	.244	.192	.045	.123	.144	.216	.202

	1986		1987		1988	
	1	2	1	2	1	2
0	.000	.063	.000	.059	.000	.060
1	.088	.227	.031	.081	.047	.036
2	.114	.084	.034	.119	.227	.170
3	.085	.168	.030	.092	.187	.170
4	.057	.150	.052	.051	.155	.170
5	.308	.713	.049	.062	.126	.170
6	.211	.500	.151	.500	.096	.170
7+	.211	.500	.151	.500	.096	.170
F 2- 5	.141	.279	.041	.081	.174	.170

Table 5.4.22

SANDEEL: VIa: STOCK AT AGE IN NUMBERS   (-1 REPRESENTS < HALF A UNIT)
PROPORTION OF F (INTERVAL 1) BEFORE SPAWNING = .00   PROPORTION OF M (INTERVAL 1) BEFORE SPAWNING = .00
O-GROUP NOT ACCOUNTED FOR IN TOTAL NUMBER OR BIOMASS
UNITS = MILLIONS:

	1980		1981		1982		1983		1984		1985	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0	19899	0	23183	0	43029	0	47042	0	14622	0	40282
1	9919	3649	8924	3283	10116	3566	18992	6685	19673	6738	5441	1921
2	1257	843	2970	1986	2435	1470	2862	1808	5377	3421	5427	3284
3	456	306	688	459	1441	806	1135	692	1454	863	2741	1690
4	140	94	250	167	345	181	578	298	547	313	603	293
5	16	11	76	51	124	62	118	56	228	130	221	104
6	-1	-1	8	6	42	25	29	10	43	22	83	34
7+	0	-1	0	0	10	6	4	3	8	9	23	3
TBM	43233		55918		66486		94492		117019		90545	
SSB	14468		30040		37150		39414		59967		74766	

	1986		1987		1988	
	1	2	1	2	1	2
0	0	63600	0	15078	0	4288
1	16023	5398	26821	9565	6388	2242
2	1561	933	3523	2283	7221	3858
3	2542	1565	702	457	1660	923
4	1278	810	1083	689	341	196
5	174	86	570	364	536	317
6	60	33	34	20	280	171
7+	36	17	12	12	34	53
TBM	103449		131728		99579	
SSB	56981		53947		81053	

Table 5.5.1 Sandeel North Sea. Southern area. Mean weight at
age (g) in the catch by quarter and half year for
1988. Data from Denmark.

Age	Quarter				Half-year	
	1	2	3	4	1	2
0	–	1.3	–	–	1.3	–
1	5.3	7.2	–	–	7.2	–
2	11.9	13.2	9.8	9.9	13.2	9.8
3	11.8	14.2	13.2	10.3	14.2	13.2
4	13.7	17.2	16.4	15.8	17.2	16.4
5	15.9	17.5	15.0	15.0	17.5	15.0
6	16.3	18.2	–	–	18.2	–
7+	20.0	22.8	–	–	22.8	–

Table 5.5.2 Sandeel North Sea. Northern area. Mean weight at
age (g) in the catch by quarter and half year for
1988. Data from Denmark and Norway.

Age	Quarter				Half-year	
	1	2	3	4	1	2
0	–	1.7	2.7	4.8	1.7	3.4
1	2.1	4.9	11.1	9.7	4.5	10.8
2	7.3	11.2	19.2	22.8	9.9	22.8
3	17.0	25.2	26.0	–	24.0	26.0
4	–	19.5	39.0	–	19.5	39.0
5	–	31.2	–	–	31.2	–

Table 5.5.3   SANDEEL North Sea. Shetland area [UK (Scotland)
              data]. Mean weight (g) at age in the catch by
              month for 1988.

Age	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
0	–	–	0.2	0.9	1.2	2.3	4.1	3.8
1	3.2	3.1	5.9	6.5	2.4	8.8	9.0	8.3
2	5.7	5.7	7.9	9.0	11.1	12.5	11.4	10.4
3	6.5	6.8	10.2	12.4	–	12.5	13.1	12.0
4	9.9	8.9	11.2	13.1	–	17.5	12.7	11.6
5	10.8	11.8	13.6	16.3	14.3	18.8	16.6	15.3
6	13.3	14.6	14.2	17.8	....	22.0	18.9	17.4
7	–	12.2	19.7	21.1	–	23.3	–	–

Table 5.5.4   SANDEEL Division VIa. Mean weight (g)
              at age in the catch by month 1988 [UK
              (Scotland) data].

Age	Apr	May	Jun	Jul	Aug	Sep	Oct
0	–	0.2	0.6	1.0	1.0	1.0	–
1	1.8	3.0	5.7	6.6	5.4	8.1	–
2	3.7	8.1	9.5	8.8	9.8	13.8	–
3	5.2	10.7	11.6	11.0	11.8	15.7	–
4	7.6	11.7	15.7	14.7	13.6	17.7	–
5	8.5	14.8	19.3	18.5	17.1	19.9	–
6	9.8	15.3	24.2	19.4	19.0	24.3	–
7	13.3	–	27.9	19.7	21.0	21.9	–
8	–	–	21.0	–	27.9	20.2	–

Table 5.5.5   SANDEEL Southern North Sea.   Mean
weight at age (g) in the stock by
half-year.

Age	Jan-Jun	Jul-Dec
0	-	1.0
1	4.0	10.5
2	12.5	14.0
3	15.5	17.0
4	18.0	19.0
5	20.0	20.5
6	21.0	21.5
7+	22.0	22.0

Table 5.5.6   SANDEEL Northern North Sea. Mean
weight at age (g) in the stock by
half-year.

Age	1976-1984		1985-1988	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
0	-	2.0	-	2.0
1	6.5	14.0	5.0	11.5
2	19.5	25.0	16.0	21.0
3	30.5	36.5	24.0	27.0
4	40.5	45.0	29.0	31.0
5+	49.0	52.0	33.0	35.0

Table 5.6.1 SANDEEL. Half-yearly exploitation
pattern (average 1982-1986) used
for Y/R calculations.

Age	Southern North Sea		Northern North Sea	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
0	–	0.02	–	0.06
1	0.27	0.08	0.40	0.12
2	0.89	0.16	0.88	0.22
3	1.00	0.50	1.00	0.13
4	0.67	0.11	0.82	0.08
5	0.45	0.19	0.39	0.39
6	0.60	0.17	0.39	0.39
7+	0.30	0.20	0.39	0.39

Table 5.6.2 Monthly average percentage (by numbers) of
sandeel below 10 cm in Danish landings from the
Northern North Sea, 1979-1988.

Year	Month							
	3	4	5	6	7	8	9	10
1979	3.4	11.3	6.1	0.0	5.6	58.0	78.1	41.8
1980	7.7	5.7	3.9	0.3	52.4	16.2	13.8	13.6
1981	30.2	12.6	1.3	1.0	13.1	12.0	–	–
1982	–	16.3	0.9	0.4	96.8			–
1983	–	1.4	1.1	2.1	–	81.1	44.9	–
1984	9.2	22.7	13.1	–	–			–
1985	30.6	2.4	1.5	0.0	–	–	–	–
1986	5.6	11.7	14.5	0.0	26.0	35.9	–	–
1987	8.2	21.0	6.1	0.2	0.0	–	61.4	–
1988	8.6	6.4	4.1	71.2	–	–	45.3	12.5

Table 5.6.3 Expected percentage re-
            duction in fishing mor-
            tality at age in the
            Northern North Sea with
            a minimum landing size
            of 10 cm and a 25% by-
            catch rule,

Age	Jan-Jun	Jul-Dec
0	–	97
1	32	41
2	3	26
3	6	–
4+	–	–

Table 6.1 Landings of SPRAT in Division IIIa (tonnes). Data provided
           by Working Group members.)

Year	Skagerrak				Kattegat			Div. IIIa total
	Denmark	Sweden	Norway	Total	Denmark	Sweden	Total	
1974	17.9	2.0	1.2	21.1	31.6	18.6	50.2	71.3
1975	15.0	2.1	1.9	19.0	60.7	20.9	81.6	100.6
1976	12.8	2.6	2.0	17.4	27.9	13.5	41.4	58.8
1977	7.1	2.2	1.2	10.5	47.1	9.8	56.9	67.4
1978	26.6	2.2	2.7	31.5	37.0	9.4	46.4	77.9
1979	33.5	8.1	1.8	43.4	45.8	6.4	52.2	95.6
1980	31.7	4.0	3.4	39.1	35.8	9.0	44.8	83.9
1981	26.4	6.3	4.6	37.3	23.0	16.0	39.0	76.3
1982	10.5	6.7	1.8	19.0	21.4	4.8	26.2	45.2
1983	3.4	6.4	1.9	11.7	9.1	5.7	14.8	26.5
1984	13.2	5.4$_2$	1.8	20.4	10.9	5.2	16.1	36.5
1985	1.3	8.1^2	2.5	11.9	4.6	5.4	10.0	21.9
1986[1]	0.4	6.6	1.1	8.1	0.9	9.0	9.9	18.0
1987[1]	1.4	7.1	0.4	8.9	1.4	5.5	6.9	15.8
1988[1]	1.7	2.4	0.3	4.4	1.3	3.1	4.4	8.8

[1] Preliminary figures.
[2] 14,000 t reported as clupeoid by-catch in the Skagerrak were not
    sampled, but 4,000 t of this are estimated to be sprat.

Table 6.4   Indices of SPRAT, 1-group, ⩾2-group, and
            all ages in Division IIIa from IYFS, 1974–
            1989.

Year	1-group	⩾2-group	Total
1974	1,325	–	–
1975	5,339	–	–
1976	2,069	–	–
1977	5,713	984	6,697
1978	5,119	2,117	7,236
1979	3,338	1,482	4,820
1980	4,960	3,592	8,558
1981	2,809	3,068	5,877
1982	1,577	4,695	6,272
1983	1,173	1,685	2,858
1984	4,141	2,216	6,357
1985	2,077	2,667	4,744
1986	684	4,834	5,518
1987	1,830	16,543	18,373
1988	945	8,238	9,183
1989	442	2,891	3,333

Table 7.1.1 SPRAT catches in the North Sea ('000 tonnes), 1979-1987. (Data provided by Working Group members.)

Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[1]
				Division IVa West						
Denmark	-	-	2.8	-	-	-	0.9	0.6	0.2	0.1
Germany, Fed.Rep.	-	0.1	-	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	6.7	-	-	-
UK (Scotland)	6.8	3.8	1.0	+	-	+	-	+	+	-
Total	6.8	3.9	3.8	+	-	+	7.6	0.6	0.2	0.1
			Division IVa East (North Sea) stock							
Denmark	-	-	-	+	-	-	+	0.2	+	+,
Norway	+	0.4	-	-	3.0	-	-	-	-	4.9[4]
Total	+	0.4	-	+	3.0	-	+	0.2	+	4.9
		Division IVb West								
Denmark	75.3[2]	76.7[2]	53.6	23.1	32.6	5.6	1.8	0.4	3.4	1.4
Faroe Islands	2.8[2]	2.8[2]	-	-	-	-	-	-	-	-
Norway	47.8	18.3	0.2	8.6	-	-	-	-	-	4.2
UK (England)	12.9	2.4	-	-	-	+	-	-	-	-
UK (Scotland)	5.0	2.5	0.7	0.2	+	+	-	-	0.1	-
Total	143.8	102.7	54.5	31.9	32.6	5.6	1.8	0.4	3.5	5.6

[1] Preliminary figures as reported.
[2] Includes Division IVb East.
[3] Includes Division IVb West.
[4] Norwegian Fjords.
+ = less than 0.1.
- = magnitude known to be nil.

(cont'd)

Table 7.1.1 (cont'd).

Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[1]
Division IVb East										
Denmark	191.5	149.0	127.5	91.2	39.2	62.1	36.6	10.3	28.0	80.7
Germany, Fed.Rep.	1.8	6.1	4.8	1.5	-	0.6	0.6	0.6[3]	-	-
Norway	27.4	33.7	0.2	7.2	12.0	3.9	-		-	-
Sweden	-	0.6	-	-	-	-	-		-	-
Total	222.7	189.4	132.5	99.9	51.2	66.6	37.2	10.9	28.0	80.7
Division IVc										
Belgium	-	-	-	-	-	-	+	+	+	-
Denmark	1.5	6.5	4.3	2.4	1.0	0.5	+	0.1	+	0.1
France	-	-	-	-	-	-	-	+	-	-
Netherlands	-	-	-	-	-	0.1	-	-	-	-
Norway	3.1	16.2	-	3.7	-	3.5	-	-	-	-
UK (England)	1.4	4.3	14.0	14.9	3.6	0.9	3.4	4.1	0.7	0.6
Total	6.0	27.0	18.3	21.0	4.6	5.0	3.4	4.3	0.7	0.7
Total North Sea										
Belgium	+	-	-	-	-	-	+	+	+	-
Denmark	268.3	232.2	188.2	116.6	72.6	68.1	39.5	11.7	31.7	82.3
Faroe Islands	2.8	2.8	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	+	-	-
Germany, Fed.Rep.	3.8	6.2	4.8	1.5	-	0.6	-	0.6	-	-
Netherlands	-	-	-	-	-	0.1	0.6	-	0.5	-
Norway	78.6	68.6	0.4	19.5	12.0	7.4	6.7	-	-	9.1
Sweden	-	0.6	-	-	-	-	-	-	-	-
UK (England)	14.3	6.7	14.0	14.9	3.6	0.9	3.4	4.1	0.7	0.6
UK (Scotland)	11.8	6.3	1.7	0.2	+	+	-	+	0.2	-
Total	379.6	323.4	209.1	152.7	88.2	77.2	50.2	16.4	33.1	92.0

[1]Preliminary figures as reported.
+ = less than 0.1.
- = magnitude known to be nil.

Table 7.1.2 SPRAT catches (tonnes) by quarter in 1988, 1987,
1986 (Denmark and the UK), and 1985 (Denmark,
Norway, and the UK). Catches in fjords of western
Norway excluded.

Year	Quarter	Area					Total
		1	2	3	4	5	
1988	1	−	−	5	206	529	740
	2	−	−	229	682	28	939
	3	−	11	4,682	72,317	73	77,083
	4	55	−	651	7,529	31	8,266
Total		55	11	5,567	80,734	621	87,028
1987	1	70	10	148	17	564	809
	2	−	7	118	3,297	57	3,479
	3	−	6	65	6,999	46	7,116
	4	98	−	3,191	16,456	17	19,762
Total		168	23	3,522	26,769	684	31,166
1986	1	282	123	104	2,899	4,134	7,542
	2	5	39	206	5,048	22	5,320
	3	3	10	6	389	9	417
	4	373	63	80	2,005	51	2,571
Total		663	235	396	10,341	4,216	15,851
1985	1	1	−	97	6,533	1,370	8,001
	2	−	−	149	659	−	808
	3	44	15	176	4,535	5	4,775
	4	7,550	9	1,407	24,913	1,547	35,426
Total		7,595	24	1,829	36,640	2,922	49,010

Table 7.1.3 SPRAT in Division VIa. Landings in t.

Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[1]
Denmark	-	-	242	-	-	-	-[1]	-	268[2]	364
Germany, Fed.Rep.	97	-	2	-	-	-	-	-	-	-
Ireland	12	1,787	790	287	-	192	51	348	-	-
Netherlands	125	428	892	2,156	1,863	-	-	-[1]	-	-
Norway	-	-	-	24	-	-	557	-[1]	-	-
UK (England & Wales)	-	-	-	-	-	-	-	2	-	-
UK (Scotland)[3]	1,087	2,987	1,488	1,057	1,971	2,456	2,946	520	582	3,844
Total	1,321	5,202	3,414	3,524	3,834	2,648	3,554	870	850	4,208

[1] Preliminary figures.
[2] Includes Division VIb.
[3] Amended from national data.
Source: ICES Statistician.

Table 7.3.1   North Sea SPRAT. Catch in numbers (millions) taken
               by quarter in 1987 and 1988 by Denmark, Norway,
               and UK (England).

Country	Fishing area	Quarter	Age					
			0	1	2	3	4	5
1987								
Denmark	North Sea	3	–	555.11	85.23	1.00	–	–
	(SA IV)	4	28.79	1,546.19	319.81	8.44	–	–
(UK)	England Thames (Div. IVc)	1	–	1.01	37.18	12.14	0.76	–
1988								
Denmark	North Sea	1		0.24	23.04	1.19	–	–
	(SA IV)	2	–	1.05	101.47	5.23	–	–
		3	–	471.43	4615.42	9.68	–	–
		4	–	37.63	461.13	2.36	–	–
(UK)	England Thames (Div. IVc)	1	–	7.53	34.24	6.89	1.66	0.14
Norway	North Sea	3	–	0.4	125.6	48.7	3.9	–
	(Div. IVb)	4	0.7	11.0	13.2	6.2	–	–

Table 7.4   North Sea SPRAT.
            IYFS research vessel indices (no./hr).

Year	North Sea all ages	Division IVb 1-group	Division IVb E 1-group
1970	-	-	-
1971	-	-	-
1972	873	90	-
1973	713	123	-
1974	2,631	481	-
1975	-	-	-
1976	2,127	1,186	-
1977	3,031	136	-
1978	2,208	1,474	-
1979	569[1]	248[1]	-
1980	3,770	1,402	1,916
1981	2,107	886	1,146
1982	602	183	512
1983	852	512	944
1984	-[2]	347	638
1985	638	659	1,187
1986	170	73	103
1987	1,248	807	1,446
1988	1,097	145[3]	269[3]
1989	4,997	3,516[3]	6,176[3]

[1] Low figures due to abnormal conditions on the survey.
[2] Not yet available.
[3] Preliminary.

Table 7.5   SHOT forecast of North Sea SPRAT landings in 1989.

Year	Landings	Recruitment	Y/R	Hang-over	Estimated landings
1979	380	248	0.70	0.30	-
1980	323	1,402	0.70	0.30	-
1981	209	886	0.60	0.40	-
1982	153	183	0.50	0.50	-
1983	88	512	0.40	0.60	105
1984	77	347	0.30	0.70	58
1985	50	659	0.20	0.80	59
1986	16	73	0.20	0.80	42
1987	33	807	0.30	0.70	43
1988	92	145	0.70	0.30	64
1989	-	3,516	0.70	0.30	313

Table 8.1.1 Nominal catch of SPRAT in Divisions VIId,e, 1979-1988.

Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[1]
Belgium	-	-	-	-	3	-	-	-	-	-
Denmark	9,981	7,483	-	286	638	1,417	-	15	250	2,529
France	2,373	1,867	146	44	60	47	14	15	48	234
Germany, Fed.Rep.	6	52	1	-	-	-	-	-	-	-
Netherlands	441	1,401	1,015	1,533	1,454	589	-	-	-	-
Norway	-	65	-	-	-	-	-	-	-	-
UK (England + Wales)	2,032	6,864	10,183	4,749	4,756	2,402	3,771	1,163	2,454	2,944
Total	14,833	17,732	13,890	6,612	6,911	4,455	3,785	1,193	2,752	5,707

[1] Preliminary.

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	Apr	Total
1961-62	-	-	-	1	27	4	427	428	35	-	922
1962-63	-	-	-	309	238	131	148	187	58	-	1,071
1963-64	-	-	-	263	53	82	385	276	24	-	1,083
1964-65	-	-	-	25	56	20	242	465	8	-	816
1965-66	-	-	-	47	81	165	610	302	17	-	1,222
1966-67	-	-	-	3	152	368	703	355	1	-	1,583
1967-68	-	-	18	76	238	422	560	43	3	-	1,360
1968-69	11	-	4	122	142	298	373	123	1	-	1,074
1969-70	-	-	-	140	131	276	915	283	76	-	1,821
1970-71	-	7	38	90	184	549	553	106	20	-	1,547
1971-72	-	-	369	101	232	228	410	70	-	-	1,410
1972-73	-	-	107	209	132	87	404	165	49	-	1,153
1973-74	-	-	313	186	194	350	311	96	40	-	1,490
1974-75	184	451	209	533	838	405	157	30	-	-	2,807
1975-76	-	-	66	649	289	111	204	6	-	-	1,325
1976-77	289	440	1,039	123	594	347	234	103	5	-	3,174
1977-78	31	680	768	725	115	84	201	54	-	-	2,658
1978-79	-	252	368	545	450	209	58	37	28	-	1,947
1979-80	-	-	90	674	706	337	150	38	2	-	1,997
1980-81	-	-	458	815	1,423	1,872	2,069	138	54	-	6,829
1981-82	-	-	11	475	1,854	4,311	855	265	100	-	7,871
1982-83	-	-	54	844	1,017	641	522	90	31	-	3,199
1983-84	-	-	82	477	1,706	1,772	157	101	55	-	4,350
1984-85	-	-	331	834	643	252	225	94	19	-	2,398
1985-86	-	104	463	1,401	769	132	52	1	-	-	2,933
1986-87	-	9	138	312	192	393	313	145	18	-	1,520
1987-88	-	-	471	675	636	163	322	129	58	-	2,454
1988-89	-	2	1,179	413	491	306	not available				(2,391)[1]

[1] Preliminary.

Table 8.4   Lyme Bay SPRAT fishery, 1966-1988. Numbers caught
per age group (millions).

Season	Age group					
	0/1	1/2	2/3	3/4	4/5	5/6
1966-67	0.55	11.67	44.00	18.56	11.67	3.60
1967-68	2.28	46.79	33.10	5.08	0.66	0.39
1968-69	0.08	29.99	29.24	4.03	0.44	0.10
1969-70	0.13	17.53	62.78	18.60	2.73	0.35
1970-71	0.01	4.12	46.03	26.94	1.57	0.54
1971-72	0.80	20.22	28.01	22.96	4.12	0.34
1972-73	1.51	32.20	22.20	10.20	3.96	0.38
1973-74	0.50	22.91	46.12	9.08	5.06	2.42
1974-75	0.30	40.77	82.73	12.67	8.84	3.55
1975-76	0.16	13.33	25.25	23.28	6.39	1.47
1976-77	0.73	40.34	108.52	34.87	6.56	0.37
1977-78	0.12	19.48	69.33	43.89	7.50	0.48
1978-79	9.20	41.71	44.64	18.97	5.72	0.01
1979-80	1.17	26.97	55.45	7.58	4.07	0.33
1980-81	0.76	51.33	220.79	55.35	6.15	0.26
1981-82	1.08	52.00	161.91	131.28	20.94	0.55
1982-83	1.16	4.81	49.74	58.89	25.41	0.25
1983-84	7.19	13.18	47.05	74.09	40.61	9.16
1984-85	1.21	40.15	44.27	28.25	9.60	1.23
1985-86	1.53	15.24	105.48	21.05	7.78	1.01
1986-87	-	10.36	42.40	17.14	2.84	0.70
1987-88	-	25.49	47.47	29.66	9.52	1.07
1988-89[1]	2.16	14.56	75.19	25.32	4.84	0.62

[1] September - December only.

Table 8.5 Lyme Bay area SPRAT, 1974-1989. Mean weight at age.

Season	Quarter	Age group						Overall mean
		0/1	1/2	2/3	3/4	4/5	5/6	
1974-75	3	4.4	11.0	17.6	24.4	29.0	30.7	15.9
	4	3.6	9.2	18.9	25.6	29.6	30.7	19.0
	1	4.7	8.6	14.8	20.6	23.3	24.8	12.3
	Season	3.9	9.8	18.1	25.2	29.4	30.6	17.4
1975-76	3	-	15.4	17.1	22.1	28.6	27.0	19.1
	4	3.7	9.5	16.4	24.1	29.1	28.0	19.2
	1	2.5	9.6	15.7	23.0	28.9	26.7	17.7
	Season	3.1	9.7	16.3	23.8	29.0	27.8	18.9
1976-77	3	-	12.8	16.8	20.4	27.2	26.2	17.3
	4	3.3	7.7	17.7	23.7	28.1	32.7	17.2
	1	2.6	8.2	15.1	21.0	27.2	-	12.3
	Season	2.9	9.3	16.8	22.0	27.7	28.1	16.5
1977-78	3	-	8.2	16.3	22.4	26.4	32.4	18.6
	4	-	6.8	18.1	22.6	24.9	30.5	19.3
	1	6.4	5.2	14.5	21.8	22.4	28.7	9.8
	Season	6.4	6.2	16.7	22.3	25.5	31.3	17.5
1978-79	3	3.5	15.4	19.2	25.4	29.6	-	20.9
	4	6.3	11.8	16.5	23.9	29.6	-	15.2
	1	4.9	10.1	13.1	19.9	28.3	-	10.6
	Season	5.7	12.1	16.8	24.5	29.6	-	16.2
1979-80	3	3.0	18.2	23.6	25.8	32.9	30.7	23.1
	4	3.5	16.5	23.2	27.0	31.6	-	22.4
	1	4.0	9.7	19.2	22.1	20.7	-	12.5
	Season	3.9	14.3	22.9	26.8	30.7	31.0	21.0
1980-81	3	-	17.4	24.3	25.6	29.9	34.5	24.4
	4	5.2	16.1	21.4	24.8	29.9	32.0	21.7
	1	3.1	11.8	17.1	21.0	28.6	34.5	16.3
	Season	3.1	13.5	19.9	23.6	29.7	32.9	19.7
1981-82	3	-	17.3	19.5	21.4	33.0	-	19.6
	4	6.1	14.7	21.5	25.5	28.5	31.0	23.4
	1	6.4	12.1	16.5	20.2	-	-	14.7
	Season	6.4	12.9	20.3	25.2	28.5	31.0	21.4
1982-83	3	-	16.0	18.9	24.9	27.5	32.9	23.9
	4	6.1	15.8	19.6	24.7	27.9	32.4	23.7
	1	-	13.0	18.8	22.5	26.1	-	20.0
	Season	6.1	14.1	19.3	24.4	27.8	32.4	22.9
1983-84	4	4.1	15.2	20.6	23.6	27.1	27.6	23.2
	1	-	16.2	19.9	23.3	26.9	28.7	23.3
	Season	4.1	15.3	20.5	23.5	27.0	27.5	23.2
1984-85	3	-	12.5	17.3	22.9	25.7	-	18.7
	4	5.9	16.0	19.4	23.5	26.5	27.9	20.3
	1	5.9	11.5	17.2	22.8	26.7	30.7	13.9
	Season	5.9	14.0	18.7	23.4	26.4	28.1	18.8
1985-86	3	-	16.1	19.2	22.6	22.0	-	19.3
	4	6.4	15.6	17.9	21.9	23.6	32.0	18.6
	1	5.7	15.9	19.0	22.9	28.3	-	17.5
	Season	6.3	15.7	18.2	22.0	23.4	32.0	18.7
1986-87	4	-	18.1	20.9	24.6	27.8	29.6	22.4
	1	-	13.3	18.6	23.5	29.6	-	17.3
	Season	-	14.8	19.9	24.4	28.0	29.6	20.6

contd.

Table 8.5 (contd.)

Age group Season	Quarter	0/1	1/2	2/3	3/4	4/5	5/6	mean	Overall
1987-88	4	−	15.4	23.1	26.9	27.3	27.7		24.8
	1	−	14.0	17.4	19.4	−	−		15.3
	Season		14.2	21.5	26.3	27.3	27.7		21.7
1988-89	3	−	13.9	18.7	24.3	26.8	25.0		20.0
	4	5.7	14.1	19.1	24.0	25.8	27.0		19.0

Table 8.6   Percentage weight in the catch. Lyme Bay sprat fishery.

Season	Age 0/1	1/2	2/3	3/4	4/5	5/6	Mean age
1976-77	0.1	11.9	57.7	24.3	5.8	0.3	3.03
1977-78	0.03	4.9	47.0	39.7	7.8	0.6	3.29
1978-79	2.7	26.0	38.6	23.9	8.7	0.02	2.75
1979-80	0.2	19.3	63.5	10.2	6.3	0.5	2.87
1980-81	0.04	10.5	66.7	19.8	2.8	0.1	3.05
1981-82	0.1	8.5	41.7	41.9	7.6	0.2	3.33
1982-83	0.2	2.1	30.1	45.1	22.2	0.3	3.74
1983-84	0.7	4.7	22.5	40.6	25.6	5.9	3.81
1984-85	0.3	24.0	35.3	28.2	10.8	1.5	3.07
1985-86	0.3	8.4	67.4	16.3	6.4	1.1	3.15
1986-87	−	10.2	55.7	27.5	5.2	1.4	3.35
1987-88[1]	−	14.8	41.6	31.8	10.6	1.2	3.23
1988-89[1]	0.5	8.5	59.4	25.6	5.3	0.7	3.15

([1] Sep-Dec only).

Figure 4.2.1   Norway pout. Regression of CPUE on
              GRT-50. 88:1988.
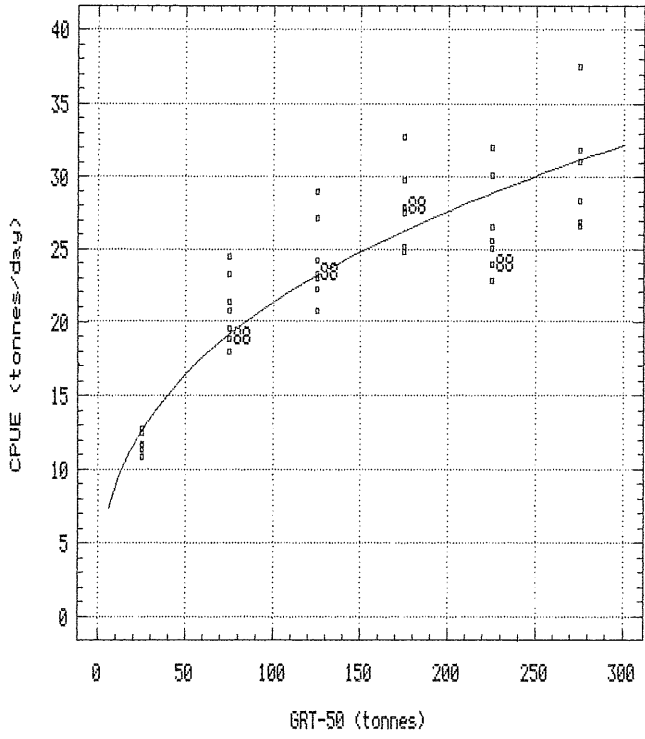
Figure 4.4.1 Norway pout. North Sea. IYFS 1-group index and VPA 1-group estimates.
(Labels indicate year class).
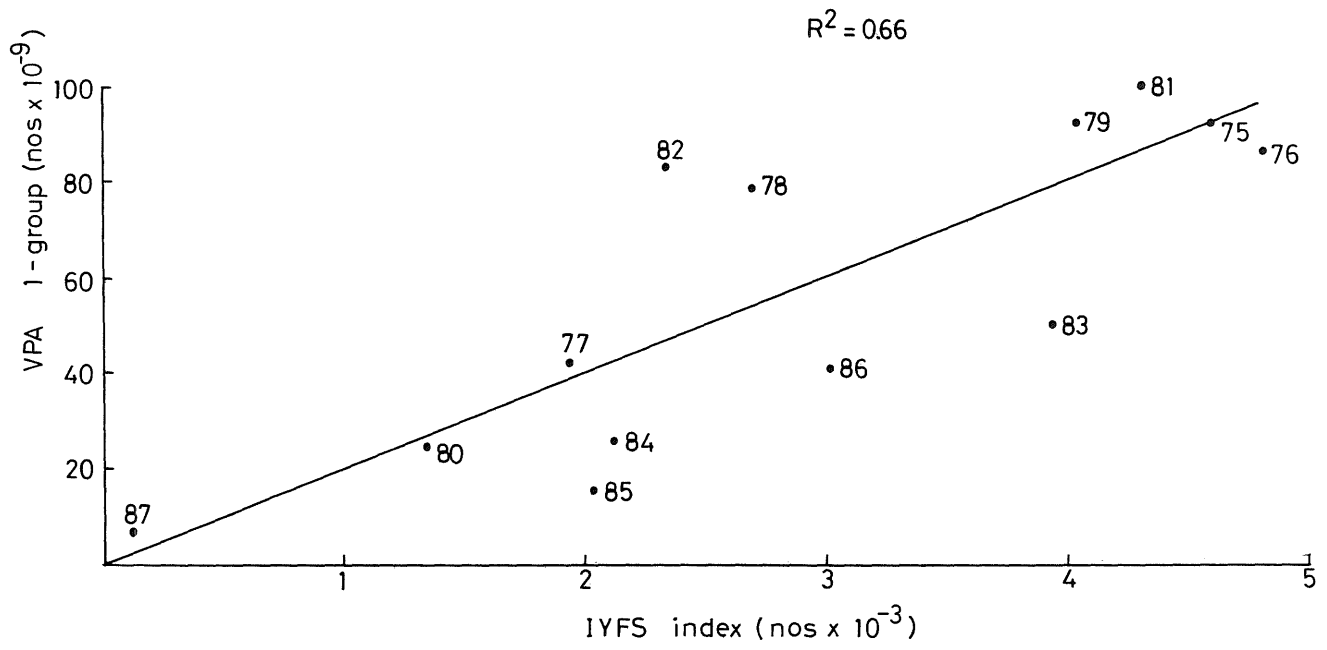
Figure 4.4.2 Norway **pout**. North Sea. Fishing mortality
and effort.
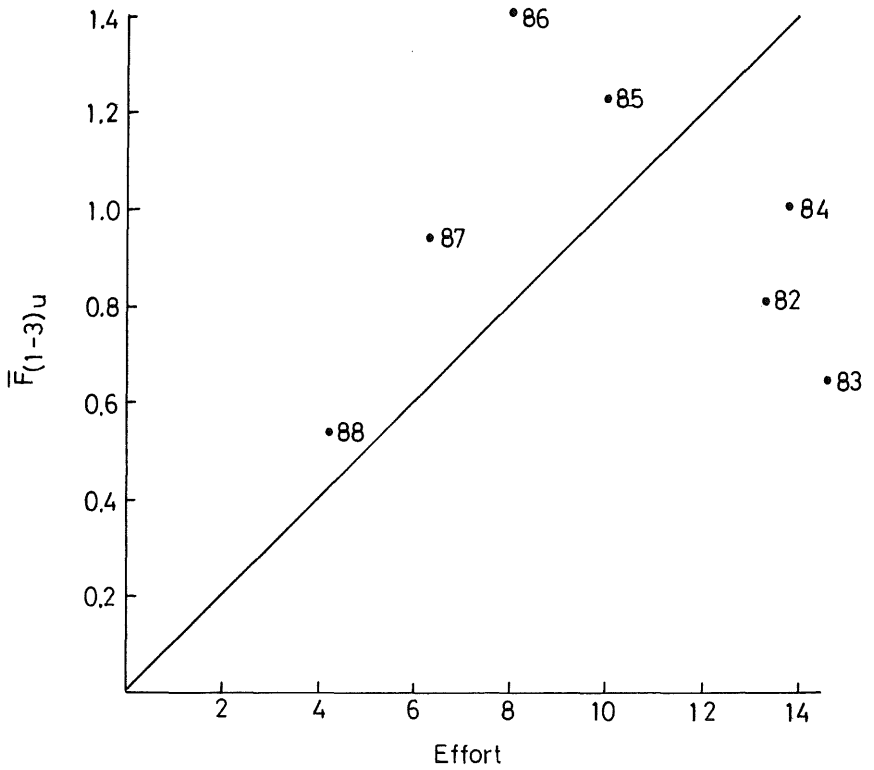
Figure 4-4-3   Norway pout, North Sea. Total stock biomass (1 Jan).

Figure 4.7

Norway pout
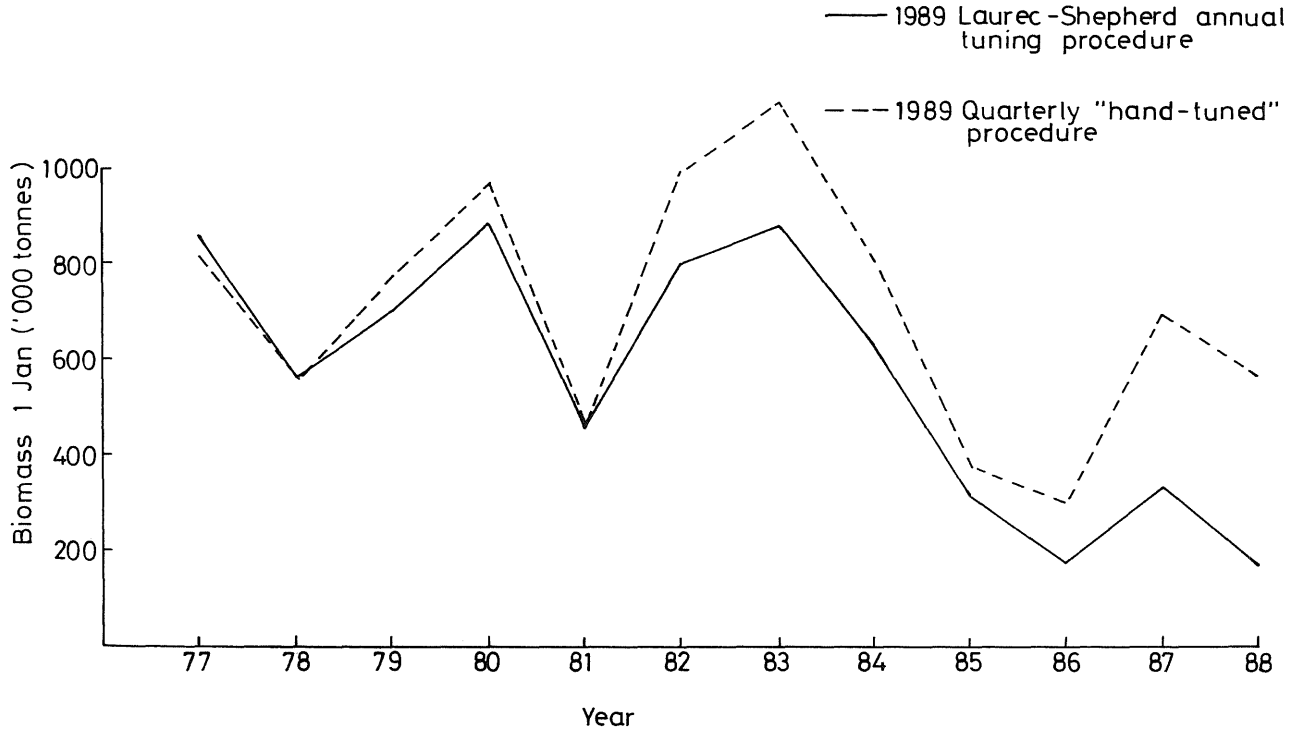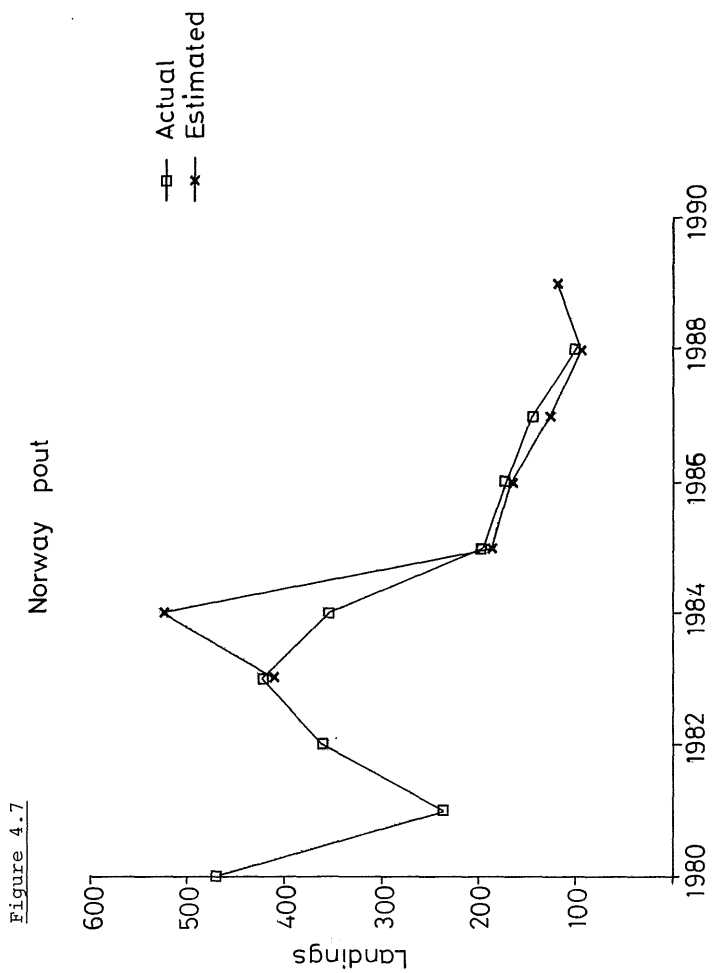
Figure 5.1   Danish SANDEEL areas and assessment areas used by the Working Group.
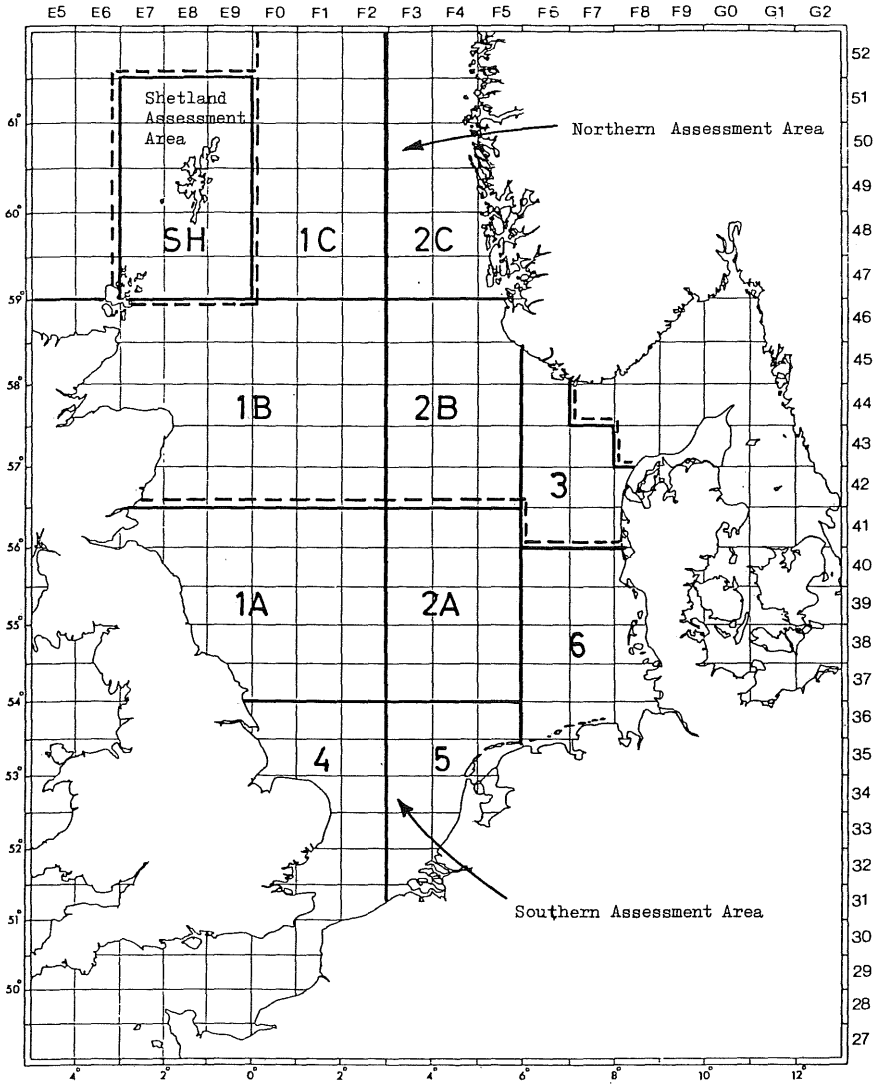
Figure 5.2 Sandeel, Southern North Sea. Regression
of CPUE on GRT. 81: 1988, Jan – Jun; 82:
1988, Jul – Dec.
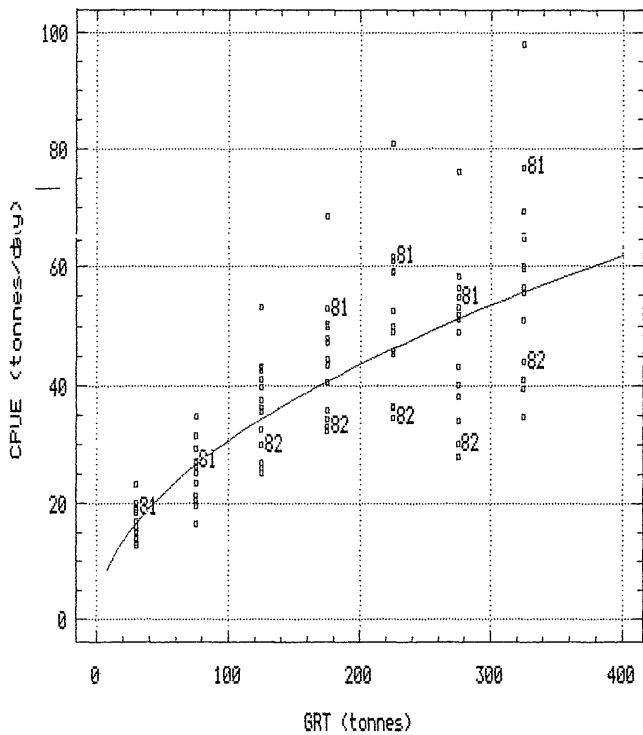
Figure 5.3 Sandeel, Northern North Sea. Regression of CPUE on GRT. 81: 1988, Jan-Jun; 82: 1988, Jul-Dec.
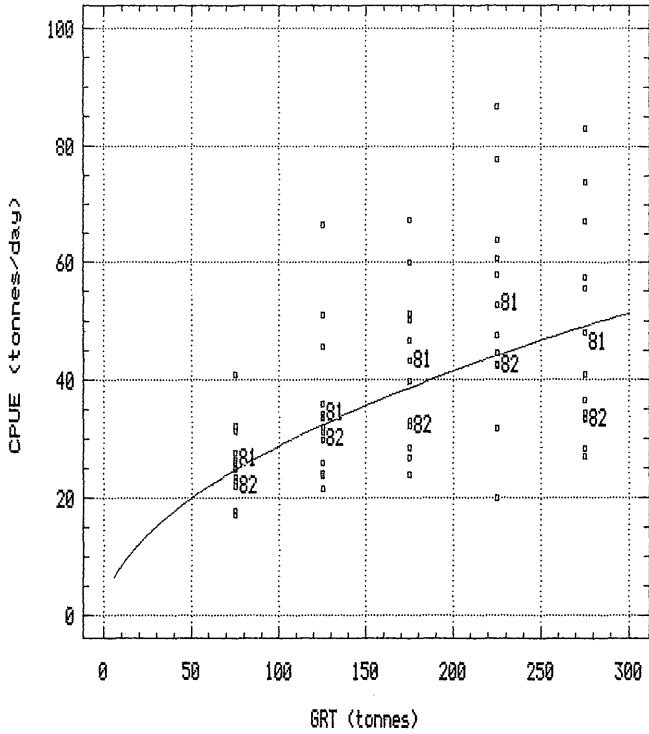
Figure 5.4   Sandeel, Southern North Sea. Fishing effort,
             $\bar{F}_{1-2}$ and $\bar{F}_{1-3}$. Annual VPA, Laurec-Shepherd
             tuning method.
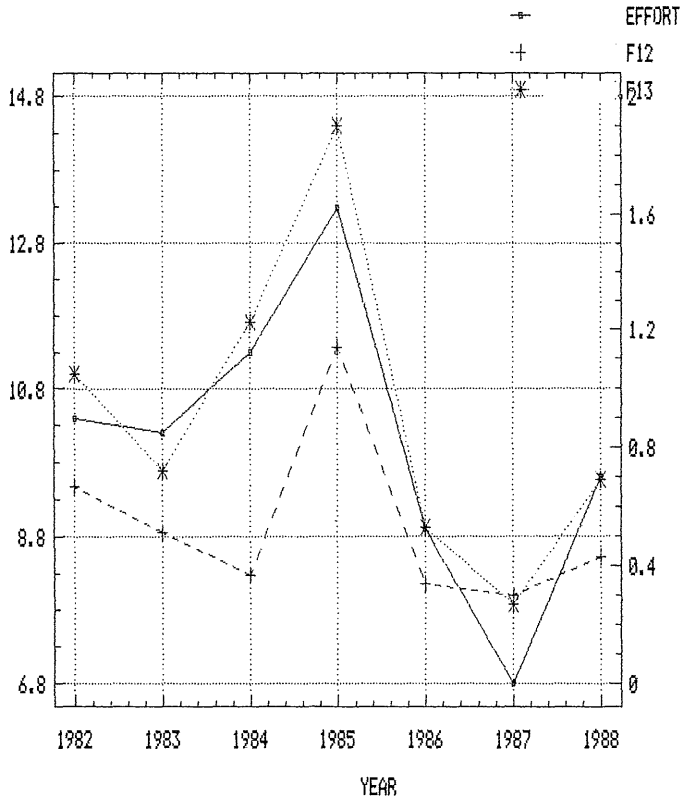
Table 5.5   Sandeel, Southern North Sea. Semi-annual
            $\bar{F}_{1-2}$ versus semi-annual fishing efffort.

            881 = 1988 Jan-Jun
            882 = 1988 Jul-Dec

Figure 5.6   Sandeel, Southern North Sea. Semi-annual
              VPA $\bar{F}_{1-2}$ and effort.
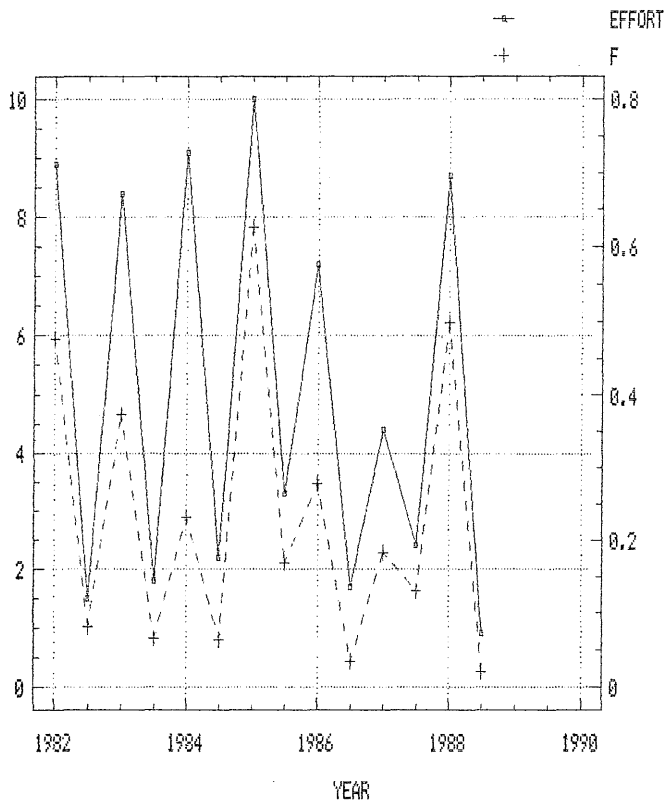
Figure 5.7 Sandeel, Northern North Sea. $\overline{F}_{1-2}$ versus
fishing effort. Annual VPA, Laurec-Shepherd
tuning. 88 = 1988.
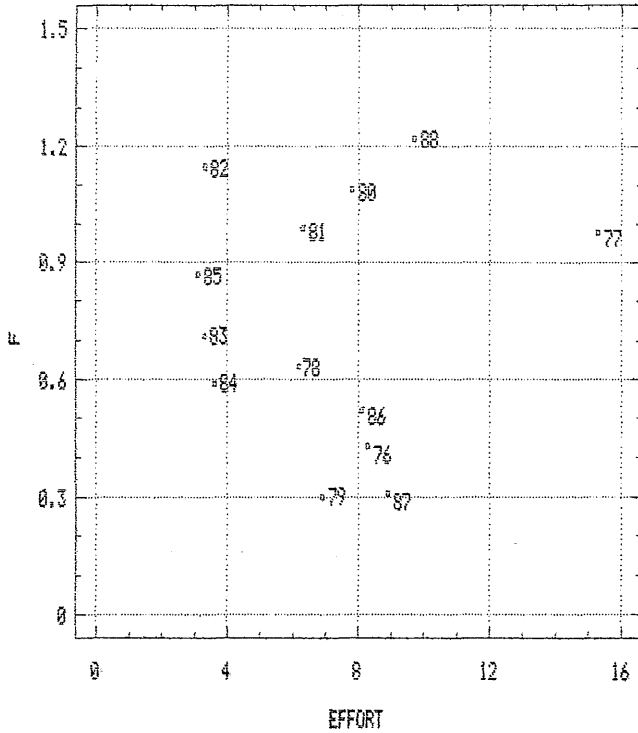
Figure 5.8 Sandeel, Northern North Sea. Semi-annual
VPA. $\overline{F}_{1-2}$ versus fishing effort. 881: 1988
Jan-Jun; 882: 1988 Jul-Dec.
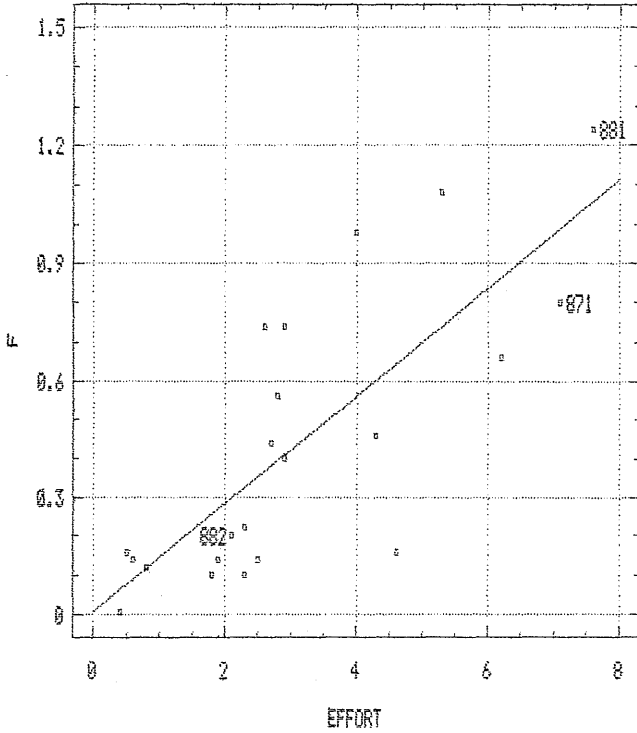
Figure 5.9 Sandeel, Northern North Sea. Semi-annual VPA. $\bar{F}_{1-2}$ and effort.
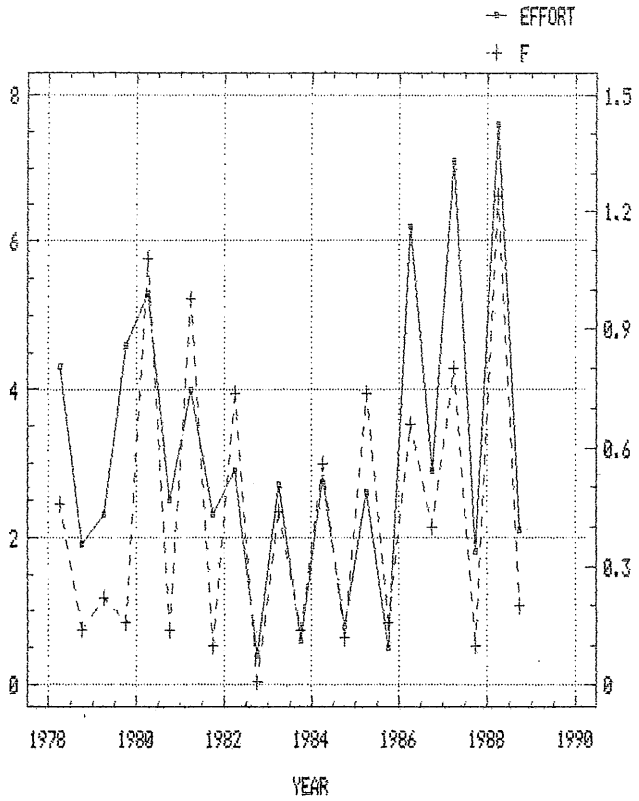
Figure 5.10 Sandeel, Shetland. Plot of F and effort (1974-1983).

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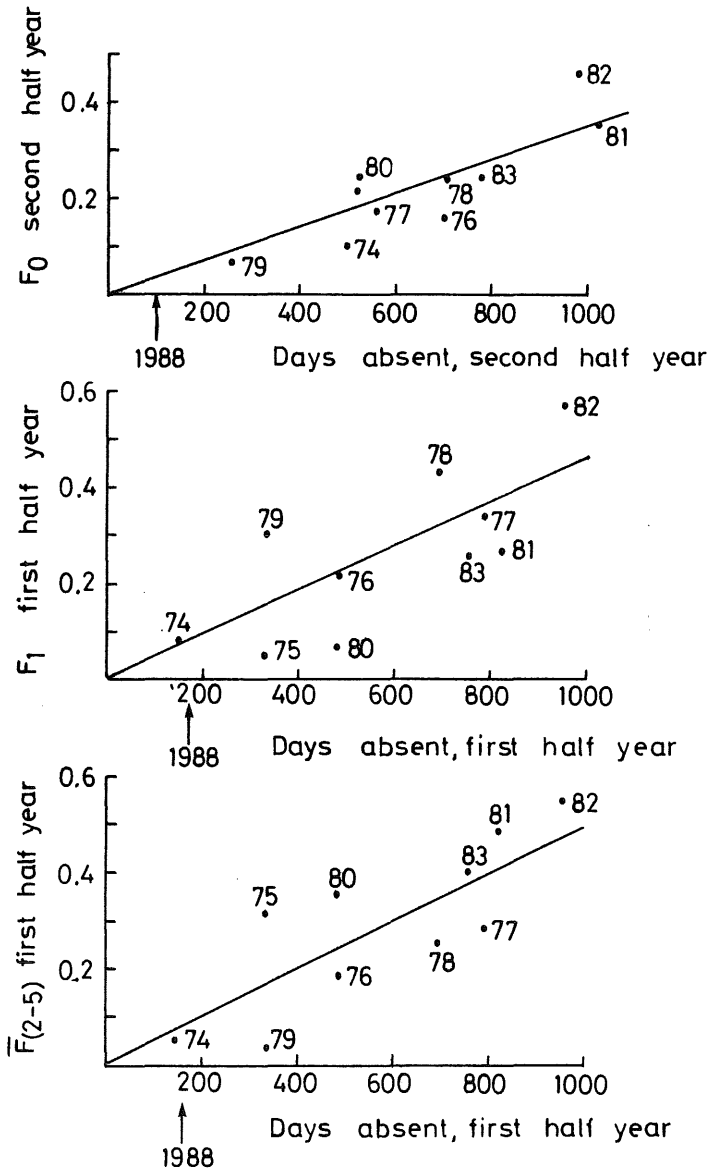
Figure 5.11 Sandeel, Division VIa. Plot of F and effort (1980-1985).
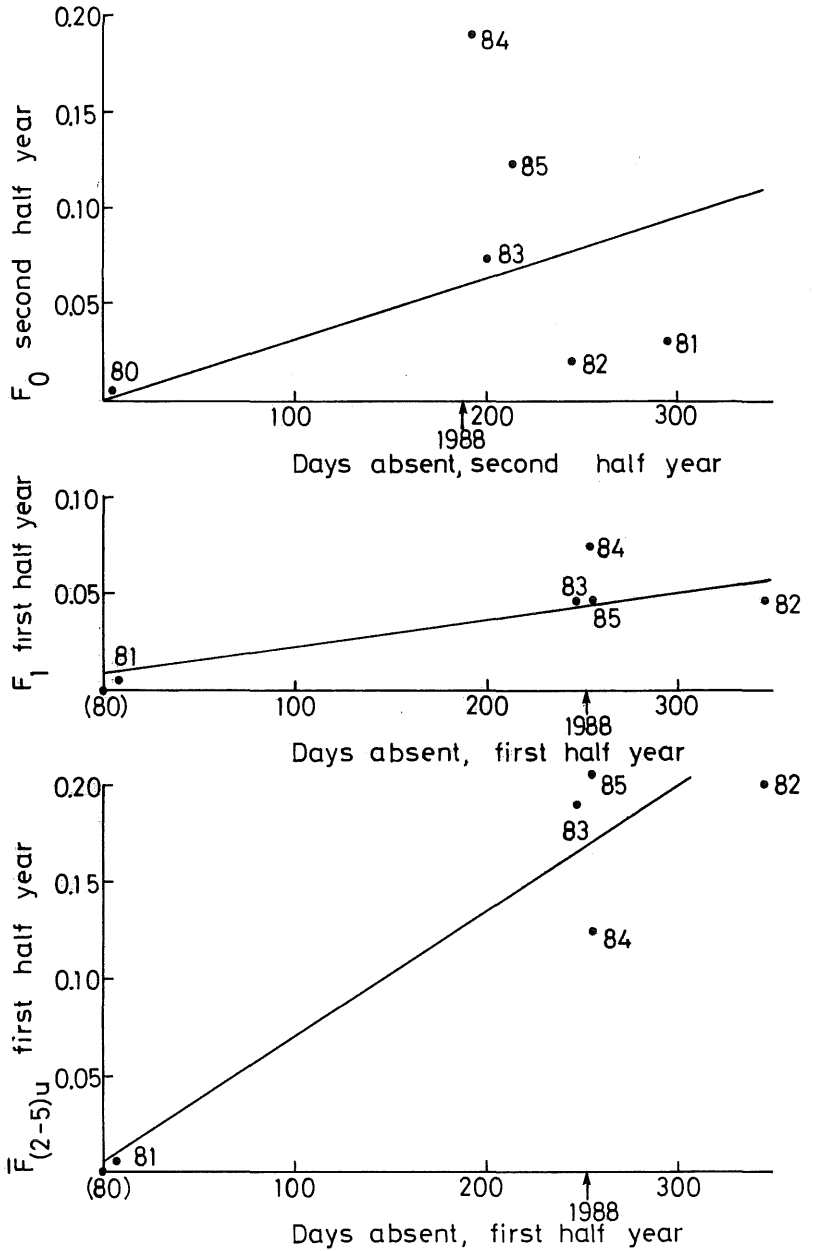
Figure 5.12 Sandeel, Southern North Sea. SSB as estimated by
annual and semi-annual VPA.
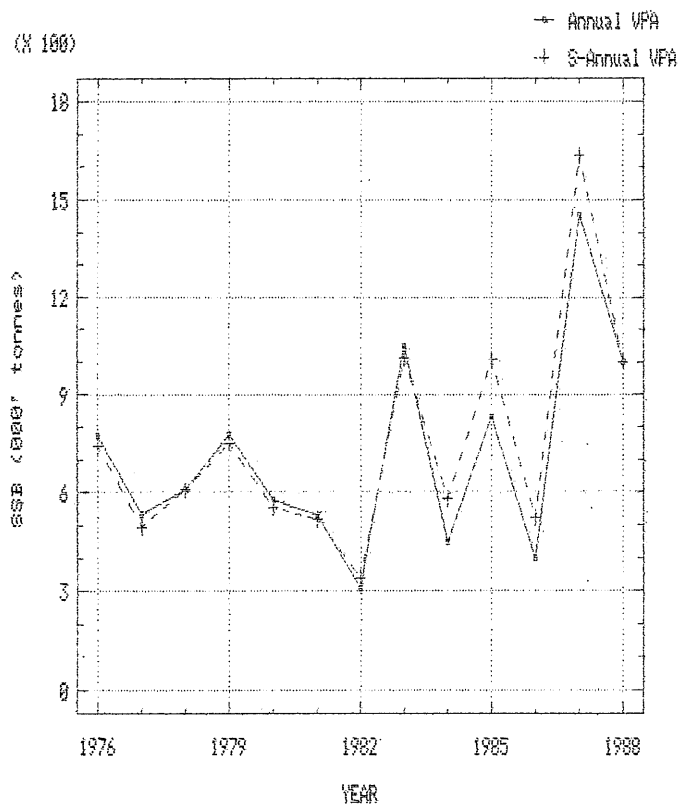
Figure 5.13 Sandeel, Shetland. Trends in total biomass,
spawning stock biomass, and recruitment (1974–
1988).
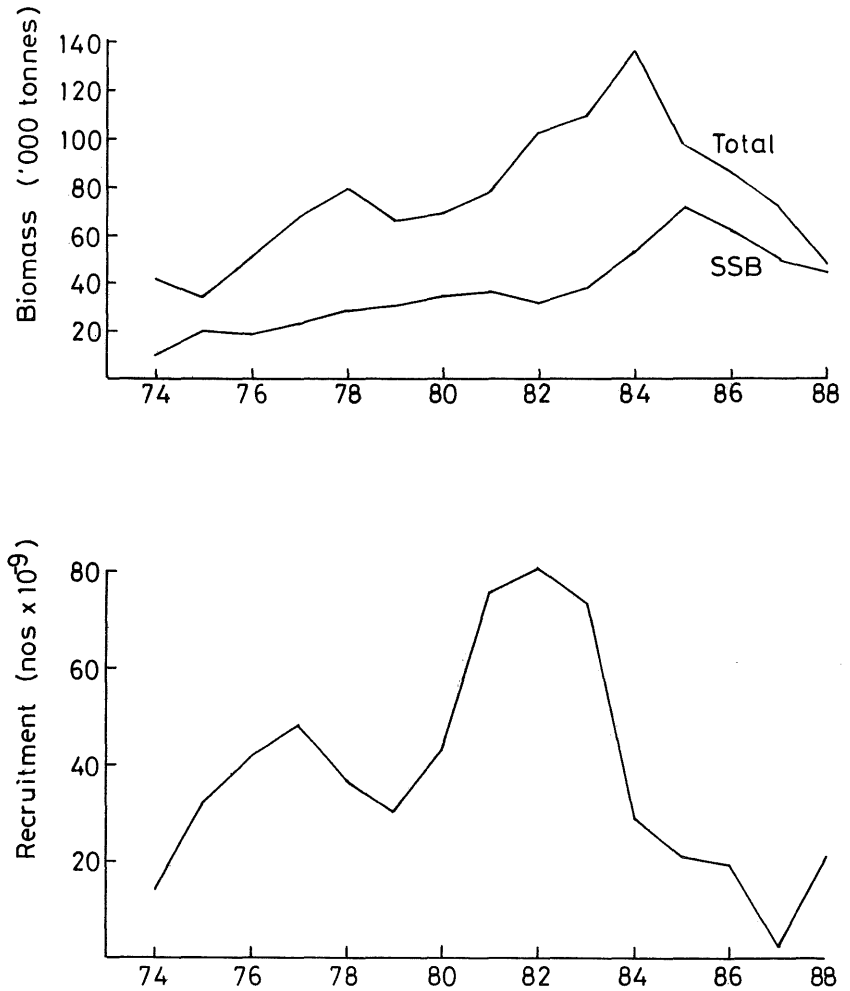
Figure 5.14   Sandeel, Southern North Sea.
              Weight at age for various year classes.
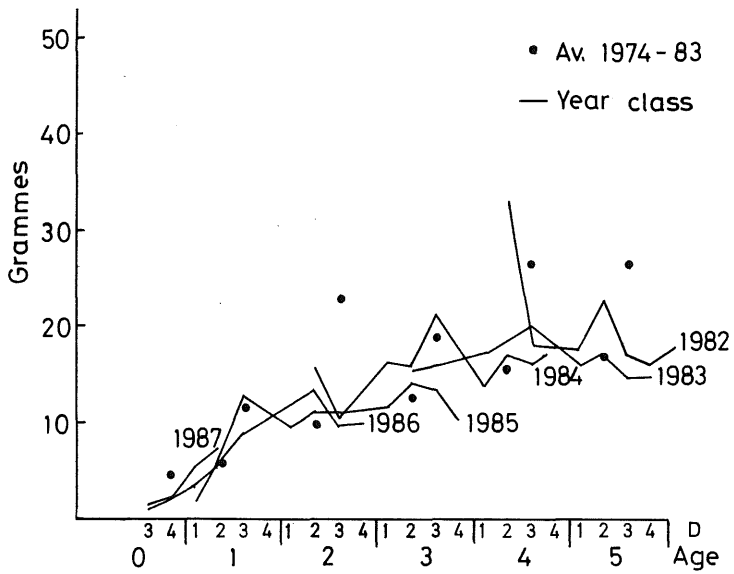
Figure 5.15 Sandeel, Northern North Sea.
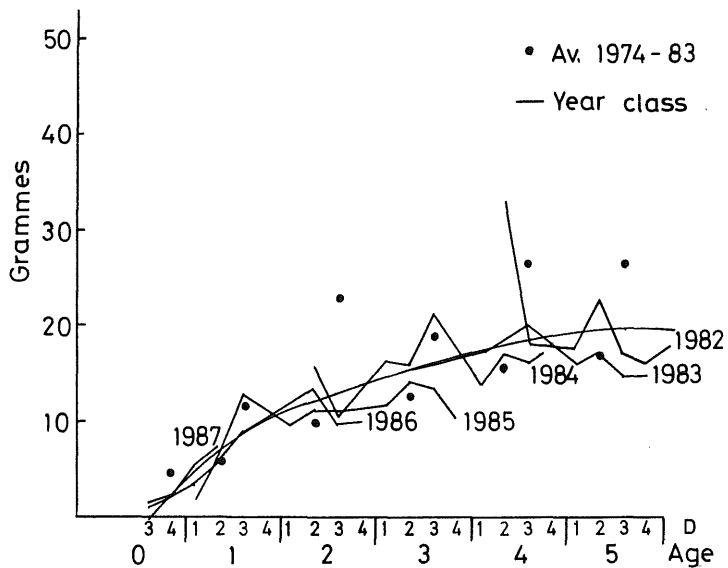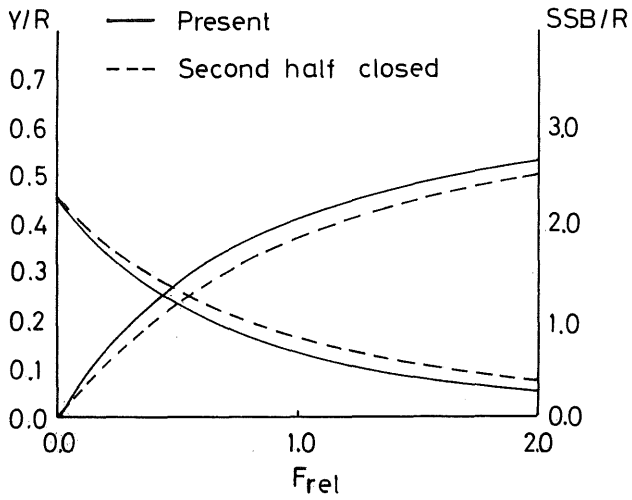Weight at age for various year classes.
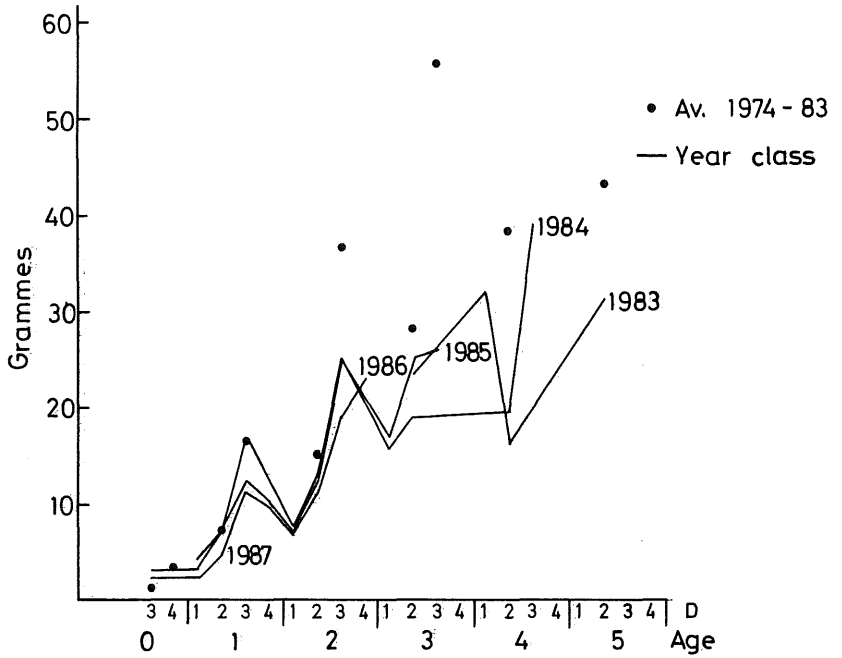
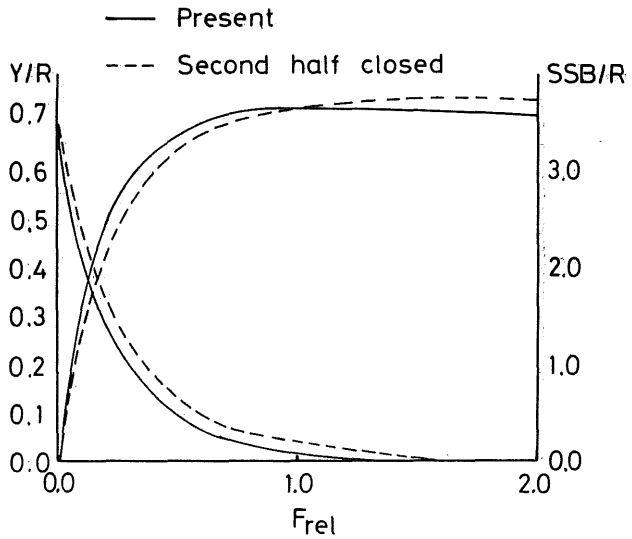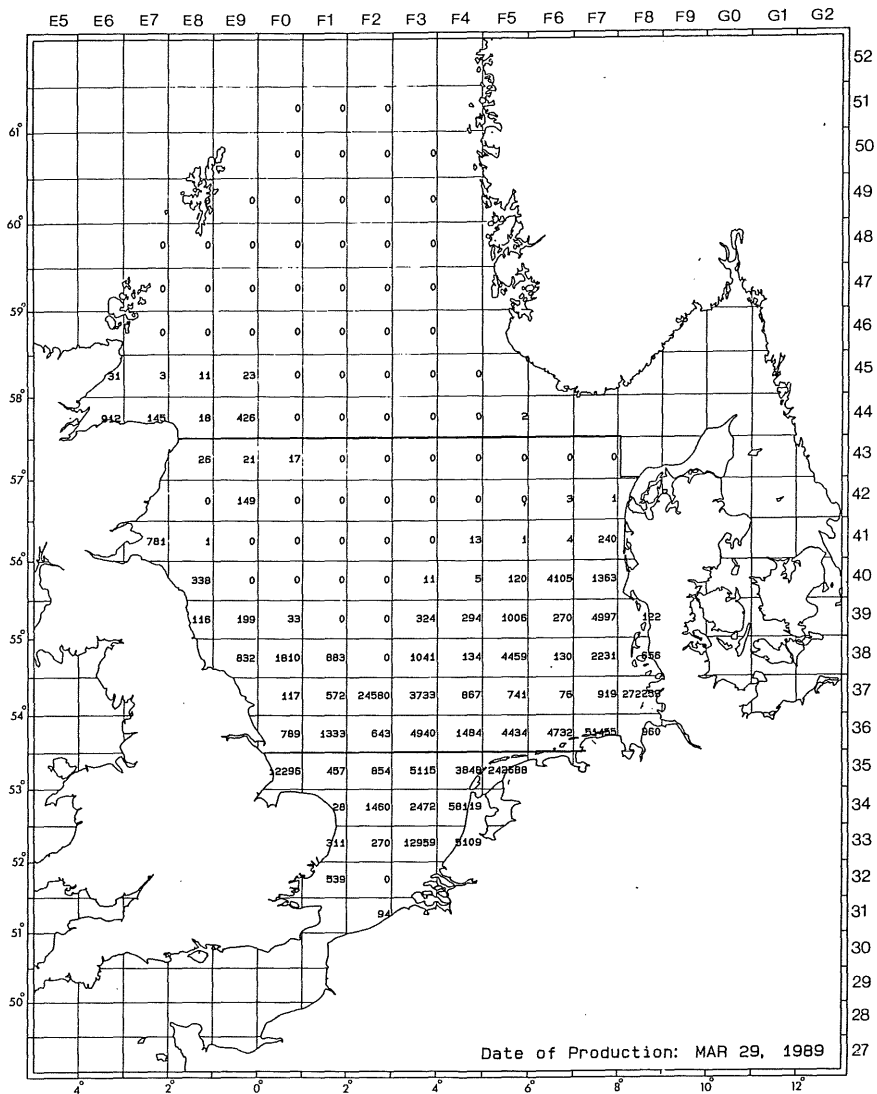Figure 5.16 Sandeel, Southern North Sea. Smoothed growth curve.
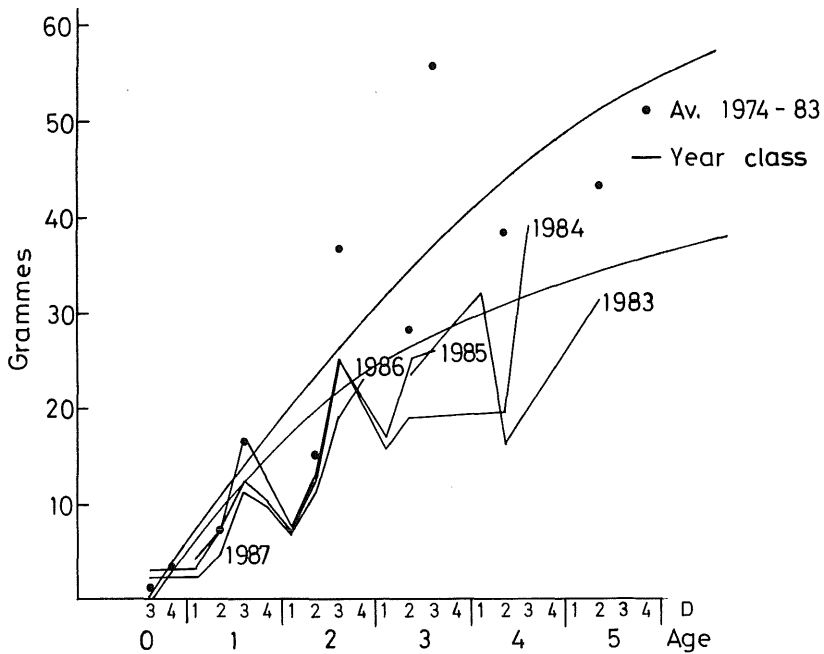
Figure 5.17 Sandeel, North Sea. Y/R and SSB/R (g) with and without a closure of the fishery in the second half of the year. (F_{rel} = 1.0: present (1988) level of $\bar{F}_{1-2}$).
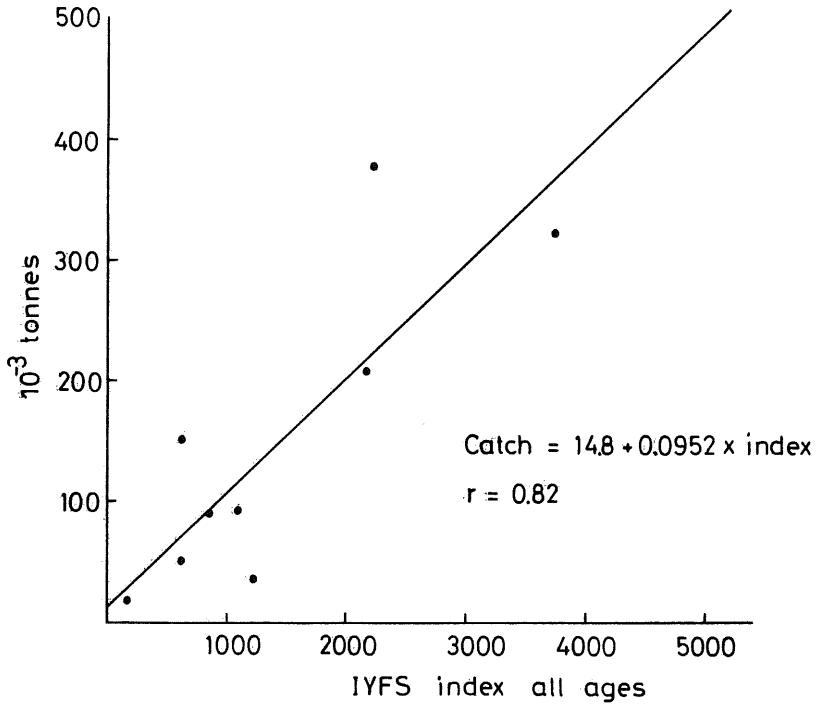
International Young Fish Survey 1989

Sprat, SPRA SPR

Number per Hour per Haul, all ages

Figure 7.4.1

Figure 7.5.1 North Sea sprat. Landings versus IYFS
index (all ages).

Catch = 14.8 + 0.0952 x index

r = 0.82

ANNEX 1

A1   THE FAROESE NORWAY POUT FISHERY

A1.1 The Fishery

In the 1980s, a Norway pout fishery emerged in Faroese waters, almost exclusively on the Faroe plateau. Landings by sub-division and country are shown in Table A1.1 for the period 1980-1988.

Landings in the period 1982-1985 remained at a level of 3,000-7,000 t per year, but then increased rapidly to approximately 30,000 t per year in the period 1986-1988.

In 1988, the yearly mean by-catch was 11.5%. This year, 10 ships, ranging from 128 to 277 BRT, participated in this fishery.

Since 1985, the fishing season has been from August to April.

A1.2 Catch and Weight at Age

Since 1985, landings have been sampled for length, age, and weight measurements. Catch at age for 1985-1988 and weight at age data for 1988 are shown in Tables A1.2 and A1.3, respectively.

The catches in 1985-1988 consist of four-five year classes. The recruits enter the fishery in the third quarter of the year. In the course of the year, the 1-group increases in numbers, while older age groups decrease. Four- and 5-year-olds are only present in the first or second quarters.

Table A1.1 NORWAY POUT. Annual landings (t) by sub-division
and country in Division Vb, Faroes, 1980-1988.

| Year | Vb1, Faroe Plateau | | Vb2, Faroe Bank | Total |
	Faroes	Denmark	Faroes	
1988	27,716	–	–	27,716
1987	32,534	–	–	32,534
1986	17,499	–	–	17,499
1985	7,802	–	–	7,802
1984	5,486	–	44	5,530
1983	3,048	–	26	3,074
1982	4,137	233	–	4,370
1981	173	–	–	173
1980	–	181	–	181

Table A1.2 NORWAY POUT. Catch at age in Division Vb, Faroes,
1985-1988. (Data for 1985-1986 are preliminary.)

| Year | Quarter | Age group | | | | | |
		0	1	2	3	4	5
1985	1	–	7	52	10	1	+
	2	–	4	32	6	+	+
	3	30	82	26	1	–	–
	4	33	66	17	+	–	–
1986	1	–	16	118	23	2	1
	2	–	10	72	14	1	+
	3	68	185	60	2	–	–
	4	74	148	38	1	–	–
1987	1	–	112	406	82	8	1
	2	–	26	108	19	–	–
	3	–	257	49	2	–	–
	4	102	319	68	1	–	–
1988	1	–	16	360	73	37	–
	2	–	3	63	17	–	–
	3	36	240	154	7	–	–
	4	148	137	53	2	–	–

Table A1.3 NORWAY POUT. Mean weight at age by quarters in Division Vb, Faroes, 1988.

Quarter	Age group				
	0	1	2	3	4
1	–	4.55	21.09	33.80	45.50
2	–	6.50	19.40	26.41	–
3	4.00	18.56	29.15	32.00	–
4	5.34	19.45	33.90	36.00	–

Table A.2.1   North Sea Norway pout. Length distribution of catch (1988) in numbers (millions).

Length class (mean)	Quarter								Total
	1		2		3		4		
	Nor.	Den.	Nor.	Den.	Nor.	Den.	Nor.	Den.	Total
8.5	0.5	–	–	–	–	1.1	–	20.2	21.8
9.5	2.3	1.8	–	–	–	4.6	59.8	221.8	290.3
10.5	2.8	23.4	3.6	–	1.2	5.7	368.1	635.1	1,039.9
11.5	33.9	62.9	29.3	–	7.0	–	306.4	688.9	1,128.4
12.5	43.1	23.4	38.7	–	6.8	–	80.6	188.2	380.8
13.5	22.8	16.2	4.6	–	1.4	–	13.3	33.6	91.9
14.5	24.6	115.6	8.2	–	1.2	17.2	11.4	30.2	208.4
15.5	38.5	213.9	9.4	–	1.9	79.2	26.6	131.1	500.6
16.5	42.6	176.8	19.9	–	5.3	88.4	40.8	248.7	622.5
17.5	37.0	64.7	17.6	–	7.3	88.4	26.6	295.7	537.3
18.5	6.9	13.2	15.2	–	7.8	86.1	9.5	171.4	310.1
19.5	1.3	3.6	2.4	–	4.9	14.9	5.7	33.6	66.4
20.5	–	–	–	–	1.4	8.0	–	20.2	29.6
21.5	0.5	–	–	–	–	–	–	–	0.5

Table A.2.2 SANDEEL North Sea. Length distributions of catch (1988) in numbers (millions).

Length class (mean)	Quarter				Total
	1	2	3	4	
	Nor.	Nor.	Nor.	Nor.	Total
7.5	5.4	13.9	95.3	23.2	137.8
8.5	27.0	21.6	268.4	59.2	376.2
9.5	91.8	93.9	575.9	301.1	1,062.7
10.5	78.3	172.1	709.2	568.8	1,528.4
11.5	94.5	352.0	585.7	684.7	1,716.9
12.5	332.2	515.8	326.8	525.1	1,699.9
13.5	599.6	911.0	113.4	211.1	1,835.1
14.5	578.0	1,611.9	36.4	51.5	2,277.8
15.5	421.4	1,866.4	20.7	25.7	2,334.2
16.5	272.8	1,828.7	24.6	41.2	2,167.3
17.5	113.4	1,269.6	25.0	30.9	1,438.9
18.5	54.0	763.0	27.0	33.5	877.5
19.5	21.6	379.4	8.6	12.9	422.5
20.5	10.8	202.7	8.3	5.1	226.9
>20.5	–	69.0	4.7	–	73.7

<u>Table A.2.3</u> Shetland sandeel. Length distribution of catch
(1988) in numbers (thousands).

Length class (mean)	Jan-Jun	Jul-Dec	Total
4.5	463	–	463
5.5	4,605	2,220	6,825
6.5	11,007	27,593	38,600
7.5	27,609	220,303	247,912
8.5	8,993	149,431	158,424
9.5	752	32,193	32,945
10.5	1,619	21,945	23,564
11.5	9,077	16,494	25,571
12.5	39,806	4,476	44,282
13.5	79,647	1,178	80,825
14.5	80,146	1,647	81,793
15.5	66,458	2,463	68,921
16.5	52,499	2,229	54,728
17.5	27,077	779	27,856
18.5	15,300	352	15,652
19.5	7,568	176	7,744
20.5	2,831	87	2,918
21.5	154	–	154

<u>Table A.2.4</u> Sprat North Sea (Norwegian fjords excluded). Length
distribution of catch (1988) in numbers (millions).

Length class (mean)	Quarter								Total
	1		2		3		4		
	Denmark	Norway	Denmark	Norway	Denmark	Norway	Denmark	Norway	
6.75	0.2	–	1.0	–	19.5	0.6	–	0.1	21.4
7.25	–	–	–	–	–	1.2	–	0.2	1.4
7.75	–	–	–	–	48.8	0.6	–	0.1	49.5
8.25	0.5	–	2.1	–	166.0	9.0	–	1.6	179.2
8.75	0.7	–	3.1	–	126.9	19.7	–	3.4	153.8
9.25	0.5	–	2.1	–	9.8	15.5	–	2.7	30.6
9.75	1.2	–	5.1	–	39.1	12.5	2.3	2.2	62.4
10.25	4.2	–	18.5	–	107.4	6.6	4.7	1.1	142.5
10.75	5.8	–	25.7	–	478.4	10.2	23.4	1.8	543.3
11.25	5.1	–	22.6	–	585.8	16.7	56.2	2.9	689.3
11.75	4.9	–	21.6	–	703.0	15.5	70.3	2.7	818.0
12.25	0.5	–	2.1	–	1,005.6	22.1	77.3	3.8	1,111.4
12.75	0.5	–	2.1	–	839.7	19.1	79.6	3.3	944.3
13.25	0.5	–	2.1	–	527.2	17.9	89.0	3.1	639.8
13.75	–	–	–	–	234.3	8.4	56.2	1.5	300.4
14.25	–	–	–	–	156.2	1.2	26.8	0.2	184.4
14.75	–	–	–	–	29.3	0.6	14.1	0.1	44.1
15.25	–	–	–	–	19.5	1.2	2.3	0.2	23.2